Half Yearly Examination 2024 – 2025
Time - 3:00 Hrs.   **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. 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.
7. You may use the following values of physical constants where ever necessary
   1. $c = 3 \times 10^8$ m/s
   2. $m_e = 9.1 \times 10^{-31}$ kg
   3. $e = 1.6 \times 10^{-19}$ C
   4. $M_o = 4 \times 10^{-7}$ TmA^{-1}
   5. $h = 6.63 \times 10^{-34}$ Js
   6. $E_o = 8.854 \times 10^{-12}$ C^{2}N^{-1}m^{-2}
   7. Avogadro's number = 6.023×10^{23} per gram mole

Section – A

Q.1   Motion along a straight line is called ----------------.
(a) parabolic motion   (b) circular motion
(c) oscillatory motion   (d) rectilinear motion

Q.2   Which of the following sets cannot enter into the list of fundamental quantities in any system of units?
(a) Length, time and velocity   (b) Length, mass and velocity
(c) Mass, time and velocity   (d) Length, time and mass

Q.3   The mass and volume of a body are 4.237 g and 2.5cm^3 respectively. The density of the material of the body in correct significant figures is
(a) 1.6048g /cm^3 (b) 1.69 g /cm^3 (c) 1.7 g /cm^3 (d) 1.695 g /cm^3

Q.4   A stone is dropped from a certain height and at the same time another stone is thrown horizontally from the same height which one will reach the ground earlier.
(a) first stone   (b) second stone   (c) simultaneously   (d) not sure

Q.5   Which one of the following statements is true?
(a) A scalar quantity is the one that is conserved in a process.
(b) A scalar quantity is the one that can never take negative values.
(c) A scalar quantity is the one that does not vary from one point to another in space.
(d) A scalar quantity has the same value for observers with different orientations of the axes.

Q.6   Consider the quantities, pressure, power, energy, impulse, gravitational potential, electrical charge. Temperature, area. Out of these, the only vector quantities are
(a)Impulse, pressure and area   (b)Impulse and area
(c) Area and gravitational potential.   (d)Impulse and pressure

Q.7 A body of mass collides against a wall with the velocity v and rebounds with the same speed. Its change of momentum is:

(a) 2mv   (b) mv   (c)-mv   (d) zero

Q.8 The proper use of lubricants cannot reduce:

(a) static friction   (b) inertia   (c) sliding friction   (d) rolling friction

Q.9 A ball of mass m moving with a velocity v collides with an identical ball at rest. After collision, the first ball comes to rest. The speed of the other ball is

(a) v / 2   (b) 2v   (c) v   (d) zero

Q.10 In which case does the potential energy decrease?

(a) On compressing the spring   (b) On stretching a spring.

(c) On moving a body against gravitational pull.

(d) On the rising of an air bubble in water.

Q.11 Which of the following is a dimensional constant?

(a) Refractive index   (b) Dielectric constant   (c) Relative density (d) Gravitational constant.

Q.12 The displacement of a particle is given by $x = (t - 2)^2$ where x is in metres and t in seconds. The distance covered by the particle in first 4 seconds is

(a) 4 m   (b) 8 m   (c) 12 m   (d) 16 m

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.

Q.13 **Assertion** : Uniform circular motion is accelerated motion.

       Reason : In uniform circular motion velocity of the motion is not constant.

Q.14 **Assertion** : The slope of momentum versus time represents the force.

       Reason : According to Newton's second law of motion acceleration is given by the rate of change of momentum.

Q.15 **Assertion** : A kinetic energy of a body is quadrupled when its velocity is doubled.

       Reason : Kinetic energy is inversely proportional to square of velocity.

Q.16 **Assertion** : Maximum horizontal range of the projectile motion obtained at 45° of angle of projection.

       Reason : The projectile motion influenced by the acceleration due to gravity.

Section – B

Q.17 Check and accept the following formulae for kinetic energy on the basis of dimensional arguments: (1) 3/16 mv^2 (2) 1/2 mv^2 + ma

Q.18 A car moving on a straight highway with speed of 126km/hr. is brought to stop within a distance of 200m. What is the retardation of the car (assumed uniform) and how long does it take for the car to stop?

Q.19 A thief jumps from the roof of a house with a box of weight on his head. What will be the weight of the box as experienced by the thief during jump? Explain.

Q.20 "Friction is a necessary evil " comment on this statement?

Q.21 Define kinetic energy and find it's relation?

OR

State work energy theorem for variable force?

Section – C

Q.22 Derive the following equations of motion for uniformly accelerated motion by using calculus method:

(i) $v = u + at$ (ii) $s = ut + \frac{1}{2}at^2$ (iii) $v^2 - u^2 = 2as$

Q.23 Two vectors A and B are inclined to each other at an angle θ. Using triangle law of vector addition, find the magnitude and direction of their resultant.

Q.24 On an open ground, a motorist follows a track that turns to his left by an angle of 60^0 after every 500 m. Starting from a given turn, specify the displacement of the motorist at the third, sixth and eighth turn. Compare the magnitude of the displacement with the total path length covered by the motorist in each case.

Q.25 Why is it easier to pull a lawn mower (lawn roller) than to push plain.

Q.26 Derive an expression for the potential energy of an elastic stretched spring? Plot a graph between kinetic energy, potential energy and total energy with displacement.

Q.27 The frequency ' f ' of vibration of a stretched string depends upon :

(i) Its length L, (ii) its mass per unit length 'm' and (iii) the tension T in the string. Obtain dimensionally an expression for frequency f.

OR

Consider a simple pendulum, having a bob attached to a string, that oscillates under the action of the force of gravity. Suppose that the period of oscillation of the simple pendulum depends on (i) mass m of the bob   (ii) length L of the pendulum and

(iii) acceleration due to gravity g at the place. Derive the expression for its time period using method of dimensions.

Q.28 Ten one-rupee coins are put on top of each other an a table. Each coin has a mass m kg. Give the magnitude and direction of

(i)   The force on the 7th coin (counted from the bottom) due to all the coins on its top.

(ii)   The force on the 7th coin by the eighth coin.

(iii)   The reaction of the 6th coin on the 7th coin.

Section – D Case study

Q.29 **Read the following paragraph and answer the questions that follow:**

Every measurement involves errors. The result of a measurement should be reported in a way that indicates the precision of measurement. The reported result is a number that includes all the digits in the number which are known reliably plus the first digit that is uncertain. The reliable digits plus the first uncertain Digit are known as significant figures. Significant figures indicate the precision of measurement which, in turn, depends on the least count of the measuring instrument. A choice of change of different units does not change the number of significant figures in a measurement. Only proper significant figures should be retained in reporting measured and computed quantities. Rules for determining the number of significant pes, carrying out arithmetic operations with them, and 'rounding off the uncertain digits must be followed.

(i)   The significant figures of the number 6.0023 are

(a) 1   (b) 5   (c) 4   (d) 2

(ii)   If L = 2.331cm, B = 21cm, then L + B = ?

(a)4.431 cm   (b) 4.43 cm   (c) 4.4 cm   (d) 4 cm

(iii)   The respective number of significant figures for the numbers 23.023, 0.0003 and 21x 10^{-3} are

(a) 4,4,2   (b) 5, 1, 2   (c) 5,1,5   (d) 5, 5, 2

(iv)   The mass of a box measured by a grocer's balance is 2.3 kg. Two gold pieces of masses 20.15 g and 20.17 g are added to the box. What is the total mass of the box and the difference in the masses of the pieces to correct significant figures?

(a)2.34 kg, 0 g   (b) 2.3 kg, 0.02 g   (c) 2.34 kg, 0.02 g   (d) 2.3 kg, 0 g

OR

The mean length of an object is 5cm. which of the following measurement is most accurate.

(a) 4.9 cm   (b) 4.805 cm   (c) 5.25 cm   (d) 5.4 cm

Q.30 **Read the following paragraph and answer the questions that follow:**

If an object moving along the straight line covers equal distances in equal intervals of time, it is said to be in uniform motion along a straight line. Distance and displacement are two quantities that seem to mean the same but are different with different meanings and definitions. Distance is the measure of actual path length travelled by object. It is scalar quantity having SI unit of metre while displacement refers to the shortest distance between initial and final position of object. It is vector quantity. The magnitude of the displacement for a course of motion may be zero but the corresponding path length is not zero. using this data answer following questions.

(i)   **Can path length be zero for motion of body from one point to other point?**
(a) Yes   (b) No
(ii)   **For any given motion from point A to B, displacement =10m and distance = 5m. Is it possible?**
(a) Yes   (b) No
(iii)   **For rectilinear motion displacement can be**
 (a) Positive only   (b) Negative only   (c) Can be zero   (d) All of the above
(iv)   **The ratio of distance to displacement is always.**
    (a) Greater than one   (b) Less than one
    (c) Greater than and equal to one   (d) Less than and equal to one
                                OR
Consider body moving with an acceleration of 2 m/sec². After t sec. its velocity is 10m/sec, time t will be
    (a) 4 Sec.   (b) 20 Sec.   (c) 5 Sec.   (d) 8 Sec.

Section – E
Q.31 A projectile is fired with a velocity u making an angle θ with the   horizontal. Show that its trajectory is a parabola. Derive expressions for -
(i) time of maximum height   (ii) time of flight   (iii) maximum height   (iv) horizontal range.
                            OR
 (a)   Define centripetal acceleration. Derive an expression for the centripetal acceleration of a particle moving with uniform speed v along a circular path of radius r. Discuss the direction of this acceleration.
(b)   A cricketer can throw a ball to a maximum horizontal distance of 100 m. How high above the ground can the cricketer throw the same ball?

Q.32 Define elastic collision and discuss it for two bodies in one dimension. Calculate the velocities of bodies after collision.

<center>OR</center>

(a) Prove that in an elastic one-dimensional collision between two bodies, the relative velocity of approach before collision is equal to the relative velocity of

(b) The bob of a pendulum is released from a horizontal position A as shown. If the length of the pendulum is 1.5 m, what is the speed with which the bob arrives at the lowermost point B, given that it dissipates 5% of its initial energy against air resistance ?

Q.33 What is meant by banking of roads? What is the need for banking a road? Obtain an expression for the maximum speed with which a vehicle can safely negotiate a curved road banked at an angle θ. The coefficient of friction between the wheels and the road is μ.

<center>OR</center>

Three bodies A, B and C each of mass m are hanging on a string over a fixed pulley, as shown in Fig. What are the tensions in the strings connecting bodies B to C.

<center>*****</center>