BK BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
SENIOR SECONDARY CO-ED DAY CUM BOYS' RESIDENTIAL SCHOOL

MID-TERM EXAMINATION 2023-24

PHYSICS (042)

Class : XI
Date : 09/10/2023
Admission No:

Duration: 3 Hrs
Max. Marks: 70
Roll No. :

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.

SECTION-A

1. SI unit of force is;
(a) Newton (b) Pascal (c) m/s (d) None of the above

2. Which among the following is the Supplementary Unit?
(a) Mass (b) Time (c) Solid angle (d) Luminosity

3. Number of significant figures in 0.00205 is;
(a) 3 (b) 4 (c) 2 (d) 5

4. The slope of the tangent drawn on position-time graph at any instant is equal to the instantaneous;
(a) acceleration (b) force (c) velocity (d) momentum

5. A particle moves along a circular path of radius R. The distance and displacement of the particle after one complete revolution is;
(a) 0, 2πR (b) 2πR, 0 (c) 0, πR (d) πR, 0

6. A body is travelling in a circle at a constant speed. It…
(a) has a constant velocity (b) is not accelerated
(c) has an inward radial acceleration (d) has an outward radial acceleration

7. In the projectile motion, if air resistance is ignored, the horizontal motion is at…
(a) constant acceleration (b) constant velocity
(b) variable acceleration (d) constant retardation

8. In an explosion, a body breaks up into two pieces of unequal masses. In this…
(a) both parts will have numerically equal momentum
(b) lighter part will have more momentum
(c) heavier part will have more momentum
(d) both parts will have equal kinetic energy

9. When a body is stationary;
(a) there is no force acting on it (b) the force acting on it is not in contact with it
(c) the combination of forces acting on it balances each other (d) the body is in vacuum

10. If a light body and heavy body have same kinetic energy, then which one has greater linear momentum?
(a) Lighter body (b) Heavier body (c) Both have same momentum (d) Can't be predicted

11. A man pushes a wall and fails to displace it, he does…
(a) negative work (b) positive but not maximum work
(c) no work at all (d) maximum positive work

12. A body in rotational motion possesses rotational kinetic energy given by …..
(a) KE= 1/2 ωI^2 (b) KE= 1/2 $I\omega^2$ (c)KE= 2 ωI^2 (d)KE= $I\omega$

For Questions 13 and 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.

13. Assertion: If dot product and cross product of two vectors A and B are zero. It implies that one of the vector A and B must be null vector.
Reason: Null vector is a vector of magnitude zero.

14. Assertion: If the net external force on a body is zero, then its acceleration will be zero.
Reason: Acceleration does not depend upon the force.

15. Assertion: The change in kinetic energy of a particle is equal to the work done on it by the net force.
Reason: Change in kinetic energy of particle is equal to work done only in case of a system of one particle.

16. Assertion: If no external force acts on a system of particles, then the centre of mass will not move in any direction.
Reason: If net external force is zero, then the linear momentum of the system remains constant.

SECTION-B

17. What are derived units? Write two examples. 2

18. What is centripetal acceleration? Find its magnitude and direction in case of uniform circular motion. 2

Or

The ceiling of a long hall is 25 m high. What is the maximum horizontal distance that a ball thrown with a speed of 40 m s^{-1} can go without hitting the ceiling of the hall?

19. State and explain Newton's third law of motion. 2

20. State and prove work-energy theorem for constant force. 2

21. Find the centre of mass of three particles at the vertices of an equilateral triangle. The masses of the particles are 100g, 150g, and 200g respectively. Each side of the equilateral triangle is 0.5m long. 2

SECTION-C

22. The length, breadth and thickness of a rectangular sheet of metal are 4.234 m, 1.005 m, and 2.01m respectively. Give the area and volume of the sheet to correct significant figures. 3

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 its length (*l*), mass of the bob (*m*) and acceleration due to gravity (*g*). Derive the expression for its time period using method of dimensions.

23. A passenger arriving in a new town wishes to go from the station to a hotel located 10km away on a straight road from the station. A dishonest cab man takes him along a circuitous path 23km long and reaches the hotel in 28min. What is…..? 3

(a) The average speed of the taxi?

(b) The magnitude of average velocity? Are the two equal?

24. Derive three equations of the motion using graphical method. 3

25. Derive the expression of magnitude and direction of resultant vector **R**, addition of two vectors **P** and **Q** using parallelogram method. The angle between **P** and **Q** is **ϴ**. 3

26. State and prove law of conservation of momentum. Give its one example in daily life. 3

27. Define inelastic collision. Prove that there is always a loss in kinetic energy in an inelastic collision. 3

28. A solid cylinder of mass 20kg rotates about its axis with angular speed 100rad/sec. The radius of the cylinder is 0.25m. What is the kinetic energy associated with the rotation of the cylinder? What is the magnitude of angular momentum of the cylinder about its axis? 3

SECTION-D

Case Study Based Questions

29. Two cars start from same point on a straight road due North. While car A starts with an initial velocity of 10 m/s and an acceleration of 1m/s^2, car B starts from rest with an acceleration of 2m/s^2. Answer the following questions by choosing the correct option. 4

(i) As seen by a passenger in car A.

(a) Car B moves forward (b) First, the car B moves backward and then forward

(c) Car B moves backward (d) first, the car B moves forward and then backward forward

(ii) As seen by a passenger in car B.

(a) Car A moves forward (b)First, the car A moves backward and then forward

(c)Car A moves backward (d) First, the car A moves forward and then backward forward

(iii) The separation between the cars

(a) Continuously increases

(b) Continuously decreases

(c)First increases, then decreases and finally increases again

(d)First decreases, then increases and finally decreases again

(iv) The position of car A at the moment (t=5 s) is;

(a) 62.5 m due North of starting point (b)37.5 m due North of starting point

(c)62.5 m due South of starting point (d) 37.5 m due South of starting point

Or

(iv) The position of car B at the moment (t=5 s) is;

(a) 25 m due North of starting point (b)37.5 m due North of starting point
(c)25 m due South of starting point (d)37.5 m due South of starting point

30. Work energy theorem states that – change in kinetic energy of a body is equal to the work done by the net force. In deriving the theorem, it is assumed that force is effective only in changing the KE. When the force and displacement are in same direction, KE increases and work done is positive. When the force and displacement are in opposite direction, KE decreases and work done is negative. When the body is in uniform motion, KE does not change and work done by centripetal force is zero.

Answer the following questions. *4*

(i) A body of mass 10 kg initially at rest, acquires a velocity of 10 m/s. The work done is:

(a) -500J (b) 500J (c) 50J (d) - 50J

(ii) How much work must be done by a force on 50 kg body in order to accelerate from rest to 20 m/s in 10 sec?

(a) 10^3 J (b) 10^4 J (c) $2X10^3$ J (d) $4X10^4$ J

(iii) A gun of mass *M,* fires a bullet of mass *m,* with maximum speed *v*. The KE of gun will be?

(a) ½ mv^2 (b) 1/2 Mv^2 (c) more than ½ mv^2 (d) less than ½ mv^2

(iv) An unloaded car moving with velocity *v,* on a friction less road can be stopped in a distance *s*. If the passengers add 40% to its weight and breaking force remains the same then the stopping distance will be:

(a) 1.4 s (b) 1.5 s (c) 1.6 s (d) 1.8 s

Or

(iv) A block of mass 10 kg is moving in *x* direction with a constant speed of 10 m/s. It is subjected to a retarding force F = - 0.1 x j /m during its travel from x=20m to x=30m. Final KE will be:

(a) 250J (b) 275J (c) 450J (d) 475J

SECTION-E

31. Prove that the path of projectile is parabola. Find expressions of: (i) Time of flight (ii) Maximum height and (iii) Horizontal range, of a projectile, projected with initial velocity u at an angle θ from the horizon. 5

Or

Define uniform circular motion. Find the expression of centripetal acceleration for uniform circular motion.

Rain is falling vertically with a speed of 30 m s^{-1}. A woman rides a bicycle with a speed of 10 m s^{-1} in the north to south direction. What is the direction in which she should hold her umbrella?

32. (a) Why are circular roads banked? Deduce an expression for the angle of banking.

(b)A 1000 kg car rounds a curve on a flat road of radius 50 m at a speed of 50 km/hr. Will the car make the turn or will it skid if the coefficient of friction is 0.60? Justify. 5

Or

(a)Explain the terms: friction and limiting friction.

(b)Give some methods for reducing friction.

(c)Write applications of ball bearing in rotating devices

33. (a) Define moment of inertia of a body. Give its units and dimensions. State the factors on which the moment of inertia of a body depends.
(b) State and explain radius of gyration. 5

Or

(a) Establish a relation between Torque and angular acceleration.
(b) Find the scalar and vector products of two vectors. $\mathbf{a} = 3\mathbf{i} - 4\mathbf{j} + 5\mathbf{k}$ and $\mathbf{b} = -2\mathbf{i} + \mathbf{j} + 3\mathbf{k}$

---------- ALL THE BEST ----------