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Mark scheme

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2 3 6 Y 9 2 6 0 / 2 E / M S

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Key to mark types and abbreviations

M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
oe	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leq \text{value} < b$
3.14...	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
Use of brackets	It is not necessary to see the bracketed work to award the marks.

Q	Answer	Mark	Comments
1	0.4 : 1	B1	

Q	Answer	Mark	Comments
2(a)	4, 5, 7, 8	B1	

Q	Answer	Mark	Comments
2(b)	5	B1	

Q	Answer	Mark	Comments
3	$6x^2 + 3x$	B1	

Q	Answer	Mark	Comments
4	B and 50^{70} and 50^{72} or B and $[8, 8.5] \times 10^{118}$ and $[2, 2.12] \times 10^{122}$ or B and $\frac{A}{B} = 50^{-2}$ oe or B and $\frac{B}{A} = 50^2$ oe	B2	B1 50^{70} or 50^{72} or $[8, 8.5] \times 10^{118}$ or $[2, 2.12] \times 10^{122}$ or $\frac{A}{B} = 50^{-2}$ oe or $\frac{B}{A} = 50^2$ oe or $50^{30 + 40}$ and $50^{75 - 3}$
	Additional Guidance		
	Accept answer of 50^{72} with 50^{70} seen		B2
	Accept answer of $50^{75} \div 50^3$ with 50^{70} and 50^{72} seen		B2
	Accept B and 70 and 72		B2
	Answer only 50^{72}		B1
	Answer only B or $50^{75} \div 50^3$		B0

Q	Answer	Mark	Comments
5	$\frac{2}{3} \times 72$ or 48 or $\left(1 - \frac{2}{3}\right) \times 72$ or $\frac{1}{3} \times 72$ or 24	M1	oe
	$180 \div (5 + 4)$ or 20	M1	oe
	5 × their 20 or 100 or 4 × their 20 or 80	M1dep	oe dep on 2nd M1 $\frac{5}{5+4} \times 180$ implies 2nd and 3rd M1 $\frac{4}{5+4} \times 180$ implies 2nd and 3rd M1
	$\frac{\text{their 48} + \text{their 100}}{72 + 180}$ or $\frac{\text{their 48} + \text{their 100}}{252}$ or $1 - \frac{\text{their 24} + \text{their 80}}{72 + 180}$ or $1 - \frac{\text{their 24} + \text{their 80}}{252}$	M1	oe denominator must = 72 + 180 or 252 their 48 and their 72 must be integers their 48 must be < 72 their 100 must be < 180 their 24 and their 80 must be integers their 24 must be < 72 their 80 must be < 180 must not mix the number of open and closed shops
	$\frac{148}{252}$ or $\frac{74}{126}$ or $\frac{37}{63}$	A1	oe fraction

Additional Guidance is on the next page

5 cont	Additional Guidance	
	Ignore incorrect cancellation of a fraction if correct answer seen	
	Up to M4 may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts	
	A correct fraction seen but decimal or percentage on answer line	M1M1M1M1A0
	0.587... or 0.59 or 58.7...% or 59%	M1M1M1M1A0
	$148 \div 252$	M1M1M1M1
	148 (shops open) or 104 (shops closed)	M1M1M1
	37 : 63	M1M1M1
	100 : 80 scores the 2nd and 3rd M marks	M1M1

Q	Answer	Mark	Comments
6(a)	40	B1	

Q	Answer	Mark	Comments
6(b)	$28.8 \div 9$ or 3.2 or $9 \div 28.8$ or 0.3125 or $\frac{7}{9}$ or $\frac{9}{7}$	M1	oe may be seen on diagram
	22.4	A1	oe

Q	Answer	Mark	Comments
7(a)	A correct statement relating to the difference between the two distributions	B1	
	Additional Guidance		
	A correct statement may refer to different measures of location, eg different modal classes or the different shapes of the distributions or a correct interpretation of one of the distributions		
	Condone 'mode' or 'peak' for modal class		
	Any reading(s) from the graph(s) must be correct		
	Comments may compare parts of the distributions but not particular points other than the class midpoints		
	Parts of the distributions may be referred to using class intervals or midpoints eg 0 to 5 or 2.5, 10 to 15 or 12.5		
	Ignore irrelevant, non-contradictory statements		
	More part-time people travel less	B1	
	More full-time workers live further away	B1	
	There are more part-time workers travelling a short distance	B1	
	(On average) full-time workers travel further	B1	
	The modal class of the full-time workers is in the middle	B1	
	The full-time workers graph is (almost) symmetrical	B1	
	The part-time workers graph decreases	B1	
	The part-time graph goes down at the beginning, full-time graph goes up	B1	
	The part-time workers graph decreases, full-time workers graph increases	B1	
	The full-time workers peak at 12.5 but the part-time workers do not	B1	
	36 full-time workers travel 12.5 km, 6 part-time travel 12.5 km	B1	
	25 full-time workers travel 10 km, 13 part-time travel 10 km	B0	
	The part-time graph is negative	B0	
	The part-time workers are inversely proportional to the distance	B0	
	There are more full-time workers	B0	

Q	Answer	Mark	Comments												
7(b)	Correct class boundaries	B1													
	Correct frequencies	B2	B1 2 or 3 frequencies correct or frequencies of (24), 21, 6, 2, 2 for the part-time workers seen or frequencies of (8), 14, 36, 17, 10 for the full-time workers seen												
	Additional Guidance														
	<table><tr><th>Distance travelled, d (km)</th><th>Frequency (all workers)</th></tr><tr><td>$0 \leq d < 5$</td><td>32</td></tr><tr><td>$5 \leq d < 10$</td><td>35</td></tr><tr><td>$10 \leq d < 15$</td><td>42</td></tr><tr><td>$15 \leq d < 20$</td><td>19</td></tr><tr><td>$20 \leq d < 25$</td><td>12</td></tr></table>		Distance travelled, d (km)	Frequency (all workers)	$0 \leq d < 5$	32	$5 \leq d < 10$	35	$10 \leq d < 15$	42	$15 \leq d < 20$	19	$20 \leq d < 25$	12	B1B2
	Distance travelled, d (km)	Frequency (all workers)													
$0 \leq d < 5$	32														
$5 \leq d < 10$	35														
$10 \leq d < 15$	42														
$15 \leq d < 20$	19														
$20 \leq d < 25$	12														
Correct frequencies for the part-time or full-time workers may be on the graph															

Q	Answer	Mark	Comments
8	True False True	B2	B1 2 correct
	Additional Guidance		
	Any indication		
	If there are ticks and crosses in the same row, mark the ticks		

Q	Answer	Mark	Comments
9	Alternative method 1		
	$\tan 49 = \frac{x}{26}$ or $\frac{x}{26} = 1.15\dots$	M1	any letter oe eg $\tan (90 - 49) = \frac{26}{x}$ or $\tan 41 = \frac{26}{x}$ or $\frac{x}{\sin 49} = \frac{26}{\sin (90 - 49)}$ oe or $\frac{x}{\sin 49} = 39.6\dots$ or $\sin 49 \div x = 0.025\dots$
	$26 \times \tan 49$ or $26 \times 1.15\dots$ or [29.9, 30]	M1dep	oe eg $26 \div \tan 41$ or $26 \times \sin 49 \div \sin 41$
	[31.9, 32]	A1	
	Alternative method 2		
	$x = \frac{26}{\cos 49}$ or 39.63... and $x^2 - 26^2$ or [894.5, 894.6]	M1	oe eg $x = \frac{26}{\sin(90 - 49)}$ and $x^2 - 26^2$ or [894.5, 894.6]
	$\sqrt{\text{their } [894.5, 894.6]}$ or [29.9, 30]	M1dep	
	[31.9, 32]	A1	
	Additional Guidance		
	In the equation for M1, x may appear as $x - 2$ (where x is the height of the tree)		
	$\cos 49 = \frac{26}{x}$ or $\sin 41 = \frac{26}{x}$ with no further relevant working		M0

Q	Answer	Mark	Comments
10	$5a = 20$ or $b + 3 = -11$	M1	oe allow $5ax = 20x$
	$a = 4$ or $b = -14$	A1	
	$a = 4$ and $b = -14$	A1	
	Additional Guidance		
	$5ax = 20$ is M0 unless recovered		

Q	Answer	Mark	Comments
11	$-8 < 4n$ or $4n \leq 12$ or $n > -2$ or $n \leq 3$	M1	oe
	$n > -2$ and $n \leq 3$ or $-2 < n \leq 3$	A1	may be implied by correct answer
	$-1 \ 0 \ 1 \ 2 \ 3$	A1ft	ft inequality of the form $a < n \leq 3$ oe or $a \leq n \leq 3$ oe with $a < 3$ and $a \neq -5$ or $-2 < n \leq b$ oe or $-2 < n < b$ oe with $b > -2$ and $b \neq 15$ SC2 $-1 \ 1 \ 2 \ 3$
	Additional Guidance		
	$-1.25 < n \leq 3$ with answer $-1 \ 0 \ 1 \ 2 \ 3$		M1A0A1ft
	Solving $-5 = 4n + 3$ and $4n + 3 = 15$ is M0 unless recovered		

Q	Answer	Mark	Comments
12	The line on map B is 4 times longer than the line on map A	B1	

Q	Answer	Mark	Comments
13	$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$	B1	

Q	Answer	Mark	Comments
14	$200 \times 1.3 \times y \div d$ where y (yen) and d (dollars) are a correct pair of values from the graph $\pm \frac{1}{2}$ square or $200 \times 1.3 \times [115, 115.4]$ or $[29\,000, 31\,000]$	M3	oe M2 200×1.3 or 260 and a correct pair of values for y and d or 200×1.3 or 260 and $[115, 115.4]$ or any two of the operations eg $1.3 \times y \div d$ or $1.3 \times [115, 115.4]$ $200 \times 1.3 \div d$ and y is seen $200 \times 1.3 \times y$ and d is seen $200 \times y \div d$ or $200 \times [115, 115.4]$ M1 200×1.3 or 260 or $y \div d$ or $[115, 115.4]$ or a correct pair of values for y and d
	$[29\,900, 30\,000]$	A1	
	Additional Guidance		
	Up to M3 may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts		
	Intermediate values may be rounded or truncated eg with $\$39 = 4500$ yen $4500 \div 39 = 115.38$ or 115.3 or 115.4 or 115		
	A correct pair of values for y and d may be shown on the graph but values need to be seen		
	A correct pair of values for y and d may be seen as ratio		
	A correct pair of values may be implied by an incorrect operation eg 4500×39		
	Further work after $200 \times 1.3 \times y \div d$		M3
	For M2 the values of y and d must be seen eg1 $200 \times 1.3 \div 13$ and 1500 yen = 13 dollars seen eg2 $200 \times 1.3 \div 13$ and 1500 yen = 13 dollars not seen		M2 M1
	$200 \times 1.3 = 260$ ($\$26 = 3000$ yen) and 3000×10		M3
	$y = [115, 115.4]x$ and $x = 260$ correctly substituted		M3
	$y = [115, 115.4]x$		M1
	Accept 4600 yen = 40 dollars even if the graph is not extended		M1
	Equation of the line worked out in the form $y = mx + c$ ($c \neq 0$) and $x = 260$ correctly substituted can score max M1		M1

Q	Answer	Mark	Comments
15	$25\,000 \times 1.14$ or $28\,500$ or 1.14^2 or 1.2996	M1	oe eg $25\,000 + 25\,000 \times 0.14$ may be implied by $32\,000$ or 2nd M1
	their $28\,500 \times 1.14$ or $25\,000 \times$ their 1.2996 or $32\,490$	M1dep	oe
	$\frac{\text{their } 32\,490 - 21\,600}{\text{their } 32\,490}$ or $\frac{10\,890}{32\,490}$ or $0.33(5\dots)$ or 0.34 or 33%	M1	oe eg $1 - \frac{21\,600}{\text{their } 32\,490}$ or $1 - 0.66(4\dots)$ or $1 - 0.665$ or $100(\%) - 66(.4\dots)(\%)$ or $100(\%) - 66.5(\%)$ their $32\,490$ must be greater than $21\,600$
	$33.5\dots$ or 34	A1	oe percentage
	Additional Guidance		
	If only one month's increase is done it is still possible to score the 3rd M mark		
	33% from 32.5%		M1M0M1
	Condone using $-10\,890$ for the 3rd M mark but answer $-33.5\dots$ or -34		M1M1M1A0

Q	Answer	Mark	Comments
16	$\pi \times (7 \div 2)^2 \times 0.5$ or 6.125π or $[19.2, 19.245]$	M1	oe
	their $6.125\pi \times 10.5$ or 64.3125π or their $[19.2, 19.245] \times 10.5$	M1dep	oe
	$[201.6, 202.1]$	A1	

Q	Answer	Mark	Comments
17(a)	Children and correct comment comparing the medians	B1	eg the adult median is more than the median of the children
	Additional Guidance		
	If medians are stated they must be 14 and 26		
	Ignore references to the quartiles but not the interquartile range		
	Children and The median of the children is 14 and the adults is 26		B1
	Children and The median of the children is 14		B0
	Children and (Children's average =) 14 (Adults' average =) 26		B1
	Children and $14 < 26$		B1
	The mean of the children is less than the adults'		B0
	The average of the children is less than the adults'		B0

Q	Answer	Mark	Comments
17(b)	Adults and (Adults' IQR =) 19 and (Children's IQR =) 22	B2	B1 19 or 22 or correct comment comparing the interquartile ranges or $29 - 7$ and $36 - 17$
	Additional Guidance		
	Ignore references to the range		
	Condone quartile range for interquartile range		
	Examples of a correct comment comparing the interquartile ranges Adults' IQR was lower Adults' times were closer together Children's IQR was higher Children's times were more spread out The box for Adults is smaller than the Children		
	Adults and Adults' average = 19 and Children's average = 22		B1
	The average for the Adults is 19		B1

Q	Answer	Mark	Comments
18	$\begin{pmatrix} -6 \\ -7 \end{pmatrix}$	B1	

Q	Answer	Mark	Comments
19	Alternative method 1		
	$\frac{5-3}{-3-1}$ or $-\frac{1}{2}$	M1	oe
	$y - 3 = \text{their } -\frac{1}{2}(x - 1)$ or $y - 5 = \text{their } -\frac{1}{2}(x - -3)$ or $3 = \text{their } -\frac{1}{2} \times 1 + c$ or $5 = \text{their } -\frac{1}{2} \times -3 + c$ or $c = \frac{7}{2}$	M1dep	oe equation
	$y = -\frac{1}{2}x + \frac{7}{2}$ or $y = \frac{7}{2} - \frac{1}{2}x$	A1	oe fractions or decimals

Mark scheme and Additional Guidance continue on the next page

Q	Answer	Mark	Comments
19 cont	Alternative method 2		
	$3 = m + c$ and $5 = -3m + c$ and correct method to eliminate m or c	M1	oe equations
	m evaluated and correct method to evaluate c or c evaluated and correct method to evaluate m	M1dep	
	$y = -\frac{1}{2}x + \frac{7}{2}$	A1	oe fractions or decimals
	Additional Guidance		
	For $-\frac{1}{2}x$ accept $-\frac{x}{2}$ or $\frac{-x}{2}$		
	$y = -0.5x + 3.5$		M1M1A1
	$-\frac{1}{2}x + \frac{7}{2}$		M1M1A0

Q	Answer	Mark	Comments
20	$3a + 2b$	B1	

Q	Answer	Mark	Comments
21	Alternative method 1		
	(Angle $PQN =$) $180 - 50$ or 130 or (angle $RQN =$) $360 - 180 + 50 - 125$ or 105	M1	may be on diagram
	Angle $QRN = 180 - (360 - 125 - \text{their } 130)$ or angle $QRN = 180 - 105$ or angle $QRN = 75$	M1dep	oe may be on diagram
	285	A1	
	Alternative method 2		
	South line drawn and (angle $RQS =$) $125 - 50$ or 75	M1	may be on diagram where S is south
	Angle $QRN = \text{their } 75$	M1dep	may be on diagram
	285	A1	
	Additional Guidance		
	285 on answer line or answer line blank but 285 correctly shown on diagram	M1M1A1	
	$180 - 50$ or 130 but no position shown or angle labelled or $360 - 180 + 50 - 125$ or 105 but no position shown or angle labelled or $125 - 50$ or 75 but no position shown or angle labelled	M1	
	Angle $QRN = 130$ with no other relevant working	M0	

Q	Answer	Mark	Comments
22	$2 \times \pi \times 15 \times \frac{240}{360}$ or 20π or [62, 63] or $2 \times \pi \times 12 \times \frac{240}{360}$ or 16π or [50, 50.3]	M1	oe eg $2 \times \pi \times 15 - 2 \times \pi \times 15 \times \frac{120}{360}$ or $30\pi - 10\pi$ $2 \times \pi \times 12 - 2 \times \pi \times 12 \times \frac{120}{360}$ or $24\pi - 8\pi$
	$2 \times \pi \times (15 + 12) \times \frac{240}{360}$ or their 20π + their 16π or 36π or their [62, 63] + their [50, 50.3] or [112, 113.3]	M1dep	oe eg $2 \times \pi \times 15 + 2 \times \pi \times 12$ $- \left(2 \times \pi \times 15 \times \frac{120}{360} + 2 \times \pi \times 12 \times \frac{120}{360} \right)$ their 20π and their 16π must both be from correct methods their [62, 63] and their [50, 50.3] must be from correct methods
	$36\pi + 6$ or [118, 119.3]	A1	
	Additional Guidance		
	$2 \times \pi \times (15 - 12) \times \frac{240}{360}$		M1M0
	$2 \times \pi \times 3 \times \frac{240}{360}$ or 4π without $2 \times \pi \times (15 - 12) \times \frac{240}{360}$		M0
	36π from $3 \times \pi \times 12$		M0

Q	Answer	Mark	Comments
23	Alternative method 1		
	28 : 12 and 12 : 27 or 28 : 12 : 27	M1	oe common value for k eg (7 : 3 and) $3 : \frac{27}{4}$ or $7 : 3 : \frac{27}{4}$ allow as fractions eg $\frac{28}{12}$ and $\frac{12}{27}$
	their 27 – their 12 or 15 and their 28 + 2 × their 12 or 52	M1dep	oe eg their $\frac{27}{4} - 3$ and $7 + 2 \times 3$ allow as a fraction eg $\frac{27-12}{28+24}$ or $\frac{15}{52}$
	15 : 52	A1	oe numerical ratio eg $\frac{15}{4} : 13$ or $5 : \frac{52}{3}$
	Alternative method 2		
	$9k = 4m$ and $3j = 7k$	M1	oe equations
	$\frac{9k}{4} - k : \frac{7k}{3} + 2k$ or $\frac{5k}{4} : \frac{13k}{3}$	M1dep	oe ratio in terms of a single letter eg $\frac{15j}{28} : \frac{13j}{7}$ or $\frac{5m}{9} : \frac{52m}{27}$ allow as fractions
	15 : 52	A1	oe numerical ratio eg $\frac{15}{4} : 13$ or $5 : \frac{52}{3}$

Mark scheme and Additional Guidance continues on next page

Q	Answer	Mark	Comments
23 cont	Alternative method 3 $j = 7x$ $k = 3x$ $k = 4y$ $m = 9y$		
	j and k and m expressed in terms of a single unknown	M1	eg $j = 7x$ and $k = 3x$ and $m = \frac{27}{4}x$ oe or $j = \frac{28}{3}y$ and $k = 4y$ and $m = 9y$ oe any letters for x and y
	$m - k$ and $j + 2k$ expressed in terms of a single unknown	M1dep	eg $\frac{27}{4}x - 3x$ and $7x + 2 \times 3x$ oe or $\frac{15}{4}x$ and $13x$ or $9y - 4y$ and $\frac{28}{3}y + 2 \times 4y$ oe or $5y$ and $\frac{52}{3}y$
	15 : 52	A1	oe numerical ratio eg $\frac{15}{4} : 13$ or $5 : \frac{52}{3}$
	Additional Guidance		
	Up to M2 may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts		
	Condone use of k as the constant in Alt 3 eg $j = 28k$ $k = 12k$ $m = 27k$		M1
	Allow arithmetic errors provided the method is shown, eg $j = 7 \times 4 = 21$ and $21 : 12 : 27$		M1
	Answer $\frac{15}{52}$		M1M1A0
	Answer 52 : 15		M1M1A0
	Answer $15k : 52k$		M1M1A0
	$j = \frac{28}{39}n$ and $k = \frac{4}{13}n$ and $m = \frac{9}{13}n$		M1
	$j = \frac{7}{10}p$ and $k = \frac{3}{10}p$ and $m = \frac{27}{40}p$		M1

Q	Answer	Mark	Comments
24	$\sqrt{144a^2b}$ or $12\sqrt{a^2b}$ or $2\sqrt{36a^2b}$ or $2a\sqrt{36b}$ or $(\sqrt{18ab} \Rightarrow) 3\sqrt{2ab}$	M1	oe single correct expression not in its simplest form eg $6\sqrt{4a^2b}$
	$12a\sqrt{b}$	A1	oe
	Additional Guidance		
	Accept power $\frac{1}{2}$ or 0.5 for square root		
	Squaring to get $18ab \times 4 \times 2a$ oe is M0 unless recovered		

Q	Answer	Mark	Comments
25	Alternative method 1		
	$y(1 - x) = 8x$	M1	
	$y - yx = 8x$ or $yx = y - 8x$	M1dep	bracket expanded
	$y = 8x + yx$ or $y = x(8 + y)$ or $\frac{y}{8 + y}$	M1dep	oe collection of terms in x eg $-yx - 8x = -y$
	$x = \frac{y}{8 + y}$	A1	oe with x as the subject
	Alternative method 2		
	$\frac{1-x}{x} = \frac{8}{y}$	M1	
	$\frac{1}{x} - 1 = \frac{8}{y}$	M1dep	
	$\frac{1}{x} = \frac{8}{y} + 1$ or $\frac{1}{\frac{8}{y} + 1}$	M1dep	oe expression for $\frac{1}{x}$
	$x = \frac{1}{\frac{8}{y} + 1}$	A1	oe with x as the subject
	Additional Guidance		
	A student may begin by Alt 1 and then continue with Alt 2 or vv. Award the best mark available by either scheme		
	Equations for the first two M marks have equivalents by multiplying through by -1 , eg $-y + yx = -8x$		M1M1
	Condone $\frac{y}{8 + y}$ on answer line if $x = \frac{y}{8 + y}$ seen in working		M1M1M1A1
	$x = \frac{y}{8 + y}$ followed by further incorrect work		M1M1M1A0

Q	Answer	Mark	Comments
26(a)	528	B1	

Q	Answer	Mark	Comments
26(b)	$\frac{1}{2}(n^2 + n) - 10\,000 (< 0)$ or $n^2 + n - 20\,000 (< 0)$ or $10\,000 - \frac{1}{2}(n^2 + n) (> 0)$ or $20\,000 - n - n^2 (> 0)$	M1	allow = 0
	$\frac{-\frac{1}{2} \pm \sqrt{\left(\frac{1}{2}\right)^2 - 4 \times \frac{1}{2} \times (-10\,000)}}{2 \times \frac{1}{2}}$ or $\frac{-1 \pm \sqrt{1^{(2)} - 4 \times 1 \times (-20\,000)}}{2 \times 1}$ or 140.9(...)	M1dep	oe eg $-\frac{1}{2} \pm \sqrt{\left(\frac{1}{2}\right)^2 + 20\,000}$
	140	A1	SC2 9870
	Additional Guidance		
	Trial and Improvement is 3 or 0		
	140 without working		M1M1A1
	140 in working but 9870 on answer line		M1M1A0

Q	Answer	Mark	Comments											
27(a)	12 ÷ 5 or 2.4 or 17 ÷ 10 or 1.7 or 15 ÷ 15 or 1(.0) or 26 ÷ 20 or 1.3 or two other values for the frequency densities in correct proportion	M1	oe may be implied by heights of bars or points plotted at the midpoints $\pm \frac{1}{2}$ square eg 12 and 8.5 or 12 and 5 or 12 and 6.5											
	Three or four correct frequency densities	M1dep	at least three from 2.4, 1.7, 1(.0), 1.3 implied by bars of correct heights or points plotted at the midpoints $\pm \frac{1}{2}$ square											
	Fully correct histogram with linear vertical scale or correct key shown	A1	$\pm \frac{1}{2}$ square											
	Additional Guidance													
	Mark intention													
	Ignore frequency polygon if included													
	Bar widths and heights													
	<table><tr><td>25 ≤ x < 30</td><td>5</td><td>2.4</td></tr><tr><td>30 ≤ x < 40</td><td>10</td><td>1.7</td></tr><tr><td>40 ≤ x < 55</td><td>15</td><td>1</td></tr><tr><td>55 ≤ x < 75</td><td>20</td><td>1.3</td></tr></table>		25 ≤ x < 30	5	2.4	30 ≤ x < 40	10	1.7	40 ≤ x < 55	15	1	55 ≤ x < 75	20	1.3
25 ≤ x < 30	5	2.4												
30 ≤ x < 40	10	1.7												
40 ≤ x < 55	15	1												
55 ≤ x < 75	20	1.3												
Unsuitable vertical scale for heights of 2.4, 1.7, 1 and 1.3, eg 1 cm = 2		A0												

Q	Answer	Mark	Comments
27(b)	$\frac{29}{70}$ or 0.41(4...) or 41(.4...) % and $\frac{28}{69}$ or 0.40(5...) or 0.406 or 40(.5...) % or 40.6%	M1	oe fraction
	$\frac{58}{345}$ or 0.16(8...) or 0.17 or 16(.8...) % or 17%	A1	oe fraction
	Additional Guidance		
	Ignore attempts to simplify or convert a correct fraction		
	$\frac{29}{70} + \frac{28}{69}$	M1	
	Decimal or percentage answers must not come from wrong working eg $\frac{29}{70} \times \frac{29}{70} = 17\%$		MOA0

Q	Answer	Mark	Comments
28	$-m^3 - 6m^2$	M1	oe may be implied by final answer
	$m^2 + 2m + 2m + 4$ or $m^2 + 4m + 4$	M1	4 terms with at least 3 correct implied by $m^2 + 4m + k$ or $pm^2 + 4m + 4$ where k and p are non-zero constants may be seen in a grid
	$m^3 + 2m^2 + 2m^2 + 4m + 2m^2 + 4m + 4m + 8$ or $m^3 + 4m^2 + 4m + 2m^2 + 8m + 8$ or $m^3 + 6m^2 + 12m + 8$	M1dep	oe full expansion of the cube with correct multiplication of their 3 or 4 terms by m or by 2 dep on 2nd M1 may be seen in a grid
	$12m + 8$ or $4(3m + 2)$ or $2(6m + 4)$	A1	terms in either order
	Additional Guidance		
	2nd M1 with a 4-term expansion followed by incorrect simplification to 3 terms can still score the 3rd M1 using their 3 terms		
	One single expansion for the cube is M2 if correct or M0 if incorrect but terms may be in an unsimplified form eg $m^3 + 3 \times m^2 \times 2 + 3 \times m \times 2^2 + 2^3$		
	Ignore an incorrect factorisation of $12m + 8$, but $12m + 8$ followed by other further incorrect work eg $20m$ is A0		
	$m^2 + 2m + 2m + 2$ (3 terms correct)		2nd M1
	$m^3 + 2m^2 + 2m^2 + 2m + 2m^2 + 4m + 4m + 4$		3rd M1
	$m^3 + 8 - m^3 - 6m^2 = 8 - 6m^2$		M1M0
	$8 - 6m^2$ with no working		M0
	$m^3 + 6m^2$ is M0 unless recovered		
	$\dots - m^3 + 6m^2$ is M0 unless recovered		

Q	Answer	Mark	Comments
29	Alternative method 1 Working with 1.24...		
	$10x = 12.4\dots$ or $100x = 124.4\dots$	M1	oe multiplication by a power of 10 eg $1000x = 1244.4\dots$ any letter
	$10x - x = 12.4\dots - 1.24\dots$ or $9x = 11.2$ with $10x = 12.4\dots$ seen or $100x - 10x = 124.4\dots - 12.4\dots$ or $90x = 112$ with $100x = 124.4\dots$ and $10x = 12.4\dots$ seen or $100x - x = 124.4\dots - 1.24\dots$ or $99x = 123.2$ with $100x = 124.4\dots$ seen	M1dep	oe subtraction to eliminate recurring digits eg $1000x - 10x = 1244.4\dots - 12.4\dots$ or $990x = 1232$ with $1000x = 1244.4\dots$ and $10x = 12.4\dots$ seen numbers must all be correct
	M2 scored and $9x = 11.2$ and $x = \frac{11.2}{9} = \frac{56}{45}$ or M2 scored and $90x = 112$ and $x = \frac{112}{90} = \frac{56}{45}$ or M2 scored and $99x = 123.2$ and $x = \frac{123.2}{99} = \frac{56}{45}$	A1	oe eg M2 scored and $990x = 1232$ and $x = \frac{1232}{990} = \frac{56}{45}$

Mark scheme and Additional Guidance continue on next two pages

Q	Answer	Mark	Comments
29 cont	Alternative method 2 Working with 0.24...		
	$10x = 2.4...$ or $100x = 24.4...$	M1	oe multiplication by a power of 10 eg $1000x = 244.4...$ any letter
	$10x - x = 2.4... - 0.24...$ or $9x = 2.2$ with $10x = 2.4...$ seen or $100x - 10x = 24.4... - 2.4...$ or $90x = 22$ with $100x = 24.4...$ and $10x = 2.4...$ seen or $100x - x = 24.4... - 0.24...$ or $99x = 24.2$ with $100x = 24.4...$ seen	M1dep	oe subtraction to eliminate recurring digits eg $1000x - 10x = 244.4... - 2.4...$ or $990x = 242$ with $1000x = 244.4...$ and $10x = 2.4...$ seen numbers must all be correct
	M2 scored and $9x = 2.2$ and $x = \frac{2.2}{9}$ and $1\frac{2.2}{9} = \frac{56}{45}$ or M2 scored and $90x = 22$ and $x = \frac{22}{90}$ and $1\frac{22}{90} = \frac{56}{45}$ or M2 scored and $99x = 24.2$ and $x = \frac{24.2}{99}$ and $1\frac{24.2}{99} = \frac{56}{45}$	A1	oe eg M2 scored and $990x = 242$ and $x = \frac{242}{990}$ and $1\frac{242}{990} = \frac{56}{45}$

Mark scheme and Additional Guidance continue on the next page

Q	Answer	Mark	Comments
29 cont	Alternative method 3 Working with 0.04...		
	$10x = 0.4...$ or $100x = 4.4...$	M1	oe multiplication by a power of 10 eg $1000x = 44.4...$ any letter
	$10x - x = 0.4... - 0.04...$ or $9x = 0.4$ with $10x = 0.4...$ seen or $100x - 10x = 4.4... - 0.4...$ or $90x = 4$ with $100x = 4.4...$ and $10x = 0.4...$ seen or $100x - x = 4.4... - 0.04...$ or $99x = 4.4$ with $100x = 4.4...$ seen	M1dep	oe subtraction to eliminate recurring digits eg $1000x - 10x = 44.4... - 0.4...$ or $990x = 44$ with $1000x = 44.4...$ and $10x = 0.4...$ seen numbers must all be correct
	M2 scored and $9x = 0.4$ and $x = \frac{0.4}{9}$ and $1.2 + \frac{0.4}{9} = \frac{56}{45}$ or M2 scored and $90x = 4$ and $x = \frac{4}{90}$ and $1.2 + \frac{4}{90} = \frac{56}{45}$ or M2 scored and $99x = 4.4$ and $x = \frac{4.4}{99}$ and $1.2 + \frac{4.4}{99} = \frac{56}{45}$	A1	oe eg M2 scored and $990x = 44$ and $x = \frac{44}{990}$ and $1.2 + \frac{44}{990} = \frac{56}{45}$
	Additional Guidance		
	$56 \div 45 = 1.24...$		MOM0A0
	Use of x may be implied for up to M2		

Q	Answer	Mark	Comments
30	$2x^2 + 6x - x(-3)$ or $2x^2 + 5x(-3)$	M1	
	$4x + 6 - 1$ or $4x + 5$	M1	oe eg $2 \times 2x^{2-1} + 5x^{1-1}$ ft their expansion of the form $ax^2 + bx + c$ with $a \neq 0$ and $b \neq 0$
	13	A1ft	ft M0M1
	Additional Guidance		
	Answer $y = 13x - 11$		A0
	Answer (2, 13)		A0
	$2x^2 + 5x$ followed by $4x + 5$ and answer 13		M1M1A1
	$2x^2 + 5x - 2$ followed by $4x + 5$ and answer 13		M0M1A1ft
	$2x^2 - 5x(-3)$ followed by $4x - 5$ and answer 3		M0M1A1ft

Q	Answer	Mark	Comments
31	$\frac{\sin CAB}{23.45} = \frac{\sin 63}{25.2}$ or $\frac{\sin CAB}{23.45} = [0.035, 0.0354]$	M1	oe eg $\frac{23.45}{\sin CAB} = \frac{25.2}{\sin 63}$ or $\frac{23.45}{\sin CAB} = [28.28, 28.3]$ CAB may be a single letter if unambiguous
	$(\sin CAB =) \frac{\sin 63}{25.2} \times 23.45$ or $(\sin CAB =) [0.82075, 0.83013]$ or $(CAB =) [55.1599, 56.1121]$	M1dep	oe CAB may be a single letter if unambiguous
	$\frac{DC}{\sin(75 - \text{their } CAB)} = \frac{25.2}{\sin 121}$ or $\frac{DC}{\sin(75 - \text{their } CAB)} = [29.399, 29.4]$	M1dep	oe eg $\frac{\sin(75 - \text{their } CAB)}{DC} = \frac{\sin 121}{25.2}$ or $\frac{\sin(75 - \text{their } CAB)}{DC} = [0.034, 0.034015]$ their CAB must be a value DC may be a single letter if unambiguous
	$\frac{25.2}{\sin 121} \times \sin(75 - \text{their } CAB)$	M1dep	oe their CAB must be a value
	[9.57, 9.6]	A1	

Q	Answer	Mark	Comments
32	Correct method for area of one vertical section	M1	eg $\frac{1}{2} \times 20 \times 18$ or 180 or $\frac{1}{2} \times 20 \times (18 + 28)$ or 460 or $\frac{1}{2} \times 20 \times (28 + 22)$ or 500
	Correct method for area of two vertical sections	M1dep	eg $\frac{1}{2} \times 20 \times 18$ or 180 and $\frac{1}{2} \times 20 \times (18 + 28)$ or 460
	1140	A1	
	Additional Guidance		
	Allow $\pm \frac{1}{2}$ square in readings for speeds		
	Dividing into vertical sections of unequal width can score up to M2		
	Dividing into 4 or more vertical sections can score up to M2		
	Dividing into 2 vertical sections can score up to M2		
	Using 1 vertical section can score up to M1		
	The area of a vertical section may be evaluated using a rectangle and a triangle, eg for the 2nd vertical section $20 \times 18 + \frac{1}{2} \times 20 \times (28 - 18)$ or $360 + 100$ or $20 \times 28 - \frac{1}{2} \times 20 \times (28 - 18)$ or $560 - 100$		
	Answer 1140 with no incorrect working		M1M1A1
	The area of a vertical section may be implied from a longer calculation or from calculations that are done separately and then added eg (rectangles) $360 + 440 = 800$ (triangles) $180 + 100 + 60 = 340$ and $800 + 340$		M1M1
	$\frac{1}{2} \times 20 \times \{0 + 22 + 2(18 + 28)\}$		M1M1

Q	Answer	Mark	Comments
33	Angle $BCE = 180 - 3x$ or $180 - x - y$ or angle $BCD = 180 - x$ or $180 - 3x + y$ or angle $CDE = 180 - 3x$ or $180 - x - y$ or angle $AEC = 180 - x$ or angle $CED = x$	M1	a correct expression for one of the unknown angles may be on the diagram
	A correct unsimplified equation in x and y by using the angles of a quadrilateral or triangle or equating equal angles and with the relevant expressions for the angles used seen	M1dep	eg using angle BAD and angle BCD in quadrilateral $ABCD$ $x + 180 - 3x + y = 180$ oe with the relevant expressions for angle BCE or angle BCD seen in terms of x and y
	$y = 2x$ and relevant working for M2 seen and correct relevant reasons given	A1	

Additional Guidance continues on the next page

33 cont	Additional Guidance	
	Up to M2 may be awarded for correct work with no or incorrect answer, even if this is seen amongst multiple attempts	
	Allow equivalent unambiguous notation eg allow angle ECB for angle BCE	
	Allow eg BAD for x and DCE for y	
	Use of single letters for angles (eg C for BCE or E for AEC) must be unambiguous	
	Possible equations are: angle $BAD + \text{angle } BCD = 180$ angle $ABC + \text{angle } BCE = 180$ angle $ECD = \text{angle } BCD - \text{angle } BCE$ sum of angles of quadrilateral $ABCD = 360^\circ$ sum of angles of triangle $CDE = 180^\circ$ angle $AEC = \text{angle } CDE + \text{angle } DCE$	
	Examples of relevant reasons for the A mark are (co-)interior angles (of parallel lines) corresponding angles angles on a straight line opposite angles of cyclic quadrilateral angle sum of quadrilateral angle sum of triangle exterior angle of triangle	
	To award the 2nd M mark the expressions used for the angles to construct the equation used must have been seen eg angle $CDE = 180 - 3x$ and using angle sum of triangle CDE $x + 180 - 3x + y = 180$ (oe) without seeing angle $CED = x$	M1 M0
	The equation for the 2nd mark may be derived from a correct pair of simultaneous equations in x and y and one other unknown eg $3x + w = 180$ and $x + w + y = 180$ with angle $CED = x$ and angle $CDE = w$ seen and w correctly eliminated	M1M1
	Substitutes a value for x and works out y eg $x = 45$ and works out $y = 90$	M0

Q	Answer	Mark	Comments
34	Alternative method 1		
	$(x + 3)^2 = 5x + 39$	M1	oe eg $x^2 + 3x + 3x + 9 = 5x + 39$
	$x^2 + x - 30 (= 0)$ or $30 - x - x^2 (= 0)$ or $x^2 + x = 30$	M1dep	
	$(x + 6)(x - 5) (= 0)$ or $\frac{-1 \pm \sqrt{1^2 - 4 \times 1 \times -30}}{2 \times 1}$ or $-\frac{1}{2} \pm \sqrt{\frac{121}{4}}$	M1	oe eg $\frac{-1 \pm \sqrt{121}}{2}$ ft their 3-term quadratic
	$(x =) -6$ and $(x =) 5$	A1	may be implied by correct coordinates
	$(-6, -3)$ and $(5, 8)$	A1	either order

Mark scheme and Additional Guidance continue on the next page

Q	Answer	Mark	Comments
34 cont	Alternative method 2		
	$y^2 = 5(y - 3) + 39$	M1	oe eg $y^2 = 5y - 15 + 39$
	$y^2 - 5y - 24 (= 0)$ or $24 + 5y - y^2 (= 0)$ or $y^2 - 5y = 24$	M1dep	
	$(y + 3)(y - 8) (= 0)$ or $\frac{- -5 \pm \sqrt{(-5)^2 - 4 \times 1 \times -24}}{2 \times 1}$ or $\frac{5}{2} \pm \sqrt{\frac{121}{4}}$	M1	oe eg $\frac{5 \pm \sqrt{121}}{2}$ ft their 3-term quadratic
	$(y =) -3$ and $(y =) 8$	A1	may be implied by correct coordinates
	$(-6, -3)$ and $(5, 8)$	A1	either order
	Additional Guidance		
	Mark by the scheme that gives the better mark		
	$(x + 3)^2 = 5x + 39$ $x^2 + x = 30$ $x(x + 1) = 30$ $(x =) 5$ and 6 $(5, 8)$ and $(6, 9)$		M1M1M0
	$x^2 + 9 = 5x + 39$ $x^2 - 5x - 30 (= 0)$ $(x =) \frac{- -5 \pm \sqrt{(-5)^2 - 4 \times 1 \times -30}}{2 \times 1}$ or $\frac{5}{2} \pm \sqrt{\frac{145}{4}}$ or $-3.5(2\dots)$ and $8.5(2\dots)$		M0M0M1