
AS

Mathematics

MPC1 – Pure Core 1

Mark scheme

6360
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Version: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Key to mark scheme abbreviations

| | |
|--------------|--|
| M | mark is for method |
| m or dM | mark is dependent on one or more M marks and is for method |
| A | mark is dependent on M or m marks and is for accuracy |
| B | mark is independent of M or m marks and is for method and accuracy |
| E | mark is for explanation |
| √ or ft or F | follow through from previous incorrect result |
| CAO | correct answer only |
| CSO | correct solution only |
| AWFW | anything which falls within |
| AWRT | anything which rounds to |
| ACF | any correct form |
| AG | answer given |
| SC | special case |
| OE | or equivalent |
| A2,1 | 2 or 1 (or 0) accuracy marks |
| -x EE | deduct x marks for each error |
| NMS | no method shown |
| PI | possibly implied |
| SCA | substantially correct approach |
| c | candidate |
| sf | significant figure(s) |
| dp | decimal place(s) |

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Otherwise we require evidence of a correct method for any marks to be awarded.

| Q1 | Solution | Mark | Total | Comment |
|--------------|---|---|----------|--|
| (a) | $y = \pm \frac{5}{3}x + \dots$ $m = -\frac{5}{3}$ | M1 A1 | 2 | $y = -\frac{5}{3}x - 1$ for guidance must see $m = \dots$ or statement such as “ AB has gradient $-\frac{5}{3}$ so line parallel to AB also has gradient $-\frac{5}{3}$.” |
| (b) | $5x + 3y + 3 = 0$ & $3x - 2y + 17 = 0$ } eg $10x + 6 + 9x + 51 = 0$ } $x = -3$ or $x = -\frac{57}{19}$ } or $y = 4$ or $y = \frac{76}{19}$ } {both $x = -3$ and $y = 4$ } or $(-3, 4)$ | M1 A1 A1 | 3 | correct equations used and correct elimination of x or y eg $19x + 57 = 0$ or $19y - 76 = 0$ etc either x or y correct in any equivalent form both coordinates written as integers |
| (c) | $5(2k + 3) + 3(4 - 3k) + 3 = 0$ } $10k + 15 + 12 - 9k + 3 = 0$ } $k = -30$ | M1 A1 | 2 | correct substitution into correct equation & correct expansion of brackets |
| Total | | | 7 | |
| (a) | Do not penalise incorrect rearrangement if $m = -\frac{5}{3}$ is stated. Example $y = -\frac{5}{3}x - 3$ so $m = -\frac{5}{3}$ scores M1 A1 NMS $m = -\frac{5}{3}$ earns 2 marks. NMS $-\frac{5}{3}$ earns M1 A0 . NMS ($m =$) $\frac{5}{3}$ earns M1 A0 . NMS Award M1 A0 only for “ $m = -\frac{5}{3}x$ ”. | | | |
| (b) | $5\left(\frac{2y}{3} - \frac{17}{3}\right) + 3y + 3 = 0$ earns M1 , however $5\left(\frac{2y}{3} + \frac{17}{3}\right) + 3y + 3 = 0$, for example, scores M0 . Other examples scoring M1 are $3x - 2\left(-\frac{5}{3}x - 1\right) + 17 = 0$; $-\frac{5}{3}x - 1 = \frac{3}{2}x + \frac{17}{2}$ Accept any correct equivalent fraction for first A1 but must have both $x = -3$ and $y = 4$ for final A1 . NMS $(-3, 4)$ scores 3 marks | | | |

| Q2 | Solution | Mark | Total | Comment |
|--|--|--|----------|---|
| (a) | 45 | B1 | 1 | |
| (b) | $\frac{**+\sqrt{5}}{7+3\sqrt{5}} \times \frac{7-3\sqrt{5}}{7-3\sqrt{5}}$ <p>(Numerator =) $315+7\sqrt{5}-135\sqrt{5}-15$</p> <p>(Denominator = $49+21\sqrt{5}-21\sqrt{5}-45$) = 4</p> $\text{Value} = \frac{300-128\sqrt{5}}{4}$ $= 75-32\sqrt{5}$ | <p>M1</p> <p>A1</p> <p>B1</p> <p>A1cso</p> | <p>4</p> | <p>at least this far</p> <p>must be seen as denominator</p> |
| Total | | | 5 | |
| <p>NO MISREADS ALLOWED IN THIS QUESTION</p> <p>(b) Condone multiplication by $7-3\sqrt{5}$ instead of $\times \frac{7-3\sqrt{5}}{7-3\sqrt{5}}$ for M1 only if subsequent working shows multiplication by both numerator and denominator – otherwise M0</p> <p>For first A1 45×7, 45×3 and 3×5 must be evaluated correctly</p> <p>An error in the denominator such as $49+7\sqrt{5}-7\sqrt{5}-45=4$ should be given B0 and it would then automatically lose the final A1cso</p> <p>May use alternative conjugate $\times \frac{3\sqrt{5}-7}{3\sqrt{5}-7}$ M1; numerator = $-315-7\sqrt{5}+135\sqrt{5}+15$ A1 etc</p> | | | | |

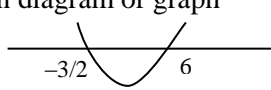
| Q3 | Solution | Mark | Total | Comment |
|--|--|---|----------|---|
| (a)(i) | $\left(x - \frac{7}{2}\right)^2 \dots$ | M1 | 2 | $(x - 3.5)^2 \dots$ OE |
| | $\left(x - \frac{7}{2}\right)^2 - \frac{41}{4}$ | A1 | | $(x - 3.5)^2 - 10.25$ |
| | (ii) (Minimum value =) -10.25 OE | B1F | 1 | must FT their q |
| | (b) Translation | E1 | 3 | or translate(d) (by/through) (and no other transformation given) |
| $\begin{bmatrix} 0.5 \\ * \end{bmatrix}$ | M1 | | | |
| $\begin{bmatrix} 0.5 \\ 10.25 \end{bmatrix}$ | A1 | must express as vector to earn A1 mark | | |
| Total | | | 6 | |
| (a)(i) | If M1 is not earned, award SC1 for $\left(x - \frac{7}{2}\right) - \frac{41}{4}$ | | | |
| (ii) | Do NOT accept any pair of values. Example (3.5, -10.25) scores B0 since this is hedging bets Condone $y = \text{"their"} q$ for B1 but $x = \text{"their"} q$ scores B0 | | | |
| (b) | Do NOT accept “shift”, “move”, “slide”, “transformation”, “trans” etc for E1 Accept “0.5 in x -direction”, “ $\frac{1}{2}$ to the right”, “(0.5,*)” for M1 only | | | |

| Q4 | Solution | Mark | Total | Comment |
|--------------|--|--------------------|-----------|---|
| (a)(i) | $\begin{aligned} p(-3) &= (-3)^3 - 5(-3)^2 - 8(-3) + 48 \\ &= -27 - 45 + 24 + 48 \\ &= 0 \end{aligned}$ therefore $x + 3$ is a factor | M1 A1 | 2 | clear attempt at $p(-3)$ NOT long division must see powers of -3 simplified correctly working showing that $p(-3)=0$ and correct statement |
| (ii) | $x^2 + bx + c$ with $b = -8$ or $c = 16$ $x^2 - 8x + 16$ $(p(x) =) (x+3)(x-4)(x-4)$ | M1 A1 A1 | 3 | by inspection may see as quotient in long division must see product |
| (b)(i) | $\begin{aligned} p(2) &= 2^3 - 5 \times 2^2 - 8 \times 2 + 48 \\ &= 8 - 20 - 16 + 48 \end{aligned}$ (Remainder =) 20 | M1 A1 | 2 | clear attempt at $p(2)$ NOT long division |
| (ii) | Quadratic factor $x^2 + bx + c$ $b = -3$ or $c = -14$ $x^2 - 3x - 14$ $(p(x) =) (x-2)(x^2 - 3x - 14) + 20$ | M1 A1 A1 | 3 | by inspection may see as quotient in long division must see full correct expression |
| Total | | | 10 | |
| (a)(i) | Minimum required for statement is “ \therefore factor” Powers of -3 must be evaluated: Example “ $p(-3) = -27 - 45 + 24 + 48 = 0$ so factor” scores M1 A1 Statement may appear first : Example “ $x+3$ is factor if $p(-3) = 0$ & $p(-3) = -27 - 45 + 24 + 48 = 0$ ” scores M1 A1 However, Example “ $p(-3) = (-3)^3 - 5(-3)^2 - 8(-3) + 48 = 0$ therefore $x+3$ is a factor” scores M1 A0 | | | |
| (ii) | M1 may also be earned for a full long division attempt by $(x+3)$, or a clear attempt to find a value for both b and c (even though incorrect) by comparing coefficients . M1 may also be earned for <i>showing</i> $p(4) = 0$ and <i>stating</i> that $(x-4)$ is a factor NMS $p(x) = (x+3)(x-4)^2$ scores 3 marks ; | | | |
| (b)(i) | Do not apply ISW for eg “ $p(2) = 20$, therefore remainder is -20 ” May use “their” product of factors $p(2) = (2+3)(2-4)(2-4)$ for M1 and A1 if factors and working are all correct giving 20. | | | |
| (ii) | M1 may be earned for a full long division attempt by $(x-2)$, or a clear attempt to find a value for both b and c (even though incorrect) by comparing coefficients . M1 may also be earned for using their value from part (b)(i) for r and a full attempt to find b and c . | | | |

| Q5 | Solution | Mark | Total | Comment |
|--------------|---|--|-----------|--|
| (a) | $(x-5)^2 + (y+3)^2 = \dots$ $7^2 + 4^2$ or $49 + 16$ or 65 $(x-5)^2 + (y+3)^2 = 65$ | M1 B1 A1 | 3 | or $(x-5)^2 + (y-3)^2 = \dots$ or seen under square root or $(x-5)^2 + (y-3)^2 = 65$ |
| (b) | $x_B = 12$ $y_B = -7$ | B1 B1 | 2 | $B(12, -7)$ |
| (c) | $\text{Grad } AC = \frac{1-3}{-2-5}$ $= -\frac{4}{7}$ $\text{Grad } \text{tgt} = \frac{7}{4}$ Equation of tgt: $y-1 = \text{"their"} \frac{7}{4}(x-2)$ $7x-4y+18=0$ | M1 A1 B1F m1 A1 | 5 | condone one sign error in one term FT their B if grad AB or grad BC is used. or $y = \text{"their"} \frac{7}{4}x + c$ & attempt to find c using $x = -2$ and $y = 1$ any multiple – must have integer coefficients and all terms on one side |
| (d) | $CT^2 = AT^2 + AC^2$ $(CT^2 =) 4^2 + \text{"their"} 65$ $(CT^2 =) 81$ $(CT =) 9$ | M1 A1 A1 | 3 | Pythagoras with hyp= CT & $AC^2 = \text{"their"} k$ or correct or $(CT =) \sqrt{81}$ all notation correct; must simplify $\sqrt{81}$ |
| Total | | | 13 | |
| (a) | NMS $(x-5)^2 + (y+3)^2 = 65$ scores 3 marks allow RHS = $(\sqrt{65})^2$ instead of 65 for full marks Example: $(x-5)^2 + (y+3)^2 = \sqrt{65}$ earns M1 B1 A0 Equation of circle must be written explicitly as $(x-5)^2 + (y+3)^2 = 65$ to earn A1 mark | | | |
| (c) | Award M1 A0 for grad $AC = 4/7$ For m1 candidate must be attempting equation of tangent; if B1F not earned and their gradient of AC is m then award m1 if using $1/m$ or $-m$ and correct coordinates $(-2, 1)$. For final A1 accept answers such as $0 = 8y - 14x - 36$ but NOT $7x - 4y = -18$ | | | |
| (d) | Example: $4^2 + 65 = 81 = 9$ scores M1, A1, A0 ; Example: $4^2 + 65 = 81, \sqrt{81} = 9$ scores M1, A1, A1 | | | |

| Q6 | Solution | Mark | Total | Comment |
|--------------|--|-------------|----------|--|
| (a)(i) | $(x =) \frac{4 \pm \sqrt{80}}{-4}, \text{ or } (x =) \frac{-4 \pm \sqrt{80}}{4}$ | M1 | 2 | if completing square must have at least $x+1 = \pm\sqrt{5}$ |
| | or $(x =) \frac{-2 \pm \sqrt{20}}{2}$ $(x =) -1 \pm \sqrt{5}$ | A1 | | do not accept $-1 \pm -\sqrt{5}$ for A1 |
| (ii) | | M1 A1 | 2 | ∧ shape as shown in all 4 quadrants, max to left of y-axis with y-intercept 8 stated/marked |
| (b)(i) | $k(x+4) = 8 - 4x - 2x^2$ $2x^2 + kx + 4x + 4k - 8 = 0$ $2x^2 + (k+4)x + 4(k-2) = 0$ | B1 | 1 | must expand $k(x+4)$ & have all terms on one side with $=0$ before final line AG be convinced |
| (ii) | $(k+4)^2 - 4 \times 2 \times 4(k-2) (=0)$ | M1 | 3 | correct discriminant |
| | $k^2 - 24k + 80 (=0)$ $k = 4, k = 20$ | A1 A1cso | | |
| Total | | | 8 | |
| (a)(ii) | Withhold A1 if maximum y- value is clearly not greater than 8, or graph has wrong curvature in third and fourth quadrants. Do not withhold A1 if incorrect x-intercepts are marked on x-axis, etc. Accept (0,8) stated or marked on y-axis as y-intercept, but do NOT accept (8,0). | | | |
| (b)(i) | Must have “=0” on final line but this may be on LHS. Do not accept incorrect “trailing equal” signs, ie from line 1 to line 2 of proof. | | | |
| (ii) | Condone poor use/omission of brackets for M1 if correct discriminant is intended, but the A1 cso cannot then be earned even if recovered later. Candidates must have “= 0” on at least one line of working or statement “ $b^2 - 4ac = 0$ ” and all working correct to earn A1cso. If candidate uses “> 0” etc then withhold A1cso even if final answer is written as $k = 4, k = 20$. | | | |

| Q7 | Solution | Mark | Total | Comment |
|----------------|---|------------------------|-----------|---|
| (a)(i) | $\left(\frac{dy}{dx} =\right) -2x - 9x^2$ | M1 A1 | | one term correct all correct (no +c etc) |
| | when $x = -2$, $\frac{dy}{dx} = (4 - 36) = -32$ | A1 | | |
| | $y = \text{"their"} - 32x + c$ & attempt to find c using $x = -2$ and $y = 24$ | m1 | | or $y - 24 = \text{"their"} - 32(x - -2)$ |
| | $y = -32x - 40$ | A1 | 5 | must write in this form; no ISW here |
| (ii) | $y = 0 \Rightarrow x = -\frac{5}{4}$ OE | B1F | 1 | strict FT from their answer to (a)(i) |
| (b)(i) | $4x - \frac{x^3}{3} - \frac{3x^4}{4} (+c)$ | M1 A1 | | two terms correct all correct |
| | $\left[4 \times 1 - \frac{1^3}{3} - \frac{3 \times 1^4}{4}\right] -$ $\left[4 \times (-2) - \frac{(-2)^3}{3} - \frac{3(-2)^4}{4}\right]$ | m1 | | "their" $F(1) - F(-2)$ |
| | $\left[4 - \frac{1}{3} - \frac{3}{4}\right] - \left[-8 + \frac{8}{3} - \frac{48}{4}\right]$ | A1 | | correct with powers of 1 and (-2) and minus signs handled correctly |
| | $= 20\frac{1}{4}$ | A1 | 5 | 20.25 , $\frac{81}{4}$, $\frac{243}{12}$ OE |
| (ii) | Area of missing triangle $= \left(\frac{1}{2} \times 24 \times \frac{3}{4}\right) = 9$ | B1 | | or correct single equivalent fraction |
| | Area of region = "their" (b)(i) – "their" Δ | M1 | | "their" $(20\frac{1}{4} - 9)$ |
| | $= 11\frac{1}{4}$ | A1 | 3 | 11.25 , $\frac{45}{4}$, $\frac{135}{12}$ OE |
| | Total | | 14 | |
| (a)(i) | Must see $y = -32x - 40$ explicitly for final A1 ; ie not enough to see $y = -32x + c$ with $c = -40$ appearing on later line. | | | |
| (a)(ii) | Allow $-\frac{40}{32}$ etc. | | | |
| (b)(i) | Must combine terms for final A1 ; Example ... $3\frac{1}{4} + 17$ scores final A0 . | | | |
| (ii) | May find triangle area by considering trapezium with one side of zero length or integration for B1 . For M1 condone use of "their" Δ – "their" (b)(i) if appropriate for their values. Be generous in awarding this M1 provided you are convinced they are considering the area of a triangle. | | | |

| Q8 | Solution | Mark | Total | Comment |
|--------------|---|-------------------------------------|-----------|--|
| (a)(i) | $\left(\frac{d^2y}{dx^2}\right) = 27 - 12x$ | M1 A1 | 2 | one term correct all correct (no +c etc) |
| (ii) | $\left(\frac{dy}{dx}\right) = 54 + 27 \times \left(-\frac{3}{2}\right) - 6 \times \left(-\frac{3}{2}\right)^2$ $\frac{dy}{dx} = 54 - \frac{81}{2} - \frac{54}{4} = 0$ $\left(\frac{d^2y}{dx^2}\right) = 27 - 12 \times \left(\frac{-3}{2}\right)$ $\frac{d^2y}{dx^2} = 27 + 18 (= 45) > 0$ $\Rightarrow P$ is minimum point | M1 A1 M1 A1cso | 4 | convincingly showing $\frac{dy}{dx} = 0$ and $\frac{dy}{dx} = \dots$ must appear on at least one line correct substitution into “their” $\frac{d^2y}{dx^2}$ correct working and $\frac{d^2y}{dx^2}$ used and value shown to be > 0 with correct statement(s) must earn 3 previous marks to earn A1cso |
| (b)(i) | (Decreasing so) $54 + 27x - 6x^2 < 0$ $6x^2 - 27x - 54 > 0$ $2x^2 - 9x - 18 > 0$ | M1 A1 | 2 | AG be convinced |
| (ii) | $(2x+3)(x-6)$ CVs are $x = -\frac{3}{2}, x = 6$ $\begin{array}{c} + \quad \quad - \quad \quad + \\ \hline -\frac{3}{2} \quad \quad \quad \quad 6 \end{array}$ $x < -\frac{3}{2}, x > 6$ | M1 A1 M1 A1 | 4 | correct factors or correct use of formula as far as $\frac{9 \pm \sqrt{225}}{4}$ condone equivalent fractions here use of sign diagram or graph  |
| Total | | | 12 | |
| (b)(ii) | <p>For second M1, if critical values are correct then sign diagram or sketch must be correct with correct CVs marked. However, if CVs are not correct then second M1 can be earned for attempt at sketch or sign diagram but their CVs MUST be marked on the diagram or sketch. Final A1, inequality must have x and no other letter.</p> <p>Final answer of $x < -\frac{3}{2}$ OR $x > 6$ (with or without working) scores 4 marks.</p> <p>(A) $x < -\frac{3}{2}, x > 6$ (B) $x < -\frac{3}{2}$ AND $x > 6$ (C) $x \leq -\frac{3}{2}, x \geq 6$ with or without working, each score 3 marks (SC3)</p> <p>Example NMS $x < \frac{3}{2}, x > 6$ scores M0 (since one CV is incorrect)</p> <p>Example NMS $x > -1.5, x > 6$ scores M1 A1 M0 (since both CVs are correct)</p> | | | |