

1.) Given that

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

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

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

i) $\frac{df}{dx} \text{ at } x=1 = 2(1)i + \cos(2)k$

$$= 2i + k$$

$\frac{df}{dx}$	at $x=1$	$\sqrt{2^2 + 1^2}$
		$= \sqrt{4 + 1}$
		$= \sqrt{5}$

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

$\frac{d}{dx} (f \cdot f) = 4x^3 + 18x + 12$

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

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

$$b) \frac{d^2 r}{dt^2} = 2i + 10 \sin(3t)j + 12e^{2t} k.$$

$$c) \left| \frac{d^2 r}{dt^2} \right|_{t=0} = 2i + 10 \sin(0)j + 12e^{2(0)} k$$

$$= 2i + 32 \cdot 64 k = \sqrt{2^2 + 32 \cdot 64^2}$$