

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

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

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

c) $\left| \frac{dF}{dx} \right| = \sqrt{2^2 + 3^2 + 1^2}$ i.e. at $x = 1$ $\left| \frac{dF}{dx} \right| = 2i + 3j + k$
 $= \sqrt{13}$

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

$F \cdot F = x^4 + (3x+2)^2 + \sin^2 x$ [$i \cdot i = j \cdot j = k \cdot k = 1$]

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

$= 4 + 4(5) + 2(1) = 36$

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

a) $\frac{dr}{dt} = (2t+3)i - 6\cos 3tj + 9e^{3t}k$

b) $\frac{d^2 r}{dt^2} = 2i + 18\sin 3tj + 27e^{3t}k$

c) at $t = 0$

$= 2i + 0 + 27k$

$\left| \frac{d^2 r}{dt^2} \right| = \sqrt{2^2 + 27^2}$

$= 27.07$