

# Worked Solutions: Applied Ratio Extension Problems

## Recipe Questions Past

### 1. Increasing muffin yield by 50%:

Original yield: 12 muffins.

Increase by 50%:  $12 \times 1.5 = 18$  muffins.

Scaling factor:  $\frac{18}{12} = 1.5$ .

New quantities:

- Flour:  $300 \times 1.5 = 450$  g
- Sugar:  $200 \times 1.5 = 300$  g
- Eggs:  $2 \times 1.5 = 3$  eggs (or 150 g)
- Milk:  $250 \times 1.5 = 375$  ml

### 2. Reducing sauce recipe to 75%:

Scaling factor: 0.75.

New quantities:

- Tomato passata:  $400 \times 0.75 = 300$  ml
- Garlic:  $2 \times 0.75 = 1.5$  cloves (or 15 g)
- Olive oil:  $100 \times 0.75 = 75$  ml
- Basil:  $50 \times 0.75 = 37.5$  g

### 3. Serving 10 people from a 6-person cake recipe:

Scaling factor:  $\frac{10}{6} = \frac{5}{3} \approx 1.6667$ .

Percentage increase:  $(\frac{5}{3} - 1) \times 100\% = \frac{2}{3} \times 100\% \approx 66.67\%$ .

New quantities:

- Flour:  $240 \times \frac{5}{3} = 400$  g
- Butter:  $180 \times \frac{5}{3} = 300$  g
- Sugar:  $150 \times \frac{5}{3} = 250$  g
- Eggs:  $3 \times \frac{5}{3} = 5$  eggs (or 250 g)

**4. Finding original pasta mass:**

Let original mass =  $x$  g.

Increased by 40%:  $x \times 1.4 = 560$

$$x = \frac{560}{1.4} = 400 \text{ g.}$$

Original mass: 400 g.

**5. Bread recipe reduction:**

(a) Original flour: 1000 g, new flour: 850 g.

Reduction factor:  $\frac{850}{1000} = 0.85$ .

Percentage reduction:  $(1 - 0.85) \times 100\% = 15\%$ .

(b) New quantities:

- Water:  $600 \times 0.85 = 510$  ml
- Salt:  $20 \times 0.85 = 17$  g
- Yeast:  $15 \times 0.85 = 12.75$  g

## Recipe Questions Future

**6. Square brownie tray enlargement:**

Original area:  $20 \times 20 = 400 \text{ cm}^2$ .

New area:  $25 \times 25 = 625 \text{ cm}^2$ .

Scaling factor:  $\frac{625}{400} = 1.5625$ .

New quantities:

- Chocolate:  $200 \times 1.5625 = 312.5$  g
- Butter:  $150 \times 1.5625 = 234.375$  g
- Eggs:  $3 \times 1.5625 = 4.6875 \approx 4.7$  eggs (practically 5 eggs)

**7. Circular cake tin enlargement:**

Original radius: 10 cm, new radius: 15 cm.

Area scales with square of linear factor:

Linear scaling factor:  $\frac{30}{20} = 1.5$ .

Area scaling factor:  $1.5^2 = 2.25$ .

New quantities:

- Flour:  $250 \times 2.25 = 562.5$  g
- Sugar:  $200 \times 2.25 = 450$  g
- Eggs:  $4 \times 2.25 = 9$  eggs

**8. Rectangular pizzas:**

(a) Areas:

Small pizza:  $20 \times 15 = 300 \text{ cm}^2$ .

Large pizza:  $35 \times 25 = 875 \text{ cm}^2$ .

(b) Scaling factor:  $\frac{875}{300} = \frac{35}{12} \approx 2.9167$ .

New quantities:

- Cheese:  $200 \times \frac{35}{12} \approx 583.33$  g
- Flour:  $150 \times \frac{35}{12} = 437.5$  g
- Tomato sauce:  $100 \times \frac{35}{12} \approx 291.67$  ml

### 9. Cake perimeter decoration:

(a) Perimeter:  $2 \times (28 + 18) = 92$  cm.

(b) Sprinkles needed:  $\frac{92}{4} = 23$  g.

(c) Double perimeter means linear dimensions multiplied by 2 (since perimeter is linear).

Area scales by  $2^2 = 4$ , so cake base and icing should be multiplied by 4.

Perimeter scales by 2, so sprinkles multiplied by 2.

### 10. Triangular dessert scaling:

(a) Original perimeter:  $12 + 12 + 8 = 32$  cm.

(b) New perimeter:  $32 \times 1.5 = 48$  cm.

(c) Sugar (for area): scales with square of linear factor.

Scaling factor:  $1.5^2 = 2.25$ .

Sugar:  $120 \times 2.25 = 270$  g.

(d) Cocoa powder (for perimeter): scales linearly.

Cocoa:  $80 \times 1.5 = 120$  g.

(e) Eggs: typically scale with volume (cube of linear factor), but recipe may vary.

If eggs scale with volume:  $3 \times 1.5^3 = 3 \times 3.375 = 10.125$  eggs.

If eggs scale with area:  $3 \times 2.25 = 6.75$  eggs.

Usually in baking, eggs scale with area for cakes, but problem doesn't specify.

Assuming linear scaling for simplicity:  $3 \times 1.5 = 4.5$  eggs.

## Best Buys Past

### 11. Cereal boxes:

500g box:  $\frac{4.50}{500} = 0.009$  £/g = 9p per 10g.

750g box:  $\frac{6.30}{750} = 0.0084$  £/g = 8.4p per 10g.

750g box is better value.

### 12. Soda cans:

Store A: 6 cans for \$4.80  $\Rightarrow$  per can:  $\frac{4.80}{6} = 0.80$  dollars.

Store B: Single can normally \$0.95, 15% discount:  $0.95 \times 0.85 = 0.8075$  dollars.

For 6 cans: Store A: \$4.80, Store B:  $6 \times 0.8075 = 4.845$  dollars.

Store A is cheaper.

**13. Juice bottles:**

2L bottle:  $\frac{3.20}{2} = 1.60$  €/L.

1.5L bottle: Sale price:  $2.80 \times 0.80 = 2.24$  €.

Per liter:  $\frac{2.24}{1.5} \approx 1.493$  €/L.

1.5L bottle on sale is better value.

**14. Electronics store:**

Headphones after discount:  $120 \times 0.80 = 96$  £.

Speakers after discount:  $85 \times 0.70 = 59.50$  £.

Buy 3 get cheapest free: Buy headphones, speakers, and a third cheap item (e.g., £10 item).

Total before free:  $96 + 59.50 + 10 = 165.50$  £. Cheapest free: remove £10.

Pay: 155.50 £.

Selling to local shop at 50% of non-discounted price:

Headphones:  $120 \times 0.50 = 60$  £, Speakers:  $85 \times 0.50 = 42.50$  £.

Total if bought at discount and sold:  $60 + 42.50 = 102.50$  £, cost 155.50 £, net loss.

Cheapest is to buy separately:  $96 + 59.50 = 155.50$  £.

**15. Furniture payment plans:**

Plan A: Down:  $0.25 \times 1200 = 300$  £, then  $12 \times 80 = 960$  £. Total: 1260 £.

Plan B:  $18 \times 75 = 1350$  £.

Plan A is better by  $1350 - 1260 = 90$  £.

Percentage of original price:  $\frac{90}{1200} \times 100\% = 7.5\%$ .

## Best Buys Future

**16. Garden fencing:**

Perimeter:  $2 \times (10 + 8) = 36$  m.

Store A:  $36 \times 12 = 432$  dollars.

Store B: Each section 2 m, need  $\frac{36}{2} = 18$  sections.

Cost:  $18 \times 20 = 360$  dollars.

Store B is cheaper.

**17. Tiling floor:**

Room area:  $4 \times 5 = 20$  m<sup>2</sup>.

Type A:  $20 \times 25 = 500$  £.

Type B: Needs 15% more tiles:  $20 \times 1.15 = 23$  m<sup>2</sup>.

Cost:  $23 \times 18 = 414$  £.

Type B is cheaper.

**18. Paint coverage:**

Total wall area:  $(4 \times 3) + (5 \times 3) = 12 + 15 = 27$  m<sup>2</sup>.

Standard paint: Liters needed:  $\frac{27}{12} = 2.25$  L. Cost:  $2.25 \times 35 = 78.75$  £.

Brand X: Coverage per liter:  $12 \times 1.20 = 14.4$  m<sup>2</sup>/L.

Liters needed:  $\frac{27}{14.4} = 1.875$  L. Cost:  $1.875 \times 42 = 78.75$  £.

Same cost. Buying cheapest: 78.75 £.

19. **Grass seed:**

Lawn area: Rectangle:  $10 \times 6 = 60 \text{ m}^2$ .

Semicircle:  $\frac{1}{2}\pi r^2 = \frac{1}{2}\pi \times 3^2 = \frac{9\pi}{2} \approx 14.137 \text{ m}^2$ .

Total area:  $60 + 14.137 = 74.137 \text{ m}^2$ .

Seed A: kg needed:  $\frac{74.137}{15} \approx 4.9425 \text{ kg}$ . Cost:  $4.9425 \times 4.80 \approx 23.724 \text{ dollars}$ .

Seed B: kg needed:  $\frac{74.137}{25} \approx 2.9655 \text{ kg}$ . Cost:  $2.9655 \times 7.50 \approx 22.241 \text{ dollars}$ .

Seed B is more economical.

20. **Pool cover:**

Pool area: Rectangle:  $8 \times 4 = 32 \text{ m}^2$ .

Two semicircles = one circle:  $\pi r^2 = \pi \times 2^2 = 4\pi \approx 12.566 \text{ m}^2$ .

Total area:  $32 + 12.566 = 44.566 \text{ m}^2$ .

Material X: Cost:  $44.566 \times 18 \approx 802.19 \text{ dollars}$ . Per year:  $\frac{802.19}{3} \approx 267.40 \text{ dollars/year}$ .

Material Y: Cost:  $44.566 \times 25 \approx 1114.15 \text{ dollars}$ . Per year:  $\frac{1114.15}{5} \approx 222.83 \text{ dollars/year}$ .

Material Y is more economical per year. Cost per year: 222.83 dollars.

## Scaling Past

21. **Drawing scaled up 150%:**

New length:  $8 \times 1.5 = 12 \text{ cm}$ .

22. **Map scale 1:25,000:**

1 cm represents  $25,000 \text{ cm} = 250 \text{ m} = 0.25 \text{ km}$ .

Percentage:  $\frac{1}{25000} \times 100\% = 0.004\%$ .

23. **Photo reduced to 80%:**

Reduced width =  $12 \text{ cm} = 80\%$  of original.

Original width:  $\frac{12}{0.8} = 15 \text{ cm}$ .

24. **Bedroom scale drawing:**

Scale 2% of actual size  $\Rightarrow$  ratio  $2 : 100 = 1 : 50$ .

Bed length:  $2 \text{ m} = 200 \text{ cm}$ . Drawn length:  $200 \times 0.02 = 4 \text{ cm}$ .

25. **Scale models:**

(a) Window width  $1.2 \text{ m} = 120 \text{ cm}$ .

Model A:  $120 \times 0.025 = 3 \text{ cm}$ .

Model B:  $120 \times 0.04 = 4.8 \text{ cm}$ .

(b) Model A height  $45 \text{ cm} = 0.025$  of actual.

Actual height:  $\frac{45}{0.025} = 1800 \text{ cm} = 18 \text{ m}$ .

(c) Model B scale factor relative to Model A:  $\frac{0.04}{0.025} = 1.6$ .

Percentage larger:  $(1.6 - 1) \times 100\% = 60\%$ .

## Scaling Future

26. **Square enlargement:**

Original perimeter 12 cm, side length 3 cm.

Scale factor 3, new side: 9 cm, new perimeter:  $4 \times 9 = 36$  cm.

27. **Rectangular field:**

Scale 1:200, drawing dimensions 6 cm  $\times$  4 cm.

Actual dimensions:  $6 \times 200 = 1200$  cm = 12 m,  $4 \times 200 = 800$  cm = 8 m.

Actual area:  $12 \times 8 = 96$  m<sup>2</sup>.

28. **Equilateral triangle park:**

Scale 1:50, drawn side 2 cm.

Actual side:  $2 \times 50 = 100$  cm = 1 m.