SURAJ BHAN DAV PUBLIC SCHOOL

PHYSICS CLASS XI FIRST TERM EXAMINATION

M.M. 70 **Time: 03 Hours**

General Instructions:

1. There are 36 questions in all. All questions are compulsory.
2. The question paper has five sections. Section-A, B, C, D & E
3. Section-A contains 15 MCQs and 5 A & R questions of 1 mark each.
4. Section-B contains 6 questions of 2 marks each with an internal choice.
5. Section-C contains 5 questions of 3 marks each with an internal choice.
6. Section-D contains 2 Case- Study Based questions of 4 marks each.
7. Section-E contains 3 questions of 5 marks each with an internal choice in each question.

Section-A (1 Mark Each)

Q.1. Which of the physical quantity has the dimension of $[ML^2T^{-2}\ mol^{-1}K^{-1}]$?

a) Work b) Power c) Pressure d) Universal gravitational constant.

Q.2. If two balls are projected at an angle of 60° and 45° and the total heights reached are same, then their initial velocities are in the ratio of

a) $\sqrt{3} : \sqrt{2}$ b) $\sqrt{2} : \sqrt{3}$ c) 3 : 2 d) 2 : 3

Q.3. A particle moves along the X – axis from $x = 0$ to $x = 5$ m under the influence of a force given by $F = 7 - 2x + 3x^2$. Find the work done in the process

a) 135 J b) 145 c) 155 J d) 165 J

Q.4. What does the slope of distance-time graph for uniformly accelerated motion represent?

a) Acceleration b) Force c) Distance d) Speed

Q.5. A body executing uniform circular motion has at any instant its velocity vector and acceleration vector

a) along the same direction b) in opposite direction

c) normal to each other d) not related to each other

Q.6. In a system of units, the units of mass, length and time are 1 quintal, 1 km and 1 h respectively. In this System 1 N force will be equal to

a) 1 new unit b) 129.6 new units c) 125.7 new units d) 1000 new units

Q.7. If $t = \sqrt{x} + 4$, then the value of dx/dt at t = 4 s is:

a) 4 b) zero c) 8 d) 16

Q.8. A bird flies from (-3, 4, -3) m to (7, -2, -3) m in the xyz co-ordinates. The bird's displacement in the Unit vectors is given by:

a) $(4\hat{i} + 2\hat{j} - 6\hat{k})$ b) $(10\hat{i} - 6\hat{j})$ c) $(4\hat{i} - 2\hat{j})$ d) $(10\hat{i} + 6\hat{j} - 6\hat{k})$

Q.9. The effective acceleration of a body, when thrown upward with acceleration a is:

a) (a - g) b) $\sqrt{a^2 + g^2}$ c) (a + g) d) $\sqrt{a^2 - g^2}$

Q.10. One body of mass 8 kg and another of mass 2 kg are moving with equal kinetic energy. The ratio of Their respective momenta will be:

a) 1 : 1 b) 2 : 1 c) 1 : 4 d) 4 : 1

Q.11. A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and the spring balance reads 49 N, when the lift is stationary. If the lift moves downwards with an acceleration of 5 m/s^2, the reading of the spring balance will be

a) 24 N b) 74 N c) 15 N d) 49 N

Q.12. Moment of inertia of a circular wire of mass M and radius R about its diameter is:

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

Q.13. The mass of moon is 1 % of mass of earth. The ratio of gravitational pull of earth on moon and that of moon on earth will be:

a) 1 : 1 b) 1 : 10 c) 1 : 100 d) 2 : 1

Q.14. If g be the acceleration due to gravity at the earth's surface, then what will be the increase in potential energy (or work done) if object of mass m is raised by its radius R?

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

Q.15. A particle of mass m is circulating on a circle of radius r having angular momentum L, then the Centripetal force will be:

a) L^2 / mr b) $L^2 m / r$ c) L^2 / mr^3 d) L^2 / mr^2

ASSERTION-REASONING BASED QUESTIONS

For Q.16. to Q.20., 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.

a) Both A and R 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 but R is true.

Q16. **Assertion (A):** If there is no external torque on a body about its centre of mass, then the velocity of the centre of mass remains constant.

Reason (R): The linear momentum of an isolated system remains constant.

Q.17. **Assertion (A):** The square of the period of revolution of a planet is proportional to the cube of its semi-major axis.

Reason (R): Sun's gravitational field is inversely proportional to the square of its distance from the planet.

Q.18. **Assertion (A):** Mass and energy are not conserved separately, but are conserved as a single entity Called mass-energy.

Reason (R): Mass and energy are inter-convertible in accordance with Einstein's relation, $E = mc^2$

Q.19. **Assertion (A):** It is difficult to move a cycle along the road with its brakes on.

Reason (R): Sliding friction is greater than rolling friction.

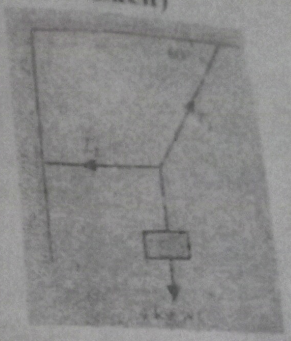
Q.20. **Assertion (A):** A body can have acceleration even if its velocity is zero at that instant of time.

Reason (R): The body will be momentarily at rest when it reverses its direction of motion.

Section-B

(2 Marks Each)

Q.21. Determine the tensions T_1 and T_2 in the given arrangement. (2)



Q.22. Under what condition does the equality: $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$ holds good? (2)

OR

Calculate the area of parallelogram whose two adjacent sides are formed by the vectors

$\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = -3\hat{i} + 7\hat{j}$

Q.23. Calculate the velocity of the bob of a simple pendulum at its mean position if it can rise to a vertical height of 10 cm. Take $g = 10\ m/s^2$. (2)

Q.24. If the kinetic energy of a body increases by 300 %, by what % will the linear momentum of the body increase? (2)

Q.25. The angular speed of a motor wheel is increased from 1200 rpm to 3120 rpm in 16 seconds. (2)
(i) What is its angular acceleration, assuming the acceleration to be uniform?
(ii) How many revolutions do the wheel make during this time?

Q.26. A motorboat is racing towards north at 25 km/h and the water current in that region is 10 km/h in the direction of 60° east of south. Find the resultant velocity of the boat. (2)

Section-C

(3 Marks Each)

Q.27. State and prove the work-energy theorem for a variable force. (3)

Q.28. Derive by the method of dimensions, an expression for the volume of a liquid flowing out per second through a narrow pipe. Assume that the rate of flow of liquid depends on the coefficient of viscosity η of the liquid, the radius r of the pipe and the pressure gradient (P/l) along the pipe. Take $k = \pi/8$ (3)

OR

The frequency (f) of vibration of a stretched string depends upon its length(l), its mass per unit length(m) and the tension T in the string. Obtain dimensionally an expression for frequency (f).

Q.29. Draw the position-time graphs for the following: (3)
(i) For an object in uniform motion.
(ii) For uniformly accelerated motion.
(iii) For uniformly decelerated motion.

Q.30. Define escape velocity. Obtain an expression for the escape velocity of a body from the surface of the earth (3)

Q.31. (i) Write the dimensional formula of planck's constant. (1)
(ii) Find the dimensions of a/b in the equation (2)
$(P + a/V^2)(V - b) = RT$, where P is pressure and V is volume

Section-D

(4 Marks Each)

Case-Study Based Questions

Q.22 A body released near the surface of the earth is accelerated downward under the influence of force of gravity. In the absence of air resistance, all bodies fall with the same acceleration ($g = 9.8\ m/s^2$) near the surface of the earth. This motion of a body falling towards the earth is called free fall. It is an example of constant acceleration. For a body falling freely under the action of gravity, g is taken positive and for a body thrown vertically upward, g is taken negative.

(i) When a ball is thrown vertically upwards, at the maximum height

a) the velocity is zero and therefore there is no acceleration acting on the particle.

b) the acceleration is present and therefore velocity is not zero.

c) the acceleration depends on the velocity as $a = dv/dt$

d) the acceleration is independent of velocity.

(ii) The velocity of a body on reaching the point, from which it was projected upwards, is

a) $v = 0$ b) $v = 2u$ c) $v = 0.5u$ d) $v = u$

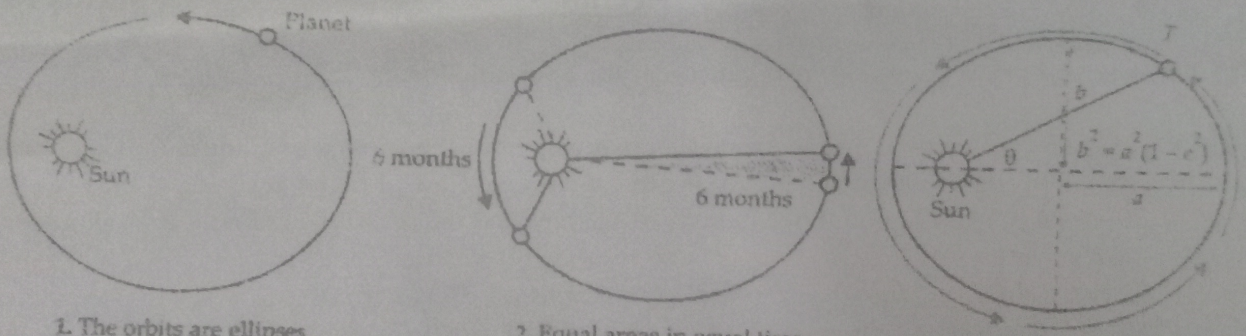
(iii) Three different masses M_1, M_2 & M_3 are allowed to fall from the same point along three different frictionless paths. The speeds of the three objects, on reaching the ground, will be in the ratio of

a) $M_1 : M_2 : M_3$ b) $M_1 : 2M_2 : 3M_3$ c) $1/M_1 : 1/M_2 : 1/M_3$ d) 1 : 1 : 1

(iv) A body falling from rest describes distances S_1, S_2 & S_3 in the first, second and third seconds of its fall, then the ratio $S_1 : S_2 : S_3$ is

a) 1: 1 : 1 b) 1 : 3 : 5 c) 1 : 2 : 3 d) 1 : 4 : 9

Q.23 **Kepler's Laws of Planetary Motion**



Three laws are stated as follows:

1. Law of Orbits: All planets move in elliptical orbits with the sun at one of the foci.
2. Law of Areas: The radius vector drawn from the sun to the planet sweeps out equal areas in equal intervals of time.
3. Law of Periods. The square of time period of revolution (T) of a planet is proportional to the cube of the semi-major (a) axis of the ellipse traced out by the planet.

$$T^2 = K\,a^3$$

(i) A satellite is orbiting around the earth with orbital radius R and time period T. The quantity which remains constant is

a) T/R b) T^2/R c) T^2/R^2 d) T^2/R^3

(ii) Satellite is revolving around the earth. If its height is increased four times the initial height, what will become its time-period?

a) 8 days b) 4 days c) 2 days d) 16 days

(iii) The period of a planet around the sun is 27 times that of the earth. The ratio of planet's orbit to the radius of earth's orbit is

a) 4 b) 9 c) 64 d) 27

(iv) The maximum and minimum distances of a comet from the sun are 8×10^{12} m and 1.6×10^{12} m. If its velocity when nearest to the sun is 60 m/s, what will be its velocity in m/s when it is farthest?

a) 12 b) 6 c) 112 d) 60

Section-E (5 Marks Each)

Q.34. What do you mean by banking of a curved road? Determine the angle of banking so as to minimise the wear and tear of the tyres of a car negotiating a banked curve. (5)

OR

a) Define angle of friction. Deduce its relation with coefficient of friction. (2)

b) Derive an expression for the acceleration of a body sliding down a rough inclined plane. (3)

Q.35. a) What is zero vector? Give two important properties and two examples of zero vector. (3)

b) Define scalar and vector product of two vectors. (2)

OR

A projectile is fired with a velocity u making an angle θ with the horizontal. Derive expressions for

i) Time of flight (1 ½)

ii) Maximum height (1 ½)

iii) Horizontal Range and condition of Maximum horizontal range (2)

Q.36. a) Define centre of mass of a system of particles. Derive an expression for the position vector of centre of mass of a system of two particles. (3)

b) Three masses 3, 4 & 5 kg are located at the corners of an equilateral triangle of side 1 m. Locate the centre of mass of the system.

OR

a) A body is rotating with uniform angular velocity ω about an axis. Establish the formula for its kinetic energy of rotation. (3)

b) A solid cylinder of mass 20 kg rotates about its axis with angular speed 100 rad/s. The radius of the cylinder is 0.25 m. What is the rotational kinetic energy of the cylinder? What is the magnitude of angular momentum of the cylinder about its axis? (2)

$\frac{8 \times 10^{12}}{1.6 \times 10^{12}}$

-3 4 -3

7 -2 -3

1 2