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MATRIC NO: 18/ENG02/052 (CARRY OVER)
DEPT: COMPUTER ENGINEERING

1. A particle moves along a curve $x = 8t^3$, $y = 4t^2 - 7t$ and $z = t + 3$ where t is time. Find its
(i) velocity (ii) acceleration

Solution

$$r = 8t^3\hat{i} + (4t^2 - 7t)\hat{j} + (t+3)\hat{k}$$

$$\frac{dr}{dt} = 24t^2\hat{i} + (12t^2 - 7)\hat{j} + \hat{k}$$

when $t = 1$

$$= 24(1)^2\hat{i} + 12(1)^2 - 7\hat{j} + \hat{k}$$

$$= \cancel{576}\ 24\hat{i} + (12 - 7)\hat{j} + \hat{k}$$

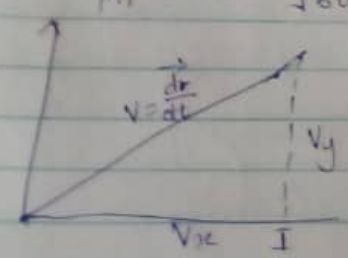
$$= 24\hat{i} + 5\hat{j} + \hat{k}$$

$$\frac{d^2r}{dt^2} = 48t\hat{i} + 24t\hat{j}$$

when $t = 1$

$$= 48\hat{i} + 24\hat{j}$$

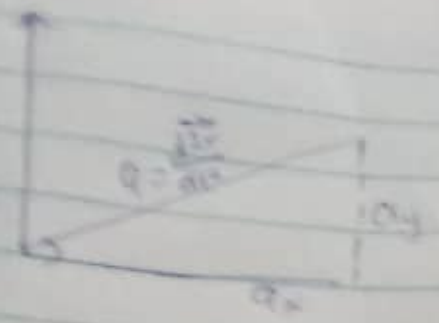
$$|\vec{I}| = \frac{\vec{A}}{|\vec{A}|} = \frac{24\hat{i} + 5\hat{j} + \hat{k}}{\sqrt{602}}$$ For velocity



$$V_x = \frac{d\vec{r}}{dt}\cos\theta$$

$$V_x = \frac{d\vec{r}}{dt}\vec{I} = (24\hat{i} + 5\hat{j} + \hat{k})\frac{(24\hat{i} + 5\hat{j} + \hat{k})}{\sqrt{602}} = 35.35$$

$$|\vec{I}| = \frac{\vec{A}}{|\vec{A}|} = \frac{48\hat{i} + 24\hat{j}}{24\sqrt{5}}$$ For acceleration



$a_x = \frac{d^2x}{dt^2}$ $\cos\theta$

$= \frac{d^2r}{dt^2} \cdot \vec{T} = (48i + 24j) \cdot \frac{(48i + 24j)}{24\sqrt{5}} = 80.2$

2) Find the unit tangent vector to the space curve $x = 3t, y = t^3$ and $z = t^2$ at $t = 1$

solution

$r = 3ti + t^3 j + t^2 k$

$\frac{dr}{dt} = 3i + 3t^2 j + 2t\hat{k}$ at $t = 1$

$\left.\frac{dr}{dt}\right|_{t=1} = 3i + 3j + 2\hat{k}$

$\left|\frac{dr}{dt}\right| = \sqrt{3^2 + 3^2 + 2^2}$

$= \sqrt{22}$

$\therefore$ Unit tangent vector $T = \frac{3i + 3j + 2k}{\sqrt{22}}$