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 ÷ Time

Speed = 180 ÷ 4 = 45 mph

Time = Distance ÷ Speed = 315 ÷ 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 × Hours Worked

Earnings = 13.50 × 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 ÷ 8 = 25 g

Flour for 30 cookies = 25 × 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 ÷ Volume

Density = 540 ÷ 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 ÷ 3 = 2.5 litres/hour

Leak in 8 hours = 2.5 × 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 ÷ 6 = 0.4 kg

Mass of 10 balls = 0.4 × 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 × 60 = 120 seconds
 Speed = Distance ÷ Time = 800 ÷ 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 ÷ 3 = 15
 Units in 8 hours = 15 × 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 ÷ Time
 Acceleration = (60 - 0) ÷ 8 = 60 ÷ 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 ÷ Hours
 Hourly rate = 270 ÷ 18 = £15/hour

Q11. Convert 1.75 hours into minutes.
 Answer: 105 minutes
 Solution:
 1 hour = 60 minutes
 1.75 × 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 ÷ Time = 40 ÷ 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 ÷ 2 = 42
Sand part = 5 × 42 = 210 kg

Q14. A bottle contains 1.5 litres of juice. How many millilitres is this?
Answer: 1500 ml
Solution:
1 litre = 1000 ml
1.5 × 1000 = 1500 ml

Q15. The pressure on a surface is 60 N/m² and the force is 1200 N. Find the area.
Answer: 20 m²
Solution:
Pressure = Force ÷ Area
Area = Force ÷ Pressure = 1200 ÷ 60 = 20 m²

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:
Mass = Density × Volume
Mass = 1.2 × 500 = 600 g

Q17. A bus travels 120 miles in 2.5 hours. What is its average speed?
Answer: 48 mph
Solution:
Speed = Distance ÷ Time
Speed = 120 ÷ 2.5 = 48 mph

Q18. Convert 2.4 km² to m².
Answer: 2,400,000 m²
Solution:
1 km² = 1,000,000 m²
2.4 × 1,000,000 = 2,400,000 m²

Q19. A person walks 6 km at 4 km/h. How long does the journey take?
Answer: 1.5 hours
Solution:
Time = Distance ÷ Speed
Time = 6 ÷ 4 = 1.5 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:

Total work = 6 × 10 = 60 man-days
Time for 4 men = 60 ÷ 4 = 15 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:
 Time = Distance ÷ Speed
 Time = 90 ÷ 60 = 1.5 hours
 Time in minutes = 1.5 × 60 = 90 minutes

Q22. Convert 0.85 m³ into litres.
 Answer: 850 litres
 Solution:
 1 m³ = 1000 litres
 0.85 × 1000 = 850 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:
 Total parts = 3 + 2 = 5
 Alcohol part = 2
 Volume of alcohol = (2 ÷ 5) × 750 = 300 mL

Q24. The area of a rectangle is 48 cm². If the length is 6 cm, what is the width?
 Answer: 8 cm
 Solution:
 Area = Length × Width
 Width = Area ÷ Length = 48 ÷ 6 = 8 cm

Q25. A cylinder has a height of 10 cm and volume of 942 cm³. Find the radius of the base (use π = 3.14).
 Answer: 5.48 cm
 Solution:
 Volume = $\pi r^2 h$
 942 = 3.14 × r² × 10
 942 ÷ 3.14 = r² × 10
 300 = r² × 10
 r² = 300 ÷ 10 = 30
 r = √30 ≈ 5.48 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:

 Basic pay = 40 × 15 = £600

 Overtime hours = 48 - 40 = 8

 Overtime pay = 8 × 22.50 = £180

 Total pay = 600 + 180 = £780

Q27. The density of a substance is 8.5 g/cm³. What volume is occupied by 255 g of the substance?

 Answer: 30 cm³

 Solution:

 Volume = Mass ÷ Density

 Volume = 255 ÷ 8.5 = 30 cm³

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 × 60 = 360

 Units per minute = 480 ÷ 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 ÷ 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 ÷ Time

 Speed = 180 ÷ 2.25 = 80 km/h

Q31. A cube has a volume of 125 cm³. What is the length of one side?

 Answer: 5 cm

 Solution:

 Volume of cube = side³

 side = $\sqrt[3]{125}$ = 5 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 ÷ 100) × 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 ÷ Time = 225 ÷ 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 ÷ 6 = £0.45

 Cost of 14 pencils = 0.45 × 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 ÷ 100 = 1.2 m

 Weight per metre = 2.4 ÷ 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 ÷ 6 = 7.5 litres

 Containers needed = 7.5 ÷ 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 ÷ 3.33 ≈ 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 × 8 = 9.6 m²

1 m² = 10000 cm²
Area = 9.6 × 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 ÷ 90 = 0.0667 litres/km
 Fuel for 150 km = 0.0667 × 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:
 Flour per person = 300 ÷ 4 = 75 g
 Flour for 10 people = 75 × 10 = 750 g

Q41. A box of cereal weighs 750 g. Convert this to kilograms.
 Answer: 0.75 kg
 Solution:
 1 kilogram = 1000 grams
 Weight in kg = 750 ÷ 1000 = 0.75 kg

Q42. The exchange rate is £1 = €1.18. How many euros would you get for £250?
 Answer: €295
 Solution:
 Euros = Pounds × Exchange rate
 Euros = 250 × 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:
 Increase = 3% of 12000 = (3 ÷ 100) × 12000 = 360
 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:
 Units per hour = 240 ÷ 8 = 30 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:

Convert kg to g: 1.5 kg = 1500 g
Number of jars = 1500 ÷ 250 = 6 jars

Q46. A boat travels 84 miles downstream in 4 hours. What is the speed of the boat?
 Answer: 21 mph
 Solution:
 Speed = Distance ÷ Time
 Speed = 84 ÷ 4 = 21 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:
 Total parts = 5 + 4 = 9
 Girls part = 4
 Girls = (4 ÷ 9) × 36 = 16

Q48. A tank has a volume of 0.75 m³. Convert this to litres.
 Answer: 750 litres
 Solution:
 1 m³ = 1000 litres
 Litres = 0.75 × 1000 = 750 litres

Q49. A person cycles at 15 km/h for 2.5 hours. How far do they travel?
 Answer: 37.5 km
 Solution:
 Distance = Speed × Time
 Distance = 15 × 2.5 = 37.5 km

Q50. A rectangular room is 5 m by 4.5 m. What is the area in square centimetres?
 Answer: 225,000 cm²
 Solution:
 Area in m² = 5 × 4.5 = 22.5 m²
 1 m² = 10,000 cm²
 Area in cm² = 22.5 × 10000 = 225,000 cm²

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:
 Total time = 3 hours = 3 × 60 = 180 minutes
 Rate = Total volume ÷ Time
 Rate = 180 litres ÷ 180 minutes = 1 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 hour 20 minutes = 1 + 20/60 = 1.333... hours

Speed = Distance ÷ Time

Speed = 36 km ÷ 1.333... h = 27 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:

Fuel consumption = Distance ÷ Fuel used

Fuel consumption = 150 miles ÷ 12 gallons = 12.5 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 × (1000 ÷ 3600) = 72 × (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 × 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 × Volume

Mass = 7.8 g/cm³ × 250 cm³ = 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 ÷ Volume

Density = 2.5 kg ÷ 0.0005 m³ = 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 ÷ Area

Area = Force ÷ Pressure
Area = 300 N ÷ 50 N/m² = 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 × Days = 5 × 12 = 60 worker-days
 Days = Work ÷ Workers = 60 ÷ 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 g ÷ 8 = 30 g
 For 5 servings = 30 g × 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:
 Cost per kg = £19.25 ÷ 7 = £2.75
 Cost of 3.5 kg = 3.5 × £2.75 = £9.625 ≈ £9.63

Q62. A car travels 40 km in 32 minutes. Calculate its speed in km/h.
 Answer: 75 km/h
 Solution:
 Time in hours = 32 ÷ 60 = 0.533... hours
 Speed = Distance ÷ Time
 Speed = 40 ÷ 0.533... = 75 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:
 Acceleration = (Final speed - Initial speed) ÷ Time
 Acceleration = (40 - 20) ÷ 5 = 20 ÷ 5 = 4 m/s²

Q64. Divide £84 between A and B in the ratio 5:7.
 Answer: A gets £35, B gets £49
 Solution:
 Total parts = 5 + 7 = 12
 A's share = (5/12) × 84 = £35
 B's share = (7/12) × 84 = £49

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

Answer: 60 ml and 210 ml

Solution:

Total parts = 2 + 7 = 9

First part = (2/9) × 270 = 60 ml

Second part = (7/9) × 270 = 210 ml

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

Answer: 4:15

Solution:

Whole = 4 + 11 = 15

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 (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:

Total parts = 3 + 2 = 5

Juice = (3/5) × 1.25 = 0.75 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:

Total parts = 3 + 5 = 8

Girls = (3/8) × 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:

Actual distance = 8 × 25,000 = 200,000 cm

Convert to km: 200,000 ÷ 100,000 = 2 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:

Actual length = 4.2 m = 420 cm
Model length = 420 ÷ 20 = 21 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:

Area scale factor = (Linear scale factor)² = (1.5)² = 2.25
New area = 48 × 2.25 = 108 cm²

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:

Surface area scale factor = (Scale factor)² = (2)² = 4
New surface area = 150 × 4 = 600 cm²

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 ÷ 3 = 0.666... litres
Orange juice = 5 × 0.666... = 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 × 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 × 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 × 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 ÷ 150) × 100 = 20%

Q79. A value reduces from 260 to 208. Calculate the percentage decrease.
 Answer: 20%
 Solution:
 Decrease = 260 - 208 = 52
 % Decrease = (52 ÷ 260) × 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 ÷ Time = 160 ÷ 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:
 Total parts = 5 + 7 = 12
 First share = (5/12) × 1.2 = 0.5 kg
 Second share = (7/12) × 1.2 = 0.7 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:
 Total parts = 2 + 3 + 7 = 12
 First = (2/12) × 96 = £16
 Second = (3/12) × 96 = £24
 Third = (7/12) × 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 parts = 24 ⇒ 1 part = 24 ÷ 3 = 8
 5 parts = 8 × 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:

 Let girls = 100, boys = 60

 Total = 100 + 60 = 160

 Fraction of boys = 60 ÷ 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 × 4 = 8:12

 4:5 × 3 = 12:15

 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:

 Total parts = 1 + 3 = 4

 Smaller share = 1 part ⇒ Fraction = 1/4

Q87. The mass of sugar in a mixture is 120 g, which is 3/5 of the total mass. What is the total mass?

 Answer: 200 g

 Solution:

 Total mass = 120 ÷ (3/5) = 120 × (5/3) = 200 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:

 Total parts = 2 + 5 + 3 = 10

 Green = (3/10) × 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 parts = 28 cm ⇒ 1 part = 7 cm

 Height = 3 × 7 = 21 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:

 Actual distance = 12 × 100,000 = 1,200,000 cm

 Convert to km: 1,200,000 ÷ 100,000 = 12 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 parts = 300 ml ⇒ 1 part = 75 ml

 Acid = 1 part = 75 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:

 Area of 1 tile = 30 × 30 = 900 cm² = 0.09 m²

 Number of tiles = 9 ÷ 0.09 = 100 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 hours = 300 minutes

 Items per minute = 320 ÷ 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 ÷ 12 = 0.333... minutes

 Time for 54 = 54 × 0.333... = 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 ÷ 12 = 25 g

 Flour for 30 = 25 × 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 × 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) × 84 = 36

Q98. A train travels 180 miles in 3 hours. What is its average speed?
 Answer: 60 mph
 Solution:
 Speed = 180 ÷ 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 ÷ 1200) × 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 × 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 ÷ 3 = 160 g
 Sugar = 2 parts = 160 × 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 × 50,000 = 375,000 cm
Convert to km:
375,000 ÷ 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 ÷ 15 = 12

Q104. If the pressure exerted by a force of 400 N on a surface is 80 N/m², find the area of the surface.
 Answer: 5 m²
 Solution:
 Pressure = Force ÷ Area
 Rearranged: Area = Force ÷ Pressure
 Area = 400 ÷ 80 = 5 m²

Q105. The density of a metal is 8.4 g/cm³. Calculate the mass of a 250 cm³ block of the metal.
 Answer: 2,100 g
 Solution:
 Density = Mass ÷ Volume
 Rearranged: Mass = Density × Volume
 Mass = 8.4 × 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 ÷ Speed
 Time = 225 ÷ 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 ÷ 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 × 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 × 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 ∝ (side length)²

 √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 × Days

 3 × 10 = 30 worker-days

 Days for 5 workers = 30 ÷ 5 = 6 days

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

 Answer: 30%

 Solution:

 Increase = 312 - 240 = 72

 Percentage increase = (72 ÷ 240) × 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:

 Water = 5 parts = 150 ml

 1 part = 150 ÷ 5 = 30 ml

 Acid = 2 parts = 30 × 2 = 60 ml

Q114. Express 72 as a percentage of 300.
 Answer: 24%
 Solution:
(72 ÷ 300) × 100 = 0.24 × 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:
 Year 1: 25,000 × 1.08 = 27,000
 Year 2: 27,000 × 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:
 Initial speed = 60 km/h = 16.67 m/s
 Final speed = 90 km/h = 25 m/s
 Acceleration = (25 - 16.67) ÷ 10 = 8.33 ÷ 10 = 0.83 m/s²

Q117. A machine produces 360 units in 45 minutes. What is its production rate in units per hour?
 Answer: 480 units/hour
 Solution:
 360 units in 45 minutes
 1 minute = 360 ÷ 45 = 8 units
 60 minutes = 8 × 60 = 480 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:
 Girls : Boys = 5 : 6
 1 part = 22 ÷ 5 = 4.4
 Boys = 6 × 4.4 = 26.4

Q119. The pressure on a surface is 100 N/m² and the area is 0.5 m². Calculate the force exerted.
 Answer: 50 N
 Solution:
 Pressure = Force ÷ Area
 Rearranged: Force = Pressure × Area
 Force = 100 × 0.5 = 50 N

Q120. Convert a speed of 90 km/h to metres per second.
 Answer: 25 m/s
 Solution:
 1 km = 1,000 m; 1 hour = 3,600 seconds
 Speed = (90 × 1,000) ÷ 3,600 = 90,000 ÷ 3,600 = 25 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:
 Rate of first pipe = 1 ÷ 4 = 0.25
 Rate of second pipe = 1 ÷ 6 ≈ 0.1667
 Combined rate = 0.25 + 0.1667 = 0.4167
 Time = 1 ÷ 0.4167 ≈ 2.4 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:
 Sale price = 70% of original
 0.7x = 56
 x = 56 ÷ 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:
 Fuel efficiency = Distance ÷ Fuel
 = 180 ÷ 12 = 15 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:
 Total parts = 3 + 4 = 7
 1 part = 56 ÷ 7 = 8
 Red = 3 × 8 = 24

Q125. A company's revenue increases from £50,000 to £65,000. What is the percentage increase?
 Answer: 30%
 Solution:

Increase = 65,000 - 50,000 = 15,000
Percentage increase = (15,000 ÷ 50,000) × 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:
 Speed = Distance ÷ Time
 Speed = 180 ÷ 2.25 = 80 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:
 Total parts = 2 + 3 = 5
 1 part = 25 ÷ 5 = 5 litres
 Oil = 3 × 5 = 15 litres

Q128. A student scored 18 out of 30 in a test. Express the score as a percentage.
 Answer: 60%
 Solution:
 (18 ÷ 30) × 100 = 0.6 × 100 = 60%

Q129. A pair of shoes originally cost £80. After a 15% discount, what is the new price?
 Answer: £68
 Solution:
 Discount = 0.15 × 80 = £12
 New price = 80 - 12 = £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:
 Density = Mass ÷ Volume
 Density = 5.6 ÷ 0.007 = 800 kg/m³

Q131. Two quantities are in the ratio 7:5. If the larger quantity is 49, find the smaller.
 Answer: 35
 Solution:
 Larger = 7 parts = 49
 1 part = 49 ÷ 7 = 7
 Smaller = 5 × 7 = 35

Q132. A factory produces 1200 items in 5 hours. How many items are produced per minute?
 Answer: 4 items/minute
 Solution:
 5 hours = 5 × 60 = 300 minutes
 Items per minute = 1200 ÷ 300 = 4

Q133. A cyclist covers 24 km in 1.5 hours. What is the average speed?
 Answer: 16 km/h
 Solution:
 Speed = Distance ÷ Time
 Speed = 24 ÷ 1.5 = 16 km/h

Q134. A population of 18,000 grows by 5% per year. Find the population after one year.
 Answer: 18,900
 Solution:
 Increase = 0.05 × 18,000 = 900
 New population = 18,000 + 900 = 18,900

Q135. Express 9:4 as a fraction of the whole.
 Answer: 9/13
 Solution:
 Total parts = 9 + 4 = 13
 Fraction = 9 ÷ 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:
 Total parts = 3 + 7 = 10
 1 part = 84 ÷ 10 = 8.4 litres
 Alcohol = 3 × 8.4 = 25.2 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:
 Depreciation = 0.10 × 18,000 = 1,800
 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:

Area ∝ (side length)²
Scale factor = 3² = 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 hours 30 minutes = 6.5 hours
 Cost = 15 × 6.5 = £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 hours 36 minutes = 3.6 hours
 Speed = 144 ÷ 3.6 = 40 mph

Q141. A £40 shirt is reduced by 35% in a sale. What is the sale price?
 Answer: £26
 Solution:
 Discount = 0.35 × 40 = 14
 Sale price = 40 - 14 = £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 ÷ 25 = 16 teachers

Q143. A quantity increases from 320 to 400. What is the percentage increase?
 Answer: 25%
 Solution:
 Increase = 400 - 320 = 80
 Percentage increase = (80 ÷ 320) × 100 = 25%

Q144. A 2.5 m³ container is filled with a liquid. Convert this volume into litres.
 Answer: 2,500 litres
 Solution:
 1 m³ = 1,000 litres
 2.5 m³ = 2.5 × 1,000 = 2,500 litres

Q145. A loan of £5,000 accumulates simple interest at 6% per annum. What is the interest after one year?
 Answer: £300

Solution:
Interest = Principal × Rate × Time
Interest = 5,000 × 0.06 × 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:
Speed = 84 ÷ 3 = 28 km/h
Time = 56 ÷ 28 = 2 hours
2 hours = 2 × 60 = 120 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:
Zinc = 3 parts = 120 g
1 part = 120 ÷ 3 = 40 g
Copper = 5 × 40 = 200 g

Q148. A company's profit falls from £240,000 to £192,000. Calculate the percentage decrease.
Answer: 20%
Solution:
Decrease = 240,000 - 192,000 = 48,000
Percentage decrease = (48,000 ÷ 240,000) × 100 = 20%

Q149. A car travels 120 km in 80 minutes. Calculate the speed in km/h.
Answer: 90 km/h
Solution:
80 minutes = 80 ÷ 60 = 1.33 hours
Speed = 120 ÷ 1.33 ≈ 90 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:
Total parts = 5 + 7 = 12
1 part = 9600 ÷ 12 = 800
Children = 7 × 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 ÷ 1.12 = £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
 Speed = 150 ÷ 1.667 ≈ 90 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 ÷ Area
 Pressure = 900 ÷ 3 = 300 N/m²

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 km = 2,500 × 100 = 250,000 cm
 Map distance = 250,000 ÷ 25,000 = 10 cm

Q155. A £90 jacket is increased in price by 20%. What is the new price?
 Answer: £108
 Solution:
 Increase = 0.20 × 90 = £18
 New price = 90 + 18 = £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:
 Fuel consumption = 650 ÷ 50 = 13 km/litre

Q157. A 3:2 ratio of boys to girls represents 45 children. How many are girls?
 Answer: 18
 Solution:
 Total parts = 3 + 2 = 5
 1 part = 45 ÷ 5 = 9
 Girls = 2 × 9 = 18

Q158. A speed of 20 m/s is equivalent to how many km/h?
 Answer: 72 km/h

Solution:
1 m/s = 3.6 km/h
20 × 3.6 = 72 km/h

Q159. If a 15% tip is added to a £60 bill, what is the total amount paid?
 Answer: £69
 Solution:
Tip = 0.15 × 60 = £9
Total = 60 + 9 = £69

Q160. A student earns £12 per hour. How much will they earn in a 37.5-hour week?
 Answer: £450
 Solution:
Earnings = 12 × 37.5 = £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:
Alcohol = 1 part = 1.2 L
1 part = 1.2
Water = 4 × 1.2 = 4.8 litres

Q162. A phone is reduced by 30% in a sale and now costs £350. What was the original price?
 Answer: £500
 Solution:
70% of original = 350
0.7x = 350
x = 350 ÷ 0.7 = £500

Q163. A lorry travels 360 km in 4.5 hours. Find the average speed.
 Answer: 80 km/h
 Solution:
Speed = 360 ÷ 4.5 = 80 km/h

Q164. A cylinder has a volume of 0.75 m³. Convert this volume into litres.
 Answer: 750 litres
 Solution:
1 m³ = 1,000 litres
0.75 × 1,000 = 750 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 ÷ 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 ÷ 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 ÷ (1/3) = 1.8 × 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 ÷ Volume
Density = 4.5 ÷ 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 ÷ 480) × 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 × 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 × 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:
 Interest = 2,000 × 0.05 × 1 = £100
 Total value = 2,000 + 100 = £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:
 GCD of 24 and 16 = 8
 24 ÷ 8 = 3
 16 ÷ 8 = 2
 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:
 Current value = 82% of original
 0.82x = 12,300
 x = 12,300 ÷ 0.82 = £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:
 Area ∝ base × height
 Area scale factor = 3 × 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:
 Work = Workers × Days = 4 × 15 = 60
 New time = 60 ÷ 6 = 10 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 hours 30 minutes = 2.5 hours
 Distance = Speed × Time = 84 × 2.5 = 210 km

Q178. A map distance of 4 cm represents 1.2 km. What is the map scale?
 Answer: 1:30,000
 Solution:
 1.2 km = 120,000 cm
 Scale = 120,000 ÷ 4 = 30,000
 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 minutes = 1.5 hours
 Rate = 72 ÷ 1.5 = 48 parts/hour
 4 hours = 48 × 4 = 192 parts

Q180. A discount of 20% is applied to a price of £350. What is the final amount?
 Answer: £280
 Solution:
 Discount = 0.20 × 350 = £70
 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:
 Mass = Density × Volume = 7.2 × 300 = 2,160 g

Q182. A student's mark improves from 64 to 80. What is the percentage increase?
 Answer: 25%
 Solution:
 Increase = 80 - 64 = 16
 Percentage increase = (16 ÷ 64) × 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:
 Total parts = 5 + 3 = 8
 1 part = 64 ÷ 8 = 8
 Dogs = 3 × 8 = 24

Q184. A bicycle is bought for £240 and sold for £180. What is the percentage loss?
 Answer: 25%
 Solution:
 Loss = 240 - 180 = £60
 Percentage loss = (60 ÷ 240) × 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:

 Total parts = 2 + 3 + 5 = 10

 1 part = 1 ÷ 10 = 0.1 kg

 Ingredients = 2 × 0.1 = 0.2 kg, 3 × 0.1 = 0.3 kg, 5 × 0.1 = 0.5 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 × 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 ÷ 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 × 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 × 10,000 = 48,000 m²

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

 Answer: £28,800

 Solution:

 Annual salary = 2400 × 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 ÷ 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 ÷ Volume = 250 ÷ 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:
Increase = 120 - 80 = 40
Percentage increase = (40 ÷ 80) × 100 = 50%

Q194. A shop buys items at £3 each and sells them at £5. What is the percentage profit?
 Answer: 66.67%
 Solution:
Profit = 5 - 3 = £2
Percentage profit = (2 ÷ 3) × 100 ≈ 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:
Current = 110% of original
1.1x = 1,100
x = 1,100 ÷ 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:
Area scale factor = 2² = 4
New area = 120 × 4 = 480 cm²

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:
Weekday pay = 35 × 11 = £385
Weekend pay = 8 × 15 = £120
Total = 385 + 120 = £505

Correction:
 Answer: £505

Q198. A population decreased from 30,000 to 24,000. Find the percentage decrease.
 Answer: 20%
 Solution:
 Decrease = 30,000 - 24,000 = 6,000
 Percentage decrease = (6,000 ÷ 30,000) × 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:
 Distance = (40 ÷ 8) × 100 = 5 × 100 = 500 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 cost = 120 × 0.10 = £12
 Total = 15 + 12 = £27

Q201. A cyclist covers 72 km in 3 hours. What is their average speed in km/h?
 Answer: 24 km/h
 Solution:
 Average speed = Distance ÷ Time
 = 72 ÷ 3
 = 24 km/h

Q202. A worker earns £9.80 per hour. How much will they earn for working 42 hours?
 Answer: £411.60
 Solution:
 Earnings = Rate of pay × Hours worked
 = 9.80 × 42
 = £411.60

Q203. A shop sells 5 apples for £1.45. Find the unit price for one apple.
 Answer: £0.29
 Solution:
 Unit price = Total cost ÷ Number of apples
 = 1.45 ÷ 5
 = £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:

Density = Mass ÷ Volume
= 450 ÷ 150
= 3 g/cm³

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:
Pressure = Force ÷ Area
= 600 ÷ 0.5
= 1200 N/m²

Q206. A cube has side length 6 cm. What is its volume?
Answer: 216 cm³
Solution:
Volume = Side³
= 6³
= 216 cm³

Q207. Two similar rectangles have lengths in the ratio 2:5. What is the ratio of their areas?
Answer: 4:25
Solution:
Area ratio = (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:
Area scale factor = (Side scale factor)²
= 3²
= 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:
Volume scale factor = (Radius scale factor)³
Let radius scale factor = x
Then x³ = 4
x = $\sqrt[3]{4}$
x ≈ 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:

 Height ratio = 5:15 = 1:3

 Volume ratio = (Height ratio)³

 = 1³ : 3³

 = 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√3 ≈ 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°)

 tan(30°) = opposite / adjacent

 tan(30°) = 6 / x

 x = 6 / tan(30°)

 x ≈ 6 / 0.577

 x ≈ 10.39 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

 $\cos(\theta)$ = adjacent ÷ hypotenuse

 $\cos(\theta)$ = 5 ÷ 13

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

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

 $\theta \approx 67.4°$

 Alternatively, if side is opposite:

 $\sin(\theta)$ = 5 ÷ 13

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

 $\theta \approx 22.6°$

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 × 4 = k

 k = 40

 So, X = 40 ÷ 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 × 3

k = 3

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 × Time

= 60 × 2 = 120 miles

New time = Distance ÷ New speed

= 120 ÷ 40

= 3 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 × Workers = Constant

4 × 6 = 24

8 × t = 24

t = 24 ÷ 8

t = 3 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 ÷ change in x

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

Gradient = (10 - (-2)) ÷ (4 - 2) = 12 ÷ 2 = 6

Q220. Find the average rate of change between x = 1 and x = 5 for the function y = x².

Answer: 8

Solution:

$y = x^2$

At x = 1, y = 1² = 1

At x = 5, y = 5² = 25

Average rate of change = (25 - 1) ÷ (5 - 1) = 24 ÷ 4 = 6

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

Answer: 562.43

Solution:

Population = 500 × (1.04)³

= 500 × 1.124864

≈ 562.43

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:

Value = 500 × (0.97)⁵

= 500 × 0.85873

≈ £429.27

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

Answer: £220.50

Solution:

Value = 200 × (1.05)²

= 200 × 1.1025

= £220.50

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:
Year 1: 10,000 × 1.025 = 10,250
Year 2: 10,250 × 1.025 = 10,506.25
Year 3: 10,506.25 × 1.025 = 10,768.91
Year 4: 10,768.91 × 1.025 = 11,038.13

Q225. Use iteration to solve x = √(10 + x), starting with x_0 = 2. Perform three steps.
Answer: Step 1: 3.464, Step 2: 3.605, Step 3: 3.620
Solution:
x_1 = √(10 + 2) = √12 ≈ 3.464
x_2 = √(10 + 3.464) = √13.464 ≈ 3.670
x_3 = √(10 + 3.670) = √13.670 ≈ 3.696

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(θ) = opposite ÷ hypotenuse
sin(70°) = height ÷ 5
height = 5 × sin(70°)
height ≈ 5 × 0.9397
height ≈ 4.6985 ≈ 4.70 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:
Real height = Model height × Scale factor
= 6 × 50
= 300 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:

Side ratio = 4:10 = 2:5
Area ratio = (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:
 Pressure = Force ÷ Area
 Force = Pressure × Area
 = 2000 × 0.5
 = 1000 N

Q231. A car travels 120 km in 1.5 hours. Calculate its speed in m/s.
 Answer: 22.22 m/s
 Solution:
 Speed = Distance ÷ Time
 Convert km to m: 120 km = 120000 m
 Convert hours to seconds: 1.5 hours = 5400 s
 Speed = 120000 ÷ 5400
 = 22.22 m/s

Q232. If density is 7.8 g/cm³ and the volume is 250 cm³, find the mass.
 Answer: 1950 g
 Solution:
 Mass = Density × Volume
 = 7.8 × 250
 = 1950 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 litres / 100 km = x litres / 350 km
 x = (8 × 350) ÷ 100
 x = 2800 ÷ 100
 x = 28 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 ÷ 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:
 Volume scale factor = (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:
 Surface area ratio = (Height ratio)²
 Let height ratio = x
 x^2 = 1:9
 x = √(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:
 Gradient = (Change in y) ÷ (Change in x)
 = (11 - 2) ÷ (3 - 0)
 = 9 ÷ 3
 = 3

Q239. Find the gradient of the curve y = x² 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)
 Gradient = (15 - 3) ÷ (4 - 2)
 = 12 ÷ 2
 = 6

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) ÷ (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 ≈ 13.41 m/s

50 mph ≈ 22.35 m/s

Acceleration = (Final speed - Initial speed) ÷ Time

= (22.35 - 13.41) ÷ 10

= 8.94 ÷ 10

= 0.894 m/s² ≈ 0.89 m/s²

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:

6000 litres = 6 m³

Volume = length × width × height

6 = 2 × 1.5 × height

6 = 3 × height

height = 6 ÷ 3

height = 2 m

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

Answer: £30,000

Solution:

Annual income = Monthly income × 12

= 2500 × 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:

Rate = Total pay ÷ Hours

= 150 ÷ 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:

 $\sin(\theta)$ = opposite ÷ hypotenuse

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

 $\sin(\theta) = 0.5$

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

 $\theta = 30°$

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 = x³.

 Answer: 12

 Solution:

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

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

 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:

 Value after 5 years = 200 × 3 = 600

 Value after 10 years = 600 × 3 = 1800

Or directly:
Value = 200 × 3² = 200 × 9 = £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:
 Value after 1 year = 12000 × 0.85 = 10200
 Value after 2 years = 10200 × 0.85 = 8670
 Value after 3 years = 8670 × 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:
 Value = 150000 × $(1.02)^6$
 = 150000 × 1.126162
 ≈ £159,327.63

Q253. Find the unit cost of 7 pencils costing £3.15.
 Answer: £0.45
 Solution:
 Unit cost = 3.15 ÷ 7
 = £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:
 Density = Mass ÷ Volume
 = 5.2 ÷ 2.5
 = 2.08 kg/m³

Q255. Explain how pressure changes when force increases but area remains constant.
 Answer: Pressure increases
 Solution:
 Pressure = Force ÷ 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:

Population after 1 year = 8000 × 1.015 = 8120
Population after 2 years = 8120 × 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 × $(1 + r)^2$
1.1 = $(1 + r)^2$
√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:
Increase = 4.5 × 0.6 = 2.7
New length = 4.5 + 2.7 = 7.2 m

Q259. A company makes 5 widgets in 2 hours. How many widgets in 10 hours?
 Answer: 25 widgets
 Solution:
Widgets per hour = 5 ÷ 2 = 2.5
Widgets in 10 hours = 2.5 × 10 = 25

Q260. A straight line passes through (1, 2) and (4, 8). Find its gradient.
 Answer: 2
 Solution:
Gradient = (8 - 2) ÷ (4 - 1)
= 6 ÷ 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 θ = 0.6. Find θ.
 Answer: 36.87°
 Solution:

$\theta = \sin^{-1}(0.6)$
$\theta \approx 36.87°$

Q263. A line has gradient 4. What is the change in y when x increases by 3?
Answer: 12
Solution:
Change in y = Gradient × Change in x
= 4 × 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:
New area = Original area × (2^2)
= 4 × 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:
Volume ratio = (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:
Speed = Distance ÷ Time
= 250 ÷ 3.5
= 71.43 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 × 0.8 = 1.6
Third bounce = 1.6 × 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 × $(1.03)^n$ ≥ 1.10 × Initial

 $(1.03)^n$ ≥ 1.10

 n ≈ log(1.10) ÷ log(1.03) ≈ 0.0414 ÷ 0.0128 ≈ 3.23

 So, after 4 years

Q270. Estimate the gradient of y = x² + 1 at x = 2 using a tangent.

 Answer: 4

 Solution:

 y = x² + 1

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

 Tangent gradient ≈ derivative = dy/dx = 2x

 At x = 2, dy/dx = 2 × 2 = 4

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

 Answer: Acceleration

 Solution:

 Gradient = Change in speed ÷ 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 ÷ Time

 = 240 ÷ 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 × Scale

 = 7 × 100

 = 700 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:

 After 1 year = 400 × 0.5 = 200

After 2 years = 200 × 0.5 = 100
After 3 years = 100 × 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:
 Rate = 80 ÷ 4 = 20 litres/min
 In 7 minutes = 20 × 7 = 140 litres

Q276. The side of a square increases by 50%. Find the percentage increase in area.
 Answer: 125%
 Solution:
 Let side = 1, area = 1² = 1
 New side = 1.5, area = 1.5² = 2.25
 Increase = 2.25 - 1 = 1.25
 Percentage increase = (1.25 ÷ 1) × 100 = 125%

Q277. Water flows at 6 litres per minute. How much flows in 45 minutes?
 Answer: 270 litres
 Solution:
 Flow = Rate × Time
 = 6 × 45
 = 270 litres

Q278. A graph shows the curve y = √x. Estimate the gradient at x = 4.
 Answer: 0.25
 Solution:
 y = √x
 dy/dx = 1 ÷ (2√x)
 At x = 4, dy/dx = 1 ÷ (2 × 2) = 1 ÷ 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 × 2 = 12
 When X = 3, 3 × Y = 12
 Y = 12 ÷ 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