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Mark Scheme (Results)

Summer 2023

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		$\frac{3\pi}{2}$ and $\sqrt{18}$	2	B2 both correct with no incorrect given do not allow misreads. B1 one correct with maximum of one extra incorrect one given or both correct with one extra incorrect SC B1 for awrt 4.71 and 4.24 and no other values Mark what is on the answer line, only check working or the list if the answer line is blank.
				Total 2 marks

Question	Working	Answer	Mark	Notes
2	$(12-5\times2)+(12-5\times6)$		2	M1 allow for both terms correct eg. 2 and – 18 but not added or a correct method to find both terms (which may be incorrectly calculated) and then added.
		−16		A1 cao ISW if –16 seen in working and 16 written on answer line
	Correct answer scores full marks (unless from obvious incorrect working)			***Total 2 marks***

Question	Working	Answer	Mark	Notes
3	$(-4)^2-5\times-4$		2	M1 must have brackets around the −4 unless recovered later must clearly indicate multiplication of –4 and –5 unless recovered later. Allow 16 + 20
		36		A1 cao
	Correct answer scores full marks (unless from obvious incorrect working)			***Total 2 marks***

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Question	Working	Answer	Mark	Notes
4		Correct bisector with arcs	2	B2 correct line with construction arcs shown ie 2 sets of 2 intersecting arcs or 1 pair of arcs intersecting twice. Condone a bisector only drawn on one side of line. If the bisector does not go through the whole space between the lines on the overlay penalise if it would go out of tolerance if extended. Condone dotted line. B1 for a correct line without the required construction arcs or the required construction arcs without the line. Condone a bisector only drawn on one side of line
	Working required			***Total 2 marks***

Question	Working	Answer	Mark	Notes
5	$[AB=]3.6\times\frac{10.8}{8.1}$ oe		2	M1 for a fully correct equation including *AB* eg $\frac{AB}{3.6}=\frac{4}{3}$ or a correct expression for *AB*
		4.8		A1 allow awrt 4.8 NB correct answer from incorrect assumptions (eg use of right angled trigonometry) scores no marks
				Total 2 marks

Question	Working	Answer	Mark	Notes
6	$4x-6x<5+3$ or $-3-5<6x-4x$ oe		2	M1 for isolating terms in *x* allow any of <, > or = for this mark. Allow simplified expressions eg $-2x<8$ or $-8<2x$ or $x=-4$ or $x<-4$ or just -4 without *x*
		$x>-4$		A1 accept $-4<x$ must be –4 do not ISW
	Correct answer scores full marks (unless from obvious incorrect working)			***Total 2 marks***

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Question	Working	Answer	Mark	Notes
7	$\frac{2.53}{0.92}$ or $2.53+2.53\times\frac{8}{92}$ oe		2	M1 full correct method to find the original price condone $\frac{2.53}{92\%}$
		2.75		A1 cao
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 2 marks***

Question	Working	Answer	Mark	Notes
8		$3x+2y \geqslant -2$ oe $x \leqslant 0$ $y \leqslant 0$	2	B1 $3x+2y \geqslant -2$ allow $a \geqslant 3x+2y \geqslant -2$ where $a \geqslant 0$ oe Accept equivalents eg $y \geqslant -\frac{3}{2}x-1$ or $x \geqslant -\frac{2}{3}y-\frac{2}{3}$ oe Allow > for $\geqslant$ B1 for $x \leqslant 0$ **and** $y \leqslant 0$ accept $b \leqslant x \leqslant 0$ or $c \leqslant y \leqslant 0$ where $b \leqslant -\frac{2}{3}$ and $c \leqslant -1$ Allow < for $\leqslant$
				Total 2 marks

Question	Working	Answer	Mark	Notes
9		$a = 3$ $b = -4$	2	B1 for $a = 3$ on answer line, if answer line is blank or contains $a = -3$ award for $(x-3)^2 \pm n$ where n is numerical in their working B1 for $b = -4$ on answer line, if answer line is blank or contains $b = 4$ award for $(x \pm m)^2 - 4$ where m is numerical in their working
				Total 2 marks

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Question	Working	Answer	Mark	Notes
10	$\frac{13}{5}+\frac{26}{7}$ or $[2]\frac{3\times7}{35}+[3]\frac{5\times5}{35}\left[=[2]\frac{21}{35}+[3]\frac{25}{35}\right]$		3	M1 for writing the fractions as improper fractions (addition sign not required) or for writing the fraction part of the values over a common denominator (integer parts and addition signs not required)
	$\frac{13}{5}+\frac{26}{7}=\frac{13\times7}{35}+\frac{26\times5}{35}\left[=\frac{91}{35}+\frac{130}{35}\right]$ or $2+3+\frac{3\times7}{35}+\frac{5\times5}{35}\left[=2+3+\frac{21}{35}+\frac{25}{35}\right]$			M1 for writing their improper fractions over a common denominator (may be written as a single fraction with 2 terms on the numerator), numerators need not be evaluated at this point ft their improper fractions if their denominators are different. or for adding the whole number parts and the fraction parts over a common denominator. ft their mixed numbers with common denominators
		$\frac{221}{35}=6\frac{11}{35}$ or $5\frac{46}{35}=6\frac{11}{35}$ or $5+1\frac{11}{35}=6\frac{11}{35}$		A1 for completion to the correct answer with full working shown, must gain both M marks and $\frac{221}{35}$ or $5\frac{46}{35}$ or $5+1\frac{11}{35}$ must be seen in their working
	Working required			***Total 3 marks***

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Question	Working	Answer	Mark	Notes
11	$4y = 3x - 15$ or $y = \frac{3x}{4} - \frac{15}{4}$ or $\frac{4y}{3} = x - 5$ oe		3	M1 Fully expanded, equation with no brackets. NB we consider $y = \frac{3x-15}{4}$ to still contain an implied bracket
	$3x = 4y + 15$ or $\frac{3x}{4} = y + \frac{15}{4}$ or $x = \frac{4y}{3} + 5$			M1 isolating the term in x ft their 3-term equation involving x, y and a constant. Allow a maximum of 1 sign error
		$x = \frac{4y+15}{3}$		A1 oe eg $x = \frac{4y}{3} + 5$ condone expression $\frac{4y+15}{3}$ oe on answer line as long as correct equation seen in working. Do not isw.
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 3 marks***

Question	Working	Answer	Mark	Notes
12	204×10^{-182} or 2.04×10^{-180} oe		3	M1 for a correct denominator Allow in any form
	0.125×10^{190} or 12.5×10^{188} or 1.25×10^{n} or $m \times 10^{189}$			M1 Allow a correct answer in any form
		1.25×10^{189}		A1 cao
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 3 marks***

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Question	Working	Answer	Mark	Notes
13(a)		$4b(2a+7b)$	2	B2 fully correct B1 for $4(2ab+7b^2)$ or $b(8a+28b)$ or $2b(4a+14b)$ or $4b(pa+qb)$ where p and q are integers or correct factorisation followed by incorrect subsequent working.
(b)		$(5y-6)(y+3)$	2	B2 fully correct B1 for a factorisation that gives 2 correct terms when multiplied out. Condone consistent use of x instead y must involve integer values. NB If a candidate goes on to give solutions as their final answer award a maximum of B1
				Total 4 marks

Q	Working	Answer	Mark	Notes
14	$ED = EC$ equilateral triangle **or** $AE = EB$ E midpoint of AB		3	M1 Only one of these needed for this mark. Must be explicitly stated, showing on the diagram is not sufficient. Reasons not needed for this mark.
	$\angle EDC = \angle ECD$ isosceles or equilateral triangle **and** $\angle AED = \angle EDC$ and $\angle BEC = \angle ECD$ alternate angles are equal so $\angle AED = \angle BEC$			M1 $\angle AED = \angle BEC$ with at least alternate angle given. Must establish $\angle AED = \angle CDE = \angle DCE = \angle BEC$
	All reasons and both sides for 2nd M mark	SAS		A1 dep on both M marks. **All** underlined words (or unambiguous abbreviations) needed. Withhold if any incorrect statement seen
	Working required			***Total 3 marks***

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Q	Working	Ans	Mark	Notes
15	$3\sqrt{36\times5}-2\sqrt{49\times5}$		3	M1 Both surds written correctly. Allow $3\sqrt{4\times9\times5}-2\sqrt{49\times5}$ or $3\times6\sqrt{5}-2\times7\sqrt{5}$ or with values further decomposed
	$18\sqrt{5}-14\sqrt{5}$ or $4\sqrt{5}$			M1 dep on M1. Simplify each surd correctly
		$\sqrt{80}$		A1 dep on M2 cao SC B1 $\sqrt{80}$ given as answer and no marks gained
	Working required			***Total 3 marks***
ALT	$\sqrt{180\times9}-\sqrt{245\times4}\left[=\sqrt{1620}-\sqrt{980}\right]$		3	M1 Both surds written as square roots. Allow $\sqrt{180\times3^2}-\sqrt{245\times2^2}$
	$\sqrt{324\times5}-\sqrt{196\times5}=18\sqrt{5}-14\sqrt{5}\left[=4\sqrt{5}\right]$ or $\sqrt{81\times20}-\sqrt{49\times20}=9\sqrt{20}-7\sqrt{20}\left[=2\sqrt{20}\right]$			M1 dep on M1 simplify each surd correctly, may see further decomposition eg $\sqrt{2^2\times3^4\times5}-\sqrt{2^2\times5\times7^2}=3^2\sqrt{2^2\times5}-7\sqrt{2^2\times5}\left[=2\sqrt{20}\right]$ must see both a decomposition within the surd and two multiples either of $\sqrt{5}$ or $\sqrt{20}$
		$\sqrt{80}$		A1 dep on M2 cao SC B1 $\sqrt{80}$ given as answer and no marks gained
	Working required			***Total 3 marks***

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Question	Working	Answer	Mark	Notes
16	$\begin{pmatrix} 2 \\ -4 \end{pmatrix} - \begin{pmatrix} -3 \\ 8 \end{pmatrix}$ or $\begin{pmatrix} -3 \\ 8 \end{pmatrix} - \begin{pmatrix} 2 \\ -4 \end{pmatrix}$		3	M1 oe $\begin{pmatrix} 5 \\ -12 \end{pmatrix}$ accept (5, –12) or 5 horizontally and 12 vertically shown on a diagram or indicated in writing or any other equivalent form. Also accept any of the above for *BA* Eg $\begin{pmatrix} -5 \\ 12 \end{pmatrix}$
	$\sqrt{5^2 + ([-]12)^2}$			M1 ft their *AB* or *BA*, a correct expression implies the previous M mark if not already awarded. Give benefit of doubt for ±5 and ±12 unless their 5 and 12 **clearly** come from incorrect working. Do not award for modulus of *OA* or *OB*
		13		A1 cao
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 3 marks***

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Question	Working	Answer	Mark	Notes
17	fd $\frac{15}{10}[=1.5]$ $\frac{25}{5}[=5]$ $\frac{22}{5}[=4.4]$ $\frac{20}{5}[=4]$ $\frac{18}{20}[=0.9]$		3	M2 for correct methods to find all of the FD which may be on graph M1 for at least 4 FDs which may be on graph If no values listed and there is not a scale on the *y*-axis we will allow if the bars are drawn at correct height, in relation to the bar for $95 < w \leqslant 100$
		Correct graph		A1 completely correct histogram including correct width and placement of bars, including a correct scale with at least one correct value on the *y*-axis.
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 3 marks***

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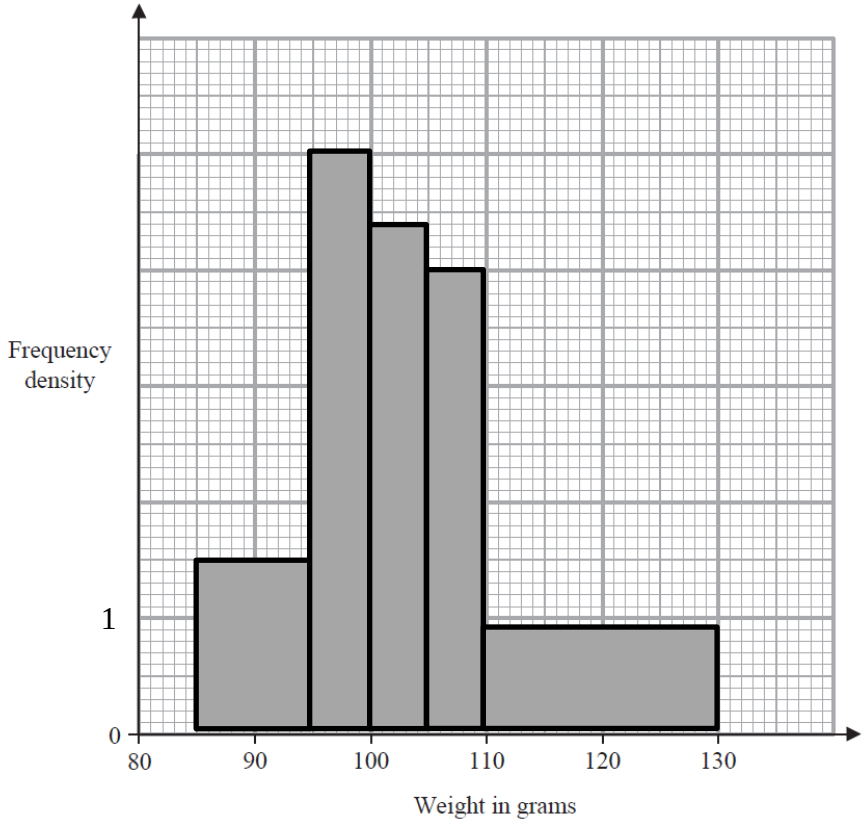
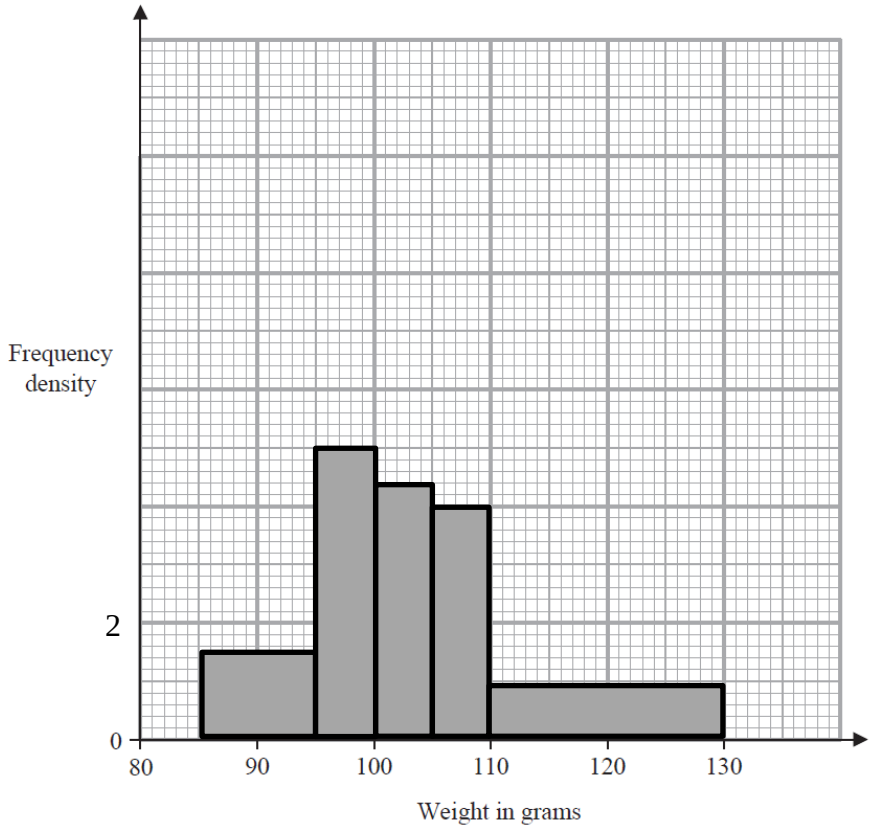
Commonly seen correct Histograms





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Question	Working	Answer	Mark	Notes
18	$\frac{x+5}{2}$ or $\frac{-20+-15+3+5+x+77+85+90}{8}\left[=\frac{225+x}{8}\right]$ oe		4	M1 for a correct expression for the median or for the mean in terms of x
	$"\frac{225+x}{8}"=2+"\frac{x+5}{2}"$ oe			M1 dep on previous M mark forming an equation in x, (need not be simplified) must contain at least one of the correct expression for the median or the correct expression for the mean. Accept one incorrect expression in terms of x but do not accept just x as either median or mean. Must see + 2 or –2 for this mark. Accept methods relating to the total eg $-15+3+5+x+77+85+90=8\left(\frac{x+5}{2}+2\right)$
	$225-16-20=4x-x$ or $\frac{225}{8}-2-\frac{5}{2}=\frac{x}{2}-\frac{x}{8}$			M1 isolating terms in x ft their linear equation in x. Condone one sign or numerical error Dep on gaining an equation in terms of x using at least 2 of correct mean, or correct median, or 2 added to median/subtracted from mean.
		63		A1 cao
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 4 marks***

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Question	Working	Answer	Mark	Notes
19(a)		0. 42	1	B1 accept $\frac{21}{50}$ or 42% oe Do not isw
(b)	$a+0.22-a+0.2+1.5a+a+0.03+2a+0.01=1$ $\left[\Rightarrow 4.5a+0.46=1\Rightarrow a=0.12\right]$ oe		3	M1 Form a correct equation in a Using $\sum p=1$ This may be seen in part (a) or by the table
	$80\times\left(\left(2\times"0.12"+0.01\right)\right)$ oe			M1 correct method to find expected value using their numerical value of a which must be $0 < a < 1$
		20		A1 cao
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 4 marks***

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Question	Working	Answer	Mark	Notes
20(a)	$y = k_1\sqrt{w}$ or $k_2 y = \sqrt{w}$ or $y = \sqrt{k_3 w}$		3	M1 for $k\sqrt{w}$ oe allow other constants and use of $\propto$
	$10 = k_1\sqrt{25}$ or $10k_2 = \sqrt{25}$ or $10 = \sqrt{25k_3}$ oe			M1method to find *k*. Accept $k_1 = 2$ or $k_2 = \frac{1}{2}$ or $k_3 = 4$ unless from obviously incorrect working condone use of $\propto$ If form is not clear assume they are finding k_1, Award of this mark implies the previous M mark if not already awarded.
		$y = 2\sqrt{w}$		A1 accept $y = \sqrt{4w}$ must be an equation (do not accept $\propto$ symbol in place of =) do not accept $\frac{1}{2}y = \sqrt{w}$ or $w = \frac{y^2}{4}$ do not isw
(b)		$x = \frac{c}{t^3}$	1	B1 allow $x = ct^{-3}$ or $x = \frac{1}{ct^3}$ must be an equation (do not accept $\propto$ symbol in place of = but condone $x \propto \frac{c}{t^3}$ oe if use of $\propto$ symbol penalised in (a)) Condone use of *k* instead of *c* or $x = \frac{c}{kt^3}$ or $x = \frac{k}{ct^3}$ do not isw
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 4 marks***

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Question	Working	Answer	Mark	Notes
21	$y = ... - bx^{-1} ...$		4	M1 writing the second term so can differentiate. Implied by $+\frac{b}{x^2}$ oe
	$\frac{dy}{dx} = 2x + \frac{b}{x^2}$			M1 one non constant term differentiated correctly – need not be simplified (eg $-b \times -x^{-2}$)
	$2 \times 1.5 + \frac{b}{1.5^2} = 0$ oe			M1 dep on previous M mark being awarded. Substitute x =1.5 into their $\frac{dy}{dx}$ and equating to zero
		−6.75		A1oe eg $-\frac{27}{4}$
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 4 marks***

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Question	Working	Answer	Mark	Notes
22	$x^2+x^2+x^2=729\left[\Rightarrow x=9\sqrt{3}=15.6\right]$ or $x=27\sin(35.3)$ oe		5	M1 forming an equation to find x Allow $x=\sqrt{\frac{729}{3}}$ or $x=\sqrt{243}$ or x = awrt 15.6
	$\pi\left(\frac{"9\sqrt{3}"}{2}\right)^2\times"9\sqrt{3}"\left[=2975.084...\right]$			M1 An attempt to find the volume of the cylinder. ft their x or allow a correct formula eg $\frac{\pi x^3}{4}$ oe Accept 3.14 or $\frac{22}{7}$ for π Commonly seen values of x and the required expression are: 19.1 $\Rightarrow$ $\pi\times9.5^2\times19.1\left[=5465.6\right]$ 3 $\Rightarrow$ $\pi\times1.5^2\times3\left[=21.2\right]$ 18.8 $\Rightarrow$ $\pi\times9.4^2\times18.8\left[=5255.0\right]$ 3.4 $\Rightarrow$ $\pi\times1.7^2\times3.4\left[=31.8\right]$ All given to 1dp. NB Value in bracket above are for guidance only, we would need to see valid working
	$\left("9\sqrt{3}"\right)^3\left[=3787.995...\right]$			M1 An attempt to find the volume of the cube. ft their x which must be numerical
	$\left("9\sqrt{3}"\right)^3-\pi\left(\frac{"9\sqrt{3}"}{2}\right)^2\times"9\sqrt{3}"$			M1 dep on previous 2 M marks correct expression for the volume required, must be numerical ft their x
		813		A1 allow awrt 813, 814, or 815
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 5 marks***

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Question	Working	Answer	Mark	Notes
23	$(3y+4)(2y-5)$		5	M1 factorise $6y^2-7y-20$ or their cubic if done later. Must achieve $(3y\pm4)(2y\pm5)$ or $(3y\pm4)(2y\pm5)(3y+17)$ NB throughout question allow *x* used in place of *y* for all method marks
	$\frac{2(3y+4)-3(y-3)}{(y-3)(3y+4)}$ oe			M1 Correct method to subtract 2 fractions to gain one fraction. Must have correct denominator. Numerator may contain a single sign error if expanded (may be seen across 2 fractions with a common denominator) but allow recovery if brackets initially omitted. May be seen after attempt to multiply.
	$"\frac{3y+17}{(y-3)(3y+4)}"\times\left(\frac{6y^2-7y-20}{6y+34}\right)$ oe			M1 invert divisor which must be an algebraic fraction and use this to multiply their other fraction. Must be only the divisor which is inverted. If attempted before fractions added, must attempt to multiply both the fractions in the first bracket by the inverted fraction
	$\frac{(6y^2-7y-20)(3y+17)}{(y-3)(3y+4)(6y+34)}$			M1 Correct **single** fraction with a maximum of 1 error in any form. Count any *x*s as *y*s for the purpose of this mark.
		$\frac{2y-5}{2y-6}$		A1oe dep on any 3 of the M marks. In which case the 4th M mark can be implied by this answer. Do not isw allow equivalent simplified form $\frac{2y-5}{2(y-3)}$ must be in terms of *y* only
	Working required			***Total 5 marks***

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Question	Working	Answer	Mark	Notes
24	$\frac{1}{2}h(9.8+20.4)[=15.1h]$ **or** $\frac{1}{2}\times 10.6\times h+9.8h[=15.1h]$ **or** $2\times\frac{1}{2}\times 5.3\times h+9.8h[=15.1h]$ oe		6	M1 Correct method to find area of trapezium $h = AX$ where X is the base of a perpendicular to CD from A mark awarded award for $h = 26$, may be marked on the diagram
	$"15.1h" = 392.6[\Rightarrow h = 26]$			M1 dep on previous M mark awarded award for $h = 26$, may be marked on the diagram
	$\frac{(20.4-9.8)}{2}[=5.3]$			M1 allow for 5.3 shown on the diagram or 5.3 used in subsequent calculations
	$\tan x = \frac{"26"}{"5.3"}[=4.90566...\Rightarrow x = 78]$ **or** $\tan x = \frac{"5.3"}{"26"}[=0.21538...\Rightarrow x = 12]$			M1 indep Method to find $\angle ADC$ (78) or $\angle DAX$ (12) Allow awrt 78 or 12 may see more complex method to find an appropriate angle. Eg. $AD = \sqrt{("26")^2+("5.3")^2} = 26.53...$ and $\cos x = \frac{"26"}{"26.53"}$ or $\frac{\sin x}{"5.3"} = \frac{\sin 90}{"26.53"}$ oe ft their 26 and their 5.3, only allow 10.6 for 5.3 from $\frac{(20.4-9.8)}{2}$ or labelled or marked on the diagram as the length DX Allow angle labelled on diagram
	180 + "12" oe or 270 – "78" oe			M1 correct method to find bearing. Correct answer seen in their working gains this mark. Must see 180 + their angle less than 45 oe or 270 – their angle greater than 45 oe
		192		A1 awrt 192 do not isw anything other than rounding
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 6 marks***

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Question	Working	Answer	Mark	Notes
25(a)		$\begin{pmatrix} -4 & -1 \\ 1 & 8 \end{pmatrix}$	2	B2 Fully correct (B1 for 2 or 3 terms correct)
(b)	$\begin{pmatrix} -15 & 10 \\ -5 & 20 \end{pmatrix} + \begin{pmatrix} 2 & 6 \\ -4 & -8 \end{pmatrix}$		2	M1 for correct two matrices added or allow for 2 or 3 terms correct in final answer
		$\begin{pmatrix} -13 & 16 \\ -9 & 12 \end{pmatrix}$		A1 cao
(c)	Det = $1\times(-4)-3\times(-2)[=2]$ oe **or** $\begin{pmatrix} -4 & -3 \\ 2 & 1 \end{pmatrix}$		2	M1 correct method to find the determinant or correct matrix without the determinant
		$\frac{1}{2}\begin{pmatrix} -4 & -3 \\ 2 & 1 \end{pmatrix}$		A1 Allow $\begin{pmatrix} -2 & -1.5 \\ 1 & 0.5 \end{pmatrix}$ oe isw incorrectly multiplying through of matrix by $\frac{1}{2}$ or if $\frac{1}{2}$ omitted on the answer line but seen in the working
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 6 marks***

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Q	Working	Answer	M	Notes
26	$x^2+\left(\frac{3x-25}{4}\right)^2=26$ or $\left(\frac{25+4y}{3}\right)^2+y^2=26$ oe $\left(\frac{3x-25}{4}\right)=\sqrt{26-x^2}$ or $\left(\frac{25+4y}{3}\right)=\sqrt{26-y^2}$		6	M1 For substituting a correct expression for x or y into the quadratic equation to form a quadratic (may be un-simplified) equation in either x or y.
	$x^2+\left(\frac{9}{16}x^2-\frac{150}{16}x+\frac{625}{16}\right)=26$ or $\left(\frac{625}{9}+\frac{200}{9}y+\frac{16}{9}y^2\right)+y^2=26$ oe			M1 For a correct method to expand their brackets which must be of form $(ax+c)^2$ or $(ay+c)^2$ resulting with 3 or 4 terms. Condone 1 error (Numerical or sign). This must then be substituted into the correct equation. A correct equation with bracket expanded implies both this and the previous M mark
	$\frac{25}{16}x^2-\frac{150}{16}x+\frac{209}{16}=0$ **or** $25x^2-150x+209=0$ **or** $\frac{25}{9}y^2+\frac{200}{9}y+\frac{391}{9}=0$ **or** $25y^2+200y+391=0$ oe			A1 For a correct 3 term quadratic dep on either previous mark being awarded.
	$\left[\frac{1}{16}\right](5x-19)(5x-11)$ or $\left[\frac{1}{9}\right](5y+23)(5y+17)$			M1 Indep Solving their 3-term quadratic equation using any correct method - if factorising, allow brackets which expanded give 2 out of 3 terms correct. If using formula or completing the square allow one sign error. Working must be seen if quadratic incorrect. By completing the square must see eg $25(x-3)^2[\pm...]=0$ Can be implied by $x=2.2$ and $x=3.8$ or $y=-4.6$ and $y=-3.4$
	$x=2.2$ and $x=3.8$ or $y=-4.6$ and $y=-3.4$ oe			A1 dep on at least 2 M marks awarded Both x values correct or both y values correct or one correct pair. Allow any correct form eg $x=11\frac{1}{5}$ and $x=19\frac{1}{5}$ or $y=-23\frac{1}{5}$ and $y=-17\frac{1}{5}$
		$x=2.2$, $y=-4.6$ and $x=3.8$, $y=-3.4$		A1 dep on all M marks awarded Both pairs correct. Allow as coordinates $(2.2,-4.6)$ and $(3.8,-3.4)$ Must show unambiguous pairings of x and y isw transcription errors eg exchanging x and y values. Accept $x=11\frac{1}{5}$, $y=-23\frac{1}{5}$ and $x=19\frac{1}{5}$, $y=-17\frac{1}{5}$
	Working required			***Total 6 marks***

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Question	Working	Ans	Mark	Notes
27	$\angle BOF = 120°$		7	B1 May be seen on the diagram
	$\angle BCF = \frac{"120"}{2}\left[= 60°\right]$			M1 Correct method to find angle *BCF* (must be numerical) may be seen on the diagram. Correct answer here not from obviously incorrect working implies the B1 for $\angle BOF = 120°$ if not awarded
	$4.5\times(4.5+3.8) = 5\times FD\left[\Rightarrow FD = 7.47\right]$ or $4.5\times(4.5+3.8) = 5\times(5+FE)\left[\Rightarrow FE = 2.47\right]$			M1 Method to find *FD* or *FE* allow for unambiguous indication on the diagram
	$\frac{\sin C\hat{F}D}{4.5} = \frac{\sin(180-"60")}{"7.47"}\left[\Rightarrow \angle CFD = 31.446...\right]$ or $("7.47")^2 = CF^2 + 4.5^2 - 2\times 4.5\times CF\cos(180-"60")$ $\left[\Rightarrow CF^2 + 4.5CF - 35.5509 = 0\right]$			M1 Method to find $\angle CFD$ allow for awrt 31 on diagram or use of cosine rule to find quadratic in *CF* allow for awrt 4.1 on diagram ft their *DF* (do not allow 5) and their $\angle BCF$
	$\angle CDF = 180-120-"31.446"\left[= 28.55...\right]$ or $CF = \frac{-4.5+\sqrt{4.5^2-4[\times 1]\times(-35.5509)}}{2[\times 1]}\left[= 4.12...\right]$			M1 dep on previous M mark. Method to find $\angle CDF$ allow awrt 29 on diagram or method to find *CF* from their quadratic allow for awrt 4.1 on diagram
	$\frac{1}{2}\times"7.47"\times 4.5\sin"28.55"$ or $\frac{1}{2}\times"4.12"\times 4.5\sin(180-"60")$			M1 method to find the area of *CDF* ft their *FD* (do not allow 3.8 or 5) and $\angle CDF$ (do not allow 30, 60 or 120 give bod on any other acute angle) or ft their *CF* (do not allow 3.8 or 5) and $\angle BCF$ (Give bod on any obtuse angle)
		8.03		A1 awrt 8.03 accept awrt 8.04 or 8.05
	Correct answer scores full marks (*unless from obvious incorrect working*)			***Total 7 marks***

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Que	Working	An	M	Notes
28	$10^2 = 16^2 + 20^2 - 2\times16\times20\cos CBA$ $16^2 = 10^2 + 20^2 - 2\times10\times20\cos CAB$ $20^2 = 16^2 + 10^2 - 2\times16\times10\cos BCA$		6	M1 using cosine rule to find an angle
	$\cos CBA = \frac{16^2 + 20^2 - 10^2}{2\times16\times20}$ **or** $\cos CAB = \frac{10^2 + 20^2 - 16^2}{2\times10\times20}$ **or** $\cos BCA = \frac{16^2 + 10^2 - 20^2}{2\times16\times10}$			M1 this mark implies the previous mark Allow $\angle CBA =$ awrt 29.7, $\angle CAB =$ awrt 52.4, $\angle BCA =$ awrt 97.9, Allow for angles on diagram Allow $\frac{1}{2}\angle CBA =$ awrt 14.8 or $\frac{1}{2}\angle CAB =$ awrt 26.2 or $\frac{1}{2}\angle BCA =$ awrt 49.0
	$a + b = 20$, $a + c = 10$, $b + c = 16$ oe $\frac{r}{a} = \tan"26.2"$, $\frac{r}{b} = \tan"14.8"$, $\frac{r}{c} = \tan"49.0"$ oe			M1 Any 3 of the equations linking a, b, c and r Where $AD = AF = a$, $BD = BE = b$, $CE = CF = c$ Take what they have labelled on their diagram or in their working. May be implied by an equivalent expression. eg $BD = 20 - a$ which may be seen on the diagram as the length BD is equivalent to $a + b = 20$. These may then be used in further working eg $\frac{r}{20-a} = \tan"14.8"$ May be implied by correct value of a, b or c Possible equivalent formulae are: $a-4=10-a$, $a+6=20-a$, $b-6=20-b$, $b-10=16-b$, $c+10=16-c$ and $c+4=10-c$
	$a = 7$ **or** $b = 13$ **or** $c = 3$			M1 Any correct value for a, b or c Give if any of these values seen in working even if it is not clear which length is which. This implies the previous mark.
	$r = "13"\tan("14.8")$ **or** $r = "7"\tan("26.2")$ **or** $r = "3"\tan("49.0")$			M1 Method to find r ft their numerical length or angle which may be seen on the diagram allow alternative method eg $\frac{r}{\sin"26.2"} = \frac{"7"}{\sin(90-"26.2")}$
		3.4		A1 accept answer between 3.4 and 3.5 inclusive
Correct answer scores full marks				***Total 6 marks***

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ALT 1	$10^2 = 16^2 + 20^2 - 2\times16\times20\cos CBA$ $16^2 = 10^2 + 20^2 - 2\times10\times20\cos CAB$ $20^2 = 16^2 + 10^2 - 2\times16\times10\cos BCA$		6	M1 using cosine rule to find an angle
	$\cos CBA = \frac{16^2 + 20^2 - 10^2}{2\times16\times20}$ or $\cos CAB = \frac{10^2 + 20^2 - 16^2}{2\times10\times20}$ or $\cos BCA = \frac{16^2 + 10^2 - 20^2}{2\times16\times10}$			M1 this mark implies the previous mark Allow $\angle CBA =$ awrt 29.7, $\angle CAB =$ awrt 52.4, $\angle BCA =$ awrt 97.9, Allow for angles on diagram Allow $\frac{1}{2}\angle CBA =$ awrt 14.8 or $\frac{1}{2}\angle CAB =$ awrt 26.2 or $\frac{1}{2}\angle BCA =$ awrt 49.0
	Area $= \frac{1}{2}\times20\times16\times\sin("29.7") = [79.2...]$ or Area $= \frac{1}{2}\times10\times16\times\sin("97.9") = [79.2...]$ or Area $= \frac{1}{2}\times10\times20\times\sin("52.4") = [79.2...]$ oe			M1 Method to find area of *ABC*
	$\frac{1}{2}16r + \frac{1}{2}10r + \frac{1}{2}20r = "79.2"$			M1 Use area to form an equation involving *r*
	"79.2" = "23"*r*			M1 Method to find *r*
		3.4		A1 awrt 3.4
Correct answer scores full marks				***Total 6 marks***

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Que	Working	Ans	M	Notes
ALT 2	$10^2 = 16^2 + 20^2 - 2\times16\times20\cos CBA$ $16^2 = 10^2 + 20^2 - 2\times10\times20\cos CAB$ $20^2 = 16^2 + 10^2 - 2\times16\times10\cos BCA$		6	M1 using cosine rule to find an angle
	$\cos CBA = \frac{16^2+20^2-10^2}{2\times16\times20}$ or $\cos CAB = \frac{10^2+20^2-16^2}{2\times10\times20}$ or $\cos BCA = \frac{16^2+10^2-20^2}{2\times16\times10}$			M1 this mark implies the previous mark Allow $\angle CBA =$ awrt 29.7, $\angle CAB =$ awrt 52.4, $\angle BCA =$ awrt 97.9, Allow for angles on diagram Allow $\frac{1}{2}\angle CBA =$ awrt 14.8 or $\frac{1}{2}\angle CAB =$ awrt 26.2 or $\frac{1}{2}\angle BCA =$ awrt 49.0
	$\angle AOC = 180 - "49" - "26.2"[=105]$ **and** $\frac{OA}{\sin("49")} = \frac{10}{\sin"105"}$ or $\angle AOB = 180 - "14.8" - "26.2"[=139]$ **and** $\frac{OB}{\sin("26.2")} = \frac{20}{\sin"139"}$ or $\angle BOC = 180 - "14.8" - "49"[=116]$ **and** $\frac{OC}{\sin("14.8")} = \frac{16}{\sin"116"}$			M1 Fully correct method to find *OA*, *OB* or *OC* from their angles found
	OA = awrt 7.8 or *OB* = awrt 13.5 or *OC* = awrt 4.6			M1 any of *OA*, *OB* or *OC* to at least 1 decimal place
	$r = "7.8"\sin("26.2")$ or $r = "4.6"\sin("49.0")$ or $r = "13.5"\sin("14.8")$			M1 Method to find *r*
		3.4		A1 awrt 3.4
Correct answer scores full marks				***Total 6 marks***
ALT 3 Herons	$\frac{16+10+20}{2}[=23]$		6	M1 Find semiperimeter
	$\sqrt{"23"("23"-16)("23"-10)("23"-20)}[=79.2...]$			M2 Find area
	Area of triangle *ABC* = $\frac{1}{2}16r + \frac{1}{2}10r + \frac{1}{2}20r$			M1 Use area to form an equation involving *r*
	"79.2" = "23"*r*			M1 Method to find *r*
		3.4		A1 awrt 3.4
Correct answer scores full marks				***Total 6 marks***

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