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# 16 Round 9-1 GCSE Maths Problem Solving Questions (Foundation & Higher)

*(Please note: These are **not** Maths Challenge or Nrich style questions. They are designed to help students with problem solving type questions on the 9-1 GCSE)*

**Name**:_____         **Target Grade: 1 2 3 4 5 6 7 8 9**

| Round | Date | Foundation | Higher | How Could I Improve? |
|-------|------|------------|--------|----------------------|
| 1 | | Y/N | Y/N | |
| 2 | | Y/N | Y/N | |
| 3 | | Y/N | Y/N | |
| 4 | | Y/N | Y/N | |
| 5 | | Y/N | Y/N | |
| 6 | | Y/N | Y/N | |
| 7 | | Y/N | Y/N | |
| 8 | | Y/N | Y/N | |
| 9 | | Y/N | Y/N | |
| 10 | | Y/N | Y/N | |
| 11 | | Y/N | Y/N | |
| 12 | | Y/N | Y/N | |
| 13 | | Y/N | Y/N | |
| 14 | | Y/N | Y/N | |
| 15 | | Y/N | Y/N | |
| 16 | | Y/N | Y/N | |

## Problem Solving Round 1

### Foundation:
By listing systematically, find two numbers that have a sum of 25 & a difference of 3.

### Higher:
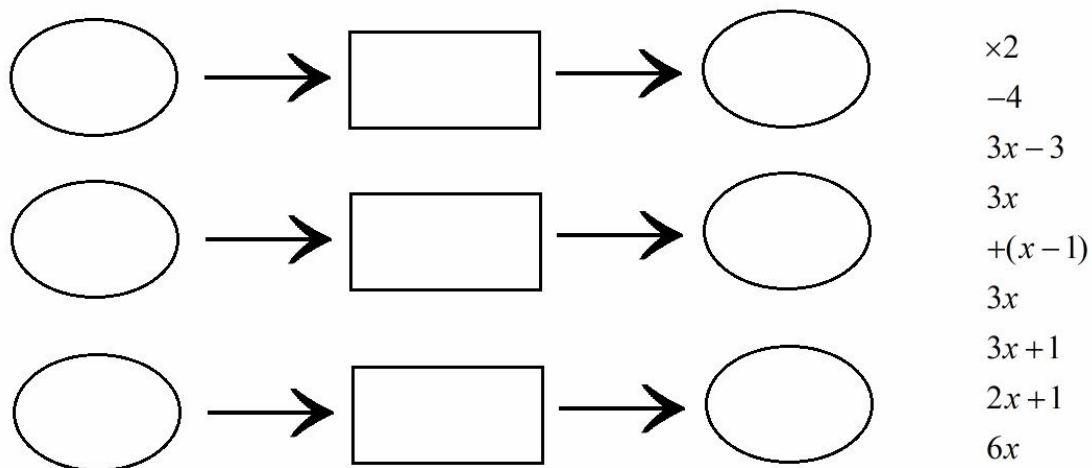In the diagram below a regular pentagon is drawn inside a regular hexagon such that their bases share the same line.

Given that angle $KLM = x$, find the value of $3x + 2$.
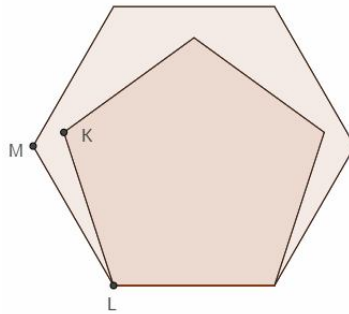
# Problem Solving Round 2

## Foundation:

Fill the 3 function machines using the 9 calculations and expressions on the right to make each one true:



$\times 2$
$-4$
$3x - 3$
$3x$
$+(x - 1)$
$3x$
$3x + 1$
$2x + 1$
$6x$

## Higher:

There is a sale on at an electrical shop. One washing machine is priced at £467.80 after an 18% reduction. A second washing machine is priced at £469.80 after a 13% reduction. What was the original price difference between the two washing machines prior to the sale?
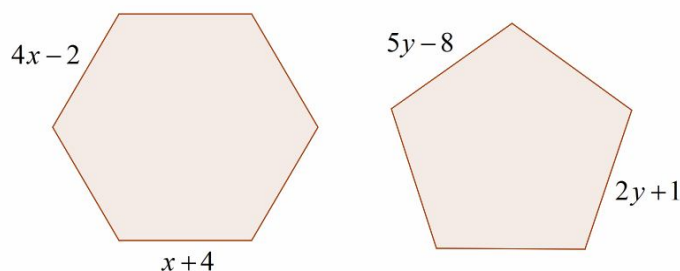
## Problem Solving Round 3

### Foundation:
Petrol costs 90p a litre and a car can travel 8 miles on one litre of petrol. John needs to travel 45 miles in his car one day.

Which of the following calculations can John use to find out the cost of his journey in pounds? **You must give a reason for your choice**.

(a) $\dfrac{0.9 \times 8}{45}$     (b) $90 \times 45 \div 8$     (c) $\dfrac{45}{8} \times 90$     (d) $8(0.90) \div 45$     (e) $0.9 \times (45 \div 8)$

### Higher:
Below is a diagram showing a regular hexagon and a regular pentagon. Each shape has the lengths of two sides shown in terms of $x$ or $y$.



$4x - 2$
$x + 4$
$5y - 8$
$2y + 1$

Find which of the two shapes has the greatest perimeter. You must clearly show how you found your answer. The shapes are not drawn to scale.

## Problem Solving Round 4

### Foundation:
Bob has a **circular** tank with a diameter **and** depth of 10m.
He begins to fill the tank with water at a constant rate of 15m³ per minute.
(a) Find the volume of the tank.
(b) Show that the tank can be filled in less than 53 minutes.

### Higher:
In a school the ratio of boys to girls is 1:1.5
A number of girls leave such that the percentage of girls in the school has dropped by 12%. What is the new ratio of boys to girls in the school?
You must give your answer in its simplest form.

**Problem Solving Round 5**

**Foundation:**
John has half a litre of milk in a glass.
The glass is currently half full with milk and half empty.
How many millilitres of the milk will John have to drink to make the 'full to empty' ratio of the glass 2:3?

**Higher:**
There are *y* counters in a bag.
8 of the counters are Red and the rest of the counters are Blue.
Counters are taken at random from the bag.
Match each event (1-4) with the correct probability below (a-d).
You must explain your reasoning.

## Event

| (1) | (2) | (3) | (4) |
|---|---|---|---|
| *The first 3 counters are taken out and none of them are replaced.* **All 3 counters are Red.** | **A Blue counter is chosen with the first pick.** | *3 counters are taken one at a time. Their colours are noted and each counter is replaced in the bag before the next is chosen.* **The counters chosen are Red, Blue and Red** | *Two counters are taken at random and not replaced.* **Both counters are the same colour.** |

## Probability

| (a) | (b) | (c) | (d) |
|---|---|---|---|
| $\left(\dfrac{8}{y}\right)^2 \times \dfrac{y-8}{y}$ | $\dfrac{8}{y} \times \dfrac{7}{y-1} \times \dfrac{6}{y-2}$ | $\dfrac{y-8}{y}$ | $\left(\dfrac{8}{y} \times \dfrac{7}{y-1}\right) + \left(\dfrac{y-8}{y} \times \dfrac{y-9}{y-1}\right)$ |

## Reasoning

(1) _____
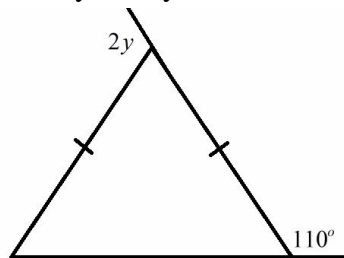
(2) _____

(3) _____

(4) _____

## Problem Solving Round 6

### Foundation:

The diagram below shows a triangle with two given exterior angles.

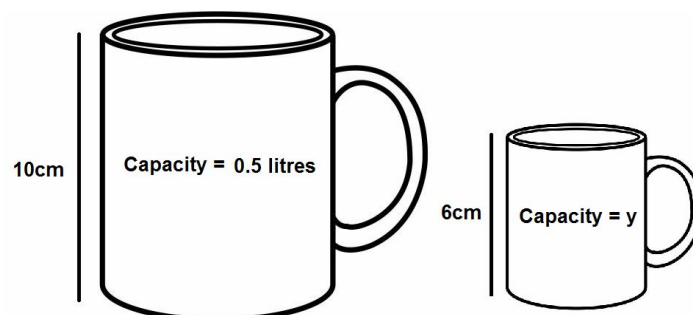The sizes of the exterior angles are $110^o$ and $2y$.

Find the value of $y$ explaining clearly how you found the answer.



### Higher:

Two **similar** mugs are shown below.



Given that $1cm^3 = 1ml$ and that tea costs £2.74 a litre, find the cost of filling the smaller mug with tea. Give your to the nearest penny.

## Problem Solving Round 7

### Foundation:
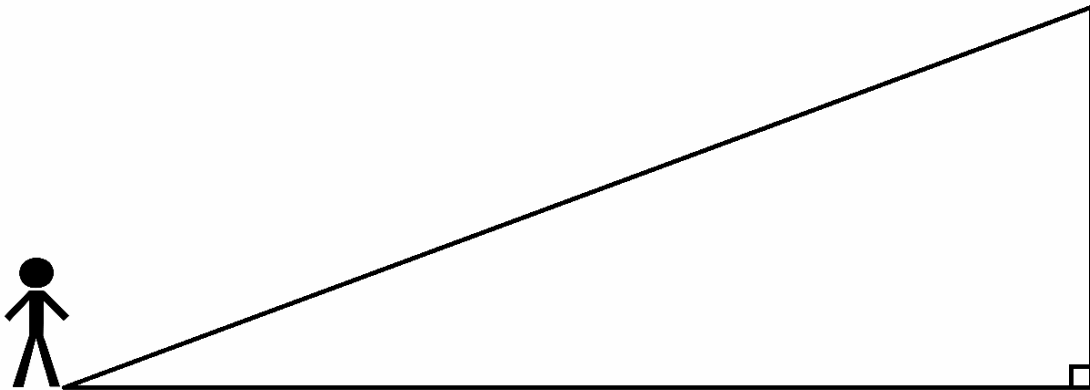James, Kevin and Leon are brothers.
Kevin is twice the age of James.
Leon is 3 years older than James.
The current combined age of the three brothers is 87.
How old was Leon two years ago?

### Higher:
Billy is standing at the bottom of a ramp as shown below.



The ramp has a vertical height of 5 meters makes an angle of 30º with the ground.
Given that Billy can walk at 1.3 meters per second on an incline, find the time it will take him to walk from the bottom of the ramp to the top of the ramp.
Give your answer to the nearest $100^{th}$ of a second.

**Problem Solving Round 8**

**Foundation:**

As a product of its prime factors $N = p^3 \times q^2 \times r$.

Given that $p + q + r = 12$ and $p < q < r$, find the value of $N$.

**Higher:**

$P, Q$ and $R$ are all different double digit positive integers.

$P, Q$ and $R$ are all less than 24.

The mean of $P, Q$ and $R$ is prime.
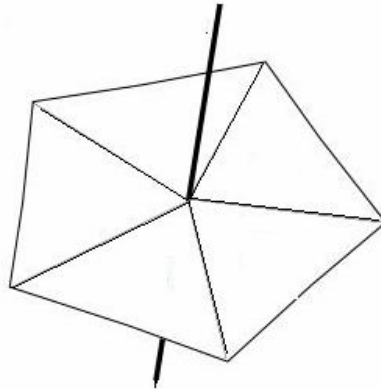
The median of $P, Q$ and $R$ is square.

The range of $P, Q$ and $R$ is square.

Find the values of $P, Q$ and $R$.

## Problem Solving Round 9

### Foundation:

Bob has the blank fair five sided spinner in the diagram below.



Place a different number on each section of the spinner such that:

The probability of spinning a prime number is 0.4

The probability of spinning a square number is $\frac{1}{5}$

The probability of spinning an even number is 0.6

### Higher:

Kelly wants to buy a car that has just been released.
She can't afford to buy the car new and must wait until she can afford to buy a used one.
The new price of the car is £25000. The value of the car depreciates by 6% a year.
Kelly invests £16500 into a savings account paying 4% compound interest a year.
Will Kelly be able to afford the car after 4 years?
You must clearly show how you decided.

**<u>Problem Solving Round 10</u>**

**<u>Foundation:</u>**
Mary rolls 3 fair 6 sided dice.
The sum of the first two dice is a factor of 6.
The product of the second two dice is a multiple of 4.
The range of the scores on the dice is 3.
Fill out the boxes below with the numbers Mary could have rolled on each dice.

|  |  |  |
|---|---|---|
| 1st dice | 2nd dice | 3rd dice |

**<u>Higher:</u>**
At *Animals R Us Vets* they have 3 different categories of animals on their register.
They have cats, dogs and 'other animals' on the register.
The ratio of cats to dogs on the register is 12:7
The ratio of dogs to 'other animals' on the register is 3:1
Work out what percentage of the register is made up of dogs.
Give your answer to 1 decimal place.

**Foundation:**
Study the numbers below:

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

Chose one square number, one prime number and one cube number **from the list above** and place them in the boxes below to make the largest possible 3 digit integer.

☐ ☐ ☐

**Higher:**
A rectangle has side lengths of $(t-4)$ and $(t+7)$.

Given that the area of the rectangle is 42, find the perimeter of the rectangle.
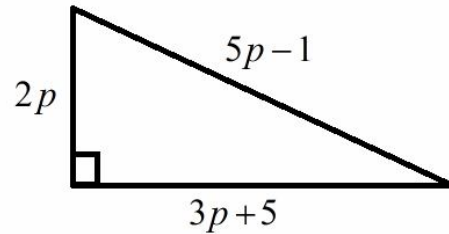**You must show full workings by setting up and solving an equation.**
**No marks will be awarded for trial and error.**

## Problem Solving Round 12

### Foundation:

The perimeter of the triangle below is 44.



Find the area of the triangle.

### Higher:

The diagram below shows a regular octagon, a regular hexagon and a triangle.
- The octagon and hexagon share one side length.
- The triangle and hexagon share one side length.
- One of the sides of the triangle forms part of a side of the octagon.
- One of the sides of the hexagon is extended to make the shortest side of the triangle.
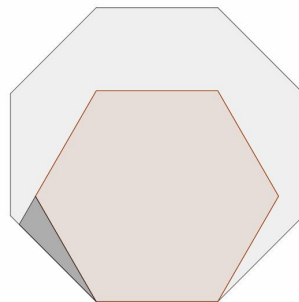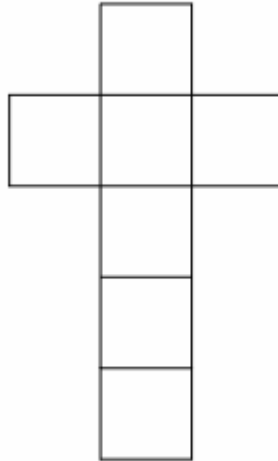


Find the size of each angle in the dark shaded triangle.

**Problem Solving Round 13**

**Foundation:**
The shape below is made up of 6 congruent squares.
Remove 3 of the squares from the shape to give it 4 lines of symmetry **and** rotational symmetry order of 4.



**Higher:**
The table below gives some information about the members of a cricket club.

| Age | Frequency | Cumulative Frequency | Frequency Density |
| --- | --- | --- | --- |
| | | 2 | 0.2 |
| $10 < a \leq 25$ | | 8 | |
| | | 16 | 0.4 |
| | | 31 | |
| $50 < a \leq 60$ | 11 | | 1.1 |

Complete the table.

## Problem Solving Round 14

### Foundation:
Fred, Jim and Colin are playing a game.
They are the only 3 players in the game.
The probability of each person winning the game is shown below

| Name | Fred | Jim | Colin |
|---|---|---|---|
| Probability of winning | $2x$ | $7x$ | $x$ |

If 300 games were played, how many more games would you expect Jim to win than Colin?

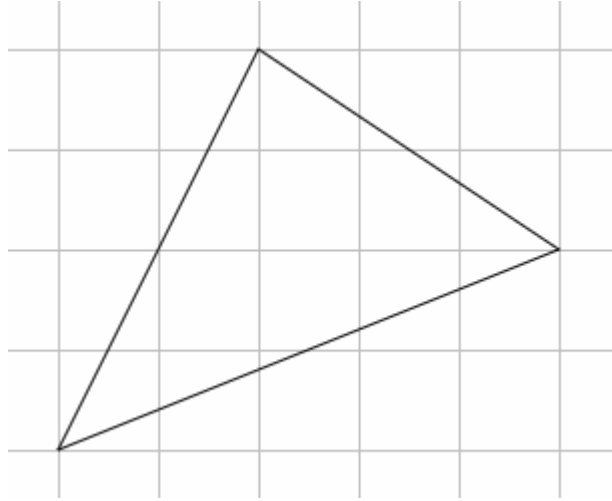### Higher (non calculator):
Circle $A$ has area $40\pi \, cm^2$.
Circle $B$ has circumference $6\sqrt{10}\pi \, cm$.

Find the ratio of the length of the radius of Circle $A$ to the length of the radius of Circle $B$ in the form $n:1$.
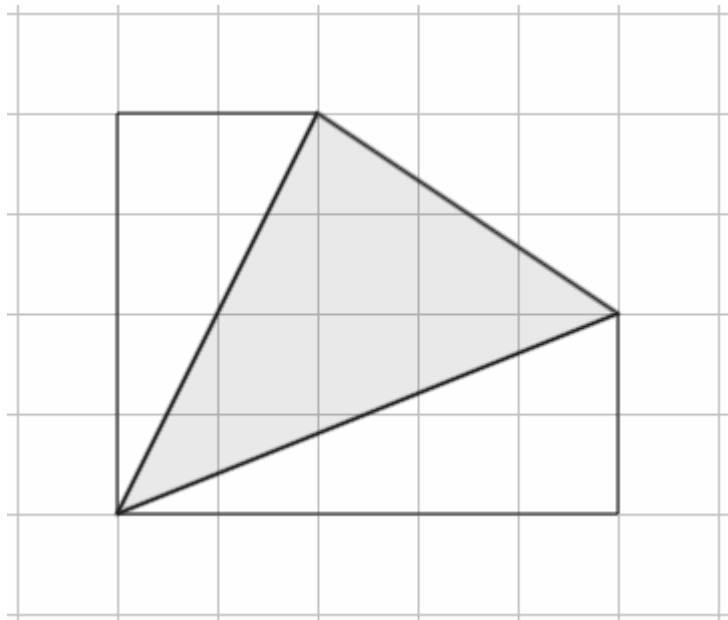
## Problem Solving Round 15

### Foundation:
Find the area of the triangle below.



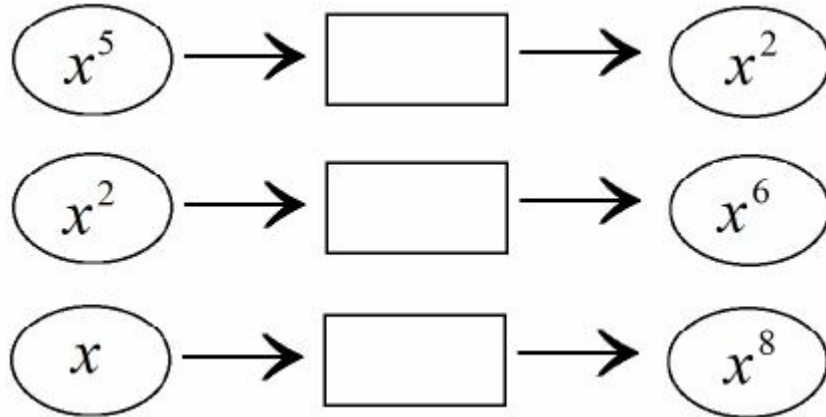### Higher:
Find the perimeter of the shaded triangle below.

## Problem Solving Round 16

### Foundation:
Complete the function machines below.

$x^5 \rightarrow \boxed{\phantom{xxx}} \rightarrow x^2$

$x^2 \rightarrow \boxed{\phantom{xxx}} \rightarrow x^6$

$x \rightarrow \boxed{\phantom{xxx}} \rightarrow x^8$

### Higher:
Shape A is a regular polygon. The ratio of the size of the interior angle to the size of the exterior angle is 7:2. The ratio of the side length to the number of sides is 5:3. Find the perimeter of Shape A .