**SINDHI HIGH SCHOOL, HEBBAL**

**HALF YEARLY EXAMINATION-2024-25**

**PHYSICS (042)**

**Grade: XI Max. Marks:70**

**Date:27/09/24 Reading time: 8:10am-8:25am**

**No of sides: 6 Writing time: 8:25am- 11:25am**

**General Instructions:**

(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(CBQ) 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 one

question in Section B, one question in Section C, one question in each CBQ 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.

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| **SECTION A** | | |
| 1. | At an instant t, the coordinates of a particle are x=at2 , y=bt2 and z=0. The magnitude of velocity of the particle at an instant t is a) t b) c) d) 2t | **1** |
| 2. | A particle moves along a curve of unknown shape but magnitude of force F is constant and always acts along the tangent to the curve. Then,  a) F may be conservative b) F must be conservative  c) F may be non conservative d) F must be non conservative | **1** |
| 3. | A body sliding on a smooth inclined plane requires 4 second to reach the bottom starting from rest at the top. How much time does it take to cover one-fourth the distance starting from rest at the top? a) 1s b) 4s c)2s d) 16s | **1** |
| 4. | A screw gauge gives the following readings when used to measure the diameter of a wire  Main scale reading : 0mm  Circular scale reading: 52 divisions  Given that 1mm on the main scale corresponds to 100 divisions on the circular scale. The diameter of the wire from the above data is a) 0.52cm b) 0.026cm c) 0.26cm d) 0.052cm | **1** |
| 5. | The position of a particle as a function of time t is given by  x(t) = at +bt2 – ct3 where a, b and c are constants. When the particle attains zero acceleration, then its velocity will be  a) a + b) a + c) a + d) a + | **1** |
| 6. | If the angle between the vectors and is θ, the value of the product (. is equal to a) BA2cos θ b) BA2sin θ c) BA2 sinθcos θ d)zero | **1** |
| 7. | A light spring balance hangs from the hook of another light spring balance and a block of mass M kg hangs from the former one. Then the true statement about the scale reading is a) both the scale reads M kg each  b) the scale of the lower one reads M kg and of the upper one zero.  c) the reading of the two scales can be anything but the sum of the readings will be M kg  d) both the scales read M/2 kg | **1** |
| 8. | The distance of the centre of mass of the T- shaped plate from O is  a) 7m b) 2.7m c) 4m d) 1m | **1** |
| 9. | The quantity jerk, j is defined as the time derivative of an object’s acceleration.  j= =  What is the physical meaning of the area under a graph of jerk versus time?  a) the area represents the object’s change in acceleration  b) the area represents the object’s acceleration  c) the area represents the object’s change in velocity  d) the area represents the object’s velocity | **1** |
| 10. | Consider a planet in some solar system which has a mass double the mass of the earth and density equal to the average density of the earth. If the weight of an object on earth is W, the weight of the same object on that planet will be  a) 2W b) W c) 21/3W d) W | **1** |
| 11. | A ladder of length L leans against a wall at an angle θ from the horizontal, as shown in the figure. What torque is applied about the  ladder’s centre of mass by the normal force FN exerted by the ground on the ladder?  a) FN(L/2) b) FN. Lcosθ c) FN. Lsinθ d) FN (L/2) cosθ | **1** |
| 12. | Taking into account of the significant figures, what is the value of 9.99m-0.0099m?  a) 9.98m b) 9.9m c) 9.980m d) 9.9801m | **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.**  **a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.**  **b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.**  **c) If Assertion is true but Reason is false.**  **d) If both Assertion and Reason are false**  **e) If Assertion is false but Reason is true** | | |
| 13. | **Assertion (A):** If there is no external torque on a body about its centre of mass, then the velocity of the centre of mass remains constant  **Reason (R):** The linear momentum of an isolated system remains constant | **1** |
| 14. | **Assertion(A) :** An astronaut in an orbiting space station above the earth experiences weightlessness  **Reason(R) :** An object moving around the earth under the influence of earth’s gravitational field is in a state of free fall | **1** |
| 15. | **Assertion(A):** Two masses in the ratio 1:2 are thrown vertically up with the same speed, reach the top simultaneously  **Reason(R) :** Acceleration due to gravity is directly proportional to the mass of the body. | **1** |
| 16. | **Assertion(A):** If the dot product and cross product of and are zero, it implies one of the vector and must be a null vector  **Reason(R) :** A null vector is a vector of zero magnitude | **1** |
| **SECTION B** | | |
| 17. | A bus starts from rest with a constant acceleration of 5m/s2. At the same time a car travelling with a constant velocity of 50m/s overtakes and passes the bus. (i) Find at what distance will the bus overtake the car ? (ii) How fast will the bus be travelling then?  **OR**  A point object is thrown vertically upward with such a speed that it returns to the thrower after 6s. With what speed was it thrown up and how high did it rise? Plot the speed time graph of this object | **2** |
| 18. | The turbine pits at Niagra falls are 50m deep. The average horse power developed is 500. If the efficiency of the generator is 85%, how much water passes through the turbines per minute?(g=10ms-2) | **2** |
| 19. | In the Atwood’s machine , shown in the figure, the system starts from rest. What is the speed and distance moved by each mass at t=3s? | **2** |
| 20. | The resultant of two vectors and is perpendicular to and its magnitude is half of that of . What is the angle between and ? | **2** |
| 21. | A circular metal disc of mass 4kg and diameter 0.4m makes 10 revolutions per second about an axis passing through its centre and perpendicular to its plane  (i) What is the angular momentum about the same axis?  (ii) Calculate the magnitude of torque which will increase the angular momentum by 20% in 10 seconds. | **2** |
| **SECTION C** | | |
| 22. | (i) Derive an expression for acceleration due to gravity g at a depth d from the surface of the earth.  (ii) At what surface above the earth is the value of g same as in a mine 80km deep? | **3** |
| 23. | An aeroplane requires for take-off a speed of 80kmh-1, the run on the ground being 100m.The mass of the aeroplane is 104kg and the coefficient of friction between the plane and the ground is 0.2. Assume that the plane accelerates uniformly during take-off. What is the maximum force required by the engine of the plane for take-off? | **3** |
| 24. | (i) Find the force required to move a train of 200 quintals up an incline of 1 in 50 with an acceleration of 2ms-2, the force of friction being 0.5 newton per quintal  (ii) A particle of mass 0.3kg is subjected to a force of F=-kx with k=15Nm-1. What will be its initial acceleration, if it is released from a point 20cm away from the origin? | **3** |
| 25. | A projectile is fired horizontally with a velocity u. Show that its trajectory is a parabola. Also obtain its expression for the time of flight and velocity of the projectile at any instant | **3** |
| 26 | (i) A gas bubble, from an explosion under water, oscillates with a period T proportional to pa db Ec, where p is the static pressure, d is the density of water and E is the total energy of the explosion. Find the value of a, b and c.  (ii) What are the dimensions of a and b in the relation : F= a+bx, where F is force and x is distance?  **OR**  If the velocity of light (c), the constant of gravitation (G) and Planck’s constant (h) be chosen as the fundamental units, find the dimensions of mass, length and time in the new system. | **3** |
| 27. | (i) The relation between t and distance x is t= ax2 + bx where a and b are constants. Express the instantaneous acceleration in terms of the instantaneous velocity  (ii) The displacement of a body is given to be proportional to the cube of the time elapsed. What is the nature of the acceleration of the body? | **3** |
| 28. | State and prove work-energy theorem for a body of mass m acted upon by a variable force | **3** |
| **SECTION D** | | |
|  | **Case study** | |
| 29. | **COLLISION**  In physics, we come across many examples of collisions. The molecules of a gas collide with one another and with the container. The collisions of a neutron with an atom is well known. In a nuclear reactor, fast neutrons produced in the fission of uranium atom have to be slowed down. They are, therefore, made to collide with hydrogen atom. The term collision does not necessarily mean that a particle or a body must actually strike another. In fact, two particles may not even touch each other and yet they are said to collide if one particle influences the motion of the other. When two bodies collide, each body exerts an equal and opposite force on the other. The fundamental conservation law of physics are used to determine the velocities of the bodies after the collision. Collision may be elastic or inelastic. Thus a collision may be defined as an event in which two or more bodies exert relatively strong forces on each other for a relatively short time. The forces that the bodies exert on each other are internal to the system.  (i) Which one of the following collisions is not elastic?  (a) A hard steel ball dropped on a hard concrete floor and rebounding to its original height.  (b) Two balls moving in the same direction collide and stick to each other  (c) Collision between molecules of an ideal gas.  (d) Collisions of fast neutrons with hydrogen atoms in a fission reactor.  **OR**  Which one of the following statements is true about inelastic collision?  (a)The total kinetic energy of the particles after collision is equal to that before collision.  (b) The total kinetic energy of the particle after collision is less than that before collision.  (c) The total momentum of the particles after collision is less than that before collision.  (d) Kinetic energy and momentum are both conserved in the collision.  (ii) On a frictionless surface, a block of mass M moving at a speed v, collides elastically with another block of the same mass M which is initially at rest. After collision the first block moves at an angle θ to its initial direction and has a speed v/3. The second block’s speed after collision is  a) v b) v c) v d) v  (iii) A body of mass m1 collides elastically with another body of mass m2 at rest. If the velocity of m1 after collision becomes 2/3 times its initial velocity, the ratio of their masses is.  a) 1:5 b) 5:1 c) 5:2 d) 2:5  (iv) Body A of mass 4m moving with a speed u collides with another body B of mass 2m, at rest. The collision is head on and elastic in nature. After the collision the fraction of energy lost by the colliding body A is  a) b) c) d) | **4** |
| 30. | **UNIFORM CIRCULAR MOTION**  If a body moves in a circle with a constant speed, then the magnitude of velocity is constant but the direction of velocity vector is changing all the time. Thus velocity is changing with time. Therefore the motion of the body is accelerated. The acceleration is directed towards the centre of the circular path and is called centripetal acceleration.  i) Centripetal acceleration associated with a body in uniform circular motion is  a) b) c)  d)    (ii) Relation between linear velocity and angular velocity of a body moving in a circular path is  a) = X b) = X  c) = X d) = X  (iii) Two cars are going in two concentric circular orbits of radius r1 and r2 with angular velocities ω1 and ω2. What is the ratio of their linear velocities?  a) b) c) d)  (iv) If two bodies have circular path of radius r1 and r2 and their time period are the same, the ratio of their angular speed is  a) 1:2 b) 2:1 c) 1:1 d) 1:5  **OR**  What would be the direction of motion of stone if at certain time its string gets broken?  a) straight line b) parabola  c) circular path d) can’t be predicted | **4** |
| **SECTION E** | | |
| 31. | (i) Derive an expression for velocity of a car on a banked circular road having coefficient of friction µ. Also deduce the expression for optimum speed without wear and tear of tyres  (ii) A block of wood of mass 3kg is resting on the surface of a rough inclined plane, inclined at an angle θ as shown in the figure. If the co efficient of static friction is 0.2, calculate the value of all the three forces.(g=10ms-2)  **OR**  (i) A body of mass m is placed on the floor of a lift. Find its apparent weight when the lift is  a) moving upward with uniform acceleration  b) moving downward with uniform acceleration  c) moving upward with constant speed  (ii) Discuss the graphical method for the measurement of impulse in the following case:  a) when constant force acts on the body  b) when a variable force acts on the body | **5** |
| 32. | (i) Prove that the rate of change of total angular momentum of a system of particles about a reference point is equal to the total torque acting on the system.  (ii) What will be the duration of a day if the earth shrinks to 1/64 of its original volume, mass remaining the same?  **OR**  (i) Show that the moment of inertia of a body about the given axis of rotation is equal to twice the kinetic energy of rotation with unit angular velocity  (ii) A wheel is rotating at a rate of 1000rpm and its kinetic energy is 106J. Determine the moment of inertia of the wheel about its axis of rotation. | **5** |
| 33. | (i) What is escape velocity? Obtain an expression for the escape velocity on the earth  (ii) With what velocity must a body be thrown upward from the surface of the earth so that it reaches a height of 10R? Earth’s radius= 6.4X106m; Earth’s mass= 6X1024kg; G=6.6X 10-11 Nm2kg-2  **OR**  (i) Define orbital speed. Establish a relation for orbital speed of a satellite orbiting very close to the surface of the earth. Find the ratio of this orbital speed and escape speed.  (ii) A remote sensing satellite of the earth revolves in a circular orbit at a height of 250km above the earth’s surface. What is the (a) orbital speed and (b) period of revolution of the satellite?  Radius of the earth, R= 6.38 X 106m | **5** |