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17/Engo1/006

1) Given that $F = x^2 i + (3x+2)j + \sin x k$, Find

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

Solution

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

$df/dx = 2x + 3i + \cos x k$

$\left.\frac{dF}{dx}\right|_{x=1} = 2(1)i + 3i + \cos(1)k$

$= 2i + 3i + \cos(1k) = 2i + 3i + 0.998k$

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

$\left.\frac{d^2F}{dx_2}\right|_{x=1} = 2i - \sin(1)k$

$= 2i - 0.0176k$

c) $\left|\frac{dF}{dx}\right|$ at $x1 = \sqrt{2^2 + 3^2 + (0.998)}$

$= \sqrt{13.996}$

$= 3.74$

d) $F \cdot F = (x^2 i + (3x+2)i + \sin x k)(x^2 i + (3k+2)i + \sin x k)$

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

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

$= 4(1) + 18 + 12 + 2\cos(1)\sin(1)$

$= 4 + 30 + 0.035$

$= 34.035$

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

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

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

$\left.\frac{dr}{dt}\right|_{t=0} = (2(0)+3)j - 6\cos 3(0)j + 6e^{2(0)}k$

$= 3i - 6j + 6k$

b) $\frac{d^2r}{dt^2} = 2i + 18\sin 3t\, j$

$\left.\frac{d^2r}{dt^2}\right|_{t=0} = 2i + 12k$

c) $\left|\frac{d^2r}{dt^2}\right| = 2i + 12k$

$= \sqrt{2^2 + 12^2}$

$= \sqrt{4 + 144}$

$= \sqrt{148} = 2\sqrt{37}$