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17/ENG 01/008

CHEMICAL ENGINEERING

Assignment 2

- (1) Given that $F = x^2i + (3x+2)j + \sin x k$
 (a) Find $\frac{dF}{dx}$ (b) $\frac{d^2F}{dx^2}$ (c) $|dF/dx|$ (d) $\frac{d(F \cdot F)}{dx}$ all at $x=1$

SOLUTION

(a) $dF/dx = 2xi + 3j + \cos x k$ at $x=1$ $dF/dx = 2(1)i + 3(1)j + \cos(1)k$
 dF/dx at $x=1 = 2i + 3j + 0.9998k$

(b) $d^2F/dx^2 = 2i - \sin x k$ at $x=1$ $d^2F/dx^2 = 2i - \sin(1)k$
 $d^2F/dx^2 = 2i - 0.0174k$

(c) $|dF/dx| = \sqrt{2^2 + 3^2 + 0.9998^2} = 3.74$

(d) $\frac{d(F \cdot F)}{dx}$ $F \cdot F = (x^2i + (3x+2)j + \sin x k) \cdot (x^2i + (3x+2)j + \sin x k)$
 $F \cdot F = x^4 + 9x^2 + 12x + 4 + \sin^2 x$

$d(F \cdot F)/dx = 4x^3 + 18x + 12 + 0 + \cos^2 x$

at $x=1$, $d(F \cdot F)/dx = 4(1)^3 + 18(1) + 12 + \cos^2(1) = 34 + (0.9998)^2 = 34.9997$
 $d(F \cdot F)/dx = 35$

(2) $r = (t^2 + 3t)i + 2\sin 3t j + 3e^{2t} k$; determine: (1) dr/dt , (2) d^2r/dt^2 and the value of $|dr/dt|$ at $t=0$ (3.)

SOLUTION:

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

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

(c) $|d^2r/dt^2|$ at $t=0$ $d^2r/dt^2 = 2i + 18\sin 3(0)j + 12e^{2(0)}k$

$d^2r/dt^2 = 2i + 0j + 12k$

$|d^2r/dt^2| = \sqrt{2^2 + 12^2} = \sqrt{4 + 144} = \sqrt{148} = 12.165$