

KAYODE Muinat Adebukola

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CHEMICAL Engineering

ENG 282 Assignment

1 Given that

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

Find: a) $\frac{dF}{dx}$ b) $\frac{d^2F}{dx^2}$ c) $\left| \frac{dF}{dx} \right|$ d) $\frac{d}{dx}(F \cdot F)$ at $x=1$

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

a) $\frac{dr}{dt}$ b) $\frac{d^2r}{dt^2}$ c) the value of $\left| \frac{d^2r}{dt^2} \right|$ at $t=0$

Solution

1 $F = x^2i + (3x+2)j + \sin xk$

a) $\frac{dF}{dx} = 2xi + 3j + \cos xk$ @ $x=1$

$$\frac{dF}{dx} = 2i + 3j + k$$

b) $\frac{d^2F}{dx^2} = 2i + 0j - \sin xk$, @ $x=1$

$$\frac{d^2F}{dx^2} = 2i + 0j + (0.0175)k$$

c) $\left| \frac{dF}{dx} \right| = \sqrt{2^2 + 3^2 + 1^2} = \sqrt{4+9+1} = \sqrt{14}$

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

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

$$\frac{d}{dx}(F \cdot F) = 4x^3 + 18x + 12 + 2\sin x \cos x$$
 @ $x=1$

$$\frac{d}{dx}(F \cdot F) = 4 + 18 + 12 + 0.035 = 34.035$$

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

$$a \quad \frac{dx}{dt} = (2t + 3)i - (6\cos 3t)j + 6e^{2t}k$$

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

$$c \quad \left| \frac{d^2x}{dt^2} \right| @ t=0 = 2i + 0j + 12k = \sqrt{2^2 + 12^2} = \sqrt{148} = 2\sqrt{37}$$