Day 184 **S Tier 10-a-day: Model Solutions**

1 Angles in polygons

Each interior angle of a regular polygon is 170°.
Work out the number of sides of the polygon.

Exterior angle = 180° − 170° = 10°
Number of sides = 360° ÷ 10° = 36
Answer: 36

2 Ordering numbers

Write these numbers in order of size, starting with the smallest.

$\frac{1}{3}$, 0.82, 0.59, 30%

Convert each to a decimal: $\frac{1}{3}$ = 0.333, 0.82 = 0.82, 0.59 = 0.59, 30% = 0.3

In order: 30%, $\frac{1}{3}$, 0.59, 0.82

Answer: 30%, $\frac{1}{3}$, 0.59, 0.82

3 Averages with algebra

Here are five numbers: x − 1, 2, x, 4, x + 2.
The mean of the five numbers is 5.
(a) Work out the value of x.
(b) Work out the range of the five numbers.

(a) Total = (x − 1) + (2) + (x) + (4) + (x + 2) = 5 × 5 = 25
3x + 7 = 25, so 3x = 18 and x = 6
The numbers are 5, 2, 6, 4, 8
(b) Range = 8 − 2 = 6
Answer: (a) x = 6 (b) 6

4 Composite functions

f(x) = 3x + 2 and g(x) = $\frac{6}{x}$

(a) Find gf(x).

(b) Solve gf(x) = $\frac{6}{11}$

(a) gf(x) = g(3x + 2) = $\frac{6}{3x + 2}$

(b) $\frac{6}{3x + 2} = \frac{6}{11}$, so 3x + 2 = 6 ÷ $\frac{6}{11}$ = 11
3x = 9
x = 3

Answer: (a) $\frac{6}{3x + 2}$ (b) x = 3

5 Time zones

A flight leaves London at 15:40 (London time).
It takes 9 hours 50 minutes.
When it is 12:00 in London it is 20:00 in Tokyo.
At what time, in Tokyo time, does the flight land? Say if it is on a different day.

Arrival in London time = 15:40 + 9 h 50 min = 01:30 the next day
Tokyo is 8 hours ahead of London, so add 8 hours
09:30 the next day
Answer: 09:30 the next day

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6 Forming and solving quadratic equations

The sum of the squares of two consecutive positive integers is 61.
Let the smaller integer be n.
(a) Show that $n^2 + n - 30 = 0$
(b) Work out the two integers.

(a) $n^2 + (n + 1)^2 = 61$, so $2n^2 + 2n + 1 = 61$
$2n^2 + 2n = 60$, so $n^2 + n - 30 = 0$
(b) Factorise: $(n - 5)(n + 6) = 0$
$n = 5$ or $n = -6$. n is positive, so $n = 5$
The integers are 5 and 6
Answer: (b) 5 and 6

7 3D problems: pyramids

VABCD is a pyramid on a square base. V is directly above the centre M. (Calculator)
(a) Work out AC as a simplified surd.
(b) Work out the angle between VA and the base, to 1 d.p.
The diagram is not drawn accurately.

(a) $AC^2 = 8^2 + 8^2 = 128$
$AC = \sqrt{128} = 8\sqrt{2}$ cm
(b) $AM = AC \div 2 = 4\sqrt{2}$ cm. The angle is VAM.
$\tan(VAM) = \frac{VM}{AM} = \frac{7}{\sqrt{32}}$
angle VAM = 51.1° (1 d.p.)
Answer: (a) $8\sqrt{2}$ cm (b) 51.1°

8 Speed and a moving train

A train travels at a constant speed of 36 km/h.
It takes 45 seconds to go completely through a tunnel which is 170 m long.
Work out the length of the train, in metres.

Speed = 36 km/h = 36,000 ÷ 3600 = 10 m/s
Distance travelled in 45 s = 10 × 45 = 450 m
This is the length of the tunnel plus the length of the train
Train = 450 − 170 = 280 m
Answer: 280 m

9 Cosine rule and area of a triangle

The diagram shows triangle ABC. (Calculator)
(a) Work out angle ACB, marked θ, to 1 decimal place.
(b) Work out the area of triangle ABC to 3 significant figures.
The diagram is not drawn accurately.

(a) $\cos\theta = \frac{12^2 + 16^2 - 12^2}{2 \times 12 \times 16} = \frac{256}{384}$
θ = 48.2° (1 d.p.)
(b) Area = $\frac{1}{2} \times 12 \times 16 \times \sin 48.2°$
= 71.6 cm^2 (3 s.f.)
Answer: (a) 48.2° (b) 71.6 cm^2

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10 Bounds and accuracy

a = 1.13 and b = 7.91, both correct to 3 significant figures.
Work out a ÷ b.
Write down your answer to a suitable degree of accuracy.
You must show your working and give a reason for your answer. (Calculator)

$1.125 \leq a < 1.135$; $7.905 \leq b < 7.915$
Lower bound = 1.125 ÷ 7.915 = 0.14214...
Upper bound = 1.135 ÷ 7.905 = 0.14358...
Both bounds round to 0.14 to 2 significant figures, but not to 3 significant figures
Answer: 0.14 (2 s.f.)