Mark Scheme (Results)

November 2023

Pearson Edexcel International GCSE
In Mathematics B (4MB1) Paper 01

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November 2023
Question Paper Log Number P73494
Publications Code 4MB1_01_2311_MS

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme.

  Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

- **Types of mark**
  - M marks: method marks
  - A marks: accuracy marks
  - B marks: unconditional accuracy marks (independent of M marks)
- **Abbreviations**
  - cao – correct answer only
  - ft – follow through
  - isw – ignore subsequent working
  - SC - special case
  - oe – or equivalent (and appropriate)
  - dep – dependent
  - indep – independent
  - awrt – answer which rounds to
  - eeoo – each error or omission
- **No working**

  If no working is shown then correct answers normally score full marks

  If no working is shown then incorrect (even though nearly correct) answers score no marks.

- **With working**

  If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.

  If it is clear from the working that the “correct” answer has been obtained from incorrect working, award 0 marks.

  If a candidate misreads a number from the question: eg. Uses 252 instead of 255; method marks may be awarded provided the question has not been simplified. Examiners should send any instance of a suspected misread to review.

  If there is a choice of methods shown, mark the method that leads to the answer on the answer line; where no answer is given on the answer line, award the lowest mark from the methods shown.

  If there is no answer on the answer line then check the working for an obvious answer.

- **Ignoring subsequent work**

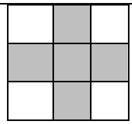
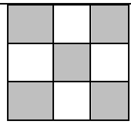
  It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. Incorrect cancelling of a fraction that would otherwise be correct.

  It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.

  Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.

- **Parts of questions**

Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded to another.

Question		Working	Answer	Mark	Notes
1	(a)		2	1	B1
	(b)		 or 	1	B1 A suitable pattern
		cas			***Total 2 marks***

Question		Working	Answer	Mark	Notes
2	(a)		4	1	B1 with no incorrect values
	(b)		$\sqrt{3}$	1	B1 with no incorrect values
		cas			***Total 2 marks***

Question		Working	Answer	Mark	Notes
3		$(3\times5^2-20)[=55]$ and $(3\times4^2-20)[=28]$ **or** $(3\times5^2-20)-(3\times4^2-20)$ [= 55 –28] **or** $(3\times5^2)-(3\times4^2)$[= 75 – 48] oe		2	M1 A correct method to find the 4th term and the 5th term **or** correct method to find the difference (condone missing brackets around the terms), which could be the other way round eg 28 – 55
			27 or – 27		A1
		cas			***Total 2 marks***

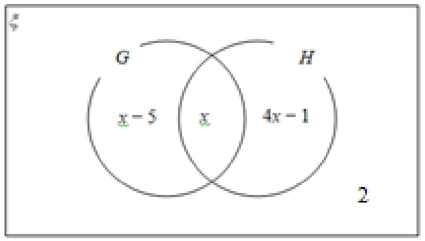
Question		Working	Answer	Mark	Notes
4				2	M1 for bisector of angle *FGH* within lines of overlay
			Accurate bisector		A1 correct bisector which must be a straight line + construction lines ignore any additional lines eg line drawn from *F* to *H*
		wr			***Total 2 marks***

Question		Working	Answer	Mark	Notes
5		$\frac{7}{3}\times\frac{5}{6}$ **or** $\frac{2+\frac{1}{3}}{1+\frac{1}{5}}=\frac{30+5}{15+3}$ **or** $\frac{\frac{35}{15}}{\frac{18}{15}}$		2	M1 Note if we see the fractions as a division then the denominators must be the same eg $\frac{7}{3}\div\frac{6}{5}=\frac{35}{18}$ or $\frac{7}{6}\div\frac{3}{5}=\frac{35}{18}$ gets M0
		$\frac{35}{18}$	$\frac{35}{18}=1\frac{17}{18}$		A1 dep on M1 We must see both the correct top heavy fraction and the correct simplified mixed fraction
		wr			***Total 2 marks***

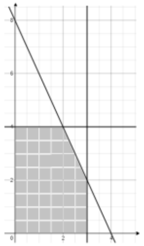
Question		Working	Answer	Mark	Notes
6			$5p(mp-2)$	2	B2 correct answer B1 for $5(mp^2-2p)$ or $p(5mp-10)$ or $5p(mp+2)$ or $5p(...-...)$ Condone missing closed bracket
		cas			***Total 2 marks***

Question		Working	Answer	Mark	Notes
7			3500	2	B2 Allow $2^2\times5^3\times7$ must be their only answer or identified as their answer B1 $2^2\times5^n\times7$ or $2^m\times5^3\times7$ where *m* and *n* must be non zero integers or having the HCF with other values in the working space Note B0 for finding the LCM only
		cas			***Total 2 marks***
Question		**Working**	**Answer**	**Mark**	**Notes**
8		$\sqrt{7^2+(-3)^2}$ or $\sqrt{7^2+3^2}$		2	M1 Condone omission of $\sqrt{\ }$, missing brackets around the -3 and subtraction of the squares rather than addition. eg allow 7^2+-3^2 and 7^2--3^2 and $7^2-(-3)^2$ Implied by $\sqrt{58}$ or $\pm\sqrt{58}$ or $-\sqrt{58}$ or 7.6….
			$\sqrt{58}$		A1 isw if they give the exact value and then 7.6…. A0 for $\pm\sqrt{58}$
		cas			***Total 2 marks***

Question		Working	Answer	Mark	Notes
9		$80\times2\frac{1}{2}[=200]$ or $80\times2\frac{1}{2}+25[=225]$ oe		3	M1 Correct method to find the distance in 2.5 hours (could be part of calculation to find the total distance or in a correct calculation to find the average speed) Ignore any incorrect units
		$\frac{80\times2.5+25}{2.5+0.5}$ or $\frac{"200"+25}{2.5+0.5}$ oe			M1 Correct method to find speed using total distance/ total time or allow a distance other than 200 provided it is clearly labelled as the distance in the first part of the journey and is not equal to 80 Ignore any incorrect units
			75		A1 ignore any additional incorrect units isw further calculations for the method marks but not for the accuracy mark
		cas			***Total 3 marks***

Question		Working	Answer	Mark	Notes
10	(a)		Correct $4x-1$ in Venn diagram	1	B1 for $4x-1$ oe (eg $5x-1-x$) correctly placed or Allow $35-2x$ oe
	(b)	$x-5+x+"4x-1"+2=32$ oe eg $x-5+x+"4x-1"=30$		2	M1 correct equation ft their $4x-1$ only. Condone the missing 2 only eg $x-5+x+"4x-1"=32$
			6		A1
		cas			***Total 3 marks***

Question		Working	Answer	Mark	Notes
11		0.4×10^{101} or 36×10^{100} or 0.2×10^{101} or 18×10^{100}		3	M1 for converting one of the numbers so that it is written as the same power of ten as the other number (this may be done after dividing by 2) Implied by 4×10^{101} or 40×10^{100} oe
		$\frac{0.4\times10^{101}+3.6\times10^{101}}{2}$ oe or $\frac{4\times10^{100}+36\times10^{100}}{2}$ oe			M1 Allow correct numbers in any form eg $\frac{4\times10^{100}+3.6\times10^{101}}{2}$
			2×10^{101}		A1 oe eg 2.0×10^{101} but not 20×10^{100} (this implies M2) Allow international multiplication symbol of . for $\times$ eg 2.10^{101} Do not isw
		cas			***Total 3 marks***

<table>
<tr><th>Question</th><th></th><th>Working</th><th>Answer</th><th>Mark</th><th colspan="2">Notes</th></tr>
<tr><td>12</td><td>(a)</td><td></td><td>$m=-2$</td><td>2</td><td>B1 cao</td><td rowspan="2">SCB1 for the wrong way round.</td></tr>
<tr><td></td><td></td><td></td><td>$c=8$</td><td></td><td>B1 cao</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Correct region shaded</td><td>1</td><td colspan="2">B1
Correct region indicated by one of the following
• correct region shaded
• correct region labelled as R
• all of outside region shaded.</td></tr>
<tr><td></td><td></td><td>cas</td><td></td><td></td><td colspan="2">Total 3 marks</td></tr>
</table>

Question		Working	Answer	Mark	Notes
13		$\frac{x^2(x+1)}{(x+1)(x+2)}$		3	M2 numerator fully factorised and denominator factorised correctly does not have to be within a fraction M1 for one of the numerator fully factorised or denominator factorised correctly does not have to be within a fraction
			$\frac{x^2}{x+2}$		A1 (do not isw)

		cas			***Total 3 marks***
Question		**Working**	**Answer**	**Mark**	**Notes**
14	(a)		$\frac{50.4}{360}[=0.14]$	1	B1 oe eg $\frac{0.25\times 50.4}{90}[=0.14]$ Allow verify eg 0.14×360=50.4 or 0.1 = 3.6 and 14 $\times$3.6 = 50.4 provided we also see the 50.4 Note: allow $0.25+0.1+3y+0.15+y=\frac{360-50.4}{360}$ to find y and then using this value of y to show or verify x = 0.14 BUT B0 for using x = 0.14 to find y and then using this value of y to show or verify that x = 0.14
	(b)	**Credit can be given for work seen in part (a) if not seen in part (b)**			
		$0.25+0.1+3y+0.15+x+y=1$ oe or $0.25+0.1+3y+0.15+0.14+y=1$ oe		3	M1 equation for y, may also be in terms of x Allow one missing probability provided we see the remaining individual probabilities added to 1 If converting to degrees and using the sum of the angles equals 360 90 + 36 + 3y + 54 + 50.4 + y = 360
		$4y=1-0.25-0.1-0.15-0.14$ oe eg $4y=0.36$			M1 For collecting y terms on 1 side and numbers on the other in a correct equation. x must be replaced with 0.14 If converting to degrees 4y = 129.6 => y = 32.4
			0.09		A1 oe
					Total 4 marks

Question		Working	Answer	Mark	Notes
15		15 : 6 and 6 : 8 oe or 15 : 6 : 8 oe or $\left[\text{no. of yellow \& blue counters =}\right]\frac{56}{4}\times 7\left[=98\right]$ $\left[\text{number of blue counters =}\right]\frac{56}{4}\times 3\left[=42\right]$ oe eg $\frac{56}{4}\times 7-56\left[=42\right]$		4	M1 for writing the ratios with a common figure or for writing a correct 3 part ratio Allow equivalent ratios eg 7.5 : 3 and 3 : 4 or 7.5 : 3 : 4 or eg 5 : 2 and 2 : $\frac{8}{3}$ or 5 : 2 : $\frac{8}{3}$ or for the number of yellow and blue counters or for the number of blue counters which may be written in the ratio ie 42 : 56
		eg $\frac{56}{8}\left[=7\right]$ or $\frac{56}{4}\left[=14\right]$ or $\frac{56}{8/3}\left[=21\right]$ or $\left[\text{number of red counters =}\right]\frac{\text{"42"}}{2}\times 5\left[=105\right]$ or $\left[\text{no. of red \& blue counters =}\right]\frac{\text{"42"}}{2}\times 7\left[=147\right]$			M1 Finding the value of 1 part eg 56/(the number for yellow in their ratio) or for finding the number of red counters or red and blue counters ft their number of blue counters provided this is from a correct method or clearly labelled or identified as total number of blue counters
		eg $(15+6+8)\times\text{"7"}$ or $(7.5+3+4)\times\text{"14"}$ or $\left(5+2+\frac{8}{3}\right)\times\text{"21"}$ or $56\div\frac{\left[\text{their ratio value for yellow}\right]}{\left[\text{sum of their ratio parts}\right]}$ eg $56\div\frac{8}{15+6+8}$ or $56\div\frac{4}{7.5+3+4}$ or $56\div\frac{8/3}{5+2+8/3}$ or $56+\text{"42"}+\text{"105"}$			M1 Implies the previous method marks. A complete method to find the total number of counters in the bag (where-values in inverted commas must come from a correct method)
			203		A1
		cas			***Total 4 marks***

Question		Working	Answer	Mark	Notes
16		$10x+6x+8=40$ oe		4	M1 condone *CD* to be $3x+1$ (for this mark only) may be implied by $16x + 10 = 40$ or $x=\frac{15}{8}$
		$x=\frac{40-8}{16}[=2]$			M1 method to solve correct equation (this may imply the previous method mark)
		$(2x+1)(3x+4)+2x(5x-(2x+1))$ $(2x+1)(3x+4)+2x(3x-1)$ oe or $(2x+1)(3x+4-2x)+5x\times 2x$ oe $(2x+1)(x+4)+10x^2$ or $5x(3x+4)-(5x-(2x+1))(x+4)$ oe $5x(3x+4)-(3x-1)(x+4)$ Or $12x^2+9x+4$			M1 for correct expression for the area, may be in terms of x or with their x value substituted, in which may be simplified, ft their value of x provided working is shown eg $(2\times"2"+1)\times(3\times"2"+4)+(5\times"2"-(2\times"2"+1))\times(2\times"2")$ oe eg $(2\times"2"+1)\times(3\times"2"+4)+(3\times"2"-1)\times(2\times"2")$ or $5\times10+5\times4$ or $(2\times"2"+1)\times(3\times"2"+4-2\times"2")+(5\times"2")\times(2\times"2")$ oe eg $(2\times"2"+1)\times("2"+4)+(5\times"2")\times(2\times"2")$ or $5\times6+10\times4$ or $(5\times"2")\times(3\times"2"+4)-(5\times"2"-(2\times"2"+1))\times("2"+4)$ oe eg $(5\times"2")\times(3\times"2"+4)-(3\times"2"-1)\times("2"+4)$ or $10\times10-5\times6$ or $12\times"2"^2+9\times"2"+4$
			70		A1 SC B2 for an answer of 51.3125, 63.0625, 70.5625 Accept values that are rounded to 1dp
		cas			***Total 4 marks***

Question		Working	Answer	Mark	Notes
17	(a)		$\begin{pmatrix} 12 & -1 \\ 8 & -5 \end{pmatrix}$	2	B2 Fully correct matrix (B1 for 2 or 3 correct entries in a matrix of correct order)
	(b)	$-3p-4=-10$ or $2p+28=32$		2	M1 A correct equation or $\begin{pmatrix} -3p-4 \\ 2p+28 \end{pmatrix}$
			2		A1
		cas			***Total 4 marks***

Question		Working	Answer	Mark	Notes
18		$\frac{75}{360}\times 2\pi r=54$		4	M1 For a correct equation with one unknown
		$\pi r=\frac{54}{\frac{75}{360}\times 2}\left[=\frac{19440}{150}=\frac{648}{5}=129.6\right]$ or $r=\frac{54}{\frac{75}{360}\times 2\pi}\left[=\frac{19440}{150\pi}=\frac{648}{5\pi}=41.2529...\right]$			M1 Correct method to find r or πr in a correct equation
		Area = $\frac{75}{360}\times\pi(\text{"}41.2529......\text{"})^2$			M1 ft their value for r or πr if working is shown
18			1100		A1 awrt 1100 (1113.83…) If an answer is given in the range in the working and then rounded incorrectly award full marks
		cas			***Total 4 marks***

Q	Working	Answer	Mark	Notes	
19	Volume scale factor **A** to **B** = 0.57 oe Volume scale factor **B** to **A** = 100/57 (=1.75…) oe		4	M1 Correct SF oe fraction or decimal may be within a calculation eg $100^3/57^3$ or (1 – 0.43) **Not** for 57%	M3 for $\left(\sqrt[3]{0.57}\right)^2$ or $\sqrt[3]{0.57^2}$ or $\frac{\left(\sqrt[3]{57}\right)^2}{\left(\sqrt[3]{100}\right)^2}\times 700$ or $\left(\sqrt[3]{\frac{100}{57}}\right)^2$ or $\sqrt[3]{\left(\frac{100}{57}\right)^2}$ or $700\div\frac{\left(\sqrt[3]{100}\right)^2}{\left(\sqrt[3]{57}\right)^2}$
	$\sqrt[3]{0.57}\left[=0.829...\right]$ or $0.57^2\left[=0.3249\right]$ oe or $\sqrt[3]{100/57}\left[=1.206...\right]$ or $(100/57)^2\left[=3.077(8...)\right]$ oe			M1 1st step to find the SF for area Condone use of 0.43 instead of 0.57 eg $\sqrt[3]{0.43}\left[=0.754(7...)\right]$ or $0.43^2\left[=0.1849\right]$ or $\sqrt[3]{100/43}\left[=1.324(8...)\right]$ or $(100/43)^2\left[=5.408...\right]$	
	$("0.829")^2\left[=0.687\right]$ or $\sqrt[3]{"0.3249"}\left[=0.687...\right]$ oe or $("1.206")^2\left[=1.454(6...)\right]$ or $\sqrt[3]{"3.077..."}\left[=1.454(6...)\right]$ oe			M1 Correct method to find an area SF from a volume SF when Volume SF is 0.57 or 0.43 If Volume SF = 0.43 Area SF = $("0.754(7)")^2$ or $\sqrt[3]{"0.1849"}\left[=0.569(6)\right]$ or $("1.324(8)")^2$ or $\sqrt[3]{"5.408..."}\left[=1.755...\right]$	
	$700\times"0.687"$ or $700\div"1.454..."$	481		A1 awrt 480 to 483 If an answer is given in the range in the working and then rounded incorrectly award full marks	
ALT	Volume scale factor **A** to **B** = 0.57 oe Volume scale factor **B** to **A** = 100/57 (=1.75…) oe			M1 for recognition that the volume scale factor is 0.57 May be seen in a calculation	
	$\sqrt{700}\left[=10\sqrt{7}=26.4(5...)\right]$ or $\left(\sqrt{700}\right)^3\left[=18520.(25918)\right]$			M1	
	$\sqrt{700}\times\sqrt[3]{0.57}\left[=21.9(3...)\right]$ oe eg $\left(\sqrt[3]{\left(\sqrt{700}\right)^3\times 0.57}\right)\left[=21.9(3...)\right]$			M1 Allow use of 0.43 instead of 0.57 If Volume SF = 0.43 then $\sqrt{700}\times\sqrt[3]{0.43}\left[=19.9(6...)\right]$	
	$("21.9(3...)")^2$	481		A1 awrt 480 to 483 If an answer is given in the range in the working and then rounded incorrectly award full marks	
	cas			***Total 4 marks***	

Question		Working	Answer	Mark	Notes
20		$AX \times 4 = 7 \times 5$ oe or $(AB + 4) \times 4 = 7 \times 5$ oe		5	M1 use chord theorem correctly to form a correct equation with one unknown Allow use of letters eg x where x has been clearly identified eg allow $4x = 7 \times 5$ where x is clearly identified as AX
		$PB = \frac{1}{2} \times \frac{35-16}{4}[= 2.375]$ oe eg $PB = \frac{"\frac{35}{4}" - 4}{2}[= 2.375]$			M1 Correct value for PB may be un-simplified May be on the diagram
		$\frac{\sin 115}{4 + "2.375"} = \frac{\sin \angle BPC}{5}$			M1 Fully correct method to enable $\sin \angle BPC$ to be found. ft their PB (or PX) provided PB (or PX) is from a correct method or clearly labelled or identified as PB (or PX) with working shown PB (or PX) must be a numerical value
		$\sin \angle BPC = \frac{\sin 115}{(4 + "2.375")} \times 5[= 0.7108...]$			M1 A correct expression for $\sin \angle BPC$ ft their PB (or PX) provided PB (or PX) is from a correct method or clearly labelled or identified as PB (or PX) with working shown PB (or PX) must be a numerical value
			45.3		A1 awrt 45.1 to 45.3 If an answer is given in the range in the working and then rounded incorrectly award full marks
		cas			***Total 5 marks***

Question		Working	Answer	Mark	Notes
21	(a)	$3\left(x^2+2x\right)\ldots\ldots$ or $3\left(x^2+2x\ldots\ldots\right)$ oe		3	M1 (where …… is any number or no number)
		$3(x+1)^2\ldots\ldots$ or $3\left[(x+1)^2\ldots\ldots\right]$ oe			M1 (where …… is any number or no number)
			$3(x+1)^2-12$		A1 condone $3(x+1)^2+(-12)$ allow $p = 3$, $q = 1$, $r = -12$
	(b)	$(x+1)^2=\frac{12}{3}$ or $(x+1)^2=4$ or $(3x + 9)(x - 1)$ or $(x + 3)(3x - 3)$ or $(x + 3)(x - 1)$ oe		2	M1 if using answer to part a then allow follow through of their r and p values provided $\frac{-r}{p}>0$ allow use of formula – no errors and substitution no more simplified than $\frac{-2\pm\sqrt{16}}{2}$ seen in the working
			1, −3		A1 dep on M1 being awarded (allow if the method is seen in the working space for part (a))
ALT (a)		$px^2 + 2pqx + pq^2 + r$			M1 for multiplying out $p(x + q)^2 + r$ to obtain $px^2 + 2pqx + pq^2 + r$ oe
		2 of: $p = 3$ $2pq = 6$ oe $pq^2 + r = -9$ oe			M1 for equating coefficients and making 2 correct statements
			$3(x+1)^2-12$		
					Total 5 marks

Question		Working	Answer	Mark	Notes
22	(a)	$v=6t^2-16t+15$		2	M1 for $6t^2$ or $\pm 16t$
			$6t^2-16t+15$		A1 do not isw an answer of $12t-16$
	(b)	$a=12t-16$		3	M1 for $12t$ or ± 16 allow if seen in (a) only if used in (b)
		$12t-16=0 \Rightarrow t=\frac{4}{3}$			M1 sets their $a=0$ leading to a value for t
			4.33		A1 allow 13/3 awrt 4.3 Note: we have not told the candidates that we must see working therefore a correct answer with no working scores full marks, an answer of $\frac{4}{3}$ scores 2 marks and an answer of $\left(\frac{4}{3},\frac{13}{3}\right)$ without identifying the $\frac{13}{3}$ oe scores 2 marks
ALT		$6\left(t-\frac{16}{6\times 2}\right)^2 \pm \ldots$			M1 1st step to completing the square ft their (a) if a 3 term quadratic
		$6\left(t-\frac{4}{3}\right)^2+\frac{13}{3}$			M1 Completing the square ft their (a) if a 3 term quadratic
			4.33		A1 allow 13/3 awrt 4.3
		cas			***Total 5 marks***

Q	Working			Answer	Mark	Notes	
23	Finding $\angle OBC$ or $\angle OCB$ eg $\angle OBC = 90 - 54[= 36]$	**ALT 1** $\angle CAB = 54$	**ALT2** $\angle OBC = 90 - 54[= 36]$		6	M1	We can not mix and match methods but we award to the scheme that is the most benefit to the candidate. Angles must be clearly labelled or otherwise identified with no ambiguity or contradiction on the diagram. Only accept one letter if: *A* = 15 *O* = 258 *B* = 36 *C* = 51
	$\angle ACB = \frac{102}{2}[= 51]$	Finding $\angle OAB$ or $\angle OBA$ eg $\angle OAB = \frac{(180 - 102)}{2}[= 39]$	$\angle BOC = 180 - 2 \times "36"$ $[= 108]$			M1	
	Finding $\angle OCA$ or $\angle OAC$ eg $\angle OCA = "51" - "36"$ or $\angle OCA = 360 - (360 - 102) - "36" - "51"$	Finding $\angle OCA$ or $\angle OAC$ eg $\angle OCA = "54" - "39"$	Finding $\angle OCA$ or $\angle OAC$ eg $\angle OCA = \frac{180 - (360 - 102 - "108")}{2}$			M1	
				15		A1	
	Note values of 36 and 15 can come from incorrect working. Some candidates incorrectly think that triangles *COB* and *COA* are congruent and that *COB* = *COA* OBC = 36 M1 Then $180 - 36 - \frac{360 - 102}{2} = 15$ $51 - "15" = 36$ To help if you are seeing 129 then check carefully Angle between <u>tangent</u> and <u>radius</u> (<u>diameter)</u> is 90° <u>Angle</u> at the <u>centre</u> is <u>2 ×</u> (double) angle at <u>circumference</u> / <u>angle</u> at <u>circumference</u> is <u>½</u> angle at <u>centre</u> Base angles in an <u>isosceles</u> triangle (are equal) <u>Angles</u> in a <u>triangle</u> add to 180° <u>Angles</u> around a <u>point</u> add up to 360° <u>Angles</u> on a <u>line</u> add to 180° <u>Alternate segment</u> theorem <u>Angles</u> in a <u>quadrilateral</u> add to 360°					These marks are independent of which method is used B2 At least 2 correct reasons related to their calculations, one of which must be a circle theorem. B1 for 1 correct reason related to their calculation. Note: We can allow symbols for the words 'triangle', 'angle' and 'sum'	
	cas					***Total 6 marks***	

Q		Working	Answer	Mark	Notes
24		P(1st Red) = $\frac{3}{8}$ or P(1st Blue) = $\frac{5}{8}$		6	M1 For correct use of ratio to find a correct probability for the 1st button or the correct number of red or blue on the first selection.
		P(both Red) = $\frac{3}{8}\times\frac{\frac{3}{8}n-1}{n-1}$ oe eg $\frac{3n}{8n}\times\frac{\frac{3}{8}n-1}{n-1}$ or P(both Blue) = $\frac{5}{8}\times\frac{\frac{5}{8}n-1}{n-1}$ oe eg $\frac{5n}{8n}\times\frac{\frac{5}{8}n-1}{n-1}$ or P(one of each colour) = $\frac{3}{8}\times\frac{\frac{5}{8}n-1}{n-1}$ or $\frac{5}{8}\times\frac{\frac{3}{8}n-1}{n-1}$ oe			M1 For finding an algebraic expression for the probability of two red or two blue buttons Allow $p\times\frac{pn-1}{n-1}$ or $p\times\frac{pn}{n}$ where $0 < p < 1$ Allow $p\times\frac{qn-1}{n-1}$ or $p\times\frac{qn}{n}$ where $0 < p < 1$ and $p+q = 1$
		$\frac{3}{8}\times\frac{\frac{3}{8}n-1}{n-1}+\frac{5}{8}\times\frac{\frac{5}{8}n-1}{n-1}$ oe or $2\times\frac{3}{8}\times\frac{\frac{5}{8}n-1}{n-1}$ oe			M1 implies previous M1 for algebraic expression for P(2 red) + Prob(2 Blue) or 2 × P(red) × Prob(Blue) Allow $p\times\frac{pn-1}{n-1}+q\times\frac{qn-1}{n-1}$ or $p\times\frac{pn}{n}+q\times\frac{qn}{n}$ where $0 < p < 1$ and $p+q = 1$
		$\frac{3}{8}\times\frac{\frac{3}{8}n-1}{n-1}+\frac{5}{8}\times\frac{\frac{5}{8}n-1}{n-1}=\frac{10}{19}$ oe or $2\times\frac{3}{8}\times\frac{\frac{5}{8}n-1}{n-1}=\frac{9}{19}$ oe			M1 implies the previous method marks a correct equation with their ratio for P(2red)+Prob(2Blue)=10/19 or 2×P(red)×Prob(Blue)=9/19 Allow $p\times\frac{pn-1}{n-1}+q\times\frac{qn-1}{n-1}$ where $0 < p < 1$ and $p+q = 1$
		$\frac{9}{8}n-3+\frac{25}{8}n-5=\frac{10}{19}\times8(n-1)$ or $285n=288(n-1)$ oe $\frac{3}{8}n\left(\frac{3}{8}n-1\right)+\frac{5}{8}n\left(\frac{5}{8}n-1\right)=\frac{10}{19}n(n-1)$ or $\frac{3}{32}n^2=9n$ oe			M1 multiplying throughout by $n-1$ or n and $n-1$ to remove the denominator to form a correct linear or quadratic equation without terms in n on the denominator. Note: if all terms are on one side, condone the missing‘=0’
			96		A1 cao (ie must have discounted $n = 0$ if found) Note: An answer of 96 with no obvious incorrect working gets all 6 marks
					Total 6 marks

Q		Working USING $n = 8x$	Answer	Mark	Notes
24		P(1st Red) = $\frac{3}{8}$ or P(1st Blue) = $\frac{5}{8}$		6	M1 For correct use of ratio to find a correct probability for the 1st button or the correct number of red or blue on the first selection.
		P(both Red) = $\frac{3}{8}\times\frac{3x-1}{8x-1}$ oe eg $\frac{3x}{8x}\times\frac{3x-1}{8x-1}$ or P(both Blue) = $\frac{5}{8}\times\frac{5x-1}{8x-1}$ oe eg $\frac{5x}{8x}\times\frac{5x-1}{8x-1}$ or P(one of each colour) = $\frac{3}{8}\times\frac{5x-1}{8x-1}$ or $\frac{5}{8}\times\frac{3x-1}{8x-1}$ oe			M1 For finding an algebraic expression for the probability of two red or two blue buttons Allow $\frac{r}{t}\times\frac{rx-1}{tx-1}$ or $\frac{r}{t}\times\frac{rx}{tx}$ Allow $\frac{r}{t}\times\frac{sx-1}{tx-1}$ or $\frac{r}{t}\times\frac{sx}{tx}$ where $r < t$ and $s < t$ and $r+s = t$
		$\frac{3}{8}\times\frac{3x-1}{8x-1}+\frac{5}{8}\times\frac{5x-1}{8x-1}$ oe or $2\times\frac{3}{8}\times\frac{5x-1}{8x-1}$ oe			M1 implies previous M1 for algebraic expression for P(2 red) + Prob(2 Blue) or 2 × P(red) × Prob(Blue) Allow $\frac{r}{t}\times\frac{rx-1}{tx-1}+\frac{r}{t}\times\frac{sx-1}{tx-1}$ or $\frac{r}{t}\times\frac{rx}{tx}+\frac{r}{t}\times\frac{sx}{tx}$ where $r < t$ and $s < t$ and $r+s = t$
		$\frac{3}{8}\times\frac{3x-1}{8x-1}+\frac{5}{8}\times\frac{5x-1}{8x-1}=\frac{10}{19}$ oe or $2\times\frac{3}{8}\times\frac{5x-1}{8x-1}=\frac{9}{19}$ oe			M1 implies the previous method marks a correct equation with their ratio for P(2red)+Prob(2Blue)=10/19 or 2×P(red)×Prob(Blue)=9/19 Allow $\frac{r}{t}\times\frac{rx-1}{tx-1}+\frac{r}{t}\times\frac{sx-1}{tx-1}$ where $r < t$ and $s < t$ and $r+s = t$
		$19(34x^2-8x)=10(64x^2-8x)$ or $646x^2-152x=640x^2-80x$ or $6x^2-72x[=0]$ oe or $19(34x-8)=10(64x-8)$ or $646x-152=640x-80$ or $6x-72=0$ oe			M1 multiplying throughout by $8x-1$ or $8x^2-x$ to remove the denominator to form a correct linear or quadratic equation without terms in x on the denominator. Note: if all terms are on one side, condone the missing'=0' Note: this leads to a value of $x = 12$
			96		A1 cao (ie must have discounted $n = 0$ if found) Note: An answer of 96 with no obvious incorrect working gets all 6 marks
					Total 6 marks

Q		Working	Answer	Mark	Notes
25		$ph-2h=5$ or $-5=2h-ph$ or $\frac{5}{h}=p-2$ or $\frac{-5}{h}=2-p$		3	M1 Multiply by h and collect terms in h on one side. Allow one sign error or separate the fraction and isolate the term in h. Allow one sign error
		$h(p-2)=5$ or $-5=h(2-p)$			M1 taking h out as a common factor (dep on two different terms in h) or multiplying throughout by h (if separated the fraction and isolated the term in h)
			$h = \frac{5}{p-2}$		A1 allow $h = \frac{-5}{2-p}$ Do not isw but condone $\frac{5}{p-2}$ or $\frac{-5}{2-p}$ on the answer line, provided $h = \frac{5}{p-2}$ or $h = \frac{-5}{2-p}$ has been seen in the working space
		cas			***Total 3 marks***

Q	Working	Answer	Mark	Notes
26	$(4x+6)^2=(6x+4)^2+(3x)^2-2\times3x\times(6x+4)\cos60$ oe or $\cos60=\frac{(6x+4)^2+(3x)^2-(4x+6)^2}{2\times3x\times(6x+4)}$ oe		6	M1 for correct substitution into the cosine rule Only condone missing brackets around the 6x+4 and 4x+6 if recovered Note having sin instead of cos is not considered a misread
	$16x^2+48x+36=36x^2+48x+16+9x^2-18x^2-12x$ or $16x^2+36=36x^2+16+9x^2-18x^2-12x$ or $\frac{1}{2}=\frac{36x^2+48x+16+9x^2-16x^2-48x-36}{36x^2+24x}$ oe eg $\frac{1}{2}=\frac{29x^2-20}{36x^2+24x}$			M1 Two out of three correct terms in 3TQ or Expand brackets in a correct equation. Condone two incorrect or missing terms (likely to be having one or two signs incorrect on the last two terms eg $16x^2+48x+36=36x^2+48x+16+9x^2+18x^2+12x$
	$22x^2-24x-40[=0]$ or $11x^2-12x-20[=0]$ oe			M1 implies previous method marks Simplifying to get correct 3TQ
	$(11x+10)(x-2)$ [=0]			M1 Attempt to solve their three term quadratic, if the quadratic is incorrect the method must be shown. For factorisation must multiply out to give 2 of the terms. Allow one error if using quadratic equation. Implied by x = 2 if previous method mark awarded
	$\frac{3x(6x+4)\sin60}{2}$ oe or $s=\frac{(4x+6)+(3x)+(6x+4)}{2}\left[=\frac{13x+10}{2}\right]$ with $\sqrt{"s"\times("s"-(4x+6))\times("s"-3x)\times("s"-(6x+4))}$			M1 indep Correct method to find the area of the triangle may be in terms of x or with their x value substituted, ft their value of x. If $x\neq2$ the working must be shown $\frac{1}{2}(6\times"2"+4)(3\times"2")\sin60$ or $s=\frac{(4\times"2"+6)+(3\times"2")+(6\times"2"+4)}{2}[=18]$ with $\sqrt{"18"\times("18"-(4\times"2"+6))\times("18"-(3\times"2"))\times("18"-(6\times"2"+4))}$
		41.6		A1 Condone $24\sqrt{3}$ If an answer is given in the range in the working and then rounded incorrectly award full marks
	cas			***Total 6 marks***

Q		Working	Answer	Mark	Notes
27	(a)		$2\sqrt{2}$	1	B1 accept $a = 2$, $b = 2$
	(b)	$\frac{6+2\sqrt{3}}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$		2	M1 Correct method to rationalise the denominator Allow $\frac{6+2\sqrt{3}}{\sqrt{2}} \times \frac{-\sqrt{2}}{-\sqrt{2}}$ or $\frac{6\sqrt{2}+2\sqrt{6}}{2}$ or $\frac{6+2\sqrt{3}}{3\sqrt{2}-\sqrt{8}} \times \frac{3\sqrt{2}+\sqrt{8}}{3\sqrt{2}+\sqrt{8}}$ or $\frac{\left(6+2\sqrt{3}\right)\left(3\sqrt{2}+\sqrt{8}\right)}{\left(3\sqrt{2}\right)^2-\left(\sqrt{8}\right)^2}$ or $\frac{6+2\sqrt{3}}{3\sqrt{2}-"2\sqrt{2}"} \times \frac{3\sqrt{2}+2\sqrt{2}}{3\sqrt{2}+"2\sqrt{2}"}$ oe Allow the denominator to be simplified to 10 Or $\frac{6+2\sqrt{3}}{\sqrt{2}} \Rightarrow 3\sqrt{2}+\sqrt{6}$ M0 for $\frac{6}{\sqrt{2}}+\sqrt{6}$ as no method seen to rationalise the denominator
			$\sqrt{18}+\sqrt{6}$		A1 dep on M mark awarded and no incorrect working seen
		wr			***Total 3 marks***

Q		Working	Answer	Mark	Notes
28	(a)	$12\left(\frac{4}{3}\right)^3-4\left(\frac{4}{3}\right)^2-25\left(\frac{4}{3}\right)+14$		2	M1 allow 1.3 or 1.33 for this mark only Allow $\frac{256}{9}-\frac{64}{9}-\frac{100}{3}+14$ but do not allow 2 without prior working
			$f\left(\frac{4}{3}\right)=2\neq 0$		A1 dep on M1 Correct evaluation (to 2) and recognition that this is not equal to zero or indicating that they know that for it to be a factor then it should be equal to 0 ie not just for = 2 therefore not a factor
		Credit can be given for work seen in part (a) if not seen in part (b)			
	(b)	$(3x-4)(4x^2...)$ Division by $(3x-4)$ giving a first term of $4x^2$ eg $\begin{array}{r\|rrrr} 4/3 & 12 & -4 & -25 & 12 \\ & & 16 & 16 & -12 \\ \hline & \mathbf{12} & 12 & -9 & 0 \end{array}$		4	M1 for realising $3x-4$ is a factor and getting $4x^2$ Allow $(2x-1)$ and $6x^2$ or $(2x+3)$ and $6x^2$ Allow $\left(x-\frac{1}{2}\right)$ and $12x^2$ etc May be seen as part of long division of synthetic long division (in which case look for the first correct non zero term on the bottom row).
		Quotient $(4x^2+4x-3)$			M1 a correct quadratic $(6x^2-11x+4)$ or $(6x^2+x-12)$ or $(4x^2+4x-3)$ or $(12x^2+2x-24)$ etc
		$(2x+3)(2x-1)$			M1 Correct factorisation of their quotient which must be a 3TQ
			$(3x-4)(2x+3)(2x-1)$		A1 dep on first 2 method marks Note: $\left(x-\frac{4}{3}\right)\left(x+\frac{3}{2}\right)\left(x-\frac{1}{2}\right)$ scores A0 A0 if they go on to solve but A1 if solve and identify correct answer on the answer line
					Total 6 marks

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