Mark Scheme (Results)

June 2022

Pearson Edexcel International GCSE
Mathematics A (4MA1)
Paper 2HR

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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**

  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**

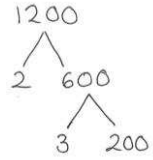
  It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. Incorrect cancelling of a fraction that would otherwise be correct.

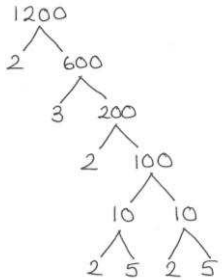
  It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.

  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.

International GCSE Maths				
Apart from Questions 2, 6a, 17, 19, 21, 25 the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method				
Q	**Working**	**Answer**	**Mark**	**Notes**
1 (a)	enlargement, enlarge, enlarged	Enlargement	3	B1 for enlargement with no mention of translate, reflect, rotate, move, flip
	scale factor 3, SF 3, ×3, factor of 3, 'three' times	Scale factor 3		B1 for (scale factor =) 3 with no mention of a vector, line of symmetry or angle
	allow (3, 0) 3, 0	Centre (3, 0)		B1 for (centre =) (3, 0)
(b)		Triangle drawn at (1, 4) (1, 6) (2, 4)	1	B1 condone missing label
				Total 4 marks

<table>
<tr>
<td>2</td>
<td>eg 2 × 2 × 300
2 × 5 × 120
2 × 3 × 200
3 × 5 × 80 or
eg
 

or
<table>
<tr><td>2</td><td>1200</td></tr>
<tr><td>3</td><td>600</td></tr>
<tr><td></td><td>200</td></tr>
</table></td>
<td></td>
<td>3</td>
<td>M1</td>
<td>for at least 2 correct stages in prime factorisation which give 2 prime factors – may be in a factor tree or a table or listed eg 2, 2, 300 (allow no more than one mistake ft (eg one mistake with 2 prime factors ft 1200 = 20 × 600 = 2 × 10 × 3 × 200))</td>
</tr>
<tr>
<td></td>
<td>2, 2, 2, 2, 3, 5, 5
or
 

oe
<table>
<tr><td>2</td><td>1200</td></tr>
<tr><td>3</td><td>600</td></tr>
<tr><td>2</td><td>200</td></tr>
<tr><td>5</td><td>100</td></tr>
<tr><td>2</td><td>20</td></tr>
<tr><td>5</td><td>10</td></tr>
<tr><td>2</td><td>2</td></tr>
<tr><td></td><td>(1)</td></tr>
</table></td>
<td></td>
<td></td>
<td>M1</td>
<td>for finding the correct prime factors condone inclusion of 1 (may be seen in a fully correct factor tree or ladder)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$2^4 \times 3 \times 5^2$</td>
<td></td>
<td>A1</td>
<td>(dep on M2 as working requested)
Can be in any order (allow $2^4 . 3 . 5^2$) but must be in index form as asked for.</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
<td>Total 3 marks</td>
</tr>
</table>

3	eg $\frac{158+C}{2}=160$ **or** (C =) 160 + (160 – 158) (= 162) oe **or** C = 162		3	M1	for method to find Candela's height or Candela's height or Candela's height in the wrong place on the answer line
	eg (D =) 175 – 21 **(=** 154) oe			M1	indep for method to find Diana's height or Diana's height or Diana's height in the wrong place on the answer line
		Candela 162 Diana 154		A1	Correctly attributed If no marks awarded, SCB1 for Candela's height 179
					Total 3 marks

4	(a)(i)		9, 15	1	B1	no repeats
	(a)(ii)		9, 11, 12, 13, 15, 17, 18, 19	1	B1	no repeats or omissions
	(b)	**No must be ticked along with a reason for the award of this mark**	No with a correct reason	1	B1	No with eg 24/it is not in the universal set, 24/it is not between 9 and 20 (need some sort of reference that the numbers in the sets do not go beyond 20)
	(c)		10, 18 and two from 9, 11, 13, 15, 17, 19	2	B2 (B1	for 10, 18 and two from 9, 11, 13, 15, 17, 19 a set of 4 numbers of which 3 are correct or a set of 5 numbers including 10, 18, and no more than one incorrect number or a set of 3 or more numbers from {10, 18, 9, 11, 13, 15, 17, 19})
						Total 5 marks

5	$\sqrt{36}\,(=6)$ **or** 6 **or** 6×6		4	M1	for method to find the length of the square – may be seen in later working
	eg $\pi \times \left(\frac{[\text{their } 6]}{2}\right)^2 \div 2 (= 14.1... \text{ or } 4.5\pi \text{ or } \frac{9}{2}\pi)$ **or** $\pi \times \left(\frac{[\text{their } 6]}{2}\right)^2 (= 28.2... \text{ or } 9\pi)$			M1	for method to find the area of one semicircle **or** circle or the incorrect number of semicircles or circles provided correct area of circle formula is seen for [their 6] allow any value if there is a clear implication this is their side length of square.
	eg $4 \times$ "14.1" $(= 56.5... \text{ or } 18\pi)$ **or** $2 \times$ "28.2" $(= 56.5... \text{ or } 18\pi)$			M1	ft dep on previous M1 for a complete method to find the total area of the semicircles [if the pupil multiplies again and uses the incorrect number of circles or semicircles this mark is not awarded]
		92.5		A1	accept 92.4 – 92.6 (not in terms of π)
					Total 4 marks

6 (a)	eg $10p = 3p - 5$ **or** $p = \frac{3p}{10} - \frac{5}{10}$ oe eg $p = 0.3p - 0.5$		3	M1	for a correct first step – multiplying both sides by 10 correctly or writing the RHS as 2 terms each over 10 or each term as a decimal [must be in a correct equation]
	eg $10p - 3p = -5$ **or** $7p = -5$ **or** $p - \frac{3p}{10} = -\frac{5}{10}$ **or** $0.7p = -0.5$			M1ft	(ft a 3 term equation) for collecting terms in p on one side and number the other
		$-\frac{5}{7}$		A1	(dep on at least M1) for $-\frac{5}{7}$ oe, accept −0.71(4...) allow –0.7 if you have seen $-\frac{5}{7}$ or $-5 \div 7$
(b)		1	1	B1	
(c)		$\frac{y^2}{2x}$	2	B2	for $\frac{y^2}{2x}$ oe eg $\frac{0.5y^2}{x}$, $0.5y^2x^{-1}$, $\frac{y^2x^{-1}}{2}$, $\frac{1}{2xy^{-2}}$ oe If not B2, award B1 for 2 of number, x, y correct eg $\frac{ky^2}{x}$ where $k \neq \frac{1}{2}$ **or** $\frac{y^2}{2x^m}$ where $m \neq 1$ **or** $0.5y^2$ **or** $\frac{y^p}{2x}$ where $p \neq 2$) **oe** [one term can be missing with 2 correct for B1]

(d)		$5cd^2(2c^2+3d^2)$	2	B2	for $5cd^2(2c^2+3d^2)$ B1 for a correct partial factorisation eg $5(2c^3d^2+3cd^4)$ or $cd^2(10c^2+15d^2)$ **or** $5d^2(2c^3+3cd^2)$ **or** $5c(2c^2d^2+3d^4)$ $5cd(2c^2d + 3d^3)$ etc **or** $5cd^2$(a 2 term expression with just one error)
					Total 8 marks

7	$(4^n =)(2^2)^n$ **or** $(4^n =)2^{2n}$ oe eg $2^k \div 2^{2n} = 2^x$ **or** $2^k = 4^{\frac{1}{2}k}$ **and** $2^x = 4^{\frac{1}{2}x}$ oe eg $\frac{4^{\frac{1}{2}k}}{4^n} = 4^{\frac{1}{2}x}$		2	M1	for writing 4^n as $\left(2^2\right)^n$ or 2^{2n} or for writing each term in terms of 4 ie $2^k = 4^{\frac{1}{2}k}$ **and** $2^x = 4^{\frac{1}{2}x}$ If these things are seen in working, award this mark even if followed by incorrect working – if not a choice of methods
		$k-2n$		A1	allow 2^{k-2n}
					Total 2 marks

8	1 + 0.12 (= 1.12) oe or 100(%) + 12(%) (=112(%)) or $\frac{18.20}{112}(=\frac{13}{80}=0.1625)$ or $x + 0.12x = 18.2(0)$ or $x \times 1.12 = 18.2(0)$		3	M1
	eg 18.2(0) ÷ "(1 + 0.12)" oe or $\frac{18.2(0)}{"112"} \times 100$ oe			M1 for a complete method
		16.25		A1
				Total 3 marks

9	(a)		8 800 000	1	B1	
	(b)		Barcelona	1	B1	accept 5.5×10^6
	(c)	$3.7 \times 10^7 - 7.7 \times 10^6$ **or** 29 300 000 oe or 37 000 000 – 7 700 000 or 29 000 000 oe or $0.29(3) \times 10^8$ or $29(.3) \times 10^6$		2	M1	allow $2.9(3) \times 10^n$ ($n \neq 7$)
			2.9×10^7		A1	accept -2.9×10^7 accept 2.93×10^7 or -2.93×10^7
						Total 4 marks

10	eg $\tan BAP = \frac{2}{5}$ or $\sin BAP = \frac{2}{\sqrt{5^2+2^2}}$ or $\frac{\sin BAP}{2} = \frac{\sin 90}{\sqrt{5^2+2^2}}$ $\cos BAP = \frac{5}{\sqrt{5^2+2^2}}$ or $\cos BAP = \frac{5^2+(\sqrt{5^2+2^2})^2-2^2}{2\times5\times\sqrt{29}}$		5	M1	for setting up a trig equation for angle BAP
	eg $(BAP =)\tan^{-1}\left(\frac{2}{5}\right)(= 21.8...)$ or $(BAP =)\sin^{-1}\left(\frac{2}{\sqrt{5^2+2^2}}\right)$ or $(BAP =)\sin^{-1}\left(\frac{2\sin 90}{\sqrt{5^2+2^2}}\right)$ $(BAP =)\cos^{-1}\left(\frac{5}{\sqrt{5^2+2^2}}\right)$ or $BAP = \cos^{-1}\left(\frac{5^2+(\sqrt{5^2+2^2})^2-2^2}{2\times5\times\sqrt{5^2+2^2}}\right)$			M1	for a complete method to find angle BAP (= 21.8….) [M2 for $90 - \tan^{-1}\frac{5}{2}$ ie 90 – 68.2]
	eg (int angle =) $(6-2)\times180\div6(=120)$ **or** (ext angle =) $360\div6(=60)$			M1	**Indep** for a method to find the size of one interior **or** one exterior angle in a regular hexagon – **could be seen on diagram**
	eg "120" – "21.8" **or** 180 – "60" – "21.8"			M1	for a complete method to find angle PAF where all values have come from a correct method
		98.2		A1	accept 98.1 – 98.3
					Total 5 marks

11	(a)	If a graph is ascending you can ft for the marks in parts (b), (c) an (d) – method should be shown by way of marks on the axes for all but the median in part (b)	Correct cf graph	2	B2	**(use overlay)** Fully correct cf graph – points at ends of intervals and joined with curve or line segments. B1 for for 6 or 7 points plotted correctly at ends of intervals not joined OR for 6 or 7 points from table plotted consistently within each interval (eg at lower bound of interval or midpoint of interval) at their correct heights and joined with smooth curve or line segments. ignore the curve < age 20
	(b)		26 – 28	1	B1ft	If out of range ft their graph
	(c)	e.g. readings at 15 and 45 from the vertical axis eg LQ = 19 – 21 eg UQ = 45 - 47 (the reading at 45 is 45/46 so be careful with the award of this mark)		2	M1ft	For use of 15 and 45, or 15.25 and 45.75 (eg reading of 21 and 46 stated or indicated by marks on horizontal axis that correspond to 15 (or 15.25) and 45 (or 45.75) on the vertical axis or correct readings ft their cf graph provided method to show readings is shown)
			24 - 28		A1ft	Any value in range (if out of range ft their cf graph reading across at 15 and 45 oe but method must be shown)
	(d)	eg reading of 49 or 50 from cf axis		2	M1ft	For correct reading at 55 eg 50 (ft from incorrect graph if method shown (lines up and across))
		must be a whole number	10 or 11		A1ft	If out of range ft their cf curve if method shown
						Total 7 marks

12	eg $6 \div 1.2$ (= 5) **or** $1.2 \div 6$ $(=\frac{1}{5})$ or $\frac{2x}{1.2}=\frac{2x+9}{6}$ oe or $\frac{2x}{2x+9}=\frac{1.2}{6}$ oe		3	M1	for finding the scale factor or using a correct ratio or fraction method
	eg "5" × 2x = 2x + 9 **or** $2x\times6=1.2(2x+9)$ oe $eg12x=2.4x+10.8$ or 9.6x = 10.8 oe			M1	for setting up an equation in x and removing denominators
		$\frac{9}{8}$		A1	oe eg 1.125 (allow 1.12 or 1.13)
					Total 3 marks

13	eg $2\times\pi\times5.2(=32.6...or\frac{52}{5}\pi)$ oe $\frac{67}{360}\times2\times\pi\times5.2(=6.08...or\frac{871}{450}\pi)$ oe		3	M1	for finding the whole circumference or the arc length
	$\frac{67}{360}\times2\times\pi\times5.2+2\times5.2$ oe			M1	for a complete method
		16.5		A1	accept 16.4 - 16.5 (not in terms of π)
					Total 3 marks

14	eg $\left(\frac{1}{2}\right)^4 \left(=\frac{1}{16} \text{ or } 0.0625\right)$ or $4\left(\frac{1}{2}\right)^4 \left(=\frac{4}{16} \text{ or } \frac{1}{4} \text{ or } 0.25\right)$ or $6\left(\frac{1}{2}\right)^4 \left(=\frac{6}{16} \text{ or } \frac{3}{8} \text{ or } 0.375\right)$ oe		3	M1	for finding the probability of one correct combination eg calculation for oooo or eeee or 4 × eooo or 4 × eeeo or 6 × eeoo
	eg $1-\left(\frac{1}{2}\right)^4$ **or** $4\left(\frac{1}{2}\right)^4+6\left(\frac{1}{2}\right)^4+4\left(\frac{1}{2}\right)^4+\left(\frac{1}{2}\right)^4$ or (e + oe + ooe + oooe) $\frac{1}{2} + \frac{1}{2}\times\frac{1}{2} + \frac{1}{2}\times\frac{1}{2}\times\frac{1}{2} + \frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}$ $\left(=\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16}\right)$ oe			M1	for a complete method
		$\frac{15}{16}$		A1	oe eg 0.9375 (allow 0.937 or 0.938)
					Total 3 marks

15	$\frac{1}{2}\times 6\times 11\times \sin 118 (= 29.1...)$		3	M1 for the area of half of the kite
	eg $2\times\frac{1}{2}\times 6\times 11\times \sin 118$			M1 for a complete method
		58.3		A1 accept 58.2 – 58.3
				Total 3 marks

16		C, F, D, H	3	B3 for all 4 correct (B2 for 2 or 3 correct) (B1 for 1 correct)
				Total 3 marks

17	eg x = 0.34545.... **and** 100x = 34.545.... with intention to subtract **OR** 10x = 3.4545.... **and** 1000x = 345.45.... with intention to subtract Must include algebra as the question asked for 'using algebra'		2	M1	for 2 recurring decimals (they must identify or show the pair they are using) that when subtracted give a whole number or terminating decimal eg 100x = 34.545.... and x = 0.34545.... **OR** 1000x = 345.45.... and 10x = 3.4545.... with intention to subtract. (If recurring dots not shown then showing at least the digits 34545, i.e. 5sf for **one** of the numbers that they are using) **OR** 0.3 + 0.0454545…. and Eg 10x = 0.454545… and 1000x = 45.4545..
	eg 100x – x = 34.545.... – 0.34545.... **and** 99x = 34.2 **and** $\frac{34.2}{99}=\frac{19}{55}$ oe **OR** 1000x – 10x = 345.45.... – 3.4545.... **and** 990x = 342 **and** $\frac{342}{990}=\frac{19}{55}$ oe **OR** 0.3 +… and (1000x –100x = 990x = 45) and $0.3+\frac{45}{990}=\frac{3\times99+45}{990}=\frac{19}{55}$ oe	shown		A1	for completion to $\frac{19}{55}$
					Total 2 marks

18	77.5 or 82.5 **or** 2.65 **or** 2.75 or 32.5 **or** 33.5 **or** 0.95 **or** 1.05 or 77500 or 82500 or 159 or 165 or 32500 or 33500 or 57 or 63		4	B1	For a UB or LB for one of the distances or times in hours or in minutes
	eg 82.5 ÷ 2.65 (= 31.13...) or 82500 ÷ 159 (= 518.867...) or km/min or m/h			M1	for a method to find the upper bound of Kaidan's average speed eg $UB_K \div LB_K$ where $80 < UB_K \leq 82.5$ and $2.65 \leq LB_K < 2.7$ or use of m/min to find upper bound for Kaidan's average speed eg $UB_K \div LB_K$ where $80000 < UB_K \leq 82500$ and $159 \leq LB_K < 162$ can use km/min or m/h
	eg 32.5 ÷ 1.05 (= 30.95...) or 32500 ÷ 63 (= 515.873…...) or km/min or m/h			M1	indep for a method to find the lower bound of Sonja's average speed eg $LB_S \div UB_S$ where $32.5 \leq LB_S < 33$ and $1 < UB_S \leq 1.05$ or use of m/min to find lower bound for Sonja's average speed $LB_S \div UB_S$ where $32500 \leq LB_S < 33000$ and $60 < UB_S \leq 63$ can use km/min or m/h
	UB K = 31132…..m/h LB S = 30952……m/h UB K = 0.51886….km/min LB S = 0.51587…km/min	Shown		A1	shown with **accurate figures** in the **same units –** sufficient figures for comparison (can be truncated) but must be from correct working and UB for Kaiden and LB for Sonja selected eg UB Kaidan = 31.13... (km/h) and LB Sonja = 30.95...(km/h) or UB Kaidan = 518.867...(m/min) and LB Sonja = 515.873...(m/min) (dep on correct method)
					Total 4 marks

19	eg $(fg(x) =)(2x+1)^2 - 4$		4	M1	for finding fg(x)
	eg $4x^2 + 4x - 3\ (> 0)$ or $4x^2 + 4x - 3 (= 0)$ **or** $(2x+1)^2 > 4$ or $(2x+1)^2 = 4$			M1	For a correct expansion and fg(x) written as a 3 term quadratic or a start to write quadratic in correct form for completing square
	$-\frac{3}{2}$ oe (**and**) $\frac{1}{2}$ oe			A1	for finding the two correct critical values (dep on previous M1) (values seen with any signs between)
		$x < -\frac{3}{2}, \quad x > \frac{1}{2}$		A1	two fully correct inequalities, oe (dep on 2nd M1)
					Total 4 marks

20	eg (x =) 4 − (6 − 4) (= 2) (y =) 7 − (11 − 7) (= 3) **or** (2, 3)		4	M1	for a method to find the coordinates of P (accept coordinates of P informally eg separately or as a vector)
	eg $\frac{11-7}{6-4}$ (= 2) or $\frac{11-[3]}{6-[2]}(=2)$ oe or $\frac{[3]-7}{[2]-4}(=2)$ oe			M1	(indep if using coordinates of A & O) for a method to find the gradient of AOP (can use **their** coordinates of P)
	eg −1 ÷ [2] (= −0.5) oe			M1ft	for a method to find the gradient of the tangent ft their stated gradient of AOP (or OA or OP) (could be embedded)
		$y-3=-0.5(x-2)$		A1	oe eg $y=-\frac{1}{2}x+4$
					Total 4 marks

21	$(3+2y)^2 - y^2 + 2(3+2y) = 10$	$x^2 - \left(\frac{x-3}{2}\right)^2 + 2x = 10$		5	M1	for using correct substitution of a linear equation into the quadratic – all terms shown correctly
	eg $3y^2 + 16y + 5(=0)$	eg $3x^2 + 14x - 49(=0)$ $3x^2 + 14x = 49$			A1	for a correct 3 term quadratic
	eg $(3y+1)(y+5)(=0)$ **or** $\frac{-16 \pm \sqrt{16^2 - 4\times3\times5}}{2\times3}$ **or** $3\left[\left(y+\frac{8}{3}\right)^2 - \left(\frac{8}{3}\right)^2\right] + 5 = 0$ (should give $(y=) -\frac{1}{3}, -5$)	eg $(3x-7)(x+7)(=0)$ **or** $\frac{-14 \pm \sqrt{14^2 - 4\times3\times(-49)}}{2\times3}$ **or** $3\left[\left(x+\frac{7}{3}\right)^2 - \left(\frac{7}{3}\right)^2\right] - 49 = 0$ (should give $(x=) \frac{7}{3}, -7$)			M1	dep on M1 method to solve **their** 3 term quadratic using any correct method (allow one sign error and some simplification – allow as far as eg $\frac{-16 \pm \sqrt{256-60}}{6}$ **or** $\frac{-14 \pm \sqrt{196+588}}{6}$ or if factorising allow brackets which expanded give 2 out of 3 terms correct) **or** correct values for x **or** correct values for y
	eg $x = 3 + 2 \times -5$ and $x = 3 + 2 \times -\frac{1}{3}$	eg $\frac{7}{3} - 2 \times y = 3$ $-7 - 2 \times y = 3$			M1ft	dep on previous M1 for substituting **their** 2 found values of x or y in a suitable equation (use 2dp or better for substitution) **or** fully correct values for the other variable (correct labels for x / y)
			$x = \frac{7}{3}, y = -\frac{1}{3}$ $x = -7, y = -5$		A1	dep on M1 (allow coordinates) must be paired correctly allow $x = -7, y = -5$ $x = 2.33(3\ldots), y = -0.33(3\ldots)$
						Total 5 marks

22 (a)(i)		$(-3, -1)$	1	B1	
(ii)		$(-6, 2)$	1	B1	
(b)		$(p + c, -q)$	2	B2	for $(p + c, -q)$
				(B1	for p + c **or** −q in the correct place)
					Total 4 marks

23	eg $\frac{20}{x^2-36}-\frac{2(x+6)}{x^2-36}$ oe **or** $\frac{20}{(x-6)(x+6)}-\frac{2(x+6)}{(x-6)(x+6)}$ oe **or** $\frac{20(x-6)}{(x^2-36)(x-6)}-\frac{2(x+6)(x-6)}{(x^2-36)(x-6)}$ or $\frac{20-2(x+6)}{(x^2-36)(4-x)}$ oe		3	M1 for writing the first two fractions with a common denominator (may be a single denominator) or multiplying both fractions by $\frac{1}{4-x}$ and writing over a common denominator
	eg $\frac{8-2x}{x^2-36}\times\frac{1}{4-x}$ **or** $\frac{8-2x}{(x-6)(x+6)}\times\frac{1}{4-x}$ **or** $\frac{20x-2x^2-48}{(x^2-36)(x-6)}\times\frac{1}{4-x}$ oe $\frac{8-2x}{(x^2-36)(4-x)}$ oe			M1 for simplifying first 2 fractions to a single fraction and expanding and simplifying numerator – must be correct, and showing intention to multiply by $\frac{1}{4-x}$ or expanding the numerator of the full solution and writing as a single fraction
		$\frac{2}{x^2-36}$		A1 oe eg $\frac{2}{(x-6)(x+6)}$
				Total 3 marks

24	eg $\frac{4}{3}\pi r^3 \div 2 (= \frac{2}{3}\pi r^3)$ oe		6	M1	for finding the volume of hemisphere
	eg $\frac{1}{3}\pi(kr)^2 kh \ - \ \frac{1}{3}\pi r^2 h (= \frac{1}{3}\pi r^2 h(k^3 - 1))$ oe			M1	for finding the volume of the frustum
	eg $\frac{1}{3}\pi r^2 h(k^3 - 1) + \frac{2}{3}\pi r^3$ **or** $\frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3$ oe			M1	for a correct expression for the volume of Solid **A or** Solid **B**
	eg $\frac{1}{3}\pi r^2 h(k^3 - 1) + \frac{2}{3}\pi r^3 = 6\left(\frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3\right)$ oe			M1	for a correct equation using the volumes of Solid **A** and Solid **B** (π could be cancelled out)
	eg $h(k^3 - 1) - 6h = 12r - 2r$ oe			M1	for simplifying to a point where the h terms are on one side of an equation and other terms the other side – must be correct
	NB: note that simplest form was not required	$\frac{10r}{k^3 - 7}$		A1	oe eg $\frac{4r - \frac{2}{3}r}{\frac{1}{3}k^3 - 2\frac{1}{3}}$
					Total 6 marks

25	eg $\overrightarrow{AK}=\lambda\mathbf{a}$ $\overrightarrow{KB}=(1-\lambda)\mathbf{a}$ $\overrightarrow{CL}=-\mu\mathbf{a}$ $\overrightarrow{DL}=(1-\mu)\mathbf{a}$	eg $\overrightarrow{AK}=\frac{1}{2}\mu\mathbf{a}$ $\overrightarrow{KB}=(1-\frac{1}{2}\mu)\mathbf{a}$ $\overrightarrow{CL}=-2\lambda\mathbf{a}$ $\overrightarrow{DL}=(1-2\lambda)\mathbf{a}$	**SEE NEXT PAGE FOR MISREAD**	5	M1	for correctly using the ratio to form an expression for a vector passing through K or L could be in terms of λ or μ $\overrightarrow{AK}$ or $\overrightarrow{KA}$, $\overrightarrow{KB}$ or $\overrightarrow{BK}$, $\overrightarrow{CL}$ or $\overrightarrow{LC}$, $\overrightarrow{DL}$ or $\overrightarrow{LD}$ (may be seen as part of another expression)
	eg $\overrightarrow{KL}=-\lambda\mathbf{a}+\mathbf{b}+(1-\mu)\mathbf{a}$ or $=(1-\lambda-\mu)\mathbf{a}+\mathbf{b}$ $\overrightarrow{LM}=(\mu-1)\mathbf{a}+0.5\mathbf{b}$ $\overrightarrow{KM}=-\lambda\mathbf{a}+\mathbf{b}+0.5\mathbf{b}\left(=-\lambda\mathbf{a}+1.5\mathbf{b}\right)$	eg $\overrightarrow{KL}=\mathbf{b}+(1-\frac{3}{2}\mu)\mathbf{a}$ or $\overrightarrow{KL}=\mathbf{b}+(1-3\lambda)\mathbf{a}$ $\overrightarrow{LM}=(2\lambda-1)\mathbf{a}+\frac{1}{2}\mathbf{b}$ or $\overrightarrow{KM}=-\lambda\mathbf{a}+\frac{3}{2}\mathbf{b}$ or			M1	for finding an expression in λ and/or μ for **one of** $\overrightarrow{KL}$ (or $\overrightarrow{LK}$), $\overrightarrow{LM}$ (or $\overrightarrow{ML}$), $\overrightarrow{KM}$ (or $\overrightarrow{MK}$) [If this mark is awarded it assumes the first M1]
	Two of the above – may have used $2\lambda=\mu$ to write all in one of λ or μ May be simplified or not – so may have brackets or not				M1	for finding an expression in λ or μ for **two of** the following: $\overrightarrow{KL}$ (or $\overrightarrow{LK}$), $\overrightarrow{LM}$ (or $\overrightarrow{ML}$), or $\overrightarrow{KM}$ (or $\overrightarrow{MK}$)
	eg using $\overrightarrow{KM}=-\lambda\mathbf{a}+1.5\mathbf{b}$ and $\overrightarrow{LM}=(2\lambda-1)\mathbf{a}+\frac{1}{2}\mathbf{b}$ $\overrightarrow{LM}=x\overrightarrow{KM}$ gives $\frac{-\lambda x}{2\lambda-1}=\frac{1.5x}{0.5}\Rightarrow 3.5\lambda=1.5\Rightarrow\lambda=\frac{3}{7}$ oe		$\lambda=\frac{3}{7}$ or $\mu=\frac{6}{7}$		A1	dep on M2 for one value correct or both values but written the wrong way round $(\mu=\frac{3}{7}\ \lambda=\frac{6}{7})$
			$\lambda=\frac{3}{7}$ & $\mu=\frac{6}{7}$		A1	dep on M2 for both values
						Total 5 marks

25	eg $\overrightarrow{AK}=\left(\frac{\lambda}{\lambda+1}\right)\mathbf{a}$ $\overrightarrow{KB}=\left(\frac{1}{\lambda+1}\right)\mathbf{a}$ $\overrightarrow{CL}=\left(\frac{-\mu}{1+\mu}\right)\mathbf{a}$ $\overrightarrow{DL}=\left(\frac{1}{1+\mu}\right)\mathbf{a}$	eg $\overrightarrow{AK}=\left(\frac{\frac{1}{2}\mu}{\frac{1}{2}\mu+1}\right)\mathbf{a}\ \left(=\left(\frac{\mu}{\mu+2}\right)\mathbf{a}\right)$ $\overrightarrow{KB}=\left(\frac{1}{\frac{1}{2}\mu+1}\right)\mathbf{a}\ \left(=\left(\frac{2}{\mu+2}\right)\mathbf{a}\right)$ $\overrightarrow{CL}=\left(\frac{-2\lambda}{1+2\lambda}\right)\mathbf{a}$ $\overrightarrow{DL}=\left(\frac{1}{1+2\lambda}\right)\mathbf{a}$	**MISREAD** $\overrightarrow{AK}:\overrightarrow{KB}=\lambda:1$ and $\overrightarrow{CL}:\overrightarrow{LD}=\mu:1$	M1 For using the ratio to form an expression for a vector passing through K or L could be in terms of λ or μ $\overrightarrow{AK}$ or $\overrightarrow{KA}$, $\overrightarrow{KB}$ or $\overrightarrow{BK}$, $\overrightarrow{CL}$ or $\overrightarrow{LC}$, $\overrightarrow{DL}$ or $\overrightarrow{LD}$ (may be seen as part of another expression)
	eg $\overrightarrow{KL}=\left(\frac{-\lambda}{\lambda+1}\right)\mathbf{a}+\mathbf{b}+\left(\frac{1}{1+\mu}\right)\mathbf{a}$ or $\overrightarrow{LM}=\left(\frac{-1}{1+\mu}\right)\mathbf{a}+0.5\mathbf{b}$ $\overrightarrow{KM}=\left(\frac{-\lambda}{1+\lambda}\right)\mathbf{a}+\frac{3}{2}\mathbf{b}$ oe	eg $\overrightarrow{KL}=\left(\frac{-\frac{1}{2}\mu}{\frac{1}{2}\mu+1}\right)\mathbf{a}+\mathbf{b}+\left(\frac{1}{1+\mu}\right)\mathbf{a}$ $\overrightarrow{LM}=\left(\frac{-1}{1+2\lambda}\right)\mathbf{a}+\frac{1}{2}\mathbf{b}$ or $\overrightarrow{KM}=\left(\frac{-\frac{1}{2}\mu}{\frac{1}{2}\mu+1}\right)\mathbf{a}+\frac{3}{2}\mathbf{b}$ oe		M1 for finding an expression in λ and/or μ using the above misread for **one of** $\overrightarrow{KL}$ (or $\overrightarrow{LK}$), $\overrightarrow{LM}$ (or $\overrightarrow{ML}$), $\overrightarrow{KM}$ (or $\overrightarrow{MK}$) [If this mark is awarded it assumes the first M1]
	Two of the above – may have used $2\lambda=\mu$ to write all in one of λ or μ May be simplified or not – so may have brackets or not			M1 for finding an expression in λ or μ for **two of** $\overrightarrow{KL}$ (or $\overrightarrow{LK}$), $\overrightarrow{LM}$ (or $\overrightarrow{ML}$), $\overrightarrow{KM}$ (or $\overrightarrow{MK}$)
	(Giving answers of $\lambda=0.5(1+\sqrt{7}),\ \mu=1+\sqrt{7}$)			**A MAXIMUM OF 3 MARKS CAN BE AWARDED FOR THIS MISREAD**

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