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MATRIC NO: 17/ENG06/039

DEPARTMENT: MECHANICAL ENGINEERING

QUESTION 1

$F = x^2 i + (3x+2) j + \sin x K$

a $\frac{dF}{dx} = 2xi + 3j + \cos x K$

b $\frac{d^2F}{dx^2} = 2i - \sin x K$

c $\left|\frac{dF}{dx}\right|$

Recall $\frac{dF}{dx} = 2xi + 3j + \cos x K$

when $x = 1$, $\frac{dF}{dx} = 2i + 3j + K$

$\left|\frac{dF}{dx}\right| = \sqrt{(2)^2 + (3)^2 + (1)^2}$

$= \sqrt{4 + 9 + 1} = \sqrt{14}$

$= 3.74$

d $\frac{d}{dx}(F \cdot F)$ at $x = 1$

$F \cdot F = (x^2 i + (3x+2) j + \sin x K) \cdot (x^2 i + (3x+2) j + \sin x K)$

$= (x^2 \cdot x^2) i (3x+2)(3x+2) j + (\sin x)(\sin x) K$

$= x^4 i + (9x^2 + 6x + 6x + 4) j + (\sin^2 x) K$

$F \cdot F = x^4 i + (9x^2 + 12x + 4) j + (\sin^2 x) K$

$\frac{d}{dx}(F \cdot F) = 4x^3 + (18x + 12) + \sin(2x)$

$\frac{d}{dx}(F \cdot F) = 4x^3 + 18x + 12 + \sin(2x)$

$= 4 + 18 + 12 + 0.035$

$= 34.035$

$\frac{d}{dx}(F \cdot F) = 34.035$

QUESTION 2

$r = (t^2 + 3t) i - 2\sin 3t j + 3e^{2t} K$

i $\frac{dr}{dt} = (2t + 3) i - 6\cos 3t j + 6e^{2t} K$

b $\frac{d^2r}{dt^2} = \frac{d}{dt}\left[\frac{dr}{dt}\right]$

$$= \frac{d}{dt}\left[(2t+3)i + (-6\cos 3t)j + 6e^{2t}k\right]$$

$$\frac{d^2r}{dt^2} = 2i + (18\sin 3t)j + 12e^{2t}k$$

$$\left|\frac{d^2r}{dt^2}\right| = \sqrt{(2)^2 + (18\sin 3(0))^2 + (12e^{2\cos})^2}$$

at $t=0$

$$= \sqrt{2^2 + (18\sin(0))^2 + (12e^0)^2}$$

$$= \sqrt{4 + 144}$$

$$= \sqrt{148}$$

$$= 2\sqrt{37}$$

$$\simeq 12.17$$