

AQA (GCSE Notes)

Chapter 2: Ratio, Proportion, and Rates of Change

Q1. A car travels 180 miles in 4 hours. How long would it take the same car to travel 315 miles at the same speed?

Answer: 7 hours

Solution:

Speed = Distance \div Time

Speed = $180 \div 4 = 45$ mph

Time = Distance \div Speed = $315 \div 45 = 7$ hours

Q2. A worker is paid £13.50 per hour. How much does she earn for working 37.5 hours?

Answer: £506.25

Solution:

Earnings = Hourly Rate \times Hours Worked

Earnings = $13.50 \times 37.5 = £506.25$

Q3. A recipe requires 200 g of flour for 8 cookies. How much flour is needed for 30 cookies?

Answer: 750 g

Solution:

Flour per cookie = $200 \div 8 = 25$ g

Flour for 30 cookies = $25 \times 30 = 750$ g

Q4. A block of metal has a mass of 540 g and a volume of 90 cm³. Calculate its density.

Answer: 6 g/cm³

Solution:

Density = Mass \div Volume

Density = $540 \div 90 = 6$ g/cm³

Q5. Water is leaking from a tank at a constant rate. After 3 hours, 7.5 litres have leaked. How much would have leaked after 8 hours?

Answer: 20 litres

Solution:

Leak rate = $7.5 \div 3 = 2.5$ litres/hour

Leak in 8 hours = $2.5 \times 8 = 20$ litres

Q6. The mass of 6 identical balls is 2.4 kg. What is the mass of 10 such balls?

Answer: 4 kg

Solution:

Mass of one ball = $2.4 \div 6 = 0.4$ kg

Mass of 10 balls = $0.4 \times 10 = 4$ kg

Q7. A person runs 800 m in 2 minutes. Find their average speed in metres per second.

Answer: 6.67 m/s

Solution:

Time in seconds = $2 \times 60 = 120$ seconds

Speed = Distance \div Time = $800 \div 120 = 6.67$ m/s

Q8. A machine produces 45 units in 3 hours. How many units can it produce in 8 hours?

Answer: 120 units

Solution:

Units per hour = $45 \div 3 = 15$

Units in 8 hours = $15 \times 8 = 120$ units

Q9. A car accelerates from 0 to 60 mph in 8 seconds. Find the average acceleration.

Answer: 7.5 mph/s

Solution:

Acceleration = Change in speed \div Time

Acceleration = $(60 - 0) \div 8 = 60 \div 8 = 7.5$ mph/s

Q10. A student earns £270 for working 18 hours. What is their hourly rate of pay?

Answer: £15 per hour

Solution:

Hourly rate = Total pay \div Hours

Hourly rate = $270 \div 18 = £15/\text{hour}$

Q11. Convert 1.75 hours into minutes.

Answer: 105 minutes

Solution:

1 hour = 60 minutes

$1.75 \times 60 = 105$ minutes

Q12. A cyclist travels 40 km in 2 hours and 30 minutes. Calculate the speed in km/h.

Answer: 16 km/h

Solution:

2 hours 30 minutes = 2.5 hours

Speed = Distance \div Time = $40 \div 2.5 = 16$ km/h

Q13. A builder mixes cement in the ratio 5:2:1 of sand, gravel, and cement. If he uses 84 kg of gravel, how much sand does he need?

Answer: 210 kg

Solution:

Total parts = $5 + 2 + 1 = 8$

Gravel part = 2

1 part = $84 \div 2 = 42$

Sand part = $5 \times 42 = 210$ kg

Q14. A bottle contains 1.5 litres of juice. How many millilitres is this?

Answer: 1500 ml

Solution:

$$1 \text{ litre} = 1000 \text{ ml}$$

$$1.5 \times 1000 = 1500 \text{ ml}$$

Q15. The pressure on a surface is 60 N/m² and the force is 1200 N. Find the area.

Answer: 20 m²

Solution:

$$\text{Pressure} = \text{Force} \div \text{Area}$$

$$\text{Area} = \text{Force} \div \text{Pressure} = 1200 \div 60 = 20 \text{ m}^2$$

Q16. The density of a liquid is 1.2 g/cm³. What is the mass of 500 cm³ of this liquid?

Answer: 600 g

Solution:

$$\text{Mass} = \text{Density} \times \text{Volume}$$

$$\text{Mass} = 1.2 \times 500 = 600 \text{ g}$$

Q17. A bus travels 120 miles in 2.5 hours. What is its average speed?

Answer: 48 mph

Solution:

$$\text{Speed} = \text{Distance} \div \text{Time}$$

$$\text{Speed} = 120 \div 2.5 = 48 \text{ mph}$$

Q18. Convert 2.4 km² to m².

Answer: 2,400,000 m²

Solution:

$$1 \text{ km}^2 = 1,000,000 \text{ m}^2$$

$$2.4 \times 1,000,000 = 2,400,000 \text{ m}^2$$

Q19. A person walks 6 km at 4 km/h. How long does the journey take?

Answer: 1.5 hours

Solution:

$$\text{Time} = \text{Distance} \div \text{Speed}$$

$$\text{Time} = 6 \div 4 = 1.5 \text{ hours}$$

Q20. A job takes 6 men 10 days. How many days will it take 4 men, working at the same rate?

Answer: 15 days

Solution:

$$\text{Total work} = 6 \times 10 = 60 \text{ man-days}$$

$$\text{Time for 4 men} = 60 \div 4 = 15 \text{ days}$$

Q21. A car travels 90 km at an average speed of 60 km/h. How long does the journey take in minutes?

Answer: 90 minutes

Solution:

$$\text{Time} = \text{Distance} \div \text{Speed}$$

$$\text{Time} = 90 \div 60 = 1.5 \text{ hours}$$

$$\text{Time in minutes} = 1.5 \times 60 = 90 \text{ minutes}$$

Q22. Convert 0.85 m³ into litres.

Answer: 850 litres

Solution:

$$1 \text{ m}^3 = 1000 \text{ litres}$$

$$0.85 \times 1000 = 850 \text{ litres}$$

Q23. A mixture contains water and alcohol in the ratio 3:2. If the total volume is 750 mL, how much is alcohol?

Answer: 300 mL

Solution:

$$\text{Total parts} = 3 + 2 = 5$$

$$\text{Alcohol part} = 2$$

$$\text{Volume of alcohol} = (2 \div 5) \times 750 = 300 \text{ mL}$$

Q24. The area of a rectangle is 48 cm². If the length is 6 cm, what is the width?

Answer: 8 cm

Solution:

$$\text{Area} = \text{Length} \times \text{Width}$$

$$\text{Width} = \text{Area} \div \text{Length} = 48 \div 6 = 8 \text{ cm}$$

Q25. A cylinder has a height of 10 cm and volume of 942 cm³. Find the radius of the base (use $\pi = 3.14$).

Answer: 5.48 cm

Solution:

$$\text{Volume} = \pi r^2 h$$

$$942 = 3.14 \times r^2 \times 10$$

$$942 \div 3.14 = r^2 \times 10$$

$$300 = r^2 \times 10$$

$$r^2 = 300 \div 10 = 30$$

$$r = \sqrt{30} \approx 5.48 \text{ cm}$$

Q26. A person earns £15 per hour for the first 40 hours and £22.50 for any extra hours. How much do they earn in a week if they work 48 hours?

Answer: £870

Solution:

$$\text{Basic pay} = 40 \times 15 = \text{£}600$$

$$\text{Overtime hours} = 48 - 40 = 8$$

$$\text{Overtime pay} = 8 \times 22.50 = \text{£}180$$

$$\text{Total pay} = 600 + 180 = \text{£}780$$

Q27. The density of a substance is 8.5 g/cm^3 . What volume is occupied by 255 g of the substance?

Answer: 30 cm^3

Solution:

Volume = Mass \div Density

Volume = $255 \div 8.5 = 30 \text{ cm}^3$

Q28. A machine produces 480 units in 6 hours. How many units does it produce per minute?

Answer: 1.33 units per minute

Solution:

Total minutes = $6 \times 60 = 360$

Units per minute = $480 \div 360 = 1.33$ units

Q29. A pipe fills a tank in 3 hours. Another pipe can fill the same tank in 5 hours. How long will it take to fill the tank if both pipes work together?

Answer: 1.875 hours

Solution:

Combined rate = $1/3 + 1/5$

LCM of 3 and 5 = 15

= $(5 + 3)/15 = 8/15$

Time = $15 \div 8 = 1.875$ hours

Q30. A car travels 180 km in 2.25 hours. Calculate its average speed.

Answer: 80 km/h

Solution:

Speed = Distance \div Time

Speed = $180 \div 2.25 = 80 \text{ km/h}$

Q31. A cube has a volume of 125 cm^3 . What is the length of one side?

Answer: 5 cm

Solution:

Volume of cube = side³

side = $\sqrt[3]{125} = 5 \text{ cm}$

Q32. A shop reduces the price of an item by 20%. The original price was £75. What is the new price?

Answer: £60

Solution:

Reduction = 20% of 75 = $(20 \div 100) \times 75 = 15$

New price = $75 - 15 = £60$

Q33. A train travels 225 miles in 3 hours and 45 minutes. What is its average speed in mph?

Answer: 60 mph

Solution:

3 hours 45 minutes = 3.75 hours

Speed = Distance \div Time = $225 \div 3.75 = 60$ mph

Q34. If 6 pencils cost £2.70, what is the cost of 14 pencils?

Answer: £6.30

Solution:

Cost per pencil = $2.70 \div 6 = £0.45$

Cost of 14 pencils = $0.45 \times 14 = £6.30$

Q35. A metal rod weighs 2.4 kg and is 120 cm long. What is the weight per metre?

Answer: 2 kg/m

Solution:

Length in metres = $120 \div 100 = 1.2$ m

Weight per metre = $2.4 \div 1.2 = 2$ kg/m

Q36. A container holds 2.5 litres of paint. How many containers are needed to paint 45 m² if 1 litre covers 6 m²?

Answer: 3 containers

Solution:

Total paint needed = $45 \div 6 = 7.5$ litres

Containers needed = $7.5 \div 2.5 = 3$

Q37. A person runs a marathon of 42.2 km in 3 hours and 20 minutes. What is their average speed?

Answer: 12.66 km/h

Solution:

3 hours 20 minutes = 3.33 hours

Speed = $42.2 \div 3.33 \approx 12.66$ km/h

Q38. A garden path is 1.2 m wide and 8 m long. What is its area in square centimetres?

Answer: 96000 cm²

Solution:

Area in m² = $1.2 \times 8 = 9.6$ m²

1 m² = 10000 cm²

Area = $9.6 \times 10000 = 96000$ cm²

Q39. A car uses 6 litres of fuel to travel 90 km. How much fuel is needed to travel 150 km?

Answer: 10 litres

Solution:

Fuel per km = $6 \div 90 = 0.0667$ litres/km

Fuel for 150 km = $0.0667 \times 150 = 10$ litres

Q40. A recipe that serves 4 people uses 300 g of flour. How much flour is needed to serve 10 people?

Answer: 750 g

Solution:

$$\text{Flour per person} = 300 \div 4 = 75 \text{ g}$$

$$\text{Flour for 10 people} = 75 \times 10 = 750 \text{ g}$$

Q41. A box of cereal weighs 750 g. Convert this to kilograms.

Answer: 0.75 kg

Solution:

$$1 \text{ kilogram} = 1000 \text{ grams}$$

$$\text{Weight in kg} = 750 \div 1000 = 0.75 \text{ kg}$$

Q42. The exchange rate is £1 = €1.18. How many euros would you get for £250?

Answer: €295

Solution:

$$\text{Euros} = \text{Pounds} \times \text{Exchange rate}$$

$$\text{Euros} = 250 \times 1.18 = €295$$

Q43. The population of a town increases by 3% per year. If the current population is 12,000, what will it be next year?

Answer: 12,360

Solution:

$$\text{Increase} = 3\% \text{ of } 12000 = (3 \div 100) \times 12000 = 360$$

$$\text{Next year's population} = 12000 + 360 = 12,360$$

Q44. A factory produces 240 units in 8 hours. How many units are produced per hour?

Answer: 30 units/hour

Solution:

$$\text{Units per hour} = 240 \div 8 = 30 \text{ units/hour}$$

Q45. A bag of sugar weighs 1.5 kg. How many 250 g jars can be filled from one bag?

Answer: 6 jars

Solution:

$$\text{Convert kg to g: } 1.5 \text{ kg} = 1500 \text{ g}$$

$$\text{Number of jars} = 1500 \div 250 = 6 \text{ jars}$$

Q46. A boat travels 84 miles downstream in 4 hours. What is the speed of the boat?

Answer: 21 mph

Solution:

$$\text{Speed} = \text{Distance} \div \text{Time}$$

$$\text{Speed} = 84 \div 4 = 21 \text{ mph}$$

Q47. The ratio of boys to girls in a class is 5:4. If there are 36 students in total, how many girls are there?

Answer: 16 girls

Solution:

$$\text{Total parts} = 5 + 4 = 9$$

Girls part = 4

$$\text{Girls} = (4 \div 9) \times 36 = 16$$

Q48. A tank has a volume of 0.75 m³. Convert this to litres.

Answer: 750 litres

Solution:

$$1 \text{ m}^3 = 1000 \text{ litres}$$

$$\text{Litres} = 0.75 \times 1000 = 750 \text{ litres}$$

Q49. A person cycles at 15 km/h for 2.5 hours. How far do they travel?

Answer: 37.5 km

Solution:

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\text{Distance} = 15 \times 2.5 = 37.5 \text{ km}$$

Q50. A rectangular room is 5 m by 4.5 m. What is the area in square centimetres?

Answer: 225,000 cm²

Solution:

$$\text{Area in m}^2 = 5 \times 4.5 = 22.5 \text{ m}^2$$

$$1 \text{ m}^2 = 10,000 \text{ cm}^2$$

$$\text{Area in cm}^2 = 22.5 \times 10000 = 225,000 \text{ cm}^2$$

Q51. A tank holds 180 litres of water. It is emptied over 3 hours at a constant rate. How many litres of water are released per minute?

Answer: 1 litre per minute

Solution:

$$\text{Total time} = 3 \text{ hours} = 3 \times 60 = 180 \text{ minutes}$$

$$\text{Rate} = \text{Total volume} \div \text{Time}$$

$$\text{Rate} = 180 \text{ litres} \div 180 \text{ minutes} = 1 \text{ litre per minute}$$

Q52. A cyclist covers 36 km in 1 hour 20 minutes. What is their average speed in km/h?

Answer: 27 km/h

Solution:

$$1 \text{ hour } 20 \text{ minutes} = 1 + 20/60 = 1.333... \text{ hours}$$

$$\text{Speed} = \text{Distance} \div \text{Time}$$

$$\text{Speed} = 36 \text{ km} \div 1.333... \text{ h} = 27 \text{ km/h}$$

Q53. A car travels 150 miles using 12 gallons of fuel. What is the car's fuel consumption in miles per gallon?

Answer: 12.5 miles per gallon

Solution:

$$\text{Fuel consumption} = \text{Distance} \div \text{Fuel used}$$

$$\text{Fuel consumption} = 150 \text{ miles} \div 12 \text{ gallons} = 12.5 \text{ miles/gallon}$$

Q54. Convert a speed of 72 km/h into m/s.

Answer: 20 m/s

Solution:

1 km = 1000 m, 1 hour = 3600 s

Speed = $72 \times (1000 \div 3600) = 72 \times (5/18) = 20$ m/s

Q55. A cylindrical tank has a volume of 1.2 m³. Convert this volume into litres.

Answer: 1200 litres

Solution:

1 m³ = 1000 litres

Volume = $1.2 \times 1000 = 1200$ litres

Q56. The density of a metal is 7.8 g/cm³ and its volume is 250 cm³. Calculate its mass.

Answer: 1950 g

Solution:

Mass = Density \times Volume

Mass = $7.8 \text{ g/cm}^3 \times 250 \text{ cm}^3 = 1950$ g

Q57. A block has a mass of 2.5 kg and a volume of 0.0005 m³. Find the density in kg/m³.

Answer: 5000 kg/m³

Solution:

Density = Mass \div Volume

Density = $2.5 \text{ kg} \div 0.0005 \text{ m}^3 = 5000$ kg/m³

Q58. The pressure exerted by a force of 300 N on a surface is 50 N/m². Calculate the area of the surface.

Answer: 6 m²

Solution:

Pressure = Force \div Area

Area = Force \div Pressure

Area = $300 \text{ N} \div 50 \text{ N/m}^2 = 6$ m²

Q59. If 5 workers can complete a task in 12 days, how long would 8 workers take, working at the same rate?

Answer: 7.5 days

Solution:

Work = Workers \times Days = $5 \times 12 = 60$ worker-days

Days = Work \div Workers = $60 \div 8 = 7.5$ days

Q60. A recipe that serves 8 uses 240 g of sugar. How much sugar is needed for a recipe that serves 5?

Answer: 150 g

Solution:

Sugar per serving = $240 \text{ g} \div 8 = 30$ g

For 5 servings = $30 \text{ g} \times 5 = 150$ g

Q61. The cost of 7 kg of rice is £19.25. What is the cost of 3.5 kg of rice?

Answer: £9.63

Solution:

$$\text{Cost per kg} = £19.25 \div 7 = £2.75$$

$$\text{Cost of 3.5 kg} = 3.5 \times £2.75 = £9.625 \approx £9.63$$

Q62. A car travels 40 km in 32 minutes. Calculate its speed in km/h.

Answer: 75 km/h

Solution:

$$\text{Time in hours} = 32 \div 60 = 0.533\dots \text{ hours}$$

$$\text{Speed} = \text{Distance} \div \text{Time}$$

$$\text{Speed} = 40 \div 0.533\dots = 75 \text{ km/h}$$

Q63. A car moves with constant acceleration and its speed increases from 20 m/s to 40 m/s in 5 seconds. Find the acceleration.

Answer: 4 m/s²

Solution:

$$\text{Acceleration} = (\text{Final speed} - \text{Initial speed}) \div \text{Time}$$

$$\text{Acceleration} = (40 - 20) \div 5 = 20 \div 5 = 4 \text{ m/s}^2$$

Q64. Divide £84 between A and B in the ratio 5:7.

Answer: A gets £35, B gets £49

Solution:

$$\text{Total parts} = 5 + 7 = 12$$

$$\text{A's share} = (5/12) \times 84 = £35$$

$$\text{B's share} = (7/12) \times 84 = £49$$

Q65. Divide 270 ml of a solution into two parts in the ratio 2:7.

Answer: 60 ml and 210 ml

Solution:

$$\text{Total parts} = 2 + 7 = 9$$

$$\text{First part} = (2/9) \times 270 = 60 \text{ ml}$$

$$\text{Second part} = (7/9) \times 270 = 210 \text{ ml}$$

Q66. Express 4:11 as a part : whole ratio.

Answer: 4:15

Solution:

$$\text{Whole} = 4 + 11 = 15$$

$$\text{Part : Whole} = 4:15$$

Q67. Express the division of 80 items into two parts as a ratio, where one part is 20 and the other is 60.

Answer: 1:3

Solution:

$$20:60 = 1:3 \text{ (Divide both parts by 20)}$$

Q68. In a mixture of juice and water in the ratio 3:2, how much juice is there if the total mixture is 1.25 litres?

Answer: 0.75 litres

Solution:

$$\text{Total parts} = 3 + 2 = 5$$

$$\text{Juice} = (3/5) \times 1.25 = 0.75 \text{ litres}$$

Q69. In a class of 40 students, the ratio of girls to boys is 3:5. How many girls are there?

Answer: 15 girls

Solution:

$$\text{Total parts} = 3 + 5 = 8$$

$$\text{Girls} = (3/8) \times 40 = 15$$

Q70. A map has a scale of 1:25,000. What is the actual distance in kilometres if the map distance is 8 cm?

Answer: 2 km

Solution:

$$\text{Actual distance} = 8 \times 25,000 = 200,000 \text{ cm}$$

$$\text{Convert to km: } 200,000 \div 100,000 = 2 \text{ km}$$

Q71. A model car is built to a scale of 1:20. If the actual car is 4.2 m long, what is the length of the model in cm?

Answer: 21 cm

Solution:

$$\text{Actual length} = 4.2 \text{ m} = 420 \text{ cm}$$

$$\text{Model length} = 420 \div 20 = 21 \text{ cm}$$

Q72. A rectangle is enlarged by a scale factor of 1.5. Its original area is 48 cm². What is the area of the enlarged rectangle?

Answer: 108 cm²

Solution:

$$\text{Area scale factor} = (\text{Linear scale factor})^2 = (1.5)^2 = 2.25$$

$$\text{New area} = 48 \times 2.25 = 108 \text{ cm}^2$$

Q73. A cube has a surface area of 150 cm². It is scaled by a factor of 2. What is the surface area of the scaled cube?

Answer: 600 cm²

Solution:

$$\text{Surface area scale factor} = (\text{Scale factor})^2 = (2)^2 = 4$$

$$\text{New surface area} = 150 \times 4 = 600 \text{ cm}^2$$

Q74. A jug contains a drink made by mixing orange juice and water in a 5:3 ratio. If there is 2 litres of water, how much orange juice is needed?

Answer: 3.33 litres

Solution:

5 parts orange juice : 3 parts water

If 3 parts = 2 litres, then 1 part = $2 \div 3 = 0.666\dots$ litres

Orange juice = $5 \times 0.666\dots = 3.33$ litres

Q75. A car was purchased for £8,000. Its value depreciates by 15% per year. What is its value after one year?

Answer: £6800

Solution:

Depreciation = 15% of 8000 = $0.15 \times 8000 = £1200$

New value = $8000 - 1200 = £6800$

Q76. A population of 5000 increases by 4% per year. What will the population be after one year?

Answer: 5200

Solution:

Increase = 4% of 5000 = $0.04 \times 5000 = 200$

New population = $5000 + 200 = 5200$

Q77. A bank offers compound interest at 3% annually. How much will £2000 grow to after one year?

Answer: £2060

Solution:

Growth = 3% of 2000 = $0.03 \times 2000 = £60$

Total = $2000 + 60 = £2060$

Q78. A value grows from 150 to 180. Calculate the percentage increase.

Answer: 20%

Solution:

Increase = $180 - 150 = 30$

% Increase = $(30 \div 150) \times 100 = 20\%$

Q79. A value reduces from 260 to 208. Calculate the percentage decrease.

Answer: 20%

Solution:

Decrease = $260 - 208 = 52$

% Decrease = $(52 \div 260) \times 100 = 20\%$

Q80. A car travels 160 km in 2.4 hours. What is its average speed?

Answer: 66.67 km/h

Solution:

Speed = Distance \div Time = $160 \div 2.4 = 66.67$ km/h

Q81. A packet of cereal weighing 1.2 kg is shared between two people in the ratio 5:7. How much cereal does each person receive?

Answer: 0.5 kg and 0.7 kg

Solution:

$$\text{Total parts} = 5 + 7 = 12$$

$$\text{First share} = (5/12) \times 1.2 = 0.5 \text{ kg}$$

$$\text{Second share} = (7/12) \times 1.2 = 0.7 \text{ kg}$$

Q82. A total of £96 is to be divided between three people in the ratio 2:3:7. Calculate each person's share.

Answer: £16, £24, £56

Solution:

$$\text{Total parts} = 2 + 3 + 7 = 12$$

$$\text{First} = (2/12) \times 96 = £16$$

$$\text{Second} = (3/12) \times 96 = £24$$

$$\text{Third} = (7/12) \times 96 = £56$$

Q83. A quantity is divided into two parts in the ratio 5:3. If the smaller part is 24, find the larger part.

Answer: 40

Solution:

$$3 \text{ parts} = 24 \Rightarrow 1 \text{ part} = 24 \div 3 = 8$$

$$5 \text{ parts} = 8 \times 5 = 40$$

Q84. In a school, the number of boys is 60% of the number of girls. Express the number of boys as a fraction of the total number of students.

Answer: $3/8$

Solution:

$$\text{Let girls} = 100, \text{ boys} = 60$$

$$\text{Total} = 100 + 60 = 160$$

$$\text{Fraction of boys} = 60 \div 160 = 3/8$$

Q85. A to B is in the ratio 2:3, and B to C is in the ratio 4:5. What is the simplified ratio of A:B:C?

Answer: 8:12:15

Solution:

Make B same in both ratios:

$$2:3 \times 4 = 8:12$$

$$4:5 \times 3 = 12:15$$

$$\text{Combined} = 8:12:15$$

Q86. If £36 is shared in the ratio 1:3, express the smaller share as a fraction of the total.

Answer: $1/4$

Solution:

$$\text{Total parts} = 1 + 3 = 4$$

$$\text{Smaller share} = 1 \text{ part} \Rightarrow \text{Fraction} = 1/4$$

Q87. The mass of sugar in a mixture is 120 g, which is $\frac{3}{5}$ of the total mass. What is the total mass?

Answer: 200 g

Solution:

$$\text{Total mass} = 120 \div \left(\frac{3}{5}\right) = 120 \times \left(\frac{5}{3}\right) = 200 \text{ g}$$

Q88. A box contains red, blue and green balls in the ratio 2:5:3. If there are 60 balls in total, how many are green?

Answer: 18

Solution:

$$\text{Total parts} = 2 + 5 + 3 = 10$$

$$\text{Green} = \left(\frac{3}{10}\right) \times 60 = 18$$

Q89. The ratio of width to height of a rectangle is 4:3. If the width is 28 cm, what is the height?

Answer: 21 cm

Solution:

$$4 \text{ parts} = 28 \text{ cm} \Rightarrow 1 \text{ part} = 7 \text{ cm}$$

$$\text{Height} = 3 \times 7 = 21 \text{ cm}$$

Q90. A map shows two towns 12 cm apart. The scale of the map is 1:100,000. What is the real distance in km?

Answer: 12 km

Solution:

$$\text{Actual distance} = 12 \times 100,000 = 1,200,000 \text{ cm}$$

$$\text{Convert to km: } 1,200,000 \div 100,000 = 12 \text{ km}$$

Q91. A chemical solution is made by mixing acid and water in the ratio 1:4. If there are 300 ml of water, how much acid is needed?

Answer: 75 ml

Solution:

$$4 \text{ parts} = 300 \text{ ml} \Rightarrow 1 \text{ part} = 75 \text{ ml}$$

$$\text{Acid} = 1 \text{ part} = 75 \text{ ml}$$

Q92. A floor is to be tiled with square tiles. Each tile measures 30 cm by 30 cm. If the area of the floor is 9 m², how many tiles are needed?

Answer: 100 tiles

Solution:

$$\text{Area of 1 tile} = 30 \times 30 = 900 \text{ cm}^2 = 0.09 \text{ m}^2$$

$$\text{Number of tiles} = 9 \div 0.09 = 100 \text{ tiles}$$

Q93. A factory produces 320 items in 5 hours. How many items does it produce per minute?

Answer: 1.07 items/minute

Solution:

$$5 \text{ hours} = 300 \text{ minutes}$$

$$\text{Items per minute} = 320 \div 300 = 1.07$$

Q94. A machine fills 12 bottles in 4 minutes. How long does it take to fill 54 bottles?

Answer: 18 minutes

Solution:

Time per bottle = $4 \div 12 = 0.333\dots$ minutes

Time for 54 = $54 \times 0.333\dots = 18$ minutes

Q95. A recipe uses 300 g of flour to make 12 cupcakes. How much flour is needed for 30 cupcakes?

Answer: 750 g

Solution:

Flour per cupcake = $300 \div 12 = 25$ g

Flour for 30 = $25 \times 30 = 750$ g

Q96. A 2.5 m³ container is filled with oil. Convert the volume into litres.

Answer: 2500 litres

Solution:

1 m³ = 1000 litres

$2.5 \times 1000 = 2500$ litres

Q97. The ratio of cats to dogs in a shelter is 3:4. If there are 84 animals, how many are cats?

Answer: 36 cats

Solution:

Total parts = $3 + 4 = 7$

Cats = $(3/7) \times 84 = 36$

Q98. A train travels 180 miles in 3 hours. What is its average speed?

Answer: 60 mph

Solution:

Speed = $180 \div 3 = 60$ mph

Q99. A salary increases from £1200 to £1320. What is the percentage increase?

Answer: 10%

Solution:

Increase = $1320 - 1200 = 120$

% Increase = $(120 \div 1200) \times 100 = 10\%$

Q100. A compound increases in value by 5% annually. If its current value is £1500, what will it be after one year?

Answer: £1575

Solution:

Increase = $0.05 \times 1500 = £75$

New value = $1500 + 75 = £1575$

Q101. A recipe requires flour and sugar in the ratio 3:2. If you have 480 g of flour, how much sugar is needed?

Answer: 320 g

Solution:

Flour : Sugar = 3 : 2

Total parts = 3 + 2 = 5

Flour = 3 parts = 480 g

1 part = $480 \div 3 = 160$ g

Sugar = 2 parts = $160 \times 2 = 320$ g

Q102. A map has a scale of 1:50,000. If two towns are 7.5 cm apart on the map, what is their actual distance in kilometres?

Answer: 3.75 km

Solution:

Scale = 1 cm : 50,000 cm

Distance on map = 7.5 cm

Actual distance = $7.5 \times 50,000 = 375,000$ cm

Convert to km:

$375,000 \div 100,000 = 3.75$ km

Q103. A car travels 180 miles using 15 gallons of fuel. How many miles per gallon does the car achieve?

Answer: 12 miles per gallon

Solution:

Miles = 180

Gallons = 15

Miles per gallon = $180 \div 15 = 12$

Q104. If the pressure exerted by a force of 400 N on a surface is 80 N/m^2 , find the area of the surface.

Answer: 5 m^2

Solution:

Pressure = Force \div Area

Rearranged: Area = Force \div Pressure

Area = $400 \div 80 = 5 \text{ m}^2$

Q105. The density of a metal is 8.4 g/cm^3 . Calculate the mass of a 250 cm^3 block of the metal.

Answer: 2,100 g

Solution:

Density = Mass \div Volume

Rearranged: Mass = Density \times Volume

Mass = $8.4 \times 250 = 2,100$ g

Q106. A train travels at an average speed of 75 km/h. How long will it take to cover 225 km?

Answer: 3 hours

Solution:

Time = Distance \div Speed

Time = $225 \div 75 = 3$ hours

Q107. The value of a machine depreciates by 12% per year. If it is currently worth £8,000, what was its value a year ago?

Answer: £9,090.91

Solution:

Current value = 88% of original (since $100\% - 12\% = 88\%$)

Let original value be x

$0.88x = 8,000$

$x = 8,000 \div 0.88 = £9,090.91$

Q108. A tank fills in 6 hours when water is pumped in at a constant rate. How long will it take to fill 5 such tanks?

Answer: 30 hours

Solution:

Time for 1 tank = 6 hours

Time for 5 tanks = $6 \times 5 = 30$ hours

Q109. A laptop originally costing £1,200 is now being sold at a 25% discount. What is the sale price?

Answer: £900

Solution:

Discount = 25% of £1,200 = $0.25 \times 1,200 = £300$

Sale price = $1,200 - 300 = £900$

Q110. The surface area of a cube increases by a scale factor of 4. What is the scale factor of the side length?

Answer: 2

Solution:

Surface area \propto (side length)²

$\sqrt{4} = 2$

Scale factor of side length = 2

Q111. If 3 workers complete a job in 10 days, how many days would it take 5 workers to complete the same job?

Answer: 6 days

Solution:

Work = Workers \times Days

$3 \times 10 = 30$ worker-days

Days for 5 workers = $30 \div 5 = 6$ days

Q112. A quantity increases from 240 to 312. Calculate the percentage increase.

Answer: 30%

Solution:

$$\text{Increase} = 312 - 240 = 72$$

$$\text{Percentage increase} = (72 \div 240) \times 100 = 30\%$$

Q113. A solution is made by mixing acid and water in the ratio 2:5. If there are 150 ml of water, how much acid is used?

Answer: 60 ml

Solution:

$$\text{Water} = 5 \text{ parts} = 150 \text{ ml}$$

$$1 \text{ part} = 150 \div 5 = 30 \text{ ml}$$

$$\text{Acid} = 2 \text{ parts} = 30 \times 2 = 60 \text{ ml}$$

Q114. Express 72 as a percentage of 300.

Answer: 24%

Solution:

$$(72 \div 300) \times 100 = 0.24 \times 100 = 24\%$$

Q115. A population increases by 8% each year. What will be the population after 2 years if the current population is 25,000?

Answer: 29,160

Solution:

$$\text{Year 1: } 25,000 \times 1.08 = 27,000$$

$$\text{Year 2: } 27,000 \times 1.08 = 29,160$$

Q116. A car's speed changes from 60 km/h to 90 km/h in 10 seconds. What is the average acceleration?

Answer: 0.83 m/s²

Solution:

$$\text{Initial speed} = 60 \text{ km/h} = 16.67 \text{ m/s}$$

$$\text{Final speed} = 90 \text{ km/h} = 25 \text{ m/s}$$

$$\text{Acceleration} = (25 - 16.67) \div 10 = 8.33 \div 10 = 0.83 \text{ m/s}^2$$

Q117. A machine produces 360 units in 45 minutes. What is its production rate in units per hour?

Answer: 480 units/hour

Solution:

$$360 \text{ units in 45 minutes}$$

$$1 \text{ minute} = 360 \div 45 = 8 \text{ units}$$

$$60 \text{ minutes} = 8 \times 60 = 480 \text{ units/hour}$$

Q118. If the ratio of girls to boys in a class is 5:6 and there are 22 girls, how many boys are there?

Answer: 26.4 (not possible in real life; round to nearest whole: 26)**

Solution:

$$\text{Girls : Boys} = 5 : 6$$

$$1 \text{ part} = 22 \div 5 = 4.4$$

$$\text{Boys} = 6 \times 4.4 = 26.4$$

Q119. The pressure on a surface is 100 N/m^2 and the area is 0.5 m^2 . Calculate the force exerted.

Answer: 50 N

Solution:

$$\text{Pressure} = \text{Force} \div \text{Area}$$

$$\text{Rearranged: Force} = \text{Pressure} \times \text{Area}$$

$$\text{Force} = 100 \times 0.5 = 50 \text{ N}$$

Q120. Convert a speed of 90 km/h to metres per second.

Answer: 25 m/s

Solution:

$$1 \text{ km} = 1,000 \text{ m}; 1 \text{ hour} = 3,600 \text{ seconds}$$

$$\text{Speed} = (90 \times 1,000) \div 3,600 = 90,000 \div 3,600 = 25 \text{ m/s}$$

Q121. A pipe can fill a tank in 4 hours. A second pipe can fill it in 6 hours. How long will it take to fill the tank if both pipes are used together?

Answer: 2.4 hours

Solution:

$$\text{Rate of first pipe} = 1 \div 4 = 0.25$$

$$\text{Rate of second pipe} = 1 \div 6 \approx 0.1667$$

$$\text{Combined rate} = 0.25 + 0.1667 = 0.4167$$

$$\text{Time} = 1 \div 0.4167 \approx 2.4 \text{ hours}$$

Q122. A jacket is marked down by 30% in a sale. Its sale price is £56. What was the original price?

Answer: £80

Solution:

$$\text{Sale price} = 70\% \text{ of original}$$

$$0.7x = 56$$

$$x = 56 \div 0.7 = £80$$

Q123. A car uses 12 litres of petrol to travel 180 km. Calculate the fuel efficiency in km per litre.

Answer: 15 km/litre

Solution:

$$\text{Fuel efficiency} = \text{Distance} \div \text{Fuel}$$

$$= 180 \div 12 = 15 \text{ km/litre}$$

Q124. The ratio of red to blue balls in a bag is 3:4. If there are 56 balls in total, how many are red?

Answer: 24

Solution:

$$\text{Total parts} = 3 + 4 = 7$$

$$1 \text{ part} = 56 \div 7 = 8$$

$$\text{Red} = 3 \times 8 = 24$$

Q125. A company's revenue increases from £50,000 to £65,000. What is the percentage increase?

Answer: 30%

Solution:

$$\text{Increase} = 65,000 - 50,000 = 15,000$$

$$\text{Percentage increase} = (15,000 \div 50,000) \times 100 = 30\%$$

Q126. A train travels at a constant speed and covers 180 km in 2.25 hours. What is its speed in km/h?

Answer: 80 km/h

Solution:

$$\text{Speed} = \text{Distance} \div \text{Time}$$

$$\text{Speed} = 180 \div 2.25 = 80 \text{ km/h}$$

Q127. A tank contains water and oil in the ratio 2:3. If the total volume is 25 litres, how much oil is in the tank?

Answer: 15 litres

Solution:

$$\text{Total parts} = 2 + 3 = 5$$

$$1 \text{ part} = 25 \div 5 = 5 \text{ litres}$$

$$\text{Oil} = 3 \times 5 = 15 \text{ litres}$$

Q128. A student scored 18 out of 30 in a test. Express the score as a percentage.

Answer: 60%

Solution:

$$(18 \div 30) \times 100 = 0.6 \times 100 = 60\%$$

Q129. A pair of shoes originally cost £80. After a 15% discount, what is the new price?

Answer: £68

Solution:

$$\text{Discount} = 0.15 \times 80 = \text{£}12$$

$$\text{New price} = 80 - 12 = \text{£}68$$

Q130. If the mass of an object is 5.6 kg and its volume is 0.007 m³, find its density in kg/m³.

Answer: 800 kg/m³

Solution:

$$\text{Density} = \text{Mass} \div \text{Volume}$$

$$\text{Density} = 5.6 \div 0.007 = 800 \text{ kg/m}^3$$

Q131. Two quantities are in the ratio 7:5. If the larger quantity is 49, find the smaller.

Answer: 35

Solution:

$$\text{Larger} = 7 \text{ parts} = 49$$

$$1 \text{ part} = 49 \div 7 = 7$$

$$\text{Smaller} = 5 \times 7 = 35$$

Q132. A factory produces 1200 items in 5 hours. How many items are produced per minute?

Answer: 4 items/minute

Solution:

$$5 \text{ hours} = 5 \times 60 = 300 \text{ minutes}$$

$$\text{Items per minute} = 1200 \div 300 = 4$$

Q133. A cyclist covers 24 km in 1.5 hours. What is the average speed?

Answer: 16 km/h

Solution:

$$\text{Speed} = \text{Distance} \div \text{Time}$$

$$\text{Speed} = 24 \div 1.5 = 16 \text{ km/h}$$

Q134. A population of 18,000 grows by 5% per year. Find the population after one year.

Answer: 18,900

Solution:

$$\text{Increase} = 0.05 \times 18,000 = 900$$

$$\text{New population} = 18,000 + 900 = 18,900$$

Q135. Express 9:4 as a fraction of the whole.

Answer: 9/13

Solution:

$$\text{Total parts} = 9 + 4 = 13$$

$$\text{Fraction} = 9 \div 13 = 9/13$$

Q136. A mixture contains alcohol and water in the ratio 3:7. If there are 84 litres in total, how much alcohol is present?

Answer: 25.2 litres

Solution:

$$\text{Total parts} = 3 + 7 = 10$$

$$1 \text{ part} = 84 \div 10 = 8.4 \text{ litres}$$

$$\text{Alcohol} = 3 \times 8.4 = 25.2 \text{ litres}$$

Q137. A car depreciates by 10% each year. What is its value after one year if originally worth £18,000?

Answer: £16,200

Solution:

$$\text{Depreciation} = 0.10 \times 18,000 = 1,800$$

$$\text{New value} = 18,000 - 1,800 = £16,200$$

Q138. A triangle's side lengths are increased by a scale factor of 3. By what scale factor does the area increase?

Answer: 9

Solution:

$$\text{Area} \propto (\text{side length})^2$$

$$\text{Scale factor} = 3^2 = 9$$

Q139. A painter charges £15 per hour. How much would it cost for 6 hours and 30 minutes of work?

Answer: £97.50

Solution:

$$6 \text{ hours } 30 \text{ minutes} = 6.5 \text{ hours}$$

$$\text{Cost} = 15 \times 6.5 = \text{£}97.50$$

Q140. A train travels 144 miles in 3 hours and 36 minutes. Calculate its average speed in mph.

Answer: 40 mph

Solution:

$$3 \text{ hours } 36 \text{ minutes} = 3.6 \text{ hours}$$

$$\text{Speed} = 144 \div 3.6 = 40 \text{ mph}$$

Q141. A £40 shirt is reduced by 35% in a sale. What is the sale price?

Answer: £26

Solution:

$$\text{Discount} = 0.35 \times 40 = 14$$

$$\text{Sale price} = 40 - 14 = \text{£}26$$

Q142. A school has a student to teacher ratio of 25:1. If there are 400 students, how many teachers are there?

Answer: 16

Solution:

$$400 \div 25 = 16 \text{ teachers}$$

Q143. A quantity increases from 320 to 400. What is the percentage increase?

Answer: 25%

Solution:

$$\text{Increase} = 400 - 320 = 80$$

$$\text{Percentage increase} = (80 \div 320) \times 100 = 25\%$$

Q144. A 2.5 m³ container is filled with a liquid. Convert this volume into litres.

Answer: 2,500 litres

Solution:

$$1 \text{ m}^3 = 1,000 \text{ litres}$$

$$2.5 \text{ m}^3 = 2.5 \times 1,000 = 2,500 \text{ litres}$$

Q145. A loan of £5,000 accumulates simple interest at 6% per annum. What is the interest after one year?

Answer: £300

Solution:

$$\text{Interest} = \text{Principal} \times \text{Rate} \times \text{Time}$$

$$\text{Interest} = 5,000 \times 0.06 \times 1 = £300$$

Q146. A cyclist rides 84 km in 3 hours. How many minutes would it take to ride 56 km at the same speed?

Answer: 120 minutes

Solution:

$$\text{Speed} = 84 \div 3 = 28 \text{ km/h}$$

$$\text{Time} = 56 \div 28 = 2 \text{ hours}$$

$$2 \text{ hours} = 2 \times 60 = 120 \text{ minutes}$$

Q147. A metal alloy is made from copper and zinc in the ratio 5:3. If there are 120 g of zinc, how much copper is used?

Answer: 200 g

Solution:

$$\text{Zinc} = 3 \text{ parts} = 120 \text{ g}$$

$$1 \text{ part} = 120 \div 3 = 40 \text{ g}$$

$$\text{Copper} = 5 \times 40 = 200 \text{ g}$$

Q148. A company's profit falls from £240,000 to £192,000. Calculate the percentage decrease.

Answer: 20%

Solution:

$$\text{Decrease} = 240,000 - 192,000 = 48,000$$

$$\text{Percentage decrease} = (48,000 \div 240,000) \times 100 = 20\%$$

Q149. A car travels 120 km in 80 minutes. Calculate the speed in km/h.

Answer: 90 km/h

Solution:

$$80 \text{ minutes} = 80 \div 60 = 1.33 \text{ hours}$$

$$\text{Speed} = 120 \div 1.33 \approx 90 \text{ km/h}$$

Q150. A population of 9600 is made up of adults and children in the ratio 5:7. How many are children?

Answer: 5,600

Solution:

$$\text{Total parts} = 5 + 7 = 12$$

$$1 \text{ part} = 9600 \div 12 = 800$$

$$\text{Children} = 7 \times 800 = 5,600$$

Q151. A sum of money increases by 12% per year. If it's now £560, what was it a year ago?

Answer: £500

Solution:

Current value = 112% of original = £560

Let original be x

$$1.12x = 560$$

$$x = 560 \div 1.12 = \text{£}500$$

Q152. A train covers 150 km in 1 hour and 40 minutes. Find the average speed in km/h.

Answer: 90 km/h

Solution:

1 hour 40 minutes = $1 + 40/60 = 1.667$ hours

$$\text{Speed} = 150 \div 1.667 \approx 90 \text{ km/h}$$

Q153. A force of 900 N is applied over an area of 3 m². What is the pressure?

Answer: 300 N/m²

Solution:

Pressure = Force \div Area

$$\text{Pressure} = 900 \div 3 = 300 \text{ N/m}^2$$

Q154. A map scale is 1:25,000. How many cm on the map represent 2.5 km in real life?

Answer: 10 cm

Solution:

$$2.5 \text{ km} = 2,500 \times 100 = 250,000 \text{ cm}$$

$$\text{Map distance} = 250,000 \div 25,000 = 10 \text{ cm}$$

Q155. A £90 jacket is increased in price by 20%. What is the new price?

Answer: £108

Solution:

$$\text{Increase} = 0.20 \times 90 = \text{£}18$$

$$\text{New price} = 90 + 18 = \text{£}108$$

Q156. A car uses 50 litres of petrol to travel 650 km. What is the fuel consumption in km/litre?

Answer: 13 km/litre

Solution:

$$\text{Fuel consumption} = 650 \div 50 = 13 \text{ km/litre}$$

Q157. A 3:2 ratio of boys to girls represents 45 children. How many are girls?

Answer: 18

Solution:

$$\text{Total parts} = 3 + 2 = 5$$

$$1 \text{ part} = 45 \div 5 = 9$$

$$\text{Girls} = 2 \times 9 = 18$$

Q158. A speed of 20 m/s is equivalent to how many km/h?

Answer: 72 km/h

Solution:

$$1 \text{ m/s} = 3.6 \text{ km/h}$$

$$20 \times 3.6 = 72 \text{ km/h}$$

Q159. If a 15% tip is added to a £60 bill, what is the total amount paid?

Answer: £69

Solution:

$$\text{Tip} = 0.15 \times 60 = \text{£}9$$

$$\text{Total} = 60 + 9 = \text{£}69$$

Q160. A student earns £12 per hour. How much will they earn in a 37.5-hour week?

Answer: £450

Solution:

$$\text{Earnings} = 12 \times 37.5 = \text{£}450$$

Q161. A bottle contains a solution with water and alcohol in the ratio 4:1. If there is 1.2 litres of alcohol, how much water is there?

Answer: 4.8 litres

Solution:

$$\text{Alcohol} = 1 \text{ part} = 1.2 \text{ L}$$

$$1 \text{ part} = 1.2$$

$$\text{Water} = 4 \times 1.2 = 4.8 \text{ litres}$$

Q162. A phone is reduced by 30% in a sale and now costs £350. What was the original price?

Answer: £500

Solution:

$$70\% \text{ of original} = 350$$

$$0.7x = 350$$

$$x = 350 \div 0.7 = \text{£}500$$

Q163. A lorry travels 360 km in 4.5 hours. Find the average speed.

Answer: 80 km/h

Solution:

$$\text{Speed} = 360 \div 4.5 = 80 \text{ km/h}$$

Q164. A cylinder has a volume of 0.75 m^3 . Convert this volume into litres.

Answer: 750 litres

Solution:

$$1 \text{ m}^3 = 1,000 \text{ litres}$$

$$0.75 \times 1,000 = 750 \text{ litres}$$

Q165. A factory produces 450 units in 75 minutes. What is the production rate in units per hour?

Answer: 360 units/hour

Solution:

75 minutes = 1.25 hours

Rate = $450 \div 1.25 = 360$ units/hour

Q166. A bag of flour weighs 2.5 kg. A recipe uses 0.4 kg per cake. How many full cakes can be made?

Answer: 6 cakes

Solution:

$2.5 \div 0.4 = 6.25$

Only full cakes = 6

Q167. A person walks 1.8 km in 20 minutes. What is their speed in km/h?

Answer: 5.4 km/h

Solution:

20 minutes = $1/3$ hour

Speed = $1.8 \div (1/3) = 1.8 \times 3 = 5.4$ km/h

Q168. A block has a mass of 4.5 kg and a volume of 0.003 m³. Find its density.

Answer: 1,500 kg/m³

Solution:

Density = Mass \div Volume

Density = $4.5 \div 0.003 = 1,500$ kg/m³

Q169. The price of a laptop increases from £480 to £600. Find the percentage increase.

Answer: 25%

Solution:

Increase = $600 - 480 = 120$

Percentage increase = $(120 \div 480) \times 100 = 25\%$

Q170. A job pays £9.50 per hour. How much is earned in 7 hours and 15 minutes?

Answer: £68.88

Solution:

7 hours 15 minutes = 7.25 hours

Earnings = $9.5 \times 7.25 = £68.88$

Q171. A mixture contains paint and thinner in a 5:1 ratio. If there is 7.5 litres of thinner, how much paint is used?

Answer: 37.5 litres

Solution:

Thinner = 1 part = 7.5 litres

Paint = $5 \times 7.5 = 37.5$ litres

Q172. A person invests £2,000 at 5% simple interest per annum. What will the value be after one year?

Answer: £2,100

Solution:

$$\text{Interest} = 2,000 \times 0.05 \times 1 = \text{£}100$$

$$\text{Total value} = 2,000 + 100 = \text{£}2,100$$

Q173. A class has 24 girls and 16 boys. Express the ratio of girls to boys in simplest form.

Answer: 3:2

Solution:

$$\text{GCD of 24 and 16} = 8$$

$$24 \div 8 = 3$$

$$16 \div 8 = 2$$

$$\text{Ratio} = 3:2$$

Q174. A car's value depreciates by 18% in a year. If the value is now £12,300, what was it a year ago?

Answer: £15,000

Solution:

$$\text{Current value} = 82\% \text{ of original}$$

$$0.82x = 12,300$$

$$x = 12,300 \div 0.82 = \text{£}15,000$$

Q175. A triangle's base and height are scaled by a factor of 3. How is the area affected?

Answer: Area increases by a factor of 9

Solution:

$$\text{Area} \propto \text{base} \times \text{height}$$

$$\text{Area scale factor} = 3 \times 3 = 9$$

Q176. A job is completed by 4 workers in 15 days. How many days would it take 6 workers?

Answer: 10 days

Solution:

$$\text{Work} = \text{Workers} \times \text{Days} = 4 \times 15 = 60$$

$$\text{New time} = 60 \div 6 = 10 \text{ days}$$

Q177. A journey takes 2 hours 30 minutes at an average speed of 84 km/h. What is the total distance?

Answer: 210 km

Solution:

$$2 \text{ hours } 30 \text{ minutes} = 2.5 \text{ hours}$$

$$\text{Distance} = \text{Speed} \times \text{Time} = 84 \times 2.5 = 210 \text{ km}$$

Q178. A map distance of 4 cm represents 1.2 km. What is the map scale?

Answer: 1:30,000

Solution:

$$1.2 \text{ km} = 120,000 \text{ cm}$$

$$\text{Scale} = 120,000 \div 4 = 30,000$$

$$\text{Map scale} = 1:30,000$$

Q179. A machine makes 72 parts in 90 minutes. How many does it make in 4 hours?

Answer: 192 parts

Solution:

$$90 \text{ minutes} = 1.5 \text{ hours}$$

$$\text{Rate} = 72 \div 1.5 = 48 \text{ parts/hour}$$

$$4 \text{ hours} = 48 \times 4 = 192 \text{ parts}$$

Q180. A discount of 20% is applied to a price of £350. What is the final amount?

Answer: £280

Solution:

$$\text{Discount} = 0.20 \times 350 = £70$$

$$\text{Final price} = 350 - 70 = £280$$

Q181. A metal block has a density of 7.2 g/cm³ and a volume of 300 cm³. Find its mass.

Answer: 2,160 g

Solution:

$$\text{Mass} = \text{Density} \times \text{Volume} = 7.2 \times 300 = 2,160 \text{ g}$$

Q182. A student's mark improves from 64 to 80. What is the percentage increase?

Answer: 25%

Solution:

$$\text{Increase} = 80 - 64 = 16$$

$$\text{Percentage increase} = (16 \div 64) \times 100 = 25\%$$

Q183. The ratio of cats to dogs in a shelter is 5:3. If there are 64 animals, how many are dogs?

Answer: 24

Solution:

$$\text{Total parts} = 5 + 3 = 8$$

$$1 \text{ part} = 64 \div 8 = 8$$

$$\text{Dogs} = 3 \times 8 = 24$$

Q184. A bicycle is bought for £240 and sold for £180. What is the percentage loss?

Answer: 25%

Solution:

$$\text{Loss} = 240 - 180 = £60$$

$$\text{Percentage loss} = (60 \div 240) \times 100 = 25\%$$

Q185. A recipe uses ingredients in the ratio 2:3:5. If the total weight is 1 kg, how much is each ingredient?

Answer: 0.2 kg, 0.3 kg, 0.5 kg

Solution:

$$\text{Total parts} = 2 + 3 + 5 = 10$$

$$1 \text{ part} = 1 \div 10 = 0.1 \text{ kg}$$

$$\text{Ingredients} = 2 \times 0.1 = 0.2 \text{ kg}, 3 \times 0.1 = 0.3 \text{ kg}, 5 \times 0.1 = 0.5 \text{ kg}$$

Q186. A lorry's load weighs 2.4 tonnes. Convert this weight into kilograms.

Answer: 2,400 kg

Solution:

1 tonne = 1,000 kg

$2.4 \times 1,000 = 2,400$ kg

Q187. A car travels 132 km in 1 hour and 36 minutes. What is the speed in km/h?

Answer: 82.5 km/h

Solution:

1 hour 36 minutes = 1.6 hours

Speed = $132 \div 1.6 = 82.5$ km/h

Q188. A £500 laptop increases in price by 8%. What is the new price?

Answer: £540

Solution:

Increase = $0.08 \times 500 = £40$

New price = $500 + 40 = £540$

Q189. A field has an area of 4.8 hectares. Convert this to m².

Answer: 48,000 m²

Solution:

1 hectare = 10,000 m²

$4.8 \times 10,000 = 48,000$ m²

Q190. A salary is £2400 per month. What is the annual salary?

Answer: £28,800

Solution:

Annual salary = $2400 \times 12 = £28,800$

Q191. A factory's output grows by 6% per year. If current output is 10,000 units, what was it a year ago?

Answer: 9,433.96 units

Solution:

Current = 106% of original

$1.06x = 10,000$

$x = 10,000 \div 1.06 = 9,433.96$

Q192. The mass of a cube is 250 g and its volume is 50 cm³. What is the density?

Answer: 5 g/cm³

Solution:

Density = Mass \div Volume = $250 \div 50 = 5$ g/cm³

Q193. A train increases its speed from 80 km/h to 120 km/h. What is the percentage increase?

Answer: 50%

Solution:

$$\text{Increase} = 120 - 80 = 40$$

$$\text{Percentage increase} = (40 \div 80) \times 100 = 50\%$$

Q194. A shop buys items at £3 each and sells them at £5. What is the percentage profit?

Answer: 66.67%

Solution:

$$\text{Profit} = 5 - 3 = £2$$

$$\text{Percentage profit} = (2 \div 3) \times 100 \approx 66.67\%$$

Q195. A compound value grows 10% each year. If it's now £1,100, what was it a year ago?

Answer: £1,000

Solution:

$$\text{Current} = 110\% \text{ of original}$$

$$1.1x = 1,100$$

$$x = 1,100 \div 1.1 = £1,000$$

Q196. A triangle's area is 120 cm². After enlargement by scale factor 2, what is the new area?

Answer: 480 cm²

Solution:

$$\text{Area scale factor} = 2^2 = 4$$

$$\text{New area} = 120 \times 4 = 480 \text{ cm}^2$$

Q197. A worker is paid £11 per hour for weekdays and £15 on weekends. If they work 35 weekday hours and 8 weekend hours, what is the total pay?

Answer: £553

Solution:

$$\text{Weekday pay} = 35 \times 11 = £385$$

$$\text{Weekend pay} = 8 \times 15 = £120$$

$$\text{Total} = 385 + 120 = £505$$

Correction:

Answer: £505

Q198. A population decreased from 30,000 to 24,000. Find the percentage decrease.

Answer: 20%

Solution:

$$\text{Decrease} = 30,000 - 24,000 = 6,000$$

$$\text{Percentage decrease} = (6,000 \div 30,000) \times 100 = 20\%$$

Q199. A fuel tank holds 40 litres. If the car uses 8 litres per 100 km, how far can it travel?

Answer: 500 km

Solution:

$$\text{Distance} = (40 \div 8) \times 100 = 5 \times 100 = 500 \text{ km}$$

Q200. A phone plan charges £15 per month plus £0.10 per text. How much is the bill for 120 texts?

Answer: £27

Solution:

$$\text{Text cost} = 120 \times 0.10 = \text{£}12$$

$$\text{Total} = 15 + 12 = \text{£}27$$

Q201. A cyclist covers 72 km in 3 hours. What is their average speed in km/h?

Answer: 24 km/h

Solution:

$$\text{Average speed} = \text{Distance} \div \text{Time}$$

$$= 72 \div 3$$

$$= 24 \text{ km/h}$$

Q202. A worker earns £9.80 per hour. How much will they earn for working 42 hours?

Answer: £411.60

Solution:

$$\text{Earnings} = \text{Rate of pay} \times \text{Hours worked}$$

$$= 9.80 \times 42$$

$$= \text{£}411.60$$

Q203. A shop sells 5 apples for £1.45. Find the unit price for one apple.

Answer: £0.29

Solution:

$$\text{Unit price} = \text{Total cost} \div \text{Number of apples}$$

$$= 1.45 \div 5$$

$$= \text{£}0.29$$

Q204. A block of metal has a mass of 450 g and a volume of 150 cm³. Calculate the density of the metal.

Answer: 3 g/cm³

Solution:

$$\text{Density} = \text{Mass} \div \text{Volume}$$

$$= 450 \div 150$$

$$= 3 \text{ g/cm}^3$$

Q205. A force of 600 N is applied to an area of 0.5 m². Work out the pressure in N/m².

Answer: 1200 N/m²

Solution:

$$\text{Pressure} = \text{Force} \div \text{Area}$$

$$= 600 \div 0.5$$

$$= 1200 \text{ N/m}^2$$

Q206. A cube has side length 6 cm. What is its volume?

Answer: 216 cm³

Solution:

$$\text{Volume} = \text{Side}^3$$

$$= 6^3$$
$$= 216 \text{ cm}^3$$

Q207. Two similar rectangles have lengths in the ratio 2:5. What is the ratio of their areas?

Answer: 4:25

Solution:

$$\text{Area ratio} = (\text{Length ratio})^2$$
$$= (2:5)^2$$
$$= 4:25$$

Q208. The sides of a triangle are enlarged by a scale factor of 3. What is the scale factor of the new area?

Answer: 9

Solution:

$$\text{Area scale factor} = (\text{Side scale factor})^2$$
$$= 3^2$$
$$= 9$$

Q209. The volume of a sphere is increased by a scale factor of 4. What is the scale factor of its radius?

Answer: Cube root of 4 ≈ 1.587

Solution:

$$\text{Volume scale factor} = (\text{Radius scale factor})^3$$

Let radius scale factor = x

$$\text{Then } x^3 = 4$$
$$x = \sqrt[3]{4}$$
$$x \approx 1.587$$

Q210. Two cylinders are similar. The height of the smaller one is 5 cm and the height of the larger one is 15 cm. Find the ratio of their volumes.

Answer: 1:27

Solution:

$$\text{Height ratio} = 5:15 = 1:3$$
$$\text{Volume ratio} = (\text{Height ratio})^3$$
$$= 1^3 : 3^3$$
$$= 1:27$$

Q211. A triangle has angles 30° , 60° , and 90° . One side is 6 cm. Use trigonometric ratios to find another side.

Answer: $6\sqrt{3} \approx 10.39$ cm

Solution:

Let the 6 cm be the side opposite 30°

In a 30° - 60° - 90° triangle, the ratio of the opposite to adjacent is $\tan(30^\circ)$

$$\tan(30^\circ) = \text{opposite} / \text{adjacent}$$
$$\tan(30^\circ) = 6 / x$$

$$x = 6 / \tan(30^\circ)$$

$$x \approx 6 / 0.577$$

$$x \approx 10.39 \text{ cm}$$

Q212. In a right-angled triangle, the hypotenuse is 13 cm and one side is 5 cm. Find the size of one of the other angles.

Answer: 22.6°

Solution:

Let the side of 5 cm be adjacent

$\cos(\theta) = \text{adjacent} \div \text{hypotenuse}$

$$\cos(\theta) = 5 \div 13$$

$$\theta = \cos^{-1}(5/13)$$

$$\theta \approx \cos^{-1}(0.3846)$$

$$\theta \approx 67.4^\circ$$

Alternatively, if side is opposite:

$$\sin(\theta) = 5 \div 13$$

$$\theta = \sin^{-1}(5/13)$$

$$\theta \approx 22.6^\circ$$

Q213. X is inversely proportional to Y. If Y = 4 when X = 10, find the equation linking X and Y.

Answer: $XY = 40$ or $X = 40/Y$

Solution:

Inverse proportion: $XY = k$

$$10 \times 4 = k$$

$$k = 40$$

$$\text{So, } X = 40 \div Y$$

Q214. X is directly proportional to Y. If Y = 3 when X = 9, write the equation linking X and Y.

Answer: $X = 3Y$

Solution:

Direct proportion: $X = kY$

$$9 = k \times 3$$

$$k = 3$$

$$\text{So, } X = 3Y$$

Q215. When a car travels at 60 mph, the journey takes 2 hours. If the speed is reduced to 40 mph, how long does the journey take?

Answer: 3 hours

Solution:

Distance = Speed \times Time

$$= 60 \times 2 = 120 \text{ miles}$$

New time = Distance \div New speed

$$= 120 \div 40$$

$$= 3 \text{ hours}$$

Q216. The time taken to do a job is inversely proportional to the number of workers. If 4 workers take 6 days, how long would 8 workers take?

Answer: 3 days

Solution:

Time \times Workers = Constant

$$4 \times 6 = 24$$

$$8 \times t = 24$$

$$t = 24 \div 8$$

$$t = 3 \text{ days}$$

Q217. The gradient of a line is 3. What is the rate of change of y with respect to x ?

Answer: 3

Solution:

Gradient = Rate of change of y with respect to x

So, the rate of change is 3

Q218. A straight line has the equation $y = 2x + 5$. What does the gradient represent?

Answer: The rate of change of y with respect to x is 2

Solution:

From $y = mx + c$

Gradient $m = 2$

It means for every 1 unit increase in x , y increases by 2

Q219. On a graph, a curve passes through the point (3, 4). Draw a tangent at that point and estimate the gradient.

Answer: Approx. 6 (depending on tangent drawn)

Solution:

Draw a tangent at (3, 4)

Choose two points on the tangent line

Find gradient = change in $y \div$ change in x

Suppose tangent passes through (2, -2) and (4, 10)

$$\text{Gradient} = (10 - (-2)) \div (4 - 2) = 12 \div 2 = 6$$

Q220. Find the average rate of change between $x = 1$ and $x = 5$ for the function $y = x^2$.

Answer: 8

Solution:

$$y = x^2$$

$$\text{At } x = 1, y = 1^2 = 1$$

$$\text{At } x = 5, y = 5^2 = 25$$

$$\text{Average rate of change} = (25 - 1) \div (5 - 1) = 24 \div 4 = 6$$

Q221. A population of 500 people grows by 4% each year. What is the population after 3 years?

Answer: 562.43

Solution:

$$\begin{aligned}\text{Population} &= 500 \times (1.04)^3 \\ &= 500 \times 1.124864 \\ &\approx 562.43\end{aligned}$$

Q222. A machine loses 3% of its value each year. If it is worth £500 now, what is its value after 5 years?

Answer: £429.27

Solution:

$$\begin{aligned}\text{Value} &= 500 \times (0.97)^5 \\ &= 500 \times 0.85873 \\ &\approx \text{£}429.27\end{aligned}$$

Q223. £200 is invested at a compound interest rate of 5% per annum. What is the value after 2 years?

Answer: £220.50

Solution:

$$\begin{aligned}\text{Value} &= 200 \times (1.05)^2 \\ &= 200 \times 1.1025 \\ &= \text{£}220.50\end{aligned}$$

Q224. A town's population increases by 2.5% per year. Use an iterative process to estimate the population after 4 years if it starts at 10,000.

Answer: 10,000 → 10,250 → 10,506.25 → 10,768.91 → 11,038.13

Solution:

$$\begin{aligned}\text{Year 1: } &10,000 \times 1.025 = 10,250 \\ \text{Year 2: } &10,250 \times 1.025 = 10,506.25 \\ \text{Year 3: } &10,506.25 \times 1.025 = 10,768.91 \\ \text{Year 4: } &10,768.91 \times 1.025 = 11,038.13\end{aligned}$$

Q225. Use iteration to solve $x = \sqrt{10 + x}$, starting with $x_0 = 2$. Perform three steps.

Answer: Step 1: 3.464, Step 2: 3.605, Step 3: 3.620

Solution:

$$\begin{aligned}x_1 &= \sqrt{10 + 2} = \sqrt{12} \approx 3.464 \\ x_2 &= \sqrt{10 + 3.464} = \sqrt{13.464} \approx 3.670 \\ x_3 &= \sqrt{10 + 3.670} = \sqrt{13.670} \approx 3.696\end{aligned}$$

Q226. A quantity grows exponentially according to the formula $N = 100(1.02)^t$. What does 1.02 represent?

Answer: A 2% growth per time unit

Solution:

The value 1.02 represents the growth multiplier
It means the quantity increases by 2% each time unit

Q227. A ladder leans against a wall, making an angle of 70° with the ground. The ladder is 5 m long. How high up the wall does it reach?

Answer: 4.70 m

Solution:

Use sine: $\sin(\theta) = \text{opposite} \div \text{hypotenuse}$

$$\sin(70^\circ) = \text{height} \div 5$$

$$\text{height} = 5 \times \sin(70^\circ)$$

$$\text{height} \approx 5 \times 0.9397$$

$$\text{height} \approx 4.6985 \approx 4.70 \text{ m}$$

Q228. A 3D model is made with a scale factor of 1:50. If the model is 6 cm tall, how tall is the real object?

Answer: 300 cm

Solution:

$$\text{Real height} = \text{Model height} \times \text{Scale factor}$$

$$= 6 \times 50$$

$$= 300 \text{ cm}$$

Q229. Two squares are similar. The side of the smaller one is 4 cm, and the side of the larger is 10 cm. Find the ratio of their areas.

Answer: 4:25

Solution:

$$\text{Side ratio} = 4:10 = 2:5$$

$$\text{Area ratio} = (\text{Side ratio})^2 = (2:5)^2 = 4:25$$

Q230. The pressure in a gas cylinder is 2000 Pa when the area is 0.5 m². Find the force applied.

Answer: 1000 N

Solution:

$$\text{Pressure} = \text{Force} \div \text{Area}$$

$$\text{Force} = \text{Pressure} \times \text{Area}$$

$$= 2000 \times 0.5$$

$$= 1000 \text{ N}$$

Q231. A car travels 120 km in 1.5 hours. Calculate its speed in m/s.

Answer: 22.22 m/s

Solution:

$$\text{Speed} = \text{Distance} \div \text{Time}$$

$$\text{Convert km to m: } 120 \text{ km} = 120000 \text{ m}$$

$$\text{Convert hours to seconds: } 1.5 \text{ hours} = 5400 \text{ s}$$

$$\text{Speed} = 120000 \div 5400$$

$$= 22.22 \text{ m/s}$$

Q232. If density is 7.8 g/cm³ and the volume is 250 cm³, find the mass.

Answer: 1950 g

Solution:

$$\text{Mass} = \text{Density} \times \text{Volume}$$

$$= 7.8 \times 250$$
$$= 1950 \text{ g}$$

Q233. A car uses 8 litres of fuel for 100 km. How many litres will it use for 350 km?

Answer: 28 litres

Solution:

Use ratio:

$$8 \text{ litres} / 100 \text{ km} = x \text{ litres} / 350 \text{ km}$$

$$x = (8 \times 350) \div 100$$

$$x = 2800 \div 100$$

$$x = 28 \text{ litres}$$

Q234. A graph shows distance against time. Explain how you can find the speed from the graph.

Answer: By finding the gradient of the graph

Solution:

Speed = Gradient of the distance-time graph

Gradient = Change in distance \div Change in time

Q235. The height of a cone is increased by scale factor 2. What happens to the volume?

Answer: Volume increases by scale factor 8

Solution:

$$\text{Volume scale factor} = (\text{Linear scale factor})^3$$

$$= 2^3$$

$$= 8$$

Q236. The surface area of two similar pyramids is in the ratio 1:9. What is the ratio of their heights?

Answer: 1:3

Solution:

$$\text{Surface area ratio} = (\text{Height ratio})^2$$

Let height ratio = x

$$x^2 = 1:9$$

$$x = \sqrt{1/9}$$

$$x = 1:3$$

Q237. X is proportional to 1/Y. If Y = 2, X = 6. Find X when Y = 8.

Answer: 1.5

Solution:

$$X \propto 1/Y \Rightarrow X = k/Y$$

$$6 = k/2 \Rightarrow k = 12$$

$$X = 12/8$$

$$X = 1.5$$

Q238. A straight line goes through (0, 2) and (3, 11). Find its gradient.

Answer: 3

Solution:

$$\begin{aligned}\text{Gradient} &= (\text{Change in } y) \div (\text{Change in } x) \\ &= (11 - 2) \div (3 - 0) \\ &= 9 \div 3 \\ &= 3\end{aligned}$$

Q239. Find the gradient of the curve $y = x^2$ at $x = 3$ using the tangent method.

Answer: 6 (approx.)

Solution:

Draw a tangent at point (3, 9)
Choose two points on the tangent, e.g. (2, 3) and (4, 15)

$$\begin{aligned}\text{Gradient} &= (15 - 3) \div (4 - 2) \\ &= 12 \div 2 \\ &= 6\end{aligned}$$

Q240. Explain how the gradient of a chord estimates the average rate of change between two points.

Answer: It shows the average rate of change of y with respect to x

Solution:

Gradient of a chord = (Change in y) \div (Change in x)
It connects two points and gives an average rate of change over the interval

Q241. A car's speed increases from 30 mph to 50 mph in 10 seconds. Find the average acceleration.

Answer: 0.89 m/s²

Solution:

Convert mph to m/s:
30 mph \approx 13.41 m/s
50 mph \approx 22.35 m/s

$$\begin{aligned}\text{Acceleration} &= (\text{Final speed} - \text{Initial speed}) \div \text{Time} \\ &= (22.35 - 13.41) \div 10 \\ &= 8.94 \div 10 \\ &= 0.894 \text{ m/s}^2 \approx 0.89 \text{ m/s}^2\end{aligned}$$

Q242. A rectangular tank holds 6000 litres of water and is 2 metres long and 1.5 metres wide. Find its height in metres.

Answer: 2 m

Solution:

$$\begin{aligned}6000 \text{ litres} &= 6 \text{ m}^3 \\ \text{Volume} &= \text{length} \times \text{width} \times \text{height} \\ 6 &= 2 \times 1.5 \times \text{height} \\ 6 &= 3 \times \text{height}\end{aligned}$$

$$\text{height} = 6 \div 3$$

$$\text{height} = 2 \text{ m}$$

Q243. A person earns £2500 per month. What is their annual income?

Answer: £30,000

Solution:

$$\text{Annual income} = \text{Monthly income} \times 12$$

$$= 2500 \times 12$$

$$= £30,000$$

Q244. A builder is paid £150 for 8 hours of work. What is the rate of pay per hour?

Answer: £18.75 per hour

Solution:

$$\text{Rate} = \text{Total pay} \div \text{Hours}$$

$$= 150 \div 8$$

$$= £18.75$$

Q245. A triangle has sides 5 cm, 12 cm and 13 cm. Show it is a right-angled triangle.

Answer: Yes, it is a right-angled triangle

Solution:

Check Pythagoras:

$$5^2 + 12^2 = 25 + 144 = 169$$

$$13^2 = 169$$

Since $5^2 + 12^2 = 13^2$, it is right-angled

Q246. Use trigonometry to find the angle in a triangle where the opposite side is 7 cm and the hypotenuse is 14 cm.

Answer: 30°

Solution:

$$\sin(\theta) = \text{opposite} \div \text{hypotenuse}$$

$$\sin(\theta) = 7 \div 14$$

$$\sin(\theta) = 0.5$$

$$\theta = \sin^{-1}(0.5)$$

$$\theta = 30^\circ$$

Q247. Sketch a graph of a function showing inverse proportion.

Answer: A decreasing curve from top left to bottom right

Solution:

The graph of $y = k/x$ is an inverse proportion

It curves downward and never touches the axes

Q248. Sketch a graph of $y = 3x$ and describe its gradient.

Answer: A straight line with gradient 3

Solution:

The line goes through the origin and rises steeply

Gradient = 3 means for every 1 unit increase in x, y increases by 3

Q249. Use a tangent to estimate the rate of change at $x = 2$ for $y = x^3$.

Answer: 12

Solution:

$$y = x^3 \Rightarrow \text{at } x = 2, y = 8$$

Tangent at $x = 2$ has a gradient of $dy/dx = 3x^2$

$$\text{At } x = 2, dy/dx = 3(2)^2 = 3 \times 4 = 12$$

So, rate of change = 12

Q250. A value triples every 5 years. If the current value is £200, what will it be in 10 years?

Answer: £1800

Solution:

$$\text{Value after 5 years} = 200 \times 3 = 600$$

$$\text{Value after 10 years} = 600 \times 3 = 1800$$

Or directly:

$$\text{Value} = 200 \times 3^2 = 200 \times 9 = \text{£}1800$$

Q251. A car loses 15% of its value each year. If it's worth £12,000 now, estimate its value in 3 years.

Answer: £7,377

Solution:

$$\text{Value after 1 year} = 12000 \times 0.85 = 10200$$

$$\text{Value after 2 years} = 10200 \times 0.85 = 8670$$

$$\text{Value after 3 years} = 8670 \times 0.85 = 7377$$

Q252. A house value increases by 2% per month. If it is worth £150,000 now, what is it worth in 6 months?

Answer: £159,327.63

Solution:

$$\text{Value} = 150000 \times (1.02)^6$$

$$= 150000 \times 1.126162$$

$$\approx \text{£}159,327.63$$

Q253. Find the unit cost of 7 pencils costing £3.15.

Answer: £0.45

Solution:

$$\text{Unit cost} = 3.15 \div 7$$

$$= \text{£}0.45$$

Q254. Find the density of an object with mass 5.2 kg and volume 2.5 m³.

Answer: 2.08 kg/m³

Solution:

$$\text{Density} = \text{Mass} \div \text{Volume}$$

$$= 5.2 \div 2.5$$
$$= 2.08 \text{ kg/m}^3$$

Q255. Explain how pressure changes when force increases but area remains constant.

Answer: Pressure increases

Solution:

$$\text{Pressure} = \text{Force} \div \text{Area}$$

If area is constant and force increases, pressure increases proportionally

Q256. A population of 8000 increases at a rate of 1.5% per year. How many people after 2 years?

Answer: 8242

Solution:

$$\text{Population after 1 year} = 8000 \times 1.015 = 8120$$

$$\text{Population after 2 years} = 8120 \times 1.015 = 8242$$

Q257. An investment grows from £2000 to £2200 in 2 years. Find the annual percentage growth rate.

Answer: 4.88%

Solution:

$$2200 = 2000 \times (1 + r)^2$$

$$1.1 = (1 + r)^2$$

$$\sqrt{1.1} = 1 + r$$

$$1.0488 = 1 + r$$

$$r = 0.0488 = 4.88\%$$

Q258. A length of 4.5 m is increased by 60%. Find the new length.

Answer: 7.2 m

Solution:

$$\text{Increase} = 4.5 \times 0.6 = 2.7$$

$$\text{New length} = 4.5 + 2.7 = 7.2 \text{ m}$$

Q259. A company makes 5 widgets in 2 hours. How many widgets in 10 hours?

Answer: 25 widgets

Solution:

$$\text{Widgets per hour} = 5 \div 2 = 2.5$$

$$\text{Widgets in 10 hours} = 2.5 \times 10 = 25$$

Q260. A straight line passes through (1, 2) and (4, 8). Find its gradient.

Answer: 2

Solution:

$$\text{Gradient} = (8 - 2) \div (4 - 1)$$

$$= 6 \div 3$$

$$= 2$$

Q261. Use iteration to solve $x = (6 + x)/2$, starting with $x = 1$.

Answer: Step 1: 3.5, Step 2: 4.75, Step 3: 5.375

Solution:

$$x_1 = (6 + 1)/2 = 7/2 = 3.5$$

$$x_2 = (6 + 3.5)/2 = 9.5/2 = 4.75$$

$$x_3 = (6 + 4.75)/2 = 10.75/2 = 5.375$$

Q262. In a right-angled triangle, $\sin \theta = 0.6$. Find θ .

Answer: 36.87°

Solution:

$$\theta = \sin^{-1}(0.6)$$

$$\theta \approx 36.87^\circ$$

Q263. A line has gradient 4. What is the change in y when x increases by 3?

Answer: 12

Solution:

$$\text{Change in } y = \text{Gradient} \times \text{Change in } x$$

$$= 4 \times 3$$

$$= 12$$

Q264. If area is proportional to the square of the scale factor, what happens to the area if the scale factor is doubled?

Answer: Area becomes 4 times greater

Solution:

$$\text{New area} = \text{Original area} \times (2^2)$$

$$= 4 \times \text{Original area}$$

Q265. Two cones are similar. Their heights are in the ratio 3:5. Find the ratio of their volumes.

Answer: 27:125

Solution:

$$\text{Volume ratio} = (\text{Height ratio})^3$$

$$= (3:5)^3$$

$$= 27:125$$

Q266. A truck travels 250 km in 3.5 hours. Find the speed in km/h.

Answer: 71.43 km/h

Solution:

$$\text{Speed} = \text{Distance} \div \text{Time}$$

$$= 250 \div 3.5$$

$$= 71.43 \text{ km/h}$$

Q267. An object is 2.5 m tall in real life and 5 cm tall in a model. Find the scale factor.

Answer: 1:50

Solution:

Convert 2.5 m = 250 cm

Scale = 5:250 = 1:50

Q268. A ball bounces to 80% of its previous height each time. If the first bounce is 2 m, how high is the third?

Answer: 1.28 m

Solution:

Second bounce = $2 \times 0.8 = 1.6$

Third bounce = $1.6 \times 0.8 = 1.28$ m

Q269. A salary increases by 3% each year. How many years until it grows by at least 10%?

Answer: 4 years

Solution:

Use growth formula:

Final = Initial $\times (1.03)^n \geq 1.10 \times$ Initial

$(1.03)^n \geq 1.10$

$n \approx \log(1.10) \div \log(1.03) \approx 0.0414 \div 0.0128 \approx 3.23$

So, after 4 years

Q270. Estimate the gradient of $y = x^2 + 1$ at $x = 2$ using a tangent.

Answer: 4

Solution:

$y = x^2 + 1$

At $x = 2$, $y = 4 + 1 = 5$

Tangent gradient \approx derivative = $dy/dx = 2x$

At $x = 2$, $dy/dx = 2 \times 2 = 4$

Q271. A graph shows speed-time. What does the gradient represent?

Answer: Acceleration

Solution:

Gradient = Change in speed \div Time

So, gradient of speed-time graph is acceleration

Q272. A boat travels 240 km in 5 hours. Find the average speed.

Answer: 48 km/h

Solution:

Speed = Distance \div Time

= $240 \div 5$

= 48 km/h

Q273. A model is made with scale 1:100. What is the real length if the model is 7 cm?

Answer: 700 cm

Solution:

Real length = Model length \times Scale

$$= 7 \times 100$$

$$= 700 \text{ cm}$$

Q274. An object loses half its value every year. If it's worth £400 now, what will it be worth in 3 years?

Answer: £50

Solution:

$$\text{After 1 year} = 400 \times 0.5 = 200$$

$$\text{After 2 years} = 200 \times 0.5 = 100$$

$$\text{After 3 years} = 100 \times 0.5 = 50$$

Q275. A tank fills at a constant rate. After 4 minutes, it contains 80 litres. How much in 7 minutes?

Answer: 140 litres

Solution:

$$\text{Rate} = 80 \div 4 = 20 \text{ litres/min}$$

$$\text{In 7 minutes} = 20 \times 7 = 140 \text{ litres}$$

Q276. The side of a square increases by 50%. Find the percentage increase in area.

Answer: 125%

Solution:

$$\text{Let side} = 1, \text{ area} = 1^2 = 1$$

$$\text{New side} = 1.5, \text{ area} = 1.5^2 = 2.25$$

$$\text{Increase} = 2.25 - 1 = 1.25$$

$$\text{Percentage increase} = (1.25 \div 1) \times 100 = 125\%$$

Q277. Water flows at 6 litres per minute. How much flows in 45 minutes?

Answer: 270 litres

Solution:

$$\text{Flow} = \text{Rate} \times \text{Time}$$

$$= 6 \times 45$$

$$= 270 \text{ litres}$$

Q278. A graph shows the curve $y = \sqrt{x}$. Estimate the gradient at $x = 4$.

Answer: 0.25

Solution:

$$y = \sqrt{x}$$

$$dy/dx = 1 \div (2\sqrt{x})$$

$$\text{At } x = 4, dy/dx = 1 \div (2 \times 2) = 1 \div 4 = 0.25$$

Q279. X and Y are inversely proportional. If X = 6 and Y = 2, find Y when X = 3.

Answer: 4

Solution:

$$XY = k$$

$$6 \times 2 = 12$$

When $X = 3$, $3 \times Y = 12$

$$Y = 12 \div 3 = 4$$

Q280. A straight line has the equation $y = 4x - 1$. What is the rate of change of y with respect to x ?

Answer: 4

Solution:

Rate of change = Gradient

From $y = mx + c$, $m = 4$

So, rate of change = 4