Mark scheme

Question			Answer/Indicative content	Marks	Guidance	
1	a		2250 with correct working	5	**M3** for $(1-(0.25+0.15))\times\frac{5}{6}\times 3000$ **oe** **M1** for 0.25 × 3000 **oe** OR **B2** for rel freq of yellow disc = 0.5 or for 1200 green and red discs in bag or **M1** for 0.25+ 0.15 + P(y) + P(b) = 1 or better or for (0.25 + 0.15) × 3000 **oe** **M2dep** for (*their* 0.5 + 0.25) × 3000 **oe** or **M1dep** for (*their* 0.5 + 0.25) **oe** If **0** or **M1** only scored, instead award **SC2** for answer 2250 If **0** scored, award **SC1** for 750	"Correct working" requires evidence of **M3** Condone 2250 rounded to 2000 as answer for **5** marks For **M3** accept 1500 yellow **M1** implied by 750 For **B2** accept 750 for green and 450 for red **M1** for e.g.1 – (0.25 + 0.15) **oe** **M2dep** and **M1 dep** on at least **M1** earned **M1dep** implied by 0.75
	b		She may not have done the experiment a lot of times **oe**	1		
			Total	**6**		
2	a		3000	1		
	b		15	1		

	c		That the annual percentage increase stays the same **oe**	1		Accept % increase/interest/%change remains constant each year If % value is given then accept 15% or *their* **(b)** For additional information refer to '2024 November, J560/05, Alternative, Mark Scheme Appendix: appendix 3' within downloadable extra resource materials.
			Total	**3**		
3			$30.\dot{5}$	4	**M3** for $(1-\frac{1}{1.2^2})$ [× 100] **oe soi** $\frac{11}{36}$ **oe** or **M2** for $\frac{1}{1.2^2}$ [× 100] **oe soi** $\frac{25}{36}$ **oe** or $\frac{625}{9}$ or 69.4(...) or **M1** for 1.2 [× 100] **oe** or for $y=\frac{k}{x^2}$ **oe**	Alternative method following a valid combination of values where $x_1^2y_1 = k$ e.g. $x_1 = 5$, $y_1 = 10$, $k = 250$ **M3** for $\frac{y_1-y_2}{y_1}$ [×100] or **M2** for $\frac{\text{their } k}{(1.2x_1^2)}$ **soi** or **M1** for $1.2x_1$ **soi**
			Total	**4**		
4			[y =] $112x^3$ with correct working	6	**B2** for $y = 1.75t^3$ or **M1** for $y = kt^3$ or better e.g.14 = $k2^3$ or $k = 1.75$ **B2** for $t = 4x$ or **M1** for $t = mx$ or better e.g. 16 = $m4$ or $m = 4$	"Correct working" requires evidence of at least **M1M1** or **B2** condone e.g. $y = kt^3$ and $k = 1.75$ for **B2** Condone e.g. t =

					M1 for $y = 1.75(4x)^3$ If **0**, **1** or **2** scored, instead award **SC3** for $y = 112x^3$ with no working or insufficient working	mx and $m = 4$ for **B2** For **M1FT** allow combining *their* two expressions for y and t
			Total	**6**		
5			6250.5[0]	3	**M2** for $12000\ ^{(1+\frac{15}{100})^3}$ **oe** or **M1** for *their* 18250.5[0] − 12000 or $^{(1+\frac{15}{100})^3}$ **oe** implied by 1.52[0875]	**M2** implied by 18250.5[0] Note : 17400 and 5400 are the results by simple interest and score **0**
			Total	**3**		
6			112	4	**M3** for $\frac{328}{14k+21k+6k}\times 14k$ **oe** or **M2** $\frac{328}{14k+21k+6k}\times 14k$ **oe** or all three in a ratio e.g. $14k : 21k : 6k$ or **M1** for two ratios with a common number of red implied by $14k$ (white) and $6k$ (green) seen, $k > 0$ or for $14k : 21k$ [: $6k$] or [$14k$:] $21k : 6k$	**M3** implied by 112, 168, 48 with 112 not selected e.g. 4.66… : 7 : 2 and condone $14k$: $21k$ with $21k$: $6k$ Also 4.66… : 7 [: 2]

			Total	**4**		
7			9930 to 9931.5	4	**B2** for 25.2 or **M1** for $\frac{11.2}{4} \times 9$ **oe** AND **M1** for $\pi \times 11.2^2 \times$ *their* 25.2	Condone answer of 9925.8… or 9926
			Total	**4**		
8			The formula should be $y = kx$ [not the one they use] $y = 4.5x$ or $y = \frac{9}{2}x$ **oe**	1 2	**M1** for y = *kx* or better e.g. 9 = *k* × 2	For additional information refer to 'Qn10, 2024 June, Alternative J560/04, Mark Scheme Appendix' within downloadable resource materials. Allow any letter for *k* can be awarded in the first statement
			Total	**3**		
9			16 **nfww**	4	**B2** for 22.5 **M1** for 360 ÷ *their* 22.5 seen OR **B1** for 7*a* and *a* or 8*a* **M1** for 7*a* + *a* = 180 **oe** **M1** for 360 ÷ *their* 22.5 seen Alternative method 1: **M2** for 7 × 360 = 180(*n* – 2) or better or **M1** for $\frac{180(n-2)}{n} = 7 \times \frac{360}{n}$ and **M1** for 180*n* = 2520 + 360 **oe**	*a* = exterior angle and allow any consistent single letter **B1 M1** implied by 8*a* = 180 or $\frac{180}{7+1}$ **oe** Alternative for number of sides: e.g. **M1** for $\frac{180(n-2)}{n}$ = 180 – *their* 22.5

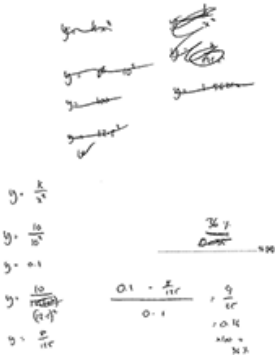
					Alternative method 2: Use of trials by choosing a value for *n*. **M1** for each correct trial up to a maximum of **M3** for using <u>two</u> of these [exterior angle] = $\frac{360}{n}$ (formula A) [interior angle] = $\frac{180(n-2)}{n}$ (formula B) interior + exterior = 180 and for checking that interior = 7 × exterior if **0** scored **SC1** for one of formula A or B seen or used	If they get 16 from any number of trials they score **4** marks. Trials can be seen from a calculation or a list. See Appendix* for likely results *Refer to 'Qn6, 2024 June, Alternative J560/04, Mark Scheme Appendix' within downloadable resource materials.
			Total	**4**		
10			Correct statement with supporting working No/not correct **oe** and e.g. 1160[.6]… with 1124 or 0.645[6]… **oe** with 0.666… **oe** or $\frac{1124}{1741} - \frac{2}{3} > 0$ or $\frac{1124}{1741}$ and 1160[.6]…	5	**B4** for 1160[.6]… and 1124 OR **M1** for $\frac{1210}{7+2+2}$ [× 7] or better $\frac{1210}{9+3+2}$ [× 9] **M1** for $\frac{531}{6+1+2}$ [× 6] or better $\frac{531}{8+1+2}$ [× 8] **M1** for *their* 770 + *their* 354 or 1210 + 531 *their* 778 + *their* 386 **M1** for $\frac{\text{their}\,1124}{\text{their}\,1741}$ $\frac{\text{their}\,1164}{\text{their}\,1741}$ or for *their* 1741 × $\frac{2}{3}$ or 1160[.6]… for those that sum the columns (i.e. 13 : 3 : 4) (i.e. 17 : 4 : 4) **M1** for $\frac{1210+531}{\text{their}(13+3+4)}$ [× 13] or better or $\frac{\text{their}\,13}{\text{their}(13+3+4)}$ $\frac{1210+531}{\text{their}(17+4+4)}$ [× 17] or better or $\frac{\text{their}\,17}{\text{their}(17+4+4)}$ **M1** for $\frac{\text{their}\,1131.65}{\text{their}\,1741}$ $\frac{\text{their}\,1183.88}{\text{their}\,1741}$ or for *their* 1741 × $\frac{2}{3}$ or 1160[.6]… or $\frac{2}{3}$ [× 20] $\frac{2}{3}$ [× 25] **M1** for 0.65 and 0.66… or 1131[.65]/1132 and 1160[.6]… 0.68 and 0.66… or 1183[.88]/1184 and	implied by 110 or 770 86 or 778 implied by 59 or 354 48 or 386 implied by 1124 or 1741 implied by 0.645[6]… **oe** or $\frac{1124}{1741}$ 0.668[5]… **oe** or $\frac{1164}{1741}$ implied by 87.05 or 1131.65 or $\frac{13}{20}$ or 0.65 69.64 or 1183.88 or 69.64 or 1183.88 or $\frac{17}{25}$ or 0.68 implied by 0.65 0.68 **oe** or 1160[.6]… or 13.3.. or 0.66… or $0.\dot{6}$ 16.6..

					1160[.6] for 0.668 and 0.66… or 1131[.65]/1132 and 1160[.6]…	allow 13 and 13.3 to 13.4
			Total	**5**		
11	a		No **oe** AND correct valid reason or correct supporting values e.g. • The value of the interest changes each year as the amount grows • It is exponential growth • Compound interest means the interest grows each year	1		e.g. Accept e.g. • There will 3% interest on the £G300 as well as an extra £G300 **oe** • It will increase by 3% of 10 300 • Finds £10 609 or 609 or 309 for 2nd year If they show a calculation in their reason it must be correct For additional information refer to 'Qn12a, 2024 June, Alternative J560/05, Mark Scheme Appendix' within downloadable resource materials.
	b		[a =] 9000 [b =] 0.8	4	**B1** for [a =] 9000 AND **B3** for [b =] 0.8 **oe** or **M2** for $\frac{7200}{9000}$ **oe** or 80% **oe** or $\frac{9000-7200}{9000}$ **oe** 0.2 **oe** or **M1** for 7200 = $a \times b$[1] soi or better	Allow **M2** for e.g. a = 0.8 **M2** for e.g. 20% e.g. For **M1** 7200 = *their* $a \times b$[1] seen or 7200 = 9000× b[1] For **M1** accept 9000 – 7200 = 9000b[1] seen
			Total	**5**		

12			60 with correct working	6	**B1** for $\frac{1}{9}$. or 9 **soi** **M4** for $\frac{5}{3}\times\frac{4}{1}\times\frac{9}{1}$ **oe** or better or **M3** for $\frac{5}{3}\times\frac{4}{1}$ **oe isw** or better $\frac{5}{3}\times\frac{9}{1}$ **oe** **isw** or better or $1666.\dot{6}\times4\times9$ **oe** or better or **M2** for $\frac{5}{3}\div\frac{1}{4}$ **oe** or $\frac{5}{3}\div\frac{1}{9}$ **oe** for $\frac{1}{4}\times\frac{1}{9}$ **oe** or better or $1666.\dot{6}\times4$ **oe** or $1666.\dot{6}\times9$ **oe** or better or **M1** for $1\frac{2}{3}\div\frac{1}{4}$ **oe** or $1\frac{2}{3}\div\frac{1}{9}$ **oe** If **0** or **1** scored, instead award **SC2** for answer 60 If **0** scored **SC1** for $\frac{5}{3}\times8$ **oe** seen	Correct working requires evidence of at least **B1M3** (could be done in stages) or other alternate correct approach leading to 60 accept use of equivalent decimals throughout e.g. **M4** for 1666[.6…] ÷ 1000 × 4 × 9 or 1667 ÷ 1000 × 4 × 9 **M3** implied by $\frac{20}{3}$ **oe** or 6.66[6..] or 6.67 **nfww** or $\frac{45}{3}$ **oe** or 15 **nfww oe** e.g. **M3** for 1666[.6…] ÷ 1000 × 4 [or × 9] **oe** or 1667 ÷ 1000 × 4 [or × 9] **oe** If $\frac{1}{8}$ or 8 used as ratio then max mark is **M3** for $\frac{5}{3}\times\frac{4}{1}$ **oe isw** (leads to answer $53\frac{1}{3}$) or for equivalent improper fraction to $\frac{5}{3}$ **M2 oe** for both decimal values correct e.g. $1.\dot{6}\div0.25$ or $1.\dot{6}\div0.1$ e.g. 1.6 ÷ 0.25 or 1.6 ÷ 0.1, For **M2**, allow error in decimal e.g. 0.110 for 0.1 if 1 ÷ 9 method shown Accept 9 × 4 Allow **M1** for $1.\dot{6}\div\frac{1}{4}$ or $1.\dot{6}\div\frac{1}{9}$ Implied by $\frac{40}{3}$ **oe** seen, 13.3[3…] seen
			Total	**6**		

13	a		200	1		Not e.g. 200*x*, 200*k*
	b		100	1		Not e.g. –100, 100*x*, 100*k*
			Total	**2**		
14	a		Both bags may have 3 apples and 7 bananas or both bags may have 3 apples and 10 fruit A numerical example with some explanation (*n* fruit where *n* is a multiple of 10, $n \neq 10$) "Jack might be correct or might not be correct"	1 1 1dep	Accept 3 : 7 and $\frac{3}{10}$ are equivalent or 3 + 7 = 10 with $\frac{3}{10}$ or $\frac{3}{10}$, $\frac{7}{10}$ with 3 : 7 **Dep** on at least one other mark If **0** scored, instead award **SC1** for explanation along lines of: don't know how many fruit in the bag and middle box ticked	See Appendix Check for working at the top of the page More than just numbers Accept single tick, cross or other highlight
	b		24 as answer **nfww**	3	<u>By ratios:</u> **B2** for both 24 : 56 and 24 : 60 identified or for 6 : 14, 6 : 15 and 24 : 60 or **B1** for 2 ratios equivalent to 3 : 7 and 2 : 5 with a common number of apples <u>By equation:</u> **B2** for a correct equation that would lead directly to the number of apples or **B1** for a correct equation that would lead directly to the number of apples or	e.g. 6 : 14 and 6 : 15 or 12 : 28 and 12 : 30 e.g.: *a* = apples, *b* = bananas, *t* = original total, or 3*x* apples **B2** for $\frac{7a}{3} + 4 = \frac{5a}{2}$ **oe** or better or **B1** for $\frac{7t}{10} + 4 = \frac{5(t+4)}{7}$ **oe** or better or for $\frac{3x}{7x+4} = \frac{2}{5}$ **oe** or better

					total fruit, either before or after the addition of 4 apples By fractions: **B2** for $\frac{56[+4]}{80[+4]}$ and $\frac{60}{84}$ identified or **B1** for 2 fractions of the form $\frac{7k+4}{10k+4}$, where k is a positive integer All methods: If **0** scored, instead award **SC1** for answer 60 or 84	e.g. $\frac{11}{14}, \frac{18}{24}$ **oe**, $\frac{25}{34}, \frac{32}{44}$ **oe**, $\frac{39}{54}, \frac{46}{64}$ **oe**, $\frac{53}{74}, \frac{60}{84}$ **oe**
			Total	**6**		
15			$y = \frac{5184}{x^4}$ **oe**	3	**M1** for $y = \frac{k}{x^4}$ **oe soi** by $4 = \frac{k}{6^4}$ **oe** **B1** for [k =] 5184	
			Total	**3**		
16			36	4	**M3** for $(1 - \frac{1}{1.25^2})$ [× 100] oe soi $\frac{9}{25}$ oe or **M2** for $\frac{1}{1.25^2}$ [× 100] oe soi $\frac{16}{25}$ oe or 64 or **M1** for 1.25 [× 100] oe or for $y = \frac{k}{x^2}$ oe	Alternative method following a valid combination of values where $x_1^2 y_1 = k$ eg $x_1 = 4$, $y_1 = 10$, $k = 160$ **M3** for $\frac{y_1 - y_2}{y_1}$ [×100] or **M2** for $\frac{their\ k}{(1.25x_1^2)}$ soi or **M1** for $1.25x_1$ soi eg continued $\frac{10-6.4}{10}$ [×100] $\frac{160}{5^2}$ soi by 6.4 1.25 × 4 soi by 5

					Examiner's Comments Few candidates progressed beyond 1 mark for 1.25 or for $y =$ $\frac{k}{x^2}$. The more efficient method shown in the mark scheme was seldom seen. However, some candidates did make further progress by using amade-up pair of values for x and y to find their k, increase their x by 25% and use it to find the corresponding value of y, and then work out the percentage decrease in their y values. A few candidates succeeded in reaching the correct answer at the end. Exemplar 2  This exemplar shows a variation of the method described above where the candidate has exhibited some thought in the careful selection of values to use. The candidate makes sure they get a mark at the start by expressing the information algebraically. Rather than finding k for their chosen x and y values as above, this candidate chose 10 as the value ofboth x and k enabling instead y to be quickly found. They then increase x by 25% to 12.5 and calculate the new y value. The decrease in y as a fraction, decimal and percentage are then found.	
			Total	**4**		
17	a		1300 with correct working	5	**M3** for $(1 - (0.35 + 0.25)) \times \frac{3}{4} \times 2000$ oe **M1** for 0.35×2000 oe OR	'Correct working' requires evidence of M3 Condone 1300 rounded to 1000 as

					B2 for rel freq of yellow disc = 0.3 or for 1200 Green and red discs in bag or **M1** for 0.35+ 0.25 + P(y) + P(b) = 1 or better or for (0.35 + 0.25) × 2000 oe **M2dep** for (*their* 0.3 + 0.35) × 2000 oe or **M1dep** for (*their* 0.3 + 0.35) oe If 0 or M1 only scored, instead award **SC2** for answer 1300 If 0 scored, award **SC1** for 700	answer for 5 marks For M3 accept 600 yellow M1 implied by 700 For B2 accept 700 for green and 500 for red M1 for e.g.1 – (0.35 + 0.25) oe M2dep and M1 dep on at least M1 earned M1dep implied by 0.65
					Examiner's Comments Candidates that were successful in this part, worked systematically and showed each step of their working. There were two approaches used. Some worked with the probabilities and found the probability of yellow and blue first and then added the probability of yellow and green before working out the expected number of green and yellow. Others worked out the expected number of green and red and then subtracted from 2000 and used ratio to find the numbers of blue and yellow before adding green and yellow together. Candidates need to show each step as they will not receive credit if arithmetic mistakes are made within the method, e.g. probability of yellow and blue = 0.5 with no method will not receive any credit but (1 – 0.25 – 0.35) = 0.5 will receive some credit for the method shown despite the arithmetic error.	
	b		She may not have done the experiment a lot of times oe	1	**Examiner's Comments** Candidates found this part challenging and did not focus on how the reliability of any experiment depends on the number of trials. Responses included rounding values, not recording correctly and picking the same counter more than once.	

			Total	**6**	
18	a		2500	1	**Examiner's Comments** Many gave the correct answer. Some gave 3000 from 2500 × 1.2
	b		20	1	**Examiner's Comments** A number of candidates gave the correct answer. Some gave 1.2, 101.2 or 25 as the answer.
	c		That the annual percentage increase stays the same oe	1	Accept % increase/interest/%change remains constant each year If % value is given then accept 20% or *their*(b) For additional information refer to '2024 November, J560/05, Mark Scheme Appendix: item 3' within downloadable extra resource materials. **Examiner's Comments** Correct responses referred to the percentage rate of increase remaining constant for the period. Some stated the formula stayed the same. Incorrect responses referred to the annual value increasing rather than the percentage increase staying the same.
			Total	**3**	
19			144	4	**M3** for $\frac{354}{15k+20k+24k} \times 24k$ oe or **M2** $\frac{354}{15k+20k+24k}$ or all three in a ratio e.g. $15k : 20k : 24k$ **M3** implied by 90, 120, 144 with 144 not selected e.g. 3.75 : 5 : 6 and

					or **M1** for two ratios with a common number of red implied by 15*k* (white) and 24*k* (red seen, $k > 0$ or for 15*k* : 20*k* [:24*k*] or [15*k* :] 20*k* : 24*k* **Examiner's Comments** Many added the ratios so 5 + 6 = 11 and then they divided 354 by 11 and multiplied by 6. The key is to generate the ratio linking all three together by equating the red ball ratios of 4 and 5 so it was common to see 3 : 4 multiplied by 5 and 5 : 6 multiplied by 4.	condone 15*k* : 20*k* with 20*k* : 24*k* also 3.75 : 5 [: 6]
			Total	**4**		
20			4 655 to 4 655.7 or 4 656	4	**B2** for 21 or **M1** for $\frac{8.4}{2} \times 5$ oe and **M1** for $\Pi \times 8.4^2 \times$ *their* 21 **Examiner's Comments** Many were able to find the height of 21 cm, but they could not use the correct formula for the volume of the cylinder.	Condone answer of 4652.7… or 4653 or 4656.9… or 4657
			Total	**4**		
21			[*y* =] $56x^2$ with correct working	6	**B2** for $y = 3.5t^2$ or **M1** for $y = kt^2$ or better e.g.14 = $k2^2$ or $k = 3.5$ **B2** for $t = 4x$ or **M1** for $t = mx$ or better e.g. $12 = m^3$ or $m = 4$ **M1** for $y = 3.5(4x)^2$ If **0**, **1** or **2** scored, instead award **SC3** for $y = 56x^2$ with no working or insufficient working **Examiner's Comments**	"Correct working" requires evidence of at least **M1M1** or **B2** condone e.g. $y = kt^2$ and $k = 3.5$ for **B2** condone e.g. $t = mx$ and $m = 4$ for **B2** for **M1FT** allow combining *their* two expressions for *y* and *t*

					Many candidates did start to answer this question correctly, but they would often write the equations as, e.g. $t = kx$ and then give $k = 4$ but they did not write the complete equation $t = 4x$. These candidates would then find it difficult to combine the two equations. **Assessment for learning** The purpose of these questions is often to write out the equation linking two variables and that finding the value of the constant of proportionality, usually k, is not the end of the process.
			Total	**6**	
22			1261	3	**M2** for 8000 $(1+\frac{5}{100})^3$ oe or **M1** for *their* 9261 – 8000 or ☐ oe implied by 1.157[625] or 1.158 **M2** implied by 9261 Note : 9200 and 1200 are the results by simple interest and score **0** **Examiner's Comments** This question was answered well but many gave the total investment not the interest alone. A few used simple interests which underlines the value of reading the question carefully.
			Total	**3**	
23	a		y is directly proportional to x	1	
	b		$y = \frac{28}{x^3}$ **oe**	3	**M1** for $y = \frac{k}{x^3}$ **oe** or 3.5 = $\frac{k}{2^3}$ **oe** **B1** for [k =] 28
			Total	**4**	
24			6 **nfww**	4	**M3** for $\sqrt{\frac{2809}{2500}}$ **oe soi** by Condone 6% as final answer for full marks

					1.06 or **M2** for $\frac{2809}{2500}$ **oe soi** by 1.12… or **M1** for $2500x^2 = 2809$ <u>Alternative method</u> **M3** for $[r =]100 \times \sqrt{\frac{2809}{2500}} - 100$ or **M2** for $\left[\left(\frac{100+r}{100}\right)^2 =\right]\frac{2809}{2500}$ or **M1** for $2500 \times \left(\frac{100+r}{100}\right)^2 = 2809$ **oe**	May be done in stages Allow any letter in place of x. Condone use of r for **M1** May be done in stages Equivalents for $\frac{100+r}{100}$ may be seen, e.g. $1 + \frac{r}{100}$
			Total	**4**		
25			16 **nfww**	4	**B3** for 32 : 24 and 27 : 24 both identified or **M2** for trials leading to 32 : 24 or 27 : 24 or for two correct ratios identified with a common number of milk chocolates e.g. 64 :48 and 54 : 48 or **M1** for at least two correct trials of 4p : 3p where $p > 1$	May be expressed as dark = 32, milk = 24, etc. <u>Alternative method using algebra</u> **M2** for $\frac{4k-5}{3k} = \frac{9}{8}$ **oe** or **M1** for $4k - 5$ and $3k$ **A1dep** for $k = 8$, **dep** on **M2** <u>Alternative method using algebra</u> **M2** for $\frac{9m+5}{8m} = \frac{4}{3}$ **oe** or **M1** for $9m + 5$ and $8m$

					A1dep for $m = 3$, **dep** on **M2**	
			Total	**4**		
26		i	[2036 =] 3926 to 3927 and [2037 =] 4060 to 4061	3	**B2** for 3926 to 3927 or 4060 to 4061 or **M1** for 2300×1.034^{16} **oe** or 2300×1.034^{17} 16.1 3940.11 16.2 3953.31 16.3 3966.55 16.4 3979.83 16.5 3993.16 16.6 4006.53 16.7 4019.95 16.8 4033.41 16.9 4046.92 Other numbers will need calculating. Logarithms $2300\ (1.034)^n = 4000$ $(1.034)^n = 4000 \div 2300 = 1.739\ldots$ $n = \log 1.739 \div \log 1.034$ $n = 16.5[48\ldots]$ or 16.55 will score **M2** 2020 + 16.55 [= 2036.5…] or 2036 – 2020 [= 16] scores **A1**	Also condone values of n between 16 and 17. For **3** marks one must be below 4000 and one at or above 4000, with each **rot** to at least the nearest integer
		ii	It will take longer than 2036 [for the population to reach 4000]	1		*Their* response must relate to the figures in **(c)(i)** e.g. condone "decrease the number in part **(c)(i)**".

					Response Mark It will take longer to reach 4000 **1** It will not exceed 4000 by 2036 or 2037 **1** The population will be lower in 2036 **1** The population growth will be slower **1** There will be less birds [than expected] **1** They will need to use a different equation to calculate the population **0** The answer will reduce (or increase) **0** It will have a different outcome **0** The population of birds is going to decrease **0**	
			Total	**4**		
27	a		0.3 and 0.7 **oe** on the correct branches	3	**B1** for 0.3 or 0.7 **oe** **M1** for 0.3 and 0.7 on first branch or on all second branches in the correct places If **0** scored, award **SC1** for two probabilities consistently placed and adding to 1	Accept equivalent fractions $\frac{3}{10}$ and $\frac{7}{10}$
	b		0.91 or $\frac{91}{100}$ **oe**	3	**FT** for **M1** and **M2** and **3** from *their* 0.7 and *their* 0.3 throughout providing *their* 0.7 + *their* 0.3 = 1 **M2** for correct method e.g. 1 – *their* 0.3 × *their* 0.3 **oe** or **M1** for one correct branch e.g. *their* 0.7 × *their* 0.7 or *their* 0.3 × *their* 0.7	Accept 91% for **3** marks e.g. **M2** for *their* $\frac{7}{10}$ + *their* $\frac{7}{10}$ × *their* $\frac{3}{10}$ For one correct branch condone just P(lose) e.g. *their* $\frac{7}{10}$
	c		Any correct reason e.g. the answer will be smaller	1	**Response Mark** [The answer] It will be smaller **1** The probability of winning will increase **1 bod** The probability of losing will decrease **1 bod**	Their answer should explain the effect on the answer to part (b), ignore calculations.

					They lose less games **0** The answer will change because the probabilities have changed **0** The probability of losing will increase **0** The probability of winning will decrease **0**
			Total	**7**	
28	a		3.4	1	
	b		2718 to 2719	2	**M1** for 2300×1.034^5 **oe** Condone answer 2700 with **M1**
			Total	**3**	
29			x: 1, 3, 6 y: 5, 45, 180	4	**B3** for 45 or 6 or **M2** for 5×3^2 or $5x^2 = 180$ or **M1** for $y = kx^2$ **M1** implied by $y = 5x^2$ seen
			Total	**4**	
30			$y = \frac{6912}{x^3}$ oe	3	**M1** for $y = \frac{k}{x^3}$ oe soi by $4 = \frac{k}{12^3}$ oe **B1** for [k =] 6912 **Examiner's Comments** Similar questions have been set in the past and many candidates were well-prepared for this question. Nearly half scored full marks, however around a third still scored 0 marks. Candidates scored M1 for $y = \frac{k}{x^3}$ or $4 = \frac{k}{12^3}$. While most evaluated k correctly as 6912 to score B1, others wrote 12^3 yet calculated 12^2 and hence found k to be 432. Of those that reached k = 6912, some gave it as their final answer and did not write the requested formula $(y = \frac{6912}{x^3})$. There were some instances of starting with $y = kx^3$, $y = kx$ and $y = \frac{k}{x}$, all of which scored 0 marks.
			Total	**3**	

					Accept 5 : 7 and $\frac{5}{12}$ are equivalent or 5 + 7 = 12 with $\frac{5}{12}$ or $\frac{5}{12}$, $\frac{7}{12}$ with 5 : 7 Dep on at least one other mark If **0** scored **SC1** for explanation along lines of: don't know how many fruit in the bag and middle box ticked Check for working at the top of the page More than just numbers Accept single tick, cross or other highlight
31	a		Both bags may have 5 apples and 7 bananas or both bags may have 5 apples and 12 fruit A numerical example with some explanation (*n* fruit where *n* is a multiple of 12, $n \neq 12$) "Finley might be correct or might not be correct"	1 1 1dep	**Mark Reason** 5 apples : 7 bananas means the same as $\frac{5}{12}$ of the fruit are apples. 10 apples :14 bananas also means $\frac{5}{12}$ of the fruit are apples C&NC 1 1 1 An example with the same number of apples An example with a different number of apples with some words of explanation C&NC **1** Insufficient for second mark. Some words of explanation required. 5 : 7 = $\frac{5}{12}$. 1 × 5 = 5 apples and 1 × 7 = 7 bananas. 3 × 5 = 15 apples and 3 × 7 = 21 bananas still has the same ratio but different numbers. C&NC **1 1 1** Sufficient. Middle column of mark scheme. Bag Y must be 5*x* : 7*x* as $\frac{5x}{12x} = \frac{5}{12}$ for the number of apples. This ratio is 5 : 7. The number of apples will only be equal if *x* = 1. In other case the number of apples will not be equal. C&NC. **1 0 1** Not true 5 + 7 = 12. So, a : b = 5 : 7 and a = $\frac{5}{12}$ However, the amount of fruit in each bag is unknown, so it cannot be certain. C&NC. **1 0 1** Not numerical but would be SC if 0 scored 5 + 7 = 12. So, a = $\frac{5}{12}$. C&NC. **1 NR 1** Sufficient. Middle column of mark scheme There may be $\frac{5}{12}$ apples in one bag but $\frac{10}{24}$ apples in the other. C&NC. **0 1bod 1** Implies different numbers of apples but same fraction 5 : 7 means that there must be 5 apples so the fraction of apples must be $\frac{5}{12}$. C. **1 NR 0** Not strictly true; condone use of "must" 25 apples and 35 bananas is 25 : 35 which is 5 : 7 and the fraction of apples is $\frac{25}{60} = \frac{5}{12}$. C. **1 0 0** 25 apples and 35 bananas give 5 : 7 and $\frac{5}{12}$ **0, 1, 0** is also acceptable If both bags have same number of fruits they will

					have the same proportion and the same number of apples. However, if A or B have more fruits than the other, they will have more apples than the other. C&NC. **SC1** No numbers. Correct statement and tick. $\frac{5}{12}$ of the fruit are apples in both bags. Both bags could have the same number of apples but they could be different as we do not know how much fruit is in each bag. C&NC. **SC1** First sentence does not refer to ratio Bag Y is $\frac{5}{12}$ apples so bag X is $\frac{5}{12}$ apples. C&NC. **0 NR 0** Insufficient compared with middle column of scheme. Ticked box mark is dependent on at least one other mark **Examiner's Comments** Clear explanations were rare. Most candidates were given just the first mark on the mark scheme, followed by awarding both the first and third marks (the third mark was not given just for ticking the middle box, it was dependent on at least one other mark). Most candidates compared the fraction and ratio successfully to convey the idea that there could be the same number of apples in the bags. This was often by showing that 5 : 7 in bag X meant a total of 5 + 7 = 12 fruits and since five of these were apples, $\frac{5}{12}$ of the bag was apples, the same as in bag Y. Others started with bag Y, stating that if $\frac{5}{12}$ of its fruit were apples then $\frac{7}{12}$ would be bananas and that $\frac{5}{12} : \frac{7}{12}$ was equivalent to bag X's ratio. Explanations like these usually led to a tick in the first box, to score 1 mark. Other candidates used the same argument, but suggested that bag X's 5 : 7 could have been simplified while bag Y contained five apples, or similar. This usually led to the selection of the second box, to score 2 marks. A fuller and clear explanation including numerical examples could receive 3 marks. Many explanations were vague, however if they included the idea that knowing the total amount of fruit in the bags was key to deciding if Finley was correct and the middle box was ticked, an SC mark could be given. Many examples of comments and how they were marked are included in the mark scheme appendix.

	b		56 as answer nfww	3	By ratios: **B2** for both 40 : 56 and 44 : 56 identified or for 10 : 14, 11 : 14 and 44 : 56 or **B1** for 2 ratios equivalent to 5 : 7 and 11 : 14 with a common number of bananas By equation: **B2** for a correct equation that would lead directly to the number of bananas or **B1** for a correct equation that would lead directly to the number of apples or total fruit, either before or after the addition of 4 apples By fractions: **B2** for $\frac{40[+4]}{96[+4]}$ and $\frac{44}{100}$ identified or **B1** for 2 fractions of the form $\frac{5k+4}{12k+4}$, where *k* is a positive integer All methods: If **0** scored **SC1** for answer 44 or 100	eg. 10 : 14 and 11 : 14 or 20 : 28 and 22 : 28 eg: *b* = bananas, *a* = apples, *t* = original total **B2** for $\frac{5b}{7} + 4 = \frac{11b}{14}$ oe or better or **B1** for $\frac{5t}{12} + 4 = \frac{11(t+4)}{25}$ oe or better or for $\frac{5a+4}{7a} = \frac{11}{14}$ oe or better eg $\frac{9}{16}$, $\frac{14}{28}$ oe, $\frac{19}{40}$, $\frac{24}{52}$ oe, $\frac{29}{64}$, $\frac{34}{76}$ oe $\frac{39}{88}$, $\frac{44}{100}$ oe

Examiner's Comments

Questions like this have been set quite regularly on J560/06 previously and this was probably a more accessible version than most.

The simplest approach is to obtain two ratios of apples : bananas, with the same number of bananas. This was usually done with 10 : 14 for the old bag X and 11 : 14 for the new bag (as given in the question). These ratios have the same number of bananas (scoring B1) and a difference

					of one apple. Multiplying each ratio by 4 gives 40 : 56 and 44 : 56 (scoring B2). Some candidates did not multiply by 4 and instead listed ratios of 5 : 7 and 11 : 14 until they reached a pair with the same number of bananas and a difference of 4 in the number of apples. A few candidates then extracted an incorrect answer from their working, but most successfully interpreted what they had found as meaning there were 56 bananas. Setting up an equation is an equally valid method, but candidates attempting it were generally less successful. They usually started with $\left(\frac{\text{number of apples after the extra 4}}{\text{number of bananas}} =\right) \frac{5x+4}{7x} = \frac{11}{14}$. Many correctly solved this to reach $x = 8$, but then often didn't know what to do with it. The words included in the equation above were rarely seen, but shows they needed to multiply their x by 7 to get to the number of bananas. Trials and addition or multiplier methods were quite common, but almost always scored 0.
			Total	**6**	
32	a		100	1	Not e.g. 100x, 100k **Examiner's Comments** Most candidates answered this question correctly. Incorrect answers included 50% or 200%.
	b		50	1	Not e.g. –50, 50x, 50k **Examiner's Comments** Candidates generally struggled with this part. Common incorrect responses were 100%, -100% and 0%.
			Total	**2**	
33	a		No oe AND correct valid reason or correct supporting values e.g.	1	e.g. Accept e.g.

			• The value of the interest changes each year as the amount grows • It is exponential growth • Compound interest means the interest grows each year			• There will 5% interest on the £50 as well as an extra £50 oe • It will increase by 5% of 1050 • Finds £1102.5[0] or 102.5[0] or 52.50 for 2nd year If they show a calculation in their reason it must be correct

Response Mark
A No, compound interest does not increase by the same amount each year, just the same % **1**
B No, compound interest increases exponentially **1**
C No, it is 5% of the amount at the end of the first year **1**
D No, The 5% is calculated on the previous year **1**
E No, it is 5% of the 2nd year, not the first again **1**
F Incorrect, interest is taken on the total including added interest **1**
G Incorrect, she gets 5% of the new amount **1**
H No it is compound interest not simple interest **0**
I No, She has used simple interest not compound interest **0**
J No its not simple interest **0**
K No in the second year the interest is more than £50 **0**
L No she gets £51 interest in 2nd year (incorrect value for calculation) **0**

Examiner's Comments

Most candidates were able to explain that compound interest means that the interest is based on the balance at the start of each year rather than the original investment. The strongest responses referred to the calculation for the interest in the second year (either 5% of £1050 or just that the interest would be £52.50). Some candidates did not explain their reasoning fully enough, for example saying that Sasha was using simple interest rather than compound interest, but

					without any further explanation about the difference between these two types of interest.
	b		[*a* =] 8000 [*b* =] 0.8	4	**B1** for [*a* =] 8000 AND **B3** for [*b* =] 0.8 oe or **M2** for $\frac{6400}{8000}$ oe or 80% oe or $\frac{8000-6400}{8000}$ oe 0.2 oe or **M1** for 6400 = *a* × *b*[1] soi or better Allow M2 for e.g. *a* = 0.8 M2 for e.g. 20% e.g. For M1 6400 = *their a* × *b*[1] seen or 6400 = 8000× *b*[1] For M1 accept 8000 – 6400 = 8000*b*[1] seen **Examiner's Comments** There were some excellent responses, but only a minority of candidates gained full marks in this part. Many obtained one mark by substituting a relevant value into the formula and writing 6400 = *a* × *b*, or realising that *a* = 8000. Some attempted to go further and showed the calculation 6400 ÷ 8000, but didn't reach the correct value for *b*. A few calculated 8000 ÷ 6400 instead and gave the value of *b* as 1.25, which would have resulted in an increasing value rather than a decreasing value. A number of candidates did not understand how to make a start or how the equation related to the values on the graph. **Assessment for learning** Candidates should be encouraged to recognise that a multiplier above 1 increases the initial value. If they need to decrease a value, the multiplier should be less than 1. **Misconception**

					Some candidates did not appreciate that at year $n = 0$, $b^0 = 1$ and so using $8000 = a \times b^0$ the value for a can be directly found as 8000.	
			Total	**5**		
34			84 with correct working	6	**B1** for $\frac{1}{8}$ or 8 soi **M4** for $\frac{7}{4}\times\frac{6}{1}\times\frac{8}{1}$ oe or better or **M3** for $\frac{7}{4}\times\frac{6}{1}$ oe isw or better $\frac{7}{4}\times\frac{8}{1}$ oe isw or better or 1750 × 6 × 8 oe or better or **M2** for $\frac{7}{4}\div\frac{1}{6}$ oe or $\frac{7}{4}\div\frac{1}{8}$ oe or for $\frac{1}{6}\times\frac{1}{8}$ oe or better or 1750 × 6 oe or 1750 × 8 oe or better or **M1** for $1\frac{3}{4}\div\frac{1}{6}$ oe or $1\frac{3}{4}\div\frac{1}{8}$ oe If 0 or 1 scored, instead award **SC2** for answer 84 If 0 scored **SC1** for $\frac{7}{4}\times 7$ oe seen	Correct working requires evidence of at least B1M3 (could be done in stages) or other alternate correct approach leading to 84 accept use of equivalent decimals throughout e.g. M4 for 1750 ÷ 1000 × 6 × 8 M3 implied by $\frac{42}{4}$ oe or 10.5 nfww or $\frac{56}{4}$ oe or 14 nfww oe e.g. M3 for 1750 ÷ 1000 × 6 [or × 8] oe If $\frac{1}{7}$ or 7 used as ratio then max mark is M3 for $\frac{7}{4}\times\frac{6}{1}$ oe isw (leads to answer 73.5) or for equivalent improper fraction to $\frac{7}{4}$ M2 oe for both decimal values correct e.g. 1.75 ÷ 0.167 or 1.75 ÷ 0.125, For M2, allow error in decimal e.g. 0.160 for 0.167 if 1 ÷ 6 method shown Accept 8 × 6 Allow M1 for 1.75 ÷ $\frac{1}{6}$ oe 1.75 ÷ $\frac{1}{8}$ Implied by $\frac{49}{4}$ oe seen ,

						12.25 seen See AG

Example A

1.75 × 8 = 14
14 × 6 = 84

Concise complete method with decimals award 6 marks

Example B

1 : 7

$7 \times 1\frac{3}{4} = 12\frac{1}{4}$, $12\frac{1}{4} + 1\frac{3}{4} = 15$,

15 ÷ 0.6 = 25

B1 earned when they add $12\frac{1}{4}$ and $1\frac{3}{4}$ as ×8 implied and $\frac{7}{4}$ × 8 oe earns M3
There is an arithmetic error but does not affect the method
Division by 0.6 is incorrect, should be $\frac{1}{6}$ Award **B1M3**

Example C

1.75 ÷ 0.125 = 10 + 6 = 16

16 × 6 = 96

0.125 implies B1
1.75 ÷ 0.125 × 6 is equivalent to M4. The only error is 16 should be 14 which is arithmetic.
Method is fine
Award **B1M4**

Example D

$7 \times 1\frac{3}{4} = 12\frac{1}{4}$

$12\frac{1}{4}$ × 6 = 73.5 73 cups

B0 as 7 used not 8 and is not recovered

$1\frac{3}{4}$ × 6 is embedded within lines 1 and 2 and scores M3.

Award **B0M3**

					Example E 1750 [ml] × 8 = 14000 14000 × 6 = 84000 84000 cups B1 for 8 in line 1 Works in ml and earns M3 for 1750 × 8 × 6 there is no divide by 1000 Award **B1M3** Example F 1750 ml × 8 = 14000 1000 ÷ 6 = 160 14000 ÷ 160 = 87.5 = 87 cups B1 for 8 in line 1 Works in ml and earns M4 for a correct method 1750 ÷ 1000 × 8 × 6 oe , the only error is using 160 but this comes from 1000 ÷ 6 which is correct Award **B1M4** Example G $\frac{7}{4} \div \frac{8}{1}$, $\frac{7}{4} \times \frac{1}{8} = \frac{7}{32}$ $\frac{7}{32} \times \frac{1}{6} = \frac{7}{192}$, $\frac{7}{4} \times \frac{192}{7} = \frac{192}{4}$ 192 ÷ 4 = 48 B1 for 8 in line 1 There is an error in dividing $\frac{7}{4}$ by $\frac{8}{1}$ After this error the remaining steps imply $\frac{1}{6} \times \frac{1}{8}$ and earn M2 Award **B1M2** Example H $\frac{1}{6} \times \frac{1}{8} = \frac{1}{48}$ [litres cordial for 1 cup] $\frac{7}{4}$ [litres] = 48 + 36 $\frac{7}{4} = \frac{84}{48}$ 84 cups Non-standard approach using ratio after $\frac{1}{6} \times \frac{1}{8} = \frac{1}{48}$ and finding an equivalent fraction over 48 resulting in

84 cups

Award **6** marks for convincing alternate approach

Examiner's Comments

This question was attempted by the vast majority of candidates, but with mixed success. There were two methods that proved to be the most efficient and successful approaches.

The first of these was to identify that each cup required $\frac{1}{8}$ of $\frac{1}{6} = \frac{1}{48}$ litres of cordial and then converting $1\frac{3}{4}$ into $\frac{84}{48}$, from which it could be identified that the bottle had enough cordial to make 84 cups.

The second approach was to work in equivalent ratios, taking the ratio 1 : 7 and scaling it to $\frac{7}{4} : \frac{49}{4}$, followed by adding the parts of the ratio to arrive at 14L of squash, then finally multiplying this by 6.

A number of candidates attempted to work in decimals or in millilitres rather than with fractions and although method marks were often scored by these, the resulting answers were rarely accurate enough to score full marks (due to the challenge of dividing values by recurring decimals using non-calculator methods).

A number of candidates struggled to make a start. Others had quite disordered working with unstructured calculations written all over the page, which in many cases were presented without selection of a particular method to be marked.

Assessment for learning

When completing a multi-step question such as this, it's advisable for candidates to annotate steps and work in a structured fashion, so that they can keep track of which steps are left to take.

In a non-calculator paper, working with fractions is usually more accurate than attempting to convert them and work with decimals instead.

Misconception

					A common misconception is that when attempting to multiply a fraction by a whole number, some candidates multiply both the numerator and denominator by the whole number. This results in an equivalent fraction instead of a multiplied fraction.	
			Total	**6**		
35			32 nfww	4	**B2** for 11.25 **M1** for 360 ÷ *their* 11.25 seen OR **B1** for 15*a* and *a* or 16*a* **M1** for 15*a* + *a* = 180 oe **M1** for 360 ÷ *their* 11.25 seen Alternative method 1: **M2** for 15 × 360 = 180(*n* – 2) or better or **M1** for $\frac{180(n-2)}{n} = 15 \times \frac{360}{n}$ and **M1** for 180*n* = 5400 + 360 oe Alternative method 2: Use of trials by choosing a value for *n*. **M1** for each correct trial up to a maximum of **M3** for using <u>two</u> of these [exterior angle] = $\frac{360}{n}$ (formula A) [interior angle] = $\frac{180(n-2)}{n}$ (formula B) interior + exterior = 180 and for checking that interior = 15 × exterior if **0** scored **SC1** for one of formula A or B seen or used	*a* = exterior angle and allow any consistent single letter **B1 M1** implied by 16*a* = 180 or $\frac{180}{15+1}$ oe Alternative for number of sides: e.g. **M1** for $\frac{180(n-2)}{n}$ = 180 – *their*11.25 If they get 32 from any number of trials they score **4** marks. Trials can be seen from a calculation or a list. see appendix for likely results

sides	interior	exterior			
5.00	108.00	72.00	35.00	169.71	10.29
6.00	120.00	60.00			
7.00	128.57	51.43			
8.00	135.00	45.00			
9.00	140.00	40.00			
10.00	144.00	36.00			
11.00	147.27	32.73			
12.00	150.00	30.00			
13.00	152.31	27.69			
14.00	154.29	25.71			
15.00	156.00	24.00			
16.00	157.50	22.50			
17.00	158.82	21.18			
18.00	160.00	20.00			
19.00	161.05	18.95			
20.00	162.00	18.00			
21.00	162.86	17.14			
22.00	163.64	16.36			
23.00	164.35	15.65			
24.00	165.00	15.00			
25.00	165.60	14.40			
26.00	166.15	13.85			
27.00	166.67	13.33			
28.00	167.14	12.86			
29.00	167.59	12.41			
30.00	168.00	12.00			
31.00	168.39	11.61			
32.00	168.75	11.25			
33.00	169.09	10.91			
34.00	169.41	10.59			

Examiner's Comments

					Many found this difficult. A large number attempted it as if the interior angle and the exterior angle sum to 360° and not 180°, therefore giving an answer of 16 rather than 32. Some correctly found the exterior angle of 11.25° and the interior angle of 168.75° but did not know how to use these to find the number of sides. Some thought the formula to find the interior angle of a regular polygon was $180(n - 2)$. Few seemed to know the formula $360 \div n$.
			Total	**4**	
36			Correct statement with supporting working yes/correct oe and e.g. 1533 with 1532 or 0.667[1]… oe with 0.666… oe or $\frac{511}{766} - \frac{2}{3} > 0$ or $\frac{511}{766}$ and 510.6	5	**B4** for 1533 and 1532 OR **M1** for $\frac{1638}{9+3+2}$[× 9] or better — implied by 117 or 1053 **M1** for $\frac{660}{8+1+2}$[× 8] or better — implied by 60 or 480 **M1** for *their*1053 + *their*480 or 1638 + 660 — implied by 1533 or 2298 **M1** for $\frac{their\,1533}{their\,2298}$ or for *their* 2298 × $\frac{3}{5}$or 1532 — implied by 0.667[1]… oe or $\frac{511}{766}$ for those that sum the columns (i.e 17 : 4 : 4); **M1** for $\frac{1638+660}{their(17+4+4)}$[× 17] or better or $\frac{their\,17}{their(17+4+4)}$ — implied by 91.92 or1562.64 or $\frac{17}{25}$or 0.68 **M1** for $\frac{their\,1562.64}{their\,2298}$ or for *their* 2298 × $\frac{3}{5}$or 1532 or $\frac{2}{3}$[×25] — implied by 0.68 oe or 1532 or 16.6.. or 0.66… or $0.\dot{6}$ **M1** for 0.68 and 0.66… or 1562[.64]/1563 and 1532 — allow 17 and 16.6 to 16.7 **Examiner's Comments** The most successful candidates found the number of UK stamps in both collections and added these together. They then found ⅔ of the overall total and showed that there were more UK stamps than required. Some added together the ratios (to get 17 : 4 : 4) and made their argument using this information, which was not correct.

			Total	**5**	
37			The formula should be $y = kx$ [not the one they use] $y = 4.5x$ or $y = \frac{9}{2}x$ oe	1 2	**M1** for y = *kx* or better e.g. 9 = *k* × 2 Allow any letter for *k* can be awarded in the first statement *The error is……* **Mark** The formula should be *y* = *kx* [not the one they use] **1** the formula they use is not direct proportion **1** He should have multiplied *x* and *c* not added **1** They have added the constant [instead of multiplying] **1** They have used the wrong equation **1** It should not be + [*c*] **1** They should not add **1** *y* = *x* + *c* **1** They are directly proportional **0** **Examiner's Comments** Many candidates correctly described the error, but many did not give the correct equation, some leaving it as '*y* = *kx* and *k* = 4.5'. Some thought the question involved inverse proportion and gave an equation such as $y = \frac{18}{x}$.
			Total	**3**	
38	a		65 nfww	3	**M2** for [(50 × 3) – (20 × 3)] ÷ 2 oe implied by 45 or for [(50 × 3) – 20] ÷ 2 oe or **M1** for 50 × 3 implied by 150 Alternative method: **M2** for 50 + (50 ─ 20) ÷ 2 or **M1** for (50 ─ 20) ÷ 2
	b		[0].25 oe	3	**B1** for $y = \frac{k}{x^2}$ oe soi by $4 = \frac{k}{1.5^2}$ or *k* = 9

					M1 for $y = \frac{their\ k}{6^2}$ OR **M2** for $1.5^2 \times 4 = 6^2 \times y$ or $4 \div (\frac{6}{1.5})^2$	
			Total	**6**		
39			[*a* =] 15 000 [*b* =] [0].92	4	**B1** for 15 000 AND **B3** for 0.92 oe or **B2** for $\frac{13800}{15000}$ or 92% oe or $\frac{15000-13800}{15000}$ or 0.08 oe or **M1** for 13800 = $b^{[1]}a$ or 13800 = $15000b^{[1]}$	
			Total	**4**		
40			$y = \frac{1}{3}\sqrt{x}$ oe	3	**M1** for $y = k\sqrt{x}$ oe **B1** for k = 0.333… or $\frac{1}{3}$ oe	**M1** includes e.g. $y = k\sqrt{9}$ and $1 = k\sqrt{9}$
			Total	**3**		
41	a		3[%]	1		
	b		$4300 \div 1.03^6$ oe 3601 to 3602	2	**M1** for $4300 \div 1.03^k$ or 3600×1.03^6 or $4300 = n \times 1.03^6$	Equivalent is 4300×1.03^{-6} Condone 3600×1.03^6 = 4298 to 4299 for **2** marks Accept 1.194…for 1.03^6 and 0.8374… for 1.03^{-6}
			Total	**3**		
42	a		[0].8	1		
	b		51×1.008^{39} = 69.58… or 69.59	2		

					M1 for [51 ×] 1.008^{39}	Accept 69 after correct method
			Total	**3**		
43			60	2	**M1** for $\frac{45 \times 4}{3}$ **oe** or **B1** for 180 or 1.3[333..] or 0.75	
			Total	**2**		
44			52	4	**Ratios:** **B3** for 20 : 30 and 20 : 32 identified or for 30 : 20 : 32 or **M2** for 10*k* : 15*k* and 10*k* : 16*k* or for 15*k* : 10*k* : 16*k* where *k* is a positive integer or for $\frac{8}{5} - \frac{3}{2}$ **oe** implied by $\frac{1}{10}$ or **M1** for 10*k* : 15*k* or 10*k* : 16*k* where *k* is a positive integer or for or $\frac{3}{2}$ or $\frac{8}{5}$ or $\frac{3}{5}$ or $\frac{2}{5}$ or $\frac{8}{13}$ or $\frac{5}{13}$ or their reciprocals seen or used **Listing:** **M3** for multiples of 13 reaching at least 52 and multiples of 5 reaching at least 50 or for reaching 26 and 25 and then doubling or **M2** for listing multiples of 13 and 5 reaching at least 26 and 25 or **M1** for listing at least three multiples of 13 and 5	**Alternative methods using equations:** **M2** for correct unsimplified equation(s) to find original or new numbers of fiction, non-fiction or total **A1** for correct solution(s) of the equation(s), no **FT** or **M1** for one correct equation involving two variables e.g. using ***t* as new total** **M2**: $\frac{2}{5}(t - 2) = \frac{5}{13}t$ **oe** $\frac{8}{13}t - \frac{3}{5}(t - 2) = 2$ **oe** should lead to [*t* =] 52, full marks e.g. using ***t* as old total** **M2**: $\frac{2}{5}t = \frac{5}{13}(t + 2)$ **oe** $\frac{8}{13}(t + 2) - \frac{3}{5}t = 2$ **oe** **A1**: [*t* =] 50 e.g. using ***n* as new number of non-fiction**, *f* as number of

					Fractions and ratios: **B3** for $\frac{20}{50}\cdot\frac{30}{50}$ and $\frac{20}{52}\cdot\frac{32}{52}$ identified or **M2** for $\frac{10}{25}\cdot\frac{15}{25}$ and $\frac{10}{26}\cdot\frac{16}{26}$ or **M1** for $\frac{10}{25}\cdot\frac{15}{25}$ or $\frac{10}{26}\cdot\frac{16}{26}$ **All methods:** If 0 scored	fiction **M2**: $8f = 5n$ and $3f = 2(n-2)$ **A1**: $f = 20$ and $n = 32$ e.g. **using *n* as old number of non-fiction**, *f* as number of fiction **M2**: $5(n+2) = 8f$ and $3f = 2n$ **A1**: $f = 20$ and $n = 30$ e.g. **M**1: $8f = 5n$ or $3f = 2(n-2)$ or $5(n+2) = 8f$ or $3f = 2n$
			Total	**4**		
45			10	3	**M1** for $y = \frac{k}{\sqrt{x}}$ **oe** e.g. $5 = \frac{k}{\sqrt{256}}$ (k anywhere) **M1** for $y = \frac{\text{their } k}{\sqrt{64}}$ or **B1** for $k = 80$	Alternative : **M1** for $256 \div 64$ [= 4] **M1** for $5 \times \sqrt{\text{their } 4}$ Note : Direct proportionality leads to an answer of $\frac{5}{2}$ **oe**
			Total	**3**		
46	a		4865	3	**M2** for [3500 +] $3500 \times$ [0].065 $\times$ 6 **oe** or **M1** for $3500 \times$ [0].065 **oe**	Implied by 1365 Implied by 227.5 or 3727.5[0] If they use <u>compound interest</u>, put MR **M2** for $3500 \times \left(1+\frac{6.5}{100}\right)^6$ **oe** implied by 5106.9[9…] or 5107 or **M1** for $3500 \times \left(1+\frac{6.5}{100}\right)^k$ (k = 2, 3, 4, 5 or 7) or interest only implied by e.g. 1606.9[9…] In trials they must have a figure that is accurate to 3 figures. Some are using compound interest so they will get

0	3500.00
1	3727.50
2	3969.79
3	4227.82
4	4502.63
5	4795.30
6	5107.00
7	5438.95
8	5792.48
9	6168.99
10	6569.98
11	6997.03
12	7451.84
13	7936.21
14	8452.06
15	9001.44
16	9586.54
17	10 209.66
18	10 873.29

Note : Neat solution: $\log(\frac{19}{7}) \div \log(1.065) = 15.86\ldots$ **oe** hence 16 but it is not in our specification. If you see it award **M2**.
OR $1.065^t = \frac{19}{7}$ scores **M1** and a further trial will score **M1**

	b		27	3	**M2** for $\frac{9500-3500}{\textit{their } 227.50}$ **oe** or any correct method e.g. $\frac{9500-\textit{their } 4865}{\textit{their } 227.50} + 6$ or **M1** for 9500 – 3500 or 6000 or 9500 – *their* 4865

Condone 26.37… or 26.[4] as answer for **3** marks.

7	5092.50	19	7822.50
8	5320.00	20	8050.00
9	5547.50	21	8277.50
10	5775.00	22	8505.00

					Alternative method using trials **M1** for each correct trial over 4 evaluated correctly and **rot** to at least 3 s.f. to a maximum of **M2** If **0** scored **SC1** for answer of 41 or 42 from $\frac{9500}{227.50}$ **oe** A different method is : $9500 - 4500(1 + \frac{6.5}{100} \times t)$ $\frac{19}{7} - 1 = \frac{6.5}{100} \times t \; \frac{12}{7} = \frac{6.5}{100} \times t$ $1200 = 45.5t \; t = \frac{1200}{45.5}$ $t = 26.3736\ldots$	If they use compound interest, put MR **M1** for each correct trial over 4 evaluated correctly and **rot** to at least 3 s.f. to a maximum of **M2**
			Total	**6**		
47			60	4	**M3** for $\frac{4}{10-9} \times 15$ **oe** or for answer 36 : 60 : 40 or **B2** for 9 : 15 **and** 10 : 15 or 9 : 15 **and** 15 : 10 **oe seen** or ratio of B :[W] : G = $9k$: [$15k$]: $10k$ **seen** or $\frac{2}{3}[k] - \frac{2}{3}[k] = 4$ **oe** or **M1** for $\frac{2}{3}[k]$ and $\frac{3}{3}[k]$ **oe** or for attempt to adjust ratios using a common multiple of 3 and 5 with one correctly adjusted value	If working to this question is seen in part (a) then it has to be used in part (b) to score any marks For **B2** e.g. [B : W : G =] 9 :[15]:10 **oe seen** (allow in any order) **M1** for [B : W =] 9 : 15 **seen** or [G : W =] 10 : 15 **seen**

11	6002.50	23	8732.5
12	6230.00	24	8960.00
13	6457.50	25	9187.50
14	6685.00	26	9415.00
15	6912.50	27	9642.50
16	7140.00	28	9870.00
17	7367.50	29	10 097.50
18	7595.00	30	10 325.00

						or [W : G =] 15 : 10 **seen**
			Total	**4**		
48			64	4	**M3** for $(1 – (1 – 0.4)^2)$ **oe soi** or **M2** for $(1 – 0.4)^2$ **oe soi** or 0.36 or 36 or **M1** for $(1 – 0.4)$ **oe soi** or for $y = kx^2$ **oe** or $yk = x^2$ **oe**	$\frac{64}{100}$ **oe** and $^-64$ implies **M3** For method **soi** if a value of x introduced e.g. if 100 used **M2** for $100 \times (1 – 0.4)^2$ **oe** **M1** for $100 \times (1 – 0.4)$ **oe** or 60 seen Not e.g. $y \propto kx^2$
			Total	**4**		
49			375	4	**M3** for $150 \div (25 – 15) \times 25$ **oe** or **M2** for $150 \div (25 – 15)$ or $150 = \frac{25-15}{25}$ **oe** or **M1** for $\frac{25-15}{25}$ **oe** or $\frac{10}{25}$ **oe** or $(25 – 15) : 25$ **oe** or $10 : 25$ **oe** If **0** scored **SC1** for answer 250	**M3** for a complete method that would lead to 300 M2 implied by 1 [dose] = 15 **oe** e.g. 5 [doses] = 75, 2 [doses] = 30 etc Accept reciprocals of fractions for **M1** or ratios reversed
			Total	**4**		
50			133.5[0] with correct working	6	**B1** for $3a$ or $a + 4$ or $5a + 4$ or $25.5[0] + 4x$ seen **M1** for $a + 3a + a + 4 = 89$ or better or for a trial correctly evaluated	"correct working" requires at least **M1**AND**M1** or **M2** If working in pence: • Allow up to 5 part marks for consistent working • Allow full marks if answer is clearly

					A1 for [*a* =] 17 [hours] AND **M2** for $\frac{25.5[0]}{their\ 17} \times 89$ or 1.5 × 89 oe or 25.5[0] + 76.5[0] $+\frac{25.5[0]}{their\ 17} \times$ *their* 21 oe or 25.5[0] + 1.5 × 51 + 1.5 × 21 oe or **M1** for $\frac{25.5[0]}{their\ 17}$ implied by 1.5 or $\frac{25.5[0]}{5}$ implied by 5.1[0] If 0 or 1 scored, instead award **SC2** for 133.5[0] with no or insufficient working If 0 scored, instead award **SC1** for 17 [hours] with no or insufficient working	stated as 13350 p[ence] **M1** implied by sub into *a* + 3*a* + *a* [+ 4] with evaluation **B1 max** possible for using 4*a* instead of *a* + 4 e.g. **M2** for $\frac{3}{2} \times 89$ Method marks may be earned in stages May see equivalent algebraic methods. See Appendix. Non-algebraic methods may earn up to full marks.
					There are possibly many algebraic methods for this question. Examiners should use the main scheme as a template, matching steps or positions in the solution as best as possible. If in doubt, contact your Team Leader. For example: (tips) Ariel : Blake : Casey is 25.5 : 76.5 : 25.5 + 4*x* (where *x* is hourly rate of tips) This is on the scheme at B1 **B1** (total tips) 25.5 + 76.5 + 25.5 + 4*x* = 89*x* There is an equation on the scheme, so M1 would be a good judgement **M1** (solving) *x* = 1.5 And then this would be the A1 **A1** (substitution into either side of the equation) e.g. 89 × 1.5 (final answer) 133.5[0] This is on the scheme at M2 The answer is correct and the candidate has satisfied the “correct working” requirement and so is awarded full marks **M2**	
			Total	**6**		
51	a		54	4	**B3** for *x* = 15 or	

					M2 for $3(x + 11) = 2(x + 24)$ oe or better or for 39 : 26 seen or **M1** $(x + 11)$ and $(x + 24)$ seen or better	For M2 accept [P =] 39 and [F =] 26 (An answer of 69 may indicate this but check working for 39 and 26) For M1, could appear as $\overset{3}{x+24}$ $\overset{2}{x+11}$ or e.g. $3y = 24 + x$ and $2y = x + 11$
	b	$\frac{8}{13}$ oe	2FT		**B2FT** for $\frac{24}{\text{their(a)} - 15}$ dep on $0 < \text{answer} < 1$ or **B1** for numerator $8n$ or for denominator $13n$ or *their* (a) – 15	isw cancelling/conversion after correct answer seen For FT - if fraction is simplified or given as a decimal check for equivalents for B2FT or B1 **B1** must be part of a proper fraction $0 < P < 1$
			Total	**6**		
52			$\frac{7\pi r}{12}$ with correct working	5	**B4** for correct unsimplified answer with correct working OR **M1** for $\frac{45}{360} \times [2 \times]\pi k$ oe **A1** for $\frac{45}{360} \times 2\pi r$ oe or better isw incorrect cancelling/simplification AND **M1** for $\frac{45}{360} \times [2 \times] \pi\frac{4k}{3}$	Condone '×' sign oe in simplified answer if otherwise correct e.g. $\frac{7}{12} \times \pi r$ "correct working" requires **M1A1M1A1** Condone *R* for *r* throughout For method marks, allow use of 3.14, 3.142, 22/7 for π Where *k* is numeric or algebraic **but does not** come from squaring Allow e.g. $k = 3$, r, d, $\frac{3}{7}r, \frac{3}{7}x$

					A1 for $\frac{45}{360} \times \pi \frac{8}{3} r$ oe or better isw incorrect cancelling/simplification If 0 or 1 scored, instead award **SC2** for final answer $\frac{7\pi r}{12}$ oe simplified answer with no or insufficient working	For A1 accept e.g. 0.25 π*r* Correct expression implies M1A1 For M1 must use *their* previous *k* e.g. uses *k* = 6 for first M1 then uses 8 here for $\frac{4k}{3}$ gets 2nd M1 **unless** the expression is correctly stated as $\frac{45}{360} \times \pi \frac{8}{3} r$ oe which gets M1A1 Correct expression implies M1A1
			Total	**5**		
53			13.5	3	**M2** for 2 : 27 oe or for 9 ÷ $\frac{2}{3}$ oe seen or **M1** for $\frac{2}{3}$: 9 oe ratio seen **Alternative method in tablespoons:** **M2** for $\frac{2}{9}$: 3 oe seen or **M1** for $\frac{2}{3} \times \frac{1}{3}$[: 3] oe seen	For M1 e.g. 0.67 : 9 M2 for e.g. 1 : $\frac{27}{2}$ oe If in decimal form allow 0.33 for $\frac{1}{3}$ and 0.22 for $\frac{2}{9}$
			Total	**3**		
54			0.5 oe final answer	3	**B1** for $y = \frac{k}{x^2}$ oe soi by $8 = \frac{k}{3^2}$ or *k* =72 **M1** for $y = \frac{\text{their } k}{12^2}$ OR **M2** for $3^2 \times 8 = 12^2 \times y$ oe	oe e.g. for 3 marks $\frac{72}{144}$ oe
			Total	**3**		
55	a		1.045 is greater than 1 oe	1	**Response Mark** 1.045 is above 1 **1** the percentage multiplier is above 1 **1** it is being multiplied by a number greater than 1 **1**	

					the rate is above 1 **1** the multiplier is higher than 1 **1** 104.5 means 104.5% and that means 4.5% is **added** each year **1(BOD)** 104.5% is an increase **add on** to 100 **1(BOD)** it is above 1 **1** the number is multiplied by 1 and 4.5% **1(BOD)** the multiplier starts with a 1 **0** it is being added to 100% **0** the multiplier is positive **0** the multiplier is 1.045 **0**
	b		4.5	1	
	c		195 000	1	
	d		232 500	2	**M1** for $195\,000 \times 1.045^4$ soi 232541[…] If **0** scored **B1** for *their* answer to more than 4 figs correctly rounded to 4 s.f.
	e	i	any correct method, e.g. 377 380[…] 394 362[…]	2 1	**M1** for $195\,000 \times 1.045^{15}$ Alternative method 1 e.g. 1.045^{15} = 1.93 to 1.94 scores **2** 1.045^{16} = 2.02 to 2.03 scores **1** Alternative method 2 188 690[…] for **2** marks 197 181[…] for **1** mark
		ii	any correct explanation e.g. the rate of increase may not continue	1	**Response Mark** the rate of increase may not continue **1** house prices fluctuate **1** they could drop **1** 'something' may cause the price to drop (e.g. damage, inflation, local flooding, financial crisis or Brexit) **1** they may increase at different rates **1** the house may be demolished **1** accept any home improvement e.g. extension (might increase faster than predicted) **1**

					it is only an estimate **0** it is only a prediction **0** house market may have changed **0**	
			Total	**9**		
56	a		$y = \frac{42}{\sqrt{x}}$ **oe**	3	**M1** for $y = \frac{k}{\sqrt{x}}$ **oe** **B1** for [k =] 42	e.g. condone $y = \frac{k}{\sqrt{49}}$ for **M1**
	b		1.96 **oe**	3	**B2** for $\sqrt{x} = \frac{42}{30}$ **oe** Or **M1** for $30 = \frac{their\ 42}{\sqrt{x}}$ or $\frac{30}{6} = \frac{\sqrt{49}}{\sqrt{x}}$	
			Total	**6**		
57			45 with correct working	5	**B3** for angle BCD = 105 with correct working Or **M1** for angle BAD = 75 or for angle BDE = 180 – 75 or 105 **M1** for angle BCD = 180 – *their* angle BAD AND **M2** for *their* angle BCD ÷ 7 × 3 **oe** Or **M1** for *their* angle BCD ÷ 7 **oe** If **0** scored **SC2** for answer 45	For full marks 'correct working' requires evidence of at least **M1** AND **M1** i.e. at least a correct angle and some ratio work Ignore geometric reasons if given For **B3** "correct working" requires at least **M1** or alternate convincing approach Angles may be indicated on diagram for part marks

					Or **SC1** for angle BCD = 105	May be seen on diagram
			Total	**5**		
58			10 with correct working	7	**M1** for $\frac{BD}{12}$ = sin 30 **oe** **B1** for sin 30 = 0.5 **soi** **A1** for [BD =] 6 **M1** for *their* BD × $\frac{4}{3}$ **oe** **A1** for CD = 8 **M1** for (*their* BD)^2 + (*their* CD)^2 [= BC^2] **oe** If **0** scored **SC3** for answer 10 with no working Or **SC2** for CD = 8 with no working Or **SC1** for BD = 6 with no working	'Correct working' requires evidence of at least **M1** or **B1** and **M1M1** or alternate convincing approach Answer 8 gets **A0** unless CD = 8 shown in working or on diagram **SCs** may be seen on the diagram
			Total	**7**		
59			2.25	4	**B3** for 0.0225 OR **M1** for 8900 – 8000 or $\frac{8900}{8000}$ **M1** for $\frac{\textit{their}\ 900}{8000}$ or $\frac{\textit{their}\ 900}{8}$ or 1.1125 – 1 **M1** for *their* 0.1125 ÷ 5 or *their* 112.5 ÷ 5000	Accept any correct method and condone extra % symbol Implied by 900 or 1.1125 Implied by 0.1125 or 112.5 Implied by 0.0225
			Total	**4**		
60	a		8500	1		
	b		5.4	1		Condone extra %
	c	i	15 200 or 15 160 or 15 159	2		

					M1 for 8500×1.054^{11} **oe**	Allow 15 158 or 15 158.8[2…]
		ii	Any correct reason e.g. the rate may not continue	1	**Response Mark** The rate may not continue **1** There may not be enough housing on the island **1** They may run out of space **1** There may be a famine **1** There may be disease **1** The answer is a decimal **0** People will die **0**	
			Total	**5**		
61	a		7 × 275 **soi** by 1925 1925 ÷ 2000 **soi** by 0.96[25] or 1 and 1 × 218 = 218[p] or £2.18 1975 ÷ 600 **soi** by 3.29[1…] or 4 and 4 × 65 = 260[p] or £2.60	M1 B1 B1	Accept any correct argument If **B0** then **SC1** for 1 [of 2 litres] and 4 [of 600 ml]	Condone omitting one day so 6 × 275 **soi** by 1650 for **M1** 1 carton, so 218[p] or [£]2.18 is sufficient 4 × 65 = 260[p] is sufficient
	b		600 ml with three correct comparisons	3	Allow any correct comparison e.g. (converting all to 600 ml) **B2** for three correct figures to compare Or **B1** for two correct figures OR **M1** for one correct appropriate calculation e.g. $2.18 \times \frac{3}{20}$ or $34 \times 20 \div 3$ **oe**	11.3[3…], 10.8[3…], 10.9p per 100 ml Or 34, 32.5, 32.7p per 300 ml Or 68, 65, 65.4p per 600 ml Or 226[.6…], 216[.6…], 218p per 2 litres e.g. 32.5[p] is sufficient for **B1** as it compares to 34[p]
			Total	**6**		
62			4 nfww	4		

					M3 for $\sqrt{\frac{2704}{2500}}$ oe soi by 1.04 or **M2** for $\frac{2704}{2500}$ oe soi by 1.08… or **M1** for $2500x^2 = 2704$ <u>Alternative method</u> **M3** for [r =] $100\sqrt{\frac{2704}{2500}} - 100$ or **M2** for $\left[\left(\frac{100+r}{100}\right)^2 =\right]\frac{2704}{2500}$ or **M1** for $2500 \times \left(\frac{100+r}{100}\right)^2 = 2704$ oe	Condone 4% as final answer for full marks May be done in stages Allow any letter in place of x. Condone use of r for **M1** May be done in stages Equivalents for $\frac{100+r}{100}$ may be seen, eg. $1+\frac{r}{100}$

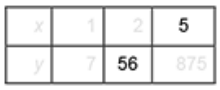
<u>Examiner's Comments</u>

Nearly all candidates attempted this question. About half gained no marks and about a third gained full marks.

Two successful methods were seen. The most straightforward was to set up and solve $2500x^2 = 2704$, which leads to $x = 1.04$ therefore the answer is 4%. The other started with substitution into the formula given on the formula sheet, leading to $2500\left(1+\frac{r}{100}\right)^2 = 2704$ and resulting in $r = 4$.

					Either of the above equations gained M1. Valid working to solve the equation was given further method marks. A common error was to treat the question as simple interest, i.e. 2704 − 2500 = 204, then 204/2500 = 8.16% and then 4.08%. This gained no marks because it has simplified the demand. **Misconception** Simple interest and compound interest appear fairly regularly in questions on both the Foundation and Higher tiers. Candidates appear to engage well with these questions, but confusion between the two is likely to result in loss of marks.
			Total	**4**	
63			32 nfww	4	**B3** for 24 : 16 and 18 : 16 both identified or **M2** for trials leading to 24 : 16 or 18 : 16 or for two correct ratios identified with a common number of milk chocolates eg. 12 : 8 and 9 : 8 or **M1** for at least two correct trials of $3p : 2p$ where $p > 1$ or for two correct ratios identified with a difference of six dark chocolates eg 15 : 10 and 9 : 8 May be expressed as dark = 24, milk = 16, etc. Alternative method using algebra **M2** for $\frac{3k-6}{2k} = \frac{9}{8}$ oe or **M1** for $3k - 6$ and $2k$ **A1dep** for $k = 8$, **dep** on **M2** Alternative method using algebra **M2** for $\frac{9m+6}{8m} = \frac{3}{2}$ oe or **M1** for $9m + 6$ and $8m$ **A1dep** for $m = 2$, **dep** on **M2** **Examiner's Comments** This was an accessible question for some candidates, but most struggled to make worthwhile progress despite similar questions being set

					previously. There are many approaches possible (as detailed on the mark scheme), but the most common and successful was using equivalent ratios. Correct solutions came from noting that the number of milk chocolates is unchanged and therefore the first step is to write down the two ratios equivalent to those in the question that have the same number of milk chocolate parts, e.g. 12 : 8 : 16 and 9 : 8, which gained M2. That gives a difference of 12 − 9 = 3 dark chocolates, so scaling up the two ratios to have a difference of six dark chocolates gives 24 : 16 : 32 and 18 : 16, from which the answer 32 can be extracted. A few correct algebraic methods were also seen from candidates, but most used incorrect starting equations.
			Total	**4**	
64	a		*y* is inversely proportional to *x*	1	**Examiner's Comments** This was a multiple-choice question, but few candidates recognised the equation as a rearrangement of the more usual $y = \frac{36}{x}$ form for inverse proportion.
	b		$y = \frac{40}{x^2}$ oe	3	**M1** for $y = \frac{k}{x^2}$ oe or $2.5 = \frac{k}{2^2}$ oe **B1** for [*k* =] 40 **Examiner's Comments** This question had a high omission rate. Similar questions have been set in the past and were answered well. Some candidates did not interpret the information given in the question correctly, instead treating this part as $y = \frac{k}{x}$. Some candidates found success by writing $y = \frac{k}{x^2}$ algebraically then substituting the values and finding *k* as 40, but for full marks it is necessary to

					write down the response to the question asked, i.e. $y = \frac{40}{x^3}$ or equivalent. Candidates either appeared confident on this topic and were able to pick up full marks, or struggled to show understanding and received few marks.
			Total	**4**	
65				4	**B3** for 56 or 5 or **M2** for 7×2^3 or $7x^3 = 875$ or **M1** for $y = kx^3$ **M1** implied by $y = 7x^3$ seen **Examiner's Comments** There were a few good answers scoring all 4 marks. Others were able to give a correct equation for the proportional relationship but only find one correct value. Many were unable to interpret the proportional relationship; having $y = 7x$ leading to 14 and 125 was a common error. Many candidates omitted this question.
			Total	**4**	
66	a		4.2	1	**Examiner's Comments** Many candidates gave the correct response of 4.2 but some wrote 1.042 instead. This was the most common incorrect response.
	b		4479 to 4480	2	**M1** for 3800×1.042^4 oe condone answer 4500 with **M1** **Examiner's Comments** This part was answered very well. The most common error was to calculate 3800×1.042^2 using $n = 2$.
	c	i	[2034=] 6759 to 6760 and [2035=] 7043 to 7044	3	

					B2 for 6759 to 6760 or 7043 to 7044 or **M1** for 3800×1.042^{14} oe or 3800×1.042^{15} oe	Also condone values of *n* between 14 and 15, for **3** marks one must be below 7000 and one at or above 7000, each rot to at least the nearest integer (see appendix)

14.1	6787.63
14.2	6815.62
14.3	6843.72
14.4	6871.93
14.5	6900.26
14.6	6928.71
14.7	6957.27
14.8	6985.96
14.9	7014.76

Other numbers will need calculating.
Logarithms
$3800\ (1.042)^n = 7000$
$(1.042)^n = 7000 \div 3800 = 1.842\ldots$
$n = \log 1.842 \div \log 1.042$
n = 14.8[48…] or 14.85 will score **M2**

2020 + 14.85 [= 2034.8…] or 2034 – 2020 [= 14] scores **A1**

Examiner's Comments

This was answered quite well although many candidates thought giving 3800×1.042^{15} = 7043….. was enough to show what the question demand required. However, this showed that it had reached 7000 by the end of 2034/start of 2035 but it does not show it happened during 2034 unless they show the population at the start of 2034 as well. Many candidates did get marks on this question.

		ii	It will take longer than 2034 [for the population to reach 7000]	1		

					their response must relate to the figures in **(c)(i)** e.g condone "decrease the number in part **(c)(i)**" It will take longer to reach 7000 **1** It will not exceed 7000 by 2034 or 2035 **1** the population will be lower in 2034 **1** the population growth will be slower **1** there will be less birds [than expected] **1** they will need to use a different equation to calculate the population **0** the answer will reduce (or increase) **0** It will have a different outcome **0** The population of birds is going to decrease **0** **Examiner's Comments** Many candidates did give an acceptable response. The common error was to suggest that the population will be greater than expected or the population would reach 7000 earlier than expected.
			Total	**7**	
67	a		0.4 and 0.6 oe on the correct branches	3	**B1** for 0.4 or 0.6 oe **M1** for 0.4 and 0.6 on first branch or on all second branches in the correct places If **0** scored **SC1** for two probabilities consistently placed and adding to 1 Accept equivalent fractions $\frac{2}{5}$ and $\frac{3}{5}$ **Examiner's Comments** Most candidates found $\frac{2}{5}$ and $\frac{3}{5}$ but some only put these probabilities on the first branch, with many going on to put $\frac{1}{3}$ and $\frac{2}{3}$ or $\frac{1}{4}$ and $\frac{3}{4}$ on the second branches. Despite this being a probability tree, some candidates wrote integers in the spaces.
	b		0.64 or $\frac{16}{25}$ oe	3	

					FT for **M1** and **M2** and **3** from *their* 0.6 and *their* 0.4 throughout providing *their* 0.6 + *their* 0.4 = 1 **M2** for correct method e.g. 1 – *their* 0.6 × *their* 0.6 oe or **M1** for one correct branch e.g. *their* 0.6 × *their* 0.6 or *their* 0.4 × *their* 0.6 **Examiner's Comments** Most candidates did write down one correct product, but many only wrote down the two products that lead to the probability of exactly one win when they were asked for the probability at least one win. Most did multiply the two probabilities on successive branches and add together the alternatives, although some multiplied all the probabilities together.	Accept 64% for **3** marks e.g. **M2** for $their\ \frac{2}{5} + their\frac{3}{5} \times their\frac{2}{5}$ for one correct branch condone just P(win) e.g. $their\ \frac{2}{5}$
	c		any correct reason e.g. the answer will be smaller	1	[the answer] it will be smaller **1** the probability of winning will decrease **1bod** The probability of losing will increase **1 bod** They win less games **0** the answer will change because the probabilities have changed **0** the probability of losing will decrease **0** the probability of winning will increase **0** **Examiner's Comments** The question asks for the effect on the answer to part (b), but many candidates discussed how many games they are likely to win and some started to do calculations. Some thought that there would be a greater chance of winning. Still there were many correct responses to this question.	Their answer should explain the effect on the answer to part (b), ignore calculations, see appendix

			Total	**7**	
68			21	3	**M1** for $y = \frac{k}{\sqrt{x}}$ oe e.g. $7 = \frac{k}{\sqrt{144}}$ (k anywhere) **M1** for $y = \frac{their\ k}{\sqrt{16}}$ or **B1** for $k = 84$ Alternative : **M1** for $144 \div 16$ [= 9] **M1** for $7 \times \sqrt{their 9}$ Note : Direct proportionality leads to an answer of $\frac{7}{3}$ oe **Examiner's Comments** This question was answered well. Quite a few candidates were able to get as far as $y = \frac{k}{\sqrt{x}}$ and k = 84, but then gave an answer of 5.25 from $\frac{84}{16}$ (not applying the square root to 16). Common misconceptions included attempting y inversely proportional to x^2 or y directly proportional to the square root of x. Only a few candidates used the alternative method, which started with $\frac{144}{16} = 9$, but then they generally attempted 7×9 or $\frac{7}{9}$ instead of doing $7 \times \sqrt{9}$.
			Total	**3**	
69	a		5850	3	**M2** for [4500 +] $4500 \times$ [0].075 $\times$ 4 oe (implied by 1350) or **M1** for $4500 \times$ [0].075 oe (implied by 337.5[0] or 4837.5[0]) or If they use compound interest, put MR **M2** for $4500 \times (1 + \frac{7.5}{100})^4$ oe implied by 6009.6[1…] or 6010 or **M1** for $4500 \times (1 + \frac{7.5}{100})^k$ (k = 2, 3 or 5) or interest only implied by e.g. 1509.6[1…] For additional information refer to **2023 June**

					(J56004) Mark scheme Appendix within downloadable additional mark guidance. **Examiner's Comments** Misreads were commonplace in both parts (a) and (b), with a large number of candidates using compound interest, which made the question more difficult. Those candidates who used simple interest and $\frac{7.5}{100}$ or 0.075 in many cases found the interest of £337.50 for one year and usually went on to obtain the correct answer. Some candidates tried to use year-by-year calculations and inaccuracies would often creep in when they rounded or truncated numbers prematurely. Other common mistakes included using 0.75 for 7.5% instead of 0.075.
	b		27	3	**M2** for $\frac{13\,500-4500}{their337.50}$ oe or any correct method e.g. $\frac{13\,500-their\ 5850}{their337.50}+4$ or **M1** for 13 500 – 4500 or 9 000 or 13 500 – *their* 5850 <u>Alternative method using trials</u> **M1** for each correct trial over 4 evaluated correctly and rot to at least 3 s.f. to a maximum of **M2** If **0** scored **SC1** for answer of 40 or 41 from $\frac{13\,500}{337.50}$ oe Condone 26.66… or 26.[7] as answer for **3** marks. If they use compound interest, put MR **M1** for each correct trial over 4 evaluated

5	6187.50	18	10575.00
6	6525.00	19	10912.50
7	6862.50	20	11250.00
8	7200.00	21	11587.50
9	7537.50	22	11925.00
10	7875.00	23	12262.50
11	8212.50	24	12600.00
12	8550.00	25	12937.50
13	8887.50	26	13275.00
14	9225.00	27	13612.50
15	9562.50	28	13950.00
16	9900.00	29	14287.50
17	10237.50	30	14625.00

					correctly and rot to at least 3 s.f. to a maximum of **M2** A different method is : $13500 = 4500(1 + \frac{7.5}{100} \times t)$ $3 = 1 + \frac{7.5}{100} \times t$ $2 = \frac{7.5}{100} \times t$ $200 = 7.5t$ $t = \frac{200}{7.5}$ *t = 26.6666…..* **Examiner's Comments** The most common technique used to obtain the correct answer was $\frac{9000}{337.50}$ with simple interest, although $\frac{200}{7.5}$ following $\frac{13500 - 4500}{4500} = 2$ was a very unusual method seen. For those who misread the question and used compound interest, using trials was the most common method to find *t*.
			Total	**6**	
70	a		[0].9	1	**Examiner's Comments** About half of the candidates simply wrote down the correct answer as instructed. Candidates who gave incorrect answers usually gave 0.009 or did some work to find *P* for two consecutive values of *n* and then attempted to find the percentage increase, invariably with at least one error (or they merely subtracted the two answers).
	b		49×1.009^{39} = 69.49… or 69.5[0]	2	**M1** for [49 ×] 1.009^{39} Accept 69 after correct method **Examiner's Comments** Candidates either correctly worked out *P* when *n* is 39 or they worked out *P* when *n* is 40. The award of 1 mark for using n as 39, but evaluating incorrectly, was rare.

			Total	**3**	
71			100	2	**M1** for $\frac{40 \times 5}{2}$ oe or **B1** for 200 or 2.5 or 0.4 **Examiner's Comments** Candidates generally either recognised the context as being inverse proportion and then usually scored full marks, or they dd not and scored zero. Most of the latter showed an incorrect two-step calculation based on direct proportion, i.e. 40 ÷ 5 = 8 minutes for 1 hose, and so 8 × 2 = 16 minutes for 2 hoses. Successful candidates either started with 40 × 5 = 200 minutes for 1 hose pipe and then halved to get the time for 2 hose pipes, or they used a table/scaling approach showing that 5 hose pipes to 2 hose pipes is a division by 2.5 (or a multiplication by 0.4) and so because of inverse proportion, 40 × 2.5 = 100 minutes. A few candidates showed some understanding of inverse proportion, if not the context. For example, some candidates stated that it would take 80 minutes for 2.5 hoses but they were then unable to deal correctly with 0.5 of a hose pipe. These candidates had not really made any worthwhile progress beyond what was given in the question and so scored 0 marks.
			Total	**2**	
72			78	4	**Ratios:** **B3** for 32 : 48 and 30 : 48 identified or for 32 : 48 : 30 or **Alternative methods using equations:** **M2** for correct unsimplified equation(s) to find original or new numbers of fiction, non-fiction or total

					M2 for $16k : 24k$ and $15k : 24k$ or for $16k : 24k : 15k$ where k is a positive integer or for $\frac{2}{3} - \frac{5}{8}$ oe implied by $\frac{1}{24}$ or **M1** for $16k : 24k$ or $15k : 24k$ where k is a positive integer or for $\frac{2}{3}$ or $\frac{5}{8}$ or $\frac{2}{5}$ or $\frac{3}{5}$ or $\frac{5}{13}$ or $\frac{8}{13}$ or their reciprocals seen or used **<u>Listing:</u>** **M3** for multiples of 13 reaching at least 78 and multiples of 5 reaching at least 80 or for reaching 39 and 40 and then doubling or **M2** for listing multiples of 13 and 5 reaching at least 39 and 40 or **M1** for listing at least three multiples of 13 and 5 **<u>Fractions and ratios:</u>** **B3** for $\frac{32}{80} : \frac{48}{80}$ and $\frac{30}{78} : \frac{48}{78}$ identified	**A1** for correct solution(s) of the equation(s), no FT or **M1** for one correct equation involving two variables eg using ***t* as new total** **M2**: $\frac{3}{5}(t+2) = \frac{8}{13}t$ oe $\frac{2}{5}(t+2) - \frac{5}{13}t = 2$ oe should lead to [t =] 78, full marks eg using ***t* as old total** **M2**: $\frac{3}{5}t = \frac{8}{13}(t-2)$ oe $\frac{2}{5}t - \frac{5}{13}(t-2) = 2$ oe **A1**: [t =] 80 eg using ***f* as new number of fiction**, n as number of non-fiction **M2**: $8f = 5n$ and $3(f + 2) = 2n$ **A1**: $f = 30$ and $n = 48$ eg **using *f* as old number of fiction**, n

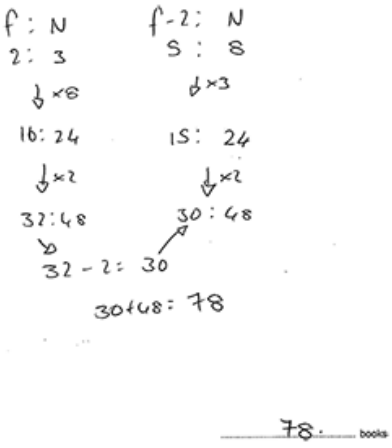
					or **M2** for $\frac{16}{40}:\frac{24}{40}$ and $\frac{15}{39}:\frac{24}{39}$ or **M1** for $\frac{16}{40}:\frac{24}{40}$ or $\frac{15}{39}:\frac{24}{39}$ **All methods:** If **0** scored **SC1** for answer 30, 32, 48 or 80	as number of non-fiction **M2**: $8(f-2)=5n$ and $3f=2n$ **A1**: $f=32$ and $n=48$ eg **M**1: $8f=5n$ or $3(f+2)=2n$ or $8(f-2)=5n$ or $3f=2n$

Examiner's Comments

The question could be answered using a variety of methods including ratios, listing, fractions and by setting up algebraic equations, or by combinations of these methods.

One of the most successful methods was through realising that the number of non-fiction books remains unchanged and, therefore, the number of non-fiction books must be a multiple of 24 (3 × 8). This leads to the ratios being rewritten as 16 : 24 and 15 : 24. Candidates then realised that this has a difference of 1 fiction book, so doubling gives 32 : 48 and 30 : 48, and hence the answer of 30 + 48 = 78. A few candidates gave the answer of 32 + 48 = 80 rather than 30 + 48 = 78. A common incorrect answer from ratios was 26, usually from using 12 : 18 and 10 : 16.

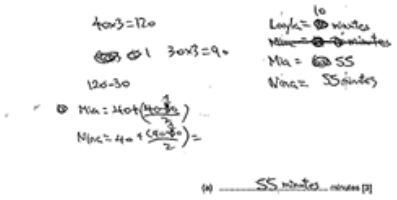
A similar approach, but different presentation, was listing. This was seen more frequently, although only with some success. Candidates needed to list multiples of 5 (2 + 3) and 13 (5 + 8) until they found a multiple of 5 that was greater than a multiple of 13 by 1 (i.e. 40 and 39) and then double or continue listing to get a difference of 2 (i.e. 80 and 78).

					Other candidates worked in fractions, commonly ending up with a denominator of 65 that then led to a variety of wrong answers. A mark was quite frequently given for certain fractions, such as $\frac{5}{13}$ and $\frac{2}{5}$. Candidates attempting to use algebra often had trouble setting up the equations and made no progress. The exception was candidates who initially equated the two ratios after the two fiction books had been removed; for some integer value x, $2x – 2 : 3x$ must be in the ratio 5 : 8, which leads to $8(2x – 2) = 15x$ and then $x = 16$; substituting this into the first ratio gives 30 : 48 and, hence, 78 books. This question was particularly susceptible to multiple attempts. Often the working was confused and abandoned methods were not crossed out, making it difficult for the examiner to decipher. Some candidates had something creditworthy on the page but could not score method marks for it because it did not form part of the method leading to their final answer. Exemplar 3  The exemplar above shows a clear presentation of a method using ratios. The candidate aims for a common number of non-fiction books in the two ratios, scoring M2 for 16 : 24 and 15 : 24. They then double the two ratios to give a difference of 2 in the number of fiction books, with 32 : 48 and 30 : 48 moving the mark to M3, before going on to the correct answer.
			Total	**4**	
73			300	4	

					M3 for 180 ÷ (20 – 8) × 20 **oe** or **M2** for 180 ÷ (20 – 8) or $180 = \frac{20-8}{20}$ **oe** or **M1** for $\frac{20-8}{20}$ **oe** or $\frac{8}{20}$ **oe** or (20 – 8) : 20 **oe** or 8 : 20 **oe** If **0** scored **SC1** for answer 450	M3 for a complete method that would lead to 300 M2 implied by 1 [dose] = 15 **oe** e.g. 4 [doses] = 60, 2 [doses] = 30 etc Accept reciprocals of fractions for M1 or ratios reversed
					Examiner's Comments The vast majority of candidates answered this question well, showing a correct method and scoring full marks. The most common error was not recognising that 180 ml was the amount of medicine remaining, so they linked 180 ml to 8 days rather than 12 days. Where candidates did attempt to divide 180 by 12 within the method, a few made arithmetic errors in the calculation, but were then able to show a full correct method when multiplying the value of their division by 20. A few candidates with an incorrect answer showed limited working and as a consequence were unable to score any method marks.	
			Total	**4**		
74			18	4	**M3** for $\frac{15}{14-9} \times 6$ **oe** or for answer 27 : 18 : 42 or **B2** for 9 : 6 **and** 14 : 6 or 9 : 6 **and** 6 : 14 **oe seen** or ratio of *A* :[Z] : *M* = 9*k*: [6*k*]: 14*k* **seen** or $\frac{7}{3}[k] - \frac{3}{2}[k] = 15$ **oe**	If working to this question is seen in part (a) then it has to be used in part (b) to score any marks For B2 e.g. [A : Z : M =] 9 :[6]:14 oe **seen** (allow in any order)

					or **M1** for $\frac{7}{3}[k]$ and $\frac{3}{2}[k]$ **oe** or for attempt to adjust ratios using a common multiple of 2 and 3 with one correctly adjusted value If 0 scored, **SC1** for 21: 14 : 6 **oe** seen	M1 for [A : Z =] 9 : 6 seen or [M : Z =] 14 : 6 seen or [Z : M =] 6 : 14 seen
					Examiner's Comments This question really challenged candidates' understanding of ratio, but really demonstrated improvement in the topic when compared to previous series. Many correctly combined the ratios and gained part marks for showing a correct combined ratio, e.g. 9 : 6 : 14. The next stage of linking the combined ratio to the difference of 15 more meerkats than antelope proved more challenging, but a significant number reached a correct answer. Those who were more confident were able to link the 15 with, for example, 14 – 9 to find the correct multiplier to complete the calculation. Some showed a sequence of equivalent ratios until a difference of 15 between meerkats and antelopes was seen. A few attempted to combine the two ratios, but used addition rather than looking for a common multiple for the zebra element of both ratios.	
			Total	**4**		
75			51	4	**M3** for $(1 - (1 - 0.3)^2)$ **oe soi** or **M2** for $(1 - 0.3)^2$ **oe soi** or 0.49 or 49 or **M1** for $(1 - 0.3)$ **oe soi**	$\frac{51}{100}$ oe and −51 implies M3 For method soi if a value of x introduced e.g. if 100 used M2 for $100 \times (1 - 0.3)^2$ oe M1 for $100 \times (1 - 0.3)$ oe or 70 seen Not e.g. $y \propto kx^2$

					or for $y = kx^2$ **oe** or $yk = x^2$ **oe** **Examiner's Comments** Only a small number of candidates reached the correct answer here. Most were able to give an equation of proportionality, but some confused direct and indirect proportion, or square and square root. Many reached 0.7 or 0.7^2, which was awarded partial credit. Those that reached 49% often did not complete the question by subtracting from 100% to get the correct answer. For many candidates, working was quite random. Many included multiple attempts, where awarding credit for method was not possible owing to the number of choices given.
			Total	**4**	
76	a		55 nfww	3	**M2** for [(40 × 3) – (10 × 3)] ÷ 2 oe implied by 45 or for [(40 × 3) – 10] ÷ 2 oe or **M1** for 40 × 3 implied by 120 Alternative method: **M2** for 40 + (40 ─ 10) ÷ 2 or **M1** for (40 ─ 10) ÷ 2 **Examiner's Comments** Candidates often applied inverse proportion to correctly identify that a total of 120 minutes were needed to paint the entire wall. This scored M1. Various approaches could then be used to answer the question and a good number of correct final answers were seen. Those that did not find the

					answer of 55 minutes often did not score a second method mark because the logic in their working could not be followed. Probably the most efficient method seen was to reason 120 minutes were needed in total and Layla had stopped after 10 minutes; therefore, Mia and Nina needed to paint for 120 – 10 = 110 minutes between them, so it will take them 55 minutes. Exemplar 2  In this exemplar the candidate finds that a total of 120 minutes is needed but then changes direction. Instead, they reason that 40 minutes is needed per person to paint the wall. So when Layla stops after 10 minutes, there is an extra (40 – 10) minutes of painting that needs to be done, to be divided between Mia and Nina. Therefore, it will take $40 + \frac{(40-10)}{2}$ minutes to paint the wall. Some candidates continued from 120 with 120 – 30 = 90, representing the number of minutes needed to finish the wall after Layla stops at 10 minutes. This 90 minutes is divided between Mia and Nina as 45 minutes each. With the initial 10 minutes, this also makes a total of 10 + 45 = 55 minutes.
	b		[0].25 oe	3	**B1** for $y = \frac{k}{x^3}$ soi by $16 = \frac{k}{2^3}$ or $k = 128$ **M1** for $y = \frac{their\ k}{8^3}$ OR **M2** for $2^3 \times 16 = 8^3 \times y$ or $16 \div (\frac{8}{2})^3$

					Examiner's Comments Candidates who were able to interpret the proportional relationship in a correct algebraic statement usually completed the question correctly. Starting with either $y = kx^3$ or $y = \frac{k}{x}$ was common though.
			Total	**6**	
77			[a =] 25 000 [*b* =] [0].94	4	**B1** for 25 000 AND **B3** for 0.94 oe or **B2** for $\frac{23500}{25000}$ or 94% oe or $\frac{25000-23500}{25000}$ or 0.06 oe or **M1** for $23500 = ab^{[1]}$ or $23500 = 25000b^{[1]}$ **Examiner's Comments** This question on exponential decay was found to be challenging for all except the most able candidates.
			Total	**4**	
78			$y = 0.25\sqrt{x}$ oe	3	**M1** for $y = k\sqrt{x}$ oe B1 for $k = 0.25$ or $\frac{1}{4}$ oe **M1** includes e.g. $y = k\sqrt{16}$ and $1 = k\sqrt{16}$ **Examiner's Comments** Many were not able to form an equation with a constant of proportionality, *k*, and use the information to find the value of *k*. Some did not realise that the final answer was the formula.

			Total	**3**	
79	a		2[%]	1	**Examiner's Comments** Many answers were given such as 2, 2.1, 1.02, 102, 1.04 and 5200.
	b		5200 ÷ 1.02^5 oe 4709 to 4710	2	**M1** for 5200 ÷ 1.02^k or 4700 × 1.02^5 or 5200 = n × 1.02^5 equivalent is 5200 × 1.02^{-5} condone : 4700 × 1.02^5 = 5189 to 5190 for **2** marks accept 1.104… for 1.02^5 and 0.9057… for 1.02^{-5} **Examiner's Comments** Many correct responses were seen and there were a variety of ways to use the formula to show that 4700 seals were on the island at the start of year 2010. The common error was to attempt to show this without using the formula, such as 5200 × 0.98^5.
			Total	**3**	
80	a		1.035 is greater than 1 oe	1	**Response** 1.035 is above 1 **1** the percentage multiplier is above 1 **1** it is being multiplied by a number greater than 1 **1** the rate is above 1 **1** the multiplier is higher than 1 **1** 103.5 means 103.5% and that means 3.5% is **added** each year **1(BOD)** 103.5% is an increase **add on** to 100 **1(BOD)** it is above 1 **1** the number is multiplied by 1 and 3.5% **1(BOD)** the multiplier starts with a 1 **0** it is being added to 100% **0** the multiplier is positive **0** the multiplier is 1.035 **0** **Examiner's Comments** A precise and correct answer was needed for this

					question so to say that the multiplier was 1.035 or that we are multiplying or that it was a positive number was not enough. An explanation was needed to show why multiplying by 1.035 always increased the other number.
	b		3.5	1	**Examiner's Comments** This was well answered. The two most common errors were either 1.035% or 35%.
	c		185 000	1	**Examiner's Comments** This was answered well, though some candidates found it necessary to multiply 185 000 by 1.035 to give an answer of 191 475.
	d		212 300	2	**M1** for $185\,000 \times 1.035^4$ soi 212 291[. …] If **0** scored **B1** for *their* answer to more than 4 figs correctly rounded to 4 s.f. **Examiner's Comments** Most candidates used the correct method with 4 as the power. The biggest issue appeared to be the rounding, some did not round at all so gave an answer of 212 291 while others rounded down to 212 000.
	e	i	any correct method, e.g. 368 110[. …] or 368 111 380 994[. …] or 380 995	2 1	**M1** for $185\,000 \times 1.035^{20}$ Alternate method 1 e.g. 1.035^{20} = 1.98 to 1.99 scores **2** 1.035^{21} = 2.05 to 2.06 scores **1** Alternate method 2 184 055 to 184 056 for **2** marks 190 497 to 190 498 for **1** mark **Examiner's Comments** Candidates needed to show the predicted value at

					the start of 2036 and then the predicted value at the start of 2037. Many candidates showed just one of these values and then tried to make an argument from that point.
		ii	any correct explanation e.g. the rate of increase may not continue	1	**Response** the rate of increase may not continue **1** house prices fluctuate **1** they could drop **1** 'something' may cause the price to drop (e.g. damage, inflation, local flooding, financial crisis or Brexit) **1** they may increase at different rates **1** the house may be demolished **1** accept any home improvement e.g. extension (might increase faster than predicted) **1** it is only an estimate **0** it is only a prediction **0** house market may have changed **0** **<u>Examiner's Comments</u>** This proved to have many possible answers and it was well answered. The answer needed to show that the increase of 3.5% each year may not happen for 20 years.
			Total	**9**	
81			107.95 with correct working	6	**B1** for 2*a* or *a* + 5 or 4*a* + 5 or 25.4[0] + 5*x* seen **M1** for *a* + 2*a* + *a* + 5 = 85 or better or for a trial correctly evaluated **A1** for [*a* =] 20 [hours] AND **M2** for $\frac{25.4[0]}{their\ 20} \times 85$ or 1.27×85 oe or 25.4[0] + 50.8[0] + $\frac{25.4[0]}{their\ 20} \times their25$ oe or 25.4[0] + 1.27 × 40 + 1.27 × 25 oe "correct working" requires at least **M1**AND**M1** or **M2** If working in pence: • Allow up to 5 part marks for consistent working • Allow full marks if answer is clearly stated as 10795 p[ence] **M1** implied by sub into *a* + 2*a* + *a* [+ 5] with evaluation **B1 max** possible for using 5*a* instead of *a* + 5 e.g. **M2** for $\frac{25.4[0]}{4} \times 17$

					or **M1** for $\frac{25.4[0]}{their\ 20}$ implied by 1.27 or $\frac{25.4[0]}{4}$ implied by 6.35 If 0 or 1 scored, instead award **SC2** for 107.95 with no or insufficient working If 0 scored, instead award **SC1** for 20 [hours] with no or insufficient working	Method marks may be earned in stages May see equivalent algebraic methods. There are possibly many algebraic methods for this question. Examiners should use the main scheme as a template, matching steps or positions in the solution as best as possible. If in doubt, contact your Team Leader. For example: Non-algebraic methods may earn up to full marks.

There are possibly many algebraic methods for this question. Examiners should use the main scheme as a template, matching steps or positions in the solution as best as possible.

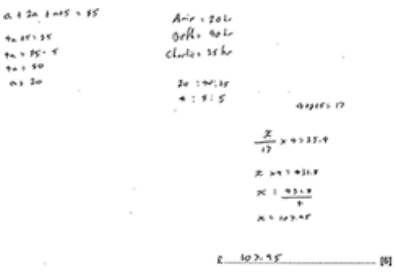
Exemplar Responses

(tips): Amir : Beth : Charlie are 25.4 : 50.8: 25.4 + 5x (where x is hourly rate of tips) (total tips): 25.4 + 50.8 + 25.4 + 5x = 85x.
This is on the scheme at B1. There is an equation on the scheme, so M1 would be a good judgement. B1 M1

(solving): x = 1.27 (substitution into either side of the equation) eg 85 × 1.27 (final answer) 107.95 And then this would be the A1 This is on the scheme at M2. The answer is correct and the candidate has satisfied the “correct working” requirement and so is awarded full marks. A1 M2

Examiner’s Comments

While many candidates gave the correct final answer, a few were not given full marks due to lack of working. There were several possible methods that could be used to reach the final answer. Candidates needed to show a minimum of M1M1 or M2 to enable full marks. This was typically met

					by showing (i) an algebraic equation such as $a + 2a + a + 5 = 85$ or a trial and correct evaluation of $a + 2a + a + 5$, together with a tips per hour or tips per 5 hours calculation implied by 1.27 or 6.35, or (ii) a more concise but clear approach using ratios. Insufficient working included just the values 20, 31.75, 107.95 with no supporting method. Generally, solutions were not presented in a logical manner with unstructured working being 'scattered' across the page. Many solutions started in the middle of the answer space and, on running out of space, continued above the initial working. Some candidates used a trial and improvement method for the hours, with no totals indicated. Those using an algebraic approach often created a suitable equation, but many did not solve accurately: $a + 2a + a + 5 = 85$ becoming $3a = 80$ was a common incorrect simplification. Another common error was the expression for Charlie, often written as '$2a + 5$' or '$5a$', the latter simplifying the problem and therefore losing access to the majority of the marks. Some candidates could access the problem but showed little supporting work. Having spotted the correct value for a, these candidates would often continue with just a list of totals for each person and no indication of the key divisions and multiplications being made. Some candidates used the ratio of the hours (1 : 2 : 1.25) to calculate the final amount in a much shorter method, such as 25.4×4.25.  We can assume that the candidate is using a to represent the number of hours worked by Amir. They then have algebraic expressions $2a$ and $a + 5$ for the hours worked by Beth and Charlie (B1 for either of these). The algebraic terms are summed, equated to 85 (M1) and solved to reach $a = 20$ (A1) and hence the hours worked by each person. There are various approaches available from here. This candidate uses a ratio method, first simplifying 20 : 40 : 25 to 4 : 8 : 5. They then set

					up an equation for Amir's share of the tips: $\frac{4}{17}$ of the total tips (x) which is given as £25.40 in the question (equivalent to M2). They then solve the equation to reach the total tips of £107.95. The candidate has shown sufficient working (M1M1 or M2) for full marks. The presentation of the work is also clear.	
			Total	**6**		
82			$\frac{5\pi r}{6}$ with correct working	5	**B4** for correct unsimplified answer with correct working OR **M1** for $\frac{60}{360} \times [2\times] \pi k$ oe **A1** for $\frac{60}{360} \times 2\pi r$ oe or better isw incorrect cancelling/simplification AND **M1** for $\frac{60}{360} \times [2\times] \pi \frac{3k}{2}$ **A1** for $\frac{60}{360} \times \pi 3r$ oe or better isw incorrect cancelling/simplification If 0 or 1 scored, instead award **SC2** for final answer $\frac{5\pi r}{6}$ oe simplified answer with no or insufficient working	Condone '×' sign oe in simplified answer if otherwise correct e.g. $\frac{5}{6} \times \pi r$ "correct working" requires **M1A1M1A1** Condone R for r throughout For method marks, allow use of 3.14, 3.142, 22/7 for π Where k is numeric or algebraic **but does not** come from squaring Allow e.g. $k = 2$, r, d, 0.4 , $0.4x$ For A1 accept e.g. 0.333 πr Correct expression implies M1A1 For M1 must use *their* previous k e.g. uses $k = 10$ for first M1 then uses 15 here for $\frac{3k}{2}$ gets 2nd M1 **unless** the expression is correctly stated as $\frac{60}{360} \times \pi 3r$ oe which gets M1A1 Correct expression implies M1A1
					Examiner's Comments	

					Candidates found this question very challenging and there were a number of 'no response'. Some worked out the area of the sector. Those attempting an arc calculation for AB often preferred to replace *r* with a constant value. In those cases, credit was given for the arc CD if the constant used was consistent with the ratio 2 : 3 for that used in AB. A number of candidates gave a correct fraction $\frac{60}{360}$ for the sector but then evaluated this as 6. In this case, method marks were awarded provided the fraction was shown. A small number of candidates found correct expressions in terms of π and *r* for the two arcs AB and CD and most of these then added correctly and gave a simplified expression. A few misunderstood the demand and gave the full perimeter of the shaded shape ABCD for which they were given partial credit.
			Total	**5**	
83			0.36 oe final answer	3	**B1** for $y = \frac{k}{x^2}$ oe soi $9 = \frac{k}{2^2}$ or $k = 36$ **M1** for $y = \frac{\text{their } k}{10^2}$ OR **M2** for $2^2 \times 9 = 10^2 \times y$ oe oe e.g. for 3 marks $\frac{36}{100}$ oe **Examiner's Comments** This was generally very well answered. Candidates were able to interpret the proportional relationship in a correct algebraic statement and then usually completed correctly. There were a number of arithmetic errors seen within an otherwise correct method but candidates generally showed their working and so method marks could be given in those cases. The most common error was in missing the 'inverse' element and starting with $y = kx^2$.
			Total	**3**	
84	a		59	4	**B3** for $x = 17$ or **M2** for $2(x + 28) = 5(x +$

					1) oe or better or for 45 : 18 seen or **M1** (x + 28) **and** (x + 1) seen or better	For M2 accept [P =] 45 and [R =] 18 (An answer of 76 may indicate this but check working for 45 and 18) For M1, could appear as $\frac{5}{x+28}$ $\frac{2}{x+1}$ or e.g. $5y = 28 + x$ and $2y = x + 1$
					Examiner's Comments Candidates found this question challenging and very few were able to combine ratio 5 : 2 to form a correct equation using the information given in the Venn diagram. The most successful responses included an equation equivalent to $2(x + 28) = 5(x + 1)$ and continued to find the value of x. A few other candidates were successful in using trial and improvement with values in the ratio 5 : 2 and finding 45 : 18 gave the correct values for set P and set R. Many candidates appeared to be randomly trying values for x, with little success.	
	b		$\frac{28}{45}$ oe	2FT	**B2FT** for $\frac{28}{their(a)-14}$ dep on 0 < answer < 1 or **B1** for numerator 28 or for denominator 45 or *their* (a) – 14	isw cancelling/conversion For FT - if fraction is simplified or given as a decimal check for equivalents for B2FT or B1 **B1** must be part of a proper fraction $0 < P < 1$
					Examiner's Comments Those who answered part (a) correctly invariably gave the correct probability in this part. Many other candidates were able to score 1 mark for giving a proper fraction with the numerator 28. A follow through was available for 2 marks from an incorrect answer in part (a) but this was rarely awarded.	
			Total	**6**		

85			4	3	**M2** for 3 : 12 oe or for 3 ÷ $\frac{3}{4}$ oe seen or **M1** for $\frac{3}{4}$: 3 oe ratio seen **Alternative method in tablespoons:** **M2** for $\frac{1}{4}$: 1 oe seen or **M1** for $\frac{3}{4} \times \frac{1}{3}$ [: 1] oe seen	For M1 e.g. 0.75 : 3 M2 for e.g. 1 : 4 oe If in decimal form allow 0.33 for $\frac{1}{3}$
			Total	**3**		
86	a		$y = \frac{30}{\sqrt{x}}$ oe	3	**M1** for $y = \frac{k}{\sqrt{x}}$ oe **B1** for [**k** =] 30	eg condone $y = \frac{k}{\sqrt{36}}$ for **M1**

Examiner's Comments

Many candidates were able to find equivalent ratios through multiplicative reasoning and scored full marks. For a number, this question revealed a lack of application to forming ratios with different units; some candidates treated the teaspoon to tablespoon ratio and the salt to baking powder ratio separately. This misconception was highlighted frequently as most candidates did not form a ratio of the same unit, therefore demonstrating a limited understanding of proportion.
A common error was to multiply $\frac{3}{4}$ by 3 to give 2.25.

Assessment for learning

Centres can help candidates by investigating ratios involving a variety of unit conversions (not limited to common metric and imperial conversions) and thereby practising how to construct equivalent ratios with a consistent unit.

Examiner's Comments

					AfL Most candidates were able to write a statement such as $y = \frac{k}{\sqrt{x}}$ and to find k = 30. It is always good practice to complete this working with the conclusion $y = \frac{30}{\sqrt{x}}$, and this was required for the full three marks.
	b		2.25 oe	3	**B2** for $\sqrt{x} = \frac{3}{2}$ oe or **M1** for $20 = \frac{their\ 30}{\sqrt{x}}$ or $\frac{20}{5} = \frac{\sqrt{36}}{\sqrt{x}}$
			Total	**6**	
87	a		285	2	**M1** for 760 ÷ (2 + 3 +3) soi by 95
	b		24	2	**M1** for $\frac{2}{3} \times 36$ oe Allow (0.66 or 0.7) × 36 for **M1** only
			Total	**4**	
88			5 : 6 nfww	4	**B3** for 5*kn* : 6*kn* *k*>0 or equivalent correct unsimplified ratio seen OR **M1** for two ratios with a common number of mints implied by … : 10*k* **and** 10*k* : … seen, *k*>0 with one correct ratio or for 2.5*n* : 5 seen **A1** for 5*kn* : 10*k* : 6*kn* Accept for all part marks *n* replaced by a consistent integer Eg 2.5*n* : 3*n* or 5*n* : 6*n* or 10 : 12 etc May be seen as two separate ratios Eg 5*n* : 10 and 10 : 6*n* or 10 : 20 and 20 : 12 etc For **M1** the examples just require the common 10 or the common 20 etc **Examiner's Comments** **AfL**

					There have been several similar questions in the past but this was the first time that an algebraic element has been included. The success rate was very good, with half of the candidates scoring at least three marks out of four. The most common and productive strategy was to rewrite the two given ratios so that they had a common number of mints (usually indicated as 10). The required ratio could then be identified as 5*n* : 6*n* which scored three marks, the correct simplified answer being 5 : 6.	
			Total	**4**		
89			44 with correct working	5	**B3** for angle BCD = 110 with correct working or **M1** for angle BAD = 70 or for angle BDE = 180 – 70 or 110 **M1** for angle BCD = 180 – *their* angle BAD AND **M2** for *their* angle BCD ÷ 5 × 2 **oe** or **M1** for *their* angle BCD ÷ 5 **oe** If 0 scored **SC2** for answer 44 or **SC1** for angle BCD = 110	For full marks "correct working" requires evidence of at least M1 AND M1 ie at least a correct angle and some ratio work Ignore geometric reasons if given For B3 "correct working" requires at least M1 or alternate convincing approach Angles may be indicated on diagram for part marks May be seen on diagram
			Total	**5**		
90			5000 [ml] or 0.45 [L] soi 9 × 450 oe Correct attempt to find 80% or 20% of 5000oe 4050 and 4000 or 950 **and** 1000 **and** [They are] correct **oe**	B1 M1 M1 A2	or $\frac{9\times450}{5000}[\times100]$ **oe** or $\frac{5000-9\times450}{5000}[\times100]$ **oe** or 81% [and 80%] or 19% [and 20%] After A0 scored **B1** for 4050 or 4000 or 950 or 1000	Correct conversion at any stage Alternate approaches are possible M1 may be implied by 4000 or 1000 or 81% or 19% seen For A2 accept in other correct consistent units for comparison e.g.4.05[L] and 4[L]and

						must have no incorrect statement For B1 accept e.g. 4.05[L] or 4[L]
			Total	**5**		
91			Shows actual increase is 21 [%] with correct working	5	**M3** for [*k* ×] 1.1 × 1.1 **oe** **A1** for 121[%] or for 1.21 OR **M1** for 1.1 **oe soi** **A1** for a correct evaluation of the first stage with *their* value If 0 scored **SC2** for answer 21[%] or **SC1** for 121% or 1.21 with no working	"Correct working" requires evidence of at least **M3** or alternate convincing approach Allow method marks if contained in correct method involving any invented starting price e.g. **M3** for 100 × 1.1 × 1.1 **oe** e.g. for M1A1 uses 80 as value then gives 88 in working
			Total	**5**		
92			13 with correct working	7	**M1** for $\frac{BD}{10} = \sin 30$ **oe** **B1** for sin 30 = 0.5 **soi** **A1** for [BD =] 5 **M1** for *their* BD × 2.4 **oe** **A1** for CD = 12 **M1** for (*their* BD)^2 + (*their* CD)^2 [= BC^2] **oe** If 0 scored **SC3** for answer 13 with no working or **SC2** for CD = 12 with no working or **SC1** for BD = 5 with no working	"Correct working" requires evidence of at least M1 or B1 and M1M1 or alternate convincing approach Answer 12 gets A0 unless CD = 12 shown in working or on diagram SCs may be seen on the diagram
			Total	**7**		
93	a		6800	1		
	b		4.5	1		

					condone extra %	
	c	i	11500 or 11530 or 11532	2	**M1** for 6800×1.045^{12} oe	allow 11531 and 11531.9[9…]
		ii	Any correct reason e.g. the rate may not continue	1	see appendix	
			Total	**5**		
94	a		500 ml with three correct comparisons	3	Allow any correct comparison e.g.(converting all to 500 ml) **B2** for three correct figures to compare or **B1** for two correct figures OR **M1** for one correct appropriate calculation e.g. 1.96 ÷ 4 or 31 × 5 ÷ 3 oe	See appendix for other values e.g. 49[p] is sufficient for **B1** as it compares to 47[p]
	b		7 × 120 soi by 840 840 ÷ 300 soi by 2.8 or 3 and 3 × 31 = 93[p] 840 ÷ 500 soi by 1.68 or 2 and 2 × 47 = 94[p]	M1 B1 B1	accept any correct argument If **B0** then **SC1** for 3 [of 300 ml] and 2[of 500 ml]	Condone omitting one day so 6 × 120 soi by 720 for **M1** 3 × 31 = 93[p] is sufficient 2 × 47 = 94[p] is sufficient
			Total	**6**		
95			3.25	4	**B3** for 0.0325 OR **M1** for 7170 – 6000 or $\frac{7170}{6000}$ **M1** for $\frac{\textit{their } 1170}{6000}$ or $\frac{\textit{their } 1170}{6}$ or 1.195 − 1 **M1** for *their* 0.195 ÷ 6 or *their* 195 ÷ 6000	Accept any correct method and condone extra % symbol implied by 1170 or 1.195 implied by 0.195 or 195 implied by 0.0325 watch out for $\sqrt[6]{1170}$ = 3.246…
			Total	**4**		