

3.3.1 Compound Rates

Name: _____ Class: _____ Date: _____

KEY WORDS density

<!-- Session 2 native-skill companion -->

Objective

Practise compound rates within the labelled native lessons. Public original tasks; locally authored answer guidance.

1 Key knowledge and worked examples

■ Rates, unit prices, density and pressure · Foundation

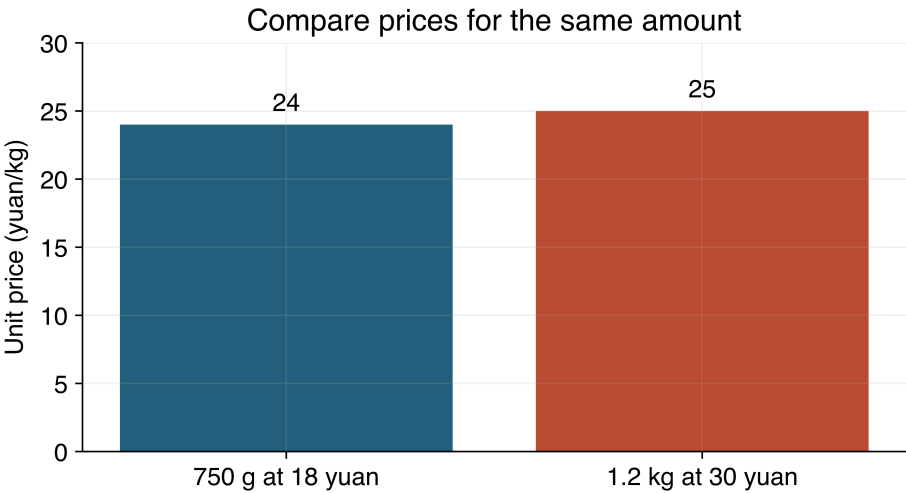
A compound rate divides one quantity by another: speed=d/t, pay=earnings/time, unit price=cost/amount, density=mass/volume and pressure=force/area. Rearrange these equations before substituting. Convert each dimension separately; converting cm² to m² uses a squared length factor. Comparisons must use the same units and conditions.

$$\rho = \frac{m}{V}, \quad p = \frac{F}{A}, \quad m = \rho V$$

A 750 g pack costing 18 yuan has unit price 18/0.75=24 yuan/kg. A 1.2 kg pack at 30 yuan costs 25 yuan/kg, so the first is better value if quality and waste are equal. A block of mass 540 g and volume 200 cm³ has density 2.7 g/cm³; a 50 cm³ piece of that material has mass 135 g. Since 1 g=0.001 kg and 1 cm³=0.000001 m³, 2.7 g/cm³=2700 kg/m³. A 120 N force over 0.03 m² gives pressure 4000 N/m²=4000 Pa. At fixed force, halving the area doubles pressure. An hourly pay rate of 48 yuan/hour gives 120 yuan for 2.5 hours.

Volume conversions cube the length factor and area conversions square it. A density of 2.7 g/cm³ is not 2.7 kg/m³. A cheaper package may cost more per kilogram; include only comparable products.

AQA R1/R11 includes speed, pay, pricing, density and pressure in numerical and algebraic contexts. Show the rearrangement with named quantities and carry units through the answer; use an inverse check such as density×volume=mass.



Original native-lesson illustration; labels belong to its worked example.

2 Practice

2.1 (Foundation) Find density for mass 540 g and volume 200 cm³.

2.2 (Foundation) Find pressure in Pa for 120 N on 0.03 m².

2.3 (Foundation) Find the unit price in yuan/kg for 750 g at 18 yuan.

3 Exam-style questions

3.1 Decide whether this claim is true. Justify with a concrete calculation or counterexample: Converting density from g/cm^3 to kg/m^3 leaves its numerical value unchanged.

Solutions

2.1 Density= $540/200=2.7\text{ g/cm}^3$.

2.2 Pressure=force/area= $120/0.03=4000$.

2.3 $750\text{ g}=0.75\text{ kg}$, so $18/0.75=24$.

3.1 False. $1\text{ g/cm}^3=(0.001\text{ kg})/(0.000001\text{ m}^3)=1000\text{ kg/m}^3$. Convert both mass and volume.

Local review guidance: show the chosen method; give the checked result; explain the condition or failed shortcut. This is authored classroom guidance.