Exercises in GCSE Mathematics Intermediate level

**Robert Joinson** 

**Sum**books

Sumbooks Chester CH4 8BB

## **Exercises in GCSE Mathematics-Intermediate level**

First Published 1997 Reprinted 1998 Updated 2002

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ISBN 0 9543580 2 3

# Preface

This book covers the GCSE syllabi to be examined for the first time in 2003. It was written with year 11 pupils in mind but can be used in year 10 for those pupils intending to do the higher papers at the end of year 11.

Some areas have more questions than are needed for some pupils. Exercises on pages 1, 4, 22, 23, 24, 25, 26, 27, 28 and 30 contain lots of questions and are aimed at pupils requiring a great deal of practice. However the questions are graded and it might only be necessary for some students to do the first column and then each row when they begin to have problems. In general questions in the same row tend to be of the same difficulty, whereas the difficulty increases down the page.

All graphs can be accommodated on A4 size graph paper used in 'portrait' mode. The answers to the questions on reflections, rotations, translations and enlargements can be drawn within the size of graph paper indicated in the question.

I would like to thank my wife Jenny and my daughters Abigail and Hannah for all the help and encouragement they have given me in writing this.

R Joinson

August 2002 Chester .

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# **1** Multiplication and Division

Do not use a calculator

#### **Exercise 1**

Short division with or without remainders

1) 57÷7	2) 83 ÷ 6	3) 94 ÷ 8	4) 106 ÷ 4
5) 183 ÷ 9	6) 401 ÷ 6	7) 372 ÷ 3	8) 861 ÷ 7
9) 974 ÷ 5	10) 462 ÷ 8	11) 341÷9	12) 576 ÷ 6

#### Exercise 2

Long division with or without remainders

1) 87 ÷ 17	2) 96÷23	3) 84 ÷ 11	4) 143 ÷ 34
5) 176 ÷ 26	6) 541 ÷ 67	7) 341 ÷ 44	8) 183 ÷ 14
9) 196÷16	10) 215 ÷ 18	11) 326÷24	12) 184 ÷ 17
13) 285 ÷ 22	14) 497 ÷ 31	15) 567÷34	16) 674 ÷ 23
17) 841 ÷ 21	18) 456 ÷ 27	19) 845 ÷ 42	20) 956 ÷ 51

#### Exercise 3

Division without remainders (answer in decimal form)

1) $15.0 \div 2$	2) 25.0 ÷ 4	3) 58 ÷ 8	4) 34÷5
5) 30 ÷ 4	6) 93 ÷ 6	7) 188 ÷ 8	8) 90 ÷ 8
9) 81 ÷ 4	10) 273 ÷ 6	11) 27.6 ÷ 5	12) 210 ÷ 8
13) 145 ÷ 4	14) 238÷8	15) 214÷4	16) 156 ÷ 8
17) 14.7 ÷ 5	18) 50.4 ÷ 5	19) 58.8 ÷ 7	20) 583 ÷ 4

#### Exercise 4

Long multiplication

1) 27 × 32	2) 84×19	3) 26×47	4) 33 × 34	5) 86×54
6) 121 × 17	7) 216×27	8) 143 × 34	9) 256×47	10) 354 × 3
11) 374 × 63	12) 542 × 73	13) 431 × 86	14) 853 × 64	15) 427 × 27
16) 862×73	17) 491 × 93	18) 354×76	19) 529×69	20) 592×74

## **2** Negative Numbers

Do not use a calculator

#### **Exercise 1**

Calculate the final temperature.	
1) 5°C increases by 9°C	2) 5°C falls by 3°C
3) 12°C falls by 15°C	4) –2°C increases by 4°C
5) –5°C falls by 8°C	6) 9°C – 4°C
7) −8°C − 12°C	8) -4°C + 2°C
9) 8°C – 12°C	10) -6°C - 5°C
11) –17°C + 3°C	12) –1°C + 15°C
13) 0°C – 6°C	14) 12°C − 12°C
$15) - 6^{\circ}C + 6^{\circ}C$	$16) - 17^{\circ}C - 6^{\circ}C$
17) –43°C + 26°C	$18) - 17^{\circ}C + 26^{\circ}C$
19) –7°C – 19°C	20) -31°C + 27°C

## Exercise 2

What is the change in temperature between each of the following?

1) 3°C and 7°C	2) 17°C and 23°C
3) –5°C and 4°C	4) –7°C and 2°C
5) –6°C and –3°C	6) –7°C and 0°C
7) 5°C and 2°C	8) 7°C and −2°C
9) 5°C and –3°C	10) –2°C and –7°C
11) –8°C and –4°C	12) 0°C and -12°C
13) –17°C and –12°C	14) 8°C and –16°C
15) –9°C and –15°C	16) –12°C and 22°C
17) –12°C and 34°C	18) –16°C and –8°C
19) –16°C and 0°C	20) 12°C and –20°C

## Exercise 3

In each of the following, write down the number represented by the '?'

1) $5 - ? = 1$	2) 3 – ? = 3	3) $4 - ? = -2$	4) 7 - ? = -9
(5) - 2 + ? = 3	6) -5 + ? = 1	7) -4 - ? = -7	(8) - 3 + ? = 4
9) ? + 3 = 5	10)? - 4 = 3	11) $5 - ? = -2$	12) 5 - ? = -3
13) ? + 2 = -7	14) $4 + ? = -9$	15) $? - 2 = -2$	16) $7 + ? = 0$
17) 8 + ? = 1	18) 10 - ? = -6	19)4 + ? = -6	20) ? – 14 = –4

## **Exercise 4**

- 1) Two numbers are multiplied together to make -30.
  - One of the numbers is 6. What is the other?
- 2) Two numbers are multiplied together to make -18. One of the numbers is -6. What is the other?
- 3) Two numbers are multiplied together to make –60. The sum of the two numbers is 4. What are they?
- 4) Two numbers are multiplied together to make –144. The sum of the numbers is 0. What are the numbers?

# **3** Use of the Calculator

## Exercise 1

Calculate each of the following pairs of problems. Predict the answers before you do them.

1)	$4 + 8 \div 4$	and	$(4+8) \div 4$
2)	$3+5\times 4$	and	$(3+5) \times 4$
3)	$18 - 2 \times 3$	and	$(18 - 2) \times 3$
4)	$30-6 \div 2$	and	$(30 - 6) \div 2$
5)	$16 \div 4 + 4$	and	$16 \div (4 + 4)$
6)	$40 \div 8 + 2$	and	$40 \div (8 + 2)$
7)	$6 \times 4 + 2$	and	$6 \times (4 + 2)$

**Exercise 2** (give your answer correct to 4 significant figures wherever necessary )

1)	$\frac{16.59 - 8.25}{3.8}$	2)	$\frac{12.7 - 2.4}{3.6 - 1.4}$
3)	$5.7+3.6\div2.4$	4)	$4.3 - 2.4 \div 3.8$
5)	$\frac{6.3 - 2.8}{1.7 + 3.6 \times 1.4}$	6)	$\frac{3.2}{5.7 + 3.6 \times 1.4}$
7)	5.3 - (2.6-1.4)	8)	$(4.3 + 3.6) \times (2.7 - 1.63)$
9)	$\frac{9.7 - 7}{4.2 - 3.5 \div 5}$	10)	$\frac{2.63 \times 3.8}{11.4 - 6.3}$
11)	$\frac{5.8\times(7+3)}{8\div5}$	12)	7.83 - (12.41 - 6.32)
13)	$\frac{7.2}{9.8+12.7}$	14)	$\frac{7.2+12.7}{9.8}$
15)	$\frac{9.48 \times 2.54 - 1.48}{6.42}$	16)	$\frac{9.48 \times 2.54 - 1.48}{2.67 + 3.14}$
17)	$\frac{18.31 - (2.48 + 3.65)}{6.51 - (2.87 + 2.61)}$	18)	$\frac{26.14 \div 15.41}{3.87 \div 7.63}$
19)	$\frac{(16.14 - 3.65) \div 2.16}{4.27 - 3.18}$	20)	$\frac{19.42 - 3.15 \times 4.26}{3.17 \div (4.16 + 3.67)}$
21)	$5-6\cos 20^\circ$	22)	$5.2^2 - 2.3\cos 30^\circ$
23)	$\sqrt{(6+3\tan 25)}$	24)	$6+5\sin 40^{\circ}$
25)	$4\tan 35^\circ + 3\sin 45^\circ$	26)	$\sqrt{(3.12+3\tan 40^\circ)} + (2.56)^2$
27)	$\frac{4.63 + 3.12^2 - 3\sin 55^\circ}{\sqrt{5.84 + 0.31}}$	28)	$\frac{8.91 \times 3.14 + 4\tan 27^{\circ}}{4.35^2 - 3.86}$

Intermediate level

## **4** Estimation

#### Do not use a calculator

In each of the following questions a) write down a calculation that could be done mentally to check the answer to each of the following and b) write down your answer

#### **Exercise 1**

5
53
174
482
325
1 4 3

#### Exercise 2

1)	$6.314 \times 2.876$	2)	$15.914 \times 32.14$
3)	$17.68 \times 57.58$	4)	$9.32 \times 0.076$
5)	$15.421 \times .0034$	6)	$0.00234 \times 0.0157$
7)	37.6 – 9.4	8)	17.73 – 4.65
9)	14.32 - 2.98	10)	8.65 - 0.357
11)	0.631 – 0.214	12)	$\frac{3.54 \times 2.64}{4.31}$
13)	$\frac{5.64 \times 14.78}{5.74}$	14)	$\frac{7.64 + 3.87}{2.56}$
15)	$\frac{5.31 + 2.64}{3.74 - 1.68}$	16)	$\frac{7.32 \times 4.28}{1.64 \times 3.17}$
17)	$\frac{0.314 \times 2.64}{4.13}$	18)	$\frac{6.43 + 4.95}{0.341}$
19)	$\frac{3.152 \times 0.48}{2.63}$	20)	$\frac{2.31 - 1.42}{3.64}$
21)	$\frac{7.43 \times (4.35)^2}{230 + 175}$	22)	$\frac{(6.82)^2 \times 17.34}{8.97 - 3.14}$
23)	$\frac{3.14(4.85+3.94)}{8.32-2.15}$	24)	$\frac{(3.78)^3 - 4.79}{0.156 \times 0.734}$
25)	If $y = 2 \times 0.81 \times 17.4$ astimate the value of y		

- 25) If  $v = 2 \times 9.81 \times 17.4$  estimate the value of *v*.
- 26) If  $c = 2.21 \times 13.6 \times 5.2 13.6$  estimate *c*.
- 27)  $t = \frac{2.54 \times 37.2}{9.82}$  estimate the value of *t*. 28)  $D = \frac{3.54(6.48 + 3.21)}{3.54(6.48 + 3.21)}$  estimate the value of
- 28)  $D = \frac{3.54(6.48 + 3.21)}{6.48 3.21}$  estimate the value of *D*.
- 29) Estimate the value of  $8 \times 8 \times 10 \times 11 \times 12$ .

# **5** Fractions, Decimals and Percentages **1**

#### **Exercise 1**

Change into decimals (correct to 4 decimal places where necessary)

1) $\frac{3}{4}$	2) $\frac{5}{8}$	3) $\frac{2}{5}$	4) $\frac{3}{8}$	5) $\frac{5}{12}$	6) $\frac{7}{20}$
7) $\frac{8}{15}$	8) $\frac{7}{25}$	9) $\frac{3}{13}$	10) $\frac{4}{27}$	11) $\frac{14}{25}$	12) $\frac{8}{30}$
13) $\frac{11}{20}$	14) $\frac{3}{7}$	15) $\frac{5}{9}$	16) $\frac{7}{16}$	17) $\frac{8}{23}$	18) $\frac{9}{16}$

#### Exercise 2

Change these	decimals into per	rcentages			
1) 0.26	2) 0.34	3) 0.72	4) 0.87	5) 0.64	6) 0.35
7) 0.42	8) 0.961	9) 0.432	10) 0.614	11) 0.584	12) 0.826
13) 0.932	14) 0.3	15) 0.6	16) 1.9	17) 2.38	18) 6.41

## Exercise 3

Change into percentages correct to 4 significant figures

1) $\frac{4}{5}$	2) $\frac{8}{10}$	3) $\frac{7}{15}$	4) $\frac{3}{20}$	5) $\frac{9}{16}$	6) $\frac{5}{14}$
7) $\frac{10}{23}$	8) $\frac{24}{50}$	9) $\frac{18}{35}$	10) $\frac{12}{37}$	11) $\frac{25}{40}$	12) $\frac{15}{32}$
13) $\frac{18}{26}$	14) $\frac{27}{34}$	15) $\frac{81}{94}$	16) $\frac{41}{56}$	17) $\frac{81}{156}$	18) $\frac{57}{96}$

#### Exercise 4

Compare each of the following sets of numbers by first changing them into percentages and then writing them down in order of size, smallest to largest.

1) $\frac{1}{4}$	0.2	23%	2) $\frac{3}{8}$	0.41	36%
3) $\frac{7}{8}$	0.8	87%	4) $\frac{5}{16}$	0.3	31%
5) $\frac{3}{20}$	0.14	10%	6) $\frac{7}{16}$	0.47	43.7%
7) $\frac{8}{23}$	0.35	30%	8) $\frac{9}{17}$	0.47	47.3%
9) $\frac{6}{28}$	0.2	21%	$10) \frac{8}{31}$	0.25	25.6%

#### Exercise 5 Calculate

1) $\frac{3}{4}$ of 20	2) $\frac{3}{4}$ of 204	3) $\frac{7}{8}$ of £90	4) $\frac{5}{8}$ of £1.68
5) $\frac{5}{8}$ of 20 metres	6) $\frac{3}{4}$ of $12\frac{1}{2}$ metres	7) $\frac{5}{12}$ of £75	8) $\frac{7}{16}$ of 84 metres
9) $\frac{7}{30}$ of £66	10) $\frac{9}{16}$ of 4.4 metres	11) $\frac{7}{8}$ of £44	12) $\frac{3}{10}$ of 7.7 metres

# 6 Fractions, Decimals and Percentages 2

#### **Exercise 1**

1) 37% of 600	2) 24% of 50	3) 36% of 950	4) 41% of 500
5) 15% of £6	6) 40% of £1.50	7) 60% of £19	8) 17% of 8 metres
9) 24% of £9	10) 72% of £4.50	11) 52% of £16.50	12) 93% of 1200

### Exercise 2

Change these marks into percentages. (Give your answer correct to the nearest whole number)

1) 24 out of 50	2) 38 out of 60	3) 27 out of 40	4) 37 out of 80
5) 56 out of 90	6) 97 out of 150	7) 43 out of 200	8) 63 out of 70
9) 84 out of 120	10) 156 out of 250	11) 17 out of 20	12) 76 out of 110
13) 43 out of 76	14) 58 out of 95	15) 62 out of 68	16) 27 out of 45

#### Exercise 3

Find the percentage profit on each of the following, correct to the nearest whole number.

	Buying Price	Selling Price
1)	£100	£120
2)	£50	£80
3)	£60	£80
4)	£1.50	£1.80
5)	£2.80	£3.10
6)	£1,500	£1,700
7)	£45,000	£47,000
8)	£42.50	£45.00
9)	£900	£950
10)	£2010	£2500

#### Exercise 4

Find the selling price for each of these.

	Buying Price	Profit
1)	£100	17%
2)	£200	21%
3)	£150	20%
4)	£2000	15%
5)	£4200	32%
6)	£200	7.5%
7)	£70	25%
8)	£49,000	15%
9)	£80	27%
10)	£450	22%

#### 7 Interest

#### **Exercise 1**

Find the simple and compound interest (without using the compound interest formula) on each of the following. Wherever necessary give your answer correct to the nearest penny.

- 1) £100 invested for 2 years at 2% interest per annum.
- 2) £150 invested for 2 years at 12% interest per annum.
- 3) £500 invested for 3 years at 9% interest per annum.
- 4) £1000 invested for 4 years at 10% interest per annum.
- 5) £1500 invested for 3 years at 7% interest per annum.
- 6) £2000 invested for 3 years at 4% interest per annum.
- 7) £5200 invested for 4 years at 5% interest per annum.
- 8) £120 invested for 2 years at 7% interest per annum.
- 9) £550 invested for 3 years at 8% interest per annum.
- 10) £2100 invested for 4 years at 6% interest per annum.

#### **Exercise 2**

The Compound Interest Formula is

$$x = P \left( 1 + \frac{R}{100} \right)^n$$

Where *x* represents the amount in the bank after *n* years with a rate of *R*% on a principle of *P*.

- 1) Use the compound interest formula to calculate the amount of money in a bank account when
  - a) 200 Euros is invested for 5 years at a rate of 4.5%
  - b) 500 Euros is invested for 7 years at a rate of 3.7%
  - c) 1,200 Euros is invested for 12 years at a rate of 5.6%
- 2) 6,000 Euros is invested in an account that pays interest at a compound rate of 4.7%
  - a) Calculate the value of  $x = 1 + \frac{R}{100}$
  - b) By using the  $x^y$  key on your calculator, make a list of the amounts of money in the account at the end of each of the 10 years the money is left in the account.
- 3) Calculate the interest gained when 10,000 Euros is invested for 15 years in a bond which pays an interest of 3.74% per annum.
- 4) What is the difference between the simple and compound interest earned on an investment of 5,000 Euros over a period of 12 years at a rate of 4.86%?

# 8 Scale Drawings and Ratio

Do not use a calculator

#### Exercise1

Fill in the missing values for each of the following

Scale	Dimensions on Drawing	Actual Dimensions
1:4	10cm	
1:5		40cm
1:10	6.2cm	
1:20		140cm
1:40	10cm	
1:8		1.28cm
	20cm	6 metres
	15cm	3 metres
1:50		2.5 metres
1:100	2.5cm	
	2.5cm	5 metres
	7cm	17.5cm
1:500		27.5m
1:75	6cm	
	15cm	4.5m
1:12		138cm
1:250	3.6cm	
	4.5cm	22.5cm
1:75		600cm
1:40	2.6cm	

#### Exercise 2

Divide each of the following into the ratios given.

- 1)  $\pounds 900$  into the ratio 4:5
- 3)  $\pounds 200$  into the ratio 3:5
- 5)  $\pounds 800$  into the ratio 5:11
- 7)  $\pounds 630$  into the ratio 7:11
- 9) £2205 into the ratio 8:13
- 11)  $\pounds$ 450 into the ratio 5:6:7
- 13) £1008 into the ratio 7:8:9
- 15) £550 into the ratio 5:8:9
- 17) £150 into the ratio 6:8:11
- 19) £864 into the ratio 4:7:13

- 2) £1000 into the ratio 3:74) £600 into the ratio 7:8
- 4)  $\pm 000$  into the ratio 7.8
- 6) £700 into the ratio 5:9
- 8) £1265 into the ratio 9:14
- 10) £1200 into the ratio 3:4:5
- 12) £315 into the ratio 2:3:4
- 14) £1215 into the ratio 7:9:11
- 16) £78.40 into the ratio 3:4:7
- 18) £13.86 into the ratio 3:7:11
- 20) £343 into the ratio 3:4:7

#### Exercise 3

Three people, A, B and C, share an amount of money in the ratios shown below. In each case calculate the total amount of money shared out and the amount C gets.

- 1) Ratio 2:3:4. A gets £8
- 2) Ratio 3:4:5. B gets £12
- 3) Ratio 3:8:10. B gets £24
- 4) Ratio 3:5:7. A gets £33
- 5) Ratio 7:11:14. B gets £99
- 6) Ratio 3:5:11. A gets £1.65
- 7) Ratio 2:5:8. B gets £3.35
- 8) Ratio 3:6:13. B gets £6.72
- 9) Ratio 5:7:9. A gets £11.55
- 10) Ratio 4:11:13. B gets £56.10

## 9 Standard Form

#### **Exercise 1**

Write down these numbers in standard form

1)	36	2)	426	3)	8300
4)	94 000	5)	562 000	6)	0.15
7)	0.0314	8)	0.0054	9)	0.00023
10)	0.000015	11)	0.00143	12)	157.3
Chan	ge these numbers from star	ndard	form.		
13)	$1.3 \times 10^{3}$	14)	$3.4 \times 10^4$	15)	$1.48 \times 10^{5}$
16)	$2.1 \times 10^{7}$	17)	$3.41 \times 10^4$	18)	$4.32 \times 10^{6}$
19)	$2.180 \times 10^{5}$	20)	$9.36 \times 10^{-3}$	21)	$4.21 \times 10^{-5}$
22)	$5.97 \times 10^{-4}$	23)	$3.26 \times 10^{-6}$	24)	$4.85 \times 10^{-5}$

#### **Exercise 2**

Calculate each of the following, leaving your answer in standard form. Round off to 4 significant figures where necessary.

1)	$(2.5 \times 10^2) \times (3.0 \times 10^4)$	2) $(4.6 \times 10^3) \times (2.8 \times 10^5)$
3)	$(5.3 \times 10^{-2}) \times (2.4 \times 10^{-5})$	4) $(6.4 \times 10^{-4}) \times (3.7 \times 10^{-8})$
5)	$(3.6 \times 10^4) \times (4.2 \times 10^{-2})$	6) $(4.81 \times 10^{-3}) \times (3.8 \times 10^{7})$
7)	$(5.4 \times 10^{10}) \div (2.7 \times 10^{5})$	8) $(7.61 \times 10^6) \div (4.31 \times 10^{-2})$
9)	$\left(8.31\times10^{6}\right)\div\left(4.36\times10^{4}\right)$	10) $(3.54 \times 10^{-4}) \div (5.36 \times 10^{-5})$
11)	$\frac{5.7 \times 10^7}{45,000}$	12) $\frac{8.36 \times 10^7}{41,000}$
13)	$\frac{(1.73 \times 10^6) \times (2.41 \times 10^5)}{3.17 \times 10^4}$	14) $\frac{(4.83 \times 10^{-7}) \times (4.61 \times 10^{-11})}{6.31 \times 10^4}$

#### Exercise 3

- 1) If  $x = 3 \times 10^5$  and  $y = 2 \times 10^5$  write down the value of a) xy and b) x + y leaving your answer in standard form.
- 2) If  $x = 3 \times 10^{-4}$  and  $y = 3 \times 10^{-4}$  write down the value of a) xy and b) x + y leaving your answer in standard form.
- 3) If  $x = 3 \times 10^{-5}$  and  $y = 7 \times 10^{-3}$  write down the value of xy leaving your answer in standard form.
- 4) The mass of the earth is  $5.976 \times 10^{24}$  kilograms and the mass of the moon is  $7.35 \times 10^{22}$  kilograms. Write down the ratio of the mass of the moon to that of the earth in the form 1: n.
- 5) The distance of the moon from the earth is 384 400 kilometres. The speed of light is approximately  $3.0 \times 10^5$  kilometres per second. How long does it take light to travel from the moon to the earth?
- 6) A neutron has a mass of  $1.675 \times 10^{-27}$  kilograms and an electron  $9.109 \times 10^{-31}$  kilograms. Calculate the ratio of the mass of a neutron to the mass of an electron in the form 1 : *n*.
- 7) Light travels at a speed of approximately  $3.0 \times 10^5$  kilometres per second. a) How far will it travel in 1 year (365 days)? b) If the distance from the earth to a star is  $7.865 \times 10^{13}$  kilometres, how long will its light take to reach earth?

# **10 Prime Factors**

Do not use a calculator

### **Exercise 1**

The prime factors of a number can be found by using a tree diagram. The example below shows how to find the prime factors of 36. In the same way find the prime factors of the other numbers.



#### Exercise 2

Write down all the factors of the following numbers.

1) 15	2) 20	3) 24	4) 30	5) 32
6) 40	7) 45	8) 60	9) 71	10) 84
11) 90	12) 100	13) 120	14) 130	15) 150

## Exercise 3

Express the following numbers as products of their prime factors.

1) 150	2) 160	3) 200	4) 210	5) 260
6) 675	7) 945	8) 1715	9) 1155	10)1035
11) 1680	12) 1404	13) 1260	14) 2376	15) 1540

## **Exercise 4**

Express the following numbers as products of their prime factors.

In each case state the smallest whole number it has to be multiplied by to produce a perfect square.

1) 12	2) 18	3) 180	4) 80	5) 162
6) 252	7) 343	8) 468	9) 608	10) 980
11) 600	12) 360	13) 300	14) 192	15) 1850

## Exercise 5

Calculate the largest odd number that is a factor of each of the following.

1) 108	2) 180	3) 200	4) 271	5) 294
6) 504	7) 588	8) 720	9) 780	10) 468
11) 1248	12) 1200	13) 2160	14) 2520	15) 3920

## **11 Number Patterns and Sequences 1**

#### **Exercise 1**

In each of the following patterns write down the next two numbers

1) 2, 4, 6, 8, 10	2) 5, 7, 9, 11, 13	3) 7, 10, 13, 16, 19
4) 5, 9, 13, 17, 21	5) 3, 8, 13, 18, 23	6) 3, 12, 21, 30, 39
7) 3, 4, 6, 9, 13	8) 5, 5, 6, 8, 11	9) 5, 7, 11, 17, 25
10) 2, 3, 5, 8, 12	11) 20, 21, 23, 26, 30	12) 3, 5, 8, 12, 17
13) 15, 13, 11, 9, 7	14) 20, 20, 19, 17, 14	15) 22, 19, 16, 13, 10
16) 15, 13, 10, 6, 1	17) 7, 5, 3, 1, -1	18) 8, 8, 7, 5, 2
19) 5, 2, -2, -7, -13	20) -1, -2, -4, -7, -11	21) -2, 1, 4, 7, 10
22) 1, 3, 7, 13, 21	23) 1, 2, 4, 8, 16	24) 1, 3, 7, 15, 31

#### Exercise 2

In each of the following patterns (a) write down the next two numbers, (b) write down in words the rule for finding the next number and (c) write down the rule for finding the *n*th number in the pattern in terms of n.

1) 1, 3, 5, 7, 9	2) 2, 5, 8, 11, 14	3) 5, 9, 13, 17, 21
4) 6, 12, 18, 24, 30	5) 7, 13, 19, 25, 31	6) 12, 17, 22, 27, 32
7) 20, 18, 16, 14, 12	8) 17, 14, 11, 8, 5	9) 42, 36, 30, 24, 18
10) -7, -5, -3, -1, 1	11) -15, -10, -5, 0, 5	12) -14, -8, -2, 4, 10
13) 5, 3, 1, -1, -3	14) 12, 9, 6, 3, 0	15) -1, -3, -5, -7, -9

#### **Exercise 3**

1) The diagrams below show square 'holes' surrounded by centimetre squares.

Length of side	1	2	3
Number of squares	8	12	16

Find the number of squares needed for holes of side a) 4cm b) 5cm c) n cm d) Calculate the number of squares needed for a hole of side 20cm.

2) A child places blocks on a floor making the pattern shown below. The first row contains 1 block, the second 3 blocks, the third 5 and so on.



How many blocks will be in a) row 5 b) row 6 c) row n d) Calculate how many will be in row 40.

## 12 Number Patterns and Sequences 2

1) The diagram shows a number of rectangles where the length is 1 unit longer than the width.



d) Calculate also the area of rectangle 20

2) A library shelving system is made from uprights and shelves as shown below.



How many shelves can be made from a) 4 uprights b) 5 uprights c) n uprights.

d) How many shelves are needed for 10 uprights.

3) Shapes are made from matchsticks as shown below.



Write down the number of matches needed for shapes with a) 4 layers b) 5 layers c) n layers Calculate how many matches are needed for a shape having 12 layers.

4) Pens, in which animals are kept are made from posts and cross bars. One pen requires 4 posts and 8 cross bars, 2 bars along each side.



If more pens are made in this way, write down the number of posts and cross bars needed for a) 4 pens b) 5 pens c) n pens.

Calculate the number of posts needed if there are 122 cross bars.



#### **13 Distance Time Diagrams 1**

The diagram shows the journey of a lorry from home H to destination D.

- a) What is the distance between H and D?
- b) For how long did the driver stop?
- c) What was his average speed when travelling slowest?
- d) What was the average speed for the whole journey?

The diagram shows a distance time graph for two buses A and B, travelling between towns F, G and H. Bus A travels from F to H and bus B from H to F. Find

- a) the average speed of bus A between F and G in miles per hour.
- b) the length of time bus A stops at G
- c) the time at which bus B leaves H
- d) the average speed of bus B in m.p.h
- e) the approximate time at which the buses pass each other
- f) the approximate distance from G at which the buses pass
- g) the time at which bus B arrives at F.

Two towns are 120 miles apart. The graph shows the journeys of two trains.

The first goes from A to B.

The second goes from B to A. From the graph find

- a) the speed of the first train over the first part of its journey.
- b) the time at which the first train stopped and for how long.
- c) the speed of the first train during the second part of its journey.
- d) the average speed of the second train.
- e) the time and distance from town A of the two trains when they passed each other.



### 14 Distance Time Diagrams 2

The diagram shows a distance-time graph for two journeys.

One journey is by bicycle, the other is jogging.

a) Which journey do you think is by bicycle and why, A or B?

b) What is the average speed of the cyclist on her outward journey?

c) Who travelled furthest?

d) What is the average speed of the jogger on his homeward journey?

e) For how long did the jogger stop?

f) If both journeys were made along the same road, at what approximate times did they meet?

g) At what time did the cyclist arrive home?



d) For how long did car B stop?

e) At what time, and how far from town X, are the two cars when they pass each other?

f) Approximately how far apart are the two cars at 06:00?

g) At what times will the cars be 50 miles apart?

## **15** Conversion Graphs 1

1) The graph can be used to convert pounds (£) into Euros. Use it to convert; a) £4.50 into Euros

b) 5.00 Euros into pounds and pence.



- 2) The graph can be used to convert pounds (£) into US dollars (\$). Use it to convert;a) £70 into dollars
  - b) \$60 into pounds.



# **16 Conversion Graphs 2**

1) 1kg is approximately 2.2lbs. Calculate what 40 kg is in pounds. From this information draw a conversion graph to convert kg into pounds.

Use a horizontal scale of 4cm to 10kg and a vertical scale of 4cm to 20lbs. From your graph convert;

- a) 23kg into pounds
- b) 75 pounds into kg.
- 2) It is known that 1 gallon is approximately equal to 4.5 litres. Use this information to change 10 gallons into litres. Plot a graph to convert gallons into litres using a scale of 2cm to represent 2 gallons on the horizontal axis and 2cm to represent 5 litres on the vertical axis. From your graph; a) convert 11 gallons into litres

b) convert 32 litres into gallons

In each case give your answer correct to 1 decimal place.

3) The table below shows the cost of gas. There is a fixed charge of  $\pounds 10.00$ .

Cost	£10.00	£25.00	£85.00	£160.00
Units Used	0	1,000	5,000	10,000

Use this information to plot a conversion graph with a scale of 2cm to represent 2000 units on the horizontal axis and 2cm to represent  $\pounds 20$  on the vertical axis.

From your graph find;

a) the cost of 5,200 units

- b) the number of units that can be bought for  $\pounds 145.00$ .
- 4) Water is run from a tap into a container which has a large base and narrower neck. The height of the water in the container is measured every 30 seconds. The following table gives the results;

Height of water (cm)	0	2	8	18	32	50
Time (secs)	0	30	60	90	120	150

Using a vertical scale of 2cm to represent 10cm for the height of the water and a horizontal scale of 2cm to represent 20 secs for the time, plot the above information to produce a conversion chart. From your graph find;

a) the time it takes to reach a height of 25cm

b) the height of water after the tap has been running for  $1\frac{1}{4}$  minutes.

5) David has to make pastry but his scales measure in ounces and the recipe uses grammes. He has a tin of beans which say on the label that  $15\frac{1}{2}$  ounces is equivalent to 440 grammes. Using a scale of 2cm to represent 2oz on the horizontal axis and 2cm to represent 50 grammes on the vertical axis, draw a line to show the relationship between ounces and grammes. From the graph convert the following to the nearest half ounce, so that David can use his scales;

a) 85g of butter

b) 200 g of flour

When he has mixed all the ingredients together he weighs out  $13\frac{1}{2}$  ounces of pastry.

c) What is this weight in grammes?

## 17 Sketching and Recognising Graphs 1

1) Sammi walks to school, keeping at the same speed all the way. Which of these graphs represents her journey.



2) The Swimming Pool Corporation makes round swimming pools. The table below shows their prices.

Diameter	8 metres	10 metres	12 metres	14 metres	16 metres
Cost	£1920	£3,000	£4,320	£5,880	£7,680

Which of these graphs represents the prices of the pools.



3) A train travels from Dorcaster to Newchester. Its speed increases from 0 to 60mph. It then travels at a constant 60mph and finally it slows down from 60mph to 0mph. Which of these diagrams shows that journey.



4) A shop sells stamps which cost 25p each. In order to help calculate their cost, the assistant uses the following list of prices to help him.

Number of stamps	1	5	10	20	50	100
Cost	25p	£1.25	£2.50	£5	£12.50	£25

Sketch the graph which represents their price plotted against the number sold.

Intermediate level

## 18 Sketching and Recognising Graphs 2

1) A water tank with straight sides is full. A tap at the bottom is turned on and the water drained out <u>at a constant rate</u>. Which of these diagrams shows this.



2) A car is bought for £5000. During each year it loses 20% of its value at the beginning of that year. (compound depreciation). Which of these diagrams represents its value?



3) Niki travels to her gran's house. The first part of her journey she travels by bike, the second part she walks, and the last part she goes by bus. Which of these diagrams represents her journey?



4) The table below shows the volume of some cubes. Sketch a graph of the length of their side against their volume.

Length of side (cm)	1	2	5	10	20
Volume of cube $(cm^3)$	1	8	125	1000	8,000

# **19 Plotting Graphs 1**

1) a) Complete the table below which gives the values of  $y = x^2+3$  for values of x ranging from -3 to +3.

x	-3	-2	-1	0	1	2	3
У	12		4	3		7	

- b) On graph paper, draw the graph of  $y = x^2+3$ . Use the scale of 2cm to 1 unit on the x axis and 2cm to 2 units on the y axis.
- c) From your graph determine, correct to 1 decimal place, the values of x when y=6
- d) Draw the line y = 7 on the same graph and write down the co-ordinates of the points where they cross.
- 2) a) Complete the table below which gives the values of  $y = 2x^2+3x-1$  for values of x ranging from -3 to +2.

x	-3	-2	-1	0	1	2
у		1	-2			13

- b) On graph paper, draw the graph of  $y = 2x^2 + 3x 1$ . Use the scale of 2cm to 1 unit on the x axis and 2cm to 2 units on the y axis.
- c) Draw the line y = x+3 on the same graph and write down the co-ordinates of the points where they cross.
- d) Show that the solution to the equation  $2x^2+2x-4 = 0$  can be found at these points. Write down the solution to this equation
- 3) a) Complete the table below which gives the values of  $y = x^3+6$  for values of x ranging from -1.5 to +1.5.

x	-1.5	-1	-0.5	0	0.5	1	1.5
У		5		6		7	

- b) On graph paper, draw the graph of  $y = x^3+6$ . Use the scale of 4cm to 1 unit on the x axis and 2cm to 1 unit on the y axis.
  - c) Draw the line y = x + 6 on the same graph and write down the co-ordinates of the points where they cross.
  - d) Show that the solution to the equation  $x^3 x = 0$  can be found at these points. Write down the solution to this equation
- 4) a) Complete the table below which gives the values of  $y = 3x^2-6$  for values of x ranging from -3 to +3.

x	-3	-2	-1	0	1	2	3
У	21		-3	-6			

- b) On graph paper, draw the graph of  $y = 3x^2-6$ . Use the scale of 2cm to 1 unit on the x axis and 2cm to 5 units on the y axis.
- c) Draw the line y = 10 on the same graph and write down the co-ordinates of the points where they cross, correct to 1 decimal place.
- d) Show that the solution to the equation  $3x^2-16=0$  can be found at these points. Write down the solution to this equation

# 20 Plotting Graphs 2

1) a) Complete the table below which gives the values of  $y = 5 + \frac{2}{x}$  for values of x ranging from 0.5 to 8.

x	0.5	1	2	4	5	8
у		7		5.5	5.4	

- b) On graph paper, draw the graph of  $y = 5 + \frac{2}{x}$ . Use the scale of 2cm to 1 unit on the x axis and 2cm to 1 unit on the y axis.
  - c) From your graph determine, correct to 1 decimal place, the value of x when y=6.5.
  - d) Draw the line  $y = 8 \frac{x}{2}$  on the same graph and write down the co-ordinates of the points where they cross, correct to 1 decimal place.
  - e) Show that the solution to the equation  $\frac{x}{2} 3 + \frac{2}{x} = 0$  can be found at these points. Write down the solution to this equation.
- 2) a) Complete the table below which gives the values of  $y = x^2+2x+5$  for values of x ranging from -3 to +2.

x	-3	-2	-1	0	1	2
У	8		4	5		

- b) On graph paper draw the graph of  $y = x^2+2x+5$ . Use the scale of 2cm to 1 unit on the x axis and 2cm to 2 units on the y axis.
- c) By drawing a suitable straight line on the grid, solve the equation  $x^2+x+5=7$
- 3) a) Complete the table below which gives the values of  $y = 2x^3-5$  for values of x ranging from -1.5 to +2.

x	-1.5	-1	-0.5	0	0.5	1	1.5	2
У	-11.75			-5	-4.75	-3	1.75	

- b) On graph paper, draw the graph of  $y = 2x^3-5$ . Use the scale of 4cm to 1 unit on the x axis and 2cm to 2 units on the y axis.
- c) By drawing a suitable straight line on the grid, solve the equation  $2x^3-4x-1=0$
- 4) a) Complete the table below which gives the values of  $y = \frac{5}{x} 4$  for values of x ranging from 0.5 to 8.

x	0.5	1	2	5	8
У		1		-3	
			-		

- b) On graph paper, draw the graph of  $y = \frac{5}{x} 4$ . Use the scale of 2cm to 1 unit on the x axis and 2cm to 1 unit on the y axis.
- c) By drawing a suitable straight line on the grid, solve the equation  $x 7 + \frac{5}{x} = 0$

#### **21 Substitution**

Calculate the following values given that a = 3, b = 4 and c = 5

1) 3a + 4b2) 5a - b3) a - b - c4) 3a + 2b - 4c5) 5c - 7a6) 3a - 2b + 6

Calculate the values of the expressions in questions 7 to 12 given that a = 1, b = -2 and c = 3

- 7) 4a + 2b c 8) 3a + 2b 4c 9) 6a 7b
- 10) a + b c 11) 3a 3b c 12) 4a 2b c
- 13) If v = u + at, find v when u = 2, a = 0.25 and t = 6
- 14) Find the area of a circle of radius 2.54cm if A =  $\pi r^2$  and  $\pi = 3.142$
- 15) Find the circumference of a circle of diameter 6.5cm if  $C = \pi D$
- 16) If y = mx + c find the value of y when m = 6, x = 2 and c = 1
- 17) The volume of a cone is given by  $V = \frac{1}{3} \pi r^2 h$ . Find its volume when  $\pi = 3.142$ , r = 3cm, and h = 2.5cm.
- 18) The temperature F (° Fahrenheit) is connected to the temperature C (° Celsius) by the formula C =  $\frac{5}{9}$  (F 32). Find, to the nearest degree, the value of C when F = 82°
- 19) Find the simple interest paid if the principal (P) is £250, the time (T) is 3 years and the rate

of interest (*R*) is 9.5% using the formula  $I = \frac{PTR}{100}$ 20) If  $v^2 = u^2 + 2as$  find *v* when u = 7.3, a = 1.1 and s = 150. 21) If  $v^2 = 2gh$  find *v* when g = 9.8 and h = 12. 22) If  $S = \frac{1}{2}(u + v)t$  find S when u = 20, v = 57.5 and t = 2.5. 23) If  $A = \frac{2x + y}{3}$  find A when x = 6 and y = 1924) If  $P = \frac{Rx^2}{2y}$  find P when (a) R = 6, x = 7 and y = 4, (b) R = -3, x = -2, and y = 525) If  $x = \frac{bc}{b-c}$  find x when b = 13 and c = 9. 26) If  $y = 4x^2 + 3x - 2$  find y when x is (a) 3 (b) -2 27) If  $y = 3x^2 - 2x + 1$  find y when x is (a) 5 (b) -1 28) If y = (x + 3)(x - 4) find y when x is (a) 3 (b) -3 29) If y = (3x - 2)(x + 1) find y when x is (a) 7 (b) -3 30) If  $y = 2x^2 + \frac{1}{x}$  find y when x = -231) If v = u + at, calculate v when u = 10, a = -9.8 and t = 6. 32) If  $v^2 = u^2 + 2as$ , calculate the value of v when u = 40, a = -9.8 and s = 40

# 22 Simplifying Expressions

# Exercise 1 Simplify

1)	7 + 4
3)	12-3
5)	6-9
7)	-4+8
9)	-4 + 10
11)	-7 - 4
13)	4-3+2
15)	5 - 9 + 5
17)	-4+6-3
19)	8-15+3
21)	-5+3-4+8
23)	-8 - 6 - 4 + 3
25)	5 - 6 - 4 + 8
27)	-9 - 4 + 2 - 8
29)	8 + 6 - 5 - 4
Exerc	cise 2 Simplify
1)	3y + 8y
3)	9y - 6y
5)	16 <i>y</i> – 18 <i>y</i>
7)	-12y + 3y
9)	-16a - 7a
11)	12b + 3b + 2a + 3a
13)	4b + 5a + 3b + 3a
15)	6a - 2a + 3b + 4b
17)	12a + 3b - 4a - b
19)	16x + 8y - 10x - 9y
21)	6x + 3y - 8x - 6y
23)	5xy + 3y - 6xy
25)	-7ab+6b-3ab-4b-3ab
27)	5ab + 3bc - 4ab + 5bc - 6ab - 3bc
29)	9xy - 4x + 2xy - 5x + 3xy
31)	$x^2 + 3x^2$
33)	$x^2 + 2y^2 + 4x^2 + 5y^2$
35)	$3xy + 2x^2 + 3xy - x^2$
37)	$-6x^2y + 2xy^2 + 3xy^2 + 2x^2y$
39)	$\frac{1}{4}x + \frac{1}{2}x$

2)	10-5
4)	8-9
6)	7-10
8)	-6+9
10)	-5-3
12)	-9-6
14)	6 – 7 + 1
16)	6-10-2
18)	-7 + 2 + 4
20)	-5 - 4 + 9
22)	-6+4-9-4
24)	8 - 10 - 6 + 4
26)	-9 - 6 + 3 - 4
28)	-7 + 2 + 3 - 9
30)	-6 - 4 + 3 - 8
2)	5y + 3y
4)	12x - 4x
6)	27x - 19x
8)	-23x+17x
10)	-14w - 5w
12)	9x + 7y + 3x + 6y
14)	x + 6y + y + x
16)	12p - 4p + 3q + 7q
18) :	5x + 7y - y - x
20)	21a + 3b - 17a - 2b
22)	12a + 9b - 6a - 12b
24)	4xy + 4y + 2xy
26)	-5xy + 7x - 2xy - 3xy - 2x
28)	7xy + 9yz - 3xy - 3yz + 7xy - 2yz
30)	12ab - 4a - 3ab + 5a + 9ab
32)	$7y^2 + 6y^2$
34)	$7x^2 + 4y^2 - 3x^2 - 4y^2$
36)	$9x^2 - 3x + 5x - 3x^2$
38) ′	$7x^2y - 12xy^2 - 5x^2y + 3xy^2$
40)	$\frac{3}{4}y - \frac{1}{4}y$

## **23 Indices**

#### **Exercise 1**

Write down the values of the following.

1) 3 <sup>2</sup>	2) 3 <sup>3</sup>	3) 3 <sup>4</sup>	4) 3 <sup>5</sup>	5) 10 <sup>2</sup>	6) 10 <sup>3</sup>	7) 10 <sup>4</sup>	8) 10 <sup>5</sup>

#### Exercise 2

Use a calculator to write down the values of the following.

1) 6 <sup>5</sup>	2) 5 <sup>6</sup>	3) 4 <sup>7</sup>	4) 7 <sup>6</sup>	5) 9 <sup>5</sup>	6) 11 <sup>5</sup>	7) 13 <sup>6</sup>	8) 7 <sup>9</sup>

#### Exercise 3

Write down the answers to these both in index form and, where necessary, numerical form.

1) $2^3 \times 2^4$	2) $3^4 \times 3^5$	3) $4 \times 4^5$	4) $10^4 \times 10^3$	5) $7^4 \times 7^4$
6) $8 \times 8^3 \times 8$	7) $x^5 \times x^2$	8) $a^3 \times a^{10}$	9) $b^2 \times b^3 \times b^4$	10) $y^{10} \times y^{15}$

#### Exercise 4

Write down the answers to each of the following in index form.

1)  $4^8 \div 4^4$  2)  $5^9 \div 5^4$  3)  $7^7 \div 7^4$  4)  $10^{10} \div 10^7$  5)  $15^7 \div 15^4$  6)  $\frac{10^4}{10^2}$ 7)  $\frac{9^7}{9^4}$  8)  $\frac{12^6}{12^3}$  9)  $\frac{8^{10}}{8^4}$  10)  $\frac{20^7}{20^4}$  11)  $a^5 \div a^2$  12)  $y^{15} \div y^3$  13)  $\frac{x^7}{x^2}$ 

## **Exercise 5**

Write down the answers to each of the following in index form.

1) $(2^2)^4$	2) $(4^2)^5$	3) $(7^3)^3$	4) $(4^4)^3$	5) $(5^2)^3$	6) $(2^3)^5$
7) $(3^2)^8$	8) $(7^2)^4$	9) $(3^2)^5$	10) $(5^2)^4$	11) $(x^2)^5$	12) $(y^3)^3$

#### Exercise 6

Calculate the answers to each of these in numerical form.

1) $(2 \times 3)^4$	2) $(4 \times 3)^5$	3) $(7 \times 2)^3$	4) $(4 \times 2)^3$	5) $(5 \times 3)^3$
6) $(2 \times 5)^5$	7) $(3 \times 4)^6$	8) $(7 \times 3)^4$	9) $(3 \times 2)^5$	10) $(5 \times 4)^4$

## Exercise 7

Simplify each of the following

1) a)	$x^2 \times x^3$	b) $x^5 \times x^6$	c) $a^4 \times a^8$	d) $y^2 \times y^{11}$
2) a)	$a^4 \div a^2$	b) $a^2 \div a^2$	c) $x^5 \div x^3$	d) $2^{10} \div 2^4$
3) a)	$\left(a^{6}\right)^{4}$	b) $(x^3)^6$	c) $(y^2)^4$	d) $(b^3)^6$
4) a)	$(xy)^2 \times x^2$	b) $(ab)^3 \times a^2$	c) $(xy)^4 \times y^2$	d) $(ab)^3 \times b^3$
5) a)	$(3x)^{2}$	b) $(2x)^3$	c) $(3x)^3$	d) $(5a)^2$
6) a)	$12a^3 \div 4a^2$	b) $21x^5 \div 7x^2$	c) $\frac{50b^5}{10b^2}$	d) $\frac{100x^7}{20x^2}$
7) a)	$3x^2 \times 4x^2$	b) 9	$a^4 \times 12a^3$	c) $6y^5 \times 5y^4$
8) a)	$x^5 \times x^3 \div x^2$	b) -	$\frac{x^2 \times x^3 \times x^4}{x^5}$	c) $\frac{x^2 \times x \times x^5}{x^8}$

## **24 Multiplying Brackets**

#### **Exercise 1**

Calculate

1)	8×3	2)	$5 \times 7$	3)	$4 \times (-6)$
4)	$6 \times (-4)$	5)	$-3 \times 2$	6)	$-8 \times 5$
7)	$-5 \times (-4)$	8)	$-6 \times (-5)$	9)	$-7 \times (-3)$
10)	$-6 \times 5$	11)	$4 \times (-3)$	12)	$-8 \times (-7)$

#### Exercise 2

Expand and simplify

1) 
$$3(x+y)$$
  
3)  $-(2x-3)$   
5)  $-4(2x+5)$   
7)  $4(-3x-3)$   
9)  $-3(-3x-2)$   
11)  $12x-3y-2(4x+y)$   
13)  $7x-3y-(5x+2y)$   
15)  $12x-4y+(4y-2x)$   
17)  $4(2x+4y)+5(6x-7y)$   
19)  $7(3x-5y)-4(4x-5y)$   
21)  $3x(3x-2)-4x(3x+4)$   
23)  $6x(2x+1)-x(5x+3)$ 

25) 5x(2x+3) - 3x(-4-2x)

#### Exercise 3

Expand and simplify

1) 
$$(x+2)(x+3)$$
  
3)  $(3x+2)(x+4)$   
5)  $(3x+4)(2x-3)$   
7)  $(6x+3)(4x-6)$   
9)  $(4x-3)(2x+1)$   
11)  $(6x-5)(4x+3)$   
13)  $(6x-4)(7x-5)$   
15)  $(8x-6)(9x-2)$   
17)  $(5x+3)^2$   
19)  $(4x-5)^2$ 

2) 
$$6(3x+4)$$
  
4)  $-(3x+2)$   
6)  $-7(3x-4)$   
8)  $-5(-2x+3)$   
10)  $7x+8y+3(2x+4y)$   
12)  $14x+8y-6(6x-2y)$   
14)  $12x+3y-(4x-2y)$   
16)  $2(3x+2y)+3(3x+3y)$   
18)  $5(3x-2y)-4(3x+4y)$   
20)  $5x(2x+3)-2x(2x-1)$   
22)  $5x(3x+2)+3x(4x-5)$   
24)  $4x(3x-2)-x(-3x-2)$   
26)  $3x(4x-6)-3x(2x+5)$ 

2) (2x+1)(x+2)4) (5x+2)(6x+7)6) (4x+5)(3x-5)8) (3x+2)(5x-3)10) (3x-4)(x+2)12) (3x-7)(2x-8)14) (3x-6)(4x-5)16) (3x+7)(5x-2)18)  $(6x-2)^2$ 20)  $(-4x-9)^2$ 

# **25 Factorising**

#### **Exercise 1**

## Factorise

1)	3x + 6	2)	5x - 15	3)	6x - 15
4)	4 <i>z</i> + 12	5)	8y + 20	6)	18y – 6
7)	16x - 20	8)	16x - 24	9)	14 <i>a</i> – 16
10)	24x + 36y	11)	24x + 16y	12)	21a + 14b
13)	8x - 18z	14)	18y + 27z	15)	24p - 40q
16)	3a + 3	17)	16x + 16	18)	$5 - 5x^2$
19)	6a - 4b + 8c	20)	5a + 10b - 5c	21)	12 - 9a + 3b

#### Exercise 2

Factorise

1)	$2a - a^2$	2)	$6y - y^2$	3)	$9x - x^2$
4)	$x^2 - 3x$	5)	$3a + 6a^2$	6)	$4b - b^2$
7)	$2y + 4y^2$	8)	$5x^2 - 10x$	9)	$4z^2 - 12z$
10)	$6x - 9x^2$	11)	$16y^2 + 20y$	12)	$32z - 16z^2$
13)	$20a - 35a^2$	14)	$18x^2 - 15x$	15)	$27a^2 - 18a$

## Exercise 3

Factorise

1)	ab+2a	2)	4x - xy	3)	6 <i>a</i> – 2 <i>ab</i>
4)	$3a + 6a^2$	5)	$9x^2 - 6x$	6)	$2xy + 6x - x^2$
7)	$12ab - a + a^2$	8)	$7a^2 - 14ab$	9)	$4\pi r^2 - 6\pi rh$
10)	$20xy + 5y^2$	11)	16xy - 8xyz	12)	$8pq - 4p^2q$
13)	$26p^2q - 13pq^2$	14)	$9ab^2 - a^2b$	15)	$16x^2y - 12xy^2$

#### Exercise 4 (mixed)

Factorise

2a+4b	2)	$3ah-a^2$	3)	5a + 15b + 10c
$3y^2 + 21y$	5)	$4abc-12bc^2$	6)	$6xy - 14x^2y^2$
$14x^2 - 32y$	8)	$7x^2y + 14x$	9)	$3\pi d - 7\pi d^2$
16a + 30x	11)	$9ab - 27b^2$	12)	$16a + 48a^2$
$8a + 6a^2 - 2ab$	14)	$8x^2 + 2y - 6z$	15)	$x + x^2 + xy$
	2a + 4b $3y^{2} + 21y$ $14x^{2} - 32y$ 16a + 30x $8a + 6a^{2} - 2ab$	$2a + 4b$ 2) $3y^2 + 21y$ 5) $14x^2 - 32y$ 8) $16a + 30x$ 11) $8a + 6a^2 - 2ab$ 14)	$2a + 4b$ 2) $3ah - a^2$ $3y^2 + 21y$ 5) $4abc - 12bc^2$ $14x^2 - 32y$ 8) $7x^2y + 14x$ $16a + 30x$ 11) $9ab - 27b^2$ $8a + 6a^2 - 2ab$ 14) $8x^2 + 2y - 6z$	$2a + 4b$ 2) $3ah - a^2$ 3) $3y^2 + 21y$ 5) $4abc - 12bc^2$ 6) $14x^2 - 32y$ 8) $7x^2y + 14x$ 9) $16a + 30x$ 11) $9ab - 27b^2$ 12) $8a + 6a^2 - 2ab$ 14) $8x^2 + 2y - 6z$ 15)

# **26 Equations**

Find the value of the letter in each of the following equations

### Exercise 1

1)	x + 4 = 6	2)	x + 7 = 17	3)	7 + y = 19
4)	x - 2 = 4	5)	y - 7 = 11	6)	a - 9 = 18
7)	6 - y = 4	8)	12 - x = 2	9)	19 - x = 5
10)	12 <i>a</i> = 36	11)	6x = 42	12)	8 <i>y</i> = 36
13)	7b = -35	14)	4y = -24	15)	4b = -10
16)	4a + 2 = 10	17)	9a + 6 = 33	18)	12x + 6 = 30
19)	7x - 3 = 18	20)	12x - 7 = 17	21)	6x - 7 = 35
22)	4y + 4 = 14	23)	3b + 2 = -4	24)	6y - 5 = -35

## Exercise 2

1)	x + 3 = 2x	2)	6x - 5 = 5x	3)	7x - 6 = 6x
4)	3x + 5 = 4x	5)	2x + 3 = 3x	6)	4x + 2 = 5x
7)	4x - 12 = 2x	8)	5x - 6 = 2x	9)	4x - 7 = 2x
10)	3x + 6 = 5x	11)	8x + 5 = 10x	12)	7x + 7 = 9x
13)	4x + 2 = 2x	14)	4x + 4 = -12	15)	3x - 2 = x + 6
16)	x + 7 = 2x - 2	17)	6x - 12 = 3x + 12	18)	5x - 2 = 2x + 4
19)	4x + 9 = 2x + 15	20)	3x + 7 = 2x - 1	21)	4x + 3 = 2x - 3

#### Exercise 3

1)	2(x+1) = 8	2)	3(x-1) = 9	3)	5(x+2) = 15
4)	4(x+2) = 36	5)	7(x-2) = 21	6)	2(2x+1) = 26
7)	3(2x-1) = 27	8)	2(5x+4) = 28	9)	3(3x-7) = 15
10)	2(x+1) = 3x	11)	4(x-2) = 3x	12)	5(x+6) = 15x
13)	2(2x+3) = 10x	14)	3(2x-5) = 3x	15)	6(2x+7) = 33x
16)	3(2x+1) = 8x - 5	17)	6(x-6) = 4x + 4	18)	4(3x+2) = 11x + 18
19)	4(x+3) = 5(3x-2)	20)	2(x+3) = 4(2x-9)	21)	3(2x-1) = 5(3x-15)
22)	2(x+1) + x = 11	23)	3(2x-2) + x = 29	24)	5(3x+2) - 4x = 87

# **27 More Equations**

Find the value of the letter in each of the following

#### **Exercise 1**

1)	$\frac{1}{2}x = 6$	2)	$\frac{1}{3}x = 4$	3) $\frac{1}{6}x = 8$
4)	$\frac{3x}{4} = 6$	5)	$\frac{7x}{10} = 14$	6) $\frac{2x}{3} = 12$
7)	$\frac{7}{9}x = 14$	8)	$\frac{7}{4}x = 21$	9) $\frac{13}{4}x = 39$
10)	$\frac{1}{2}x + 2 = 5$	11)	$\frac{1}{4}x + 7 = 15$	12) $\frac{1}{6}x - 3 = 12$
13)	$\frac{2}{3}x + 5 = 13$	14)	$\frac{3}{4}x - 3 = 6$	15) $\frac{2}{5}x + 3 = 9$
16)	$\frac{7}{9}x - 6 = 1$	17)	$\frac{5}{6}x + 2 = 17$	18) $\frac{6}{7}x + 2 = 14$
19)	$\frac{x+3}{3} = 3$	20)	$\frac{2x+4}{7} = 2$	21) $\frac{3x-2}{4} = 4$
22)	$\frac{3x+3}{6} = 4$	23)	$\frac{5x+4}{7} = 2$	24) $\frac{3x-7}{2} = 16$
25)	$\frac{x}{3} + \frac{x}{4} = 14$	26)	$\frac{2x}{5} + \frac{x}{4} = 13$	27) $\frac{x}{3} - \frac{x}{7} = 12$
28)	$\frac{x-1}{3} + \frac{x+2}{2} = 34$	29)	$\frac{2x-1}{3} - \frac{x+1}{4} = 4$	$30) \ \frac{3(x+2)}{5} = 6$
31)	$\frac{1}{2}(x+2) + \frac{1}{3}(x-1) = 4$		32) $\frac{1}{4}(10)$	$(-x) + \frac{1}{3}(x+7) = 5$
33)	$\frac{1}{4}(x+5) + \frac{1}{2}(1+x) = 7$		34) $\frac{3}{4}(8)$	(x-1) = 8
35)	$\frac{1}{2}(x-2) + \frac{1}{4}(x-1) = 1$		36) $\frac{3}{4}(x - x)$	$(+11)-\frac{2}{3}(17-x) = 4$

## Exercise 2

1) $(x-2)(x-3) = 0$	2) $(x+1)(x-5) = 0$	3) $(x+2)(x+5) = 0$
4) $(x+2)(x-3) = 0$	5) $(x+6)(x-2) = 0$	6) $(5x+20)(x+1) = 0$
7) $x^2 + 5x + 6 = 0$	8) $x^2 - 5x + 6 = 0$	9) $x^2 + 5x + 4 = 0$
10) $x^2 - 5x + 4 = 0$	11) $x^2 + 11x + 18 = 0$	12) $x^2 - 11x + 18 = 0$
13) $x^2 - 7x + 10 = 0$	14) $x^2 + 9x + 20 = 0$	15) $x^2 + 7x + 12 = 0$
16) $x^2 - 3x - 10 = 0$	17) $x^2 + 5x - 6 = 0$	$18) \ x^2 - 9x - 10 = 0$
$19) \ x^2 + 5x - 14 = 0$	$20) \ x^2 - 8x - 20 = 0$	21) $x^2 - 4x - 21 = 0$
$22) \ x^2 - 6x + 9 = 0$	23) $x^2 - 10x + 25 = 0$	24) $x^2 - 4x - 32 = 0$

### 28 Straight Line Graphs and Simultaneous Equations

#### **Exercise 1**

Draw the graph of each of the following equations

1)	y = x + 1	2)	y = x + 3	3)	y = x + 4
4)	y = x - 2	5)	y = x - 6	6)	y = x - 4
7)	y = -x + 1	8)	y = -x + 5	9)	y = -x - 3
10)	y = 2x + 1	11)	y = 3x - 1	12)	y = 4x - 6
13)	y = -2x + 1	14)	y = -3x - 4	15)	y = -4x - 7
16)	$y = \frac{1}{2}x + 1$	17)	$y = \frac{1}{3}x + 3$	18)	$y = \frac{1}{2}x - 3$
19)	$y = -\frac{1}{3}x - 2$	20)	$y = -\frac{1}{2}x + 1$	21)	$y = -\frac{1}{4}x + 7$
22)	y = 3 + x	23)	y = 4 - x	24)	y = -1 + x
25)	$y = 3 - \frac{x}{2}$	26)	$y = 5 + \frac{x}{3}$	27)	$y = 7 - \frac{x}{4}$
28)	3x + 2y = 6	29)	4x + 5y = 20	30)	6x + 4y = 24
31)	4x - 5y = 0	32)	6x - 3y = 0	33)	4y - 3x = 0
34)	x + 3 - y = 0	35)	x - y - 2 = 0	36)	4 + x - y = 0
37)	2x + y - 2 = 0	38)	y + 2x + 3 = 0	39)	x + 2 - 2y = 0

#### **Exercise 2**

Solve each of the following pairs of simultaneous equations by drawing them. All diagrams can be drawn on axes where x lies between -3 and 6, and y lies between -4 and 6.

- 1) y = x and 3x + 3y = 92) y = 4x and 2x + y = 6
- 3) 3x + 2y = 12 and y = x + 14)  $y = \frac{1}{2}x + 3$  and x + y = 6
- 5) y = x 4 and y = -x6) y = 2x + 2 and 2x + y = 4
- 7) y = 3x 3 and  $y = \frac{x}{2} + 2$ 8) x + y = 5 and  $y = \frac{x}{3} + 1$
- 9) y = 2x + 4 and 2x + 4y = 110) y - x = 0 and 2y - x - 3 = 0
- 11) x + y + 2 = 0 and 2y = x 112)  $y = x + \frac{3}{2}$  and 2x + y = 6
- 13) 2y = 3x 3 and  $y = \frac{1}{3}x + 2$ 14) y = 2x + 5 and x + y = 2

### **29 Trial and Improvement**

#### **Exercise 1**

Calculate the value of *x*, correct to 1 decimal place for each of the following, using a trial and improvement method. Show all your attempts.

1)  $x^3 = 41$ 2)  $x^3 = 57$ 3)  $x^3 = 86$ 4)  $x^3 = 97$ 5)  $x^3 = 132$ 6)  $x^3 = 77$ 7)  $x^3 = 60$ 8)  $x^3 = 117$ 9)  $x^3 = 142$ 

#### **Exercise 2**

By using a suitable trial and improvement method find the value of x, correct to one decimal place, which satisfies each of the following equations. Show all your attempts.

- 1)  $x^2 + x = 23$ 2)  $x^2 + x = 37$ 3)  $x^2 x = 45$ 4)  $x^2 4x = 49$ 5)  $x^2 + 3x = 23$ 6)  $x^2 + 5x = 32$ 7)  $x^2 2x = 41$ 8)  $x^2 4x = 57$ 9)  $x^3 + x = 67$ 10)  $x^3 + 2x = 55$ 11)  $x^3 x = 67$ 12)  $x^3 3x = 100$
- 13) If  $x^2 = 30$ , find the value of x correct to 1 decimal place.
- 14) If  $x^2 + x = 27$ , what is the value of x correct to 1 decimal place?
- 15) Calculate the value of x in the equation  $x^2 + 3x = 36$ , correct to one decimal place.
- 16) Solve the equation  $x^3 3x = 40$ , correct to 1 decimal place.
- 17) A square has an area of 32cm<sup>2</sup>. Use a trial and improvement method to calculate the length of one side.
- 18) The longer side of a rectangle is 3 cm greater than the shorter side. If its area is 24cm<sup>2</sup> use a trial and improvement method to calculate the size of the shorter side?
- 19) The perpendicular height of a right angled triangle is 5cm more than its base. If its area is  $92 \text{cm}^2$ , what is the length of its base.
- 20) A cuboid has a height and length which are each 6cm greater than its width. If its volume is 600cm<sup>3</sup>, calculate its width correct to one decimal place.

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# **30 Inequalities**

Solve these inequalities in the form  $x \ge a$  number,  $x \le a$  number, x > a number or x < a number.

1) $x + 1 > 4$	2) $x + 2 < 5$	3) $7 < 2 + x$
4) $x + 2 < 8$	5) $x - 3 > 7$	6) $3 > x - 7$
7) 3 <i>x</i> ≥ 12	8) $5x \ge -25$	9) $25 \ge 5x$
10) $2x + 1 \ge 7$	11) $3x - 6 < 6$	12) $3 < 6x + 39$
13) $6x - 26 \le 10$	14) $5x + 5 \ge 40$	15) $3x + 7 < 40$
16) $6 > x - 3$	17) 12 < <i>x</i> + 20	18) $15 > x + 7$
19) $14 + 3x \le 38$	20) $18 + 2x < 60$	21) $15 + 3x \le 45$
22) $x + 4 > 3x - 8$	23) $x - 3 > 2x + 11$	24) $x - 7 < 3x - 1$
25) $4x + 3 \ge 3x - 7$	26) $5x - 6 \le 2x + 9$	27) $3x + 9 \ge 5x + 2$
28) $7x - 12 < 3x - 2$	29) $5x - 15 > 3x + 2$	30) $4x + 15 < 3x + 22$
31) $\frac{1}{2}x - 7 \le 4$	32) $\frac{1}{3}x - 3 \le 2$	33) $\frac{1}{8}x + 7 \le 2$
34) $\frac{1}{4}x + 15 > 12$	35) $\frac{1}{5}x - 6 > 10$	36) $\frac{1}{6}x + 3 > 10$
37) $7 - \frac{1}{3}x \le \frac{2}{3}x - 3$	$38) \ 9 - \frac{4}{5}x > \frac{1}{5}x + 4$	$39) \ 12 - \frac{3}{8}x > \frac{5}{8}x + 7$
40) $3(x+2) > 12$	41) 2( <i>x</i> + 8) >12	42) $2(2x+7) > 10$
43) $2(2x+4) \le -6$	44) 2( $3x + 2$ ) $\leq 16$	45) $2(4x+4) \le 32$
46) $3x - 5 > 2(x + 1)$	47) $4x + 3 > 3(x + 4)$	48) $9x - 3 > 3(2x + 5)$
$49) 4(x+2) \le 2x + 20$	50) $5(x-7) \ge 3x + 15$	51) 6( $x - 7$ ) $\le 3x + 18$
### **31 Inequalities - Graphs**



- 3) Using a scale of 0 to 8 on the x axis and 0 to 10 on the y axis, plot the following graphs; y = x, y = 7 and y = 4. Shade in the region which satisfies all the inequalities y < x, x < 7 and y > 4.
- 4) Using a scale of 0 to 9 on the x axis and 0 to 9 on the y axis, plot the following graphs; y = x, y = 6 and 8x + 8y = 64. Shade in the region which satisfies all the inequalities y > x, y < 6 and 8x + 8y > 64.
- 5) Using a scale of 0 to 8 on the *x* axis and 0 to 10 on the *y* axis, plot the following graphs;  $y = \frac{1}{2}x$ , x = 2 and 8x + 5y = 40. Shade in the region which satisfies all the inequalities  $y > \frac{1}{2}x$ ,  $x \ge 2$  and 8x + 5y < 40.
- 6) Using a scale of 0 to 8 on the x axis and -6 to 6 on the y axis, plot the following graphs; y = x 3, x = 6 and y = -x. Shade in the region which satisfies all the inequalities y < x 3, x < 6 and y > -x. Which of the following points lie within this region? (2,1), (4,-2), (5,2), (5,1)
- 7) Using a scale of 0 to 8 on the x axis and 0 to 8 on the y axis, plot the following graphs;  $y = -\frac{1}{2}x + 3$ , x = 1 and 7x + 6y = 42. Shade in the region which satisfies all the inequalities  $y \ge -\frac{1}{2}x + 3$ , x > 1 and 7x + 6y < 42. Which of the following points lie within this region? (2.4) (5.4) (3.2) (4.1)

Which of the following points lie within this region? (2,4), (5,4), (3,3), (4,1).

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# 32 Rearranging Formulae

Rearrange each of the following formulae to make its subject the letter indicated in the brackets.

1) $C = \pi D$	( <i>D</i> )	2) $C = 2\pi r$	( <i>r</i> )
3) F = ma	( <i>m</i> )	4) V = lbh	( <i>h</i> )
$5) A = \frac{1}{2}bh$	<i>(h)</i>	$6) = \frac{1}{3}\pi r^2 h$	( <i>h</i> )
7) y = mx + c	(c)	8) y = mx + c	<i>(m)</i>
9) $v = \pi r^2 h$	<i>(h)</i>	10) $v = \pi r^2 h$	( <i>r</i> )
11) $C = \frac{5}{9}(F - 32)$	(F)	12) $y = \frac{2}{3}(a+b)$	<i>(b)</i>
$13) v^2 = 2gh$	( <i>h</i> )	14) $v^2 = u^2 + 2as$	<i>(s)</i>
15) = $ut + \frac{1}{2}at^2$	<i>(a)</i>	16) $s = \frac{1}{2}(u+v)t$	(v)
17) $N = 2\pi \sqrt{l}$	( <i>l</i> )	18) $X = 4lr^2$	( <i>r</i> )
19) $A = \frac{2x+y}{3}$	<i>(x)</i>	20) $p = \frac{(x-y)^2}{6}$	( <i>x</i> )
$21) p = \frac{Rx^2}{2y}$	( <i>x</i> )	$22) C = \frac{Dx^2}{zy}$	(y)
$23) I = \frac{x}{y} \sqrt{w}$	(w)	$24) I = \frac{PTR}{100}$	( <i>R</i> )
$25) C = d + t \sqrt{x}$	<i>(x)</i>	26) $A = \pi (R^2 - r^2)$	(R)
27) $A = \pi (R^2 - r^2)$	( <i>r</i> )	28) $x = 2a + b^2$	<i>(b)</i>
$29) \ a = \sqrt{\frac{C(x-c)}{b}}$	(b)	$30) \ x = \sqrt{\frac{a}{a+b}}$	<i>(b)</i>

### **33 Bearings**

#### **Exercise 1**

Draw diagrams to show the following bearings. 1) A is 030° from B 2) C is 315° from D 3) G is 153° from H 4) J is 232° from K 5) L is 317° from M 6) P is 208° from Q 7) R is 098° from T

8) U is  $076^{\circ}$  from V

#### Exercise 2

By measuring these angles, write down the bearing of point P from point A in each case.



#### Exercise 3

- 1) If the bearing of A from B is 324° what is the bearing of B from A?
- 2) If the bearing of C from D is  $234^{\circ}$  what is the bearing of D from C?
- 3) A ship sails from port P on a bearing of 035° for 6km until it reaches point X. It then changes course onto a bearing of 132° for a distance of 8km until it reaches point Y. Draw the ship's path accurately using a scale of 1cm to 1km. What is the bearing and distance of point Y from the port P?
- 4) An aeroplane flies from airport A on a bearing of 202° for 75km until it reaches point B. It then changes course onto a bearing of 222° for a distance of 80km until it reaches point C. Draw the aircraft's path accurately using a scale of 1cm to 10km. What is the bearing and distance of point C from the airport A?

# **34** Parallel Lines

In each of the following diagrams find the sizes of the marked angles.



# 35 Nets and Isometric Drawing

- 1) Draw the net of a cube whose sides are 4cm.
- Draw the net of this cuboid. Also draw, on triangular dotty paper or isometric paper, a cuboid whose volume is the same as this one.
- 3) This diagram shows part of the net of a triangular prism.Copy and complete the diagram.On triangular dotty paper or isometric paper, draw a diagram of the shape.
- 4) Draw the net of this triangular prism
- ) The diagram on the right shows part of the net of a square based pyramid. Copy and complete the diagram. On triangular dotty or isometric paper, sketch a diagram of the shape.
- 6) The diagram shows a square based pyramid. Its base edges measure 3cm and its sloping edges are 6cm. Draw the net of its shape.
- 7) The diagram shows part of the net of a rectangular based pyramid. Copy and complete the diagram. On triangular dotty or isometric paper, sketch a diagram of the shape.
- 8) The diagram shows a rectangular based pyramid. Its base edges measure 2.5cm and 4cm and its sloping edges are each 5cm. Draw the net of the shape.



# **36 Triangles**

Calculate the sizes of each of the marked angles.



## **37 Regular Polygons**

Calculate the interior and exterior angles in each of the regular shapes in questions 1 to 4.

- 1) A Hexagon
- 2) A Nonagon (9 sides)
- 3) A 12 sided figure
- 4) A 20 sided figure
- 5)



ABCDE is a regular pentagon.Line BF is a line of symmetry.a) What is the size of angle *x*?b) Calculate the sizes of angles *y* and *z*.

ABCDEFGH is a regular octagon. CG is a line of symmetry. Calculate the sizes of angles *p*, *q*, *r*, *s* and *t*.

ABCDEFG is a regular heptagon. Three lines of symmetry are shown. What are the sizes of angles v, w, x, y and z?

- 8) What is the order of rotational symmetry of a regular octagon?
- 9) Explain why a regular pentagon will not tessellate and a regular hexagon will.
- 10) How many lines of symmetry has a regular nonagon?

D

11) ABCDEFGHIJ is a regular 10 sided polygon (decagon) with centre O (where the lines of symmetry cross). Calculate the sizes of the angles ABC and AOC.

6)

7)





E

# **38 Irregular Polygons**

- 1) A quadrilateral has internal angles of 90°, 100° and 105°. What is the size of the fourth angle?
- 2) A hexagon has angles of 100°, 110°, 115°, 130° and 140°. What is the size of the sixth angle?
- 3) An octagon has six angles of 145°. If the remaining two angles are equal, what is the size of them?
- 4) A heptagon has six angles each of 130°. What is the size of the other angle?
- 5) A decagon has two angles of the same size and a further eight angles of twice the size. What are the sizes of the angles?
- 6) What is the size of the angle *x*?
- 7) This hexagon is symmetrical about the line AD. The angles at A and B are 140° and 110°. If the side BC is parallel to FE and the angle at C is twice the angle at D, what are the sizes of the other angles?
- 8) The pentagon ABCDE has three angles of 90°. If the other two angles are equal, what are their size?
- 9) In the diagram, the octagon has two lines of symmetry. There are two different sizes of angle in the shape. If one of them is 130°, what is the other?
- 10) The diagram shows the cross section of a steel bar.It is symmetrical about the line AB. If it has six interior angles of 90° and another of 160°, what are the sizes of the other interior angles?



Β

### 39 Pythagoras' Theorem

1) Calculate the length of the hypotenuse in each of the following triangles



2) Calculate the length of the side marked *x* in each of the following right angled triangles.



- 7) Calculate the length of the diagonal of a rectangle measuring 9cm by 12cm.
- 8) A rhombus has diagonals of 7cm and 4cm. Find the length of its sides.
- 9) A square has a side of 7cm. Find the length of its diagonals.
- 10) How far from the centre of a circle of radius 7cm is a chord of length 7cm
- 11) A ladder rests against a wall. The ladder is 5 metres long. The base of the ladder is 2m from the foot of the wall. How far up the wall will the ladder rest?
- 12) A ladder, 6 metres long, rests against the side of a house. The ladder reaches 5 metres up the side of the house. How far, to the nearest centimetre, is the bottom of the ladder from the base of the house?
- 13) Calculate the length of the side of a square whose diagonal is 12 cm.

Use the sine ratio

1) Calculate the length of the unknown side (*x*) in each of the following triangles.



2) Calculate the sizes of the unknown angles in each of the following triangles.



3) Calculate the length of the unknown side (*x*) in each of the following triangles



Use the cosine ratio

1) Calculate the length of the unknown side (*x*) in each of the following triangles.



2) Calculate the sizes of the unknown angles in each of the following triangles.



3) Calculate the length of the unknown side (*x*) in each of the following triangles



Use the tangent ratio 1) Calculate the length of the unknown side (*x*) in each of the following triangles.



2) Calculate the sizes of the unknown angles in each of the following triangles.



3) Calculate the length of the unknown side (x) in each of the following triangles.





- i) A ladder, 4.5 metres long, rests against a wall at an angle of 21° to the wall. How far up the wall does the ladder reach and how far is its base from the wall?
- j) The angle between the diagonal and longest side of a rectangle is 34°. If the longest side measures 6cm, what is the length of the shortest side?
- k) A swimming pool is 15 metres long. If its depth varies from 1 metre to 2.5 metres, at what angle to the horizontal is its base?



y

1) The diagram shows a square A, B, C, D. Copy this diagram and show the reflections a) A', B', C', D' about  $\mathbf{D}$ the line y = xb) *A*", *B*", *C*", *D*" about the line y = -x2) The diagram shows a rectangle A, B, C, D. Copy this diagram and show the reflections a) *A*', *B*', *C*', *D*' about the x axis b) *A*", *B*", *C*", *D*" about the y axis 3) The diagram shows a triangle A, B, C. Copy this diagram and show the reflections a) A', B', C' about the line y = xb) *A*", *B*", *C*" about the line y = -x

1) The diagram below shows the triangle A, B, C. Copy this diagram and show the rotation a) to  $A_1$ ,  $B_1$ ,  $C_1$  of 90° clockwise about (0,0) b) to A<sub>2</sub>, B<sub>2</sub>, C<sub>2</sub> of 90° anticlockwise about (0,0) Also show the translation  $\begin{pmatrix} -6 \\ -6 \end{pmatrix}$  to A<sub>3</sub>, B<sub>3</sub>, C<sub>3</sub>. у 6 2) The diagram below shows the rectangle A, B, C, D. Copy this diagram and show the rotation a) to A', B', C', D' of 90° clockwise about (-1,2)b) to A", B", C", D" of 180° about (-1,2) y 3 -6

- The diagram below shows the hexagon A, B, C, D, E, F. Copy this diagram and show:
   a) the rotation to A', B', C', D', E', F' of 90° clockwise about (0,0)
  - b) the translation  $\begin{pmatrix} -2 \\ -3 \end{pmatrix}$  to A", B", C", D", E", F",



- 2) The diagram below shows the parallelogram A, B, C, D. Copy this diagram and show
  - a) the rotation to A', B', C', D' of  $90^{\circ}$  clockwise about (0,0)
  - b) the translation  $\begin{pmatrix} -4 \\ -4 \end{pmatrix}$  to A", B", C", D".



### **48** Enlargements 1

1) The diagram shows a rectangle A, B, C, D.

Copy this diagram and enlarge it by a scale factor of 2 through the point (0,0)



2) The diagram shows a triangle A, B, C.Copy this diagram and enlarge it by a scale factor of 3 through the point (0,0



### 49 Enlargements 2

1) The diagram shows a rectangle A, B, C, D.

Copy this diagram and enlarge it by a scale factor of  $2\frac{1}{2}$  through the point (-4, -3)



2) The diagram shows a triangle A, B, C.

Copy this diagram and 'enlarge' it by a scale factor of  $\frac{1}{2}$  through the point (2,-3)



#### **50 Similar Shapes**

1) The two triangles below, ABC and DEF are similar.

- a) Which angle is equal to angle CAB?
- b) What is the scale factor between triangles ABC and DEF?
- c) Calculate the size of side DE.
- d) Calculate the size of side AC.



- 2) The diagrams below show the fronts of two similar garden sheds.
  - a) What is the ratio of the lengths of the smaller shed to the larger one?
  - b) What is the width of the larger shed?
  - c) What is the total height of the smaller shed?



# **51 Locus Problems 1**



# 52 Locus Problems 2

1) A house has external dimensions of 16 metres by 10 metres. It has security lights on each corner with detectors which can recognise movement up to a distance of 8 metres.

Using a scale of 1cm to represent 4 metres, shade in the area in which it will detect movement.

- 2) The entrance to a yachting marina is though a gap in the breakwater. The breakwater is 10 metres wide and the gap is 20 metres. Yachts cannot go within 6 metres of the breakwater. Using a scale of 1 cm to represent 2 metres, shade in the area around the breakwater within which yachts are not allowed.
- 3) A field is watered through a nozzle which moves along a fixed rail 40 metres long. Water can reach up to a distance of 10 metres from the nozzle. Using a scale of 1cm to represent 4 metres, draw a diagram to show the area which can be covered by the water.



4) The diagram shows the plan of a house and garden. A tree is to be planted which must be at least 10 metres from the house and 5 metres from each of the fences. It also has to be at least 6 metres from the apple tree, located in the corner of the garden, 4 metres from each of the two fences. Using a scale of 1cm to represent 10 metres, copy this diagram and shade in the area in which the tree can be planted.



5) An aeroplane's course is determined by three radar stations, A, B and C. C is 15km north of B and A is 12km west of B. An aeroplane must always be the same distance from A and B until it is 10km from C when it turns due west. By construction, show the course of the aeroplane with respect to the three stations. Use a scale of 1cm to represent 2km. How far from B is the aeroplane when it alters course?



# **53 Degree of Accuracy**

#### Exercise 1.

1) Round off each of the following n	umbers to the accuracy stated.	
a) 4321 to the nearest thousand.	b) 5226 to the nearest	st hundred.
c) 457 to the nearest ten.	d) 784 to the nearest	t hundred.
e) 14640 to the nearest thousand.	f) 23457 to the near	est thousand.
2) Round off the number 23297.		
a) to the nearest ten.	b) to the nearest hu	ndred.
c) to the nearest thousand.	d) to the nearest ten	thousand.
3) Which of these numbers can be ro	ounded off to 25000?	
a) 25432 b) 24953	c) 24436 d) 2553	57
e) 25500 f) 25499	g) 24500 h) 2449	9
4) State the limits between which the	e following whole numbers lie. Each h	as been rounded off
in the way shown in the brackets.		
a) 1300 (to the nearest 100)	b) 2500 (to the nearest 1	.00)
c) 4200 (to the nearest 100)	d) 23000 (to the nearest	1000)
e) 70000 (to the nearest 10000)	f) 7000 (to the nearest 1	000)
g) 205000 (to the nearest 1000)	h) 240 (to the nearest 10	)
i) 750 (to the nearest 10)	j) 1350 (to the nearest 1	0)
Francisa 7		
Copy these diagrams into your book	and fill in the blanks with either a pur	mber < or <
1)	and fin in the blanks with either a num	$10001, < 01 \leq .$
1)		
120 120	0.5 121 ?	
A length of	121 cms to the nearest centimetre	
1	$120.5 \leq \text{Length} < \dots$	

2)					
	129	129.5	130	130.5	131
	A le	ength of 130	cms to the r	nearest centin	netre
		129.5	Length .	130.5	
3)					
	r	?	19.3	19.35	19.4

? 19.3 19.35 19.4 A time of 19.3 seconds, to the nearest 0.1 second.  $\dots \leq \text{time} \dots 19.35$ 

7.81 ? 7.82 ? 7.83  
A mass of 7.82 Kg to 2 decimal places  
$$\dots \leq Mass < \dots$$

5)

4)

2.6	2.605	2.61	2.615	2.62
	A capacity of	2.61 litres c	correct to 2 d.p.	
	2.605	. capacity	2.615	

#### Exercise 3.

Each of these values has been rounded to the last figure shown. Write down their limits.

1) 9.4 seconds 2) 62.3 mm 3) 19.5 kg 4) 27.6 kilometres 5) 19.62 metres 6) 25.64 seconds 7) 16 mg 8) 17.3 litres 9) 37.3 centimetres 10) 6.48 tonnes 11) 9.34 ml 12) 1.33 seconds

Intermediate level

# 54 Circumference of a Circle.

In each of the following questions use  $\pi = 3.142$  or use the  $\pi$  button on your calculator.

#### **Exercise 1**

Calculate the circumference of each of the following circles

1) Radius 4cm	2) Radius 6cm	3) Radius 10cm
4) Radius 18 metres	5) Radius 8 metres	6) Radius 7 metres
7) Diameter 12cm	8) Diameter 16cm	9) Diameter 24cm
10) Diameter 2.3m	11) Diameter 17m	12) Diameter 23m

#### Exercise 2

Calculate the diameters of circles with the following circumferences (correct to 4 significant figures)

1) 20cms	2) 105 cms	3) 2.3metres
4) 15metres	5) 256cms	6) 176metres

#### **Exercise 3**

1) A car wheel has a diameter of 50cm. How far will the car travel if the wheel turns 5 times?

2) If the same car wheel turns 500 times, find the distance travelled correct to the nearest metre.

- 3) A hose pipe is stored by winding it around a drum of diameter 70cms. If it makes 12 turns, how long is the hose correct to the nearest metre?
- 4) A car has a wheel diameter of 55cms. How many revolutions does it make while travelling a distance of 1 kilometre? (give your answer correct to the nearest whole number)
- 5) A length of cotton measuring 2 metres is wound around a cotton reel of diameter 3cms. How many turns does it make? (correct to the nearest turn)
- 6) A bicycle wheel has a diameter of 65cms. How many turns will it make while travelling a distance of 2km?
- 7) Another bicycle travels 2km and its wheels each turn 1157 times. Calculate the diameter of its wheels, correct to the nearest cm.
- 8) A pulley wheel, of diameter 1.3 metres, raises a lift in a hotel from the ground floor to the 9th floor. In doing so it makes 9 complete turns. What is the distance, correct to the nearest centimetre, between each floor?.
- 9) An artificial lake is in the shape of a circle of diameter 200 metres and has a path running around it. It is planned to hold a 10 kilometre race around the lake. How far apart, to the nearest metre, must the start and finish be?

### **55 Area and Perimeter**

1) Calculate the areas and perimeters of rectangles measuring;a) 3cm by 3cmb) 6cm by 8cmc) 9cm by 3.4cmd) 8.4cm by 9.3cme) 1.2 metres by 80cmf) 160cm by 0.9 metres.

2) Calculate the areas of the following shapes;



3) Calculate the areas of the following circles. Use  $\pi = 3.142$  or the  $\pi$  button on your calculator. Give your answer correct to 1 decimal place.

a) Radius 3cm	b) Radius 7.5cm	c) Radius 19cm
d) Diameter 7cm	e) Diameter 3.6cm	f) Diameter 17.4cm

4) Calculate the areas of the shaded parts of each of the following shapes.



- 5) How many 30cm square tiles are needed to cover the floor of a room measuring 3 metres by  $4\frac{1}{2}$  metres?
- 6) A lawn is in the shape of a quarter circle. If its radius is 8 metres, calculate its area and perimeter.

# 56 Volume

2) 0.003 cm<sup>3</sup> into mm<sup>3</sup>

8) 53.000 ml into litres

10) 0.003 litres into ml.

6) 1,200,000 cm<sup>3</sup> into m<sup>3</sup>

4)  $0.015 \text{m}^3$  into  $\text{cm}^3$ 

#### Exercise 1

Without using a calculator, change;

- 1)  $2 \text{cm}^3$  into  $\text{mm}^3$
- 3)  $3.4m^3$  into  $cm^3$
- 5) 550,000 mm<sup>3</sup> into cm<sup>3</sup>
- 7)  $0.5m^3$  into litres
- 9) 28 litres into ml

### Exercise 2

- 1) A cardboard box is in the shape of a cuboid measuring 6cm by 12cm by 15cm. Calculate its volume.
- 2) A large cardboard box has internal base dimensions of 80cm by 50cm and a height of 60cm. It is to be packed with smaller boxes measuring 10cm by 12cm by 16cm. How many boxes can be put on the bottom layer and how many of these layers can be put in altogether?
- 3) A trench 0.7m wide by 1.2m deep and 20 metres long is dug on a building site. Calculate the amount of earth removed.
- 4) A cylindrical drinks can has a base of 7cm and a height of 10cm. Calculate; a) its volume in cm<sup>3</sup> and b) its capacity correct to the nearest ml.
- 5) A water tank, in the shape of an open cuboid, has a base measuring 50cm by 60cm and a height of 30cm. How many litres of water will it hold?
- 6) A circular pond of 4m diameter and 25cm depth is filled with water. How many litres are needed?
- 7) A rolling pin is made from 3 pieces of wood as shown below. The thicker piece is 5cm in diameter and 35cm long. The two end pieces are each 2.3cm in diameter and 10cm long. If 1cm<sup>3</sup> of this wood weighs 0.75g, find its total weight.



- 8) A beaker is in the shape of a cylinder with a base diameter of 5cm and a height of 9cm. How many times can the beaker be completely filled from a jug holding 2 litres?
- 9) A metal tube has an outside diameter of 1.5cm and a thickness of 4mm. If its length is 5m, calculate the volume of metal it contains to the nearest cm<sup>3</sup>.
- 10) An open tank, in the form of a cuboid, can hold 400 litres of water. If its base has dimensions of 50cm by 80cm, what is its height?
- 11) A water tank, in the shape of an open cuboid, has a base measuring 50cm by 70cm and a height of 30cm. It has water in it to a depth of 20cm. A metal cube of sides 12cm is lowered into the water. By how much will the water rise?
- 12) A swimming pool is 0.8m deep at the shallow end and 2m deep at the other end. If its length is 25m and its width is 10m, calculate its capacity in litres.



# 57 Compound Measure - Speed and Density

### **Exercise 1. Speed**

- 1) A car travels at the following speeds (a) 40 mph (b) 30 mph (c) 60 mph. In each case say how far the car travels in
  - (i)  $\frac{1}{2}$  hour (ii) 2 hours (iii)  $\frac{1}{4}$  hour
- 2) A train goes from Chester to London, a distance of 200 miles. It travels at a speed of 80 mph.(a) How far does it travel in 2 hours?
  - (b) How far will it travel in  $\frac{1}{2}$  hour
  - (c) How long will it take to travel from Chester to London?
- 3) (a) A train travels between two towns, A and B. Its average speed is 60mph.

The train takes  $1\frac{1}{2}$  hours. How far apart are the towns?

(b) Another train makes the same journey. This train takes 2 hours. What is its average speed?

- 4) Jane travels to London down the motorway. She travels the first 75 miles at an average speed of 50 mph. She then travels the remaining 20 miles at an average speed of 40 mph. How long did her journey take?
- 5) A car travels at an average speed of 60 miles per hour down the motorway. How far will the car travel in (a) 15 minutes (b) 1 hour 10 minutes

# **Exercise 2. Density**

1) These cubes measure 1cm by 1cm by 1cm.



Their volumes are each 1cm<sup>3</sup>.

The weight of each black cube in 4g. The weight of each white cube is 2g.

Calculate the average weight of

(a) 2 black and 2 white cubes (b) 3 black and 5 white cubes

- 2) Red centimetre cubes weigh 3g and blue centimetre cubes weigh 5g. Find an arrangement of cubes which give an average density of 3.5g per cm<sup>3</sup>.
- 3) Using red and blue cubes find an arrangement with an average density of 4.5g per cm<sup>3</sup>.
- 4) Can you list other arrangements of blue and red cubes which give an average density of 4.5g per cm<sup>3</sup>?
- 5) Black cubes weigh 6 gram and white cubes weigh 2 grams.
  - (a)



A black cube and a white cube are put together. What is their average density?

(b) If one black cube and 3 white cubes are put together, what is their average density?

# 58 Compound Measure - Best Buy and a Mixed Exercise

#### **Exercise 1. Finding the best buy**

Calculate which of the following sizes give the best buy.

1) Toothpaste costing	85p for a 75ml tube, £1.15 for a 125ml tube £1.90 for a 200ml tube
2) Shampoo costing	50p for a 250ml bottle 95p for a 500ml bottle 140p for a 800ml bottle
3) Baked beans costing	18p for a 250g tin 25p for a 450g tin 36p for a 700g tin
4) Paint costing	£2.50 for a 1 litre tin £5.25 for a $2\frac{1}{4}$ litre tin £7.95 for a 4 litre tin

5) Oil paint is sold in 3 different sizes.

A 75ml tube costs £1.20. A 150ml tube costs £2.10. A 200ml tube costs £3.10.

#### Exercise 2. Mixed

- 1) Decide which one of the following pairs of cars is the most economical.
  - (a) Car A travels 180 miles and uses 11 litres of petrol. Car B travels 120 miles and uses 7 litres of petrol.
  - (b) Car C travels 160 miles and uses 9 litres of petrol. Car D travels 96 miles and uses 5 litres of petrol.
- 2) Sally has to paint the ceilings of her house. She needs to give each two coats and the total area of the 8 ceilings is 110 square metres. 1 litre of paint will cover 12m<sup>2</sup>. If she can buy the paint in 5 litre and 2<sup>1</sup>/<sub>2</sub> litre tins, how much paint will she buy?
- 3) David plans to spread "lawn care" over his lawn. The instructions say that it has to be used at the rate of  $1\frac{1}{4}$  ounces per square yard. His lawn is in the shape of a rectangle measuring 10 yards by 8 yards. How much "lawn care" will he have to buy if it is sold in 2lb packets? (Note 16 ounces (oz) = 1 pound (1lb))
- 4) Jane needs to paint the walls in her bedroom. The room measures 4m by 3m and is  $2\frac{1}{2}$  metres high. However  $3m^2$  is taken up by the door and a window. Paint is sold in 5 litre and 2 litre cans and it will cover the walls at a rate of  $11m^2$  per litre. She gives the walls 2 coats of paint. How many cans of paint will she have to buy?

# 59 Formulae for Area, Volume and Perimeter 1

With each of the following shapes a number of formulae are given. Decide which formula best satisfies the situation given.

1) Which formula could be used to find (a) the area (b) the perimeter?



2) Which formula could be used to find (a) the area (b) the perimeter?



3) Which formula could be used to find (a) the volume (b) the surface area?





4) Which formula could be used to find (a) the area (b) the perimeter?





5) In this bottle shape, which formula could be used to find (a) the volume

(b) the surface area?



(i) 
$$\frac{5}{7}\pi xy^2 - 7y^2$$
  
(ii)  $\frac{1}{2}\pi xy$   
(iii)  $\frac{5}{6}\pi x^2 - xy^2$   
(iv)  $\frac{3}{2}\pi x^3 - 16y^2$   
(v)  $\frac{1}{12}\pi x^2 y$   
(vi)  $\frac{5}{8}x^2y - 4xy$ 

## 60 Formulae for Area, Volume and Perimeter 2

1) An electrician installs the electrical wiring in new houses. She estimates the amount of cable needed for a house by using one of the formulae shown below, where L is the length of the front of the house, H is the height of the house and W is the distance from the front to the back of the house.



a) 
$$5L + 4W + 7H + 20$$

b) L(3W + 9H)

c) 
$$3LW + 4LH + 2HW$$

- d) 24LWH
- (i) Explain why you think that formula d is not the one she uses.
- (ii) Which formula do you think she uses? Explain how you come to this conclusion.
- 2) Which of the following formulae could represent (a) area, (b) volume and (c) perimeter? The letters *a*, *b*, *c*, *d*, *x* and *y* are dimensions measured in centimetres.

1) 
$$ab + cd^2$$
2)  $a + b^2 + cd$ 3)  $a + x + y$ 4)  $ab + 2xy$ 5)  $\pi a^2 + b^2$ 6)  $3x + ab + c^2$ 7)  $axy + 3bac$ 8)  $5ax + \pi a + 3c$ 9)  $3(x + y)$ 10)  $\frac{1}{2}(7x + 14y - ax)$ 11)  $7xy + \pi ab$ 12)  $3xy - \pi y$ 13)  $3(xy^2 + 2x^2)$ 14)  $\pi(a^2 - b^2)$ 15)  $\frac{3(ax^2 + b^2)}{2}$ 16)  $\frac{5(a^2 + b^2)}{6}$ 17)  $5x + 7y - \frac{1}{3}ab$ 18)  $17x + \frac{2}{3}a - 3b$ 19)  $\frac{7x^2 - 3x^2a - 4ax^2}{7}$ 20)  $\frac{12x^3 - 3x^2y}{2}$ 

# **61** Questionnaires

- 1) A large company want to build a supermarket in the town. Paul designs a questionnaire to find out whether local residents want it and if so whether they will use it. Write down two questions he might use, each question having a choice of 3 responses.
- 2) Bill is keen to have a wine bar in the high street. He wants to find out what local residents think. In order to get an unbiased response, he chooses two of the following groups of people to ask.
  - (a) the youth club
  - (b) the old peoples home
  - (c) the local supermarket
  - (d) the residents of the high street
  - (e) the residents of a local housing estate
  - Which groups do you think he should choose and why?
- 3) The local council decide to pedestrianise the centre of town (i.e. stop all vehicles using it). They decide to ask the traders in the town centre their opinion and no one else. Is this a good idea? Explain your answer.
- 4) The school committee decide that the tuck shop is to sell vegetarian snacks. The snacks they want are a) fruit b) yoghurt c) oatmeal biscuits d) nuts and e) wholemeal sandwiches. Devise a questionnaire in which they can determine the snacks pupils like best.
- 5) A new burger restaurant is to be opened near to Claire's school. Lots of the local people have said that they don't want it. Claire thinks that most people do want it to be opened so she writes a questionnaire to get the necessary evidence.
  - She decides to give out the questionnaire to members of year 11.
  - (a) Why is this not a good idea?
  - (b) Which of the following groups of people would give the least biased replies? Say why.
    - (i) Members of the youth club
    - (ii) Customers leaving the local supermarket
    - (iii) Members of the local golf club
    - (iv) The people living next to the school
- 6) The manager of a D.I.Y. store wants her staff to wear a new uniform. She thinks that they should all wear green tops and either a black skirt or trousers. The deputy manager thinks that they would prefer a red top and jeans. The manager designs this questionnaire for the staff



Do you think that this is a good questionnaire? Make comments

Bicycle 50

# **62 Pie Charts**

 A class of 36 pupils were asked how they normally came to school. 15 said they came by bus, 10 walked, 8 came by car and 3 by bicycle. Draw a pie chart to show this information by first calculating

 a) the number of degrees representing 1 pupil and hence
 b) the number of degrees representing each of the groups.

 The number of people, correct to the nearest 100, who voted at the local election were Conservative 600
 Labour 400
 Liberal Democrat 700
 Independent 500
 Green party 200

Draw a pie chart to show this.

3) A town council wants to make its transport system more efficient. As a first step they interviewed a sample of 900 people. They were asked how they got into town. Their results were as follows.
 Train 50 Bus 250 Car 400

Walked 150

Show this information on a pie chart.

4) The United Kingdom is made up of the following approximate areas, measured in millions of hectares
England 12.5 Wales 2
Scotland 8 Northern Ireland 1.5
Show this information on a pie chart.

5) David earns £90 a week. His expenses each week are as follows<br/>Lodging/Food £40Clothes £10Entertainment £15Bus fares £12Savings £5Other £8Show this information on a pie chartClothes £10Clother £8



7) The table below shows the number of visitors to Dibchester castle in 1996.

Spring	Summer	Autumn	Winter
700	1300	800	200

Construct a pie chart to show this information. Write down

- a) the number of degrees representing 100 people
- b) the number of degrees representing each season.

# 63 Frequency Polygons 1

#### Exercise 1

Construct a frequency polygon from each of the following sets of data

1) This table shows the heights of 20 tomato plants.

Height of tomato plant	89cm	90cm	91cm	92cm	93cm
Frequency	2	4	5	6	3

2) This table shows the number of goals scored per game in the English football league during one particular week.

Number of goals scored	0	1	2	3	4	5	6	7
Frequency	3	8	10	7	7	5	4	2

3) A milkman delivers milk to 400 houses on his morning round. The table shows the number of bottles the households take.

Number of bottles	1	2	3	4	5	6	7
Frequency	72	95	105	70	30	18	10

4) A firm makes egg timers, which are supposed to run for exactly 4 minutes. A sample of 100 were tested and the times they gave were as follows.

Time (secs)	236	237	238	239	240	241	242	243
Frequency	4	8	12	18	30	15	10	3

#### Exercise 2

Construct a frequency polygon from each of the following sets of grouped data. In each case <u>make a list</u> of the mid value of each group first (as in question 1).

1) The scores of 200 students in an examination were as follows.

Mark	0- 10	11- 20	21- 30	31- 40	41- 50	51- 60	61- 70	71- 80	81- 90	91- 100
Frequency	2	7	9	21	53	67	25	8	6	2
Mid mark	5	15.5	25.5	35.5	45.5	55.5	65.5	75.5	85.5	95.5

2) This table shows the marks gained by 100 students in an examination.

Mark	0-	11-	21-	31-	41-	51-	61-	71-	81-	91-
	10	20	30	40	50	60	70	80	90	100
Frequency	0	4	6	15	21	28	14	7	5	0

3) This table shows the heights of 100 college students in a class (to the nearest cm).

Height (cm)	141-	146-	151-	156-	161-	166-	171-	176-	181-
	145	150	155	160	165	170	175	180	185
Frequency	7	10	16	15	10	18	13	8	3

Why do you think that this polygon has two peaks?

4) This table shows the times at which 600 pupils arrived at school.

Time	8.10-	8.20-	8.30-	8.40-	8.50-	9.00-	9.10-
	8.20	8.30	8.40	8.50	9.00	9.10	9.20
Number	10	46	110	295	75	54	10

From the polygon decide at which time you think that school starts.

# 64 Frequency Polygons 2

1) These tables show the average monthly rainfall and temperature at two holiday destinations. Destination A

Month	J	F	Μ	Α	Μ	J	J	Α	S	0	Ν	D
Temp ℃	9	10	15	17	20	25	28	31	25	21	14	11
Rainfall cm	5.2	4.0	3.6	1.9	1.8	1.7	1.0	1.2	1.9	4.1	8.3	6.2

Destination B

Month	J	F	Μ	Α	Μ	J	J	Α	S	0	Ν	D
Temp ℃	27	30	32	26	23	17	13	11	12	17	20	23
Rainfall cm	3.2	4.4	5.7	6.3	7.2	8.0	6.4	6.2	5.0	4.1	3.5	3.1

a) Draw a frequency polygon showing the *temperatures* at both destinations. Show both polygons on the same diagram.

(i) Which destination is in Australia and which is in Europe?

(ii) Give reasons for your choice.

(iii) In which months of the year are the temperatures about the same?

b) Draw a frequency polygon to show the *rainfall* at both destinations.

Choose the best month to go on holiday, for each destination. Explain why you made your choices.

2) The following table shows the amount of profit made by a company during 1991 and 1992 (in millions of pounds)

Year	J	F	Μ	А	Μ	J	J	Α	S	0	Ν	D
1991	5.4	5.3	4.9	4.4	4.5	4.0	3.2	3.1	2.9	3.5	4.0	3.9
1992	3.7	3.4	3.0	2.7	2.8	2.7	2.1	2.0	2.1	1.9	2.7	2.5

- a) Draw a frequency polygon showing the profits for both years. Show them both on the same diagram. Plot the profit vertically and the <u>twelve</u> months of the year horizontally.
- b) From the diagram, make comments on
  - (i) The profit in 1992 compared with 1991.
  - (ii) The trend at the end of 1992 (i.e. are profits still going down or are they picking up?) Explain your answer.
  - (iii) Predict what the profits will be for the first three months of 1993.
- 3) Devonham High School are allowed to enter one person for each event in the annual county games. The three best athletes in the 100 metres are Brian, Mike and John. At the last ten races in which they ran against each other, their times (in seconds) were

Brian	12.3	12.2	12.4	12.3	12.4	12.2	12.2	12.4	12.3	12.4
Mike	12.2	12.7	12.9	12.1	12.0	12.7	12.9	12.8	12.1	12.7
John	12.9	12.9	12.8	12.7	12.6	12.5	12.4	12.3	12.3	12.2

Draw the three frequency polygons <u>on one diagram</u>, using a different colour for each. Use a scale of 1cm between each of the races on the horizontal axis and 1cm to represent 0.1sec on the vertical axis. Begin your vertical scale at 12 secs.

From the diagram decide who is to represent the school. Explain why you chose that person.

4) The table below shows the profits made by two companies during 1992.

						1			0			
Month	J	F	Μ	A	Μ	J	J	A	S	0	N	D
Company A	2.3	2.5	2.6	2.4	2.8	2.5	3.1	2.9	3.4	3.0	3.7	3.9
Company B	4.2	4.1	3.5	3.2	2.7	2.5	2.2	2.7	2.8	2.9	2.9	3.4

Draw a frequency polygon showing the profits for both companies. Show both polygons on the same diagram. Compare the two graphs and make comments

# 65 Mean, Median, Mode and Range

#### **Exercise 1**

In each of the following, put the data into a frequency table and write down the mode and range.

- 2, 3, 3, 3, 4, 2, 6, 1, 5, 1, 1, 4, 4, 3, 5, 2, 3
   2, 1, 1, 1, 3, 1, 5, 4, 5, 1, 2, 2, 2, 3, 4, 7, 6
   1, 4, 7, 4, 3, 8, 0, 0, 1, 8, 2, 9, 2, 6, 0, 8
   2, 0, 6, 2, 8, 1, 9, 0, 3, 7, 1, 0, 7, 5, 1, 9
   8, 3, 2, 6, 2, 6, 0, 2, 5, 2, 8, 7, 3, 0, 1, 2
- 13, 14, 17, 14, 15, 14, 17, 14, 13
   16, 15, 13, 16, 17, 15, 13, 16, 17
   17, 16, 14, 15, 13, 17, 14, 16, 16
   15, 15, 15, 14, 14, 15, 15, 15, 13
   15, 16, 13, 15, 14, 16, 14, 17, 15

#### Exercise 2.

Find the median and range of each of the following sets of data.

- $1. \quad 8, 7, 4, 10, 1, 5, 6, 6, 5, 4, 3, 4, 8, 7 \ 10, 4, 9, 5, 3, 2, 7$
- 2. 9, 9, 7, 6, 7, 4, 3, 2, 3, 7, 7, 6, 5, 7, 5, 8
- 70, 72, 30, 74, 80, 83, 36, 50, 38, 85
   92, 50, 70, 68, 17, 48, 77, 72, 60, 74
   14, 75, 83, 65, 33, 52, 46, 34, 32, 37

### Exercise 3.

Calculate the mean of each of the following sets of data, giving your answer correct to four significant figures wherever necessary.

- 1. 4cm, 7cm, 8cm, 5cm, 4cm, 3cm, 2cm, 9cm, 8cm, 6cm
- 2. 21 grams, 40 grams, 8 grams, 73 grams, 68 grams
- 3. 6 metres, 4m, 3m, 8m, 5m, 6m, 4m, 7m, 2m, 5m
- 4. 13, 16, 20, 24, 27, 29, 33
- 5. 221, 352, 234, 421, 301, 383
- 6. 2.6, 1.9, 2.7, 2.1, 3.2, 3.0
- 7.  $43\frac{1}{2}, 47\frac{1}{2}, 39\frac{1}{2}, 34\frac{1}{2}$
- 8. 179, 111, 152, 233, 244, 221
- 9. 141, 126, 117, 64, 72, 65, 85, 120, 141, 132
- 10. 41, 85, 72, 17, 41, 16, 54, 55, 10

#### Exercise 4.

In each of the following give the answer correct to four significant figures wherever necessary.

- 1. The mean of six numbers is 25.5 and the mean of a further seven numbers is 23. What is the mean of all thirteen numbers combined?
- 2. The mean weight of six people is 83kg. If three more people, weighing 93kg, 107kg and 78kg join them, what is their new mean weight?
- 3. The mean weight of six people in a lift is 90kg. If the maximum total weight allowable in the lift is 1 tonne, approximately how many more people will be allowed in?

# 66 Mean 1

- 1. Find the average speed of a car which travels 94 miles in 3 hours, then 58 miles in 2 hours and finally 87 miles in 2 hours.
- 2. The car in question 1 returns home in 6 hours. What is the average speed for the complete journey?
- 3. A batsman scores 73, 47, 52, 83, 24, 19 and 7 in 7 innings. What is his batting average?
- 4. The cricketer in question 3 scored 0 (zero) in his eighth innings. What was his new batting average?
- 5. A car makes the following journeys.

23 miles in city traffic using  $1\frac{1}{2}$  gallons of petrol, 86 miles on the motorway using 2 gallons of petrol and 93 miles on country roads using 3 gallons of petrol. Calculate the average fuel consumption of the car in miles per gallon.

- 6. A cricketer has a batting average of 37 runs per innings over 7 innings. During his next three innings he scores 16, 27 and 0. What is his new batting average?
- 7. A certain type of vegetable is classed as grade 1, grade 2 or grade 3. Grade 1 have an average weight of less than 50 grams, Grade 2 from 50 grams to 100 grams and Grade 3 more than 100 grams. What grade are the following
  - (a) A bag weighing 2kg containing 35 vegetables.
  - (b) A bag weighing 5 kg containing 45 vegetables.
  - (c) A bag weighing  $2\frac{1}{2}$  kg containing 65 vegetables.

If the three bags are mixed together, what grade would they be sold as?

8. Sarah keeps records of how much petrol her car uses. She finds that after servicing the car she gets a better fuel consumption. These are her figures for last year.

Month	Speedometer r	eading	Petrol used
	(miles)		
	Beginning	End	Litres
January	23247	23407	15
February	23407	23577	16
March	23577	23745	16
April	23745	23902	15
May	23902	24091	18
June	24091	24234	14
July	24234	24426	19
August	24426	26390	194
September	26390	26543	15
October	26543	26684	13
November	26684	26855	16
December	26855	27014	15

Calculate her average fuel consumption for each month (in miles per litre) Use these figures to determine in which month she had the car serviced
# 67 Mean 2

Find the mean value for each of the following sets of frequencies, correct to 4 significant figures.

1. The number of children in the families of pupils in a class.

No. of children	frequency		
in a family			
1	7		
2	13		
3	5		
4	2		
5	1		
7	1		

2. The number of absentees from a class during a period of 60 days.

No. of absentees	frequency		
	(days absent)		
0	9		
1	12		
2	15		
3	11		
4	6		
5	4		
6	2		
7	1		

3. The number of broken glasses found when 1500 boxes, each containing 6 glasses were opened.

No. of broken glasses	frequency		
0	1337		
1	76		
2	49		
3	21		
4	10		
5	6		
6	1		

4) Packets of sweets each contain 24 sweets. The number of red sweets were counted in a sample of 100 packets.

Number of red sweets	frequency
(number of packets)	
3	5
4	12
5	33
6	23
7	18
8	9

# 68 Mean 3 - Diagrams

 The goals scored by 120 teams on a Saturday are shown below in the diagram. Calculate the mean number of goals scored.



2) The diagram shows the marks obtained by year 10 in an examination.Calculate the mean mark.



3) Jane carries out a survey to find the number of brothers and sisters year 8 pupils have. The results are shown in the diagram.

Calculate the mean number they have.



# 69 Mean 4 - Frequency distributions with class intervals

By first finding the mid value of each class interval, calculate an approximate mean for each of the tables of values shown below. State also the modal class in each case.

1. This table shows the heights of a sample of pupil	ls in a scho	ol.
Height of child(cm)	Freque	ncv
$120 < h \le 130$	2	
$130 < h \le 140$	5	
$140 < h \le 150$	23	
$150 < h \le 160$	55	
$160 < h \le 170$	27	Give your answer correct
$170 < h \le 180$	14	to the nearest millimetre.
2. This table shows the weights in grammes of 5k	g hags of p	otatoes
Weight of bag	Frequenc	v
5000 < w < 5010	76	- 5
$5010 < w \le 5020$	70 54	
$5020 < w \le 5030$	48	
$5030 < w \le 5040$	12	
$5030 < w \le 5050$ $5040 < w \le 5050$	7	Give your answer correct
$5050 < w \le 5050$ $5050 < w \le 5060$	3	to the nearest gramme
3 This table shows the weekly wage for employees	in a factor	v
Wage	Frequen	y.
40 < f < 80	7	C y
$40 < x \le -30$ 80 < f < 120	16	
120 < f < 160	23	
$120 < x \le 100$ 160 < f < 200	23	
$100 < x \le 200$ 200 < f < 240	27	
$200 < x \le 240$ 240 < f < 280	J1 /3	
$240 < x \le 200$ 280 < f < 320	43	Give your answer correct
$200 < x \le 520$ 320 < f < 360	+J 12	to the nearest penny
4  The life in hours of betterior tooted by a manufactor of the second by a manufactor of th	12	to the hearest penny.
4. The file, in nours, of batteries tested by a manufa	Engage and an	
Life (nours) $10 < h < 15$	Frequenc	У
$10 < \Pi \le 13$	2	
$13 < \Pi \le 20$	9 27	
$20 < \Pi \le 25$	21 42	
$20 < \Pi \le 30$	43	
$30 < \Pi \le 33$	33 10	City was a second a second st
$33 < n \le 40$	19	Give your answer correct
$40 < n \le 45$	6	to the nearest minute.
5. This table shows the heights of tomato plants ran	iging from	39 cms to 46 cms.
Height of plant	Frequency	1
$39 < h \le 40$	4	
$40 < h \le 41$	10	
$41 < h \le 42$	14	
$42 < h \le 43$	17	
$43 < h \le 44$	10	
$44 < h \le 45$	5	Give your answer correct
$45 < h \le 46$	2	to the nearest millimetre.

# 70 Mean 5 - Histograms

# 1) The frequency table below shows the heights of 86 plants.

- (a) Draw a histogram of the information.
- (b) By using the mid-value for each class interval, calculate an approximate value for the mean height of the plants.



# 71 Cumulative Frequency 1

1) The table below shows the frequency distribution of the weekly wages for employees in a factory.

Wages (£w)	$0 < w \le 80$	$80 < w \le 100$	$100 < w \le 130$	$130 < w \le 150$	$150 < w \leq 180$
Frequency	7	15	41	20	7

a) Complete this cumulative frequency table.

Wage	£80	£100	£130	
Cumulative frequency	7	22		

b) Draw the cumulative frequency graph

- c) From the graph estimate
  - (i) the median wage (ii) the interquartile range (iii) the approximate number of employees who earn more than £120 per week.

2)



This diagram shows the heights of 110 plants.

a) Use the diagram to complete the table below.

	Frequency	Cumulative frequency
$60 \text{ cm} < \text{height} \le 65 \text{ cm}$	15	15
$65 \text{ cm} < \text{height} \le 70 \text{ cm}$	26	
$70 \text{ cm} < \text{height} \le 75 \text{ cm}$	36	
$75 \text{ cm} < \text{height} \le 80 \text{ cm}$		
$80 \text{ cm} < \text{height} \le 85 \text{ cm}$		
85 cm < height < 90 cm		

- b) From the table above, draw the cumulative frequency diagram.
- c) From the cumulative frequency diagram estimate (i) the median (ii) the number of plants whose height is less than 81 cms.

# 72 Cumulative Frequency 2

1) Nina carries out a survey of the speeds of vehicles passing a certain point on a motorway. Her results are shown in the table below.

Speed (mph)	Frequency	Cumulative frequency
$20 < \text{speed} \le 30$	3	
$30 < \text{speed} \le 40$	26	
$40 < \text{speed} \le 50$	41	
$50 < \text{speed} \le 60$	48	
$60 < \text{speed} \le 70$	37	
$70 < \text{speed} \le 80$	26	
$80 < \text{speed} \le 90$	5	

- a) Copy and complete the table for the cumulative frequency.
- b) Draw the cumulative frequency graph.
- c) From the graph estimate (i) the median speed (ii) the approximate number of cars whose speed is below 75mph
- 2) Batteries are tested by using them in an electric toy and recording the length of time the toy operates before the battery fails. The results of 50 batteries are shown below

Time (t hours)	$9 < t \le 11$	$11 < t \le 13$	$13 < t \le 15$	$15 < t \le 17$	$17 < t \le 19$
Frequency	4	10	19	14	3

- a) From the data draw a cumulative frequency graph.
- b) From the graph, estimate (i) the median life of a battery
  - (ii) the interquartile range.

If the battery company guarantee that their batteries last longer than 12 hours, approximately what percentage of their batteries don't meet this criteria?

3) The table below shows the runs scored by batsmen in a cricket team.

Runs scored	1 - 20	21 - 40	41 - 60	61 - 80	81 - 100
Frequency	10	22	36	14	2

a) Complete this cumulative frequency table

Runs	20	40	60	
Cumulative frequency	10	32		

b) Draw the cumulative frequency graph

c) From the graph estimate (i) the median number of runs scored

(ii) the number of times more than 70 was scored

# 73 Scatter Diagrams 1

Draw a scatter diagram for each of the following results. Draw a line of best fit and use it to answer each of the questions. You must show clearly on your diagram how you get your answer.

1) A class of pupils sat an examination in mathematics. The examination consisted of two papers. The following table shows the marks scored by a sample of 10 of the pupils.

Paper 1	46	77	49	57	67	52	72	59	54	27
Paper 2	53	84	43	63	65	61	74	73	57	35

- a) A pupil missed paper 2 but got 53 on paper 1. What was her estimated mark for paper 2?
- b) Another pupil missed paper 1 but got 84 on paper 2. What was her estimated mark for paper 1?
- 2) A garden centre raises plants from seed. The gardener puts the seeds into trays of different sizes. When they have germinated he takes one tray of each size and checks how many plants have germinated.

No of seeds in tray	10	20	24	36	50	100
No of plants germinated	8	17	23	34	45	79

He finds that he has forgotten to check a tray which holds 70 seeds. How many plants would he expect from it?

3) The heights and weights of 7 ladies are shown in the table below.

Height (cm)	150	153	155	160	162	168	170
Weight (kg)	51	51	57	60	61	62	63

Estimate the weight of a woman whose height is 158cm.

4) A survey is carried out into the sizes of 10 apple trees in a garden. The height is measured (using trigonometry) and the circumference of its trunk is measured one metre from the ground. This is a table of the results obtained.

Circumference cm	8	7	9	10.5	13	15	15.5	18	20
Height metres	3.9	4.1	4.3	4.6	4.8	4.7	5.1	5.0	4.8

What is the approximate circumference of a tree whose height is 4.5m?

5) The table shows the number of hours of rainfall per day at Northend-on-sea and the number of deck chairs hired out each day over a period of one week.

Hours of rainfall	2	5	3	0	7	10	3
No of deck chairs hired out	150	100	160	190	45	10	155

From your graph predict how many deck chairs would be hired out if there were 8 hours of rainfall.

# 74 Scatter Diagrams 2

Draw a scatter diagram for each of the following results. Draw a line of best fit and use it to answer each of the questions. You must show clearly on your diagram how you get your answer.

1) A vertical spring, fixed at its upper end, was stretched by a weight at its lower end. The length of the spring for different loads was measured and the results recorded, as follows.

Load (g)	0	10	20	30	40	50	60	70	80
Length (cm)	12.5	13.4	14.7	15.5	16.3	17.7	18.6	19.4	20.6

From your diagram, estimate

- a) The load when the length of the spring is 15cm.
- b) The length of the spring for a load of 55g.
- 2) David travels to work each day by car. Most of his journey is down a ten mile stretch of motorway. Over a ten day period, he records the time taken to get to work and the speed he travels down the motorway.

Speed (mph)	65	50	45	50	70	55	60	70	70	45
Time taken (min)	19	24	26	25	17	22	21	19	18	28

From your diagram, estimate how fast he would have to travel down the motorway in order to get to work in 20 mins.

3) At the end of each week, Jenny saves whatever pocket money she has left from that week. She finds that the more times she goes out each week, the less money she has left. Here is a table showing the number of times she went out over a period of 8 weeks, together with the amount of money she saved.

Number of times out	5	3	4	1	1	4	5	2
Money saved (pence)	120	290	210	510	480	180	90	380

Jenny wants to save £2.50 every week for her holidays. From your graph decide on the maximum number of times she can go out each week.

4) In an experiment twelve pupils were weighed and their heights measured. Here are their results.

Weight (kg)	52	59	58.5	63	60.5	66	66	66.5	72	76.5	71	79.5
Height (cm)	122	124	126	127	128	128	132	134	136	139	142	144

It is known that another pupil weights 75kg. Approximately how tall is he?

# 75 Probability 1

Find the probability of the events in questions 1 to 6 happening

- 1) Throwing a number 2 on a dice numbered 1 to 6
- 2) Drawing a king from a pack of 52 playing cards (there are 4 kings in a pack)
- 3) Selecting a girl at random from a class of 20 boys and 15 girls.
- 4) Winning first prize in a raffle if you hold 10 tickets and 200 have been sold.
- 5) Picking an even number from the numbers 1 to 20 inclusive.
- 6) Throwing an odd number on a dice numbered 1 to 6.
- 7) Find the probability of an event not happening if the probability of it happening is 0.3.
- 8) The order of play in a badminton competition in decided by drawing names from a hat. Six names, Jane, Andrew, Stephen, Claire, Jenny and Jonathan are put into the hat and drawn at random. Find the probabilities of
  - a) drawing Claire's name first
  - b) drawing a boy's name first
  - c) not getting Stephen's name first.
- 9) A bag contains 12 discs, 4 red, 5 green and 3 blue. A disc is taken out at random. What is the probability of drawing
  - a) a green disc
  - b) a red disc
  - c) a disc which is not a blue disc.
- 10) In a raffle, 1000 tickets are sold. Emily buys 5 tickets. What is her chance of winning? If the chance of David winning is 0.02, how many tickets did he buy? What is the probability of him not winning?
- 11) A biased spinner has the numbers 1, 2, 3 and 4 on it. The probability of getting a 1 is 0.1, a 2 is 0.2, and a 3 is 0.2.
  - a) What is the probability of getting a 4?
  - b) What number are you most likely to get?
  - c) If it is spun 100 times, how many 2's would you expect to get?
  - d) What is the probability of scoring a 1 or a 2?
  - e) What is the probability of scoring a 6?
- 12) A fair dice is numbered 1 to 6 and a fair spinner is numbered 1 to 3.
  - The dice and spinner are played at the same time. What is the probability of getting
  - a) a 2 on the dice and a 2 on the spinner?
  - b) a total of 5?
  - c) a 1 and a 2 (any way around)?
  - d) a total score of 10?
- 13) 10 cards have the numbers 1 to 10 on them. The cards are shuffled and placed face down on the table. A card is drawn at random. Calculate the probability of each of the following a) The card drawn will have the number 6 on it
  - b) The number on the card will be greater than 6
  - After the card has been taken it is returned to the pack and another taken. What is the probability that
  - c) The number 6 will be chosen both times
  - d) A number greater than 6 will be chosen both times
  - e) A number greater than 6 is chosen the first time and one less than 6 the second time.
- 14) The probability of drawing a red ball from a bag is 0.3 and the probability of a black is 0.5.
  - a) What is the probability of drawing a red or a black?
  - b) If there are 10 black balls in the bag, how many red balls are there?

# 76 Probability 2

1) Two dice are thrown together and their values added. Copy and complete the table below to show their sums and find the probability that their sum is 8.

			S	econ	d Die	ce	
		1	2	3	4	5	6
	1	2	3	4	5		
First	2	3	4	5			
Dice	3	4	5				
Dicc	4	5					
	5						
	6						

2) Two dice bearing the numbers 1,1,2,2,3,3 are thrown together and the numbers shown are added. Copy and complete the table below which shows the possible outcomes.



What is the probability of getting a total of

- a) 6
- b) more than 4
- c) less than 4
- 3) Five cards have the numbers 1, 2, 3, 4, 5 on them.



Two cards are taken at random and their sum recorded in this table. Copy and complete the table.



Use the table to find the probability of obtaining a sum a) of 8 b) greater than 4

# 77 Probability 3

1) The diagram shows two spinners, one numbered 1 to 4, the other 1 to 3. The outcome 1+2=3 is shown

- a) Make a list of all the possible outcomes.
- b) What is the probability of getting numbers adding up to 5?
- c) What is the probability of getting a sum of more than 5?



Three red discs are numbered 1 to 3, and two blue discs are numbered 1 and 2. A red disc is chosen at random followed by a blue disc. List all the possible outcomes. What is the probability of getting

- a) a 2 followed by a 1?
- b) a 1 and a 2 in any order?
- c) a 3 and a 1 in any order?
- 3)

2)



Three black cards are numbered 1 to 3 and 4 red cards are numbered 1 to 4.

- A black card is chosen at random followed by a red card.
- a) List all the possible outcomes.
- b) In how many ways can the cards add up to 6?
- c) What is the probability of the two cards adding up to 6?
- 4) A bag contains 5 red discs with the numbers 1 to 5 on them. A second bag holds 6 discs, 2 white, 2 black, one green and one yellow. A disc is taken at random from both bags . Copy and complete this table of possible results.



Use the table to find the probability of choosing

- a) a 1 followed by a black disc
- b) a black disc
- c) a black or white disc.

# 78 Tree diagrams



- 2) The probability that Dave will win the long jump final is 0.3 and the probability that he will win the 100 metres is 0.2. Draw a tree diagram to show this. From the diagram find
  - a) the probability of him winning both
  - b) the probability of him winning neither
  - c) the probability of him winning one only.
- 3) A bag contains 3 blue and 2 white discs.
  - A second bag contains 3 blue and 5 white discs.
  - Complete the tree diagram and use it to find the
  - probability of getting
  - a) a blue followed by a white disc.
  - b) two blue discs.
  - c) two discs of the same colour.



4) In form 11C there are 15 girls and 10 boys. In 11D there are 18 boys and 12 girls. Two people are to be chosen at random, one from each group.

Show this on a tree diagram. From the diagram find the probability of choosing

- a) a boy and a girl
- b) two boys
- c) two girls
- 5) A bag contains 3 red sweets and 3 green sweets. A second bag contains 4 red sweets and 5 green sweets. A sweet is chosen at random from each bag in turn. Draw a tree diagram to represent this.

From the diagram find the probability of taking

- a) a red followed by a green sweet
- b) two sweets of the same colour
- c) at least one red sweet

# 79 Relative Frequency 1

1) Two dice are thrown together and their values added. Copy and complete the table below to show their sums and find the probability that their sum is 6.

		Seco	ond L	nce		
	1	2	3	4	5	6
1	2	3	4	5		
2	3	4	5			
3	4	5				
4	5					
5						
6						
	1 2 3 4 5 6	1 2 3 3 4 4 5 5 6	1     2       1     2     3       2     3     4       3     4     5       4     5     5       6     6	1         2         3           1         2         3         4           2         3         4         5           3         4         5         5           4         5         5         5           6         6         6         6	1     2     3     4       1     2     3     4     5       2     3     4     5     5       3     4     5     5       4     5     5     5       6     6     6	1     2     3     4     5       1     2     3     4     5       2     3     4     5     -       3     4     5     -     -       4     5     -     -     -       5     -     -     -     -       6     -     -     -     -

If the dice are thrown 180 times, approximately how many times would you expect to get a total of 6?

2) A bag contains 5 discs with the numbers 1 to 5 on them. A second bag holds 6 discs, 3 red,2 white and one green. A disc is taken at random from both bags, <u>and then returned</u>. Copy and complete this table of possible results.



- a) Use the table to find the probability of choosing
  - (i) a 2 followed by a white disc
  - (ii) a red disc
- b) If this procedure is carried out 100 times, how many times would you expect to choose (i) a red disc?
  - (ii) a disc with a number 2 on it?
- 3) A drawing pin is thrown in the air and allowed to fall to the ground. It can either land point upwards or point down. The table shows the number of times it lands each way.

Number of throws	10	20	30	40	50
Number of times point up	3	8	14	19	26
Number of times point down	7	12	16	21	24

From the results

- (a) suggest what you think the probability is of it landing point up?
- (b) explain why you would not make any assumptions after 10 throws.
- (c) calculate how many times you think it will fall point up when thrown 500 times.
- 4) Jenny does a survey of the people using her local newsagents over a period of 30 minutes. She counts 30 men and 50 women leaving the shop.
  - a) What is the probability that the next person to leave the shop will be a man?
  - b) During the day 1000 people use the shop. Approximately how many will be women?

# 80 Relative Frequency 2

- 1) Over a period of 10 minutes, 5 buses, 40 cars, 10 lorries and 15 vans travel down the high street.
  - a) What is the probability that the next vehicle will be a van?
  - b) Over the next hour approximately how many vehicles would you expect to travel down the street?
  - c) How many of those vehicles would you expect to be buses?
  - d) During another period, 50 lorries are observed. Approximately how many vans would you expect?
- 2) A fair dice having the numbers 1 to 6 is thrown 60 times.
  - a) How many times would you expect the number 6 to occur?
  - b) How many times would you expect the number to be greater than 4?
- 3) A bag contains red, white and yellow coloured discs. A disc is taken from the bag, its colour noted and then replaced. This is carried out 100 times. Red is chosen 52 times, white 29 times and yellow 19 times.
  - a) If there are 10 discs in the bag, how many of each colour would you expect there to be?
  - b) If the experiment is carried out 500 times, how many times would you expect to get a white disc?
- 4) A machine makes plastic cups. An inspector checks 100 cups and finds that 90 are acceptable and 10 are not.
  - a) What is the probability that the next cup will be acceptable? During the day 100,000 cups are made.
  - b) Approximately how many are likely to be unacceptable?
  - c) If 12,000 cups are unacceptable the next day, approximately how many have been made altogether?
- 5) Raffle tickets are sold in aid of the local church. 500 are blue, 200 white and 50 pink. They are all put into a box and taken out at random.
  - a) What is the probability that the first ticket is blue?
  - b) If there are 12 prizes to be won, about how many prize-winners would you expect to have a blue ticket?
- 6) David has a biased coin. He tosses the coin 60 times and fills in the table shown below as he is doing it.

Number of tosses	10	20	30	40	50	60
Number of heads	7	10	18	22	29	34
Number of tails	3	10	12	18		
Probability of a head	0.7	0.5	0.6			
Probability of a tail	0.3	0.5				

- a) Copy and complete the table
- b) Plot a graph of 'Number of tosses' against 'Probability of a head'. Use the scale of 2cm to represent 10 tosses on the horizontal axis and 2cm to represent 0.1 on the vertical axis. From your graph estimate the probability of getting a head.

# **81** Constructions



# 82 Simultaneous Equations

1) $2x + 2y = 10$	2) $3x + y = 18$	3) $4x + 2y = 2$	4) $5x + 3y = 18$
x + 2y = 6	2x + y = 13	2x + 2y = 0	5x + y = 16
5) $x + y = 1$	6) $3x + 4y = 29$	7)  3x - 2y = 10	8) $3x + 4y = 18$
x - y = 5	x-4y = -17	-3x + y = -11	3x - 4y = -6
9) $4x + 3y = 11$	10) $5x + 2y = 33$	11) $6x + 2y = 10$	12) $3x - 2y = 13$
2x + y = 7	2x + y = 14	4x + y = 7	x-y = 5
13) $2x + 3y = 28$	14) $2x + 3y = 15$	15) $4x + 3y = 13$	16) $5x + 3y = 14$
3x - y = 9	5x - y = 46	6x - 2y = 13	2x + 2y = 4

17) A family of 2 adults and 2 children go to the cinema. Their tickets cost a total of £14.00.Another family of 1 adult and 4 children go to the same cinema and their bill is £13.60.

a) Letting *x* represent the cost of an adult's ticket and *y* the cost of a child's ticket, write down two equations connecting *x* and *y*.b) Solve for *x* and *y*.

c) What are the prices of an adult's and a child's ticket?

18) The sum of two numbers is 39 and their difference is 9.

a) Letting *x* and *y* be the two numbers write down two equations.

- b) Solve the equations.
- 19) A rectangle has a perimeter of 42cm. Another rectangle has a length double that of the first and a width one third of that of the first. The perimeter of the second is 57cm. Letting *x* and *y* represent the dimensions of the first rectangle, write down two equations containing *x* and *y*. Solve the equations and write down the dimensions of the second rectangle.
  - y. Solve the equations and write down the dimensions of the second rectangle.
- 20) 4 oranges and 3 apples weigh 720 grams. 3 oranges and 4 apples weigh 750 grams. Let *x* and *y* represent their weights. Write down two equations containing *x* and *y*. Calculate the weights of each piece of fruit.
- 21) Three mugs and two plates cost £7.20, but four mugs and one plate cost £7.90. Let x represent the cost of a mug and y the cost of a plate. Write down two equations involving x and y. Solve these equations and calculate the cost of seven mugs and 6 plates.
- 22) Sandra withdrew £400 from the bank. She was given £20 and £10 notes, a total of 23 notes altogether. Let *x* represent the number of £20 notes and *y* the number of £10 notes. Write down two equations and solve them.
- 23) A quiz game has two types of question, hard (*h*) and easy (*e*). Team A answers 7 hard questions and 13 easy questions. Team B answers 13 hard questions and 3 easy questions. If they both score 74 points, find how many points were given for each of the two types of question.
- 24) A man stays at a hotel. He has bed and breakfast (*b*) for three nights and two dinners (*d*). A second man has four nights bed and breakfast and three dinners.

If the first man's bill is  $\pounds 90$  and the second man's bill is  $\pounds 124$ , calculate the cost of a dinner. 25) Four large buckets and two small buckets hold 58 litres. Three large buckets and five small

buckets hold 68 litres. How much does each bucket hold?

# 83 Using Simple Equations

- 1) A bus costs £200 to hire for a day. A social club charges £10 for each non member (*n*) and £6 for each member (*m*) to go on an outing.
  - a) Write down an equation linking *m* and *n* and the cost of hiring the bus if the club is not to lose money.
  - b) If twenty members go on the outing, how many non-members need to go?
- 2) Annabel has two bank accounts, both containing the same amount of money. She transfers £300 from the first account to the second. She now has twice as much money in the second account.
  - a) If she originally had  $\pm x$  in each account, how much does she have in each after the transfer?
  - b) Write down an equation linking the money in her two accounts after the money has been moved.
  - c) How much money has she altogether?
- 3) Lucy buys 400 tiles for her bathroom. Patterned tiles cost 34p each and plain white tiles cost 18p each. She spends exactly  $\pm 100$  on *x* patterned tiles and white tiles.
  - a) Write down, in terms of *x*, the number of white tiles she buys.
  - b) Write down an equation for the total cost of the tiles. Calculate the value of *x*.
  - c) How many white tiles did she buy?.
- 4) The length of a rectangle is 12cm and its width is (x 4)cm. If its perimeter is numerically the same as its area, calculate the value of x and hence its area



- 5) Three consecutive numbers are added together and their sum is 69.
  - a) If the first number is *x*, write down expressions for the 2nd and 3rd numbers.
  - b) Use these expressions to calculate the value of *x* and hence the three numbers.
- 6) The distance between two towns, A and B is 300 miles. A car travels between the two towns on motorways and ordinary roads. Its average speed on the motorways is 60mph and 40mph on the ordinary roads.
  - a) If *x* is the distance travelled on the motorways, write down, in terms of *x* the distance travelled on ordinary roads.
  - b) Write down, in terms of x, the time taken to travel the two parts of the journey.
  - c) If the total time taken was 6 hours, write down an equation in terms of *x* and solve it. What distance was travelled on ordinary roads?
- 7) Sarah drives her car from her home to the railway station, a distance of x kilometres. She then gets the train and travels to London, 8 times the distance she travelled in her car. If her total journey is 36 kilometres, calculate the length of the car journey.
- 8) Calculate the sizes of the angles in each of these diagrams



# 84 Using Quadratic Equation

1) A rectangle has a length of (x + 4) centimetres and a width of (x - 3) centimetres.
a) If the perimeter is 34cm, what is the value of x?
b) If the area is 18cm<sup>2</sup>, show that x<sup>2</sup> - x - 30 = 0 and calculate the value of x when the area is 18cm<sup>2</sup>



- 2) *x* people go to the cinema. The cost of one ticket is  $\pounds(x-4)$ . If the total cost of the tickets is  $\pounds 12$ , calculate the number of people who went to the cinema.
- 3) The mean of x numbers is x-3. If the total of all the numbers is 70:
  - a) show that  $x^2 3x 70 = 0$ .
  - b) Hence calculate *x*.
  - c) What is the mean of the numbers?
- 4) The square and the rectangle have the

same areas.

a) Show that  $x^2 - 5x = 0$ 

b) calculate *x* and hence the area of the square.



- a) Show that  $x^2 x 210 = 0$
- b) Solve this equation
- c) (i) What is the cost of one shirt?
  - (ii) How many shirts were bought?



- centimetres, shown in the diagram.
- a) By using Pythagoras' theorem, show that  $x^2 10x 11 = 0$
- b) Solve this equation and write down the length of the sides of the triangle.
- 7) A company manufacture x thousand boxes of chocolates

each week. The number of chocolates in each box is (x+5) chocolates. During one particular week, the chocolate making machine breaks down and they only make (x-9) thousand boxes. At the end of the week they find that they have produced 120 thousand chocolates.

a) Show that  $x^2 - 4x - 165 = 0$ .

b) Solve this equation and calculate the number of boxes produced.



3x + 5

х

2x

2x

# **85 Surds**

# Do not use a calculator

# **Exercise 1**

Simplify each of the following by writing as products of whole numbers and surds. The first one has been done for you.

1)	$\sqrt{12} = \sqrt{4 \times 3} = \sqrt{4}$	$\overline{4} \times \sqrt{3} = 2\sqrt{3}$			
2)	$\sqrt{24}$	3) $\sqrt{27}$	<ol> <li>√32</li> </ol>	5)	$\sqrt{45}$
6)	$\sqrt{63}$	7) $\sqrt{48}$	8) $\sqrt{50}$	9)	$\sqrt{72}$
10)	$\sqrt{75}$	11) $\sqrt{80}$	12) \sqrt{125}	13)	$\sqrt{147}$

# Exercise 2

Simplify each of the following by rationalising the denominator. The first one has been done for you.

1)	$\frac{10}{\sqrt{5}} = \frac{10}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} =$	$\frac{10\sqrt{5}}{\sqrt{5\times5}} = \frac{10\sqrt{5}}{\sqrt{25}} =$	$\frac{10\sqrt{5}}{5} = 2\sqrt{5}$	
2)	$\frac{1}{\sqrt{3}}$	3) $\frac{1}{\sqrt{5}}$	4) $\frac{1}{\sqrt{7}}$	5) $\frac{1}{\sqrt{11}}$
6)	$\frac{2}{\sqrt{2}}$	7) $\frac{3}{\sqrt{3}}$	8) $\frac{6}{\sqrt{3}}$	9) $\frac{6}{\sqrt{2}}$
10)	$\frac{9}{\sqrt{3}}$	11) $\frac{7}{\sqrt{5}}$	12) $\frac{10}{\sqrt{2}}$	13) $\frac{21}{\sqrt{7}}$
14)	$\frac{14}{\sqrt{7}}$	15) $\frac{22}{\sqrt{3}}$	16) $\frac{21}{\sqrt{3}}$	17) $\frac{30}{\sqrt{2}}$

# **Exercise 3**

Simplify each of the following, the first one has been done for you.

1)	$\sqrt{3} \times \sqrt{8} =$	$\sqrt{3} \times \sqrt{4 \times 2} = \sqrt{3} \times \sqrt{4}$	$\overline{4} \times \sqrt{2} = \sqrt{3}$	$\times 2 \times \sqrt{2} = 2\sqrt{3 \times 2}$	$= 2\sqrt{6}$
2)	$\sqrt{5} \times \sqrt{20}$	3)	$\sqrt{2} \times \sqrt{6}$	4)	$\sqrt{3} \times \sqrt{12}$
5)	$\sqrt{3} \times \sqrt{21}$	6)	$\sqrt{5} \times \sqrt{10}$	7)	$\sqrt{2} \times \sqrt{12}$
8)	$\sqrt{6} \times \sqrt{3}$	9)	$\sqrt{3} \times \sqrt{18}$	10)	$\sqrt{10} \times \sqrt{2}$
11)	$\sqrt{5} \times \sqrt{30}$	12)	$\sqrt{2} \times \sqrt{14}$	13)	$\sqrt{10} \times 2\sqrt{2}$
14)	$\sqrt{2} \times 3\sqrt{12}$	15)	$4\sqrt{8} \times \sqrt{12}$	16)	$\sqrt{10} \times 2\sqrt{2}$

# Exercise 4

In each of the following right angled triangles, write down the length of the unknown side as a surd.



# **86 Recognising Graphs**

Below there are 12 sketches of graphs and 12 functions representing them. Write down the letter of the function which goes with its graph.



# **87 Plans and Elevations 1**

The diagram below shows an engineering component. In the grid below it three views of the component have been started, two elevations in directions S(side) and F(front), and a plan P. Finish off these three elevations.





# 88 Plans and Elevations 2

Below are shown two engineering components. Draw diagrams of each shape when viewed from the directions A, B and C. 1)



2)



# **89** Moving Averages

The table below shows the value of sales in a shop over a period of 20 days. The proprietor wants to keep track of the trend in her sales over a period of time so she calculates a simple 7 day moving average.

Day	Value of Sales	7 day moving average
1	£210 00	
2	£135.00	
3	£230.00	
4	£350.00	
5	£240.00	
6	£250.00	
7	£310.00	
8	£275.00	
9	£150.00	
10	£310.00	
11	£345.00	£268.57
12	£235.00	
13	£295.00	
14	£350.00	
15	£295.00	
16	£145.00	
17	£375.00	
18	£355.00	
19	£265.00	
20	£305.00	

a) If sales on a Sunday are usually lower than other days, what day of the week is day 1?

- b) Explain why there can be no moving average for day 4.
- c) When can the first moving average be calculated?
- d) Complete the table of moving averages.
- e) By looking at the moving averages, what do you think the trend in sales is?

# **90 Recurring Decimals**

1) Without using a calculator, change the following fractions into recurring decimals.

a) $\frac{5}{9}$	b) $\frac{8}{9}$	С	c) $\frac{2}{9}$	d) $\frac{7}{9}$
e) $\frac{43}{99}$	f) $\frac{27}{99}$	٤	g) $\frac{36}{99}$	h) $\frac{51}{99}$
Use a calculator	r to change these fract	tions into recurring	decimals.	
i) $\frac{122}{999}$	j) <u>542</u> <u>999</u>	k)	) $\frac{418}{999}$	1) $\frac{74}{999}$
2) Which of the	following fractions a	re equivalent to rea	curring decimals?	
a) $\frac{5}{12}$	b) $\frac{52}{99}$	c) $\frac{7}{45}$	d) $\frac{3}{8}$	e) $\frac{11}{16}$
f) $\frac{97}{144}$	g) $\frac{43}{55}$	h) $\frac{31}{88}$	i) $\frac{5}{6}$	j) $\frac{7}{32}$
k) $\frac{41}{64}$	1) $\frac{63}{80}$	m) $\frac{541}{660}$	n) $\frac{6}{11}$	o) $\frac{63}{125}$

3) It is said that fractions with denominators that have prime factors of only 2 and 5 will represent terminating decimals.

For example  $20 = 2 \times 2 \times 5$  so  $\frac{1}{20} = 0.05$   $64 = 2 \times 2 = 0.359375$ Other fractions are represented by recurring decimals.

For example  $15 = 3 \times 5$  so  $\frac{1}{15} = 0.0\dot{6}$   $26 = 2 \times 13$  so  $\frac{11}{26} = 0.4\dot{2}\dot{3}\dot{0}\dot{7}\dot{6}\dot{9}$ 

Write down five fractions representing terminating decimals and five fractions representing recurring decimals. In each case write down both the fraction and the decimal.

# 4) Consider the number $0.\dot{2}\dot{3}\dot{4}$ . Call this x

- a) Write down the value of  $0.\dot{2}\dot{3}\dot{4} \times 10$ . Call this 10x.
- b) Write down the value of  $0.234 \times 100$ . Call this 100x.
- c) What is the value of 1000x?
- d) Subtract *x* from 1000*x* to get 999*x*. Write down the value of 999*x*?
- e) What is  $0.\dot{2}\dot{3}\dot{4}$  as a fraction?

5) Change each of the following recurring decimals into fractions in their lowest terms.

a) 0.13	b) 0.03	c) 0.20	d) 0.81	e) 0.05
f) 0.50	g) 0.61	h) 0.011	i) 0.518	j) 0.009

#### Answers

1. Multiplication and division Exercise 1 1) 8r1 2) 13r5 3) 11r6 4) 26r2 5) 20r3 6) 66r5 7) 124 8) 123 9) 194r4 10) 57r6 11) 37r8 12) 96 Exercise 2 1) 5r2 2) 4r4 3) 7r7 4) 4r7 5) 6r20 6) 8r5 7) 7r33 8) 13r1 9) 12r4 10) 11r17 11) 13r14 12) 10r14 13) 12r21 14) 16r1 15) 16r23 16) 29r7 17) 40r1 18) 16r24 20) 18r38 19) 20r5 Exercise 3 1) 7.5 2) 6.25 3) 7.25 4) 6.8 5) 7.5 6) 15.5 7) 23.5 8) 11.25 9) 20.25 11) 5.52 12) 26.25 13) 36.25 10) 45.5 14) 29.75 15) 53.5 16) 19.5 17) 2.94 18) 10.08 19) 8.4 20) 145.75 Exercise 4 1) 864 2) 1596 3) 1222 4) 1122 5) 4644 6) 2057 7) 5832 8) 4862 9) 12032 10) 1062 11) 23562 12) 39566 13) 37066 14) 54592 15) 11529 16) 62926 17) 45663 18) 26904 19) 36501 20) 43808

#### 2. Negative numbers Exercise 1

1) 14 2) 2 3) -3 4) 2 5) -13 6) 5 7) -20 8) -2 9) -4 10) -11 11) -14 12) 14 13) -6 14) 0 15) 0 16) -23 17) -17 18) 9 19) -26 20) - 4Exercise 2 1) 4 2) 6 3) 9 4) 9 5) 3 6) 7 7) 3 8) 9 9) 8 10) 5 11) 4 12) 12 13) 5 14) 24 15) 6 16) 34 17) 46 18) 8 19) 16 20) 32 Exercise 3 1) 4 2) 0 3) 6 4) 16 5) 5 6) 6 7) 3 8) 7 9) 2 10) 7 11) 7 12) 8 13) -9 14) -13 15) 0 16) -7 17) -7 18) 16 19) -10 20) 10 Exercise 4 1) -5 2) 3 3) 10 and -6 4) 12 and -12

# 3. Use of the Calculator

Exercise 1 1) 6,3 2) 23,32 3) 12,48 4) 27,12 5) 8,2 6) 7,4 7) 26,36 **Exercise 2** 4) 3.668 1) 2.195 2) 4.682 3) 7.2 5) 0.5193 6) 0.2980 7) 4.1 8) 8.453 9) 0.7714 10) 1.960 11) 36.25 12) 1.74 14) 2.031 15) 3.520 16) 3.890 13) 0.32 17) 11.83 18) 3.344 19) 5.305 20) 14.82 21) - 0.638222) 25.05 23) 2.720 24) 9.214 26) 8.928 25) 4.922 27) 4.801 28) 1.993

### 4. Estimation

#### **Exercise 1**

1) 1800 2) 2100 3) 2500 4) 4000 5) 3200 6) 3000 7) 6300 8) 5000 9) 16000 10)18000 11) 20000 12) 40000 13) 120000 14) 450000 15) 160000 16) 100000 17) 120000 18) 50000 19) 60000 20) 150000

#### Exercise 2

1) 18	2) 600	3) 1200	4) 0.8	5) 0.06
6) 0.00004	7) 29	8) 13	9) 11	10) 8.3
11) 0.4	12) 3	13) 10	14) 4	15) 4
16) 5	17) 0.2	18) 40	19) 0.5	20) 0.25
21) 0.3	22) 200	23) 5	24) 400	25) 400
26) 90	27) 12	28) 12	29)	100,000

#### 5. Fractions, Decimals and Percentages 1

#### Exercise 1

1) 0.75 2) 0.625 3) 0.4 4) 0.375 5) 0.4167 6) 0.35 7) 0.5333 8) 0.28 9) 0.2308 10) 0.1481 11) 0.56 12) 0.2667 13) 0.55 14) 0.4286 15) 0.5556 16) 0.4375 17) 0.3478 18) 0.5625

#### Exercise 2

1) 26% 2) 34% 3) 72% 4) 87% 5) 64% 6) 35% 7) 42% 8) 96.1% 9) 43.2% 10) 61.4% 11) 58.4% 12) 82.6% 13) 93.2% 14) 30% 15) 60% 16) 190% 17) 238% 18) 641%

#### **Exercise 3**

 1) 80%
 2) 80%
 3) 46.67%
 4) 15%

 5) 56.25%
 6) 35.71%
 7) 43.48%
 8) 48%

 9) 51.43%
 10) 32.43%
 11) 62.5%

 12) 46.88%
 13) 69.23%
 14) 79.41%

 15) 86.17%
 16) 73.21%
 17) 51.92%

 18) 59.38%

#### Exercise 4

1) 0.2, 23%, $\frac{1}{4}$ 2) 36%, $\frac{3}{8}$ , 0.4	1
3) 0.8, 87%, $\frac{7}{8}$ 4) 0.3, 31%, $\frac{5}{16}$	-
5) 10%, 0.14, $\frac{3}{20}$ 6) 43.7%, $\frac{7}{16}$ , 0	).47
7) $30\%, \frac{8}{23}, 0.35$ 8) 0.47, 47.3%	$,\frac{9}{17}$
9) 0.2, 21%, $\frac{6}{28}$ 10) 0.25, 25.69	$^{6}, \frac{8}{31}$

#### **Exercise 5**

1) 15 2) 153 3) £78.75 4) £1.05 5) 12.5m 6) 9.375m 7) £31.25 8) 36.75m 9) £15.40 10) 2.475m 11) £38.50 12) 2.31m

#### 6. Fractions, Decimals and Percentages 2 Exercise 1

1) 222 2) 12 3) 342 4) 205 5) 90p 6) 60p 7) £11.40 8) 1.36m 9) £2.16 10) £3.24 11) £8.58 12) 1116 Exercise 2 1) 48% 2) 63% 3) 68% 4) 46% 5) 62% 6) 65% 7) 22% 8) 90% 9) 70% 10) 62% 11) 85% 12) 69% 13) 57% 14) 61% 15) 91% 16) 60% Exercise 3 1) 20% 2) 60% 3) 33% 4) 20% 5) 11% 6) 13% 7) 4% 8) 6% 9) 6% 10) 24% Exercise 4 1) £117 2) £242 3) £180 4) £2300 5) £5544 6) £215 7) £87.50 8) £56350 9) £101.60 10) £549

7. Interest Exercise 1 2) £36, £38.16 1) £4, £4.04 3) £135, £147.51 4) £400, £464.10 5) £315, £337.56 6) £240, £249.73 7) £1040, £1120.63 8) £16.80, £17.39 9) £132, £142.84 10) £504, £551.20 Exercise 2 1) a) 249.24 b) 644.79 c) 2307.53 2) a) 1.047 b) 6282, 6577.25, 6886.38, 7210.05, 7548.92, 7903.72, 8275.19, 8664.12, 9071.34, 9497.69 3) 7345.77 4) 920.66

# 8. Scale Drawing and Ratio Exercise 1

1) 40cm 2) 8cm 3) 62cm 4) 7cm 5) 400cm 6) 16cm 7) 1:30 8) 1:20 9) 5cm 10) 2.5m 11) 1:200 12) 1:2.5 13) 5.5cm 14) 450cm 15) 1:30 16) 11.5cm 17) 9m 18) 1:5 19) 8cm 20) 104cm **Exercise 2** 1) £400, £500 2) £300, £700 3) £75, £125 4) £280, £320 5) £250, £550 6) £250, £450 7) £245, £385 8) £495, £770 9) £840, £1365 10) £300, £400,£500 11) £125, £150, £175 12) £70, £105, £140 13) £294, £336, £378 14) £315, £405, £495 15) £125, £200, £225 16) £16.80, £22.40, £39.20 17) £36, £48, £66 18) £1.98, £4.62, £7.26 19) £144, £252, £468 20) £73.50, £98, £171.50

#### Exercise 3

1) £36, £16 2) £36, £15, 3) £63, £30 4) £165, £77 5) £288, £126 6) £10.45, £6.05 7) £10.05, £5.36 8) £24.64, £14.56 9) £48.51, £20.79 10) £142.80, £66.30

#### 9. Standard Form

## Exercise 1

## Exercise 2

 $\begin{array}{l} 1)7.5\times10^{6} \hspace{0.2cm} 2)1.288\times10^{9} \hspace{0.2cm} 3)1.272\times10^{-6} \\ 4)2.368\times10^{-11} \hspace{0.2cm} 5)1.512\times10^{3} \hspace{0.2cm} 6)1.828\times10^{5} \\ 7)2.0\times10^{5} \hspace{0.2cm} 8)1.766\times10^{8} \hspace{0.2cm} 9)1.906\times10^{2} \\ 10)6.604\times10^{0} \hspace{0.2cm} 11)1.267\times10^{3} \hspace{0.2cm} 12)2.039\times10^{3} \\ 13)1.315\times10^{7} \hspace{0.2cm} 14)3.529\times10^{-22} \end{array}$ 

### Exercise 3

1)  $6 \times 10^{10}$ ,  $5 \times 10^5$  2)  $9 \times 10^{-8}$ ,  $6 \times 10^{-4}$ 3)  $2.1 \times 10^{-7}$  4) 1:81.31 5) 1.281 secs 6) 1:0.0005438 7) a.  $9.461 \times 10^{12}$  km b. 8.313 years

## **10. Prime Factors**



Exercise 2 1) 1,3,5,15 2) 1,2,4,5,10,20 3) 1,2,3,4,6,8,12,24 4) 1,2,3,5,6,10,15,30 5) 1,2,4,8,16,32 6) 1,2,4,5,8,10,20,40 7) 1,3,5,9,15,45 8) 1,2,3,4,5,6,10,12,15,20,30,60 9) 1,71 10) 1,2,3,4,6,7,12,14,21,28,42,84 11) 1,2,3,5,6,9,10,15,18,30,45,90 12) 1,2,4,5,10,20,25,50,100 13) 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 24, 30, 40, 60, 120 14) 1, 2, 5, 10, 13, 26, 65, 130 15) 1, 2, 3, 5, 6, 10, 15, 25, 30, 50, 75, 150 Exercise 3  $1)2 \times 3 \times 5^{2}$   $2)2^{5} \times 5$   $3)2^{3} \times 5^{2}$  $4)2 \times 3 \times 5 \times 7 \quad 5)2^2 \times 5 \times 13$  $(6)3^3 \times 5^2 \quad (7)3^3 \times 5 \times 7 \quad (8)5 \times 7^3$  $9)3 \times 5 \times 7 \times 11 \ 10)3^2 \times 5 \times 23$  $11)2^4 \times 3 \times 5 \times 7$   $12)2^2 \times 3^3 \times 13$ 13)  $2^2 \times 3^2 \times 5^2 \times 14$ )  $2^3 \times 3^3 \times 14$ 15)  $2^2 \times 5 \ \text{amed} \times 11$ **Exercise 4** 1)  $2^2 \times 3$ , 3 2)  $2 \times 3^2$ , 2 3)  $2^2 \times 3^2 \times 5$ , 5  $4)2^4 \times 5$ , 5 5)2×3<sup>4</sup>, 2 6)2<sup>2</sup>×3<sup>2</sup>×7, 7 7) $7^3$ , 7 8) $2^2 \times 3^2 \times 13$ , 13 9) $2^5 \times 19$ , 38  $10)2^2 \times 5 \times 7^2$ , 5  $11)2^3 \times 3 \times 5^2$ , 6  $(12)2^3 \times 3^2 \times 5, 10$ 13)  $2^2 \times 3 \times 2^2$ , 3 14)  $2^6 \times 3$ , 3 15)  $2 \ge 5^2 \ge 37, 54$ Exercise 5 1) 27 2) 45 3) 25 4) 271 5) 147 6) 63 7) 147 8) 45 9) 195 10) 117 11) 39 12) 75 13) 135 14) 315 15) 245

### 11. Number Patterns and Sequences 1 Exercise 1

1) 12,14 2) 15,17 3) 22,25 4) 25,29 5) 28,33 6) 48,57 7) 18,24 8) 15,20 9) 35,47 10) 17,23 11) 35,41 12) 23,30 14) 10,5 13) 5,3 15) 7,4 16) - 5, -1217) -3, -5 18) -2, -7 19) -20, -28 20) -16, -22 21) 13,16 22) 31,43 23) 32,64 24) 63,127 **Exercise 2** 1) 11,13; Add 2; 2 *n*-1 2) 17,20; Add 3; 3 *n*-1 3) 25,29; Add 4; 4 *n*+1 4) 36,42; Add 6; 6 *n* 5) 37,43; Add 6; 6 *n*+1 6) 37,42; Add 5; 5 *n*+7 7) 10,8; Subtract 2; 22–2 n 8) 2,-1; Subtract 3; 20-3n 9) 12.6: Subtract 6: 48–6 n 10) 3.5; Add 2; 2 *n*-9 11) 10,15; Add 5; 5 *n*-20 12) 16,22; Add 6; 6 *n*-20 13) -5,-7; Subtract 2; 7-2 n 14) -3,-6; Subtract 3; 15–3 n 15) -11,-13; Subtract 2; 1-2 n

### **Exercise 3**

1) a. 20 b. 24 c. 4*n*+4 d. 84 2) a. 9 b. 11 c. 2*n*-1 d. 79

#### 12. Number Patterns and Sequences 2

1) a. 20 b. 30 c. n(n+1) d. 420 2) a. 15 b. 20 c. 5(n-1) d. 45 3) a. 22 b. 27 c. 5n+2 d. 62 4) a. 10,26 b. 12,32 c. 2n+2, 6n+2 d. 42

#### 13. Distance Time Diagrams 1

1) a. 220 miles b. 40 mins c. 30mph d. 44mph 2) a. 45mph b. 4 mins c. 8:10 d. 32.5mph e. 8:27 f. 1.5 miles g. 8:58

### 14. Distance Time Diagrams 2

a. 60mph b. 12:40; 4 mins c) 80mph d.
 mph e. 13:04, 68 miles
 a. Journey B. It goes further in a shorter time. b. 15kph c. B d. 7.5kph
 e. 2 hours 48 mins f. 11:12 and 15:54
 g. 17:24 5) a. 144 miles b. 18 mph and 72 mph c. 60 mph and 22.5 mph d. 36 mins
 e. 05:12, 104 miles f. 30 miles
 g. 04:00 and 06:24

### **15.** Conversion Graphs 1

1) a. 6.50 b. £3.30 (approx0 2) a. \$114 b. £37

# 16. Conversion Graphs 2

1) a. 51 b. 34 2) a. 49.5 b. 7.1 3) a. £88 b. 9000 4) a. 105 secs b. 12cms 5) a. 3 b. 7 c. 382

**17. Sketching and recognising Graphs 1** 1) b 2) b 3) c



18. Sketching and recognising Graphs 2
1) d
2) b
3) b
4)



#### **19. Plotting Graphs 1**

1) a. 7,4,12 c. 1.7, -1.7 d. (2,7) (-2,7) 2) a. 8, -1, 4 c. (1,4) (-2,1) d. x=1 or x=-2 3) a. 2.625, 5.875, 6.125, 9.375 c. (0,6) (1,7) (-1,5) d. x=-1, 0 or 1 4) a. 6, -3, 6, 21 c. (2.3,10) (-2.3,10) d. x=2.3 or -2.3

#### **20. Plotting Graphs 2**

1) a. 9,6,5.25 c. 1.3 d. (0.8,7.6) (5.2,5.4) e. x=0.8 or 5.2 2) a. 5,8,13 c. Line is x+7, solution is x=1 or -23) a. -7,-5.25,11 c. Line is 4x-4, Solution is x=1.5,-0.3 or -1.34) a. 6,-1.5,-3.375 c. Line is 3-x, Solution is x=0.8 or x=6.2

**21.** Substitution 1) 25 2) 11 3) -6 4) -3 5) 4 6) 7 7) -3 8) -13 9) 20 10) -4 11) 6 12) 5 13) 3.5 14) 20.27 15) 20.423 16) 13 17) 23.57 18) 28°C 19) £71.25 20) 19.58 21) 15.34 22) 96.88 23) 10.33 24) a. 36.75 b. -1.2 25) 29.25 26) a. 43 b. 8 27) a. 66 b. 6 28) a. -6 b. 0 29) a. 152 b. 22 30) 7.5 31) -48.8 32) 28.57

# 22. Symplifying Expressions Exercise 1

#### Exercise 2

#### 23. Indices

### **Exercise 1**

1) 9 2) 27 3) 81 4) 243 5) 100 6) 1000 7) 10,000 8) 100,000

#### Exercise 2

1) 7,776 2) 15,625 3) 16,384 4) 117,649 5) 59,049 6) 161,051 7) 4,826,809 8) 40,353,607

#### Exercise 3

1) $2^7$ , 128 2) $3^9$ , 19683 3) $4^6$ , 4096 4) $10^7$ , 10,000,000 5) $7^8$ , 5,764,801 6) $8^5$ , 32768 7) $x^7$  8) $a^{13}$  9) $b^9$  10) $y^{25}$ 

#### Exercise 4

1) $4^{4}$  2) $5^{5}$  3) $7^{3}$  4) $10^{3}$  5) $15^{3}$  6) $10^{2}$  7) $9^{3}$ 8) $12^{3}$  9) $8^{6}$  10) $20^{3}$  11) $a^{3}$  12) $y^{12}$  13) $x^{5}$ 

#### Exercise 5

1) $2^{8}$  2) $4^{10}$  3) $7^{9}$  4) $4^{12}$  5) $5^{6}$  6) $2^{15}$  7) $3^{16}$ 8) $7^{8}$  9) $3^{10}$  10) $5^{8}$  11) $x^{10}$  12) $y^{9}$ 

#### Exercise 6

1) 1296 2) 248832 3) 2744 4) 512 5) 3375 6) 100000 7) 2985984 8) 194481 9) 7776 10) 160000

#### Exercise 7

1)a.  $x^5$  b.  $x^{11}$  c.  $a^{12}$  d.  $y^{13}$ 2)a.  $a^2$  b. 1 c.  $x^2$  d.  $2^6$ 3)a.  $a^{24}$  b.  $x^{18}$  c.  $y^8$  d.  $b^{18}$ 4)a.  $x^4y^2$  b.  $a^5b^3$  c.  $x^4y^6$  d.  $a^3b^6$ 5)a.  $9x^2$  b.  $8x^3$  c.  $27x^3$  d.  $25a^2$ 6)a. 3a b.  $3x^3$  c.  $5b^3$  d.  $5x^5$ 7)a.  $12x^4$  b.  $108a^7$  c.  $30y^9$ 8)a.  $x^6$  b.  $x^4$  c. 1

# 24. Multiplying Brackets

Exercise 1 1) 24 2) 35 3) -24 4) -24 5) -6 6) -40 7) 20 8) 30 9) 21 10) -30 11) -12 12) 56

#### Exercise 2

1) 3x + 3y 2) 18x + 24 3) -2x + 34) -3x - 2 5) -8x - 20 6) -21x + 287) -12x - 12 8) 10x - 15 9) 9x + 610) 13x + 20y 11) 4x - 5y 12) 20y - 22x13) 2x - 5y 14) 8x + 5y 15) 10x16) 15x + 13y 17) 38x - 19y 18) 3x - 26y19) 5x - 15y 20)  $6x^2 + 17x$  21)  $-3x^2 - 22x$ 22)  $27x^2 - 5x$  23)  $7x^2 + 3x$  24)  $15x^2 - 6x$ 25)  $16x^2 + 27x$  26)  $6x^2 - 33x$ 

#### Exercise 3

# 25. Factorising

Exercise 1 1) 3(x+2) 2) 5(x-3) 3) 3(2x-5)4) 4(z+3) 5) 4(2y+5) 6) 6(3y-1)7) 4(4x-5) 8) 8(2x-3) 9) 2(7a-8)10) 12(2x+3y) 11) 8(3x+2y)12) 7(3a+2b) 13) 2(4x-9z)14) 9(2y+3z) 15) 8(3p-5q)16) 3(a+1) 17) 16(x+1)18)  $5(1-x^2)$  19) 2(3a-2b+4c)20) 5(a+2b-c) 21) 3(4-3a+b)

#### Exercise 2

1) $a(2-a)$	2) $y(6-y)$	3) $x(9-x)$
4) $x(x-3)$	5) $3a(1+2a)$	6) $b(4-b)$
7) $2y(1+2y)$	8) $5x(x-2)$	9) $4z(z-3)$
10) $3x(2-3x)$	11) $4y(4y +$	5)
12) $16z(2-z)$	13) $5a(4-7)$	<i>a</i> )
14) $3x(6x-5)$	15) 9a(3a -	2)
Exercise 3		
1)a(b+2) = 2	(1)x(4-y) = 3	2a(3-b)
4)3a(1+2a)	5)3x(3x)	-2)

,	
4)3a(1+2a)	5)3x(3x-2)
6)x(2y+6-x)	7) $a(12b - 1 + a)$
8)7 $a(a-2b)$	9) $2\pi r(2r-3h)$
10)5y(4x + y)	11)8xy(2-z)
12)4pq(2-p)	13)13pq(2p-q)
$(14)\hat{ab}(9b-a)$	(15)4xy(4x-3y)

### Exercise 4

 $\begin{array}{ll} 1)2(a+2b) & 2)a(3h-a) & 3)5(a+3b+2c) \\ 4)3y(y+7) & 5)4bc(a-3c) & 6)2xy(3-7xy) \\ 7)2(7x^2-16y) & 8)7x(xy+2) & 9)\pi d(3-7d) \\ 10)2(8a+15x) & 11)9b(a-3b) & 12)16a(1+3a) \\ 13)2a(4+3a-b) & 14)2(4x^2+y-3z) \\ 15)x(1+x+y) \end{array}$ 

# 26. Equations

Exercise 1

3) y = 12 4) x = 61) x = 22) x = 105) y = 18 6) a = 27 7) y = 2 8) x = 109)x = 14 10) a = 3 11) x = 7 12) y = 4.5 $(13)b = -5 \quad (14)y = -6 \quad (15)b = -2.5 \quad (16)a = 2$ 20)x = 2**Exercise 2** (9) x = 3.510) x = 3(11) x = 2.512) x = 3.5(13) x = -1 (14) x = -4(15)x = 4 (16)x = 9 (17)x = 8 (18)x = 2(20) x = -8 (21) x = -3(19) x = 3

## **Exercise 3**

1) $x = 3$	2) $x = 4$	3) $x = 1$	(4) x = 7
(5) x = 5	6) $x = 6$	(7) x = 5	8) $x = 2$
(9) x = 4	10) x = 2	(11) x = 8	(12)x = 3
(13)x = 1	(14) x = 5	(15) x = 2	16)x = 4
(17) x = 20	(18) x = 10	(19) x = 2	20) x = 7
(21) x = 8	(22)x = 3	23) $x = 5$	(24) x = 7

# 27. More Equations

Exercise 1 1)x = 122) x = 12(3) x = 48(4) x = 85) x = 206) x = 187)x = 188) x = 129) x = 1210) x = 6(11) x = 32(12) x = 90(13) x = 12(16) x = 9(14) x = 1217) x = 18(15) x = 15(18) x = 14(19) x = 620) x = 521) x = 622) x = 7(23) x = 224) x = 13(25)x = 2426)x = 2027) x = 6328) x = 4029) x = 1130) x = 831) x = 432) x = 233) *x* = 7 34) x = 435) x = 336) x = 5**Exercise 2** 1) x = 2 or 32) x = -1 or 53) x = -2 or -54) x = -2 or 35) x = -6 or 26) x = -4 or -17) x = -3 or -28) x = 3 or 29) x = -4 or -110) x = 4 or 1(11) x = -9 or -2(12) x = 9 or 2(13) x = 5 or 2(14) x = -5 or -4(15) x = -3 or -416) x = 5 or -2(17) x = -6 or 1(18) x = 10 or -120) x = -2 or 1019) x = 2 or -721) x = -3 or 722) x = 3





### Exercise 2

1) $x = 1.5 y = 1.5$	2) $x = 1 y = 4$
3) $x = 2 y = 3$	4) $x = 2$ $y = 4$
5) $x = 2$ $y = -2$	6) $x = 0.5 y = 3$
7) $x = 2$ $y = 3$	8) $x = 3 y = 2$
9) $x = -1.5 y = 1$	10) $x = 3 y = 3$
11) $x = -1$ $y = -1$	12) $x = 1.5 y = 3$
13) $x = 3 y = 3$	14) $x = -1$ $y = 3$

# **29.** Trial and Improvement

Exercise 1

1) 3.4 2) 3.8 3) 4.4 4) 4.6 5) 5.1 6) 4.3 7) 3.9 8) 4.9 9) 5.2 Exercise 2 1) 4.3 2) 5.6 3) 7.2 4) 9.3 5) 3.5 6) 3.7 7) 7.5 8) 9.8 9) 4.0 10) 3.6 11) 4.1 12) 4.9 13) 5.5 14) 4.7 15) 4.7 16) 3.7 17) 5.7 18) 3.6 19) 11.3 ins 20) 5.0 cm

## **30.** Inequalities

1) $x > 3$ 2)	x < 3 = 3 (3) (x >	5 4) <i>x</i> < 6
5) $x > 10$	6) <i>x</i> < 10	7) $x \ge 4$
8) $x \ge -5$	9) $x \le 5$	10) $x \ge 3$
11) $x < 4$	12) $x > -6$	13) $x \le 6$
14) $x \ge 7$	15) $x < 11$	16) <i>x</i> < 9
17) $x > -8$	18) <i>x</i> < 8	19) $x \le 8$
20) $x \le 21$	21) $x \le 10$	22) <i>x</i> < 6
23) <i>x</i> < -14	24) $x > -3$	25) $x \ge -10$
26) $x \le 5$	27) $x \le 3.5$	28) $x < 2.5$
29) $x > 8.5$	30) $x < 7$	31) $x \le 22$
32) <i>x</i> ≤ 15	33) $x \le -40$	34) $x > -12$
35) $x > 80$	36) $x > 42$	37) $x \ge 10$
38) <i>x</i> < 5	39) <i>x</i> < 5	40) $x > 2$
41) $x > -2$	42) $x > -1$	43) $x \le -3.5$
44) $x \le 2$	45) $x \le 3$	46) $x > 7$
47) <i>x</i> > 9	48) $x > 6$	49) $x \le 6$
50) $x \ge 25$	51) $x \le 20$	

## **31.** Inequalities– Graphs

- 1) (4,3)(5,3)(3.5,3.5) etc
- 2) (3,3) (4,3) (4,4) (4.5,4.5) etc
- 3) Area bounded by (4,4) (7,4) (7,7)
- 4) Area bounded by (4,4) (6,6) (2,6)
- 5) Area bounded by (2,1) (2,4.8) (3.8,1.9)
- 6) (4,-2) and (5,1) 7) (2,4) (3,3) and (4,1)

# **32.** Rearranging Formulae

1) 
$$D = \frac{C}{\pi}$$
 2)  $r = \frac{C}{2\pi}$  3)  $m = \frac{F}{a}$   
4)  $h = \frac{V}{lb}$  5)  $h = \frac{2A}{b}$  6)  $h = \frac{3V}{\pi r^2}$   
7)  $c = y - mx$  8)  $m = \frac{y - c}{x}$   
9)  $h = \frac{v}{\pi r^2}$  10)  $r = \sqrt{\frac{v}{\pi h}}$ 

$$\begin{array}{ll} 11) \ F = \frac{9}{5}C + 32 \\ 12) \ b = \frac{3}{2}y - a \\ 13) \ h = \frac{v^2}{2g} \\ 14) \ s = \frac{v^2 - u^2}{2a} \\ 15) \ a = \frac{2(s - ut)}{t^2} \\ 16) \ v = \frac{2s}{t} - u \\ 17) \ \frac{N^2}{4\pi^2} \\ 18) \ \sqrt{\frac{X}{4l}} \\ 19) \ \frac{3A - y}{2} \\ 20) \ \sqrt{6p} + y \\ 21) \ \sqrt{\frac{2py}{R}} \\ 22) \ \frac{Dx^2}{Cz} \\ 23) \ \left(\frac{Iy}{x}\right)^2 \\ 26) \ \sqrt{\frac{A}{\pi} + r^2} \\ 27) \ \sqrt{R^2 - \frac{A}{\pi}} \\ 28) \ \sqrt{x - 2a} \\ 29) \ \frac{C(x - c)}{a^2} \\ 30) \ \frac{a}{x^2} - a \end{array}$$

# 33. Bearings



### Exercise 2

- 1) N 29° E or 029° 2) S 58° W or 238°
- 3) N 28° W or 332° 4) S 63° W or 243°
- 5) N 74° E or 074°

# Exercise 3

- 1) S 36° E or 144° 2) N 54° E or 054°
- 3) 9.4 km S 88° E or 092°
- 4) 152 km S 33° W or 213°

### **34.** Parallel Lines

- 1) 115°, 65°, 115° 2) 123°, 57°
- 3) 48° 4) 127° 5) 137°, 43°, 50°
- 6) 71°, 29°, 151°, 29° 7) 112°, 31°, 31°

- 8) 36°, 36°, 36°, 60°, 120°
- 9) 124°, 56°, 56°
- 10) 48°, 132°, 62°

#### 35. Nets and Isometric Drawing

(Diagrams are not to scale- use as a guide only)



#### **36.** Triangles

- 1)  $105^{\circ}$  2)  $70^{\circ}$  and  $60^{\circ}$  3)  $150^{\circ}$ ,  $60^{\circ}$
- 4) 70°, 60° 5) 121°, 130°, 109°
- 6) 39°, 27°, 12° 7) 43°, 94°, 137°
- 8) 27°, 27°, 63° 9) 60°, 120°
- 10) 109°, 37°, 109° 11) 90°, 35°, 55°
- 12) 120°, 26° 13) 50°, 40°

### **37. Regular Polygons**

- 1) 120°, 60° 2) 140°, 40° 3) 150°, 30°
- 4) 162°, 18° 5) 90°, 72°, 54°
- 6) 135°, 67.5°, 22.5°, 45°, 45°
- 7) 51.4°, 64.3°, 51.4°, 128.6°, 90°

8) 8 9) The interior angle of a regular pentagon is not a factor of 360° but in a regular 10) 9 11) 144°, 72° hexagon it is.

## **38. Irregular Polygons**

1) 65° 2) 125° 3) 105° 4) 120° 5) 80°, 160° 6) 120° 7) 72° and 144° 9) 140° 10) 290° 8) 135°

## **39.** Pythagoras Theorem

- 1) a. 15cm b. 10cm c. 12.53cm
- 2) a. 3.606cm b. 8.139cm c. 11.53cm
- 3) 5.657cm 4) 12.37cm 5) 4.899cm
- 6) 40.82cm 7) 15cm 8) 4.031cm
- 9) 9.899cm 10) 6.062cm 11) 4.583cm
- 12) 3m 32cm 13) 8.485cm

### 40. Trigonometry 1

- 1) a. 6.143 b. 9.801 c. 12.08 d. 4.404
- e. 12.76
- 2) a. 44.90° and 45.10° b. 49.79° and 40.21°
- c.  $38.68^{\rm o}$  and  $51.32^{\rm o}$   $\,$  d.  $26.39^{\rm o}$  and  $63.61^{\rm o}$ e. 36.87° and 53.13°
- 3) a. 5.866 b. 8.428 c. 12.34 d. 15.83
- e. 14.37

# 41. Trigonometry 2

- 1) a. 4.045 b. 6.343 c. 1.915 d. 5.891
- e. 5.634
- 2) a. 25.84° and 64.16° b. 45.57° and 44.43°
- c. 31.86° and 58.14°  $\,$  d. 38.57° and 51.43°  $\,$
- e. 39.36° and 50.64°
- 3) a. 6.625cm b. 15.42cm c. 11.65cm
- d. 15.45cm e. 16.35cm

## 42. Trigonometry 3

- 1) a. 5.124 b. 5.211 c. 5.684 d. 55.60 e. 18.22
- 2) a. 59.53° and 30.47° b. 53.97° and 36.03°
- c.  $42.51^{\circ}$  and  $47.49^{\circ}$  d.  $61.39^{\circ}$  and  $28.61^{\circ}$
- e.  $36.25^{\circ}$  and  $53.75^{\circ}$
- 3) a. 16.66 b. 10.70 c. 43.09 d. 31.40 e 5.750

## 43. Trigonometry 4

a. x=4.292 b. x=15.65 c. 49.81° and 40.19° d. x=4.890 e. 27.09° and 62.91° f. 42.37° and 47.63° g. 17.46° h. 18.71° i. 4.201m, 1.613m j. 4.047cm k. 5.711°

## 44. Reflections, Rotations and Translations 1

- 1) a. (1,-1) (4,-3.4) (4,-1) b. (-1,1) (-4,3.4) (-4,1)
- 2) a. (0,4) (-3,4) (-3,2) (0,2) b. (2,-2) (5,-2) (5,0) (2,0)
- 3) a. (3,-1) (0,-1) (0,-3) (1,-3) (3,-2) b. (-5,2) (-2,2) (-2,4) (-3,4) (-5,3) c. (1,2) (4,2) (4,0) (3,0) (1,1)

#### 45. Reflections, Rotations and Translations 2

- 1) a. (3,-1) (3,1) (1,1) (1,-1)
- b. (-3,1) (-3,-1) (-1,-1) (-1,1)
- 2) a. (2,-2) (5,1) (4,2) (1,-1) b. (-2,2) (-5,-1) (-4,-2) (-1,1)
- 3) a. (0,-4)(2,-1)(-2,-1)b. (0,4)(-2,1)(2,1)

# 46. Reflections, Rotations and Translations 3

- 1) a. (2,-1) (4.4,-4) (2,-4) b. (-2,1) (-4.4,4) (-2,4) c. (-5,-4) (-2,-1.6) (-2,-4)
- 2) a. (1.6,-1) (1.6,-3) (-1,-3) (-1,-1) b. (-4,-0.6) (-6,-0.6) (-6,2) (-4,2)

#### 47. Reflections, Rotations and Translations 4

- 1) a. (2,3) (2,-1) (0,-2) (-2,-1) (-2,3) (0,4)b. (-5,-1) (-1,-1) (0,-3) (-1,-5) (-5,-5) (-6,-3)
- 2) a. (4,2) (4,0) (-1,-2) (-1,0) b. (-6,0) (-4,0) (-2,-5) (-4,-5)

# 48. Enlargements 1

- 1) (4,8) (12,8) (12,4) (4,4)
- 2) (3,9) (12,3) (3,3)

### 49. Enlargements 2

- 3) (1,2) (3.5,2) (3.5,-3) (1,-3)
- 4) (-1,1) (0,-1) (-2,-1)

### **50. Similar Shapes**

- 1) a. FDE b. 3:2 or 1.5:1 c. 4.8cm d. 6.6cm
- 2) a. 4:5 or 1:1.25 b. 3m c. 2.6m
- 3) a. DBC b. 1.8cm c. 1.4cm
- 4) a. DCE b. 1:2.5 or 2:5 c. 7cm d. 3.6

## 51. Locus Problems 1







5) 9.4km

## **53. Degree of Accuracy**

### Exercise 1

- 1) a. 4000 b. 5200 c. 460 d. 800 e. 15000 f. 23000
- 2) a. 23300 b. 23300 c. 23000
- d. 20000
- 3) a,b,f,g.
- 4) a. 1250 1349 b. 2450 2549 c. 4,150 4,249 d. 22,500 23,499 e. 65,000, 74,999 f. 6500 7499 g. 204,500 205,499 h. 235 244 i. 745 754 j. 1345 1354

## Exercise 2

1) 121.5cm 2) ≤,< 3) 19.25,< 4) 7.815, 7.825 5) ≤,<

# **Exercise 3**

1)	9.35, 9.45	2)	62.25, 62.35
3)	19.45, 19.55	4)	27.55, 27.65
5)	19.615, 19.625	6)	25.635, 25.645
7)	15.5, 16.5	8)	17.25, 17.35
9)	37.25, 37.35	10)	6.475, 6.485
11)	9.335, 9.345	12)	1.325, 1.335

### 54. Circumference of a Circle

#### Exercise 1

LA						
1)	25.136cm	2)	37.704cı	m	3)	62.84cm
4)	113.112m	5)	50.272m	ı	6)	43.988m
7)	37.704cm	8)	50.272ci	m	9)	75.408cm
10)	7.2266m	11	) 53.414	m	12)	72.266m
Exercise 2						
1)	6.365cm	2)	33.42cm	3)	73	.20cm
4)	4.774m	5)	81.48cm	6)	56	.02m
Exe	ercise 3					
1)	785.5cm	2)	786m	3)	26	m
4)	579 turns	5)	21 turns	6)	97	9 turns
7)	55cm	8)	4m 8cm	9)	54	m

# 55. Area and Perimeter

- 1) a.  $9 \text{cm}^2$  and 12 cm
  - b.  $48 \text{cm}^2$  and 28 cm
  - c. 30.6 cm<sup>2</sup> and 24.8 cm
  - d. 78.12cm<sup>2</sup> and 35.4cm
  - $e. \ 0.96m^2 \ and \ 4m$
  - f.  $1.44m^2$  and 5m
- 2) a. 96cm<sup>2</sup> b. 31.92cm<sup>2</sup> c. 68cm<sup>2</sup> d.  $67.5 \text{cm}^2$
- 3) a. 28.3cm<sup>2</sup> b. 176.7cm<sup>2</sup>
- c. 1134.3cm<sup>2</sup> d. 38.5cm<sup>2</sup>
- e. 10.2cm<sup>2</sup> f. 237.8cm<sup>2</sup>
- 4) a.  $48 \text{cm}^2$  b.  $41 \text{cm}^2$ c. 21.994 cm<sup>2</sup> d. 150 cm<sup>2</sup> e. 117.45cm<sup>2</sup> f. 204cm<sup>2</sup>
- 5) 150 6)  $50.272 \text{ cm}^2$ , 28.568cm

# 56. Volume

## Exercise 1

- 1) 2000 2) 3 3) 3,400,000 4) 15000 5) 550 6) 1.2m<sup>3</sup> 7) 500 8) 53
- 9) 28,000 10) 3

## **Exercise 2**

- 2) 25, 5 1)  $1080 \text{ cm}^3$ 3)  $16.8m^3$
- 4) a. 384.895cm<sup>3</sup> b. 385ml 5) 90 6) 3142 litres 7) 577.8g 8) 11 times 9)  $691 \text{cm}^3$ 10) 100cm
- 11) 4.94mm 12) 350,000 litres

## 57. Compound Measure - Speed and Density Exercise 1

- 1) a. 20, 80, 10 b. 15, 60, 7.5 c. 30, 120, 15
- 2) a. 160 miles b. 40 miles c.  $2\frac{1}{2}$  hours
- 3) a. 90 miles b. 45mph
- 4) 2 hours 5) a. 15 miles b. 70 miles **Exercise 2**
- 1) a. 3g b. 2.75g 2) 3 red 1 blue etc.
- 3) 1 red 3 blue etc.
- 4) multiples of 1 red and 3 blue.
- 5) a. 4g per cm<sup>3</sup> b. 3g per cm<sup>3</sup>

# 58. Compound Measure - Best Buy and Mixed Exercise 1

- 1) 125ml
   2) 800ml
   3) 700g
   4) 4 litre
   5) 150ml
   Exercise 2
   1) a. B
   b. D
   2) 4 tins of 5 litres
- 3) 4 packets
- 4) 1 tin of 5 litres and 1 tin of 2 litres

## 59. Formulae for Area, Volume and Perimeter 1 Exercise 1

1)	a, (iii)	b. (v)	2)	a. (v)	b. (iv)
3)	a. (i)	b. (iv)	4)	a. (vi)	b. (iii)
5)	a. (v)	b. (ii)			

### 60 Formulae for Area, Volume and Perimeter 2

1) (i) She is trying to get a length of cable. Multiplying L, W and H togethergives a cubic measurement

(ii) 'a' because all the dimensions are in length. All the others give either area or

volume measurements.

2) Area. 4, 5, 11, 14, 16 Volume. 7, 20 Perimeter 3, 9, 18

### 61. Questionaires

These answers are examples only, there are many other acceptable answers

- 1) a How often do you use a supermarket (i) Once a week
  - (ii) Less than once a week
  - (iii) Never?

b Do you think there is a need for a supermarket in the town?

- (i) Yes
- (ii) No
- (iii) Don't know

2) The local supermarket– good cross-section of ages- potential customers.

Residents of the high street- they will be most affected, so probably biased.

Residents of the local housing estate-crosssection of ages- potential customers

3) No- they will probably get a one-sided

view of the problem (biased).

4) Would you be prepared to buy vegetarian

food from the tuck shop? yes/no. Which two of the following would you prefer to eat? a) Fruit b) Yoghurt c) Oatmeal

biscuits d) Nuts e) Wholemeal sandwiches.

5) a. Biased- needs a group more

representative of people in general.

b. (i) Biased- same age group

(ii) Probably the least biased group as they are more representative of people in general

(iii) Biased- no young people.

(iv) It is important to ask these people as they will be most affected but they will be biased.

6) Not a good questionairre because a) it only gives one choice, b) it puts pressure on the staff to agree by saying the manager thinks it is a good idea. It would be better to give the two choices with no comment about whether the manager likes it. A third choice such as 'None of these' or a space for their own comment would make it less biased.

# 62. Pie Charts

- 1)  $10^{\circ}$ ,  $150^{\circ}$ ,  $100^{\circ}$ ,  $80^{\circ}$  and  $30^{\circ}$
- 2) Angles of the pie chart are:
- 90°, 60°, 105°, 75° and 30° 3) Angles are:
- 20°, 100°, 160°, 20° and 60° 4) 187.5°, 30°, 120°, 22.5°
- 5) 160°, 40°, 60°, 48°, 20° and 32°
- 6) a. 6 b. 720, 540, 360, 270, 180, 90.
- 7) a. 12° b. 84°, 156°, 96°, 24°

# 63. Frequency Polygons 1











Exercise 1
#### 64. Frequency Polygons 2



(i) A-Europe, B- Australia (ii) Temperatures are high in August in Europe and high in February in Australia. (iii) May and October.

b)



Personal choices with references made to a) the temperatures b) the rainfall.





b) (i) Profits in 1991 were generally higher than in 1992. (ii) Profits are picking up as the graph is generally rising, but it did the same in 1991 and then fell in the new year. (iii) Just over 2 million per month

3)



Choose from a)Brian is most consistant b)John is getting worse c) Mike is not consistant but has best times.



Company A's profits are steadily rising but company B's profits went down substantially during the first half of the year, but rose again during the second half.

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# 65. Mean, Median, Mode and Range. Exercise 1

1)

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

Mode=1, Range =6

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

Mode=2, Range=9

3)

13	14	15	16	17
7	10	13	8	7

Mode=15, Range=4

### Exercise 2

1)									
1	2	3	4	5	6	7	8	9	10
1	1	2	4	3	2	3	2	1	2

Median=5, Range=9

2)						
2	3	4	5	6	7	
1	2	1	2	2	5	

Median=6.5, Range=7

#### Exercise 3

1)	5.6cm	2)	42	3)	5.0	4)	23.14
5)	318.7	6)	2.583	7)	41.25	8)	190
9)	106.3	10)	43.44				

#### **Exercise 4**

1) 24.15 2) 86.22kg 3) 5

#### 66. Mean 1

1)	34.14mph	2)	36.77mph	3)	43.57
4)	38.13	5)	31.08mpg	6)	30.2
7)	a. Grade 2	b.	Grade 3		
	c. Grade 1.	Gra	de 2		
8)	10.7, 10.6,	10.5	, 10.5, 10.5,	10.2	, 10.1,
10.	1, 10.2, 10.8	, 10.	7, 10.6		
Oc	tober				

# 67. Mean 2

, , , , , , ,	1) 2.345 2) 2.3 3	3) 0.2087 4	4)	5.6
---------------	-------------------	-------------	----	-----

# 68. Mean 3

1) 1.658 2) 5.462 3) 2.051

# 69. Mean 4

- Mean 156.3cm Modal Class 150–160
   Mean 5016
- Modal Class 5000–5010
- 3) Mean 223.92 Modal Class 280–320
- 4) Mean 28 hours 52 mins Modal Class 25–30
- 5) Mean 42.2cm Modal Class 42–43

#### 70. Mean 5

1) Mean 13.71 2) Mean 78.46

3) Mean 53.06 4) Mean 138.6

# 71. Cumulative Frequency 1

9 2

1

80	100	130	150	180
7	22	63	83	90

c. (i) £117 (ii) £34 (iii) 41

2) a.

65	70	75	80	85	90
15	41	77	95	105	110

c. (i) 72 (ii) 97

# 72. Cumulative Frequency 2

1) a. 30 40 50 60 70 80 90

50	40	50	00	10	00	70
3	29	70	118	155	181	186

c. (i) 54mph (ii) 168

a.			
1	1		

11	13	15	17	19
4	14	33	47	50

b. (i) 14.2 hours (ii) 2.9 hours. 17.6%

<u>)</u> a.				
20	40	60	80	100
10	32	68	82	84

c. (i) 46 (ii) 9

#### 73. Scatter Diagrams 1

Answers are approximate 1) a. 56 b. 79 2) 58 3) 57kg 4) 11.8cm 5) 40

# 74. Scatter Diagrams 2

Answers are approximate 1) a. 29g b. 18.1cm 2) 64mph 3) 3 4) 142cm

# 75. Probability 1

1) 
$$\frac{1}{6}$$
 2)  $\frac{1}{13}$  3)  $\frac{15}{35}$  or  $\frac{3}{7}$  4)  $\frac{1}{20}$   
5)  $\frac{1}{2}$  6)  $\frac{1}{2}$  7) 0.7 8) a.  $\frac{1}{6}$  b.  $\frac{1}{2}$  c.  $\frac{5}{6}$   
9) a.  $\frac{5}{12}$  b.  $\frac{4}{12}$  or  $\frac{1}{3}$  c.  $\frac{9}{12}$  or  $\frac{3}{4}$   
10) a.  $\frac{5}{100}$  or  $\frac{1}{200}$  b. 20 c. 0.98  
11) a. 0.5 b. 4 c. 20 d. 0.3 e. 0  
12) a.  $\frac{1}{18}$  b.  $\frac{3}{18}$  or  $\frac{1}{6}$  c.  $\frac{2}{18}$  or  $\frac{1}{9}$  d. 0  
13) a.  $\frac{1}{10}$  b.  $\frac{4}{10}$  or  $\frac{2}{5}$  c.  $\frac{1}{100}$  d.  $\frac{4}{25}$  e.  $\frac{1}{5}$   
14) a. 0.8 b. 6

# 76. Probability 2

1) $\frac{5}{36}$		
2) a. $\frac{4}{36}$ or $\frac{1}{9}$	b. $\frac{12}{36}$ or $\frac{1}{3}$	c. $\frac{12}{36}$ or $\frac{1}{3}$
3) a. $\frac{2}{20}$ or $\frac{1}{10}$	b. $\frac{16}{20}$ or $\frac{4}{5}$	

# 77. Probability 3

1) b. 
$$\frac{3}{12}$$
 or  $\frac{1}{4}$  c.  $\frac{3}{12}$  or  $\frac{1}{4}$   
2) a.  $\frac{1}{6}$  b.  $\frac{2}{6}$  or  $\frac{1}{3}$  c.  $\frac{1}{6}$   
3) a. 1,1 1,2 1,3 1,4  
2,1 2,2 2,3 2,4  
3,1 3,2 3,3 3,4  
b. 2 c.  $\frac{2}{12}$  or  $\frac{1}{6}$   
4) a.  $\frac{2}{30}$  or  $\frac{1}{15}$  b.  $\frac{10}{30}$  or  $\frac{1}{3}$  c.  $\frac{2}{3}$ 

# 78. Tree Diagrams

1) a. $\left(\frac{2}{5}\right), \left(\frac{3}{5}\right)$ 2) a. 0.06	$\left(\frac{2}{5}\right)$   b. 0.56 c.	b. <u>6</u> . 0.38	c. $\frac{9}{25}$
3) $\frac{3}{5}, \frac{5}{8}, \frac{3}{8}$	$, \frac{5}{8} a. \frac{3}{8}$	b. $\frac{9}{40}$	c. $\frac{19}{40}$
4) a. $\frac{13}{25}$	b. $\frac{6}{25}$	c. $\frac{6}{25}$	
5) a. $\frac{5}{18}$	b. $\frac{1}{2}$	c. $\frac{13}{18}$	

# 79. Relative Frequency 1

1) 25 2) a. (i) $\frac{1}{15}$  (ii)  $\frac{1}{2}$  b. (i) 50 (ii) 20 3) a.  $\frac{1}{2}$  b. Too few throws c. 250 4) a.  $\frac{3}{8}$  b. 625

# **80. Relative Frequency 2**

5) a.  $\frac{3}{14}$  b. 420 c. 30 d. 75 6) a. 10 b. 20 7) a. 5, 3 and 2 b. 150 8) a.  $\frac{9}{10}$  b. 10,000 c. 120,000 9) a.  $\frac{2}{3}$  b. 8 10) b. 0.57

# 82. Simultaneous Equations

# 83. Using Simple equations

1)a)10n + 6m = 200 b) 8 2) a) x-300, x+300 b) x+300=2(x-300) c) £1800 3) a) 400 - x b) 175 c) 225 4) 28.8 5) 22, 23, 24 6) 120 7) 4 8) a) 50, 75, 55 b) 70, 95, 75, 120

# 84. Using Quadratic Equations

1) a) 8 b) 5 2) 6 3) b) 10, c) 7 4) b) 5,100 5) b) 15 c) £9, 20 6) 9, 12, 15 7) b) 6000

# 85. Surds

# **Exercise 1**

1)  $2\sqrt{3}$  2)  $2\sqrt{6}$  3)  $3\sqrt{3}$  4)  $4\sqrt{2}$  5)  $3\sqrt{5}$ 6)  $3\sqrt{7}$  7)  $4\sqrt{3}$  8)  $5\sqrt{2}$  9)  $6\sqrt{2}$  10)  $5\sqrt{3}$ 11)  $4\sqrt{5}$  12)  $5\sqrt{5}$  13)  $7\sqrt{3}$ 

# **Exercise 2**

1) 2√5	2) $\frac{\sqrt{3}}{3}$	3) $\frac{\sqrt{5}}{5}$	4) $\frac{\sqrt{7}}{7}$	5) $\frac{\sqrt{11}}{11}$
6) √2	7) √3	<b>8</b> ) 2√3	9) 3√2	10) 3√3
11) $\frac{7\sqrt{5}}{5}$	12) 5.	$\sqrt{2}$ 13	3) 3√7	14) 2√7
15) $\frac{22\sqrt{3}}{3}$	16) 7	7√3	17) 15√2	

# **Exercise 3**

3)  $2\sqrt{3}$  4) 6 1) 2√6 2) 10 5) 3√7 6)  $5\sqrt{2}$  7)  $2\sqrt{6}$  8)  $3\sqrt{2}$  9)  $3\sqrt{6}$  10)  $2\sqrt{5}$ 11) 5√6 12) 2√7 13) 4√5 14) 6√6 15) 16√6 16) 4√5

# Exercise 4

a)  $\sqrt{2}$  b)  $\sqrt{10}$  c)  $2\sqrt{3}$  d)  $\sqrt{21}$  e)  $2\sqrt{13}$ 

# 86. Recognising Graphs

(i) f	(ii) e	(iii) k	(iv) c	(v) d	(vi) j
(vii) b	(viii) l	(ix) i	(x) a	(xi) h	(xii) g

# 87. Plans and Elevations 1



88. Plans and Elevations 2



a) Saturday

b) There has to be at least 7 days for this moving average to be calculated.

# c) Day 7

# d)

Day	Value of Sales	7 day moving average
1	£210 00	
2	£135.00	
3	£230.00	
4	£350.00	
5	£240.00	
6	£250.00	
7	£310.00	£246.43
8	£275.00	£255.71
9	£150.00	£257.86
10	£310.00	£269.29
11	£345.00	£268.57
12	£235.00	£267.86
13	£295.00	£274.29
14	£350.00	£280.00
15	£295.00	£282.86
16	£145.00	£282.14
17	£375.00	£291.43
18	£355.00	£292.86
19	£265.00	£297.14
20	£305.00	£298.57

e) The sales are increasing.

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# 90 Recurring Decimals

```
1) a) 0.5 b) 0.8 c) 0.2 d) 0.7 e) 0.43 f) 0.27
g) 0.36 h) 0.51 i) 0.122 j) 0.542 k) 0.418
l) 0.074
2) a, b, c, f, g, h, i, m, n
3) - Five fractions of each type -
4) a) 10x = 2.342 b) 100x = 23.423
c) 1000x = 234.234 d) 999x = 234
e) x = \frac{234}{999} or \frac{26}{111}
5) a) \frac{13}{99} b) \frac{1}{33} c) \frac{20}{99} d) \frac{9}{11} e) \frac{5}{99} f) \frac{50}{99}
g) \frac{61}{99} h) \frac{11}{999} i) \frac{14}{27} j) \frac{1}{111}
```