APEEJAY SCHOOL, PANCHSHEEL PARK

Class – XI
Subject – Physics
MIDTERM EXAMINATION (2024-25)

Date:
Name of the student: M.M.:70
Time Allowed: 3hr

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 three long answer questions of five marks each. **Section E** contains two case study based questions of four marks each.
(5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
(6) Use of calculators is not allowed.

SECTION A

1 The respective number of significant figures for numbers 23.023, 0.0003 and 2.1×10^3 are 1
(a) 4, 4, 2 (b) 5, 1, 5 (c) 5, 1, 2 (d) 5, 5, 2

2 The density of a material in CGS system is 10 g cm^{-3}. If unit of length becomes 10 cm and unit of mass becomes 100 g, the new value of density will be 1
(a) 10 units (b) 100 units (c) 1000 units (d) 1 unit

3 The numerical ratio of displacement to the distance covered by an object is always equal to or less than _____.(choose correct option to fill in the blank) 1
(a) 1 (b) zero (c) Both (a) and (b) (d) infinity

4 The x-t equation is given as $x = 2t + 1$. The corresponding v-t graph is 1
(a) a straight line passing through origin
(b) a straight line not passing through origin
(c) a parabola
(d) a hyperbola

5 At the top of the trajectory of a projectile, the directions of its velocity and acceleration are 1
(a) parallel to each other
(b) antiparallel to each other
(c) inclined to each other at an angle of 45°
(d) perpendicular to each other

6 A vector is inclined at an angle 60° to the horizontal. If its rectangular component in the horizontal direction is 50 N, then its magnitude in the vertical direction is 1
(a) 25 N (b) 75 N (c) 87 N (d) 100 N

7 'Net force acting on an object is found to be zero.' It can be inferred that the object
(a) May be at rest (b) May be in uniform motion
(c) May be in uniformly accelerated motion (d) Both (a) & (b) 1

8 A body is sliding down a rough inclined plane which makes an angle of 30° with the horizontal. If the co-efficient of friction is 0.26, the acceleration in m/s^2 is (take $g = 10\ m/s^2$ and $\sqrt{3} = 1.7$)
(a) 1.95 (b) 2.79 (c) 3.47 (d) 4.6 1

9 A body of mass 5 kg is thrown vertically up with a kinetic energy of 490 J. The height at which the kinetic energy of the body becomes half of the original value is
(a) 12.5 m (b) 10 m (c) 2.5 m (d) 5 m 1

10 During inelastic collision between two bodies, which of the following quantities always remain conserved?
(a) Total kinetic energy (b) Total mechanical energy
(c) Total linear momentum (d) Speed of each body 1

11 Escape velocity of a body on the surface of earth is independent of
(a) mass (b) radius of earth
(c) direction of projection of body (d) Both (a) and (c) 1

12 In case of planetary motion, choose the correct statement
(a) velocity remain constant in its orbit.
(b) angular velocity remain constant.
(c) total angular momentum remain constant
(d) radius of orbit remain constant.

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) Both Assertion and Reason are true and Reason is correct explanation of Assertion.
b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c) Assertion is true but Reason is false.
d) Both Assertion and Reason are false.

13 Assertion: The light year and wavelength consist of dimensions of length.
Reason: Both light year and wavelength represent time. 1

14 Assertion: Work done by or against gravitational force in moving a body from one point to another is independent of the actual path followed between the two points.
Reason: This is because gravitational forces are conservative in nature. 1

15 Assertion: Quick collision between two bodies is more violent than a slow collision; even when the initial and final velocities are identical.
Reason: The momentum is greater in first case. 1

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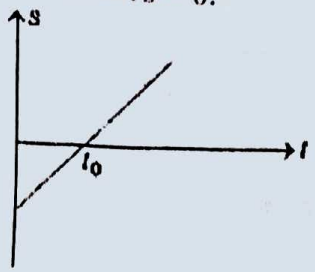
Assertion: In the s-t diagram as shown in figure, the body starts moving in positive direction but not from $s = 0$. 1



Reason: At $t = t_0$, velocity of body changes its direction of motion.

SECTION B

17 If the unit of force is 1kN, unit of length is 1km and the unit of time is 100s, what will be the unit of mass? 2

18 Water drops fall freely from a tap at a height of 4.9 m. If time interval between successive drops is equal and the 4th drop is released when the first lands on the ground, find the separation between the second and third drops. 2

19 Find a unit vector parallel to the vector $\vec{A} = 3\hat{\imath} + 7\hat{\jmath} + 4\hat{k}$. 2

20 Derive an expression for acceleration of a body of mass 'm' moving down a rough inclined plane? (Sliding only) 2

OR

A block of mass 2 kg rests on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of static friction between the block and the plane is 0.7. Find the frictional force on the block.

21 Distinguish between elastic and inelastic collision. 2

SECTION C

22 Check the following equation for dimensional consistency : 3

$$H = \frac{2S\cos\theta}{r.\rho g}$$

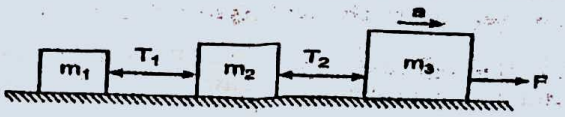
Where H = height, S = surface tension, ρ = density, r = radius and g = acceleration due to gravity.

23 (a) Derive Second equation of motion $\mathbf{s = ut + \frac{1}{2} a t^2}$, using velocity-time graph for uniformly accelerated motion(symbols have usual meanings). 2+1

(b) Distance as a function of time given as $s = 4t^2 + 3t + 5$. Calculate velocity after 2 sec.

24 Define uniform circular motion. Derive expression for centripetal acceleration. 3

25 Three blocks are connected as shown below and are on a horizontal frictionless table. They are pulled to right with a force F = 50 N. If $m_1 = 5$ kg, $m_2 = 10$ kg and $m_3 = 15$ kg. Calculate tensions T_1 and T_2. 3



26 State and explain Kepler's law of planetary motion. Draw diagrams to illustrate these laws. 3

OR

If earth has a mass 9 times and radius 4 times than that of a planet "P". Calculate the escape velocity of the planet "P" if its value on earth is 11.2 km s^{-1}.

27 Define Gravitational potential energy Hence deduce an expression for gravitational potential energy of a body placed at a point near the surface of earth? 3

28 A man of mass 70 kg stands on a weighing scale in a lift which is moving
(a) upwards with a uniform speed of 10 ms^{-1}.
(b) downwards with a uniform acceleration of 5ms^{-2}.
(c) upwards with a uniform acceleration of 5ms^{-2}.
Find the values of weight shown by weighing scale in above three cases.

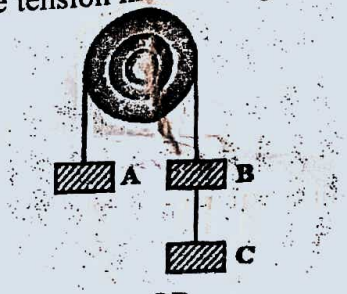
SECTION D

29 (a) Derive an expression for the magnitude and direction of the resultant vector using parallelogram law. 3+2
(b)Find the magnitude of the two forces such that if they act at the right angle their resultant is $\sqrt{10}$ N. But if the same forces act at 60^0, their resultant is $\sqrt{13}$ N.

OR

A body is projected with some initial velocity making an angle θ with the horizontal. Show that its path is a parabola. Find the maximum height attained, time for maximum height, horizontal range, maximum horizontal range, and the time of flight. 5

30 (a) In a simple Atwood machine, two unequal masses m_1 and m_2 are connected by a string going over a smooth pulley. Find the expression of tension in the string and acceleration of the system if the system is released from rest. 2+3
(b) Three equal blocks of mass 2 kg each are hanging on a string passing over a fixed pulley as shown in the figure. What is the tension in the string connecting the weights B and C?



OR

(a) Body tied to one end of a string is made to revolve in a vertical circle. Derive an expression for the velocity of the body and tension in the string at any point. 3+2
(b) In the above mentioned case, find
(i) Tension at the bottom and the top of circle.
(ii) Minimum velocity at the lowest point so that it is just able to complete the loop.

31 (a) What are conservative and non-conservative forces? Give example of each. 2+2+1
(b) Prove gravitational force is conservative in nature.
(c) A particle of mass 100g is thrown vertically upward with speed 5m/s. What is the work done by the force of gravity during the time the particle goes up?

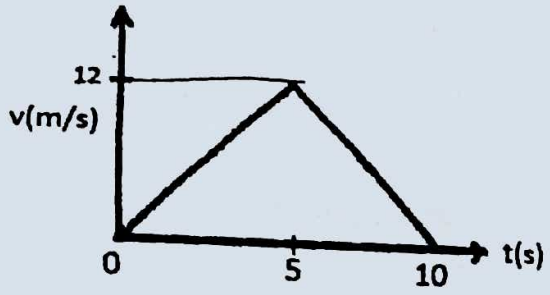
OR

(a) Show that at any instant of time during the motion total mechanical energy of a freely falling body remains constant. Show graphically the variation of K.E. and P.E. during the motion. 3+2
(b) The bob of a pendulum is released from a horizontal position. If the length of the pendulum is 1.5 m, what is the speed with which the bob arrives at the lowermost point, given that it dissipated 5% of its initial energy against air resistance?

SECTION E

32 Read the following paragraph and answer the questions that follow.

The time rate of change of position of the object in any direction is called speed of the object If an object covers equal distances in equal intervals of time, then its speed is called uniform speed and if it covers unequal distances in equal intervals of time, then its speed is called nonuniform or variable speed. The speed may be positive or zero but never negative. The speed-time graph of a particle moving along a fixed direction is shown in following figure.



Based on above paragraph answer following questions:

(a) Distance travelled by the particle between 0 to 10s

(b) Find the acceleration of the particle between 0 to 5s and 5 to 10s.

(c) For the above velocity time graph draw corresponding distance time graph. 1+1+2

OR

(c) Draw velocity-time graph and acceleration-time graph for freely falling body.

33 Read the following paragraph and answer the questions that follow.

Acceleration due to gravity

The acceleration for any object moving under the sole influence of gravity is known as acceleration due to gravity. So, for an object of mass m, the acceleration experienced by it is usually denoted by the symbol g which is related to F by Newton's second law by relation $F = mg$. Thus,

$$g = \frac{F}{m} = \frac{GM_e}{R_e^2}$$

Acceleration g is readily measurable as Re is a known quantity. The measurement of G by Cavendish's experiment (or otherwise), combined with knowledge of g and R_e enables one to estimate M_e from the above equation. This is the reason why there is a popular statement regarding Cavendish "Cavendish weighed the earth". The value of g decrease as we go upwards from the earth's surface or downwards, but it is maximum at its surface. 1+1+2

Based on above paragraph answer following questions:

(a) Draw the graph showing variation of g with distance from centre of Earth.

(b) What is weightlessness?

(c) If the mass of the earth is doubled and its radius halved, what will be new acceleration due to the gravity?