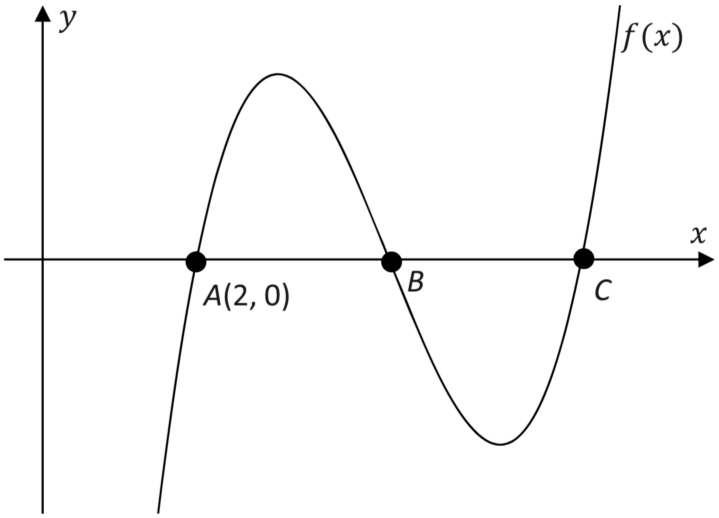
Question 4 **(25 marks)**

(a) Find $\int (4x^3 - 6x + 10)\, dx$.

(b) Part of the graph of a cubic function $f(x)$ is shown below (graph not to scale).
The graph cuts the x-axis at the three points $A(2, 0)$, B, and C.



(i) Given that $f'(x) = 6x^2 - 54x + 109$, show that $f(x) = 2x^3 - 27x^2 + 109x - 126$.

(ii) Find the co-ordinates of the point B and the point C.

Q4	Model Solution – 25 Marks	Marking Notes
(a)	$\frac{4x^4}{4} - \frac{6x^2}{2} + 10x + C$ $x^4 - 3x^2 + 10x + C$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* - Any relevant integration *High Partial Credit:* - 3 correct terms
(b) **(i)**	$\int (6x^2 - 54x + 109)\, dx$ $= 2x^3 - 27x^2 + 109x + C = f(x)$ $(2, 0) \in f(x)$ $2(2)^3 - 27(2)^2 + 109(2) + C = 0$ $2(8) - 27(4) + 218 + C = 0$ $16 - 108 + 218 + C = 0$ $16 + 110 + C = 0$ $126 + C = 0$ $C = -126$ $\therefore f(x) = 2x^3 - 27x^2 + 109x - 126$	**Scale 10D (0, 4, 5, 8, 10)** *Low Partial Credit:* - Any relevant integration *Mid Partial Credit* - 3 correct terms *High Partial Credit:* - Relevant equation in C *Note:* Must integrate or indicate integration to gain any credit

(b) (ii)	2 is a root $\Rightarrow (x-2)$ is a factor $2x^3 - 27x^2 + 109x - 126 = 0$ $2x^2(x-2) - 23x(x-2) + 63(x-2)$ $2x^2 - 23x + 63 = 0$ $(2x - 9)(x-7) = 0$ $x = 4{\cdot}5$ or $x = 7$ $\therefore B(4{\cdot}5, 0)$ and $C(7, 0)$	**Scale 10D (0, 4, 5, 8, 10)** *Low Partial Credit:* - 2 identified as root - 0 given as the y co-ordinate - Sets up equation - Any integer fully substituted in $f(x)$ fully worked - $(x-2)$ is a factor - Sets up the correct equation *Mid Partial Credit* - Division completed with no remainder - 7 identified as a root - One coordinate pair found *High Partial Credit:* - x values found from factors