Day 166 **B Tier 10-a-day: Model Solutions**

1 Adding fractions

Work out

(a) $\frac{3}{10} + \frac{1}{4}$

(b) $\frac{3}{4} - \frac{3}{5}$

Give each answer in its simplest form.

(a) Common denominator 20: $\frac{6}{20} + \frac{5}{20} = \frac{11}{20}$

(b) Common denominator 20: $\frac{15}{20} - \frac{12}{20} = \frac{3}{20}$

Answer: (a) $\frac{11}{20}$ (b) $\frac{3}{20}$

2 Factorising

Factorise fully $6x^2 - 4x$

The highest common factor of 6 and 4 is 2, and both terms have x
So take out 2x. Divide each term by 2x: $3x - 2$
Answer: $2x(3x - 2)$

3 Factors and multiples

(a) Write down all the prime numbers between 21 and 33.
(b) Explain why 27 is not a prime number.

(a) A prime number has exactly two factors. Check each number: 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32
(b) 27 is divisible by 3 ($3 \times 9 = 27$), so it has more than two factors
Answer: (a) 23, 29, 31 (b) $3 \times 9 = 27$

4 Rates

Electricity costs 18p per unit.
There is also a standing charge of £10.
Work out the total bill for 350 units.

Cost of units: $350 \times 18p = 6300p = £63$
Add the standing charge: £63 + £10 = £73
Answer: £73

5 Pythagoras' theorem

Work out the length of t.
The diagram is not drawn accurately.

Use Pythagoras: $a^2 + b^2 = c^2$
$t^2 = 8^2 + 15^2 = 64 + 225 = 289$
$t = \sqrt{289} = 17$
Answer: t = 17 mm

6 Sequences from patterns

Matchsticks are used to make a row of triangles.
1 triangle needs 3 matchsticks, 2 triangles need 5 and 3 triangles need 7.
(a) Find an expression, in terms of n, for the number of matchsticks needed for n triangles.
(b) Dan uses 57 matchsticks to make a row. How many triangles are in his row?

(a) The number of matchsticks goes up by 2 each time, so the rule starts with 2n
When n = 1 we need 3, and $2 \times 1 = 2$, so add 1: $2n + 1$
(b) $2n + 1 = 57$
$2n = 56$
$n = 56 \div 2 = 28$
Answer: (a) $2n + 1$ (b) 28

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7 Capture-recapture

60 snails in a lake are caught, tagged and returned to the lake.
Later, a sample of 80 snails is caught and 12 of them are tagged.
Estimate the total number of snails in the lake.

Proportion tagged in the sample = 12 ÷ 80
This is the same proportion as 60 out of the whole population
Population ≈ 60 × 80 ÷ 12 = 400
Answer: 400

8 Estimation

Estimate the value of

$$\frac{72.5 \times 0.931}{0.131}$$

Show your rounding to 1 significant figure.

Round each number to 1 significant figure: 72.5 → 70, 0.931 → 0.9, 0.131 → 0.1
Estimate = 70 × 0.9 ÷ 0.1 = 630
Answer: 630

9 Isosceles triangles and Pythagoras

Triangle ABC is isosceles with AB = AC = 15 cm.
The base BC = 18 cm.
(a) Work out the perpendicular height of the triangle.
(b) Work out the area of the triangle.

(a) The height splits the base in half: 18 ÷ 2 = 9
$h^2 = 15^2 - 9^2 = 225 - 81 = 144$, so h = 12
(b) Area = ½ × 18 × 12 = 108
Answer: (a) 12 cm (b) 108 cm^2

10 Speed unit conversion

A boat travels at 108 km/h.
Work out its speed in metres per second.

108 km = 108,000 m
1 hour = 3600 seconds
108,000 ÷ 3600 = 30 m/s
Answer: 30 m/s