Day 329 **B Tier 10-a-day: Model Solutions**

1 Direct proportion

P is directly proportional to n.
When n = 10, P = 120.
Find the value of n when P = 180.

P = kn
k = 120 ÷ 10 = 12
n = 180 ÷ 12 = 15
Answer: n = 15

2 Number machines

Here is a number machine.
Input → × 2 → + 6 → Output
(a) The input is 12. Work out the output.
(b) The output is 14. Work out the input.

(a) 12 × 2 = 24, then 24 + 6 = 30
(b) Work backwards: undo + 6 to get 8, then undo × 2 to get 4
Answer: (a) 30 (b) 4

3 Map scales

The scale of a map is 1 : 20,000.
Two towns are 17.5 cm apart on the map.
Work out the real distance between the towns.
Give your answer in kilometres.

17.5 × 20,000 = 350,000 cm
100 000 cm = 1 km, so divide by 100 000
= 3.5 km
Answer: 3.5 km

4 Real-life graphs

A company hires out bikes. There is a fixed charge plus a cost for each hour.
The graph shows the total cost.
(a) Write down the fixed charge.
(b) Work out the cost for each hour.

(a) The fixed charge is the cost when nothing has been used, where the line meets the vertical axis
(b) Take two points on the line, for example (0, 8) and (4, 20)
Cost for each hour = (20 − 8) ÷ 4 = 3
Answer: (a) £8 (b) £3

5 Reading pie charts

The pie chart shows the favourite choices of 72 people.
The angle for Art is not shown.
Work out how many people chose Art.

Angle for Art = 360° − (50° + 60° + 160°) = 360° − 270° = 90°
90 ÷ 360 × 72 = 18
Answer: 18

6 Substitution into formulae

$E = \frac{1}{2}mv^2$

Work out the value of E when m = 6 and v = 5

$E = \frac{1}{2} \times 6 \times 5^2$

$E = \frac{1}{2} \times 6 \times 25 = 75$

Answer: E = 75

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7 Bounds

The length of a rectangle is 9 cm and its width is 18 cm.
Both measurements are correct to the nearest cm.
Work out the upper bound for the perimeter of the rectangle.

Upper bound of each side = value + 0.5: 9.5 cm and 18.5 cm
Perimeter = 2 × (9.5 + 18.5) = 56 cm
Answer: 56 cm

8 Area of an isosceles trapezium

An isosceles trapezium has parallel sides of length 16 m and 6 m.
Each sloping side is 13 m long.
(a) Work out the perpendicular height of the trapezium.
(b) Work out the area of the trapezium.

(a) The difference in the parallel sides is 16 − 6 = 10, so each end sticks out 5
$h^2 = 13^2 - 5^2 = 169 - 25 = 144$, so h = 12
(b) Area = ½ × (16 + 6) × 12 = 132
Answer: (a) 12 m (b) 132 m^2

9 Growth in standard form

There are 6.8×10^6 bacteria in a dish.
The number triples every day.
How many are there after 5 days?
Give your answer in standard form.

Each day multiply by 3, so multiply by $3^5 = 243$
$6.8 \times 10^6 \times 243 = 1652.4 \times 10^6$
In standard form: 1.6524×10^9
Answer: 1.6524×10^9

10 Bearings with Pythagoras and trigonometry

A boat sails 6 m on a bearing of 270° from P to Q, then 8 m on a bearing of 000° to R. (Calculator)
(a) Work out the distance PR.
(b) Work out the bearing of R from P.
Give your answers correct to 1 decimal place.

(a) Triangle PQR has a right angle at Q
$PR^2 = 6^2 + 8^2 = 100$
$PR = \sqrt{100} = 10$ m
(b) tan (angle QPR) = $\frac{8}{6}$, so angle QPR = 53.130° (to 3 d.p.)
PQ is on a bearing of 270°, and R is a further 53.130° clockwise from PQ
Bearing = 270 + 53.130 = 323.1°
Answer: (a) 10 m (b) 323.1°