HALF YEARLY EXAMINATION, 2024-25

PHYSICS

Time – 3:00 Hrs. **Class – XI** **M.M. : 70**

Date – 20.09.2024 (Friday)

Name of the student _____Section _____

GENERAL INSTRUCTIONS:

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

(2) This question paper has five sections: Section A, B, C, D and 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 one question in Section B, one question in Section C and all three questions in Section E. You have to attempt only one of the choices insuch questions.

(6) Use of calculators is not allowed.

(7) You may use the following values of physical constants where ever necessary

(i) $c = 3 \times 10^8$ m/s (ii) me = 9.1×10^{-31} kg

(iii) $e = 1.6 \times 10^{-19}$ C (iv) $\mu 0 = 4\pi \times 10^{-7}$ TmA^{-1} v.

(v) $h = 6.63 \times 10^{-34}$ Js

SECTION A

Q1. The displacement x of a particle along a straight line at a time t is given by $x = a_0 + a_1t + a_2t^2$. The acceleration of the particle is: **1**

a) a_0 b) a_1 c) a_2 d) $2a_2$

Q2. A body is thrown with speed 20m/s vertically upward , It will return to thrower's hand after a time of: (assume $g=10m/s^2$) **1**

a) 2 s b) 4 s c) 20 s d) never

Q3. A man goes 10m towards North, then 20m towards east then displacement is **1**

a) 22.5m b) 25m c) 25.5m d) 30m

Q4. A particle is given a displacement of 4m in the x - y plane. If the x component of displacement vector is 2m, then y component is: **1**

a. 2m b. $2\sqrt{2}$m c. $2\sqrt{3}$m d. 4m

Q5. When a body is projected horizontally with a velocity of 20 m/s, the angle of projection is **1**

a) 45° b) 0° c) 90° d)60°

Q6. The horizontal range of a projectile fired at an angle of 15° is 50 m. If it is fired with the same speed at an angle of 45°, its range will be **1**

(a) 60 m (b) 71 m (c) 100 m (d) 141 m

Q7. Two vectors $\vec{A}$ and $\vec{B}$ are parallel to each other if their scalar product has the magnitude **1**

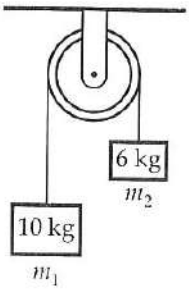
a) $\vec{A}.\vec{B} = \vec{A}\,\vec{B}$ b) $\vec{A}.\vec{B} = 0$ c) $\vec{A}.\vec{B} = -\vec{A}\,\vec{B}$ d) $\vec{A}.\vec{B} = -1$

Q8. A person is sitting in a lift accelerating up. Measured weight of person will be **1**

a) less than actual weight b)equal to actual weight

c)more than actual weight d) Zero

Q9. Two masses m_1 and m_2 are attached to a string which passes over a frictionless smooth pulley. When m_1=10 kg, m_2 = 6 kg, the acceleration of masses is **1**



a) 20 m/s^2 b) 5 m/s^2 c) 2.5 m/s^2 d) 10 m/s^2

Q10. A particle moves with a constant speed v along a circular path of radius r and completes the circle in time T. The acceleration of the particle is ____. **1**

a) $2\pi r/T$ b) $2\pi v/T$ c) $2\pi r^2/T$ d) $2\pi v^2 / T$

Q11. A light body and a heavy body have equal kinetic energy. Which one has greater momentum? **1**

a) The heavy body b) The light body

c) Both have equal momentum d) Data given is incomplete.

Q12. To avoid a vehicle skidding while negotiating a circular frictionless track; the outer edge of the road should be raised above the inner edge by an angle Θ such that: **1**

a) $\tan \Theta = v^2rg$ b) $\tan \Theta = v^2/rg$ c) $\tan \Theta = rg/v^2$ d) $\tan \Theta = v/rg$

For Question number 13 to 16, two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true and R is NOT the correct explanation of A.

c) A is true but R is false

d) A is false and R is also false

Q13. Assertion: K.E is conserved at every instant of elastic collision. **1**

Reason: No deformation of matter occurs in elastic collision.

Q14. Assertion: Generally the path of a projectile from the Earth is parabolic but it is elliptical for projectiles going to a very great height. **1**

Reason: Up to ordinary height the projectile moves under a uniform gravitational force, but for great heights projectile moves under a variable force.

Q15. Assertion: If dot product and cross product of $\vec{p}$ and $\vec{q}$ are zero; it implies that one of the vector $\vec{p}$ and $\vec{q}$ must be null vector. **1**

Reason: A null vector is a vector of zero magnitude.

Q16. Assertion: For a particle in state of motion, average velocity can be zero, but average speed cannot be zero in any finite interval of time. **1**

Reason: For a particle in state of motion, displacement in an interval of time can be zero but distance can never be zero.

SECTION - B

Q17. Find the angle between the vectors $\vec{A} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{B} = -\hat{i} + \hat{j} - 2\hat{k}$. **2**

Q18. Derive relation between angular velocity and linear velocity. **2**

Q19. A person falling from a certain height receives more injuries when he falls on a cemented floor than when he falls on a heap of send. Why? **2**

Q20. State and prove work-energy theorem. **2**

OR

If a body collides with the target body of equal mass at rest, show that the two bodies move at right angle to each other after the collision.

Q21. Why does a cyclist lean inward when moving along a curved path? Determine the angle through which a cyclist bends from the vertical while negotiating a curve. **2**

SECTION - C

Q22. A balloon is ascending at the rate of 9.8m/s at a height of 39.2 m above the ground when a food packet is dropped from the balloon. After how much time and with what velocity does it reach the ground? (g= 9.8m/s^2) **3**

Q23. Derive s = ut+1/2at^2 by calculus method. **3**

Q24. If unit vectors $\hat{a}$ and $\hat{b}$ are inclined at an angle Θ then prove that $|\hat{a} - \hat{b}| = 2\sin\frac{\theta}{2}$. **3**

Q25. A cricketer can throw a ball to a maximum horizontal distance of 100m. How much high above the ground can the cricketer throw the same ball? **3**

Q26. State three laws of limiting friction. **3**

Q27. State the law of conservation of linear momentum and derive it from Newton's second law of motion. **3**

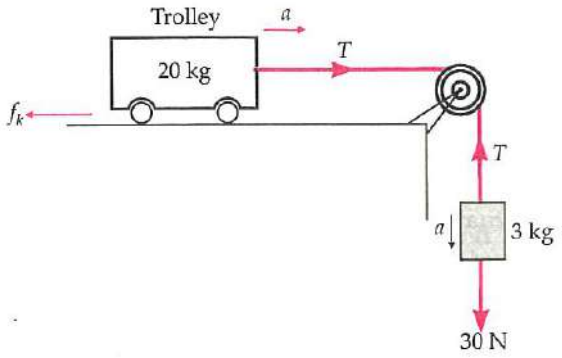
Q28. A wooden block of mass 2 kg rests on a soft horizontal floor. When an iron cylinder of mass 25 kg is placed on top of the block, the floor yields steadily and the block and the cylinder together go down with an acceleration of 0.1m/s^2. What is the action of the block on the floor **3**

a) before and

b) after the floor yields? Take g=10 m/s^2.

OR

What is the acceleration of the block and the trolley system shown in the 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.



SECTION - D

Q29. The first law refers to the simple case when the net external force on a body is zero. The second law of motion refers to the general situation when there is net external force acting on the body. It relates the net external force to the acceleration of the body. These qualitative observations lead to the second law of motion expressed by Newton as follows: **4**

The rate of change of momentum of a body is directly proportional to the applied force and takes place in the direction in which the force acts. Thus, if under the action of a force F for time interval Δt, the velocity of a body of mass m changes from v to v + Δv i.e. its initial momentum

p = m v changes by Δp = mΔv. According to the Second Law

$$F \alpha \frac{\Delta P}{\Delta t} \quad \text{or} \quad F = k \frac{\Delta P}{\Delta t}$$

Where k is a constant of proportionality. Mathematically,

F = ma, the unit of force is kg-m/s^2 or Newton, which has the symbol N. Let us note at this stage some important points about the second law:

- In the second law, F = 0 implies a = 0. The second law is obviously consistent with the first law.
- The second law of motion is a vector law.
- The second law of motion given by Newton is applicable to a single point particle as well as to the rigid body but internal forces are not considered in F.
- The second law of motion is a local relation which means that force F at a point in space (location of the particle) at a certain instant of time is related to and at that point at that instant. Answer the following questions.

i) Newton's second law of motion is applicable to which of the following?

a) Only rigid bodies

b) Only single point particles

c) Both single point particles and rigid bodies

d) Neither single point particles nor rigid bodies

ii) Which of the following statements is true regarding the second law of motion?
a) It is inconsistent with the first law of motion.

b) It only considers internal forces.

c) It is a vector law.

d) It is applicable to non-rigid bodies.

iii) If a car with a mass of 1000 kg is accelerating at 2 m/s^2, what is the net force acting on the car?

a) 500 N b) 1000 N c) 2000 N d) 5000 N

iv) Two masses M and 4M are moving with equal kinetic energy. The ratio of their linear momenta is

(a) 1:8 (b) 1:4 (c) 1:2 (d) 4:1

Q30. A body released near the surface of the earth is accelerated downwards under the influence of force of gravity. In the absence of air resistance, all bodies fall with the same acceleration near the surface of the earth. This motion of a body falling towards the earth from a small height ($h<<R_e$) is called free fall. The body falls with a constant acceleration g, equals to 9.8 m/s^2. Free fall is thus an example of motion with constant acceleration. **4**

i) When a ball is thrown vertically upwards, at the maximum height

a) the velocity is zero and therefore there is no acceleration acting on the particle

b) the acceleration is present and therefore velocity is not zero

c) the acceleration depends on the velocity as $a = \frac{dv}{dt}$

d) the acceleration is independent of the velocity

ii) velocity of a body on reaching the point from which it was projected upwards is

a) v=0 b) v= 2u c) v= 0.5u d) v= u

iii) A body falling from rest describes distances S_1, S_2 and S_3 in the first, second, and third seconds of its fall, then the ratio $S_1: S_2: S_3$ is

a) 1:1:1 b) 1:3:5 c)1: 2:3 d)1: 4:9

iv) Three different objects of masses m_1, m_2 and m_3 are allowed to fall from the same point O along three different frictionless paths. The speeds of the three objects, on reaching the ground, will be in the ratio of

a) $m_1: m_2: m_3$ b) $m_1: 2m_2: 3m_3$ c) $1/m_1: 1/m_2: 1/m_3$ d) 1:1:1

SECTION – E

Q31. A Projectile is fired with a velocity u, making an angle θ with the horizontal. Show that its trajectory is a parabola. Derive expressions for i) time of flight ii) maximum height and iii) horizontal range. **5**

OR

A projectile is fire horizontally with a velocity u. Show that it's trajectory is a parabola. Also obtained expressions for its time of flight, horizontal range, and velocity at any instant.

Q32. i) Define centripetal acceleration. Derive an expression for centripetal acceleration of a particle moving with uniform speed v along a circular path of radius r. **5**

ii) Define centripetal force. Derive expression for it.

OR

What do you mean by banking of a curved road? Determine the angle of banking so as to minimise the wear and tear of the tyres of a car negotiating a banked road.

Q33. Prove that in an elastic, one dimensional collision between two bodies, the relative velocity of approach before collision is equal to the relative velocity of separation after the collision. Hence derive expressions for the velocity of the two bodies in terms of their initial velocities before collision. **5**

OR

A body tied to one end of a string is made to revolve in a vertical circle. Derive the expression for the velocity of the body and tension in the string at any point and find tension at the bottom and at the top of the circle. Also, find the minimum velocity at the lowest point so that it is just able to loop the loop and the minimum velocity at the top.