

BUDHA DAL PUBLIC SCHOOL, PATIALA

First Term Examination (2 September 2024)

Class XI (Science)
Subject - Physics (Set-A)

M.M.70

Time: 3hrs

General Instructions:

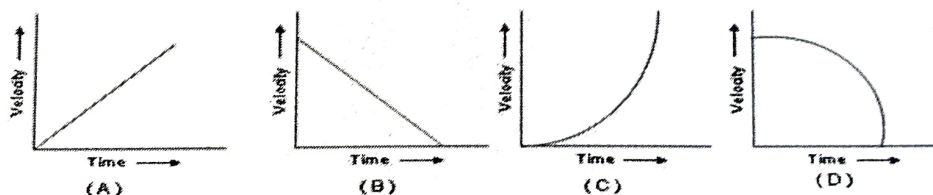
- (1) There are 35 questions in all. All questions are compulsory.
- (2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
- (3) All the sections are compulsory.
- (4) **Section A** contains 18 questions, 15 MCQ and 3 Assertion Reasoning based of 1 mark each, **Section B** contains 7 questions of two marks each, **Section C** contains 5 questions of three marks each, **Section D** contains three long answer questions of five marks each and **Section E** contains two case study based questions of four marks each.
- (5) Use of calculators is not allowed.

Section - A

- Q1. What is the dimensional formula of gravitational constant?
- a) $[M^{-1} L^3 T^{-2}]$ b) $[M^{-2} L^3 T^{-2}]$ c) $[M^{-1} L^2 T^{-2}]$ d) $[M^{-1} L^3 T^{-1}]$
- Q2. A body is dropped from a certain height h and travels 40 m in last 2 seconds, then value of h will be
- a) 25 m b) 45 m c) 85 m d) 54 m.
- Q3. Vectors \vec{A} and \vec{B} are parallel if
- a) $[\vec{A} \times \vec{B}] = 0$ b) $[\vec{A} \times \vec{B}] = 1$ c) $\vec{A} \cdot \vec{B} = 1$ d) $\vec{A} \cdot \vec{B} = 0$
- Q4. For angles of projection of a projectile at angle $(45^\circ - \theta)$ and $(45^\circ + \theta)$, the horizontal range described by the projectile are in the ratio:
- a) 2 : 1 b) 1 : 1 c) 2 : 3 d) 1 : 2
- Q5. A body is moved in straight line by machine with constant power. The distance travelled by it is proportional to
- a) $t^{3/2}$ b) $t^{1/2}$ c) t^2 d) t

OR

Which of the following graph represent uniform retardation?



- Q6. A gun fires a small bullet with kinetic energy K . Then kinetic energy of the gun while recoiling is
- a) Kb b) More than K c) Less than K d) \sqrt{K}
- Q7. A force $\vec{F} = (5\hat{i} + 3\hat{j} + 2\hat{k})N$ is applied over a particle which displaces it from origin to be point $\vec{r} = (2\hat{i} - \hat{j})m$. The work done on the particle in joules is
- a) -7 b) +7 c) +10 d) +13
- Q8. Acceleration of a body moving with constant speed in circle is
- a) zero b) $r\omega$ c) $r\omega^2$ d) $\frac{\omega^2}{r}$
- Q9. A body of mass 10 kg, is moving with a velocity of 5 m/s in a circle of radius 5 m, what is the centripetal acceleration of the body?
- a) $5m/s^2$ b) $25m/s^2$ c) $0.5 m/s^2$ d) $50 m/s^2$

A-1

- Q10. The angular velocity of a stone being rotated is 11 rad/s. What is the angular displacement covered in 0.5s?
a) 5.5 rad b) 0.55 rad c) 55 rad d) 0
- Q11. A force F is given by $F = at + bt^2$, where t is the time, the dimensions of a and b are :
a) $[MLT^{-3}]$ and $[MLT^{-4}]$ b) $[MLT^{-4}]$ and $[MLT^{-3}]$
c) $[MLT^{-1}]$ and $[MLT^{-2}]$ d) $[MLT^{-2}]$ and $[MLT^{-4}]$
- Q12. Dimensional formula for coefficient of restitution is
a) $[M^0LT]$ b) $[M^0L^0T]$ c) $[M^0L^0T^0]$ d) $[M^0L^{-1}T^0]$
- Q13. If normal force is doubled, then coefficient of friction is
a) Halved b) Doubled c) Tripled d) Remains unchanged
- Q14. A car moving towards south with speed v changes in direction and moves with same speed towards west. Then change in velocity of car will be
a) v along N-W b) v along S-E c) $\sqrt{2}v$ along N-W d) $\sqrt{2}v$ along S-E.

OR

A particle is projected at 60° to the horizontal with kinetic energy K . the kinetic energy at the highest point is

- a) $K/2$ b) K c) zero d) $K/4$

- Q15. A man of mass 60kg standing on weighing machine in an elevator. If the elevator starts moving up with 2 m/s^2 then reading of the weighing machine will be

- a) 480 N b) 600 N c) 720 N d) 0

In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

- a) Both Assertion (A) and Reason (R) true and Reason (R) is the correct explanation of Assertion (A).
b) Both Assertion (A) and Reason (R) are true but Reason (R) is not a correct explanation of Assertion (A).
c) Assertion (A) is true but Reason (R) is false.
d) Assertion (A) is false and Reason (R) is also false.

- Q16. Assertion (A) : The dot product of one vector with another vector may be a scalar or a vector.

Reason (R) : If the product of two vectors is a vector, then product is called a dot product.

- Q17. Assertion (A) : Use of ball-bearings between two moving parts of a machine is a common practice.

Reason (R) : Ball-bearings reduce vibrations and provide good stability.

- Q18. Assertion (A) : A particle strikes head-on with another stationary particle such that the first particle comes to rest after the collision. The collision should necessarily be elastic.

Reason (R) : In elastic collision, there is a loss of momentum of the system of particles.

Section - B

- Q19. A balloon with mass M is descending down with an acceleration a , where $a < g$. What mass m of its contents must be removed so that it starts moving up with an acceleration a ?

OR

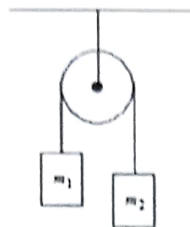
How much high above the ground a person can throw a ball if he is able to throw the same ball up to maximum horizontal distance of 100 m?

- Q20. Determine the vector which when added to the resultant of

$$\vec{A} = 2\hat{i} - 6\hat{j} - 3\hat{k} \text{ and } \vec{B} = 4\hat{i} + 3\hat{j} - \hat{k} \text{ gives unit vector along Z-axis.}$$

- Q21. State and prove parallelogram law of vector addition.

as shown in figure. Calculate the acceleration of these blocks.



OR

A river is 500m wide flows at a rate of 4 km h^{-1} . A swimmer who can swim at 8 km h^{-1} in still water, wishes to cross the river straight then

- i) Along what direction must he strike?
- ii) What should be his resultant velocity?

- Q23. What do you mean by law of conservation of momentum? Derive law of conservation of linear momentum from Newton's third law of motion.
- Q24. Derive the expression of time of flight and horizontal range attained when a projectile is fired at an angle θ with horizontal
- Q25. Define conservative force. Show that gravitational force is conservative force.

Section - C

- Q26. What is need of banking of roads? Obtain an expression for the maximum speed with which a vehicle can safely negotiate a curved road banked at angle θ . (Take coefficient of friction as μ)

OR

Derive an expression for the work done on a rough inclined surface.

- Q27. A bomb at rest explodes into three fragments of equal masses. Two fragments fly off at right angle to each other with velocity of 9 m s^{-1} and 12 m s^{-1} respectively. Calculate speed of third fragment.
- Q28. Derive the expression of potential energy of a spring.
- Q29. Derive the equation
- a) $S = ut + \frac{1}{2}at^2$
 - b) $v^2 - u^2 = 2aS$ graphically.
- Q30. Derive an expression for position vector of CM of two particle system?

Section - D

- Q31. Discuss the dynamics of motion in a vertical circle and find the tensions and velocities at highest and lowest points of circular path.

OR

A 10g bullet is fired from a gun horizontally into 5kg block of wood suspended by a string and the bullet gets embedded in the block. The impact causes the block to swing to a height of 5cm above the initial level. Calculate velocity of bullet.

- Q32. a) Discuss the elastic collision between two balls in one dimension and obtain an expression for their velocities after collision.
- b) If the momentum of a body increases by 20%, what will be the increase in the K.E. of body?

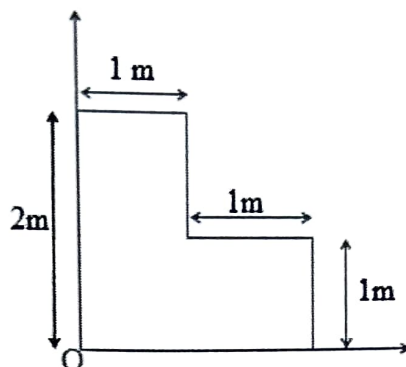
OR

- a) What is the geometrical interpretation of dot product and cross product of two vectors?
- b) A man walking towards east with a velocity of 3 km h^{-1} encounters rain falling vertically with

a velocity of $3\sqrt{3} \text{ km h}^{-1}$. At what angle should he hold his umbrella in order to protect himself from rain? Also find relative velocity of rain w.r.t. man?

Q33.

Find the position vector of center of mass of a uniform L shaped lamina (a thin flat plate) with dimensions as shown in figure. The mass lamina is $m \text{ kg}$.



OR

Three masses 2 kg, 3 kg and 4 kg are located at the corners of an equilateral triangle of side 1m. Find out the position vector of its C.M.

Section - E

Case Based Questions:

Q 34.

Magnitude of Resultant Vector and direction: -

In one dimensional motion of the objects only two directions are possible so the directional aspects of the quantities like displacement position velocity and acceleration can be described by using either positive or negative sign. A physical quantity shown along positive direction will be given the positive sign whereas shown along negative direction possesses negative sign. But in case of motion of objects in two dimensions or in three dimensions any object can have large number of directions so in order to deal with such situation we need to introduce the concept of new physical quantities in which we take care of both magnitude and direction. In physics the physical quantities are broadly classified into categories scalars and vectors.

Q1. Angle between negative vectors is

- a) 0° b) 60° c) 90° d) 180°

Q2. If resultant of two vectors of equal magnitude is equal to the magnitude of either vector then the angle between the two vectors is

- a) 30° b) 90° c) 60° d) 180°

Q3. Which of the following is a scalar

- a) displacement b) kinetic energy c) couple d) momentum

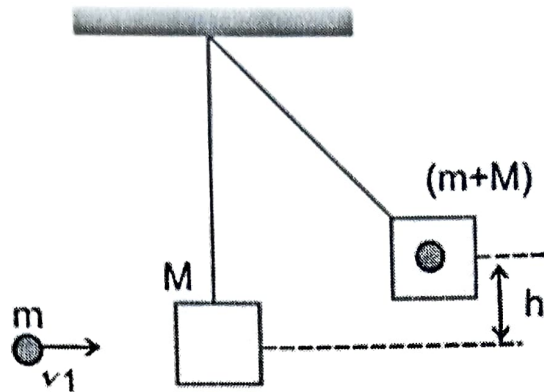
Q4. Which of the following is not essential for three forces to produce zero resultant?

- a) they should be in the same plane.
b) it should be possible to represent them by the three sides of a triangle taken in same order.
c) they should act along the sides of a parallelogram.
d) the resultant of any two forces should be equal and opposite to the third force.

Q5. What is the maximum number of rectangular components into which a vector can be resolved in a plane?

- a) two b) three c) four d) Any number

Collision Between Bullet and Vertically Suspended Block is described as below in the figure where a block of mass M suspended by vertical thread and a bullet of mass m moving with initial velocity v_1 struck the block and get embedded in it. The system rises to a height of h .



- i) The type of collision demonstrated above is,
 - a) Elastic collision b) Inelastic c) Perfectly elastic d) Perfectly inelastic
- ii) Velocity of the bullet in terms of masses and height is,
 - a) $v_1 = \frac{(m+M)}{m} \sqrt{2gh}$ b) $v_1 = \frac{(m+M)}{m\sqrt{2gh}}$ c) $\sqrt{2gh}$ d) $\frac{m}{m+M} \sqrt{2gh}$
- iii) For the collision shown above value of e must be,
 - a) 1 b) <1 c) >1 d) 0.
- iv) Type of force involved in above collision is,
 - a) Conservative b) non-conservative c) balanced d) none.

OR

- v) Which of the following statements are correct for above collision,
 - a) K.E and momentum are conserved.
 - b) K.E is conserved but not momentum.
 - c) Momentum is conserved but not K.E.
 - d) Both momentum and K.E are not conserved.