# DIRECTORATE OF EDUCATION, GNCT OF DELHI

## PRACTICE PAPER FOR MID TERM EXAM

## (SESSION: 2025-26)

### CLASS: XI SUBJECT: PHYSICS (042)

**DURATION:3 HOURS** **MAXIMUM MARKS:70**

***GENRAL INSTRUCTIONS:***

Read the following questions very carefully and strictly follow them:

1) There are 33 questions in all. All questions are compulsory.

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(3) All the sections are compulsory.

(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study-based questions of four marks each and Section E contains three long answer questions of five marks each.

(5) There is no overall choice. However, an internal choice has been provided in two question in Section B, one question in Section C, one question in each Case study-based questions in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

| **SECTION A (16X1=16)** | | |
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| **Q.N.** | **DESCRIPTION OF QUESTION** | **MARKS** |
| 1. | The closeness of a measurement to the true value of the physical quantity is known as:<br>(a) Precision **(b) Accuracy**<br>(c) Resolution (d) Systematic Error | 1 |
| 2. | Which of the following scenarios is physically possible?<br>(a) An object has constant non-zero velocity but a varying acceleration.<br>(b) An object has a constant non-zero acceleration but its velocity is zero at an instant.<br>(c) An object has a positive acceleration but its speed is decreasing.<br>(d) An object moves in a circle with constant velocity. | 1 |
| 3. | A car travels from point A to point B, which is 5 km away, and then returns to point A. The entire trip takes 1 hour. Which of the following statements is true for the entire trip?<br>(a) The average speed is 10 km/h and the average velocity is 10 km/h.<br>(b) The average speed is 10 km/h and the average velocity is 0 km/h.<br>(c) The average speed is 0 km/h and the average velocity is 10 km/h.<br>(d) The average speed is 0 km/h and the average velocity is 0 km/h. | 1 |

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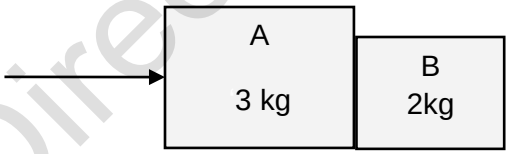
| 4. | The quantities which have the same dimensions as those of solid angle are:<br>(a) strain and stress (b) stress and angle<br>(c) strain and angle (d) strain and radius | 1 |
| 5. | A student is standing still in a park, and rain is falling vertically downwards. The student then starts running forward at a constant speed. To stay as dry as possible, how must the student hold their umbrella?<br><br>(a) Vertically, just as when they were standing still.<br>(b) Tilted forward, in the direction they are running.<br>(c) Tilted backward, against the direction they are running.<br>(d) The angle of the umbrella doesn't matter as the rain is falling vertically. | 1 |
| 6. | A bullet is fired from a gun at the speed of 280 m s–1 in the direction 30° above the horizontal. The maximum height attained by the bullet is (g = 9.8 m s–2, sin30° = 0.5)<br><br>(a) 2800 m (b) 2000 m<br><br>(c) 1000 m (d) 3000 m | 1 |
| 7. | A salad spinner is used to dry washed lettuce. The lettuce is placed in a perforated basket that spins at a high speed. The water droplets fly off the lettuce and escape through the holes in the basket. Which physics principle best explains why the water separates from the lettuce?<br><br>(a) A strong centrifugal force pushes the water outwards.<br>(b) The force of gravity becomes stronger at high speeds, pulling the water out.<br>(c) The basket wall provides an inward centripetal force to the lettuce, but when a water droplet reaches a hole, this force vanishes, and the droplet continues in a straight-line tangent to its path due to inertia.<br>(d) The high speed of rotation reduces the air pressure inside, sucking the water out. | 1 |
| 8. | A horizontal force 50 N is applied to 3kg block. The two blocks A and B held on smooth horizontal surface as shown in the fig. If the blocks slide over a smooth surface. The force exerted by block A on block B:<br><br>  <br><br><br>(a) 20N (b) 30N (c) 50N (d) 60N<br><br>**For VI-Candidates**<br>A ball of mass 0.15 kg is dropped from a height 10 m, strikes the ground and rebounds to the same height. The magnitude of impulse imparted to the ball is ($g=10\ m/s^2$) nearly:<br>(a) 0 kg m/s (b) 4.2 kg m/s (c) 2.1 kg m/s (d) 1.4 kg m/s | 1 |

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| 9. | Chose the correct statement in the following:<br>(a) In an elastic collision of two bodies, the momentum and energy of each body is conserved.<br>(b) Total energy of a system is always conserved, no matter what internal and external forces on the body are present.<br>(c) Work done in the motion of a body over a closed loop is zero for every force in nature.<br>(d) In an inelastic collision, the final kinetic energy is always less than the initial kinetic energy of the system. | 1 |
| 10. | A body is initially at rest. It undergoes one-dimensional motion with constant acceleration. The power delivered to it at time t is proportional to:<br><br>(a) $t^{1/2}$ (b) t (c) $t^{3/2}$ (d) $t^2$ | 1 |
| 11. | The escape velocity from the Earth's surface is v. The escape velocity from the surface of another planet having a radius, four times that of Earth and same mass density is:<br><br>(a) v (b) 2 v (c) 3 v (d) 4 v | |
| 12. | The minimum energy required to launch a satellite of mass m from the surface of the earth of mass M and radius R in a circular orbit at an altitude of 2R from the surface of the earth is:<br><br>(a) $\frac{GMm}{3R}$ (b) $\frac{GMm}{2R}$ (c) $\frac{5GMm}{6R}$ (d) $\frac{6GMm}{5R}$ | 1 |
| | **For Questions 13 to 16, two statements are given one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.**<br>(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.<br>(B) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.<br>(C) Assertion is true but Reason is false.<br>(D) Both Assertion and Reason are false. | |
| 13. | **Assertion (A):** The center of mass of a diver's body follows a parabolic path as they jump off the diving board, even while they are rotating.<br>**Reason (R):** The motion of the center of mass of a system of particles is determined only by the external forces acting on the system, which in this case is primarily gravity. | 1 |
| 14. | **Assertion:** Wearing a seatbelt in a car can prevent serious injuries during an accident.<br>**Reason:** The seatbelt increases the time interval over which the passenger's momentum is brought to zero, thus reducing the force experienced. | 1 |
| 15. | **Assertion:** When lifting a heavy box from the ground to a shelf, a person does positive work on the box.<br>**Reason:** The force applied by the person is in the same direction as the displacement of the box. | |

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| 16. | **Assertion:** When opening a door, it is easier to apply force at the handle, which is farthest from the hinges.<br>**Reason:** The torque produced is the product of the force and the perpendicular distance from the axis of rotation (hinges). A larger distance requires less force to produce the same torque. | |
| | **SECTION (B) (5X2=10)** | |
| 17. | When brakes are applied to a moving vehicle, the distance it travels before stopping is called stopping distance. It is an important factor for road safety and depends on the initial velocity ($v_0$) and the braking capacity, or deceleration, –a that is caused by the braking. Derive an expression for stopping distance of a vehicle in terms of $v_o$ and a. | 2 |
| 18. | A batsman hits back a ball straight in the direction of the bowler without changing its initial speed of 20 m $s^{-1}$. If the mass of the ball is 20 g, determine the impulse imparted to the ball. (Assume linear motion of the ball) | 2 |
| 19. | Show that that change in kinetic energy of a body is equal to work done by variable force applied on a body.<br>**OR**<br>The sign of work done by a force on a body is important to understand. State carefully if the following quantities are positive or negative:<br>(a) work done by a man in lifting a bucket out of a well by means of a rope tied to the bucket.<br>(b) work done by gravitational force in the above case,<br>(c) work done by friction on a body sliding down an inclined plane,<br>(d) work done by an applied force on a body moving on a rough horizontal plane with uniform velocity. | 2 |
| 20. | Find the centre of mass of three particles at the vertices of an equilateral triangle. The masses of the particles are 100g, 150g, and 200g respectively. Each side of the equilateral triangle is 0.5m long. | 2 |
| 21. | Show that, the time rate of change of the angular momentum of a particle is equal to the torque acting on it.<br>**OR**<br>Show that moment of a couple does not depend on the point about which you take the moments. | 2 |
| | **SECTION (C) (7X3=21)** | |
| 22. | The frequency of vibration of a string depends of on, (i) tension in the string (ii) mass per unit length of string, (iii) vibrating length of the string. Establish dimensionally the relation for frequency. | 3 |
| 23. | For an object projected upward with a velocity $v_0$, which comes back to the same point after some time, draw:<br>(i) Acceleration-time graph (ii) Position-time graph (iii) Velocity -time graph.<br>**For VI-Candidates**<br>Obtain equations of motion i.e., velocity time relation, position time relation and position velocity relation for constant acceleration using method of calculus. | 3 |

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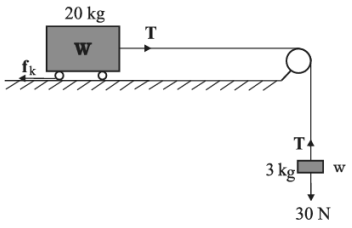
| 24. | A player throws a ball upwards with an initial speed of 29.4 m $s^{-1}$.<br>(a) What is the direction of acceleration during the upward motion of the ball?<br>(b) What are the velocity and acceleration of the ball at the highest point of its motion?<br>(c) Choose the x = 0 m and t = 0 s to be the location and time of the ball at its highest point, vertically downward direction to be the positive direction of x-axis, and give the signs of position, velocity and acceleration of the ball during its upward, and downward motion. | 3 |
| 25. | Define elastic and inelastic collision. A lighter body collides with a much more massive body at rest. Prove that the direction of lighter body is reversed and massive body remains at rest.<br>**OR**<br>A body of mass M at rest is struck by a moving body of mass m. Prove that fraction of the initial K.E. of the mass m transferred to the struck body is 4 m M/$(m + M)^2$ in an elastic collision | 3 |
| 26. | A satellite of mass m orbiting the earth with constant angular velocity.Draw a graph for (i) kinetic energy $E_k$ and orbital radius R<br>(ii) potential energy $U_k$ and orbital radius R<br>(iii) total energy $T_k$ and orbital radius R<br><br>**For VI-Candidates**<br><br>Define gravitational potential at a point in the gravitational field. Obtain a relation for it. What is the position at which it is (i) maximum (ii) minimum. | 3 |
| 27. | A child stands at the centre of turn table with his two arms out stretched. The turn table is set rotating with an angular speed of 40 rpm.<br>(i) How much is the angular speed of the child if he folds his hands back and thereby reduces his moment of inertia to 2/3 times the initial value ? Assume that the turn table rotates without friction.<br>(ii) Show that the child's new kinetic energy of rotation is more than the initial kinetic energy of rotation. How do you account for this increase in kinetic energy ? | 3 |
| 28. | What is the acceleration of the block and trolley system shown in figure, if the coefficient of kinetic friction between the trolley and the surface is 0.04? What is the tension in the string? (Take g = 10 m $s^{-2}$). Neglect the mass of the string<br>  <br><br>**For VI-Candidates**<br>A man of mass 70 kg stands on a weighing scale in a lift which is moving<br>(a) upwards with a uniform speed of 10 m s-1,<br>(b) downwards with a uniform acceleration of 5 m $s^{-2}$,<br>(c) upwards with a uniform acceleration of 5 m $s^{-2}$.<br>What would be the readings on the scale in each case? | 3 |

| | SECTION (D) (4X2=8) | |
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| 29. | **Case Study:The Projectile motion**<br>An object that is in flight after being thrown or projected is called a projectile.Such a projectile might be a football, a cricket ball, a baseball or any other object. The motion of a projectile may be thought of as the result of two separate, simultaneously occurring components of motions. One component is along a horizontal direction without any acceleration and the other along the vertical direction with constant acceleration due to the force of gravity. A ball is projected from the ground level with an angle θ with an initial velocity u. The ball goes upto a maximum height H due to vertical component of velocity and then starts moving downward. Finally the ball falls back on the ground after taking some horizontal distance X.<br><br>(i) What is the value of maximum height (H) up to which the ball goes?<br>(a) $\frac{u^2}{2g}$ (b)$\frac{u^2}{g}$ (c) $\frac{2u^2}{g}$ (d)$\frac{u^2}{4g}$<br><br>(ii) What is the shape of position-time graph for entire motion of the ball?<br>(a) straight line parallel to time axis.<br>(b) straight line inclined at some angle with time axis.<br>(c) circular with radius R<br>(d) path followed by a ball hits by bats man and caught by bowler.<br><br>(iii) The angle between velocity and acceleration at its highest point is :<br>(a) $30^0$ (b) $45^0$ (c) $90^0$ (d) $0^0$<br>(iv) A body projected at an angle with the horizontal has a range 300 m. If the time of flight is 6s, then the horizontal component of velocity is:<br>(a) 30 m/s (b)40m/s (c)45m/s (d)50m/s<br>**OR**<br>If K is the kinetic energy of a projectile fired at an angle 45°, then what is the kinetic energy at the highest point.<br>(a) K/4 (b) K/2 (c) K (d) 2K | 1<br><br>1<br><br>1<br><br>1 |
| 30. | **Case Study: The Interplanetary Voyager**<br>An ambitious new space mission is underway to send a probe, the "Stardust Explorer," to study the asteroid belt between Mars and Jupiter. The mission is planned in two critical phases.<br><br>**Phase 1: Parking in Low Earth Orbit (LEO)**<br>The probe, weighing 1,500 kg, is launched from Earth. After ascending through the atmosphere, the launch vehicle adjusts its trajectory to place the Stardust Explorer into a stable, circular Low Earth Orbit (LEO) at an altitude of 400 km above the Earth's surface. To remain in this orbit, the probe must travel at a precise, constant speed, known as the orbital velocity ($v_0$).At this altitude, the gravitational pull of the Earth provides the exact centripetal force required to keep the probe in its circular path.<br><br>**Phase 2: The Great Escape**<br>Once mission control confirms all systems are nominal, it's time for the "trans-planetary injection." This maneuver is designed to make the probe escape Earth's gravitational influence and begin its long journey toward the asteroid belt. At a specific point in its orbit, the probe fires its onboard rocket engines for a short duration, providing a powerful forward thrust. This burst of acceleration rapidly | |

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| | increases the probe's speed. To successfully break free from Earth's gravity, its new speed must reach or exceed the escape velocity ($v_e$) corresponding to its altitude. Once this speed is achieved, the engines shut down, and the probe coasts away from Earth, its path now primarily influenced by the Sun's gravity.<br><br>(i) What is the primary reason the Stardust Explorer must maintain a high horizontal speed to stay in a stable Low Earth Orbit?<br>(a) To overcome the force of atmospheric drag.<br>**(b)** So that the gravitational force on it provides the necessary centripetal force for circular motion.<br>(c) To generate lift, similar to an airplane.<br>(d) To ensure its communication signals can reach Earth.<br><br>(ii) In a follow-up mission, a satellite is being moved from a lower circular orbit to a *higher* circular orbit around the Earth. Which of the following statements about its orbital speed is correct in a counter-intuitive way?<br>(a) Its final orbital speed in the higher orbit will be greater than its initial orbital speed.<br>(b) Its final orbital speed in the higher orbit will be the same as its initial orbital speed.<br>**(c)** Its final orbital speed in the higher orbit will be less than its initial orbital speed.<br>(d) The orbital speed is independent of the orbit's radius.<br><br>(iii) A student watching a documentary claims, "For a rocket to escape Earth's gravity, it must achieve a speed of 11.2 km/s and maintain it continuously until it is free." Using the principles of escape velocity, evaluate this statement.<br>(a) The statement is correct; continuous thrust is needed to counteract gravity.<br>(**b)** The statement is incorrect because escape velocity is the initial speed required for an unpowered object to coast away; a rocket with continuous thrust could escape at a lower speed.<br>(c) The statement is correct, but the required speed is much higher than 11.2 km/s.<br>(d) The statement is incorrect because escape velocity depends on the rocket's mass.<br><br>**OR**<br><br>How would the required escape velocity for the 1,500 kg "Stardust Explorer" compare to the escape velocity for a much heavier 5,000 kg probe, assuming both are launched from the same altitude?<br>(a) The heavier probe would require a significantly higher escape velocity.<br>(b) The heavier probe would require a significantly lower escape velocity.<br>**(c)** The escape velocity is independent of the mass of the object being launched.<br>(d) The escape velocity is only dependent on the object's shape, not its mass.<br><br>(iv) During Phase 2, the rocket burn increases the probe's speed. If the final speed is greater than its orbital velocity but *less* than the escape velocity, what would be the resulting trajectory of the Stardust Explorer?<br>(a) It would continue in the same circular orbit.<br>(b) It would fall back to Earth.<br>(c) It would escape Earth's gravity and travel to the asteroid belt.<br>**(d)** It would move into a stable, elliptical orbit around the Earth. | 1<br><br>1<br><br>1<br><br>1 |

| | SECTION (E) (5X3=15) | |
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| 31. | (a) Show that uniform circular motion is an example of accelerated motion and define centripetal acceleration.<br>(b)Derive an expression for the centripetal acceleration of a particle moving with constant speed v along a circular path of radius r.<br><br>**OR**<br>(a) Find the magnitude and direction of the resultant of two vectors **A** and **B** in terms of their magnitudes and angle θ between them.<br><br>(b)Three particles A, B and C are situated at the vertices of an equilateral triangle ABC of side 's' at t = 0. Each of the particles moves with constant speed v. A always has its velocity along AB, B along BC and C along CA. At what time will the particles meet each other ? | 5 |
| 32. | (a) Show that Newton's second law of motion is the real law of motion.<br>(b) A helicopter of mass 2000 kg rises with a vertical acceleration of 15 $m/s^2$. The total mass of the crew and passengers is 500 kg. Give the magnitude and direction of the :<br><br>(i) Force on the floor of the helicopter by the crew and passenger.<br>(ii) Action of the rotor of the helicopter on the surrounding air<br>(iii) Force on the helicopter due to the surrounding air (g =10 $m/s^2$)<br>**OR**<br>(a) How friction force help to move a car on a (i) level road and (ii) a banked road. Why the outer edge of a curved road is generally raised over the inner edge.<br>(b) A circular racetrack of radius 300 m is banked at an angle of 30°. If the coefficient of friction between the wheels of a race-car and the road is 0.1, what is the<br><br>(i) optimum speed of the race car to avoid wear and tear on its tyres, and<br><br>(ii) maximum permissible speed to avoid slipping ? | 5 |
| 33. | A bob of mass m is suspended by a light string of length L . It is imparted a horizontal velocity $v_o$ at the lowest point A such that it completes a semi-circular trajectory in the vertical plane with the string becoming slack only on reaching the topmost point, C. Obtain an expression for<br>(i) velocity $v_o$ of a bob its lowest point for completing the loop;<br>(ii) the ratio of the kinetic energies ($K_A$ /$K_C$ ) at A and C. Comment on the nature of the trajectory of the bob after it reaches the mid point C.<br>**OR**<br>(a) Show that total mechnical energy of a freely falling body remains conserved throught its motion.<br>(b) The bob of a pendulum is released from a horizontal position. If the length of the pendulum is 1.5 m, what is the speed with which the bob arrives at the lowermost point, given that it dissipated 5% of its initial energy against air resistance ? | 5 |