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Paper 1E

Mark scheme

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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	$\frac{12}{5}$	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
2	(10.5, 9)	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
3	$6x \equiv 7x - x$	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
4	$\frac{1}{2}$	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
5(a)	$(x - 2)(x - 3)$ or $(3 - x)(2 - x)$	B2	B1 $(x + a)(x + b)$ where $ab = 6$ or $a + b = -5$ or $x(x - 3) - 2(x - 3)$ or $x(x - 2) - 3(x - 2)$
	Additional Guidance		
	$(x - 3)(x - 2)$		B2
	Condone missing final bracket for B2 or B1 eg $(x - 2)(x - 3$		B2
	Condone multiplication signs for B2 or B1 eg1 $(x - 2) \times (x - 3)$ eg2 $(x - 1) \times (x - 6)$		B2 B1
	$(x + 2)(x + 3)$		B1
	Ignore any attempt to solve		

Q	Answer	Mark	Comments
5(b)	$a^2b^3(ab^2 + 2)$	B2	oe eg $b^3a^2(ab^2 + 2)$ B1 partial factorisation with a factor of at least degree two extracted eg $a^2(ab^5 + 2b^3)$ or $b^3(a^3b^2 + 2a^2)$ or $b^2(a^3b^3 + 2a^2b)$ or $ab(a^2b^4 + 2ab^2)$
	Additional Guidance		
	Condone $(ab^2 + 2)a^2b^3$		B2
	Condone missing final bracket for B2 or B1 eg $a^2b^3(ab^2 + 2$		B2
	Condone multiplication signs for B2 or B1 eg1 $a^2 \times b^3 \times (ab^2 + 2)$ eg2 $b^3 \times (a^3 \times b^2 + 2 \times a^2)$		B2 B1

Q	Answer	Mark	Comments
6	Alternative method 1		
	$(x \Rightarrow) 180 - 124$ or 56	M1	oe
	$2 \times \text{their } 56 + 16$ or 128 or their $56 + 2 \times \text{their } 56 + 16$ or 184	M1dep	oe
	No and 56 and 128 (and 124) or No and 56 and 184 (and 180)	A1	oe No may be implied eg $128 \neq 124$
	Alternative method 2		
	$2x + 16 = 124$	M1	oe
	$(124 - 16) \div 2$ or 54	M1dep	oe
	No and 54 and 178	A1	oe No may be implied eg $54 + 124 \neq 180$
	Alternative method 3		
	$x + 2x + 16 = 180$	M1	oe
	$(180 - 16) \div 3$ or [54.6, 54.7]	M1dep	oe
	No and [54.6, 54.7] and [178.6, 178.7] (and 180) or No and [54.6, 54.7] and [125, 125.4] (and 124)	A1	oe No may be implied eg $54.7 + 124 \neq 180$

Alternative method and Additional Guidance on the next page

6 cont	Alternative method 4		
	$(x =) 180 - 124$ or 56 or $2x + 16 = 124$ or $x + 2x + 16 = 180$	M1	oe
	Any two of $180 - 124$ or 56 and $(124 - 16) \div 2$ or 54 and $(180 - 16) \div 3$ or [54.6, 54.7]	M1dep	oe
	No and any two of 56 and 54 and [54.6, 54.7]	A1	oe No may be implied eg $56 \neq 54$
	Additional Guidance		
	Using 120 for 124 is from measuring and is not a misread		
	In Alt 1 and Alt 2 allow use of their x to work out angle PQD using $180 - \text{angle } CQP$ and then compare with their x eg Alt 1, $x = 56$ and $180 - 16 - 2 \times 56$ or 52 and No eg Alt 2, $x = 54$ and $180 - 16 - 2 \times 54$ or 56 and No		M2A1 M2A1

Q	Answer	Mark	Comments
7(a)	$\frac{28}{79}$	B1	oe fraction, decimal or percentage allow 0.35 or 35% if correct division seen
	Additional Guidance		
	35.4(...)%		B1
	0.354(...)		B1
	Answer given as a ratio		B0
	Ignore incorrect cancelling or conversion to decimal or percentage after correct answer seen		

Q	Answer	Mark	Comments
7(b)	79 – 15 – 28 – 32 or 4 or $1 - \frac{15 + 28 + 32}{79}$	M1	oe 4 may be on diagram
	$\frac{4}{79}$	A1	oe fraction, decimal or percentage allow 0.05 or 5% if correct method seen
	Additional Guidance		
	$\frac{4}{75}$		M1A0
	4 seen on diagram even if not subsequently used		M1
	5.06(...) % or 5.1%		M1A1
	0.0506(...) or 0.051		M1A1
	Answer given as a ratio		A0
	Ignore incorrect cancelling or conversion to decimal or percentage after correct answer seen		

Q	Answer	Mark	Comments
8	Alternative method 1		
	3000×1.04 or 3120	M1	oe eg $3000 + 3000 \times 0.04$
	their 3120×0.8	M1	oe 3120 must not be 3000 or 120
	2496	A1	SC1 2520 or 3456
	Alternative method 2		
	3000×0.8 or 2400	M1	oe eg $3000 - 3000 \times 0.2$
	their 2400×1.04	M1	oe their 2400 must not be 3000 or 600
	2496	A1	SC1 2520 or 3456
	Alternative method 3		
	1.04×0.8 or 0.832	M1	oe
	their 0.832×3000	M1dep	oe
	2496	A1	SC1 2520 or 3456
	Additional Guidance		
	$3000 \times 1.04 - 3000 \times 0.2 = 2520$		SC1
	$3000 \times 0.96 \times 1.2 = 3456$		SC1

Q	Answer	Mark	Comments
9	Alternative method 1		
	$\frac{3 \times 3 + 1}{3}$ or $\frac{9 + 1}{3}$ or $\frac{10}{3}$	M1	oe improper fraction
	$\dots \times \frac{9}{5}$	M1	
	6 with full method seen	A1	
	Alternative method 2		
	$\frac{3 \times 3 + 1}{3}$ or $\frac{9 + 1}{3}$ or $\frac{10}{3}$	M1	oe improper fraction
	$\frac{30}{9} \div \frac{5}{9}$	M1dep	
	6 with full method seen	A1	
	Additional Guidance		
	6 with full method not seen		M0M0A0

Q	Answer	Mark	Comments
10	Alternative method 1		
	$x - 5$ or $8 \times x$ or $8x$	M1	oe may be implied by $4x - 20$
	$4x + 4(x - 5) (= 90)$ or $8x - 20 (= 90)$	M1dep	oe eg $4x - 10 = 45$
	$4x + 4x = 90 + 20$ or $8x = 110$ or $(90 + 20) \div 8$	M1dep	oe eg $4x = 55$
	13.75	A1	oe fraction or mixed number
	Alternative method 2		
	$90 + 4 \times 5$ or 110	M1	oe
	$(90 + 4 \times 5) \div 2$ or $110 \div 2$ or 55	M1dep	oe $90 \div 2 + 5 + 5$ implies M2
	$(90 + 4 \times 5) \div 2 \div 4$ or $55 \div 4$	M1dep	oe eg $(90 \div 2 + 5 + 5) \div 4$
	13.75	A1	oe fraction or mixed number
	Alternative method 3		
	$(x =) y + 5$ or $8 \times y$ or $8y$	M1	oe where y is the length of a shorter side any letter except x may be implied by $4y + 20$
	$4y + 4(y + 5) (= 90)$ or $8y + 20 (= 90)$	M1dep	oe eg $4y + 10 = 45$
	$8(x - 5) = 90 - 20$ or $(90 - 20) \div 8 + 5$ or $8.75 + 5$	M1dep	oe eg $4(x - 5) = 35$
	13.75	A1	oe fraction or mixed number

Additional Guidance on the next page

10 cont	Additional Guidance	
	$13.75 \times 4 + 8.75 \times 4 = 90$ Answer 13.75	M1M1M1A1
	$13.75 \times 4 + 8.75 \times 4 = 90$ 13.75 not on answer line	M1M1M1A0
	8.75 from incorrectly solving $8x - 20 = 90$	M2M0A0
	Using trial and improvement is 4 marks (if answer correct) or 0 marks	

Q	Answer	Mark	Comments
11(a)	2^{-6}	B2	B1 $\frac{1}{2^6}$ or 64^{-1} or 8^{-2} or 4^{-3} SC1 -6
	Additional Guidance		
	$a = -6$		B2
	2^{-6} seen, answer -6		B2
	Answer -6 only		SC1

Q	Answer	Mark	Comments
11(b)	$\left((5^4)^{10} =\right) 5^{40}$	M1	
	$(125 =) 5^3$	M1	
	5^{37}	A1	SC1 37
	Additional Guidance		
	5^{37} seen, answer 37		M2A1
	Answer 37 only		SC1
	$7.275957614 \times 10^{25}$ with no M marks seen		M0M0A0

Q	Answer	Mark	Comments
12	Ratios equivalent to 3 : 2 and 5 : 4 with matching whole numbers of adults eg 30 : 20 and 30 : 24 or 15 : 10 or 15 : 12 or 15 + 10 or 15 + 12 or $15 \times \frac{3+2}{3}$ or 5×5 or 25 or $15 \times \frac{5+4}{5}$ or 3×9 or 27	M1	oe eg $3 \times 5 : 2 \times 5$ may be implied
	15 : 10 and 15 : 12 or 15 + 10 and 15 + 12 or $15 \times \frac{3+2}{3}$ or 5×5 or 25 and $15 \times \frac{5+4}{5}$ or 3×9 or 27	M1dep	oe may be implied
	52	A1	
	Additional Guidance		

Q	Answer	Mark	Comments
13(a)	<p>Correct probabilities on branches for A</p> <p>(odd) $\frac{3}{4}$</p> <p>(even) $\frac{1}{4}$</p>	B1	oe fraction, decimal or percentage
	<p>Correct probabilities on both sets of branches for B</p> <p>(odd) $\frac{2}{5}$</p> <p>(even) $\frac{3}{5}$</p>	B1	oe fraction, decimal or percentage
	Additional Guidance		

Q	Answer	Mark	Comments
13(b)	Alternative method 1		
	$\frac{3}{4} \times \frac{3}{5}$ or $\frac{9}{20}$ or $\frac{1}{4} \times \frac{2}{5}$ or $\frac{2}{20}$	M1	oe fraction or decimal ft their tree diagram provided probabilities in range (0, 1)
	$\frac{3}{4} \times \frac{3}{5} + \frac{1}{4} \times \frac{2}{5}$ or $\frac{9}{20} + \frac{2}{20}$	M1dep	oe fraction or decimal ft their tree diagram provided probabilities in range (0, 1)
	$\frac{11}{20}$	A1ft	oe fraction, decimal or percentage ft their tree diagram provided probabilities in range (0, 1)
	Alternative method 2		
	$\frac{3}{4} \times \frac{2}{5}$ or $\frac{6}{20}$ or $\frac{1}{4} \times \frac{3}{5}$ or $\frac{3}{20}$	M1	oe fraction or decimal ft their tree diagram provided probabilities in range (0, 1)
	$1 - \frac{3}{4} \times \frac{2}{5} - \frac{1}{4} \times \frac{3}{5}$ or $1 - \frac{6}{20} - \frac{3}{20}$	M1dep	oe fraction or decimal ft their tree diagram provided probabilities in range (0, 1)
	$\frac{11}{20}$	A1ft	oe fraction, decimal or percentage ft their tree diagram provided probabilities in range (0, 1)
	Additional Guidance		
	May start again and not follow through from their tree diagram		
	$\frac{9}{20}$, $\frac{2}{20}$, $\frac{6}{20}$ and $\frac{3}{20}$ may be seen at the RHS of the tree diagram		M1

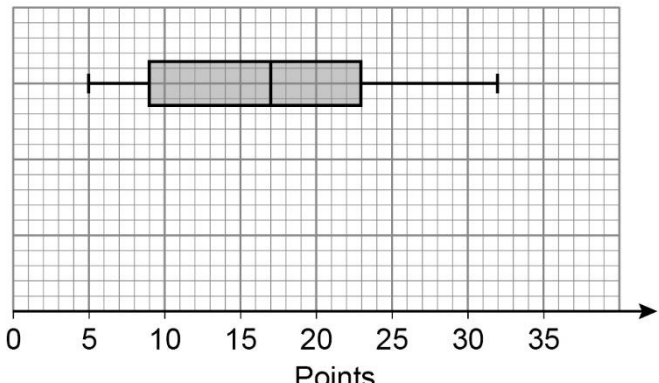
Q	Answer	Mark	Comments
14	$3x + 6 = 72 \times 2$ or $3x + 6 = 144$ or $(72 - 3) \div 1.5$	M1	oe
	46	A1	
	Additional Guidance		

Q	Answer	Mark	Comments
15(a)	$\begin{pmatrix} 6 \\ 4 \end{pmatrix}$ drawn on the grid	B2	B1 $\begin{pmatrix} 6 \\ 4 \end{pmatrix}$ seen in working or $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$ drawn from right-hand end of $\begin{pmatrix} 4 \\ 1 \end{pmatrix}$
	Additional Guidance		
	Direction arrow must be shown for B2		
	$\begin{pmatrix} 6 \\ 4 \end{pmatrix}$ drawn in a triangle of vectors		B2
	$\begin{pmatrix} -6 \\ -4 \end{pmatrix}$ drawn on the grid		B1
	Condone $\begin{smallmatrix} 6 \\ 4 \end{smallmatrix}$ without brackets		B1
	Condone $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$ with no direction arrow		B1
	$\begin{pmatrix} 2 \\ 3 \end{pmatrix}$ with incorrect direction arrow		B0

Q	Answer	Mark	Comments	
15(b)	$\begin{pmatrix} -6 \\ 3 \end{pmatrix}$ drawn on the grid or $\begin{pmatrix} 6 \\ -3 \end{pmatrix}$ drawn on the grid	B2	B1 $\begin{pmatrix} -6 \\ 3 \end{pmatrix}$ seen in working or $\begin{pmatrix} 6 \\ -3 \end{pmatrix}$ seen in working or any vector drawn that is $k \begin{pmatrix} -2 \\ 1 \end{pmatrix}$ with $k \neq 0$ and $k \neq 1$	
	Additional Guidance			
	Direction arrow must be shown for B2			
	Condone no direction arrow for B1			
	Condone $\frac{-6}{3}$ or $\frac{6}{-3}$ without brackets		B1	
	Vectors may be drawn including the given vector eg1 $\begin{pmatrix} -6 \\ 3 \end{pmatrix}$ drawn by extending $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$ (Direction implied by given arrow) eg2 $\begin{pmatrix} -4 \\ 2 \end{pmatrix}$ drawn by extending $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$ (Direction implied by given arrow)		B2 B1	

Q	Answer	Mark	Comments
16(a)	$\begin{pmatrix} 13 & -12 \\ -9 & 16 \end{pmatrix}$	B2	B1 at least two entries correct in a 2 by 2 matrix or $\begin{pmatrix} 1 \times 1 + -4 \times -3 & 1 \times -4 + -4 \times 2 \\ -3 \times 1 + 2 \times -3 & -3 \times -4 + 2 \times 2 \end{pmatrix}$ oe
	Additional Guidance		

Q	Answer	Mark	Comments
16(b)	$\begin{pmatrix} 4a + 15 \\ 8 - 5 \end{pmatrix}$ or $\begin{pmatrix} 4a + 15 \\ 3 \end{pmatrix}$ or $\begin{pmatrix} 18 \\ 6b \end{pmatrix}$ or $4a + 15 = 18$ or $6b = 3$	M1	oe eg $\begin{pmatrix} 4 \times a + 15 \\ 8 - 5 \end{pmatrix}$ or $\begin{pmatrix} 6 \times 3 \\ 6 \times b \end{pmatrix}$ or $4a = 3$ or $6b = 8 - 5$
	$4a + 15 = 18$ and $6b = 3$ or $a = \frac{3}{4}$ or $b = \frac{3}{6}$ or $b = \frac{1}{2}$	M1dep	oe pair of equations or value eg $4a = 3$ and $6b = 3$ or $a = 0.75$ or $b = 0.5$
	$a = \frac{3}{4}$ $b = \frac{3}{6}$ or $a = \frac{3}{4}$ $b = \frac{1}{2}$	A1	oe eg $a = 0.75$ and $b = 0.5$
	Additional Guidance		
	Condone matrices without brackets		
	$4a + 15 = \dots$ and $8 - 5 = \dots$ implies $\begin{pmatrix} 4a + 15 \\ 8 - 5 \end{pmatrix}$		M1
	$\dots = 18$ and $\dots = 6b$ implies $\begin{pmatrix} 18 \\ 6b \end{pmatrix}$		M1

Q	Answer	Mark	Comments
17	Median 17	B1	may be implied by box plot
	Lower quartile 9 and upper quartile 23	B1	may be implied by box plot
	Lowest 5 and highest 32	B1	may be implied by box plot
	Fully correct box plot	B1ft	ft their measures with B2 awarded and at least four correct measures
	Additional Guidance		
	NB mean is 16.7...		
	Circling numbers in the stem-and-leaf is not sufficient to show values		
			B4

Q	Answer	Mark	Comments
18	Alternative method 1		
	$\frac{h}{r} = \frac{12}{5}$ or $h = \frac{12r}{5}$ or $r = \sqrt{\frac{72.9 \times 3}{h}}$	M1	oe
	$72.9\pi = \frac{1}{3}\pi r^2 \times \frac{12r}{5}$ or $72.9 = \frac{1}{3}r^2 \times \frac{12r}{5}$	M1dep	oe
	$r^3 = \frac{15 \times 72.9}{12}$ or $\frac{729}{8}$ or 91.125	M1dep	oe
	4.5 or $\frac{9}{2}$ or $4\frac{1}{2}$	A1	
	Alternative method 2		
	$r = 5x$ and $h = 12x$	M1	oe eg $r = \frac{5}{17}y$ and $h = \frac{12}{17}y$
	$72.9\pi = \frac{1}{3}\pi(5x)^2 \times 12x$ or $72.9 = \frac{1}{3}(5x)^2 \times 12x$	M1dep	oe eg $72.9\pi = \frac{1}{3}\pi\left(\frac{5}{17}y\right)^2 \times \frac{12}{17}y$
	$x^3 = \frac{72.9 \times 3}{25 \times 12}$ or $\frac{729}{1000}$ or 0.729 or $x = 0.9$	M1dep	oe eg $y^3 = \frac{72.9 \times 3 \times 17^3}{5^2 \times 12}$ or 3581.577 or $y = 15.3$
	4.5 or $\frac{9}{2}$ or $4\frac{1}{2}$	A1	

Alternative method and Additional Guidance on the next page

18 cont	Alternative method 3		
	$\frac{h}{r} = \frac{12}{5}$ or $r = \frac{5h}{12}$ or $h = \frac{72.9 \times 3}{r^2}$	M1	oe
	$72.9\pi = \frac{1}{3}\pi\left(\frac{5h}{12}\right)^2 \times h$ or $72.9 = \frac{1}{3}\left(\frac{5h}{12}\right)^2 \times h$	M1dep	oe
	$h^3 = \frac{72.9 \times 3 \times 144}{25}$ or 1259.712 or $h = 10.8$	M1dep	oe
	4.5 or $\frac{9}{2}$ or $4\frac{1}{2}$	A1	
	Additional Guidance		

Q	Answer	Mark	Comments
19	$\frac{\sin x}{7} = \frac{\sin 124}{16}$ or $\frac{7}{\sin x} = \frac{16}{\sin 124}$	M1	oe eg $\frac{\sin x}{7} = 0.051(8\dots)$ or 0.052 or $\frac{7}{\sin x} = 19.2(9\dots)$ or 19.3(0)
	$(\sin x =) \frac{\sin 124}{16} \times 7$ or $(\sin x =) 0.36(2\dots)$ or $(\sin x =) 0.363$	M1dep	oe eg $\sin^{-1}\left(\frac{\sin 124}{16} \times 7\right)$ may be implied by $x = 21(.1\dots)$
	[21.2, 21.3]	A1	
	Additional Guidance		
	Condone incorrect notation if recovered eg $x = \frac{\sin 124}{16} \times 7$ Answer 21.3		M1M1A1
	$\frac{\sin}{7} = \frac{\sin 124}{16}$ not recovered		Zero
	Answer in range seen followed by 21 or 22		M1M1A1
	Answer only [21.2, 21.3]		M1M1A1

Q	Answer	Mark	Comments
20	$a + 1$	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
21	$5^2 + 8^2$ or 89 or $\sqrt{89}$ or 9.4(3...)	M1	oe
	(Angle $BOC =$) $\tan^{-1}\left(\frac{8}{5}\right)$ or 58 or 57.9(...)	M1	oe eg (Angle $BOC =$) $\sin^{-1}\left(\frac{8}{\sqrt{5^2 + 8^2}}\right)$ or (Angle $BOC =$) $\cos^{-1}\left(\frac{5}{\sqrt{5^2 + 8^2}}\right)$
	$\pi \times \text{their } (\sqrt{89})^2 \times \frac{(180 - \text{their } 58)}{360}$ or $\frac{5429}{180}\pi$ or $[29.9, 30.2]\pi$ or $[94, 94.8]$	M1dep	oe dep on M2
	their $[94, 94.8] + \frac{1}{2} \times 5 \times 8$	M1dep	oe
	$[114, 115]$ or $\frac{5429}{180}\pi + 20$ or $[29.9, 30.2]\pi + 20$	A1	oe
	Additional Guidance		

Q	Answer	Mark	Comments
22(a)	$x^2 = 14 - 5$ or $x^2 = 9$ or $x^2 - 9 = 0$ or $(x + 3)(x - 3) = 0$ or $\pm\sqrt{9}$ or ± 3 or $\sqrt{9}$ or $-\sqrt{9}$ or 3	M1	
	-3	A1	
	Additional Guidance		
	3 and -3 given as answer		M1A0
	Only 3 given as answer		M1A0
	$x^2 - 9$ or $(x + 3)(x - 3)$ is M0 unless one of the other ways to score M1 is also seen or final answer is correct		

Q	Answer	Mark	Comments
22(b)	$\frac{x}{7}$	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
22(c)	$4x^3$	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
23	Alternative method 1		
	(second differences =) 4 or $2n^2$ or $a = 2$	M1	second difference seen at least once and not contradicted
	$3 - 2 \times 1^2$ and $10 - 2 \times 2^2$ and $21 - 2 \times 3^2$ (and $36 - 2 \times 4^2$) or 1 and 2 and 3 (and 4) or n	M1dep	
	$2n^2 + n$	A1	oe
	Alternative method 2		
	Any two of $a + b + c = 3$ $4a + 2b + c = 10$ $9a + 3b + c = 21$ $16a + 4b + c = 36$	M1	oe
	$3a + b = 10 - 3$ and $5a + b = 21 - 10$ or $a = 2$ and $b = 1$ (and $c = 0$)	M1dep	oe obtains two correct equations in same two variables from their equations
	$2n^2 + n$	A1	oe
	Alternative method 3		
	(second differences =) 4 or $2n^2$ or $a = 2$	M1	second difference seen at least once and not contradicted
	$3a + b = 10 - 3$ and substitutes $a = 2$ or $b = 1$ or n	M1dep	
	$2n^2 + n$	A1	oe

Alternative method and Additional Guidance on the next page

23 cont	Alternative method 4		
	(second differences =) 4 or $2n^2$ or $a = 2$	M1	second difference seen at least once and not contradicted
	Continues sequence backwards to the 0th term to find the value of c then substitutes $n = 1$ into $2n^2 + bn = 3$ or substitutes $n = 2$ into $2n^2 + bn = 10$	M1dep	oe substitutes $n = 3$ or $n = 4$
	$2n^2 + n$	A1	oe
	Additional Guidance		
	$n = 2n^2 + n$	M2A1	
	$2x^2 + x$	M2A1	
	$2n^2 + 1n$	M2A1	

Q	Answer	Mark	Comments
24	Alternative method 1		
	$x^2 - 5x + 4x - 20$ with three terms correct or $x^2 - x + k$ where k is a non-zero constant	M1	oe no omissions or extra terms
	$x^3 - 5x^2 + 4x^2 - 20x$ or $x^3 - x^2 - 20x$ or $4x^2 - 20x + 16x - 80$ or $4x^2 - 4x - 80$	M1dep	attempt at full expansion with correct multiplication of their 3 or 4 terms by one of the terms in the remaining bracket
	$x^3 - x^2 + 4x^2 - 20x - 4x - 80$	A1	oe eg $x^3 - 5x^2 + 4x^2 - 20x + 4x^2 - 20x + 16x - 80$ implied by correct final answer
	$x^3 + 3x^2 - 24x - 80$	A1	
	Alternative method 2		
	$x^2 + 4x + 4x + 16$ with three terms correct or $x^2 + 8x + k$ where k is a non-zero constant	M1	oe no omissions or extra terms
	$x^3 + 4x^2 + 4x^2 + 16x$ or $x^3 + 8x^2 + 16x$ or $-5x^2 - 20x - 20x - 80$ or $-5x^2 - 40x - 80$	M1dep	attempt at full expansion with correct multiplication of their 3 or 4 terms by one of the terms in the remaining bracket
	$x^3 + 8x^2 - 5x^2 + 16x - 40x - 80$	A1	oe eg $x^3 + 4x^2 + 4x^2 + 16x - 5x^2 - 20x - 20x - 80$ implied by correct final answer
	$x^3 + 3x^2 - 24x - 80$	A1	

Additional Guidance on the next page

24 cont	Additional Guidance	
	$x^3 + 3x^2 - 24x - 80$ seen with further work eg factorising	M1M1A1A0
	For the first two marks terms may be seen in a grid	
	If an attempt at the expansion of all three brackets in one go is made it must be fully correct to gain M2A1, otherwise M0	
	Ignore equating to zero and/or solving an equation	

Q	Answer	Mark	Comments
25	Alternative method 1		
	$16\,000 \times \left(1 + \frac{r}{100}\right)^4 = 28\,000$ or $16 \times \left(1 + \frac{r}{100}\right)^4 = 28$	M1	oe allow $r\%$ for $\frac{r}{100}$
	$1 + \frac{r}{100} = \sqrt[4]{\frac{28\,000}{16\,000}}$ or $1 + \frac{r}{100} = \sqrt[4]{\frac{28}{16}}$ or $1 + \frac{r}{100} = 1.15(0\dots)$	M1dep	oe allow $r\%$ for $\frac{r}{100}$
	15(.0...)	A1	SC2 0.15...
	Alternative method 2		
	$16\,000 \times x^4 = 28\,000$ or $x^4 = 1.75$	M1	oe eg $16 \times x^4 = 28$ any letter except r
	$\sqrt[4]{\text{their } 1.75} - 1$	M1dep	oe
	15(.0...)	A1	SC2 0.15...
	Additional Guidance		
	$r = 0.15\dots$ from $16\,000 \times (1+r)^4 = 28\,000$		M0M0A0

Q	Answer	Mark	Comments
26	$(x - 2a)^2 - (2a)^2$ or $(x - 2a)^2 - 4a^2 + 6a^2$	M1	oe
	$a = 5$	A1	must be from completing the square
	$-4a^2 + 6a^2 = 7a + b$ or $-4 \times 5^2 + 6 \times 5^2 = 7 \times 5 + b$ or $x^2 - 20x + 150 = 7a + b$ and substitutes $x = 10$ and their a	M1	oe
	$b = 15$	A1	
	Additional Guidance		
	Allow first M1 even if not subsequently used		

Q	Answer	Mark	Comments
27(a)	$\frac{3}{2}$	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
27(b)	Alternative method 1		
	$\frac{1}{2} \times 4 \times 6 + 6 \times (10 - 4)$ or $12 + 36$	M1	oe distance for runner eg $\frac{6}{2} \times (10 + (10 - 4))$ or $3 \times (10 + 6)$
	$\frac{1}{2} \times 4 \times 12 + 12 \times (10 - 8)$ or $24 + 24$	M1	oe distance for cyclist eg $\frac{12}{2} \times ((10 - 4) + (10 - 8))$ or $6 \times (6 + 2)$
	(runner =) 48 and (cyclist =) 48 with M2 seen	A1	
	Alternative method 2		
	$\frac{1}{2} \times 4 \times 6 + 6(t - 4)$ or $\frac{1}{2} \times 4 \times 12 + 12(t - 8)$	M1	t is time cyclist overtakes oe eg $\frac{6}{2} \times (t + (t - 4))$ or $\frac{12}{2} \times ((t - 4) + (t - 8))$
	$12 - 24 - 24 + 96 = 12t - 6t$ or $60 = 6t$	M1dep	oe
	$60 = 6t$ and $t = 10$	A1	from correct working only
	Alternative method 3		
	$\frac{1}{2} \times 4 \times 6 + 6k$ or $\frac{1}{2} \times 4 \times 12 + 12(k - 4)$	M1	k is time after cyclist starts oe eg $\frac{6}{2} \times (k + (k + 4))$ or $\frac{12}{2} \times (k + (k - (8 - 4)))$
	$12 - 24 + 48 = 12k - 6k$ or $36 = 6k$	M1dep	oe
	$36 = 6k$ and $6 + 4 = 10$	A1	from correct working only
	Additional Guidance		

Q	Answer	Mark	Comments
28	$6x^2$ or 1	M1	oe eg $3 \times 2x^{3-1}$ or $1x^0$
	$6 \times 7^2 + 1$	M1dep	oe
	295	A1	
	Additional Guidance		
	Allow up to M2 even if not subsequently used		
	Further work eg substitutes $x = 7$ into $2x^3 + x$ or attempts equation of tangent		M1M1A0

Q	Answer	Mark	Comments
29	Enlargement	B1	
	(Scale factor) $-\frac{1}{3}$	B1	
	$(-1, -2)$	B1	
	Additional Guidance		
	Enlarge ($\times$) $-\frac{1}{3}$ $(-1, -2)$		B1B1B1
	'Reduces' or 'gets smaller' or 'unenlargement' or 'negative enlargement'		1st B0
	Do not accept $\div (-\frac{1}{3})$ or $\div (-3)$ for scale factor		2nd B0
	Condone $-1, -2$		3rd B1
	Combined transformation eg enlarge by $\frac{1}{3}$ and rotate 180 about $(-1, -2)$		B0B0B0

Q	Answer	Mark	Comments
30	60, 300, 420 and 660 with no other values in range	B3	B2 three of 60, 300, 420 and 660 B1 300 or 420 or 660
	Additional Guidance		
	Ignore extra values inside or outside the range $[0, 720]$ for B1 or B2		

Q	Answer	Mark	Comments
31	Alternative method 1 km/min		
	15.25 or 15.75 or 13.5 or 14.5	M1	oe
	their $15.75 \div$ their 13.5 or 1.166... or 1.17	M1	their 15.75 must be x where $15.5 < x < 16$ their 13.5 must be y where $13 < y < 14$
	their $1.166... \times 60$	M1dep	oe dep on M2
	70 with 15.75 and 13.5 used	A1	
	Alternative method 2 m/min		
	15250 or 15750 or 13.5 or 14.5	M1	oe
	their $15750 \div$ their 13.5 or 1166.(...) or 1167 or 1170	M1	their 15750 must be x where $15500 < x < 16000$ their 13.5 must be y where $13 < y < 14$
	their $1166.(...) \times 60 \div 1000$	M1dep	oe dep on M2
	70 with 15750 and 13.5 used	A1	
	Alternative method 3 m/s		
	15250 or 15750 or 810 or 870	M1	
	their $15750 \div$ their 810 or 19.4(...)	M1	their 15750 must be x where $15500 < x < 16000$ their 810 must be y where $780 < y < 840$
	their $19.4(...) \times 60 \times 60 \div 1000$	M1dep	oe dep on M2
	70 with 15750 and 810 used	A1	

Alternative method and Additional Guidance on the next page

31 cont	Alternative method 4 km/h		
	15.25 or 15.75 or 0.225 or 0.2416(...) or 0.2417	M1	oe
	their 15.75 $\div$ 0.225 or 15.75 $\div$ their 0.225	M2	M1 their 15.75 $\div$ their 0.225 their 15.75 must be x where $15.5 < x < 16$ their 0.225 must be y where $0.21\dot{6} < y < 0.2\dot{3}$
	70 with 15.75 and 0.225 used	A1	
	Additional Guidance		
	Accept eg 15.74 $\dot{9}$ for 15.75		