* p (3) :-

$U_i + K_i = U_f + K_f$

$0 + \frac{1}{2} I_{com} \omega^2 + \frac{1}{2} m v_{com}^2 = mgh + 0$

* $I_{com} = \frac{2}{5} mr^2$

$\frac{1}{2} \cdot \frac{2}{5} mr^2 \cdot \frac{v_{com}^2}{r^2} + \frac{1}{2} m v_{com}^2 = mgh$

$h = \frac{\frac{1}{5} v_{com}^2 + \frac{1}{2} v_{com}^2}{g}$

P4

a) if $a_{com} = 0.1sg$, Find θ?

$$a_{com} = \frac{g\sin\theta}{1 + \frac{I_{com}}{MR^2}}, \quad I_{com(sphere)} = \frac{2}{5}MR^2$$

$$0.1sg = \frac{g\sin\theta}{1 + \frac{2}{5}\frac{MR^2}{MR^2}} = \frac{g\sin\theta}{1 + 2/5}$$

$$\sin\theta = 0.1s\left(\frac{7}{s}\right) \Rightarrow \boxed{\theta = 12.12^\circ}$$

b)

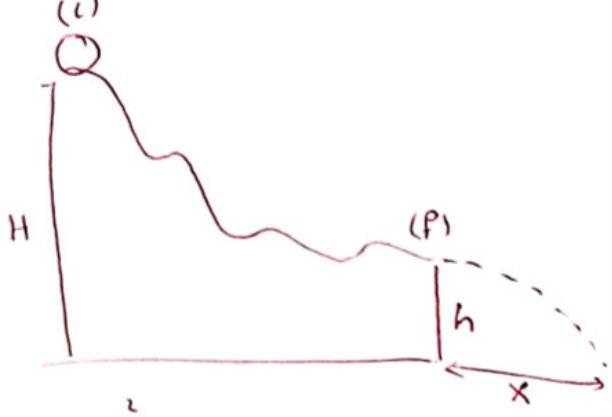
$$\Sigma F = ma$$

$$mg\sin\theta = ma$$

$$\boxed{a = 0.21g}$$

If acceleration will be larger

P9| $H = 6\,m$, $h = 2\,m$



$$(E_{mech})_i = (E_{mech})_f$$

$$U_i + K_i = U_f + K_f$$

$$mgH + 0 = mgh + \frac{1}{2} I_{com} \omega^2 + \frac{1}{2} m V_{com}^2$$

$$\omega = \frac{V_{com}}{R} \quad , \quad I_{com} = \frac{2}{5} m R^2$$

$$mgH = \frac{1}{2}\left(\frac{2}{5} m R^2\right)\left(\frac{V_{com}}{R}\right)^2 + \frac{1}{2} m V_{com}^2 + mgh$$

$$gH = \frac{1}{2} V_{com}^2 \left(\frac{7}{5}\right) + gh$$

$$V_{com} = \sqrt{\frac{10}{7} g (H-h)}$$

$= 7.48\ m/s$

To find x :

$$\Delta y = V_{oy} t - \frac{1}{2} g t^2$$

$$-2 = 0 - \frac{1}{2}(9.8) t^2 \Rightarrow t = 0.639\ sec$$

$$x = V_x t$$

$$= V_{com} t = (7.48)(0.639)$$

$$x = 4.8\ m$$

P21] Find the torque about the origin on a particle located at $(0, -4, 3)$ m, if that torque due to

a) $\vec{F}_1 \rightarrow F_{1x} = 2\,N$, $F_{1y} = F_{1z} = 0$

$\vec{F}_1 = 2\hat{i}$

$\vec{r} = -4\hat{j} + 3\hat{k}$

$\vec{\tau}_1 = \vec{r}_1 \times \vec{F}_1$

$= (-4\hat{j} + 3\hat{k}) \times (2\hat{i})$

$= -8(\hat{j} \times \hat{i}) + 6(\hat{k} \times \hat{i})$

$= -8(-\hat{k}) + 6\hat{j}$

$= 8\hat{k} + 6\hat{j}$ N.m

b) $\vec{F}_2$; $F_{2x} = 0$, $F_{2y} = 2N$, $F_{2z} = 4N$

$\vec{F}_2 = 2\hat{j} + 4\hat{k}$

$\vec{r} = -4\hat{j} + 3\hat{k}$

$$\vec{\tau}_2 = \begin{vmatrix} \hat{i} & -\hat{j} & \hat{k} \\ 0 & -4 & 3 \\ 0 & 2 & 4 \end{vmatrix} = \hat{i}(-16 - 6) - \hat{j}(0) + \hat{k}(0)$$

$= -22\hat{i}$ N.m

P 23| $\vec{F} = 2\hat{i} - 3\hat{k}$

a) if $\vec{r} = 0.5\hat{j} - 2\hat{k}$, Find $\vec{\tau}$?

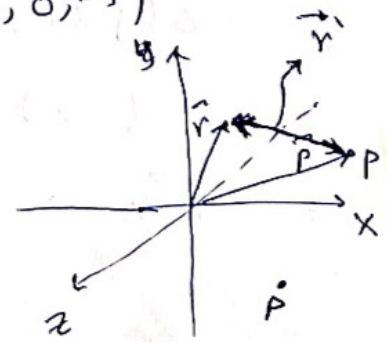
$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$= \begin{vmatrix} \hat{i} & -\hat{j} & \hat{k} \\ 0 & 0.5 & -2 \\ 2 & 0 & -3 \end{vmatrix}$$

$$= \hat{i}\left((0.5)(-3) - 0\right) - \hat{j}\left(0 - (-2)(2)\right) + \hat{k}\left(0 - (0.5)(2)\right)$$

$$= -1.5\hat{i} - 4\hat{j} - 1\hat{k} \quad N.m$$

b) The resulting torque on the pebble about the point $(2, 0, -3) \Rightarrow P: (2, 0, -3)$



$$\vec{r}' = \vec{r} - \vec{P}$$

$$\vec{P} = 2\hat{i} - 3\hat{k}$$

$$\vec{r}' = (0.5\hat{j} - 2\hat{k}) - (2\hat{i} - 3\hat{k})$$

$$= -2\hat{i} + 0.5\hat{j} + \hat{k}$$

$$\vec{\tau} = \vec{r}' \times \vec{F}$$

$$= \begin{vmatrix} \hat{i} & -\hat{j} & \hat{k} \\ -2 & 0.5 & 1 \\ 2 & 0 & -3 \end{vmatrix}$$

$$\vec{\tau} = \hat{i}\left((0.5)(-3) - 0\right) - \hat{j}\left((-2)(-3) - (2)(1)\right) + \hat{k}\left(0 - (0.5)(2)\right)$$

$$= -1.5\hat{i} - 4\hat{j} - \hat{k} \quad N.m$$