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MathsNet : A-Level+

steve blades

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My S1 full paper

Syllabus: **EdExcel** Questions: **185** Time: **30 hours 3 minutes** Total Marks: **1504**

This paper contains a set of questions followed by the corresponding mark schemes. The time you should spend on each question together with its worth in marks is also given. The content of this paper is based on material from a wide selection of national and international examination boards and organisations.

You are advised to have:
a set of geometrical equipment, pen, HB pencil, eraser. Check if you are allowed a calculator. Some examinations, but not all, allow calculators, including graphical models.

NOTES: The following browsers have been tested with this facility: Mozilla Firefox 3.x, 4.x; Microsoft Internet Explorer versions 6, 7, 8 and 9 RC (see the website for the small font problem with IE7 and IE8 was tested in IE7 compatibility mode), Apple Safari and Google Chrome. Best results are when the background printing of images and colours is enabled (not available in Chrome on Windows/Mac or Safari on Windows). There are known printing format issues with the Opera web browser and we do not recommend using this browser.

Many of the questions use the jsMath applet. This requires special fonts to be installed for successful printing. These fonts can be downloaded from: **http://www.math.union.edu/~dpvc/jsMath/**. Use the **Download the TeX** fonts option. Full instructions for their use can be found at: **http://pubpages.unh.edu/~jsh3/jsMath/**

My S1 full paper

Questions: **185** Time: **30 hours 3 minutes** Total Marks: **1504**

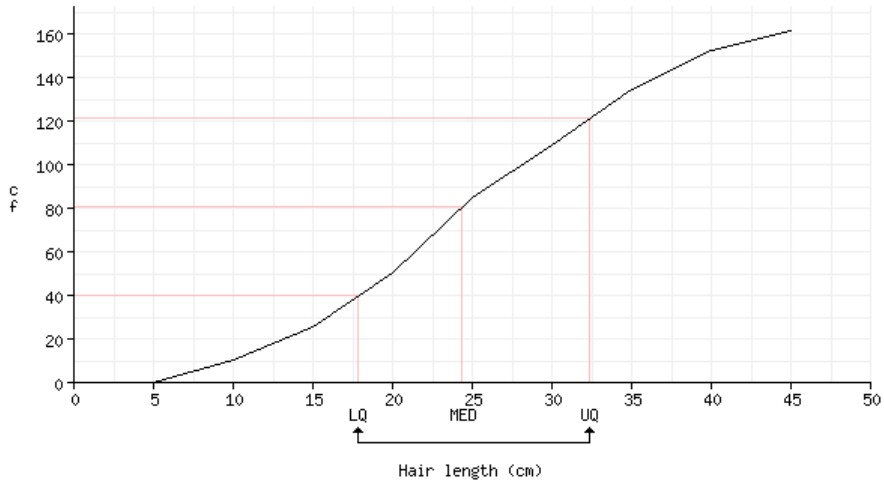
Q1 - ID: 433 *[2 marks, 2 minutes]*

Explain briefly what you understand by
(a) independent events.
(b) a statistical experiment.

Q2 - ID: 898 *[7 marks, 8 minutes]*

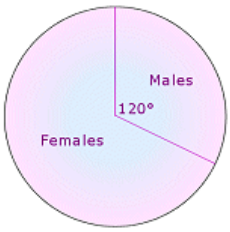
(a) Write down two reasons for using statistical models.
(b) Give an example of a random variable that could be modelled by
(i) a normal distribution,
(ii) a discrete random distribution.

Q3 - ID: 6087 *[6 marks, 7 minutes]*



A random sample of 162 females measured the length of their hair in cm.
The results are displayed in the cumulative frequency curve.
(a) Write down the median length of hair in the sample.
(b) Find the interquartile range for the length of hair in the sample.
(c) Given that the shortest length was 6 cm and the longest 45 cm,
draw and label a box and whisker plot for the data.

Q4 - ID: 6095 *[2 marks, 2 minutes]*



The numbers of males and females in Year 12 at a school are illustrated in the pie chart. The number of males in Year 12 is 106.
(a) Find the number of females in Year 12.
(b) On a corresponding pie chart for Year 13, the angle of the sector representing males is 148°. Explain why this does not necessarily mean that the number of males in Year 13 is more than 106.

Q5 - ID: 681 *[5 marks, 6 minutes]*

The 45 students on a modern science course each recorded the number of whole minutes, x, spent conducting experiments during a given day. The results are summarised below:

$$\sum x = 2183, \quad \sum x^2 = 107379$$

(a) Find μ (to the nearest minute) and σ for these data.
(b) Two other students times were 59 and 39. Without further calculation, explain the effect on the mean of including these two students.

Q6 - ID: 876 *[6 marks, 7 minutes]*

The labeling on bags of garden compost indicates that the bags weigh 16 kg. The weights of a random sample of 50 bags are summarised in the table below.

Weight(*kg*)	*frequency*
10.6 − 10.8	3
10.8 − 14	2
14 − 14.5	8
14.5 − 16	11
16 − 16.2	15
16.2 − 16.4	8
16.4 − 17	3

Using the coding $y = 10(weight - 10)$, find an estimate for the mean and standard deviation of the weight of a bag.
[Use $\sum fy^2 = 147101.75$]

Q7 - ID: 4126 *[6 marks, 7 minutes]*

The age in months at which a child first starts to walk is observed for a random group of children from a town in Brazil. The results are:

14.6, 11.8, 12.7, 14.2, 18.3, 13.8, 13.4, 12.1, 13.6.

(a) Find the mean of the ages of these children.
(b) Find the standard deviation of the ages of these children.
(c) Find the median age.

Q8 - ID: 3135 *[14 marks, 17 minutes]*

Cotinine is a chemical that is made by the body from nicotine which is found in cigarette smoke. A doctor tested the blood of 12 patients, who claimed to smoke a packet of cigarettes a day, for cotinine.
The results, in appropriate units, are shown below

Patient	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*
Cotinine level, x	173	402	185	194	139	436	190	265	229	270	207	261

You may use $\sum x^2 = 815447$

(a) Find the mean and standard deviation of the level of cotinine in a patient's blood.
(b) Find the median, upper and lower quartiles of these data.
A doctor suspects that some of his patients have been smoking more than a packet of cigarettes per day. He decides to use $Q_3 + 1.5(Q_3 - Q_1)$ to determine if any of the cotinine results are far enough away from the upper quartile to be outliers.
(c) Identify which patient(s) may have been smoking more than a packet of cigarettes a day. Show your working clearly.
Research suggests that cotinine levels in the blood form a skewed distribution.
One measure of skewness is found using $\dfrac{Q_1 - 2Q_2 + Q_3}{Q_3 - Q_1}$
(d) Evaluate this measure and describe the skewness of these data.

Q9 - ID: 5454 *[6 marks, 7 minutes]*

In a survey a sample of 42 fields is taken. Their areas are summarised in the grouped frequency table.

Area	$0 < x \leq 2$	$2 < x \leq 7$	$7 < x \leq 9$	$9 < x \leq 13$	$13 < x \leq 24$
frequency	2	7	13	13	7

(a) Calculate an estimate of the sample mean and sample standard deviation.
(b) Decide whether there could be any outliers at the upper end of the distribution.

Q10 - ID: 5770 *[11 marks, 13 minutes]*

The maximum temperatures x degrees Celsius recorded during each month of 2005 in Cambridge are given in the table below

Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
9	7.2	10.9	14.2	17.1	22.2	20.3	22.9	21	17.7	10.1	7.7

These data are summarised by $n = 12$, $\sum x = 180.3$, $\sum x^2 = 3090.63$
(a) Calculate the mean and standard deviation of the data.
(b) Determine whether there are any outliers.
(c) The formula $y = 1.8x + 32$ is used to convert degrees Celsius top degrees Fahrenheit.
Find the mean and standard deviation of 2005 maximum temperatures in degrees Fahrenheit.
(d) In New York the monthly maximum temperatures are recorded in degrees Fahrenheit.
In 2005 the mean was 74 and the standard deviation was 13. Briefly compare the maximum monthly temperatures in Cambridge and New York in 2005.

Q11 - ID: 6009 *[7 marks, 8 minutes]*

A box contains 100 cards. Each card has a number between 2 and 7 written on it.
The following table shows the frequencies for each number.

Number	2	3	4	5	6	7
Frequency	26	6	22	*k*	27	7

(a) Calculate the value of *k*.
(b) Find the median
(c) Find the interquartile range.

Q12 - ID: 6079 *[6 marks, 7 minutes]*

A survey was conducted of the number of bedrooms in 181 randomly chosen houses.
The results are shown in the following table.

Number of bedrooms	1	2	3	4	5	6
Frequency	38	50	41	28	15	9

(a) State whether the data is discrete or continuous.
(b) Write down the mean number of bedrooms per house.
(c) Write down the rmsd of the number of bedrooms per house.
(d) Find how many houses have a number of bedrooms greater than one rmsd above the mean.

Q13 - ID: 6188 *[3 marks, 4 minutes]*

Rachel measured the lengths in millimetres of some of the leaves on a tree.
Her results are recorded below.

31	43	38	45	36	43	48	37	31	42

Find the mean and standard deviation of the lengths of these leaves.

Q14 - ID: 7112 *[11 marks, 13 minutes]*

The birth weights, in kg, of 1423 babies are summarised in the table below.

Weight (kg)	Midpoint *x*, (kg)	Frequency *f*
0.0 – 1.0	0.5	1
1.0 – 2.0	1.5	8
2.0 – 2.5	2.25	59
2.5 – 3.0	–	230
3.0 – 3.5	3.25	790
3.5 – 4.0	3.75	320
4.0 – 5.0	4.5	12
5.0 – 6.0	–	3

[You may use $\sum fx = 4615.75$ and $\sum fx^2 = 15234.4375$]
(a) Write down the missing midpoints in the table above.
(b) Calculate an estimate of the mean birth weight.
(c) Calculate an estimate of the standard deviation of the birth weight.
(d) Use interpolation to estimate the median birth weight.
(e) Describe the skewness of the distribution. Give a reason for your answer.

Q15 - ID: 352 *[2 marks, 2 minutes]*

Each of the 21 students on a computer course recorded the number of minutes, x, to the nearest minute, spent surfing the internet during a given day. The results are summarised below:

$$\sum x = 1084, \quad \sum x^2 = 56544$$

Find μ for these data.

Q16 - ID: 6093 *[3 marks, 4 minutes]*

In an exam the mean mark for 114 male students was 56.
The mean mark for 97 female students was 59.
Calculate the mean mark for all 211 students.

Q17 - ID: 7935 *[4 marks, 5 minutes]*

Jacob records the amount of rainfall, in mm, at his school, each day for a week. The results are given below.

3.5 6.4 3.4 8.2 1 0.6 1.5

Evie then records the amount of rainfall, x mm, at the school each day for the following 21 days.
The results for the 21 days are summarised below.

$$\sum x = 82.6$$

(a) Calculate the mean amount of rainfall during the whole 28 days.
Jacob realises that he has transposed two of his figures.
The number 8.2 should have been 2.8 and the number 0.6 should have been 6.0
Jacob corrects these figures.
(b) State, giving your reason, the effect this will have on the mean.

Q18 - ID: 7937 *[7 marks, 8 minutes]*

On a randomly chosen day, each of the 36 students in a class recorded the time, t minutes to the nearest minute, they spent on their homework. The data for the class is summarised in the following table.

time, t	Number of students
10 – 19	3
20 – 29	4
30 – 39	10
40 – 49	11
50 – 69	5
69 – 79	3

(a) Use interpolation to estimate the value of the median.
Given that $\sum t = 1411$ and $\sum t^2 = 69447$
(b) find the mean and the standard deviation of the times spent by the students on their homework.
(c) Comment on the skewness of the distribution of the times spent by the students on heir homework. Give a reason for your answer.

Q19 - ID: 822 *[13 marks, 16 minutes]*

The following stem and leaf diagram shows the aptitude scores x obtained by all the applicants for a particular job.

3	3 5 8	(3)
4	1 5 7 8 9	(5)
5	2 3 4 5 6 7 9	(7)
6	1 2 3 3 3 5 6 8 8 9	(10)
7	1 2 2 3 4 5 5 5 6 8 8 8 8 9	(14)
8	1 1 2 3 5 8 8 9	(8)
9	0 4 7	(3)

(a) Write down the modal aptitude score
(b) Find the three quartiles for these data
(c) Outliers can be defined to be outside the limits Q1-1.5(Q3-Q1) and Q3+1.5(Q3-Q1). Identify the outliers
From these data $\sum x = 3382$ and $\sum x^2 = 240916$
(d) Calculate, to 2 decimal places, the mean and standard deviation for these data.
(e) Use two different methods to show that these data are negatively skewed.

Q20 - ID: 900 *[8 marks, 10 minutes]*

Two swimmers, Alan and Bob record the number of lengths of the swimming pool they can swim during each practice session over several weeks. This table summarises their results.

	Alan	*Bob*
Smallest value	31	32
Lower quartile	35	38
Median	39	43
Upper quartile	50	48
Largest value	60	58

(a) Using the same scale and on the same sheet of graph paper draw box plots to represent the data.
(b) Compare and contrast the two box plots.

Q21 - ID: 526 *[16 marks, 19 minutes]*

The number of bags of peanuts sold per day in a bar was recorded over a two-week period. The results are shown below.

30, 11, 31, 18, 39, 18, 14, 29, 39, 6, 39, 18, 33, 34

(a) Calculate the mean of these data
(b) Draw a stem and leaf diagram to represent these data.
(c) Find the median and the quartiles of these data.
An outlier is an observation that falls either 1.5× (interquartile range) above the upper quartile or 1.5× (interquartile range) below the lower quartile.
(d) Determine whether or not any items of data are outliers.
(e) Draw a box plot to represent these data.
(f) Comment on the skewness of the distribution of bags of peanuts sold per day. Justify your answer.

Q22 - ID: 4230 *[10 marks, 12 minutes]*

The values of daily sales of a specialist magazine, to the nearest £, taken at a newsagents over 485 days are summarised in the table below.

sales	0 – 5	5 – 25	25 – 50	50 – 85	85 – 130
days	10	80	175	175	45

(a) Draw a histogram to represent these data.
(b) Estimate the median of these data.
(c) Estimate the mean of these data.

Q23 - ID: 4231 *[8 marks, 10 minutes]*

The following table summarises the distances, to the nearest km, that 136 examiners travelled to attend a meeting in London.

Distance	44 − 49	50 − 55	56 − 65	66 − 77	78 − 94	95 − 148
number	5	17	57	41	12	4

(a) Give a reason to justify the use of a histogram to represent these data.
(b) Calculate the frequency densities needed to draw a histogram for these data.
(c) Use interpolation to estimate the median Q_2, the lower quartile Q_1 and upper quartile Q_3 for these data.
(d) Estimate the mean of these data.

Q24 - ID: 5521 *[9 marks, 11 minutes]*

Aeroplanes fly from City A to City B. Over a long period of time the number of minutes delay in take-off from City A was recorded. The minimum delay was 6 minutes and the maximum delay was 54 minutes. A quarter of all delays were at most 11 minutes, half were at most 15 minutes and 75% were at most 23 minutes. Only one of the delays was longer than 35 minutes. An outlier is an observation that falls either $1.5\times$ (interquartile range) above the upper quartile or $1.5\times$ (interquartile range) below the lower quartile.
(a) Draw a box plot to represent these data.
(b) Comment on the distribution of delays. Justify your answer.

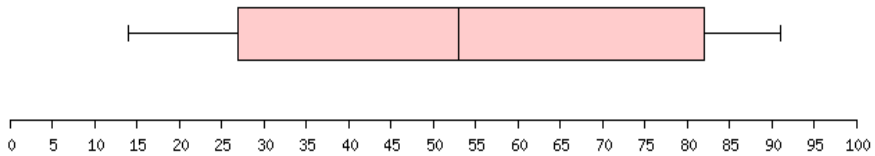
Q25 - ID: 3513 *[6 marks, 7 minutes]*

The following results give the heights of 18 sunflowers in centimetres.

180, 191, 173, 158, 176, 186, 188, 169, 153
187, 187, 168, 170, 157, 172, 175, 167, 158

Represent the data by a stem and leaf diagram.

Q26 - ID: 4143 *[3 marks, 4 minutes]*



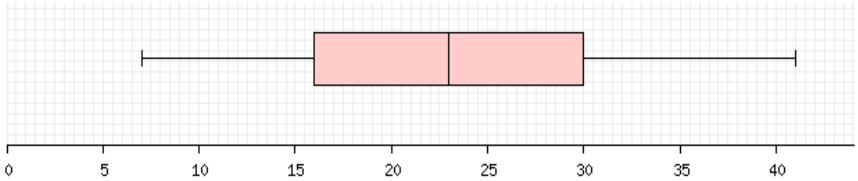
The exam results for 100 boys are displayed.

(a) Find the range of the results.
(b) Find the interquartile range.
(c) Write down the median.

Q27 - ID: 736 *[7 marks, 8 minutes]*

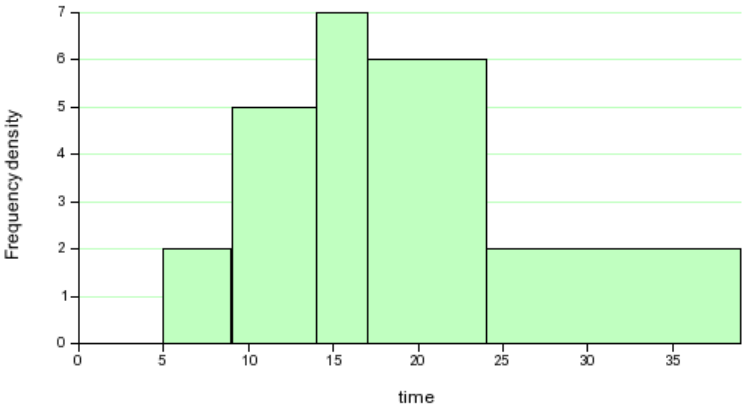
A teacher recorded, to the nearest hour, the time spent watching TV during a particular week by each child in a random sample. The times were summarised in a grouped frequency table and represented by a histogram.
One of the classes in the grouped frequency distribution was $23 - 35$ and its associated frequency was 8. On the histogram the height of the rectangle representing that class was $2\,cm$ and the width was $2\,cm$.
(a) Give a reason to support the use of a histogram to represent these data.
(b) Write down the underlying feature associated with each of the bars in the histogram.
(c) Show that on this histogram each child was represented by $0.5\,cm^2$.
The total area under the histogram is $29\,cm^2$.
(d) Find the total number of children in the group.

Q28 - ID: 5539 *[6 marks, 7 minutes]*



(a) Describe, briefly, three distinct features of box plots which make them appropriate for summarising a set of data.
There are approximately the same number of boys and girls in the 6th form of a city school. The total times, in hours, that 6th form boys spent watching television during a particular week were recorded. A box plot of the results is shown. In the same week, the total times that 6th form girls from the same school spent watching television were also recorded. The least time for girls was 5 hours and the longest time was 37 hours.
The median time for the girls was 21 hours. The lower and upper quartiles were 15 and 27 hours respectively.
(b) Compare the data sets for the boys and girls.

Q29 - ID: 4228 *[8 marks, 10 minutes]*



The histogram is for the variable t which represents the time taken, in minutes, by a group of people to swim 500 m.

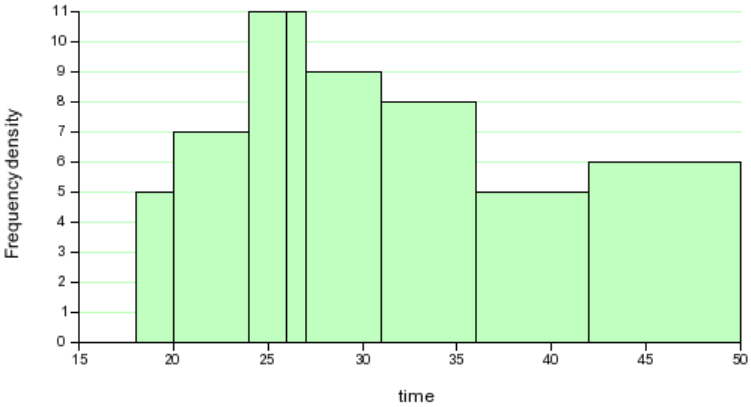
(a) Complete the frequency table for t.

t	5 – 9	9 – 14	14 – 17	17 – 24	24 – 39
f	8	25	21	?	?

(b) Estimate the number of people who took longer than 19 minutes to swim 500 m.

(c) Estimate the mean time taken.

Q30 - ID: 4227 *[5 marks, 6 minutes]*



The histogram shows the time taken, to the nearest minute, for 450 runners to complete a short fun run. Use the histogram to calculate the number of runners who took between 42 and 50 minutes to complete the fun run.

Q31 - ID: 5771 *[6 marks, 7 minutes]*

Text messages

0	2
1	0 0 1 2 3 4 4
2	0 0 2
3	2 5 6 9
4	0 1 2 2 2 2 4 5 5 6 7
5	2

A survey is carried out on 27 pupils in a class to find out how many text messages each sent the previous day. The results are shown in the stem and leaf diagram.
(a) Find the mode and median of the number of text messages.
(b) Identify the type of skewness of the distribution.
The mean or median could be used as a measure of central tendency for these data.
(c) In view of the skewness of the distribution, state whether the mean or median should be used.
(d) The mean number of text messages is 30.3. If each message costs 10 pence, find the total cost of all these messages.

Q32 - ID: 6069 *[6 marks, 7 minutes]*

The table below shows the number of words in the extended essays of a class.

words	3300 – 3400	3400 – 3500	3500 – 3600	3600 – 3700	3700 – 3800
frequency	4	4	7	22	2

(a) Draw a histogram for the data in this table.
(b) Write down the modal group.
The maximum word count is 3700 words.
(c) Write down the probability that a student chosen at random is on or over the word count.

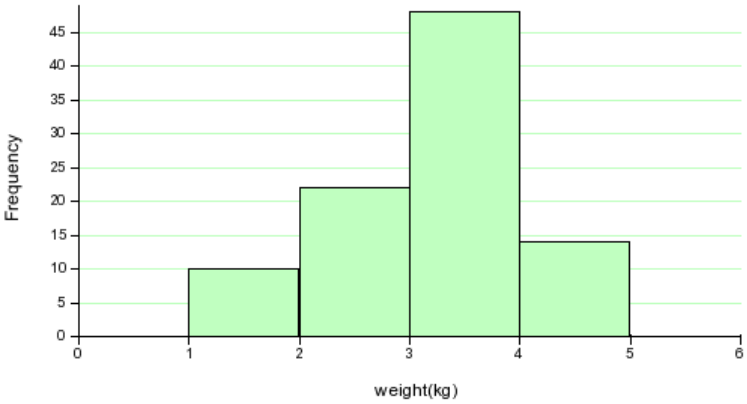
Q33 - ID: 6074 *[6 marks, 7 minutes]*

(a) Complete the following table of values for the height and weight of seven students.

	Values	*Mode*	*Median*	*Mean*	*Standard deviation*
Height(cm)	147, 157, 166, 161, 175, 143, 166			159.3	10.4
Weight(kg)	92, 102, 99, 176, 42, 170, 176	176	102		

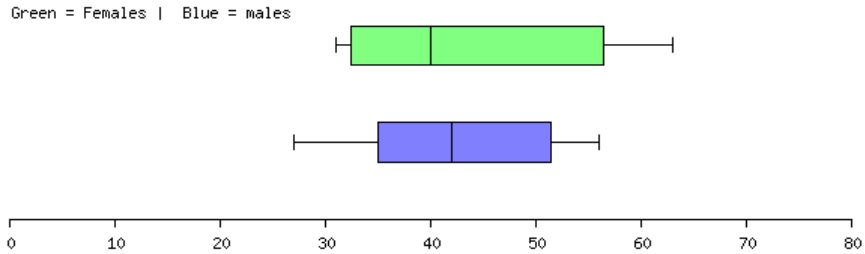
(b) The ages (in months) of seven students are 196, 207, 208, 212, 221, 200, 210
Represent these values in an ordered stem and leaf diagram.

Q34 - ID: 6089 *[4 marks, 5 minutes]*



The histogram shows the weights of a number of frozen chickens in a supermarket.
The weights are grouped such that $1 \leq weight < 2, 2 \leq weight < 3$, and so on.
(a) Find the total number of chickens.
(c) Write down the modal group.
(d) Gabriel chooses a chicken at random. Find the probability that this chicken weighs less than 4 kg.

Q35 - ID: 6096 *[5 marks, 6 minutes]*



Year 12 students taken a General studies examination. The results are illustrated in the box and whisker plots.
One student commented that the plots show there were more males than females.
(a) Comment on this statement.
(b) Give two comparisons between the overall performance of the males and females.
(c) Give one advantage and one disadvantage of using box and whisker plots rather than histograms to display the results.

Q36 - ID: 6192 *[8 marks, 10 minutes]*

The pulse rates, in beats per minute, of a random sample of 15 small animals are shown in the following table.

106, 109, 112, 148, 152
129, 136, 159, 143, 107
107, 121, 122, 129, 138

(a) Draw a stem and leaf diagram to represent the data.
(b) Find the median and the quartiles.
(c) Draw a box plot to represent these data.

Q37 - ID: 5559 *[3 marks, 4 minutes]*

The variable x was measured to the nearest whole number. 66 observations are given in the table below.

x :	13 – 22	23 – 27	28 –
Frequency :	30	15	21

A histogram was drawn and the bar representing the 13 – 22 class has a width of 2 cm and a height of 5 cm. For the 23 – 27 class find
(a) the width,
(b) the height.

Q38 - ID: 5481 *[8 marks, 10 minutes]*

In a study of how students use their mobile telephones, the phone usage of a random sample of 11 students was examined for a particular week. The total length of calls, in minutes, for the 11 students were

75, 110, 32, 68, 83, 74, 61, 58, 69, 30, 56

(a) Find the median and quartiles for these data.
A value that is greater than $Q3 + 1.5 \times (Q3 - Q1)$ or smaller than $Q1 - 1.5 \times (Q3 - Q1)$ is defined as an outlier.
(b) Show that 110 is the only outlier.
(c) Draw a box plot for these data indicating clearly the position of the outlier.

Q39 - ID: 5483 *[8 marks, 10 minutes]*

In a shopping survey a random sample of 97 teenagers were asked how many hours, to the nearest hour, they spent shopping in the last month. The results are summarised in the table below.

hours :	0 – 6	7 – 11	12 – 17	18 – 22	23 – 32	33 – 68
frequency :	21	16	15	26	10	9

A histogram was drawn and the group (12 – 17) hours was represented by a rectangle that was 3 cm wide and 1.25 cm high.

(a) Calculate the width and height of the rectangle representing the group (23 – 32) hours.

(b) Use linear interpolation to estimate the median and interquartile range.

Q40 - ID: 7111 *[9 marks, 11 minutes]*

Aptitude test

0	0
1	2 4 5 7
2	0 2 2 3 6 6 6 7 7 8 9
3	5 7 8

The 19 employees of a company take an aptitude test.
The scores out of 40 are illustrated in the stem and leaf diagram.

(a) Find the median score.

(b) Find the interquartile range.

The company director decides that any employees whose scores are so low that they are outliers will undergo retraining. An outlier is an observation whose value is less than the lower quartile minus 1.0 times the interquartile range.

(c) Explain why there is only one employee who will undergo retraining.

(d) Draw a box plot to illustrate the employees' scores.

Q41 - ID: 670 *[4 marks, 5 minutes]*

A sixth-form class consists of 7 girls and 10 boys. Three students from the class are chosen at random. The number of boys chosen is denoted by the random variable X. Show that

(a) $P(X = 0) = \frac{210}{4080}$

(b) $P(X = 2) = \frac{1890}{4080}$

Q42 - ID: 724 *[7 marks, 8 minutes]*

For any married couple who are members of a squash club, the probability that the husband has a degree is $\frac{4}{6}$ and the probability that the wife has a degree is $\frac{1}{7}$. The probability that the husband has a degree given that his wife has a degree is $\frac{7}{11}$.

A married couple is chosen at random.

(a) Show that the probability of them both having degrees is $\frac{7}{77}$.

(b) Find the probability that only one of them has a degree.

(c) Find the probability that neither of them has a degree.

Q43 - ID: 426 *[4 marks, 5 minutes]*

An unbiased die has faces numbered 1 to 6 inclusive. The die is rolled and the number that appears on the uppermost face is recorded.

(a) State the probability of not recording a 6 in one roll of the die.

The die is thrown until a 6 is recorded.

(b) Find the probability that a 6 occurs for the first time on the third roll of the die.

Q44 - ID: 652 *[8 marks, 10 minutes]*

The events A and B are independent such that P(A) = 0.24 and P(B) = 0.21.

Find

(a) $P(A \cap B)$

(b) $P(A \cup B)$

(c) $P(A|B')$, where B' denotes *not* B

Q45 - ID: 766 *[7 marks, 8 minutes]*

There are 113 sixth-fomers in a college, of who 61 are studying only arts subjects, 22 only science subjects and the rest a mixture of both. Three students are selected at random, without replacement. Find the probability that

(a) all three students are studying only arts subjects,

(b) exactly one of the three students is studying only science subjects.

Q46 - ID: 935 *[9 marks, 11 minutes]*

A car dealer offers purchases a three year warranty on a new car. He sells two models, the Flash and the Naf. For the first 55 cars sold of each type the number of claims under the warranty is shown here.

	Claim	No claim
Flash	44	11
Naf	48	7

One of these purchases is chosen at random. Let A be the event that no claim is made by the purchaser under the warranty and B the event that the car purchased is a Naf.
(a) Find $P(A \cap B)$, (b) $P(A')$
Given that the purchaser chosen does not make a claim under the warranty,
(c) Find the probability that the car chosen is a Flash.
(d) Show that making a claim is not independent of the make of the car purchased. Comment on this result.

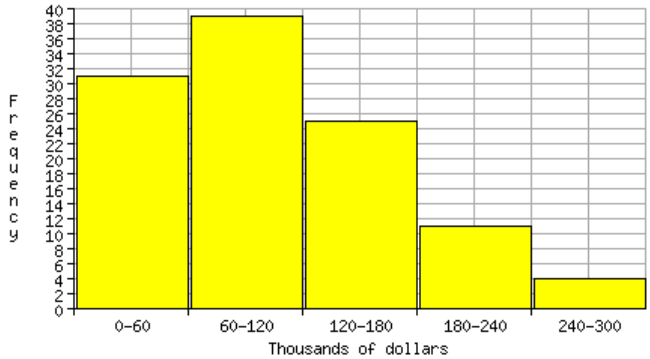
Q47 - ID: 458 *[8 marks, 10 minutes]*

Three events A, B and C are defined such that A and B are mutually exclusive and A and C are independent.
Given that $P(A) = 0.3$, $P(B) = 0.4$ and $P(A \cup C) = 0.7$, find
(a) $P(A|C)$
(b) $P(A \cup B)$
(c) $P(C)$.

Q48 - ID: 3538 *[6 marks, 7 minutes]*

Events A and B have probabilities $P(A) = 0.5$, $P(B) = 0.7$ and $P(A \cup B) = 0.78$
(a) Calculate $P(A \cap B)$
(b) State with a reason whether events A and B are independent.
(c) State with a reason whether events A and B are mutually exclusive.

Q49 - ID: 4128 *[6 marks, 7 minutes]*



The diagram shows the house prices in thousands of Australian dollars (AUD) of a random sample of houses in an Australian town.
(a) How many houses are in the sample?
(b) What is the modal group for houses prices?
(c) Find the probability of choosing a house at random which costs less than 60,000 AUD or more than 240,000 AUD.
(d) Given that a houses costs more than 120,000 AUD, find the probability that it costs between 180,000 and 240,000 AUD.

Q50 - ID: 4570 *[7 marks, 8 minutes]*

A bag contains 8 black balls and 5 red balls.
A disc is selected at random from the bag. If it is red it is replaced in the bag. If it is black, it is not replaced. A second disc is now selected at random from the bag.
Find the probability that
(a) the second disc is black, given that the first disc was black,
(b) the second disc is black,
(c) the two discs are of different colours.

Q51 - ID: 5518 *[6 marks, 7 minutes]*

A bag contains 3 red balls and 4 blue balls. A random sample of 3 balls is selected from the bag, without replacement. Calculate the probability that
(a) all the selected balls are red,
(b) more blue balls are selected than red balls.

Q52 - ID: 5478 *[9 marks, 11 minutes]*

The events A and B are such that $P(A) = 0.5$ and $P(A \cup B) = 0.6$.
Determine the value of P(B) in each of the cases when
(a) A and B are mutually exclusive,
(b) A and B are independent,
(c) $P(B|A) = 0.2$.

Q53 - ID: 4375 *[8 marks, 10 minutes]*

(a) A biased coin is thrown twice. The probability that it shows heads both times is 0.64. Find the probability that it shows tails both times.
(b) Another coin is biased so that the probability that it shows heads on any throw is p. The probability that the coin shows heads exactly once in two throws is 0.455. Find the two possible values of p.

Q54 - ID: 4377 *[7 marks, 8 minutes]*

A bag contains 7 white discs and 9 blue discs. Discs are removed at random, one at a time, without replacement. Find the probability that
(a) the second disc is blue, given that the first disc was blue,
(b) the second disc is blue,
(c) the third disc is blue, given that the first disc was blue.

Q55 - ID: 4667 *[6 marks, 7 minutes]*

If $P(A) = \frac{1}{4}, P(B) = \frac{1}{3}$ and $P(A \cup B) = \frac{7}{13}$
what is $P(A'|B')$?

Q56 - ID: 5368 *[7 marks, 8 minutes]*

A bag contains 13 balls of which 4 are red, 6 are blue and 3 are yellow.
Bill chooses 3 of these balls at random without replacement. Find the probability that
(a) he chooses 3 yellow balls,
(b) he chooses no blue balls,
(c) he chooses 1 ball of each colour.

Q57 - ID: 5524 *[6 marks, 7 minutes]*

Consider the events A and B where $P(A) = \frac{4}{7}, P(B') = \frac{2}{5}$ and $P(A \cup B) = \frac{4}{7}$.
(a) Write down $P(B)$.
(b) Find $P(A \cap B)$
(c) $P(A|B)$.

Q58 - ID: 5479 *[8 marks, 10 minutes]*

The events A and B are such that $P(A) = 0.5$, $P(B) = 0.33$ and $P(A \cap B) = 0.22$.
Calculate
(a) $P(A \cup B)$
(b) $P(A' \cap B')$
(c) $P(B \mid A')$.

Q59 - ID: 3142 *[8 marks, 10 minutes]*

Steve is going on holiday. The probability that he is delayed on his outward flight is 0.11. The probability that he is delayed on his return flight is 0.13, independently of whether or not he is delayed on the outward flight.
(a) Find the probability that Steve is delayed on his outward flight but not on his return flight.
(b) Find the probability that he is delayed on at least one of the two flights.
(c) Given that he is delayed on at least one flight, find the probability that he is delayed on both flights.

Q60 - ID: 3144 *[8 marks, 10 minutes]*

Adam and Eve are having a tennis competition. The winner of the competition is the first to win 2 matches in a row. If the competition has not been decided after 5 matches, then the player who has won more matches is declared the winner of the competition. For example, the following sequences are two ways in which Adam could win the competition. (A represents a match won by Adam; E represents a match won by Eve.)
AEAA AEAEA
(a) Explain why the sequence AAE is not possible.
(b) Write down the other three possible sequences in which Adam wins the competition.
(c) The probability that Adam wins a match is 0.67. Find the probability that he wins the competition in no more than 4 matches.

Q61 - ID: 4368 *[4 marks, 5 minutes]*

A supermarket has a large stock of eggs. 40% of the stock are from a company called The Eggery. 13% of the stock are brown eggs from The Eggery.
An egg is chosen at random from the stock. Find the probability that.
(a) the egg is brown given that it is from The Eggery.
(b) the egg is from The Eggery and is not brown.

Q62 - ID: 4526 *[10 marks, 12 minutes]*

David and his partner, Amber, both work at their district hospital.
The probability that David cycles to work each morning is 0.84 . On a morning when David cycles to work, the probability that Amber cycles to work is 0.79 . On a morning when David does not cycle to work, the probability that Amber cycles to work is 0.3.
Calculate the probability that, on a particular morning:

(a) they both cycle to work;
(b) only Amber cycles to work;
(c) exactly one of them cycles to work.

(d) Assuming that decisions as to whether to cycle to work are independent from day to day, calculate the probability that, during a period of 3 working days, they both cycle to work on exactly 2 of the days and neither of them cycles to work on the other day.

Q63 - ID: 5372 *[10 marks, 12 minutes]*

The two events A, B are such that $P(A) = 0.21$, $P(B) = 0.26$, $P(A \cup B) = 0.34$.
(a) Evaluate $P(A \cap B)$.
(b) Determine whether or not A and B are independent.
(c) Evaluate $P(A|B')$.

Q64 - ID: 5373 *[6 marks, 7 minutes]*

A bag contains 16 sweets of which 6 are red, 5 are green and 5 are yellow. Jill chooses 2 of these sweets at random.
(a) Calculate the probability that these 2 sweets are of the same colour.
(b) Hence, or otherwise, calculate the probability that these 2 sweets are of different colours.

Q65 - ID: 5374 *[10 marks, 12 minutes]*

The two independent events A and B are such that $P(A) = 0.5$, $P(A \cup B) = 0.7$.
(a) Evaluate $P(B)$.
(b) Find the probability that exactly one of the two events occurs.
(c) Given that exactly one of the two events occurs, calculate the probability that A occurs.

Q66 - ID: 5408 *[9 marks, 11 minutes]*

(a) A bag contains 25 red discs and 8 black discs. Two discs are removed at random, without replacement. Find the probability both discs are red.
(b) Another bag contains 9 green discs and 6 blue discs. Three discs are removed at random, without replacement. Find the probability that exactly two are green.
(c) A third bag contains 45 discs, all of which are either yellow or brown. Two discs are removed at random, without replacement. The probability that both discs are yellow is $\frac{1}{15}$. Find the number of yellow discs that were in the bag at first.

Q67 - ID: 5986 *[6 marks, 7 minutes]*

Let A and B be events such that $P(A) = 0.6$, $P(A \cup B) = 0.8$ and $P(A|B) = 0.5$. Find $P(B)$.

Q68 - ID: 5557 *[7 marks, 8 minutes]*

Given that $P(A) = a$ and $P(B) = b$ express $P(A \cup B)$ in terms of a and b wh
(a) A and B are mutually exclusive,
(b) A and B are independent.
Two events R and Q are such that
$P(R \cap Q') = 0.16$, $P(Q) = 0.39$ and $P(R|Q) = 0.16$.
Find the value of
(c) $P(R \cup Q)$
(d) $P(R \cap Q)$
(e) $P(R)$

Q69 - ID: 6010 *[7 marks, 8 minutes]*

There are 18 students in a classroom. Each student plays only one sport. The table below gives their sport and gender.

	Football	*Tennis*	*Hockey*
Female :	3	3	3
male :	5	2	2

(a) One student is selected at random.
(i) Calculate the probability that the student is a male or is a tennis player.
(ii) Given that the student selected is female, calculate the probability that the student does not play football.
(b) Two students are selected at random. Calculate the probability that neither student plays football.

Q70 - ID: 5498 *[8 marks, 10 minutes]*

A group of office workers were questioned for a health magazine and $\frac{1}{4}$ were found to take regular exercise. When questioned about their eating habits $\frac{1}{5}$ said they always eat breakfast and, of those who always eat breakfast $\frac{6}{29}$ also took regular exercise.
Find the probability that a randomly selected member of the group
(a) always eats breakfast and takes regular exercise,
(b) does not always eat breakfast and does not take regular exercise
(c) Determine, giving your reason, whether or not always eating breakfast and taking regular exercise are statistically independent.

Q71 - ID: 8032 *[7 marks, 8 minutes]*

Events A and B are such that $P(A' \cap B') = \frac{1}{8}$
(a) Find $P(A \cup B)$
(b) Given that $P(A|B) = \frac{1}{3}$ and $P(B) = \frac{1}{4}$, find $P(A \cap B)$ and $P(A)$
(c) In playing the UK Lottery, a set of 7 different integers is chosen irrespective of order from the integers 1 to 49 inclusive.
How many different sets of 7 integers can be chosen?

Q72 - ID: 5519 *[6 marks, 7 minutes]*

A company assembles drills using components from two sources.
Acemart supplies 86% of the components and Begud supplies the rest.
It is known that 6% of the components supplied by Acemart are faulty and 8% of those supplied by Begud are faulty.
(a) Represent this information on a tree diagram.
An assembled drill is selected at random.
(b) Find the probability that it is not faulty

Q73 - ID: 486 *[7 marks, 8 minutes]*

A bag contains 5 red balls and 5 blue balls.
A ball is selected at random from the bag and its colour is recorded.
The ball is not replaced. A second ball is selected and its colour is recorded.
(a) Draw a tree diagram to represent this information.
Find the probability that
(b) the second ball selected is blue.
(c) both balls selected are blue, given that the second ball selected is blue.

Q74 - ID: 5538 *[9 marks, 11 minutes]*

A contestant reaches the final round of a quiz competition.
The round consists of only two questions, A and B, on a related topic.
The probability of the contestant getting question A correct is $\frac{4}{7}$.
If she gets A correct, the probability of getting B correct is $\frac{3}{8}$.
If she does not get A correct, the probability of getting B correct is $\frac{2}{5}$.
(a) By using a tree diagram, or otherwise, find the probability that she gets at least one question correct.
(b) Given that she gets B correct, find the probability that she also gets A correct.

Q75 - ID: 734 *[11 marks, 13 minutes]*

In a factory machines A, B and C are all producing metal rods of the same length. Machine A produces 35% of the rods, machine B produces 30% and the rest are produced by machine C. Of their production of rods, machines A, B and C produce 6%, 5% and 3% defective rods respectively.
(a) Draw a tree diagram to represent this information.
Find the probability that a randomly selected rod is
(b) produced by machine A and is defective.
(c) defective.
(d) Given that a randomly selected rod is defective, find the probability that it was produced by machine C.

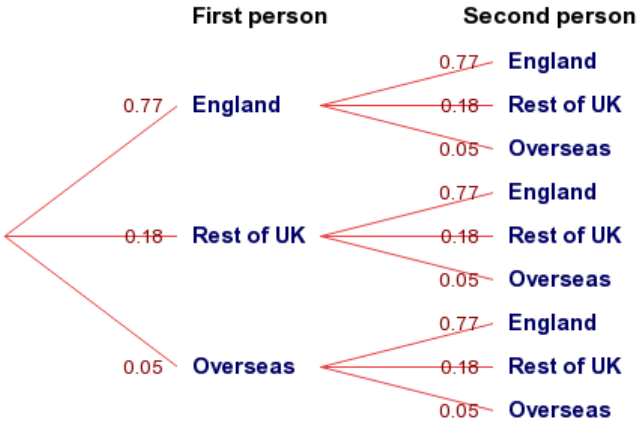
Q76 - ID: 5515 *[11 marks, 13 minutes]*

A bag contains 4 1p coins and 7 2p coins. Coins are removed at random one at a time, without replacement, until the total value of the coins removed is at least 3p. Then no more coins are removed.
(a) Complete a probability tree diagram.
Find the probability that
(b) exactly two coins are removed,
(c) the total value of the coins removed is 4p.

Q77 - ID: 3299 *[8 marks, 10 minutes]*

A disease is known to be present in 3% of a population.
A test is developed to help determine whether or not someone has the disease.
Given that a person has the disease, the test is positive with probability 0.9.
Given that a person does not have the disease, the test is positive with probability 0.04.
(a) Draw a tree diagram to represent this information.
A person is selected at random from the population and tested for this disease.
(b) Find the probability that the test is positive.
A doctor randomly selects a person from the population and tests him for the disease.
Given that the test is positive,
(c) find the probability that he does not have the disease.

Q78 - ID: 5509 *[16 marks, 19 minutes]*



In a large town 77% of the population were born in England, 18% in the rest of the UK and 5% abroad. Two people are selected at random. You may use the above tree diagram in answering this question. Find the probability that

(a) both these people were born in the rest of the UK.

(b) at least one of these people was born in England.

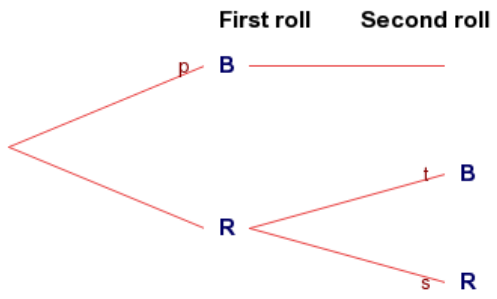
(c) neither of these people was born overseas.

(d) Find the probability that both these people were born in the rest of the UK given that neither was born overseas.

(e) 3 people are selected at random. Find the probability that at least one of them was not born in England

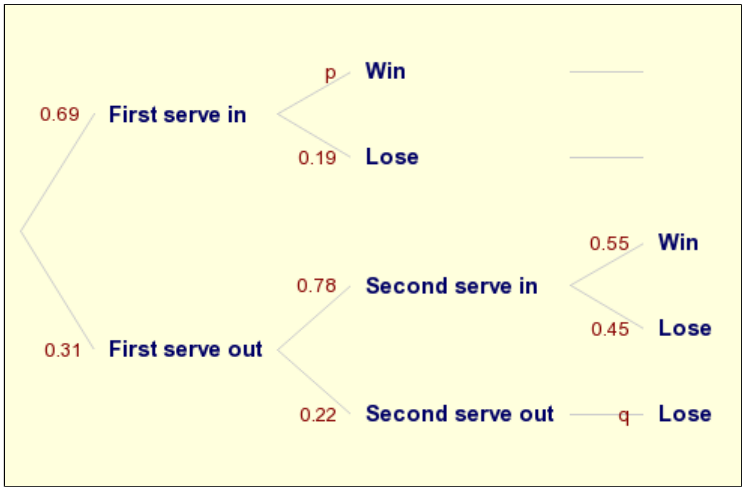
(f) An interviewer selects n people at random. The interviewer wishes to ensure that the probability that at least one of them was not born in England is more than 85%. Find the least possible value of n.

Q79 - ID: 6004 *[16 marks, 19 minutes]*



A four-sided die has three blue faces and one red face. The die is rolled.
Let B be the event a blue face lands down, and R be the event a red face lands down.
(a) Write down (i) P(B); (ii) P(R).
If the blue face lands down, the die is not rolled again. If the red face lands down, the die is rolled once again. This is represented by the tree diagram shown, where p , s , t are probabilities.
(b) Find the value of p , of s and of t.
Guiseppi plays a game where he rolls the die. If a blue face lands down, he scores 2 and is finished. If the red face lands down, he scores 1 and rolls one more time.
Let X be the total score obtained.
(c) Show that $P(X = 3) = \frac{3}{16}$.
(d) Find $P(X = 2)$.
(e) Construct a probability distribution table for X.
(f) Calculate the expected value of X.
(g) If the total score is 3, Guiseppi wins £10. If the total score is 2, Guiseppi gets nothing. Guiseppi plays the game twice. Find the probability that he wins exactly £10.

Q80 - ID: 6082 *[6 marks, 7 minutes]*



When Andy plays tennis, 69 % of his first serves go into the correct area of the court. If the first serve goes into the correct area, his chance of winning the point is 81 %. If his first serve does not go into the correct area, Andy is allowed a second serve and, of these, 78 % go into the correct area. If the second serve goes into the correct area, his chance of winning the point is 55 %. If neither serve goes into the correct area, Andy loses the point.
(a) Find probabilities p and q.
(b) Find the probability that Andy loses the point.

Q81 - ID: 6190 *[10 marks, 12 minutes]*

There are three sets of traffic lights on Bob's journey to work.
The independent probabilities that Bob has to stop at the first, second and third set of lights are 0.3, 0.6 and 0.1 respectively.
(a) Draw a tree diagram to show this information.
(b) Find the probability that Bob has to stop at each of the first two sets of lights but does not have to stop at the third set.
(c) Find the probability that Bob has to stop at exactly two of the three sets of lights.
(d) Find the probability that Bob has to stop at the first set of lights, given that he has to stop at exactly two sets of lights.

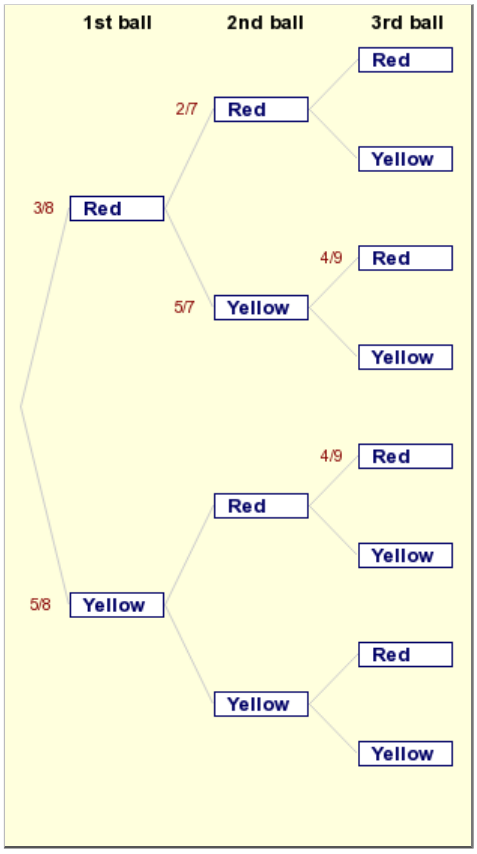
Q82 - ID: 5556 *[11 marks, 13 minutes]*

On a randomly chosen day, the probability that Bill travels to school by car, by bicycle or on foot is $\frac{3}{5}$, $\frac{1}{5}$ and $\frac{1}{5}$ respectively.
The probability of being late when using these methods of travel is. $\frac{1}{4}$, $\frac{1}{4}$ and $\frac{2}{9}$ respectively.
(a) Draw a tree diagram to represent this information.
Find the probability that on a randomly chosen day
(b) Bill travels by foot and is late,
(c) Bill is not late.
(d) Given Bill is late, find the probability that he did not travel on foot.

Q83 - ID: 7105 *[5 marks, 6 minutes]*

A jar contains 3 red, 2 blue and 2 green beads.
Two beads are drawn at random from the jar without replacement.
(a) Draw a tree diagram to illustrate all the possible outcomes and associated probabilities.
State your probabilities clearly.
(b) Find the probability that a blue bead and a green bead are drawn from the jar.

Q84 - ID: 7939 *[17 marks, 20 minutes]*



The bag P contains 8 balls of which 3 are red and 5 are yellow.
The bag Q contains 7 balls of which 3 are red and 4 are yellow.
A ball is drawn at random from bag P and placed in bag Q. A second ball is drawn at random from bag P and placed in bag Q.
A third ball is then drawn at random from the 11 balls in bag Q.
The event A occurs when the 2 balls drawn from bag P are of the same colour.
The event B occurs when the ball drawn from bag Q is red.

(a) Complete the tree diagram.
(b) Find $P(A)$
(c) Show that $P(B) = \frac{5}{12}$
(d) Show that $P(A \cap B) = \frac{5}{28}$.
(e) Hence find $P(A \cup B)$
(f) Given that all three balls drawn are the same colour, find the probability that they are all red.

Q85 - ID: 400 *[10 marks, 12 minutes]*

A gambler places two bets. He estimates that the probability of winning the first bet is 0.8, the probability of winning the second is 0.3 and the probability of winning both is 0.2. By drawing a Venn diagram,
(a) find the probability that he does not win either bet.
(b) find the probability that he wins exactly one bet.
(c) Given that he does not win the first bet, find the probability that he wins the second.
(d) By calculation, determine whether or not winning the bets are independent events.

Q86 - ID: 5476 *[13 marks, 16 minutes]*

Articles made on a lathe are subject to three kinds of defect, A, B or C.
A sample of 950 articles was inspected and the following results were obtained.
29 had type A defect; 36 had type B defect; 44 had had type C defect.
10 had both type A and type B defects. 10 had both type A and C defects.
12 had both type B and C defects. 5 had all 3 types of defects
(a) Represent these data on a Venn diagram.
Find the probability that a randomly selected article from this sample had
(b) no defects,
(c) no more than one of these defects.
An article selected at random from this sample had only one defect.
(d) Find the probability that it was a type B defect.
Two different articles were selected at random from this sample.
(e) Find the probability that both had type B defects.

Q87 - ID: 593 *[11 marks, 13 minutes]*

For the events A and B,

$$P(A \cap B') = 0.31, P(A' \cap B) = 0.18, P(A \cup B) = 0.53$$

(a) Draw a Venn diagram to illustrate the complete sample space for the events A and B.
(b) Write down the values of $P(A)$ and $P(B)$.
(c) Find $P(A|B')$.
(d) Determine whether or not A and B are independent.

Q88 - ID: 5472 *[13 marks, 16 minutes]*

A group of 105 people produced the following information relating to three attributes.
The attributes were wearing glasses, being left-handed and having dark hair.
Glasses were worn by 38 people, 39 were left-handed and 37 had dark hair. There were 19 who wore glasses and were left-handed, 20 who wore glasses and had dark hair and 19 who were left-handed and had dark hair. Only 10 people wore glasses, were left-handed and had dark hair.
(a) Represent these data on a Venn diagram.
A person was selected at random from this group. Find the probability that this person
(b) wore glasses but was not left-handed and did not have dark hair,
(c) did not wear glasses, was not left-handed and did not have dark hair,
(d) had only two of the attributes,
(e) wore glasses, given they were left-handed and had dark hair.

Q89 - ID: 3148 *[9 marks, 11 minutes]*

A survey of the reading habits of some students revealed that, on a regular basis, 21% read quality newspapers, 41% read tabloid newspapers and 40% do not read newspapers at all.
(a) Find the proportion of students who read both quality and tabloid newspapers.
(b) Draw a Venn diagram to represent this information.
student is selected at random. Given that this student reads newspapers on a regular basis,
(c) find the probability that this student only reads quality newspapers.

Q90 - ID: 5540 *[5 marks, 6 minutes]*

A DVD rental company knows that:
23% of its customers rent DVDs on a Monday;
39% of its customers rent DVDs on a Friday;
50% of its customers rent DVDs on a Monday or a Friday.
Find the probability that a customer chosen at random from this group of customers:
(a) rents DVDs on both days;
(b) rents DVDs only on a Monday.

Q91 - ID: 3236 *[10 marks, 12 minutes]*

A person's blood group is determined by whether or not it contains any of 3 substances A, B and C.
A doctor surveyed 306 patients' blood and produced the table below.

Blood contains	No. of patients
only C	105
A and C but not B	101
only A	26
B and C but not A	29
only B	13
A, B and C	11
A and B but not C	5

(a) Draw a Venn Diagram to represent these data.
(b) Find the probability that a randomly chosen patient's blood contains substance C
Harry is one of the patients. Given that his blood contains substance A,
(c) find the probability that his blood contains all 3 substances.
Patients whose blood contains none of these substances are called universal blood donors.
(d) Find the probability that a randomly chosen patient is a universal blood donor.

Q92 - ID: 2628 *[16 marks, 19 minutes]*

The following shows the results of a wine tasting survey of 105 people,
95 like wine A, 92 like wine B, 98 like wine C, 90 like A and B,
89 like B and C, 91 like A and C, 88 like all three wines
(a) Draw a Venn Diagram to represent these data.
Find the probability that a randomly selected person from the survey likes
(b) none of the three wines,
(c) wine A but not wine B,
(d) any wine in the survey except wine C,
(e) exactly two of the three kinds of wine.
Given that a person from the survey likes wine A,
(f) find the probability that the person likes wine C.

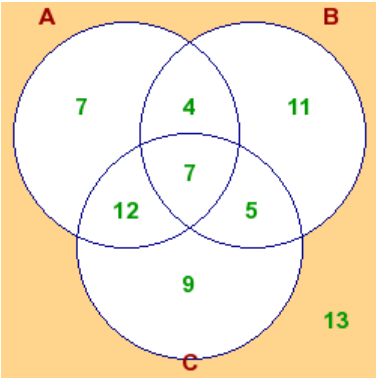
Q93 - ID: 5469 *[8 marks, 10 minutes]*

In the 2001 census, people in Wales were asked whether or not they could speak Welsh. A resident of Wales is selected at random.
W is the event this person can speak Welsh.
C is the event this person is a child
You are given that $P(W) = 0.2$, $P(C) = 0.15$ and $P(W \cap C) = 0.01$,
(a) Determine whether the events W and C are independent.
(b) Draw a Venn diagram corresponding to the events W and C, and fill in the probability corresponding to each region of your diagram.
(c) Find $P(W|C)$.
(d) Given that $P(W|C') = 0.03$, use this answer and your answer to part (c) to comment very briefly on how the ability to speak Welsh differs between children and adults.

Q94 - ID: 5477 *[7 marks, 8 minutes]*

A health club has a number of facilities which include a gym and a sauna. Andrew visits the health club on Tuesday evenings.
On any visit, Andrew uses either the gym or the sauna or both, but no other facilities.
The probability that he uses the gym, P(G), is 0.92 . The probability that he uses the sauna, P(S), is 0.43. The probability that he uses both the gym and the sauna is 0.35.
Calculate the probability that, on a particular visit:
(a) he does not use the gym;
(b) he uses the gym but not the sauna;
(c) he uses either the gym or the sauna but not both.
(d) Assuming that Andrew's decision on what facility to use is independent from visit to visit, calculate the probability that, during a month in which there are exactly four Tuesdays, he does not use the gym.

Q95 - ID: 6088 *[4 marks, 5 minutes]*



(a) In the Venn diagram, the number of elements in each region is given.
Find $n((A \cap B) \cup C)$.

U is the set of positive integers, Z^+

E is the set of even numbers.

M is the set of multiples of 5.

(b) List the first six elements of the set M.

(c) List the first six elements of the set $E' \cap M$.

Q96 - ID: 7108 *[9 marks, 11 minutes]*

There are 179 students at a college following a general course in computing.
Students on this course can choose to take up to three extra options.

102 take systems support,
73 take developing software,
82 take networking,
32 take developing software and systems support,
33 take networking and developing software,
37 take systems support and networking,
5 take all three extra options.

(a) Draw a Venn Diagram to represent this information.

A student from the course is chosen at random. Find the probability that the student takes

(b) none of the three extra options,

(c) networking only.

Students who want to become technicians take systems support or networking.
Given that a randomly chosen student wants to become a technician,

(d) find the probability that this student takes all three extra options.

Q97 - ID: 664 *[2 marks, 2 minutes]*

On a particular day in Autumn 1988 at 1200 hours, the height above sea level, x metres, and the temperature, y degrees C, were recorded in 40 Scandinavian towns.
The following statistics were calculated from the results:
$\sum x = 1995$, $\sum x^2 = 101363$, $S_{xy} = -36.5$, $S_{yy} = 1532.4$
Find S_{xx}.

Q98 - ID: 853 *[3 marks, 4 minutes]*

On a particular day in Autumn 1988 at 1200 hours, the height above sea level, x metres, and the temperature, y degrees C, were recorded in 70 Scandinavian towns.
The following statistics were calculated from the results:
$\sum x = 3498$, $\sum x^2 = 176942$, $S_{xy} = -54.286$, $S_{yy} = 2292.571$
Given that $S_{xx} = 2141.943$, calculate, to 3 decimal places, the product moment correlation coefficient between x and y.

Q99 - ID: 648 *[10 marks, 12 minutes]*

A company owns two petrol stations P and Q along a main road.
Total daily sales in the same week for P and Q are summarised in this table.

	p	q
Monday	4910	5530
Tuesday	5570	4550
Wednesday	5990	4710
Thursday	4750	5620
Friday	5480	4380
Saturday	5140	5560
Sunday	4530	5900

When these data are coded using $x = \frac{p - 4530}{100}$ and $y = \frac{q - 4380}{100}$
$\sum x = 46.6$, $\sum y = 55.9$, $\sum x^2 = 468.06$, $\sum y^2 = 670.07$, $\sum xy = 208.82$
(a) Calculate S_{xy}, S_{xx} and S_{yy}
(b) Calculate, to 3 decimal places, the product moment correlation coefficient between x and y.
(c) Write down the product moment correlation between p and q.
(d) Give an interpretation of this value.

Q100 - ID: 787 *[4 marks, 5 minutes]*

A young family were looking for a new 3 bedroom semi-detached house. A local survey recorded the price x in £1000, and the distance y, in miles from the station of such houses. The following statistics were provided:

$S_{xx} = 120385$, $S_{yy} = 8.273$, $S_{xy} = -954.494$

(a) Use these values to calculate the product moment correlation coefficient.
(b) Give an interpretation of your answer to part (a).
Another family asked for the distances to be measured in km rather than miles.
(c) State the value of the product moment correlation coefficient in this case.

Q101 - ID: 4567 *[6 marks, 7 minutes]*

The table contains data concerning five households selected at random from a certain town.

Number of people in household	2	2	3	6	4
Number of cars belonging to people in household	1	1	1	1	7

(a) Calculate the product moment correlation coefficient, r, for the data in the table.
(b) Give a reason why it would not be sensible to use your answer to draw a conclusion about all the households in the town.

Q102 - ID: 5543 *[15 marks, 18 minutes]*

Crickets make a noise. The pitch, v kHz, of the noise made by a cricket was recorded at 16 different temperatures, t °C. These data are summarised below.

$\sum t^2 = 10920.83$, $\sum v^2 = 42.3412$, $\sum t = 401.4$, $\sum v = 24.42$, $\sum tv = 677.88$

(a) Find S_{tt}, S_{vv}, S_{tv} for these data.
(b) Find the product moment correlation coefficient between t and v.
(c) State, with a reason, which variable is the explanatory variable.
(d) Give a reason to support fitting a regression model of the form $v = a + bt$ to these data.
(e) Find the value of a and the value of b. Give your answers to 3 significant figures.
(f) Using this model, predict the pitch of the noise at 24 °C.

Q103 - ID: 6100 *[3 marks, 4 minutes]*

A city council attempted to reduce traffic congestion by introducing a congestion charge. The charge was set at £4 for the first year and then was increased by £2 each year. For each of the first eight years, the council recorded the average number of vehicles entering the city centre per day. The results are shown in the table.

Charge £x	4	6	8	10	12	14	16	18
Average number, y millior	2.5	2.4	2.4	2.3	2.2	1.8	1.5	1.4

$n = 8, \sum x = 88, \sum x^2 = 1136, \sum y = 16.5, \sum y^2 = 35.35, \sum xy = 167.$

Calculate the product moment correlation coefficient for these data.

Q104 - ID: 4366 *[2 marks, 2 minutes]*

A sample of bivariate data was taken and the results were summarised as follows:

$n = 10, \sum x = 746, \sum x^2 = 56470, \sum y = 746, \sum y^2 = 56570, \sum xy = 5593$

Show that the value of the the product moment correlation coefficient is 0.33, correct to 3 significant figures.

Q105 - ID: 2630 *[5 marks, 6 minutes]*

A personnel manager wants to find out if a test carried out during an employee's interview and a skills assessment at the end of basic training is a guide to performance after working for the company for one year. The table below shows the results of the interview test of 10 employees and their performance after one year.

Employee	A	B	C	D	E	F	G	H	I	J
Interview test x	62	72	83	78	86	79	80	92	77	65
Performance y	69	73	81	65	88	82	60	64	82	73

[You may use $\sum x^2 = 60656$, $\sum y^2 = 55093$, $\sum xy = 57120$]

Showing your working clearly, calculate the product moment correlation coefficient between the interview test and the performance after one year.

Q106 - ID: 5560 *[6 marks, 7 minutes]*

The volume of a sample of gas is kept constant. The gas is heated and the pressure p, is measured at 15 different temperatures, t °C. The results are summarised below.

$\sum p = 415, \sum p^2 = 38140, \sum t = 246, \sum t^2 = 27501, \sum pt = 2683$

(a) Find S_{pp} and S_{pt} for these data.

Given that $S_{tt} = 23466.6$,

(b) calculate the product moment correlation coefficient.

(c) Give an interpretation of your answer to part (b).

Q107 - ID: 7109 *[8 marks, 10 minutes]*

The blood pressures, p mmHg, and the ages, t years, of 7 hospital patients are shown in the table below.

Patient	A	B	C	D	E	F	G
t	39	72	46	38	60	28	55
p	99	127	123	84	177	78	136

$\sum t = 338, \sum t^2 = 17674, \sum p = 824, \sum p^2 = 104024, \sum tp = 4213$

(a) Find S_{tt}, S_{pp} and S_{tp} for these data.

(b) Calculate the product moment correlation coefficient for these data.

(c) Interpret the correlation coefficient.

Q108 - ID: 7934 *[6 marks, 7 minutes]*

A random sample of 54 salmon was caught by a scientist.
He recorded the length l cm and weight w kg of each salmon.
The following summary statistics were calculated from these data.

$\sum l = 4039, \sum l^2 = 327756, \sum w = 369, \sum lw = 29332, S_{ww} = 262$

(a) Find S_{ll} and S_{lw} for these data.

(b) Calculate, to 3 significant figures, the product moment correlation coefficient between l and w.

(c) Give an interpretation of your answer to part (b).

Q109 - ID: 867 *[10 marks, 12 minutes]*

A drilling machine can run at various speeds, but in general the higher the speed the sooner the drill needs to be replaced. Over several months, 15 pairs of observations relating to speed, s revolutions per minute, and life of drill, h hours, are collected. For convenience the data are coded so that $x = s - 24$ and $y = h - 93$ and the following summations obtained:

$\sum x = 120, \sum y = 344, \sum x^2 = 1056, \sum y^2 = 8384, \sum xy = 277$

Find the equation of the regression line of h on s.

Q110 - ID: 403 *[7 marks, 8 minutes]*

A music teacher monitored the sight-reading ability of one of her students over a 10 week period. At the end of each week, the student was given a new piece to sight-read and the teacher noted the number of errors y. She also recorded the number of hours x that the student had practised each week.
The data are shown in the table below.

x	15	2	12	4	1	10	5	14	14	14
y	8	7	4	9	5	5	8	12	6	19

Find the equation of the regression line of y on x in the form $y = a + bx$.

Q111 - ID: 446 *[10 marks, 12 minutes]*

An agricultural researcher collected data, in appropriate units, on the annual rainfall x and the annual yield of wheat y at 8 randomly selected places.
The data are coded using $s = x - 7$ and $t = y - 20$
and the following summations were obtained:
$\sum s = 76$, $\sum t = 233$, $\sum s^2 = 800$, $\sum t^2 = 7035$, $\sum st = 219$
(a) Find the equation of the regression line of t on s in the form $t = p + qs$.
(b) Find the equation of the regression line of y on x in the form $y = a + bx$, giving a and b to 3 decimal places.

Q112 - ID: 672 *[11 marks, 13 minutes]*

Eight students took part in tests in maths and physics. The results are given in the table below, where m represents the maths mark and p the physics mark.

m	8	16	17	9	8	6	22	16
p	10	22	25	17	20	12	34	22

(a) Write down the explanatory variable.
(b) Showing your working, find the equation of the regression line of p on m.
A student was absent for the physics test but she sat the maths test and scored 12.
(c) Using this model, estimate the mark she would have scored in the physics test.

Q113 - ID: 634 *[10 marks, 12 minutes]*

A long distance lorry driver recorded the distance travelled, m miles, and the amount of fuel used, f litres, each day.
Summarised below are data from the driver's records for a random sample of 8 days.
The data are coded such that $x = m - 21$ and $y = f - 103$
$\sum x = 128$, $\sum y = 60$, $\sum xy = 943$, $S_{xx} = 88$
(a) Find the equation of the regression line of y on x in the form $y = a + bx$.
(b) Hence find the equation of the regression line of f on m.
(c) Predict the amount of fuel used on a journey of 242 miles.

Q114 - ID: 846 *[18 marks, 22 minutes]*

A metallurgist measured the length, l *mm*, of a copper rod at various temperatures, t °*C*, and recorded the following results.

t	23	29	33	42	43	49	50	64
l	2461.08	2461.27	2461.37	2461.53	2461.81	2462.06	2462.63	2463.13

The results were then coded such that $x = t$ and $y = l - 2460$.

(a) Calculate S_{xy} and S_{xx}.

(You may use $\sum x^2 = 15069$ and $\sum xy = 681.73$)

(b) Find the equation of the regression line of y on x in the form $y = a + bx$.

(c) Estimate the length of the rod at 40°*C*.

(d) Find the equation of the regression line of l on t.

(e) Estimate the length of the rod at 90°*C*.

(f) Comment on the reliability of your estimate in part (e).

Q115 - ID: 4569 *[6 marks, 7 minutes]*

Some observations of bivariate data were made and the equations of the two regression lines were found to be as follows.

y on x : $y = -0.5x + 13$

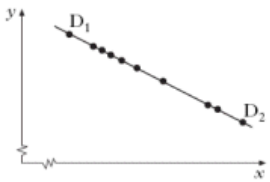
x on y : $x = -1.5y + 20.5$

(a) State, with a reason, whether the correlation between x and y is negative or positive.

(b) Neither variable is controlled. Calculate an estimate of the value of x when $y = 10$.

(c) Find the values of $\bar{x}$ and $\bar{y}$.

Q116 - ID: 2477 *[5 marks, 6 minutes]*



A scatter graph is drawn for a data set as shown above.

(a) State the correlation coefficient.

(b) The two data points shown are $D_1(20, 10)$ and $D_2(40, 5)$. Find the relationship between x and y.

(c) Make a prediction for y when $x = 80$ and comment.

Q117 - ID: 3136 *[10 marks, 12 minutes]*

A second hand car dealer has 10 cars for sale. She decides to investigate the link between the age of the cars, x years, and the mileage, y thousand miles. The data collected from the cars are shown in the table below.

Age (years) x	4	6	5.5	2	3	5.5	3.5	4	2.5	2.5
Mileage (1000) y	26	30	28	22	45	34	30	28	35	21

You may assume that $\sum x = 38.5, \sum y = 299, \sum x^2 = 166.25, \sum xy = 1161$

(a) Find S_{xx} and S_{xy}

(b) Find the equation of the regression line of y on x in the form $y = a + bx$. Give the values of a and b to 2 decimal places.

(c) Give a practical interpretation of the slope b.

(d) Using your answer to part (b), find the mileage predicted by the regression line for a 4 year old car.

Q118 - ID: 4372 *[11 marks, 13 minutes]*

It is thought that the pH value of sand may affect the extent to which a particular species of plant will grow in that sand. A botanist wished to determine whether there was any correlation between the ph value of the sand on certain sand dunes and the amount of each of two species of plant growing there. She chose random sections of equal area on each of 8 sand dunes and measured the pH values. She then measures the area within each section that was covered by each of the two species. The results were as follows:

Dune	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
pH value x	8.5	8.5	9.5	8.5	6.5	7.5	8.5	9
area species P	160	143	563	320	45	13	351	346
area species Q	160	19	65	259	69	21	6	4

The results for Species P can be summarised by

$n = 8, \sum x = 66.5, \sum x^2 = 558.75, \sum y = 1941, \sum y^2 = 710529, \sum xy = 17131.$

(a) Calculate the equation of the regression line for Species P, in the form $y = a + bx$ where a and b are given to three significant figures.

(b) Estimate the value for Species P on sand where the pH value is 7.0.

(c) State with a reason whether the regression line of y on x for Species P will provide a reliable estimate of the y value when the pH value is (i) 8, (ii) 4.

Q119 - ID: 5482 *[10 marks, 12 minutes]*

A teacher is monitoring the progress of students using a computer based revision course. The improvement in performance, y marks, is recorded for each student along with the time, x hours, that the student spent using the revision course. The results for a random sample of 10 students are recorded below.

Hours x	1.6	0.6	3.5	3.4	2.6	4.1	1.2	2.6	3.7	4.2
marks y	−9	29	16	23	25	24	18	11	17	15

You may use $\sum x = 27.5$, $\sum y = 169$, $\sum x^2 = 89.83$, $\sum xy = 476.7$

(a) Find S_{xx} and S_{xy}

(b) Find the equation of the least squares regression line of y on x in the form $y = a + bx$.

(c) Give an interpretation of the gradient of your regression line.

Rosemary spends 1.8 hours using the revision course.

(d) Predict her improvement in marks.

Lee spends 10 hours using the revision course claiming that this should give him an improvement in performance of over 60 marks.

(e) Comment on Lee's claim.

Q120 - ID: 5932 *[12 marks, 14 minutes]*

Roseen is a self-employed decorator who wishes to estimate the times that it will take her to decorate bedrooms based upon their floor areas. She records the floor area, $x\,m^2$, and the decorating time, y hours, for each of 10 bedrooms she has recently decorated.

x	10.5	21	6	20	12	14.5	12.5	14.5	18.5	21
y	15	36	18	23.5	23	16	13.5	25.5	23	34.5

(a) Plot a scatter diagram of these data.

(b) Calculate the equation of the least squares regression line of y on x.

(c) Draw your regression line on the diagram.

(d) Use your regression equation estimate the time that Roseen will take to decorate a bedroom with a floor area of $16.3\,m^2$.

(e) Making reference to the diagram, comment on the likely reliability of your estimate in part (d)

Q121 - ID: 6099 *[8 marks, 10 minutes]*

A city council attempted to reduce traffic congestion by introducing a congestion charge. The charge was set at £5 for the first year and then was increased by £2 each year. For each of the first eight years, the council recorded the average number of vehicles entering the city centre per day. The results are shown in the table.

Charge £x	5	7	9	11	13	15	17	19
Average number, y millior	2.3	2.7	2.1	2.2	1.9	1.9	1.8	1.3

$n = 8, \sum x = 96, \sum x^2 = 1320, \sum y = 16.2, \sum y^2 = 33.98, \sum xy = 18$

(a) Explain why x is the independent variable.
(b) Calculate the equation of the regression line y on x.
(c) Use your equation to estimate the average number of vehicles which will enter the city centre per day when the congestion charge is raised to £21
(d) Comment on the reliability of your estimate.

Q122 - ID: 5562 *[9 marks, 11 minutes]*

The weight, w grams, and the length l mm, of 10 randomly selected newborn turtles are given in the table below.

l	52.2	50.6	54	53.8	54.6	50.7	54.7	50.3	54.8	51.7
w	35	37	38	39	42	37	36	36	29	34

You may use $S_{ll} = 30.324, S_{wl} = 0.88, S_{ww} = 104.1$

(a) Find the regression line of w on l in the form $w = a + bl$.
(b) Use your regression line to estimate the weight of a newborn turtle of length 58 mm. Comment on the reliability of your estimate, giving a reason for your answer.

Q123 - ID: 7110 *[13 marks, 16 minutes]*

The blood pressures, p mmHg, and the ages, t years, of 7 hospital patients are shown in the table below.

Patient	*A*	*B*	*C*	*D*	*E*	*F*	*G*
t	41	71	46	37	58	30	56
p	97	132	117	84	179	80	134

$\sum t = 339, \sum t^2 = 17607, \sum p = 823, \sum p^2 = 103975, \sum tp = 4212$

(a) Draw the scatter diagram of blood pressure against age for these 7 patients.
(b) Find S_{tt} and S_{tp} for these data.
(c) Find the equation of the regression line of p on t.
(d) Plot your regression line on your scatter diagram.
(e) Use your regression line to estimate the blood pressure of a 43 year old patient.

Q124 - ID: 7936 *[6 marks, 7 minutes]*

A farmer collected data on the annual rainfall, x cm, and the annual yield of peas, p tonnes per acre.

The data for annual rainfall was coded using $v = \dfrac{x-3}{20}$

and the following statistics were found.

$S_{vv} = 5.913$ $S_{pv} = 1.309$ $S_{pp} = 1.283$ $p = 3.96$ $v = 4.39$

(a) Find the equation of the regression line of p on v in the form $p = a + bv$.

(b) Using your regression line estimate the annual yield of peas per acre when the annual rainfall is 93 cm.

Q125 - ID: 676 *[3 marks, 4 minutes]*

The discrete random variable X has the probability function shown in the table below.

x	7	8	9	10	11	12
$P(X = x)$	0	0	0.2	0.1	0.2	0.5

Find $P(8 < X \leq 11)$ and $F(10)$

Q126 - ID: 682 *[3 marks, 4 minutes]*

The discrete random variable X has the probability function shown in the table below.

x	5	6	7	8	9	10
$P(X = x)$	0.1	α	0.3	0	0.1	0.5

Find α.

Q127 - ID: 3237 *[5 marks, 6 minutes]*

The discrete random variable X can take only the values 7,8 or 9.

For these values the cumulative distribution function is defined by

$$F(x) = \frac{(x+k)^2}{144} \text{ for } x = 7,8,9$$

where k is a positive integer.

(a) Find k.

(b) Find the probability distribution of X.

Q128 - ID: 5980 *[5 marks, 6 minutes]*

The probability distribution of a discrete random variable X is defined by $P(X = x) = cx(8 - x), x = 1, 2, 3, 4$

(a) Find the value of c.

(b) Find $E(X)$.

Q129 - ID: 5522 *[10 marks, 12 minutes]*

The discrete random variable X has $E(X) = 3$ and $E(X^2) = 17$
(a) Find the value of $Var(X)$.
(a) Find $E(X)$.
A circle has radius $X + 3$.
(b) Find in terms of π values for the mean and variance of the circumference, C, of the circle.
The area S of the circle with radius $X + 3$ is to be expressed in the form $\pi(X^2 + aX + b)$ where a and b are constants.
(c) Find values for a and b.
(d) Find in terms of π the value of $E(S)$.

Q130 - ID: 3143 *[6 marks, 7 minutes]*

A company is searching for oil reserves. The company has purchased the rights to make test drillings at four sites. It investigates these sites one at a time but, if oil is found, it does not proceed to any further sites. At each site, there is probability 0.33 of finding oil, independently of all other sites. The random variable X represents the number of sites investigated.
The probability distribution of X is shown below.

r	1	2	3	4
$P(X = r)$	0.33	0.2211	0.1481	0.3008

(a) Find the expectation and variance of X.
(b) It costs £25000 to investigate each site. Find the expected total cost of the investigation.

Q131 - ID: 5407 *[7 marks, 8 minutes]*

On a fairground stall, on each turn a player receives prize money with these probabilities

Prize money	£0.00	£0.50	£5.00
Probability	$\frac{7}{10}$	$\frac{2}{10}$	$\frac{1}{10}$

(a) Find out the probability that a player who has two turns will win £5.50
(b) The stall-holder wishes to make a profit of 50p per turn on average.
Calculate the amount the stall-holder should charge for each turn.

Q132 - ID: 5455 *[7 marks, 8 minutes]*

In a game of darts, the player throws three darts. Let X represent the number of darts that hit the bullseye. The probability distribution of X is shown in the table.

r	0	1	2	3
$P(X = r)$	0.2	0.46	p	q

(a) Show that $p + q = 0.34$.
(b) Given that the expectation of X is 1.33, show that $2p + 3q = 0.87$.
(c) Find the values of p and q.
(d) Find the variance of X.

Q133 - ID: 6195 *[7 marks, 8 minutes]*

A fair die has one face numbered 2, one face numbered 5, two faces numbered 8 and two faces numbered 10.
The die is thrown twice. Let X be the sum of the two scores. The following table shows the possible values of X.

	2	5	8	8	10	10
2	4	7	10	10	12	12
5	7	10	13	13	15	15
8	10	13	16	16	18	18
8	10	13	16	16	18	18
10	12	15	18	18	20	20
10	12	15	18	18	20	20

(a) Draw up a table showing the probability distribution of X.
(b) Calculate $E(X)$.
(c) Find the probability that X is greater than $E(X)$.

Q134 - ID: 5499 *[16 marks, 19 minutes]*

When Bob plays a game, the number of points he receives is given by the discrete random variable X with the following probability distribution.

x	0	1	2	3
$P(X = x)$	0.4	0.1	0.4	0.1

(a) Find $E(X)$.
(b) Find $F(1.5)$.
(c) Show that $Var(X) = 1.16$.
(d) Find $Var(8–2X)$.
Bob can win a prize if the total number of points he has scored after 5 games is at least 10. After 3 games he has a total of 6 points. You may assume that games are independent.
(e) Find the probability that Bob wins the prize.

Q135 - ID: 494 *[8 marks, 10 minutes]*

The discrete random variable X has probability function

$$P(X = x) = \begin{cases} kx, & x = 8, 9, 10, 11, 12 \\ 0, & otherwise \end{cases}$$

(a) Show that $k = \frac{1}{50}$
(b) Find $E(3X + 3)$

Q136 - ID: 758 *[4 marks, 5 minutes]*

The discrete random variable X has the probability function shown in the table below.

x	12	13	14	15	16	17
$P(X = x)$	0.1	0.2	0.1	0.1	0.2	0.3

Find $E(9X + 3)$.

Q137 - ID: 834 *[7 marks, 8 minutes]*

The discrete random variable X has the probability function shown in the table below.

x	3	4	5	6	7	8
$P(X = x)$	0	0.3	0.2	0	0.1	0.4

Find

(a) $P(4 < X \leq 7)$, (b) $F(6)$, (c) $E(12X + 11)$

Q138 - ID: 460 *[12 marks, 14 minutes]*

A discrete random variable X only takes positive integer values. It has a cumulative distribution function $F(x) = P(X \leq x)$ defined in the table below.

x	2	3	4	5	6	7	8	9
$F(x)$	0	0	0.2	0.3	0.5	0.8	0.8	1

(a) Determine the probability function $P(X = x)$, of X.

(b) Calculate $E(X)$ and show that $Var(X) = 2.84$

(c) Given that $Y = 7X + 5$, find the mean and variance of Y.

Q139 - ID: 597 *[15 marks, 18 minutes]*

The discrete random variable X has the following probability distribution.

x	-2	-1	0	1	2	3
$P(X = x)$	α	0.2	0	0.2	0.1	β

(a) Given that $E(X) = 1.2$, find the values of α and β.

(b) Write down $F(0.8)$.

(c) Evaluate $Var(X)$.

Find the value of

(d) $E(2X - 4)$, (e) $Var(3X + 4)$.

Q140 - ID: 760 *[7 marks, 8 minutes]*

A discrete random variable X has the probability function shown in the table below.

x	2	3	4
$P(X = x)$	$\frac{1}{2}$	a	$\frac{1}{2} - a$

(a) Given that $E(X) = 2.5$, find a.

(b) Find the value of $Var(X)$.

(c) Find the value of $P(X \leq 3.5)$.

Q141 - ID: 897 *[9 marks, 11 minutes]*

The discrete random variable X has probability function

$$P(X = x) = \begin{cases} k(4 - x), & x = 0 \text{ to } 4 \\ k(x - 4), & x = 5 \\ 0, & otherwise \end{cases}$$

where k is a positive constant

(a) Show that $k = 0.091$

(b) Find $E(X)$ and show that $E(X^2) = 4.095$.

(c) Find $Var(4X - 4)$.

Q142 - ID: 563 *[11 marks, 13 minutes]*

The discrete random variable X has probability function

$$P(X = x) = \begin{cases} k(x^2 - 16), & x = 5, 6, 7 \\ 0, & otherwise \end{cases}$$

where k is a positive constant

(a) Show that $k = \frac{1}{62}$.

(b) Find $E(X)$ and $Var(X)$.

(c) Find $Var(4X - 3)$.

Q143 - ID: 423 *[13 marks, 16 minutes]*

A discrete random variable X has a probability function as shown in the table below, where a and b are constants.

x	1	2	3	4
$P(X = x)$	0	0.2	b	a

Given that $E(X) = 3.4$,

(a) find the value of a and the value of b.

(b) find $P(1 < X < 2.5)$,

(c) find $E(5X - 3)$

(d) show that $Var(X) = 0.64$.

(e) Evaluate $Var(5X - 3)$.

Q144 - ID: 631 *[10 marks, 12 minutes]*

The random variable X has probability function

$$P(X = x) = \begin{cases} kx, & x = 4, 5, 6 \\ k(x + 2), & x = 7, 8 \end{cases}$$

where k is a constant

(a) Find the value of k.

(b) Find the exact value of $E(X)$.

(c) Show that, to 3 sig figs, $Var(X) = 1.84$.

(d) Find, to 1 decimal place, $Var(4 - 2X)$.

Q145 - ID: 5520 *[9 marks, 11 minutes]*

The following table gives the probability distribution of the discrete random variable X, where θ is a constant.

x	4	5	6	7
$P(X = x)$	0.2	0.2	θ	$0.6 - \theta$

(a) State the range of possible values of θ.

Given that $E(X) = 6$,

(b) find the value of θ.

(c) find $E(X^3)$.

Q146 - ID: 880 *[12 marks, 14 minutes]*

A discrete random variable X has a probability function as shown in the table below, where a and b are constants.

x	2	3	4	5	6
$P(X = x)$	0.2	p	0.2	q	0.35

(a) Given that $E(X) = 4.45$, write down two equations involving p and q.

(b) Find the value of p and the value of q.

(c) Find $Var(X)$.

(d) Find $Var(5 - 3X)$.

Q147 - ID: 2319 *[8 marks, 10 minutes]*

A discrete random variable X has probability function

$$P(X = x) = \begin{cases} k(x + 2), & x = 0, 1, 2, 3, 4 \\ 0, & otherwise \end{cases}$$

(a) Show that $k = \frac{1}{20}$

(b) Find $E(X)$

Q148 - ID: 4571 *[9 marks, 11 minutes]*

The probability distribution of a discrete random variable, X, is given in the table.

x	1	2	3	4
$P(X = x)$	$\frac{1}{5}$	$\frac{1}{3}$	p	q

It is given that $E(X) = 2\frac{2}{4}$

(a) Calculate the values of p and q.

(b) Calculate the standard deviation of X.

Q149 - ID: 687 *[13 marks, 16 minutes]*

The random variable X has probability function

$P(X = x) = \dfrac{5x - 2}{93}, x = 1, 2, 3, 4, 5, 6$

(a) Construct a table giving the probability distribution of X.

(b) Find $P(2 < X \leqslant 5)$,

(c) Find the exact value of $E(X)$

(d) Show that $Var(X) = 2.03$ to 3 sig figs.

(e) Find $Var(5 - 3X)$.

Q150 - ID: 5536 *[14 marks, 17 minutes]*

The discrete random variable X has the probability function $f(x)$ defined by

$f(x) = kx^2 \quad x = 0, 1, 2, 3, 4$

(a) Construct a table showing the probability distribution of the random variable X.

(b) Find the value of k.

(c) Find $E(X)$ and $Var(X)$.

(d) Find the mean and variance of the random variable Y where

$Y = 6X - 8$

Q151 - ID: 2479 *[8 marks, 10 minutes]*

A discrete random variable X has a probability function as shown in the table below, where k is a constant.

x	4	5	6	7
$P(X = x)$	$\frac{k}{3}$	$\frac{3k}{2}$	$\frac{k}{2}$	$\frac{k}{6}$

(a) Calculate the value of k.

(b) Find the value of $E(X)$ and $Var(X)$.

Q152 - ID: 3150 *[13 marks, 16 minutes]*

The random variable X has probability distribution

x	6	8	10	12	14
$P(X = x)$	0	p	0.4	q	0.2

(a) Given that $E(X) = 10.8$, write down two equations involving p and q.
(b) Find the value of p and the value of q.
(c) Find $P(9 < X \leq 12)$.
Given that $E(X^2) = 120.8$, find
(d) $Var(X)$, (e) $E(56–5X)$, (f) $Var(56–5X)$

Q153 - ID: 4373 *[5 marks, 6 minutes]*

The table shows the probability distribution for a random variable X

x	0	1	2	3
$P(X = x)$	0.1	0.2	0.2	0.5

Calculate $E(X)$ and $Var(X)$

Q154 - ID: 4566 *[4 marks, 5 minutes]*

Part of the probability distribution of a variable, X, is given in the table.

x	2	3	4	5
$P(X = x)$		$\frac{3}{16}$	$\frac{2}{8}$	$\frac{4}{8}$

(a) Find $P(X = 2)$
(b) Find $E(X)$

Q155 - ID: 3210 *[11 marks, 13 minutes]*

The random variable X has probability distribution

x	1	2	3	4	5
$P(X = x)$	p	q	0.2	0.15	0.55

Given that $E(X) = 4.15$, find
(a) the value of p and the value of q.
(b) $Var(X)$, (c) $E(7X–5)$

Q156 - ID: 4370 *[11 marks, 13 minutes]*

The random variable Y has probability distribution

y	1	2	3
$P(Y = y)$	0.3	0.1	0.6

(a) Calculate $E(Y)$ and $Var(Y)$
Another random variable Z is independent of Y and has the probability distribution

z	1	2	3
$P(Z = z)$	0.1	0.15	0.75

One value of Y and one value of Z are chosen at random. Find
(b) the probability that $Y + Z = 3$.
(c) the probability that $Y \times Z$ is even.

Q157 - ID: 5376 *[8 marks, 10 minutes]*

The probability distribution of the discrete random variable X is given by

$$P(X = x) = \begin{cases} k(9 + x) & x = 1, 2, 3 \\ 0 & otherwise \end{cases}$$

(a) Show that $k = \frac{1}{33}$

(b) Evaluate $E(X)$.

(c) Evaluate $E\left(\frac{1}{X}\right)$.

Q158 - ID: 5470 *[12 marks, 14 minutes]*

The discrete random variable X has the following probability distribution.

x	1	2	3
$P(X = x)$	θ	2θ	$2 - 6\theta$

(a) State the range of possible values of the constant θ.

Given that $E(X) = 2.1$,

(b) show that $\theta = 0.3$,

(c) calculate the standard deviation of X,

(d) calculate $E\left(\frac{1}{x}\right)$.

Q159 - ID: 5558 *[15 marks, 18 minutes]*

The discrete random variable X has the following probability distribution.

$$P(X = x) = \begin{cases} a(4 - x) & x = 1, 2, 3 \\ b & x = 4 \end{cases}$$

(a) Find $P(X = 3)$ to complete the table below

x	1	2	3	4
$P(X = x)$	$3a$	$2a$		b

Given that $E(X) = 1.9$,

(b) find the value of a and the value of b.

(c) Find $P(1.5 < X < 4)$.

(d) Find $E(2X - 3)$.

(e) Show that $Var(X) = 0.99$.

(f) Calculate $Var(2X - 3)$.

Q160 - ID: 7107 *[10 marks, 12 minutes]*

The probability function of a discrete random variable X is given by

$P(x) = kx^2, \quad x = 3, 4, 5.$ where k is a positive constant.

(a) Show that $k = \frac{1}{50}$.

(b) Find $P(X \geq 4)$

(c) Find $E(X)$

(d) Find $Var(9 - X)$.

Q161 - ID: 7938 *[14 marks, 17 minutes]*

The discrete random variable X has the probability distribution

x	1	2	3	4
$P(X = x)$	k	$2k$	$4k$	$6k$

(a) Show that $k = \frac{1}{13}$
(b) Find $E(X)$
(c) Find $E(X^2)$
(d) Find $Var(3 - 4X)$
Two independent observations X_1 and X_2 are made of X.
(e) Show that $P(X_1 + X_2 = 4) = 0.07$ to 2 dp
(f) Complete the probability distribution table for $X_1 + X_2$

y :	2	3	4	5	6	7	8
$P(X_1 + X_2 = y)$:	0.01	0.02	0.07	–	0.24	0.28	–

(g) Find $P(1.5 < X_1 + X_2 \leq 3.5)$

Q162 - ID: 756 *[3 marks, 4 minutes]*

The continuous random variable Y is normally distributed with mean 99 and variance 100
Find $P(Y < 83)$.

Q163 - ID: 928 *[5 marks, 6 minutes]*

The continuous random variable Y is normally distributed with mean 91 and variance 121
Find k such that

$$P(91 - k \leq Y \leq 91 + k) = 0.946$$

Q164 - ID: 3149 *[7 marks, 8 minutes]*

The continuous random variable Y is normally distributed with mean 25 and standard deviation 5
(a) Find $P(X > 33)$.
(b) Find the value of d such that $P(25 < X < d) = 0.3762$

Q165 - ID: 3578 *[5 marks, 6 minutes]*

The continuous random variable X is normally distributed with mean 106 and variance 36
(a) Find the value of X which is 1.03 standard deviations above the mean.
(b) Find the value of X which is 1.03 standard deviations below the mean.

Q166 - ID: 5480 *[10 marks, 12 minutes]*

The random variable X has a normal distribution with mean 36 and standard deviation 8
(a) Find $P(X < 40)$.
(b) Find the value of d such that $P(X < d) = 0.1548$
(c) Find the value of e such that $P(X > e) = 0.1548$
(d) Find $P(d < X < e)$.

Q167 - ID: 577 *[8 marks, 10 minutes]*

The weight of coffee in glass jars labelled 100g is normally distributed with mean 100.8g and standard deviation 7.7g. The weight of an empty glass is normally distributed with mean 262g and standard deviation 5.3g. The weight of a glass jar is independent of the weight of the coffee it contains. Find the probability that a randomly selected jar weighs less than 266g and contains less than 94g of coffee.

Q168 - ID: 708 *[7 marks, 8 minutes]*

A group of pupils believe that the time taken to travel to school, T minutes, can be assumed to be normally distributed. Within the school 2 percent of pupils take at least 53 minutes to travel to school and 0.9 percent take less than 7 minutes.
Find the mean and standard deviation of T.

Q169 - ID: 362 *[11 marks, 13 minutes]*

The duration of the pregnancy of a certain breed of cow is normally distributed with mean μ days and standard deviation σ days. Only 1 percent of all pregnancies are shorter than 205 days and 17 percent are longer than 271 days.
(a) Show that $\mu - 205 = 2.327\sigma$.
(b) Obtain a second equation in μ and σ.
(c) Find the value of μ and the value of σ.
(d) Find the values between which the middle 68.3 percent of pregnancies lie.

Q170 - ID: 768 *[10 marks, 12 minutes]*

A company produces electronic components which have life spans that are normally distributed. Only 1.5 percent have a life span less than 3570 hours and 2.5 percent have a life span greater than 5940 hours.
(a) Determine the mean and standard deviation of the life spans of the components.
There is a warranty of 4510 hours on the components.
(b) Find the proportion of components that the company can expect to replace under the warranty

Q171 - ID: 799 *[11 marks, 13 minutes]*

Strips of metal are cut to length L cm, where $L \sim N(\mu, 0.4^2)$.
(a) Given that 2 percent of the cut lengths exceed 48.84 cm, show that $\mu = 48$, to 1 decimal place.
(b) Find $P(47.32 < L < 48.68)$.
Those strips with length less than 47.32 cm or greater than 48.68 cm cannot be used. Two strips of metal are selected at random.
(c) Find the probability that both strips cannot be used.

Q172 - ID: 451 *[6 marks, 7 minutes]*

The lifetimes of batteries used for a computer game have a mean of 11 hours and a standard deviation of 5 hours. Battery lifetimes may be assumed to be normally distributed.
Find the lifetime, t hours, of a battery such that 1 battery in 4 will have a lifetime longer than t.

Q173 - ID: 894 *[11 marks, 13 minutes]*

A drinks machine dispenses coffee into cups. A sign on the machine indicates that each cup contains 50 ml of coffee. The machine actually dispenses a mean amount of 55 ml per cup and 11 percent of the cups contain less than the amount stated on the sign. Assuming that the amount of coffee dispensed into each cup is normally distributed find
(a) the standard deviation of the amount of coffee dispensed per cup in ml.
(b) the percentage of cups that contain more than 60 ml.
Following complaints, the owners make adjustments. Only 2.5 percent of cups now contain less than 50 ml. The standard deviation of the amount dispensed is reduced to 2 ml.
Assuming the amount of coffee dispensed is still normally distributed,
(c) find the new mean amount of coffee per cup.

Q174 - ID: 711 *[9 marks, 11 minutes]*

A health club lets members use, on each visit, its facilities for as long as they wish. The club records suggest that the length of a visit can be modelled by a normal distribution with mean 110 minutes. Only 30 percent of members stay for more than 131 minutes.
(a) Find the standard deviation of the normal distribution.
(b) Find the probability that a visit lasts less than 20 minutes.
The club introduce a closing time of 10 pm. Tara arrives at the club at 8 pm.
(c) Decide whether or not the normal distribution is still a suitable model for the length of her visit.

Q175 - ID: 929 *[9 marks, 11 minutes]*

The heights of a group of athletes are modelled by a normal distribution with mean 180 cm and standard deviation 5.2 cm. The weights of this group of athletes are modelled by a normal distribution with mean 85 kg and standard deviation 7.1 kg.
Find the probability that a randomly chosen athlete
(a) is taller than 188 cm,
(b) weighs less than 97 kg.
(c) Assuming that for these athletes height and weight are independent, find the probability that a randomly chosen athlete is taller than 188 cm and weighs more than 97 kg
Comment on the assumption that height and weight are independent.

Q176 - ID: 2320 *[7 marks, 8 minutes]*

The speeds of cars at a certain point on a straight road are normally distributed with mean μ and standard deviation σ.
19% the cars traveled at speeds greater than $96 kmh^{-1}$ and 15% of them at speeds less than $40 kmh^{-1}$.
Find μ and σ.

Q177 - ID: 5537 *[7 marks, 8 minutes]*

Golf balls are manufactured such that their diameters are Normally distributed with mean 1.66 inches. It is found that 15% of golf balls have diameters greater than 1.81 inches.
(a) Find the standard deviation of golf ball diameters.
22% of golf balls are not sold because their diameters are too short.
(b) Find the minimum diameter of golf balls which are sold.

Q178 - ID: 802 *[8 marks, 10 minutes]*

A measure of intelligence QI of a group of students is normally distributed with mean 105 and standard deviation 13.
(a) Find the probability that a student selected at random has a QI of less than 92.
The probability that a randomly selected student has a QI of at least $105 + k$ is 0.209.
(b) Find, to the nearest integer, the value of k.

Q179 - ID: 2629 *[9 marks, 11 minutes]*

The weights of bags of popcorn are normally distributed with mean of 200*g* and 50% of all bags weighing between 190*g* and 210*g*.
(a) Write down the median weight of the bags of popcorn.
(b) Find the standard deviation of the weights of the bags of popcorn.
A shopkeeper finds that customers will complain if their bag of popcorn weighs less than 180*g*.
(c) Find the probability that a customer will complain.

Q180 - ID: 3238 *[12 marks, 14 minutes]*

A packing plant fills bags with cement. The weight X kg of a bag of cement can be modelled by a normal distribution with mean 48 kg and standard deviation 2 kg.
(a) Find $P(X > 50)$.
(b) Find the weight that is exceeded by 94% of the bags.
Three bags are selected at random.
(c) Find the probability that two weigh more than 50 kg and one weighs less than 50 kg.

Q181 - ID: 4525 *[8 marks, 10 minutes]*

In large-scale tree-felling operations, a machine cuts down trees, strips off the branches and then cuts the trunks into logs of length X metres for transporting to a sawmill. It may be assumed that values of X are normally distributed with mean 4.2 and standard deviation 0.16.
(a) Determine $P(X < 4.4)$.
(b) Determine $P(X > 4)$.
(c) Determine $P(4 < X < 4.4)$.

Q182 - ID: 6191 *[6 marks, 7 minutes]*

The daily minimum temperature in degrees Celsius (°C) in January in Ottawa is a random variable with distribution $N(-14.5, 62)$. Find the probability that a randomly chosen day in January in Ottawa has a minimum temperature above 0°C.
(b) In another city the daily minimum temperature in °C in January is a random variable with distribution $N(\mu, 37)$. In this city the probability that a randomly chosen day in January has a minimum temperature above 0°C is 0.88. Find the value of μ.

Q183 - ID: 7447 *[6 marks, 7 minutes]*

A company produces computer microchips, which have a life expectancy that follows a normal distribution with a mean of 84 months and a standard deviation of 3.3 months.
(a) If a microchip is guaranteed for 78 months find the probability that it will fail before the guarantee ends.
(b) The probability that a microchip does not fail before the end of the guarantee is required to be 96%. For how many months should it be guaranteed?
(c) A rival company produces microchips where the probability that they will fail after 78 months is 0.88. Given that the life expectancy also follows a normal distribution with standard deviation 3.3 months, find the mean.

Q184 - ID: 5561 *[11 marks, 13 minutes]*

The lifetimes of bulbs used in a lamp are normally distributed.
A company X sells bulbs with a mean lifetime of 862 hours and a standard deviation of 50 hours.
(a) Find the probability of a bulb, from company X, having a lifetime of less than 840 hours.
(b) In a box of 400 bulbs, from company X, find the expected number having a lifetime of less than 840 hours.
A rival company Y sells bulbs with a mean lifetime of 882 hours and 19% of these bulbs have a lifetime of less than 839 hours.
(c) Find the standard deviation of the lifetimes of bulbs from company Y.
Both companies sell bulbs for the same price.
(d) State which company you would recommend. Give reasons for your answer.

Q185 - ID: 7106 *[10 marks, 12 minutes]*

The heights of a population of women are normally distributed with mean μ cm and standard deviation σ cm.
It is known that 30% of the women are taller than 177 cm and 5% are shorter than 158 cm.
(a) Show that $\mu = 158 - -1.645\sigma$.
(b) Obtain a second equation and hence find the value of μ and the value of σ.
A woman is chosen at random from the population.
(c) Find the probability that she is taller than 165 cm.

My S1 full paper - Mark Scheme

A1 - ID: 433 *[2 marks, 2 minutes]*

(a) independent events The occurrance of one does not affect the occurrance of the other. *B1*

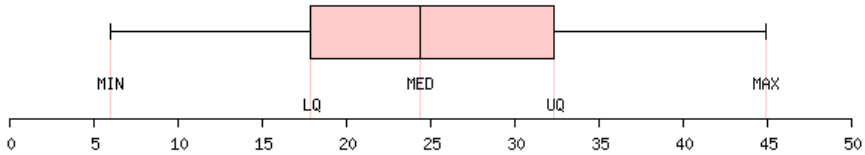
(b) a statistical experiment A process adopted for collecting data to provide evidence for or against a hypothesis. *B1*

A2 - ID: 898 *[7 marks, 8 minutes]*

(a) Reason 1 = Quicker and cheaper than using real thing
Reason 2 = To improve understanding, describe or analyse a real world problem

(b) (i) Example = area
(ii) Example = score on a spinner

A3 - ID: 6087 *[6 marks, 7 minutes]*



(a) median = 24.4 *A1*

(b) lower quartile = 17.9, upper quartile = 32.4
interquartile range = 32.4 − 17.9 = 14.5 *M1A1*

(c) box plot = see below *A3*

A4 - ID: 6095 *[2 marks, 2 minutes]*

(a) number = 106 × 2 = 212 *B1*

(b) reason = the totals are unknown
the angle represents the proportion not the number *B1*

A5 - ID: 681 *[5 marks, 6 minutes]*

A6 - ID: 876 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} & \ qquad \ qquad \ qquad \ sum fy & \ , \ , \ ,= \ , \ ,&2606.5 \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ & \ text{Mean weight} &=& 10 + \ displaystyle \ frac{2606.5}{50 \ times 10}& | \ color{#ff0066}{M1} \ qquad \ \ & &=&15.213& | \ color{#ff0066}{A1} \ qquad \ \ & S_y &=& \ displaystyle \ sqrt{ \ frac{147101.75}{50} - \ left(\ frac{2606.5}{50} \ right)^2 } & | \ color{#ff0066}{M1} \ qquad \ \ & &=& 14.98 & | \ color{#ff0066}{A1} \ qquad \ \ & & \ Rightarrow& SD \ , = \ , \ frac{S_y}{10} \ , = \ , 1.498 & | \ color{#ff0066}{A1} \ end{steps}}

A7 - ID: 4126 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad \ displaystyle \ frac{ \ sum x}{n}&=& \ , = \ , \ frac{14.6+ 11.8+ 12.7+ 14.2+18.3+ 13.8+ 13.4+12.1+ 13.6}{9} \ qquad \ \ & &=& \ frac{124.5}{9} \ , = \ , 13.833 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ displaystyle \ frac{ \ sum x^2}{n} &=& \ displaystyle \ frac{1751.59}{9} \ , = \ , 194.621 \ qquad \ \ & \ sigma &=& \ displaystyle \ sqrt{ \ frac{ \ sum x^2}{n} - \ bar{x}^2} \ , = \ , \ sqrt{194.621 - (13.833)^2} \ , = \ , 1.806& | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{median} &=&13.6 & | \ color{#ff0066}{M1A1} \ end{steps}}

A8 - ID: 3135 *[14 marks, 17 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ qquad \ sum x & \ , \ , \ ,= \ , \ ,&2951 \ qquad \ \ & \ text{Mean level} &=& \ frac{2951}{12} \ , = \ , 245.917 \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & \ text{standard deviation} &=& \ sqrt{ \ frac{815447}{12} - \ left(\ frac{2951}{12} \ right)^2 } \ , = \ , 86.48 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text{median} &=& \ frac{207+229}{2} \ , = \ , 218& | \ color{#ff0066}{B1} \ qquad \ \ & Q_1 &=& \ frac{185+190}{2} \ , = \ , 187.5& | \ color{#ff0066}{B1} \ qquad \ \ & Q_3 &=& \ frac{265+270}{2} \ , = \ , 267.5& | \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & Q_3 + 1.5(Q_3 – Q_1) &=&267.5+1.5(267.5 – 187.5) \ , = \ , 387.5 & | \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& \ text{Patients B and F} & | \ color{#ff0066}{B2} \ qquad \ \ \ text{(d)} & \ displaystyle \ frac{Q_1 - 2Q_2 + Q_3}{Q_3 - Q_1} &=&0.238 & | \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& \ text{positive skew} & | \ color{#ff0066}{A1} \ end{steps}}

A9 - ID: 5454 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ text{sample mean} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ frac{ \ sum fx}{ \ sum f} \ qquad \ \ & &=& \ displaystyle \ frac{2 \ times 1 + 7 \ times 4.5+13 \ times 8+13 \ times 11+7 \ times 18.5 }{42} \ , = \ , \ displaystyle 9.76 \ qquad \ \ & \ displaystyle \ sum fx^2 &=&2 \ times 1 + 7 \ times 20.25+13 \ times 64+13 \ times 121+7 \ times 342.25 \ qquad \ \ & &=& \ displaystyle 4944.5 \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & \ text{standard deviation} &=& \ sqrt{ \ frac{4944.5}{42}- 9.76^2} \ qquad \ \ & &=& 4.74 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ bar{x} + 2s &=&9.76 + 9.47 \ , = \ , 19.23 &| \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& \ text{there could be outliers} &| \ color{#ff0066}{A1} \ end{steps}}

A10 - ID: 5770 *[11 marks, 13 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad \ qquad \ bar{x} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ frac{180.3}{12} \ , = \ , 15.025 \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ & s &=& \ displaystyle \ sqrt{ \ frac{3090.63}{12}- \ left(\ frac{180.3}{12} \ right)^2 } \ , = \ , 5.64 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ bar{x} + 2s &=&26.31 &| \ color{#ff0066}{M1} \ qquad \ \ & \ bar{x} - 2s &=&3.75 &| \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& \ text{no outliers} &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & \ bar{y} &=&1.8(\ bar{x})+32 \ , = \ , 59.05 &| \ color{#ff0066}{B1} \ qquad \ \ & s &=&1.8 \ times 5.64 \ , = \ , 10.15 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & 74 > 59.05 & \ Rightarrow& \ text{New York has higher mean} &| \ color{#ff0066}{B1} \ qquad \ \ & 13 > 10.15 & \ Rightarrow& \ text{New York has higher spread} &| \ color{#ff0066}{M1A1} \ end{steps}}

A11 - ID: 6009 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad \ qquad \ qquad k & \ , \ , \ ,= \ , \ ,& 100 - (26 + 6 + 22 + 27+ 7) \ , = \ , 12 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text{median} &=& \ text{50th item} \ , = \ , 4 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{lower quartile} &=& \ text{25th item} \ , = \ , 2 &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{upper quartile} &=& \ text{75th item} \ , = \ , 6 &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{interquartile range} &=&6-2 \ , = \ , 4 &| \ color{#ff0066}{A1} \ end{steps}}

A12 - ID: 6079 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ text{data is} & \ , \ , \ ,: \ , \ ,& \ text{discrete} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{mean} &=& \ displaystyle \ frac{ \ sum fx}{ \ sum f} \ , = \ , \ frac{502}{181} \ , = \ , 2.77 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{rmsd} &=& \ displaystyle \ sqrt{ \ frac{ \ sum fx^2}{ \ sum f} - \ bar{x}^2} \ , = \ , \ displaystyle \ sqrt{ \ frac{1754}{181} - 2.77^2} \ , = \ , 1.41 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(d)} & \ text{mean+rmsd} &=&4.19 \ qquad \ \ & & \ Rightarrow& \ text{number = 24} &| \ color{#ff0066}{M1A1} \ end{steps}}

A13 - ID: 6188 *[3 marks, 4 minutes]*

\ displaystyle{ \ begin{steps} & \ frac{ }{ } \ quad \ qquad \ qquad \ text{mean} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ frac{ \ sum x }{10} \ qquad \ \ & &=& \ frac{31+43+38+45+36+43+48+37+31+42}{10} \ , = \ ,39.4 &| \ color{#ff0066}{B1} \ qquad \ \ & \ sum x^2 &=&31^2+43^2+38^2+45^2+36^2+43^2+48^2+37^2+31^2+42^2 \ qquad \ \ & &=& 15822 \ qquad \ \ & \ text{standard deviation} &=& \ displaystyle \ sqrt{ \ frac{ \ sum x^2 }{10} - \ left(\ frac{ \ sum x }{10} \ right)^2 } \ , = \ , \ displaystyle \ sqrt{ \ frac{15822 }{10} - \ left(39.4 \ right)^2 } \ qquad \ \ & &=& \ displaystyle 5.4626 &| \ color{#ff0066}{M1A1} \ end{steps}}

A14 - ID: 7112 *[11 marks, 13 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ text{missing midpoints} & \ , \ , \ ,= \ , \ ,& 2.75, 5.5 \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B2} \ qquad \ \ \ text{(b)} & \ text{mean} &=& \ displaystyle \ frac{ \ sum fx }{1423} \ , = \ , \ frac{4615.75}{1423} \ , = \ ,3.244 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{standard deviation} &=& \ displaystyle \ sqrt{ \ frac{ \ sum fx^2 }{1423} - \ left(\ frac{ \ sum fx }{1423} \ right)^2 } \ qquad \ \ & &=& \ displaystyle \ sqrt{ \ frac{15234.4375 }{1423} - \ left(3.244 \ right)^2 } \ , = \ , 0.429 &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(d)} & \ text{median m } & \ Rightarrow& \ text{$711.5th$ value} \ qquad \ \ & & \ Rightarrow& \ displaystyle \ frac{m - 3.0}{3.5 - 3.0} = \ frac{711.5 - 298 }{1088-298} \ qquad \ \ & & \ Rightarrow& m = 3.262 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & \ text{skew} &=& \ text{negative because mean < median} &| \ color{#ff0066}{M1A1} \ end{steps}}

A15 - ID: 352 *[2 marks, 2 minutes]*

\ displaystyle{ \ begin{steps} & \ mu &=& \ displaystyle \ frac{ \ sum x}{n} \ qquad \ \ & &=& \ displaystyle \ frac{1084}{21} \ , = \ , 51.619 \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ end{steps}}

A16 - ID: 6093 *[3 marks, 4 minutes]*

\ displaystyle{ \ begin{steps} & \ text{total marks} &=&(114 \ times 56) +(97 \ times 59) &| \ color{#ff0066}{M1} \ qquad \ \ & &=& 12107 &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{mean} &=& \ displaystyle \ frac{12107}{211} \ , = \ , 57.4 &| \ color{#ff0066}{A1} \ end{steps}}

A17 - ID: 7935 *[4 marks, 5 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{total rainfall} &=&3.5 +6.4 +3.4 + 8.2 + 1 + 0.6 + 1.5 +82.6 \ , = \ , 107.2 &| \ color{#ff0066}{M1} \ qquad \ \ & \ text{mean} &=& 107.2 \ div 28 \ , = \ , 3.83 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{effect} &=& \ text{none because one is 5.4 above what it should be} \ qquad \ \ &&& \ text{and the other is 5.4 under} &| \ color{#ff0066}{B2} \ end{steps}}

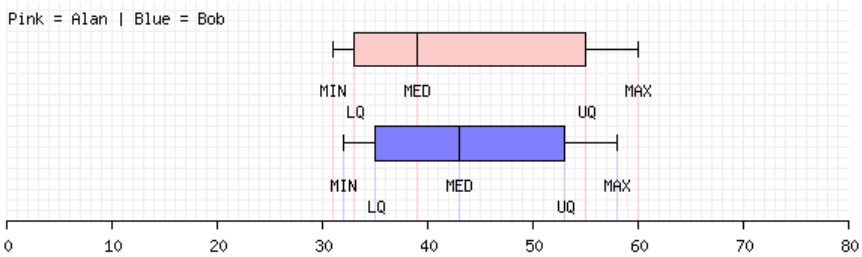
A18 - ID: 7937 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad \ qquad \ text{median} & \ , \ , \ ,= \ , \ ,& \ text{$36/2 = 18th term} \ qquad \ \ & & \ Rightarrow& \ displaystyle \ frac{x - 39.5}{49.5 - 39.5} = \ frac{18 - 17}{28 - 17} &| \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& x = \ frac{1}{11}10 + 39.5 \ , = \ , 40.4 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{mean} &=&1411 \ div 36 \ , = \ , 39.2 &| \ color{#ff0066}{B1} \ qquad \ \ & \ text{standard deviation} &=& \ displaystyle \ sqrt{ \ frac{69447}{36} - 39.2^2} &| \ color{#ff0066}{M1} \ qquad \ \ & &=& 19.8 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & \ text{skew} &=& \ text{negative } &| \ color{#ff0066}{B1} \ qquad \ \ & \ text{because} &:&40.4 > 39.2 &| \ color{#ff0066}{B1} \ end{steps}}

A19 - ID: 822 *[13 marks, 16 minutes]*

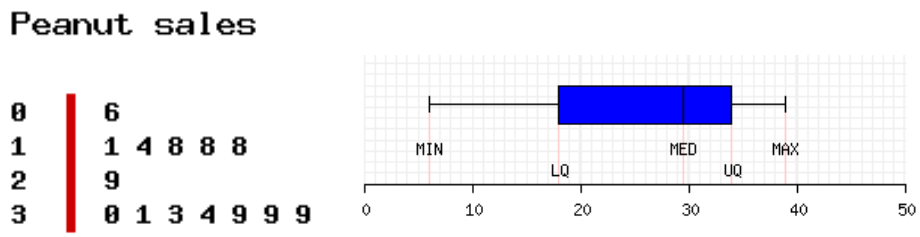
\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ qquad \ qquad \ text{Mode} &=&78 \ qquad \ qquad \ qquad \ qquad \ qquad \ quad &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ qquad \ qquad n &=&50 \ quad \ qquad \ \ & \ text{ median} &=& \ frac{n+1}{2} \ text{th item = 25.5th item} \ qquad \ \ &&=& \ frac{69 + 71}{2} = 70 &| \ color{#ff0066}{A1} \ qquad \ \ & Q1 &=& \ text{13th item} \ , = \ , 56 &| \ color{#ff0066}{A1} \ qquad \ \ & Q3 &=& \ text{38th item} \ , = \ , 78 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & Q1-1.5(Q3-Q1) &=& 23 \ qquad \ \ & Q3+1.5(Q3-Q1) &=& 111 \ Rightarrow \ text{no outliers} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & \ text{mean} &=& \ frac{ \ sum x}{50} \ , = \ , \ frac{3382}{50} \ , = \ , 67.64 &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{stand dev.} &=& \ sqrt{ \ frac{ \ sum x^2}{n} - \ bar{x}^2} \ , = \ , \ sqrt{ \ frac{240916}{50} - 67.64^2} &| \ color{#ff0066}{M1} \ qquad \ \ & &=& 15.59 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(e)} & \ text{neg skew} &:& \ text{mode > median} &| \ color{#ff0066}{M1A1} \ qquad \ \ & &:& Q2-Q1 > Q3-Q2 &| \ color{#ff0066}{M1A1} \ end{steps}}

A20 - ID: 900 *[8 marks, 10 minutes]*



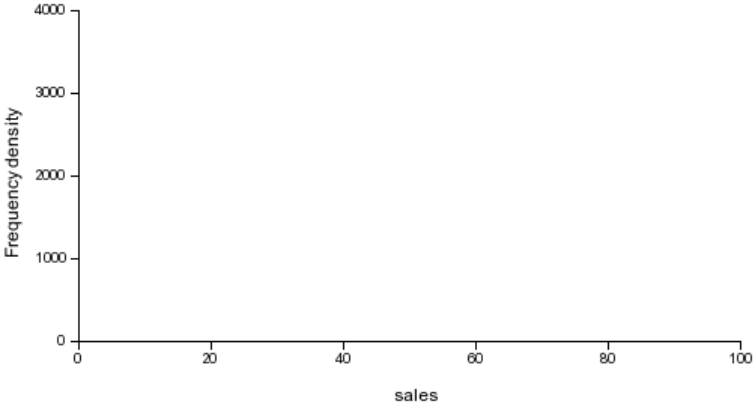
\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ text{box plot} &:& \ text{see below} \ qquad \ qquad \ qquad &| \ color{#ff0066}{A4} \ qquad \ \ \ text{(b)} & \ text {Range} &:& \ text{Alan has the largest range} &| \ color {#ff0066}{B1} \ qquad \ \ & \ text{IQ range} &:& \ text {Alan has the largest IQR} &| \ color{#ff0066}{B1} \ qquad \ \ & \ text{average} &:& \ text{Bob has the highest average} &| \ color {#ff0066}{B1} \ qquad \ \ & \ text{skew for Alan} &:& \ text{positive} \ qquad \ \ & \ text{skew for Bob} &:& \ text{symmetric} &| \ color{#ff0066}{B1} \ end{steps}}

A21 - ID: 526 *[16 marks, 19 minutes]*



\ displaystyle{ \ begin {steps} \ text{(a)} & \ qquad \ qquad \ text {Mean} & \ , \ , \ ,= \ , \ ,& \ text {total} \ div 14 \ , = \ , 359 \ div 14 \ , = \ , 25.643 \ qquad &| \ color {#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text {See diagram} && &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(c)} & \ text{median} &=& \ text{29.5 } &| \ color {#ff0066}{B1} \ qquad \ \ & \ text{LQ} &=& \ text{18} \ qquad \ text{UQ} \ ,= \ , \ text{34} &| \ color {#ff0066}{B2} \ qquad \ \ \ text{(d)} & \ text{limits} &=& -6 \ text{ and } 58 \ quad \ qquad \ \ & & \ Rightarrow& \ text{no outliers} &| \ color{#ff0066}{M2A1} \ qquad \ \ \ text{(e)} & \ text{See diagram} && &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(f)} & \ text{skewness} &=& \ text {negative} &| \ color{#ff0066}{M1A1} \ end{steps}}

A22 - ID: 4230 *[10 marks, 12 minutes]*

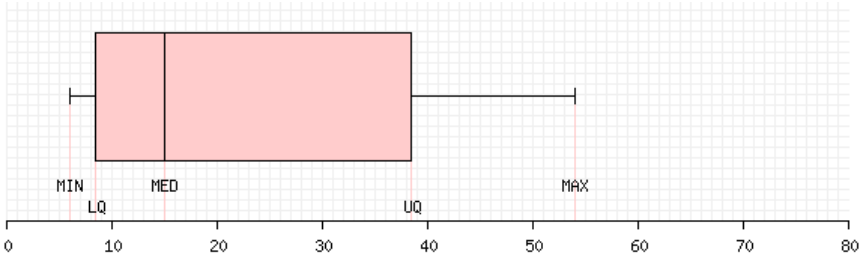


\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{frequency densities} & \ , \ , \ ,= \ , \ ,& \ matrix{0-5 & 5-25 & 25-50 & 50-85 & 85-130 \ cr 2 & 4 &7 & 5 & 1} &| \ color{#ff0066}{M1A1} \ qquad \ \ & \ text{histogram} &:& \ text{see below} &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)} & median &=&25 + \ frac{ \ frac{485}{2}-10-80}{175} \ times 25 \ , = \ , 25 + \ frac{152.5}{175} \ times 25 \ , = \ , 46.79 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ sum fx &=&(2.5 \ times 10) + (15 \ times 80)+(37.5 \ times 175) + \ qquad \ \ &&& + (67.5 \ times 175) + (107.5 \ times 45) \ qquad \ \ & &=& 24437.5 &| \ color{#ff0066}{M1} \ qquad \ \ & \ text{mean} &=& \ frac{24437.5}{485} \ , = \ , 50.39 &| \ color{#ff0066}{M1A1} \ end{steps}}

A23 - ID: 4231 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ qquad \ text{reason} & \ , \ , \ ,= \ , \ ,& \ text{data is continuous} \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ text{frequency densities} & \ , \ , \ ,= \ , \ ,&0.83, 2.83 ,5.7 , 3.42 , 0.71 , 0.07 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & Q_2 &=&55.5 + \ frac{ \ frac{136}{2}-5-17}{57} \ times 10 \ qquad \ \ & &=& 55.5 + \ frac{46}{57} \ times 10 \ , = \ , 63.57 &| \ color{#ff0066}{M1A1} \ qquad \ \ & Q_1 &=&55.5 + \ frac{ \ frac{136}{4}-5-17}{57} \ times 10 \ qquad \ \ & &=& 55.5 + \ frac{12}{57} \ times 10 \ , = \ , 57.61 &| \ color{#ff0066}{A1} \ qquad \ \ & Q_3 &=&65.5 + \ frac{ \ frac{3(136) }{4}-5-17-57}{41} \ times 12 \ qquad \ \ & &=& 65.5 + \ frac{23}{41} \ times 12 \ , = \ , 72.23 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(d)} & \ sum fx &=&(46.5 \ times 5) + (52.5 \ times 17)+(60.5 \ times 57) + \ qquad \ \ &&& + (71.5 \ times 41) + (86 \ times 12)+(121.5 \ times 4) \ qquad \ \ & &=& 9023 &| \ color{#ff0066}{M1} \ qquad \ \ & \ text{mean} &=& \ frac{9023}{136} \ , = \ , 66.35 &| \ color{#ff0066}{M1A1} \ end{steps}}

A24 - ID: 5521 *[9 marks, 11 minutes]*



\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ text{minimum} & \ , \ , \ ,= \ , \ ,&6, \ quad \ text{maximum} = 54 \ qquad \ \ & \ quad Q_1 &=& 11 \ , \ quad Q_2= 15 \ , \ quad Q_3= 23 \ qquad \ \ & IQR &=&Q_3-Q_1 \ , = \ , 12 \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ & Q_3+ 1.5 \ times 12 &=&41 \ qquad \ \ & & \ Rightarrow& \ text{54 is an outlier} &| \ color{#ff0066}{M1A1} \ qquad \ \ & Q_1- 1.5 \ times 12 &=&-7 \ qquad \ \ & & \ Rightarrow& \ text{no more outliers} &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{box plot} &:& \ text{see below} &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)} & \ text{Comments} &:& \ text{positive skew because $Q_2-Q_1 < Q_3-Q_2$ } &| \ color{#ff0066}{M1A1} \ end{steps}}

A25 - ID: 3513 *[6 marks, 7 minutes]*

Sunflowers

15	3 7 8 8
16	7 8 9
17	0 2 3 5 6
18	0 6 7 7 8
19	1

\ displaystyle{ \ begin{steps} & \ qquad \ qquad \ qquad \ text{key} & \ , \ , \ ,= \ , \ ,& \ text{16 | 1 represents 161 cm} \ qquad \ qquad &| \ color{#ff0066}{A2} \ qquad \ \ & \ text{sorted}&& &| \ color{#ff0066}{M2} \ qquad \ \ & \ text{all correct} && &| \ color{#ff0066}{A2} \ end{steps}}

A26 - ID: 4143 *[3 marks, 4 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ text{min}& \ , \ , \ ,= \ , \ ,&14, \ quad \ text{max} =91 \ qquad \ \ & & \ Rightarrow& \ text{range} = 91 - 14 \ , = \ , 77 \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{LQ} &=&27, \ quad \ text{UQ} =82 \ qquad \ \ & & \ Rightarrow& \ text{interquartile range} = 82 - 27 \ , = \ , 55 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & \ text{median} &=&53 &| \ color{#ff0066}{A1} \ end{steps}}

A27 - ID: 736 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ text{Reason} & \ , \ , \ ,: \ , \ ,& \ text{time is continuous variable} \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ text{Feature} &:& \ text{area is proportional to frequency} & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & \ text{each child} &=&2 \ times 2 \ div 8 \ ,cm^2 \ , = \ , 0.5 \ , cm^2 & | \ color{#ff0066}{M2A1} \ qquad \ \ \ text{(d)} & \ text{total number} &=&29 \ div 0.5 \ , = \ , 58& | \ color{#ff0066}{M1A1} \ end{steps}}

A28 - ID: 5539 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad \ qquad \ qquad \ text{1} & \ , \ , \ ,: \ , \ ,& \ text{Shows shape of distribution, median, spread} \ qquad \ \ &&& \ text{maximum and minimum values, range and outliers} \ quad & | \ color{#ff0066}{A1} \ qquad \ \ & \ text{2} &:& \ text{Enables comparison of data sets, both continuous} \ qquad \ \ &&& \ text{and discrete data, relative positions of quartiles} & | \ color{#ff0066}{A1} \ qquad \ \ & \ text{3}&:& \ text{Useful when large number of observations are made} \ qquad \ \ &&& \ text{demonstrates skewness} & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & 23 > 21 & \ Rightarrow& \ text{Boys spend more time on average watching TV} & | \ color{#ff0066}{A1} \ qquad \ \ & 30- 16 > 27 - 15 & \ Rightarrow& \ text{More variation in boys times than girls} & | \ color{#ff0066}{A1} \ qquad \ \ & \ text{symmetry} & \ Rightarrow& \ text{both distributions roughly symmetric} & | \ color{#ff0066}{A1} \ end{steps}}

A29 - ID: 4228 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad \ text{$17-24$ frequency} & \ , \ , \ ,= \ , \ ,&(7 \ times 6) \ , = \ , 42 \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ & \ text{$24-39$ frequency} & \ , \ , \ ,= \ , \ ,&(15 \ times 2) \ , = \ , 30 & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ text{number} &=&(5 \ times 6) + (15 \ times 2) \ , = \ , 60 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ sum f &=&8 + 25 + 21+ 42+ 30 \ , = \ , 126 & | \ color{#ff0066}{B1} \ qquad \ \ & \ sum fx &=&(7 \ times 8) + (11.5 \ times 25)+(15.5 \ times 21) + \ qquad \ \ &&& + (20.5 \ times 42) + (31.5 \ times 30) \ qquad \ \ & &=& 2475 & | \ color{#ff0066}{M1} \ qquad \ \ & \ text{mean} &=& \ frac{2475}{126} \ , = \ , 19.64 & | \ color{#ff0066}{M1A1} \ end{steps}}

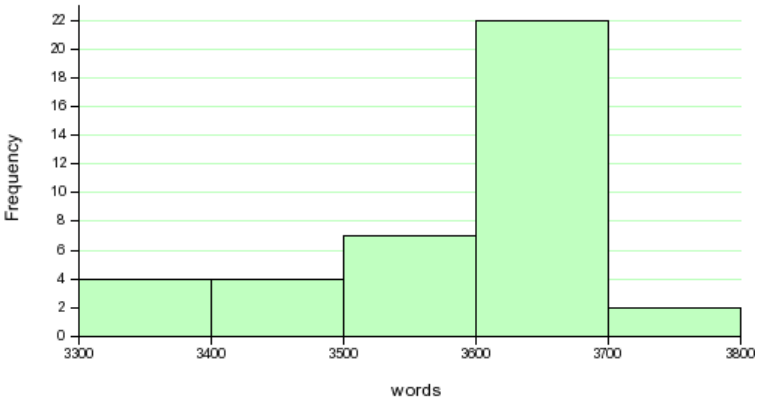
A30 - ID: 4227 *[5 marks, 6 minutes]*

\ displaystyle{ \ begin{steps} & \ qquad \ text{total area} & \ , \ , \ ,= \ , \ ,&(2 \ times 5) + (4 \ times 7) +(2 \ times 11)+(1 \ times 11)+ \ qquad \ \ &&& (4 \ times 9)+(5 \ times 8)+(6 \ times 5)+(8 \ times 6) & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& 225 & | \ color{#ff0066}{B1} \ qquad \ \ & & \ Rightarrow& \ text{frequency $42-50$ } = 8 \ times 6 \ times \ frac{450}{225} \ , = \ , 96& | \ color{#ff0066}{M1A1} \ end{steps}}

A31 - ID: 5771 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{median score } & \ , \ , \ ,= \ , \ ,& \ text{score of student 14} \ , = \ , 36 &| \ color{#ff0066}{B1} \ qquad \ \ & \ text{mode} &=&42 &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ text{skewness} &=& \ text{negative} &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & \ text{measure} &=& \ text{median} &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(d)} & \ text{total cost} &=&30.3 \ times 27 \ times 10 \ , = \ , £81.80 &| \ color{#ff0066}{M1A1} \ end{steps}}

A32 - ID: 6069 *[6 marks, 7 minutes]*



\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{frequency densities} & \ , \ , \ ,= \ , \ ,& \ matrix{4 & 4 &7 & 22 & 2} \ qquad \ \ & \ text{histogram} &:& \ text{see below} &| \ color{#ff0066}{A3} \ qquad \ \ \ text{(b)} & \ text{modal class} &=&3600-3700 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & probability &=& \ displaystyle \ frac{2}{39} &| \ color{#ff0066}{A2} \ end{steps}}

A33 - ID: 6074 *[6 marks, 7 minutes]*

Ages

19	6
20	0 7 8
21	0 2
22	1

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ qquad \ text{mode height} & \ , \ , \ ,= \ , \ ,&166 \ qquad \ qquad \ qquad &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{median height} &=&161 &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{mean weight} &=&122.4 &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{sd weight} &=&48.3 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & && \ text{16 | 1 represents 161 } &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{see below} && &| \ color{#ff0066}{A1} \ end{steps}}

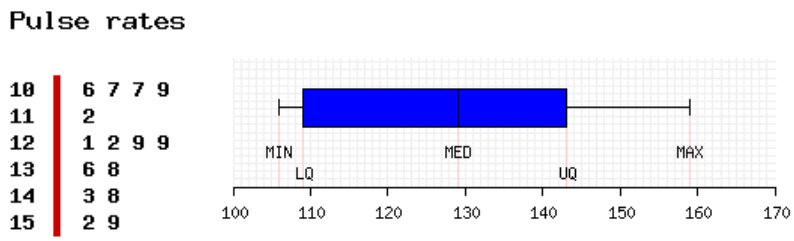
A34 - ID: 6089 *[4 marks, 5 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{total number} &=&0+10+22+48+14+0 \ , = \ , 94 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{modal group} &=&3 \ leq weight < 4 &| \ color {#ff0066}{A1} \ qquad \ \ \ text{(c)} & \ text{probability} &=& \ displaystyle \ frac{80}{94} &| \ color {#ff0066}{M1A1} \ end{steps}}

A35 - ID: 6096 *[5 marks, 6 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ text{comment} &:& \ text{not true; box plots do not show frequencies} \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ text{any two comments} &:& \ text{Females has the largest range} \ qquad \ \ & \ text{IQR} &:& \ text{Females has the largest IQR} \ qquad \ \ & \ text{average} &:& \ text{Males has the highest average} \ qquad \ \ & \ text{skew for Females} &:& \ text{positive} \ qquad \ \ & \ text{skew for Males} &:& \ text{positive} &| \ color{#ff0066}{B2} \ qquad \ \ \ text{(c)} & \ text{advantage} &:& \ text{box plot shows key values (quartiles etc)} &| \ color{#ff0066}{B1} \ qquad \ \ & \ text{disadvantage} &:& \ text{box plot does not show mode or frequencies} &| \ color{#ff0066}{B1} \ end{steps}}

A36 - ID: 6192 *[8 marks, 10 minutes]*

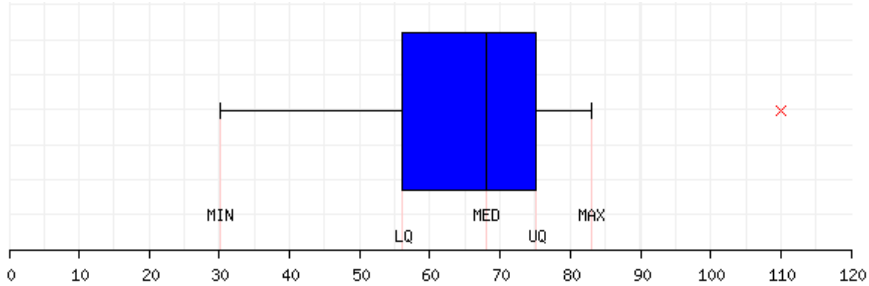


\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{stem and leaf diagram} &:& \ text{See diagram} \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B3} \ qquad \ \ \ text{(b)} & \ text{median} &=&129 &| \ color{#ff0066}{B1} \ qquad \ \ & \ text{LQ} &=& \ text{109} \ qquad \ text{UQ} \ ,= \ , \ text{143} &| \ color{#ff0066}{B2} \ qquad \ \ \ text{(c)} & \ text{box plot} && \ text{See diagram} &| \ color{#ff0066}{B3} \ end{steps}}

A37 - ID: 5559 *[3 marks, 4 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ text{$(13-22)$ width} & \ , \ , \ ,= \ , \ ,& \ text{10 represented by 2 cm} \ qquad \ \ & \ text{$(23-27)$ width} & \ , \ , \ ,= \ , \ ,& \ text{5 represented by 1 cm} \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ text{$(13-22)$ height} & \ , \ , \ ,= \ , \ ,& \ text{freq. density} \ , = \ , 30 \ div 10 \ qquad \ \ & &=& \ text{3 represented by 5 cm} \ qquad \ \ & \ text{$(23-27)$ height} & \ , \ , \ ,= \ , \ ,& \ text{freq. density} \ , = \ , 15 \ div 5 \ qquad \ \ & &=& \ text{3 represented by 5 cm} &| \ color{#ff0066}{M1A1} \ end{steps}}

A38 - ID: 5481 *[8 marks, 10 minutes]*

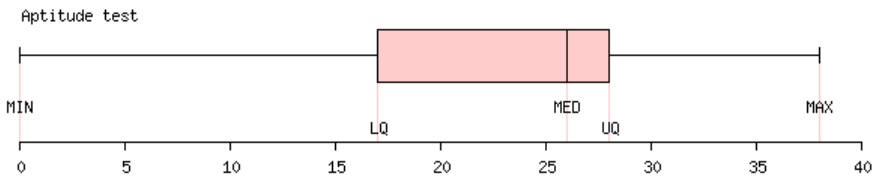


\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ text{data sorted} & \ , \ , \ ,= \ , \ ,& \ text{30, 32, 56, 58, 61, 68, 69, 74, 75, 83, 110} \ qquad \ \ & \ text{Median} &=&68 \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ & Q1 &=&56 &| \ color{#ff0066}{B1} \ qquad \ \ & Q3 &=&75 &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ text{limits} &=&27.5 \ text{ and } 103.5 \ quad \ qquad \ \ & & \ Rightarrow& \ text{110 is only outlier} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{See below} && &| \ color{#ff0066}{M1A2} \ end{steps}}

A39 - ID: 5483 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ text{$(12-17)$ width} & \ , \ , \ ,= \ , \ ,& \ text{6 represented by 3 cm} \ qquad \ \ & \ text{$(23-32)$ width} & \ , \ , \ ,= \ , \ ,& \ text{10 represented by 5 cm} \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ & \ text{$(12-17)$ height} & \ , \ , \ ,= \ , \ ,& \ text{freq. density} \ , = \ , 15 \ div 6 \ qquad \ \ & &=& \ text{2.5 represented by 1.25 cm} \ qquad \ \ & \ text{$(23-32)$ height} & \ , \ , \ ,= \ , \ ,& \ text{freq. density} \ , = \ , 10 \ div 10 \ qquad \ \ & &=& \ text{1 represented by 0.5 cm} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text{Median, Q_2 } &=&11.5 + \ displaystyle \ frac{48.5 -37 }{15} \ times 6 \ , = \ , 16.1 &| \ color{#ff0066}{M1A1} \ qquad \ \ & Q1 &=&6.5 + \ displaystyle \ frac{24.25 -21 }{16} \ times 5 \ , = \ , 7.5 &| \ color{#ff0066}{A1} \ qquad \ \ & Q3 &=&17.5 + \ displaystyle \ frac{72.75 -52 }{26} \ times 5 \ , = \ , 21.5 &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{IQR} &=&21.5 - 7.5 \ , = \ , 14&| \ color{#ff0066}{A1} \ end{steps}}

A40 - ID: 7111 *[9 marks, 11 minutes]*



\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{median score }
& \ , \ , \ ,= \ , \ ,& \ text {score of student 10} \ , = \ , 26 &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & Q_1 &=&17 &| \ color {#ff0066}{B1} \ qquad \ \ & Q_3 &=&28 &| \ color{#ff0066}{B1} \ qquad \ \ & & \ Rightarrow& \ text{IQ = 11} &| \ color{#ff0066} {B1} \ qquad \ \ \ text{(c)} & Q_1 - IQ &=&6 &| \ color{#ff0066}{B1} \ qquad \ \ & & \ Rightarrow& \ text{only one score less than 6} &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(d)} & \ text{boxplot} &=& \ text{see diagram} &| \ color{#ff0066}{A3} \ end{steps}}

A41 - ID: 670 *[4 marks, 5 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & P(X=0) &=& \ displaystyle \ frac{7}{17} \ times \ frac{6} {16} \ times \ frac{5}{15} \ ,= \ frac{7 \ times 6 \ times 5}{17 \ times 16 \ times 15 } \ ,= \ frac{210} { 4080} \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(X=2) &=&3 \ times \ displaystyle \ frac{ 7 }{17} \ times \ frac{10}{16 } \ times \ frac{ 9 }{15 }= \ frac{3 \ times 7 \ times 10 \ times 9 }{17 \ times 16 \ times 15 } \ , = \ frac{1890}{4080} &| \ color{#ff0066}{M1A1} \ end{steps}}

A42 - ID: 724 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ qquad \ qquad P(H \ cap W) &=&P(H | W).P(W) \ quad \ quad \ quad \ quad \ quad \ quad &| \ color{#ff0066}{M1} \ qquad \ \ &&=& \ frac {7}{11} \ times \ frac{1}{7} \ , = \ , \ frac{7}{77} &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{P(only one degree)}&=&P(H \ cup W) - P(H \ cap W) \ qquad \ \ &&=& P(H)+P(W) - 2P(H \ cap W)&| \ color{#ff0066}{M1} \ qquad \ \ &&=& \ frac{4}{6} + \ frac{1}{7} - 2 \ frac{7}{77} \ qquad \ \ &&=& \ frac{2156+462-588}{3234} \ , = \ ,0.63&| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & \ text{P(neither has degree)}&=&1-(0.63+ \ frac{7}{77}) &| \ color{#ff0066}{M1A1} \ qquad \ \ &&=&0.28 &| \ color{#ff0066}{A1} \ end{steps}}

A43 - ID: 426 *[4 marks, 5 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ text{P(not 6)} &=&1 - \ frac{1}{6} \ , = \ , \ frac{5}{6} \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ text{P(6 on third)} &=& \ text{P(not 6, not 6, 6)}&| \ color{#ff0066}{M1} \ qquad \ \ &&=& \ frac{5}{6} \ times \ frac{5} {6} \ times \ frac{1}{6}&| \ color{#ff0066}{A1} \ qquad \ \ &&=& \ frac{5 \ times 5 \ times 1}{6 \ times 6 \ times 6} \ qquad \ \ &&=& \ frac{25}{216} &| \ color{#ff0066}{A1} \ end{steps}}

A44 - ID: 652 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & P(A \ cap B) &=&P(A) \ times P(B) \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1} \ qquad \ \ &&=& 0.24 \ times 0.21 \ quad \ , = \ , 0.0504 \ quad & | \ color {#ff0066}{A1} \ qquad \ \ \ text{(b)} & P(A \ cup B) &=& P(A) + P(B) - P(A \ cap B) \ qquad \ \ &&=& 0.24 + 0.21 - 0.0504 \ quad \ , = \ , 0.3996 \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(A|B') &=& \ frac{P(A \ cap B') }{P(B')} \ , = \ , \ frac{0.24 \ times (1 - 0.21) }{1 - 0.21} \ , = \ , 0.24 & | \ color{#ff0066}{M2A2} \ end{steps}}

A45 - ID: 766 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & P(3 A) &=&P(A) \ times P(A) \ times P(A) \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1} \ qquad \ \ & &=& \ frac{61}{113} \ times \ frac{60}{112} \ times \ frac{59}{111} \ quad& | \ color{#ff0066}{M2} \ qquad \ \ & &=& 0.1537 \ quad & | \ color{#ff0066} {A1} \ qquad \ \ \ text{(b)} & P(1 S) &=& 3 \ times P(S) \ times P(not S) \ times P(not S) & | \ color {#ff0066}{M1} \ qquad \ \ &&=& 3 \ times \ frac{22}{113} \ times \ frac{91}{112} \ times \ frac{90} {111} & | \ color{#ff0066}{M1} \ qquad \ \ &&=& 0.3848 \ quad & | \ color{#ff0066}{A1} \ end{steps}}

A46 - ID: 935 *[9 marks, 11 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ qquad P(A \ cap B) & \ , \ , \ ,= \ , \ ,& \ frac {1}{2} \ times \ frac{7}{55} \ quad \ , = \ , \ frac{7}{110} \ qquad \ qquad \ qquad \ qquad & | \ color {#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(A') &=& \ text{P(a claim is made)} \ , = \ , \ frac{92} {110} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{P(Flash|no claim)} &=& \ frac{11 } {18 } & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & P(A) \ times P(B) &=& \ frac{18}{110} \ times \ frac{1}{2} \ , = \ , \ frac{18}{220} \ qquad \ \ && \ neq & P(A \ cap B) & | \ color{#ff0066} {M1A1} \ qquad \ \ && \ Rightarrow & \ text{one model less reliable} & | \ color{#ff0066}{A1} \ end {steps}}

A47 - ID: 458 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad P(A|C) & \ , \ ,= \ , \ , \ ,&P(A) \ , = \ , 0.3 \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(A \ cup B) &=& P(A) + P(B) \ , = \ , 0.7& | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text {Let } P(C) &=& p \ qquad \ \ && \ Rightarrow& P(A \ cup C) = P(A) + P(C) - P(A \ cap C) \ qquad \ \ && \ Rightarrow& P(A \ cup C) = P(A) + P(C) - P(A) \ times P(C) & | \ color{#ff0066}{M1A1} \ qquad \ \ && \ Rightarrow& 0.7 = 0.3 + p - 0.3p \ quad \ qquad \ \ && \ Rightarrow& 0.4 = 0.7p \ qquad \ \ && \ Rightarrow& p = 0.571 & | \ color{#ff0066}{M1A1} \ end{steps}}

A48 - ID: 3538 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad P(A \ cap B) & \ , \ , \ ,= \ , \ ,&P(A)+P(B) - P(A \ cup B) \ qquad \ \ & &=& 0.5 + 0.7 - 0.78 \ , = \ , 0.42 \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(A) \ times P(B) &=&0.5 \ times 0.7 \ , = \ , 0.35 \ qquad \ \ & & \ Rightarrow& P (A) \ times P(B) \ ne P(A \ cap B) \ qquad \ \ & & \ Rightarrow& \ text{not independent} &| \ color {#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(A \ cap B) \ ne 0 & \ Rightarrow& \ text{not mutually exclusive} &| \ color{#ff0066}{M1A1} \ end{steps}}

A49 - ID: 4128 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ text{number} & \ , \ , \ , = \ , \ ,&31+39+25+11+4 \ , = \ , 110 \ qquad \ qquad \ qquad &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{modal group} &=&60-120 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & \ text {Probability} &=& \ displaystyle \ frac{31 + 4}{110} \ , = \ , \ displaystyle \ frac{35}{110} &| \ color {#ff0066}{A2} \ qquad \ \ \ text{(d)} & P(B|A) &=& \ displaystyle \ frac{P(A \ cap B) }{P(B)} \ , = \ , \ displaystyle \ frac{P(180,000 < H < 240,000) }{P(H>120,000)} \ qquad \ \ & &=& \ displaystyle \ frac { \ frac{11}{110} }{ \ frac{25+11+4}{110} } \ , = \ , \ displaystyle \ frac{11}{40} &| \ color{#ff0066} {A2} \ end{steps}}

A50 - ID: 4570 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ qquad \ qquad P(B|B) & \ , \ ,= \ , \ , \ ,& \ displaystyle \ frac{7}{12} \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & P(Second \ , choice \ , = \ , black) &=& \ displaystyle \ frac{8}{13} \ times \ frac{7}{12} + \ frac{5}{13} \ times \ frac{8}{13} &| \ color{#ff0066}{M2} \ qquad \ \ & &=& \ displaystyle \ frac {1208}{2028} &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & P(different) &=& \ displaystyle \ frac {8}{13} \ times \ frac{5}{12} + \ frac{5}{13} \ times \ frac{8}{13} &| \ color{#ff0066}{M2} \ qquad \ \ & &=& \ displaystyle \ frac{1000}{2028} &| \ color{#ff0066}{M1A1} \ end{steps}}

A51 - ID: 5518 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & P(RRR) & \ , \ , \ ,= \ , \ ,& \ displaystyle \ frac{3}{7} \ times \ frac{2}{6} \ times \ frac{1}{5} \ qquad \ \ & &=& \ displaystyle \ frac{6}{210} \ , = \ , \ frac{1} {35} \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(B>R) &=&P(BB) + P(BRB) + P(RBB) \ qquad \ \ & &=& \ displaystyle \ frac{4}{7} \ times \ frac{3}{6} + \ frac{4}{7} \ times \ frac{3}{6} \ times \ frac{3}{5} + \ frac{3}{7} \ times \ frac{4}{6} \ times \ frac{3}{5} &| \ color{#ff0066}{M1A1} \ qquad \ \ & &=& \ displaystyle \ frac{12}{42} + \ frac{72}{210} \ qquad \ \ & &=& \ displaystyle \ frac{132}{210} \ , = \ , \ frac{22}{35} &| \ color{#ff0066}{M1A1} \ end {steps}}

A52 - ID: 5478 *[9 marks, 11 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{mutually exclusive} & \ Rightarrow&P(A \ cap B) = 0 \ qquad \ \ & & \ Rightarrow& P(A) + P(B) -P(A \ cup B) = 0 \ qquad \ \ & & \ Rightarrow& P(B) = 0.6 - 0.5 = 0.1 \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text{independent} & \ Rightarrow&P(A \ cap B) = P(A) \ times P(B) \ qquad \ \ & & \ Rightarrow& P(A) + P(B) - P(A \ cup B) = P(A) \ times P(B) \ qquad \ \ & & \ Rightarrow& 0.5 + P(B) -0.6 = 0.5P(B) & | \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& 0.5P(B) =0.1 \ qquad \ \ & & \ Rightarrow& P(B) =0.2 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(B | A) = 0.2 & \ Rightarrow& \ displaystyle \ frac{P(A \ cap B) }{P(A)} = 0.2 & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& P(A \ cap B) = 0.1 & | \ color{#ff0066}{A1} \ qquad \ \ & & \ Rightarrow& P(B) = P(A \ cup B) + P(A \ cap B) - P(A) \ , = \ , 0.2 & | \ color{#ff0066}{A1} \ end{steps}}

A53 - ID: 4375 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad P(HH) = 0.64 & \ Rightarrow&P(H) = \ sqrt{0.64} \ , = \ , 0.8 \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& P(TT) = (1-0.8)^2 \ , = \ , 0.04 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(1H) = 0.455 & \ Rightarrow&2p(1-p) = 0.455 & | \ color{#ff0066}{B1M1} \ qquad \ \ & & \ Rightarrow& 2p^2 - 2p + 0.455 = 0 & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& p = \ displaystyle \ frac{2 \ pm \ sqrt{4-3.64}}{4} \ ,= \ ,0.65, 0.35 & | \ color{#ff0066}{M1A1} \ end{steps}}

A54 - ID: 4377 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ qquad \ qquad P(B|B) & \ , \ , \ ,= \ , \ ,& \ displaystyle \ frac{8}{15} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & P(WB) + P(BB) &=& \ displaystyle \ frac{7}{16} \ times \ frac{9}{15} + \ frac{9}{16} \ times \ frac{8}{15} \ , = \ , \ displaystyle \ frac{135}{240} & | \ color{#ff0066}{M2A1} \ qquad \ \ \ text{(c)} & P(WB|B) + P(BB|B) &=& \ displaystyle \ frac{7}{15} \ times \ frac{8}{14} + \ frac{8}{15} \ times \ frac{7}{14} \ , = \ , \ displaystyle \ frac{112}{210} & | \ color{#ff0066}{M2A1} \ end{steps}}

A55 - ID: 4667 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} & \ qquad P(B') & \ , \ , \ ,= \ , \ ,&1 - P(B) \ qquad \ \ & &=& \ frac{2}{3} \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & P(A' \ cap B') & \ , \ , \ ,= \ , \ ,&P((A \ cup B)') \ , = \ , \ frac{6}{13} & | \ color{#ff0066}{M1A1} \ qquad \ \ & P(A' | B') &=& \ frac{P(A' \ cap B') }{P(B')} \ qquad \ \ & &=& \ displaystyle \ frac{ \ frac{6}{13}}{ \ frac{2}{3}} \ , = \ , \ displaystyle \ frac{9}{13} & | \ color{#ff0066}{M1A1} \ end{steps}}

A56 - ID: 5368 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ quad \ qquad \ text{P(3 Y)} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ frac{3}{13} \ times \ frac{2}{12} \ times \ frac{1}{11} \ , = \ , \ displaystyle \ frac{6}{1716} \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text{P(no B)} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ frac{7}{13} \ times \ frac{6}{12} \ times \ frac{5}{11} \ , = \ , \ displaystyle \ frac{210}{1716} \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{P(1 of each)} & \ , \ , \ ,= \ , \ ,&6 \ times \ frac{4}{13} \ times \ frac{6}{12} \ times \ frac{3}{11} & | \ color{#ff0066}{M1} \ qquad \ \ & &=& \ displaystyle \ frac{432}{1716} \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ end{steps}}

A57 - ID: 5524 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad P(B) & \ , \ , \ ,= \ , \ , & \ displaystyle \ frac{3}{5} \ qquad \ qquad \ qquad & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & P(A \ cap B) &=&P(A)+P(B) - P(A \ cup B) \ qquad \ \ & &=& \ displaystyle \ frac{4}{7}+ \ frac{3}{5}- \ frac{4}{7} & | \ color{#ff0066}{M1} \ qquad \ \ & &=& \ displaystyle \ frac{147}{245} \ , = \ , \ displaystyle \ frac{3}{5} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(A | B) &=& \ displaystyle \ frac{P(A \ cap B) }{P(B)} \ , = \ , \ displaystyle \ frac{ \ frac{3}{5}}{ \ frac{3}{5}} \ , = \ , \ displaystyle \ frac{1}{1} & | \ color{#ff0066}{M1A1} \ end{steps}}

A58 - ID: 5479 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad P(A \ cup B) & \ , \ , \ ,= \ , \ , &P(A) + P(B) -P(A \ cap B) \ qquad \ \ & &=& 0.5 + 0.33 - 0.22 \ , = \ , 0.61 \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(A' \ cap B') &=&P((A \ cup B)') \ , = \ , 1 - P(A \ cup B)) \ qquad \ \ & &=& 1 - 0.61 \ , = \ , 0.39 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(B | A') &=& \ displaystyle \ frac{P(B \ cap A') }{P(A')} \ , = \ , \ displaystyle \ frac{P(B) - P(A \ cap B) }{P(A')} & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& \ displaystyle \ frac{0.33 - 0.22}{0.5} \ , = \ , 0.22 & | \ color{#ff0066}{M1A1} \ end{steps}}

A59 - ID: 3142 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad probability &=&0.11 \ times (1-0.13) \ , = \ , 0.0957 \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & probability &=&1 - \ text{P(no delays)} \ qquad \ \ & &=& 1 - (1- 0.11) \ times (1-0.13) \ , = \ , 0.2257 \ qquad \ qquad & | \ color{#ff0066}{M2A1} \ qquad \ \ \ text{(c)} & A &=& \ text{delayed on both flights} \ qquad \ \ & B &=& \ text{delayed on at least one flight} \ qquad \ \ & A \ cap B &=& \ text{delayed on both flights} \ qquad \ \ & P(A|B) &=& \ displaystyle \ frac{P(A \ cap B) }{P(B)} \ , = \ , \ displaystyle \ frac{0.11 \ times 0.13}{0.2257} \ , = \ , \ displaystyle 0.0634 & | \ color{#ff0066}{M2A1} \ end{steps}}

A60 - ID: 3144 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ text{reason} &=& \ text{Adam won after 2 games} \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ text{sequences} &=& \ text{AA, EAA, EAEAA} & | \ color{#ff0066}{B3} \ qquad \ \ \ text{(c)} & P(A \ , wins) &=&0.67^2 + (0.33)0.67^2 + 0.67(0.33)0.67^2 \ qquad \ \ & &=& 0.6963 & | \ color{#ff0066}{M3A1} \ end{steps}}

A61 - ID: 4368 *[4 marks, 5 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ text{P(B|TE)} &=& \ displaystyle \ frac{13}{40} \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text{P(not B & TE)} &=& \ displaystyle \ frac{27}{100} &| \ color{#ff0066}{M1A1} \ end{steps}}

A62 - ID: 4526 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad P(D \ cap A) &=&0.84 \ times 0.79 \ , = \ , 0.6636 \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(D' \ cap A) &=& 0.16 \ times 0.3 \ , = \ , 0.048 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(one) &=& (0.84 \ times 0.21) + 0.048 \ , = \ , 0.2244 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & Prob &=& 3 \ times (0.6636)^{2} \ times (0.16 \ times 0.7) &| \ color{#ff0066}{B1M1A1} \ qquad \ \ & &=& 0.148&| \ color{#ff0066}{A1} \ end{steps}}

A63 - ID: 5372 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad P(A \ cap B) & \ , \ , \ ,= \ , \ ,&P(A) +P(B) - P(A \ cup B) \ qquad \ \ & &=& 0.21 + 0.26 - 0.34 \ , = \ , 0.13 \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(A) \ times P(B) &=& 0.0546&| \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& P(A) \ times P(B) \ ne P(A \ cap B) \ qquad \ \ & & \ Rightarrow& \ text{A and B are not independent} &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & P(A|B'') &=& \ displaystyle \ frac{P(A \ cap B') }{P(B')} &| \ color{#ff0066}{M1} \ qquad \ \ & &=& \ displaystyle \ frac{0.08}{0.74} \ , = \ , \ displaystyle 0.108 &| \ color{#ff0066}{B1M1A1} \ end{steps}}

A64 - ID: 5373 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ text{P(same colour)} & \ , \ , \ ,= \ , \ ,&P(RR) +P(GG) + P(YY) \ qquad \ \ & &=& \ displaystyle \ frac{6}{16} \ times \ frac{5}{15} + \ frac{5}{16} \ times \ frac{4}{15} + \ frac{5}{16} \ times \ frac{4}{15} \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B3} \ qquad \ \ & &=& \ displaystyle \ frac{7}{24} &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{P(same colour)} &=& 1 - \ displaystyle \ frac{7}{24} \ , = \ , \ displaystyle \ frac{17}{24} &| \ color{#ff0066}{M1A1} \ end{steps}}

A65 - ID: 5374 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ text{independence} & \ Rightarrow& P(A \ cap B) = P(A) \ times P(B) \ qquad \ \ & & \ Rightarrow& P(A \ cup B) = P(A) + P(B) - P(A) \ cdot P(B) \ qquad \ \ & & \ Rightarrow& 0.7 = 0.5 + P(B) - 0.5P(B) \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& 0.2 = 0.5P(B) \ qquad \ \ & & \ Rightarrow& P(B) = 0.4 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text{P(exactly one)} &=& P(A \ cup B) - P(A \ cap B) \ , = \ , 0.7 - 0.2 \ , = \ , 0.5 &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(c)} & \ text{P(A|exactly one)} &=& \ displaystyle \ frac{P(\ text{A only}) }{P(\ text{exactly one})} \ , = \ , \ displaystyle \ frac{0.5 \ times (1-0.4) }{0.5} \ , = \ , \ displaystyle 0.6&| \ color{#ff0066}{M1A2} \ end{steps}}

A66 - ID: 5408 *[9 marks, 11 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad P(RR) & \ , \ , \ ,= \ , \ ,& \ displaystyle \ frac{25}{33} \ times \ frac{24}{32} \ , = \ , \ displaystyle \ frac{25}{44} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text{P(2G)} &=& P(GGB)+P(GBG)+P(BGG) \ qquad \ \ & &=& 3 \ times \ frac{9}{15} \ times \ frac{8}{14} \ times \ frac{6}{13} & | \ color{#ff0066}{M2} \ qquad \ \ & &=& \ frac{216}{455} & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & P(YY)= \ frac{1}{15} & \ Rightarrow& \ displaystyle \ frac{n}{45} \ times \ frac{n-1}{44} = \ frac{1}{15} & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& \ displaystyle 15n(n-1)= 1980 \ qquad \ \ & & \ Rightarrow& \ displaystyle n^2 - n - 132 = 0 & | \ color{#ff0066}{A1} \ qquad \ \ & & \ Rightarrow& \ displaystyle (n - 12)(n+11) = 0 \ qquad \ \ & & \ Rightarrow& \ displaystyle n = 12 & | \ color{#ff0066}{M1A1} \ end{steps}}

A67 - ID: 5986 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} & \ frac{ }{ } \ qquad \ qquad P(A|B) =0.5 & \ Rightarrow& \ displaystyle \ frac{P(A \ cap B) }{P(B)}=0.5 \ qquad \ \ & & \ Rightarrow& \ displaystyle P(A \ cap B) =0.5P(B) \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & P(A \ cup B) &=& P(A)+P(B)-P(A \ cap B) \ qquad \ \ & & \ Rightarrow& 0.8 = 0.6 + P(B) - 0.5P(B) & | \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& 0.2 = 0.5P(B) & | \ color{#ff0066}{A1} \ qquad \ \ & & \ Rightarrow& P(B) = 0.4 & | \ color{#ff0066}{A1} \ end{steps}}

A68 - ID: 5557 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad \ qquad P(A \ cap B) = 0 & \ Rightarrow&P(A \ cup B) = a +b \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & P(A \ cap B) = P(A) \ times P(B) & \ Rightarrow&P(A \ cup B) = a +b - ab & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & P(R \ cup Q) &=&P(R \ cap Q') + P(Q) \ qquad \ \ & &=& 0.16 +0.39 \ , = \ , 0.55 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(d)} & P(R | Q) = 0.16 & \ Rightarrow& \ displaystyle \ frac{P(R \ cap Q) }{P(Q)} = 0.16 \ qquad \ \ & & \ Rightarrow& P(R \ cap Q) = 0.16 \ times 0.39 \ , = \ , 0.0624 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & P(R) &=&P(R \ cup Q) + P(R \ cap Q) - P(Q) \ qquad \ \ & &=& 0.55+0.0624-0.39 \ , = \ , 0.2224 & | \ color{#ff0066}{M1A1} \ end{steps}}

A69 - ID: 6010 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a) (i)} & \ frac{ }{ } \ qquad P(male \ cup tennis \ , player) & \ , \ , \ ,= \ , \ ,& \ displaystyle \ frac{5+2+2 + 3}{18} \ , = \ , \ displaystyle \ frac{12}{18} \ qquad & | \ color{#ff0066}{A2} \ qquad \ \ \ text{(a)(ii)} & P(not \ , football | female) &=& \ displaystyle \ frac{P(not \ , football \ cap female) }{P(female)} \ qquad \ \ & &=& \ displaystyle \ frac{ \ frac{6}{18}}{ \ frac{ 9}{18}} \ , = \ , \ displaystyle \ frac{6}{ 9} & | \ color{#ff0066}{A2} \ qquad \ \ \ text{(b)} & P(not \ , football \ cap not \ , football) &=& \ displaystyle \ frac{10}{18} \ times \ frac{9}{17} \ , = \ , \ displaystyle \ frac{90}{306} & | \ color{#ff0066}{A3} \ end{steps}}

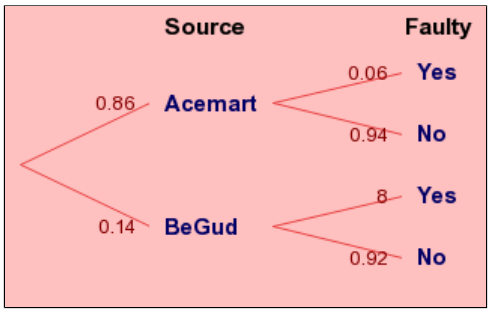
A70 - ID: 5498 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad P(B \ cap E) & \ , \ , \ ,= \ , \ ,&P (E | B) \ times P(B) \ , = \ , \ frac{6}{29} \ times \ frac{1}{5} \ , = \ , \ frac{6}{145} \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(E' \ cap B') &=& P((E \ cup B)') \ , = \ , 1 - P(E \ cup B) \ qquad \ \ & &=& 1 - (P(E) + P(B) - P(E \ cap B)) & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& 1 - (\ frac{1}{4} + \ frac{1}{5} - \ frac{6}{145}) \ , = \ , \ frac{343}{580} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(E) \ times P(B) &=& \ frac{1}{4} \ times \ frac{1}{5} \ , = \ , \ frac{1}{20} & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& P(E) \ times P(B) \ ne P(E \ cap B) \ qquad \ \ & & \ Rightarrow& \ text{not independent} & | \ color{#ff0066}{A1} \ end{steps}}

A71 - ID: 8032 *[7 marks, 8 minutes]*

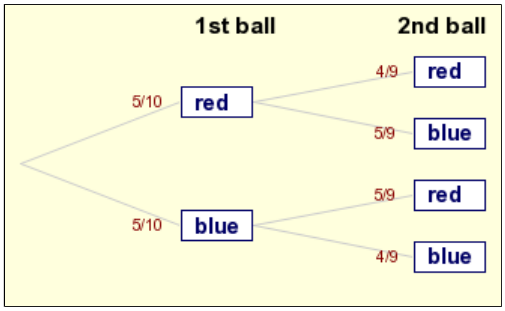
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad P(A \ cup B) & \ , \ , \ ,= \ , \ ,&1 - P(A' \ cap B') \ , = \ , \ frac{7}{8} \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(A \ cap B) &=&P(A|B) \ times P(B) \ , = \ , \ frac{1}{12} & | \ color{#ff0066}{B1} \ qquad \ \ & P(A \ cup B) &=& P(A) + P(B) - P(A \ cap B) \ qquad \ \ & & \ Rightarrow& P(A) = P (A \ cup B) + P(A \ cap B) - P(B) \ qquad \ \ & & \ Rightarrow& P(A) = \ frac{7}{8}+ \ frac{1}{12} - \ frac{1}{4} \ , = \ , \ frac{17}{24} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{Number} &=& \ displaystyle \ frac{49!}{42! 7!} \ , = \ , 85900584 & | \ color{#ff0066}{M1A1} \ end{steps}}

A72 - ID: 5519 *[6 marks, 7 minutes]*



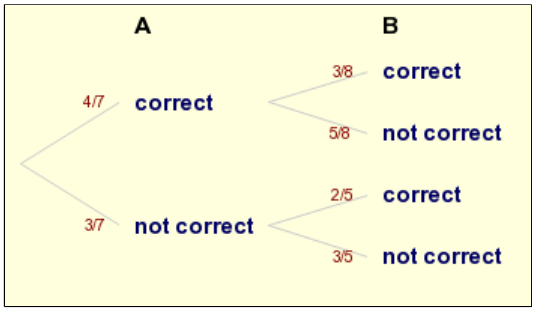
\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ text{Tree diagram} & \ , \ , \ ,: \ , \ ,& \ text{see below} \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)} & P(not \ , faulty) &=&(0.86 \ times 0.94) + (0.14 \ times 0.92) & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& 0.9372 & | \ color{#ff0066}{A1} \ end{steps}}

A73 - ID: 486 *[7 marks, 8 minutes]*



\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad \ qquad \ qquad \ qquad \ text{tree diagram} & \ , \ , \ ,: \ , \ , \ ,& \ text {see below} \ qquad \ qquad & | \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)} & P(Second \ , choice \ , = \ , blue) &=& \ frac{5}{10} \ times \ frac{5}{9} + \ frac{5}{10} \ times \ frac{4}{9} \ qquad \ \ & &=& \ frac{45}{90} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(A|B) &=& \ displaystyle \ frac{P(A \ cap B) }{P(B)} \ qquad \ \ & &=& \ displaystyle \ frac{ \ frac{5}{10} \ times \ frac{4}{9}} { \ frac{45}{90}} \ , = \ , \ displaystyle \ frac{20}{45} & | \ color{#ff0066}{M1A1} \ end{steps}}

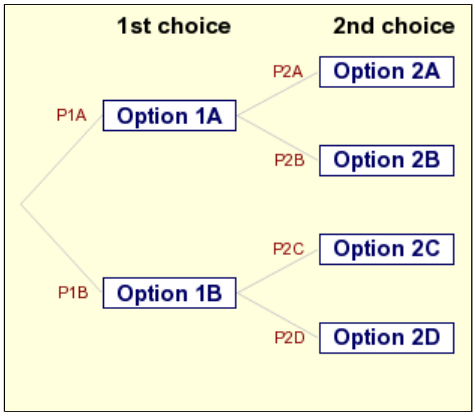
A74 - ID: 5538 *[9 marks, 11 minutes]*



\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ text{tree diagram} & \ , \ , \ ,: \ , \ ,& \ text{see below} \ qquad \ \ & P(\ text{none}) &=& \ displaystyle \ frac{3}{7} \ times \ frac{3}{5} \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& \ displaystyle \ frac{9}{35} \ qquad \ \ & & \ Rightarrow& P(\ text{at least one}) = 1 - \ displaystyle \ frac{9}{35} \ , = \ , \ displaystyle \ frac{26}{35} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(B \ text{ correct}) &=& \ displaystyle \ frac{4}{7} \ times \ frac{3}{8} + \ frac{3}{7} \ times \ frac{2}{5} \ , = \ , \ displaystyle \ frac{108}{280} & | \ color{#ff0066}{M1A1} \ qquad \ \ & P(A | B) &=& \ displaystyle \ frac{P(A \ cap B) }{P(B)} \ qquad \ \ & &=& \ displaystyle \ frac{ \ frac{4}{7} \ times \ frac{3}{8}}{ \ frac{108}{280}} \ , = \ , \ displaystyle \ frac{5}{9} & | \ color{#ff0066}{M2A1} \ end{steps}}

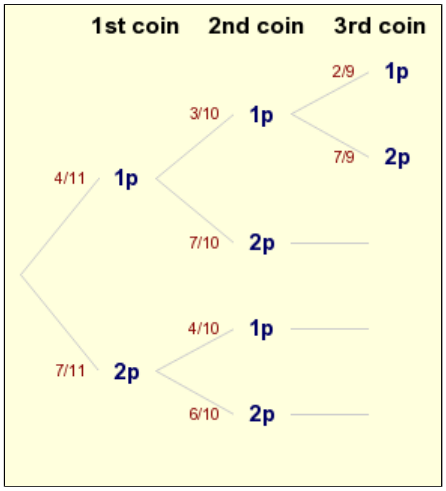
A75 - ID: 734

[11 marks, 13 minutes]



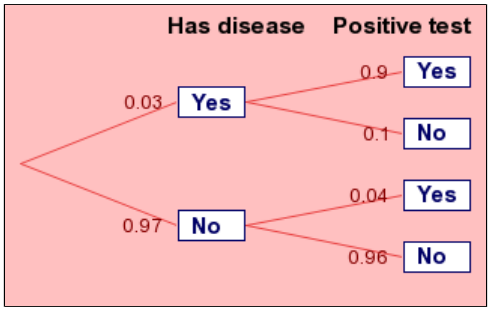
\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ text{tree diagram} & \ , \ ,: \ , \ , \ ,& \ text{see below} \ qquad \ qquad & | \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)} & \ text{P(A and D)} & \ , \ ,= \ , \ , \ ,&0.35 \ times 0.06 \ , = \ , 0.021 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{P(D)} & \ , \ ,= \ , \ , \ ,&(0.35 \ times 0.06) + (0.3 \ times 0.05)+ (0.35 \ times 0.03) & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& 0.0465 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(d)} & P(C|D) &=& \ displaystyle \ frac{P(C \ cap D) }{P(D)} \ ,= \ , \ displaystyle \ frac{0.35 \ times 0.03}{0.0465} & | \ color{#ff0066}{M1A1} \ qquad \ \ &&=& \ displaystyle 0.23 & | \ color{#ff0066}{A1} \ end{steps}}

A76 - ID: 5515 *[11 marks, 13 minutes]*



\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{tree diagram} & \ , \ ,: \ , \ , \ ,& \ text{see below} \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B5} \ qquad \ \ \ text{(b)} & \ text{P(2 coins)} &=& \ displaystyle \ frac{4}{11} \ times \ frac{7}{10} + \ frac{7}{11} &| \ color{#ff0066}{M2} \ qquad \ \ & &=& \ displaystyle \ frac{98}{110} \ , = \ , \ frac{49}{55} &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & \ text{P(4p)} &=& \ displaystyle \ left(\ frac{4}{11} \ times \ frac{3}{10} \ times \ frac{7}{9} \ right)+ \ left(\ frac{7}{11} \ times \ frac{6}{10} \ right) &| \ color{#ff0066}{M2} \ qquad \ \ & &=& \ displaystyle \ frac{84}{990} + \ frac{42}{110} \ qquad \ \ & &=& \ displaystyle \ frac{7}{15} &| \ color{#ff0066}{A1} \ end{steps}}

A77 - ID: 3299 *[8 marks, 10 minutes]*



\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ text{Tree diagram} & \ , \ , \ ,: \ , \ ,& \ text{see below} \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)} & P(positive) &=&0.03 \ times 0.9 + 0.97 \ times 0.04 \ qquad \ \ & &=& 0.0658 &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(c)} & P(A|B) &=& \ displaystyle \ frac{P(A \ cap B) }{P(B)} \ qquad \ \ & &=& \ displaystyle \ frac{0.97 \ times 0.04}{0.0658} \ , = \ , 0.59 &| \ color{#ff0066}{M1A1} \ end{steps}}

A78 - ID: 5509 *[16 marks, 19 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{P(both in rest of UK)} & \ , \ , \ ,= \ , \ ,&0.18^2 \ , = 0.0324 \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text{P(at least 1 England)} &=&0.77 + (0.18 \ times 0.77) + (0.05 \ times 0.77) \ qquad \ \ & &=& 0.9471 &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(c)} & \ text{P(neither overseas)} &=&(1-0.05)^2 \ , = \ , 0.9025 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & A &:& \ text{both in rest of UK} \ qquad \ \ & B &:& \ text{neither overseas} \ qquad \ \ & P(A | B) &=& \ displaystyle \ frac{P (A \ cap B) }{P(B)} \ , = \ , \ displaystyle \ frac{0.0324}{0.9025} \ , = \ , 0.0359&| \ color{#ff0066}{M2A1} \ qquad \ \ \ text{(e)} & Prob &=&1 - 0.77^{3} \ , = \ , 0.5435 &| \ color{#ff0066}{M2A1} \ qquad \ \ \ text{(f)} & 1 - 0.77^{n} > 0.85 & \ Rightarrow&0.77^n < 0.15 &| \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& n > \ displaystyle \ frac{ \ log 0.15}{ \ log 0.77} \ , = \ , 7.2585 \ qquad \ \ & & \ Rightarrow& n = 8 &| \ color{#ff0066}{M1A1} \ end{steps}}

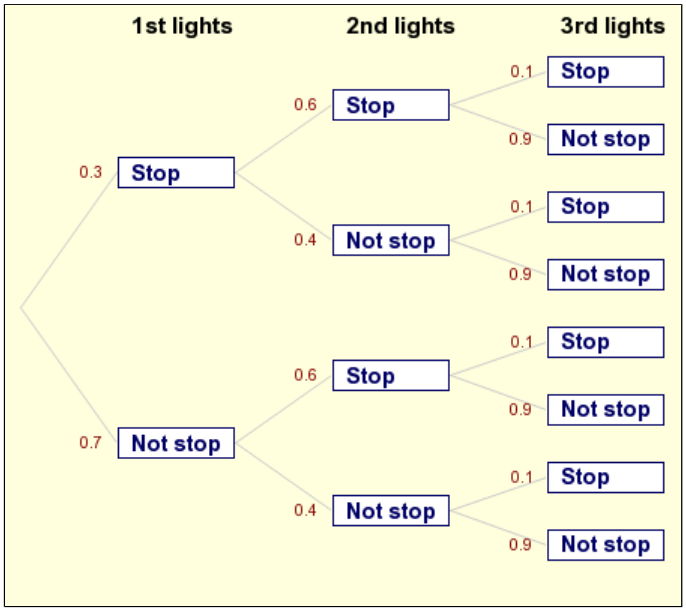
A79 - ID: 6004 *[16 marks, 19 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad P(B) & \ , \ , \ ,= \ , \ ,& \ frac{3}{4}, \ quad P(R) \ ,= \ , \ frac{1}{4} \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{A2} \ qquad \ \ \ text{(b)} & p &=& \ frac{3}{4}, \ quad s \ ,= \ , \ frac{1}{4}, \ quad t \ ,= \ , \ frac{3}{4} & | \ color{#ff0066}{A2} \ qquad \ \ \ text{(c)} & P(X=3) &=&P(RB) \ , = \ , \ frac{1}{4} \ times \ frac{3}{4} \ , = \ , \ frac{3}{16} & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(d)} & P(X=2) &=&P(B \ cup RR) \ , = \ , \ frac{3}{4} + \ left(\ frac{1}{4} \ times \ frac{1}{4} \ right) \ , = \ , \ frac{13}{16} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & \ text{table} &=& \ bbox[border:2px #A2170C solid,1pt] { \ bbox[#FEFFD3,0pt] { \ color{#800000}{ \ matrix{x : & 2 & 3 \ cr P(X=x) : & \ frac{13}{16} & \ frac{3}{16}}}}} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(f)} & E(X) &=&2 \ times \ frac{13}{16} + 3 \ times \ frac{3}{16} \ , = \ , \ frac{35}{16} & | \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(g)} & P(£10) &=&P(3) \ times P(2) + P(2) \ times P(3) & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& 2 \ times \ frac{3}{16} \ times \ frac{13}{16} \ , = \ , \ frac{78}{256} & | \ color{#ff0066}{M1A1} \ end{steps}}

A80 - ID: 6082 *[6 marks, 7 minutes]*

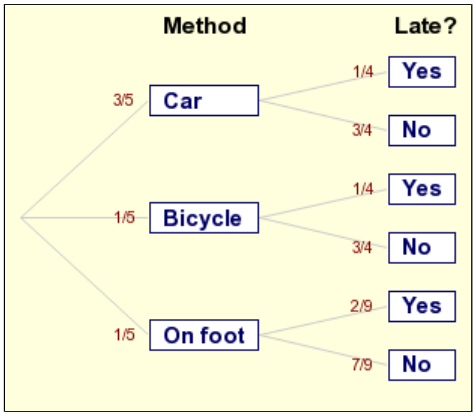
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad p & \ , \ , \ ,= \ , \ ,&0.81 \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{A1} \ qquad \ \ & q & \ , \ , \ ,= \ , \ ,&1 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{P(First serve in; loses)} &=&0.69 \ times 0.19 \ , = \ , 0.1311 & | \ color{#ff0066}{A1} \ qquad \ \ & \ text{P(First serve out; Second serve in; loses)} &=&0.31 \ times 0.78 \ times 0.45 \ , = \ , 0.1088 & | \ color{#ff0066}{A1} \ qquad \ \ & \ text{P(First serve out; Second serve out)} &=&0.31 \ times 0.22 \ , = \ , 0.0682 & | \ color{#ff0066}{A1} \ qquad \ \ & \ text{P(Loses)} &=&0.1311 + 0.1088 + 0.0682 \ qquad \ \ & &=& 0.3081 & | \ color{#ff0066}{A1} \ end{steps}}

A81 - ID: 6190 *[10 marks, 12 minutes]*



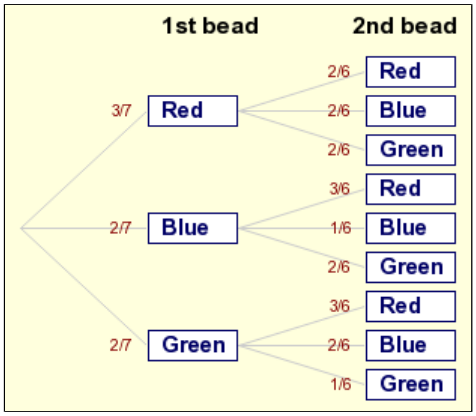
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad \ text{tree diagram} & \ , \ ,: \ , \ , \ ,& \ text{see below} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B2} \ qquad \ \ \ text{(b)} & P (S,S,NS) & \ , \ ,= \ , \ , \ ,&0.3 \ times 0.6 \ times 0.9 \ , = \ , 0.162 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{P(2 stops)} &=&P(S,S,NS) + P(S,NS,S) + P(NS,S,S) \ qquad \ \ & &=& 0.216 & | \ color{#ff0066}{B1M1A1} \ qquad \ \ \ text{(d)} & \ text{P (stop at 1st|2 stops)} &=& \ displaystyle \ frac { \ text{P(stop at 1st & 2 stops)}}{ \ text{P(2 stops)}} & | \ color{#ff0066}{M1} \ qquad \ \ & &=& \ frac{P(S,S,NS) + P(S,NS,S) }{0.216} \ qquad \ \ & &=& \ frac{0.174}{0.216} \ , = \ , 0.806 & | \ color{#ff0066}{M1A1} \ end {steps}}

A82 - ID: 5556 *[11 marks, 13 minutes]*



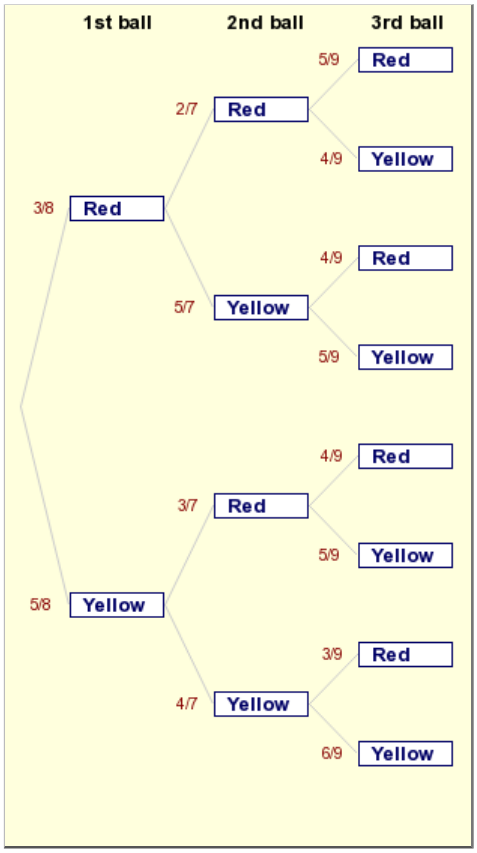
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad \ qquad \ text{tree diagram} & \ , \ ,: \ , \ , \ ,& \ text{see below} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)} & \ text{P(by foot and late)} & \ , \ ,= \ , \ , \ ,& \ displaystyle \ frac{1}{5} \ times \ frac{2}{9} \ , = \ , \ frac{2}{45} & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & \ text{P(not late)} &=& \ displaystyle \ frac{3}{5} \ times \ frac{3}{4} + \ frac{1}{5} \ times \ frac{3}{4} + \ frac{1}{5} \ times \ frac{7}{9} & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& \ displaystyle \ frac{9}{20} + \ frac{3}{20} + \ frac{7}{45} \ , = \ , \ displaystyle \ frac{34}{45} & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(d)} & \ text{P(not foot|Late)} &=& \ displaystyle \ frac{ \ text{P(not foot and Late)}}{ \ text{P(Late)}} \ qquad \ \ & &=& \ displaystyle \ frac{ \ frac{3}{5} \ times \ frac{1}{4} + \ frac{1}{5} \ times \ frac{1}{4}}{1 - \ frac{34}{45}} & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& \ displaystyle \ frac{ \ frac{3}{20} + \ frac{1}{20}}{ \ frac{11}{45}} \ , = \ , \ displaystyle \ frac{ \ frac{80}{400} }{ \ frac{11}{45} } \ , = \ , \ displaystyle \ frac{9}{11} & | \ color{#ff0066}{M1A1} \ end{steps}}

A83 - ID: 7105 *[5 marks, 6 minutes]*



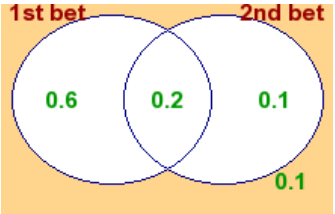
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad \ qquad \ text{tree diagram} & \ , \ ,: \ , \ , \ ,& \ text{see below} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)} & \ text{P (Blue, Green)} & \ , \ ,= \ , \ , \ ,& \ displaystyle \ frac{2}{7} \ times \ frac{2}{6} + \ frac{2}{7} \ times \ frac{2}{6} \ , = \ , \ frac{4}{21} & | \ color{#ff0066}{M1A1} \ end{steps}}

A84 - ID: 7939 *[17 marks, 20 minutes]*



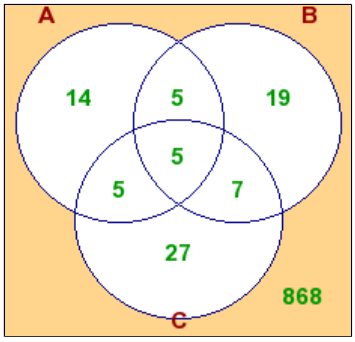
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ text{tree diagram} & \ , \ ,: \ , \ , \ ,& \ text{as shown} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B4} \ qquad \ \ \ text{(b)} & P(A) & \ , \ ,= \ , \ , \ ,& \ displaystyle \ frac{3}{8} \ times \ frac{2}{7} + \ frac{5}{8} \ times \ frac{4}{7} \ , = \ , \ frac{13}{28} & | \ color{#ff0066}{B1M1A1} \ qquad \ \ \ text{(c)} & P(B) && \ displaystyle \ frac{3}{8} \ times \ frac{2}{7} \ times \ frac{5}{9} + \ frac{3}{8} \ times \ frac{5}{7} \ times \ frac{4}{9} + \ frac{5}{8} \ times \ frac{3}{7} \ times \ frac{4}{9} + \ frac{5}{8} \ times \ frac{4}{7} \ times \ frac{3}{9} \ , = \ , \ frac{5}{12} & | \ color{#ff0066}{M2A1} \ qquad \ \ \ text{(d)} & P(A \ cap B) &=&P(RRR) + P(YYR) \ , = \ , \ displaystyle \ frac{3}{8} \ times \ frac{2}{7} \ times \ frac{5}{9} + \ frac{5}{8} \ times \ frac{4}{7} \ times \ frac{3}{9} \ , = \ , \ frac{5}{28} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & P(A \ cup B) &=&P(A)+P(B)-P(A \ cap B) \ , = \ , \ frac{13}{28} + \ frac{5}{12} - \ frac{5}{28} \ , = \ , \ frac{59}{84} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(f)} & P(Red|Same) &=& \ displaystyle \ frac{ \ frac{3}{8} \ times \ frac{2}{7} \ times \ frac{5}{9}}{ \ frac{3}{8} \ times \ frac{2}{7} \ times \ frac{5}{9} + \ frac{5}{8} \ times \ frac{4}{7} \ times \ frac{6}{9}} \ , = \ , \ frac{1}{5} & | \ color{#ff0066}{M1A2} \ end{steps}}

A85 - ID: 400 *[10 marks, 12 minutes]*



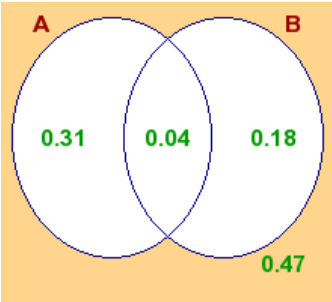
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad \ qquad \ text{Venn diagram} & \ , \ , \ ,: \ , \ ,& \ text{see below} \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & \ text{P(wins neither)} &=&0.1&| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{P(wins one bet)}&=&0.6 + 0.1 &| \ color{#ff0066}{M1} \ qquad \ \ &&=& 0.7 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & \ text{P(2nd bet | not 1st bet)} &=& \ frac{0.1}{0.2} \ , = \ , 0.5 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & \ text{P(wins both)} &=&0.2 \ qquad \ \ & \ text{P(wins 1st)} \ times \ text{P(wins 2nd)} &=&0.8 \ times 0.3= 0.24&| \ color{#ff0066}{A1} \ qquad \ \ && \ Rightarrow& \ text{Not independent} &| \ color{#ff0066}{M1A1} \ end{steps}}

A86 - ID: 5476 *[13 marks, 16 minutes]*



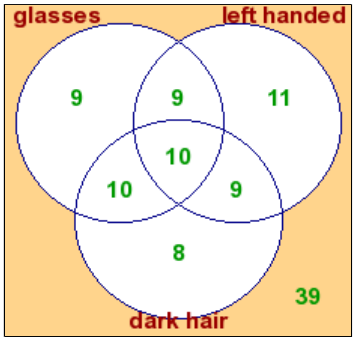
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ quad \ qquad \ text{Venn diagram} & \ Rightarrow& \ text{see below} \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{M2A4} \ qquad \ \ \ text{(b)} & P(none) &=& \ displaystyle \ frac{868}{950} &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & P(\ text{no more than 1}) &=& \ displaystyle \ frac{868+14+19+27}{950} \ qquad \ \ & &=& \ displaystyle \ frac{928}{950} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & P(B | \ text{only 1 defect}) &=& \ displaystyle \ frac{19}{14+19+27} \ , = \ , \ displaystyle \ frac{19}{60} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & P(BB) &=& \ displaystyle \ frac{36}{950} \ times \ frac{35}{949} \ , = \ , \ frac{1260}{901550} &| \ color{#ff0066}{M1A1} \ end{steps}}

A87 - ID: 593 *[11 marks, 13 minutes]*



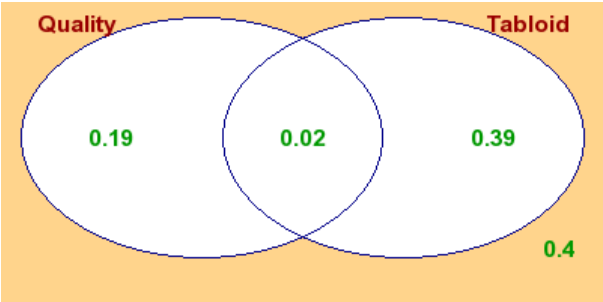
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ text{Venn diagram} & \ Rightarrow& \ text{see below} \ qquad \ qquad &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)} & P(A) &=&0.35 \ qquad \ \ & P(B) &=&0.22 &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(c)} & P(A|B') &=& \ displaystyle \ frac{P(A \ cap B') }{P(B')} \ qquad \ \ & &=& \ displaystyle \ frac{0.31}{1-0.22} \ , = \ , 0.397 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & P(A \ cap B) &=&0.04 &| \ color{#ff0066}{A1} \ qquad \ \ & P(A) \ times P(B) &=&0.35 \ times 0.22 \ , = \ , 0.077 &| \ color{#ff0066}{A1} \ qquad \ \ & & \ Rightarrow& \ text{not independent} &| \ color{#ff0066}{M1} \ end{steps}}

A88 - ID: 5472 *[13 marks, 16 minutes]*



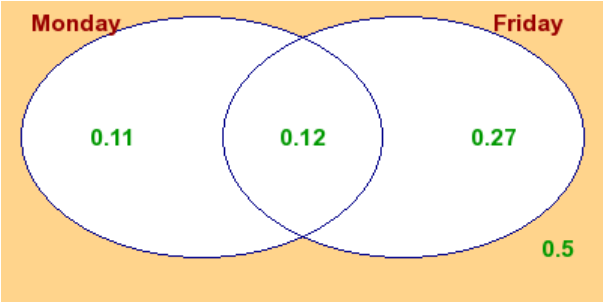
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ text{Venn diagram} & \ Rightarrow& \ text{see below} \ qquad \ qquad &| \ color{#ff0066}{M2A4} \ qquad \ \ \ text{(b)} & P(G) &=& \ displaystyle \ frac{9}{105} &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & P(not \ ,G D L) &=& \ displaystyle \ frac{39}{105} &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(d)} & P(2 \ , attributes) &=& \ displaystyle \ frac{9+10+9}{105} \ , = \ , \ displaystyle \ frac{28}{105} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & P(G | L \ & D) &=& \ displaystyle \ frac{10}{10+9} \ , = \ , \ displaystyle \ frac{10}{19} &| \ color{#ff0066}{M1A2} \ end{steps}}

A89 - ID: 3148 *[9 marks, 11 minutes]*



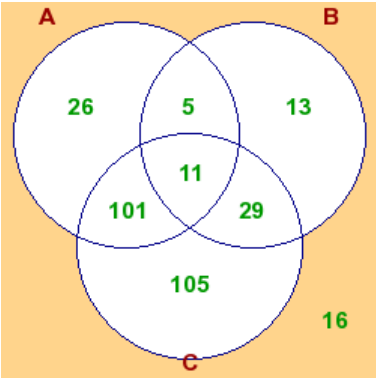
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{A = quality, B = tabloid} & \ Rightarrow&P(A)=0.21, P(B)=0.41, P(A \ cup B) = 0.6 \ quad &| \ color{#ff0066}{B1} \ qquad \ \ & & \ Rightarrow& P(A \ cap B) = 0.21+0.41-0.6 \ , = \ , 0.02 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & &=& \ text{see diagram} &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(c)} & P(A \ cap B'| A \ cup B) &=& \ displaystyle \ frac{0.19}{0.6} \ , = \ , 0.32 &| \ color{#ff0066}{M1A2} \ end{steps}}

A90 - ID: 5540 *[5 marks, 6 minutes]*



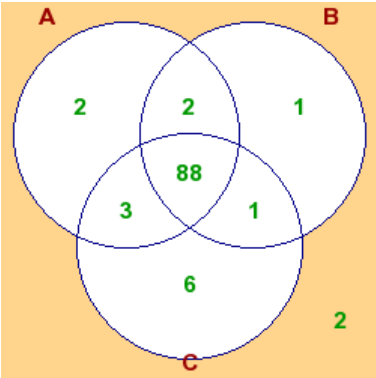
\ displaystyle{ \ begin{steps} \ text{(a)} & P(M \ cup F) = 0.5 & \ Rightarrow&P(M \ cap F) = P(M) + P(F) - P(M \ cup F) \ qquad \ \ & & \ Rightarrow& P(M \ cap F) \ , = \ , 0.23 + 0.39 - 0.5 \ , = \ , 0.12 \ qquad &| \ color{#ff0066}{M1A2} \ qquad \ \ & & & \ Rightarrow& \ text{see Venn diagram} \ qquad \ \ \ text{(b)} & P(M \ , only) &=&P(M) - P(M \ cap F) \ , = \ , 0.23 - 0.12 \ qquad \ \ & &=& 0.11 \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ end{steps}}

A91 - ID: 3236 *[10 marks, 12 minutes]*



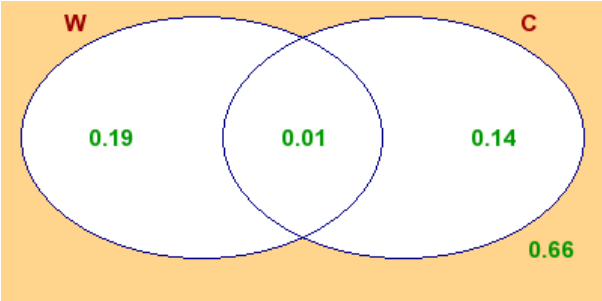
\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{Venn diagram} & \ Rightarrow& \ text{see below} \ quad &| \ color{#ff0066}{M2A2} \ qquad \ \ \ text{(b)} & P(C) &=& \ displaystyle \ frac {101+11+29+105}{306} = \ frac{246}{306} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P &=& \ displaystyle \ frac{11} {26+5+11+101} = \ frac{11}{143} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & P &=& \ displaystyle \ frac{16}{306} &| \ color {#ff0066}{M1A1} \ end{steps}}

A92 - ID: 2628 *[16 marks, 19 minutes]*



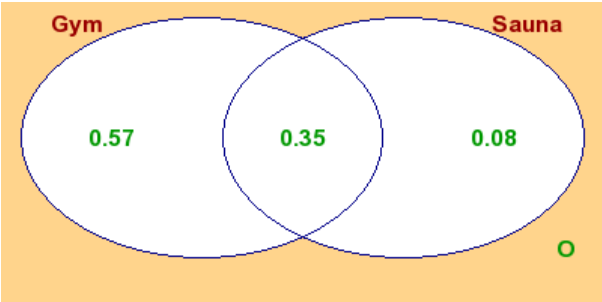
\ displaystyle{ \ begin{steps} \ text{(a)} & n(A \ cap B \ cap C) &=& 88 \ qquad \ \ & & \ Rightarrow& \ text{work out from there, see diagram} \ quad &| \ color{#ff0066}{M2A4} \ qquad \ \ \ text{(b)} & P &=& \ displaystyle \ frac{2}{105} &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & P &=& \ displaystyle \ frac{2+3}{105} = \ frac{5}{105} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & P &=& \ displaystyle \ frac{2+2+1}{105} = \ frac{5}{105} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & P &=& \ displaystyle \ frac{3+2+1}{105} = \ frac{6}{105} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(f)} & P &=& \ displaystyle \ frac{3+88}{A} = \ frac{91}{95} &| \ color{#ff0066}{M1A2} \ end{steps}}

A93 - ID: 5469 *[8 marks, 10 minutes]*



\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad P(W) \ times P(C) & \ , \ , \ ,= \ , \ ,&0.2 \ times 0.15 \ qquad \ \ & &=& 0.03 \ ne P(W \ cap C) \ Rightarrow \ text{events not independent} \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text{Venn diagram} &:& \ text{see below} &| \ color{#ff0066}{B3} \ qquad \ \ \ text{(c)} & P(W | C) &=& \ displaystyle \ frac{P(W \ cap C) }{P(C)} \ , = \ , \ displaystyle \ frac{0.01}{0.15} \ , = \ , 0.067 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & \ text{comment} &:& \ text{children more likely than adults to speak Welsh} &| \ color{#ff0066}{B1} \ end{steps}}

A94 - ID: 5477 *[7 marks, 8 minutes]*

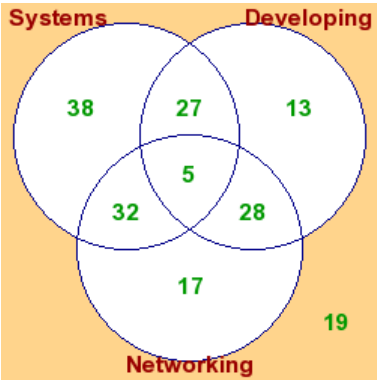


\ displaystyle{ \ begin{steps} \ text{(a)} & \ text {Venn diagram} & \ Rightarrow& \ text{P(not gym)} = 0.08 \ qquad \ qquad \ qquad \ qquad &| \ color {#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ text{Venn diagram} & \ Rightarrow& \ text{P(gym, not sauna)} = 0.57 \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{Venn diagram} & \ Rightarrow& \ text{P(not both)} = 0.57+0.08 \ , = 0.6499999999999999 \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & \ text{P(not gym)} &=&0.08^4 \ , = \ , 0 &| \ color{#ff0066}{M1A1} \ end {steps}}

A95 - ID: 6088 *[4 marks, 5 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & n((A \ cap B) \ cup C) & \ , \ , \ ,= \ , \ ,&4+12+7+5+9 \ , = \ , 37 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & M &=& \ {5,10,15,20,25,30 ... \ } &| \ color {#ff0066}{A1} \ qquad \ \ \ text{(c)} & E' \ cap M &=& \ {5,15,25,35,45,55 ... \ } &| \ color{#ff0066} {A1} \ end{steps}}

A96 - ID: 7108 *[9 marks, 11 minutes]*



\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{Venn diagram} &:& \ text{see diagram} \ quad &| \ color{#ff0066}{M2A3} \ qquad \ \ \ text{(b)} & P &=& \ displaystyle \ frac{19}{179} &| \ color{#ff0066} {B1} \ qquad \ \ \ text{(c)} & P &=& \ displaystyle \ frac{17}{179} &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(d)} & P(\ text{All 3|technician}) &=& \ displaystyle \ frac{ \ frac{5}{179}}{ \ frac{147} {179}} \ , = \ , \ displaystyle \ frac{5}{147} &| \ color{#ff0066}{M1A1} \ end{steps}}

A97 - ID: 664 *[2 marks, 2 minutes]*

\ displaystyle{ \ begin{steps} & \ qquad \ displaystyle S_{xx} \ , \ ,&=& \ displaystyle \ sum x^2 - \ frac {(\ sum x)^2}{n} \ qquad \ \ \ qquad \ \ &&=& \ displaystyle 101363 - \ frac{(1995)^2}{40} \ qquad \ \ \ qquad \ \ &&=& 1862.375 \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ end{steps}}

A98 - ID: 853 *[3 marks, 4 minutes]*

\ displaystyle{ \ begin{steps} & \ qquad r \ , \ ,&=& \ displaystyle \ frac{S_{xy}}{ \ sqrt{S_{xx}S_{yy}}} \ qquad \ \ \ qquad \ \ & &=& \ displaystyle \ frac{ - 54.286}{ \ sqrt{2141.943 \ ,. \ ,2292.571}} \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & &=& - 0.024 \ qquad \ qquad &| \ color{#ff0066}{A1} \ end{steps}}

A99 - ID: 648 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & S_{xy} &=& \ displaystyle \ sum xy - \ frac{ \ sum x . \ sum y}{n} \ , = \ , \ displaystyle 208.82 - \ frac{46.6 \ times 55.9 }{7} \ , = \ , - 163.314 \ quad &| \ color {#ff0066}{M1A1} \ qquad \ \ & S_{xx} &=& \ displaystyle \ sum x^2 - \ frac{ \ sum x . \ sum x}{n} \ , = \ , 468.06 - \ frac{46.6 \ times 46.6 }{7} \ , = \ , 157.837 \ quad \ qquad \ \ & S {yy} &=& \ displaystyle \ sum y^2 - \ frac{ \ sum x . \ sum y}{n} \ , = \ , \ displaystyle 670.07 - \ frac{55.9 \ times 55.9 }{7} \ , = \ , 223.669 &| \ color{#ff0066}{A2} \ qquad \ \ \ text{(b)} & r &=& \ displaystyle \ frac{S_{xy} } { \ sqrt{S_{xx}.S_{yy} }} \ , = \ , \ displaystyle \ frac{ - 163.314 }{ \ sqrt{157.837 \ times 223.669 }} \ quad \ , = \ , - 0.869 &| \ color{#ff0066}{M2A1} \ qquad \ \ \ text{(c)} & r &=& - 0.869 &| \ color {#ff0066}{B1} \ qquad \ \ \ text{(d)} & &=& \ text{strong negative correlation} &| \ color{#ff0066}{M2} \ end{steps}}

A100 - ID: 787 *[4 marks, 5 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad r &=& \ displaystyle \ frac{S_{xy}}{ \ sqrt{S_{xx}S_ {yy}}} \ , = \ , \ displaystyle \ frac{ - 954.494}{ \ sqrt{120385 \ ,. \ ,8.273}} \ , = \ , - 0.956 &| \ color {#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & &:& \ text{very strong negative correlation} &| \ color {#ff0066}{B1} \ qquad \ \ \ text{(c)} & r &=& - 0.956 &| \ color{#ff0066}{B1} \ end{steps}}

A101 - ID: 4567 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad \ quad \ quad \ sum x &=& 17 \ quad \ sum x^2 \ ,= \ ,69 \ quad \ sum y \ ,= \ ,11 \ quad \ sum y^2 \ ,= \ ,53 \ quad \ sum xy \ ,= \ ,41, \ quad \ qquad \ \ & S_{xx} &=& \ displaystyle \ sum x^2 - \ frac{(\ sum x)^2}{n} \ , = \ , \ displaystyle 69 - \ frac {17^2}{8} \ , = \ , 11.2 \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & S_{yy} &=& \ displaystyle \ sum y^2 - \ frac{(\ sum y)^2}{n} \ , = \ , \ displaystyle 53 - \ frac{11^2}{5} \ , = \ , 28.8 \ qquad \ \ & S_{xy} &=& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 41 - \ frac{17 \ times 11}{5} \ , = \ , 3.6&| \ color{#ff0066}{M1A1} \ qquad \ \ & r &=& \ displaystyle \ frac{S_{xy}}{ \ sqrt{S_{xx} S_{yy}}} \ , = \ , \ displaystyle \ frac{3.6}{ \ sqrt{11.2 \ times 28.8}} \ , = \ , 0.2&| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{reason} &:& \ text {too small a sample} &| \ color{#ff0066}{B1} \ end{steps}}

A102 - ID: 5543 *[15 marks, 18 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad S_{tt} &=& \ displaystyle \ sum t^2 - \ frac{(\ sum t)^2}{n} \ , = \ , \ displaystyle 10920.83 - \ frac{401.4^2}{16} \ , = \ , 850.708 \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & S_{vv} &=& \ displaystyle \ sum v^2 - \ frac{(\ sum v)^2}{n} \ , = \ , \ displaystyle 42.3412 - \ frac{24.42^2}{16} \ , = \ , 5.07 \ qquad \ qquad & | \ color{#ff0066}{A1} \ qquad \ \ & S_{tv} &=& \ displaystyle \ sum tv - \ frac{(\ sum t)(\ sum v) }{n} \ , = \ , \ displaystyle 677.883 - \ frac{401.4 \ times 24.42}{16} \ , = \ , 65.246& | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & r &=& \ displaystyle \ frac{S_{tv}}{ \ sqrt{S_{tt} S_{vv}}} \ , = \ , \ displaystyle \ frac{65.246}{ \ sqrt{850.708 \ times 5.07}} \ , = \ , 0.993& | \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(c)} & \ text{explanatory variable} &=& \ text{t because temp can be controlled} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & \ text{reason} &:& \ text{high correlation} & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(e)} & b &=& \ displaystyle \ frac{S_{tv}}{S_{tt}} \ , = \ , \ frac{65.246}{850.708} \ , = \ , 0.0767 & | \ color{#ff0066}{M1A1} \ qquad \ \ & a &=& \ displaystyle \ frac{24.42}{16} - b \ times \ frac{401.4}{16} \ , = \ , -0.398 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(f)} & t=24 & \ Rightarrow&v = -0.398 + 0.0767 \ times 24 \ , = \ , 1.44& | \ color{#ff0066}{A1} \ end{steps}}

A103 - ID: 6100 *[3 marks, 4 minutes]*

\ displaystyle{ \ begin{steps} & S_{xx} &=& \ displaystyle \ sum x^2 - \ frac{(\ sum x)^2}{n} \ , = \ , \ displaystyle 1136 - \ frac{(88)^2}{8} \ , = \ , 168 \ qquad \ \ & S_{yy} &=& \ displaystyle \ sum y^2 - \ frac{(\ sum y)^2}{n} \ , = \ , \ displaystyle 35.35 - \ frac{(16.5)^2}{8} \ , = \ , 1.3188 \ qquad \ \ & S_{xy} &=& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 167.4 - \ frac{88 \ times 16.5}{8} \ , = \ , -14.1 \ qquad \ \ & r &=& \ displaystyle \ frac{S_{xy}}{ \ sqrt{S_{xx}S_{yy}}} \ ,= \ , \ frac{-14.1}{ \ sqrt{168 \ times 1.3188}} \ ,= \ , -0.9473 & | \ color{#ff0066}{M2A1} \ end{steps}}

A104 - ID: 4366 *[2 marks, 2 minutes]*

\ displaystyle{ \ begin{steps} & \ quad S_{xx} &=& \ displaystyle \ sum x^2 - \ frac{(\ sum x)^2}{n} \ , = \ , \ displaystyle 56470 - \ frac{746^2}{10} \ , = \ , 818.4 \ qquad \ \ & S_{yy} &=& \ displaystyle \ sum y^2 - \ frac{(\ sum y)^2}{n} \ , = \ , \ displaystyle 56570 - \ frac{746^2}{10} \ , = \ , 918.4 \ qquad \ \ & S_{xy} &=& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 55938 - \ frac{746 \ times 746}{10} \ , = \ , 286.4& | \ color{#ff0066}{B1} \ qquad \ \ & r &=& \ displaystyle \ frac{S_{xy}}{ \ sqrt{S_{xx} S_{yy}}} \ , = \ , \ displaystyle \ frac{286.4}{ \ sqrt{818.4 \ times 918.4}} \ , = \ , 0.33& | \ color{#ff0066}{A1} \ end{steps}}

A105 - ID: 2630 *[5 marks, 6 minutes]*

\ displaystyle{ \ begin{steps} & \ quad \ quad \ quad \ sum x &=& 774, \ quad \ qquad \ \ & \ sum y &=&737, \ quad \ qquad \ \ & S_{xx} &=& \ displaystyle \ sum x^2 - \ frac{(\ sum x)^2}{n} \ , = \ , \ displaystyle 60656 - \ frac{774^2}{10} \ , = \ , 748.4 \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & S_{yy} &=& \ displaystyle \ sum y^2 - \ frac{(\ sum y)^2}{n} \ , = \ , \ displaystyle 55093 - \ frac{737^2}{10} \ , = \ , 776.1 \ qquad \ \ & S_{xy} &=& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 57120 - \ frac{774 \ times 737}{10} \ , = \ , 76.2& | \ color{#ff0066}{M1A1} \ qquad \ \ & r &=& \ displaystyle \ frac{S_{xy}}{ \ sqrt{S_{xx} S_{yy}}} \ , = \ , \ displaystyle \ frac{76.2}{ \ sqrt{748.4 \ times 776.1}} \ , = \ , 0.1& | \ color{#ff0066}{A1} \ end{steps}}

A106 - ID: 5560 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad S_{pp} &=& \ displaystyle \ sum p^2 - \ frac{(\ sum p)^2}{n} \ , = \ , \ displaystyle 38140 - \ frac{415^2}{15} \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1} \ qquad \ \ & &=& 26658.333 &| \ color{#ff0066}{A1} \ qquad \ \ & S_{pt} &=& \ displaystyle \ sum pt - \ frac{(\ sum p)(\ sum t) }{n} \ , = \ , \ displaystyle 26832 - \ frac{415 \ times 246}{15} \ qquad \ \ & &=& 20026&| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & r &=& \ displaystyle \ frac{S_{pt}}{ \ sqrt{S_{tt} S_{pp}}} \ , = \ , \ displaystyle \ frac{20026}{ \ sqrt{23466.6 \ times 26658.333}} \ , = \ , 0.801&| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{interpretation} &:& \ text{strong positive correlation} \ qquad \ \ &&& \ text{higher temperature is associated with higher pressure} &| \ color{#ff0066}{B1} \ end{steps}}

A107 - ID: 7109 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad S_{tt} &=& \ displaystyle \ sum t^2 - \ frac{(\ sum t)^2}{n} \ , = \ , \ displaystyle 17674 - \ frac{(338)^2}{7} \ , = \ , 1353.4286 \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & S_{pp} &=& \ displaystyle \ sum p^2 - \ frac{(\ sum p)^2}{n} \ , = \ , \ displaystyle 104024 - \ frac{(824)^2}{7} \ , = \ , 7027.4286 &| \ color{#ff0066}{A1} \ qquad \ \ & S_{tp} &=& \ displaystyle \ sum tp - \ frac{(\ sum t)(\ sum p) }{n} \ , = \ , \ displaystyle 42139 - \ frac{338 \ times 824}{7} \ , = \ , 2351.5714 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & r &=& \ displaystyle \ frac{S_{tp}}{ \ sqrt{S_{tt}S_{pp}}} \ ,= \ , \ frac{2351.5714}{ \ sqrt{1353.4286 \ times 7027.4286}} \ ,= \ , 0.7625 &| \ color{#ff0066}{M2A1} \ qquad \ \ \ text{(c)} & \ text{interpretation} &=& \ text{moderately strong} \ qquad \ \ &&& \ text{higher blood pressure associated with higher age} &| \ color{#ff0066}{B1} \ end{steps}}

A108 - ID: 7934 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ quad \ qquad \ qquad S_{ll} &=& \ displaystyle \ sum l^2 - \ frac{(\ sum l)^2}{n} \ , = \ , \ displaystyle 327756 - \ frac{4039^2}{54} \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1} \ qquad \ \ & &=& 25653.759 &| \ color{#ff0066}{A1} \ qquad \ \ & S_{lw} &=& \ displaystyle \ sum lw - \ frac{(\ sum l)(\ sum w) }{n} \ , = \ , \ displaystyle 29332 - \ frac{4039 \ times 369}{54} \ qquad \ \ & &=& 1732.167 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & r &=& \ displaystyle \ frac{S_{lw}}{ \ sqrt{S_{ll} S_{ww}}} \ , = \ , \ displaystyle \ frac{1732.167}{ \ sqrt{262 \ times 25653.759}} \ , = \ , 0.668 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{interpretation} &:& \ text{positive correlation} \ qquad \ \ &&& \ text{longer salmon is associated with heavier weight} &| \ color{#ff0066}{B1} \ end{steps}}

A109 - ID: 867 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} & \ qquad \ qquad S_{xx} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ sum x^2 - \ frac{(\ sum x)^2}{n} \ , = \ , \ displaystyle 1056 - \ frac{(120)^2}{15} \ , = \ , 96 \ qquad \ \ & S_{xy} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 2776 - \ frac{120 \ times 344}{15} \ , = \ , 24&| \ color{#ff0066}{M1A1} \ qquad \ \ & b &=& \ displaystyle \ frac{S_{xy}}{S_{xx}} \ ,= \ , \ frac{24}{96} \ ,= \ , 0.25 &| \ color{#ff0066}{A1} \ qquad \ \ & a &=& \ displaystyle \ bar{y} - b \ bar{x} \ ,= \ , \ frac{344}{15 } - 0.25 \ frac{120}{15 } \ , = \ , 20.9333 &| \ color{#ff0066}{M1A1} \ qquad \ \ & y \ ,&=& \ ,20.9333+0.25x &| \ color{#ff0066}{B1} \ qquad \ \ & h-93 &=& \ ,20.9333+0.25(s-24) &| \ color{#ff0066}{M1A1} \ qquad \ \ & h &=& \ ,107.93+0.25s &| \ color{#ff0066}{A1} \ end{steps}}

A110 - ID: 403 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} & S_{xx} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ sum x^2 - \ frac{(\ sum x)^2}{n} \ , = \ , \ displaystyle 1103 - \ frac{(91)^2}{10} \ , = \ , 274.9 \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & S_{xy} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 831 - \ frac{91 \ times 83}{10} \ , = \ , 75.7 &| \ color{#ff0066}{M1A1} \ qquad \ \ & b &=& \ displaystyle \ frac{S_{xy}}{S_{xx}} \ ,= \ , \ frac{75.7}{274.9} \ ,= \ , 0.275 \ qquad \ \ \ qquad \ \ & a &=& \ displaystyle \ bar{y} - b \ bar{x} \ ,= \ , \ frac{83}{10} - 0.275 \ frac{91}{10} \ ,= \ , 5.798 \ qquad \ \ \ qquad \ \ & & \ Rightarrow& y = 5.798+0.275x &| \ color{#ff0066}{M1A2} \ end{steps}}

A111 - ID: 446 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad S_{ss} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ sum s^2 - \ frac{(\ sum s)^2}{n} \ , = \ , \ displaystyle 800 - \ frac{(76)^2}{8} \ , = \ , 78 \ qquad \ \ & S_{st} &=& \ displaystyle \ sum st - \ frac{(\ sum s)(\ sum t) }{n} \ , = \ , \ displaystyle 2195 - \ frac{76 \ times 233}{8} \ , = \ , -18.5&| \ color{#ff0066}{M1A1} \ qquad \ \ & b &=& \ displaystyle \ frac{S_{st}}{S_{ss}} \ ,= \ , \ frac{-18.5}{78} \ ,= \ , -0.2372 &| \ color{#ff0066}{M1A1} \ qquad \ \ & a \ , \ ,&=& \ displaystyle \ bar{t} - b \ bar{s} \ ,= \ , \ displaystyle \ frac{233}{8 } - -0.2372 \ frac{76}{8 } \ , = \ , 31.3784 &| \ color{#ff0066}{M1A1} \ qquad \ \ & t \ ,&=& \ ,31.3784+ -0.2372s &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & y-20 &=& \ ,31.3784+ -0.2372(x-7) &| \ color{#ff0066}{M1A1} \ qquad \ \ & y &=& \ ,53.039+ -0.237x &| \ color{#ff0066}{A1} \ end{steps}}

A112 - ID: 672 *[11 marks, 13 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{exp. var.} & \ , \ , \ ,= \ , \ ,& \ text{the maths mark} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & S_{mm} &=& \ displaystyle \ sum m^2 - \ frac{(\ sum m)^2}{n} \ , = \ , \ displaystyle 1530 - \ frac{(102)^2}{8} \ , = \ , 229.5 \ qquad \ \ & S_{mp} &=& \ displaystyle \ sum mp - \ frac{(\ sum m)(\ sum p) }{n} \ , = \ , \ displaystyle 2342 - \ frac{102 \ times 162}{8} \ , = \ , 276.5&| \ color{#ff0066}{M1A1} \ qquad \ \ & b &=& \ displaystyle \ frac{S_{mp}}{S_{mm}} \ ,= \ , \ frac{276.5}{229.5} \ ,= \ , 1.205 &| \ color{#ff0066}{M1A1} \ qquad \ \ &a &=& \ bar{p} - b \ bar{m} \ ,= \ , \ frac{162}{8} - 1.205 \ frac{102}{8} \ qquad \ \ &&=& 4.886 &| \ color{#ff0066}{M1A1} \ qquad \ \ & p \ ,&=& \ ,4.886+1.205m &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{mark} &=&4.886+1.205(12) = 19.3 &| \ color{#ff0066}{M1A1} \ end{steps}}

A113 - ID: 634 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad S_{xy} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 943 - \ frac{128 \ times 60}{8} \ , = \ , -17& | \ color{#ff0066}{M1A1} \ qquad \ \ & b &=& \ displaystyle \ frac{S_{xy}}{S_{xx}} \ ,= \ , \ frac{-17}{88} \ ,= \ , -0.1932 & | \ color{#ff0066}{A1} \ qquad \ \ & a &=& \ displaystyle \ bar{y} - b \ bar{x} \ ,= \ , \ frac{60}{8 } - -0.1932 \ frac{128}{8 } \ , = \ , 10.5912 & | \ color{#ff0066}{M1A1} \ qquad \ \ & y \ ,&=& \ ,10.5912+-0.1932x & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & f-103 &=& \ ,10.5912+-0.1932(m-21) & | \ color{#ff0066}{M1A1} \ qquad \ \ & f &=& \ ,117.65+-0.19m & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & m=242 & \ Rightarrow&f = 70.89 & | \ color{#ff0066}{A1} \ end{steps}}

A114 - ID: 846 *[18 marks, 22 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad \ qquad \ sum x & \ , \ , \ ,= \ , \ ,& 333, \ sum y = 14.88 \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1B1} \ qquad \ \ & S_{xx} &=& \ displaystyle \ sum x^2 - \ frac{(\ sum x)^2}{n} \ , = \ , \ displaystyle 15069 - \ frac{(333)^2}{8} \ , = \ , 1207.875& | \ color{#ff0066}{M1A1} \ qquad \ \ & S_{xy} &=& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 681.73 - \ frac{333 \ times 14.88}{8} \ , = \ , 62.35& | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & b &=& \ displaystyle \ frac{S_{xy}}{S_{xx}} \ ,= \ , \ frac{62.35}{1207.875} \ ,= \ , 0.052 & | \ color{#ff0066}{M1A1} \ qquad \ \ & a &=& \ bar{y} - b \ bar{x} \ ,= \ , \ frac{14.88}{8} - 0.052 \ frac{333}{8} \ , = \ , -0.304 & | \ color{#ff0066}{M1A1} \ qquad \ \ & y \ ,&=& \ ,-0.304+0.052x & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & y &=&-0.304+0.052 \ times 40 \ , = \ , 1.8 & | \ color{#ff0066}{M1A1} \ qquad \ \ & l &=& 1.8+ 2460 \ , = \ , 2461.8 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(d)} & l - 2460 &=& -0.304+0.052t \ qquad \ \ & & \ Rightarrow& l = 2459.696+0.052t & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & l &=&2459.696+0.052 \ times 90 \ , = \ , 2464.376 & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(f)} & comment &:& \ text{unreliable because outside range} & | \ color{#ff0066}{M1A1} \ end{steps}}

A115 - ID: 4569 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ text{correlation} & \ , \ , \ ,= \ , \ ,& \ text{negative because negative gradient} \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & x = -1.5(10) + 20.5 &=& 5.5 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{point of intersection} & \ Rightarrow&y = -0.5(-1.5y + 20.5) + 13& | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& 0.25y = 2.75 \ qquad \ \ & & \ Rightarrow& y = 11& | \ color{#ff0066}{A1} \ qquad \ \ & & \ Rightarrow& x = -1.5 \ times11+20.5 \ , = \ , 4& | \ color{#ff0066}{A1} \ end{steps}}

A116 - ID: 2477 *[5 marks, 6 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{correlation coefficient} & \ , \ , \ ,= \ , \ ,& -1 \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & gradient &=& \ displaystyle \ frac{y_2-y_1}{x_2-x_1} \ , = \ , \ frac{-5}{20} \ qquad \ \ & equation &:& y-10 = \ frac{-5}{20}(x-20) \ qquad \ \ & &:& y = - \ frac{1}{4}x+15 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & x=80 & \ Rightarrow&y = -5 & | \ color{#ff0066}{A1} \ qquad \ \ & & \ Rightarrow& \ text{unreliable because outside range} & | \ color{#ff0066}{A1} \ end{steps}}

A117 - ID: 3136 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad S_{xx} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ sum x^2 - \ frac{(\ sum x)^2}{n} \ , = \ , \ displaystyle 166.25 - \ frac{(38.5)^2}{10} \ , = \ , 18.025 \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & S_{xy} &=& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 1161 - \ frac{38.5 \ times 299}{10} \ , = \ , 9.85 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & b &=& \ displaystyle \ frac{S_{xy}}{S_{xx}} \ ,= \ , \ frac{9.85}{18.025} \ ,= \ , 0.546 & | \ color{#ff0066}{M1A1} \ qquad \ \ & a &=& \ displaystyle \ bar{y} - b \ bar{x} \ ,= \ , \ frac{299}{10} - 0.546 \ frac{38.5}{10} \ ,= \ , 27.798 \ qquad \ \ & & \ Rightarrow& y = 27.8+0.55x & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{Comment} &:& \ text{A typical car will travel 550 miles every year} & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(d)} & x = 4 & \ Rightarrow&y = 27.8+0.55(4) \ , = \ , 30 \ qquad \ \ & & \ Rightarrow& \ text{mileage} = 30000 & | \ color{#ff0066}{M1A1} \ end{steps}}

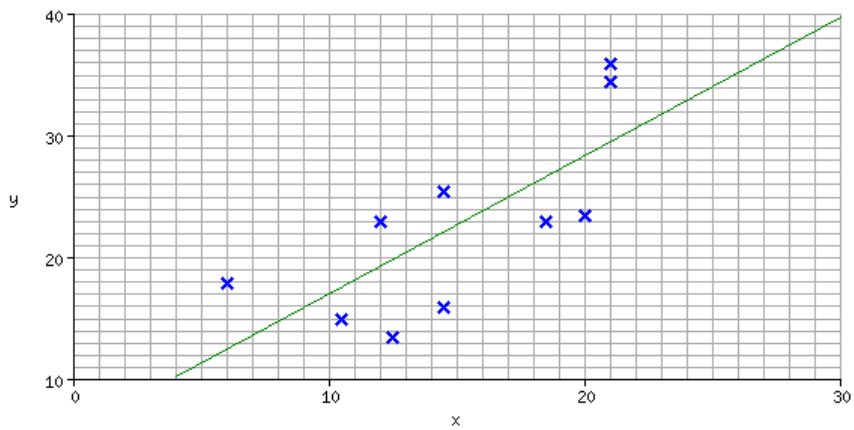
A118 - ID: 4372 *[11 marks, 13 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a) } & \ qquad \ quad S_{xx} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ sum x^2 - \ frac{(\ sum x)^2}{n} \ , = \ , \ displaystyle 558.75 - \ frac{(66.5)^2}{8} \ , = \ , 5.9688 \ qquad \ \ & S_{xy} &=& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 17131.5 - \ frac{66.5 \ times 1941}{8} \ , = \ , 996.9375 \ qquad \ \ & b &=& \ displaystyle \ frac{S_{xy}}{S_{xx}} \ ,= \ , \ frac{996.9375}{5.9688} \ ,= \ , 167 \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & a &=& \ bar{y} - b \ bar{x} \ ,= \ , \ frac{1941}{8} - 167.026 \ frac{66.5}{8} \ , = \ , -1150 \ qquad \ \ & y \ , &=& \ ,-1150+167x & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & x=7 & \ Rightarrow&y = -1150+167(7) = 23.4 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & pH=8 & \ Rightarrow& \ text{yes; r is high} & | \ color{#ff0066}{B1} \ qquad \ \ & pH=4 & \ Rightarrow& \ text{no; extrapolation} & | \ color{#ff0066}{B1} \ end{steps}}

A119 - ID: 5482 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad S_{xx} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ sum x^2 - \ frac{(\ sum x)^2}{n} \ , = \ , \ displaystyle 89.83 - \ frac{(27.5)^2}{10} \ , = \ , 14.205 \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & S_{xy} &=& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 476.7 - \ frac{27.5 \ times 169}{10} \ , = \ , 11.95 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & b &=& \ displaystyle \ frac{S_{xy}}{S_{xx}} \ ,= \ , \ frac{11.95}{14.205} \ ,= \ , 0.841 & | \ color{#ff0066}{M1A1} \ qquad \ \ & a &=& \ displaystyle \ bar{y} - b \ bar{x} \ ,= \ , \ frac{169}{10} - 0.841 \ frac{27.5}{10} \ ,= \ , 14.587 \ qquad \ \ & & \ Rightarrow& y = 14.59+0.84x & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{Comment} &:& \ text{Each extra hour revising produces about 1 more marks} & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(d)} & x = 1.8 & \ Rightarrow&y = 14.59+0.84(1.8) \ , = \ , 16.1 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & \ text{Comment} &:& \ text{Not valid as 10 outside range of x } & | \ color{#ff0066}{B1} \ end{steps}}

A120 - ID: 5932 *[12 marks, 14 minutes]*



\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad \ text{scatter graph}& \ , \ , \ ,: \ , \ ,& \ text{see below} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B2} \ qquad \ \ \ text{(b)} & S_{xx} & \ , \ , \ ,= \ , \ ,& \ displaystyle 2491.25 - \ frac{(150.5)^2}{10} \ , = \ , 226.225 \ qquad \ \ & S_{xy} &=& \ displaystyle 3688 - \ frac{150.5 \ times 228}{10} \ , = \ , 256.6 \ qquad \ \ & b &=& \ displaystyle \ frac{S_{xy}}{S_{xx}} \ ,= \ , \ frac{256.6}{226.225} \ ,= \ , 1.134 & | \ color{#ff0066}{B2} \ qquad \ \ & a &=& \ displaystyle \ bar{y} - b \ bar{x} \ ,= \ , \ frac{228}{10} - 1.134 \ frac{150.5}{10} \ ,= \ , 5.733 & | \ color{#ff0066}{B2} \ qquad \ \ & & \ Rightarrow& y = 5.733+1.134x \ qquad \ \ \ text{(c)} & \ text{regression line}& \ , \ , \ ,: \ , \ ,& \ text{see below} & | \ color{#ff0066}{B2} \ qquad \ \ \ text{(d)} & x = 16.3 & \ Rightarrow&y = 5.733+1.134(16.3) \ , = \ , 24.22 & | \ color{#ff0066}{B2} \ qquad \ \ \ text{(e)} & \ text{estimate} &=& \ text{unreliable because points widely scattered} & | \ color{#ff0066}{B2} \ end{steps}}

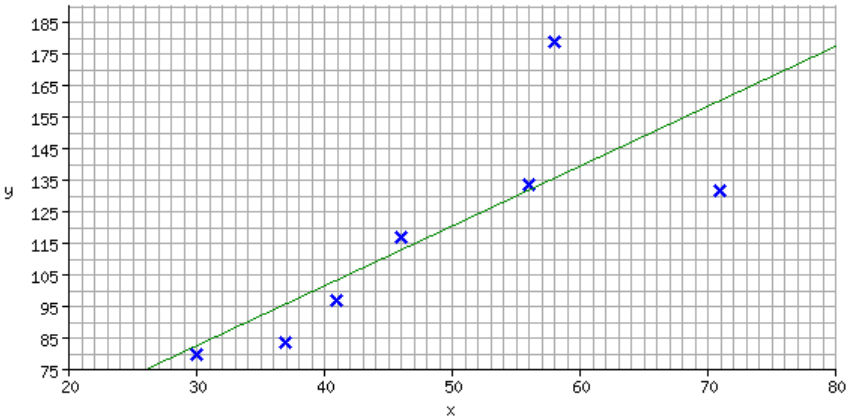
A121 - ID: 6099 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a) } & \ frac{ }{ } \ quad \ text{Reason} & \ , \ , \ ,: \ , \ ,& \ text {x is controlled} \ quad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(b) } & S_{xx} &=& \ displaystyle \ sum x^2 - \ frac {(\ sum x)^2}{n} \ , = \ , \ displaystyle 1320 - \ frac{(96)^2}{8} \ , = \ , 168 \ qquad \ \ & S_{xy} &=& \ displaystyle \ sum xy - \ frac{(\ sum x)(\ sum y) }{n} \ , = \ , \ displaystyle 182 - \ frac{96 \ times 16.2}{8} \ , = \ , -12.4 \ qquad \ \ & b &=& \ displaystyle \ frac{S_{xy}}{S_{xx}} \ ,= \ , \ frac{-12.4} {168} \ ,= \ , -0.0738 & | \ color{#ff0066}{M1A1} \ qquad \ \ & a &=& \ bar{y} - b \ bar{x} \ ,= \ , \ frac {16.2}{8} - -0.0738 \ frac{96}{8} \ , = \ , 2.9 \ qquad \ \ & y \ , &=& \ ,2.9-0.0738x & | \ color {#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & x= 21 & \ Rightarrow&y = 2.9-0.0738(21) \ , = \ , £1.4 \ text {million} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & \ text{comment} &:& \ text{only just outside given data so reliable} & | \ color{#ff0066}{B1} \ end{steps}}

A122 - ID: 5562 *[9 marks, 11 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad b &=& \ displaystyle \ frac{S_{wl}}{S_{ll}} \ ,= \ , \ frac{0.88}{30.324} \ ,= \ , 0.029 \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & a &=& \ displaystyle \ bar{w} - b \ bar{l} \ ,= \ , \ frac{363}{10} - 0.029 \ frac{527.4}{10} & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& 34.771 \ qquad \ \ & & \ Rightarrow& w = 34.77+0.03l & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & l = 58 & \ Rightarrow&w = 34.77+0.03(58) \ , = \ , 36.45 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{Comment} &:& \ text{Unreliable as 58 outside range of l } & | \ color{#ff0066}{B2} \ end{steps}}

A123 - ID: 7110 *[13 marks, 16 minutes]*



\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{scatter diagram} & \ , \ , \ ,= \ , \ ,& \ text{see below} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & S_{tt} & \ , \ , \ ,= \ , \ ,& \ displaystyle \ sum t^2 - \ frac{(\ sum t)^2}{n} \ , = \ , \ displaystyle 17607 - \ frac{(339)^2}{7} \ , = \ , 1189.7143 & | \ color{#ff0066}{M1A1} \ qquad \ \ & S_{tp} &=& \ displaystyle \ sum tp - \ frac{(\ sum t)(\ sum p) }{n} \ , = \ , \ displaystyle 42125 - \ frac{339 \ times 823}{7} \ , = \ , 2268.2857 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & \ qquad \ qquad b &=& \ displaystyle \ frac{S_{tp}}{S_{tt}} \ ,= \ , \ frac{2268.2857}{1189.7143} \ ,= \ , 1.9066 & | \ color{#ff0066}{A1} \ qquad \ \ & a &=& \ displaystyle \ bar{p} - b \ bar{t} \ ,= \ , \ frac{823}{7} - 1.9066 \ frac{339}{7} & | \ color{#ff0066}{A1} \ qquad \ \ & &=& 25.238 \ qquad \ \ & & \ Rightarrow& p = 25.24+1.91t & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & \ text{plot line} & \ , \ , \ ,= \ , \ ,& \ text{see below} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & t = 43 & \ Rightarrow&p = 25.24+1.91(43) \ , = \ , 107.22 & | \ color{#ff0066}{M1A1} \ end{steps}}

A124 - ID: 7936 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad b & \ , \ , \ ,= \ , \ ,& \ displaystyle \ frac{1.309}{5.913} \ , = \ , 0.221 \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & a &=&3.96 - 4.39 \ times 0.221 \ , = \ , 2.988 & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& p = 2.988 + 0.221v & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & x=93 & \ Rightarrow& v = \ displaystyle \ frac{93-3}{20} \ , = \ , 4.5 & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& p = 2.988 + 0.221(4.5) \ , = \ , 3.98 & | \ color{#ff0066}{A1} \ end{steps}}

A125 - ID: 676 *[3 marks, 4 minutes]*

\ displaystyle{ \ begin{steps} & P(8< \ , X \ , \ leq 11) \ , \ , \ ,&=& P(9)+P(10)+P(11) \ quad \ quad \ quad &| \ color{#ff0066}{M1} \ qquad \ \ & &=& 0.2+0.1+0.2 \ qquad \ \ & &=& 0.5 &| \ color{#ff0066}{A1} \ qquad \ \ & F(10) &=& P(7)+P(8)+P(9)+P(10) \ qquad \ \ & &=& 0+0+0.2+0.1 \ qquad \ \ & &=& 0.3&| \ color{#ff0066}{B1} \ end{steps}}

A126 - ID: 682 *[3 marks, 4 minutes]*

\ displaystyle{ \ begin{steps} & \ sum P(X) \ , = \ , 1 \ , \ ,& \ Rightarrow& 0.1+ \ alpha+0.3+0+0.1+0.5=1 \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& \ alpha = 0 &| \ color {#ff0066}{A1} \ end{steps}}

A127 - ID: 3237 *[5 marks, 6 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad F(9) = 1 & \ Rightarrow& \ frac{ }{ } \ displaystyle \ frac{(9+k)^2}{144} = 1 \ qquad \ \ & & \ Rightarrow& (9+k)^2 = 144 \ qquad \ \ & & \ Rightarrow& 9+k = 12 \ , \ Rightarrow \ , k = 3 \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b} & P(X=7) &=&F(7) = \ displaystyle \ frac{100}{144} &| \ color{#ff0066}{A1} \ qquad \ \ & P(X=8) &=&F(8)-F(7) \ , = \ , \ displaystyle \ frac{121}{144} - \ frac{100}{144} \ , = \ , \ displaystyle \ frac{21}{144} \ qquad \ \ & P(X=9) &=&F(9)-F(8) \ , = \ , \ displaystyle \ frac{144}{144} - \ frac{121}{144} \ , = \ , \ displaystyle \ frac{23}{144} \ qquad \ \ & \ qquad \ qquad & \ Rightarrow& \ matrix{x & 7 & 8 & 9 \ cr P(X=x) & \ displaystyle \ frac{100}{144} & \ displaystyle \ frac{21}{144} & \ displaystyle \ frac{23}{144}} &| \ color{#ff0066}{M1A1} \ end{steps}}

A128 - ID: 5980 *[5 marks, 6 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ displaystyle \ sum P(X) = 1 & \ Rightarrow&7c + 12c + 15c + 16c= 1 &| \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& c = \ frac{1}{50} &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & E(X) &=&7c + 24c + 45c + 64c &| \ color{#ff0066}{M1A1} \ qquad \ \ & &=& \ frac{14}{5} &| \ color{#ff0066}{A1} \ end{steps}}

A129 - ID: 5522 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad Var(X) & \ , \ , \ ,= \ , \ ,& E(X^2) - E^2(X) \ , = \ , 8 \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & C= 2 \ pi (X+3) & \ Rightarrow&E(C) = 2 \ pi E(X) + 6 \ pi \ , = \ , 12 \ pi &| \ color{#ff0066}{B2} \ qquad \ \ & & \ Rightarrow& Var(C) = 4 \ pi^2 Var(X) \ , = \ , 32 \ pi^2 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text {(c)} & S &=& \ pi(X+3)^2 \ , = \ , \ pi(X^2 + 6X + 9) &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text {(d)} & E(S) &=& E(\ pi(X^2 + 6X + 9)) \ qquad \ \ & &=& \ pi (E(X^2) + 6E(X) + 9) \ qquad \ \ & &=& 44 \ pi &| \ color{#ff0066}{M1A1} \ end{steps}}

A130 - ID: 3143 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad E(X) &=&1 \ times 0.33+ 2 \ times 0.2211 + 3 \ times 0.1481 + 4 \ times 0.3008 \ qquad \ \ & &=& 2.42 \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & E(X^2) &=&1 \ times 0.33+ 4 \ times 0.2211 + 9 \ times 0.1481+ 16 \ times 0.3008 \ qquad \ \ & &=& 7.36&| \ color{#ff0066}{M1} \ qquad \ \ & Var(X) &=&7.36 - (2.42)^2 \ , = \ , 1.505 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ text{Expected cost} &=&25000 \ times 2.42 \ , = \ , £60492.5 &| \ color{#ff0066}{B1} \ end{steps}}

A131 - ID: 5407 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad P(£5.50) & \ , \ , \ ,= \ , \ ,& P(£5.00, £0.50) + P(£0.50,£5.00) \ qquad \ \ & &=& \ displaystyle 2 \ times \ left(\ frac{1}{10} \ times \ frac{2}{10} \ right) \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{M2} \ qquad \ \ & &=& \ displaystyle \ frac{1}{25} &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & E(\ text{Prize money}) &=&£0.00 \ times \ frac{7}{10} + £0.50 \ times \ frac{2}{10} + £5.00 \ times \ frac{1}{10} \ qquad \ \ & &=& 60p &| \ color{#ff0066}{M1A1} \ qquad \ \ & \ text{charge} &=&60 + 50 \ , = \ , 110p &| \ color{#ff0066}{M1A1} \ end{steps}}

A132 - ID: 5455 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad \ sum P(X) \ , = \ , 1 & \ Rightarrow& 0.2+0.46+p+q=1 \ qquad \ \ & & \ Rightarrow& p+q= 0.34 \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & E(X) = 1.33 & \ Rightarrow& 0 + 0.46 + 2p + 3q =1.33 \ qquad \ \ & & \ Rightarrow& 2p + 3q =0.87 &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & p = 0.34-q & \ Rightarrow&2(0.34-q) + 3q =0.87 \ qquad \ \ & & \ Rightarrow& q = 0.19 \ qquad \ \ && \ Rightarrow& p = 0.15 &| \ color{#ff0066}{B2} \ qquad \ \ \ text{(d)} & E(X^2) &=&0+0.46+0.6+1.71 \ qquad \ \ & &=& 2.77&| \ color{#ff0066}{M1} \ qquad \ \ & Var(X) &=&2.77 - (1.33)^2 \ , = \ , 1.001 &| \ color{#ff0066}{M1A1} \ end{steps}}

A133 - ID: 6195 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ text{Distribution} & \ , \ , \ ,= \ , \ ,& \ bbox[border:2px #A2170C solid,1pt] { \ bbox[#FEFFD3,0pt] { \ color{#800000}{ \ matrix{X & 4 & 7 & 10 & 12 & 13 & 15 & 16 & 18 & 20 \ cr P & \ frac{1}{36} & \ frac{2}{36} & \ frac{5}{36} & \ frac{4}{36} & \ frac{4}{36} & \ frac{4}{36} & \ frac{4}{36} & \ frac{8}{36} & \ frac{4}{36} }}}} \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B3} \ qquad \ \ \ text{(b)} & E(X) &=& \ sum px \ qquad \ \ & &=& \ frac{1}{36} \ times 4 + \ frac{2}{36} \ times 7 +... + \ frac{4}{36} \ times 20 \ , = \ , \ frac{43}{3} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(X > E(X)) &=&P(X=15)+P(X=16)+P(X=18)+P(X=20) \ qquad \ \ & &=& \ frac{5}{9} &| \ color{#ff0066}{M1A1} \ end{steps}}

A134 - ID: 5499 *[16 marks, 19 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ text{ } \ qquad \ qquad E(X) & \ , \ , \ ,= \ , \ ,& 0 \ times 0.4 + 1 \ times 0.1 + 2 \ times 0.4 + 3 \ times 0.1 \ , = \ , 1.2 \ qquad \ qquad \ qquad & | \ color {#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & F(1.5) &=&P(X \ leq 1.5) \ , = \ , 0.4 + 0.1 \ , = \ , 0.5 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & E(X^2) &=& 0^2 \ times 0.4 + 1^2 \ times 0.1 + 2^2 \ times 0.4 + 3^2 \ times 0.1 \ , = \ , 2.6 & | \ color{#ff0066}{M1A1} \ qquad \ \ & Var(X) &=&E (X^2) - E^2(X) \ , = \ , 2.6 - 1.2^2 \ , = \ , 1.16 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & Var (8 – 2X) &=& 4Var(X) \ , = \ , 4.64 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & P(S \ geq 4) &=& P(1,3)+P(3,1)+P(2,2)+P(2,3)+P(3,2)+P(3,3) & | \ color{#ff0066}{B3} \ qquad \ \ & &=& 2(0.1 \ times 0.1) + 0.4^2+2(0.4 \ times 0.1) + 0.1^2 & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& 0.27& | \ color{#ff0066}{A1} \ end{steps}}

A135 - ID: 494 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ sum P = 1 & \ Rightarrow&8 k + 9 k+10 k+11 k+12 k = 1 \ quad \ quad \ quad \ quad \ quad \ quad \ quad & | \ color{#ff0066}{M1A1} \ qquad \ \ && \ Rightarrow& 50 k = 1 \ qquad \ \ && \ Rightarrow& k = \ frac{1}{50 }& | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & E(X) &=& \ sum X.P(X) \ qquad \ \ &&=& \ frac{1}{50 }(8 \ times 8 +9 \ times 9 + 10 \ times 10 + 11 \ times 11 + 12 \ times 12) & | \ color{#ff0066}{M1A1} \ qquad \ \ &&=& \ frac{1}{50 }(64 + 81 +100 +121 +144) \ , = \ ,10.2 & | \ color{#ff0066}{A1} \ qquad \ \ && \ Rightarrow& E(3X+3)= 3 \ times 10.2+3 & | \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& E (3X+3) \ , = \ , 33.6 & | \ color{#ff0066}{A1} \ end{steps}}

A136 - ID: 758 *[4 marks, 5 minutes]*

\ displaystyle{ \ begin{steps} & E(9X+3) \ , \ , \ ,&=&9E(X)+ 3 \ qquad \ \ & &=&9 \ sum x.p + 3 \ qquad \ \ & &=&9(12 \ times0.1 + 13 \ times0.2 + ... + 17 \ times0.3) + 3 \ qquad \ qquad & | \ color{#ff0066} {M1A2} \ qquad \ \ & &=&138 & | \ color{#ff0066}{A1} \ end{steps}}

A137 - ID: 834 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & P(4< \ , X \ , \ leq 7) \ , \ , \ ,&=& P(5)+P(6)+P(7) \ qquad \ qquad \ quad & | \ color{#ff0066}{M1} \ qquad \ \ &&=& 0.2+0+0.1 \ qquad \ \ &&=& 0.3& | \ color {#ff0066}{A1} \ qquad \ \ \ text{(b)} & F(6) &=& P(3)+P(4)+P(5)+P(6) \ qquad \ \ \ qquad \ \ &&=& 0+0.3+0.2+0 \ qquad \ \ &&=& 0.5& | \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & E(X) &=&3 \ times0 + 4 \ times0.3 + ... + 8 \ times0.4& | \ color{#ff0066}{M1} \ qquad \ \ &&=&6.1& | \ color {#ff0066}{A1} \ qquad \ \ && \ Rightarrow& E(12X+11) \ , = \ ,12 \ times 6.1+11 & | \ color{#ff0066} {M1} \ qquad \ \ && \ Rightarrow& E(12X+11) \ , = \ ,84.2 & | \ color{#ff0066}{A1} \ end{steps}}

A138 - ID: 460 *[12 marks, 14 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ text{function} &=& \ matrix{x &2 &3 &4 &5 & 6& 7 & 8 &9 \ cr P &0 &0 &0.2 & 0.1&0.2 & 0.3& 0 & 0.2} &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)} & E(X) &=& \ sum x.P(X) = 2 \ times 0+...+9 \ times 0.2 \ ,= \ , 6.4&| \ color{#ff0066}{M1A1} \ qquad \ \ & E(X^2) &=& \ sum x^2.P(X) = 4 \ times 0+...+81 \ times 0.2 \ ,= \ , 43.8&| \ color{#ff0066}{M1A1} \ qquad \ \ & Var(X) &=&E(x^2)-E(x)^2 = 2.84&| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & E(Y) &=&7E(X)+5 = 49.8&| \ color{#ff0066}{B1} \ qquad \ \ & Var(Y) &=&49 Var(X) = 139.16 &| \ color{#ff0066}{M1A1} \ end{steps}}

A139 - ID: 597 *[15 marks, 18 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ sum P(X) \ , = \ , 1 & \ Rightarrow& \ alpha+0.2+0+0.2+0.1+ \ beta=1 \ quad \ qquad &| \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& \ alpha+ \ beta= 0.5 &| \ color{#ff0066}{A1} \ qquad \ \ & E(X) = 1.2 & \ Rightarrow& -2 \ alpha + -0.2 + 0 + 0.2 + 0.2 + 3 \ beta=1.2 &| \ color{#ff0066}{M1A1} \ qquad \ \ && \ Rightarrow& -2 \ alpha + 0.2 + 3 \ beta=1.2 \ qquad \ \ \ qquad \ \ && \ Rightarrow& -2(0.5 - \ beta) + 0.2 + 3 \ beta=1.2 &| \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& -1 + 0.2 + 5 \ beta=1.2 \ qquad \ \ \ qquad \ \ && \ Rightarrow& 5 \ beta=2 \ , \ Rightarrow \ , \ beta = 0.4, \ quad \ alpha = 0.1 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & F(0.8) &=&0.3 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & Var(X) &=&E(X^2) - E(X)^2 \ , = \ , 4.8 - (1.2)^2 \ , = \ , 3.36 &| \ color{#ff0066}{M2A2} \ qquad \ \ \ text{(d)} & E(2X-4) &=&2E(X) - 4 \ , = \ , -1.6&| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)}& Var(3X+4) &=&9Var(X) \ quad \ , = \ , 30.24&| \ color{#ff0066}{M1A1} \ end{steps}}

A140 - ID: 760 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & E(X)= 2.5 & \ Rightarrow&2 \ times \ frac{1}{2}+ 3 \ times a + 4 \ times (\ frac{1}{2}-a) = 2.5 \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ && \ Rightarrow& a= 0.5 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & E(X^2) &=&2^2 \ times \ frac{1}{2}+ 3^2 \ times a + 4^2 \ times (\ frac{1}{2}-a) &| \ color{#ff0066}{M1} \ qquad \ \ &&=&6.5 \ qquad \ \ && \ Rightarrow& Var(X) = 6.5- (2.5)^2 &| \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& Var(X) = 0.25 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & P(X \ le 3.5)&=& \ text{P(2)+P(3)} \ qquad \ \ &&=& \ frac{1}{2} + 0.5 \ , = \ , 1 &| \ color{#ff0066}{A1} \ end{steps}}

A141 - ID: 897 *[9 marks, 11 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ sum P = 1 & \ Rightarrow&4 k + 3 k+ ... + 0 + k = 1 \ quad \ quad \ quad \ qquad \ quad \ quad & | \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& 11 k = 1 \ , \ Rightarrow \ , k = 0.091 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & E(X) &=& \ sum X.P(X) \ qquad \ \ &&=& 0.4k+1.3k+...+4.0.k+5.1.k & | \ color{#ff0066}{M1} \ qquad \ \ &&=& 15k \ , = \ ,1.365 & | \ color{#ff0066}{A1} \ qquad \ \ & E(X^2) &=& \ sum X^2.P(X) \ qquad \ \ &&=& 0^2 . 4k+1^2 . 3k+...+4^2 . 0.k+5^2 . 1.k & | \ color{#ff0066}{M1} \ qquad \ \ &&=& 45k \ , = \ ,4.095 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & Var(4X-4) &=& 16Var(X) & | \ color{#ff0066}{M1} \ qquad \ \ &&=& 16(E(X^2)-E^2 (X)) \ qquad \ \ &&=& 16(4.095 - 1.365^2) \ , = \ , 35.708 & | \ color{#ff0066}{M1A1} \ end{steps}}

A142 - ID: 563 *[11 marks, 13 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ sum P = 1 & \ Rightarrow&k(5^2-16) + k(6^2-16) + k(7^2-16) = 1 \ quad \ quad & | \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& k(9 + 20 + 33) = 1 \ , \ Rightarrow \ , k(62) = 1 \ quad \ qquad \ \ && \ Rightarrow& k = \ frac{1}{62 } & | \ color{#ff0066}{M1} \ qquad \ \ \ text{(b)} & E(X) &=& \ sum X.P(X) \ qquad \ \ &&=& 5 k(5^2-16) + 6 k(6^2-16) + 7 k(7^2-16) & | \ color{#ff0066}{M1} \ qquad \ \ &&=& k(45 + 120 + 231) \ , = \ , \ frac{396}{62} \ , = \ , \ frac{198}{31} & | \ color{#ff0066}{M1A1} \ qquad \ \ & E(X^2) &=& \ sum X^2.P(X) \ qquad \ \ &&=& 25 k(5^2-16) + 36 k(6^2-16) + 49 k(7^2-16) & | \ color{#ff0066}{M1} \ qquad \ \ &&=& k(225 + 720 + 1617) \ qquad \ \ &&=& \ frac{2562}{62} \ , = \ , \ frac{1281}{31} & | \ color{#ff0066}{A1} \ qquad \ \ & Var(X) &=& \ frac{1281}{31} - \ left(\ frac{198}{31} \ right)^2 \ , = \ , \ frac{507}{961} & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & Var(4X-3) &=&16 Var(X) \ , = \ , \ frac{8112}{961} & | \ color{#ff0066}{M1A1} \ end{steps}}

A143 - ID: 423 *[13 marks, 16 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ sum P(X) \ , = \ , 1 & \ Rightarrow& 0+0.2+b+a=1 \ quad \ qquad &| \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& b+a= 0.8 &| \ color{#ff0066}{A1} \ qquad \ \ & E(X) = 3.4 & \ Rightarrow& 0 + 0.4 + 3b + 4a =3.4 &| \ color{#ff0066}{M1A1} \ qquad \ \ && \ Rightarrow& 3b + 4a = 3 \ quad \ qquad \ \ && \ Rightarrow& 3(0.8 - a) + 4a = 3 \ qquad \ \ && \ Rightarrow& 2.4 + a = 3 \ qquad \ \ && \ Rightarrow& a = 0.6, \ quad b = 0.2 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & P(1 < X < 2.5) &=&0.2 &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(c)} & E(5X-3) &=&5E(X) - 3 \ , = \ , 14 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & Var(X) &=&12.2 - (3.4)^2 \ , = \ , 0.64 &| \ color{#ff0066}{M2A1} \ qquad \ \ \ text{(e)} & Var(5X-3) &=&25Var(X) \ , = \ , 16 &| \ color{#ff0066}{M1A1} \ end{steps}}

A144 - ID: 631 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ sum P = 1 & \ Rightarrow&k(4) + k(5) + k(6) + k(9) + k(10) = 1 \ quad \ quad &| \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& k(34) = 1 \ quad \ qquad \ \ && \ Rightarrow& k = \ frac{1}{34 } &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & E(X) &=& \ sum X.P(X) \ qquad \ \ &&=& k(16) + k(25) + k(36) + k(63) + k(80) \ qquad \ \ &&=& \ frac{220}{34} \ , = \ , \ frac{110}{17} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & E(X^2) &=& \ sum X^2.P(X) \ qquad \ \ &&=& k(64) + k(125) + k(216) + k(441) + k(640) &| \ color{#ff0066}{M1} \ qquad \ \ &&=& \ frac{1486}{34} \ , = \ , \ frac{743}{17} &| \ color{#ff0066}{A1} \ qquad \ \ & Var(X) &=& \ frac{743}{17} - \ left(\ frac{110}{17} \ right)^2 \ , = \ , 1.84 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & Var(4-2X) &=&4 Var(X) \ , = \ , 7.3 &| \ color{#ff0066}{M1A1} \ end{steps}}

A145 - ID: 5520 *[9 marks, 11 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ text{range} & \ , \ , \ ,= \ , \ ,& 0 \ leq \ theta \ leq 0.6 \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B2} \ qquad \ \ \ text{(b)} & E(X) = 6 & \ Rightarrow& 4 \ times 0.2 + 5 \ times 0.2 +6 \ theta + 7(0.6- \ theta) =6 &| \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& 1.8 +6 \ theta + 4.2-7 \ theta =6 \ qquad \ \ & & \ Rightarrow& 6 - \ theta =6 \ qquad \ \ & & \ Rightarrow& \ theta = 0 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & E(X^3) &=&4^3 \ times 0.2 + 5^3 \ times 0.2 +6^3 \ times 0 + 7^3 \ times 0.6 &| \ color{#ff0066}{B1} \ qquad \ \ & &=& 12.8 + 25 +0 + 205.8 \ qquad \ \ & &=& 243.6 &| \ color{#ff0066}{M1A1} \ end{steps}}

A146 - ID: 880 *[12 marks, 14 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ sum P(X) \ , = \ , 1 & \ Rightarrow& 0.2+p+0.2+q+0.35=1 \ quad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ & E(X) = 4.45 & \ Rightarrow& 0.4 + 3p + 0.8 + 5q + 2.1=4.45 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & 0.75+p+q=1 & \ Rightarrow&p = 0.25-q \ qquad \ \ && \ Rightarrow& 3.3 + 3(0.25-q) + 5q =4.45 &| \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& 2q =0.4 \ , \ Rightarrow \ , q = 0.2, \ quad p = 0.05 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & E(X^2) &=&0.8 + 0.45 + 3.2 + 5 + 12.6=22.05 &| \ color{#ff0066}{M1A1} \ qquad \ \ & Var(X) &=&22.05 - (4.45)^2 \ , = \ , 2.247 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & Var(5-3X) &=&9Var(X) \ , = \ , 20.227 &| \ color{#ff0066}{M1A1} \ end{steps}}

A147 - ID: 2319 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ sum P = 1 & \ Rightarrow&2 k + 3 k+4 k+5 k+6 k = 1 \ quad \ quad \ quad \ quad \ quad \ quad \ quad &| \ color{#ff0066}{M1A1} \ qquad \ \ && \ Rightarrow& 20 k = 1 \ qquad \ \ && \ Rightarrow& k = \ displaystyle \ frac{1}{20 }&| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & E(X) &=& \ sum X.P(X) \ qquad \ \ &&=& \ displaystyle \ frac{1}{20 }(0 \ times 2 +1 \ times 3 + 2 \ times 4 + 3 \ times 5 + 4 \ times 6) &| \ color{#ff0066}{M1A1} \ qquad \ \ &&=& \ displaystyle \ frac{1}{20 }(0 + 3 +8 +15 +24) \ , = \ ,2.5 &| \ color{#ff0066}{A1} \ end{steps}}

A148 - ID: 4571 *[9 marks, 11 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ sum P(X) \ , = \ , 1 & \ Rightarrow& \ frac{1}{5} + \ frac{1}{3} +p + q =1 \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ & E(X) = 2 \ frac{2}{4} & \ Rightarrow& 1 \ times \ frac{1}{5} + 2 \ times \ frac{1}{3} +3p + 4q =2 \ frac{2}{4} &| \ color{#ff0066}{B1} \ qquad \ \ & & \ Rightarrow& p + q = \ frac{7}{15} \ qquad \ \ & & \ Rightarrow& 3p + 4q = \ frac{98}{60} \ qquad \ \ & & \ Rightarrow& q = \ frac{98}{60} - \ frac{21}{15} \ , = \ , \ frac{7}{30} &| \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& p = \ frac{7}{15} - \ frac{7}{30} \ , = \ , \ frac{7}{30} &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ sum x^2p &=&1 \ times \ frac{1}{5} + 4 \ times \ frac{1}{3} +9 \ times \ frac{7}{30} + 16 \ times \ frac{7}{30} &| \ color{#ff0066}{M1} \ qquad \ \ & &=& \ frac{221}{30} &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{standard deviation} &=& \ sqrt{E(X^2) - E^2(X)} \ qquad \ \ & &=& \ sqrt{ \ frac{221}{30} - (2 \ frac{2}{4})^2} \ , = \ , 1.06 &| \ color{#ff0066}{M1A1} \ end{steps}}

A149 - ID: 687 *[13 marks, 16 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad \ text{distribution} &=& \ matrix{x & 1 & 2 & 3 & 4 & 5 & 6 \ cr P(X=x) & \ frac{3}{93} & \ frac{8}{93} & \ frac{13}{93} & \ frac{18}{93} & \ frac{23}{93} & \ frac{28}{93} } \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)} & P(2 < X \ le 5) &=& \ displaystyle \ frac{54}{93} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & E(X) &=& \ sum X \ cdot P(X) \ , = \ , \ displaystyle \ frac{3+16+39+72+115+168}{93} \ , = \ , \ frac{413}{93} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & E(X^2) &=& \ sum X^2 \ cdot P(X) \ , = \ , \ displaystyle \ frac{3+32+117+288+575+1008}{93} \ qquad \ \ & &=& \ displaystyle \ frac{2023}{93} & | \ color{#ff0066}{M1A1} \ qquad \ \ & Var(X) &=&E(X^2)-E(X)^2 \ , = \ , \ frac{2023}{93}- \ frac{170569}{8649} \ , = \ , 2.03 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & Var(5-3X) &=&9Var(X) \ , = \ , 18.27 & | \ color{#ff0066}{M1A1} \ end{steps}}

A150 - ID: 5536 *[14 marks, 17 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad \ text{table} & \ , \ , \ ,= \ , \ ,& \ bbox[border:2px #A2170C solid,1pt] { \ bbox[#FEFFD3,0pt] { \ color{#800000} { \ matrix{x : & 0 & 1 & 2 & 3 & 4 \ cr f(x) : & 0k & 1k & 4k & 9k & 16k}}}} \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & \ sum f(x) = 1 & \ Rightarrow&(0+ 1 + 4+ 9+ 16)k = 1 \ qquad \ \ & & \ Rightarrow& k = \ frac{1}{30} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & E(X) &=&(0+ 1 + 8+ 27+ 64)k \ qquad \ \ & &=& 3.33 & | \ color{#ff0066}{M1A1} \ qquad \ \ & E(X^2) &=&(0+ 1 + 16+ 81+ 256)k \ qquad \ \ & &=& 11.8 & | \ color{#ff0066}{M1A1} \ qquad \ \ & Var(X) &=& E(X^2) - E^2(X) \ , = \ , 0.69 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & E(6X-8) &=&6E(X) - 8 \ , = \ , 12 & | \ color{#ff0066}{M1A1} \ qquad \ \ & Var(6X-8) &=&36Var(X) \ , = \ , 24.8 & | \ color{#ff0066}{M1A1} \ end{steps}}

A151 - ID: 2479 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ sum P(X) \ , = \ , 1 & \ Rightarrow& \ frac{k}{3} + \ frac{3k}{2} + \ frac{k}{2} + \ frac{k}{6} =1 \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ & & \ Rightarrow& 2k + 9k + 3k + k =6 \ qquad \ \ & & \ Rightarrow& 15k =6 \ , \ Rightarrow \ , k = 0.4 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & E(X) &=&4 \ frac{k}{3}+ 5 \ frac{3k}{2} + 6 \ frac{k}{2} + 7 \ frac{k}{6} \ , = \ , 5.2& | \ color{#ff0066}{M1A1} \ qquad \ \ & E(X^2) &=&16 \ frac{k}{3}+ 25 \ frac{3k}{2} + 36 \ frac{k}{2} + 49 \ frac{k}{6} \ , = \ , 44.667& | \ color{#ff0066}{M1A1} \ qquad \ \ & Var(X) &=&44.667 - (5.2)^2 \ , = \ , 17.627 & | \ color{#ff0066}{M1A1} \ end{steps}}

A152 - ID: 3150 *[13 marks, 16 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ sum P(X) \ , = \ , 1 & \ Rightarrow& 0+p+0.4+q+0.2=1 \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ & E(X) = 10.8 & \ Rightarrow& 0 + 8p + 4 + 12q + 2.8=10.8 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & 0.6+p+q=1 & \ Rightarrow&p = 0.4-q \ qquad \ \ && \ Rightarrow& 6.8 + 8(0.4-q) + 12q =10.8 & | \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& 4q =0.8 \ , \ Rightarrow \ , q = 0.2, \ quad p = 0.2 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(9 < X \ leq 12) &=&P(10) + P(12) \ , = \ , 0.6 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & Var(X) &=&120.8 - (10.8)^2 \ , = \ , 4.16 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & E(56-5X) &=&56-5E(X) \ , = \ , 2 & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(f)} & Var(56-5X) &=&25Var(X) \ , = \ , 104 & | \ color{#ff0066}{M1A1} \ end{steps}}

A153 - ID: 4373 *[5 marks, 6 minutes]*

\ displaystyle{ \ begin{steps} & \ qquad \ qquad E(X) &=& \ sum x P(X=x) \ qquad \ \ & &=& 0 \ cdot 0.1 + 1 \ cdot 0.2+2 \ cdot 0.2 + 3 \ cdot 0.5 \ , = \ , 2.1 \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & E(X^2) &=&0^2 \ cdot 0.1 + 1^2 \ cdot 0.2+2^2 \ cdot 0.2 + 3^2 \ cdot 0.5 \ qquad \ \ & &=& 0+0.2+0.8+4.5 \ , = \ , 5.5& | \ color{#ff0066}{M1} \ qquad \ \ & Var(X) &=&5.5 - (2.1)^2 \ , = \ , 1.09 & | \ color{#ff0066}{M1A1} \ end{steps}}

A154 - ID: 4566 *[4 marks, 5 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & P(X = 2) & \ , \ , \ ,= \ , \ ,&1- \ frac{3}{16} - \ frac{2}{8} - \ frac{4}{8} \ , = \ , \ frac{1}{16} \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & E(X) &=& \ sum x P(X=x) \ qquad \ \ & &=& 2 \ cdot \ frac{1}{16} + 3 \ cdot \ frac{3}{16} +4 \ cdot \ frac{2}{8} + 5 \ cdot \ frac{4}{8} \ qquad \ \ & &=& \ frac{2}{16} + \ frac{9}{16} + \ frac{8}{8} + \ frac{20}{8} \ qquad \ \ & &=& \ frac{67}{16} & | \ color{#ff0066}{M1A1} \ end{steps}}

A155 - ID: 3210 *[11 marks, 13 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ sum P(X) \ , = \ , 1 & \ Rightarrow& p+ q +0.2+0.15+0.55=1 \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ & E(X) = 4.15 & \ Rightarrow& 1p + 2q + 0.6 + 0.6 + 2.75=4.15 & | \ color{#ff0066}{M1} \ qquad \ \ & 0.9+p+q=1 & \ Rightarrow&p = 0.1-q \ qquad \ \ && \ Rightarrow& 3.95 + 1(0.1-q) + 2q =4.15 & | \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& q = 0.1, \ quad p = 0 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & E(X^2) &=&0+0.4+1.8+2.4+13.75 \ qquad \ \ & &=& 18.35& | \ color{#ff0066}{M1A1} \ qquad \ \ & Var(X) &=&18.35 - (4.15)^2 \ , = \ , 1.127 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & E(7X-5) &=&7E(X)-5 \ , = \ , 24.05 & | \ color{#ff0066}{M1A1} \ end{steps}}

A156 - ID: 4370 *[11 marks, 13 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad E(Y) &=& \ sum y P(Y=y) \ qquad \ \ & &=& 0.3 \ cdot 1 + 0.1 \ cdot 2 + 0.6 \ cdot 3 \ , = \ , 2.3 \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ & E(Y^2) &=&0.3+0.4+5.4 \ , = \ , 6.1& | \ color{#ff0066}{M1} \ qquad \ \ & Var(X) &=&6.1 - (2.3)^2 \ , = \ , 0.81 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(Y+Z = 3) &=&P(1,2)+P(2,1) \ qquad \ \ & &=& 0.3 \ cdot 0.15 + 0.1 \ cdot 0.1 & | \ color{#ff0066}{M2} \ qquad \ \ & &=& 0.055 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & P(Y \ times Z \ text{ even}) &=&P(1,2)+P(2,1) +P(2,2)+P(2,3)+P(3,2) \ qquad \ \ & &=& 0.3 \ cdot 0.15 + 0.1 \ cdot 0.1 + 0.1 \ cdot 0.15 + 0.1 \ cdot 0.75 + 0.6 \ cdot 0.15& | \ color{#ff0066}{M2} \ qquad \ \ & &=& 0.235& | \ color{#ff0066}{A1} \ end{steps}}

A157 - ID: 5376 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ sum P(X=x) = 1 & \ Rightarrow&(10 + 11 + 12)k = 1 \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& k = \ displaystyle \ frac{1}{33} & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & E(X) &=& \ displaystyle 1 \ times \ frac{10}{33} + 2 \ times \ frac{11}{33} + 3 \ times \ frac{12}{33} & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& \ displaystyle \ frac{68}{33} & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} &E \ left(\ frac{1}{X} \ right) &=& \ displaystyle \ frac{1}{1} \ times \ frac{10}{33} + \ frac{1}{2} \ times \ frac{11}{33} + \ frac{1}{3} \ times \ frac{12}{33} & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& 0.591 & | \ color{#ff0066}{A1} \ end{steps}}

A158 - ID: 5470 *[12 marks, 14 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad \ text{range} & \ , \ , \ ,= \ , \ ,& 0 \ leq \ theta \ leq \ frac{2}{6} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & E(X) = 2.1 & \ Rightarrow&1 \ times \ theta + 2 \ times 2 \ theta + 3 \ times (2-6 \ theta) = 2.1 & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& -13 \ theta = -3.9 \ qquad \ \ & & \ Rightarrow& \ theta = 0.3 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & E(X^2) &=&1 \ times \ theta + 4 \ times 2 \ theta + 9 \ times (2-6 \ theta) \ qquad \ \ & &=& 4.5 & | \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& Var(X) = E(X^2) - E^2(X) \ qquad \ \ & &=& 4.5 - 2.1^2 \ , = \ , 0.09 & | \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& sd = 0.3 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(d)} & E \ left(\ frac{1}{x} \ right) &=& \ frac{1}{1} \ times \ theta + \ frac{1}{2} \ times 2 \ theta + \ frac{1}{3} \ times (2-6 \ theta) & | \ color{#ff0066}{M1} \ qquad \ \ & &=& 0.667& | \ color{#ff0066}{A1} \ end{steps}}

A159 - ID: 5558 *[15 marks, 18 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad \ qquad P(X= 3) & \ , \ , \ ,= \ , \ ,& a \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & \ sum P(x=x) = 1 & \ Rightarrow&6a + b = 1 \ qquad \ \ & E(X) = 1.9 & \ Rightarrow&10a + 4b = 1.9 & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& 14a = 2.1 \ qquad \ \ & & \ Rightarrow& a = 0.15 & | \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& b = 0.1 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(1.5 < X < 4) &=&3a \ , = \ , 0.45 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & E(2X-3) &=&2E(X) - 3 \ , = \ , 0.8& | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & E(X^2) &=&20a + 16b & | \ color{#ff0066}{M1} \ qquad \ \ & &=& 4.6 & | \ color{#ff0066}{A1} \ qquad \ \ & & \ Rightarrow& Var(X) = E(X^2) - E^2(X) \ qquad \ \ & &=& 4.6 - 1.9^2 \ , = \ , 0.99 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(f)} & Var(2X-3) &=&4Var(X) \ , = \ , 3.96 &| \ color{#ff0066}{M1A1} \ end{steps}}

A160 - ID: 7107 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ sum P(X=x) = 1 & \ Rightarrow&(9 + 16 + 25)k = 1 \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& k = \ displaystyle \ frac{1}{50} & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & P(X \ geq 4) &=&(16 + 25)k \ , = \ , \ frac{41}{50} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & E(X) &=& \ displaystyle \ sum xP(x) \ , = \ , (27 + 64 + 125)k \ , = \ , \ frac{216}{50} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & E(X^2) &=& \ displaystyle \ sum x^2P(x) \ , = \ , (81 + 256 + 625)k \ , = \ , \ frac{962}{50} & | \ color{#ff0066}{M1A1} \ qquad \ \ & Var(9-X) &=&Var(X) \ , = \ , E(X^2) - E^2(X) \ qquad \ \ & &=& \ frac{962}{50} - \ left(\ frac{216}{50} \ right)^2 \ , = \ , 0.578 & | \ color{#ff0066}{M1A1} \ end{steps}}

A161 - ID: 7938 *[14 marks, 17 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ qquad k + 2k +4k + 6k = 1 & \ Rightarrow&13k=1 \ , \ Rightarrow k = \ frac{1}{13} \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & E(X) &=& \ sum x P(X=x) \ qquad \ \ & &=& 1 \ cdot k + 2 \ cdot 2k +3 \ cdot 4k + 4 \ cdot 6k \ qquad \ \ & &=& 41k \ , = \ , \ frac{41}{13} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & E(X^2) &=& \ sum x^2 P(X=x) \ qquad \ \ & &=& 1^2 \ cdot k + 2^2 \ cdot 2k +3^2 \ cdot 4k + 4^2 \ cdot 6k \ qquad \ \ & &=& 141k \ , = \ , \ frac{141}{13} &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & Var(X) &=& E(X^2)-E^2(X) \ , = \ , 10.846 - 9.947 \ , = \ , 0.899 &| \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& Var(3-4X) = 16Var(X) \ , = \ , 14.391 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(e)} & P(X_1 + X_2 = 4) &=&P(1,3)+P(2,2)+P(3,1) \ qquad \ \ & &=& 2 \ times k \ times 4k + 2k \ times 2k \ , = \ , 12k^2 \ , = \ , 0.07 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(f)} & P(X_1 + X_2 = 8) &=&6k \ times 6k \ , = \ , 0.21 &| \ color{#ff0066}{B1} \ qquad \ \ & P(X_1 + X_2 = 5) &=&1 - 0.01 - 0.02 - 0.07 - 0.24 - 0.28 - 0.21 \ , = 0.17 &| \ color{#ff0066}{B1} \ qquad \ \ \ text{(g)} & P(1.5 < X_1 + X_2 \ leq 3.5) &=&P(2) + P(3) \ , = \ , 0.03 &| \ color{#ff0066}{M1A1} \ end{steps}}

A162 - ID: 756 *[3 marks, 4 minutes]*

\ displaystyle{ \ begin{steps} & P(Y<83) &=& \ displaystyle \ Phi \ left(\ frac{x - \ mu}{ \ sigma} \ right) \ , = \ , \ displaystyle \ Phi \ left(\ frac{83-99}{10} \ right) \ qquad \ qquad &| \ color{#ff0066}{M1} \ qquad \ \ &&=& \ displaystyle \ Phi \ left(-1.6 \ right) \ qquad \ \ &&=& 0.0548 &| \ color{#ff0066}{M1A1} \ end{steps}}

A163 - ID: 928 *[5 marks, 6 minutes]*

\ displaystyle{ \ begin{steps} & P(91 - k \ leq Y \ leq 91 + k) = 0.946 & \ Rightarrow&P(91 \ leq Y \ leq 91 + k) = 0.473 \ qquad \ \ && \ Rightarrow& P(Y \ leq 91 + k) = 0.5 + 0.473 \ qquad \ \ && \ Rightarrow& P(Y \ leq 91 + k) = 0.973 &| \ color{#ff0066}{B1} \ qquad \ \ && \ Rightarrow& \ displaystyle \ frac{91 + k - 91}{11} = \ Phi^{-1}(0.973) &| \ color{#ff0066}{B1M1} \ qquad \ \ && \ Rightarrow& \ displaystyle \ frac{k}{11} = 1.927 &| \ color{#ff0066}{B1} \ qquad \ \ && \ Rightarrow& k = 21.197 &| \ color{#ff0066}{A1} \ end{steps}}

A164 - ID: 3149 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ qquad P(X > 33) & \ , \ , \ ,= \ , \ ,&1 - P(X < 33) \ , = \ , 1 - \ Phi \ left(\ displaystyle \ frac{33-25}{5} \ right) \ qquad &| \ color{#ff0066}{B1} \ qquad \ \ & & =& 1 - 0.9452 \ , = \ , 0.0548&| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(25 < X < d) = 0.3762 & \ Rightarrow&P(X < d) = 0.8762 &| \ color{#ff0066}{B1} \ qquad \ \ & & \ Rightarrow& \ Phi \ left(\ displaystyle \ frac{d-25}{5} \ right) = 0.8762 \ qquad \ \ & & \ Rightarrow& \ displaystyle \ frac{d-25}{5}= 1.156 &| \ color{#ff0066}{B1} \ qquad \ \ & & \ Rightarrow& d = 30.78 &| \ color{#ff0066}{M1A1} \ end{steps}}

A165 - ID: 3578 *[5 marks, 6 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ text{standard deviation} & \ , \ , \ ,= \ , \ ,& \ sqrt {36} \ , = \ , 6 \ qquad &| \ color{#ff0066}{A1} \ qquad \ \ & \ text{value} &=&106 + (1.03 \ times 6) &| \ color{#ff0066}{M1} \ qquad \ \ & &=& 112.18 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{value} &=&106 - (1.03 \ times 6) &| \ color{#ff0066}{M1} \ qquad \ \ & &=& 99.82 &| \ color {#ff0066}{A1} \ end{steps}}

A166 - ID: 5480 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad \ qquad \ qquad P(X < 40) & \ , \ , \ ,= \ , \ ,& \ Phi \ left(\ displaystyle \ frac{40-36}{8} \ right) \ , = \ , 0.6915 \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(X < d) = 0.1548 & \ Rightarrow& \ Phi \ left(\ displaystyle \ frac{d-36}{8} \ right) = 0.1548 &| \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& \ displaystyle \ frac{d-36} {8}= -1.016 \ qquad \ \ & & \ Rightarrow& d = 27.9 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(X > e) = 0.1548 & \ Rightarrow& \ Phi \ left(\ displaystyle \ frac{e-36}{8} \ right) = 0.8452 \ qquad \ \ & & \ Rightarrow& \ displaystyle \ frac{e-36}{8}= 1.016 \ qquad \ \ & & \ Rightarrow& e = 44.1 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & P(d < X < e) &=&P(X < e) - P(X < d) \ qquad \ \ & &=& (1-0.1548) - 0.1548 \ , = \ , 0.6904 &| \ color{#ff0066}{M1A1} \ end{steps}}

A167 - ID: 577 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} & P(J < 266) & \ , \ , \ , = \ , \ , & \ Phi \ left(\ frac{266- \ mu}{ \ sigma} \ right) \ , = \ , \ Phi \ left(\ frac{266-262}{5.3} \ right) \ qquad \ qquad \ qquad &| \ color{#ff0066} {M1A1} \ qquad \ \ &&=& \ Phi (0.755) \ qquad \ \ &&=& 0.7734 &| \ color{#ff0066}{A1} \ qquad \ \ & P(C < 94) &=& \ Phi \ left(\ frac{94- \ mu}{ \ sigma} \ right) \ , = \ , \ Phi \ left(\ frac{94-100.8} {7.7} \ right) &| \ color{#ff0066}{M1A1} \ qquad \ \ & &=& \ Phi (-0.883) \ qquad \ \ & &=& 0.1894 &| \ color{#ff0066}{A1} \ qquad \ \ & & \ Rightarrow& P(J<266 \ text{ and } C<94)=0.7734 \ times 0.1894 &| \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& P(J<266 \ text{ and } C<94)=0.1465 &| \ color{#ff0066}{A1} \ end{steps}}

A168 - ID: 708 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} & \ quad P(T > 53) = 0.02 & \ Rightarrow&P(T < 53) = 0.98 \ qquad \ \ & & \ Rightarrow& \ phi \ left(\ frac{53- \ mu}{ \ sigma} \ right) = 0.98 \ qquad \ \ & & \ Rightarrow& \ frac{53- \ mu}{ \ sigma} =2.054 \ qquad \ \ && \ Rightarrow& 53 - \ mu = 2.054 \ sigma \ qquad \ text{[1]} \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & P(T < 7) = 0.009 & \ Rightarrow& \ phi \ left(\ frac{7- \ mu}{ \ sigma} \ right) = 0.009 \ qquad \ \ && \ Rightarrow& \ frac{7- \ mu}{ \ sigma} =-2.366 \ qquad \ \ && \ Rightarrow& 7 - \ mu = -2.366 \ sigma \ qquad \ text{[2]} &| \ color{#ff0066}{M1A1} \ qquad \ \ & \ text{[1]-[2]} & \ Rightarrow& 46 = 4.42 \ sigma \ qquad \ \ && \ Rightarrow& \ sigma = 10.407 \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ && \ Rightarrow& \ mu = 53 - 2.054 \ times 10.407 \ , = \ ,31.623 &| \ color{#ff0066}{A1} \ end{steps}}

A169 - ID: 362 *[11 marks, 13 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & P(P < 205)= 0.01 & \ Rightarrow& \ frac{205 - \ mu}{ \ sigma} = -2.327 \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& \ mu-205 = 2.327 \ sigma \ qquad [1] &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & P(P > 271)= 0.17 & \ Rightarrow& \ frac{271- \ mu}{ \ sigma} = -0.954 &| \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& \ mu-271 = -0.954 \ sigma \ qquad [2] &| \ color{#ff0066}{B1A1} \ qquad \ \ \ text{(c)}& [1] - [2] \ qquad \ qquad & \ Rightarrow& 66= 3.281 \ sigma &| \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& \ sigma= 20.1 &| \ color{#ff0066}{A1} \ qquad \ \ && \ Rightarrow& \ mu = 251.8 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & \ mu \ , \ pm \ , \ sigma &=&251.8 \ pm 20.1 &| \ color{#ff0066}{M1} \ qquad \ \ &&=& 231.7, 271.9 &| \ color{#ff0066}{A1} \ end{steps}}

A170 - ID: 768 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & P(X < 3570)= 0.015 & \ Rightarrow& \ mu-3570 = 2.171 \ sigma \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & P(X > 5940)= 0.025 & \ Rightarrow& \ mu-5940 = -1.96 \ sigma &| \ color{#ff0066}{A1} \ qquad \ \ && \ Rightarrow& 2370 = 4.131 \ sigma \ qquad \ \ && \ Rightarrow& \ sigma= 573.7 &| \ color{#ff0066}{M1A1} \ qquad \ \ && \ Rightarrow& \ mu = 4815.5 &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & P(X<4510)&=& \ phi \ left(\ frac{4510-4815.5}{573.7} \ right) &| \ color{#ff0066}{M1A1} \ qquad \ \ &&=& \ phi (-0.533) &| \ color{#ff0066}{A1} \ qquad \ \ &&=& 0.2981 &| \ color{#ff0066}{A1} \ end{steps}}

A171 - ID: 799 *[11 marks, 13 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad P(L > 48.84)= 0.02 & \ Rightarrow& \ frac{48.84 - \ mu}{0.4}= 2.054 \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M2A1} \ qquad \ \ && \ Rightarrow& 48.84 - \ mu = 0.8216 & | \ color{#ff0066}{A1} \ qquad \ \ && \ Rightarrow& \ mu = 48.0184 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & P(47.32< L < 48.68) &=&P(L < 48.68) - P(L <47.32) \ quad \ qquad \ \ &&=& \ phi \ left(\ frac{48.68-48}{0.4} \ right) - \ phi \ left(\ frac {47.32-48}{0.4} \ right) & | \ color{#ff0066}{M2} \ qquad \ \ &&=& 0.9554-0.0446 & | \ color{#ff0066} {A1} \ qquad \ \ &&=& 0.9108& | \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & \ text{P(both not used)}&=&(1-0.9108)^2 \ , = \ , 0.008 & | \ color{#ff0066}{M1A1} \ end{steps}}

A172 - ID: 451 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} & \ text{Battery lifetime} & \ , \ , \ approx \ , \ ,&N(11, 5^2) \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ & P(B > t) = \ frac{1}{4} & \ Rightarrow&P (B < t) = \ frac{3}{4} & | \ color{#ff0066}{M1A1} \ qquad \ \ && \ Rightarrow& \ phi \ left(\ frac{t-11} {5} \ right) = \ frac{3}{4} & | \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& \ frac{t-11}{5} = 0.674 \ quad \ qquad \ \ && \ Rightarrow& t-11 = 3.37 \ quad \ qquad \ \ && \ Rightarrow& t = 14.37 \ text{ hours} & | \ color{#ff0066}{M1A1} \ end{steps}}

A173 - ID: 894 *[11 marks, 13 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad P(C < 50)= 0.11 & \ Rightarrow& \ frac{50 - 55} { \ sigma}= -1.227 \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{M2A1} \ qquad \ \ && \ Rightarrow& \ sigma = \ frac{-5}{-1.227} \ quad \ , = \ , 4.075 \ qquad & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & P(C > 60) &=&1 - P(C < 60) \ quad \ qquad \ \ &&=& 1 - \ phi \ left(\ frac {60-55}{4.075} \ right) & | \ color{#ff0066}{M1} \ qquad \ \ &&=& 1 - 0.8907 \ , = \ , 0.1093 & | \ color {#ff0066}{A2} \ qquad \ \ \ text{(c)} & P(C < 50)= 0.025 & \ Rightarrow& \ frac{50 - \ mu}{2}= -1.96 & | \ color{#ff0066}{M1B1} \ qquad \ \ && \ Rightarrow& 50 - \ mu = 2 \ times -1.96 & | \ color {#ff0066}{M1} \ qquad \ \ && \ Rightarrow& \ mu = 50 - -3.92 \ quad \ , = \ , 53.92 & | \ color{#ff0066} {A1} \ end{steps}}

A174 - ID: 711 *[9 marks, 11 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ quad P(V > 131) = 0.3 & \ Rightarrow&P(V < 131) = 0.7 \ qquad \ \ && \ Rightarrow& \ phi \ left(\ frac{131-110}{ \ sigma} \ right) = 0.7 \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& \ frac{131-110}{ \ sigma} =0.524 &| \ color{#ff0066}{M1} \ qquad \ \ && \ Rightarrow& 21 = 0.524 \ sigma \ qquad \ \ && \ Rightarrow& \ sigma \ , = \ , 40.076 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(V < 20) &=& \ phi \ left(\ frac{20-110}{40.076} \ right) &| \ color{#ff0066}{M1} \ qquad \ \ &&=& \ phi \ left(-2.246 \ right) \ qquad \ \ &&=& 0.0124 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & \ text{Suitable model} &=& \ text{No. The model excludes} \ qquad \ \ &&& \ text{about 30% of visitors.} &| \ color{#ff0066}{M1A1} \ end{steps}}

A175 - ID: 929 *[9 marks, 11 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)}& \ quad P(H>188) & \ , \ , \ ,= \ , \ ,&1 - \ displaystyle \ Phi \ left(\ frac{x- \ mu}{ \ sigma} \ right) \ ,= \ , 1 - \ displaystyle \ Phi \ left(\ frac{188-180}{5.2} \ right) \ qquad \ \ &&=& 1- \ displaystyle \ Phi \ left(1.54 \ right) \ , = \ , 1-0.9382 \ , = \ , 0.062 \ qquad &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(b)}& P(W<97)&=& \ displaystyle \ Phi \ left(\ frac{x- \ mu}{ \ sigma} \ right) \ ,= \ , \ displaystyle \ Phi \ left(\ frac{97-85}{7.1} \ right) \ qquad \ \ &&=& \ displaystyle \ Phi \ left(1.69 \ right) \ , = \ , 0.9545 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & Probability &=&0.062 \ times (1-0.9545) \ , = \ , 0.0028 &| \ color{#ff0066}{M1A2} \ qquad \ \ \ text{(d)}& Comment &:& \ text{Evidence suggests height & weight} \ qquad \ \ &&& \ text{positively correlated, so assumption} \ qquad \ \ & && \ text{of independence is not sensible} &| \ color{#ff0066}{B1} \ end{steps}}

A176 - ID: 2320 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} & \ quad P(S > 96) = 0.19 & \ Rightarrow&P(S < 96) = 0.81 \ qquad \ \ & & \ Rightarrow& \ phi \ left(\ frac{96- \ mu}{ \ sigma} \ right) = 0.81 \ qquad \ \ & & \ Rightarrow& \ frac{96- \ mu}{ \ sigma} =0.878 \ qquad \ \ && \ Rightarrow& 96 - \ mu = 0.878 \ sigma \ qquad \ text{[1]} \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ & P(S < 40) = 0.15 & \ Rightarrow& \ phi \ left(\ frac{40- \ mu}{ \ sigma} \ right) = 0.15 \ qquad \ \ && \ Rightarrow& \ frac{40- \ mu}{ \ sigma} =-1.036 \ qquad \ \ && \ Rightarrow& 40 - \ mu = -1.036 \ sigma \ qquad \ text{[2]} &| \ color{#ff0066}{M1A1} \ qquad \ \ & \ text{[1]-[2]} & \ Rightarrow& 56 = 1.914 \ sigma \ qquad \ \ && \ Rightarrow& \ sigma = 29.255 &| \ color{#ff0066}{M1A1} \ qquad \ \ && \ Rightarrow& \ mu = 96 - 0.878 \ times 29.255 \ , = \ ,70.321 &| \ color{#ff0066}{A1} \ end{steps}}

A177 - ID: 5537 *[7 marks, 8 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)}& \ frac{ }{ } \ quad P(D<1.81) = 0.85 & \ Rightarrow& \ displaystyle \ Phi \ left(\ frac{1.81-1.66}{ \ sigma} \ right) = 0.85 \ qquad & | \ color {#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& \ displaystyle \ frac{0.15}{ \ sigma} = 1.036 & | \ color {#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& \ sigma = \ displaystyle \ frac{0.15}{1.036} \ ,= \ , 0.1448 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)}& P(X < min) = 0.22 & \ Rightarrow& \ displaystyle \ Phi \ left(\ frac{min-1.66}{0.1448} \ right) = 0.22 & | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& \ displaystyle \ frac{min-1.66}{0.1448} = -0.772 \ qquad \ \ & & \ Rightarrow& min-1.66 = -0.1118 \ qquad \ \ & & \ Rightarrow& min = 1.55 & | \ color{#ff0066}{M1A1} \ end{steps}}

A178 - ID: 802 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)}& \ frac{ }{ } \ quad \ qquad \ qquad \ qquad P(Ql<92) & \ , \ , \ ,= \ , \ ,& \ displaystyle \ Phi \ left(\ frac{x- \ mu}{ \ sigma} \ right) \ ,= \ , \ displaystyle \ Phi \ left(\ frac{92-105}{13} \ right) \ quad & | \ color{#ff0066}{M1A1} \ qquad \ \ &&=& \ displaystyle \ Phi \ left(-1 \ right) \ , = \ , 0.1587 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)}& P(Ql>105+k) = 0.209 & \ Rightarrow&P(Ql<105+k) = 0.791 \ qquad \ \ & & \ Rightarrow& \ displaystyle \ Phi \ left(\ frac{105+k-105}{13} \ right) = 0.791 & | \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& \ displaystyle \ frac{k}{13} = 0.81 \ qquad \ \ & & \ Rightarrow& \ displaystyle k = 11 & | \ color {#ff0066}{M1A1} \ end{steps}}

A179 - ID: 2629 *[9 marks, 11 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad \ text{median} & \ , \ , \ ,= \ , \ ,&200g \ qquad \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color{#ff0066}{B1} \ qquad \ \ \ text{(b)} & P(X < 210) &=&0.75 & | \ color{#ff0066}{B1} \ qquad \ \ & & \ Rightarrow& \ phi \ left(\ displaystyle \ frac {210-200}{ \ sigma} \ right) = 0.75 & | \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& \ displaystyle \ frac{10}{ \ sigma} =0.67 \ qquad \ \ & & \ Rightarrow& \ sigma = \ displaystyle \ frac {10}{0.67} \ , = \ , 14.925 & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(X < 180) &=& \ phi \ left(\ displaystyle \ frac{180-200}{14.925} \ right) \ , = \ , \ phi \ left(-1.34 \ right) & | \ color {#ff0066}{M1A1} \ qquad \ \ & &=& 0.0901 & | \ color{#ff0066}{A1} \ end{steps}}

A180 - ID: 3238 *[12 marks, 14 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad P(X > 50) & \ , \ , \ , = \ , \ , &1 - P(X < 50) \ , = \ , 1 - \ Phi \ left(\ frac{50- \ mu}{ \ sigma} \ right) \ qquad \ \ &&=& 1 - \ Phi \ left(\ frac {50-48}{2} \ right) \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ &&=& 1 - \ Phi (1) \ , = \ , 1 - 0.8413 \ qquad \ \ &&=& 0.159 \ qquad & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & P(X < W) = 0.06 & \ Rightarrow& \ Phi \ left(\ frac{W -48}{2} \ right) \ , = \ , 0.06 & | \ color{#ff0066} {A1} \ qquad \ \ & & \ Rightarrow& \ frac{W -48}{2} = -1.5551 & | \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& W -48 = -3.1102 \ qquad \ \ & & \ Rightarrow& W = 44.8898& | \ color{#ff0066} {M1A1} \ qquad \ \ \ text{(c)} & P &=&3 \ times 0.159^2 \ times 0.8413 & | \ color{#ff0066}{M1A1} \ qquad \ \ & &=& 0.0636 & | \ color{#ff0066}{M1A1} \ end{steps}}

A181 - ID: 4525 *[8 marks, 10 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad P(X < 4.4) & \ , \ , \ , = \ , \ , & \ Phi \ left (\ frac{4.4- \ mu}{ \ sigma} \ right) \ qquad \ \ &&=& \ Phi \ left(\ frac{4.4-4.2}{0.16} \ right) \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ &&=& \ Phi (1.25) \ , = \ , 0.894 \ qquad & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & P(X > 4) & \ , \ , \ , = \ , \ , &1 - P(X < 4) \ , = \ , 1 - \ Phi \ left(\ frac{4- \ mu}{ \ sigma} \ right) \ qquad \ \ &&=& 1 - \ Phi \ left(\ frac{4-4.2} {0.16} \ right) \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1A1} \ qquad \ \ &&=& 1 - \ Phi (-1.25) \ , = \ , 1 - 0.1056 \ qquad \ \ &&=& 0.894 \ qquad & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & P(4 < X < 4.4) &=&0.894 - (1 - 0.894) & | \ color{#ff0066}{M1} \ qquad \ \ & &=& 0.789 & | \ color {#ff0066}{A1} \ end{steps}}

A182 - ID: 6191 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad P(X > 0) & \ , \ , \ , = \ , \ , &1 - P(X < 0) \ , = \ , \ displaystyle 1 - \ Phi \ left(\ frac{0- \ mu}{ \ sigma} \ right) \ qquad \ \ &&=& \ displaystyle 1 - \ Phi \ left(\ frac{0- -14.5}{ \ sqrt{62}} \ right) \ qquad \ qquad \ qquad & | \ color{#ff0066}{M1} \ qquad \ \ &&=& 1 - \ Phi (1.842) & | \ color{#ff0066}{M1} \ qquad \ \ & &=& 1 - 0.9671 \ , = \ , 0.0329 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & P(X > 0) = 0.88 & \ Rightarrow&P(X < 0) = 0.12 \ qquad \ \ & & \ Rightarrow& \ Phi \ left(\ frac{0 - \ mu}{ \ sqrt{37}} \ right) \ , = \ , 0.12 \ qquad \ \ & & \ Rightarrow& \ left(\ frac{- \ mu}{ \ sqrt{37}} \ right) \ , = \ , -1.1751 & | \ color{#ff0066} {B1M1} \ qquad \ \ & & \ Rightarrow& \ mu = 7.15 & | \ color{#ff0066}{A1} \ end{steps}}

A183 - ID: 7447 *[6 marks, 7 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ qquad \ qquad P(X < 78) & \ , \ , \ , = \ , \ , & \ Phi \ left (\ frac{78 - \ mu}{ \ sigma} \ right) \ , = \ , \ Phi \ left(\ frac{78 - 84}{3.3} \ right) \ qquad \ \ &&=& \ Phi (-1.818) \ , = \ , 0.0344 \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(X < M) = 0.04 & \ Rightarrow& \ Phi \ left(\ frac{M - 84}{3.3} \ right) \ , = \ , 0.04 \ qquad \ \ & & \ Rightarrow& \ frac{M - 84}{3.3} = -1.7511 \ qquad \ \ & & \ Rightarrow& M - 84 = -5.7786 \ qquad \ \ & & \ Rightarrow& M = 78.22 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(X < 78) = 0.12 & \ Rightarrow& \ Phi \ left(\ frac{78 - \ mu}{3.3} \ right) = 0.12 \ qquad \ \ & & \ Rightarrow& \ frac{78 - \ mu}{3.3} = -1.1751 \ qquad \ \ & & \ Rightarrow& 78 - \ mu = -3.8778 \ qquad \ \ & & \ Rightarrow& \ mu = 81.9 &| \ color{#ff0066}{M1A1} \ end{steps}}

A184 - ID: 5561 *[11 marks, 13 minutes]*

\ displaystyle{ \ begin{steps} \ text{(a)} & \ frac{ }{ } \ quad \ qquad P(X < 840) & \ , \ , \ , = \ , \ , & \ displaystyle \ Phi \ left(\ frac{840 - \ mu}{ \ sigma} \ right) \ qquad \ \ &&=& \ displaystyle \ Phi \ left(\ frac{840 - 862}{50} \ right) \ qquad \ qquad \ qquad \ qquad \ qquad &| \ color{#ff0066}{M1A1} \ qquad \ \ &&=& \ displaystyle \ Phi (-0.44) \ , = \ , 0.33 \ qquad &| \ color{#ff0066}{A1} \ qquad \ \ \ text{(b)} & \ text{Expected number} &=&400 \ times 0.33 \ , = \ , 132 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(c)} & P(Y < 839) = 0.19 & \ Rightarrow& \ displaystyle \ Phi \ left(\ frac{839 - 882}{ \ sigma} \ right) = 0.19 &| \ color{#ff0066}{M1A1} \ qquad \ \ & & \ Rightarrow& \ frac{839 - 882}{ \ sigma} = -0.8778 \ qquad \ \ & & \ Rightarrow& \ sigma =49 &| \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(d)} & \ text{Choose} &:& \ text{Company Y because} \ qquad \ \ &&& \ text{higher mean but similar standard deviation} &| \ color{#ff0066}{M1A1} \ end{steps}}

A185 - ID: 7106 *[10 marks, 12 minutes]*

\ displaystyle{ \ begin{steps} \ qquad \ \ \ text{(a)} & \ qquad P(H < 158) = 0.05 & \ Rightarrow& \ phi \ left(\ frac{158- \ mu}{ \ sigma} \ right) = 0.05 \ qquad \ qquad \ qquad \ qquad \ qquad & | \ color {#ff0066}{M1} \ qquad \ \ && \ Rightarrow& \ frac{158- \ mu}{ \ sigma} =-1.645 \ qquad \ \ && \ Rightarrow& \ mu = 158 --1.645 \ sigma \ qquad \ text{[1]} & | \ color{#ff0066}{M1A1} \ qquad \ \ \ text{(b)} & P(H > 177) = 0.3 & \ Rightarrow&P(H < 177) = 0.7& | \ color{#ff0066}{M1} \ qquad \ \ & & \ Rightarrow& \ phi \ left(\ frac{177- \ mu}{ \ sigma} \ right) = 0.7 \ qquad \ \ & & \ Rightarrow& \ frac{177- \ mu}{ \ sigma} =0.524 \ qquad \ \ && \ Rightarrow& 177 - \ mu = 0.524 \ sigma \ qquad \ text{[2]} & | \ color{#ff0066}{A1} \ qquad \ \ & \ text{[1]+[2]} & \ Rightarrow& 19 = 2.169 \ sigma \ qquad \ \ && \ Rightarrow& \ sigma = 8.759 \ qquad \ qquad & | \ color{#ff0066}{A1} \ qquad \ \ && \ Rightarrow& \ mu = 177 - 0.524 \ times 8.759 \ , = \ ,172.41 & | \ color{#ff0066}{A1} \ qquad \ \ \ text{(c)} & P(H > 165) &=&1 - P(H < 165) \ , = \ , \ displaystyle 1 - \ Phi \ left(\ frac{165 - \ mu}{ \ sigma} \ right) & | \ color{#ff0066}{M1} \ qquad \ \ & &=& 1 - \ Phi(-0.85) \ , = \ , 1 - 0.1977 \ , = \ , 0.8023 & | \ color{#ff0066}{M1A1} \ end{steps}}