# BUDHA DAL PUBLIC SCHOOL, PATIALA
## First Term Examination (6 September 2023)
**Class XI (Science)**
**Subject - Physics**
**(Set - B)**

**Time: 3hrs** **M.M. 70**

**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.** Which of the following represents dimensions of velocity gradient?

a) $[M^0\ L^0\ T^{-1}]$ b) $[ML^0\ T^{-2}]$ c) $[ML^2\ T^{-2}]$ d) $[MT^{-2}]$

**Q2.** From a building two balls A to B are thrown such that A is thrown upwards and B downwards (both vertically). If $v_A$ *and* $v_B$ are their respective velocities on reaching the ground then.

a) $v_B > v_A$ b) $v_A > v_B$ c) $v_A = v_B$ d) their velocities depends on their masses

**Q3.** Acceleration of a body moving with constant speed in circle is

a) *zero* b) $r\omega$ c) $r\omega^2$ d) $\frac{\omega^2}{r}$

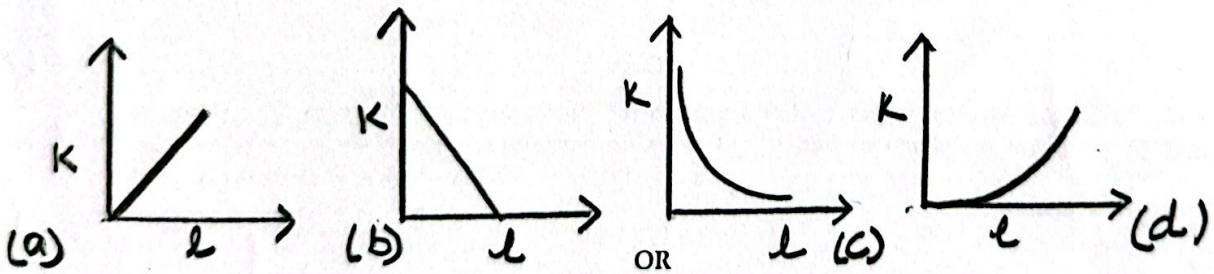
**Q4.** Two non zero vectors $\vec{A}$ *and* $\vec{B}$ are perpendicular to each other then

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

**Q5.** Four angles of projection of a projectile at angle $(45^0 - \theta)$ and $(45^0 + \theta)$, the horizongal range described by the projectile are in the ratio:

a) 2 : 1 b) 1 : 1 c) 2 : 3 d) 1 : 2

**Q6.** Which of the following graph depicts spring constant K versus length L of the spring correctly?




OR

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

**Q7.** A gun fires a small bullet with kinetic energy K. Then kinetic energy of the gun while recoiling is

a) K b) More than K c) Less than K d) $\sqrt{K}$

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Q8. 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) $+13$

Q9. A gun fires a bullet of mass 50g with a velocity of 30 $ms^{-1}$. Because of this the gun is pushed back with a velocity of 1 $ms^{-1}$. The mass of the gun is

a) 5.5 kg b) 3.5 kg c) 1.5 kg d) 0.5kg

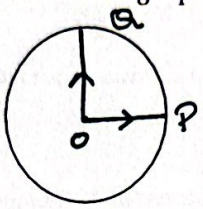
Q10. A cyclist starts from the centre O of a circular park of radius 1 km, reaches the edge P of the park, then cycles along the circumference and returns to the centre along QO as shown in figure. If the round trip takes 10 minutes, the net displacement and average speed of the cyclist (in metre and km/h) is

a) 0, 21.4

b) $21.4, \frac{\pi+4}{2}$

c) 0, 1

d) $\frac{\pi+4}{2}, 0$



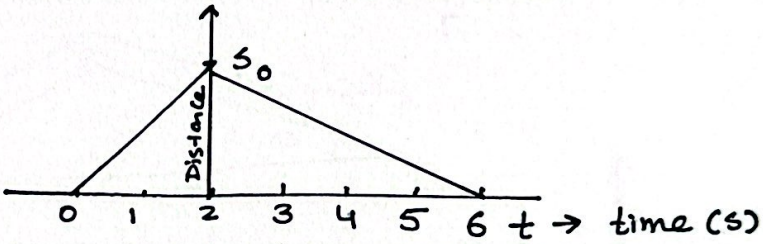

Q11. What will be the ratio of speed in first two seconds to the speed in next 4 seconds?

a) $\sqrt{2} : 1$

b) 3 : 1

c) 2 : 1

d) 1 : 2




Q12. A force F is given by $F = at + bt^2$, where t is the time, the dimensions of a and b are :

b) $[MLT^{-3}]$ and $[MLT^{-4}]$ b) $[MLT^{-4}]$ and $[MLT^{-3}]$

c) $[MLT^{-1}]$ and $[MLT^{-2}]$ d) $[MLT^{-2}]$ and $[MLT^{-4}]$

Q13. Dimensional formula for force constant is

a) $[M^0 L T^{-2}]$ b) $[ML^0 T^{-1}]$ c) $[ML^0 T^{-2}]$ d) $[M^0 L^2 T^{-2}]$

Q14. If normal force is doubled, then coefficient of friction is

a) Halved b) Doubled c) Trippled d) Remains unchanged

Q15. A particle is projected at $60^0$ 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

OR

Two stones are projected with same speed but making different angles with the horizontal. Their ranges are equal. If the angle of projection of one is $(\pi/3)$ and its maximum height is h1 then maximum height of the other will be

a) $3h_1$ b) $2h_1$ c) $h_1/2$ d) $h_1/3$

**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.**

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.

Q17. 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.

Q18. Assertion (A) : Use of ball-bearings between two moving parts of a machine is a common practice.

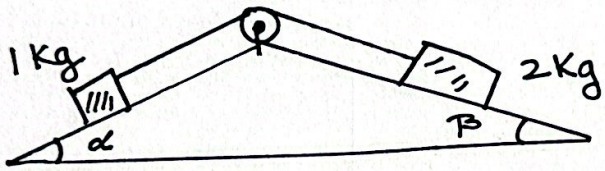
Reason (R) : Ball-bearings reduce vibrations and provide good stability.

## Section - B

Q19. 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?

OR

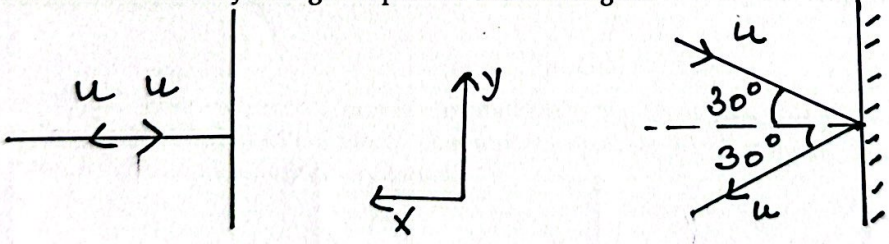
Two blocks of mass 1kg and 2kg are connected by an inextensible string passes over a friction less pulley as shown in figure. Calculate the acceleration of these blocks.




Q20. 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

Two identical billiard balls strike a rigid wall with a same speed but at different angles, and get reflected without any change in speed as shown in figure.




What is (i) the directions of the force on the wall due to each ball? (ii) the ratio of the magnitude of impulses imparted to the balls by the wall?

Q21. A vector $\vec{X}$, when added to the resultant of vectors $\vec{A} = 3\,i - 5\,j + 7\,k$ and $\vec{B} = 2\,i + 4\,j - 3\,k$ gives a unit vector along y axis. Find the vector $\vec{X}$.

Q22. State and prove triangle law of vector addition. (Analytically)

Q23. What do you mean by law of conservation of linear momentum? Derive law of conservation of linear momentum from Newton's third law of motion.

Q24. Show the Newton's second law of motion is real law of motion.

Q25. Define conservative force. Show that gravitational force is conservative force.

## Section – C

**Q26.** Derive the expression of potential energy of a spring.

**Q27.** 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 $\theta$. (Take coefficient of friction as $\mu$)

OR

Derive an expression for the work done in moving a body up on a rough inclined surface.

**Q28.** 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.

**Q29.** Derive the equation

a) $v = u + at$ b) $v^2 - u^2 = 2aS$ graphically

**Q30.** A ball rolls off the top of a stairway with a constant horizontal velocity u. If the steps are h metre high and w metre wide, show that the ball will just hit the edge of the nth step if $n = \frac{2hu^2}{gw^2}$

OR

Derive the expression of time of flight, horizontal range and maximum height attained when a projectile is fired at an angle $\theta$ with horizontal.

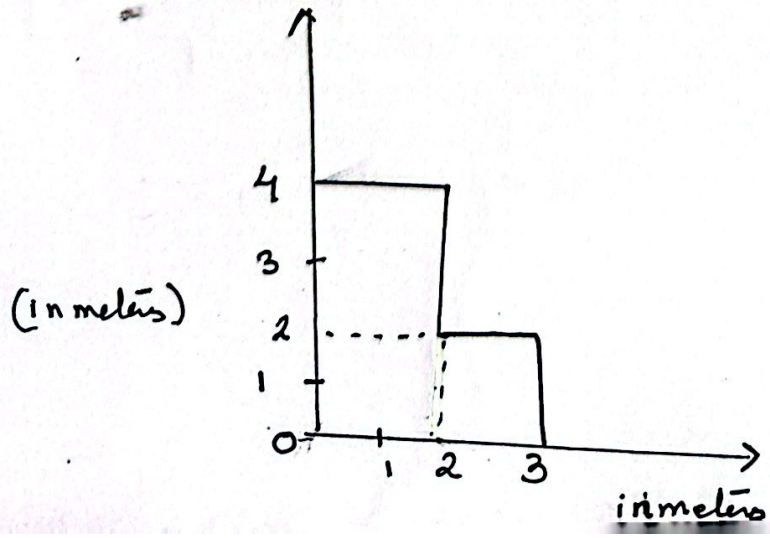
## Section – D

**Q31.** Discuss the motion in a vertical circle, find condition of looping the loop and tensions at lowest and highest points.

OR

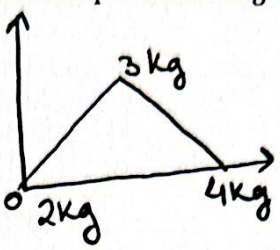
A 10g bullet is fired from a gun horizontally into 5kg block of wood suspended by a string and the bullet gets embedded in the block. The impact causes the block to swing to a height of 5cm above the initial level. Calculate velocity of bullet.

**Q32.** Find the centre of mass of a uniform L shaped lamina ( a tin flat plate) with dimensions as shown in figure. The mass lamina is m 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 of C.M.




Q33. 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 $3\sqrt{3}$ km $h^{-1}$. At what angle should be hold his umbrella in order to protect himself from rain? Also find relative velocity of rain w.r.t. man?

Section – E

Q34. **Friction**

**Friction between any two surfaces in contact is the opposing force that comes into play whenever a body moves or tends to move over the surface of another body. The force of limiting friction (F) between any two surfaces in contact is directly proportional to the normal reaction (R) between them *i.e.* $F \propto R$ or $F = \mu R$, where $\mu$ is coefficient of limiting friction. If $\theta$ is the angle of friction, then $\mu = \tan\theta$. The value of coefficient of friction depends on nature of surfaces in contact, material of the surfaces in contact and tempeature of surfaces in contact. Friction is actually necessary evil . We can sometimes increase and sometimes decrease friction.**

(i) Direction of force of friction is

(a) perpendicular to the motion of body

(b) along the direction of motion

(c) opposite to the direction of motion

(d) none of these.

(ii) What will be the angle of friction between two bodies in contact if coefficient of friction is $\frac{1}{\sqrt{3}}$ ?

(a) 0° (b) 30°

(c) 45° (d) 90°.

(iii) If $\mu_s$, $\mu_k$ and $\mu_r$ be the coefficient of static, kinetic and rolling friction respectively then

(a) $\mu_s > \mu_k > \mu_r$ (b) $\mu_s < \mu_k < \mu_r$

(c) $\mu_s < \mu_k > \mu_r$ (d) $\mu_s > \mu_k > \mu_r$

iv) Is large brake on a bicycle wheel effective than smaller one? Explain.

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## Relative Velocity

When two objects A and B are moving with different velocities then velocity of object A w.r.t. object B is called as relative velocity of object A w.r.t. object B. Relative velocity can also be known as the time rate of change of relative position of one object w.r.t. other object. It $v_A$ and $v_B$ be the velocities of two objects then

$v_{AB} = v_A - v_B$ (Relative velocity of object A w.r.t object B)

$v_{BA} = v_B - v_A$ (Relative velocity of object B w.r.t. object A)

When body C is moving with velocity $v_c$ on a body A, which is moving with velocity $v_A$ then the velocity of the body C w.r.t. ground is $v_C + v_A$

(i) What will be the relative velocity of object A w.r.t. object B if they move with equal velocity but in opposite directions ?

(a) $v_1 - v_2$ (b) $-2v$

(c) $2v$ (d) $v/2$.

(ii) When two objects A and B are moving along parallel straight lines with velocities $v_A$ and $v_B$ in opposite directions then relative velocity of object A w.r.t. object B in magnitude will be

(a) $v_A + v_B$ (b) $v_A - v_B$

(c) $\frac{v_A + v_B}{2}$ (d) $\frac{v_A - v_B}{2}$

(iii) The speedometer of a car A moving eastward reads 50 km/h. It passes another car B which travels westwards at 50 km/h. What is relative velocity of car A w.r.t. car B?

(a) 0 (b) 50 km/h

(c) 100 km/h (d) none of these.

iv) Draw position – time graph if two objects are moving with same velocities.

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