

3- a) $\vec{L} = \vec{r} \times \vec{p}$

$$\frac{d\vec{L}}{dt} = \vec{0} \Rightarrow \vec{L} = \text{cte}$$

$$\vec{M} = \vec{r} \times \vec{F} = \vec{0} \left\{ \begin{array}{l} r = 0 \\ F = 0 \\ \sin \alpha = 0; \vec{r} \parallel \vec{F} \end{array} \right.$$

b)

$$P(2, -3, -2) \text{ m}$$

$$m = 25 \text{ kg}$$

$$\vec{v} = \left(\frac{12}{\sqrt{3}}, -\frac{12}{\sqrt{3}}, -\frac{12}{\sqrt{3}} \right) \text{ m/s}$$

$$\vec{p} = m\vec{v} = \frac{12 \cdot 25}{\sqrt{3}} (1, -1, -1) \text{ kg} \cdot \text{m/s}$$

173,2

$$\left. \begin{array}{l} v = 12 \text{ m/s} \\ \hat{u}_v \parallel \hat{i} - \hat{j} - \hat{k} = (1, -1, -1) \\ \hat{u}_v = \frac{1}{\sqrt{3}} (1, -1, -1) \end{array} \right\}$$

$$\vec{L} = \vec{r} \times \vec{p} = 173,2$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -3 & -2 \\ 1 & -1 & -1 \end{vmatrix} =$$

$$\vec{r} = OP = (2, -3, -2) \text{ m}$$

$$= \underline{(173,2, 0, 173,2) \text{ kg} \cdot \text{m}^2 / \text{s}}$$

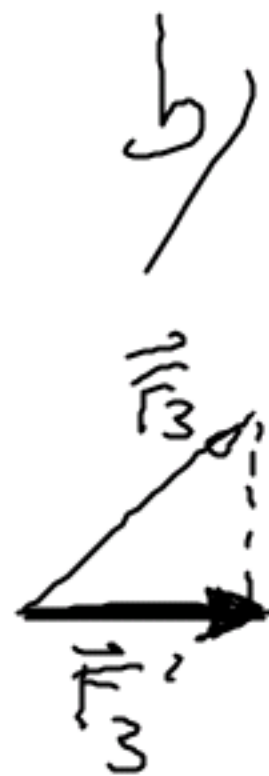
$$L = 244,95 \text{ kg} \cdot \text{m}^2 / \text{s}$$

$$\textcircled{2} \quad a) \quad \vec{R} = \sum_{i=1}^4 \vec{F}_i = (-3, 5, -1) \text{ N}$$

$$R = 5,92 \text{ N}$$

$$\cos \alpha = \frac{\vec{R} \cdot \vec{F}_2}{R F_2} = 0,97$$

$$\alpha = 14,1^\circ$$



$$F_3' = F_3 \cos \alpha = F_3 \cdot \frac{\vec{R} \cdot \vec{F}_3}{R F_3} = \boxed{-2,20 \text{ N}}$$

$$|F_3'| = 2,20 \text{ N}$$

$$\hat{u}_R = \frac{\vec{R}}{R} = \frac{1}{\sqrt{35}} (-3, 5, -1)$$

$$\vec{F}_3' = |F_3'| \cdot \hat{u}_R = (-1,12, 1,86, -0,37) \text{ N}$$

$$m = 20 \text{ kg}$$

3-

$$a) \vec{r}(t) = (4t^3 - 3t, 6t - 2, -2t^2 + 1) \text{ m}$$

$$\vec{v} = \frac{d\vec{r}}{dt} = (12t^2 - 3, 6, -4t) \text{ m/s}$$

$$\vec{a} = \frac{d\vec{v}}{dt} = (24t, 0, -4) \text{ m/s}^2$$

$$\vec{p} = m\vec{v} = (240t^2 - 60, 120, -80t) \text{ kg}\cdot\text{m/s}$$

$$\vec{F} = \frac{d\vec{p}}{dt} = (480t, 0, -80) \text{ N}$$

$$b) \quad W = \int \vec{F} \cdot d\vec{r} = \quad \vec{F}(t) = (480t, 0, -80) \text{ N}$$

$$\frac{d\vec{r}}{dt} = \vec{v} \quad = \int \vec{F} \cdot \vec{v} dt$$

$$\boxed{d\vec{v} = \vec{v} \cdot dt} \quad W_{2-5} = \int_2^5 (480t, 0, -80) \cdot (12t^2 - 3, 6, -4t) dt$$

$$= \int_2^5 (5760t^3 - 1120t) dt = 1440t^4 - 560t^2 \Big|_2^5$$
$$= \boxed{8,65 \cdot 10^5 \text{ J}}$$

$$[W] = M L^2 T^{-2}$$