Ratio, rates and similarity - applications paper

16 questions | 43 marks | 60 minutes

Apply proportional reasoning to routes, shadows, design decisions and the limits of models.

Equivalent correct methods earn the corresponding marks.

1. A bakery uses 450 g of flour for six rolls. Find the amount per roll. [1 mark]

$\frac{450}{6} = 75$ g.

Answer: 75 g

2. Using the same recipe, how much flour is needed for 14 rolls? [2 marks]

$14 \times 75 = 1\,050$ g.

Answer: $1,050$ g

3. A portable battery supplies 18 Wh each hour at a steady load. Write the energy-use rule in terms of hours t. [2 marks]

The rate is 18 Wh per hour.

$\text{Energy used} = \text{rate} \times \text{time}.$

Answer: $E = 18t$, E in Wh.

4. A cyclist averages 6 m/s. Express the speed in km/h. [2 marks]

$6 \times 3.6 = 21.6.$

Answer: 21.6 km/h

5. A designer uses $1:40$ for a 3.2 m bench. Find its length on the plan. [2 marks]

3.2 m $= 320$ cm.

$\frac{320}{40} = 8$ cm.

Answer: 8 cm

6. A trail map uses $1:50\,000$. A planned route measures 13.6 cm. Find the walking distance. [2 marks]

Each cm represents 0.5 km.

$13.6 \times 0.5 = 6.8$ km.

Answer: 6.8 km

7. A walker covers that 6.8 km route at 4 km/h without stops. Find the time in hours and minutes. [3 marks]

$t = \frac{6.8}{4} = 1.7$ h.

$0.7 \times 60 = 42$ min.

Answer: 1 h 42 min

8. A 2 m vertical pole casts a 1.6 m shadow. At the same time a tower casts a 14.4 m shadow on level ground. Find its height. [3 marks]

$k = \frac{14.4}{1.6} = 9$.

Height $= 2 \times 9 = 18$ m.

Answer: 18 m

9. A photo 12 cm wide is enlarged to 30 cm wide without distortion. Its original height is 8 cm. Find the new height. [2 marks]

$k = \frac{30}{12} = 2.5$.

$8 \times 2.5 = 20$ cm.

Answer: 20 cm

10. A learner resizes a photo originally 12 cm wide and 8 cm high to 30 cm wide and 18 cm high. Explain whether this preserves the original shape. [3 marks]

Width factor is $\frac{30}{12} = 2.5$.

Height factor is $\frac{18}{8} = 2.25$.

The factors differ, so the photo is distorted.

Answer: No.

11. Enlarge a layout point $P(5, 3)$ by factor 2 about $C(2, 1)$. Find the image. [3 marks]

$P - C$ is $(3, 2)$.

Double to $(6, 4)$, then add C to get $(8, 5)$.

Answer: $(8, 5)$

12. A catering quote is 180 dollars for 10 people and 300 dollars for 20 people. Explain why a directly proportional model is unsuitable. [3 marks]

$\frac{180}{10} = 18$ dollars/person and $\frac{300}{20} = 15$ dollars/person.

A fixed preparation charge may explain the difference.

Answer: The per-person prices differ.

13. Those quotes fit $C = 60 + 12n$. Predict the cost for 25 people and identify the fixed charge. [3 marks]

$C = 60 + 12 \times 25 = 360$.

The 60 dollars term does not depend on n.

Answer: 360 dollars; fixed charge 60 dollars.

14. One cleaning solution covers 8 m² per litre. A room has 46 m² to clean. Bottles contain 2 L. How many bottles must be bought? [4 marks]

Needed $\frac{46}{8} = 5.75$ L.

Bottle count $\frac{5.75}{2} = 2.875$, so round up to 3.

Answer: 3 bottles

15. A model predicts a tank fills at 15 L/min for 12 minutes. The tank capacity is 150 L and it starts empty. Explain why the prediction needs a restriction. [4 marks]

The unconstrained model gives $15 \times 12 = 180$ L, more than capacity.

At $\frac{150}{15} = 10$ minutes the tank is full; stored volume cannot keep increasing at that rate.

Answer: The tank is full after 10 minutes.

16. A builder draws a 4.5 m fence as a 9 cm line. A printer then enlarges every drawing length by a factor of 1.25. [4 marks]

(a) Find the final scale. [2 marks]

Original scale $= 9 : 450 = 1 : 50$.

New scale denominator $= \frac{50}{1.25} = 40$.

Answer: $1 : 40$

(b) Find the final drawing length for a 3 m gate. [2 marks]

3 m $= 300$ cm.

Drawing length $= \frac{300}{40} = 7.5$ cm.

Answer: 7.5 cm