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Junior Inter
PHYSICS

GRAVITATION

(Continuation from Sakshi Vidya 06-01-2009)

6) $\boxed{If\ F\alpha\frac{1}{R^n},\ then\ T^2\alpha\ R^{n+1}}$ where F is a gravitational force between two bodies

T is time period of revolution

7) **In satellite motion, angular momentum in conserved**

8) Orbital velocity is independent of mass of the satellite

9) Escape velocity is independent of mass of the satellite and the angle of projection of the body

10) The nature of the orbit of a satellite depends on the velocity of projection

If $V = V_o$, **orbit is circular**

$If\ V > V_o\ but\ V < V_e$ **, orbit is elliptical**

$If\ V = V_e,$ **orbit is parabola**

$If\ V > V_e,$ **orbit is hyperbola**

Practice Bits

1. Two identical bodies of mass 'm' are initially at rest and infinite distance apart. Now they start moving towards each other under mutual force of attraction. When the distance between them at any instant is 'r', the velocity of each body will be

   1) $\sqrt{\frac{Gm}{r}}$ 2) $\sqrt{\frac{Gm}{2r}}$ 3) $\sqrt{\frac{2Gm}{r}}$ 4) $\sqrt{\frac{Gm}{4r}}$

2. For a body projected vertically up, its escape velocity is V. If it is projected at an angle 45^0 to the horizontal then escape velocity is

   1) V 2) $\frac{V}{\sqrt{2}}$ 3) $V\sqrt{2}$ 4) $\frac{V}{2}$

3. The masses and radii of earth and moon are M_1, R_1 and M_2, R_2 respectively. Their centres are at a distance 'd' part. The minimum speed with which a particle of mass 'm' should be projected from a point mid way between the two centres so as to escape to infinity is

1) $2\sqrt{\dfrac{G(M_1 + M_2)}{d}}$ 2) $\sqrt{\dfrac{G(M_1 + M_2)}{d}}$

3) $\sqrt{\dfrac{Gd}{(M_1 + M_2)}}$ 4) $2\sqrt{\dfrac{Gd}{(M_1 + M_2)}}$

4. A body is projected from the surface of the earth with a velocity equal to $2V_e$, where Ve is the escape velocity from the surface of earth. The velocity of the body at infinity is

1) V_e 2) O 3) $\dfrac{V_e}{2}$ 4) $\sqrt{3}\ V_e$

5. 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) $\dfrac{T}{4}$ 3) 8T 4) $\dfrac{T}{8}$

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

1) 22 2) 15.5 3) 11 4) 5.5

7. The radii of earth and moon are respectively R and r. Densities of earth and moon are respectively D and d. The ratio of the escape velocities from the surface of earth and moon will be

1) $\dfrac{RD}{rd}$ 2) $\dfrac{Rd}{rD}$ 3) $\dfrac{R\sqrt{D}}{r\sqrt{d}}$ 4) $\dfrac{\sqrt{RD}}{\sqrt{rd}}$

8. The radius in kilometers, to which the present radius of the earth (R = 6400 km) is to be compressed so that the escape velocity is increased ten times, is (keeping Mass constant)

1) 6.4 2) 64 3) 640 4) 4800

9. The kinetic energy of a satellite in its orbit around the earth is E. What should be the kinetic energy of the satellite so as to enable it to escape from the gravitational pull of the earth?

1) 4E 2) 2E 3) $\sqrt{2}E$ 4) E

10. Orbital velocity of satellite revolving in a circular path close to the planet

1) is directly proportional to the density of planet
2) is directly proportional to the square root of density of planet
3) is directly proportional to square of density of planet
4) is inversely proportional to square root of density of planet

11. **Assertion (A) :** An object would be a black hole if all of its mass inside a sphere with a radius equal to Schwarzchild radius.

Reason (R) : A Schwarzchild radius, escape velocity is equal to velocity of light

1) Both (A) and (R) are true and (R) is correct explanation of (A)
2) Both (A) and (R) are true and (R) is not correct explanation of (A)
3) (A) is true and (R) is false 4) (A) is false and (R) is true

12. The mass of a planet is 6 times that of earth. The radius is twice that of earth. If V is the escape velocity from the surface of Earth, then the escape velocity from the surface of the planet will be

1) V 2) $\sqrt{2}V$ 3) $\sqrt{3}V$ 4) $\sqrt{5}V$

13. Two particles of equal mass go around a circle of radius R under the action of their mutual gravitational force of attraction. The speed of each particle is (M = mass of the particle) [G is universal gravitational constant]

1) $\sqrt{\dfrac{Gm}{R}}$ 2) $\dfrac{1}{2}\sqrt{\dfrac{GM}{R}}$ 3) $\dfrac{1}{3}\sqrt{\dfrac{GM}{R}}$ 4) $\dfrac{1}{3}\sqrt{\dfrac{GM}{R}}$

14. A body is projected vertically from the surface of the Earth with a velocity equal to half of the escape velocity. Maximum height reached by the body is

1) 5R/3 2) R/3 3) 2R/3 4) R/2

15. A body is dropped from a height equal to the radius of the Earth. M is the mass of the Earth. R is the radius of the Earh. The velocity of the body on reaching the surface of Earth will be [G is universal gravitational constant]

1) $\sqrt{\dfrac{GM}{R}}$ 2) $\sqrt{\dfrac{2GM}{R}}$ 3) $\sqrt{\dfrac{3GM}{R}}$ 4) $\sqrt{\dfrac{7GM}{R}}$

16. In a order to shift a body of mass m from a circular orbit of radius 3R to a higher orbit of radius 5R around the Earth, the work done is [G is universal gravitaional constant]

1) $\dfrac{3GMm}{5R}$ 2) $\dfrac{GMm}{2R}$ 3) $\dfrac{2}{15}\ \dfrac{GMm}{R}$ 4) $\dfrac{GMm}{5R}$

17. A satellite of mass m is revolving in a circular orbit of radius r around the Earth. If M be the mass of the Earh, then the angular momentum of the satellite is [G is universal gravitational constant]

1) $\sqrt{GMr}$ 2) $\sqrt{Gmr}$ 3) $\sqrt{GMm^2r}$ 4) $\sqrt{GM^2mr}$

18. A double star consists of two stars, one of mass M and the other 2M. Distance between them is r. The two starts revolve under their mutual gravitational force. Then

1) the kinetic energy of the heavier star is 2 times the kinetic energy of the ligher star

2) the two starts will revolve around the point of trisection of the straight line joining their mass - centre, nearer to the heavier star

3) the two stars have equal periods of revolution 4) both (2) and (3) are correct.

19. Two particles each of mass M go round a circle of radius R under the action their mutual gravitational attraction. The speed of each particle is

1) $\sqrt{\dfrac{GM}{4R}}$ 2) $\sqrt{\dfrac{GM}{2R}}$ 3) $\sqrt{\dfrac{3}{2}\dfrac{GM}{R}}$ 4) $\sqrt{\dfrac{GM}{R}}$

20. The distance between the centres of two stars is 6 a. Their mass are M and 4 M and their radii are ‘a’ and ‘2a’ respectively. The gravitational field is zero at a distance 2a from the centre of the smaller star on the line joining them. A body of mass m is fired straight from the surface of the larger star towards the smaller star. The minimum speed of the mass required so that it reaches the surface of the smaller star is

1) $\dfrac{3}{2}\sqrt{\dfrac{GM}{2a}}$ 2) $\dfrac{3}{2}\sqrt{\dfrac{GM}{2a}}$ 3) $\dfrac{3}{2}\sqrt{\dfrac{GM}{2a}}$ 4) $\sqrt{\dfrac{GM}{10a}}$

21. A planet has a mass of eight times the mass of earth and density is also equal to eight times the average density. Acceleration due to gravity on the planet’s surface will be

1) 2g 2) 4g 3) 8g 4) 16 g

22. The magnitude of potential energy per unit mass of the object at the surface of the earth is E. The escape velocity of the object is

1) E 2) $\sqrt{2E}$ 3) $2E^2$ 4) $\sqrt{\dfrac{E}{2}}$

23. There particles of mass m each are placed at the three coners of an equailateral triangle of side ‘a’. The work required to increase the sides of the triangle to 2a is

1) $\dfrac{2Gm^2}{\sqrt{2}}$ 2) $\dfrac{3Gm^2}{2a}$ 3) $\dfrac{Gm^2}{2a}$ 4) $\dfrac{G^2M}{2a}$

24. A particle is projected upwards from the surface of the earth of radius R, with a kinetic energy equal to half the minimum value needed for it to escape. The height to which it rises from the surface of the earth is

1) R 2) 2R 3) 3R 4) 4R

25. The escape velocity of a projectile on the surface of earth is v_e. A body is projected from earth’s surface with a velocity 2 . The velocity of the body when it is at infinite distance from the centre of the earth is

1) v_e 2) v_e 3) $\sqrt{3}v_e$ 4) $V_e\sqrt{2}$

26. A body is projected up with a velocity equal to 3/4 th of the escape velocity from the surface of the earth. The height it reaches is __. (Radius of the earth is R)

1) 10R/9 2) 9R/7 3) 9R/8 4) 10R/3

27. Mass M is divided into two parts Xm and (1–X)m. For a given seperation the value of X for which the gravitational attraction between the two pieces becomes maximum is

1) 1/2 2) 3/5 3) 1 4) 2

28. When a satellite going around the earth in a circular orbit of radius r and speed v loses some of its energy, then

1) r and v both increase 2) r and v both decrease
3) r will increase and v will decrease 4) r will decrease and v will increase

29. Two satellites of mass 50 kgs and 100 kgs revolve around the earth in circular orbit of radii 9R and 16 R respectively, where 'R' is the radius of the earth. The speeds of the two satellites will be in the ratio.
1) 3/4 2) 4/3 3) 9/16 4) 16/9

30. A body is projected vertically up from the surface of Earth of radius 'R' with a velocity of $\sqrt{\frac{3GM}{5R}}$ (M Mass of earth). The max. height reached by the body above the earth's surface is
1) 7R/3 2) 3R 3) 17R/7 4) 17 R/3

31. The escape velocity of a body on earth's surface is Ve. A body is thrown with a speed of thrice the escape velocity Assuming the sun and planets do not influence the motion of the body, the speed at infinity would be
1) Zero 2) Ve 3) $\sqrt{2}Ve$ 4) $2\sqrt{2}Ve$

32. Suppose the gravitational force various is inversely an n^{th} power of distance. Then the time period of a place in a circular orbit of radius 'R' around the sun will be proportional to
1) $R^{\frac{n}{2}}$ 2) $R^{\left(\frac{n-1}{2}\right)}$ 3) $R^{\left(\frac{n+1}{2}\right)}$ 4) $R^{\frac{n}{2}}$

33. A body is projected vertically up from the surface of earth with an initial velocity 'V'. If it reaches to a maximum height of half of radius of earth then the value of 'V' in terms of escape velocity of escape velocity
1) $\frac{V_e}{\sqrt{2}}$ 2) $\sqrt{\frac{2}{3}}Ve$ 3) $\frac{Ve}{\sqrt{3}}$ 4) $\frac{Ve}{3}$

34. The magnitude of the potential energy per unit mass of the object at the surface of earth is E. Then the escape velocity of the object is
1) $\sqrt{2E}$ 2) 4E 3) $\sqrt{E}$ 4) $\sqrt{E/2}$

35. Two satellites A and B are revolving round a planet in coplannar concentric circular orbits of radii R and R_2 in the same direction respectively. Their respective periods of revolution are 1 hr and 8 hrs. If the radius of the orbit of A is 10^1KM, their relative speed, when they are closest in KMPH is
1) $\frac{\pi\times10^4}{2}$ 2) $\pi\times10^4$ 3) $2\pi\times10^4$ 4) $4\pi\times10^4$

36. Match the following

List - I	List - II
A) Black Hole	E) 1, 4 times the mass of sun
B) Chandrasekhar limit	F) Newton's Law of gravitation
C) Action at a distance	G) Einistein's concept of Gravity
D) Distortion of space	H) Star with 10 times mass of sun

1) A - H; B - E; C - E; B - G 2) A - E; B - H; C - E; D - G
3) A - E; B - H; C - G; D - H 4) A - H; B - G; C - E; D - F

37. The life of a star of mass 9 x 10^{30}kg ends as a block hole. The schwartzehild radius of star is (G = 6.7 x 10^{-11} Nm^2 kg^2)
1) 6.7 km 2) 26.8 km 3) 13.4 km 4) 3.35 km

38. During the formation of a black hole, a massive star undergoes teh following changes in a sequence. Give the correct order of sequence of changes
A) A, C, B, D 2) A, B, C, D 3) B, C, A, D 4) D, C, B, A

39. If value of universal gravitational constant (G) starts to decrease, then
A) length of the year will increase B) Kinetic energy of earth will decrease
C) Acceleration due to gravity decreases
1) Only (A) and (B) are true 2) Only B, C are true 3) Only C is true 4) A, B, C are true

40. Three uniform spheres each of mass M and radius 'R' each are kept in such a way that each touches the other two the magnitude of the gravitational force on any of the spheres due to the other two is
1) $\sqrt{\frac{3}{4}}\frac{GM^2}{R^2}$ 2) $\frac{\sqrt{3}GM^2}{R^2}$ 3) $\sqrt{\frac{3}{16}}\frac{GM^2}{R^2}$ 4) $\frac{3GM^2}{2R^2}$

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Key:

1) 1	2) 1	3) 1	4) 4	5) 3	6) 1	7) 3	8) 2	9) 2	10) 2
11) 1	12) 3	13) 2	14) 2	15) 1	16) 3	17) 3	18) 4	19) 1	20) 2
21) 4	22) 2	23) 2	24) 1	25) 3	26) 2	27) 4	28) 4	29) 2	30) 2
31) 4	32) 3	33) 3	34) 1	35) 2	36) 1	37) 3	38) 1	39) 4	40) 3