ST. MARGARET SR. SEC. SCHOOL
SAMPLE PAPER 2023-24
PHYSICS (042)
CLASS XI

Time: 3Hrs **M.M: 70**

General Instructions:

(1)There are 33 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 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)Use of calculators is not allowed.

SECTION- A

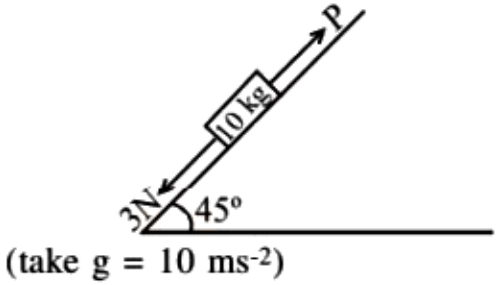
1 **Which of the following quantity does not have any dimensions?** 1

(a) Bulk Modulus (b) Power
(c) Strain (d) Torque

2 **If force(F), velocity(V) and time(T) are taken as fundamental units, then the dimensions of mass are** 1

(a) $[F^1V^1T^{-2}]$ (b) $[F^1V^{-1}T^{-1}]$ (c) $[F^1V^{-1}T^1]$ (d) $[F^1V^1T^{-1}]$

3 **A block of mass 10 kg is kept on a rough inclined plane as shown in the figure. A force of 3 N is applied on the block. The coefficient of static friction between the plane and the block is 0.6. What should be the minimum value of force P, such that the block does not move downward?** 1



(take g = 10 ms^{-2})

a) 32 N b) 25N c) 23N d)18N

4 **If M is the mass of the earth and R its radius, the ratio of the acceleration due to gravity and universal gravitational constant is** 1

(a)R^2/M (b) M/R^2
(c) MR^2 (d) M/R

5 **The number of significant figures in 0.008010 is:** 1

(a) 3 (b) 4 (c) 5 (d) 6

6 **The motion of a particle is described by the equation $u = at$. The distance travelled by the particle in the first 4 sec is** 1

(a) 4a (b) 12a (c) 6a (d) 8a

7 **Which one of the following statements is incorrect?** 1

a) Rolling friction is smaller than sliding friction
b) Coefficient of sliding friction has dimensions of length
c) Frictional force opposes the relative motion
d) Limiting value of state friction is directly proportional to normal reaction.

8 **The relation between time t and distance x is $t = ax^2 + bx$, where a and b are constants. The acceleration is** 1

(a) $-2abv^2$ (b) $-2bv^3$ (c) $-2av^3$ (d) $-2av^2$

9 **When a body is taken from poles to equator on the earth, its weight** 1

(a) Increases (b) Decreases

(c) remains the same (d) increases at south pole and decreases at north pole

10 **An object moving with a speed of 6.25 m/s, is decelerated at a rate given by** 1

$$\frac{dv}{dt} = -2.5\sqrt{v}$$

Where v is the instantaneous velocity speed. The time taken by the object, to come to rest, would be

a) 1 sec b) 2 sec c) 4 sec d) 8 sec

11 **Two vectors are perpendicular if** 1

a) $\hat{A} \cdot \hat{B} = 1$ b) $\hat{A} \times \hat{B} = 0$ c) $\hat{A} \cdot \hat{B} = 0$ d) $\hat{A} \times \hat{B} = AB$

12 **Two bodies are projected with the same velocity. If one is projected at an angle of 30° and the other at 60° to the horizontal, then ratio of maximum heights reached is** 1

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

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.

b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

c) If Assertion is true but Reason is false.

d) If both Assertion and Reason are false.

13. **Assertion**: The equation of motion in scalar form can be applied only if acceleration is along the direction. 1

Reason: If the acceleration of a body is constant then its motion is known as uniform motion

14 **Assertion**: a table cloth can be pulled from a table without disloading the clothes. 1

Reason: To every action, there is an equal and opposite reaction

15. **Assertion**: The comets do not obey Kepler's laws of planetary motion 1
Reason: The comets do not have elliptical orbits.

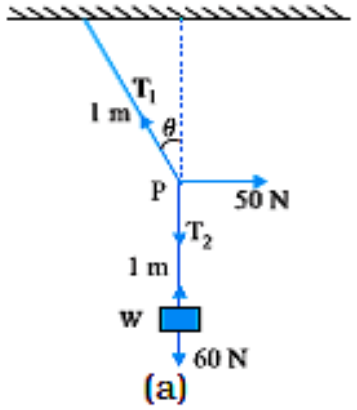
16. **Assertion**: Angle of repose is equal to coefficient of limiting friction. 1
Reason: When the body is just at the point of motion, the force of friction in this stage is called as limiting friction.

SECTION-B

17. A body weighs 63N on the surface of the earth. What is the gravitational force on it due to the earth at a height equal to half the radius of the earth 2

18. A body of mass 0.5kg travels in a straight line with velocity $\boldsymbol{v = ax^{3/2}}$ where $= 5m^{-1/2}s^{-1}$. what is the work done by the net force during its displacement from $x = 0\ to\ x = 4m.$ 2

19. A mass of 6 kg is suspended be a rope of length 2m from a ceiling. A force of 50N in the horizontal direction is applied at the midpoint of the rope as shown in the figure. What is the angle rope makes with the vertical in equilibrium? Take g=9.8 m/s^2. Neglect the mass of the rope. 2



20. The distance travelled by a particle in time t is given be $s = (5ms^{-2})t^2$. Find 2
a) The average speed of the particle during the time 0 to 5.0 s and
b) The instantaneous speed at t=5.0 s

21. The volume of a liquid flowing out per second of a pipe of length l and radius r is written by a student is $\boldsymbol{V = \frac{\pi Pr^2}{8\eta}}$ 2

where P is pressure difference between the two ends of the pipe and η is coefficient of viscosity of the liquid having dimensional formula [ML^{-1}T^{-1}] Check whether the equation is dimensionally correct.

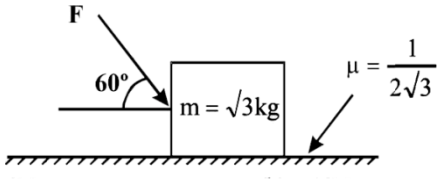
SECTION-C

22. Two bodies of masses 10 kg and 20 kg respectively kept on a smooth, horizontal surface are tied to the ends of a light string. A horizontal force F = 600N is applied to (i) B (ii) A along the direction of string. What is the acceleration of the system tension in the string in each case? 3

OR

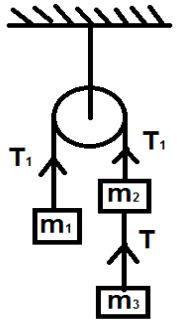
A motorboat is racing towards north at 25km/h and the water current in that region is 10km/h in the direction of 60° east of south. Find the resultant velocity of boat

23. What is the maximum value of the force F such that the block shown in the arrangement does not move 3



24. In the arrangement shown in the figure (b). Show that the tension in the string between masses m_2 and m_3 is 3

$$T = \frac{2m_1m_3g}{m_1 + m_2 + m_3}$$



25. Define Orbital velocity of a satellite. Derive an expression for orbital velocity of a satellite. Does it 3

26. A ball is thrown vertically upwards with a velocity of 20 m/s from the top of a multistory building. The height of the point from where the ball is thrown is 25m from the ground. (i) How high will the ball rise? (ii) How long will it be before the ball hits the ground? 3

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27. A gas bubble, from an explosion under water, oscillates with a period T proportional to $\boldsymbol{P^a, d^b E^c}$ where P is the static pressure, d is the density of water and E is the total energy of the explosion. Find the values of a, b and c. 3

28. The spring shown in figure has a force constant of 24 N/m. The mass of the block attached to the spring is 4 kg. Initially the block is at rest and spring is unstretched. The horizontal surface is frictionless. If a constant horizontal force of 10N is applied on the block, then what is the speed of the block when it has been moved through a distance of 0.5m? 3

SECTION-D

29. To drive a nail into a wooden block, we blow a hammer on the nail. When a ball hits a wall, it bounces back. In both of these examples, a large force acts for a very short duration producing a finite change in momentum of the body. Here it is difficult to measure force and time separately. The product of the force and time that produces a finite change of momentum is called impulse. 4

(i) A particle is moving in a circle with uniform speed v. In moving from a point to another diametrically opposite point,

(a) the momentum changes by mv (b) the momentum changes by 2mv

(c) the kinetic energy changes by $\frac{1}{2}mv^2$ (d) the kinetic energy changes by mv^2

(ii) A ball strikes a bat with velocity v. The ball has mass m and after striking it retraces its path. What is the impulse imparted by the bat?

(a) $3mv$ (b) mv (c) $zero$ (d) $2mv$

(iii) Dimensions of impulse are same as that of

(a) force (b) momentum (c) energy (d) acceleration

(iv) A player caught a cricket ball of mass 150kg moving at a rate of 20 m/s. If the ball catching process is completed in 0.1 s, the force on the blow exerted by the ball on the hand of the player is equal to

(a) 30N (b) 300N (c) 150N (d) 3N

30. To put a satellite into an orbit around the earth, it must be given a minimum vertical velocity so that it can overcome gravity and reach a suitable height. Then the satellite must be given sufficient tangential velocity so that it may not fall back to the earth. Once it is done, the gravitational force provides the needed centripetal force to maintain the satellite in orbit. The minimum vertical velocity with which a body must be projected vertically upward in order that it may just escape the gravitational field of the earth is called escape velocity. 4

(i) The velocity with which a projectile, must be fired so that it escapes earth's gravitation, does not depend on

a) Mass of the earth b) mass of the projectile

c) radius of the projectile's orbit d) Not related to each other

(ii) Escape velocity of a body, when projected from the earth's surface is 11.2 km/s. If it is projected at an angle of 60° with the horizontal, then escape velocity will be

a) $11.2\ km/s$ b) $12.8 km/s$ c) $16.2\ km/s$ d) $11.8\ km/s$

(iii) There is no atmosphere on the moon, because

a) It is closer to the earth and also it has the inactive inert gases in it.

b) It is too far from the sun and has very low pressure in its outer surface

c) Escape velocity of gas molecules is greater than their root mean square velocity

d) Escape velocity of gas molecules is less than their root mean square velocity.

(iv) The required kinetic energy of an object of mass m, so that it may escape, will be

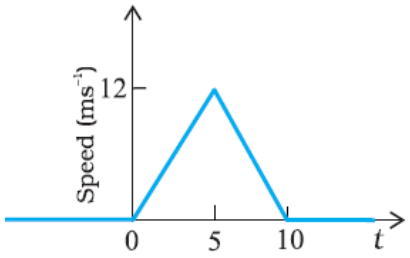
a) $\frac{1}{4}mgR$ b) $\frac{1}{2}mgR$ c) mgR d) $2mgR$

SECTION-E

31. (A) Define projectile. Show that the path of projectile is parabola. Find the angle of projection at which the horizontal range and maximum height of the projectile are equal. 5

(B) The speed time graph of a particle moving along a fixed direction is shown below in figure. Obtain the distance travelled by the particle between (i) $t = 0\ s\ to\ t =$

$10s$ $(ii) t = 2\ s\ to\ t = 6\ s$. What is the average speed of the particle over the intervals in (i) and (ii)



OR

(C) A stone is thrown horizontally with a speed $\sqrt{2gh}$ from the top of a height h. It strikes the level ground through the foot of the wall at a distance x from the wall. What is the value of x?

(D) Derive the equation of motion by calculus method for a body moving with constant acceleration.

. **(3+2)**

32. **A)** What is kinetic energy of a body? Derive its relation with linear momentum. 5

B) A particle of mass 10g moves along a cicle of radius 6.4 cm with a constant tangential acceleration. What is the magnitude of this acceleration if the kinetic energy of the particle becomes equal to $8 \times 10^{-4} J$ by the end of the second revolution after the beginning of the motion.

OR

C) Distinguish between elastic and inelastic collision. Two bodies of masses m_1 and m_2 moving with velocities u_1 and u_2 undergo one dimensional elastic collision. Determine their velocities after the collision.

D) What is coefficient of restitution?

33. (i) Define limiting friction. State laws of limiting friction. 5

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

a) What is the direction of the force on the wall due to each ball?
b) What is the ratio of the magnitudes of impulses imparted to the balls by the wall?