



Mark Scheme (Results)

January 2022

Pearson Edexcel International GCSE
Mathematics A (4MA1)
Paper 1H

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January 2022

Publications Code 4MA1_1H_2201_MS

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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
 - eoo – 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 18, 19, 22 and 24, 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) | | a^{11} | 1 | B1 | |
| (b) | | w^{12} | 1 | B1 | |
| (c) | | $64x^{10}y^6$ | 2 | B2 | if not B2 then award B1 for 2 correct parts as part of a product eg $kx^{10}y^6$ where $k \neq 64$ or $64x^k y^6$ where $k \neq 10$ or $64x^{10} y^k$ where $k \neq 6$ |
| (d) | $c + 8v = t^3$ | | 2 | M1 | |
| | | $t = \sqrt[3]{c+8v}$ | | A1 | oe |
| | | | | | SCB1 for an answer of $t = \frac{c+8v}{3}$ oe |
| | | | | Total 6 marks | |
| 2 | | | | | |
| | $196 \div (9 - 5) (= 49)$ oe | | 3 | M1 | |
| | $3 \times "49"$ | | | M1 | |
| | | 147 | | A1 | SCB1 for an answer from 34.5 – 34.6 or an answer of 42 |
| | | | | Total 3 marks | |

| | | | | |
|----------|--|------|---|---|
| 3 | eg $\sin 65 = \frac{AB}{8.4}$ or $\frac{AB}{\sin 65} = \frac{8.4}{\sin 90}$ | | 3 | M1 for setting up a trig equation in AB |
| | eg ($AB =$) $8.4 \sin 65$ or ($AB =$) $\frac{8.4 \sin 65}{\sin 90}$ | | | M1 for a complete method |
| | | 7.61 | | A1 accept 7.61 – 7.613 |
| | | | | Total 3 marks |

| | | | | |
|----------|--|----|---|--|
| 4 | eg $\frac{2}{5} \times 150 (= 60)$ or eg $0.32 \times 150 (= 48)$ | | 5 | M1 for finding the number of small mugs or number of medium mugs |
| | eg $150 - "60" - "48" (= 42)$ | | | M1 for finding the number of large mugs |
| | eg $"60" \times 8.50 + "48" \times 11.20 + "42" \times 14.20 (= 1644)$ or $510 + 537.6 + 596.4 (= 1644)$ | | | M1 for working out the income, Profit = 504 implies M3 |
| | eg $\frac{"1644" - 1140}{1140} \times 100$ or $\frac{"1644" - 1140}{1140} \times 100$ | | | M1 (indep) for a complete method to find the percentage profit for their total income (must be greater than 1140) |
| | | 44 | | An answer of 144 implies M4 |
| | | | | A1 44 or better (44.2105...) |
| | | | | Total 5 marks |

| | | | | | |
|----------|-----|------------------------|---|-----|---|
| 5 | (a) | (5), 8, 8, 20, x, (24) | 3 | B3 | for (5), 8, 8, 20, x, (24) where $x = 21$ or 22 or 23 |
| | | | | (B2 | for (5), 8, 8, 20, x, (24) where x is blank or any value other than 21, 22 or 23) |
| | | | | (B1 | for a list with a median of 14 or a mode of 8 or the 3 rd and 4 th cards having a sum of 28 (ignoring other cards)) |
| | | | | M1 | |
| (b) | | | 3 | M1 | |
| | | | | M1 | |
| | | | | A1 | |
| | | | | | Total 6 marks |

33

| | | | | | |
|----------------------|--------|---|------------------|---|--|
| 6 | (a) | $5x \leq 2 + 7$ or $5x \leq 9$ or $\frac{5x-7}{5} \leq \frac{2}{5}$ oe | | 2 | M1 allow any sign instead of \leq or for an answer of 1.8 oe or x and 1.8 oe with the incorrect sign A1 oe |
| | | | $x \leq 1.8$ | | |
| | (b)(i) | $(y \pm 7)(y \pm 5)$ | | 2 | M1 for $(y \pm 7)(y \pm 5)$ or $(y + a)(y + b)$ where $ab = -35$ or $a + b = -2$ |
| | | | $(y - 7)(y + 5)$ | | A1 isw if student goes on to solve the equation in this part |
| | (ii) | | 7, -5 | 1 | B1ft answer must fit from their $(y + a)(y + b)$ in (b)(i). Award B0 for 7, -5 if no marks scored in (i) |
| Total 5 marks | | | | | |

| | | | | | |
|----------------------|--|--|--|---|--|
| 7 | | | | 3 | B3 all 4 parts of diagram correct (B2 for 2 or 3 parts correct) (B1 for 1 part correct) |
| | | | | | SCB1 if no marks scored, award B1 if 4,6 in the section $A \cap B'$ and 9, 11, 12, 13 in the section $A' \cap B$ |
| Total 3 marks | | | | | |

| | | | |
|----------|--|---|--------------------------------|
| 8 | $12.6 \times 10^{(-24+145)}$ or 12.6×10^{121} or 1.26×10^9 | 2 | M1 |
| | 1.26×10^{122} | | A1 allow 1.3×10^{122} |
| | | | Total 2 marks |

| | | | | |
|----------|--|---|----------------------|---|
| 9 | $17.5^2 - 14^2 (= 110.25)$ | 4 | M1 | or for use of cosine rule to find one of the angles eg $28^2 = 17.5^2 + 17.5^2 - 2 \times 17.5 \times 17.5 \times \cos A$ or eg $\cos B = \frac{14}{17.5}$ |
| | $\sqrt{17.5^2 - 14^2} (= 10.5)$ | | M1 | or for rearranging the cosine rule to eg $\cos A = \frac{2 \times 17.5 \times 17.5}{17.5^2 + 17.5^2 - 28^2}$ ($A = 106.26\dots$) or eg $B = \cos^{-1}\left(\frac{14}{17.5}\right)$ ($= 36.86\dots$) |
| | $0.5 \times 28 \times "10.5" \text{ oe}$ | | M1 | or for $0.5 \times 17.5 \times 17.5 \times \sin 106.26\dots \text{ oe}$ eg $0.5 \times 17.5 \times 28 \times \sin 36.86\dots$ |
| | | | | [clear use of Heron's formula: M1 for $S = 0.5(17.5 + 17.5 + 28)(=31.5)$ M2 for $\sqrt{31.5(31.5-17.5-17.5)^2(31.5-28)}$ oe] |
| | 147 | | A1 | accept awrt 147 |
| | | | Total 4 marks | |

| | | | | | |
|-----------|-----|--------------------|--------------------|---|--|
| 10 | (a) | eg $2y = -7x(+10)$ | | 2 | M1 for $2y = -7x(+10)$ or an answer of $-3.5x$ oe or an answer of 3.5 oe |
| | (b) | | -3.5 $(0, 5)$ | 1 | A1 oe B1 cao |
| | | | | | Total 3 marks |

| | | | | | |
|-----------|--|---|--|---|--|
| 11 | | eg $200\,000 \times 0.018 (= 3600)$ or $200\,000 \times 1.018 (= 203\,600)$ | | 3 | M1 for method to find 1.8% or 101.8% of 200 000 |
| | | eg $\sqrt{209\,754 \div "203\,600"} (= 1.015000\dots)$ | | | M1 for a complete method to find the multiplier for the compound interest for 2 nd and 3 rd year A1 or better eg 1.500045971... |
| | | | | | Total 3 marks |

| | | | | | | |
|-----------|-----|--|-----------------------|---|----------------------|---|
| 12 | (a) | | | 1 | B1 | |
| | (b) | | 7, 33, 57, 71, 78, 80 | 2 | B2 | Fully correct cf graph – points at ends of intervals and joined with curve or line segments. If not B2 then B1 (ft from a table with only one arithmetic error) for 5 or 6 of their points at ends of intervals and joined with curve or line segments OR for 5 or 6 points plotted correct at ends of intervals not joined OR for 5 or 6 points from table plotted consistently within each interval (not at upper ends of intervals) at their correct heights and joined with smooth curve or line segments. |
| (c) | | | | 1 | B1ft | any value in range or ft their cf curve |
| (d) | | | 21 – 24 | 2 | M1ft | eg reading of 72 – 74 or 6 – 8 could be seen as the numerator of a fraction ft their cf graph |
| | | | $\frac{8}{80}$ | | A1ft | oe, ft their cf graph fractional answers must have an integer numerator and denominator |
| | | | | | Total 6 marks | |

| | | | | |
|--------|---|-----------------------|---|---|
| 13 (a) | $5x(x+2) = 5x^2 + 10x$ or $(x+2)(3x-4) = 3x^2 - 4x + 6x - 8 (= 3x^2 + 2x - 8)$ or $5x(3x-4) = 15x^2 - 20x$ | | 3 | M1 for a correct intention to multiply all 3 factors by starting to multiply 2 factors only, allow one error |
| | eg $[(5x^2 + 10x)(3x - 4) =] 15x^3 - 20x^2 + 30x^2 - 40x$ or $[5x(3x^2 + 2x - 8) =] 15x^3 + 10x^2 - 40x$ or $[(x+2)(15x^2 - 20x) =] 15x^3 - 20x^2 + 30x^2 - 40x$ | | | M1 (dep)ft for expanding by the third factor, allow one error (some may do the expansion in one stage and will get to $15x^3 - 20x^2 + 30x^2 - 40x$ without firstly expanding two factors, allow two errors) |
| | | $15x^3 + 10x^2 - 40x$ | | A1 isw correct factorisation eg $5(3x^3 + 2x^2 - 8x)$ do not isw incorrect factorisation eg $15x^3 + 10x^2 - 40x = 3x^3 + 2x^2 - 8x$ |

| | | | | |
|-----|--|-----------------------|-------------------------|---|
| (b) | $\left(\frac{2w^2}{y^5}\right)^{-3} \text{ or } \left(\frac{y^{20}}{16w^8}\right)^{\frac{3}{4}} \text{ or } \left(\frac{4096w^{24}}{y^{60}}\right)^{-\frac{1}{4}}$ $\left(\frac{8w^6}{y^{15}}\right)^{-1} \text{ or } \frac{2^{-3}w^{-6}}{y^{-15}} \text{ or } \frac{w^{-6}}{y^{-15}} \text{ or } \left(\frac{y^5}{2w^2}\right)^3 \text{ or } \left(\frac{y^{60}}{4096w^{24}}\right)^{\frac{1}{4}}$ $0.125y^{15} \quad 0.125w^{-6} \quad 0.125$ $\text{or } \frac{y^{15}}{w^6} \text{ or } \frac{y^{-15}}{y^{-15}} \text{ or } \frac{y^{-15}w^6}{y^{-15}w^6} \text{ oe}$ | | 3 | <p>M1 for one of fourth rooting or reciprocating or cubing</p> <p>M1 for two of fourth rooting or reciprocating or cubing</p> |
| | | $\frac{y^{15}}{8w^6}$ | A1 allow | $\frac{y^{15}}{8w^6} \text{ or } \frac{y^{15}w^{-6}}{8} \text{ or } 0.125y \quad w^{-6}$ $\text{or } \frac{1}{8} y \quad w^{-6} \text{ or } \frac{1}{8y^{-15}} \text{ or } \frac{1}{8y^{-15}w^6}$ |
| | ALTERNATIVE | | | |
| | | | 3 | M2 for 2 correct terms |
| | | | (M1 for 1 correct term) | |
| | | $\frac{y^{15}}{8w^6}$ | A1 allow | $\frac{y^{15}}{8w^6} \text{ or } \frac{y^{15}w^{-6}}{8} \text{ or } 0.125y \quad w^{-6}$ $\text{or } \frac{1}{8} y \quad w^{-6} \text{ or } \frac{1}{8y^{-15}} \text{ or } \frac{1}{8y^{-15}w^6}$ |
| | | | Total 6 marks | |

| | | | | |
|--------|------------------------------------|--|---|--|
| 14 (a) | | $\frac{5}{12}, \frac{8}{15}, \frac{7}{15}, \frac{8}{15}, \frac{7}{15}$ | 2 | <p>B2 for all correct probabilities</p> <p>(B1 for $\frac{5}{12}, \frac{8}{15}, \frac{7}{15}, \frac{8}{15}, \frac{7}{15}$)</p> <p>oe eg for $\frac{5}{12}$ accept 0.41(666...) or 0.42, for $\frac{8}{15}$ accept 0.53(333...) or 0.53, for $\frac{7}{15}$ accept 0.46(666...) or 0.47</p> |
| (b) | $\frac{7}{12} \times \frac{8}{15}$ | | 2 | M1 ft their tree diagram |
| | $\frac{14}{45}$ | $\frac{14}{45}$ | | A1 oe eg $\frac{56}{180}$ or 0.31(111...) or 31(.111...)% |
| | | | | Total 4 marks |

| | | | | |
|-----------|---|-----|----------------------|-------------------------------------|
| 15 | $\text{eg } 40 = \frac{k}{1.5^2} \text{ or } k = 90 \text{ or } \frac{C^2}{1.5^2} = \frac{40}{1000} (= 0.04)$ $\text{or } (C^2 =) 1.5^2 \times \frac{40}{1000} (= 0.09) \text{ or } \frac{1.5^2}{C^2} = \frac{1000}{40} (= 25)$ $\text{or } (C^2 =) 1.5^2 \div \frac{1000}{40} (= 0.09)$ $\text{eg } (C =) \sqrt{\frac{90}{1000}} \text{ oe or } (C =) \sqrt{1.5^2 \times "0.04"}$ $\text{or } (C =) \sqrt{1.5^2 \div "25"} \text{ or } (C =) \sqrt{"0.09"}$ | 3 | M1 | |
| | | | M1 | |
| | | 0.3 | A1 | oe, allow ± 0.3 oe or -0.3 oe |
| | | | Total 3 marks | |

| | | | | |
|-----------|---|------|----------------------|---|
| 16 | $\text{eg } \frac{55}{360} \times \pi \times d = 5 \text{ or } \frac{55}{360} \times \pi \times 2 \times r = 5 \text{ oe}$ $\text{OR } \frac{360}{55} \times 5 (= 32.7...) \text{ oe}$ $\text{eg } d = \frac{5 \times 360}{55\pi} (= 10.4...) \text{ or } r = \frac{5 \times 360}{55 \times 2 \times \pi} (= 5.2...)$ $\text{OR } d = \frac{32.7...}{\pi} (= 10.4...) \text{ or } r = \frac{32.7...}{2 \times \pi} (= 5.2...)$ $(\text{area} =) \text{eg } \pi \times \left(\frac{("10.4...")^2}{2} \right) \text{ or } \pi \times "5.2..."^2$ | 4 | M1 | for a correct equation for the diameter or radius OR for a method to find the circumference of the circle |
| | | | M1 | for a method to work out the diameter or radius |
| | | | M1 | |
| | | 85.2 | A1 | allow 84.9 – 85.4 |
| | | | Total 4 marks | |

| | | | | |
|-----------|---|-----|---|--|
| 17 | <p>eg $2^3 : 3^3$ or $8 : 27$ or $10^3 : 15^3$ oe or $\left(\frac{15}{10}\right)^3$</p> <p>or $1.5^3 (= 3.375)$ or $\left(\frac{3}{2}\right)^3 \left(\frac{27}{8}\right) = \frac{27}{8}$ or $\left(\frac{10}{15}\right)^3$</p> <p>or $\left(\frac{2}{3}\right)^3 \left(\frac{8}{27}\right)$</p> | | 4 | M1 for a correct ratio or scale factor for the volumes |
| | <p>eg $\frac{1197}{27-8}$ or $\frac{1197}{15^3-10^3}$</p> <p>or $\frac{19}{8} V^{-A} = 1197$ oe or $\frac{19}{8} V^{-A} = 1197$ oe</p> | | | M1 for a correct method to find the value of 1 share of volume or for setting up a correct equation using the scale factor for the volumes |
| | <p>eg $8 \times \frac{1197}{27-8}$ or $10^3 \times \frac{1197}{15^3-10^3}$ or $\frac{8}{19} \times 1197$ oe</p> | | | M1 complete correct method to find volume of vase A |
| | | 504 | | A1 |
| | | | | Total 4 marks |

| | | | | |
|-----------|------------------------------------|-----|---|---|
| 18 | 3.445, 3.455, 1.85, 1.95, 4.5, 5.5 | | 3 | B1 any one bound |
| | $(A =) 3.445 - \frac{1.95^2}{4.5}$ | | | M1 $A = LB_W - \frac{(UB_x)^2}{LB_y}$ where $3.445 \leq LB_W < 3.45$, $1.9 < UB_x \leq 1.95$, $4.5 \leq LB_y < 5$ |
| | | 2.6 | | A1 oe, (dep on M1), from correct figures (3.445, 1.95, 4.5) |
| | | | | Total 3 marks |

| | | | | | |
|----|--|---|--|---|---|
| 19 | $3x^2 + (2x-3)^2 - x(2x-3) = 5$ $5x^2 - 9x + 4(=0)$ oe or $5x^2 - 9x = -4$ | $3\left(\frac{y+3}{2}\right)^2 + y^2 - y\left(\frac{y+3}{2}\right) = 5$ $5y^2 + 12y + 7(=0)$ oe or $5y^2 + 12y = -7$ | | 5 | <p>M1 Correct substitution of x for y (or y for x)</p> |
| | $(5x-4)(x-1)(=0)$ or $(x =) \frac{9 \pm \sqrt{(-9)^2 - 4 \times 5 \times 4}}{2 \times 5}$ or $\left[\left(\frac{9}{10} \right)^2 - \left(\frac{9}{10} \right)^2 \right]$ $5 \left[\left(\frac{x-1}{10} \right) - \left(\frac{1}{10} \right) \right] + 4(=0)$ [leading to x values of 0.8 and 1] | $(5y+7)(y+1)(=0)$ or $(y =) \frac{-12 \pm \sqrt{12^2 - 4 \times 5 \times 7}}{2 \times 5}$ or $\left[\left(\frac{6}{5} \right)^2 - \left(\frac{6}{5} \right)^2 \right]$ $5 \left[\left(\frac{y+1}{5} \right) - \left(\frac{1}{5} \right) \right] + 7(=0)$ [leading to y values of -1.4 and -1] | | | <p>M1 for a correct equation in the form $ax^2 + bx + c (=0)$ oe or $ax^2 + bx = -c$</p> |
| | $(y =) 2 \times "0.8" - 3$ and $2 \times "1" - 3$ | $(y =) \frac{"-1.4"+3}{2}$ and $\frac{"-1"+3}{2}$ | $x = 0.8$ & $y = -1.4$ / $x = 1$ & $y = -1$ | | <p>M1ft dep on M1 for solving their 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 and some simplification – allow as far as $\frac{9 \pm \sqrt{81-80}}{10}$ oe or $\frac{-12 \pm \sqrt{144-140}}{10}$ oe $\left(\frac{9}{10} \right)^2 - \frac{1}{10}$ or $\left(\frac{6}{5} \right)^2 - \frac{1}{5}$ or $5 \left(\frac{x-\frac{1}{10}}{10} \right) - \frac{1}{20}$ oe or $5 \left(\frac{y+\frac{1}{5}}{5} \right) - \frac{1}{5}$ oe M1 dep on previous M1</p> |
| | | | | | <p>A1 oe, for both solutions dep on M2</p> |
| | | | | | <p>Total 5 marks</p> |

| | | | | | |
|-----------|-----|------------------------|-------------------|---|--|
| 20 | (a) | $7 - 3(x^2 - 4x)$ | | 3 | M1 or for one of a , b or c correct |
| | | $7 - 3[(x - 2)^2 - 4]$ | | | M1 or for two of a , b or c correct |
| | | | $19 - 3(x - 2)^2$ | | A1 |
| | (b) | | (2, 19) | 1 | B1 ft their expression |
| | | | | | Total 4 marks |

| | | | | |
|----|--|------------------------------------|---|--|
| 21 | <p>eg $(AM =) \sqrt{x^2 + (4x)^2} (= \sqrt{17x^2} = x\sqrt{17})$ oe</p> <p>or $(AM =) \sqrt{(0.5x)^2 + (2x)^2} = \left(\sqrt{\frac{17}{4}x^2} = x\sqrt{\frac{17}{4}} \right)$ oe</p> <p>or $(AM =) \sqrt{20^2 + 5^2} (= \sqrt{425} = 5\sqrt{17})$ oe</p> | | 5 | M1 for a correct method to find AM as a numerical value or in algebraic form, must have brackets or recover |
| | <p>Height of triangle eg $\sqrt{(2x)^2 - x^2} (= \sqrt{3x^2} = x\sqrt{3})$ oe</p> <p>or $\sqrt{x^2 - (0.5x)^2} = \left(\sqrt{\frac{3}{4}x^2} = x\sqrt{\frac{3}{4}} \right)$ oe</p> <p>or $\sqrt{10^2 - 5^2} (= \sqrt{75} = 5\sqrt{3})$ oe</p> | | | M1 for a correct method to find height of equilateral triangle HJK as a numerical value or in algebraic form |
| | <p>eg $\tan MAJ = \frac{\sqrt{3}+2}{\sqrt{17}}$ or $\tan MAJ = \frac{\frac{\sqrt{3}}{2}+1}{\frac{\sqrt{17}}{2}}$ or $\tan MAJ = \frac{5\sqrt{3}+10}{5\sqrt{17}}$</p> | | | M1 for correct values for the correct angle (no algebra) or for $\tan MAJ$ is given numerically in the range 0.9 – 0.91 |
| | <p>eg $\frac{(\sqrt{3}+2)}{\sqrt{17}} \times \frac{\sqrt{17}}{\sqrt{17}} = \frac{\sqrt{51}+2\sqrt{17}}{17}$</p> | | | M1 |
| | | $\frac{\sqrt{68} + \sqrt{51}}{17}$ | | A1 $\frac{\sqrt{51} + \sqrt{68}}{17}$ or $\frac{\sqrt{51} + \sqrt{68}}{17}$ |
| | | | | Total 5 marks |

| | | | | |
|----|--|---------------------------------------|---|--|
| 22 | <p>eg $\overrightarrow{ON} = 8\mathbf{a} + \frac{1}{2}(6\mathbf{b} - 8\mathbf{a})(= 3\mathbf{b} + 4\mathbf{a})$ or $\overrightarrow{ON} = 6\mathbf{b} + \frac{1}{2}(-6\mathbf{b} + 8\mathbf{a})(= 3\mathbf{b} + 4\mathbf{a})$ or $\overrightarrow{NO} = \frac{1}{2}(8\mathbf{a} - 6\mathbf{b}) - 8\mathbf{a}(= -4\mathbf{a} - 3\mathbf{b})$ or $\overrightarrow{NO} = -6\mathbf{b} + \frac{1}{2}(6\mathbf{b} - 8\mathbf{a})(= -3\mathbf{b} - 4\mathbf{a})$ or $\overrightarrow{AM} = -8\mathbf{a} + \frac{1}{3}(6\mathbf{b})(= 2\mathbf{b} - 8\mathbf{a})$ or $\overrightarrow{AM} = -8\mathbf{a} + 6\mathbf{b} - \frac{2}{3}(6\mathbf{b})(= 2\mathbf{b} - 8\mathbf{a})$ or $\overrightarrow{MA} = 8\mathbf{a} - \frac{1}{3}(6\mathbf{b})(= 8\mathbf{a} - 2\mathbf{b})$ or $\overrightarrow{MA} = \frac{4}{3}(6\mathbf{b}) + 8\mathbf{a} - 6\mathbf{b}(= 8\mathbf{a} - 2\mathbf{b})$</p> | | 5 | M1 a correct expression for \overrightarrow{ON} or \overrightarrow{NO} or \overrightarrow{AM} or \overrightarrow{MA} |
| | <p>$\overrightarrow{OP} = \mu(3\mathbf{b} + 4\mathbf{a})$ and one of eg $\overrightarrow{OP} = 8\mathbf{a} + x(2\mathbf{b} - 8\mathbf{a}) (= (8 - 8x)\mathbf{a} + 2x\mathbf{b})$ or $\overrightarrow{OP} = 2\mathbf{b} + y(8\mathbf{a} - 2\mathbf{b})(= (2 - 2y)\mathbf{b} + 8y\mathbf{a})$</p> | | | M2 oe (M1 for one correct expression for \overrightarrow{OP}) (where μ, x, y are scalars) |
| | <p>eg $\frac{4}{3} = \frac{8y}{2-2y}$ or $\frac{4}{3} = \frac{8-8x}{3}$ or $3\mu = 2x$ and $4\mu = 8 - 8x$ or $3\mu = 2 - 2y$ and $4\mu = 8y$</p> | | | M1 A correct expression to find the position of P along ON or two correct simultaneous equations coming from the expressions for \overrightarrow{OP} |
| | | $2\mathbf{a} + \frac{3}{2}\mathbf{b}$ | | A1 dep on M3, oe eg $2\mathbf{a} + 1.5\mathbf{b}$ |
| | | | | Total 5 marks |

| | | | | |
|----|------|---------|---|----------------------|
| 23 | (i) | (-4, 7) | 1 | B1 |
| | (ii) | (5, 10) | 1 | B1 |
| | | | | Total 2 marks |

| | | | | |
|-----------|--|----|---|--|
| 24 | eg $-6 = 8a + 4b - 24 + 6$ or $8a + 4b = 12$ oe | | 6 | M1 for substituting $x = 2$ and $y = -6$ into the equation for C |
| | $\left(\frac{dy}{dx}\right) = 3ax^2 + 2bx - 12$ oe | | | M1 at least 2 terms correct |
| | eg $16 = 12a + 4b - 12$ or $12a + 4b = 28$ oe | | | M1ft (dep on previous M1) follow through their $\frac{dy}{dx}$ |
| | $a = 4$ and $b = -5$ | | | M1 for $a = 4$ and $b = -5$ |
| | eg $4^3 + (-5)^3 = 12 \times 3 + 6$ | | | M1ft correctly substituting their a , their b and $x = 3$ into the equation for C |
| | | 33 | | A1 (dep on M3) allow (3, 33) |
| | | | | Total 6 marks |

