

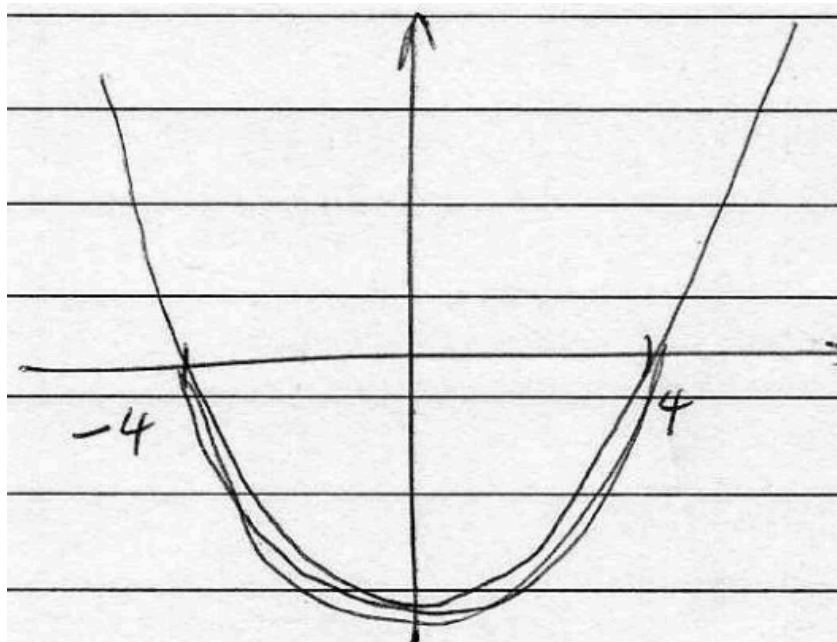
- 1
- Complete the square: $x^2 - 6x + 11 = (x - 3)^2 + 2$. (M1)
 - Identify that the minimum point is (3, 2). (A1)
 - Since $(x - 3)^2 \geq 0$, conclude that $(x - 3)^2 + 2 > 0$ for all real x . (C1)

(Total for question 1 is 3 marks)

- 2
- Rearrange the inequality to $x^2 + 3x + 9 > 0$. (M1)
 - Complete the square: $x^2 + 3x + 9 = \left(x + \frac{3}{2}\right)^2 + \frac{27}{4}$. (M1)
 - Identify the minimum point as $\left(-\frac{3}{2}, \frac{27}{4}\right)$, so the minimum value is positive. (A1)
 - Conclude that $x^2 + 4x + 12 > x + 3$ for all real x . (C1)

(Total for question 2 is 4 marks)

- 3
- (a)
- Complete the square: $\left(x + \frac{p}{2}\right)^2 - \frac{p^2}{4} + 4 = 0$. (M1)
 - Rearrange to $\left(x + \frac{p}{2}\right)^2 = \frac{p^2}{4} - 4$ and take both square roots. (M1)
 - Obtain $x = -\frac{p}{2} \pm \sqrt{\frac{p^2}{4} - 4}$. (A1)
- (b)
- Require $\frac{p^2}{4} - 4 < 0$, giving $p^2 < 16$ and hence $-4 < p < 4$. (A1)



(Total for question 3 is 4 marks)

- 4
- Use the minimum point to write the quadratic as $(x - 4)^2 - 3$. (M1)
 - Expand $(x - 4)^2 - 3$ to obtain $x^2 - 8x + 13$. (M1)
 - Compare coefficients to find $a = -8$. (A1)
 - Compare coefficients to find $b = 13$. (A1)

(Total for question 4 is 4 marks)

- 5
- Factor out 2: $2(x^2 + 4x + \frac{1}{2})$. (M1)
 - Complete the square inside the brackets: $2((x + 2)^2 - \frac{7}{2})$. (M1)
 - Simplify to $f(x) = 2(x + 2)^2 - 7$. (A1)
 - State $a = 2$, $b = 2$ and $c = -7$. (A1)

(Total for question 5 is 4 marks)

- 6
- (a)
- Form the square $(x + \frac{9}{2})^2$ and compensate with $-\frac{81}{4} + 3$. (M1)
 - Simplify to $(x + \frac{9}{2})^2 - \frac{69}{4}$. (A1)
- (b)
- Use the completed-square form to identify the x -coordinate as $-\frac{9}{2}$. (B1)
 - State the minimum point as $(-\frac{9}{2}, -\frac{69}{4})$. (A1)

(Total for question 6 is 4 marks)

- 7
- (a)
- Complete the square: $(x + \frac{k}{2})^2 - \frac{k^2}{4} - 6 = 0$. (M1)
 - Rearrange to $(x + \frac{k}{2})^2 = \frac{k^2}{4} + 6$. (M1)
 - Take both square roots: $x + \frac{k}{2} = \pm \sqrt{\frac{k^2}{4} + 6}$. (M1)
 - Obtain $x = -\frac{k}{2} \pm \sqrt{\frac{k^2}{4} + 6}$. (A1)
- (b)
- Substitute $k = 4$ into the result from part (a): $x = -2 \pm \sqrt{\frac{16}{4} + 6}$. (M1)
 - Simplify to $x = -2 + \sqrt{10}$ or $x = -2 - \sqrt{10}$. (A1)

(Total for question 7 is 6 marks)