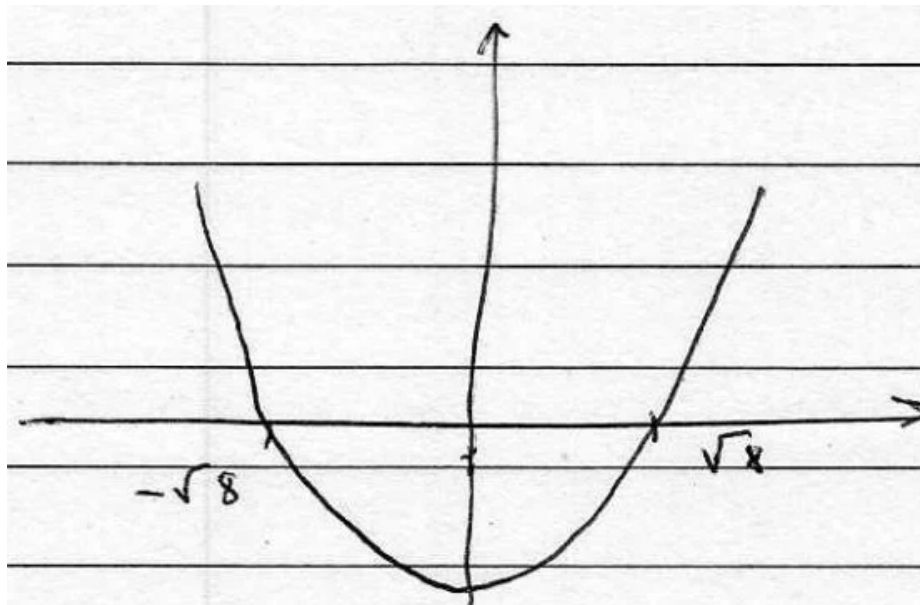


- 1
- Uses the condition for no real roots: $b^2 - 4ac < 0$. (M1)
 - Obtains $k^2 - 8 < 0$. (A1)
 - Concludes $-\sqrt{8} < k < \sqrt{8}$. (A1)



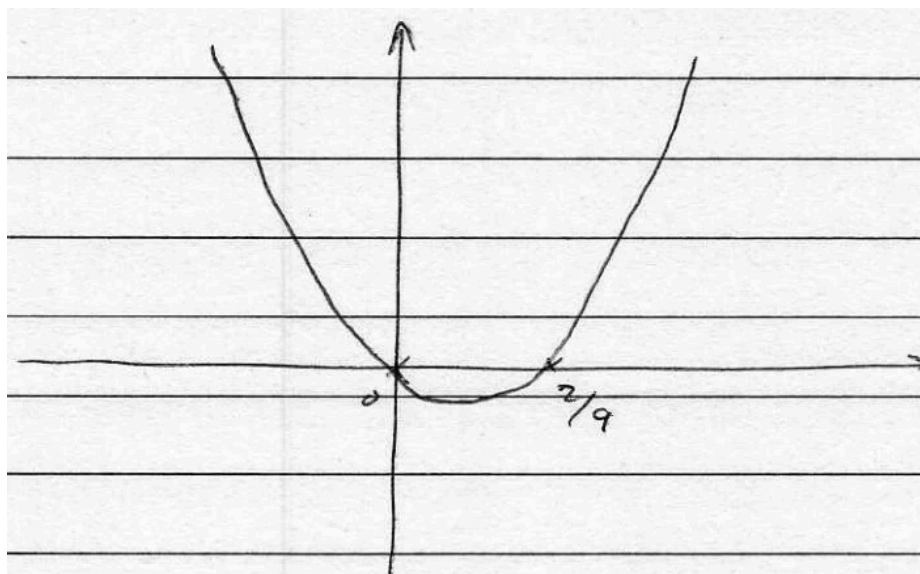
(Total for question 1 is 3 marks)

- 2
- Uses the condition for equal roots: $b^2 - 4ac = 0$. (M1)
 - Obtains $25 - 4k^2 = 0$ and hence $k = \pm \frac{5}{2}$. (A1)
 - Uses the fact that k is positive to give $k = \frac{5}{2}$. (A1)

(Total for question 2 is 3 marks)

3

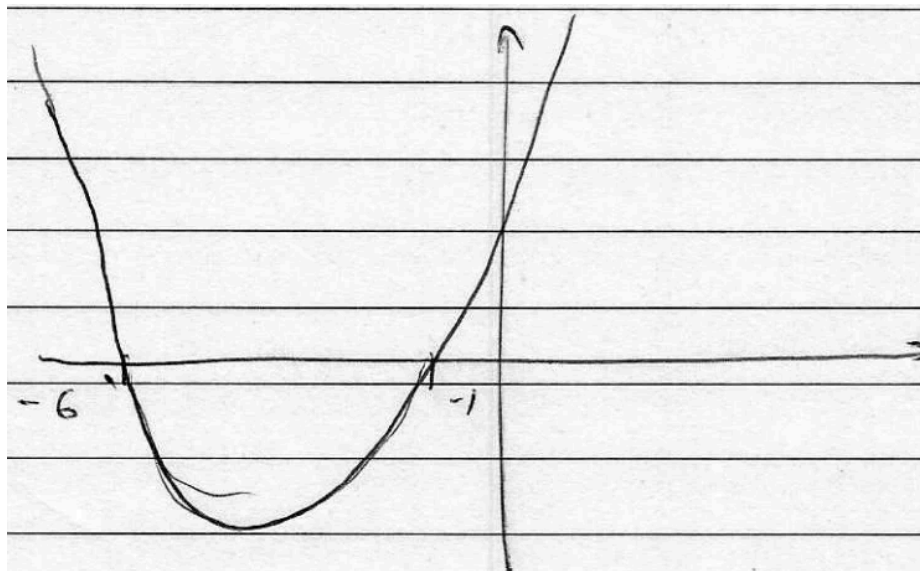
- Uses $b^2 - 4ac < 0$ with $a = k$, $b = 6k$ and $c = 2$. (M1)
- Obtains $36k^2 - 8k < 0$. (A1)
- Factorises to $4k(9k - 2) < 0$ and identifies the boundary values 0 and $\frac{2}{9}$. (M1)
- Concludes $0 < k < \frac{2}{9}$. (A1)



(Total for question 3 is 4 marks)

4

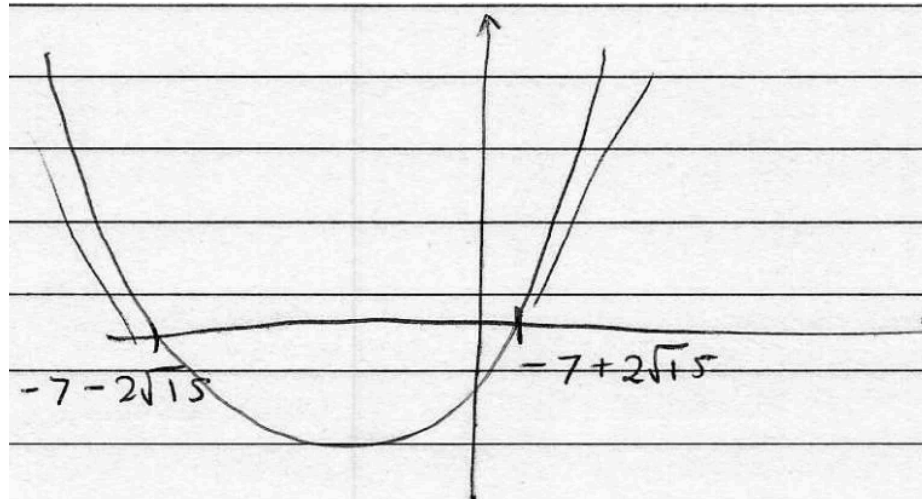
- Uses the condition for two distinct real solutions: $b^2 - 4ac > 0$. (M1)
- Substitutes the coefficients to obtain $16 - 4(k + 5)(k + 2) > 0$. (A1)
- Expands to obtain $16 - 4(k^2 + 7k + 10) > 0$. (M1)
- Rearranges to $k^2 + 7k + 6 < 0$. (A1)
- Factorises to $(k + 6)(k + 1) < 0$. (M1)
- Identifies the boundary values $k = -6$ and $k = -1$. (A1)
- Concludes $-6 < k < -1$. (A1)



(Total for question 4 is 7 marks)

5

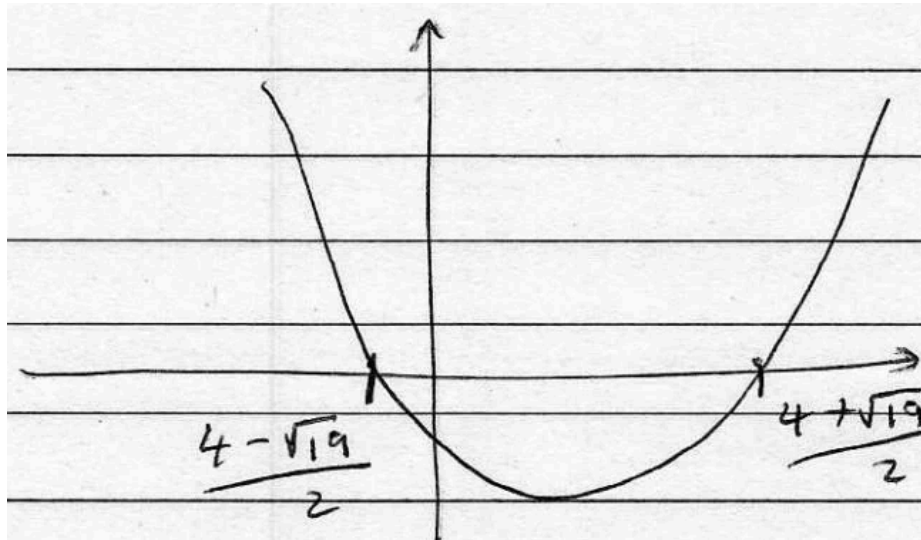
- Uses the condition for two distinct real roots: $b^2 - 4ac > 0$. (M1)
- Substitutes the coefficients to obtain $(n + 1)^2 - 4(3 - 3n) > 0$. (A1)
- Expands and simplifies to $n^2 + 14n - 11 > 0$. (A1)
- Applies the quadratic formula to $n^2 + 14n - 11 = 0$. (M1)
- Finds the boundary values $n = -7 \pm 2\sqrt{15}$. (A1)
- Selects the regions outside the two boundary values. (M1)
- Concludes $n < -7 - 2\sqrt{15}$ or $n > -7 + 2\sqrt{15}$. (A1)



(Total for question 5 is 7 marks)

6

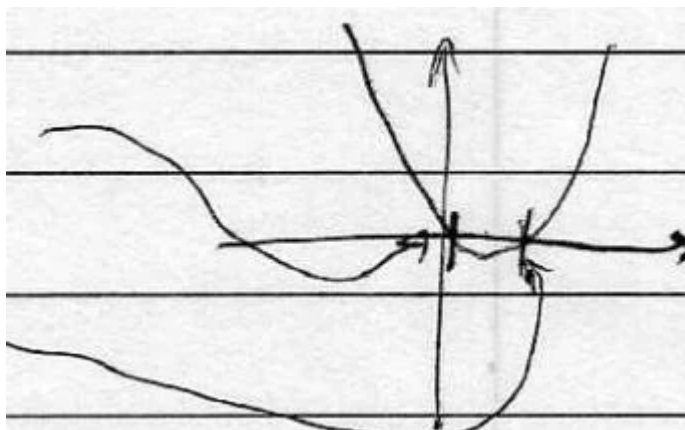
- Uses the condition for no real roots: $b^2 - 4ac < 0$. (M1)
- Substitutes the coefficients to obtain $(2k - 3)^2 - 4(k + 3) < 0$. (A1)
- Expands the squared expression correctly. (M1)
- Simplifies to $4k^2 - 16k - 3 < 0$. (A1)
- Applies the quadratic formula to $4k^2 - 16k - 3 = 0$. (M1)
- Simplifies the boundary values to $\frac{4-\sqrt{19}}{2}$ and $\frac{4+\sqrt{19}}{2}$. (A1)
- Selects the interval between the boundary values. (M1)
- Concludes $\frac{4-\sqrt{19}}{2} < k < \frac{4+\sqrt{19}}{2}$. (A1)



(Total for question 6 is 8 marks)

7

- (a)
- Equates the curve and line to obtain $px^2 - 4px - 5p = 2x - 12$. (M1)
 - Rearranges to $px^2 - (4p + 2)x + (12 - 5p) = 0$. (A1)
 - Uses $b^2 - 4ac < 0$ because there are no points of intersection. (M1)
 - Substitutes the coefficients to obtain $(4p + 2)^2 - 4p(12 - 5p) < 0$. (A1)
 - Expands, simplifies and divides by 4 to show that $9p^2 - 8p + 1 < 0$. (A1)
- (b)
- Solves $9p^2 - 8p + 1 = 0$ using the quadratic formula. (M1)
 - Obtains the boundary values $p = \frac{4-\sqrt{7}}{9}$ and $p = \frac{4+\sqrt{7}}{9}$. (A1)
 - Concludes $\frac{4-\sqrt{7}}{9} < p < \frac{4+\sqrt{7}}{9}$. (A1)



(Total for question 7 is 8 marks)

8

- Substitutes $y = mx - 2$ into the circle equation. (M1)
- Expands and simplifies to $(m^2 + 1)x^2 + (6 - 12m)x + 25 = 0$. (A1)
- Uses the tangent condition $b^2 - 4ac = 0$. (M1)
- Obtains $(6 - 12m)^2 - 100(m^2 + 1) = 0$. (A1)
- Expands and simplifies to $11m^2 - 36m - 16 = 0$. (A1)
- Applies the quadratic formula to solve for m . (M1)
- Obtains $m = \frac{18+10\sqrt{5}}{11}$ or $m = \frac{18-10\sqrt{5}}{11}$. (A1)

(Total for question 8 is 7 marks)

9

- Substitutes $y = mx + 2$ into the circle equation. (M1)
- Expands and simplifies to $(1 + m^2)x^2 + (6m - 10)x + 19 = 0$. (A1)
- Uses the tangent condition $b^2 - 4ac = 0$. (M1)
- Obtains $(6m - 10)^2 - 76(1 + m^2) = 0$. (A1)
- Expands and simplifies to $5m^2 + 15m - 3 = 0$. (A1)
- Applies the quadratic formula to solve for m . (M1)
- Obtains $m = \frac{-15 + \sqrt{285}}{10}$ or $m = \frac{-15 - \sqrt{285}}{10}$. (A1)

(Total for question 9 is 7 marks)
