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Mark Scheme (Results)

Summer 2022

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

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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**

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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.

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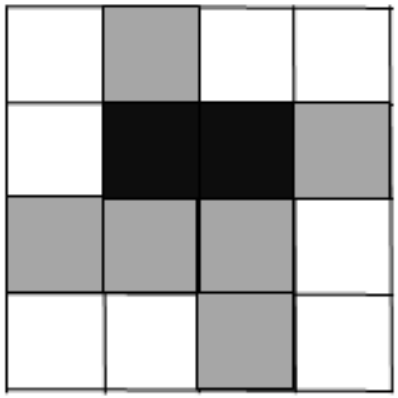
Question		Working	Answer	Mark	Notes
1			–8 –4	2	B1 B1
					Total 2 marks

2		$\frac{12.5}{22+3}\times 22$ oe eg $12.5-\left(\frac{12.5}{22+3}\right)\times 3$		2	M1 a fully correct method that leads to the correct answer
			11		A1 (SCB1 for an answer of 11 000)
					Total 2 marks

3			2	B2 Both correct squares and no incorrect squares shaded. (B1 one correct square and no more than one incorrect **or** both correct squares and at most one incorrect square shaded)
				Total 2 marks

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4		$s - \frac{1}{2}at^2 = ut$ **or** $-ut = \frac{1}{2}at^2 - s$ oe $2s - at^2 = 2ut$ **or** $-2ut = -2s + at^2$ oe $\frac{s}{t} = u + \frac{1}{2}at$ oe		2	M1 for isolating *ut* or *–ut or* 2*ut or* –2*ut* or dividing each term by *t*
			$u = \frac{s}{t} - \frac{1}{2}at$		A1 oe eg $u = \frac{2s - at^2}{2t}$ or $u = \frac{s - \frac{1}{2}at^2}{t}$ oe (we must see *u* = ….either in the working or on the answer line)
					Total 2 marks

5		$\frac{25}{8} \times \frac{14}{5}$ oe or $3 \times 2 + \frac{1}{8} \times 2 + 3 \times \frac{4}{5} + \frac{1}{8} \times \frac{4}{5}$ oe		2	M1 correct improper fractions or clear alternative method – **this stage must be shown to award any marks**
			$8\frac{3}{4}$		A1 dep on M1 A fractional method is required unless you see the **full** working for 3.125 × 2.8
					Total 2 marks

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6			$2c^2\ (m + 3p^2c^2)$	2	B2 (B1 for a correct partial factorisation ie $2(mc^2 + 3p^2c^4)$ or $c^2(2m + 6p^2c^2)$ or $2c(cm + 3p^2c^3)$ or $c(2mc + 6p^2c^3)$ or the correct common factor of $2c^2$ outside a bracket with just one error in the bracket)
					Total 2 marks

7		$\frac{6.4}{\frac{40}{60}}$ oe eg $\frac{6.4}{40} \times 60$		2	M1 (allow 0.66 or better for $\frac{40}{60}$ in working)
			9.6		A1 oe eg $\frac{48}{5}$
					Total 2 marks

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8		48 (±2) seen		3	B1 may be seen in a calculation
		$\frac{"48"}{360}\times 150$			M1 a correct calculation for the number of students who preferred blue paper - allow use of their angle (even if outside range) for blue (but must be a value and not x)
			20		A1 Accept 19, 20 or 21 - must be a whole number and their answer can be truncated or rounded
					Total 3 marks

9		$2x + 14 = 5x - 6$ **or** $x + 7 = \frac{5x}{2} - \frac{6}{2}$ oe		3	M1 for correctly multiplying out bracket (need not be in an equation) or for dividing each term by 2 in an equation.
		$14 + 6 = 5x - 2x$ oe eg $3x = 20$ or $-5x + 2x = -6 - 14$ oe eg $-3x = -20$			M1ft for isolating terms in x on one side and number terms the other side ft their equation dep on an x term and a number term on both sides
			$\frac{20}{3}$		A1 oe isw for 6.6 if $\frac{20}{3}$ or $\frac{-20}{-3}$ seen Allow 6.7, 6.66, 6.67, etc
					Total 3 marks

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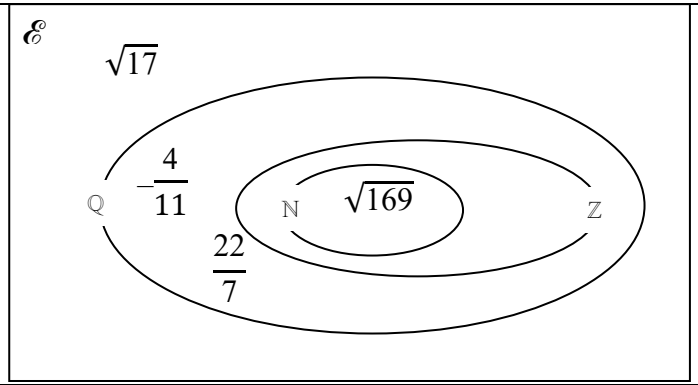
10				3	B3 All 4 in correct positions no repetition B2 3 in correct positions no repetition B1 2 in correct positions no repetition Allow 13 for $\sqrt{169}$
					Total 3 marks

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11		1 – 0.25 (= 0.75) oe or		3	M1 showing understanding that probabilities add to 1 (could be embedded – allow even if not correct algebraic values for *r* or *b* or *y*)
		eg $r + 2r + 6r =$ "0.75" oe [*r* = red] or "0.75" ÷ 9 (= $\frac{1}{12} = 0.083\ldots$) oe or $\frac{1}{2}b + b + 3b = "0.75"$ oe [*b* = blue] or "0.75" ÷ 4.5 (= $\frac{1}{6} = 0.16...$) oe or $\frac{1}{6}y + \frac{1}{3}y + y = "0.75"$ oe [*y* = yellow] or "0.75" ÷ 1.5 oe			M1 a correct equation for the probability of red or blue or yellow or a correct calculation for the probability of red or blue counter or yellow. Allow fractions, decimals or percentages. (award M2 (both M marks for any of the following $r + 2r + 6r + 0.25 = 1$ $\frac{1}{2}b + b + 3b + 0.25 = 1$ $\frac{1}{6}y + \frac{1}{3}y + y + 0.25 = 1$)
			$\frac{1}{2}$		A1 oe 0.5, 50%
					Total 3 marks

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12		2.1×10^{13}, 3.2×10^{14}, 1.1×10^{15}, 3.7×10^{16} or 3.2×10^{14} and 1.1×10^{15} identified		3	M1 for correctly ordering the numbers (ascending or descending order) or for identifying the 2 middle numbers from a correctly ordered list (list need not be seen if correct values chosen)
		$(3.2 \times 10^{14} + 1.1 \times 10^{15}) \div 2$			M1 oe
			7.1×10^{14}		A1 (if no marks awarded SCB1 for 1.705×10^{14} or if their list is in the wrong order - the **correct** value for their median)
					Total 3 marks

13		$x(x + 4)$		3	M1 need not be seen as part of the fraction
		$2(x + 4)$			M1 need not be seen as part of the fraction
			$\frac{x}{2}$		A1 oe eg $\frac{1}{2}x$ or $0.5x$ **(watch out for correct answer from incorrect working)**
					Total 3 marks

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14		angle *CAB* = *ACD* **and** angle *ABC* = *BCE*		3	B1 identifying the 2 pairs of alternate angles **or** identifying one pair of alternate angles with 'alternate angles' stated.
		alternate angles			B1 for stating alternate (or alternating) for the 2 sets of alternate angles
		angle *ACB* is common oe eg 'the same'			B1 oe eg *ACB* is in the triangle and on the straight line *DCE* or *ACB* is common [NB: not use of 180º]
					Total 3 marks

15	(a)	$3^5 \times 7^a$ or $3^b \times 7^4$ or $3^5 \times 7^4 \times n$ (where n = 1039, 11, 11^2, 11^3, 11^4, 269, 269^2)		2	M1
			583 443		A1 allow $3^5 \times 7^4$
	(b)	$\sqrt{3^8 \times 7^4 \times 269^2}$ oe eg $\sqrt{1.139900011 \times 10^{12}}$ or $\sqrt{6561 \times 2401 \times 72\,361}$ oe		2	M1
			1 067 661		A1 allow $3^4 \times 7^2 \times 269$
					Total 4 marks

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16	(a)		$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	2	B2 (B1 for a 2 × 2 matrix with 2 or 3 correct entries)
	(b)		$\begin{pmatrix} -9 & 1 \\ 3 & -7 \end{pmatrix}$	2	B2 (B1 for a 2 × 2 matrix with 2 or 3 correct entries)
					Total 4 marks

17		$\frac{100}{360} \times \pi r^2 = 27$ oe		4	M1 a correct equation for the area of the sector
		$(r =) \sqrt{\frac{27 \times 360}{\pi \times 100}}$ (=5.5(6...)) oe			M1 a correct expression for the radius of the sector (or the correct radius) or a completely correct process to find the radius
		$\frac{100}{360} \times 2 \times \pi \times$ "5.56" + 2 × "5.56" oe			M1ft a correct calculation for the perimeter of the sector (if *r* is incorrect, then their value can be used if clearly labelled/implied)
			20.8		A1 awrt 20.8
					Total 4 marks

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18	$p-1=\frac{\sqrt{5}-1}{2}$ or $\frac{-1+\sqrt{5}}{2}$			3	***Numerical approaches (use of p = 1.618)are not acceptable*** B1 showing $p-1$ correctly
	$\frac{2}{1+\sqrt{5}}\times\frac{1-\sqrt{5}}{1-\sqrt{5}}$				M1 a correct method to rationalise $\frac{1}{p}$
	$\frac{2}{1+\sqrt{5}}\times\frac{1-\sqrt{5}}{1-\sqrt{5}}=\frac{2(1-\sqrt{5})}{-4}=\frac{\sqrt{5}-1}{2}$ oe **and** showing $p-1$ (gaining B1)				A1 dep on M1 for a correct result from rationalisation and showing $p-1$ in working.
18 Alt	$p-1=\frac{\sqrt{5}-1}{2}$ or $\left(\frac{1+\sqrt{5}}{2}\right)\left(\frac{1+\sqrt{5}}{2}\right)=\frac{1+2\sqrt{5}+5}{4}=\frac{3+\sqrt{5}}{2}$			3	B1 working out $p-1$ correctly or working out p^2 correctly
	$\left[\left(\frac{1}{p}=p-1\right)\right]\Rightarrow 1=p(p-1)$				M1 for a correct rearrangement of $\frac{1}{p}=p-1$
	$\frac{1+\sqrt{5}}{2}\times\frac{\sqrt{5}-1}{2}=\frac{5-1}{4}=1$ or $\left(\frac{1+\sqrt{5}}{2}\right)^2-\left(\frac{1+\sqrt{5}}{2}\right)=\frac{1+2\sqrt{5}+5}{4}-\left(\frac{1+\sqrt{5}}{2}\right)=\frac{3+\sqrt{5}}{2}-\frac{1+\sqrt{5}}{2}=1$				A1 dep on M1 for a correct result for multiplying $p(p-1)$ and showing $1 = p(p-1)$ in working oe
18 Alt	$\frac{\sqrt{5}-1}{2}\left(=\frac{2}{1+\sqrt{5}}\right)$	$2p=1+\sqrt{5}$ **and** $(2p-1)^2=5$ oe		3	B1 working out $p-1$ correctly or showing a correct equation for $(2p-1)^2$
	$\left(\sqrt{5}-1\right)\left(1+\sqrt{5}\right)=2\times 2$ oe	$4p^2-4p+1=5$ **and** $p^2-p-1=0$ oe			M1 oe rearranging a correct equation or forming a correct quadratic and simplifying
	$\sqrt{5}+5-1-\sqrt{5}=4\Rightarrow 4=4$	$p-1-\frac{1}{p}=0$ so $\frac{1}{p}=p-1$ or $p(p-1)=1$ so $\frac{1}{p}=p-1$			A1 correctly showing that LHS = RHS or showing that $\frac{1}{p}=p-1$ by factorising for p or dividing throughout by p

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					Total 3 marks

19		Volume scale factor 1.331 oe eg $\frac{133.1}{100}$ oe **or** 133.1 : 100 oe or $\frac{100}{133.1}$ oe or 100 : 133.1 oe **or** Volume of new carton = $1000+(1000\times\frac{33.1}{100})$ (=1331)		4	B1 for a correct SF for the volume of the new carton **or** for a correct fraction or ratio for volume SF **or** the new volume
		$\sqrt[3]{\text{"1.331"}}$ (= 1.1) oe **or** $\sqrt[3]{\frac{100}{133.1}}\left(=\frac{10}{11}\right)$ oe **or** $\sqrt[3]{\frac{1000}{1331}}\left(=\frac{10}{11}=0.\dot{9}\dot{0}\right)$			M1 for a correct linear SF (may be seen as part of another sum)
		$\left(\sqrt[3]{1.331}\right)^2\times 700$ oe eg $700\times$ "1.1"^{2} **or** $700\div\left(\sqrt[3]{\frac{100}{133.1}}\right)^2$ oe eg $700\div\left(\frac{10}{11}\right)^2$ **or** $700\div\frac{100}{121}$ **or** $\left(\frac{11\times\sqrt{700}}{10}\right)^2$ oe			M1 dep for a correct calculation to find the total surface area of the new carton
			847		A1
					Total 4 marks

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20		$\sqrt{(x-2)^2+(\sqrt{2x})^2}=\sqrt{5}$ oe or $(x-2)^2 + 2x = 5$ oe		4	M1 a correct equation for the modulus of the vector (condone lack of brackets if meaning is clear)
		$x^2-4x+4+2x=5$ oe **or** eg $x^2 - 2x - 1 (= 0)$			M1 expand brackets correctly and equate to 5
		$(x=)\dfrac{--2\pm\sqrt{(-2)^2-4\times1\times-1}}{2\times1}$ or $(x-1)^2-1-1=0$ oe			M1 for a correct method to solve their 3 term quadratic equation **dep on 1st M1** (must see substitution if using the wrong equation) (allow some simplification and one sign error). Allow as far as $\dfrac{2+\sqrt{4+4}}{2}$ or for the 2 answers of $1 + \sqrt{2}$ and $1 - \sqrt{2}$
			$1 + \sqrt{2}$		A1 oe (but must be in exact form) as the only answer eg accept $\dfrac{2+\sqrt{8}}{2}$
					Total 4 marks

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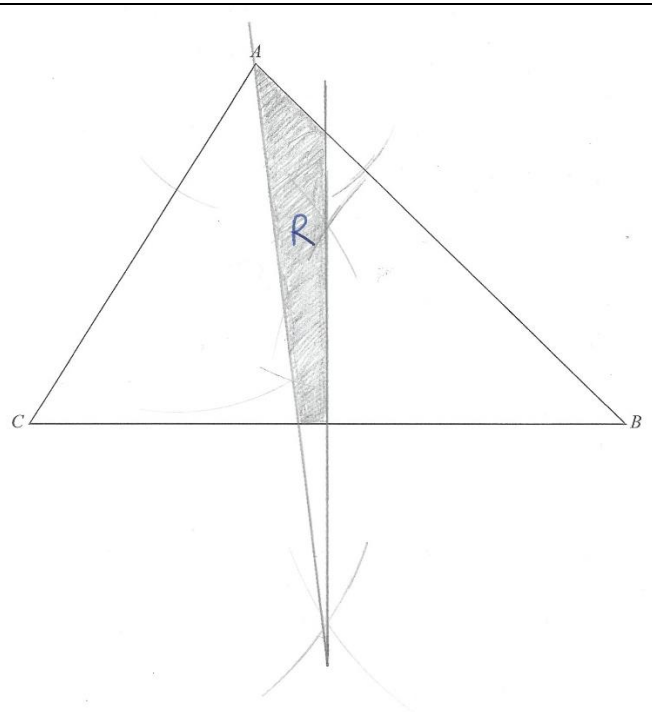
21		Construction lines and perpendicular bisector of *BC*		3	M1 **(use overlay & make sure you can see all the construction lines)**
		Construction lines and bisector of *BAC*			M1
			Region *R* correctly identified		A1 dep on a correct bisector of the line and the angle (region may not be labelled *R* but award if clearly indicated eg shaded) SCB1 for the correct area *R* identified but missing all correct construction lines (but having a bisector of the line and the angle)
					Total 3 marks

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22	(a)		$y = -\frac{1}{2}x + 6$	2	B2 for a correct equation for line **L** eg $y = -\frac{1}{2}x + 6$ or $2y + x = 12$ oe or eg $y - 5 = -0.5(x - 2)$ oe (ie use of any pair of coordinates with correct gradient) (B1 for an equation of a line with the correct gradient or the correct y intercept eg $y = -\frac{1}{2}x + c$ where $c \neq 6$ or $y = mx + 6$ where $m \neq -\frac{1}{2}$ but there is a term in x oe or for $-\frac{1}{2}x + 6$)	
	(b)	NB: inequalities can be in any order for this part	$y \geq 2$	3	B1	condone strict inequalities eg. $y > 2$
			$y \leq x$		B1	
			$y \leqslant -\frac{1}{2}x + 6$		B1ft	ft their equation from (a) provided **gradient is negative** SC B1 for $y \leq 2$, $y \geq x$ and $y \geqslant -\frac{1}{2}x + 6$ (condone <, >)
						Total 5 marks

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23	(*CE* =) 12 or (*OE* =) 4.5 (*O* is centre)		5	B1 shown on diagram, stated or clearly used
	eg $BE^2 = "12" \times 3$ or $2BE^2 + "12"^2 + 3^2 = 15^2$ or $7.5^2 = 4.5^2 + BE^2$			M1 for a correct calculation to find *BE*/*ED* "12" must come from correct working eg $(2 \times 7.5) - 2$
	$BE = 6$ or $ED = 6$ or $BD = 12$			A1 may be shown on diagram
	$0.5 \times 15 \times "12"$ or $\frac{"12" \times 3}{2} + \frac{"12" \times "12"}{2}$ or $2(0.5 \times 3 \times "6") + 2(0.5 \times "6" \times "12")$ oe or $2 \times \left(0.5 \times (\sqrt{6^2 + 3^2}) \times \sqrt{(15^2 - (3\sqrt{5})^2)}\right)$ oe eg $2 \times (0.5 \times 6\sqrt{5} \times 3\sqrt{5})$			M1
		90		A1
				Total 5 marks

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24	$\frac{\sin A}{12}=\frac{\sin 30}{6.5}$ oe	CN = 12sin 30 (= 6) where CN is perpendicular to AB		6	M1
	$\sin A=\frac{12\sin 30}{6.5}$	$BN=\sqrt{12^2-"6"^2}$ $(6\sqrt{3}=10.39...)$ $BN=\frac{12\sin 30}{\tan 30}$ or BN=12cos 30			M1 dep assumes previous mark unless they use BN = 12cos30
	$A=\sin^{-1}\left(\frac{12\sin 30}{6.5}\right)(=67.3(8...))$	$AN=\sqrt{6.5^2-(12\sin 30)^2}$ (=2.5)			M1
	180 – 30 – (180 – "67.38..")(= 37.38) **or** $\frac{1}{2}\times 12\times 6.5\times\sin"82.619..."(=38.6(7\ldots))$ (where 180 – 30 – "67.38.."(= 82.619…)	Smallest AB = "10.39…" – "2.5" (= 7.89) **or** $\frac{1}{2}\times("10.39"...+"2.5")\times 6(=38.6(7..))$			M1 method to find correct angle or correct side for smallest area. **or** Correct method to find largest area
	$\frac{1}{2}\times 12\times 6.5\times\sin"37.38..."$ or $\frac{1}{2}\times\frac{6.5\sin"37.3(8..)"}{\sin 30}\times 12\times\sin 30$ or $\frac{1}{2}\times\frac{6.5\times\sin 37.3(8..)}{\sin 30}\times 6.5\times\sin"112.6"$	$\frac{1}{2}\times(10.39...-"2.5")\times 6$			M1 use of correct angle or correct lengths for smaller triangle area in a correct formula
24 Alt			23.7		A1 (allow awrt 23.5 to 23.7)
	$6.5^2 = AB^2 + 12^2 – 2 \times AB \times 12 \times \cos 30$			6	M1 AB may be labelled in any way – eg c
	$AB^2 – 12\sqrt{3}AB + 101.75$ (= 0)				M1
	$(AB=)\frac{12\sqrt{3}\pm\sqrt{\left(12\sqrt{3}\right)^2-4\times 1\times 101.75}}{2\times 1}$ (allow as far as $\frac{12\sqrt{3}\pm\sqrt{432-407}}{2}$)				M1 ft their quadratic dep on 1st M1 allow some simplification and 1 sign error (gives 7.89, 12.89) (could complete the square)
	For selecting AB = 7.89 **or** $\frac{1}{2}\times("12.89...")\times 6(=38.6(7..))$ *(continued below)*				M1 for selecting the correct value or using the correct formula for the larger triangle

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	$\frac{1}{2} \times 12 \times$ "7.89" $\times \sin 30$			M1
		23.7		A1(allow awrt 23.5 to 23.7)
				Total 6 marks

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25	(a)		$\frac{2}{3}$	1	B1 oe 0.667 or 66.7% or better
	(b)	$\frac{n}{25}\times\frac{25-n}{24}$ or $\frac{25-n}{25}\times\frac{n}{24}$ or $\frac{n}{25}\times\frac{n-1}{24}$ or $\frac{25-n}{25}\times\frac{24-n}{24}$		6	M1 may be seen as part of a sum (allow in sum even if with other incorrect products)
		$2\times\frac{n}{25}\times\frac{25-n}{24}=\frac{1}{3}$ oe or $\frac{n}{25}\times\frac{n-1}{24}+\frac{25-n}{25}\times\frac{24-n}{24}=\frac{2}{3}$			M1 for a correct equation using the probability
		$2\times3\times n(25-n)=24\times25$ oe eg $150n-6n^2=600$ oe or $3n^2-75n+900=600$ oe			M1 for a correct equation without fractions
		$3n^2-75n=-300$ oe or $n^2-25n+100\ (=0)$ oe			A1 correct quadratic equation with 3 terms
		$(n-20)(n-5)$ or $(n=)\frac{--25\pm\sqrt{(-25)^2-4\times1\times100}}{2\times1}$ or $\left(n-\frac{25}{2}\right)^2-\left(\frac{25}{2}\right)^2+100=0$ oe			M1 ft for a complete method to solve their 3-term quadratic equation – could be by factorisation (allow factorisation that gives 2 out of 3 terms correct) or use of formula or completing the square If using formula must see substitution of values, allow one sign error and some simplification – allow as far as $\frac{25\pm\sqrt{625-400}}{2}$ and if completing the square allow as far as shown.
		A correct answer will score full marks as long as the student has gained at least 2 method marks	5 and 20		A1 dep on M2
					Total 7 marks

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26	(a)	$2\times0.5^3+9\times0.5^2-14\times0.5-9$ oe		2	M1
			–13.5		A1 oe allow 'does not equal 0 so $(2x-1)$ is not a factor oe NB: not long division as use of factor theorem stated
	(b)	2 terms of x^2+4x-9 correct (out of no more than 3 terms) **or** $2x^3+4ax^2+2a^2x+2xb+x^2+2ax+a^2+b$		3	B1 for correctly getting 2 terms out of x^2, $+4x$, -9 (out of no more than 3 terms) **or** if equating coefficients, for two of: the x^2 or the terms in x or the constant terms correct
		$(x + 2)^2$ [+ b] **Or** $4a + 1 = 9$ and $2a^2 + 2b + 2a = -14$			M1ft a method to start to complete the square with correct coefficient for a ft their quadratic eg $(x + 2)^2$ **or** two correct equations from equating coefficients
			$(x + 2)^2 - 13$		A1 (could state that $a = 2$ and $b = -13$)
	(c)		$-\frac{1}{2}, -2\pm\sqrt{13}$	2	B1 (x =) $-\frac{1}{2}$ B1 (x =) $-2\pm\sqrt{13}$ oe (**if decimals given only - award no marks, but if decimals follow a correct exact form then isw**) ft for the 2nd B mark from their answer for (b) as long as in the form $(x \pm a)^2 - b$
					Total 7 marks

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27	(a)	$3t^2$ or $-36t$ or $+81$		5	M1 2 terms correct
		$3t^2 - 36t + 81$			A1 all correct.
		$3t^2 - 36t + 81 = 0$			M1ft dep on M1
		$(t - 3)(t - 9)$			M1ft a correct method to solve their quadratic – if factorising will give 2 out of 3 terms correct and if using formula allow one sign error
			3		A1 (award 4 marks if both 9 and 3 are given for the answer)
	(b)	$6t - 36 (= 0)$		4	M1 (or suitable sketch that shows $t = 6$ or showing a method to find correct values for at least $t = 5$, $t = 6$ and $t = 7$)
		$t = 6$			A1 calculating or selecting the correct value
		$3 \times 6^2 - 36 \times 6 + 81$			M1ft for substituting their value of t into the correct expression dependent on the first M1 or for an answer of –27
			27		A1 do not accept –27
					Total 9 marks

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