19/09

St. Paul's School
First Terminal Examination 2016-2017
Class XI
PHYSICS

Time : 3 hours **M M -70**

Instructions

- *All questions are compulsory.*
- *There are questions in all. Questions 1 to 5 are very short answer type questions and carry one mark each.*
- *Questions 6 to 10 carry two marks each and questions 11 to 22 carry three marks each and Questions 24 to 26 carry five marks each.*
- *Question 23 is a value based question.*
- *Use of calculators is not permitted.*
- *Log tables may be used whenever required.*

Radius of earth = 6400 km

$G = 6.67 \times 10^{-11}\ N\ m^2\ kg^{-2}$

Q1 A body of mass m moves along X – axis such that its position coordinate at any instant t is $X = at^4 - bt^3 + ct$, where a, b and c are constants. What is the force acting on the particle at any instant t? (1)

Q2 Two bodies of mass m and 4m have equal kinetic energy. What is the ratio of momentum? (1)

Q3 Find the area of a triangle formed by the points O, A and B such that $\vec{OA} = -3\hat{i} + 2\hat{j} - 4\hat{k}$ and $\vec{OB} = -\hat{i} + 2\hat{j} + \hat{k}$ (1)

Q4 Why do you feel giddy while moving on a merry - go – round? (1)

Q5 Name the physical quantities whose dimensional formula is (1)
(i) $[ML^2T^{-2}]$
(ii) $[ML^2T^{-3}]$

Q6 A bus starts from rest accelerating uniformly with 4 m/s^2. At t= 10s, a stone is dropped out of the window of a bus 2 m high. What are the (2)
(i) magnitude of velocity and
(ii) acceleration of the stone at 10.2 s ? ($g = 10\ m/s^2$)

Q7 A car covers the first half of the distance between two places at 40 km/h and another half at 60 km/h. Find the average speed of the car. (2)

Q8 A rocket explodes in mid-air. How does this affect its total momentum and its total kinetic energy? Explain (2)

Q9 (a) The escape velocity for a satellite is 11.2 km/s. If the satellite is launched at an angle of 60° with the vertical, what will be the escape velocity? (2)
(b) State the necessary conditions for a satellite to be geostationary (any two).

Q10 Give analytical treatment of the triangle law of vector addition to find the magnitude and direction of a resultant vector. (2)

Q11 A ball thrown up is caught by the thrower after 4s. How high did it go and with what (3)

velocity was it thrown? How far was it below the highest point 3s after it was thrown?

Q12 (a) If both the speed and radius of the circular path of a body are doubled, how will the centripetal acceleration change? (3)

(b) A body of mass 0.4 kg is whirled in a horizontal circle of radius 2 m with a constant speed of 10 m/s. Calculate its (i) angular speed, (ii) frequency of revolution, (iii) time period and (iv) centripetal acceleration.

Q13 (a) Derive the equation of motion for uniformly accelerated motion (3)
$v^2 - u^2 = 2as$ using calculus method.

(b) Two balls of different masses (one lighter and one heavier) are thrown vertically upward with the same initial speed. Which one will rise to a greater height?

Q14 What is a projectile? Give two examples. (3)
Derive an expression to show that the trajectory of an angular projectile is a parabola.

Q15 (a) A person is holding a bucket by applying a force of 10 N. He moves a horizontal distance of 5 m. and then climbs up a vertical distance of 10 m. Find the total work done by him. (3)

(b) A force $\vec{F} = \hat{i} + 5\hat{j} + 7\hat{k}$ acts on a particle and displaces it through $\vec{S} = 6\hat{i} + 9\hat{k}$. Calculate the work done if the force is in newton and displacement in metre.

Q16 Give reasons (3)

(i) A passenger sitting in a carriage at rest pushes it from within. Will the carriage move?

(ii) China wares are wrapped in straw paper before packing. Why?

(iii) Why are passengers thrown forward from their seats when a speeding bus stops suddenly.

Q17 State the Kepler's three laws of planetary motion. (3)

Q18 Differentiate between accuracy and precision. (3)
The length and radius of a cylinder are found to be 4.54 cm and 1.75 cm. Calculate the volume of cylinder.

Q19 State the laws of limiting friction. (3)

Q20 Define escape velocity. Derive an expression for the escape velocity of a body from the surface of the earth. (3)

Q21 (a) State the differences between conservative and non-conservative forces. (3)

(b) Show that the total mechanical energy of a freely falling body remains constant throughout its fall.

Q22 Find the dimensions a/b in the equation, $F = a\sqrt{x} + bt^2$ where F is the force, x is the distance and t is the time. (3)

Q23 Anita was travelling by train from Delhi to Chennai with her parents. When the train stopped at Nagpur station, her father went out for buying some fruits. When she looked at the opposite side of the platform, she saw another train with passengers in it stopped parallel to her train. Few seconds later, she felt that her train started moving. She started crying as her father was still outside. Her mother immediately understood the problem and consoled her by saying that the other train was moving and not their train. Soon after that her father came back. (4)

(a) What were the values displayed by Anita's mother?

(b) Why did Anita feel that her train was moving?

(c) A ship is streaming towards east with a speed of 12 m/s. A woman runs across the deck at a speed of 5 m/s in the direction at right angles to the direction of motion of the ship i.e. towards north. What is the velocity of the woman relative to the sea?

Q24 (a) Define Gravitational Potential and Intensity of gravitational field? Write their units. (5)

(b) Find the work done to bring 4 particles each of mass 100 gram from large distances to

the vertices of a square of side 20 cm

OR

(a) Show that the value of 'g' decreases with increase in depth 'd' below the surface of earth.

(b) Find the height from the surface of the earth at which weight of a body of mass 'm' will be reduced by 36% of its weight on the surface.

Q25 (a) Define the phenomena of banking of the road. (5)

(b) Derive the expression to calculate the speed with which a car can turn safely on a banked road on a curved path.

(c) Also determine the maximum speed and angle of banking for the car to turn on the banked road so that wear and tear is minimum?

OR

(a) Prove that Newton's second law of motion is the real law of motion.

(b) Two billiard balls each of mass 0.05 kg moving in opposite directions with a speed of 6 m/s collide and rebound with the same speed. What is the impulse imparted to each ball by the other?

(c) A train runs along an unbanked circular road of radius 30 m and speed of 54 km/h. The mass of the train is 10^6 kg. Which rail will wear out faster, the outer or inner rail? What is the angle of banking required to prevent wearing out of the rails?

Q26 (a) Distinguish between elastic and inelastic collisions. Prove that in elastic one dimensional collision the relative velocity of approach before collision is equal to relative velocity of separation after collision. (5)

(b) A 10 kg ball and a 20 kg ball approach each other with velocities 20 m/s and 10 m/s respectively. What are their velocities if collision is perfectly elastic?

OR

(a) State the Work – Energy Theorem and prove it for a variable force

(b) A bullet of mass 0.012 kg and horizontal speed 70 m/s strikes a block of wood of mass 0.4 kg and instantly comes to rest with respect to the block. The block is suspended from the ceiling by means of thin wires. Calculate the height to which the block rises. Also estimate the amount of heat produced in the block.