Name: _____

IGCSE (9-1) Maths new topics: Completing the square

Date:

Time: 35 minutes

Total marks available: 30

Total marks achieved: _____

[GCSE]

Q1. The expression $x^2 - 8x + 21$ can be written in the form $(x - a)^2 + b$ for all values of x.

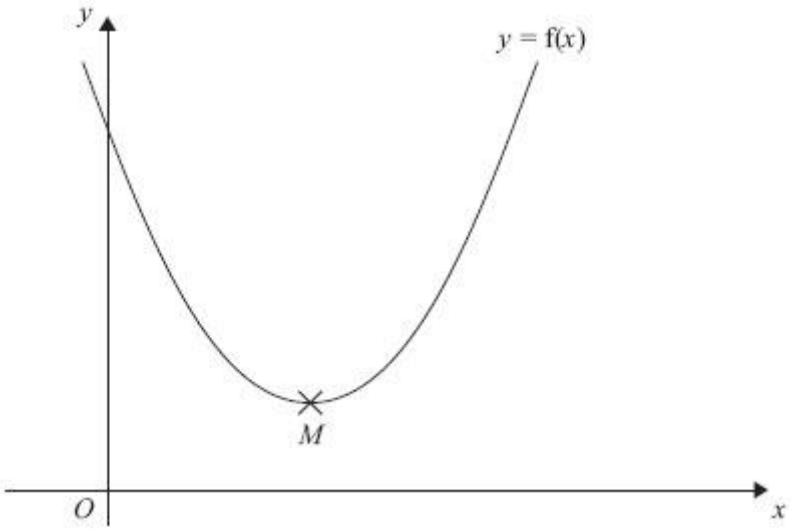
(a) Find the value of a and the value of b.

$a =$ . . . . . .

$b =$ . . . . . .

(3)

The equation of a curve is $y = f(x)$ where $f(x) = x^2 - 8x + 21$
The diagram shows part of a sketch of the graph of $y = f(x)$.



The minimum point of the curve is M.

(b) Write down the coordinates of M.

(1)

(Total 4 marks)

[GCSE]

Q2. The expression $x^2 - 8x + 6$ can be written in the form $(x - p)^2 + q$ for all values of x.

(a) Find the value of p and the value of q.

$p =$ .....

$q =$ .....

(3)

The graph of $y = x^2 - 8x + 6$ has a minimum point.

(b) Write down the coordinates of this point.

(..... , ...)

(1)

(Total 4 marks)

[GCSE]

Q3. By completing the square, find the coordinates of the turning point of the curve with equation $y = x^2 + 10x + 18$
You must show all your working.

(..... , ...)

(Total 3 marks)

Q4. (*a*) Write $2x^2 – 8x + 9$ in the form $a(x + b)^2 + c$

(3)

(*b*) Hence, or otherwise, explain why the graph of the curve with equation $y = 2x^2 – 8x + 9 = 0$ does not intersect the x-axis.

(1)

(Total 4 marks)

[Awards]

Q5. (*a*) Write the quadratic expression $x^2 + 4x + 7$ in the form $(x + m)^2 + n$
where m and n are integers.

(2)

(*b*) Write down the coordinates of the turning point of the graph of $y = x^2 + 4x + 7$

(1)

(Total 3 marks)

[Awards]

Q6. (*a*) (i) Write the quadratic expression $x^2 + 6x + 7$ in the form $(x + a)^2 + b$
where a and b are integers.

(ii) Hence solve the equation $x^2 + 6x + 7 = 0$
Give your answer in the form $p \pm \sqrt{q}$ where p and q are integers.

(4)

(*b*) Sketch the graph of $y = x^2 + 6x + 7$
You must label, with coordinates, the points of intersection with the axes and any turning points.

(3)

(Total 7 marks)

[Awards]

Q7. $x^2 - 8x = (x + p)^2 + q$ for all values of x.

(a) Find the value of p and the value of q.

p =.....

q =.....

(2)

(b) Solve the equation $4(x^2 - 8x) + 63 = 0$

(3)

(Total 5 marks)

Mark Scheme

Q1.

		Working	Answer	Mark	Notes
	(a)		$a = 4, b = 5$	3	M1 for sight of $(x – 4)^2$ M1 for $(x – 4)^2 – 16 + 21$ A1 for $a = 4, b = 5$ OR M1 for $x^2 – 2ax + a^2 + b$ M1 for $–2a = – 8$ and $a^2 + b = 21$ A1 for $a = 4, b = 5$
	(b)		(4, 5)	1	B1 ft

Q2.

5MB3H/01 June 2015				
Question	**Working**	**Answer**	**Mark**	**Notes**
(a)		$p = 4$, $q = -10$	3	M1 for sight of $(x - 4)^2$ or $p = 4$ M1 for $(x - 4)^2 - 16 + 6$ A1 for $p = 4$, $q = -10$ OR M1 for $x^2 – 2px + p^2 + q$ or $–2p = –8$ or $p^2 + q = 6$ M1 for $-2p = -8$ and $p^2 + q = 6$ A1 for $p = 4$, $q = -10$
(b)		(4, -10)	1	B1 ft

Q3.

Mock Paper 1MA1: 2H					
Question		**Answer**	**AO**	**Mark**	**Notes**
		(– 5, – 7)	1.3 b	M1	method to start to complete the square, e.g. $(x + 5)^2$
			1.3 b	M1	$(x + 5)^2 – 7$

Mock Paper 1MA1: 2H					
Question		**Answer**	**AO**	**Mark**	**Notes**
			1.3 b	A1	cao (dep on method seen)

Q4.

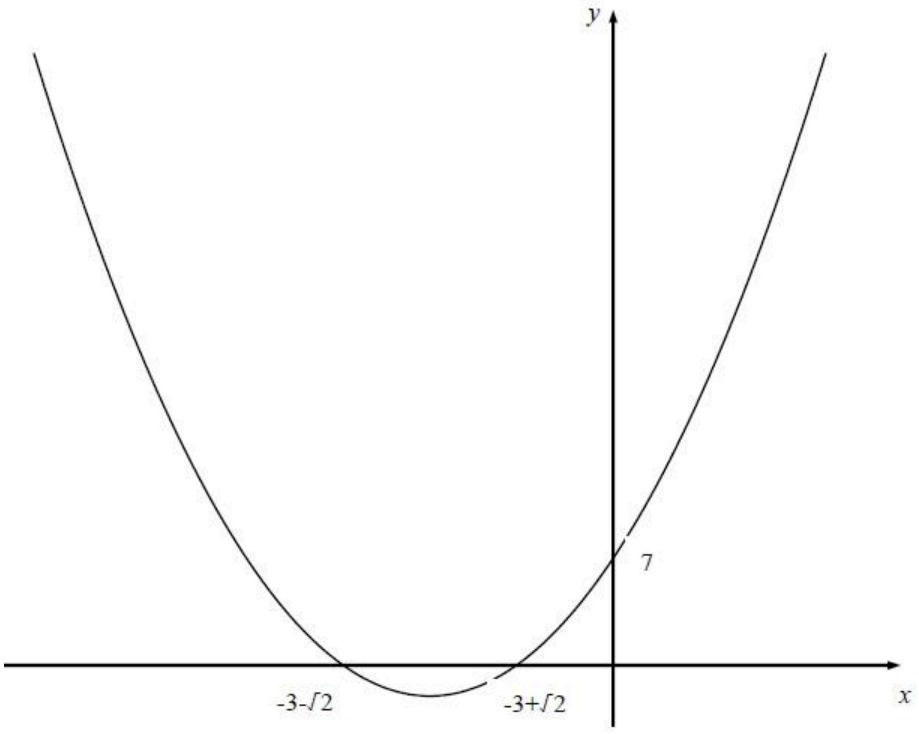
Question	Working	Answer	Mark	AO	Notes
a	$2(x^2-4x)+9$ **or**			AO1	M1
	$2(x^2-4x+\frac{9}{2})$				
	$2((x-2)^2-2^2)+9$ **or**				M1
	$2((x-2)^2-2^2+\frac{9}{2})$				
		$2(x-2)^2+1$	3		A1
b		explanation	1	AO1	B1 eg. Because minimum is at (2, 1)

Q5.

Question		Working	Answer	Mark	Notes
	(a)	$(x+2)^2-4+7$	$(x+2)^2+3$	2	M1 for $(x+2)^2$ oe A1 for $(x+2)^2+3$
	(b)		(–2, 3)	1	B1 for (–2, 3) or ft from (a)

Q6.

PAPER: AAL30_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
(a)(i)		$(x+3)^2-2$	4	B1 for $(x+3)^2$ or $a=3$ B1 for $(x+3)^2-2$ or $a=3, b=-2$
(ii)		$-3\pm\sqrt{2}$		B1 ft $-3-\sqrt{2}$ B1 ft $-3+\sqrt{2}$
(b)		Graph drawn	3	B3 ft fully correct graph sketched with labels at points where the graph intersects the axes and at the turning point. (B2 correct graph sketched without labels) (B1 correct shape of graph in any position)



Q7.

PAPER: AAL30_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
	(a)	$(x-4)^2-16$	$-4,\ -16$	2	M1 for $(x-4)^2 \pm c$ A1 cao
	(b)	$4\{(x-4)^2-16\}+63=0$ $4(x-4)^2=1$ $x-4=\pm\frac{1}{2}$ OR $4x^2-32x+63=0$ $(2x-7)(2x-9)=0$ OR $a=4,\ b=-32,\ c=63$ $\frac{--32\pm\sqrt{(-32)^2-4\times4\times63}}{2\times4}$ $=\frac{32\pm\sqrt{1024-1008}}{8}=$ $\frac{32\pm\sqrt{16}}{8}$ $=\frac{9}{2}$ or $\frac{7}{2}$	$\frac{7}{2}$, $\frac{9}{2}$	3	M1 for correct use of completing the square, eg $4\{"(x-4)^2-16"\}+63=0$ or $(2x-8)^2-64+63=0$ M1 for $(x-4)=\pm\sqrt{\frac{1}{4}}$ or $(2x-8)=\pm1$ A1 for $\frac{7}{2}$, $\frac{9}{2}$ oe OR M1 for $4x^2-32x+63=0$ M1 for factorisation of $4x^2-32x+63$ A1 for $\frac{7}{2}$, $\frac{9}{2}$ oe OR M1 for correct substitution into the formula M1 for $\frac{32\pm\sqrt{16}}{8}$ or $\frac{16\pm\sqrt{4}}{4}$ or $\frac{8\pm1}{2}$ A1 for $\frac{7}{2}$, $\frac{9}{2}$ oe