Only one option correct

1. Two bodies of mass m and M are initially at rest at very large distance from each other. They approach each other under the influence of mutual gravitational force. Their relative velocity of approach at a distance of separation d is
1. $\sqrt{\frac{2G(M+m)}{d^2}}$ 2. $\sqrt{\frac{G(M+m)}{d^2}}$ 3. $\sqrt{\frac{2G(M+m)}{d}}$ 4. $\sqrt{\frac{G(M+m)}{d}}$

2. Two planets A and B have the same material density. If the radius of A is twice that of B, then the ratio of escape velocities from the planets v_A: v_B is
1. 2 2. √2 3. 1/√2 4. 1/2

3. A body is projection horizontally from the surface of the Earth of radius R with a velocity equal to n times the escape velocity. Neglect rotational effects of the earth. If the maximum height attained by the body from the Earth's surface is $R/2$ then, n is equal to
1. √0.6 2. √3/2 3. √0.4 4. 1/√2

4. A particle is projected from the mid-point of the line joining two fixed particles each of mass m. If the distance of separation between the fixed particles is l, the minimum velocity of projection of the particle so as to escape is equal to
1. $\sqrt{\frac{GM}{l}}$ 2. $\sqrt{\frac{GM}{2l}}$ 3. $\sqrt{\frac{2GM}{l}}$ 4. $2\sqrt{\frac{2GM}{l}}$

5. A satellite is launched into a circular orbit of radius R around the earth while a second satellite is launched into an orbit of radius 1.02 R. the percentage difference in the time periods is nearly
1. 0.7 2. 1.0 3. 1.5 4. 3

6. A particle is released from infinity. Another particle is released from a height of $R/2$ (where R is the radius of the earth). The ratio of their velocities as they reach the surface of the earth is
1. √3 : 1 2. 3:2 3. 1:1 4. 1:2

7. A ball A of mass m falls to the surface of the earth from infinity. Another ball B of mass $2m$ falls to the earth from the height equal to six times the radius of the earth. Ratio of velocity of A to that of B on reaching the earth is
1. $\sqrt{\frac{6}{5}}$ 2. $\sqrt{\frac{5}{4}}$ 3. $\sqrt{\frac{5}{7}}$ 4. $\sqrt{\frac{7}{6}}$

8. A satellite is revolving around the earth with a speed of v_o. If it stops suddenly, the velocity with which is reaches the surface of the earth is (v_e is the escape velocity from the surface of the earth)
1. $\frac{v_e^2}{v_o}$ 2. v_o 3. $\sqrt{v_e^2 - v_o^2}$ 4. $\sqrt{v_e^2 - 2v_o^2}$

9. An artificial satellite is moving around the earth in a circular orbit with a speed equal to half the magnitude of escape velocity. The height of the satellite from the surface of the earth is
1. $2R$ 2. $R/2$ 3. R 4. $R/4$

10. Three identical bodies, each of mass M, are moving in a circle of radius R under the influence of mutual gravitational force. The speed of each body is
1. $\sqrt{\frac{GM}{R}}$ 2. $\sqrt{\frac{GM}{3R}}$ 3. $\sqrt{\frac{GM}{R\sqrt{3}}}$ 4. $\sqrt{\frac{GM}{9R}}$

11. Four particles of equal masses M move along a circle of radius R under the action of their mutual gravitational attraction maintaining a square shape. The speed of each particle is
1. $\sqrt{\frac{GM}{R}\left(\frac{2\sqrt{2}+1}{4}\right)}$ 2. $\sqrt{\frac{GM}{R}\left(\frac{\sqrt{2}+1}{4}\right)}$ 3. $\sqrt{\frac{GM}{R}\left(\frac{1}{\sqrt{2}+1}\right)}$ 4. $\sqrt{\frac{4GM}{R}\left(\frac{1}{\sqrt{2}+1}\right)}$

12. Three point masses, each of mass M each, are moving in a circle under their mutual gravitational attractive forces. If speed of each body is v then the distance between any two bodies is
1. $\frac{2GM}{v^2}$ 2. $\frac{3GM}{v^2}$ 3. $\frac{\sqrt{3}GM}{v^2}$ 4. $\frac{GM}{v^2}$

13. Two point masses of mass $4m$ and m respectively separated by d distance are revolving under mutual force of attraction. Ratio of their kinetic energies will be
1. 1:4 2. 1:5 3. 1:1 4. 1:2

14. If the kinetic energy of a satellite (in a stationary orbit) is 2M J, its total energy is
1. -1M J 2. -2M J 3. -4M J 4. -8M J

15. A space ship of mass m is in circular orbit of radius $2R_e$ about the earth of mass M and radius R_e. Energy required to transfer the space ship to circular orbit of radius $3R_e$ is

1. $\frac{GmM}{8R_e}$ 2. $\frac{GmM}{4R_e}$ 3. $\frac{GmM}{24R_e}$ 4. $\frac{GmM}{12R_e}$

16. A satellite of mass m is moving in a circular orbit of radius r around a planet of mass M. Its angular momentum is

1. $\sqrt{Gm^2Mr}$ 2. $\sqrt{GmM^2r}$ 3. $\sqrt{\frac{GmM^2}{r}}$ 4. $\sqrt{Gm^2Mr^2}$

17. Kinetic energy of a satellite in its orbit around the earth is E. Additional kinetic energy required by the satellite to escape the earth's orbit is

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

18. A satellite of mass m, initially at rest on the earth, is launched into a circular orbit at a height equal to the radius of the earth. The minimum energy required is

1. $\frac{\sqrt{3}}{4}mgR$ 2. $\frac{1}{2}mgR$ 3. $\frac{1}{4}mgR$ 4. $\frac{3}{4}mgR$

19. Assertion (A) : There is no atmosphere on moon
Reason (R) : RMS velocity of molecules of gases is less than the escape velocity on surface of the moon

1. A is correct and R is the correct explanation for it
2. A is correct but R is not the correct explanation for A
3. A is wrong but R is generally correct
4. Both A and R are wrong

20. The maximum energy required to launch a satellite of mass m (from the earth's surface) into a circular orbit of radius $3R$ is (R is the radius of the earth)

1. $\frac{5}{6}mgR$ 2. $\frac{3}{8}mgR$ 3. $\frac{3}{4}mgR$ 4. $\frac{7}{8}mgR$

Key

1. 3
2. 2
3. 1
4. 4
5. 4
6. 1
7. 4
8. 4
9. 3
10. 3
11. 1
12. 4
13. 1
14. 2
15. 4
16. 1
17. 4
18. 4
19. 2
20. 1