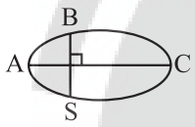
CHAPTER 7

Gravitation

Kelper's Laws and Dynamics of Planetary Motion

1. The kinetic energies of a planet in an elliptical orbit about the Sun at positions A, B and C are K_A, K_B and K_C respectively. AC is the major axis and SB is perpendicular to AC at the position of the Sun S as shown in the figure. Then *(2018)*



a. $K_B < K_A < K_C$ b. $K_A > K_B > K_C$

c. $K_A < K_B < K_C$ d. $K_B > K_A > K_C$

2. Kepler's third law states that square of period of revolution (T) of a planet around the sun, is proportional to third power of average distance r between sun and planet, i.e., $T^2 = Kr^3$ here K is constant. If the masses of sun and planet are M and m respectively then as per Newton's law of gravitation force of attraction between them is $F = \frac{GMm}{r^2}$ here G is gravitational constant. The relation between G and K is described as: *(2015)*

a. $GMK = 4\pi^2$ b. $K = G$

c. $K = \frac{1}{G}$ d. $GM = 4\pi^2$

Newton's Law of Gravitation & Acceleration Due to Gravity

3. If the mass of the Sun were ten times smaller and the universal gravitational constant were ten times larger in magnitude, which of the following is not correct? *(2018)*

a. Time period of a simple pendulum on the Earth would decrease

b. Walking on the ground would become more difficult

c. Raindrops will fall faster

d. 'g' on the Earth will not change

Variation in g Due to Altitude, Depth and Other Factors

4. A body weighs 72 N on the surface of the earth. What is the gravitation force on it, at a height equal to half the radius of the earth? *(2020)*

a. 32 N b. 30 N

c. 24 N d. 48 N

5. What is the depth at which the value of acceleration due to gravity becomes $\frac{1}{n}$ times the value that at the surface of earth? (radius of earth = R) *(2020-Covid)*

a. $\frac{R(n-1)}{n}$ b. $\frac{Rn}{(n-1)}$

c. $\frac{R}{n}$ d. $\frac{R}{n^2}$

6. A body weighs 200 N on the surface of the earth. How much will it weigh half way down to the centre of the earth? *(2019)*

a. 150 N b. 200 N

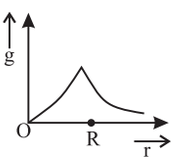
c. 250 N d. 100 N

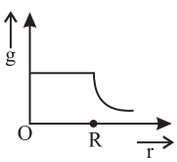
7. The acceleration due to gravity at a height 1 km above the earth is the same as at a depth d below the surface of earth. Then: *(2017-Delhi)*

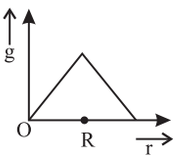
a. d = 1 km b. $d = \frac{3}{2}$ km

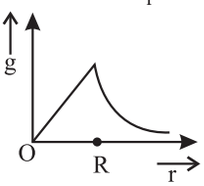
c. d = 2 km d. $d = \frac{1}{2}$ km

8. Starting from the center of the earth having radius R, the variation of g (acceleration due to gravity) is shown by: *(2016 - II)*

a. 

b. 

c. 

d. 

Gravitational Intensity, Potential and Potential Energy

9. A body of mass 60 g experiences a gravitational force of 3.0 N, when placed at a particular point. The magnitude of the gravitational field intensity at that point is : *(2022)*

a. 180 N/kg b. 0.05 N/kg

c. 50 N/kg d. 20 N/kg

10. Match List-I and List-II *(2022)*

List-I		List-II
a. Gravitational constant (G)	(i)	$[L^2T^{-2}]$
b. Gravitational potential Energy	(ii)	$[M^{-1}L^3T^{-2}]$
c. Gravitational potential	(iii)	$[LT^{-2}]$
d. Gravitational Intensity	(iv)	$[ML^2T^{-2}]$

Choose the correct answer from the options given below:

a. (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)

b. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

c. (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

d. (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

11. The work done to raise a mass m from the surface of the earth to a height h, which is equal to the radius of the earth, is: *(2019)*

a. mgR b. 2mgR

c. $\frac{1}{2}$mgR d. $\frac{3}{2}$mgR

12. At what height from the surface of earth the gravitation potential and the value of g are -5.4×10^7 J kg^{-1} and 6.0 ms^{-2} respectively. Take the radius of earth as 6400 km: *(2016 - I)*

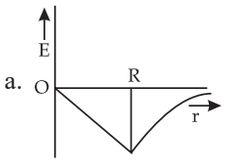
a. 2600 km

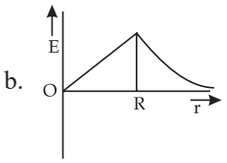
b. 1600 km

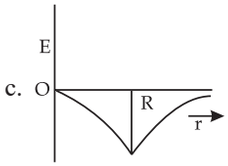
c. 1400 km

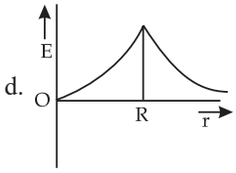
d. 2000 km

13. Dependence of intensity of gravitational field (E) of earth with distance (r) from center of earth is correctly represented by: *(2014)*

a. 

b. 

c. 

d. 

14. Infinite number of bodies, each of mass 2 kg are situated on x-axis at distances 1 m, 2 m, 4 m, 8m, ... respectively, from the origin. The resulting gravitational potential due to this system at the origin will be: *(2013)*

a. –4G b. –G

c. $-\frac{8}{3}$G d. $-\frac{4}{3}$G

15. A body of mass 'm' taken from the earth's surface to the height equal to twice the radius (R) of the earth. The change in potential energy of body will be: *(2013)*

a. $\frac{1}{3}$mgR b. 2 mgR

c. $\frac{2}{3}$mgR d. 3 mgR

Satellite, Orbital Velocity and Escape Velocity

16. The escape velocity from the Earth's surface is v. The escape velocity from the surface of another planet having a radius, four times that of Earth and same mass density is: *(2021)*

a. 2v b. 3v

c. 4v d. v

17. A particle of mass 'm' is projected with a velocity $v = kV_e$ ($k < 1$) from the surface of the earth. The maximum height above the surface reached by the particle is: *(2021)*

a. $R\left(\frac{k}{1+k}\right)^2$ b. $\frac{R^2k}{1+k}$

c. $\frac{Rk^2}{1-k^2}$ d. $R\left(\frac{k}{1-k}\right)^2$

18. The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (v_p) whose radius and mean density are twice as that of earth is: *(2016 - I)*

a. 1 : 2 b. $1:2\sqrt{2}$

c. 1 : 4 d. 1: 2

19. A satellite of mass m is orbiting the earth (of radius R) at a height h from its surface. The total energy of the satellite in terms of g_0, the value of acceleration due to gravity at the earth's surface, is: *(2016 - II)*

a. $\frac{2mg_0R^2}{R+h}$ b. $\frac{2mg_0R^2}{R\quad h}$

c. $\frac{mg_0R^2}{2(R+h)}$ d. $-\frac{mg_0R^2}{2(R+h)}$

20. A remote-sensing satellite of earth revolves in a circular orbit at a height of 0.25×10^6 m above the surface of earth. If earth's radius is 6.38×10^6 m and g = 9.8 m/s^2, then the orbital speed of the satellite is: *(2015 Re)*

a. 6.67 km/s b. 7.76 km/s

c. 8.56 km/s d. 9.13 km/s

21. 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. Then: *(2015 Re)*

a. The acceleration of S is always directed towards the center of the earth.

b. The angular momentum of S about the center of the earth changes in direction, but its magnitude remains constant.

c. The total mechanical energy of S varies periodically with time.

d. The linear momentum of S remains constant in magnitude.

22. A black hole is an object whose gravitational field is so strong that even light cannot escape from it. To what approximate radius would earth (mass = 5.98×10^{24} kg) have to be compressed to be a black hole? *(2014)*

a. 10^{-2} m

b. 10^{-6} m

c. 10 m

d. 100 m

Weightlessness

23. Two astronauts are floating in gravitational free space after having lost contact with their spaceship. The two will: *(2017-Delhi)*

a. Move towards each other

b. Move away from each other

c. Will become stationary

d. Keep floating at the same distance between them

Answer Key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b	a	d	a	a	d	c	d	c	c	c	a	a	a	c	c	c
18	19	20	21	22	23											
b	d	b	a	a	a											