# GRAVITATION

**1.** At what height in km over the earth's pole the free fall acceleration decreases by one percent? (Assume the radius of the earth to be 6400 km.)

(a) 32 (b) 64

(c) 80 (d) 1.253

**2.** $V_e$ and $V_p$ denotes the escape velocity from the earth and another planet having twice the radius and the same mean density as the earth. Then

(a) $V_e = V_p$ (b) $V_e = V_{p2}$

(c) $V_e = 2V_p$ (d) $V_e = V_{p1}$

**3.** The orbital velocity of an artificial satellite in a circular orbit just above the earth's surface is $V$. For a satellite orbiting at an altitude of half of the earth's radius, the orbital velocity is

(a) $\frac{3}{2}V$ (b) $\sqrt{\frac{3}{2}}V$

(c) $\sqrt{\frac{2}{3}}V$ (d) $\frac{2}{3}V$

**4.** For the moon to cease to remain the earth satellite its orbital velocity has to be increased by a factor of

(a) 2 (b) $\sqrt{2}$

(c) $\frac{1}{\sqrt{2}}$ (d) $\sqrt{3}$

**5.** The rotation period of an earth satellite close to the surface of the earth is 83 minutes. The satellite in an orbit at a distance of three times earth radii from its surface will be :

(a) 83 minutes (b) $83 \times \sqrt{8}$ minutes

(c) 664 minutes (d) 249 minutes

**6.** An earth satellite $S$ has an orbit radius, which is 4 times that of a communication satellite $C$. The period of revolution of $S$ is

(a) 4 days (b) 8 days

(c) 16 days (d) 32 days

**7.** Two satellites of masses $m_1$ and $m_2$ ($m_1 > m_2$) are revolving round earth in circular orbits of radius $r_1$ and $r_2$ ($r_1 > r_2$) respectively. Which of the following statements is true regarding their speeds $V_1$ and $V_2$

(a) $V_1 = V_2$ (b) $V_1 < V_2$

(c) $V_1 > V_2$ (d) $\frac{V}{r_1} = \frac{V}{r_2}$

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

(a) positive

(b) negative

(c) zero

(d) may be positive or negative depending upon its initial velocity

**9.** As we go from equator to the poles the value of

(a) remains the same

(b) decreases

(c) increases

(d) decreases upto a latitude of $45^o$.

**10.** Two satellites $A$ and $B$ go round a planet $P$ in circular orbits having radii $4R$ and $R$ respectively. If the speed of the satellite $A$ is $3V$, the speed of satellite $B$ will be

(a) $12V$ (b) $6V$

(c) $\frac{4}{3}V$ (d) $\frac{3}{2}V$

**11.** Acceleration due to gravity $g$ and the mean density of the earth $\rho$ are related by the relation, where $G$ is the gravitational constant and $R_e$ is the radius of the earth

(a) $\left(\frac{g}{G}\right)\frac{4\pi}{3}R_e^3 = \rho$ (b) $\frac{\left(\frac{g}{G}\right)}{\left(\frac{4\pi}{3}R_e\right)} = \rho$

(c) $\frac{g}{G}\frac{4\pi}{3}R_e^2 = \rho$ (d) $\frac{\left(\frac{g}{G}\right)}{\left(\frac{4\pi}{3}R_e^3\right)} = \rho$

**12.** Two particles of equal mass go round a circle of radius $R$ under the action of their mutual gravitational attraction. The speed of each particle is

(a) $V = \frac{Gm}{2R}$ (b) $V = \frac{1}{2R}\frac{\sqrt{1}}{Gm}$

(c) $V = \frac{1}{2}\frac{\sqrt{Gm}}{2}$ (d) $V = \frac{\sqrt{4}GM}{R}$

**13.** Ina satellite if the time of revolution is $T$ then K.E. is proportional to

(a) $\frac{1}{T^{2/3}}$ (b) $\frac{1}{T}$

(c) $\frac{1}{T^2}$ (d) $\frac{1}{T^3}$

**14.** A satellite is launched into a circular orbits of radius $R$ around the earth. A second satellite is launched into an orbit of radius $(1.01)R$. The period of the second satellite is larger than that of the first one by approximately

(a) 0.5% (b) 1.0%

(c) 1.5% (d) 3.0%

**15.** A spring balance is graduated on sea level. If a body is weighed with this balance at consecutively increasing heights from earth's surface, the weight indicated by the balance

(a) will go on decreasing continuously

(b) will go on increasing continuously

(c) will remain same

(d) will first increase and then decrease

**16.** The escape velocity of an object from the earth depends upon the mass of the earth ($M$), its mean density ($\rho$), its radius ($R$) and gravitational constant ($G$). Thus the formula for escape velocity is

(a) $v = R\sqrt{\frac{8\pi}{3}G\rho}$ (b) $v = M\sqrt{\frac{8\pi}{3}GR}$

(c) $v = \sqrt{2GMR}$ (d) $v = \sqrt{\frac{2GM}{R^2}}$

**17.** The mass of the earth is $6.00 \times 10^{24}$ kg and that of the moon is $7.40 \times 10^{22}$ kg. ? The constant of gravitation. G = $6.67 \times 10^{-11}$ $Nm^2/kg^2$. The potential energy of the system is $-7.79 \times 10^{28}$ J. The mean distance between earth and moon is :

(a) $3.80 \times 10^8$ metres (b) $3.37 \times 10^6$ metres

(c) $7.60 \times 10^4$ metres (d) $1.90 \times 10^2$ metres

**18.** The value of g on the earth's surface is 980 $cm/sec^2$. Its value at a height of 64 km from the earth's surface is :

(a) 960.40 $cm/sec^2$ (b) 984.90 $cm/sec^2$

(c) 982.45 $cm/sec^2$ (d) 977.55 $cm/sec^2$

**19.** Where will it be profitable to purchase one kilogram sugar

(a) at poles (b) at equator

(c) at $45^o$ latitude (d) at $40^o$ latitude

**20.** If the radius of the earth were to shrink by 1% its mass remaining same, the acceleration due to gravity on the earth's surface would :

(a) decrease by 2% (b) remain unchanged

(c) increase by 2% (d) become zero

**21.** A body of mass m is taken from earth surface to the height equal to radius of earth; the change (increase) in potential energy will be

(a) $mgR$ (b) $\frac{1}{2}mgR$

(c) $2\,mgR$ (d) $\frac{1}{4}\,mgR$

**22.** If the earth rotates faster than its present speed, the weight of an object will :

(a) increase at the equator but remains unchanged at the poles

(b) decrease at equator but remains unchanged at the poles

(c) remain unchanged at the equator but decreases at the poles

(d) remain unchanged at the equator but increases at the poles

**23.** A satellite is moving around the earth with speed v in a circular orbit of radius r. If the orbit radius is decreased by 1% its speed will

(a) increase by 1% (b) increase by 0.5%

(c) decrease by 1& (d) decrease by 0.5%

**24.** The change in potential energy when a body of mass $m$ is raised to a height $nR$ from the earth's surface is ($R$ = radius of earth)

(a) $mgR\frac{n}{n-1}$ (b) $n\,mg\,R$

(c) $mgR\frac{n^2}{n^2+1}$ (d) $mgR\frac{n}{n+1}$

**25.** Orbital velocity of an artificial satellite does not depend upon

(a) mass of earth

(b) mass of satellite

(c) radius of earth

(d) acceleration due to gravity

**26.** A satellite of mass $m$ is circulating around the earth with constant angular velocity. If radius of orbit is $R_0$, the mass of earth $M$, the angular momentum about the centre of the earth is

(a) $m\sqrt{GM}\,R_0$ (b) $M\sqrt{GM}\,R_0$

(c) $m\frac{\sqrt{GM}}{R_0}$ (d) $M\frac{\sqrt{GM}}{R_0}$

**27.** If the distance between earth and the sun were half of its present value, the no. of days in an year would have been

(a) 64.5 (b) 129

(c) 182.5 (d) 730

**28.** Given mass of the moon is $\frac{1}{81}$th of the mass of the earth and corresponding radius is $\frac{1}{4}$th of the earth. If escape velocity on earth surface is 11.2 km/s the value of same on the surface of the moon is

(a) 0.14 km/s (b) 0.5 km/s

(c) 2.5 km/s (d) 5 km/s

**29.** If radius of the earth contracted 2% and its mass remains the same then weight of the body at the earth surface

(a) will decrease

(b) will increase

(c) will remain the same

(d) none

**30.** A pendulum is clamped on the roof of a stationary car and its time period is $T$. If the car starts to move with an acceleration a then its time period will be

(a) more than $T$ (b) less than $T$

(c) equal to $T$ (d) infinite

**31.** If mass of a body is $M$ on the earth surface, then the mass of the same body on the moon surface is:

(a) $\frac{M}{6}$ (b) zero

(c) M (d) none

**32.** An earth satellite moves from an orbit $A$ to another stable lower orbit *(B)* In this process :

(a) gravitational P.E. decreases

(b) gravitational P.E. increases

(c) angular speed increases

(d) none of these

**33.** In a missile launched with a velocity less than escape velocity, the sum of its K.E. and P.E. is always :

(a) +ve (b) zero

(c) –ve (d) none

**34.** In a gravitational field, the work done in transporting mass from one point to another:

(a) depends on the end positions

(b) depends on distance between them

(c) depends on actual point of motion

(d) depends on velocity of transport

**35.** 2 bodies of different masses of 2 kg and 4 kg are moving with velocities 2 m/s and 10 m/s towards each other due to mutual gravitational attraction. What is the velocity of their centre of mass

(a) 5 m/s (b) 6 m/s

(c) 8 m/s (d) zero

**36.** The metallic bob of a simple pendulum has the relative density ρ. the time period of this pendulum is *T*. If the metallic bob is immersed in water, then the new time period is given by

(a) $T\frac{(\rho-1)}{\rho}$ (b) $T\frac{\rho}{(\rho-1)}$

(c) $T\sqrt{\frac{(\rho-1)}{\rho}}$ (d) $T\sqrt{\frac{(\rho)}{(\rho-1)}}$

**37.** The mass of the moon is about 1.2% of the mass of the earth. Compared to the gravitational force the earth exerts on the moon, the gravitational force of moon exerts on earth

(a) is the same

(b) is smaller

(c) is greater

(d) varies with its phase

**38.** A satellite is placed in a circular orbit around earth at such a height that it always remains stationary with respect to earth surface. In such case, its height from the earth surface is:

(a) 32000 km (b) 36000 km

(c) 6400 km (d) 4800 km

**39.** A space ship moves from earth to moon and back. The greatest energy required for the space ship is to overcome the difficulty in :

(a) entering the earth's gravitational field

(b) take off from earth's field

(c) take off from lunar surface

(d) entering the moon's lunar surface

**40.** A satellite is moving around the earth with speed v in a circular orbit of radius r. If the orbit radius is decreased by 1%, the speed of the satellite will :

(a) increase by 1% (b) increase by 0.5%

(c) decrease by 1% (d) decrease by 0.5%

**41.** For any rocket on earth the escape velocity is 11.2 km/sec. Its value, at the planet where acceleration due to gravity is two times that on earth and diameter is two times that of earth will be (in km/s):

(a) 11.2 (b) 5.6

(c) 22.4 (d) 33.6

**42.** What should be the velocity of earth due to rotation about its own axis so that the weight of a person becomes $\frac{3}{5}$ of the present weight at equator. Radius of earth on equator is 6400 km

(a) $7.4 \times 10^{-3}$ rad/s

(b) $6.7 \times 10^{-4}$ rad/s

(c) $7.8 \times 10^{-4}$ rad/s

(d) $8.7 \times 10^{-4}$ rad/s

**43.** A satellite is moving in a circular orbit at a height 100 km above the earth's surface. A person inside the satellite feels weightless because :

(a) acceleration due to gravity is almost zero at such a height

(b) the earth does not exert any force on the person

(c) the centripetal force makes the satellite move in a circular orbit

(d) the forces due to earth and moon are almost compensated at such a height

**44.** A satellite of mass m moving around the earth of mass $M_E$ in a circular orbit of radius $R$ has angular momentum $L$. The rate of the area swept by the line joining the centre of the earth and satellite *is*

(a) $\frac{L}{2m}$ (b) $\frac{L}{m}$

(c) $\frac{2L}{m}$ (d) $\frac{2L}{M_E}$

**45.** A body weighs 72 N on the surface of earth. What is the gravitational force on it due to earth at a height equal to half the radius of the earth from the surface

(a) 72 N (b) 28 N

(c) 16 N (d) 32 N

**46.** The periodic time of communication satellite is

(a) 6 hours (b) 12 hours

(c) 18 hours (d) 24 hours

**47.** Height at which the value of $g$ becomes one-fourth to that on earth is

(a) $R$ (b) $2R$

(c) $\left(\frac{3}{2}\right)R$ (d) $4R$

**48.** A satellite is in an orbit around the earth. If its kinetic energy is doubled, then

(a) it will rotate with greater speed

(b) it will fall on the earth

(c) it will maintain its path

(d) it will escape out of earth's gravitational field

**49.** If $v_0$ be the orbital velocity of a satellite in a circular close to the earth's surface and $v_e$ is the escape velocity for the earth, relation between the two is

(a) $v_e = \sqrt{2}\, v_0$ (b) $v_e = \sqrt{3}\, v_0$

(c) $v_0 = v_e$ (d) $v_e = 2\, v_0$

**50.** The mass of body on earth is m kg. Its mass on moon is ($g_{moon} = \left(\frac{1}{6}\right) g_{earth}$)

(a) $6m$ kg (b) $\left(\frac{1}{6}\right)m$ kg

(c) $m$ kg (d) zero

**ANSWERS KEY**

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|---|---|---|---|---|---|---|---|---|---|
| **1** | **A** | **11** | **B** | **21** | **B** | **31** | **C** | **41** | **C** |
| **2** | **B** | **12** | **C** | **22** | **B** | **32** | **A,C** | **42** | **C** |
| **3** | **C** | **13** | **A** | **23** | **B** | **33** | **C** | **43** | **A** |
| **4** | **B** | **14** | **C** | **24** | **D** | **34** | **A** | **44** | **A** |
| **5** | **C** | **15** | **A** | **25** | **B** | **35** | **B** | **45** | **D** |
| **6** | **B** | **16** | **A** | **26** | **A** | **36** | **D** | **46** | **D** |
| **7** | **B** | **17** | **A** | **27** | **B** | **37** | **A** | **47** | **A** |
| **8** | **B** | **18** | **A** | **28** | **C** | **38** | **B** | **48** | **D** |
| **9** | **C** | **19** | **B** | **29** | **B** | **39** | **B** | **49** | **A** |
| **10** | **B** | **20** | **C** | **30** | **B** | **40** | **D** | **50** | **C** |