Pearson Edexcel

Mark Scheme (Results)

Sumer 2022

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

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2022
Question Paper Log Number P69309A
Publications Code 4MB1_01R_2206_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**

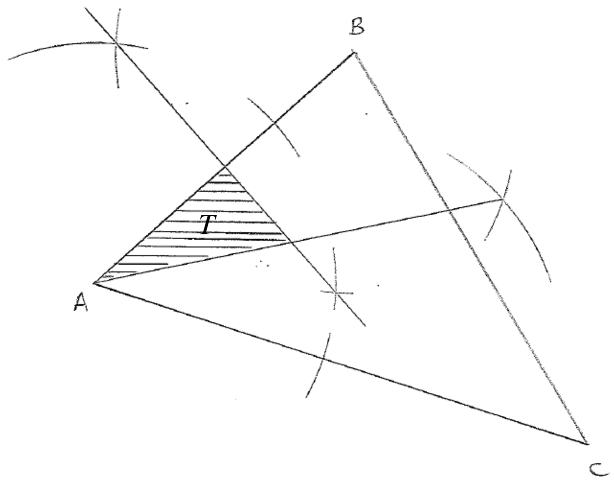
  Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded to another.

Question		Working	Answer	Mark	Notes
1			1.2092	1	B0 for 1.20920 or 1.20921
					Total 1 mark
2		$7-4n=-123$ or $4n=130$			M1 for setting the given expression equal to -123 **or** getting $4n$ = 130. This mark can also be achieved for getting the 33rd term as -125 **or** the 32nd term as -121
		$n=\frac{130}{4}=32.5$	No + valid reason	2	A1 dependent on previous M mark. For 'No' plus valid reason eg 32.5 is not an integer, is a decimal, is not a whole number, is a fraction (oe) or 130 is not a multiple of 4 etc. or stating that the 32nd term is -121 **and** the 33rd term is -125 Finding n = 32.5 and saying no without a reason is A0
					Total 2 marks
3		133 – 90			M1 oe eg 90 – (180 – 133) or for 90 – 47 (with the 47 possibly seen on the diagram)
			43	2	A1 allow 043
					Total 2 marks
4		$2\frac{7}{10}\times3\frac{5}{9}=\frac{27}{10}\times\frac{32}{9}$ oe or $2\times3+\frac{7}{10}\times3+\frac{5}{9}\times2+\frac{7}{10}\times\frac{5}{9}$			M1 correct improper fractions or clear alternative method – this stage must be shown to award any marks
		$\frac{864}{90}=\frac{48}{5}=9\frac{3}{5}$ or $3\times\frac{32}{10}=3\times\frac{16}{5}=\frac{48}{5}=9\frac{3}{5}$	$9\frac{3}{5}$	2	A1 dependent on M1 – must see at least one intermediate step between $\frac{27}{10}\times\frac{32}{9}$ and final answer – all stages of simplification if shown need to be correct. No equivalent answers allowed
					Total 2 marks

5		$h-6=2g+1$ or $2h=4g+2+12$ or $h-6=\frac{4g+2}{2}$			M1 for either dividing both sides by 2 **or** expanding brackets correctly and adding 12 to both sides
			$h=2g+7$	2	A1 allow $(h=)\frac{4g+14}{2}$ or $2g+7$ or $7+2g$ on answer line but A0 for $(h=)\frac{4g+2}{2}+6$ SC B1 for correctly making g the subject e.g. $(g=)\frac{h-7}{2}$ or $(g=)\frac{2h-14}{4}$ or $(g=)\frac{h}{2}-3.5$
					Total 2 marks
6		eg $8x>-2$ or $-2<8x$			M1 oe (eg $-8x<2$) for collecting like terms correctly and getting to one term in x and one constant term only
			$x>-\frac{1}{4}$	2	A1 (oe eg $x>-0.25$, $x>-\frac{2}{8}$, $-0.25<x$, etc.)
					Total 2 marks
7			$\frac{\sqrt{20}}{\sqrt{5}}$ and $\frac{2^4}{4^2}$	2	B2 for both correct B1 for one correct (no marks if more than 2 answers given) – allow equivalent answers eg 2 (for $\frac{\sqrt{20}}{\sqrt{5}}$) and 1 (for $\frac{2^4}{4^2}$)
					Total 2 marks

8		$\pi(4)^2(10)$			M1 for complete correct method to find volume with $r = 4$ or 8. An answer of 160π with no working scores M1 but look out for this coming from an incorrect method
			503	2	A1 cao (for reference: 502.6548246…) – allow 502 from using 3.14 as π (more accurate values of π should give 503). Allow 160π = 502 for 2 marks
					Total 2 marks
9		$\frac{4.5\times10^{14}}{60\times60\times10^{6}}$			M1 oe e.g. $\frac{4.5\times10^{14}}{3600\times10^{6}}, \frac{4.5\times10^{14}}{3.6\times10^{9}}$ or for $a\times10^5$ (where a is non-zero real number) or 1.25×10^n (where n is a non-zero integer) or 125000 or 12.5×10^4 (oe correct answer which is not in standard form)
			1.25×10^5	2	A1
					Total 2 marks
10		$\frac{557.75}{1.15}$			M1 oe correct method eg $557.75\times\frac{100}{115}$ or $557.75-557.75\times\frac{15}{115}$ or $\frac{557.75-x}{x}\times100=15$
			485		A1
					Total 2 marks

11	(a)		25	1	B1 No marks if more than one answer given
	(b)	$\frac{161+x}{8}=22.5$			M1 for setting up a correct equation in x or implying a fully correct method for finding the 8th test score eg $8(22.5)-(21+24+25+18+28+25+20)$ or $180-161$ or $8(22.5)-161$
		$x=22.5(8)-161$	19	2	A1 – a trial and improvement approach scores 2 marks if correct otherwise no marks
					Total 3 marks
12	(a)		–27	1	B1
	(b)		$3y(4x-5)$	2	B2
					B1 for a correct partial factorisation ie $3(4xy-5y)$ or $y(12x-15)$ or the common factor of $3y$ outside a bracket with just one error in the bracket
					Total 3 marks
13		$\frac{1}{2}(4)[(2x-1)+(3x+2)]=28$			M1 for setting up a correct equation in x eg $4(2x-1)+\frac{1}{2}(4)(x+3)=28$ Condone missing brackets provided recovered correctly later
		$10x+2=28\Rightarrow 10x=26$ (oe)			depM1 for collecting like terms – must be the correct order of operations to get to $ax=b$ but allow one error only when rearranging. Condone missing brackets provided recovered correctly later
			2.6	3	A1 (oe)
					Total 3 marks

14			Region T correctly identified	3	M1 for construction lines **and** perpendicular bisector of AB M1 for construction lines **and** angle bisector of BAC A1 dep on a correct bisector of line AB and the correct bisector of angle BAC and must have scored at least one M mark – so must have the construction lines for at least one of the two bisectors for T correctly identified. Shading required but condone T not being labelled If M0 M0 then SC B1 for the correct region but missing all correct construction lines (but must have the bisector of line AB and the bisector of angle BAC)
					Total 3 marks
15			$y - x \leqslant 2$		B1 condone strict inequalities eg $y - x < 2$ for all three marks. Allow any re-arrangement provided correct eg $x - y + 2 \geqslant 0$
			$3x + y \geqslant 15$		B1 oe eg $-y + 15 \leqslant 3x$
			$y \geqslant 0$	3	B1
					Total 3 marks

16		In $\triangle ECB$ and $\triangle ACD$ $AC = CE$ - sides of the square $ACEF$ are equal $BC = CD$ - sides of equilateral triangles are equal because the 'base' of each triangle is a side of the square $\angle ECB = \angle ACD \ (=150^\circ)$ because both obtuse angles are the sum of the right-angle (or ACE or 90°) and the angle at the base of an equilateral triangle (Hence $\triangle ECB$ and $\triangle ACD$ are congruent)			M1 M1 (1 mark for each with correct reason) – must have underlined words – allow singular/plural confusion (eg 'side' for 'sides') Allow Σ or '60 + 90' (but not just '150') for 'sum' – not sufficient just to say angle C in this case SC B1 if M0 M0 scored but all three of $AC = CE$, $BC = CD$ and $\angle ECB = \angle ACD$ stated together with SAS
			SAS	3	A1 for all three (with correct reasons) + SAS (ignore incorrect or additional reasons)
					Total 3 marks

17		$\frac{4-2\sqrt{3}}{\sqrt{3}+1}=\left(\frac{4-2\sqrt{3}}{\sqrt{3}+1}\right)\left(\frac{\sqrt{3}-1}{\sqrt{3}-1}\right)$			M1 for multiplying numerator and denominator by $\sqrt{3}-1$ or $1-\sqrt{3}$
		$\frac{4\sqrt{3}-4-6+2\sqrt{3}}{3-1}$ or $\frac{4\sqrt{3}-4-6+2\sqrt{3}}{(\sqrt{3})^2-1^2}$			M1dep for expanding numerator (2, 3 or 4 terms) and denominator (2 or 4 terms) – condone one error only when multiplying out both numerator and denominator
			$3\sqrt{3}-5$	3	A1 final answer (dependent on both M marks)
					Total 3 marks No marks for $\frac{4-2\sqrt{3}}{\sqrt{3}+1}=3\sqrt{3}-5$ M1 only for $\left(\frac{4-2\sqrt{3}}{\sqrt{3}+1}\right)\left(\frac{\sqrt{3}-1}{\sqrt{3}-1}\right)=-5+3\sqrt{3}$ M1 only for $\left(\frac{4-2\sqrt{3}}{\sqrt{3}+1}\right)\left(\frac{\sqrt{3}-1}{\sqrt{3}-1}\right)=\frac{-10+6\sqrt{3}}{2}(=-5+3\sqrt{3})$ SC B2 for $\left(\frac{4-2\sqrt{3}}{\sqrt{3}+1}\right)\left(\frac{\sqrt{3}-1}{\sqrt{3}-1}\right)=\frac{4\sqrt{3}-4-6+2\sqrt{3}}{2}$ regardless of subsequent working

18		$\angle POQ = 2(\angle PRQ)$ $\angle PRQ = 180 - 118$ $\angle OQP = \dfrac{180 - \angle POQ}{2}$			M1 for a correct use of angle at centre theorem M1 for complete method to find $\angle OQP$
			28		A1 – correct value implies both previous marks
		Reason 1 Angles on a straight line sum to 180° Reason 2 Angle at the centre is 2 × (or double or twice) angle at circumference / angle at circumference is ½ angle at centre (so angle needs only be mentioned once in this reason) Reason 3 Angles in a triangle add to 180° and base angles in an isosceles triangle (are equal)		4	B1 for Reason 2 **and** one of Reasons 1 **or** 3 stated correctly (must include underlined words) dependent on a correct method for finding $\angle OQP$ (or having stated the angle correctly) Allow Δ for triangle Allow $\angle$ or $\measuredangle$ for angle Allow plural/singular confusion (for example, 'angle' rather than 'angles') Do not allow 'origin' for 'centre' but allow 'central'. Allow 'inscribed' for 'circumference' Reason 3 may be given as two separate reasons
					Total 4 marks

19		$\tan 24 = \frac{6}{CD \text{ or } AD}$ or $CD \text{ or } AD = \frac{6}{\tan 24}$ or $CD \text{ or } AD = 6\tan 66$			M1 oe eg $\frac{CD \text{ or } AD}{\sin 66} = \frac{6}{\sin 24}$ or any other complete correct method for *CD* or *AD* (eg by Pythagoras eg $AD/CD = \sqrt{\left(\frac{6}{\sin 24}\right)^2 - 6^2}$) (For reference: *CD* (= *AD*) = 13.4762…)
		Arc $ABC = \left(\frac{132}{360}\right) \times 2\pi(6)\left(= \frac{22}{5}\pi\right)$			M1 or for arc *AB* or *BC* $= \left(\frac{66}{360}\right) \times 2\pi(6)$ (For reference: Arc *ABC* = 13.823…)
		$2\left(\frac{6}{\tan 24}\right) + \frac{11}{30}(12\pi)$			M1dep (on both previous M marks)
			40.8	4	A1 for awrt 40.8 (for reference: 40.775448…)
					Total 4 marks
20	(a)		25, 5, 15	2	B2 all correct B1 for one correct
	(b)	Remaining frequency densities are 1, 0.75, 0.25 Missing bars are 4, 3 and 1 square high			M1 for one correct bar or correctly stating all three required frequency densities
			Correctly completed histogram including labelling on frequency density axis	2	A1 correct histogram including frequency density axis correctly labelled (one value correctly labelled on the vertical axis is sufficient). Heights of the missing bars are 4 sq. 3 sq. and 1 sq. Check intervals carefully, these should be 80 – 90, 90 – 110 and 130 – 190 (check carefully for those that continue to 200)
					Total 4 marks

21	(a)	$\overrightarrow{OB} = \begin{pmatrix} 3 \\ -2 \end{pmatrix} + \begin{pmatrix} 1 \\ -4 \end{pmatrix}$			M1 (oe) or for one correct coordinate or for $(-4, 6)$
			$(4, -6)$	2	A1
	(b)	$\overrightarrow{AC} = \begin{pmatrix} m-3 \\ n+2 \end{pmatrix} \Rightarrow \left\|\overrightarrow{AC}\right\|^2 = (m-3)^2 + (n+2)^2$ or $\left\|\overrightarrow{AC}\right\| = \sqrt{(m-3)^2 + (n+2)^2}$			M1 for obtaining a correct expression for $\overrightarrow{AC}$ or $\left\|\overrightarrow{AC}\right\|^2$ condone finding $\overrightarrow{CA}$ for $\overrightarrow{AC}$ for all marks eg $\left\|\overrightarrow{AC}\right\|^2 = (3-m)^2 + (-2-n)^2$ scores M1
		$(m-3)^2 = 25 - (n+2)^2 \Rightarrow m = 3 \pm \sqrt{25-(n+2)^2}$ or $m^2 - 6m + n^2 + 4n - 12 = 0 \Rightarrow$ $m = \dfrac{-(-6) \pm \sqrt{(-6)^2 - 4(1)(n^2 + 4n - 12)}}{2}$			M1dep setting equal to 25 (oe) and correct order of operations to make m the subject – allow sign errors only when rearranging, or if expanding $(n+2)^2$ or $(-2-n)^2$. Taking only the positive square root is fine. Or for expanding which leads to a 3-term quadratic in m with a quadratic constant term in n (so five terms in total) and then correct use of the quadratic formula by substituting values in correctly. Allow one slip (but condone 6^2 for $(-6)^2$) and allow use of + rather than $\pm$
		$m = 3 \pm \sqrt{25-(n+2)^2}$	$m = 3 + \sqrt{25-(n+2)^2}$	3	A1 ISW once correct answer seen with positive square root only (so check working for correct answer). Allow equivalent answers eg $m = 3 + \sqrt{21 - 4n - n^2}$ If using quadratic formula, then most likely to see $m = \dfrac{6 + \sqrt{84 - 16n - 4n^2}}{2}$ ISW once seen
					Total 5 marks

22	(a)	$AD^2+CD^2=AC^2 \Rightarrow AC^2=9+\frac{18x}{1-2x}$ oe eg $AC^2=3^2+\left(\sqrt{\frac{18x}{1-2x}}\right)^2$			M1 for a correct use of Pythagoras involving AC oe eg may see $AC^2=\frac{9}{1-2x}$ or $AC=\frac{3}{\sqrt{1-2x}}$ etc. – need not be simplified
		eg $L^2+9+\frac{18x}{1-2x}=\frac{36}{3-8x}$ or $L^2+\frac{9}{1-2x}=\frac{36}{3-8x}$ or $(L^2=)\frac{36}{3-8x}-9-\frac{18x}{1-2x}$ or $(L^2=)\frac{36}{3-8x}-\frac{9}{1-2x}$			M1 for obtaining an expression/equation for $L\,(CH)$ or L^2 from a correct second application of Pythagoras (dependent on first M mark)
		eg $\left(L^2=\right)\frac{36}{3-8x}-\frac{9}{1-2x}=\frac{36(1-2x)-9(3-8x)}{(3-8x)(1-2x)}$			M1 for the correct method of obtaining a single (unsimplified) fraction for L/CH or L^2 (dependent on first two M marks) oe eg $\left(L^2=\right)\frac{36}{3-8x}-9-\frac{18x}{1-2x}$ $=\frac{36(1-2x)-9(3-8x)(1-2x)-18x(3-8x)}{(3-8x)(1-2x)}$
		$\left(L^2=\right)\frac{36-72x-27+126x-144x^2-54x+144x^2}{(3-8x)(1-2x)}$ Or $\left(L^2=\right)\frac{36-72x-27+72x}{(3-8x)(1-2x)}$			M1 for expanding all terms in their numerator – allow one slip (dependent on all previous M marks) – this mark can be implied by a correct final answer or for getting to $\left(L^2=\right)\frac{9}{(3-8x)(1-2x)}$ or $(L=)\sqrt{\frac{9}{(3-8x)(1-2x)}}$ provided previous M mark awarded
		$\left(L^2=\right)\frac{9}{(3-8x)(1-2x)}$ so $L=\frac{3}{\sqrt{(3-8x)(1-2x)}}$	3	5	A1 (dependent on all previous M marks) – allow $\frac{3}{\sqrt{(3-8x)(1-2x)}}$ without explicitly stating $k=3$

		ALTERNATIVE			
		$AD^2+CD^2=AC^2 \Rightarrow AC^2=9+\frac{18x}{1-2x}$			M1 for a correct use of Pythagoras involving *AC* (possibly implied by next M mark) or equivalent eg $AC^2=\frac{9}{1-2x}$
		$AH^2=AD^2+DC^2+L^2$ $\Rightarrow \frac{36}{3-8x}=9+\frac{18x}{1-2x}+\frac{k^2}{(3-8x)(1-2x)}$ Or $\frac{36}{3-8x}=\frac{9}{1-2x}+\frac{k^2}{(3-8x)(1-2x)}$			M1 for a correct second application of Pythagoras - obtaining an expression/equation for *k* or k^2 (dependent on first M mark)
		$36(1-2x)=9(3-8x)(1-2x)+18x(3-8x)+k^2$ or $36(1-2x)=9(3-8x)+k^2$			M1 for correctly removing all fractions (dependent on first two M marks)
		$k^2=36-72x-(27-126x+144x^2)-(54x-144x^2)=9$ or $k^2=36-72x-27+72x$			M1 for expanding and attempt to simplify (dependent on all previous M marks) – allow one slip
			3	5	A1 (dependent on all previous M marks) – not for $k=\pm3$ unless followed by k = 3 only
	(b)	Volume = $(3)\left(\sqrt{\frac{18x}{1-2x}}\right)\left(\frac{k}{\sqrt{(3-8x)(1-2x)}}\right)$			M1 for a correct expression for the volume (allow with or without x = 0.3 substituted). Allow if the expression for *CH* is still in terms of *k* or their incorrect *k*
			67.5	2	A1 final answer of 67.5 only (oe eg $\frac{135}{2}$)
					Total 7 marks

23		$3y-1=0.2$			M1 can be implied by a correct value of y seen
		$y=0.4$			A1
		$\frac{1}{2}y+0.1+(2x-4)+0.05+(3y-1)$ $+(x-2)+0.12+0.03=1$			M1 (setting up an equation in terms of x (and y or their value of y)) – must be equivalent to 8 terms equal to 1. This mark can be implied if an equation in terms of x only (with their y substituted) is seen
		$\frac{1}{2}(0.4)+0.1+(2x-4)+0.05+(3(0.4)-1)$ $+(x-2)+0.12+0.03=1$ Leading to $x=(2.1)$			M1 Setting up an equation in terms of x only and solving for x (dep on both previous M marks) If correct: $-5.3+3x=1$ or $1.4+3x=7.7$ are common
		$250\left(\frac{1}{2}y+(2x-4)+(3y-1)+0.12\right)$			M1dep (on all previous M marks) – using their values of x and y (oe eg 250 – even). Finding 70 (evens) correctly (without ever finding odds) scores 4 marks only Look out for 250('0.2' + '0.2' + '0.2' + 0.12)
			180	6	A1 180 as final answer. Do not ISW if 250 – 180 considered
					Total 6 marks

24	(a)		$\begin{pmatrix} -5 & -1 \\ -5 & 2 \end{pmatrix}$	2	B2 or B1 for a 2×2 matrix with 2 or 3 correct entries. Check carefully for transcription errors but do not condone misreading operators
	(b)		$\begin{pmatrix} 0 & 7 \\ -5 & 16 \end{pmatrix}$	2	B2 or B1 for a 2×2 matrix with 2 or 3 correct entries. Check carefully for transcription errors but do not condone misreading operators
	(c)	$\mathbf{B}^{-1} = \frac{1}{6-4}\begin{pmatrix} 2 & -2 \\ -2 & 3 \end{pmatrix}$			B2 or B1 for correct determinant or B1 for $k\begin{pmatrix} 2 & -2 \\ -2 & 3 \end{pmatrix}$ where k is non-zero
		$\mathbf{C} = \mathbf{B}^{-1}\mathbf{A} = \frac{1}{2}\begin{pmatrix} 2 & -2 \\ -2 & 3 \end{pmatrix}\begin{pmatrix} -2 & 1 \\ -3 & 4 \end{pmatrix}$			M1 for the correct intention of matrix multiplication of their inverse of **B** with **A** in the correct order (but they do not need to attempt the multiplication)
			$\begin{pmatrix} 1 & -3 \\ -2.5 & 5 \end{pmatrix}$	4	A1 (oe) eg $\frac{1}{2}\begin{pmatrix} 2 & -6 \\ -5 & 10 \end{pmatrix}$ - a correct answer with no working scores all 4 marks
	(c)	**ALTERNATIVE**			
		$\begin{pmatrix} -2 & 1 \\ -3 & 4 \end{pmatrix} = \begin{pmatrix} 3 & 2 \\ 2 & 2 \end{pmatrix}\begin{pmatrix} a & b \\ c & d \end{pmatrix}$			
		$3a + 2c = -2 \quad 2a + 2c = -3$ $3b + 2d = 1 \quad 2b + 2d = 4$			B2 or B1 for 2 or 3 correct equations
					M1 for one correct column of matrix **C**
			$\begin{pmatrix} 1 & -3 \\ -2.5 & 5 \end{pmatrix}$		A1 (oe) e.g. $\frac{1}{2}\begin{pmatrix} 2 & -6 \\ -5 & 10 \end{pmatrix}$
					Total 8 marks

25	(a)	$5y = 15x (\Rightarrow y = 3x)$			M1 for correct application of intersecting chord theorem
		$(7x)^2 = 15^2 + y^2 - 2(15)(y)\cos 120$			M1 for correct application of cosine rule (either in terms of *x* and *y* or using their result from intersecting chords to get an equation in *x* or *y*) Condone a **single** error in cosine rule eg $7x^2 = 15^2 + y^2 - 2(15)(y)\cos 120$ $(7x)^2 = 15^2 + y^2 + 2(15)(y)\cos 120$ $(7x)^2 = 15^2 + y - 2(15)(y)\cos 120$
		$49x^2 = 225 + 9x^2 + 45x$			M1dep (on both previous M marks) – substituting to obtain an equation in *x* (or *y*) only eg $49\left(\frac{y}{3}\right)^2 = 225 + y^2 + 15y$
		$40x^2 - 45x - 225 = 0$			A1 (oe – correct 3-term quadratic in *x* or in *y* eg $8y^2 - 27y - 405 = 0$)
		eg $(8x+15)(x-3) = 0$ or eg $x = \frac{-(-9) \pm \sqrt{(-9)^2 - 4(8)(-45)}}{2(8)}$			M1 for attempting to solve their 3-term quadratic in *x* or in *y* e.g. $(8y+45)(y-9) = 0$ - if no working shown then a correct answer for either *x* or *y* from a correct quadratic can imply this mark (otherwise they must show a method for solving their incorrect quadratic). For factorising when expanded, the result must give at least 2 of the 3 terms of their quadratic. Or for correct use of the formula by substituting values in correctly but allow one slip and allow 9^2 for $(-9)^2$ underneath the square root.
			$x = 3, y = 9$	6	A1 dep on all previous M marks

	(a)	**ALTERNATIVE**			
		$5y=15x\left(\Rightarrow y=3x\right)$			M1 for correct application of intersecting chord theorem
		$\dfrac{\sin CDE}{y}=\dfrac{\sin 120}{7x}$ or $\dfrac{\sin DCE}{15}=\dfrac{\sin 120}{7x}$			M1 for a correct application of the sine rule
		$\sin CDE=\dfrac{3}{7}\sin 120\Rightarrow CDE=...$			M1dep (on both previous M marks) – finding angle *CDE* (for reference: 21.7867893…)
		$DCE=180-120-21.78...=38.2$			A1 for angle *DCE* (for reference: 38.2132107…)
		$\dfrac{7x}{\sin 120}=\dfrac{15}{\sin('38.2')}$ or $\dfrac{y}{\sin('21.8')}=\dfrac{15}{\sin('38.2')}$			M1 for applying the sine rule a second time (dependent on all previous M marks)
			$x=3,\ y=9$	6	A1 condone if non-exact values seen provided final answers are integers - dependent on all previous M marks
	(b)	*AE* : *ED* = 5 : 15 or $\dfrac{AE}{ED}=\dfrac{1}{3}$ or $\dfrac{ED}{AE}=3$ or $\dfrac{5}{15}$ or $\dfrac{15}{5}$ or 3^2 but not just 3 (unless clear where this value has come from)			M1 (oe e.g. *EB* : *EC* = *x* : *y* or their *y* (possibly in terms of *x* from (a)) or consider $\dfrac{\text{area of }\triangle ABE}{\text{area of }\triangle CDE}=\dfrac{\frac{1}{2}\times 5x\times\sin 120^\circ}{\frac{1}{2}\times 15y\times\sin 120^\circ}$ $\left(=\dfrac{x}{3y}=\dfrac{3}{27}=\dfrac{1}{9}\right)$ $(\Leftrightarrow n=9)$
			$n=9$	2	A1 correct answer with no working scores both marks – do not award this A mark for 3^2
					Total 8 marks

26	(a)	$y = kx^3 + 3kx^2 - 2x - 6 \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x} = \ldots$			M1 for expanding to obtain a cubic in x with four terms and attempting to differentiate (with at least one term correct)
		$\frac{\mathrm{d}y}{\mathrm{d}x} = 3kx^2 + 6kx - 2$			A1ft for correctly differentiating their expanded expression
		$x = -1, \frac{\mathrm{d}y}{\mathrm{d}x} = -8 \Rightarrow 3k(-1)^2 + 6k(-1) - 2 = -8$			M1 for substituting $x = -1$ into their three term quadratic expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$ and setting $\frac{\mathrm{d}y}{\mathrm{d}x} = -8$ to obtain an equation in k only (for reference if correct when solved $k = 2$)
		$3kx^2 + 6kx - 2 = 0$ or $\frac{\mathrm{d}y}{\mathrm{d}x} = 3(2)x^2 + 6(2)x - 2$			M1dep (dep on both previous M marks) for setting their first derivative equal to zero **or** substituting their value for k into their first derivative
			$3x^2 + 6x - 1 = 0$	5	A1 (answer given so sufficient working must be shown eg must see the derivative set equal to zero **before** simplifying to $3x^2 + 6x - 1 = 0$) - must see $3x^2 + 6x - 1 = 0$ all on the same line (including the = 0) and clearly stated as their final answer
	(b)		$3(x+1)^2 - 4$	3	B1 for a = 3, B1 for b = 1 and B1 for $c = -4$ Award SC B2 for $3(x+1) - 4$
	(c)	$3(x+1)^2 = 4 \Rightarrow x = \ldots$ or $x = \frac{-6 \pm \sqrt{6^2 - 4(3)(-1)}}{2(3)}$			M1 for correct order of operations to find x from their $a(x+b)^2 + c$ with a, b, and c non-zero and leading to real value(s) of x. Or for correct use of the quadratic formula on $3x^2 + 6x - 1 = 0$ by substituting values in correctly - allow one slip
			$x = \frac{-3 \pm \sqrt{12}}{3}$	2	A1 oe eg $x = -1 \pm \sqrt{\frac{4}{3}}$ as a final answer (so do not ISW if replaced with non-exact values)
					Total 10 marks

27		$x = k_1 w^3$			M1 – the first two M marks can be awarded if using the same letter for the constant of proportionality in both equations Note the $x = w^3$ is M0
		$y = \frac{k_2}{\sqrt{w}}$			M1 Note that $y = \frac{1}{\sqrt{w}}$ is M0
		$\Rightarrow k = xy^6$ and $k = \frac{1}{4}(2^6)$ Or if using *k* for both constants then $\Rightarrow k^7 = xy^6$ and $k^7 = \frac{1}{4}(2^6)$			M1 (dependent on both previous M marks) for eliminating *w* **and then** using $y = 2$ and $x = \frac{1}{4}$ e.g. $xy^6 = k_1 k_2^6$ with $k_1 = 2$ and $k_2 = 6$
			$p = 6, q = 16$	4	A1 (accept $xy^6 = 16$)
					Total 4 marks

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom