

Version



**General Certificate of Education (A-level)
January 2013**

Mathematics

MPC1

(Specification 6360)

Pure Core 1

Final

Mark Scheme

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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.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

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

MPC1

| Q | Solution | Marks | Total | Comments |
|----------|---|----------------|-----------|---|
| 1(a) (i) | $21 + 5k = 1$ $\Rightarrow k = -4$ | B1 | 1 | condone $3 \times 7 + 5k = 1$ AG condone $y = -4$ |
| (ii) | $(x =) 2$ $(y =) -1$ | B1 B1 | 2 | midpoint coords are $(2, -1)$ |
| (b) | $y = \frac{1}{5} - \frac{3}{5}x$ (Gradient $AB =$) $-\frac{3}{5}$ | M1 A1 | 2 | obtaining $y = a \pm \frac{3}{5}x$ or $\frac{\Delta y}{\Delta x} = \frac{-4-2}{7--3}$ or $\frac{-1-2}{2--3}$ or $\frac{-4--1}{7-2}$ condone one sign error in expression allow -0.6 , $\frac{6}{-10}$ etc for A1 & condone error in rearranging if gradient is correct. |
| (c) | Perp grad = $\frac{5}{3}$ $y - 2 = \frac{5}{3}(x + 3)$ or $y = \frac{5}{3}x + c, \quad c = 7 \quad \text{etc}$ | M1 A1 | | $-1/$ "their" grad AB correct equation in any form (must simplify $x - -3$ to $x+3$ or c to a single term equivalent to 7) |
| | $5x - 3y + 21 = 0$ | A1 | 3 | or any multiple of this with integer coefficients – terms in any order but all terms on one side of equation |
| (d) | $3x + 5y = 1 \quad \text{and} \quad 5x + 8y = 4$ $\Rightarrow P x = Q \quad \text{or} \quad R y = S$ $x = 12$ $y = -7$ | M1 A1 A1 | 3 | must use correct pair of equations and attempt to eliminate y (or x) (generous) $(12, -7)$ |
| | Total | | 11 | |

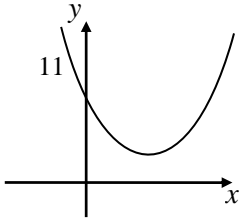
MPC1 (cont)

| Q | Solution | Marks | Total | Comments |
|--------|---|-------------|----------|--|
| 2(a) | $\left(\frac{dy}{dt} = \right) \frac{4t^3}{8} - 2t$ | M1 A1 | 2 | one of these terms correct all correct (no + c etc) |
| (b)(i) | $t = 1 \Rightarrow \frac{dy}{dt} = \frac{4}{8} - 2$ $= -1\frac{1}{2}$ | M1 A1cso | 2 | Correctly sub $t = 1$ into their $\frac{dy}{dt}$ must have $\frac{dy}{dt}$ correct (watch for t^3 etc) |
| (ii) | $\frac{dy}{dt} < 0$ \Rightarrow (height is) decreasing (when $t = 1$) | E1✓ | 1 | must have used $\frac{dy}{dt}$ in part (b)(i) must state that “ $\frac{dy}{dt} < 0$ ” or “ $-1.5 < 0$ ” or the equivalent in words FT their value of $\frac{dy}{dt}$ with appropriate explanation and conclusion |
| (c)(i) | $\left(\frac{d^2y}{dt^2} = \right) \frac{4}{8} \times 3t^2 - 2$ $\left(t = 2, \frac{d^2y}{dt^2} = \right) 4$ | M1 A1cso | 2 | Correctly differentiating their $\frac{dy}{dt}$ even if wrongly simplified Both derivatives correct and simplified to 4 |
| (ii) | \Rightarrow minimum | E1✓ | 1 | FT their numerical value of $\frac{d^2y}{dt^2}$ from part (c) (i) |
| | Total | | 8 | |

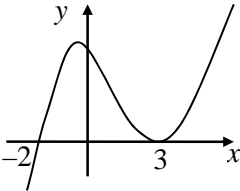
MPC1 (cont)

| Q | Solution | Marks | Total | Comments |
|--------------|---|-------------------------------------|----------|---|
| 3(a)(i) | $\sqrt{18} = 3\sqrt{2}$ | B1 | 1 | Condone $k = 3$ |
| (ii) | $\frac{2\sqrt{2}}{3\sqrt{2} + 4\sqrt{2}}$ $= \frac{2}{7}$ | M1 A1 A1 | 3 | attempt to write each term in form $n\sqrt{2}$ with at least 2 terms correct correct unsimplified or $\times \frac{\sqrt{2}}{\sqrt{2}}$ M1 integer terms = $\frac{4}{6+8}$ A1 $= \frac{2}{7}$ A1 |
| (b) | $\frac{7\sqrt{2} - \sqrt{3}}{2\sqrt{2} - \sqrt{3}} \times \frac{2\sqrt{2} + \sqrt{3}}{2\sqrt{2} + \sqrt{3}}$ (numerator =) $14 \times 2 - 2\sqrt{6} + 7\sqrt{6} - 3$ (denominator = $8 - 3 =$) 5 (Answer =) $5 + \sqrt{6}$ | M1 m1 B1 A1cso | 4 | correct unsimplified but must simplify $(\sqrt{2})^2$, $(\sqrt{3})^2$ and $\sqrt{2} \times \sqrt{3}$ correctly must be seen or identified as denominator giving $\frac{25 + 5\sqrt{6}}{5}$ $m = 5, n = 6$ |
| Total | | | 8 | |

MPC1 (cont)

| Q | Solution | Marks | Total | Comments |
|--------------|---|-------------|-----------|--|
| 4(a)(i) | $(x-3)^2$ | M1 | 2 | or $p = 3$ seen |
| | $(x-3)^2 + 2$ | A1 | | |
| (ii) | $(x-3)^2 = -2$ | M1 | 2 | FT their positive value of q not use of discriminant for graphical approach see below to see if SC1 can be awarded |
| | No (real) square root of -2 therefore equation has no real solutions | A1cso | | |
| (b)(i) | $x =$ 'their' p or $y =$ 'their' q Vertex is at $(3, 2)$ | M1 A1cao | 2 | or $x = 3$ found using calculus |
| | (ii) | B1 | | |
| (ii) |  | M1 | 3 | y intercept = 11 <i>stated</i> or <i>marked on y-axis</i> (as y intercept of any graph) ∪ shape (generous) |
| | | A1 | | |
| (iii) | Translation through $\begin{bmatrix} -3 \\ -2 \end{bmatrix}$ | E1 | 3 | and no other transformation FT negative of BOTH 'their' vertex coords both components correct for A1; may describe in words or use a column vector |
| | | M1 | | |
| | | A1 | | |
| Total | | | 12 | |

MPC1 (cont)

| Q | Solution | Marks | Total | Comments |
|--------------|---|-------|-----------|---|
| 5(a) | $p(-1) = (-1)^3 - 4 \times (-1)^2 - 3(-1) + 18$ $(= -1 - 4 + 3 + 18) = 16$ | M1 | 2 | p(-1) attempted not long division |
| | | A1 | | |
| (b)(i) | $p(3) = 3^3 - 4 \times 3^2 - 3 \times 3 + 18$ $p(3) = 27 - 36 - 9 + 18 = 0 \Rightarrow x - 3$ is a factor | M1 | 2 | p(3) attempted not long division shown = 0 plus statement |
| | | A1 | | |
| (ii) | Quadratic factor $(x^2 - x + c)$ or $(x^2 + bx - 6)$ | M1 | 3 | $-x$ or -6 term by inspection <i>or</i> full long division by $x - 3$ <i>or</i> comparing coefficients <i>or</i> $p(-2)$ attempted correct quadratic factor (or $x+2$ shown to be factor by Factor Theorem) |
| | Quadratic factor $(x^2 - x - 6)$ | A1 | | |
| (c) | $[p(x) =] (x-3)(x-3)(x+2)$  | A1 | 3 | or $[p(x) =] (x-3)^2(x+2)$ must see product of factors cubic curve with one maximum and one minimum meeting x -axis at -2 and touching x -axis at 3 |
| | | M1 | | |
| | | A1 | | |
| | Final A1 is dependent on previous A1 and can be withheld if curve has very poor curvature beyond $x = 3$, V shape at $x = 3$ etc | A1 | 3 | graph as shown , going beyond $x = -2$ but condone max on or to right of y -axis |
| Total | | | 10 | |

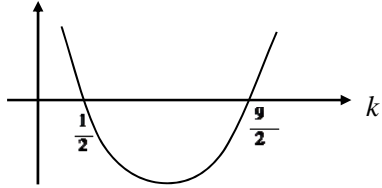
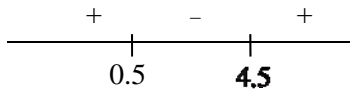
MPC1 (cont)

| Q | Solution | Marks | Total | Comments |
|------|--|-------|---|---|
| 6(a) | (Gradient = $10 - 6 + 5$) = 9 | B1 | 3 | correct gradient from sub $x=1$ into $\frac{dy}{dx}$ |
| | $y - 4 = \text{"their 9"}(x - 1)$ <i>or</i> $y = \text{"their 9"}x + c$ and attempt to find c using $x=1$ and $y=4$ | M1 | | must attempt to use given expression for $\frac{dy}{dx}$ and must be attempting tangent and not normal and coordinates must be correct |
| | $y = 9x - 5$ | A1 | | condone $y = 9x + c, \dots c = -5$ |
| (b) | $(y =) \frac{10}{5}x^5 - \frac{6}{3}x^3 + 5x + C$ | M1 | 5 | one term correct |
| | | A1 | | another term correct |
| | | A1 | | all integration correct including $+ C$ |
| | $4 = 2 - 2 + 5 + C$ $\Rightarrow C = -1$ | m1 | | substituting both $x=1$ and $y=4$ and attempting to find C |
| | $y = 2x^5 - 2x^3 + 5x - 1$ | A1cso | must have $y = \dots$ and coefficients simplified | |
| | Total | | 8 | |

MPC1 (cont)

| Q | Solution | Marks | Total | Comments |
|--------------|--------------------------------------|-------|-----------|---|
| 7(a) | $x=0 \Rightarrow y^2 - 4y - 12 (=0)$ | M1 | 3 | sub $x = 0$ & correct quadratic in y or $(y-2)^2 = 16$ or $(y-2)^2 - 16 = 0$ correct factors or formula as far as $\frac{4 \pm \sqrt{64}}{2}$ or $y - 2 = \pm\sqrt{16}$ condone $(0, -2)$ & $(0, 6)$ |
| | $(y-6)(y+2) (=0)$ | A1 | | |
| | $\Rightarrow y = -2, 6$ | A1 | | |
| (b) | $(x+3)^2 - 9 + (y-2)^2 - 4 (=12)$ | M1 | 3 | correct sum of square terms and attempt to complete squares (or multiply out) PI by next line $(r^2 =) 25$ seen on RHS $r = \sqrt{25}$ or $r = \pm 5$ scores A0 |
| | $(r^2 =) 9 + 4 + 12$ | A1 | | |
| | $(\Rightarrow r =) 5$ | A1 | | |
| (c)(i) | $(CP^2 =) (2 - -3)^2 + (5 - 2)^2$ | M1 | 2 | condone one sign slip within one bracket $n = 34$ |
| | $\Rightarrow (CP =) \sqrt{34}$ | A1 | | |
| (ii) | $PQ^2 = CP^2 - r^2 = 34 - 25$ | M1 | 2 | Pythagoras used correctly with values FT "their" r and CP |
| | $(\Rightarrow PQ =) 3$ | A1 | | |
| Total | | | 10 | |

MPC1 (cont)

| Q | Solution | Marks | Total | Comments |
|--------|---|-------------------|-----------|--|
| 8(a) | $2x^2 - x - 1 = 2kx - 3k$ $2x^2 - x - 1 - 2kx + 3k = 0$ OE $\Rightarrow 2x^2 - (2k+1)x + 3k - 1 = 0$ | B1 | 1 | equated and multiplied out and all 5 terms on one side and = 0 AG (correct with no trailing = signs etc) |
| (b)(i) | $(2k+1)^2 - 4 \times 2(3k-1)$ $(2k+1)^2 - 4 \times 2(3k-1) > 0$ $4k^2 + 4k + 1 - 24k + 8 > 0$ $\Rightarrow 4k^2 - 20k + 9 > 0$ | M1 B1 A1cso | 3 | clear attempt at $b^2 - 4ac$ discriminant > 0 which must appear before the printed answer AG (all working correct with no missing brackets etc) |
| (ii) | $4k^2 - 20k + 9 = (2k-9)(2k-1)$ critical values are $\frac{1}{2}$ and $\frac{9}{2}$  | M1 A1 M1 | | correct factors or correct use of formula as far as $\frac{20 \pm \sqrt{256}}{8}$ condone $\frac{4}{8}, \frac{36}{8}$ etc here but must combine sums of fractions |
| | $k < \frac{1}{2}, k > \frac{9}{2}$ <i>Take their final line as their answer</i> | A1 | 4 | sketch or sign diagram including values  |
| | Total | | 8 | |
| | TOTAL | | 75 | |