

Let

$$I(c) = \int_0^1 ((x-c)^2 + c^2) dx$$

where c is a real number.

- (i) Sketch $y = (x-1)^2 + 1$ for the values $-1 \leq x \leq 3$ on the axes below and show on your graph the area represented by the integral $I(1)$.
- (ii) Without explicitly calculating $I(c)$, explain why $I(c) \geq 0$ for any value of c .
- (iii) Calculate $I(c)$.
- (iv) What is the minimum value of $I(c)$ (as c varies)?
- (v) What is the maximum value of $I(\sin \theta)$ as θ varies?

