Day 106 **S Tier 10-a-day: Model Solutions**

1 Angles in polygons

The sum of the interior angles of a polygon is 2700°.
Work out the number of sides of the polygon.

Sum of interior angles = $(n - 2) \times 180°$
$(n - 2) \times 180 = 2700$
$n - 2 = 2700 \div 180 = 15$
$n = 17$
Answer: 17

2 Simple and compound interest

Amir invests £12,000 for 5 years at 1.5% per year simple interest.
Ravi invests £12,000 for 5 years at 1.5% per year compound interest.
Work out how much more interest Ravi earns than Amir.
Give your answer to the nearest penny. (Calculator)

Simple interest: £12,000 × 1.5% × 5 = £900
Compound: £12,000 × 1.015^5 = £12,927.41
Compound interest = £12,927.41 − £12,000 = £927.41
Difference = £927.41 − £900 = £27.41
Answer: £27.41

3 Similar triangles with algebra

In the diagram, DE is parallel to BC.
AD = x cm, DB = (x + 4) cm, DE = 3 cm and BC = 7 cm.
(a) Find the value of x.
(b) Work out the length of AB.
The diagram is not drawn accurately.

(a) Triangles ADE and ABC are similar, so $\frac{AD}{AB} = \frac{DE}{BC}$

$\frac{x}{2x + 4} = \frac{3}{7}$
$7x = 3(2x + 4)$
$7x = 6x + 12$
$x = 12$
(b) AB = 2x + 4 = 28 cm
Answer: (a) x = 12 (b) 28 cm

4 Simplifying surds

Write $\sqrt{20} + \sqrt{80} - \sqrt{5}$ in the form $a\sqrt{5}$
where a is an integer.

$\sqrt{20} = 2\sqrt{5}$; $\sqrt{80} = 4\sqrt{5}$
$(2 + 4 - 1)\sqrt{5} = 5\sqrt{5}$
Answer: $5\sqrt{5}$

5 Mean of a changing set

The mean of 11 numbers is 16.
One number is removed and the mean of the remaining 10 numbers is 13.9.
Work out the number that was removed.

Total of the 11 numbers = 11 × 16 = 176
Total of the 10 remaining = 10 × 13.9 = 139
Number removed = 176 − 139 = 37
Answer: 37

Day 106 **S Tier 10-a-day: Model Solutions**

6 Gradient of a chord

A and B are points on the curve $y = 3x^2 - 5x + 3$.
The x coordinate of A is 0 and the x coordinate of B is 4.
Work out the gradient of the line AB.

At A: y = 3. At B: y = 31
A is (0, 3) and B is (4, 31)
Gradient = $\frac{31 - 3}{4 - 0} = \frac{28}{4} = 7$

Answer: 7

7 Transformations of graphs

The graph of y = f(x) has a minimum point at (−3, −3).
Write down the coordinates of the turning point of the graph of
(a) y = f(x) − 3
(b) y = f(x − 1) − 5

(a) Start with the turning point (−3, −3)
Apply the transformation to the point: (−3, −6)
(b) f(x − 1) changes the x-coordinate to −2, and f(x) − 5 changes the y-coordinate to −8
Turning point: (−2, −8)
Answer: (a) (−3, −6) (b) (−2, −8)

8 Rearranging when the subject appears twice

Make r the subject of P(r + 3) = r − P

Expand the bracket: Pr + 3P = r − P
Collect the r terms: Pr − r = −3P − P
Factorise: r(P − 1) = −4P
$r = \frac{4P}{1 - P}$

Answer: r = $\frac{4P}{1 - P}$

9 Percentages with an unknown rate

A population is increased by x% in one year and then increased by a further x% the next year.
Over the two years the population increases by 21%.
Work out the value of x.

Yearly multiplier = $1 + \frac{x}{100}$

Two years: $(1 + \frac{x}{100})^2 = 1.21$

Take the square root: $1 + \frac{x}{100} = 1.1$

$\frac{x}{100} = 0.1$, so x = 10

Answer: x = 10

10 Venn diagrams with algebra

The Venn diagram shows how many of 41 students study French (F) or Spanish (S).
(a) Work out the value of x.
(b) A student is chosen at random from those who study Spanish. Work out the probability that this student also studies French.

(a) Total: (x + 1) + x + (2x − 3) + 7 = 41
4x + 5 = 41, so x = 9
(b) Students in the second circle: x + 2x − 3 = 9 + 15 = 24, of whom 9 are in both

Probability = $\frac{3}{8}$

Answer: (a) x = 9 (b) $\frac{3}{8}$