

# Gravitation

Class 11 Physics · 24 NEET MCQs with answers & explanations

Gravitation covers Newton's law of gravitation, gravitational field and potential, Kepler's laws, orbital velocity, escape velocity and variation of  $g$  with height/depth. NEET tests orbital mechanics, escape velocity, variation of  $g$  and gravitational PE — both conceptual and numerical.

## Key Gravitation Formulas

| Concept           | Key Formula                                                                                      |
|-------------------|--------------------------------------------------------------------------------------------------|
| Newton's law      | $F = GMm/r^2$ ; gravitational constant $G = 6.674 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$ |
| $g$ at height $h$ | $g' = g(1 - 2h/R)$ for $h \ll R$ ; $g' = gR^2/(R+h)^2$ for large $h$                             |
| $g$ at depth $d$  | $g' = g(1 - d/R)$ ; zero at centre                                                               |
| Orbital velocity  | $v_0 = \sqrt{gR} \approx 7.9 \text{ km/s}$ for Earth orbit near surface                          |
| Escape velocity   | $v_e = \sqrt{2gR} = \sqrt{2} \times v_0 \approx 11.2 \text{ km/s}$ for Earth                     |
| Kepler's 3rd law  | $T^2 \propto a^3$ ; relates orbital period to semi-major axis                                    |

## Questions

**Q1. The gravitational field intensity at Earth's centre is:**

- (A) Equal to  $g$  at the surface
- (B) Zero
- (C) Equal to  $g/2$
- (D) Equal to  $2g$

**Q2. The value of acceleration due to gravity decreases with altitude because:**

- (A) The distance from Earth's centre increases, reducing gravitational pull by the inverse-square law
- (B) Earth's mass decreases with altitude
- (C) The gravitational constant  $G$  decreases at higher altitudes
- (D) Earth's density increases at higher altitudes

**Q3. A planet is at aphelion in its elliptical orbit. Which quantity is minimum there?**

- (A) Orbital speed
- (B) Distance from the Sun
- (C) Gravitational potential energy
- (D) Angular momentum

**Q4. Gravitational potential energy of two point masses separated by a finite distance is always:**

- (A) Negative
- (B) Positive
- (C) Zero
- (D) Can be positive or negative depending on the masses

**Q5. Who proposed the Universal Law of Gravitation stating that every particle attracts every other particle with a force proportional to the product of their masses and inversely proportional to the square of the distance between them?**

- (A) Isaac Newton
- (B) Johannes Kepler
- (C) Albert Einstein
- (D) Galileo Galilei

**Q6. Acceleration due to gravity at Earth's surface is directed:**

- (A) Toward the centre of Earth
- (B) Away from the centre of Earth
- (C) Tangential to Earth's surface
- (D) Perpendicular to Earth's rotational axis

**Q7. An artificial satellite revolves around the Earth primarily because:**

- (A) The satellite has no weight in orbit
- (B) There is no gravity in space at orbital altitude
- (C) The atmosphere pushes the satellite forward continuously
- (D) Earth's gravitational force provides the required centripetal force

**Q8. Kepler's First Law states that planets move around the Sun in:**

- (A) Elliptical orbits with the Sun at one focus
- (B) Circular orbits with the Sun at the centre
- (C) Parabolic orbits
- (D) Hyperbolic orbits

**Q9. Orbital velocity is defined as the minimum horizontal velocity required for a satellite to maintain a stable circular orbit around Earth. This statement is:**

- (A) TRUE
- (B) FALSE
- (C) True only for geostationary satellites
- (D) True only at escape altitude

**Q10. The total mechanical energy of a satellite in a circular orbit is always:**

- (A) Negative
- (B) Positive
- (C) Zero
- (D) Can be positive or negative

**Q11. A geostationary satellite revolves around Earth with a time period of:**

- (A) 24 hours
- (B) 12 hours
- (C) 48 hours
- (D) 6 hours

**Q12. Escape speed is the minimum speed required for a body to:**

- (A) Move in a circular orbit
- (B) Escape the gravitational field of a celestial body without further propulsion
- (C) Reach the highest point and return
- (D) Become weightless

**Q13. The universal gravitational constant  $G$  is numerically equal to the gravitational force between two point masses each of 1 kg separated by 1 m. The value of  $G$  in SI units is:**

- (A) 9.8
- (B)  $3.14 \times 10^{-11}$
- (C)  $6.02 \times 10^{-23}$
- (D)  $6.67 \times 10^{-11}$

**Q14. The gravitational force between two point masses is directly proportional to:**

- (A) The sum of their masses
- (B) The product of their masses
- (C) The square of their masses
- (D) The difference of their masses

**Q15. Two masses are separated by distance  $r$ . If the distance becomes  $2r$  while masses remain unchanged, the gravitational force becomes:**

- (A) Half the original force
- (B) One-third the original force
- (C) One-fourth the original force
- (D) Twice the original force

**Q16. Two bodies of masses 4 kg and 9 kg are separated by 3 m. Taking  $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$ , the gravitational force between them is closest to:**

- (A)  $6.00 \times 10^{-10} \text{ N}$
- (B)  $1.33 \times 10^{-10} \text{ N}$
- (C)  $3.00 \times 10^{-10} \text{ N}$
- (D)  $2.67 \times 10^{-10} \text{ N}$

**Q17. What is the direction of gravitational force between two point masses?**

- (A) Always attractive, along the line joining them
- (B) Always repulsive, perpendicular to the line joining them
- (C) Attractive or repulsive depending on mass values
- (D) Attractive, perpendicular to the line joining them

**Q18. Which of the following statements about gravitational force are correct? I. It is a central force. II. It acts along the line joining two masses. III. It obeys the inverse-square law. IV. It depends on the medium between the masses.**

- (A) I and II only
- (B) I, II and III only
- (C) II, III and IV only
- (D) All four statements

**Q19. Which of the following correctly describes the universal gravitational constant  $G$ ?**

- (A)  $G$  has the same dimensions as gravitational force
- (B)  $G$  depends on the masses of the interacting bodies
- (C)  $G$  is independent of the medium, temperature, and nature of the bodies
- (D)  $G$  has different values on Earth and on the Moon

**Q20. All of the following statements about gravitational force are correct EXCEPT:**

- (A) It acts between any two masses in the universe
- (B) It is a long-range force that extends to infinity
- (C) It follows the inverse-square law with distance
- (D) It depends upon the electric charge of the bodies

**Q21. Three equal masses  $m$  are placed at the vertices of an equilateral triangle of side  $a$ . The net gravitational force on any one mass due to the other two is directed:**

- (A) Along the angle bisector from that vertex toward the centroid
- (B) Zero, because all forces cancel by symmetry
- (C) Perpendicular to the opposite side, outward
- (D) Along one of the sides toward an adjacent mass

**Q22. Two masses exert gravitational forces on each other. Which relation is always true regardless of the individual mass values?**

- (A) The forces are equal in magnitude and opposite in direction
- (B) The force is greater on the smaller mass
- (C) The forces are equal only when both masses are identical
- (D) The forces act in the same direction on both bodies

**Q23. Two point masses  $m$  and  $2m$  are separated by distance  $r$ . If both masses are doubled and the distance is also doubled, the new gravitational force compared to the original is:**

- (A)  $4F$
- (B)  $F$
- (C)  $2F$
- (D)  $F/2$

**Q24. Two identical masses attract each other with force  $F$ . If one mass is tripled while the other and the distance remain unchanged, the gravitational force becomes:**

- (A)  $F$
- (B)  $2F$
- (C)  $3F$
- (D)  $9F$

## Answer key

|      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|
| 1-B  | 2-A  | 3-A  | 4-A  | 5-A  | 6-A  | 7-D  | 8-A  |
| 9-A  | 10-A | 11-A | 12-B | 13-D | 14-B | 15-C | 16-D |
| 17-A | 18-B | 19-C | 20-D | 21-A | 22-A | 23-B | 24-C |

## Answers with explanations

### Q1 — Answer: (B) Zero

At Earth's centre, mass is symmetrically distributed in all directions. Gravitational pulls from all sides cancel exactly, giving zero net field. This differs from gravitational potential, which is most negative ( $-3GM/2R$ ) at the centre.

**Q2 — Answer: (A) The distance from Earth's centre increases, reducing gravitational pull by the inverse-square law**

$g = GM/r^2$ . As  $r$  increases with altitude,  $g$  falls as  $1/r^2$ .  $G$  and  $M$  remain constant; confusing them with altitude-dependent changes is the most common error.

**Q3 — Answer: (A) Orbital speed**

At aphelion the planet is farthest, so by Kepler's Second Law it moves slowest — orbital speed is minimum. Distance from Sun is maximum at aphelion, not minimum. Angular momentum is conserved throughout and has no minimum point.

**Q4 — Answer: (A) Negative**

$U = -GMm/r$ . With  $U=0$  at infinity as reference,  $U$  is always negative at finite separation. Unlike electric PE, gravity is always attractive — there is no repulsive case that could make  $U$  positive.

**Q5 — Answer: (A) Isaac Newton**

Newton formulated the Universal Law of Gravitation in 1687. Kepler described planetary motion empirically but never derived the force law linking it to mass and distance.

**Q6 — Answer: (A) Toward the centre of Earth**

$g$  is the gravitational acceleration produced by Earth's pull, always directed toward Earth's centre. It is not related to the rotation axis or tangential to the surface.

**Q7 — Answer: (D) Earth's gravitational force provides the required centripetal force**

Gravity is the sole reason a satellite stays in orbit — it continuously provides the centripetal force for circular motion. The common misconception that gravity is absent in space is false; gravity is fully present and responsible for the orbit.

**Q8 — Answer: (A) Elliptical orbits with the Sun at one focus**

Every planet revolves in an ellipse with the Sun at one focus, not the centre. Circular orbits are a special case only; parabolic and hyperbolic paths are unbound trajectories, not planetary orbits.

**Q9 — Answer: (A) TRUE**

Orbital velocity is exactly the minimum horizontal speed for stable circular orbit at a given radius. Students confuse this with escape velocity, which is the minimum speed to leave Earth's gravity entirely.

**Q10 — Answer: (A) Negative**

Total energy = KE + PE =  $GMm/2r - GMm/r = -GMm/2r$ , which is always negative for a bound orbit. Students confuse this with the escape condition where total energy is exactly zero.

**Q11 — Answer: (A) 24 hours**

A geostationary satellite has orbital period equal to Earth's rotation period of 24 hours. Students confuse this with 12-hour navigation satellites like those in GPS constellations.

**Q12 — Answer: (B) Escape the gravitational field of a celestial body without further propulsion**

Escape speed is the minimum speed to reach infinity with zero final KE, needing no further propulsion. Students confuse it with orbital speed (Option A), which requires sustained centripetal condition.

**Q13 — Answer: (D)  $6.67 \times 10^{-11}$**

From  $F = Gm_1m_2/r^2$  with  $m_1=m_2=1$  kg and  $r=1$  m,  $F = G$  numerically.  $G \approx 6.67 \times 10^{-11}$  N m<sup>2</sup> kg<sup>-2</sup>. Option A (9.8) is  $g$ , the acceleration due to gravity — the most common confusion.

**Q14 — Answer: (B) The product of their masses**

$F = Gm_1m_2/r^2$  shows direct proportionality to the product  $m_1m_2$ . Choosing sum of masses is the most common error, confusing additive with multiplicative dependence.

**Q15 — Answer: (C) One-fourth the original force**

$F' = Gm_1m_2/(2r)^2 = F/4$  by the inverse-square law. Students confusing inverse with inverse-square incorrectly choose half the original force.

**Q16 — Answer: (D)  $2.67 \times 10^{-10}$  N**

$F = (6.67 \times 10^{-11} \times 4 \times 9)/9 = 2.67 \times 10^{-10}$  N. Option A arises from forgetting to square  $r$ ; option B from dividing by  $r$  instead of  $r^2$ .

**Q17 — Answer: (A) Always attractive, along the line joining them**

Gravitational force is always attractive and acts along the line joining the masses, making it a central force. Unlike electrostatic force, gravity has no repulsive counterpart in classical physics.

**Q18 — Answer: (B) I, II and III only**

Statements I, II, III are correct. Gravitational force is independent of the intervening medium — unlike electrostatic force, which is reduced in a dielectric medium. Statement IV is false.

**Q19 — Answer: (C)  $G$  is independent of the medium, temperature, and nature of the bodies**

$G$  is a universal constant — its value  $6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$  does not change with location, medium, or the nature of the bodies. Option D is the most tempting trap:  $g$  changes with location, but  $G$  does not.

**Q20 — Answer: (D) It depends upon the electric charge of the bodies**

Gravitational force is entirely independent of electric charge — it depends only on mass. Confusing Coulomb's law (charge-dependent) with Newton's law of gravitation is the targeted error here.

**Q21 — Answer: (A) Along the angle bisector from that vertex toward the centroid**

The two equal forces from the other vertices are symmetric about the angle bisector. Their resultant lies along the bisector directed toward the centroid. Net force magnitude is  $\sqrt{3} Gm^2/a^2$ .

**Q22 — Answer: (A) The forces are equal in magnitude and opposite in direction**

By Newton's Third Law, the gravitational pull on  $m_1$  due to  $m_2$  equals in magnitude the pull on  $m_2$  due to  $m_1$ , regardless of the ratio of masses. Option B is the most common misconception.

**Q23 — Answer: (B) F**

Original  $F = 2Gm^2/r^2$ . New  $F' = G(2m)(4m)/(2r)^2 = 8Gm^2/4r^2 = 2Gm^2/r^2 = F$ . The  $\times 4$  increase in mass product is exactly cancelled by the  $\times 4$  increase from doubling  $r$ . Option A ( $4F$ ) is chosen by students who forget to square the new distance.

**Q24 — Answer: (C)  $3F$** 

$F \propto m_1 m_2$ , so tripling one mass triples the product and hence the force:  $F' = 3F$ . Option D ( $9F$ ) is the trap — it would apply if both masses were tripled simultaneously.

**Practise all 468 questions on Gravitation**

RankUp app — 45,000+ NEET questions, 30,000+ flashcards, mock tests. Built by Dr. Deepak Sahu, MBBS Gold Medalist.

[Download free on Google Play](#) · [Practise online](#)

Questions based on NCERT. RankUp is not affiliated with NTA.