

# Ratios

- 1 Eve is making a bird house. To make the walls, she takes a piece of wood and cuts it into four pieces in the ratio 5 : 6 : 6 : 7. The longest wall is 9 cm longer than the shortest wall.



How long was the original piece of wood?

..... cm

[Total 3 marks]

- 2 Hannah is making some green paint to paint her kitchen wall. She makes it by mixing together  $3\frac{3}{4}$  tins of yellow paint and  $1\frac{1}{2}$  tins of blue paint. The tins are all the same size.



a) Express this ratio in its simplest form.

.....

[2]

b) How much of each paint will Hannah need to make 2800 ml of green paint?

yellow paint ..... ml

blue paint ..... ml

[2]

[Total 4 marks]

- 3 Edmund, Susan and Peter shared £150 in the ratio  $(4x + 10) : (2x + 5) : (5x + 3)$ .




How much money did each person get?

Edmund: £ .....

Susan: £ .....

Peter: £ .....

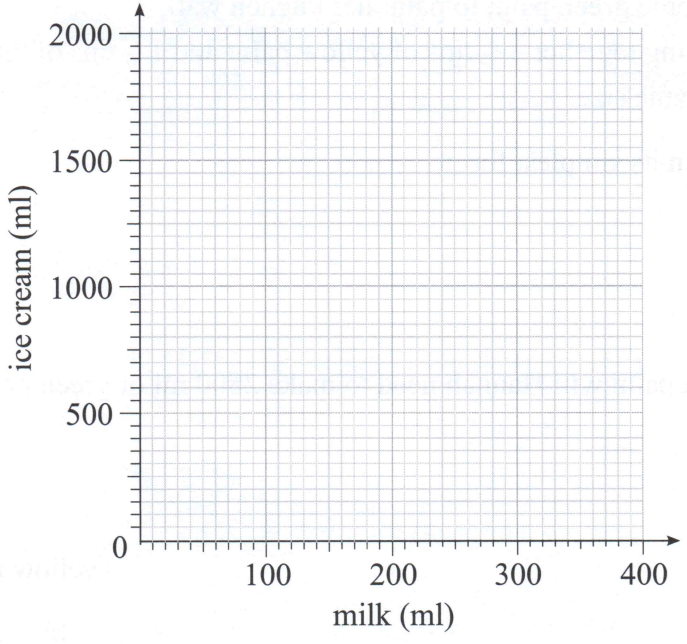
[Total 4 marks]

4 Chocolate milkshake is made by mixing milk and ice cream in the ratio 2 : 9. 


a) Give the amount of milk used as a fraction of the ice cream used.  
.....  
[1]

b) How much milkshake is made if 801 ml of ice cream are used?  
..... ml  
[2]

c) On the axes below, draw a graph that can be used to work out the amount of ice cream needed, given the amount of milk used.



[2]  
[Total 5 marks]

5 Mr Appleseed's Supercompost is made by mixing soil, compost and grit in the ratio 4 : 3 : 1.   
Soil costs £8 per 40 kg, compost costs £15 per 25 kg and grit costs £12 per 15 kg.

How much profit will be made if 16 kg of Mr Appleseed's Supercompost is sold for £10?  
.....  
£ .....  
[Total 5 marks]

6

In the morning a baker makes  $x$  muffins and  $y$  pastries.  
After selling 5 muffins and 3 pastries, the ratio of muffins to pastries is 5 : 8.  
He then makes 10 more of each item and the ratio becomes 5 : 7.

GRADE 6

Find the values of  $x$  and  $y$ .

$x - \dots : y - \dots = 5:8$  and  $x + \dots : y + \dots = 5:7$

$\frac{\dots - \dots}{\dots - \dots} = \frac{5}{8}$  and  $\frac{\dots + \dots}{\dots + \dots} = \frac{5}{7}$

$8(\dots - \dots) = 5(\dots - \dots)$  and  $7(\dots + \dots) = 5(\dots + \dots)$

Expand and simplify to give  $\dots x - \dots y = 25$  [1] and  $\dots x - \dots y = 0$  [2]

[1] – [2]:  $x = \dots$

Substitute  $x = \dots$  into [1]:  $(\dots \times \dots) - \dots y = 25$

$\dots y = \dots$ , so  $y = \dots$

$x = \dots$

$y = \dots$

[Total 5 marks]

7

Fabio has a large jar containing only black and green olives.  
The probability of randomly choosing a black olive from the jar is  $\frac{5}{16}$ .  
After eating 1 green and 3 black olives the probability of choosing a black olive is  $\frac{3}{10}$ .

GRADE 8

How many black and green olives were originally in the jar?

Start by finding the ratios of black to green olives before and after he eats some — careful though, the original ratio of black:green isn't 5:16.

Black olives:  $\dots$

Green olives:  $\dots$

[Total 6 marks]


**Exam Practice Tip**  
Ratio questions that include a changing ratio can be tough — you'll often need to set up a pair of equations and solve them simultaneously. Luckily you can always use the same method to do this. Write the ratios as equations, turn the ratios into fractions, multiply out the fractions and solve the equations simultaneously.

**Score**  
  
**32**






# Direct and Inverse Proportion

- 1
- Ishmael is making some t-shirts. It takes 5 m<sup>2</sup> of cotton to make 8 t-shirts.  
2 m<sup>2</sup> of cotton costs £5.50.
- 


How much will it cost Ishmael to buy enough cotton to make 85 t-shirts?

£ .....  
[Total 4 marks]

- 2
- Neil and Sophie are harvesting some crops. Sophie needs to harvest  
three times as many crops as Neil but she can harvest them twice as quick.
- 

Neil takes 3.5 hours to harvest his crops. How long does Sophie take to harvest her crops?

..... hours  
[Total 3 marks]

- 3
- Elijah runs a go-kart track. It takes 12 litres of petrol to  
race 8 go-karts for 20 minutes. Petrol costs £1.37 per litre.
- 


a) 6 go-karts used 18 litres of petrol. How many minutes did they race for?

..... minutes  
[4]

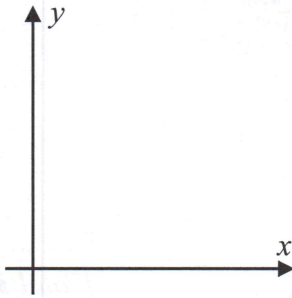
b) How much does the petrol cost to run 8 go-karts for 45 minutes?

£ .....  
[3]  
[Total 7 marks]

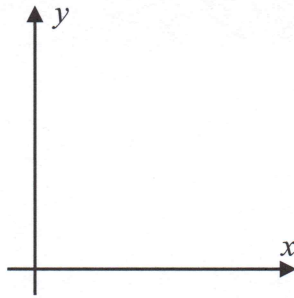


- 4 Sketch the following proportions on the axes below them. 

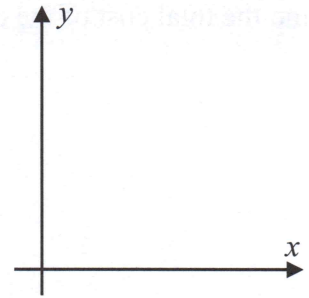
$y$  is proportional to  $x$




$y \propto \frac{1}{x}$



$y = kx^3$



[Total 3 marks]

- 5 The gravitational force,  $f$ , between two objects is inversely proportional to the square of the distance,  $d$ , between them. When  $d = 100$ ,  $f = 20$ . 


Write an equation connecting  $f$  and  $d$  and use it to find the value of  $f$  when  $d = 800$ .

$f = \dots\dots\dots$   
[Total 3 marks]

- 6 Round a bend on a railway track the height difference ( $h$  mm) between the outer and inner rails must vary in direct proportion to the square of the maximum permitted speed ( $S$  km/h).

- a) When  $S = 50$ ,  $h = 35$ . Calculate  $h$  when  $S = 40$ . 

$h = \dots\dots\dots$   
[3]

- b) The maximum speed on a bend is to be increased by 30%. What will be the percentage increase in the height difference between the outer and inner rails? 

$\dots\dots\dots\%$   
[4]  
[Total 7 marks]

Score:     
**27**

# Percentages

- 1 A computer costs £927 plus VAT, where VAT is charged at 20%.  
Find the total cost of the computer.



£ .....  
[Total 3 marks]

- 2 The ratio of grapes to cherries in a fruit salad is 2 : 5.  
Circle the correct statement below.



There are 50% more cherries than grapes.  
There are 20% as many grapes as cherries.

There are 80% more cherries than grapes.  
There are 40% as many grapes as cherries.

[Total 1 mark]

- 3 After an 8% pay rise Mr Brown's salary was £15 714.



What was his salary before the increase?

£ .....  
[Total 3 marks]


- 4 Jane has an annual salary of £45 000 before tax.



She pays no tax on the first £10 000 of her income — this is her tax-free allowance.  
She pays tax at 20% on any income between £10 000 and £41 865,  
and at 40% on any income over £41 865.

What percentage of her £45 000 annual salary does Jane pay in tax?  
Give your answer to 1 decimal place.

..... %  
[Total 4 marks]


5 In a pet rescue shelter, 50% of the animals are cats and 40% of the cats are black. 

a) What percentage of the animals at the shelter are black cats?

..... %  
[2]


b) There are 90 animals at the shelter, how many are not black cats?

.....  
[2]  
[Total 4 marks]

6 Ian makes and sells lobster pots. He sells them for £32 per pot which is a 60% profit on the cost of the materials. He wants to increase his profit to 88%. 

How much should Ian start charging per lobster pot?

£ .....  
[Total 3 marks]

7 Sophie and two friends are booking festival tickets online using their credit cards. Tickets cost £180 each, plus an additional charge of £5.40 per credit card transaction. 

a) What is the percentage increase in the cost of buying one ticket if it's bought using a credit card?

..... %  
[2]

b) What is the percentage saving if Sophie and her friends buy three tickets in one transaction rather than three separate transactions? Give your answer to 2 d.p.

..... %  
[3]  
[Total 5 marks]



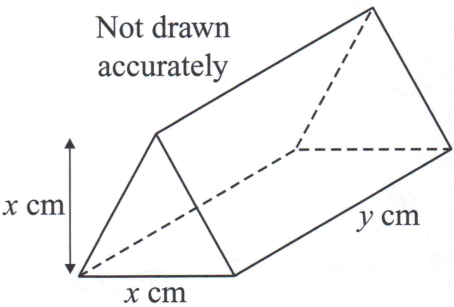
- 8
- A hairdresser recorded some details about her customers one day.  
The ratio of children : adults was 3 : 7.  
60% of the children had blond hair and 20% of the adults had blond hair.



What percentage of all the customers had blond hair?

..... %  
[Total 4 marks]

- 9
- In the triangular prism below, the base and vertical height of the triangular face are  $x$  cm and the length of the prism is  $y$  cm.



- a) Work out the percentage increase in the area of the triangular face when  $x$  is increased by 15%.



..... %  
[4]

- b) Calculate the percentage decrease in  $y$  that is required to keep the volume of the prism unchanged when  $x$  is increased by 15%. Give your answer to 1 d.p.



..... %  
[5]

[Total 9 marks]

**Exam Practice Tip**

One of the trickiest things about percentage questions can be figuring out which type of question you're dealing with. Think carefully about what the question is asking you to find and then use the correct method. Careful when you're giving your answer too — if the question asks for a percentage, don't give an amount.

Score

36



# Compound Growth and Decay

- 1 Mrs Burdock borrows £750 to buy a sofa. She is charged 6% interest per annum.



Per annum just means per year.

If Mrs Burdock doesn't pay back any of the money for 3 years, how much will she owe?  
Give your answer to the nearest penny.

Multiplier =  $1 + \dots = \dots$

In 3 years she will owe:  $£750 \times (\dots)^3 = £ \dots$

£ .....  
[Total 2 marks]

- 2 The population of fish in a lake is estimated to decrease by 8% every year.



a) How many fish will be left after 15 years if the initial population is 2000?

TIP: think about which way you should round your answer.

.....  
[2]

b) How many years will it take for the population of fish to be less than  $\frac{3}{4}$  of the initial population?

$\frac{3}{4}$  of the initial population = .....

$2000 \times \dots = \dots$

$\dots \times \dots^2 = \dots$

$\dots \times \dots^3 = \dots$

$\dots \times \dots^4 = \dots$

..... years  
[2]

[Total 4 marks]

- 3 A conservation company plants pine trees in a forest to increase their number by 16% each year. At the end of each year, a logging company is permitted to cut down up to 75% of the number of new trees planted that year.



At the start of 2013 there were 5000 pine trees in the forest.  
What was the minimum number of pine trees in the forest at the end of 2014?

.....  
[Total 4 marks]



4 Rich inherits £10 000, and wants to invest it. His bank is offering him two accounts.



Compound Collectors Account  
5.5% compound interest per year,  
paid annually into your account.  
Rate is guaranteed for 5 years.

Simple Savers Account  
6.2% simple interest paid annually by cheque.  
Rate guaranteed for 5 years,  
no further deposits permitted after opening.

a) After 5 years, which account will give him the largest balance?

.....  
[4]

b) Why might Rich not want to invest in the Simple Savers Account?

.....  
.....  
[1]  
[Total 5 marks]

5 Mrs Khan puts £2500 into a high interest savings account. Interest is added to the account at the end of each year. After 2 years Mrs Khan’s account contains £2704.



What is the interest rate on Mrs Khan’s account?

..... %  
[Total 3 marks]

6 The value of a football player decreases at a rate of 25% each year after the age of 30. At the age of 35 a player was valued at £2 000 000.




What was the player’s value when he was 31 years old? Give your answer to the nearest £100 000.

£ .....  
[Total 3 marks]

Score:   
21




# Speed

- 1 John and Alan hired a van. Their receipt gave them information about how much time they spent travelling in the van, and how fast they went. 

Travelling time: 1 hour 15 minutes  
Average speed: 56 km/h

Calculate the distance that John and Alan travelled in the van.

..... km  
[Total 2 marks]

- 2 Adam has been caught speeding by a pair of average speed cameras. The speed limit was 50 mph. 

The cameras are 2500 m apart. The time taken for his car to pass between them was 102 seconds.

- a) What was Adam's average speed between the cameras?


Give your answer to the nearest mph. Take 1 mile as 1.6 km.

..... mph  
[3]

- b) If Adam had been travelling within the speed limit, what is the minimum time it should have taken him to pass between the cameras? Give your answer to the nearest second.

..... s  
[2]

[Total 5 marks]

- 3 In 2013 Mo ran a long-distance race and finished with time  $t$ . In 2014 he finished the same race but his time was 10% quicker. 

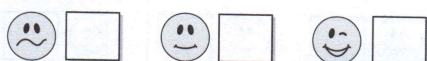
Hint: the distance will be the same for both races.

By what percentage did his average speed for the race increase?  
Give your answer to 2 decimal places.

..... %  
[Total 4 marks]

Score:

11



# Density

- 1
- The mass of a metal statue is 360 kg.  
The density of the metal alloy from which it is made is 1800 kg/m<sup>3</sup>.
- GRADE 3

a) Calculate the volume of the statue.

..... m<sup>3</sup>

[2]

b) It is decided that the metal statue is too heavy so a different metal alloy is used to make a new statue. The new statue has the same volume as the old one but has a mass of 220 kg. Calculate the density of the new statue.

..... kg/m<sup>3</sup>

[2]

[Total 4 marks]

- 2
- An iron cube has side length 4 cm and iron has a density of 7.9 grams per cm<sup>3</sup>.
- GRADE 4

a) Work out the mass of the iron cube.

..... g

[3]

b) A larger iron cube has a mass of 63.2 kg.  
What is the ratio of the side lengths of the smaller and larger cubes?

.....

[4]

[Total 7 marks]

- 3
- Brass is a metallic alloy. One type of brass consists only of copper and zinc in the ratio 7:3 by volume. Copper has a density of 8.9 g/cm<sup>3</sup> and zinc has a density of 7.1 g/cm<sup>3</sup>.
- GRADE 6

What is the density of this type of brass?

..... g/cm<sup>3</sup>

[Total 4 marks]

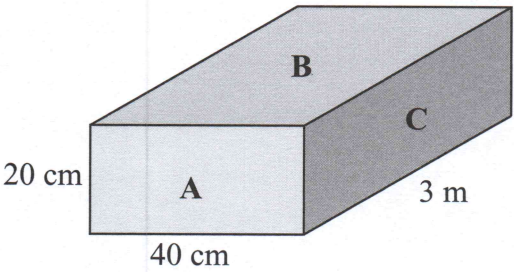
Score:

15



# Pressure

- 1 The cuboid below has three different faces (A, B and C). The cuboid has a weight of 40 N.



- a) Calculate the pressure, in  $\text{N/m}^2$ , that the cuboid exerts on horizontal ground when the cuboid is resting on face A.

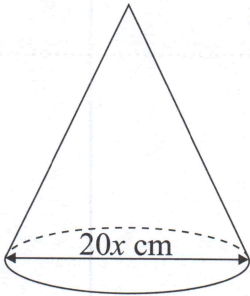
.....  $\text{N/m}^2$   
[3]

- b) Three of these cuboids are stacked directly on top of each other and the bottom cuboid is resting on face B. What pressure are they exerting on horizontal ground?

.....  $\text{N/m}^2$   
[3]

[Total 6 marks]

- 2 The cone below has a base diameter of  $20x$  cm. When the base of the cone rests on horizontal ground it exerts a pressure of  $650 \text{ N/m}^2$ .



- a) Calculate the weight of the cone in terms of  $x$  and  $\pi$ .

..... N  
[4]

- b) The diameter of the cone is halved but the weight is kept the same. What effect will this have on the pressure exerted on the ground?



[2]  
[Total 6 marks]

**Exam Practice Tip**

You might think remembering the formulas for speed, density and pressure is tough but questions involving speed, density or pressure often involve some conversion of units too. Make sure you're happy converting: metric/imperial units, speeds, areas and volumes so you don't make any silly mistakes when exam time comes.

Score  
  
**12**

