DPP
DAILY PRACTICE PROBLEMS

Class : XIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 5

Topic :- GRAVITATION

1 **(c)**

Escape velocity $v = \sqrt{\frac{2GM}{R}}$

If star rotates with angular velocity ω

Then $\omega = \frac{v}{R} = \frac{1}{R}\sqrt{\frac{2GM}{R}} = \sqrt{\frac{2GM}{R^3}}$

2 **(d)**

Time period (T) of a synchronous satellite around the earth is given by

$$T^2 = \frac{4\pi^2 r^3}{Gm_e} \Rightarrow r = \left(\frac{T^2 Gm_e}{4\pi^2}\right)^{1/3}$$

Substituting the given values, we get

$$r = \left[\frac{(24 \times 60 \times 60)^2 + 6.67 \times 10^{-11} \times 5.98 \times 10^{24}}{4 \times \frac{22}{7} \times \frac{22}{7}}\right]^{1/3}$$

$r = 42.08 \times 10^6 m$

$$\therefore \frac{r}{r_e} = \frac{42.08 \times 10^6 m}{6.37 \times 10^6 m} = 6.6 \Rightarrow r = 6.6 r_e$$

3 **(d)**

Kinetic energy of the satellite is $K = \frac{GMm}{2r}$ ...(i)

Potential energy of the satellite is $U = -\frac{GMm}{r}$ ...(ii)

Total energy of the satellite is $E = -\frac{GMm}{2r}$ ...(iii)

Divide (iii) by (i), we get $\frac{E}{K} = -1$ or $E = -K$

Divide (iii) by (ii), we get $\frac{E}{U} = \frac{1}{2}$ or $E = \frac{U}{2}$

6 **(b)**

$F = Gm_1m_2/r^2$, thus on increasing masses and reducing distance r, force of gravitational attraction F will increase

7 **(b)**

Time period is independent of mass. Therefore their periods of revolution will be same.

8 **(c)**

Kinetic energy = Potential energy

$$\frac{1}{2}m(kv_e)^2 = \frac{mg\text{h}}{1+\frac{\text{h}}{R}} \Rightarrow \frac{1}{2}mk^2 2gR = \frac{mg\text{h}}{1+\frac{\text{h}}{R}} \Rightarrow h = \frac{Rk^2}{1-k^2}$$

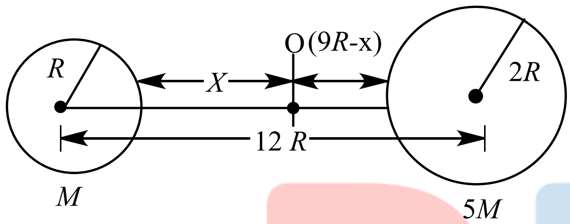
Height of Projectile from the earth's surface $= h$

Height from the centre $r = R + h = R + \frac{Rk^2}{1-k^2}$

By solving $r = \frac{R}{1-k^2}$

9 **(c)**

Let at O there will be a collision. If smaller sphere moves x distance to reach at O, then bigger sphere will move a distance of $(9R - x)$



$$a_{\text{small}} = \frac{F}{M} = \frac{G \times 5M}{(12R - x)^2}$$

$$a_{\text{big}} = \frac{F}{5M} = \frac{GM}{(12R - x)^2}$$

$$x = \frac{1}{2}a_{\text{small}}t^2$$

$$= \frac{1}{2}\frac{G \times 5M}{(12R - x)^2} \qquad \text{...(i)}$$

$$(9R - x) = \frac{1}{2}a_{\text{big}}t^2$$

$$= \frac{1}{2}\frac{GM}{(12R - x)^2}t^2 \qquad \text{...(ii)}$$

Thus, dividing Eq. (i) by Eq. (ii), we get

$\therefore \quad \frac{x}{9R - x} = 5$

$\Rightarrow \quad x = 45R - 5x$

$\Rightarrow \quad 6x = 45R$

$\Rightarrow \quad x = 7.5\ R$

10 **(b)**

In circular orbit of a satellite of potential energy

$$= -2 \times (\text{kinetic energy})$$

$$= -2 \times \frac{1}{2}m^v = -mv^2$$

Just to escape from the gravitational pull, its total mechanical energy should be zero.

Therefore , its kinetic energy should be $+mv^2$

11 **(a)**

Acceleration due to gravity at height h is

$$g' = \frac{g}{\left(1+\frac{h}{R_e}\right)^2} = \frac{g}{\left(1+\frac{32}{6400}\right)^2} = 0.99\ g$$

12 **(a)**

$v = \sqrt{2gR}$. If acceleration due to gravity and radius of the planet, both are double that of earth then escape velocity will be two times, *i.e.* $v_p = 2v_e$

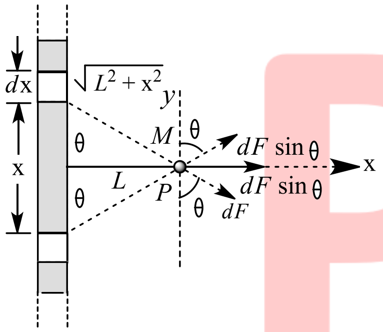
13 **(b)**

Potential energy $U = \frac{-GMm}{r} = -\frac{GMm}{R+h}$

$U_{initial} = -\frac{GMm}{3R}$ and $U_{final} = -\frac{GMm}{2R}$

Loss in $PE =$ gain in $KE = \frac{GMm}{2R} - \frac{GMm}{3R} = \frac{GMm}{6R}$

14 **(c)**



Let the mass M be placed symmetrically

$$\Rightarrow F_{\text{net}} = \int_{-\infty}^{\infty} dF \sin\theta = \int_{-\infty}^{\infty} \frac{GM(\lambda dx)}{X^2+L^2}\frac{L}{\sqrt{X^2+L^2}}$$

$$\Rightarrow F_{\text{net}} = GM\lambda L \int_{-\infty}^{\infty} \frac{dx}{(X^2+L^2)^{3/2}}$$

$$\Rightarrow F_{\text{net}} = \frac{GM\lambda L}{L^2}(2)$$

$$\Rightarrow F_{\text{net}} = \frac{2GM\lambda}{L^2}$$

15 **(d)**

The system will be bound at points where total energy is negative. In the given curve at point A, B and C the P.E. is more than K.E.

17 **(c)**

$$v_e = \sqrt{2gR} \Rightarrow \frac{v_A}{v_B} = \sqrt{\frac{g_A}{g_B} \times \frac{R_A}{R_B}} = \sqrt{x \times r} \therefore \frac{v_A}{v_B} = \sqrt{rx}$$

18 **(b)**

$$g' = g\left(1 - \frac{d}{R}\right) \Rightarrow \frac{g}{n} = g\left(1 - \frac{d}{R}\right) \Rightarrow d = \left(\frac{n - 1}{n}\right)R$$

20 **(b)**

$$U_{(r)} = \begin{cases} -\dfrac{GMm}{r}, r \geq R \\ -\dfrac{GMm}{R}, r < R \end{cases}$$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	C	D	D	A	C	B	B	C	C	B
Q.	11	12	13	14	15	16	17	18	19	20
A.	A	A	B	C	D	B	C	B	B	B