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MATRIC NO: 17ENGOB1064

COURSE: ENG 282

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Question 1

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

a. $\frac{dF}{dx} = 2xi + 3j + \cos xk$

b. $\frac{d^2F}{dx^2} = 2i - \sin xk$

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

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

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 $x=1$

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

$$= (x^2 - x^2)i + (3x+2)(3x+2)j + (\sin x)(\sin x)k$$

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

$$F \cdot F = x^4i + (9x^2 + 6x + 4)j + (\sin^2 x)k$$

$$\frac{d}{dx}(F \cdot F) = 4x^3 + (18x + 6) + \sin(2x)$$

$$\frac{d}{dx}(F \cdot F) = 4x^3 + 18x + 6 + \sin(2x)$$

$$= 4 + 18 + 6 + 0.035$$

$$= 34.035$$

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

Question 2

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

a. $\frac{dr}{dt} = (2t+3)i - 6\cos 3tj + 6e^{2t}k$

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

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

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

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

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

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

$$= \sqrt{148}$$

$$= 2\sqrt{37}$$

$$= \underline{\underline{12.17}}$$