



# EXAM PAPERS PRACTICE

GCSE OCR Math J560

Completing the square

Answers

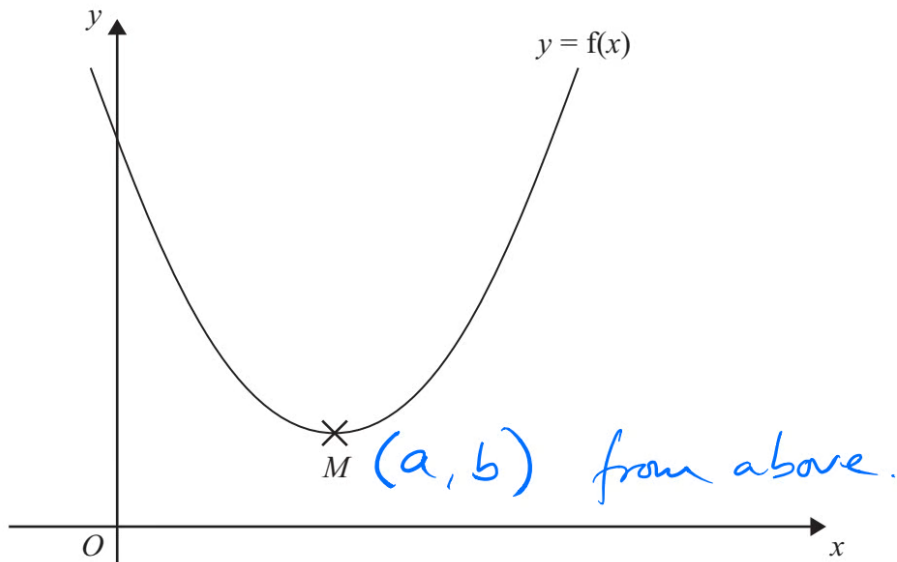
*"We will help you to  
achieve A Star "*



**Answer 1**

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  $M$ .



( 4 , 5 )

**Answer 2**

COMPLETING THE SQUARE

Write  $x^2 + 6x - 7$  in the form  $(x + a)^2 + b$  where  $a$  and  $b$  are integers.  $\rightarrow$  WHOLE NUMBERS

$$\begin{aligned} & x^2 + 6x - 7 \\ & \quad \quad \quad \text{HALF OF 6} \\ & \quad \quad \quad \downarrow \\ & \quad \quad \quad (x + 3)^2 \\ & \quad \quad \quad \downarrow \\ & \quad \quad \quad = (x + 3)(x + 3) \\ & \quad \quad \quad \text{F O I L} \\ & \quad \quad \quad = x^2 + 3x + 3x + 9 \\ & \quad \quad \quad = x^2 + 6x + 9 \\ & \quad \quad \quad \downarrow \\ & \quad \quad \quad = (x + 3)^2 - 9 - 7 \\ & \quad \quad \quad = (x + 3)^2 - 16 \end{aligned}$$



**Answer 3**

Solve  $x^2 - 6x - 8 = 0$

↗ WHOLE NUMBERS

Write your answer in the form  $a \pm \sqrt{b}$  where  $a$  and  $b$  are integers.

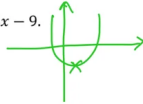
BEST WAY: COMPLETING THE SQUARE

$$\begin{aligned} & \underbrace{x^2 - 6x - 8 = 0} \\ & \downarrow \\ & (x-3)^2 - 9 - 8 = 0 \\ & (x-3)^2 - 17 = 0 \\ & \qquad \qquad \qquad +17 \quad +17 \\ & (x-3)^2 = 17 \\ & \checkmark \quad x-3 = \pm \sqrt{17} \\ & \qquad \qquad +3 \quad +3 \\ & \underline{\underline{x = 3 \pm \sqrt{17}}} \end{aligned}$$
$$\begin{aligned} & (x-3)^2 \\ & = (x-3)(x-3) \\ & \quad \quad \quad \begin{matrix} F & O & I & L \end{matrix} \\ & = x^2 - 3x - 3x + 9 \\ & = x^2 - 6x + 9 \end{aligned}$$



**Answer 4**

(b) Write down the minimum point on the graph of  $y = x^2 + 8x - 9$ .



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b)  $(x+4)^2 - 25$   $(x+b)^2 + c$   
 $(-4, -25)$   $(-b, c)$

**Answer 5**

COMPLETING THE SQUARE

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  $b$ .

$a = 4$   
 $b = 5$

$(x-4)^2 = x^2 - 8x + 16$

$a = \underline{\quad 4 \quad}$   
 $b = \underline{\quad 5 \quad}$



**Answer 6**

Solve  $(x - 2)^2 = 3$

Give your solutions correct to 3 significant figures.

$$\sqrt{(x-2)^2} = \sqrt{3}$$

$$x - 2 = \pm \sqrt{3}$$

$$+2 \quad +2$$

$$x = 2 \pm \sqrt{3}$$

$$x = 2 + \sqrt{3} \text{ or } 2 - \sqrt{3}$$

$$x = 3.732050808 \dots$$

↓  
< 5  
Round Down

$$x = \underline{\underline{3.73}}$$

NOT SIGNIFICANT  
(LEADING ZERO)

$$\text{OR } 0.2679491924 \dots$$

↓  
≥ 5  
Round Up

$$x = \underline{\underline{0.268}}$$



**Answer 7**

Write  $x^2 + 2x - 8$  in the form  $(x + m)^2 + n$  where  $m$  and  $n$  are integers.

WHOLE NUMBERS

$$\begin{aligned}x^2 + 2x - 8 &= x^2 + 2x + 1 - 9 \\ &= \underline{\underline{(x+1)^2 - 9}}\end{aligned}$$

"COMPLETING THE SQUARE"

$$(x+1)^2 = (x+1)(x+1)$$

F O I L

$$= x^2 + x + x + 1$$

$$= x^2 + 2x + 1$$

**Answer 8**

(a) Write the quadratic function  $y = x^2 + 8x - 9$  in the form  $y = a(x + b)^2 + c$  where  $a$ ,  $b$  and  $c$  are integers to be found.

COMPLETING THE SQUARE

$$\begin{aligned}a) \quad x^2 + 8x - 9 & \quad (x+b)^2 + c \\ (x+4)^2 - 4^2 - 9 & \end{aligned}$$

$$(x+4)^2 - 16 - 9$$

$$\boxed{(x+4)^2 - 25}$$



Answer 9

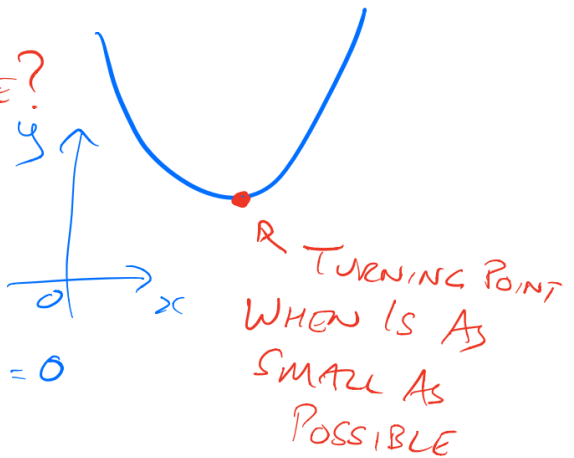
- (b) Hence, ~~or otherwise~~ <sup>DON'T!</sup> write down the coordinates of the turning point of the graph of  $y = 2x^2 + 16x + 35$

POSITIVE QUADRATIC GRAPH

WHAT VALUE OF  $x$   
MAKES  $y$  AS SMALL AS POSSIBLE?

$$y = 2(x+4)^2 + 3$$

$x = -4$   
MAKES THIS = 0



WHEN  $x = -4$

$$y = 2 \times 0^2 + 3 = 3$$

TURNING PT IS  $(-4, 3)$

Answer 10

- (a) Write the quadratic function  $y = 4x^2 + 8x - 5$  in the form  $y = a(x+b)^2 + c$  where  $a, b$  and  $c$  are integers to be found.

- (b) Write down the minimum point on the graph of  $y = 4x^2 + 8x - 5$ .



b)

$$4(x+1)^2 - 9$$

MINIMUM POINT

$$(-1, -9)$$

$(-b, c)$



Answer 11

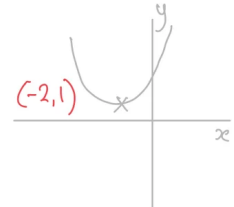
(b) Given that  $c = 5$ , hence, or otherwise, show that the function  $f(x) = x^2 + 4x + c$  has no real roots.

DISCRIMINANT  
 $b^2 - 4ac < 0$

b)  $(-2, c-4)$  MINIMUM

SUBSTITUTE

$c = 5$   $(-2, 1)$



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MINIMUM =  $(-2, 1)$

y value  $> 0$

$\therefore f(x)$  DOES NOT INTERSECT

x AXIS

$\therefore$  NO REAL ROOTS

Answer 12

(b) Write down the maximum point on the graph of  $y = -6x^2 + 8x - 5$ .

b)  $a - b(x+c)^2$

MAXIMUM =  $(-c, a)$

$-\frac{7}{3} - 6\left(x - \frac{2}{3}\right)^2$

$\left(\frac{2}{3}, -\frac{7}{3}\right)$

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Answer 13

COMPLETING THE SQUARE

(a) Write  $2x^2 + 16x + 35$  in the form  $a(x + b)^2 + c$  where  $a$ ,  $b$ , and  $c$  are integers.

$$\begin{aligned} 2x^2 + 16x + 35 &= 2(x^2 + 8x) + 35 \\ &= 2[(x+4)^2 - 16] + 35 \\ &= 2(x+4)^2 - 32 + 35 \\ &= \underline{2(x+4)^2 + 3} \end{aligned}$$

$(x+4)^2$   
 $= (x+4)(x+4)$   
F O I L  
 $= x^2 + 4x + 4x + 16$   
 $= \underline{x^2 + 8x + 16}$

Answer 14

(a) Write the quadratic function  $y = 4x^2 + 8x - 5$  in the form  $y = a(x + b)^2 + c$  where  $a$ ,  $b$  and  $c$  are integers to be found.

COMPLETING THE SQUARE

a)  $4x^2 + 8x - 5$   
 $4[x^2 + 2x] - 5$   
 $4[(x+1)^2 - 1] - 5$   
 $4(x+1)^2 - 4 - 5$   
 $4(x+1)^2 - 9$

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**Answer 15**

(a) Find the **minimum value** of the function  $f(x) = x^2 + 4x + c$ , giving your answer in terms of  $c$ .

a)  $x^2 + 4x + c$   
 $(x+2)^2 - 4 + c$

$(-2, c-4)$

COMPLETE  
THE  
SQUARE  
 $(x+p)^2 + q$   
MINIMUM  
 $(-p, q)$

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