1. At a constant temperature, the volume of a gas V is inversely proportional to its pressure p.

   By what percentage will the pressure of a gas change if its volume increases by 25%?

   _ _ _ _ _ _ _ _ _ _ _ _ _ % **[4]**

2(a). Sam and two friends put letters in envelopes on Monday.
The three of them take two hours to put 600 letters in envelopes.

On Tuesday Sam has three friends helping.

Working at the same rate, how many letters should the **four** of them be able to put in envelopes in two hours?

(a) _____ [2]

(b). Working at the same rate, how much longer would it take **four** people to put 1000 letters in envelopes than it would take **five** people?

(b) _____ [4]

(c). Sam says

It took two hours for three people to put 600 letters in envelopes.
If I assume they work all day, then in one day three people will put 7200 letters in envelopes because 600 × 12 = 7200.

Why is Sam's assumption not reasonable?
What effect has Sam's assumption had on her answer?

_____
_____ [2]

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3(a). y is directly proportional to x^2.

x	2	6
y	20	a

Find the value of a.

_____

[2]

(b). y is inversely proportional to x and $y = 18$ when $x = 4$.

Write an equation linking x and y.

_____

[3]

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4(a). On a packet of brown rice it says:

When 60 g of brown rice is cooked it will weigh 145 g.

Katy has 100 g of brown rice.

What will the rice weigh when it is cooked?

_____g

[2]

(b). Pali needs 400 g of cooked rice for a recipe.

What weight of brown rice should he cook?

_____g

[2]

5(a). A school has a delivery of identical maths textbooks.

6 of these books, placed side by side, take up 15.9 cm of shelf length.

What shelf length is taken up by 10 of these books, placed side by side?

_____ cm **[3]**

(b). Another shelf is 90 cm long.

How many of these books will fit, side by side, on this shelf?

_____ **[3]**

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6.   *y* is inversely proportional to *x* and *y* = 30 when *x* = 4.

     Write an equation linking *x* and *y*.

_____ **[3]**

7(a). The current, *I* amps, in a wire is inversely proportional to the resistance, *R* ohms.
       When the resistance is 10 ohms, the current is 1.2 amps.

       Find an equation connecting *I* and *R*.

_____ **[2]**

(b). Find the resistance when the current is 0.5 amps.

_____ ohms **[1]**

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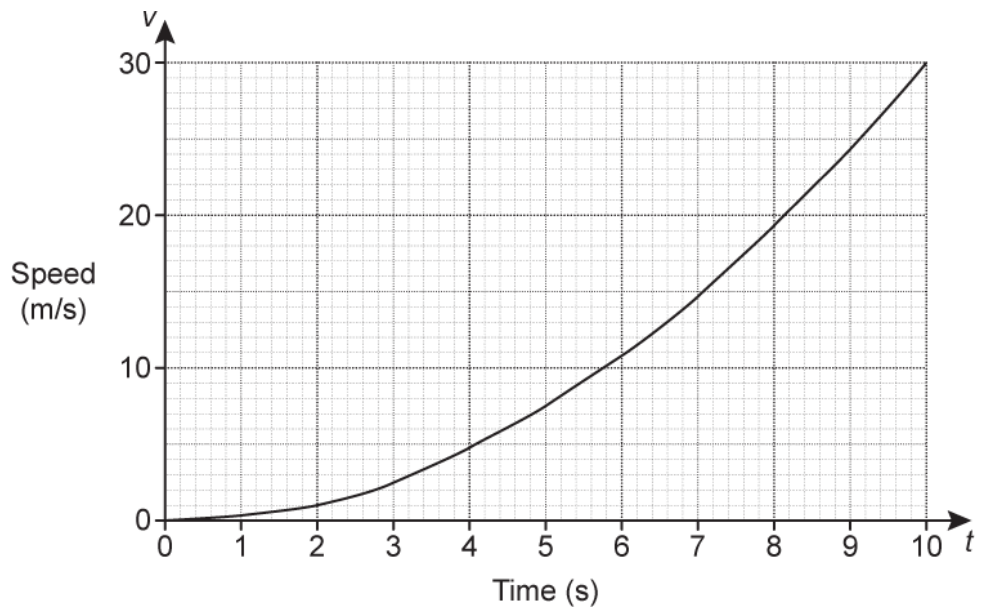
8. The mass, in milligrams, of a steel ball bearing is directly proportional to the cube of its diameter, in millimetres.
A 3.5 mm diameter ball bearing has a mass of 170 mg.

Calculate the mass of a ball bearing with a diameter of 5.5 mm.

_____ mg [3]

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9. The graph shows the speed, v metres per second (m/s), of a car at time t seconds.

The speed of this car is directly proportional to the square of the time.

Find a formula linking v and t.

_____ [3]

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10. The population of a village is in the following ratios.

- men : children = 11 : 3
- women : children = 5 : 2

There are 36 children in the village.

Find the total population of the village.

_____ [3]

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11. y is inversely proportional to the square of x.

Complete the table.

x	10	6	
y	9		4

[4]

12. y is inversely proportional to x^2 and $y = 5$ when $x = 4$.

Find a formula linking x and y.

-------------------- [3]

END OF QUESTION PAPER

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	Question		Answer/Indicative content	Marks	Part marks and guidance	
1			20 [decrease](%)	4	**M1** for PV = constant **oe** **M1** for $P_{initial}V_{initial} = P_{after}V_{after}$ **oe** **M1** for $1 \times 1 = P_{after} \times 1.25$ **oe**	
			Total	4		
2	a		800	2	**M1** for unitary work, e.g. 1 person does 200 letters in 2 hours	
	b		30 minutes **oe**	4	**M1** for 1 person does 100 letters in 1 hour **M1** for 5 people do 1000 letters in 2 hours **M1** for 4 people do 1000 letters in 2.5 hours **FT** from *their* rate in **(a)** throughout	
	c		Correct comment on the reasonableness of her assumption e.g. 'She has assumed that 'all day' means 'for 24 hours', but it is not reasonable for them to work without a break.' Correct comment on the effect it will have on the answer e.g. 'They can't work at that rate for that long, so her answer is an over-estimate.'	2	**B1** for each	
			Total	8		
3	a		180	2	**M1** for [20 ×] 3^2 or **B1** for [y =] $5x^2$	<u>Examiner's Comments</u> Many saw this as 'y proportional to x' and used ×10 or ×3 to give an answer of 60. The common method was using $20 = k \times 2^2$ to reach $k = 5$ then multiplying this by 6^2.

Question			Answer/Indicative content	Marks	Part marks and guidance	
	b		$xy = 72$ oe	3	**M1** for $xy = k$ oe **A1** for [$k =$]72 if **0** scored **SC2** for $xy \propto 72$ oe or **SC1** for $xy \propto k$ oe	Allow any letter for k except x and y **Examiner's Comments** The usual method was to form the equation $y = \frac{k}{x}$, then substituting x and y values to *get* k = 72 and then substituting k = 72 back into the equation. The common error was to use direct proportion giving a k value of 4.5 while others saw this as y inversely proportional to x^2. Sometimes $18 = \frac{k}{4}$ was reached, this was often followed by k = 4.5. Many did not write a final equation but linked x and y with this notation: $y \propto \frac{72}{x}$.
			Total	5		

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	Question		Answer/Indicative content	Marks	Part marks and guidance	
4	a		241.6 to 241.7 or 240, 241 or 242	2	**M1** for $\dfrac{100}{60} \times 145$ oe or for [1g =] 2.4(16…) or 10g = 24. (16…) or **B1** for answer with digits 2416(…) or 2417 with wrong dp	**Examiner's Comments** The first two parts of this proportion question were quite well done, but there was a tendency to 'lose' figures when dealing with recurring decimals, resulting in inaccuracies. Several different approaches were used to solve the problem in part (a). As expected, the most common wrong answers were from those who used addition/subtraction instead of multiplication/division.
	b		165 to 167 or 170	2	**M1** for $\dfrac{400}{145} \times 60$ oe or $\dfrac{400}{their\ (a)} \times 100$ oe If 0 , allow SC1 for $\dfrac{145}{60} \times$ acceptable answer = result in range 398 to 411	**Examiner's Comments** In part (b), some confused cooked and uncooked rice and multiplied their answer to part (a) by 4.
			Total	4		

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Question			Answer/Indicative content	Marks	Part marks and guidance	
5	a		26.5	3	**M2** for $\dfrac{15.9}{6} \times 10$ oe Or **M1** for $\dfrac{15.9}{6}$ soi by 2.65 **Examiner's Comments** The vast majority of candidates knew an appropriate method and could find the required shelf length.	
	b		33	3	**B2** for 33.96… to 34 seen Or **M1** for $\dfrac{90}{15.9} \times 6$ or $\dfrac{90}{their\,2.65}$ **Examiner's Comments** This was well done. However, problems arose in the rounding of the answer to the calculation. Many ignored the context of the question and rounded 33.96 to 34. A few used a trial and improvement method or a 'build up' method, often obtaining the correct answer.	
			Total	6		

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Question			Answer/Indicative content	Marks	Part marks and guidance	
6			xy = 120 **oe**	3	**M1** for $xy = k$ **oe** **B1** for [k =] 120 <u>**Examiner's Comments**</u> Many used direct proportionality rather than inverse proportionality. There is still a problem with writing the equation, even when the constant has been correctly found.	accept $30 \propto \dfrac{k}{4}$ for **M1**
			Total	3		

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	Question		Answer/Indicative content	Marks	Part marks and guidance	
7	a		$I = \dfrac{12}{R}$ or $IR = 12$ or $R = \dfrac{12}{I}$	2	Mark final answer M1 for $I = \dfrac{k}{R}$ **oe** or $1.2 = \dfrac{k}{10}$ **oe** or SC1 for $R \propto \dfrac{1}{I}$ **oe** **Examiner's Comments** In part (a) many candidates identified the word 'proportional' and took this to be a question about direct, rather than inverse, proportion and so gained no credit. Those candidates who did use inverse proportion often left in the proportionality symbol, failed to evaluate their k or, having evaluated k correctly, failed to substitute this value to give the correct final answer. Common wrong answers were $10I = 1.2R$ or $R = 8.33I$.	Allow any letter/number for k other than R or I For M1/SC1 allow any rearrangement of these

Question			Answer/Indicative content	Marks	Part marks and guidance	
	b		24	1	Or **FT** *their* equation in *I* and *R* in (a) **Examiner's Comments** Those candidates who had the correct equation in part (a) usually gave the correct answer in part (b), although there were some who were unable to divide 12 by 0.5 and reached the answer 6, clearly not having used their calculator. Candidates who had given an equation in part (a) were given credit for correctly substituting *I* = 0.5 into their equation, and some follow through marks were awarded, although often the answer was not sufficiently accurate to gain credit, as three significant accuracy was required.	Answer must be correct to 3sf
			Total	3		

Question			Answer/Indicative content	Marks	Part marks and guidance	
8			659.6 to 660 or 660.5[…]	3	M2 for $\dfrac{170}{3.5^3} \times 5.5^3$ oe OR M1 for $\dfrac{170}{3.5^3}$ or $170 = k \times 3.5^3$ or $m = kd^3$ soi OR SC2 for answer 665.5 or 666 **Examiner's Comments** Candidates who answered the question correctly usually worked in two stages, first using the relationship $m = kd^3$ to find the value of k using the values for the 3.5 mm diameter ball then using this value of k with 5.5^3 to find the mass of the second ball. Having found a correct value of k, some candidates then went on to use 5.5 rather than 5.5^3 in their second calculation. Inappropriate rounding of k to 4 rather than 3.97 led to an inaccurate final answer. Although a proportionality relationship was often identified, many candidates misinterpreted the information given in the question and a common answer of 267 was seen from using $m = kd$ or 420 from $m = kd^2$.	Method marks may be awarded for complete method in stages with inappropriate intermediate rounding, eg use of $k = 4$ Allow any letters in place of m, k, d
			Total	3		

Question			Answer/Indicative content	Marks	Part marks and guidance		
9			$v = kt^2$ where $0.25 \leq k \leq 0.33$	3	**SC2** for $v \propto kt^2$ where $0.25 \leq k \leq 0.33$ or **B1** for $v = kt^2$ AND **M1** for $30 = k(10)^2$ or FT *their* reading from the graph for values of v and t or **B1** for $0.25 \leq k \leq 0.33$	Condone use of other letters especially s for speed Can be implied by eg $30 = k(10)^2$ k could be a fraction e.g. $\frac{15}{49}$	
					Examiner's Comments In this part, the most common response was to write down $v = kt^2$ and leave it as the answer, or to correctly write $30 = k100$, but then wrongly deduce that $k = 10 \div 3$ or 3.3.		
			Total	3			

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Question			Answer/Indicative content	Marks	Part marks and guidance		
10			258	3	**M2** for $\frac{36}{2} \times 5 + \frac{36}{3} \times 11$ [+36] oe or $((2 \times 11) + (3 \times 5)) \times 36 \div 6$ [+36] oe o $\frac{6}{6+15+22} \times x = 36$ oe e or **M1** for $\frac{36}{2} \times 5$ or $\frac{36}{2} \times 7$ soi or $\frac{36}{3} \times 11$ or $\frac{36}{3} \times 14$ soi oe	M2 implied by 222 [+36] not spoiled 90 + 132 [+ 36] Implied by 90 or 126 or 132 or 168 seen	
					Examiner's Comments There were many correct solutions to part (b), but with careful arithmetic many more candidates would have earned full marks. Very common errors were $12 \times 11 = 121$ and the incorrect addition of 132, 90 and 36.		
			Total	3			

Question			Answer/Indicative content				Marks	Part marks and guidance		
11			x	10	6	[±] 15	**4** 1 AO1.1 3 AO1.3a	**B3** for one value correct	Do not follow through mis-reads.	
			y	9	25	4		OR		

M2 for $9 \times 10^2 = y \times 6^2$ oe or $9 \times 10^2 = 4 \times x^2$ oe

OR

M1 for 9×10^2 or

$$y = \frac{k}{x^2}$$ soi

Examiner's Comment
Many fully correct answers were seen with candidates using 'y is inversely proportional to the square of x'. Unfortunately, a significant number of candidates failed to understand or to read the question carefully and used 'y is inversely proportional to x', leading to the common incorrect answers $y = 15$ and $x = 22.5$. Also seen were y proportional to x, $\sqrt{x}$, x^2 or $\frac{1}{\sqrt{x}}$. Usually the question was

either entirely correct or entirely wrong. Very few M2 marks were awarded, but

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Question			Answer/Indicative content	Marks	Part marks and guidance	
					M1 for $y = \dfrac{k}{x^2}$ or $k = 900$ was quite common. A small number showed little idea of how to tackle the question and tried to spot a pattern whereby the y value was one less than the x value and so completed the table with 5 and 5.	
			Total	4		
12			$y = \dfrac{80}{x^2}$ oe	3	**M1** $y = \dfrac{k}{x^2}$ for oe **B1** for $k = 80$	implied by $5 = \dfrac{k}{4^2}$
					Examiner's Comments Many candidates did not use x^2 but just x, or even $\sqrt{x}$, so when calculating the value of k the values of 20 or 10 were seen and not 80 as expected. There were also many who used direct proportionality instead of inverse proportionality.	
			Total	3		