DPP
DAILY PRACTICE PROBLEMS

CLASS : XIth
Date :

Solutions

SUBJECT : PHYSICS
DPP No. : 9

Topic :- GRAVITATION

1 **(b)**

The energy required to remove the satellite from its orbit around the earth to infinity is called binding energy of the satellite. It is equal to negative of total mechanical energy of satellite in its orbit.

Thus, binding energy $= -E = \dfrac{GMm}{2r}$

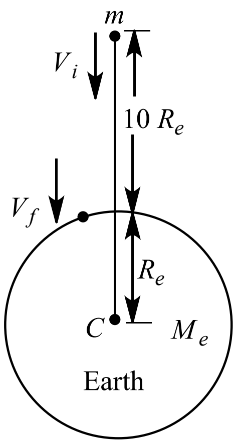
but, $g = \dfrac{GM}{R^2}$

$\Rightarrow$ $GM = gR^2$

$\therefore$ $\text{BE} = \dfrac{gmR^2}{2r}$

3 **(c)**

Applying law of conservation of energy for asteroid at a distance 10 R_e and at earth's surface.



$$K_i + U_i = K_f + U_f \quad \text{....(i)}$$

Now, $K_f = \dfrac{1}{2}mv_i^2$ and $U_i = -\dfrac{GM_e m}{10R_e}$

$$K_f = \frac{1}{2}mv_f^2 \text{ and } U_f = -\frac{GM_e m}{R_e}$$

Substituting these values in Eq. (i), we get

$$\frac{1}{2}mv_i^2 - \frac{GM_em}{10R_e} = \frac{1}{2}mv_f^2 - \frac{GM_em}{R_e}$$

$$\Rightarrow \frac{1}{2}mv_f^2 = \frac{1}{2}mv_f^2 + \frac{GM_em}{R_e} - \frac{GM_em}{10R_e}$$

$$\Rightarrow v_f^2 = v_i^2 + \frac{2GM_e}{R_e} - \frac{2GM_e}{10R_e}$$

$$\therefore \quad v_f^2 = v_i^2 + \frac{GM_em}{R_e}\left(1 - \frac{1}{10}\right)$$

5 **(b)**

$$V = -\int_{\infty}^{x} I\, dx = -\int_{\infty}^{x} \frac{C}{x^2}\, dx = \frac{C}{x}$$

6 **(c)**

$U =$ Loss in gravitational energy = gain in K.E.

So, $U = \frac{1}{2}mv^2 \Rightarrow m = \frac{2U}{v^2}$

7 **(b)**

$v_e = \sqrt{2}\, v_o$, *i.e.* if the orbital velocity of moon is increased by factor of $\sqrt{2}$ then it will escape out from the gravitational field of earth

8 **(b)**

$$v_e = R\sqrt{\frac{8}{3}G\pi\rho} \quad \therefore v_e \propto R\sqrt{\rho}$$

9 **(c)**

$$\frac{T_1}{T_2} = \left(\frac{R_1}{R_2}\right)^{3/2} = \left(\frac{10^{13}}{10^{12}}\right)^{3/2} = (1000)^{1/2} = 10\sqrt{10}$$

11 **(b)**

$F = \frac{Gm(M - m)}{x^2}$; For maxima,

$$\frac{dF}{dm} = \frac{G}{x^2}(M - 2m) = 0$$

or $\frac{m}{M} = \frac{1}{2}$

12 **(c)**

Acceleration due to gravity on moon $g_m = \dfrac{G \times M/90}{(R/3)^2} = \dfrac{1}{10}g$

13 **(c)**

Acceleration due to gravity at poles is independent of the angular speed of earth

14 **(a)**

The change in potential energy in gravitational field is given by $\Delta E = GMm\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$

In this problem; $r_1 = R$ and $r_2 = nR$

$$\Delta E = GMm\left(\frac{1}{R} - \frac{1}{nR}\right)$$

$$= \frac{GMm}{R}\left(\frac{n - 1}{n}\right)$$

$$= mgR\left(\frac{n - 1}{n}\right) \left(\because g = \frac{Gm}{R^2}\right)$$

15 **(d)**

Let escape velocity be v_e, then kinetic energy is

$$= \frac{1}{2}mv_e^2 \quad \text{....(i)}$$

and escape energy $= +\frac{GM_e m}{R_e}$ ...(ii)

Equating Eqs. (i) and (ii), we get

$$\frac{1}{2}m_e^2 = \frac{GM_e m}{R_e}$$

$$\Rightarrow \quad v_e = \sqrt{\frac{2GM_e}{R_e}}$$

$$\Rightarrow \quad R = \frac{2GM_e}{v_e^2}$$

Given, $G = 6.67 \times 10^{-11}\text{N–m}^2/\text{kg}$,

$M_e = 6 \times 10^{24}\text{kg}$, $v_e = 3 \times 10^8\ \text{m/s}^2$

$$R = \frac{2 \times 6.67 \times 10^{-11} \times 6 \times 10^{24}}{(3 \times 10^8)^2}$$

$$R = 8.89 \times 10^{-3}$$

$$R \approx 9 \times 10^{-3}\text{m} = 9\text{mm}$$

16 **(d)**

The body can be fired at any angle because the energy is sufficient to take the body out of the gravitational field of earth

17 **(b)**

Acceleration due to gravity at a height h from earth's surface

$$g' = \frac{GM}{(R+h)^2}$$

Since, $g' = \frac{g}{100}$

or $\frac{g}{100} = \frac{GM}{(R+h)^2}$

or $\frac{(R+h)^2}{100} = \frac{GM}{g}$

or $\frac{(R+h)^2}{100} = R^2$ $\left[\therefore g = \frac{GM}{R^2}\right]$

or $R + h = 10R$

$\Longrightarrow$ $h = 9R$

18 **(d)**

Acceleration due to gravity

$$g = \frac{GM}{R^2} = \frac{G}{R^2} \times \frac{4}{3}\pi R^3 \rho$$

$\therefore$ $\rho = \frac{3g}{4\pi GR}$

19 **(a)**

$v_e = \sqrt{\frac{2GM}{R}} = 100 \Rightarrow \frac{GM}{R} = 5000$

Potential energy $U = -\frac{GMm}{R} = -5000\,J$

20 **(c)**

$g \propto r$ (if $r < R$) and $g \propto \frac{1}{r^2}$ (if $r > R$)

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