

① $F = x^2 i + (3x+2)j + \sin x k$

② $\frac{dF}{dx} = 2xi + 3j + \cos x k$

③ $\frac{d^2 F}{dx^2} = 2i - \sin x k$

④ $\left| \frac{dF}{dx} \right| = \sqrt{(2)^2 + (3)^2 + 1^2}$; $2xi + 3j + \cos x k$ at $x=1$
 $= \sqrt{4+9+1}$
 $= \sqrt{14} = 3.74$

⑤ $\frac{d}{dx}(F \cdot F)$ at $x=1$

$F \cdot F = (x^2 i + (3x+2)j + \sin x k) \cdot (x^2 i + (3x+2)j + \sin x k)$
 $= x^4 i + (9x^2 + 12x + 4)j + (\sin^2 x) k$

$\frac{d}{dx}(F \cdot F) = 4x^3 + 18x + 12 + \sin(2x)$
 $= 4 + 18 + 12 + 0.035$ at $x=1$
 $= 34.034$

$\frac{d}{dx}(F \cdot F) = 34.03$

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

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

$\frac{d^2 r}{dt^2} = \frac{d}{dt} \left[\frac{dr}{dt} \right]$

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

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

$\left| \frac{d^2 r}{dt^2} \right| = \sqrt{(2)^2 + (18 \sin 3 \cos)^2 + 12e^{2(1)}}^2$

$= \sqrt{4 + 144}$

$= 2 \sqrt{37}$

$= 12.17$