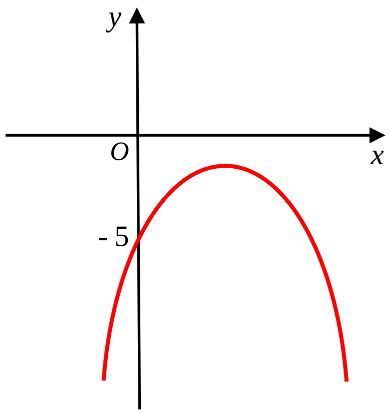
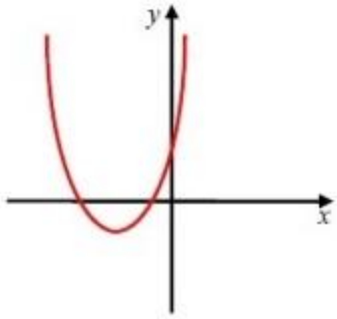
Quadratic Functions - Edexcel Past Exam Questions 2 MARK SCHEME

Question 1

	$4x - 5 - x^2 = q - (x - p)^2$, p, q are integers.	
(a)	$\{4x - 5 - x^2 =\}\ -\left[x^2 - 4x + 5\right] = -\left[(x-2)^2 - 4 + 5\right] = -\left[(x-2)^2 + 1\right]$	M1
	$= -1 - (x-2)^2$	A1 A1
		[3]
(b)	$\{"b^2 - 4ac" =\}\ 4^2 - 4(-1)(-5) \quad \{= 16 - 20\}$	M1
	$= -4$	A1
		[2]
(c)		
	Correct $\cap$ shape	M1
	Maximum **within** the 4th quadrant	A1
	Curve cuts through -5 or $(0, -5)$ marked on the y-axis	B1
		[3]
		8

Question 2

Question Number	Scheme	Marks
(a)	This may be done by completion of square or by expansion and comparing coefficients	
	$a = 4$	B1
	$b = 1$	B1
	All three of $a = 4$, $b = 1$ and $c = -1$	B1
		[3]
(b)		
	U shaped quadratic graph.	M1
	The curve is correctly positioned with the minimum in the third quadrant. . It crosses x axis twice on negative x axis and y axis once on positive y axis.	A1
	Curve cuts y-axis at $(\{0\}, 3)$ only	B1
	Curve cuts x-axis at $(-\frac{3}{2}, \{0\})$ and $(-\frac{1}{2}, \{0\})$.	B1
		[4]
		7 marks
	Notes	
(a)	**B1**: States $a = 4$ or obtains $4(x+b)^2 + c$, **B1**: States $b = 1$ or obtains $a(x+1)^2 + c$, **B1**: States $a = 4$, $b = 1$ **and** $c = -1$ or $4(x+1)^2 - 1$ (Needs all 3 correct for final mark) **Special cases:** If answer is left as $(2x+2)^2 - 1$ treat as misread B1B0B0 or as $2(x+1)^2 - 1$ then the mark is B0B1B0 from scheme	
(b)	**M1**: Any position provided U shaped (be generous in interpretation of U shape but V shape is M0) **A1** : The curve is correctly positioned with the minimum in the third quadrant. It crosses x axis twice on negative x axis and y axis once on positive y axis. **B1**: Allow 3 on y axis and allow either $y = 3$ or $(0, 3)$ if given in text Curve does not need to pass through this point and this mark may be given even if there is no curve at all or if it is drawn as a line. **B1**: Allow $-3/2$ and $-1/2$ if given on x axis – need co-ordinates if given in text or $x = -3/2$, $x = -1/2$. Accept decimal equivalents. Curve does not need to pass through these points and this mark may be given even if there is no curve. Ignore third point of intersection and allow touching instead of cutting. So even a cubic curve *might* get M0A0 B1 B1. A V shape with two ruled lines for example might get M0A0B1B1	

Question 3

Question Number	Scheme	Marks
	(a) Discriminant = $b^2-4ac=8^2-4\times2\times3,=40$	M1, A1
		(2)
	(b) $2x^2+8x+3=2(x^2+.........)$ or p=2	B1
	$=2((x+2)^2\pm...)$ or $q=2$	M1
	$=2(x+2)^2-5$ or $p=2,\ q=2$ and $r=-5$	A1
		(3)
	(c) Method 1A: Sets derivative "$4x+8$" $=4\Rightarrow x=,\quad x=-1$	M1, A1
	Substitute $x=-1$ in $y=2x^2+8x+3\quad(\Rightarrow y=-3)$	dM1
	Substitute $x=-1$ and $y=-3$ in $y=4x+c$ or into $(y+3)=4(x+1)$ and expand	dM1
	$c=1$ or writing $y=4x+1$	A1cso
		(5)
	Method 1B: Sets derivative "$4x+8$" $=4\Rightarrow x=,\quad x=-1$	M1, A1
	Substitute $x=-1$ in $2x^2+8x+3=4x+c$	dM1
	Attempts to find value of c	dM1
	$c=1$ or writing $y=4x+1$	A1cso
		(5)
	Method 2: Sets $2x^2+8x+3=4x+c$ and collects x terms together	M1
	Obtains $2x^2+4x+3-c=0$ or equivalent	A1
	States that $b^2-4ac=0$	dM1
	$4^2-4\times2\times(3-c)=0$ and so $c=$	dM1
	$c=1$	A1cso
		(5)
	Method 3: Sets $2x^2+8x+3=4x+c$ and collects x terms together	M1
	Obtains $2x^2+4x+3-c=0$ or equivalent	A1
	Uses $2(x+1)^2-2+3-c=0$ or equivalent	dM1
	Writes $-2+3-c=0$	dM1
	So $c=1$	A1cso
		(5)
	Also see special case for using a perpendicular gradient (overleaf)	(10 marks)

Notes

(a) M1 Attempts to calculate b^2-4ac using $8^2-4\times2\times3$ - must be correct – not just part of a quadratic formula

A1 Cao 40

(b) B1 See $2(....)$ or $p=2$

M1 $..((x+2)^2\pm...)$ is sufficient evidence or obtaining $q=2$

A1 Fully correct values. $2(x+2)^2-5$ or $p=2,\ q=2,\ r=-5$ cso.

Ignore inclusion of "=0".

[In many respects these marks are similar to three B marks.
$p=2$ is B1; $q=2$ is B1 and $p=2,\ q=2$ and $r=-5$ is final B1 but they must be entered on epen as **B1 M1 A1**]

Special case: Obtains $2x^2+8x+3=2(x+2)-1$ This may have first B1, for $p=2$ then M0A0 (c) Method 1A (Differentiates and puts gradient equal to 4. Needs both x and y to find c)

M1 Attempts to solve their $\frac{dy}{dx} = 4$. They must reach $x =$... (Just differentiating is M0 A0)

A1 $x = -1$ (If this follows $\frac{dy}{dx} = 4x + 8$, then give M1 A1 by implication)

dM1 (Depends on previous M mark) Substitutes **their** $x = -1$ into f(x) or into "their f(x) from (b)" to find y

dM1 (Depends on both previous M marks) Substitutes **their** $x = -1$ and **their** $y = -3$ values into $y = 4x + c$ to find c or uses equation of line is $(y + \text{"3"}) = 4(x + \text{"1"})$ and rearranges to $y = mx + c$

A1 $c = 1$ or allow for $y = 4x + 1$ cso

(c) Method 1B (Differentiates and puts gradient equal to 4. Also equates equations and uses x to find c)

M1A1 Exactly as in Method 1A above

dM1 (Depends on previous M mark) Substitutes **their** $x = -1$ into $2x^2 + 8x + 3 = 4x + c$

dM1 Attempts to find value of c then A1 as before

(c) Method 2 (uses repeated root to find c by discriminant)

M1 Sets $2x^2 + 8x + 3 = 4x + c$ and tries to collect x terms together

A1 Collects terms e.g. $2x^2 + 4x + 3 - c = 0$ or $-2x^2 - 4x - 3 + c = 0$ or $2x^2 + 4x + 3 = c$ or even $2x^2 + 4x = c - 3$ Allow "=0" to be missing on RHS.

dM1 (If the line is a tangent it meets the curve at just one point so repeated root and $b^2 - 4ac = 0$) Stating that $b^2 - 4ac = 0$ is enough

dM1 Using $b^2 - 4ac = 0$ to obtain equation in terms of c (Eg. $4^2 - 4 \times 2 \times (3 - c) = 0$) AND leading to a solution for c

A1 $c = 1$ or allow for $y = 4x + 1$ cso

(c) Method 3 (Similar to method 2 but uses completion of the square on the quadratic to find repeated root)

M1 Sets $2x^2 + 8x + 3 = 4x + c$ and tries to collect x terms together. May be implied by $2x^2 + 8x + 3 - 4x \pm c$ on one side

A1 Collects terms e.g. $2x^2 + 4x + 3 - c = 0$ or $-2x^2 - 4x - 3 + c = 0$ or $2x^2 + 4x + 3 = c$ or even $2x^2 + 4x = c - 3$ Allow "=0" to be missing on RHS.

dM1 Then use completion of square $2(x+1)^2 - 2 + 3 - c = 0$ (Allow $2(x+1)^2 - k + 3 - c = 0$) where k is non zero. It is enough to give the correct or almost correct (with k) completion of the square

dM1 $-2 + 3 - c = 0$ AND leading to a solution for c (Allow $-1 + 3 - c = 0$) ($x = -1$ has been used)

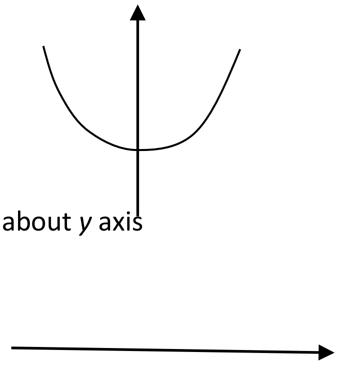
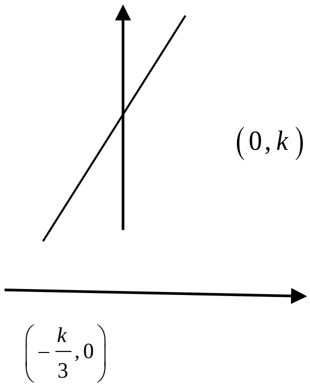
A1 $c = 1$ cso

In Method 1 they may use part (b) and differentiate their f(x) and put it equal to 4
They can earn M1, but do not follow through errors.

In Methods 2 and 3 they may use part (b) to write
their $2(x+2)^2 - 5 = 4x + c$. They need to expand and collect x terms together for M1
Then expanding gives $2x^2 + 4x + 3 - c = 0$ for A1 – do not follow through errors
Then the scheme is as before

If they just state $c = 1$ with little or no working – please send to review,

Question 4

Question Number	Scheme	Marks
(a)	 U shaped parabola – symmetric about *y* axis	B1
	(0, 8) Graph passes through (0, 8)	B1
	 Shape and position for *L*	M1
	Both $\left(-\frac{k}{3}, 0\right)$ and $(0, k)$	A1
		(4)
	Allow marks **even if** on the **same** diagram	
(b)	Equate curves $\frac{1}{3}x^2 + 8 = 3x + k$ and proceed to collect terms on one side	M1
	$\frac{1}{3}x^2 - 3x + (8 - k)$	A1
	Method 1a: Uses "$b^2 = 4ac$" ; Method 1b: Attempt $\frac{1}{3}(x - \frac{9}{2})^2 - \lambda + 8 - k$	dM1
	Method 1a: $9 = 4 \times \frac{1}{3} \times (8 - k) \Rightarrow k = ..$; Method 1b: Deduce that $k = 8 - \lambda$	dM1
	$k = \frac{5}{4}$ o.e.	A1
		(5)

Question Number	Scheme	Marks
		(9 marks)