

## KEY TO MARK TYPES AND ABBREVIATIONS

MARK TYPES	DESCRIPTION
M	Mark is for method.
dM	Mark is dependent on one or more <b>M</b> marks and is for method.
R	Mark is for reasoning.
A	Mark is <b>dependent</b> on <b>M</b> marks and is for accuracy.
B	Mark is <b>independent</b> of <b>M</b> marks and is for method and accuracy.
E	Mark is for explanation.

ABBREVIATION	DESCRIPTION
ft	Follow through from previous incorrect result.
AG	Answer given in question.
SC	Special case.
'their'	Indicates that credit can be given from previous incorrect result.
CAO	Correct answer only.
OE	Or equivalent
PI	Possibly implied
CSO	correct solution only.
AWFW	Anything which falls within.
AWRT	Anything which rounds to.
ACF	Any correct form.
NMS	No method shown.
SCA	Substantially correct approach.
s.f.	Significant figures.
d.p.	Decimal places.

## EXAMINERS SHOULD CONSISTENTLY APPLY THE FOLLOWING GENERAL MARKING PRINCIPLES

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### 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 students showing no working is that incorrect answers, however close, earn no marks.
- Where a question asks the student 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.**

### DIAGRAMS

- Diagrams that have working on them should be treated like normal responses.
- If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked.
- Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

### WORK ERASED OR CROSSED OUT


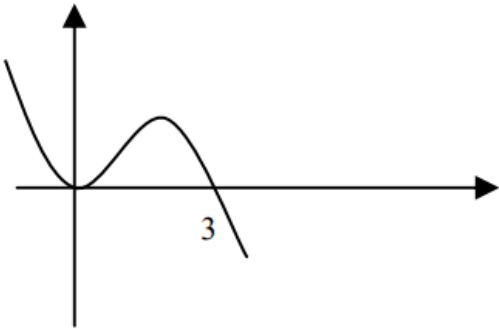

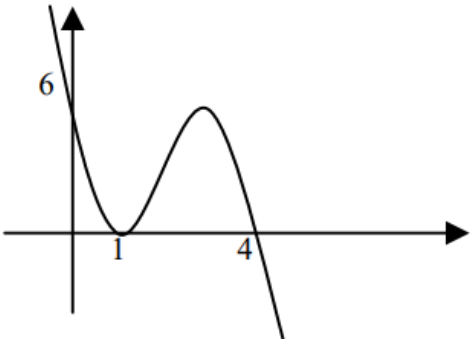

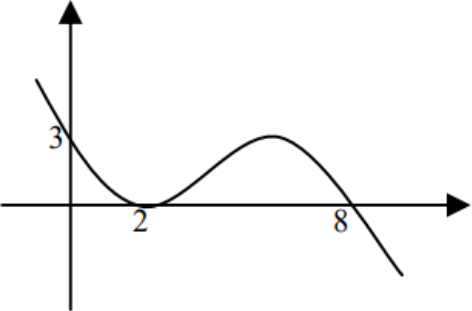
- Erased or crossed out work that is still legible and has not been replaced should be marked.
- Erased or crossed out work that has been replaced can be ignored.

### CHOICE

- When a choice of answers and/or methods is given and the student has not clearly indicated which answer they want to be marked, only the last complete attempt should be awarded marks.

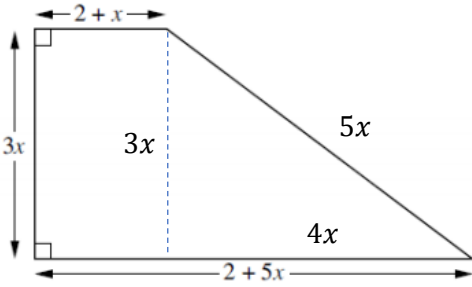
Q1	Marking Instructions	Marks	Typical Solution
1. (a)	Clear attempt at $p(-3)$ ( <b>not</b> long division)	M1	$p(-3) = (-3)^3 - 13(-3) - 12$ $= -27 + 39 - 12$ $= 0$ $\therefore (x + 3) \text{ is a factor of } p(x)$
	Correctly simplifies showing that $p(-3) = 0$ .	A1	
	Note: Powers of 3 must be evaluated.		
		2 marks	
1. (b)	Attempt at complete division by $(x - 3)$	M1	$x^3 - 13x - 12 = (x + 3)(Ax^2 + Bx + C)$ $x^3 - 13x - 12 = Ax^3 + (B + 3A)x^2 + (C + 3B)x + 3C$ <p>Equating coefficients:</p> $B + 3A = 0 \qquad C + 3B = -13$ $A = 1 \qquad B + 3 = 0 \qquad C - 9 = -13$ $B = -3 \qquad C = -4$ $\therefore p(x) = (x + 3)(x^2 - 3x - 4)$ $= (x + 3)(x - 4)(x + 1)$
	Long division: Must be subtracting on each line (allow one error)		
	Coefficient matching: Valid attempt at all 3 coefficients.		
	Inspection: Must give three correct terms on expansion.		
	Synthetic division: allow one error.		
Obtains correct quotient: $(x^2 - 3x - 4)$	A1		
Obtains $p(x) = (x + 3)(x - 4)(x + 1)$	A1		
	3 marks		

Q2	Marking Instructions	Marks	Typical Solution
2. (a)	Uses binomial theorem to expand bracket – correct unsimplified expression but condone sign error. <i>Note: Ignore bracket errors and omission or incorrect powers of k.</i>	M1	$(1 + kx)^8 = 1^8 + {}^8C_1(1)^7(kx)^1 + {}^8C_2(1)^6(kx)^2 + {}^8C_3(1)^5(kx)^3 + \dots$ $= 1 + 8kx + 28k^2x^2 + 56k^3x^3 + \dots$
	First two terms simplified and correct.	B1	
	Third term simplified and correct.	A1	
	Fourth term simplified and correct. <i>Note: Do not penalise if the terms are not in ascending powers of x.</i>	A1	
		4 marks	
Q2	Marking Instructions	Marks	Typical Solution
2. (b)	Sets <i>their</i> coefficient of $x^3$ equal to 1512 and rearranges to obtains $k^n = \dots$ where $n$ is 1 or 3.	M1	$56k^3 = 1512$ $k^3 = 27$ $k = 3$
	Obtains $k^3 = 27$ (OE, e.g. $k^3 = \frac{1512}{56}$ )	A1	
	Obtains $k = 3$ and no other solutions.	A1	
		3 marks	

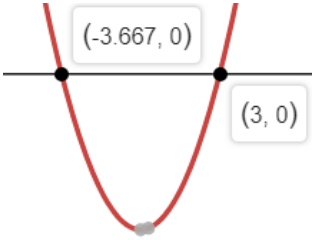
Q3	Marking Instructions	Marks	Typical Solution
3. (a)	Correct shape and orientation  with evidence of a translation in the $x$ -direction.	M1	
	Clearly through the origin.	A1	
	Axis labelled at $x = 3$ .	A1	
		3 marks	
3. (b)	Correct shape and orientation 	M1	
	Axis labelled at $x = 1$ and $x = 4$ .	A1	
	Axis labelled at $y = 6$ .	A1	
		3 marks	
3. (c)	Correct shape and orientation 	M1	
	Axis labelled at $x = 2$ and $x = 8$ .	A1	
	Axis labelled at $y = 3$ .	A1	
		3 marks	

Q4abc	Marking Instructions	Marks	Typical Solution
4. (a)	Forms a circle equation of the form $(x \pm 2)^2 + (y \pm 1)^2 = 10^2$	M1	$(x - 2)^2 + (y - 1)^2 = 10^2$
	Obtains $(x - 2)^2 + (y - 1)^2 = 100$	A1	$x^2 - 4x + 4 + y^2 - 2y + 1 = 100$
	Obtains $x^2 + y^2 - 4x - 2y - 95 = 0$ (must be in correct form)	A1	$x^2 + y^2 - 4x - 2y - 95 = 0$
		3 marks	
4. (b)	Substitutes $x = 5$ into <i>their</i> equation.	M1	Using $(5, k)$ ,
	Correct simplified quadratic. <i>Note: <math>(k - 1)^2 = 91</math> is also an acceptable simplified form.</i>	A1	$5^2 + k^2 - 4(5) - 2k = 95$
	Obtains $k = 1 + \sqrt{91}$ and no other solutions.	A1	$k^2 - 2k + 5 = 95$
		3 marks	$k^2 - 2k - 90 = 0$ $k = 1 \pm \sqrt{91}$ Since $k > 0$ , $k = 1 + \sqrt{91}$
4. (c)	Attempt to calculate distance from $(-3, 9)$ to centre using $d = \sqrt{(x - x_1)^2 + (y - y_1)^2}$	M1	Radius of circle = 10
	Obtains $d = \sqrt{89}$ or 9.43...	A1	Distance from centre t $(-3, 9)$ : $d = \sqrt{(2 + 3)^2 + (1 - 9)^2} = \sqrt{89} \approx 9.4$
	Compares $\sqrt{89}$ with 10 and concludes that the point is inside circle.	A1	Since $d < r$ the point is inside the circle.
		3 marks	

Q4d	Marking Instructions	Marks	Typical Solution
4. (d)	Uses $m = \frac{y_2 - y_1}{x_2 - x_1}$ to calculate the gradient.	M1	$\text{Gradient of radius} = \frac{9-1}{8-2} = \frac{4}{3}$ $\therefore \text{Gradient of tangent} = -\frac{3}{4}$ $\therefore y - 9 = -\frac{3}{4}(x - 8)$
	Obtains $m = \frac{4}{3}$ (OE)	A1	
	Gradient of tangent = $-\frac{1}{\text{their } m_{CP}}$	B1ft	
	Finds the equation of the tangent using the gradient of <i>their</i> tangent and (8,9).	M1	
	Obtains correct equation of tangent in any form. e.g. $y - 9 = -\frac{3}{4}(x - 8)$ $y = -\frac{3}{4}x + 15$ $4y + 3x = 60$	A1	
		5 marks	

Q5ab	Marking Instructions	Marks	Typical Solution
5. (a)	Adds lengths of all four edges with attempt to use Pythagoras to find the missing length. May be left unsimplified.	M1	 $P = (2 + x) + 3x + (2 + 5x) + 5x = 14x + 4$
	Obtains $P = 14x + 4$	2 marks	
5. (b)	<p><b>Note: AG</b></p> <p>Correct method for finding the area.</p> <p>e.g.</p> <ul style="list-style-type: none"> <li>• Splitting into rectangle and triangle</li> <li>• Area of a trapezium.</li> </ul>	M1	$\text{Area of rectangle} = 3x(2 + x) = 6x + 3x^2$ $\text{Area of triangle} = \frac{1}{2}(4x)(3x) = 6x^2$ $\text{Total area} = 9x^2 + 6x$
	Correct answer <b>from correct working.</b>	A1	
		2 marks	



Q5c	Marking Instructions	Marks	Typical Solution
5. (c)	Forms an inequality for the perimeter (must be correct for <i>their P</i> )	B1ft	Using the perimeter: $14x + 4 \geq 39$
	Obtains $x \geq \frac{5}{2}$	B1	$14x \geq 35$
	States that $9x^2 + 6x < 99$	B1	$x \geq \frac{5}{2}$
	Valid method to solve <i>their</i> three-term quadratic inequality. e.g factorising / quadratic formula.	M1	Using the area: $9x^2 + 6x < 99$ $9x^2 + 6x - 99 < 0$
	Obtains $-\frac{11}{3} < x < 3$	A1	Critical values: $x = 3, x = -\frac{11}{3}$
	root from <i>their</i> linear equation $< x <$ upper root from their quadratic	M1	$\therefore -\frac{11}{3} < x < 3$
	Fully correct answer, including correct inequality signs.	A1	To satisfy the area and perimeter equations $\frac{5}{2} \leq x < 3$
		7 marks	

Q6ab	Marking Instructions	Marks	Typical Solution
6. (a)	Correctly find the gradient of AB (allow unsimplified).	M1	$m_{AB} = \frac{7-3}{2-0} = 2$
	Correctly find the gradient of BC (allow unsimplified). <b>Note: To award M1M1, there must be evidence that the gradients have both been calculated separately.</b>	M1	$m_{BC} = \frac{-1-3}{8-0} = -\frac{1}{2}$
	States that $m_{AB} \times m_{BC} = -1$ and concludes the lines are perpendicular.	A1	$m_{AB} \times m_{BC} = -1$ $\therefore AB \perp BC$
		3 marks	$\therefore$ angle $ABC$ is $90^\circ$ .

<b>6. (b)</b>	Obtains (5, 3) for the centre.	<b>B1</b>	$\text{Midpoint } AC = \left( \frac{2+8}{2}, \frac{7+(-1)}{2} \right) = (5, 3)$ $\therefore \text{centre} = (5, 3)$ $\text{Length of diameter} = \sqrt{(8-2)^2 + (-1-7)^2} = 10$ $\text{radius} = 5$ $\text{Equation of circle: } (x-5)^2 + (y-3)^2 = 25$
	Obtains a radius of 5.	<b>B1</b>	
	Correctly forms a circle equation using <i>their</i> centre and radius.	<b>M1</b>	
	Obtains $(x-5)^2 + (y-3)^2 = 10$ (ISW)	<b>A1</b>	
		<b>4 marks</b>	

Q6c	Marking Instructions	Marks	Typical Solution
6. (c)	Obtains $m = -\frac{4}{3}$ (OE)	B1	$\text{Gradient of radius} = \frac{7-3}{2-5} = -\frac{4}{3}$ $\text{Gradient of tangent} = \frac{3}{4}$ $y - 7 = \frac{3}{4}(x - 2)$ $\text{Equation of tangent: } 4y - 28 = 3x - 6$ $4y = 3x + 22$
	Gradient of tangent = $-\frac{1}{\text{their } m_{CP}}$	M1	
	Finds the equation of the tangent using the gradient of <i>their</i> tangent and (2,7).	M1	
	Obtains $4y = 3x + 22$ (must be in correct form).	A1	
		4 marks	