Subject code: 16CCCMM14

Dynamics, Unit - I.

I. 2 Marks:-

1) Define Resultant velocity:-

If a particle has two velocities $\vec{v_1}$ & $\vec{v_2}$, then $\vec{v_1}+\vec{v_2}$ is said to be resultant velocity of the particle.

2) Define Acceleration.

The acceleration of a moving point is the rate of change of its velocity. It is a vector quantity.

3) State parallelogram law:-

If a moving point has simultaneously two velocities which are represented in the magnitude & direction by the two sides of a parallelogram drawn from a point, the resultant velocity is represented in magnitude (2)

& direction by the diagonal of the parallelogram

drawn from the points

4) Define polygon of velocities.

If a moving point passes through

Simultaneously represented by the sides AB,

BC, CD, AD of the polygon ABCD.

5) A particle is an velocity is equal to $\vec{v_1}$

in magnitude. S.T the velocity $\vec{v_1}$ is double

the new resultant is $\perp^r$ to $\vec{v_3}$

Soln:- $\vec{v_1}, \vec{v_3}$ are two forces.

$\vec{v_1}+\vec{v_3}$ is the resultant forces since the

magnitude of $\vec{v_1}+\vec{v_3}$ is equal to the magnitude

of $\vec{v_1}$

i.e.) $|v_1+v_3| = |v_1|$ cos)

$$|\vec{v_1}+\vec{v_3}|^2 = |\vec{v_1}|^2 \longrightarrow (2)$$

To prove,

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$(2\vec{v_1}+\vec{v_2})\cdot v_2 = 0$

① ⟹ $(\vec{v_1}+\vec{v_2})(\vec{v_1}+\vec{v_2}) = \vec{v_1}\vec{v_1}$

$\vec{v_1}\vec{v_1} + \vec{v_1}\vec{v_2} + \vec{v_2}\cdot\vec{v_1} + \vec{v_2}\cdot\vec{v_2} = \vec{v_1}\cdot\vec{v_1}$

$2\vec{v_1}\vec{v_2} + \vec{v_2}\cdot\vec{v_2} = \vec{v_1}\cdot\vec{v_1} - \vec{v_1}\vec{v_1}$

$(2\vec{v_1}+\vec{v_2})\vec{v_2} = 0$

Hence the new resultant is ⊥ to $\vec{v_2}$.

Unit - II

I. 2 Marks:-

1) write the formulae for range on the inclined plane

The range of the inclined plane,

Range = The value of x at time t,

$$R = \frac{2u^2 \sin(\alpha-\beta)\cos\alpha}{g\cos^2\beta} \quad \left[\because R = \frac{u^2}{g(1+\sin\beta)}\right]$$

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2) Find the greatest height attained by a projectile.

Maximum height.

Time = The value of y

$$\frac{u\sin\alpha}{g} = ut\sin\alpha - \frac{gt^2}{2}$$

Maximum height = The value of y at time t.

$$H = ut\sin\alpha - \frac{gt^2}{2}$$

$$t = \frac{u\sin\alpha}{g}.$$

$$H = u\left(\frac{u\sin\alpha}{g}\sin\alpha\right) - g/_2\left(\frac{u^2\sin^2\alpha}{g^2}\right)$$

$$= \frac{u^2\sin^2\alpha}{g} - \frac{u^2\sin^2\alpha}{2g} = \frac{u^2\sin^2\alpha}{2g}.//$$

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3) To verify in the case of a projectile K.E+P.E = a Constant

Proof:- Let m be the mass of the projectile.

And, h be the distance of the projectile.

Let P(x,y) be the position of time of initial velocity u of $\frac{d^2x}{dt^2} = -g.$

Kinetic energy $= \frac{1}{2} mv^2$

$$v = \sqrt{u^2 - 2ugt\sin\alpha + g^2t^2}$$

$$K.E = \frac{1}{2} m(u^2 - 2ugt\sin\alpha + g^2t^2)$$

$$s = ut + \frac{1}{2}at^2$$

$$s = h$$

$$u = u\sin\alpha, \; a = -g$$

$$h = u\sin\alpha t + \frac{1}{2}at^2$$

$$= u\sin\alpha t - \frac{1}{2}gt^2$$

The point of projection O as the standard potential energy at time t,

$$P.E \text{ at } g = mg \times h$$

$$= mg \times (u\sin\alpha - \frac{1}{2}gt^2)$$

$$K.E + P.E = \frac{1}{2} m(u^2 - 2gt\sin\alpha + g^2t^2) + mg(u\sin\alpha - \frac{mg}{2}gt^2)$$

$$= \frac{mu^2}{2} - \frac{\cancel{2}mugt\,\cancel{\sin\alpha}}{\cancel{2}} + \frac{mg^2\cancel{t^2}}{2} + mg(u\cancel{\sin\alpha} - \frac{mg^2t^2}{2}$$

$$\Rightarrow \frac{mu^2}{2} = 0, \text{ Hence the proof.}$$

4) Let H, R be the height of the projectile (b)

ST the velocity of the projection is $\sqrt{2gH + \frac{gR^2}{8H}}$.

Soln:- $H = \frac{u^2 \sin^2\alpha}{2g}$

$R = \frac{u^2 \sin 2\alpha}{g}$

$= \sqrt{2gH + \frac{gR^2}{8H}}$.

$= \sqrt{2g \cdot \frac{u^2 \sin^2\alpha}{2g} + \frac{g u^4 \sin^2 2\alpha}{g^2 \times u^2 \sin^2\alpha} \times 2g}$.

$= \sqrt{u^2 \sin^2\alpha + \frac{u^2 \sin^2 2\alpha}{4\sin^2\alpha}}$

$= \sqrt{u^2 \sin^2\alpha + \frac{u^2 \times 4\sin^2\alpha \cos^2\alpha}{4\sin^2\alpha}}$

$= \sqrt{u^2 \sin^2\alpha + u^2 \cos^2\alpha}$.

$= \sqrt{u^2 (\sin^2\alpha + \cos^2\alpha)} = \sqrt{u^2 (1)} = \sqrt{u^2} = u$. //

5) Define Time of flight (T)

$y = \frac{-gt^2}{2} + ut\sin\alpha$.

put $t = T$, $y = 0$

$0 = \frac{-gT^2}{2} + uT\sin\alpha$

$$0 = T\left(-\frac{gT}{2} + u\sin\alpha\right)$$

$$0 = -\frac{gT}{2} + u\sin\alpha$$

$$u\sin\alpha = \frac{gT}{2}$$

$$T = \frac{2u\sin\alpha}{g} \;//$$

Unit - II

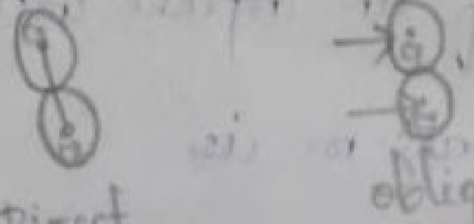
I. 2 Marks:-

1) Define Impulsive force

A large force which acting on a body for a infinitely small period, produces a finite change of moment in that interval is called an impulsive force.

2) What is direct & oblique impact

If C_1 & C_2 are the position of the centre of the sphere at the time of impact



Direct oblique

And, if the centre of the sphere had ⑧
been moving before the impact along the st. line
through c.g. as then the impact is said to be
direct otherwise it is said to be oblique.

3) Define Conservation of linear momentum.

"If the applied force on a particle is
zero. Then the linear momentum of the particle
is Conserved"

A System of particle, if the sum of the
applied force is zero

$m_1\dot{\vec{r}}_1 + m_2\dot{\vec{r}}_2 + \dots =$ a Constant

i.e) The linear momentum of the System is
Conserved.

4) Define direction of velocity

Eqn-1 of an impulse imported to a
particle of mass m is

$$I = m\vec{v}' - m\vec{v}$$

where $\vec{v}$ & $\vec{v}'$ are the velocity of the particle immediately before & immediately after the impulsive action.

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5) To show that when the two sphere of equal masses is collide directly the velocity of the sphere are interchange if $e = 1$

Soln: W.K.T,

$$v_1 = \frac{1}{m_1 + m_2}\left[m_1 u_1 + m_2 u_2 + e m_2 (u_2 - u_1)\right].$$

$$v_2 = \frac{1}{m_1 + m_2}\left[m_1 u_1 + m_2 u_2 - e m_1 (u_1 - u_2)\right].$$

$$\Rightarrow v_1 (m_1 + m_2) = m_1 u_1 + m_2 u_2 + e m_2 (u_2 - u_1).$$

$$\Rightarrow v_2 (m_1 + m_2) = m_1 u_1 + m_2 u_2 - e m_1 (u_1 - u_2).$$

$$m_1 = m_2 = m, \quad e = 1$$

$$(1) \Rightarrow v_1 (m + m) = m u_1 + m u_2 + (1) m (u_2 - u_1)$$

$$v_1 (2\cancel{m}) = \cancel{m} [u_1 + u_2 + u_2 - u_1]$$

$$\cancel{2} v_1 = \cancel{2} u_2 \Rightarrow v_1 = u_2 //$$

(2) $\Rightarrow v_2(m+m) = mu_1 + mu_2 - (1)m(u_1 - u_2)$

$v_2(2\cancel{m}) = \cancel{m}(u_1 + u_2 - u_1 + u_2)$

$\cancel{2}v_2 = \cancel{2}u_2 \Rightarrow v_2 = u_2$ //

Unit - IV

I. 2 Marks:-

1) Define simple harmonic motion.

When a particle moves in a st. line, so that its acceleration is always directed towards a fixed point in the line of the proportional to the distance from the point its motion is called simple harmonic motion.

2) Define frequency.

The no. of oscillation per second is called the frequency of the motion. i.e) the frequency is the reciprocal of the period. So it is $\frac{1}{T}$ (or) $\frac{n}{2\pi}$.

3) A body moving with S.H.M has an amplitude 'a' & period T. S.T the velocity v at a distance x from the mean position is given $v^2T^2 = 4\pi^2(a^2-x^2)$

Proof:-

$$v^2 = n^2(a^2-x^2) \longrightarrow (1)$$

$$T = \frac{2\pi}{n}$$

$$n = \frac{2\pi}{T}$$

$$n^2 = \frac{4\pi^2}{T^2}$$

Sub, eqn (1), we get,

$$(1) \Rightarrow v^2 = \frac{4\pi^2}{T^2}(a^2-x^2)$$

$$v^2T^2 = 4\pi^2(a^2-x^2),$$

$\therefore v^2T^2 = 4\pi^2(a^2-x^2)$, Hence the proof.

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4) Define S.H.M along a horizontal line

The motion in which the variable 'x' is not a displacement along a st. line, but angle $\theta \Rightarrow \ddot{\theta} = -n^2.\theta$ (or) $\ddot{s} = -n^2 s$.

5) Define Amplitude.

The maximum distance through the particle moves on either side of the mean position is called the amplitude of the motion.

Unit-V

I. 2 Marks:-

1) Define central forces.

When a particle is subject to the action of a force which is always either towards (or) away from a fixed point. The particle is said to be under the action of a central forces.

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2) Define Central orbit.

The path described by a particle under a centre force is called a central orbit.

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3) Explain equiangular Spiral:-

Equiangular Spiral is a curve which

is such that the angle b/w the radius vectors the respectively tangent is a Constant say α. Its polar eqn is $r = Ae^{(\cot\alpha)\theta}$ where A is a Constant. (13)

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4) Explain perpendicular from the pole on the tangent formula in polar Co-ordinates

Let ϕ be the angle made by the tangent at P with the radius vector OP.

W.K.T. $\tan\phi = r\dfrac{d\theta}{dr} \longrightarrow (1)$

And $p = r\sin\phi \longrightarrow (2)$

i.e.) $\dfrac{1}{p^2} = \dfrac{1}{r^2} + \dfrac{1}{r^4}\left(\dfrac{dr}{d\theta}\right)^2 \longrightarrow (3)$

Hence (3) becomes,

$\dfrac{1}{p^2} = u^2 + u^4 \cdot \dfrac{1}{u^4}\left(\dfrac{du}{d\theta}\right)^2$ i.e.) $\dfrac{1}{p^2} = u^2 + \left(\dfrac{du}{d\theta}\right)^2 \longrightarrow (4)$