Question pack for Ratio and Proportion, GCSE Exam

Included:

- 40 Normal Questions, in no particular order of difficulty.
- 10 Challenge Questions
- Exam Tips throughout
- All worked solutions are at the end of the booklet, highlighted in blue.

PLS Suggestion:

- We've included tonnes of questions to help you with your exams. It is completely up to you how you approach them, however, we would suggest doing 4-6 normal questions and one challenge question every time you revise this topic.
- Make a note of your mistakes and go back to the ones you got wrong at the end.
- Good Luck!

Important Information:

- All normal questions vary in difficulty form grade 3 up to grade 7. Challenge questions extend up to grade 9.

- Questions that are in red are non-calculator questions
  For example:

  Question One: Would be a non-calculator question
  Question One: Would be a calculator question

Ratio & Proportion	Question No.
Compound Growth	7, 29, 33, 40, C3, C8,
Decay	31, C5,
Density	9, 10, 11, 18, 21, 22, C2, C7, C9, C10,
Direct Proportion	2, 3, 28,
Inverse Proportion	5, 15, 16,
Percentages	6, 17, 26, 27, 30, 34, 37, 38, 39, C1, C4,
Pressure	12, 14, 21, 36, C6, C9, C10
Ratios	1, 4, 11, 13, 20, 23, 24, 25, 32, 35, 38, C7,
Speed	8, 19,

Normal Difficulty Questions

Question 1: Dylan is making a square out of wood. He uses one long piece of wood and cuts it into four sections in the ratio 4 : 5 : 5 : 8. The difference in length between the longest and shortest sections is 32cm. Find the total length of the original piece of wood.

Question 2: y is directly proportional to x^2. When y =18, x = 3. Find the value of y when x = 5.

Question 3: Sketch the graph that represents the statement "y is proportional to x".

Question 4: Daniel is making some jackets. It takes $10m^2$ of leather to make 7 jackets. $5m^2$ of leathers costs £45. How much will Daniel have to pay to make 50 jackets? Give your answer to 2.d.p.

Question 5: A is inversely proportional to B. When A = 48, B = 9 Find the value of A when B = 12.

Question 6: A television costs £1080 plus 20% VAT. Find the total cost of the television.

Question 7: Adam receives a £20000 bonus from work. He wants to put it in a savings account for 7 years. He has two account options:

Account Option One: 4.7% compound interest, paid annually.
Account Option Two: 2.5% simple interest, paid every six months.

Both rates remain the same for the whole 7 years.

Which account would you recommend Adam to put his £20000 in?

Question 8: Simon travels for 1 hour 30 minutes at an average speed of 75km / hour. How far did Simon travel?

Question 9: The mass of a wooden box is 450kg.
The density of the main piece of wood the box is made from is 90kg/m^3.
Calculate the volume of the wooden box.

Question 10: The density of water is 1kg/Litre.
A water bottle has a volume of 960ml.
Find the mass of the water in the bottle.

Exam Tip - Learn the different between compound interest and simple interest.

Question 11: Steel is made from iron and carbon in the ratio 6 : 5.
The density of iron is 8 g/cm^3.
The density of carbon is 3 g/cm^3.
Find the density of steel.

Question 12: A cube has sides of length 6cm. The pressure exerted on the horizontal ground beneath the cube is 720N/cm^3. Find the weight of the cube.

Question 13: Anne and Bryan have pens in the ratio 7 : 3.
Anne gives Bryan 3 pens and now the ratio is 5 : 3.
How many pens did each initially have?

Question 14: $P = \frac{F}{A}$

Find P when F = 105 and A = 15.

Question 15: The time taken, t, for patients to be seen in a doctors surgery is inversely proportional to the cube of the number of doctors, d, on-shift. It takes 45 minutes for patients to be seen when 5 doctors are working.
Find an equation linking t and d.

Question 16: Sketch the graph that represents the statement "y is inversely proportional to x".

Question 17: Jayne receives an 8% pay rise. Her new salary is £21650. Calculate Jayne's original salary.

Question 18: Find the density of a liquid that has mass of 50kg and volume of $40m^3$.

Question 19: Keira goes on a bike ride for 6 hours. Throughout her bike ride she rests for a total of 45 minutes. At the times she is cycling she travels at an average speed of 12 miles / hour. How far did Keira travel?

Question 20: A car dealership contains black cars and red cars. The ratio of black cars : red cars is 5 : 11. One red car and three black cars are purchased over the course of a week. After that week, the ratio of black cars : red cars is now 3 : 7. How many black and red cars were initially in the dealership?

Exam Tip - For your GCSE exams you need to be able to recall certain formulas from memory. These include formulas for Speed, Density and Pressure.

Question 21: A square-based pyramid made of wood has a volume of 250 m^3. The density of the wood is 3 kg/m^3. The area of the base of the pyramid is $50m^2$. Find the pressure exerted on the ground beneath the base of the pyramid.

Question 22: The mass of a metal box is 180kg
The density of the main piece of metal the box is made from is 720kg/m^3
Calculate the volume of the metal box.

Question 23: Aimee is painting her wardrobe orange. She uses $4\frac{1}{2}$ cans of red paint and mixes it with 2 cans of yellow paint to make orange paint. Write the ratio of red paint : yellow paint in its simplest form, assume all cans are the same size.

Question 24: The ratio of Black Cars : Red Cars is 5 : 3
The ratio of Red Cars : White Cars is 7 : 11. Find the ratio of Black Cars : Red Cars : White Cars.

Question 25: Alan, Bobby and Charlie share £300 between them. Alan has £50 more than Bobby. Bobby has half as much as Charlie. How much does each person get?

Question 26: Kyle makes guitars and sells them for £95 each. He makes 40% profit on his guitars and wants to increase his profit margin to 65%. How much does Kyle need to sell his guitars for to achieve his goal?

Question 27: Tom earns £125,000 a year before tax.

The first £12,500 is tax-free.

He pays 20% tax on any income earned from £12500 up to £35000.

A further 40% tax is taken on anything earned between £35000 and £64000.

50% of anything over £64000 is then taken.
Calculate how much tax Tom pays in a year, and write down how much Tom earns after tax.

Question 28: Sketch the graph that represents the statement "y is proportional to kx^2".

Question 29: Darren borrows £6000 to buy a new car. The bank that are lending him the money charge 5% compound interest per annum. Assuming Darren repays no money on the loan for 5 years, calculate how much the debt will be. Give your answer to three significant figures.

Question 30: A meal at a restaurant costs £66 plus a 15% service charge. Find the total cost of the meal.

Exam Tip - When simplifying algebraic fractions, factorise each part of the fraction first then simplify the brackets. See question 36.

Question 31: The monthly repayment of Kelly's mortgage reduces by 2.5% every year. Calculate the monthly repayment cost of the mortgage at the start of January 2022, if the monthly cost was £3400 at the start of January 2020. Round your answer to 2.d.p.

Question 32: Pot A has an amount of money in. Pot B has £5 more than Pot A. Pot C has double Pot B. All three pots combined have a total of £75. Find the simplified ratio of money between Pots A, B and C.

Question 33: Every year the population of birds in a forest increase by 15% to the nearest 0.5%.
At the start of 2014 there were 14000 birds in the forest.
Calculate the minimum number of birds that will be in the forest at the start of 2019 to the nearest whole number.

Question 34: In school, 40% of students are over 15 years of age and 50% of over 15's are girls. What percentage of students in the school are girls over the age of 15.

There are 1200 students in the school. How many are girls over the age of 15?

Question 35: The ratio of pens : pencils in a pot is 3 : 7
70% of the pens are broken and 40% of the pencils still work. What percentage of all stationary is broken?

Question 36: A cuboid is placed on a table. The weight of the cuboid is $(2x^2 + 6x)$ N. The area of the base of the cuboid is $(x^2 – 2x – 15)$ m^3. Find the pressure exerted on the table by the base of the cuboid in its simplest form.

Question 37: In 2017 the average house price was £230,000.
In 2020 the average house price is £325,000.
Calculate the percentage increase in the house price.

Question 38: The ratio of cars : motorbikes at a race is 4 : 5
60% of the cars are red and 45% of the motorbikes are red. What percentage of all vehicles are red?

Question 39: A rectangle has sides of length L and width W. If the width is increased by 25% calculate the percentage increase in the area of the rectangle.

Question 40: The price of a new car in 2015 was £10,000
The 2020 price of the same car brand new is £25,000
The price increased at the same rate from year to year.
Find the yearly price increase.

Challenge Questions

Challenge 1: A cuboid has length and width of xcm, and a depth of ycm. Calculate the percentage decrease in y that is required to keep the volume of the prism unchanged when x is increased by 35%. Give your answer to 2.d.p.

Challenge 2: A liquid has a volume of $(2x^2 + 7x + 3)$ m^3 and a mass of $(x^2 – 2x - 15)$ kg. Find the density of the liquid, giving your answer in terms of x in its simplest form.

Challenge 3: Every year the size of a reservoir increases by 2% to the nearest 0.1%. At the start of 2015 the volume of the lake is 125,000m^3.

Mackerels live in the lake. The population of Mackerels in 2015 was 25000. Every year the number of mackerels increases by 3% to the nearest 0.5% Find the lower bound for the number of mackerels per m^3 of the lake at the beginning of 2020.

Challenge 4: Every year, John receives a pay rise that matches that year's inflation rate. At the beginning of 2015 John's salary was £25000. Use the table below to find John's salary at the beginning of 2021 to 5 significant figures:

Year	2015	2016	2017	2018	2019	2020
Inflation Rate	7.6%	8.4%	9%	2%	-1.5%	3.9%

Challenge 5: The value of a house decreases in value by 7% every year between 2010 and 2020. At the end of 2020 the value of a house is £3 000 000. Calculate the value of the same house at the start of 2015 to 4 significant figures.

Challenge 6: A shape is placed on the floor. The weight of the shape is $(x^2 - 9)$ N. The area of the base of the shape is $(2x^2 + 5x - 3)$ m^3. Find the pressure exerted on the floor by the base of the shape in its simplest form.

Challenge 7: The density of material X is 15g/cm^3
Material X is comprised of materials A and B in the ratio 2 : 1
The density of materials A is 5 g/cm^3
Find the density of material B.

Challenge 8: Sally gets paid £ (x + 5) every year. If her salary doubles every year, calculate her salary after 6 years.

Challenge 9: A cone made of metal has a volume of 75 m^3. The density of the metal is 6 kg/m^3. The area of the base of the cone is 90m^2. Find the pressure exerted on the ground beneath the base of the cone.

Challenge 10: Look back at Challenge 9… Seven of these cones are stacked on top of each other. Find the pressure exerted on the ground beneath the base of the bottom cone.

Answers on next page

① 4 : 5 : 5 : 8

Longest = 8

Shortest = 4

8 − 4 = 4

32 ÷ 4 = 8

Each 1 represent 8cm

4 + 5 + 5 + 8 = 22

22 × 8 = 176cm

② $y \propto kx^2$

$18 = k(3)^2$

$18 = 9k$

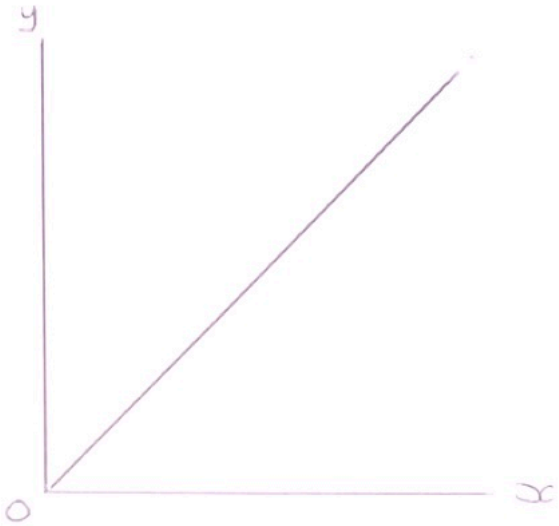
$k = 2$

$y = 2x^2$

$y = 2(5)^2$

$y = 50$

(3)



(4) $5m^2 = £45$ $1m^2 = £9$

$10m^2 = £90$

$\frac{10}{7} m^2$ / Jacket

$\frac{10}{7} \times 50 = \frac{500}{7} m^2$ for 50 Jackets

$\frac{500}{7} \times £9 = £642.86$

(5) $A \propto \frac{k}{B}$

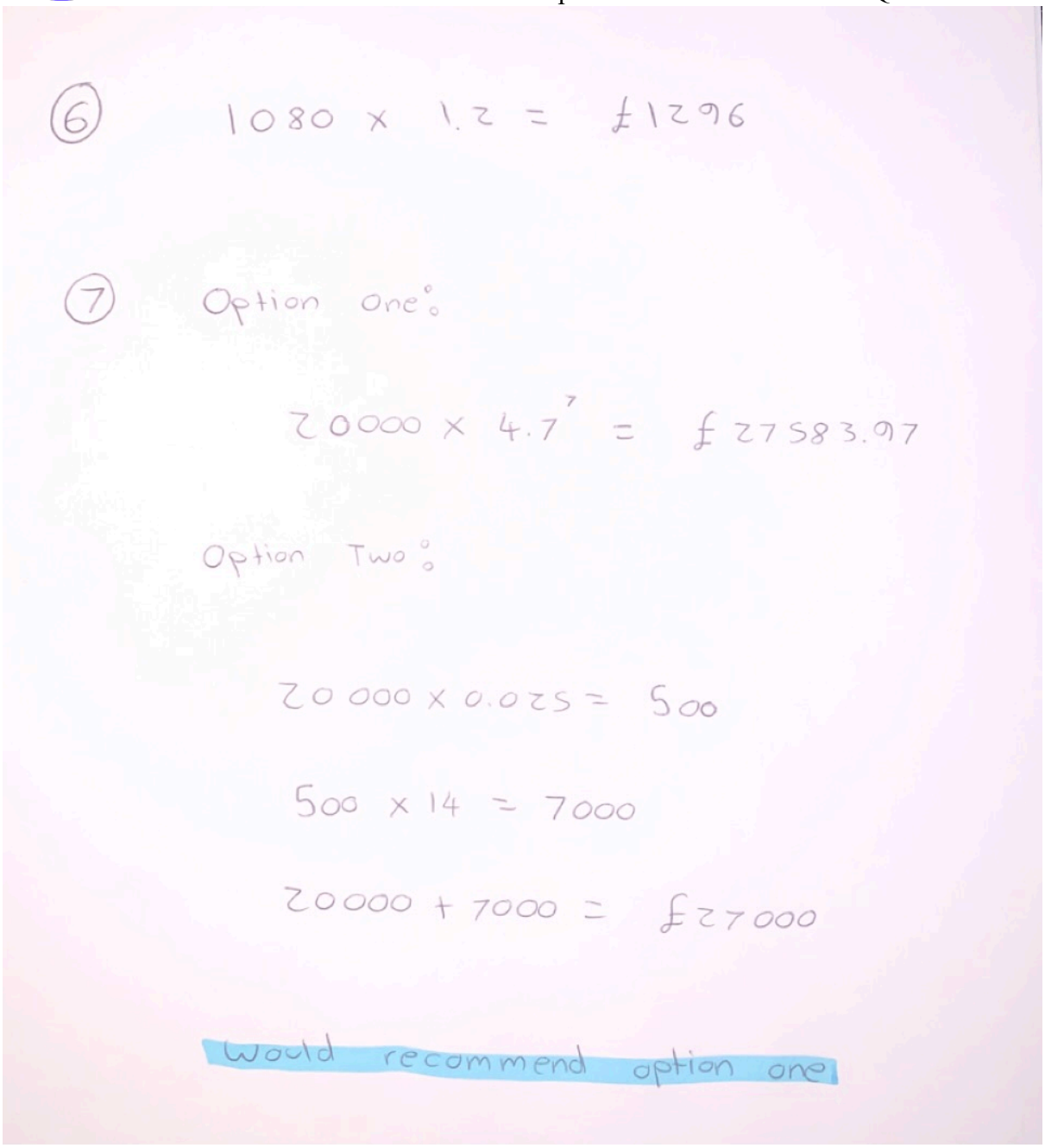
$48 = \frac{k}{9}$

$k = 432$

$A \propto \frac{432}{B}$

$A = \frac{432}{12}$

$A = 36$


6
1080 x 1.2 = £1296
7
Option one:
20000 x 4.7^7 = £27583.97
Option Two:
20 000 x 0.025 = 500
500 x 14 = 7000
20000 + 7000 = £27000
Would recommend option one

(8) Distance = speed x time

Distance = 75 kmh x 1.5 hours

= 112.5 km

(9) mass = 450 kg

density = 90 kg/m^3

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$90 = \frac{450}{\text{volume}}$$

$$\text{volume} = \frac{450}{90}$$

volume = $5m^3$

(10) density = 1 kg / litre

volume = 0.96 litres

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$1 = \frac{\text{mass}}{0.96}$$

mass = 0.96 kg

(11) Iron : Carbon = 6 : 5

8 x 6 = 48

3 x 5 = 15

48 + 15 = 63

6 + 5 = 11

63 ÷ 11 = 5.73 g / cm^3

(12) One face of cube has

area = 6 x 6

= 36cm²

$$\text{Pressure} = \frac{\text{Force}}{\text{area}}$$

$$720 = \frac{\text{Force}}{36}$$

Force = 25920 N

Weight = 25920 N

(13)

Anne : Bryan

= $7x$: $3x$

"Anne gives Bryan 3 pens"

Anne : Bryan

5 : 3

$7x - 3 : 3x + 3$

= 5 : 3

$$\frac{7x-3}{5} = \frac{3x+3}{3}$$

$3(7x-3) = 5(3x+3)$

$21x - 9 = 15x + 15$

$6x = 24$

$x = 4$

Anne = $7(4) = 28$

Bryan = $3(4) = 12$

(14) $P = \frac{f}{q}$

$P = \frac{105}{15}$

$P = 7$

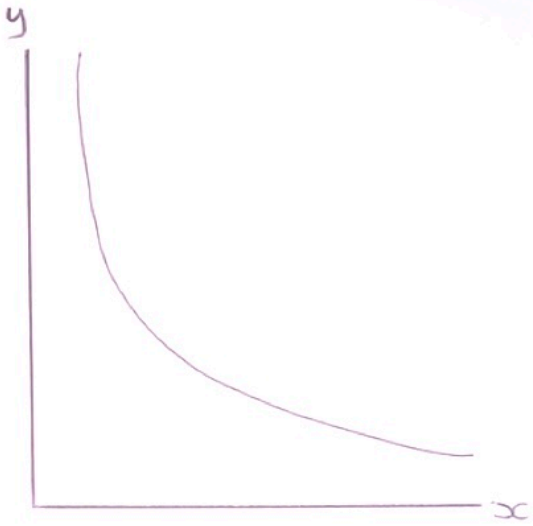
(15) $t \propto \frac{k}{d^3}$

$45 \propto \frac{k}{5^3}$

$k = 45 \times 5^3$

$t \propto \frac{5625}{d^3}$

(16)



(17)

$x \times 1.08 = 21650$

$x = \frac{21650}{1.08}$

$x = £20046.30$ (2.d.p)

(18)

$\text{density} = \frac{\text{mass}}{\text{volume}}$

$\text{density} = \frac{50}{40}$

$\text{density} = 1.25 \text{ kg/m}^3$

(19) 45 minutes = 0.75 hours

6 − 0.75 = 5.25 hours

5.25 hours spent cycling

$$\text{distance} = \frac{\text{speed}}{\text{time}}$$

$$\text{distance} = \frac{12}{5.25}$$

distance = 2.29 miles (2.d.p)

(20) black : red

$5x : 11x$

" one red car and three black cars are purchased "

$3 : 7$

$5x - 3 : 11x - 1$

$$\frac{5x-3}{3} = \frac{11x-1}{7}$$

$$7(5x-3) = 3(11x-1)$$

$$35x - 21 = 33x - 3$$

$$2x = 18$$

$$x = 9$$

black $= 5(9) = 45$

red $= 11(9) = 99$

(21) Volume $= 250 m^3$

density $= 3 kg/m^3$

weight of pyramid:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$3 kg/m^3 = \frac{\text{mass}}{250 m^3}$$

$$\text{mass} = 750 kg$$

$$\text{Pressure} = \frac{\text{force}}{\text{area}}$$

$$\text{Pressure} = \frac{750}{50}$$

Pressure $= 15 N/m^2$

22 mass = 180 kg

density = 720 kg/m³

$\text{density} = \frac{\text{mass}}{\text{Volume}}$

$720 = \frac{180}{\text{Volume}}$

Volume = 0.25 m³

23 $4\frac{1}{2} : 2$

= 9 : 4

24 Black red white

5 : 3

7 : 11

Make red the same

35 : 21

21 : 33

35 : 21 : 33

(25)

Charlie = x

Bobby = $\frac{1}{2}x$

Alan = $\frac{1}{2}x + 50$

$x + \frac{1}{2}x + \frac{1}{2}x + 50$

$= 2x + 50$

$2x + 50 = 300$

$2x = 250$

$x = £125$

Alan = $\frac{1}{2}(125) + 50 = £112.50$

Bobby = $\frac{1}{2}(125) = £62.50$

Charlie = £125

(26) Let x = costs

$0.4 \times 95 = £38$ profit

$£95 - £38 = x$

x = costs = £57

$100\% - 65\% = 35\%$

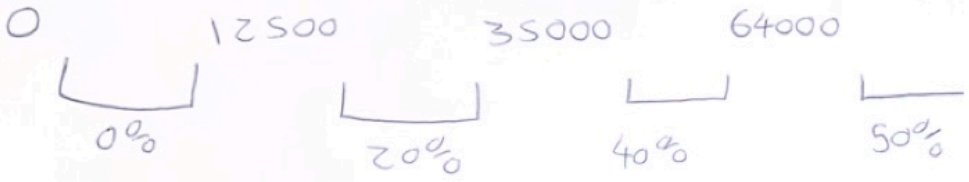
For profit margin to be 65%, costs need to be 35%

$57 = 0.35a$ where a = new price

$a = 57 \div 0.35$

$a =$ £162.86

27 Earns % £125000



35000 − 12500 = 22500

22500 × 0.2 = £4500 taken

64000 − 35000 = 29000

29000 × 0.4 = £11600 taken

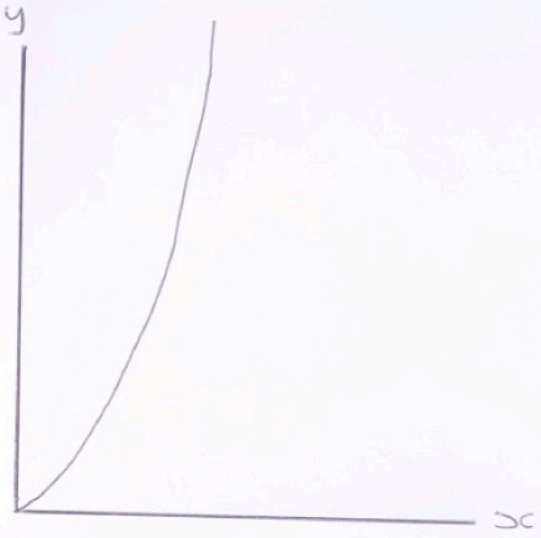
125000 − 64000 = 61000

0.5 × 61000 = £30500 taken

4500 + 11600 + 30500 = £46600 tax paid

125000 − 46600 = £78400 earned after tax

28



29 $6000 \times 1.05^5 = £7657.689$

$\approx$ £7660 (3.S.F)

30 $66 \times 1.15 =$ £75.90

(31) $3400 \times 0.975^2 =$ £3232.13

(32) Pot A = x

Pot B = $x+5$

Pot C = $2(x+5)$

$x + x + 5 + 2(x+5) = 75$

$4x + 15 = 75$

$4x = 60$

$x = 15$

A = 15

B = 20

C = 40

15 : 20 : 40

= 3 : 4 : 8

(33) Lower bound = 14.75%

$14000 \times 1.1475^2 = 27854.25$

= 27854 birds

(34) $0.5 \times 0.4 = 0.2$

20% are girls over 15

$1200 \times 0.2 =$ 240 girls over 15

(35) $0.7 \times 3 = 2.1$ broken pens

$0.4 \times 7 = 2.8$ working pencils

$7 - 2.8 = 4.2$ broken pencils

$2.1 + 4.2 = 6.3$

$\frac{6.3}{10} = \frac{63}{100} =$ 63%

(36) $\text{Pressure} = \frac{\text{force}}{\text{area}}$

$\text{Pressure} = \frac{2x^2 + 6x}{x^2 - 2x - 15}$

$\text{Pressure} = \frac{2x(x+3)}{(x-5)(x+3)}$

$\text{Pressure} = \frac{2x}{x-5}$

(37) $\frac{325000}{230000} = 41.3\%$ increase (1.d.p)

(38) $0.6 \times 4 = 2.4$

$0.45 \times 5 = 2.25$

$2.25 + 2.4 = 4.65$

$\frac{4.65}{9} = 51.7\%$ (1.d.p)

(39) $L \times w = Lw$

$1.25 \times w$

$L \times 1.25w = 1.25(Lw)$

25% increase in area

(40) $10000 \times x^5 = 25000$

$x^5 = 2.5$

$x = \sqrt[5]{2.5}$

$x = 1.201$

Yearly price increase of 20.1%

Challenge one

$x \times x \times y = \text{volume}$

$= x^2y$

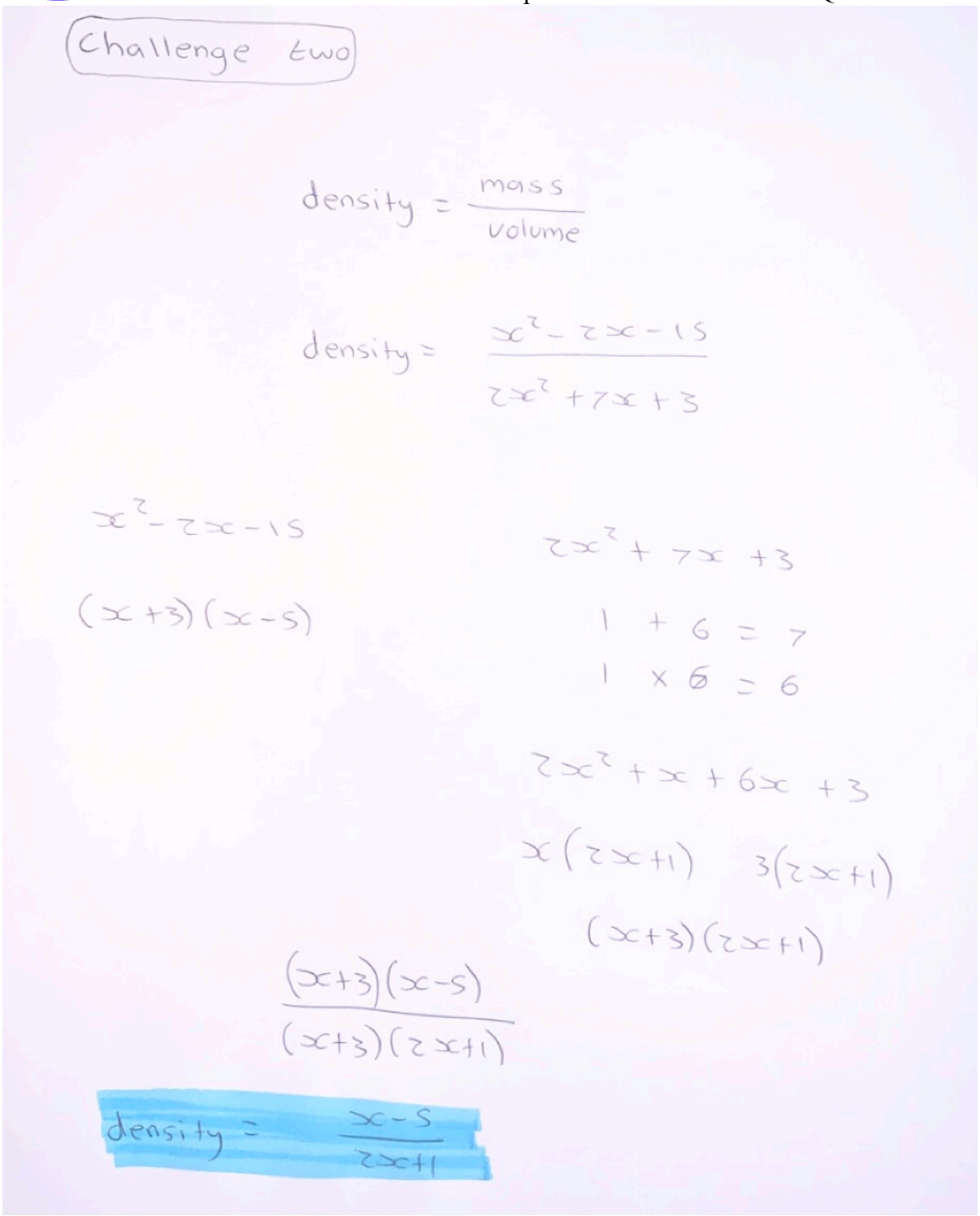
$1.35x \times 1.35x \times y = \text{volume}$

$= 1.8225x^2y$

$\frac{1}{1.8225} = 0.5487$

$= 54.87\%$ (2.d.p)

Length y needs to be decreased by 54.87% to keep volume unchanged when x is increased by 35%


Challenge two
density = mass / volume
density = $x^2 - 2x - 15$ / $2x^2 + 7x + 3$
$x^2 - 2x - 15$
$(x+3)(x-5)$
$2x^2 + 7x + 3$
$1 + 6 = 7$
$1 \times 6 = 6$
$2x^2 + x + 6x + 3$
$x(2x+1)$ $3(2x+1)$
$(x+3)(2x+1)$
$\frac{(x+3)(x-5)}{(x+3)(2x+1)}$
density = $\frac{x-5}{2x+1}$

Challenge three

To find lower bound we need to find minimum number of mackerels in largest size lake

Lake size upper bound:

$125000 \times 1.0205^5 = 138348.6922$

Mackerel count lower:

$25000 \times 1.0275^5 = 28631.8336$

$$\frac{138348.6922}{28631.8336} = 4.8 \text{ mackerels/m}^3$$

Challenge four

25000 × 1.076 = 26900

26900 × 1.084 = 29159.6

29159.6 × 1.09 = 31783.964

31783.964 × 1.02 = 32419.64328

32419.64328 × 0.985 = 31933.34863

31933.34863 × 1.039 = £33179

Challenge five

"end of 2020" so its 6 years

we are dealing with not 5

$$x \times 0.93^{6} = 3{,}000{,}000$$

$$x = \frac{3000000}{0.93^{6}}$$

$$x = £4637000$$

Challenge six

$$\text{Pressure} = \frac{\text{force}}{\text{area}}$$

$$\text{Pressure} = \frac{x^2 - 9}{2x^2 + 5x - 3}$$

$x^2 - 9$

$(x+3)$ $(x-3)$

$2x^2 + 5x - 3$

$-1 + 6 = 5$

$-1 \times 6 = -6$

$2x^2 - x + 6x - 3$

$x(2x-1) \quad 3(2x-1)$

$(x+3)(2x-1)$

$$\frac{(x+3)(x-3)}{(x+3)(2x-1)}$$

$$\text{Pressure} = \frac{x-3}{2x-1}$$

Challenge seven

$2 + 1 = 3$

$15 \times 3 = 45$

$5 \times 2 = 10$

Let x = B density

$x \times 1 = x$

$10 + x = 45$

$x = 35$

density of B = $35\ g/cm^3$

Challenge eight

$(x+5) \times 2^6$

$= (x+5) \times 64$

$= 64x + 320$

£ $(64x + 320)$

Challenge nine

Need to find mass of cone before we can calculate pressure

$$\text{density} = \frac{\text{mass}}{\text{Volume}}$$

$$6 = \frac{\text{mass}}{75}$$

$$\text{mass} = 450 \text{ kg}$$

$$\text{Pressure} = \frac{\text{force}}{\text{area}}$$

$$\text{Pressure} = \frac{450}{90}$$

Pressure = $5 N/m^3$

Challenge Ten

weight of one cone = 450N

weight of seven = 7 × 450

= 3150N

$$\text{Pressure} = \frac{\text{force}}{\text{area}}$$

$$\text{Pressure} = \frac{3150}{90}$$

Pressure = $35 N/m^3$

* Alternatively, multiply pressure of one cone by 7

$5 \times 7 = 35 N/m^3$ *

We hope this question pack was helpful. We opted for handwritten worked solutions as a pose to standard mark-scheme type answers found elsewhere. If you're still struggling, you can find in-depth video walkthrough solutions for every question in this pack on our website as well as lots more question packs for other GCSE topics.

Also, challenge papers can be found on our website too if you're feeling especially confident with the content.

Thank you
The PLS Tutors

http://www.plstutors.co.uk/