Day 206 **S Tier 10-a-day: Model Solutions**

1 Moving averages

The table shows the daily visitors over six periods.
The 3-point moving average centred on Thu is 21.
(a) Work out the value of x.
(b) Work out the 3-point moving average centred on Fri.

(a) (15 + x + 10) ÷ 3 = 21
15 + x + 10 = 63, so x = 38
(b) (38 + 10 + 24) ÷ 3 = 72 ÷ 3 = 24
Answer: (a) x = 38 (b) 24

2 Solving quadratics by factorising

Solve $6x^2 + 5x = 21$

Rearrange so that one side is 0: $6x^2 + 5x - 21 = 0$
Factorise: $(2x - 3)(3x + 7) = 0$
$2x - 3 = 0$ or $3x + 7 = 0$
$x = \frac{3}{2}$ or $x = -\frac{7}{3}$
Answer: $x = -\frac{7}{3}$ or $x = \frac{3}{2}$

3 Percentage change

The population of a village decreased by 5% in 2023.
In 2024 the population decreased by a further 25%.
Work out the overall percentage decrease over the two years.

Multipliers: 0.95 and 0.75
Overall multiplier = 0.95 × 0.75 = 0.7125
0.7125 − 1 = −0.2875, so an overall decrease of 28.75%
Answer: 28.75% decrease

4 Area of a triangle using sine

Triangle ABC has AB = 14 cm and BC = 4 cm.
The area of triangle ABC is $14\sqrt{3}$ cm^2.
Angle ABC is acute.
Work out the size of angle ABC.
Do not use a calculator.

Area = $\frac{1}{2}$ × AB × BC × sin B
$14\sqrt{3} = \frac{1}{2} \times 14 \times 4 \times \sin B$
$\sin B = 14\sqrt{3} \div 28 = \frac{\sqrt{3}}{2}$
$\sin 60° = \frac{\sqrt{3}}{2}$, and B is acute, so B = 60°
Answer: 60°

5 Percentage change in area and volume

The length of a rectangle is increased by 25%.
The width of the rectangle is increased by 50%.
Work out the percentage change in the area of the rectangle.

Length multiplier 1.25, width multiplier 1.5
Area multiplier = 1.25 × 1.5 = 1.875
1.875 − 1 = 0.875, so a 87.5% increase
Answer: 87.5% increase

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6 Reverse percentages

The price of a tablet is increased by 15%.
Later the new price is reduced by 40% in a sale.
The sale price is £345.
Work out the price before the increase. (Calculator)

Multipliers: 1.15 and 0.6
Overall multiplier = 1.15 × 0.6 = 0.69
Original × 0.69 = £345
Original = £345 ÷ 0.69 = £500
Answer: £500

7 Equation of a circle

A circle has centre C(5, −1) and passes through the point P(4, −3).
Find an equation of the circle.

$r^2 = CP^2 = (4 - 5)^2 + (-3 - (-1))^2$
$= 1 + 4 = 5$
$(x - 5)^2 + (y + 1)^2 = 5$
Answer: $(x - 5)^2 + (y + 1)^2 = 5$

8 Compound interest

Sofia invests £1,500 at 8% per year compound interest.
After how many whole years will the investment first be worth more than £2,500?
(Calculator)

Multiplier = 1.08
After 6 years: $1500 \times 1.08^6 = 2380.31$
After 7 years: $1500 \times 1.08^7 = 2570.74$
2570.74 is the first value above £2,500
Answer: 7 years

9 3D Pythagoras and trigonometry: cuboids

The diagram shows a cuboid ABCDEFGH. (Calculator)
(a) Work out the length of the diagonal AG.
(b) Work out the angle between AG and the base ABCD, to 1 decimal place.
The diagram is not drawn accurately.

(a) $AC^2 = AB^2 + BC^2 = 7^2 + 6^2 = 85$
$AG^2 = AC^2 + CG^2 = 85 + 6^2 = 121$
AG = 11 cm

(b) The angle is GAC. $\tan(GAC) = \frac{CG}{AC} = \frac{6}{\sqrt{85}}$

angle GAC = 33.1° (1 d.p.)
Answer: (a) 11 cm (b) 33.1°

10 Bounds and accuracy

a = 80.9 and b = 9.53, 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)

$80.85 \leq a < 80.95$; $9.525 \leq b < 9.535$
Lower bound = 80.85 ÷ 9.535 = 8.4793...
Upper bound = 80.95 ÷ 9.525 = 8.4987...
Both bounds round to 8.5 to 2 significant figures, but not to 3 significant figures
Answer: 8.5 (2 s.f.)