North South University

Department of Mathematics and Physics

Assignment-3

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| Course No | : | PHY-107 |
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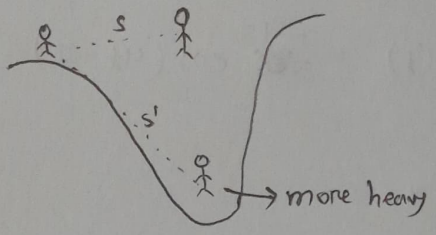
## Numerical Question

1. Briefly describe the 4th dimension.

⇒

The 4th dimension is Time. It exists in space.

Time depends on object weight. Heavy object makes time and space more distorted.




$s = vt$ | $s' = vt'$

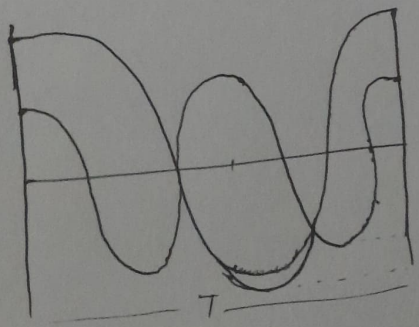
$t = \frac{s}{v}$ | $t' = \frac{s'}{v}$

$\therefore s \propto t$

$\therefore$ distortion $\propto$ time.

2. Draw a graph of two simple harmonic motion.

One has 2 times of higher frequency and other have 2 times or higher amplitude.



3. Find the maximum velocity and maximum accelaration of the give SHM equation.

$$X_{(t)} = 3\cos(4t + \phi)$$

by differentiate w.r.t. $t$,

$$V_{(t)} = -12\sin(4t + \phi)$$

again differentiate w.r.t. $t$,

$$a_{(t)} = -48\cos(4t + \phi)$$

∴ maximum velocity,

$$|V_{(t)}| = |-\omega X_m| = |3 \cdot 4|$$

$$= 12\ ms^{-1}$$

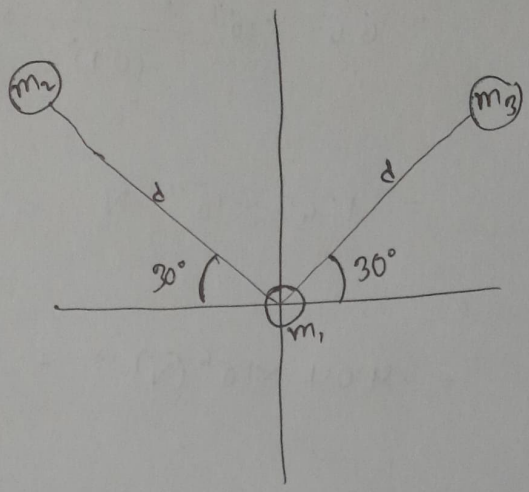
∴ maximum accelaration,

$$|a_{(t)}| = |-\omega^2 X_m| = |4^2 \cdot 3|$$

$$= 48\ ms^{-2}$$

## Conceptual Question

1. Calculate the net force ~~of~~ ~~m~~ for m1 that feels for m2 and m3.




$m_1 = 70$ kg

$m_2 = 30$ kg

$m_3 = 40$ kg

$d = 10$ cm
$= 0.1$ m

$\Rightarrow$

$$F_{1\,x\text{-axis}} = F_{13}\cos 30^\circ - F_{12}\cos 30^\circ$$

$$= G\frac{m_1 m_3}{d^2}\cos 30^\circ - G\frac{m_1 m_2}{d^2}\cos 30^\circ$$

$$= 6.67\times10^{-11}\frac{70\times40}{(0.1)^2}\cos 30^\circ - 6.67\times10^{-11}\frac{70\times30}{(0.1)^2}\cos 30^\circ$$

$$= 4.04\times10^{-6}\ \text{N}$$

$$F_{1\,y\text{-axis}} = F_{12}\sin 30^\circ + F_{13}\sin 30^\circ$$

$$= G\frac{m_1 m_2}{d^2}\sin 30^\circ + G\frac{m_1 m_3}{d^2}\sin 30^\circ$$

$$= 6.67\times10^{-11}\frac{70\times30}{(0.1)^2}\sin 30^\circ + 6.67\times10^{-11}\frac{70\times40}{(0.1)^2}\sin 30^\circ$$

$$= 1.63\times10^{-5}\ N$$

$$\therefore \vec{F}_{1net} = 4.04\times10^{-6}(N)\,\hat{i} + 1.63\times10^{-5}(N)\,\hat{j}$$

$$\therefore |\vec{F}_{1net}| = \sqrt{(4.04\times10^{-6})^2 + (1.63\times10^{-5})^2}$$

$$= 4.04\times10^{-3}\ N$$

2] Find the escape velocity for Jupiter Planet.

$M_j = 1.898\times10^{27}$ kg

$R_j = 69911$ km

$\Rightarrow$

$R_j = 69911$ km

$= 69911000$ m

We know that,

escape velocity,

$$V_{esc} = \sqrt{\frac{2GM}{R}}$$

Here, $G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

$M_j = 1.898 \times 10^{27}\ kg$

$R_j = 69911000\ m$

$$= \sqrt{\frac{2 \times 6.67 \times 10^{-11} \times 1.898 \times 10^{27}}{69911000}}$$

$$= 60180.15\ ms^{-1}$$

$$= 60.180\ km/sec$$

Ans