Law of Gravitation DPP-01

1. If two masses 8kg and 5kg are separated by 10m distance then gravitational force would be -
(1) $\frac{8}{3} \times 10^{-11}\text{N}$
(2) $\frac{1}{3} \times 10^{-11}\text{N}$
(3) $\frac{1}{3} \times 10^{-10}\text{N}$
(4) $9 \times 10^{-11}\text{N}$

2. The force of gravitation is
(1) Repulsive
(2) Electrostatic
(3) Conservative
(4) Non-conservative

3. The gravitational force F_g between two objects does not depend on
(1) Sum of the masses
(2) Product of the masses
(3) Gravitational constant
(4) Distance between the masses

4. Earth binds the atmosphere because of
(1) Gravity
(2) Oxygen between earth and atmosphere
(3) Both (1) and (2)
(4) None of these

5. Which of the following statements about the gravitational constant is true
(1) It is a force
(2) It has no unit
(3) It has same value in all systems of units
(4) It does not depend on the nature of the medium in which the bodies are kept.

6. Two particles of equal masses move in a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle is
(1) $v = \frac{1}{2R}\sqrt{\frac{1}{Gm}}$
(2) $v = \sqrt{\frac{Gm}{2R}}$
(3) $v = \frac{1}{2}\sqrt{\frac{Gm}{R}}$
(4) $v = \sqrt{\frac{4Gm}{R}}$

Answer key

Question	1	2	3	4	5	6
Answer	**1**	**3**	**1**	**1**	**4**	**3**

SOLUTIONS DPP-01

1. **(1)**

$F_g = \frac{Gm_1m_2}{r^2}$

$F_g = \frac{20}{3} \times \frac{10^{-11} \times 8 \times 5}{(10)^2}$

$F_g = \frac{8}{3} \times 10^{-11}\text{N}$

2. **(3)**

Force of gravitation is conservative

3. **(1)**

$\because \quad F_g = \frac{Gm_1m_2}{r^2}$

So F_g does not depends on sum of the masses.

4. **(1)**

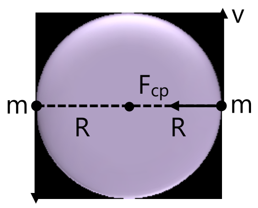
Earth binds the atmosphere because of gravity.

5. **(4)**

Gravitational constant does not depend on the nature of medium in which bodies are kept.

6. **(3)**

here gravitational force provides the necessary centripetal force.



$\Rightarrow \quad F_g = F_{cp}$

$\frac{GMm}{(2R)^2} = \frac{mv^2}{R}$

$v^2 = \frac{Gm}{4R}$

$$\boxed{v = \frac{1}{2}\sqrt{\frac{Gm}{R}}}$$

Force due to multiple particles DPP-02

1. **Four identical point masses, each equal to M are placed at four corners of square of side a. Calculate the force of attraction on another point mass M, kept at centre of the square.**

(1) $\frac{GM}{a^2}[\sqrt{2}+\frac{1}{\sqrt{2}}]$

(2) zero

(3) $\frac{GM}{2a^2}$

(4) $\sqrt{2}\frac{GM}{a^2}$

2. **Three identical point masses, each of mass 2 kg lie in $x-y$ plane at point $(0,0),(0,0.2m)$ and $(0.2m,0)$ respectively, the gravitational force on the mass at the origin is:**

(1) $1.67\times10^{-11}(\hat{i}+\hat{j})N$

(2) $3.34\times10^{-10}(\hat{i}+\hat{j})N$

(3) $6.67\times10^{-11}(\hat{i}+\hat{j})N$

(4) $6.67\times10^{-9}(\hat{i}+\hat{j})N$

3. **The unit of quantity $\frac{F}{G}$ is $(G = \text{gravitational constant } F = \text{gravitational force})$.**

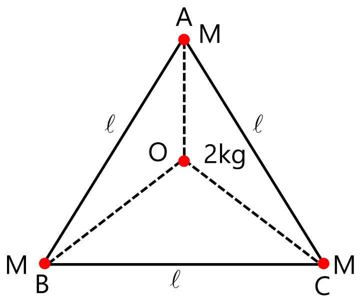
(1) kgm^{-2}

(2) kg^2m^{-2}

(3) $kg^{-2}m^2$

(4) $kg^{-1}m^2$

4. **Three masses each of mass M are placed at the vertices of an equilateral triangle ABC of side ℓ as shown in figure. The force acting on mass 2 kg. Placed at the centroid of the triangle is**



(1) zero

(2) $\frac{2Gm^2}{\ell^2}$

(3) $\frac{4Gm^2}{\ell^2}$

(4) $\frac{6Gm^2}{\ell^2}$

5. **Force between two objects of equal masses is F. If 25% mass of one object is transferred to the other object, the new force will be:**

(1) $\frac{F}{4}$

(2) $\frac{3F}{4}$

(3) $\frac{15}{16}F$

(4) F

6. **The centripetal force acting on a satellite, orbiting around the earth and the gravitational force of earth acting on the satellite both equal F. The net force on the satellite is:**

(1) Zero

(2) $2F$

(3) $\sqrt{2}F$

(4) F

Answer key

Question	1	2	3	4	5	6
Answer	2	4	2	1	3	4

SOLUTIONS DPP-02

1. **(2)**

All forces having equal magnitude and act at the centre of square with equal angle to each other so not force on mass M, kept at the centre is zero.

2. **(4)**

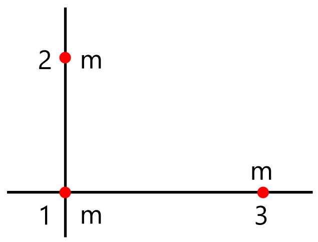
$F_1 = F_2 = \frac{G(2)(2)}{(0.2)^2}$

$\Rightarrow F_1 = F_2 = \frac{6.67\times10^{-11}\times4}{0.04}$

$\Rightarrow 6.67 \times 10^{-9}N$

$\vec{F}_{net} = F_1\hat{i} + F_2\hat{j} \Rightarrow F(\hat{i}+\hat{j})$

$\Rightarrow 6.67 \times 10^{-9}(\hat{i}+\hat{j})N$



3. **(2)**

$\frac{F}{G} \Rightarrow \frac{N}{N\frac{m^2}{kg^2}} \Rightarrow kg^2m^{-2}$

4. **(1)**

Net force at the centroid is zero.

5. **(3)**

$F = \frac{Gmm}{r^2}, F' = \frac{G\frac{3m}{4}\times\frac{5m}{4}}{r^2}$

$\Rightarrow F' = \frac{15Gm^2}{16r^2} \Rightarrow F' = \frac{15}{16}F$

6. **(4)**

As we know that necessary centripetal force is provided by gravitational force.

So, net force is (F).

Gravitational field Intensity DPP-03

1. Which of the following is true:

(1) Gravitational field intensity is a vector quantity.
(2) Range of gravitational field is infinite.
(3) Unit of gravitational intensity is $\frac{N}{kg}$.
(4) All of the above.

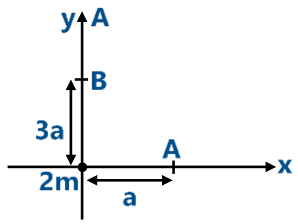
2. Which of the following is true

(1) Gravitational field due to a body extends till finite distance.
(2) Strength of gravitational intensity increases moving away from a body.
(3) Strength of gravitational intensity decreases moving away from a body.
(4) At infinite strength is not zero.

3. Gravitational field intensity due to a particle of mass "m" at 5m is 40N/kg. Then find its value at 10m.

(1) $160 N/kg$
(2) $220 N/kg$
(3) $10 N/kg$
(4) $80 N/kg$

4. Calculate intensity of gravitational field due to mass 2m at A and B respectively ?



(1) $\frac{2Gm}{a^2}(+\hat{\imath}), \frac{2Gm}{9a^2}(-\hat{\jmath})$
(2) $\frac{2Gm}{a^2}(-\hat{\imath}), \frac{2Gm}{9a^2}(+\hat{\jmath})$
(3) $\frac{2Gm}{a^2}(-\hat{\imath}), \frac{2Gm}{9a^2}(-\hat{\jmath})$
(4) $\frac{2Gm}{a^2}(+\hat{\imath}), \frac{2Gm}{9a^2}(+\hat{\jmath})$

5. Gravitational field intensity due to a particle of mass M at a position $\vec{r}$ with respect to itself can be written as.

(1) $\vec{I} = \frac{Gm}{r^2}$
(2) $\vec{I} = \frac{Gm}{r^2}(\hat{r})$
(3) $\vec{I} = \frac{Gm}{r^2}(-\hat{r})$
(4) $\vec{I} = \frac{GMm}{r^2}(-\hat{r})$

Answer key

Question	1	2	3	4	5
Answer	4	3	3	3	3

SOLUTIONS DPP-03

1. **(4)**

2. **(3)**

3. **(3)**

$\because \quad I = \frac{Gm}{r^2} \rightarrow$ here m $\rightarrow$ same

$\Rightarrow \quad I \propto \frac{1}{r^2}$

$\Rightarrow \quad \frac{I_1}{I_2} = \frac{r_2^2}{r_1^2}$

$\Rightarrow \quad \frac{40}{I_2} = \frac{(10)^2}{(5)^2}$

$\Rightarrow \quad I_2 = \frac{40}{4}$

$\Rightarrow \quad I_2 = \frac{10N}{kg}$

4. **(3)**

$\because \quad I = \frac{Gm}{r^2}(-\hat{r})$

$\vec{I}_A = \frac{G(2m)}{a^2}(-\hat{i})$

$\vec{I}_B = \frac{G(2m)}{(3a)^2}(-\hat{j})$

$\vec{I}_B = \frac{G(2m)}{9a^2}(-\hat{j})$

5. **(3)**

Gravitation field intensity due to a particle of mass m at position r with respect to itself is.

$\vec{I} = \frac{Gm}{r^2}(-\hat{r})$

Gravitational Field intensity due to multiple particles DPP-04

1. Neutral point is a point where

(1) $I_{net} = 0$
(2) $I_{net} \neq 0$
(3) At infinity
(4) None of these

2. Neutral point is closer to

(1) Heavier particle
(2) Lighter particle
(3) At mid of two particle
(4) All of the above

3. For net intensity to be zero at neutral point due to two particles, field intensity due to both particles, will be:

(1) Opposite to each other
(2) Equal in magnitude
(3) Both (1) and (2)
(4) None of these

4. Distance between the centre of a planet and its satellite is D and mass of planet is "49" times that of the satellite, at what distance from centre of planet, gravitational field will be zero.

(1) $\frac{7D}{8}$
(2) $\frac{D}{2}$
(3) $\frac{D}{7}$
(4) $\frac{9D}{10}$

5. A point mass m is kept at each of the eight vertices of a cube, the gravitational field intensity is zero at.

(1) Each face center
(2) Each edge center
(3) At body center
(4) Can not be zero anywhere

Answer key

Question	1	2	3	4	5
Answer	**1**	**2**	**3**	**1**	**3**

SOLUTIONS DPP-04

1. **(1)**

For Neutral point $I_{net} = 0$

2. **(2)**

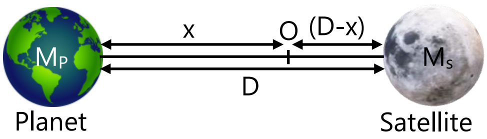
Neutral point is closer to lighter particle.

3. **(3)**

4. **(1)**

$\because$ At neutral point, gravitational field intensity due to planet and satellite will be equal and opposite.

$\frac{GM_P}{x^2} = \frac{GM_s}{(D-x)^2}$ $\quad\because M_P = 49M_s$



$\Rightarrow \frac{G49M_s}{(x)^2} = \frac{GM_s}{(D-x)^2}$

$\Rightarrow \frac{49}{x^2} = \frac{1}{(D-x)^2}$

$\Rightarrow \frac{7}{x} = \frac{1}{D-x}$

$\Rightarrow 7(D-x) = x$

$\Rightarrow 7D - 7x = x$

$\Rightarrow 7D = 8x$

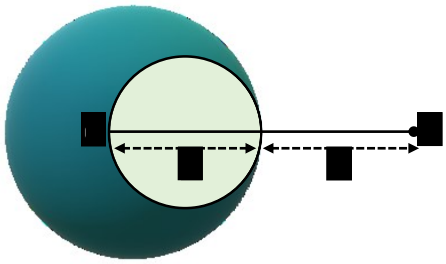
$\Rightarrow x = \frac{7D}{8}$

5. **(3)**

Field intensity would be zero at Body center.

Gravitational field Intensity due to spheres DPP-05

1. **A solid sphere of uniform density and radius R exerts a gravitational force of attraction F_1 on a particle P, distant 2R from the centre of the sphere. A spherical cavity of radius R/2 is now formed in the sphere as shown in figure. The sphere with cavity now applies a gravitational force F_2 on the same particle P. Find the ratio F_2/F_1.**



(1) $\frac{7}{9}$

(2) $\frac{9}{7}$

(3) $\frac{8}{7}$

(4) $\frac{7}{8}$

2. **Gravitational field intensity at the centre of solid sphere of Radius "R" is ?**

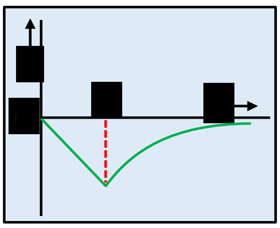
(1) $\frac{GM}{R^2}$

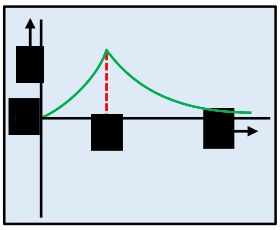
(2) Zero

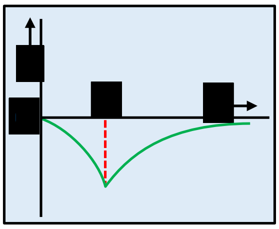
(3) $\frac{GMr}{R^2}$

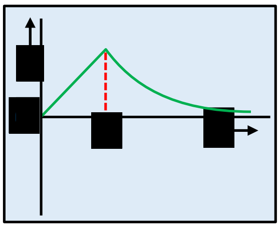
(4) None of these

3. **Graph between gravitational field intensity '$\vec{I}$' and 'r' for a solid sphere is ?**

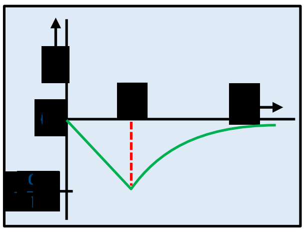
(1) 

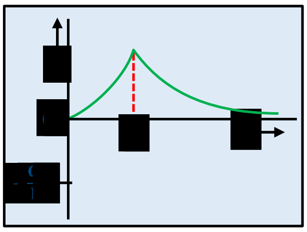
(2) 

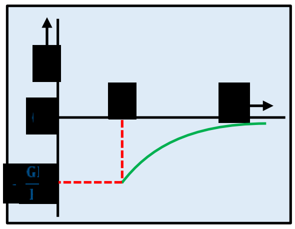
(3) 

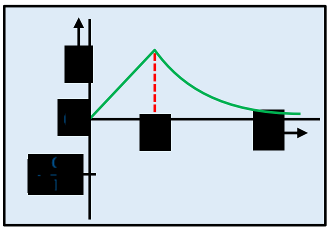
(4) 

4. Graph between gravitational field intensity '$\vec{I}$' and 'r' for a hollow sphere is ?

(1) 

(2) 

(3) 

(4) 

Answer key

Question	1	2	3	4
Answer	**1**	**2**	**1**	**3**

SOLUTIONS DPP-05

1. **(1)**

$F_1 = \frac{GMm}{4R^2}$,

F_2 = force due to whole sphere – force due to the sphere forming the cavity

$= \frac{GMm}{4R^2} - \frac{GMm}{18R^2}$ [Mass of removed part = $\frac{M}{8}$ by unitary method]

$\Rightarrow \frac{7GMm}{36R^2}$

$\therefore \frac{F_2}{F_1} = \frac{7}{9}$

2. **(2)**

3. **(1)**

4. **(3)**

Acceleration due to gravity DPP-06

1. Density of planet is four times the density of earth and radius is 2 time that of Earth, the acceleration due to gravity on the surface of planet will be?

(1) 2 times that on the surface of earth.

(2) 8 times that on the surface of Earth.

(3) 4 times that on the surface of Earth.

(4) $\frac{1}{2}$ times that on the surface of Earth.

2. If R is the radius of the Earth and g the acceleration due to gravity on the Earth's surface, the mean density of the Earth is

(1) $4\pi G/3gR$

(2) $4\pi R/4gG$

(3) $3g/4\pi RG$

(4) $\pi RG/12G$

3. If the mass of the earth increased by 3% & radius of the earth decreased by 2% then find % change in g ?

(1) –7%

(2) 7%

(3) 5%

(4) –5%

4. Imagine a new planet having the same density as that of Earth but its radius is 3 times bigger than the Earth in size. If the acceleration due to gravity on the surface of Earth is g and that on the surface of the new planet is g', then :

(1) g' = 9g

(2) g' = g/9

(3) g' = 27g

(4) g' = 3g

Answer key

Question	1	2	3	4
Answer	**2**	**3**	**2**	**4**

SOLUTIONS DPP-06

1. **(2)**

Here, $\rho_p = 4\rho_e$

and $R_p = 2R_e$

$\because \quad g = \frac{4}{3}\pi G R \rho$

$\Rightarrow \quad g \propto R\rho$

Now

$\frac{g_p}{g_e} = \frac{R_p \rho_p}{R_e \rho_e}$

$\Rightarrow \quad \frac{g_p}{g} = \frac{4R_e \times 2\rho_e}{R_e \times \rho_e}$

$\Rightarrow \quad g_p = 8g$

2. **(3)**

$\because \quad g = \frac{GM}{R^2}$

and $M = \frac{4}{3}\pi R^3 \rho$

$\Rightarrow \quad g = \frac{4}{3}\pi \rho R G$

$\boxed{\rho = \frac{3g}{4\pi R G}}$

3. **(2)**

$\because \quad \%\Delta g = \%\Delta M - 2\%\Delta R$

According to question

$M_e \uparrow \rightarrow 3\%$ *and* $Re \rightarrow \downarrow \rightarrow 2\%$

$\Rightarrow \quad \%\Delta g = 3 - 2(-2)$

$\Rightarrow \quad \%\Delta g = 7\%$

4. **(4)**

$\because \quad g = \frac{GM}{R^2}$

and $M = \frac{4}{3}\pi R^3 \rho$

$\Rightarrow \quad g = \frac{4}{3}\pi \rho R G$

If ρ is constant, then

$g \propto R$

$\frac{g'}{g} = \frac{R'}{R}$ $\qquad$ $R' = 3R$(Given)

$g' = 3g$

Variation in acceleration due to gravity with height DPP-07

1. What is the value of acceleration due to gravity at a height equal to half the radius of Earth from surface of Earth. (take g = 10m/s^2 at Earth surface)

(1) 10 m/s^2
(2) 4.44 m/s^2
(3) 2.22 m/s^2
(4) $\frac{1}{6}$ m/s^2

2. Value of acceleration due to gravity at a distance $\frac{3R}{2}$ from the center of Earth is – (g is the acceleration due to gravity at surface of Earth)

(1) $\frac{9g}{4}$
(2) $\frac{4g}{49}$
(3) $\frac{4g}{9}$
(4) $\frac{g}{4}$

3. A body weights 36N on the surface of Earth. When it is taken to a height $\frac{R}{2}$ from surface of Earth, where R is radius of Earth, its weight would be -

(1) 16N
(2) 28N
(3) 32N
(4) 72N

4. Find the percentage decrement in the weight of a body when taken to a height of 16km above the surface of Earth (Radius of Earth is 6400km)

(1) 0.5%
(2) 0.25%
(3) 1%
(4) 0.75%

5. At what height from Earth surface, acceleration due to gravity is decreased by 1%

(1) 64km
(2) 16km
(3) 32km
(4) 128km

Answer key

Question	1	2	3	4	5
Answer	2	3	1	1	3

SOLUTIONS DPP-07

1. **(2)**

$\because \quad g_h = \frac{g}{\left(1+\frac{h}{R}\right)^2}$

$\Rightarrow \quad g_h = \frac{g}{\left(1+\frac{R}{2\times R}\right)^2}$

$\Rightarrow \quad g_h = \frac{g}{\left(\frac{3}{2}\right)^2}$

$\Rightarrow \quad g_h = \frac{g}{\frac{9}{4}}$

$\Rightarrow \quad g_h = \frac{4g}{9}$ (Take g = 10m/s^2)

$g_h = \frac{40}{9} = 4.44$ m/s^2

$\Rightarrow \quad \boxed{g_h = 4.44 m/s^2}$

2. **(3)**

$\because \quad g_h = \frac{g}{\left(1+\frac{h}{R}\right)^2}$

here h = height from surface of Earth

here $h' = \frac{3R}{2}$ from center of Earth

So h → from surface of Earth

$\Rightarrow \quad h = \frac{3R}{2} - R$

$\Rightarrow \quad h = \frac{R}{2}$

Now

$\Rightarrow \quad g_h = \frac{g}{\left(1+\frac{R}{2\times R}\right)^2}$

$\Rightarrow \quad g_h = \frac{g}{\left(1+\frac{1}{2}\right)^2}$

$\Rightarrow \quad g_h = \frac{g}{\left(\frac{3}{2}\right)^2}$

$\Rightarrow \quad \boxed{g_h = \frac{4g}{9}}$

3. **(1)**

Given that

mg = 36N

$\because \quad g_h = \frac{g}{\left(1+\frac{h}{R}\right)^2}$

here $h = \frac{R}{2}$

$\Rightarrow \quad g_h = \frac{g}{\left(1+\frac{R}{2\times R}\right)^2}$

$\Rightarrow \quad g_h = \frac{g}{\left(\frac{3}{2}\right)^2}$

$\Rightarrow \quad g_h = \frac{4g}{9}$

Now weight

$\Rightarrow \quad Mg_h = \frac{4mg}{9}$

$\Rightarrow$ $Mg_h = \frac{4}{9} \times 36$

$\Rightarrow$ $\boxed{Mg_h = 16N}$

4. **(1)**

$\because$ We now that for small heights (h < 320km)

$\frac{\Delta g}{g} = -\frac{2h}{R_e}$

$\Rightarrow$ $\frac{\Delta g}{g} \times 100 = -\frac{2h}{R_e} \times 100$

$\Rightarrow$ $\frac{\Delta g}{g} \times 100 = -\frac{2 \times 16}{6400} \times 100$

$\Rightarrow$ $\frac{\Delta g}{g} = -0.5\%$

Negative sign shown decrement in acceleration due to gravity as well as weight

$\Rightarrow$ $\boxed{\frac{\Delta g}{g} = 0.5\% \text{ decrement}}$

5. **(3)**

$\because$ we know that

$\frac{\Delta g}{g} \times 100 = -\frac{2h}{R}$

Here $\frac{\Delta g}{g} \times 100 = -1$

Now

$-1 = -\frac{2h \times 100}{6400 \times 10^3}$

$\Rightarrow$ h = 32 × 10^3m

$\Rightarrow$ $\boxed{h = 32km}$

Variation in acceleration due to gravity with depth DPP-08

1. Value of acceleration due to gravity at depth $\frac{R}{2}$ from the surface of Earth is

(g is the acceleration due to gravity at surface of Earth)

(1) $\frac{g}{2}$

(2) $\frac{2g}{3}$

(3) $\frac{g}{4}$

(4) $\frac{g}{9}$

2. Value of acceleration due to gravity at a distance $\frac{R}{6}$ from the center of Earth.

(g is acceleration due to gravity at surface of Earth)

(1) $\frac{g}{2}$

(2) $\frac{g}{6}$

(3) $\frac{5g}{6}$

(4) $\frac{g}{9}$

3. A body weight 36N on surface of the Earth. When it is taken to depth $\frac{R}{4}$ from the surface of Earth, where R is radius of Earth, it weight would.

(1) 36N

(2) 27N

(3) 9N

(4) 18N

4. At what depth from Earth surface, acceleration due to gravity is decreased by 1%

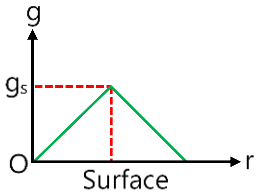
(1) 128km

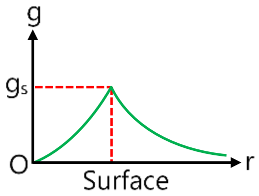
(2) 32km

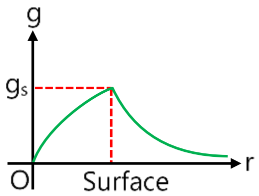
(3) 64km

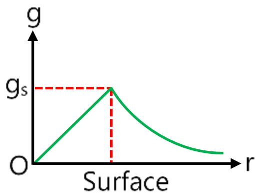
(4) 16km

5. Choose correct graph between acceleration due to gravity(g) and distance from centre of Earth(r), where R is the radius of Earth.

(1) 

(2) 

(3) 

(4) 

Answer key

Question	1	2	3	4	5
Answer	1	2	2	3	4

SOLUTIONS DPP-08

1. **(1)**

$\because \quad g_d = g\left(1-\frac{d}{R}\right)$

$\Rightarrow \quad g\left(1-\frac{R/2}{R}\right)$

$\Rightarrow \quad g_d = g\left(1-\frac{1}{2}\right)$

$\Rightarrow \quad \boxed{g_d = \frac{g}{2}}$

2. **(2)**

$\because$ we know that

$g_d = g_s\left(1-\frac{d}{R}\right)$

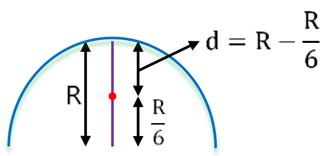
$\Rightarrow \quad d = \frac{5R}{6}$

$\Rightarrow \quad g_d = g\left(1-\frac{5R}{6\times R}\right)$

$\Rightarrow \quad g_d = g\left(1-\frac{5}{6}\right)$

$\Rightarrow \quad g_d = g\left(\frac{1}{6}\right)$

$\Rightarrow \quad \boxed{g_d = \frac{g}{6}}$



3. **(2)**

W = mg

$\Rightarrow \quad m = \frac{W}{g}$

$\Rightarrow \quad m = \frac{36}{g}$

$\because \quad g_d = g\left(1-\frac{d}{R}\right)$

$\Rightarrow \quad g_d = g\left(1-\frac{R}{4\times R}\right)$

$\Rightarrow \quad g_d = g\left(\frac{3}{4}\right)$

$\Rightarrow \quad g_d = \frac{3g}{4}$

Now W' = mg_d

$\Rightarrow \quad W' = \frac{36}{g}\times\frac{3g}{4}$

$\Rightarrow \quad \boxed{W' = 27N}$

4. **(3)**

$\because \quad \frac{\Delta g}{g} = \frac{1}{100} = \frac{d}{R}$

$\Rightarrow \quad d = \frac{R}{100}$

$\Rightarrow \quad d = \frac{6400}{100}\text{km}$

$\Rightarrow \quad \boxed{d = 64\text{km}}$

5. **(4)**

For r < R

$g = \frac{GM(r)}{R^3}$

$\Rightarrow g = \frac{g_s}{R}(r)$

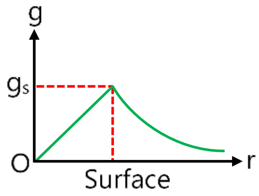
$\Rightarrow \boxed{g \propto r}$

and for r ≥ R

$g = \frac{GM}{r^2}$

$\Rightarrow g = g_s \frac{R^2}{r^2}$

$\Rightarrow \boxed{g \propto \frac{1}{r^2}}$



Rotation and shape of earth DPP-09

1. Due to rotation of Earth, effective value of acceleration due to gravity is more at -

(1) Equator
(2) Pole
(3) Same everywhere
(4) None of these

2. What should be angular velocity of Earth so that weight of a man at equator becomes 3/5^th^ of its present values. (write your answer in terms of g and R).

(1) $\sqrt{\frac{5}{2}gR}$
(2) $\sqrt{\frac{5}{2}\frac{g}{R}}$
(3) $\sqrt{\frac{2}{5}\frac{g}{R}}$
(4) $\sqrt{5gR}$

3. If the Earth suddenly stops rotating about its own axis then apparent weight of bodies will ?

(1) Increase at all the places.
(2) Decrease at all the places.
(3) Increase at all places except poles.
(4) None of these.

4. Choose correct option of acceleration due to gravity for poles and equator.

(1) $g_p > g_{eq}$
(2) $g_p < g_{eq}$
(3) $g_p = g_e$
(4) None of these

5. As we move from equator to poles the value of g -

(1) Remains the same
(2) Decreases
(3) Increases
(4) Decreases up to a latitude of 45°

6. **R is the Radius of Earth and ω is its angular velocity g_p is the g at poles. The effective value of g at the latitude. λ = 60° will be equal to**

(1) $g_p - \frac{3}{4}R\omega^2$

(2) $g_p - 4R\omega^2$

(3) $g_p + \frac{1}{4}R\omega^2$

(4) $g_p - \frac{1}{4}R\omega^2$

Answer key

Question	1	2	3	4	5	6
Answer	**2**	**3**	**3**	**1**	**3**	**4**

SOLUTIONS DPP - 09

1. **(2)**

We know that $g' = g - \omega^2 R\cos^2\lambda$

For pole $\lambda = 90°$

equator $\lambda = 0°$

So, g' = g (For pole)

$g' = g - \omega^2 r$ (For equator)

Hence, acceleration is more at pole

2. **(3)**

Weight on equator (w') = $\frac{3}{5}w$

$Mg' = Mg - m\omega^2 R\cos^2(0)$

$\frac{3}{5}Mg = Mg - M\omega^2 R$

$\omega^2 R = g - \frac{3g}{5}$

$\omega^2 = \frac{2}{5}\frac{g}{R}$

$\Rightarrow \boxed{\omega = \sqrt{\frac{2}{5}\frac{g}{R}}}$

3. **(3)**

If Earth suddenly stops rotating about its own axis then apparent weight of bodies will increases at all places except poles.

4. **(1)**

5. **(3)**

6. **(4)**

$g_{eff} = g_p - \omega^2 R\cos^2\lambda$

$\Rightarrow g_{eff} = g_p - \omega^2 R\left(\frac{1}{2}\right)^2$

$\Rightarrow \boxed{g_{eff} = g_p - \frac{1}{4}R\omega^2}$

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GDPP
GGSRDN DAILY PRACTICE PROBLEM

Gravitational potential DPP-10

1. At infinity gravitational potential is assumed to be -

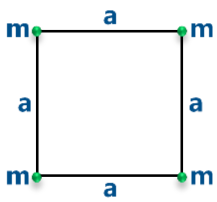
(1) $-\frac{GM}{r}$

(2) $\frac{GM}{r}$

(3) Zero

(4) None of these

2. Find gravitational potential at centroid.



(1) $-\frac{Gm}{a}3\sqrt{3}$

(2) $-\frac{Gm}{a}4\sqrt{2}$

(3) Zero

(4) $-\frac{4Gm}{a\sqrt{2}}$

3. Two masses of 10^2kg and 10^3kg are separated by 1m distance. Find the gravitational potential at the mid point of the line joining them

(1) -146.74×10^{-9}J/kg

(2) -146.74×10^{-11}J/kg

(3) -220×10^{-9}J/kg

(4) -6.67×10^{-11}J/kg

4. Two bodies of respective masses m and M are placed at distance d apart. What is the gravitational potential(V) at the position where the gravitational field due to them is zero is -

(1) $V = -\frac{G}{d}(m + m)$

(2) $V = -\frac{G}{d}$

(3) $V = -\frac{GM}{d}$

(4) $V = -\frac{G}{d}\left(\sqrt{m} + \sqrt{M}\right)^2$

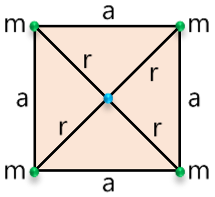
Answer key

Question	1	2	3	4
Answer	3	2	1	4

SOLUTIONS DPP-10

1. **(3)**

2. **(2)**



∵ $V = -\frac{GM}{r}$ for single particle

Now for system of particles

$V_{net} = -\frac{GM}{r} \times 4$

Here rcos45° = $\frac{a}{2}$

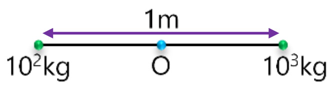
⇒ $r \times \frac{1}{\sqrt{2}} = \frac{a}{2}$

$r = \frac{q}{\sqrt{2}}$

Now $V_{net} = -\frac{GM}{\frac{a}{\sqrt{2}}} \times 4$

⇒ $\boxed{V_{net} = -\frac{4\sqrt{2}GM}{a}}$

3. **(1)**



∵ we know that

$V = -\frac{GM}{r}$

⇒ $V_{net} = -\frac{GM_1}{\frac{r}{2}} - \frac{GM_2}{r/2}$

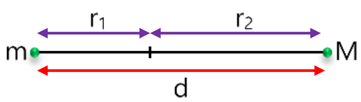
⇒ $V_{net} = -\frac{2G}{r}(m_1 + m_2)$

⇒ $V_{net} = -\frac{2G}{r}(10^2 + 10^3)$

⇒ $V_{net} = -2200 \times 6.67 \times 10^{-11} J/kg$

⇒ $V_{net} = -146.74 \times 10^{-9} J/kg$

4. **(4)**



∵ We know that

Equilibrium position of the neutral point from mass "m" is

⇒ $r_1 = \left(\frac{\sqrt{m}}{\sqrt{m}+\sqrt{M}}\right) d$

and $r_1 = \left(\frac{\sqrt{m}}{\sqrt{m}+\sqrt{M}}\right) d$

⇒ $V_1 = -\frac{GM(\sqrt{M}+\sqrt{m})}{\sqrt{m}\, d}$

and $V_2 = -\frac{GM(\sqrt{M}+\sqrt{m})}{\sqrt{M}\, d}$

$V_1 = -\frac{G}{d}\sqrt{m}(\sqrt{M} + \sqrt{m})$

⇒ $V = V_1 + V_2$

⇒ $\boxed{V = -\frac{G}{d}\left(\sqrt{M} + \sqrt{m}\right)^2}$

Relation between Potential and Intensity DPP-11

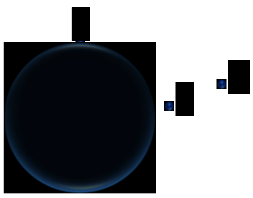
1. **In a gravitational field, at a point where the gravitational potential is zero.**

(1) The gravitational field is necessarily zero
(2) The gravitational field is not necessarily zero
(3) Nothing can be said definitely about the gravitational field.
(4) None of these

2. **In a certain region of space gravitational field is given by I = – (K/r) (Where r is the distance from a fixed point and K is constant). Taking the reference point to be at r = r_0 with V = V_0. Find the potential at a distance r.**

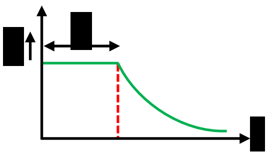
(1) $K\ln\left(\frac{r}{r_o}\right) - V_o$
(2) $K\ln\left(\frac{r}{r_o}\right) + V_o$
(3) $K\ln\left(\frac{r_o}{r}\right) - V_o$
(4) $K\ln\left(\frac{r_o}{r}\right) + V_o$

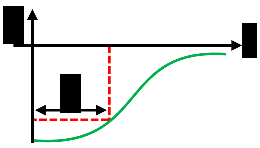
3. **In the given figure there is a hollow sphere then on which point gravitational potential due to sphere will be same.**

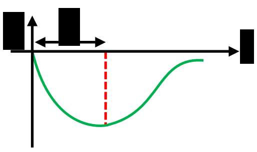


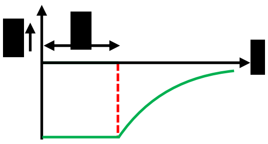
(1) O, A, B, C
(2) O, A, B
(3) O, B
(4) A, B

4. **Which of the following curve Expresses the variation of gravitational potential with distance for a solid sphere of radius R.**

(1) 

(2) 

(3) 

(4) 

5. **Gravitational potential due to a solid sphere at the center of the sphere will be -**

(1) $-\frac{3}{2}\frac{GM}{R}$

(2) $-\frac{GM}{R}$

(3) Zero

(4) $-\frac{2GM}{3R}$

Answer key

Question	1	2	3	4	5
Answer	**1**	**2**	**2**	**2**	**1**

SOLUTIONS DPP-11

1. **(1)**

$\because \quad I = -\frac{dV}{dr}$

i.e. potential is zero than field intensity = 0

so point where gravitational potential is zero than gravitational field is necessarily zero

2. **(2)**

$\because \quad I = -\frac{dV}{dr}$

$\Rightarrow \quad \int dV = -\int I dr$

$\int dV = \int \frac{K}{r} dr$

$\Rightarrow \quad V = K\ln r + c$ at r_o ; $V = V_o$

$\Rightarrow \quad V = K\ln r_o + c \qquad \Rightarrow c = V_o - K\ln r_o$

By substituting the value of c in equation.

$\Rightarrow \quad V = K\ln r + V_o - K\ln r_o$

$\Rightarrow \quad \boxed{V = K\ln\left(\frac{r}{r_o}\right) + V_o}$

3. **(2)**

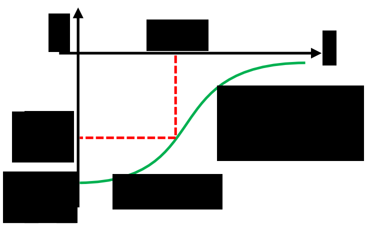
Inside the hollow sphere potential is same that of surface

So, $V_A = V_B = V_o$

4. **(2)**

For solid sphere

Outside the sphere	On the surface	Inside the surface
(r > R)	(r = R)	(r < R)
$V_{out} = -\frac{GM}{r}$	$V_{surface} = -\frac{GM}{R}$	$V_{inside} = -\frac{GM}{2R^3}(3R^2 - r^2)$



5. **(1)**

$\because \quad$ for solid sphere

$V_{in} = -\frac{GM}{2R^2}(3R^2 - r^2)$

at centre r = 0

$V_{center} = -\frac{3}{2}\frac{GM}{R}$

Gravitational potential Energy DPP-12

1. Two particles of mass 2kg and 4kg are placed at a distance of 10m then potential energy of the system is given by

(1) $-\frac{5G}{4}$

(2) $-\frac{4G}{5}$

(3) Zero

(4) None of these

2. If two particle of mass 3kg and 5kg are placed at 5m apart, then work done by external force to separate them at 12 m distance.

(1) $\frac{21G}{12}$

(2) $\frac{12G}{21}$

(3) $\frac{3G}{2}$

(4) $\frac{G}{12}$

3. What would be maximum height (h) attained by a body when it is projected with speed "V" from the surface of Earth.

(1) $h = -\frac{V^2R}{2gR+V^2}$

(2) $h = \frac{V^2R}{2gR-V^2}$

(3) $h = \sqrt{\frac{2R}{g}}$

(4) $h = \frac{V^2}{2gR+V^2}$

4. The gravitational acceleration on the surface of earth is g. Find the increase in potential energy in lifting an object of mass m to a height equal to the radius of earth.

(1) $-\frac{mgR}{2}$

(2) mgR

(3) $-mgR$

(4) $\frac{mgR}{2}$

Answer key

Question	1	2	3	4
Answer	2	1	2	4

SOLUTIONS DPP-12

1. **(2)**

$\because \quad PE = -\frac{GM_1M_2}{r}$

$\Rightarrow \quad PE = -\frac{G\times2\times4}{10}$

$\Rightarrow \quad PE = -\frac{4G}{5}$

2. **(1)**

$W_{ext} = \Delta U_{system}$

$= U_f + U_i$

$\Rightarrow \quad -\frac{G\times3\times5}{12} - \left(-\frac{G\times3\times5}{5}\right)$

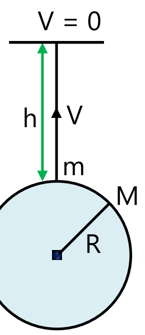
$\Rightarrow \quad -\frac{15G}{12} + 3G$

$\Rightarrow \quad W_{ext} = 3G - \frac{15G}{12}$

$\Rightarrow \quad W_{ext} = \frac{36G-15G}{12}$

$\Rightarrow \quad W_{ext} = \frac{21G}{12}$

3. **(2)**



By conservation of mechanical energy

$(KE + U)_{surface} = (KE + U)_{final}$

$\Rightarrow \quad \frac{1}{2}MV^2 - \frac{GMm}{R} = 0 - \frac{GMm}{R+h}$

4. **(4)**

$P.E_i = -\frac{GM_em}{R}$

$\Rightarrow P.E_i = -mgR$

and Similarly $\qquad (GMe = gR^2)$

$\Rightarrow P.E_f = \frac{-GM_em}{2R}$

$\Rightarrow P.E_f = \frac{-mgR}{2}$

$\Delta P.E. = P.E_f - P.E_i$

$\Rightarrow \frac{-mgR}{2} - (-mgR) = \frac{mgR}{2}$

$\Rightarrow$ increase in P.E. = $\frac{mgR}{2}$

Escape velocity DPP-13

1. The escape velocity of a body from the earth depends on -

(i) The mass of the body.

(ii) mass of the earth.

(iii) The direction of Projection.

(iv) The height of location from where the body is launched.

(1) (i) and (ii)

(2) (ii) and (iv)

(3) (i) and (iii)

(4) (iii) and (iv)

2. If velocity given to an object from the surface of the earth is n times the escape velocity then what will be its residual velocity at infinity ?

(1) $(\sqrt{n^2 - 1})V_e$

(2) $(\sqrt{V_e^2 - 1})n^2$

(3) $(\sqrt{n^2 + 1})V_e$

(4) $(\sqrt{n^2 - 1}) \times \frac{1}{V_e}$

3. A missile is launched with a velocity less than the escape velocity. The sum of its kinetic and potential energy is -

(1) Positive

(2) Negative

(3) Zero

(4) May be positive and negative depending upon its initial velocity

4. The escape velocity of a particle of mass m varies as -

(1) m^2

(2) m

(3) m^{-1}

(4) m^0

5. The escape velocity from the earth is about 11km/sec. The escape velocity from a planet having twice the radius and the same mean density as the earth is

(1) 22.4 km/sec

(2) 11 km/sec

(3) 5.5 km/sec

(4) 15.5 km/sec

Answer key

Question	1	2	3	4	5
Answer	2	1	2	4	1

SOLUTIONS DPP-13

1. **(2)**

2. **(1)**

Let the residual velocity be V, then by conservation of mechanical energy.

$K.E_i + U_i = K.E_f + U_f$

$\Rightarrow \frac{1}{2}m(nV_e)^2 - \frac{GMm}{R} = \frac{1}{2}mv^2 + 0$

At infinity $u_f = 0$

$\Rightarrow v^2 = n^2V_e^2 - \frac{2GM}{R}$

$\Rightarrow v^2 = n^2V_e^2 - V_e^2$

$\Rightarrow v^2 = V_e^2(n^2 - 1)$

$\Rightarrow v = (\sqrt{n^2 - 1})V_e$

3. **(2)**

The sum of kinetic energy and potential energy is negative. This is because for the velocity less than escape Velocity the missile is bounded due to gravitational field of the earth, Hence its total energy is negative.

4. **(4)**

$\because v_e = \sqrt{\frac{2GM_e}{R_e}}$

$\because g = \frac{GM_e}{Re^2}$

$\Rightarrow GM_e = gR_e{}^2$

$\Rightarrow v_e = \sqrt{\frac{2gRe^2}{Re}}$

$\Rightarrow v_e = \sqrt{2gR_e}$

So escape velocity is independent of mass escape velocity is varies with mass "m^0 ".

5. **(1)**

Since

$v_e = \sqrt{\frac{2GM}{R}}$

$\Rightarrow v_e = \sqrt{\frac{2G\times\frac{4}{3}\times\pi R^3\times\rho}{R}}$

Here $\rho \rightarrow$ density of the planet

And $R \rightarrow$ radius of the planet

$\Rightarrow ve = \sqrt{\frac{8}{3}G\pi\rho R^2}$

$\Rightarrow v_e \propto R$

Here $\rho \rightarrow$ const.

So it radius become twice, v_e will also become twice.

⇒ So new escape velocity = $2v_e$

= 2×11.2 = 22.4 Km/sec

Escape energy-Binding Energy DPP-14

1. The kinetic energy needed to project a body of mass m from surface of earth (radius R) to infinity is -

(1) $\frac{mgR}{2}$
(2) 2mgR
(3) mgR
(4) $\frac{mgR}{4}$

2. A body of mass m is situated at a distance 4Re above the earth's surface, where R_e is the radius of earth. How much minimum energy should be given to the body so that it may escape?

(1) mgR_e
(2) $2mgR_e$
(3) $\frac{mgRe}{5}$
(4) $\frac{mgRe}{16}$

3. If kinetic energy of a body is greater than the escape energy then

(1) Body returns to earth surface
(2) Body comes to rest at infinity
(3) Body has residual velocity at infinity
(4) None of these

4. How much energy will be necessary for making a body at 500kg escape from the earth. [g = 9.8 m/s^2, radius of earth = $6.4 \times 10^6 m$]

(1) $9.8 \times 10^6 J$
(2) $6.4 \times 10^8 J$
(3) $3.2 \times 10^{10} J$
(4) $27.4 \times 10^{12} J$

5. Reading of Barometer on moon would be -

(1) zero
(2) more than earth's pressure
(3) less than earth's pressure
(4) None of these

Answer key

Question	1	2	3	4	5
Answer	3	3	3	3	1

SOLUTIONS DPP - 14

1. **(3)**

∵ We know that

Minimum kinetic energy required by a body so that it may escape from gravitational field.

Escape $= \frac{1}{2}m(Ve)^2 = \frac{GMm}{R}$ ...(1)

$\because g = \frac{GM}{R^2}$

$\Rightarrow GM = gR^2$ ...(2)

Put value of equation (2) in equation (1)

$\Rightarrow (K.E.)_{req.} = \frac{gR^2 \times m}{R}$

$\Rightarrow (K.E.)_{req.} = mgR$

2. **(3)**

To escape from the earth total energy of the body should be zero.

i.e. K.E + P.E = 0

$\Rightarrow \frac{1}{2}mv^2 - \frac{GMm}{5Re} = 0$

$\Rightarrow KE_{min} = \frac{GMm}{5Re}$

$g = \frac{GM_e}{R_e}$

$\Rightarrow Gm_e = gR_e$

$\Rightarrow KE_{min} = \frac{mgR_e}{5}$

3. **(3)**

4. **(3)**

Here, m = 500kg

R = $6.4 \times 10^6 m$

The energy to leave the gravitational pull of earth is U

$\Rightarrow U = -\frac{GMm}{R}$

$\Rightarrow U = -mgR$

$\Rightarrow g = \frac{GM}{R^2}$

$\Rightarrow U = -9.8(500)6.4 \times 10^6$

$\Rightarrow U = -3.2 \times 10^{10} J$

If we provide energy $U = 3.2 \times 10^{10} J$ then body will escape from surface.

5. **(1)**

Since atmosphere is not present on Moon, so atmospheric pressure is zero, hence. Reading of Barometer is also zero.

1st law of Kepler DPP-15

1. Orbit of planet around a star is -

(1) A circle
(2) An ellipse
(3) A parabola
(4) A straight line

2. Kepler discovered

(1) Laws of motion
(2) Laws of rotational motion
(3) Laws of planetary motion
(4) Laws of curvilinear motion

3. The Kepler's first law is known as -

(1) The law of gravity
(2) The law of areas
(3) The law of periods
(4) The law of orbits

4. When a planet orbits the sun, one of the foci of the elliptical orbit is -

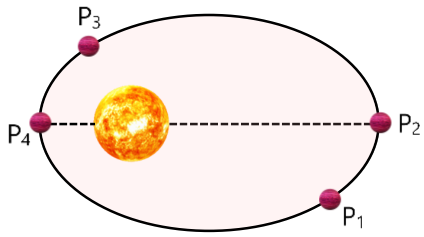
(1) The axis
(2) The perihelion
(3) The center
(4) The sun

Answer key

Question	1	2	3	4
Answer	2	3	4	4

2^{nd} law of Kepler DPP-16

1. Figure shows a planet in an elliptical orbit around the sun(S). Where the kinetic energy is maximum?

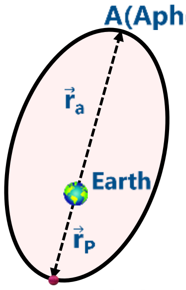


(1) P_1
(2) P_2
(3) P_3
(4) P_4

2. The variation in the speed of planet in its orbit about the sun can be explained on the basis of the conservation of -

(1) Angular kinetic energy
(2) Linear momentum
(3) Angular momentum
(4) None of these

3. Consider a satellite orbiting the Earth as shown in the figure below. Let L_a and L_p represent the angular momentum of the satellite about the Earth when at aphelion and perihelion respectively. Consider the following relation



Which of the which of the following relations are true ?

(i) $\vec{L}_a = \vec{L}_p$ **(ii)** $\vec{L}_a = -\vec{L}_p$ **(iii)** $\vec{r}_a \times \vec{L}_a = \vec{r}_p \times \vec{L}_p$

(1) (i) only
(2) (ii) only
(3) (iii) only
(4) (i) and (iii)

4. A planet is revolving around the sun in an elliptical orbit. Its closest distance from the sun is r_{min}. The farthest distance from the sun is r_{max}. If the orbital angular velocity of the planet when it is nearest to the sun is ω, then the orbital angular velocity at the point when it is at the farthest distance from the sun.

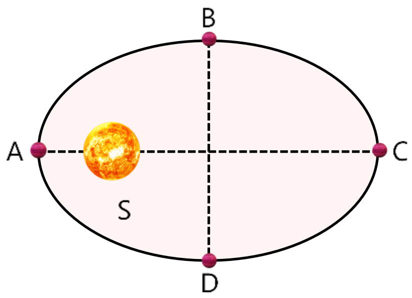
(1) $\left(\sqrt{\frac{r_{min}}{r_{max}}}\right)\omega$

(2) $\left(\sqrt{\frac{r_{max}}{r_{min}}}\right)\omega$

(3) $\left(\frac{r_{max}}{r_{min}}\right)^2\omega$

(4) $\left(\frac{r_{min}}{r_{max}}\right)^2\omega$

5. A planet is revolving around the sun as shown in Elliptical path



The correct option is

(1) The time taken in travelling DAB is less than that for BCD.

(2) The time taken in travelling DAB is greater than that for BCD.

(3) The time taken in traveling CDA is less than that for ABC.

(4) The time taken in travelling CDA is greater than that for ABC.

6. In an elliptical orbit under gravitational force, in general.

(1) Tangential velocity is constant.

(2) Angular velocity is constant.

(3) Radial velocity is constant.

(4) Areal velocity is constant.

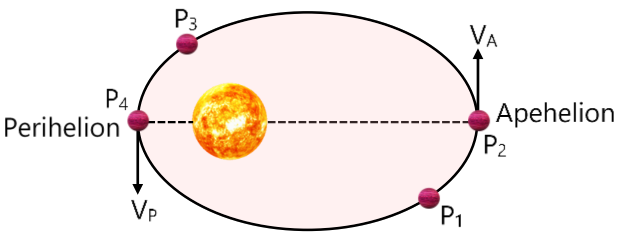
Answer key

Question	1	2	3	4	5	6
Answer	4	3	1	4	1	4

SOLUTIONS DPP-16

1. **(4)**

Since



$V_A r_A = V_P r_P$

$\Rightarrow \frac{V_A}{V_P} = \frac{r_P}{r_A} = \frac{r_{min}}{r_{max}}$

At minimum distance from sun, velocity is maximum so velocity at P_4 is maximum.

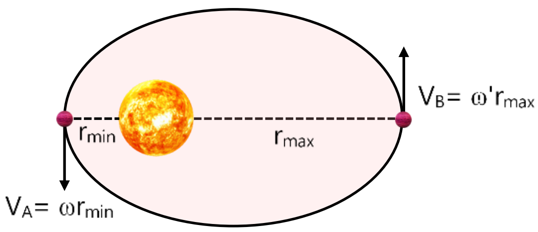
So its velocity at P_4 is maximum so kinetic energy at P_4 is maximum

2. **(3)**

3. **(1)**

Since the angular momentum of the satellite about the Earth is conserved.

4. **(4)**



$\because$ Angular momentum is conserved.

$m\omega r_{min}^2 = m\omega' r_{max}^2$

$\Rightarrow \boxed{\omega' = \left(\frac{r_{min}}{r_{max}}\right)^2 \omega}$

5. **(1)**

Since speed of planet in travelling DAB is more than that for BCD because distance from sun is minimum. So if speed is greater than time taken would be less in travelling DAB as compared to travelling BCD.

6. **(4)**

According to Kepler's second Law. A line joining any planet to sun sweeps out equal areas in equal interval of time i.e., the areal velocity of the planet remains constant.

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GDPP
GGSRDN DAILY PRACTICE PROBLEM

3rd law of Keplar DPP-17

1. **Two planets moving around sun. The periodic times and the mean radii of the orbits are T_1, T_2 and r_1, r_2 respectively. The ratio T_1/T_2 is equal to**
(1) $\left(\frac{r_1}{r_2}\right)^{1/2}$
(2) $\frac{r_1}{r_2}$
(3) $\left(\frac{r_1}{r_2}\right)^{2/3}$
(4) $\left(\frac{r_1}{r_2}\right)^{3/2}$

2. **If a graph is plotted between T^2 and r^3 for a satellite then coefficient of r^3 will be -**
(1) $\frac{4\pi^2}{GM}$
(2) $\frac{GM}{4\pi^2}$
(3) $4\pi GM$
(4) Zero

3. **If mean radius of Earth orbit around the sun is 6×10^{10}m & mean radius of mercury is 1.2×10^{11}. Calculate the length of a year of mercury.**
(1) 2.35 years
(2) 1.85 yearsp
(3) 2.82 years
(4) 2.75 years

4. **Two planets are at mean distance d_1 and d_2 from the sun and their frequencies are n_1 and n_2 respectively then.**
(1) $n_1^2 d_1^2 = n_2^2 d_2^2$
(2) $n_2^2 d_2^3 = n_1^2 d_1^3$
(3) $n_1 d_1^2 = n_2 d_2^2$
(4) $n_1^2 d_1 = n_2^2 d_2$

5. **If a new planet is discovered rotating around sun with the orbital radius double that of Earth, then what will be its time period (in Earth's days)**
(1) 1032
(2) 1023
(3) 1024
(4) 1043

Answer key

Question	1	2	3	4	5
Answer	4	1	3	2	1

SOLUTIONS DPP-17

1. **(4)**

$\because \quad T^2 \propto r^3$

$\Rightarrow \left(\frac{T_1}{T_2}\right)^2 = \left(\frac{r_1}{r_2}\right)^3$

$\Rightarrow \frac{T_1}{T_2} = \left(\frac{r_1}{r_2}\right)^{3/2}$

2. **(1)**

As we know that force of gravitation provides necessary centripetal acceleration to planet for circular motion of satellite around a planet

$\Rightarrow \frac{Gm_sM_P}{R^2} = m_s(\omega^2 R)$ $\qquad \because \omega = \frac{2\pi}{T}$

$\Rightarrow \frac{GM_P}{R^2} = \omega^2 R$

$\Rightarrow \frac{GM_P}{R^3} = \frac{4\pi^2}{T^2}$ $\qquad m_s$ mass of satellite

$\Rightarrow T^2 = \frac{4\pi^2}{GM_P} R^3$ $\qquad M_p$ mass of planet

3. **(3)**

Since

$T^2 \propto r^3$

$\Rightarrow \frac{T_m}{T_e} = \left(\frac{r_m}{r_e}\right)^{3/2}$

$\Rightarrow T_m = \left(\frac{1.2\times10^{11}}{6\times10^{10}}\right)^{3/2} \times T_e$

$\Rightarrow T_m = (2)^{3/2} \times 1$

$\Rightarrow \boxed{T_m = 2.82 \text{ years}}$

4. **(2)**

$\because$ By Kepler's III^{rd} Law.

$T^2 \propto r^3$

$\Rightarrow T^2 \propto d^3$

$\Rightarrow \frac{T_2}{T_1} = \left(\frac{d_2}{d_1}\right)^{3/2}$ ...(1)

and frequency (n) = $\frac{1}{T}$

$\Rightarrow \frac{n_1}{n_2} = \frac{T_2}{T_1}$ ...(2)

By equation (1) & (2)

$\Rightarrow \frac{n_1}{n_2} = \left(\frac{d_2}{d_1}\right)^{3/2}$

$\Rightarrow \boxed{n_1^2 d_1^3 = n_2^2 d_2^3}$

5. **(1)**

Since $T^2 \propto r^3$

$T_e = 365$ days

$\Rightarrow \frac{T_P}{T_e} = \left(\frac{r_P}{r_e}\right)^{3/2}$

$\Rightarrow \frac{T_P}{T_e} = \left(\frac{2}{1}\right)^{3/2}$

$\Rightarrow \frac{T_P}{T_e} = 2.8284$

$\Rightarrow T_P = 2.8284 \times 365$

$\Rightarrow T_P = 1032$ days

Satellite Motion DPP-18

1. An astronaut inside an Earth's satellite experiences weightlessness because.

(1) He is falling freely

(2) No external force is acting on him

(3) He is far away from the Earth's surface

(4) None of these

2. If V_e and V_o represent the escape velocity and orbital velocity of a satellite corresponding to a circular orbit of radius "R" then

(1) $V_e = V_o$

(2) $\sqrt{2}V_o = V_e$

(3) $V_e = V_o/\sqrt{2}$

(4) V_e and V_o are not related

3. An astronaut orbiting the Earth in a circular orbit 120 km above the surface of Earth, gently drops a spoon out of space-ship, the spoon will be -

(1) Fall vertically down to the Earth

(2) Move towards the moon

(3) Will move along the space ship

(4) Will move in an irregular way than full down to Earth.

4. A satellite whose mass is M, is revolving in circular orbit of radius r around the Earth. Time of revolution of satellite is -

(1) $T \propto \frac{r^5}{GM}$

(2) $T \propto \sqrt{\frac{r^3}{GM}}$

(3) $T \propto \sqrt{\frac{GM}{r^2}}$

(4) $T \propto \sqrt{\frac{r}{\frac{GM^2}{3}}}$

5. A satellite of mass m is orbiting around the earth with constant angular velocity. If radius of the orbit is R_0 and mass of the earth M, the angular momentum about the center of the earth is -

(1) $M\sqrt{GMR_0}$

(2) $m\sqrt{\frac{GM}{R_0}}$

(3) $M\sqrt{\frac{Gm}{R_0}}$

(4) $m\sqrt{GMR_0}$

6. Two satellites A and B are orbiting around the earth in circular orbit of the same radius. The mass of A is 16 times that of B. Than ratio of the period of revolution of B to that of A.

(1) 1:16

(2) 1:4

(3) 1:2

(4) 1:1

Answer key

Question	1	2	3	4	5	6
Answer	**1**	**2**	**3**	**2**	**4**	**4**

SOLUTIONS DPP-18

1. **(1)**

As astronaut's acceleration = g, so he is falling freely.

2. **(2)**

$\because \quad V_o = \sqrt{\frac{GM_e}{R}}$

and $V_e = \sqrt{\frac{2GM_e}{R}}$

$\Rightarrow \quad \boxed{V_e = \sqrt{2}V_o}$

3. **(3)**

If the spoon is gently drops out from the space-ship then this spoon have the velocity of the space ship and, then this spoon will move along with space-ship

4. **(2)**

$\because$ Speed $= \frac{\text{distance}}{\text{time}}$

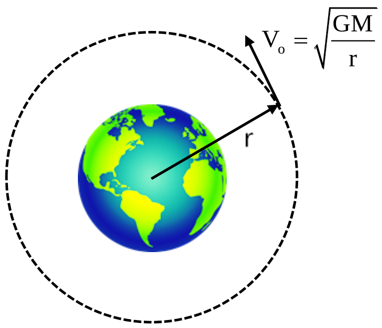
$\Rightarrow T = \frac{\text{distance}}{\text{speed}}$

$\Rightarrow T = \frac{2\pi r}{V_0}$

$\Rightarrow T = \frac{2\pi r}{\sqrt{\frac{GM}{r}}}$

$\Rightarrow T = 2\pi\sqrt{\frac{r^3}{GM}}$

$\Rightarrow T \propto \sqrt{\frac{r^3}{GM}}$



5. **(4)**

Angular momentum = mass of body × orbital velocity × Radius.

$\Rightarrow \quad m \times \left[\sqrt{\frac{GM}{R_0}}\right] \times R_0$

$\Rightarrow \quad m\sqrt{GMR_0}$

6. **(4)**

Here, $m_B = 16m_A$ (given)

Since,

Time period of satellite (T) = $2\pi\sqrt{\frac{r^3}{GM_e}}$

Here M_e = mass of earth

So, We can easily analyse from the formula of time period of satellite does not depends on mass of satellite.

So, $\frac{T_B}{T_A} = 1:1$

Satellite motion - Energy Analysis DPP-19

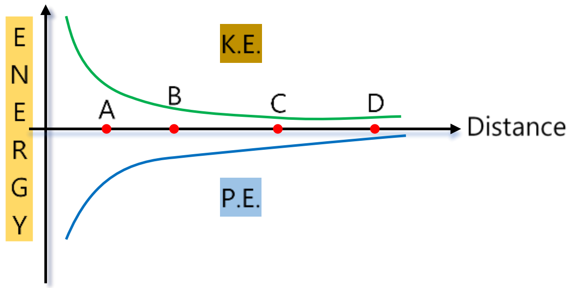
1. Potential Energy and kinetic energy of two particle system under imaginary force field are shown by curve K.E. and P.E., respectively in figure. This system is bound at -

(1) Only point A

(2) Only point D

(3) Only points A, B and C

(4) All points A, B, C and D



2. Two satellites A and B having ratio of masses 3:1 are in circular orbits of radius r and 4r. Calculate the ratio of total mechanical energies of A to B.

(1) 12:1

(2) 1:12

(3) 3:4

(4) 4:3

3. A satellite is moving in a circular orbit around earth with a speed V. Its mass is m. Then its potential energy will be -

(1) $-\frac{3}{4}mv^2$

(2) $-mv^2$

(3) $\frac{1}{2}mv^2$

(4) $-\frac{1}{2}mv^2$

4. If radius of orbit of satellite is increased, then K.E. and T.E. will be respectively.

(1) Decreases and increases

(2) Increases and decreases

(3) Both decreases

(4) Both increases

5. What would be change in total energy of a satellite to shift orbit from r_1 to r_2.

(1) $\frac{GM_em}{2}(\frac{1}{r_1}-\frac{1}{r_2})$

(2) $\frac{GM_em}{2}(r_1-r_2)$

(3) $\frac{GM_em}{2}(\frac{1}{r_2}-\frac{1}{r_1})$

(4) None of these

Answer key

Question	1	2	3	4	5
Answer	3	1	2	1	1

SOLUTIONS DPP - 19

1. **(3)**

∵ T.E. = P.E + K.E

From the figure T.E. is negative for A, B and C but for point D, total energy is positive so, at point D particle is unbounded.

2. **(1)**

Since T.E. = $\frac{-GM_em}{2r}$

$\Rightarrow T.E \propto -\frac{m}{r}$

$\Rightarrow \frac{T.E_1}{T.E_2} = \frac{m_1}{m_2} \times \frac{r_2}{r_1}$

$\Rightarrow \frac{T.E_1}{T.E_2} = \frac{3}{1} \times \frac{4}{1}$

$\Rightarrow \frac{T.E_1}{T.E_2} = \frac{12}{1}$

3. **(2)**

∵ $P.E. - \frac{-GMm}{R}$ and K.E. = $\frac{GMm}{2R}$

$\Rightarrow P.E. = -2K.E.$

$\Rightarrow P.E. = -2 \times \frac{1}{2}mv^2$

$\Rightarrow P.E. = -mv^2$

4. **(1)**

5. **(1)**

$\Delta T.E. = T.E_f - T.E_i$

$\Rightarrow \Delta T.E. = (-\frac{GM_em}{2r_2}) - (-\frac{GM_em}{2r_1})$

$\Rightarrow \Delta T.E. = \frac{GM_em}{2}(\frac{1}{r_1} - \frac{1}{r_2})$

Types of satellites - Polar and Geostationary DPP-20

1. For a satellite to be geo stationary, which of the following are essential condition.

a) It must always be stationed above the equator.

b) It must be rotated from west to east.

c) It must be about 36000 km above the earth surface.

d) Its orbit must be circular, and not elliptical.

(1) (a) & (b)

(2) (a), (b) & (c)

(3) (c) & (d)

(4) (a), (b), (c) & (d)

2. Where can a geostationary satellite be installed

(1) Over any city on the equator

(2) Over the north or south pole

(3) At height R above earth

(4) At the surface of earth

3. Orbital velocity of the geostationary satellite is -

(1) 3.1 km/s

(2) 8 km/s

(3) 11.2 km/s

(4) 2.82 km/s

4. A person sitting in a chair in a satellite feels weightlessness because -

(1) The earth does not attract the objects in a satellite.

(2) The normal force by the chair on the person balances the earth's attraction.

(3) The normal force is zero.

(4) The person in satellite is not accelerated.

5. Choose the correct option for polar satellite.

(i) It rotates in polar plane.

(ii) Its height from earth surface is 5000km-6000km.

(iii) Its time period is 100 min.

(iv) It is used for weather data collection.

(1) (i) and (ii)

(2) (i), (ii) & (iii)

(3) (i), (iii) & (iv)

(4) (i), (ii), (iii) & (iv)

Answer key

Question	1	2	3	4	5
Answer	4	1	1	3	3

SOLUTIONS DPP-20

1. **(4)**

2. **(1)**

3. **(1)**

4. **(3)**

Any satellite is said to be in a condition of Freeling falling on earth. (As only force acting on it is force of gravity.)
Hence, apparent weight of any object in a satellite is always zero.

5. **(3)**