Day 189 **A Tier 10-a-day: Model Solutions**

1 Circle area and circumference

The area of a circle is 144π cm^2.
(a) Work out the radius of the circle.
(b) Work out the circumference. Give your answer in terms of π.

(a) $\pi r^2 = 144\pi$, so $r^2 = 144$
$r = 12$
(b) Circumference $= 2\pi r = 2 \times \pi \times 12 = 24\pi$
Answer: (a) 12 cm (b) 24π cm

2 Algebraic formulae in context

A mechanic charges £55 plus £45 for each hour of work.
(a) Write a formula for the total cost, £C, after t hours.
(b) Aisha pays £595 in total. Work out the number of hours.

(a) $C = 55 + 45t$
(b) $55 + 45t = 595$
$45t = 540$
$t = 12$
Answer: (a) $C = 55 + 45t$ (b) 12

3 Circle theorems: angle in a semicircle

XY is a diameter of the circle.
Angle YXZ = 27°.
Work out the size of angle x.
Give a reason for each step of your working.

The angle in a semicircle is 90°, so angle XZY = 90°
Angles in a triangle add up to 180°
$x = 180 - 90 - 27 = 63$
Answer: $x = 63°$

4 Probabilities adding to 1

The table shows the probabilities of the outcomes of a biased spinner.
(a) Work out the value of p.
(b) The spinner is spun 200 times. Estimate the number of times it lands on blue.

(a) Probabilities add to 1: $0.25 + p + p + 0.05 = 1$
$0.3 + 2p = 1$, so $2p = 0.7$
$p = 0.35$
(b) P(blue) = 0.35, so expected number $= 0.35 \times 200 = 70$
Answer: (a) $p = 0.35$ (b) 70

5 Enlargements and coordinates

Triangle PQR has vertices P(4, 1), Q(4, 3), R(6, −1).

The triangle is enlarged with scale factor $-\frac{1}{2}$ and centre (2, −1).

Write down the coordinates of the vertices of the image.

Each vertex moves to: centre + scale factor × (vertex − centre)
A negative scale factor puts the image on the opposite side of the centre
P: (4, 1) → (1, −2)
Q: (4, 3) → (1, −3)
R: (6, −1) → (0, −1)
Answer: P'(1, −2), Q'(1, −3), R'(0, −1)

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6 Fraction calculations

Work out $(1\frac{3}{4} + 3\frac{1}{6}) \times 1\frac{1}{3}$

Give your answer as a mixed number in its simplest form.

Brackets first, as improper fractions: $\frac{7}{4} + \frac{19}{6} = \frac{59}{12}$

Then multiply: $\frac{59}{12} \times \frac{4}{3} = \frac{59}{9}$

$= 6\frac{5}{9}$

Answer: $6\frac{5}{9}$

7 Expanding three brackets

Expand and simplify

$(x + 1)(x - 3)(x + 2)$

Expand the first two brackets: $(x + 1)(x - 3) = x^2 - 2x - 3$

Multiply by the third bracket: $(x^2 - 2x - 3)(x + 2)$

$= x^3 - 2x^2 - 3x + 2x^2 - 4x - 6$

$= x^3 - 7x - 6$

Answer: $x^3 - 7x - 6$

8 Box plots

The box plot shows the scores of the students in Class A in a test.

(a) Write down the median and the interquartile range.

For Class B the median is 35 and the interquartile range is 35.

(b) Compare the distributions of the two classes.

(a) Median = 40

Interquartile range = 60 − 35 = 25

(b) The median for Class A is higher (40 compared with 35), so it has the higher values on average

The IQR for Class A is smaller (25 compared with 35), so its values are more consistent

Answer: (a) Median 40, IQR 25 (b) Class A has the higher median; Class A has the smaller IQR so is more consistent

9 Perpendicular bisector

A is the point (−5, −4) and B is the point (1, 0).

Find the equation of the perpendicular bisector of AB.

Midpoint of AB = $(\frac{(-5) + 1}{2}, \frac{(-4) + 0}{2}) = (-2, -2)$

Gradient of AB = $\frac{4}{6} = \frac{2}{3}$

Perpendicular gradient = $-1 \div \frac{2}{3} = -\frac{3}{2}$

$y = -\frac{3}{2}x + c$ through $(-2, -2)$: $-2 = -\frac{3}{2} \times (-2) + c$, so $c = -5$

$y = -\frac{3}{2}x - 5$

Answer: $y = -\frac{3}{2}x - 5$

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10 Bounds of a speed or density

A runner travels 400 m in 13.1 s. The distance is measured to the nearest 10 metres and the time to the nearest 0.1 second. (Calculator)
Work out the lower bound for the runner's speed in m/s.
Give your answer correct to 3 significant figures.

speed = distance ÷ time
For the lower bound of speed use the lower bound of distance and the upper bound of time.
395 ÷ 13.15 = 30.03802
= 30.0 m/s (3 s.f.)
Answer: 30.0 m/s