Day 331 **A Tier 10-a-day: Model Solutions**

1 Area of parallelograms and kites

The diagram shows a parallelogram.
Work out its area.
The diagram is not drawn accurately.

Area = base × perpendicular height
= 7 × 8 = 56
(the slanted side, 9 cm, is not used)

Answer: 56 cm^2

2 Factorising quadratics

Factorise $x^2 + 9x + 18$

Find two numbers that multiply to 18 and add to 9
The numbers are 3 and 6
(x + 3)(x + 6)

Answer: (x + 3)(x + 6)

3 Estimation

By rounding each number to 1 significant figure, estimate the value of

$$\frac{68.0 \times 7.0}{0.49}$$

Round each number to 1 significant figure: 70, 7, 0.5

$$\frac{70 \times 7}{0.5} = 980$$

Answer: 980

4 Solving quadratic equations

Solve $3x^2 + x - 4 = 0$

Factorise: $(3x + 4)(x - 1) = 0$
$3x + 4 = 0$ or $x - 1 = 0$

$x = -\frac{4}{3}$ or $x = 1$

Answer: $x = -\frac{4}{3}$ or $x = 1$

5 Bearings and distances

A plane leaves an airport and travels 16 km on a bearing of 190°. (Calculator)
It then travels 30 km on a bearing of 100°.
(a) Work out how far it is now from the airport.
(b) Work out the bearing of its final position from the airport. Give your answer to the nearest degree.

The two bearings differ by 90°, so the path makes a right angle

(a) Distance^2 = $16^2 + 30^2 = 1156$, so distance = 34 km

(b) The angle at the port between the first leg and the line to the end: $\tan^{-1}(\frac{30}{16}) = 61.9°$

Bearing = 190° − 61.9° = 128.1°
Bearing = 128°

Answer: (a) 34 km (b) 128°

6 HCF and LCM

(a) Write 35 and 49 as products of prime factors.
(b) Find the highest common factor (HCF) and the lowest common multiple (LCM) of 35 and 49.

(a) $35 = 5 \times 7$ and $49 = 7^2$
(b) HCF: multiply the prime factors in both lists, taking the smaller power: 7
LCM: take the larger power of every prime: $5 \times 7^2 = 245$

Answer: (a) $35 = 5 \times 7$, $49 = 7^2$ (b) HCF = 7, LCM = 245

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7 Estimating the mean from grouped data

The table shows the distances, in km, travelled by 20 lorries.
(a) Write down the class that contains the median.
(b) Work out an estimate for the mean.

(a) The median is in position (20 + 1) ÷ 2 = 10.5. Cumulative frequencies: 2, 6, 8, 16, 20
The median is in the class $30 < d \leq 40$
(b) Midpoints: 5, 15, 25, 35, 45
5 × 2 + 15 × 4 + 25 × 2 + 35 × 8 + 45 × 4 = 580
Estimate = 580 ÷ 20 = 29
Answer: (a) $30 < d \leq 40$ (b) 29

8 Surd fractions

Show that $\frac{\sqrt{96} - \sqrt{54}}{\sqrt{6}}$ is an integer, and find its value.

$\sqrt{96} = 4\sqrt{6}$ and $\sqrt{54} = 3\sqrt{6}$
Numerator = $4\sqrt{6} - 3\sqrt{6} = \sqrt{6}$
$\frac{\sqrt{6}}{\sqrt{6}} = 1$
Answer: 1

9 Volume of composite solids

A solid is made from a cylinder and a cone.
The cylinder has radius 9 cm and height 11 cm.
The cone has the same radius as the cylinder and perpendicular height 9 cm.
Work out the total volume. Give your answer in terms of π.

Cylinder = $\pi \times 9^2 \times 11 = 891\pi$
Cone = $\frac{1}{3} \times \pi \times 9^2 \times 9 = 243\pi$
Total = $891\pi + 243\pi = 1134\pi$
Answer: 1134π cm^3

10 Direct proportion formulae

y is directly proportional to the square root of x.
When x = 36, y = 30.
(a) Find a formula for y in terms of x.
(b) Work out the value of y when x = 9.

(a) $y = k\sqrt{x}$. Substitute: 30 = k × 6, so k = 5
$y = 5\sqrt{x}$
(b) y = 5 × 3 = 15
Answer: (a) $y = 5\sqrt{x}$ (b) 15