INDIAN SCHOOL SOHAR **Total No of Printed Pages :6**
TERM 1 EXAMINATION (2023-24)
PHYSICS (042)

CLASS: XI **MAX.MARKS: 70**
DATE:17/09/2023 **TIME:3 HOURS**

General Instructions:

i. There are 33 questions in all. All questions are compulsory.
ii. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
iii. All the sections are compulsory.
iv. **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.
v. 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.
vi. Use of calculators is not allowed.
vii. You may use the following values of physical constants where ever necessary

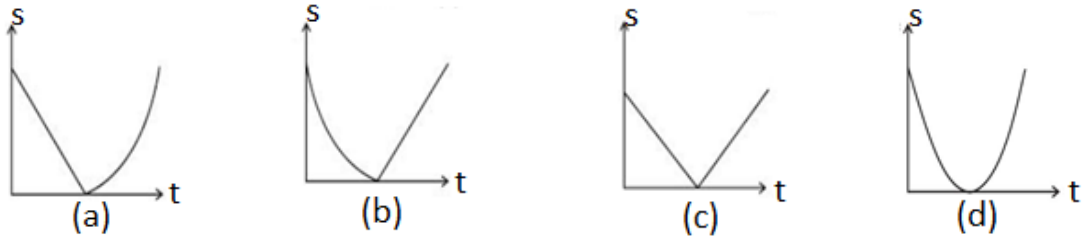
$G = 6.7 \times 10^{-11}\ Nm^2/kg^2$, Mass of earth $= 6 \times 10^{24}$ kg, Radius of earth $= 6.4 \times 10^6$ m
Solar Mass $= 2 \times 10^{30}$Kg, Orbital radius of moon $= 3.84 \times 10^5$km, $c = 3 \times 10^8$ m/s

SECTION – A

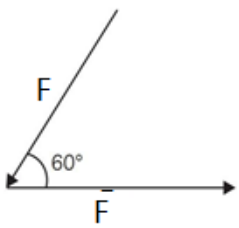
1 Find the density of the material of the body in correct significant figures if the mass and volume of a body are 4.237 g and 2.5 cm^3 respectively. 1
(a) 1.6048 g cm^{-3} (b) 1.69 g cm^{-3} (c) 1.7 g cm^{-3} (d) 1.695 g cm^{-3}

2 If momentum (P), area (A) and time (T) are taken to be fundamental quantities, then energy has the dimensional formula: 1
(a) $[P^1 A^{-1} T^1]$ (b) $[P^2 A^1 T^1]$ (c) $[P^1 A^{-1/2} T^1]$ (d) $[P^1 A^{1/2} T^{-1}]$

3 A ball is thrown vertically upwards. Which of the following plot represents the speed-time graph of the ball during its flight, if the air resistance is not ignored? 1



4 Two forces, each equal to F act on the shown figure. Their resultant is: 1



(a) F/2 (b) F (c) $\sqrt{3}$ F (d) $\sqrt{5}$ F

5 A particle is projected at an angle of 45°, 8 m away from the foot of a wall, just touches the top of the wall and falls on the ground on the opposite side at a distance 4 m from it. The height of wall is: 1
(a) 2/3 m (b) 4/3 m (c) 8/3 m (d) 3/4 m

6 In order to raise a mass of 100 kg, a man of 60 kg fastens the rope to it, and passes the rope over a smooth pulley. He climbs the rope with an acceleration(5g/4) relative to rope. The tension in the rope is: (Take g = 10 m/s^2) 1
(a) 1200 N (b) 1218 N (c) 928 N (d) 1152 N

7 Three blocks of masses m, 3m and 5m are connected by strings. After an upward force F is applied on block m, the masses move in the upward direction at constant speed v. What is the net force on the block of mass 3m? (g – acceleration due to gravity) 1
(a) zero (b) 3 mg (c) 5 mg (d) 8 mg

8 A man holds a bucket by applying 10 N force. Then he moves forward with a distance of 5 m and climbs up a vertical distance of 10 m. The total work done by him is: 1
(a) 100 J (b) 150 J (c) 50 J (d) 200 J

9 A shell, in its flight, explodes into four unequal parts. Which of the following is conserved?
(a) Momentum (b) Kinetic energy (c) Potential energy (d) Both (b) and (c) 1

10 One circular ring and one circular disc both have the same mass and radius. The ratio of their moment of inertia about the axis passing through their centres and perpendicular to their planes will be: 1
(a) 1: 1 (b) 2: 1 (c) 1: 2 (d) 4: 1

11 Gravitational force between two masses of a distance 'd' apart is 6 N. If these masses are taken to the moon and kept at the same separation, then the force between them becomes: 1
(a) 1 N (b) 16 N (c) 36 N (d) 6 N

12 When the radius of the earth is reduced by 1% without changing the mass, then the acceleration due to gravity will: 1
(a) increase by 2% (b) decrease by 1.5% (c) increase by 1% (d) decrease by 1%

For Questions 13 to 16, two statements are given Assertion (A) and 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 (A):** The length of the day would increase if the earth shrink.
Reason (R): It would take longer for smaller items to complete one rotation around their axis 1

14 **Assertion (A):** In an elastic collision between the two bodies, the relative speed of the bodies after collisions is equal to the relative speed before the collision. 1
Reason (R): In a elastic collision the linear momentum of the system is conserved.

15 **Assertion (A):** The magnitude of the resultant of two vectors may be less than the magnitude of either vector. 1
Reason (R): Vector addition is commutative

16 **Assertion (A):** An object may have varying speeds without having varying velocity.
Reason(R): If the velocity is zero at an instant, the acceleration is zero at that instant. 1

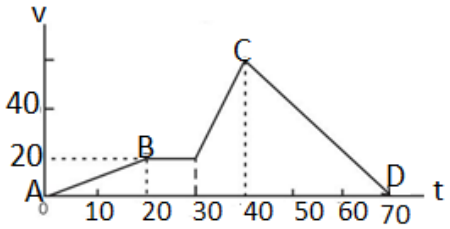
SECTION B

17 If the centripetal force is of the form $m^a v^b r^c$, where 'm' is the mass, 'v' the velocity and 'r' the radius. find the values of a, b and c

OR

If "g" is the acceleration due to gravity and "λ" is wavelength, then which physical quantity does $\sqrt{\lambda g}$ represent 2

18 The velocity versus time curve of a moving point is shown in the figure. Find the retardation of the particle.



2

19 A woman throws an object of mass 500g with a speed of 25 m/s: (a) What is the impulse imparted to the object? (b) If the object hits a wall and rebounds with half the original speed, what is the change in momentum of the objects? 2

20 There is a stick half of which is wooden and half is of steel. (a) It is pivoted at the wooden end and a force is applied at the steel end at a right angle to its length. (b) It is pivoted at the steel end and the same force is applied at the wooden end. In which case is the angular acceleration more and why? 2

21 If there is an attractive force between all objects, why do we not feel ourselves gravitating toward massive buildings in our vicinity? 2

SECTION C

22 Derive the formula for the acceleration due to gravity at a depth 'd' below the surface of the earth. 3

23 A child stands at the centre of a turntable with his two arms outstretched. The turntable is set to rotate with an angular speed of 40 rev/min. How much is the angular speed of the child if he folds his hands back and thereby reduces his moment of inertia to (2/5) times the initial value? Assume that the turntable rotates without friction. 3

24 State if each of the following statements is true or false. Give reasons for your answer.
(a) In an elastic collision of two bodies, the momentum and energy of each body is conserved.
(b) Total energy of a system is always conserved, no matter what internal and external forces on the body are present.
(c) Work done in the motion of a body over a closed loop is zero for every force in nature. 3

25 Derive the formulas for the maximum possible speed and the optimum speed of a car on a banked road. 3

26 Find the angle between the vectors **A** = **i** +2**j** – **k** and **B** = **-i** + **j** -2**k**

OR

A bullet fired at an angle of 30° with the horizontal hits the ground 3.0 km away. By adjusting its angle of projection, can one hope to hit a target 5.0 km away? Assume the muzzle speed to be fixed, and neglect air resistance. 3

27 Rule out or accept the following formulae for kinetic energy on the basis of dimensional arguments

(i) KE = $\frac{3}{16}mv^2$

(ii) KE = $\frac{1}{2}mv^2 + ma$ 3

(iii) KE = $\frac{1}{2}mv^2$

28 Read each statement below carefully and state, with reasons, if it is true or false:

(a) The net acceleration of a particle in circular motion is always along the radius of the circle towards the centre.

(b) The velocity vector of a particle at a point is always along the tangent to the path of the particle at that point. 3

(c) The acceleration vector of a particle in uniform circular motion averaged over one cycle is a null (zero) vector.

SECTION D

29 If we throw a ball vertically upwards from the surface of the earth, it rises to a certain height and falls back. If we throw it at a greater velocity, it rises to a greater height. If we throw it with sufficient velocity, it may never come back. It will escape from the gravitational pull of the earth. This minimum velocity is called escape velocity.

(**i**) Escape speed of a body of mass m depends upon its mass as:

(a) m^0 (b) m (c) m^2 (d) m^3

(**ii**) The escape velocity for an object projected vertically upward from the earth's surface is approx. 11 km/s. If the body is projected at an angle of 45° with the vertical, then the escape velocity will be:

(a) 11/√2 km/s (b) 11 km/s (c) 11√2 km/ s (d) 22 km/s

(**iii**) The value of escape velocity on a certain planet is 2 km/s. Then the value of orbital speed of a satellite orbiting close to its surface is:

(a) 12 km/s (b) 1 km/s (c) √2 km/s (d) 2√2km/s 4

OR

(**iii**)The escape speed of the planet is v. If the radius of the planet contracts to (¼)th of the present value, without any change in mass, the escape speed would become:

(a) halved (b) doubled (c) quadrupled (d) one fourth

(**iv**) The moon has no atmosphere as:

(a) The escape speed on the moon is very large as the thermal speed of the molecules of gases on the moon.

(b) The escape speed on the moon is equal to the thermal speed of the gaseous molecules on the moon.

(c) The escape speed on the moon is very small as compared to the thermal speed of the molecules of gases on moon.

(d) Size of the moon as compared to the earth is very less and hence escape speed of the moon is large

30 When two bodies are in contact, each experiences a contact force by the other. The component of the contact force parallel to the surfaces in contact, which opposes impending or actual relative motion between the two bodies in contact is opposed by static friction. Kinetic friction opposes actual relative motion between two bodies in contact. There is a yet another type of friction which opposes rolling motion of one body over the surface of another body. It is called rolling friction. We often regard friction as something undesirable. However, in many practical situations friction is critically needed.

(**i**) What is the direction of friction?
(a) Friction always acts tangential to the surface in contact.
(b) Friction acts normal to the surface in contact.
(c) Direction depends upon weight of body which moves over surface of another body.
(d) None of these.

(**ii**) Which one of the following statement is not correct about friction?
(a) Friction is a self-adjusting force.
(b) Force of friction is independent of area of contact as long as normal reaction remains same.
(c) Sliding friction is greater than static friction.
(d) Limiting friction is the maximum static friction. 4

(**iii**) An automobile is moving on a horizontal road with a speed v. If the coefficient of friction between the tyres and the road is μ. What is the shortest distance in which the automobile can be stopped?
(a) $v^2/\mu g$ (b) $2v^2/\mu g$ (c) $v^2/4\mu g$ (d) $v^2/2\mu g$

OR

(**iii**) What will be the maximum acceleration of the train in which a box lying on the floor will remain stationary? Given that the coefficient of friction between the box and trains floor is 0.15. ($g = 10\ m/s^2$)
(a) $2\ m/s^2$ (b) $2.5\ m/s^2$ (c) $1\ m/s^2$ (d) $1.5\ m/s^2$

(**iv**) A body of mass m is placed on a rough surface with coefficient of friction which is inclined at an angle of θ. If the mass is in equilibrium, then
(a) $\theta = \tan^{-1}\mu$ (b) $\theta = \tan^{-1}(1/\mu)$ (c) $\theta = \tan^{-1}(m/\mu)$ (d) $\theta = \tan^{-1}(\mu/m)$

SECTION E

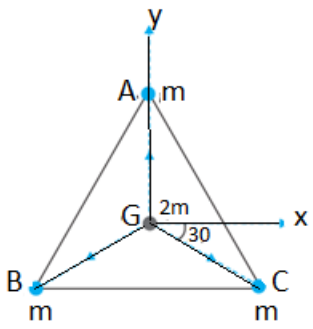
31 A car, starting from rest, accelerates at the rate 'f' through a distance 's', then continues at constant speed for some time 't' and then decelerates at the rate 'f/2' to come to rest. If the total distance is 5s, then prove that $s = (\frac{1}{2})\ ft^2$.

OR

(i) The displacement x (in m) of a body varies with time t (in s) as $x = -\frac{2}{3}t^2 + 16t + 2$. How long does the body take to come to rest? 5

(ii) A particle moves along a straight line such that its displacement 's' at any time 't' is given by $s = (t^3 - 6t^2 + 3t + 4)$ m. Find the velocity when acceleration is zero**.**

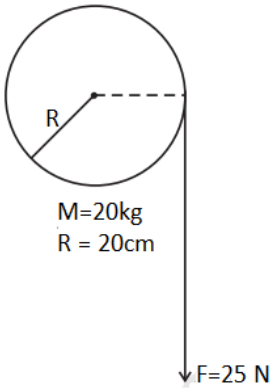
32 Three equal masses of m kg each are fixed at the vertices of an equilateral triangle ABC. (a) What is the force acting on a mass 2m placed at the centroid G of the triangle? (b) What is the force if the mass at the vertex A is doubled ? Take AG = BG = CG = 1 m



OR

5

A cord of negligible mass is wound round the rim of a fly wheel of mass 20 kg and radius 20 cm. A steady pull of 25 N is applied on the cord as shown in Fig. The flywheel is mounted on a horizontal axle with frictionless bearings. (a) Compute the angular acceleration of the wheel. (b) Find the work done by the pull, when 2m of the cord is unwound. (c) Find also the kinetic energy of the wheel at this point. Assume that the wheel starts from rest



33 Discuss elastic collision in one dimension. Obtain expressions for velocities of the two bodies after an elastic collision.

OR

A block of mass 1 kg is pushed up a surface inclined to horizontal at an angle of 30° by a force of 10 N parallel to the inclined surface as shown in figure. The coefficient of friction between block and the incline is 0.1. If the block is pushed up by 10 m along the incline. Calculate

(a) work done against gravity

(b) work done against force of friction

(c) increase in potential energy 5

(d) increase in kinetic energy

(e) work done by applied force.