THE VILLAGE
INTERNATIONAL SCHOOL
"We Nurture Dreams"

SUB: Physics

Date: Time Allowed :3 hours

Class: XI Maximum Marks: 70

General Instructions:

(1) There are 35 questions. All questions are compulsory

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.

(3) Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of four marks each.

(4) There is no overall choice. However, an internal choice has been provided in section B, C and D and. You have to attempt only one of the choices in such questions.

(5) Use of calculators is not allowed.

SECTION A

Q. NO.	QUESTION	MARKS
1	If the dimensions of a physical quantity are given by $[M^aL^bT^c]$, then the physical quantity will be: a) Force if a = 0, b = -1, c = -2 b) Pressure if a = 1, b = -1, c = -2 c) Velocity if a = 1, b = 0, c = -1 d) Acceleration if a = 1, b = 1, c = -2	1
2	The horizontal range of a projectile is maximum when the angle of projection is a) 0° b) 90° c) 60° d) 45°	1
3	The graph between displacement and time for a particle moving with uniform acceleration is a a) Straight line parallel to time axis	1

b) Straight line perpendicular to time axis
c) Parabola or hyperbola
d) Straight line with positive slope

4 If we throw a body upwards with velocity of 4 m/s, at what height does its kinetic energy reduce to half of the initial value (Taking g = 10 m / s^2) 1

a) 4 m
b) 2 m
c) 1 m
d) 0.4 m

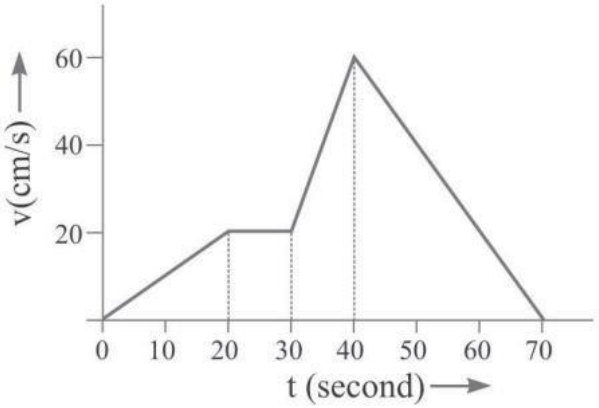
5 If F denotes force and t time, then in the equation $F = at^{-1} + bt^2$. Dimensions of a and b respectively are 1

a) $[MLT^{-1}]$ and $[MLT^{-4}]$
b) $[MLT^{-4}]$ and $[MLT^{-1}]$
c) $[MLT^{-3}]$ and $[MLT^{-1}]$
d) $[MLT^{-2}]$ and $[MLT^{-4}]$

6 The power of a water pump is 2kW. If g = 10 ms^{-2}. what is the amount of water it can raise in one minute to a height of 10 m? 1

a) 1000 litre
b) 1200 litre
c) 2000 litre
d) 2200 litre

7 The velocity versus time curve of a moving point is as given below. The maximum acceleration is 1



a) 1 cm/s^2
b) 2 cm/s^2
c) 3 cm/s^2
d) 4 cm/s^2

8 The vertical component of velocity of a projectile at its maximum height is 1

a) $v_o \sin\theta$
b) $v_o \cos\theta$
c) $-v_o \sin\theta$
d) zero

9 Three particles of the same mass lie in the x-y plane. The (x, y) coordinates of their positions are (1, 1), (2, 2) and (3, 3) respectively. The (x, y) co-ordinates of the centre of mass are: 1

a) (1, 2)
b) (2, 2)
c) (4, 2)
d) (6, 6)

10 A light and a heavy body have equal momenta. Which one has greater K.E. 1

a) the light body
b) the heavy body
c) the K.E. are equal
d) data is incomplete

11 A cyclist riding the bicycle at a speed of 14 ms^{-1} takes a turn around a circular road of radius 20 m without skidding. Given g = 9·8 ms^{-2}, what is his inclination to the vertical? 1

a) 50°
b) 90°
c) 45°
d) 60°

12 A mass m is moving with a constant velocity along a line parallel to the X-axis away from the origin, its angular momentum w.r.t. origin: 1

a) is zero
b) is constant
c) goes on decreasing
d) goes on increasing.

13 A player caught a cricket ball of mass 200 g moving at a rate of 20 m/s. If the catching process is completed in 0·1 s, the force exerted by the ball on the hand of the player is equal to: 1

a) 200 N
b) 4 N
c) 40 N
d) 400 N

14 During the motion of a lift, apparent weight of a body becomes twice its actual weight, when 1

a) lift is moving down with an acceleration g
b) lift is moving up with an acceleration g
c) lift is moving down with uniform speed of 19.6 m/s
d) lift is moving up with uniform velocity of 19.6 m/s

15 Angular momentum of the particle rotating with a central force is constant due to: 1

a) Constant linear momentum
b) Zero Torque
c) Constant Torque
d) Constant Force

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. 1

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

ASSERTION: In an elastic collision between two bodies, the relative speed of the bodies after collision is equal to the relative speed before the collision.

REASON: In an elastic collision the linear momentum of the system is conserved.

17 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. 1

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

ASSERTION: It is harder to open and shut the door if we apply force close to the hinge.

REASON: Torque is maximum about the hinge.

18 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. 1

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

ASSERTION: The recoil velocity of the gun is always much lesser than the velocity of bullet in the forward direction.

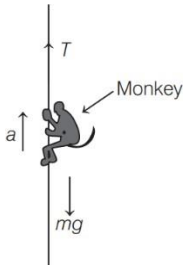
REASON: The recoil takes place according to the principle of conservation of linear momentum.

SECTION B

19 a) State law of conservation of angular momentum. 2

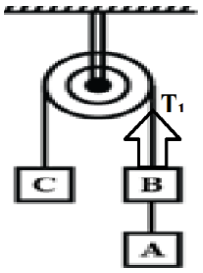
b) The angular velocity of earth revolving around the sun increases when it comes closer to the sun. Why?

20 A monkey of mass 25 kg is holding a vertical rope. The rope will not break when a mass of 30 kg is suspended from it, but will break if the mass exceeds 30 kg. What is the maximum acceleration with which the monkey can climb up along the rope? (Take g = 10 m/s^2). 2



OR

Bodies A, B & C of masses 4 kg, 1 kg and 3 kg respectively are hanging as shown in the figure. If the Pulley is a frictionless, find the common acceleration of the system. (Take g = 10 m/s^2). Also find the tension T_1 in the diagram.



21 A stone is dropped from the top of a tower 100 m high. At the same time, another stone is thrown vertically upwards with a velocity of 50 ms^{-1}. When and where the two stones will meet? 2

22 Derive the expression for the potential energy stored in a spring? 2

OR

State and Prove Work – Energy theorem for a constant force.

23 Show that the kinetic energy of the particle is ½mv^2. 2

24 Derive a relationship between linear velocity(v) and angular velocity(ω) 2

25 a) State the conditions for a rigid body to be in equilibrium. 2

b) A laborer standing near the top of an old wooden step-ladder feels unstable. why?

SECTION C

26 A projectile is fired with a velocity v_o making an angle Θ with the horizontal. Find the expression for the maximum height and horizontal range attained by the projectile. 3

27 Deduce $\mathbf{v^2 = u^2 + 2as}$ for a uniformly accelerated motion along a straight line using v-t graph where the terms have their usual meanings 3

28 State Newton's second law of motion and derive the equation of motion: F = ma. 3

OR

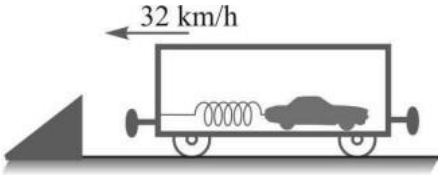
Justify the following statements:

a) Automobiles are provided with spring system.

b) A ball thrown upward in a train moving continues to move with the train.

c) When a blanket is given a sudden jerk, the dust particles fall off.

29 A railroad car travelling 36 km/h runs into a stop at a railroad terminal (see fig.). A vehicle having a mass of 1800 kg is held by a linear - restoring system that has an equivalent spring constant of 20,000 N/m. If the railroad car is assumed to stop suddenly and wheels on the vehicle are free to turns, what is the maximum force developed by the equivalent sloping system? Neglect friction and the inertia of the wheels. 3



OR

An automobile moving horizontally at a speed of 54 km/h reaches the foot of an inclined smooth plane and the engine is switched off. How much distance does the automobile go up the incline before coming to rest? The inclination of the plane to the horizontal is 30°.

30 Derive the relationship between torque and angular momentum of a particle about an axis. 3

SECTION D

31 a) What is centripetal acceleration? Derive an expression for the same in the case of a uniform circular motion. 5

b) A racer is moving with a constant tangential speed of 50 m/s, takes one lap around a circular track in 40 seconds. Calculate the magnitude of the acceleration of the car.

OR

a) Show that the trajectory of the projectile is a parabola.

b) Calculate the horizontal distance travelled by a ball thrown with a velocity $20\sqrt{2}$ ms^{-1} without hitting the ceiling of an auditorium of height 20 m. Use g = 10 ms^{-2}.

32 a) Calculate the velocities of two bodies after elastic collision in one dimension. 5

b) A body of mass 2 kg makes an elastic collision with another body at rest and continues to move in the original direction with a speed equal to one third of its original speed. Find the mass of the second body.

OR

a) State the principle of conservation of mechanical energy. Prove it for freely falling body.

b) A pump on the ground floor of a building can pump up water to fill a tank of volume 30 m^3 in 15 min. If the tank is 40 m above the ground, and the efficiency of the pump is 30%, how much electric power is consumed by the pump?(Given the density of water is 100 kg/ m^3)

33 a) What is meant by banking of roads? Derive the expression for the maximum velocity with which a vehicle can turn on a banked road. 5

b) A bend in a level road has a radius of 100 m. Find the maximum speed which a car turning this may have, if the coefficient of friction between the tyres and the road is 0.8.

OR

a) State and prove the principle of conservation of linear momentum.

b) A rifle man, who together with his rifle has a mass of 100 kg, stands on a smooth surface and fires 10 shots horizontally. Each bullet has a mass of 10 g with a muzzle velocity of 800 m/s.

(i) What velocity does the rifle man acquire at the end of 10 shots?

(ii) If the shots were fired in 5 s, what was the average force exerted on him?

SECTION E

34 To verify the laws of limiting friction, we take two exactly identical rectangular blocks of wood A and B, each of same weight mg. each block is provided with a hook on one side. The block is placed on a horizontal table provided with a frictionless pulley on one side, fig 3.1. One end of a string is attached to the hook of the block. The string is then passed over the pulley and a pan is attached to the free end of the string. Any number of weights can be added to the pan. We adjust the weights in the pan till the block just begins to move. The applied force P at this stage gives us a measure of force of limiting friction F. All blocks are similar. And all weights are similar. Carefully observe the blocks and number of weights in the pan and answer following question. Block apply force equal to its weight on the table and in return table provides normal reaction . 4

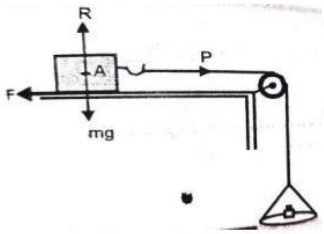


Fig. 3.1

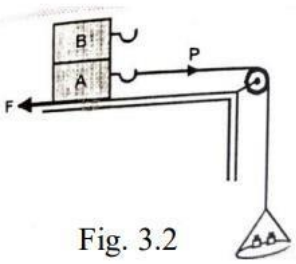


Fig. 3.2

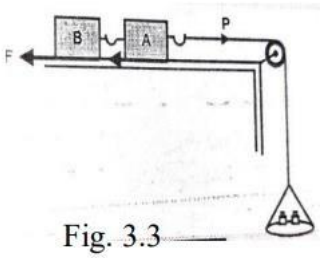


Fig. 3.3

(i) Refer fig 3.1 and 3.2 it was observed that when only one block was place, it could be just moved by placing one weight in pan and when two block were placed one over the other, then two weights were required to just move the blocks. Give the dependency of frictional force with the normal reaction.

(ii) What is limiting friction?

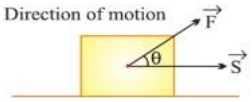
(iii) Give two methods of increasing and decreasing friction

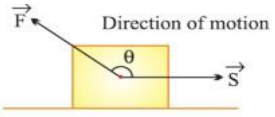
OR

(iii) Give two advantages and disadvantages of friction.

35 Work is said to be done when a force applied on the body and the body displaces through a certain distance in the direction of force Let a constant force F be applied on the body such that it makes an angle θ with the horizontal and body is displaced through a distance 's'. Then work done by the force in displacing the body through a distance 's' is given by 4

$$W = \vec{F} . \vec{s}$$





(i) A body displaces through a distance of 20m on applying a force of 20 N in a direction inclined at 60 degree to the ground. Calculate the work done.

(ii) Give one example each for positive and negative work done.

(iii) Define the unit of work and write its dimensional formula.

OR

(iii)How much is the work done by the centripetal force? Explain.