

13 Ratios, unit conversion and successive percentages

Name: _____ Class: _____ Date: _____ **Total: 13 marks**

KEY WORDS unit rate • rate

Objective

- Use proportional relationships while preserving units
- Convert rates and distinguish direct from inverse relationships
- Calculate successive changes and percentage comparisons using the correct base

Original public practice; marks below are classroom self-check points, not official criteria.

1 Key knowledge and worked examples

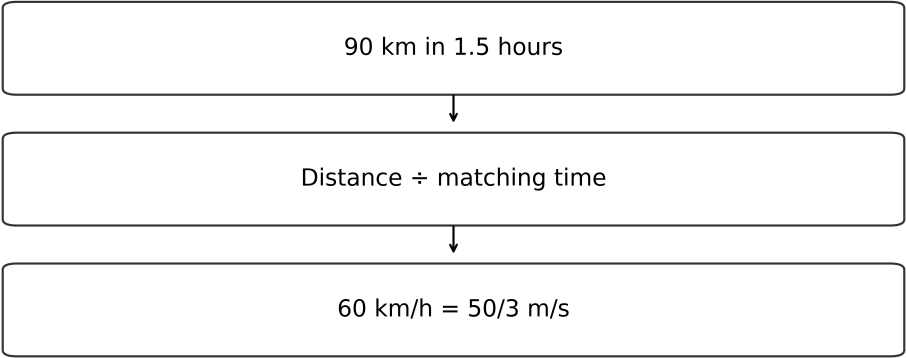
A ratio compares quantities in a chosen order. If red:blue=3:5 and the total is 64, the eight equal parts each contain eight, so red is 24 and blue 40. The ratio 3/5 describes red relative to blue; 3/8 describes red relative to the total. Read the requested denominator rather than using the first visible fraction.

A unit rate _____ divides quantity by its corresponding time, distance or count. Write conversion factors so unwanted units cancel: 72 km/hour times 1000 m/km divided by 3600 s/hour is 20 m/s. Area and volume conversions square and cube the length factor. A one-centimetre square is not one metre squared divided by one hundred.

In direct proportion $y=kx$, doubling x doubles y ; in inverse proportion $xy=k$, doubling x halves y . Constant work shared by identical workers gives an inverse time model only when productivity and conditions are fixed. A fixed initial fee added to a rate makes an affine linear model, not direct proportion through the origin.

A percentage change divides the change by the original comparison base. Successive percentage changes multiply their factors: a 20% discount followed by 20% increase gives $0.8 \cdot 1.2=0.96$ of the original. Distinguish percentage points from relative percent: 30% to 36% is six points, but a 20% relative increase.

A rate compares quantities with their units. $v = d/t = (90 \text{ km})/(1.5 \text{ h}) = 60 \text{ km/h}$. Convert using cancelling units: $v = (60 \text{ km/h})(1000 \text{ m/km})/(3600 \text{ s/h}) = 50/3 \text{ m/s}$. Do not convert only the numerator of a compound rate.



Worked steps: 90 km in 1.5 hours → Distance ÷ matching time → 60 km/h = 50/3 m/s

Worked example. A 250-unit price discounted 20% becomes 200; increasing that result 20% gives 240, four percent below 250. A pump delivers 18 litres in 3 minutes, so its rate is 6 L/min or 0.1 L/s. At a fixed rate, 45 litres takes 7.5 minutes. If a share rises from 40% to 50%, the rise is 10 percentage points and 25% relative to the old share.

2 Practice

2.1 A ratio A:B=2:3 with total 45 gives A: [1]

- **A** 18
- **B** 30
- **C** 22.5

2.2 A price rises from 80 to 100. Its percentage increase is: [1]

- **A** 25%
- **B** 20%
- **C** 125%

2.3 36 km/hour equals _____ m/s. [1]

2.4 $y=4x+7$ is directly proportional to x . [1]

3 Exam-style questions

Use the data stated in each original task.

3.1 Mix red and blue paint in ratio 4:7 to make 33 litres. Find each amount. Red paint costs 18 yuan per litre and blue 12. Find total cost. [3]

3.2 A 400-yuan item falls 15% then rises 10%. Find the final price and the single overall percentage change. [3]

3.3 A pump supplies 0.15 litres per second. How long does 54 litres take? If a square has side 30 cm, give its area in square metres. [3]
