Physics – Autumn Break Holiday Homework (Class XI)

Oct 13, 2026 · @VARAKUMAR G

Physics (Code 042) · Time: 3 hours · Maximum Marks: 70 · Syllabus: Chapters 1–7, Units and Measurements to Gravitation.

General Instructions

1. There are 33 questions in all. All questions are compulsory.
2. This question paper has five sections: A, B, C, D and E.
3. Section A has sixteen questions of 1 mark each: twelve MCQs (Q1–12) and four assertion–reason questions (Q13–16). Section B has five questions of 2 marks each. Section C has seven questions of 3 marks each. Section D has two case-study questions of 4 marks each. Section E has three long-answer questions of 5 marks each.
4. There is no overall choice. Internal choice is given in two questions of Section B (Q20, Q21), one question of Section C (Q26) and all three questions of Section E. Attempt only one of the choices in such questions.
5. Use of calculators is not allowed.
6. You may use these values wherever necessary:

Constant	Value
Acceleration due to gravity, g	10 m/s²
Gravitational constant, G	6.67 × 10^-11 N m² kg^-2
Radius of the earth, R	6.4×10^6 m
sin 37°, cos 37°	0.6, 0.8
√3	1.73

Section A – 16 × 1 = 16 marks

Q1–12 are multiple-choice questions. Choose the correct option.

1. The dimensional formula of (energy)/(frequency) is

(A) $[ML^2T^{-1}]$ (B) $[ML^2T^{-2}]$ (C) $[MLT^{-1}]$ (D) $[ML^2T^{-3}]$

2. The length and breadth of a rectangular sheet are measured as 16.2 cm and 10.1 cm. The area of the sheet, expressed with the correct number of significant figures, is

(A) 163.62 cm² (B) 164 cm² (C) 163.6 cm² (D) 160 cm²

3. The velocity of a particle moving along a straight line is v = (20 − 4t) m/s, where t is in seconds. The total distance travelled by the particle in the first 8 s is

(A) 32 m (B) 50 m (C) 68 m (D) 18 m

4. A body starts from rest and moves with constant acceleration. The ratio of the distances travelled in the 1st, 2nd and 3rd seconds is

(A) 1 : 2 : 3 (B) 1 : 3 : 5 (C) 1 : 4 : 9 (D) 1 : 1 : 1

5. A ball is thrown horizontally with a speed of 15 m/s from the top of a tower 80 m high. The horizontal distance from the foot of the tower to the point where the ball strikes the ground is

(A) 30 m (B) 45 m (C) 60 m (D) 80 m

6. The resultant of two forces of magnitudes 3 N and 4 N acting at a point cannot be

(A) 1 N (B) 5 N (C) 7 N (D) 8 N

7. A man of mass 60 kg stands on a weighing machine in a lift that is moving downward with an acceleration of 2 m/s^2. The reading of the machine, in kg, is

(A) 48 (B) 60 (C) 72 (D) 0

8. A block placed on a rough inclined plane just begins to slide when the angle of inclination is 30°. The coefficient of static friction between the block and the plane is

(A) 1/2 (B) $1/\sqrt{3}$ (C) $\sqrt{3}$ (D) $1/\sqrt{2}$

9. A car of mass 1000 kg moving at 72 km/h is brought to rest by its brakes in a distance of 40 m. The average retarding force is

(A) 2000 N (B) 5000 N (C) 10000 N (D) 500 N

10. Which of the following forces is conservative?

(A) friction (B) air resistance (C) gravitational force (D) viscous force

11. A skater spinning with her arms outstretched pulls her arms in so that her moment of inertia becomes one-third of its initial value. Her angular velocity becomes

(A) 1/3 times (B) 3 times (C) 9 times (D) unchanged

12. If the radius of the earth shrinks by 1% while its mass remains the same, the acceleration due to gravity at the surface will

(A) increase by about 2% (B) decrease by about 2% (C) increase by 1% (D) decrease by 1%

For Q13–16, two statements are given: Assertion (A) and Reason (R). Select the correct answer from the options below.

(A) Both A and R are true and R is the correct explanation of A. (B) Both A and R are true but R is not the correct explanation of A. (C) A is true but R is false. (D) Both A and R are false.

13. Assertion (A): The equation $v = u + at$ is dimensionally correct. **Reason (R):** Every term in a dimensionally correct equation has the same dimensions.

14. Assertion (A): The displacement of a body can be zero even when the distance travelled by it is not zero. **Reason (R):** Displacement is a vector quantity, whereas distance is a scalar quantity.

15. Assertion (A): The escape velocity of a body from the surface of the earth does not depend on the angle of projection. **Reason (R):** The escape velocity depends on the mass of the body projected.

16. Assertion (A): The moment of inertia of a rigid body depends only on its mass. **Reason (R):** The moment of inertia of a body does not depend on the position of the axis of rotation.

Section B – 5 × 2 = 10 marks

17. A student measures the time for 20 oscillations of a simple pendulum as 36.0 s using a stopwatch of least count 0.1 s. Find (i) the time period of the pendulum with its absolute error, and (ii) the percentage error in the measurement of the total time. [2]

18. A car travelling at 72 km/h along a straight road has an obstacle 45 m ahead when the driver notices it. The driver's reaction time is 0.5 s and, once applied, the brakes give a constant retardation of 5 m/s². (i) Find the total distance the car travels before it would stop. (ii) Does it hit the obstacle? If so, find its speed at the moment of impact. [2]

19. Derive the expression for the horizontal range of a projectile thrown with speed u at an angle θ to the horizontal. Hence show that the range is maximum for θ = 45°. [2]

20. (a) State Newton's second law of motion. Show that Newton's first law follows from it. [2]

OR

(b) A bullet of mass 20 g moving at 200 m/s strikes a wooden block and comes to rest in 0.01 s. Calculate the average force exerted by the block on the bullet. [2]

21. (a) State the work–energy theorem. Prove it for a constant force acting on a body. [2]

OR

(b) A body of mass 2 kg is dropped from rest from a height of 20 m. Find its kinetic energy just before it strikes the ground and its speed at that instant. [2]

Section C – 7 × 3 = 21 marks

22. The time period T of a simple pendulum may depend on its length l, the mass m of the bob and the acceleration due to gravity g. Using dimensional analysis, derive the expression for T. State one limitation of this method. [3]

23. A stone is dropped from the top of a tower 80 m high. Find (i) the time it takes to reach the ground, (ii) its speed just before it hits the ground, and (iii) the distance it covers in the last second of its fall. [3]

24. A swimmer can swim at 5 m/s in still water. He wants to cross a river 120 m wide that flows at 3 m/s. (i) If he heads perpendicular to the bank, find the time he takes to cross and how far downstream he is carried. (ii) In what direction must he head to reach the point exactly opposite his starting point, and how long does he then take? [3]

25. State the law of conservation of linear momentum. Derive it from Newton's second and third laws for an isolated system of two interacting bodies. [3]

26. (a) A pump lifts 600 kg of water per minute from a well 20 m deep and delivers it with a speed of 5 m/s. Find (i) the rate at which the water gains potential energy, (ii) the rate at which it gains kinetic energy, and (iii) the power rating of the pump if its efficiency is 85%. [3]

OR

(b) A block of mass 0.25 kg is pressed against a spring of force constant 400 N/m, compressing it by 10 cm on a smooth horizontal surface, and is then released. Find (i) the energy stored in the spring, (ii) the maximum speed of the block, and (iii) the speed of the block when the spring has been compressed by 5 cm. [3]

27. A student sits on a freely rotating stool holding a 1 kg mass in each hand, with the arms stretched so that each mass is 1 m from the axis. The moment of inertia of the student and the stool without the masses is 2 kg m^2. The system rotates at 5 rad/s. The student then pulls the arms in so that each mass is 0.5 m from the axis. Treat the masses as point masses. (i) Find the new angular velocity. (ii) Find the change in the kinetic energy of the system. (iii) Explain where the extra energy comes from. [3]

28. State Kepler's three laws of planetary motion. [3]

Section D – 2 × 4 = 8 marks

Q29 and Q30 are case-study based questions. Read the passage and answer the questions that follow.

29. A free kick. A footballer takes a free kick on level ground and strikes the ball with a speed of 25 m/s at 37° above the horizontal. Neglect air resistance. Take g = 10 m/s^2, sin 37° = 0.6 and cos 37° = 0.8.

(i) The time of flight of the ball is [1]

(A) 1.5 s (B) 2 s (C) 3 s (D) 4 s

(ii) The maximum height reached by the ball is [1]

(A) 7.5 m (B) 11.25 m (C) 15 m (D) 22.5 m

(iii) The horizontal range of the ball is [1]

(A) 40 m (B) 48 m (C) 60 m (D) 75 m

(iv) A teammate kicks the ball with the same speed but at 53° above the horizontal. Compared with the first kick, the ball will have [1]

(A) the same range and a longer time of flight (B) a larger range and the same time of flight (C) the same range and the same time of flight (D) a smaller range and a longer time of flight

30. A communication satellite. A communication satellite moves in a circular orbit of radius 4R around the earth, that is, at a height 3R above the surface, where R = 6400 km is the radius of the earth. Take g = 10 m/s^2 at the surface of the earth.

(i) The orbital speed of a satellite revolving very close to the earth's surface is [1]

(A) 4 km/s (B) 8 km/s (C) 11.2 km/s (D) 16 km/s

(ii) The orbital speed of the communication satellite is [1]

(A) 2 km/s (B) 4 km/s (C) 8 km/s (D) 16 km/s

(iii) The acceleration of the communication satellite towards the earth's centre is [1]

(A) 10 m/s² (B) 2.5 m/s² (C) 0.625 m/s² (D) 0.25 m/s²

(iv) Gravity still acts on an astronaut inside the satellite, yet the astronaut floats freely. Explain why. [1]

Section E – 3 × 5 = 15 marks

31. (a) (i) Derive the three equations of motion for a body moving in a straight line with uniform acceleration, using calculus or the velocity–time graph. [3] (ii) A body starts from rest with an acceleration of 2 m/s². Find the distance it covers in the 5th second and its speed at the end of 5 s. [2]

OR

(b) (i) Derive the equation of the trajectory of a projectile and show that it is a parabola. Hence write the expressions for its maximum height and time of flight. [3] (ii) A projectile is fired at 20 m/s at 60° to the horizontal. Find its maximum height and its horizontal range. [2]

32. (a) (i) Define static friction and kinetic friction. Show that the angle of repose of an inclined plane is given by tan θ = μ. [3] (ii) A block of mass 5 kg rests on a rough horizontal surface with μ = 0.5 and μ = 0.4. A horizontal force of 20 N is applied. Does the block move, and what is the friction force? What is the acceleration of the block if the applied force is 30 N? [2]

OR

(b) (i) Show that the total mechanical energy of a freely falling body is conserved at every point of its fall. [3] (ii) A pendulum bob of mass 0.5 kg is released from rest at a point 0.8 m above its lowest position. Find its speed at the lowest point and its kinetic energy when it is 0.4 m above the lowest point. [2]

33. (a) (i) Define escape velocity. Derive the expression $v_e = \sqrt{(2GM/R)}$ and show that it equals $\sqrt{(2gR)}$. [3] (ii) Find the escape speed from the earth's surface. What is the escape speed from a planet whose mass and radius are both 4 times those of the earth? [2]

OR

(b) (i) State the theorem of parallel axes and prove it. [3] (ii) A uniform solid disc has a mass of 2 kg and a radius of 0.5 m. Find (A) its moment of inertia about an axis through its edge and perpendicular to its plane, and (B) its kinetic energy when it rolls without slipping at a speed of 2 m/s. [2]

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