Class XI Physics Unit Test GRAVITATION

Maximum Marks: 50 Time Allowed: 2 Hours

General Instructions:

1. All questions are compulsory.
2. The question paper consists of five sections – A, B, C, D and E.
3. Use of calculators is not permitted.
4. Draw neat and labelled diagrams wherever necessary.
5. Take G=6.67×10−11 Nm2/kg2G=6.67\times10^{-11}\ Nm^2/kg^2 wherever required.
6. Take g=9.8 m/s2g=9.8\ m/s^2, wherever required.

SECTION A – MCQs 10 × 1 = 10 Marks

Choose the correct option.

Q1. The gravitational force between two bodies is inversely proportional to:

(a) Distance between them (b) Square of distance between them

(c) Cube of distance between them (d) Mass of the bodies

Q2. The value of acceleration due to gravity at the centre of the Earth is:

(a) 9.8 m/s29.8\ m/s^2 (b) Infinite (c) Zero (d) 4.9 m/s24.9\ m/s^2

Q3. The escape velocity from the surface of the Earth depends upon:

(a) Mass of the escaping body (b) Radius and mass of Earth

(c) Shape of the body (d) Temperature of the body

Q4. The time period of a geostationary satellite is:

(a) 12 hours (b) 24 hours approximately (c) 48 hours (d) 6 hours

Q5. Gravitational potential energy of two masses separated by distance r is:

(a) GMm/r (b) $-GMm/r$ (c) GMm/r^2 (d) Zero

Q6. If the distance between two masses is doubled, gravitational force becomes:

(a) Double (b) Half (c) One-fourth (d) Four times

Q7. The orbital velocity of a satellite depends on:

(a) Mass of satellite (b) Radius of orbit (c) Shape of satellite (d) Material of satellite

Q8. The weight of a body at the poles is:

(a) Less than at the equator (b) Greater than at the equator

(c) Zero (d) Same everywhere

Q9. Kepler's second law is based on conservation of:

(a) Energy (b) Linear momentum (c) Angular momentum (d) Mass

Q10. The dimensional formula of universal gravitational constant G is:

(a) $[M^{-1}L^3T^{-2}]$ (b) $[ML^2T^{-2}]$ (c) $[M^{-1}L^2T^{-1}]$ (d) $[ML^3T^{-2}]$

SECTION B – Very Short Answer Questions 5 × 2 = 10 Marks

Q11. State Newton's universal law of gravitation and write its mathematical expression.

Q12. Define gravitational field intensity. Write its SI unit.

Q13. Why does the value of acceleration due to gravity decrease with height above the Earth's surface?

Q14. What is a geostationary satellite? Write any two of its applications.

Q15. Differentiate between gravitational potential and gravitational potential energy.

SECTION C – Short Answer Questions 4 × 3 = 12 Marks

Q16. Derive the expression for acceleration due to gravity at the surface of the Earth.

Q17. A body is projected vertically upwards from the Earth's surface. Derive the expression for its escape velocity.

Q18. Explain Kepler's three laws of planetary motion.

Q19. A satellite revolves around the Earth in a circular orbit of radius 7×106 m7\times10^6\ m. Calculate its orbital velocity.

Given: GM=3.98×1014 m3/s2GM=3.98\times10^{14}\ m^3/s^2.

SECTION D – Long Answer Questions 2 × 4 = 8 Marks

Q20. Derive an expression for the variation of acceleration due to gravity with depth below the Earth's surface. Draw a suitable graph showing the variation of gg with depth.

Q21. Derive an expression for the orbital velocity of a satellite revolving around the Earth. Hence, show that the orbital velocity is independent of the mass of the satellite.

SECTION E – Case-Based Question 1 × 5 = 5 Marks

Q22. Read the passage carefully and answer the questions that follow.

Artificial satellites are launched into space for communication, weather forecasting, navigation and scientific research. A satellite revolving around the Earth experiences gravitational force, which provides the necessary centripetal force for its circular motion. The orbital speed of a satellite depends on the mass of the Earth and the radius of its orbit.

Answer the following:

(a) What provides the centripetal force to a satellite revolving around the Earth? (1)

(b) Write the expression for orbital velocity of a satellite. (1)

(c) What happens to the orbital velocity if the orbital radius increases? (1)

(d) Why does an astronaut feel weightless inside an orbiting satellite? (2)