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$$1 \quad \vec{F} = x^2 \mathbf{i} + (3x+2) \mathbf{j} + \sin x \mathbf{k}$$

$$a) \quad \frac{d\vec{F}}{dx} = 2x \mathbf{i} + 3 \mathbf{j} + \cos x \mathbf{k}$$

$$b) \quad \frac{\partial^2 \vec{F}}{\partial x^2} = 2 \mathbf{i} + (-\sin x) \mathbf{k}$$

$$\frac{\partial^2 \vec{F}}{\partial x^2} = 2 \mathbf{i} - \sin x \mathbf{k}$$

$$c) \quad \left. \frac{d\vec{F}}{dx} \right|_{x=1} = 2 \mathbf{i} - \sin(1) \mathbf{k}$$

$$\left. \frac{d\vec{F}}{dx} \right|_{x=1} = 2 \mathbf{i} - 0.017 \mathbf{k}$$

$$\frac{d\vec{F}}{dx}$$

$$c) \quad \left. \frac{d\vec{F}}{dx} \right|_{x=1} = 2(1) \mathbf{i} + 3 \mathbf{j} + \cos(1) \mathbf{k}$$

$$= 2 \mathbf{i} + 3 \mathbf{j} + 0.99 \mathbf{k}$$

$$\left| \left. \frac{d\vec{F}}{dx} \right|_{x=1} \right| = \sqrt{2^2 + 3^2 + (0.99)^2}$$

$$= \sqrt{4 + 9 + 0.9997}$$

$$\sqrt{13.9997}$$

$$= 3.742$$

$$\left| \left. \frac{d\vec{F}}{dx} \right|_{x=1} \right| \approx \underline{\underline{3.74}}$$

$$d) \quad \frac{d}{dx} (\vec{F} \cdot \vec{F}) \Big|_{x=1}$$

$$\vec{F} \cdot \vec{F} = (x^2 \mathbf{i} + (3x+2) \mathbf{j} + \sin x \mathbf{k}) \cdot (x^2 \mathbf{i} + (3x+2) \mathbf{j} + \sin x \mathbf{k})$$

$$= x^4 + (3x+2)(3x+2) + \sin^2 x$$

$$= x^4 + 9x^2 + 6x + 4 + \sin^2 x$$

$$\vec{F} \cdot \vec{F} = x^4 + 9x^2 + 6x + 4 + \sin^2 x$$

$$\frac{d}{dx} (\vec{F} \cdot \vec{F}) = \frac{x^5}{5} + 3x^3 + 6x^2 + 4x + 2 \sin x \cos x$$

$$\frac{d(F \cdot F)}{dt} @ t=1 = \frac{1^3}{9} + 3(1)^2 + 6(1)^2 + 4(1) + 2 \sin(1) \cos(1)$$

$$= \frac{1}{9} + 3 + 6 + 4 + 2(0.017)(0.9996)$$

$$= 0.2 + 13 + 0.035$$

$$\frac{d(F \cdot F)}{dt} @ t=1 = 13.23$$

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

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

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

$$\frac{d^2 r}{dt^2} @ t=0 = 2i + 18 \sin 3(0) j + 12e^{2(0)} k$$

$$= 2i + 18 \sin 0 j + 12e^0 k$$

$$= 2i + 18(0) j + 12(1) k$$

$$= 2i + 12k$$

$$(c) \quad \left| \frac{d^2 r}{dt^2} \right| @ t=0 = \sqrt{2^2 + 12^2}$$

$$= \sqrt{4 + 144}$$

$$= \sqrt{148}$$

$$\left| \frac{d^2 r}{dt^2} \right| @ t=0 = 12.17$$