AROH [illegible]
19/ENG04/012
Electrical & Electronics Engineering

1) Given that

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

find

(a) $\frac{df}{dx} = 2x i + 3 j + \cos x k$

At $x = 1$

$df/dx = 2(1) i + 3 j + (\cos(1)) k$

(b) $\frac{d^2 f}{dx^2} = \frac{d}{dx}\left[\frac{df}{dx}\right] = 2i - \sin x k$

at $x = 1$

$d^2f/dx^2 = 2i - \sin(1) k$

$= 2i - 0.0175k$

c. $\left[d^2f/dx\right] = 2i + 3j + 0.9998k$

$= \left[2^2 + 3^2 + 0.9998^2\right]^{1/2}$

$= 3.74$

d. $d/dx\ (f \cdot f)$

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

$= x^4 + (9x^2 + 12x + 4) - (\sin^2 k)$

Remember

$i \cdot i = j \cdot j = k \cdot k = 1$

$d/dx\ (f \cdot f) = 4x^3 + (18x + 12) + 2\sin x \cos x$ at $x = 1$

$d/dx\ (f \cdot f) = 4 + 18 + 12 + 2\sin(1)\cos(1)$

$= 4 + 30 + 0.035$

$= 34.035$

2) If

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

determine

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

at $t = 0$

$dr/dt = (2(0) + 3)i - 6\cos 3t\, j + 6e^{2t} k$

$= \cancel{3i +}\ 3i - 6j + 6k$

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

at $t = 0$

$d^2r/dt^2 = 2i + 18\sin 3(0) + 12e^{3(0)}$

$= 2i + 12k$

(c) $\left| \frac{d^2 \vec{r}}{dt^2} \right| =$

$2i + 12k$

$= [2^2 + 12^2]^{1/2}$

$= [4 + 144]^{1/2}$

$= [148]^{1/2}$

$= \sqrt{148}$

$= \sqrt{4 \times 37}$

$= \sqrt{4} \times \sqrt{37}$

$= 2\sqrt{37}$