Additional Problems For Self Practice (APSP)

PART -I : PRACTICE TEST PAPER

Max. Marks : 120 **Max. Time : 1 Hr.**

Important Instructions :

1. The test is of **1 hour** duration and max. marks 120.
2. The test consists **30** questions, **4 marks** each.
3. Only one choice is correct **1 mark** will be deducted for incorrect response. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
4. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 3 above.

1. The density of newly discovered planet is twice that of earth. The acceleration due to gravity at the surface of the planet is equal to that at the surface of the earth. If the radius of the earth is R, the radius of the planet would be :

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

2. Imagine a new planet having the same density as that of earth but it's radius is 3 times bigger than the earth. 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' = 3g (2) g' = $\frac{g}{9}$ (3) g' = 9g (4) g' = 27g

3. Change in acceleration due to gravity is same upto a height h from earth surface and below depth x then relation between x and h is (h and x <<< R_e) :

(1) x = h (2) x = 2h (3) x = $\frac{h}{2}$ (4) $x = h^2$

4. The potential energy of a satellite of mass m and revolving at a height equal to radius of earth from earth's surface, is :

(1) $-mgR_e$ (2) $-0.67\ mgR_e$ (3) $-0.5\ mgR_e$ (4) $-0.33\ mgR_e$

5. A geostationary satellite is rotating in circular orbit of radius 36000 km around the earth. A spy satellite which is rotating in circular orbit at a height of some hundred kilometre from earth's surface has time period approximately equal to (R_e = 6400 km):

(1) 1 hour (2) 2 hour (3) 24 hour (4) 36 hour

6. Assuming earth to be sphere of uniform density what is the value of acceleration due to gravity at a point 100 km below the earth surface (Given $R = 6380 \times 10^3$ m):

(1) 3.10 m/s (2) 5.06 m/s^2 (3) 7.64 m/s^2 (4) 9.66 m/s^2

7. The weight of an object at earth's surface is 700 g wt. What will be its weight at the surface of a planet whose radius is 1/2 and mass is 1/7 of that of the earth ?

(1) 200 g wt. (2) 400 g wt. (3) 50 g wt. (4) 300 g wt.

8. A satellite moves around the earth in a circular orbit of radius r with speed v. If the mass of the satellite is M, its total energy is:

(1) $-1/2\ Mv^2$ (2) $1/2\ Mv^2$ (3) $3/2\ Mv^2$ (4) Mv^2

9. Three identical stars of mass M are located at the vertices of an equilateral triangle with side L. The speed at which they will move if they all revolve under the influence of one another's gravitational force in a circular orbit circumscribing the triangle while still preserving the equilateral triangle :

(1) $\sqrt{\frac{2GM}{L}}$ (2) $\sqrt{\frac{GM}{L}}$ (3) $2\sqrt{\frac{GM}{L}}$ (4) not possible at all

10. In a spherical region, the density varies inversely with the distance from the centre. Gravitational field at a distance r from the centre is :

(1) proportional to r (2) proportional to $\frac{1}{r}$ (3) proportional to r^2 (4) same everywhere

11. In above problem, the gravitational potential is -

(1) linearly dependent on r (2) proportional to $\frac{1}{r}$
(3) proportional to r^2 (4) same every where.

12. A body of mass m is lifted up from the surface of earth to a height three times the radius of the earth. The change in potential energy of the body is (g = gravity field at the surface of the earth)

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

13. A satellite can be in a geostationary orbit around a planet at a distance r from the centre of the planet. If the angular velocity of the planet about its axis doubles, a satellite can now be in a geostationary orbit around the planet if its distance from the centre of the planet is

(1) $\frac{r}{2}$ (2) $\frac{r}{2\sqrt{2}}$ (3) $\frac{r}{(4)^{1/3}}$ (4) $\frac{r}{(2)^{1/3}}$

14 Assuming the earth to be a homogeneous sphere of radius R, its density in terms of G (constant of gravitation) and g (acceleration due to gravity on the surface of the earth) is
(1) $3g/(4\pi RG)$ (2) $4\pi g/(3RG)$ (3) $4\pi Rg/(3G)$ (4) $4\pi RG/(3g)$

15. Weight of an object is :
(1) Normal reaction between ground and the object
(2) Gravitational force exerted by earth on the object.
(3) dependent on frame of reference.
(4) net force on the object

16. In a binary star system one star has thrice the mass of other. The stars rotate about their common centre of mass then :
(1) Both stars have same angular momentum about common centre of mass.
(2) Both stars have angular momentum of same magnitude about common centre of mass.
(3) Both stars have same angular speeds.
(4) Both stars have same linear speeds.

17. An object is placed at a distance of R/2 from the centre of earth. Knowing mass is distributed uniformly, acceleration of that object due to gravity at that point is: (g = acceleration due to gravity on the surface of earth and R is the radius of earth)

(1) g (2) 2 g (3) g/2 (4) none of these

18. Altitude at which acceleration due to gravity decreases by 0.1% approximately :
(Radius of earth = 6400 km)

(1) 3.2 km (2) 6.4 km (3) 2.4 km (4) 1.6 km

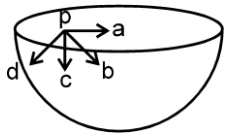
19. A particle of mass M is situated at the centre of spherical shell of mass and radius a. The magnitude of the gravitational potential at a point situated at a/2 distance from the centre, will be :

(1) $\frac{2GM}{a}$ (2) $\frac{3GM}{a}$ (3) $\frac{4GM}{a}$ (4) $\frac{GM}{a}$

20. A satellite of mass m is circulating 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 centre of the earth is

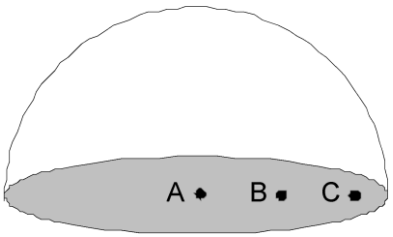
(1) $m\sqrt{GMR_0}$ (2) $M\sqrt{GmR_0}$ (3) $m\sqrt{\frac{GM}{R_0}}$ (4) $M\sqrt{\frac{GM}{R_0}}$

21. Figure show a hemispherical shell having uniform mass density. The direction of gravitational field intensity at point P will be along:



(1) a (2) b
(3) c (4) d

22. Mass M is uniformly distributed only on curved surface of a thin hemispherical shell. *A*, *B* and *C* are three points on the circular base of hemisphere, such that *A* is the centre. Let the gravitational potential at points A, B and C be V_A, V_B, V_C respectively. Then



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(1) $V_A > V_B > V_C$ (2) $V_C > V_B > V_A$
(3) $V_B > V_A$ and $V_B > V_C$ (4) $V_A = V_B = V_C$

23. A satellite close to the earth is in orbit above the equator with a period of revolution of 1.5 hours. If it is above a point P on the equator at some time, it will be above P again after time
(1) 1.5 hours
(2) 1.6 hours if it is rotating from east to west
(3) 24/17 hours if it is rotating from east to west
(4) 24/17 hours if it is rotating from west to east

24. The escape velocity of a sphere of mass m from earth having mass M and radius R is given by -

(1) $\sqrt{\frac{2GM}{R}}$ (2) $2\sqrt{\frac{GM}{R}}$ (3) $\sqrt{\frac{2GMm}{R}}$ (4) $\sqrt{\frac{GM}{R}}$

25. An artificial satellite moving in a circular orbit around the earth has a total (kinetic + potential) energy E_0. Its potential energy is :

(1) $-E^o$ (2) $1.5\ E^o$ (3) $2\ E^o$ (4) E^o

26. A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small compared to the mass of the earth :
(1) The acceleration of S is always directed towards the centre of the earth
(2) The angular momentum of S about the centre of the earth changes in direction, but its magnitude remains constant
(3) The total mechanical energy of S varies periodically with time
(4) The linear momentum of S remains constant in magnitude.

27. If a body describes a circular motion under inverse square field, the time taken to complete one revolution T is related to the radius of the circular orbit as -

(1) $T \propto r$ (2) $T \propto r^2$ (3) $T^2 \propto r^3$ (4) $T \propto r^4$

28. Two satellites A and B go round a planet P in circular orbits having radill 4R and R respectivley. If the speed of the satellite A is 3V, the speed of the satellite B will be
(1) 12 V (2) 6 V (3) 4/3 V (4) 3/2 V

29. A body attains a height equal to the radius of the earth. The velocity of the body with which it was projected is :
(1) $\sqrt{\frac{GM}{R}}$ (2) $\sqrt{\frac{2GM}{R}}$ (3) $\sqrt{\frac{5}{4}\frac{GM}{R}}$ (4) $\sqrt{\frac{3GM}{R}}$

30. The distance of neptune and saturn from sun are nearly 10^{13} and 10^{12} meters respectively. Assuming that they move in circular orbits, their periodic times will be in the ratio -
(1) $\sqrt{10}$ (2) 100 (3) $10\sqrt{10}$ (4) $1/\sqrt{10}$

Practice Test (JEE-Main Pattern)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25	26	27	28	29	30
Ans.										

PART - II : PRACTICE QUESTIONS

1. The escape velocity from the earth is about 11 km/second. The escape velocity from a planet having twice the radius and the same mean density as the earth is -
(1) 22km/sec (2) 11 km/sec (3) 5.5 km/sec (4) 15.5 km/sec

2. A satellite which is geostationary in a particular orbit is taken to another orbit. Its distance from the centre of earth in new orbit is 2 times that of the earlier orbit. The time period in the second orbit is -
(1) 4.8 hours (2) $48\sqrt{2}$ hours (3) 24 hrs (4) Infinite

3. A satellie revolves around the earth in an elliptical orbit. Its speed
(1) Is the same at all point in the orbit
(2) Is greatest when it is closest to the earth
(3) Is greatest when it is farthest from the earth
(4) Goes on increasing or decreasing continuously depending upon the mass of the satellite

4. The moon's radius is 1/4 that of the earth and its mass is 1/80 time that of the earth. If g represents the acceleration due to gravity on the surface of the earth, that on the surface of the moon is
(1) g/4 (2) g/5 (3) g/6 (4) g/8

5. A simple pendulum has a time period T_1 when on the earth's surface, and T_2 when taken to a height R above the earth's surface, where R is the radius of the earth. The value of T_2/T_1 is :
(1) 1 (2) $\sqrt{2}$ (3) 4 (4) 2

6. The orbital speed of a satellite revolving nearby the earth is :
(1) $\sqrt{2gR}$ (2) $\sqrt{gR}$ (3) $\sqrt{g/R}$ (4) $\sqrt{2g/R}$

7. If the radius of earth is decreased by 1% and mass remain constant, then the acceleration due to gravity

(1) decrease by 2% (2) decrease by 1% (3) increase by 1% (4) increase by 2%

8. The escape velocity of a particle of mass m varies as :
(1) m^2 (2) m (3) m^0 (4) m^{-1}

9. Escape velocity for a rocket is 11.2 km/s. If it is taken to a planet where the radius and acceleration due to gravity is double than earth, then escape velocity will be :
(1) 5.6 m/s (2) 11.2 m/s (3) 22.4 km/s (4) 44.2 m/s

10. If the change in the value of 'g' at a height h above the surface of the earth is the same as at a depth x below it, then (both x and h being much smaller than the radius of the earth) -
(1) x = h (2) x = 2h (3) $x = \frac{h}{2}$ (4) $x = h_2$

11. The period of a satellite in a circular orbit of radius R is T, the period of another satellite in a circular orbit of radius 4R is -
(1) 4T (2) T/4 (3) 8T (4) T/8

12. A spherical planet far out in space has a mass M_0 and diameter D_0. A particle will experience an acceleration due to gravity which is equal to
(1) GM_0/D_0^2 (2) $2mGM_0/D_0^2$ (3) $4GM_0/D_0^2$ (4) GmM_0/D_0^2

13. A geostationary satellite orbits around the earth in a circular orbit of radius 36000 km. Then, the time period of a spy satellite orbiting a few hundred kilometers above the earth's surface (R_{Earth} = 6400 km) will approximately be :
(1) 1/2 hr (2) 1 hr (3) 2 hr (4) 4 hr

14. The dimensions of universal gravitational constant are :
(1) $[M^{-1}L^3T^{-2}]$ (2) $[ML^2T^{-1}]$ (3) $[M^{-2}L^3T^{-2}]$ (4) $[M^{-2}L^2T^{-1}]$

15. Suppose radius of the moon's orbit around the earth is doubled. Its period around the earth will become:
(1) 1/2 times (2) $\sqrt{2}$ times (3) $2^{2/3}$ times (4) $2^{3/2}$ times

16. Acceleration due to gravity at earth's surface is g ms^{-2}. Find the effective value of gravity at a height of 32 km from sea level : (R_e = 6400 km)
(1) 0.5 g ms^{-2} (2) 0.99 g ms^{-2} (3) 1.01 g ms^{-2} (4) 0.90 g ms^{-2}

17. Near earth's time period of a satellite is 4 h. Find its time period at height 4R from the centre of earth :
(1) 32 h (2) $\left(\frac{1}{8\sqrt[3]{2}}\right)$ h (3) $8\sqrt[3]{2}$ h (4) 16 h

18. Radius of orbit of satellite of earth is R. Its kinetic energy is proportional to :
(1) $\frac{1}{R}$ (2) $\frac{1}{\sqrt{R}}$ (3) R (4) $\frac{1}{R^{3/2}}$

19. The radius of the orbit of a planet is two times that of the earth. The time period of planet is :
(1) 4.2 T (2) 2.8 T (3) 5.6 T (4) 8.4 T

20. Two satellite of earth, S_1 and S_2 are moving in the same orbit. The mass of S_1 is four times the mass of S_2 . Which one of the following statements is true :
(1) The time period of S_1 is four times that of S_2
(2) The potential energies of earth and satellite in the two cases are equal
(3) S_1 and S_2 are moving with the same speed
(4) The kinetic energies of the two satellites are equal

21. A cosmonaut is orbiting earth in a spacecraft at an altitude h = 630 km with a speed of 8 km/s. If the radius of the earth is 6400 km, the acceleration of the cosmonaut is
(1) 9.10 m/s^2 (2) 9.80 m/s^2 (3) 10.0 m/s^2 (4) 9.88 m/s^2

22. Two satellites A and B go around a planet P in circular orbits having radius 4R and R respectively. If the speed of satellite A is 3v, then the speed of satellite B will be
(1) 6v (2) 9v (3) 3v (4) none of these

Comprehension # 1

A pair of stars rotates about a common center of mass. One of the stars has a mass M and the other has mass m such that M = 2m. The distance between the centres of the stars is d (d being large compared to the size of either star).

23. The period of rotation of the stars about their common centre of mass (in terms of d, m, G.) is
(1) $\sqrt{\frac{4\pi^2}{Gm}d^3}$ (2) $\sqrt{\frac{8\pi^2}{Gm}d^3}$ (3) $\sqrt{\frac{2\pi^2}{3Gm}d^3}$ (4) $\sqrt{\frac{4\pi^2}{3Gm}d^3}$

24. The ratio of the angular momentum of the two stars about their common centre of mass (L_m/ L_M) is
(1) 1 (2) 2 (3) 4 (4) 9

25. The ratio of kinetic energies of the two stars (K_m/K_M.) is
(1)1 (2) 2 (3) 4 (4) 9

Comprehension # 2

An artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of escape velocity from the surface of earth. R is the radius of earth and g is acceleration due to gravity at the surface of earth. (R = 6400 km) :

26. Then the distance of satellite from the surface of earth is
(1) 3200 km (2) 6400 km (3) 12800 km (4) 4800 km

27. The time period of revolution of satellite in the given orbit is
(1) $2\pi\sqrt{\frac{2R}{g}}$ (2) $2\pi\sqrt{\frac{4R}{g}}$ (3) $2\pi\sqrt{\frac{8R}{g}}$ (4) $2\pi\sqrt{\frac{6R}{g}}$

28. If the satellite is stopped suddenly in its orbit and allowed to fall freely onto the earth, the speed with which it hits the surface of the earth.
(1) $\sqrt{gR}$ (2) $\sqrt{1.5gR}$ (3) $\sqrt{\frac{gR}{2}}$ (4) $\sqrt{\frac{gR}{\sqrt{2}}}$

APSP Answers

PART - I

1.	(4)	**2.**	(1)	**3.**	(2)	**4.**	(3)	**5.**	(2)	**6.**	(4)	**7.**	(2)
8.	(1)	**9.**	(2)	**10.**	(4)	**11.**	(1)	**12.**	(2)	**13.**	(3)	**14**	(1)
15.	(2)	**16.**	(3)	**17.**	(3)	**18.**	(1)	**19.**	(2)	**20.**	(1)	**21.**	(3)
22.	(4)	**23.**	(3)	**24.**	(1)	**25.**	(3)	**26.**	(1)	**27.**	(3)	**28.**	(2)
29.	(1)	**30.**	(3)										

PART - II

1.	(1)	**2.**	(2)	**3.**	(2)	**4.**	(2)	**5.**	(4)	**6.**	(2)	**7.**	(4)
8.	(3)	**9.**	(3)	**10.**	(2)	**11.**	(3)	**12.**	(3)	**13.**	(3)	**14.**	(1)
15.	(4)	**16.**	(2)	**17.**	(1)	**18.**	(1)	**19.**	(2)	**20.**	(3)	**21.**	(1)
22.	(1)	**23.**	(4)	**24.**	(2)	**25.**	(2)	**26.**	(2)	**27.**	(3)	**28.**	(1)