ST. XAVIER'S SENIOR SECONDARY SCHOOL, DELHI – 110 054

Class 11 Time: 3 hrs.

22-9-2023 MID TERM EXAMINATION - **PHYSICS** Max. Marks : 70

General Instructions:

i) *All questions are compulsory.*

ii) Section A contains seventeen questions of 1 mark each.

iii) Section B contains two case study/ source based questions of 4 marks each.

iv) Section C contains six questions of 2 marks each. There are two internal choices.

v) Section D contains six questions of 3 marks each. There is one internal choice.

vi) Section E contains three questions of 5 marks each. There is internal choice in all three questions.

Section A

1. The dimensions of the quantity hυ/c, where h is Plank's constant, υ is the frequency and c is the velocity of light are

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

2. A particle located at x=0 at time t=0, starts moving along the positive x direction with a velocity v that varies as $v=Y\sqrt{x}$ m/s. The displacement of the particle varies with time as

A) $t^{½}$ B) t^{3} C) t^{2} D) t

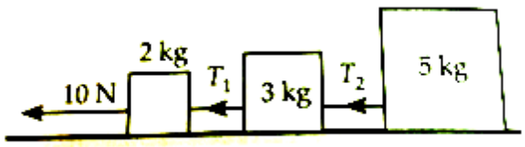
3. The square of resultant of two equal forces is three times their product. Angle between these forces is

A) π B) π/2 C) π/4 D) π/3

4. If g is the acceleration due to gravity and ƛ is the wavelength, then which physical quantity does $\sqrt{ƛg}$ represent?

A) velocity B) pressure C) displacement D) density

5. Three blocks of masses 2kg, 3kg and 5 kg are connected to each other with a light string and then placed on a frictionless surface as shown in the figure



The system is pulled by a force F = 10N, then the tension T_1 is

A) 1N B) 5N C) 8N D) 10N

6. Two bodies with kinetic energies in the ratio 4:1 are moving with equal linear momentum. The ratio of their mass is

A) 4:1 B) 1:1 C) 1:2 D) 1:4

7. A body is whirled in a horizontal circle of radius 20cm. It has angular velocity of 10rad/s. What is its linear velocity at any point on the circular path?

A) 20m/s B) $\sqrt{2}$ m/s C) 10m/s D) 2m/s

8. The angle between the vectors **A**= **i**+2 **j**- **k** and **B**= -**i**+ **j**-2 **k** is

A) 30° B) 60° C) 90° D) 120°

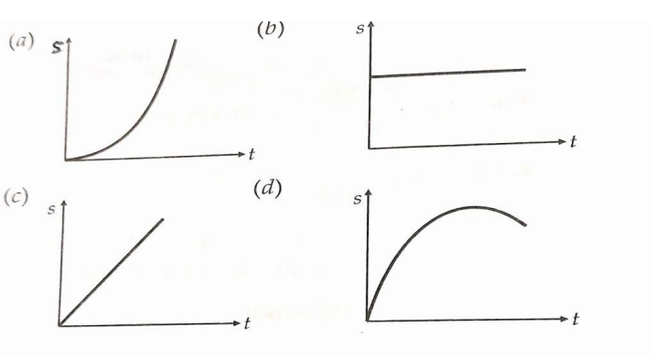
9. A uniform force of (3**i**+**j**) N acts on a particle of mass 2kg. Hence the particle is displaced from position (2**i**+**k**)m to position (4**i**+3**j**-**k**)m. The work done by the force on the particle is

A) 9J B) 6J C) 13J D) 15J

10. A man of mass 75kg is standing in an elevator which is moving with an acceleration of 5 m/s^2 in the upward direction. The apparent weight of the man will be

A) 1125N B) 1375N C) 1250N D) 1425N

11. A body is travelling in a straight line with a uniformly increasing speed. Which one of the plots represents the changes in distance travelled with time?



A) (a) B) (b)
C) (c) D) (d)

12. How much water a pump of 2KW can raise in one minute to the height of 10m?
A) 1000 litres B) 1200 litres C) 10 litres D) 2000 litres

In the following questions, a statement of assertion is followed by the statement of reason. While answering a question, you are required to choose the correct on out of the given four responses and mark it as
A) if both reason and assertion are true and reason is correct explanation of the assertion.
B) if both reason and assertion are true and reason is not correct explanation of the assertion.
C) if assertion is true, but reason is false.
D) if both assertion and reason are false.

13. **Assertion**: A body can have acceleration even if its velocity is zero at that instant of time.
Reason: The body will be momentarily at rest when it reverses its direction of motion.
A) A B) B C) C D) D

14. **Assertion**: In javelin throw, the athlete throws the projectile at an angle slightly more than 45°.
Reason: The maximum range does not depend on the angle of projection.
A) A B) B C) C D) D

15. **Assertion**: It is difficult to move a cycle along the road with its brakes on.
Reason: Sliding friction is greater than rolling friction.
A) A B) B C) C D) D

16. **Assertion**: In an elastic collision between two bodies, the energy of each body is conserved.
Reason: The total energy of an isolated system is conserved.
A) A B) B C) C D) D

Section B

17. There are many types of springs. Important among these are helical and spiral springs. Usually, we assume that the springs are mass less. Therefore, work done is stored in the spring in the form of elastic potential energy. Thus, the potential energy of a spring is the energy associated with the state of compression or expansion of an elastic spring.

17.1 The ratio of spring constants of the two springs is 2:3.What is the ratio of their potential energies when they are elongated to same distance?
A) 2:3 B) 3:2 C) 4:9 D) 9:4

17.2 The potential energy of a spring when stretched through a distance x is 10J. What is the amount of work done on the same spring to stretch it through an additional distance x?
A) 10J B) 20J C) 30J D) 40J

17.3 The potential energy of the spring increases by 15J when stretched by 3cm. If it is stretched by 4cm, the increase in potential energy is
A) 27J B) 30J C) 33J D) 36J

17.4 The potential energy of a body increases in which of the following cases?
A) If work is done by conservative force.
B) If work is done against conservative force.
C) If work is done by non conservative force.
D) If work is done against non conservative force.

18. An object is said to be in motion if it changes its position with respect to its surroundings with the passage of time. The study of the motion of the objects without taking into account the cause of their motion is called kinematics. The time rate of covering the distance by an object is called its speed. An object can have uniform motion, if its speed is constant .In case of non uniform motion, the velocity of an object changes with time. It may increase or decrease at random. The change in velocity in unit time is known as acceleration.

18.1 An object is covering distance in direct proportion to t^3, where t is the time elapsed. What conclusion might you draw about the acceleration?
A) acceleration is directly proportional to t^2 B) acceleration is directly proportional to t
C) acceleration has no dependence on t D) acceleration is directly proportional to t^3

18.2 What can you say about the force in question 18.1?
A) Force is uniformly increasing with time.
B) Force is uniformly decreasing with time.
C). Force is non uniformly increasing with time.
D) Force is non uniformly decreasing with time.

18.3 If the displacement of a body is proportional to the square of time , the body is moving with
A). uniform velocity B) uniform acceleration
C) non uniform acceleration D) none of these

18.4 The rate of change of acceleration is measured in
A) ms^{-1} B) ms^{-2} C) ms^{-3} D) ms

SECTION C

19. Plot and discuss the speed-time graph and velocity –time graph for an object projected upwards with certain initial velocity.

20. If the momentum [P], area [A] and time [T] are taken as the fundamental quantities then derive the dimensional formula for coefficient of viscosity.

21. Two vectors **A** and **B** inclined to each other at an angle of Θ .Using parallelogram law of vector addition, find their resultant. Discuss the case when Θ = 180°.

22. Show variation of force of friction with the applied force. Label and explain the plot properly. Explain why static friction is called a 'Self adjusting force'?

23. State the work- energy theorem. Prove this theorem for the variable force.

(OR)

If the linear momentum of a body increases by 20%, what will be the % increase in the kinetic energy of the body?

SECTION D

24. A small steel ball of radius r is allowed to fall under gravity through a column of a viscous liquid of coefficient of viscosity 'η'. After some time the ball attains a constant velocity (V_T) known as terminal velocity. The terminal velocity depends on (i) weight of the ball 'W' (ii) the coefficient of viscosity 'η' (iii) the radius of the ball 'r'. Using dimensional analysis, derive an expression for terminal velocity.

25. Define centripetal acceleration. Derive an expression for the centripetal acceleration of a particle moving with uniform speed v along a circular path of radius r. Discuss the direction of this acceleration.

(OR)

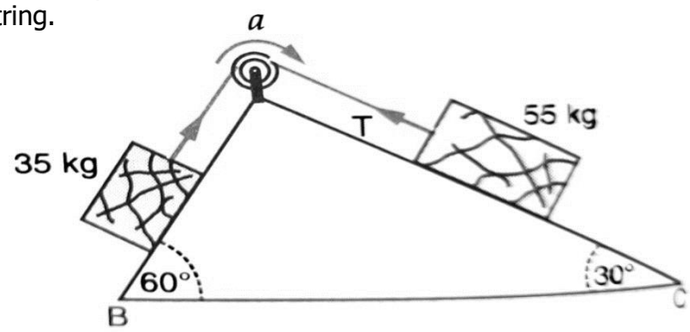
Define angular velocity. What is its SI unit .Derive the relation between linear and angular velocities. What is the angular velocity of a second hand and minute hand of a clock?

26. What do you mean by banking of curved roads? Determine the maximum and minimum speed of safe turn on banked roads.

27. Ball A is thrown upward with a speed of 35ms^{-1} from ground, while at the same time another ball B is dropped from a height of 100m with a speed of 10ms^{-1} along the same straight line. By choosing positive direction of X axis and origins for position and time, find the height from ground, where the two balls meet. Take g= 10ms^{-2}.

28. State principle of conservation of mechanical energy. Show that the total mechanical energy of a freely falling body remains constant throughout its fall. Give the necessary plot.

29. Two blocks connected by an inextensible string passing over a light frictionless pulley are resting on two smooth inclined planes as shown below. Determine the acceleration of the blocks and tension in the string.



30. What do you understand by resolution of a vector in a plane. An aeroplane takes off at an angle of 30° to the horizontal. If the component of its velocity along the horizontal is 250km/h, what is its actual velocity? Also find the vertical component of its velocity.

Section E

31. a. What do you mean by projectile motion? A projectile is fired with velocity u making an angle Θ with the horizontal. Show that its path is parabolic.
    b. Show that there are two angles of projection for a projectile to have the same horizontal range.
    c. Prove that the maximum horizontal range is four times the maximum height attained by the projectile, when fired at an inclination so as to have maximum horizontal range.
    d. A bullet fired at an angle of 60° with the vertical hits the ground at a distance of 2km. Calculate the distance at which the bullet will hit the ground when fired at an angle of 45°, assuming the speed to be the same.

(OR)

    a. Projectile is considered to be a combination of two independent motions. Explain.
    b. Show that a given gun shoot three times as high when elevated at an angle of 60° as when at an angle of 30° but will carry the same distance on the horizontal plane.
    c. Is there any optimum value of the angle of projection so that the range may be maximum? Explain.

32. a. Prove that in an elastic one dimensional collision between the 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 velocities of the two bodies. Discuss what will happen when a body collide with a stationary body of equal mass.
    b. In a one dimensional elastic collision, a body of mass 2kg collides with another body of mass m which is at rest and returns with a speed one third of its initial speed. Find the value of m. (3+2)

(OR)

    a. What is elastic collision? Show that two identical particles move at right angles to each other after elastic collision in two dimensions.
    b. Two particles of masses 0.5kg and 0.25kg moving with velocities 4m/s and -3m/s collide head on in a perfectly inelastic collision. Find the velocity of the composite particle after the collision and the loss in kinetic energy during the collision. (2+3)

33. a. State and derive law of conservation of linear momentum. Explain recoil of gun on the basis of conservation of linear momentum.
    b. A body of mass 1kg initially at rest explodes and breaks down into three fragments of masses in the ratio 1:1:3. The two pieces of equal mass fly off perpendicular to each other with a speed of 30m/s each. What is the velocity of the heavier fragment (2½+2½)

(OR)

    a. Show that Newton's second law of motion is the real law of motion.
    b. Show that the impulse of a force is equal to the change in momentum produced by the force.
    c. A balloon of mass m is rising up with an acceleration a. What fraction of mass must be detached in order to double its acceleration, assuming the up thrust of air to remain the same. (1½+1½+2)

-x-x-x-x-x-x-