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A LEVEL MATHS

(54) Using the 2nd Derivative

WORKING AT D/E

(1) $f(x) = -x^2 + 2,\ x \in R$

(a) Find $f'(x)$

(b) Find $f''(x)$

(c) Hence, show that $f(x)$ is concave for all values of x.

(2) $g(x) = 8x + 4x^2\ x\epsilon R$

By considering $g''(x)$, show that the curve is convex for all values of x.

(3) $f(x) = e^x,\ x\epsilon R$

(a) Sketch the graph of $y = f(x)$

(b) Prove that the curve is convex for all values of x

WORKING AT B/C

(1) $f(x) = \ln x + 3x^2,\ x \geq 1$

(a) Show that $f''(x) = 6 - \frac{1}{x^2}$

(b) By considering the domain of $f(x)$, explain why the function is convex for all values x.

(2) $g(x) = 2x - e^{3x},\ x\epsilon R$

(a) Find $g'(x)$

(b) Find $g''(x)$

(c) State whether $g(x)$ is concave or convex for all values of x giving a justification for your answer.

(3) $f(x) = x^3 - 2x^2 - 11x + 12,\ x\epsilon R$

(a) Show that $f(1) = 0$

(b) Use polynomial division to express $f(x)$ in the form $f(x) = (x + a)(x + b)(x + c)$

(c) Hence, sketch the graph of $y = f(x)$

(d) Show that the graph is convex when $x \geq \frac{2}{3}$ and concave when $x \leq \frac{2}{3}$

WORKING AT A*/A

(1) $f(x) = (\cos x + \sin x)^2,\ 0 \leq x \leq \pi$

Use calculus to show that the function is concave when $\frac{\pi}{2} \leq x \leq \pi$

(2) $g(x) = 3x + \frac{1}{x}\ , x \neq 0$

Find the values of x for which the curve of $y = g(x)$ is concave.