Mark Scheme (Results)

January 2020

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

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January 2020
Publications Code 4MA1_2H_2001_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.

International GCSE Maths					
Apart from Questions 3, 7b, 12, 17, 20, 22 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)		x^7	1	B1	
(b)	eg $7^8 \times 7^4 = 7^{12}$ or $7^8 \div 7^3 = 7^5$ or $7^5 \times 7^4$ or $7^4 \div 7^3 = 7$ or $7^8 \times 7$ or $7^{'12'} \div 7^3 = 7^{'12'-3}$		2	M1	for one correct step – must be written as a power of 7
		7^9		A1	for 7^9
					Total 3 marks

2	32.4×100^3		2	M1	for 32.4×100^3 oe
		32 400 000		A1	for 32 400 000 accept 3.24×10^7
					Total 2 marks

3	$\frac{14}{3}(+)\frac{19}{5}$ or $(4)\frac{10}{15}(+)(3)\frac{12}{15}$ or $(4)\frac{10a}{15a}(+)(3)\frac{12a}{15a}$		3	M1	for correct improper fractions or fractional part of numbers written correctly over a common denominator
	eg $\frac{14\times5+19\times3}{3\times5}$ or $\frac{70}{15}+\frac{57}{15}$ or $\frac{70a}{15a}+\frac{57a}{15a}$ or $4\frac{10}{15}+3\frac{12}{15}=7\frac{22}{15}$ oe			M1	for correct fractions with a common denominator of 15 or a multiple of 15
	$\frac{70}{15}+\frac{57}{15}=\frac{127}{15}=8\frac{7}{15}$ or $7\frac{22}{15}=8\frac{7}{15}$ or if shows $8\frac{7}{15}=\frac{127}{15}$ at the beginning then show that the addition comes to $\frac{127}{15}$	Shown		A1	dep on M2 for a correct answer from fully correct working **or** shows that RHS = $\frac{127}{15}$ **and** fully correct working shows LHS = $\frac{127}{15}$
					Total 3 marks

4	$30 + 4x + 10 + x + 20$ (= $5x + 60$) **or** $180 - 30$ (=150)		4	M1	Allow $5x + 60 = n$ where $n \neq 180$ or for subtracting 30 from 180	M2 for $5x + 30 = 150$ oe
	e.g. $30 + 4x + 10 + x + 20 = 180$ **or** $5x + 60 = 180$ oe **or** $180 - 30 - 10 - 20$ (=120)			M1	for setting up the equation or for subtracting all numerical values of angles from 180	
	$5x$ = '120' **or** '120' ÷ 5			M1	for correctly simplifying to $ax = b$ or for dividing '120' by 5	
		24		A1	for 24	
						Total 4 marks

5		Fully correct angle bisector with all relevant arcs shown	2	B2	Fully correct angle bisector with all arcs shown. B1 for all arcs and no angle bisector drawn or for a correct angle bisector within guidelines but not arcs or insufficient arcs
					Total 2 marks

6	1 – (0.24 + 0.31) (= 0.45) Or (0.24 + 0.31) × 180 (= 99)		4	M1	or for a correct equation for missing values eg $x + 0.24 + 2x + 0.31 = 1$ oe (can be implied by 2 probabilities that total 0.45 in table if not contradicted in working space)
	'0.45' ÷ 3 (= 0.15) Or '0.45' × 180 (= 81) Or 180 − 99 (= 81)			M1	(or 0.15 correctly placed in table as long as not contradicted)
	'0.15' × 180 Or '81' ÷ 3			M1	or for an answer of $\frac{27}{180}$
		27		A1	
					Total 4 marks

7 (a)	$2x > 4 - 7$ **or** $x + 3.5 > 2$			2	M1	For a correct first step allow $2x = 4 - 7$ or $x + 3.5 = 2$ or an answer of $x = -1.5$ or $x < -1.5$ or -1.5
			$x > -1.5$		A1	for $x > -1.5$ oe
(b)	$(x \pm 8)(x \pm 5)$	$\frac{-(-3) \pm \sqrt{(-3)^2 - 4 \times 1 \times (-40)}}{2 \times 1}$ **or** $\frac{3 \pm \sqrt{9 + 160}}{2}$			M1	**or** $(x + a)(x + b)$ where $ab = -40$ **or** $a + b = -3$ **OR** correct substitution into quadratic formula (condone one sign error in a, b or c and missing brackets) (if + rather than ± shown then award M1 only unless recovered with answers)
	$(x - 8)(x + 5)$	$\frac{3 \pm \sqrt{169}}{2}$ **or** $\frac{3 \pm 13}{2}$			M1	$\frac{3 \pm \sqrt{169}}{2}$ **or** $\frac{3 \pm 13}{2}$
			8, −5	3	A1	dep on at least M1 for correct values
						Total 5 marks

8 (a)	545 – 500 (= 45) **or** 592 – 545 (= 47)		4	M1	may be seen as part of a calculation	
	$\frac{45}{500}\times 100 (=9)$ **or** $\frac{47}{545}\times 100 (=8.6)$			M1	for one correct expression (allow 8 or 8.7 from a correct expression for 8.6 throughout)	
	$\frac{45}{500}\times 100 (=9)$ **and** $\frac{47}{545}\times 100 (=8.6)$			M1	for both correct expressions **or** having found "9%" finds 109% of 545: 1.09 × 545(=594.05) or 9% of 545 (49.05) or having found "8.6%" finds 108.6% of 500: 1.086 × 500(=543) or 8.6% of 500 (43)	
		No, 9(%) and 8.6(%)		A1	for no oe, 9% and 8.6% seen or no oe and 9% and 594.05 or 8.6% and 543 or No, 49.05 > 45 or No 594.05 > 592 oe	
Alternative mark scheme for 8(a)						
	$\frac{545}{500}\times 100 (=109)$ or $\frac{545}{500} (=1.09)$ **and** $\frac{592}{545}\times 100 (=108.6)$ or $\frac{592}{545} (=1.086)$		4	M3	for both correct expressions which should lead to 109 **or** 1.09 **and** 108.6 **or**1.086 (allow 108 or 108.7 from correct working for 108.6 or 1.08 or 1.087 from correct working for 1.086 throughout) (if not M3 then award M2 for one of these expressions)	
		No, 109(%) and 108.6(%)		A1	oe eg no and 1.09 and 1.086	
(b)	952 ÷ 85 × 100 oe (=1120)		3	M1	for a method to find price before discount	M2 for $\frac{952}{85}\times 15$
	0.15 × "1120" or "1120" – 952 oe			M1	for a correct method to find discount	
		168		A1		
						Total 7 marks

9	19.3 × 150		2	M1	for 19.3 × 150
		2895		A1	for 2895
					Total 2 marks

10	50 × 60 (= 3000) or 50 ÷ 1000 (= 0.05 or $\frac{1}{20}$) or 50 × 60 × 60 (= 180 000) or or $\frac{60\times60}{1000}(=3.6)$ or 1000 ÷ 60 ÷ 60 (= 0.27777…. or $\frac{5}{18}$)		3	M1	for 50 with at least one of ÷ 1000 or × 60 or $\frac{60\times60}{1000}(=3.6)$ or 1000 ÷ 60 ÷ 60
	$50\times\frac{60\times60}{1000}$ oe eg $50\div\frac{5}{18}$			M1	(dep) for a complete method
		180		A1	for 180 (SCB1 for both conversion factors correct but applying them wrongly eg $\frac{50\times1000}{60\times60}$)
					Total 3 marks

11	$(AC^2 =)\ 17^2 - 15^2$		5	M1
	$(AC =)\sqrt{17^2 - 15^2}\ (=\sqrt{64} = 8)$			M1
	$\frac{\pi \times '8'}{2} (= 4\pi = 12.566...)$			M1 dep on M2 for $\frac{\pi \times '8'}{2}$ oe or 4π 12.5663…
	'12.566…'+ 15 + 17			M1 for '12.566' + 15 + 17 and no additional values
		44.6		A1 for awrt 44.6
				Total 5 marks
Alternative mark scheme for 11				
	$\cos^{-1}\left(\frac{15}{17}\right) (= 28.0724)$ or $\sin^{-1}\left(\frac{15}{17}\right) (= 61.9275)$		5	M1 for a correct method to find one of the angles
	15 × tan ('28.0724')(= 8) or 15 ÷ tan ('61.9275')(= 8)			M1
	$\frac{\pi \times '8'}{2}$ (= 4π = 12.566…)			M1 dep on M2 for $\frac{\pi \times '8'}{2}$ or 12.5663… or 4π
	"12.566" + 15 + 17			M1 for "12.566" + 15 + 17 and no additional values
		44.6		A1 for awrt 44.6
				Total 5 marks

12	**Litres per amount of money and then conversion**			
	$\frac{8.6\times10^5}{770\,000}(=1.1168)$ *l*/$			M1 Number of litres per $ for D
	$\frac{4.2\times10^5}{2500\,000}(=0.168)$ *l*/k			M1 Number of litres per Krone for A
	A: *l*/$ to *l*/k '1.1168' ÷ 6.57 (= 0.1699..)or D: *l*/k to *l*/$ '0.168' × 6.57 (= 1.103..)			M1 *l*/$ to *l*/k for A or *l*/k to *l*/$ for D
		Arctic Oil and relevant figures		A1 for Arctic Oil with 1.1168… and 1.10376… **or** 0.168 and 0.1699..
	Conversion then litres per amount of money			
	$\frac{2\,500\,000}{6.57}(=380517.5..)$ or 770 000 × 6.57(= 505 8900)			M1 Changing Krone to $ or $ to Krone
	$\frac{4.2\times10^5}{2500\,000}(=0.168)$ or $\frac{4.2\times10^5}{'380517.5'}(=1.103..)$			M1 Litres per Krone or litres per $ for D
	$\frac{8.6\times10^5}{770\,000}(=1.1168)$ or $\frac{8.6\times10^5}{'5058\,900'}(=0.1699..)$			M1 Litres per Krone or litres per $ for A
		Arctic Oil and relevant figures		A1 for Arctic Oil with 1.1168… and 1.10376… **or** 0.168 and 0.1699..
	Cost per litre then conversion			
	$\frac{2\,500\,000}{4.2\times10^5}(=5.952..)$			M1 Price per litre in Krone for D
	$\frac{770\,000}{8.6\times10^5}(0.895..)$			M1 Price per litre in $ for A
	'5.952' ÷ 6.57(=0.9059..) or '0.895' × 6.57(= 5.882..)			M1 Conversion of Krone to $ or $ to Krone

			Arctic Oil and relevant figures		A1	For Arctic Oil with 5.952 and 5.882 **or** 0.895 and 0.9059
	Conversion then cost per litre					
	$\frac{2\,500\,000}{6.57}(=380517.5..)$ or 770 000 × 6.57(= 505 8900)				M1	Changing Krone to $ or $ to Krone
	$\frac{2500\,000}{4.2\times10^5}(=5.952)$ or $\frac{'380517.5..'}{4.2\times10^5}(=0.9059..)$				M1	Cost per litre in Krone or cost per litre in $ for D
	$\frac{770\,000}{8.6\times10^5}(=0.895)$ or $\frac{'5058900'}{8.6\times10^5}(=5.882..)$				M1	Cost per litre in $ or cost per litre in Krone for A
			Arctic Oil and relevant figures		A1	For Arctic Oil with 5.952 and 5.882 **or** 0.895 and 0.9059
	Comparing equal amounts					
	$\frac{8.6\times10^5}{4.2\times10^5}(=\frac{43}{21}=2.047..)$	$\frac{4.2\times10^5}{8.6\times10^5}(=\frac{21}{43}=0.488..)$			M1	Multiplier for same amount of D as A or same amount of A as D
	'2.047..'×2500 000 K (=5119047.619..)K	'0.488..' × 770 000 $ (=376046.511..)$			M1	Cost of equal amount of D as A or A as D
	'5119047.619'÷6.57 = 779154.88…$ or 770 000×6.57=5058900 K	'376046.511..'× 6.57 =2470625.58..K or 2500 000÷6.57 = 380517..$			M1	Converts so can compare costs – either K to $ or original A to K or $ to K or original D to $
			Arctic Oil and relevant figures		A1	Arctic Oil and 779154.. or with 2470625..(figures may be rounded) Or Arctic Oil with 5119047… and 5058900 or with 376046.. and 380517
Students may compare other equal amounts – please use the scheme that best fits their method and award marks appropriately.						
						Total 4 marks

13	Angle *CAD* = 28° or angle *ACB* = 32° or angle *ACD* = 90° or angle *ABD* = 90°		4	M1	
		30°		A1	For a correct answer of 30
	Angles in the **same segment** are equal, **angle** in a **semicircle** is 90° (or **angle** at centre is **double** angle at **circumference** oe) angles in a **triangle** add up to **180°**/**angles** in a **triangle** **isosceles** triangle **alternate** angles vertically **opposite angles (or vertically opposite)** **angles** at a **point** **opposite angles** in a **cyclic quad**rilateral angle between **tangent** and **radius (diameter)** **alternate segment** theorem **angles subtended** by the **same arc(**or **chord**) at the **circumference** (or **on the circle)**			B2	Dep on M1 for all correct reasons for their method used (if not B2 then award B1(dep on M1) for a correct circle theorem reason)
					Total 4 marks

14 (a)			2	B1	for $\frac{13}{20}$ and $\frac{7}{20}$ on the first branch (0.65 and 0.35)
		Correct probabilities on the tree diagram		B1	for $\frac{12}{19}, \frac{7}{19}, \frac{13}{19}$ and $\frac{6}{19}$ on the second branch (accept 2 dp or better 0.6315..., 0.3684..., 0.6842..., 0.3157...)
(b)	$\frac{7}{20} \times \frac{6}{19}$ oe only		2	M1	ft from (a) as long as probabilities less than 1
	$\frac{21}{190}$	$\frac{21}{190}$		A1	for $\frac{21}{190}$ oe or 0.11… (at least 2 dp)
					Total 4 marks

15		C, B, E	3	B3 (B2 (B1	for all 3 correct for 2 correct) for 1 correct)
					Total 3 marks

16	$y^2 = \dfrac{x+1}{x-4}$		4	M1	for squaring
	$y^2(x-4) = x+1$ or $y^2x - 4y^2 = x+1$			M1	for removing the fraction
	$y^2x - x = 4y^2 + 1$ or $-4y^2 - 1 = x - y^2x$ **or** $x(y^2 - 1) = 4y^2 + 1$ or $-4y^2 - 1 = x(1 - y^2)$			M1	for expanding the bracket **and** rearranging for x so that the terms in x are on one side of the correct equation
		$x = \dfrac{4y^2+1}{y^2-1}$		A1	for $x = \dfrac{4y^2+1}{y^2-1}$ or $x = \dfrac{-4y^2-1}{1-y^2}$ (need to see x = somewhere)
					Total 4 marks

17	e.g. $n^2 - (n-1)^2$ or $(n+1)^2 - n^2$		3	M1	for setting up a correct algebraic expression (any letter can be used)
	e.g. $n^2 - n^2 + 2n - 1$ or $n^2 + 2n + 1 - n^2$			M1	Correct expansion of brackets and correct signs or a correct result
		e.g. $2n - 1$ is always odd		A1	dep on M2 for eg $2n - 1$ or $2n + 1$ or $-(2n + 1)$ oe **and** a suitable conclusion SCB1 for eg $(2n)^2 - (2n-1)^2$ or $(2n+1)^2 - (2n)^2$ oe
					Total 3 marks

18 (a)	$(0.7 \times 10) + (3.4 \times 5) + (1 \times 9) + (2.5 \times 6) + (4.8 \times 15)$ $= 7 + 17 + 9 + 15 + 72 (= 120)$ no. of sml squares = $(10 \times 7) + (5 \times 34) + (9 \times 10) + (6 \times 25) + (15 \times 48)$ $= 70 + 170 + 90 + 150 + 720 (= 1200)$ **or** all correct values in bars oe not added		3	M1	for a correct method to work out the total area eg total frequency or number of small squares or other correct method (allow one error in method) [count use of 25 for 24 as one error] **or** all correct values in bars oe not added
	$(1 \times 7) + (2.5 \times 6) + (5 \times 4.8) = 7 + 15 + 24 (= 46)$ or no. of sml squares $(48 \times 5) + (6 \times 25) + (7 \times 10) = 240 + 150 + 70 (=460)$			M1	for a correct method to work out the area between 17 minutes and 35 minutes eg using frequency density or number of small squares oe
	$\frac{46}{120}$	$\frac{46}{120}$		A1	for $\frac{46}{120}$ oe (allow 2 dp or better 0.3833... or 38% or better)
(b)			2	M1	for $\frac{n}{15}$ where $n < 15$ or $\frac{q}{720}$ where $q < 720$ or $\frac{r}{72}$ where r < 72 or $\frac{9}{m}$ where $m > 9$ or $\frac{432}{p}$ where $p > 432$ $\frac{43.2}{t}$ where $t > 43.2$
		$\frac{9}{15}$		A1	$\frac{9}{15}$ oe
					Total 5 marks

19	(a)		$y = -4x + k$ (oe)	1	B1	for $y = -4x$ or $y = -4x + k$ where k is any numerical value $k \neq 7$ Could be written in another form e.g. $3y + 12x = 20$
	(b)	$m = \frac{-2-1}{2--3}$ *or* $m = \frac{1--2}{-3-2}$ or $-\frac{3}{5}$ or -0.6		4	M1	for using $m = \frac{y_2-y_1}{x_2-x_1}$
		$m_p = \frac{5}{3}$			M1ft	for using $m_1 \times m_2 = -1$
		$4 = \frac{5}{3}(-6) + c$ oe eg $4 = -10 + c$ ($c = 14$) $y - 4 = \frac{5}{3}(x--6)$			M1ft	dep on previous M1 for substituting $(-6, 4)$ into linear equation formula $4 = \frac{5}{3}x + c$ to find value of c or $y = \frac{5}{3}x + 14$ or $y = 1.66...x + 14$
			Eg $5x - 3y + 42 = 0$		A1	for correct simplified equation where all values are integers $10x - 6y + 84 = 0$ or $3y = 5x + 42$ oe
						Total 5 marks

20	$\frac{18}{\sqrt{7}+1}\times\frac{\sqrt{7}-1}{\sqrt{7}-1}$		3	M1	for $\frac{18}{\sqrt{7}+1}\times\frac{\sqrt{7}-1}{\sqrt{7}-1}$
	eg $\frac{18(\sqrt{7}-1)}{7-1}$			M1	Dep on M1 for a correct numerator **and** multiplying out the denominator to 7 – 1 or 6
	$3\sqrt{7}-3$	$3\sqrt{7}-3$		A1	Dep on M2 Allow $3\left(\sqrt{7}-1\right)$
					Total 3 marks

21	(a)(i)		(0, 6)	2	B1	
	(iii)		(2, 6)		B1	
	(b)	eg $(x-4)^2+3(x-4)+4$ oe or eg $(x+\frac{3}{2}-4)^2-\frac{9}{4}+4$ oe or eg $x^2+3x+10$ oe or eg $(x+\frac{3}{2})^2-\frac{9}{4}+4+6$ oe eg $y-6=x^2+3x+4$		2	M1	for applying one of the transformations to the equation
			$y=(x-4)^2+3(x-4)+10$ or $y=(x+\frac{3}{2}-4)^2-\frac{9}{4}+4+6$		A1	oe eg $y=(x-\frac{5}{2})^2+\frac{31}{4}$ or $y=x^2-5x+14$ oe
						Total 4 marks

22	$x^2+(x+2)^2-2(x+2)=24$		5	M1	for substituting linear equation into the quadratic equation
	$2x^2 + 2x - 24$ (=0) or $x^2 + x - 12$ (=0) or $2x^2 + 2x = 24$ or $x^2 + x = 12$			A1	for a correct equation in the form $ax^2 + bx + c = 0$ or $ax^2 + bx = -c$
	$(x + 4)(x - 3)$ (= 0) or $x=\frac{-1\pm\sqrt{1^2-(4\times1\times-12)}}{2\times1}$ or $\left(x-\frac{1}{2}\right)^2-\left(\frac{1}{2}\right)^2-12=0$			M1ft	dep on M1 for solving their quadratic equation using any correct method (allow one sign error and some simplification – allow as far as $\frac{-1\pm\sqrt{1+48}}{2}$) or if factorising, allow brackets which expanded give 2 out of 3 terms correct)
	$x = -4$ and $x = 3$			A1	for both x values dep on M1
	(−4, −2) and (3, 5)	(−4, −2) and (3, 5)		A1	for both solutions dep on M1
Alternative mark scheme for 22					
	$(y-2)^2+y^2-2y=24$		5	M1	for substituting linear equation into the quadratic equation
	$2y^2 - 6y - 20$ (=0) or $y^2 - 3y - 10$ (=0) $2y^2 - 6y = 20$ or $y^2 - 3y = 10$			A1	for a correct equation in the form $ay^2 + by + c = 0$ or $ay^2 + by = -c$
	$(y-5)(y+2)=0$ or $y=\frac{--3\pm\sqrt{(-3)^2-(4\times1\times-10)}}{2\times1}$ or $\left(y-\frac{3}{2}\right)^2-\left(\frac{3}{2}\right)^2-10=0$			M1ft	dep on M1 for solving their quadratic equation using any correct method (allow one sign error and some simplification – allow as far as $\frac{3\pm\sqrt{9+40}}{2}$) or if factorising, allow brackets which expanded give 2 out of 3 terms correct
	$y = 5$ and $y = -2$			A1	for both y values dep on M1
	(−4, −2) and (3, 5)	(−4, −2) and (3, 5)		A1	for both solutions dep on M1
					Total 5 marks

23	$\overrightarrow{PM} = -\frac{3}{2}\mathbf{a} - \frac{3}{4}\mathbf{b} + 4\mathbf{a} + \frac{1}{2}(2\mathbf{b} - 4\mathbf{a}) \left(= \frac{1}{2}\mathbf{a} + \frac{1}{4}\mathbf{b}\right)$ $\overrightarrow{AM} = 4\mathbf{a} + \frac{1}{2}(2\mathbf{b} - 4\mathbf{a}) (= 2\mathbf{a} + \mathbf{b})$ $\overrightarrow{AM} = 2\mathbf{b} + \frac{1}{2}(4\mathbf{a} - 2\mathbf{b}) (= 2\mathbf{a} + \mathbf{b})$ $\overrightarrow{MA} = \frac{1}{2}(2\mathbf{b} - 4\mathbf{a}) - 2\mathbf{b} (= -2\mathbf{a} - \mathbf{b})$ $\overrightarrow{MA} = \frac{1}{2}(4\mathbf{a} - 2\mathbf{b}) - 4\mathbf{a} (= -2\mathbf{a} - \mathbf{b})$		3	M1 for finding $\overrightarrow{PM}$ or $\overrightarrow{AM}$ or $\overrightarrow{MA}$
	$(AP : PM =) \left\lvert\frac{3}{2}\mathbf{a} + \frac{3}{4}\mathbf{b}\right\rvert : \left\lvert\frac{1}{2}\mathbf{a} + \frac{1}{4}\mathbf{b}\right\rvert$ oe $(AP : AM =) \left\lvert\frac{3}{2}\mathbf{a} + \frac{3}{4}\mathbf{b}\right\rvert : \lvert 2\mathbf{a} + \mathbf{b}\rvert (= 3 : 4)$ oe $(AM : PM =) \lvert 2\mathbf{a} + \mathbf{b}\rvert : \left\lvert\frac{1}{2}\mathbf{a} + \frac{1}{4}\mathbf{b}\right\rvert (= 4 : 1)$ oe $AP = 3PM$ oe eg $\frac{3}{2}\mathbf{a} + \frac{3}{4}\mathbf{b} = 3(\frac{1}{2}\mathbf{a} + \frac{1}{4}\mathbf{b})$ oe $AM = \frac{4}{3}AP$ oe $AM = 4PM$ oe			M1 For use of a correct ratio or fraction linking *AP* and *PM* **or** *AP* and *AM* **or** *AM* and *PM* (in either order) vectors must be in form $p\mathbf{a} + q\mathbf{b}$
		3 : 1		A1
				Total 3 marks

24	$\frac{4(2x-3)-3(2x-5)}{(2x-5)(2x-3)}$ or $\frac{8x-12-6x+15}{(2x-5)(2x-3)}$ oe		4	M1	Writing 1st fraction as a fraction over a common denominator (can be 2 separate fractions)
	$x(3-2x)(3+2x)$ or $(3x-1)(2x-5)$			M1	Complete factorisation of numerator or denominator of 2nd fraction
	$\frac{2x+3}{(2x-5)(2x-3)} \times \frac{(3x-1)(2x-5)}{x(3-2x)(3+2x)}$			M1	may be partially simplified
		$\frac{3x-1}{x(2x-3)(3-2x)}$		A1	e.g. $\frac{3x-1}{x(2x-3)(3-2x)}$ or $\frac{1-3x}{x(2x-3)^2}$ or $\frac{3x-1}{x(12x-9-4x^2)}$ or $\frac{3x-1}{(12x^2-9x-4x^3)}$ oe isw for incorrect denominator expansion
					Total 4 marks

25	$n = 50$		3	B1
	$33125 = \frac{50}{2}\left[2\times 50 + (50-1)\times k\right]$ oe $33125 = 25\left[100 + 49k\right]$ oe $1325 = 100 + 49k$ oe $1225 = 49k$ oe			M1 For correct equation, using formula with $a = 50$ and $n = 50$ substituted (for this mark, allow $n = 49$) (k may be written as d)
		25		A1
				Total 3 marks

26	$1600 = \frac{1}{3} \times \pi \times r^2 \times 25$ oe		6	M1	for substituting into volume formula for cone correctly and equating to 1600
	eg $r = \sqrt{\frac{1600}{\frac{1}{3} \pi \times 25}}$ or $r = \sqrt{\frac{192}{\pi}} (= \sqrt{61.1(154..)} = 7.8176...)$			M1	dep for correct rearrangement of volume formula for r
	$l = \sqrt{"7.817..."^2 + 25^2} (= \sqrt{686.1154...} = 26.193...)$			M1	Dep on M2 correct method to find slant height of cone (radius of sector)
	$2 \times \pi \times$ "7.817…" (= 49.1196…) **or** $\pi \times "7.817..." \times "26.193..." (= 643.315...)$			M1	for using $C = 2\pi r$ oe using figures from correct method **or** for using $A = \pi rl$ using figures from correct method
	$"49.1196..." = 2 \times \pi \times "26.193..." \times \frac{x}{360}$ **or** $"643.315..." = \pi \times "26.193..."^2 \times \frac{x}{360}$			M1	for using arc length = $2\pi r \times \frac{x}{360}$ **or** for using area of sector = $\pi r^2 \times \frac{x}{360}$
		107°		A1	for 107° - 108°
					Total 6 marks

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