Day 81 **A Tier 10-a-day: Model Solutions**

1 Area of parallelograms and kites

The diagram shows a rhombus.
The diagonals are 20 cm and 12 cm and cross at right angles.
Work out the area of the rhombus.
The diagram is not drawn accurately.

Area = $\frac{1}{2}$ × (diagonal 1) × (diagonal 2)

= $\frac{1}{2}$ × 20 × 12

= 120

Answer: 120 cm^2

2 Pressure

A crate rests on an area of 2.5 m^2 of the floor.
The pressure on the floor is 120 N/m^2.
Work out the force exerted by the crate.

Force = pressure × area
= 120 × 2.5 = 300
Answer: 300 N

3 Reverse fractions

$\frac{2}{5}$ of the students in a school are in Year 11.
There are 26 students in Year 11.
How many students are in the school?

$\frac{2}{5}$ of the total = 26

$\frac{1}{5}$ of the total = 26 ÷ 2 = 13

Whole = 13 × 5 = 65
Answer: 65

4 Simultaneous equations in context

3 footballs and 3 netballs cost £27.
4 footballs and 3 netballs cost £34.
Work out the cost of one netball.

Let f = cost of one football in £ and n = cost of one netball in £
3f + 3n = 27 (1)
4f + 3n = 34 (2)
The n terms have the same sign, so subtract equation (1) from equation (2)
f = 7
Substitute f = 7 into equation (1) to find n = 2
Answer: £2

5 Reverse percentages

In a sale, all prices are reduced by 30%. (Calculator)
A jacket costs £259 in the sale.
Work out the original price of the jacket.

The sale price is 70% of the original price.
70% = £259, so 1% = £259 ÷ 70 = £3.70
100% = £3.70 × 100 = £370
Answer: £370

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6 Midpoints and length of a line segment

C is the point (0, −3) and D is the point (−4, −10).
(a) Find the midpoint of CD.
(b) Work out the length of CD. Give your answer as a surd in its simplest form.

(a) Midpoint = $(\frac{0+(-4)}{2}, \frac{-3+(-10)}{2}) = (-2, -6.5)$

(b) Length = $\sqrt{(-4)^2 + (-7)^2}$
$= \sqrt{65} = \sqrt{65}$

Answer: (a) (−2, −6.5) (b) $\sqrt{65}$

7 Probability without replacement

A bag contains 4 red, 3 blue and 4 green counters.
Two counters are taken at random without replacement.
Work out the probability that the two counters are different colours.

P(same colour) = $\frac{4}{11} \times \frac{3}{10} + \frac{3}{11} \times \frac{2}{10} + \frac{4}{11} \times \frac{3}{10} = \frac{3}{11}$

P(different) = $1 - \frac{3}{11} = \frac{8}{11}$

Answer: $\frac{8}{11}$

8 Perpendicular bisector

A is the point (1, 3) and B is the point (−7, −3).
Find the equation of the perpendicular bisector of AB.

Midpoint of AB = $(\frac{1+(-7)}{2}, \frac{3+(-3)}{2}) = (-3, 0)$

Gradient of AB = $\frac{-6}{-8} = \frac{3}{4}$

Perpendicular gradient = $-1 \div \frac{3}{4} = -\frac{4}{3}$

$y = -\frac{4}{3}x + c$ through (−3, 0): $0 = -\frac{4}{3} \times (-3) + c$, so $c = -4$

$y = -\frac{4}{3}x - 4$

Answer: $y = -\frac{4}{3}x - 4$

9 Similar shapes: area and volume

Two similar model boats have heights 4 cm and 12 cm.
The smaller one has a volume of 3 cm^3.
Work out the volume of the larger one.

Length scale factor = 12 ÷ 4 = 3
Volume scale factor = $(3)^3 = 27$
Volume = 3 × 27 = 81

Answer: 81 cm^3

10 Finding a rate of compound change

Hassan invests £13,000 in a savings account. (Calculator)
Compound interest is paid at a fixed rate each year.
After 2 years the investment is worth £15,163.20.
Work out the annual rate of interest.

Overall multiplier = £15,163.20 ÷ £13,000 = 1.1664
Take the square root: $\sqrt{1.1664} = 1.08$
Rate = (1.08 − 1) × 100 = 8%

Answer: 8%