R.D. RAJPAL SCHOOL
SESSION 2024-25
MIDTERM EXAMINATION

CLASS: XI
TIME ALLOWED: 3 HOURS
NO. OF PAGES:04

SUBJECT: PHYSICS(SET-A)
MAXIMUM MARKS:70

GENERAL INSTRUCTIONS: -

i) All questions are compulsory.
ii) The question paper has five sections and 33 questions. All questions are compulsory.
iii) Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section–C has 7 questions of 3 marks each; Section– D has 2 case-based questions of 4 marks each; and Section– E has 3 questions of 5 marks each.
iv) There is no overall choice.
v) Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION – A

1. If momentum [P], area [A] and time [T] are taken as fundamental quantities, then dimensional formula of coefficient of viscosity is

(a) $[PA^{-1}T^{0}]$ (b) $[PAT^{-1}]$ (c) $[PA^{-1}T]$ (d) $[PA^{-1}T^{-1}]$

2. Which of the following pairs of physical quantities does not have the same dimensional formula?

(a) Work and Torque
(b) Angular momentum and Planck's constant
(c) Tension and surface tension
(d) Impulse and linear momentum

3. The instantaneous velocity of a particle moving in a straight line is given as $v = \alpha t + \beta t^2$, where α and β are constants. The distance travelled by the particle between 1s and 2s is

(a) $3\alpha + 7\beta$ (b) $\frac{3}{2}\alpha + \frac{7}{3}\beta$ (c) $\frac{1}{2}\alpha + \frac{1}{3}\beta$ (d) $\frac{3}{2}\alpha + \frac{7}{2}\beta$

4. Two bodies are projected with the same velocity. If one is projected at an angle of 30^0 and other at 60^0 to the horizontal, then ratio of maximum heights reached is

(a) 3:1 (b) 1:2 (c) 1:3 (d) 2:1

5. The acceleration a (in ms^{-2}) of a body , starting from rest varies with time t (in s) following the equation $a = 3t+4$. The velocity of the body at time 2s will be:

(a)10 ms^{-1} (b)18 ms^{-1} (c)14 ms^{-1} (d)26ms^{-1}

6. A body of mass 2 kg makes an elastic collision with a second body at rest and continues to move in original direction but with one-fourth of its original speed. What is the mass of the second body?

(a) 1.5 kg (b) 1.8 kg (c) 1.0 kg (d) 1.2kg

7. If two forces each of magnitude F. The angle between them so that the resultant force is F is
(a) 0^o (b)90^o (c)180^o (d)120^o

8. During projectile motion the quantities that remain constant are
(a) force and vertical velocity (b)acceleration and horizontal velocity
(c)kinetic energy and acceleration (d) acceleration and momentum

9. A constant retarding force of 50 N is applied to a body of mass 20 kg moving initially with a speed of 15m/s How long does the body take to stop?
(a)2s (b) 3s (c) 4s (d) 6s

10. If the KE becomes 4 times its initial value then the new linear momentum will be
(a) same as initial value (b) four times initial value (c) twice initial value (d) eight times initial value

11. The escape velocity of earth is Ve . If mass of a planet is 3 times mass of earth and radius is 3 times that of earth, then escape velocity from planet will be
(a)3 Ve (b) 6 Ve (c)$\sqrt{3}$ Ve (d) Ve

12. The distance of two planets from sun are 10^{13} and 10^{12} m respectively. The ratio of time periods of planets is: (a) 100 (b) $1/\sqrt{10}$ (c) $\sqrt{10}$ (d)$10\sqrt{10}$

For Questions 13 to 16, two statements are given- one labelled Assertion (A) and other Reason(R). Select the correct answer to these questions from the options given below
(a) If both assertion and reason are true and reason is the 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 assertion is false but reason is true

13. Assertion: A body can have acceleration even if its velocity is zero at a given instant of time Reason: A body is momentarily at rest when it reverses its motion.

14. Assertion: Work done by or against Frictional force in moving a body from one point to other is independent of the path followed between the two points.
Reason : Friction force is a Conservative force.

15. Assertion : Relative density and strain are dimensionless variables
Reason: Dimensionless variables have no dimensions and can take variable values.

16. Assertion: Acceleration due to gravity decreases with height as well as depth
Reason: At the center of earth , g is infinite.

SECTION-B

17. Derive the equation $s = ut + 1/2at^2$ using calculus method.

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

19. Explain the terms (i) static friction and (ii) dynamic friction. Can the value of static friction be greater than dynamic friction.?

20. The value of g at a height h above the earth is same as at a depth d below it. If h and d are small as compared to the radius of earth. what is the ratio (h/d)?

21. Define the term Gravitational potential. Obtain expression for it and write its units.

SECTION -C

22. The critical velocity Vc of a viscous liquid flowing through a capillary tube depends upon the radius of tube (r), density ƒ and coefficient of viscosity η of the liquid. Use method of dimensions to obtain relation between them.

23. Show using Suitable diagrams: Why is it easier to pull a lawn roller than to push it?

24. A body is projected at an angle θ with the horizontal. Derive an expression for maximum height. Show that maximum height $H_m = R_m / 4$ when fired at $\theta = 45°$.

25. Find the Apparent weight of a man weighing 49 kg on earth when he is standing in a lift which is (i) rising with an acceleration of $1.2ms^{-2}$ (ii)Falling freely under gravity (iii) going down with uniform velocity. Given $g=9.8ms^{-2}$.

26. What is Hooke's Law in case of elastic springs. Derive an expression for PE of an elastic stretched spring. Plot a graph between restoring force in a spring and displacement.

27. A running man has half the kinetic energy that a boy of half his mass has. The man speeds up by 1 ms^{-1}. And then has the same energy as the boy. What are the original speeds of man and boy?

28. Derive an expression of variation in g with depth. Calculate the depth below the earth's surface where value of g becomes half of its value at the surface of earth. Radius of earth= 6400 km.

SECTION-D

Case Study Based Questions

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

Potential energy is the energy stored within an object, due to the object's position, arrangement or

state. Potential energy is one of the two main forms of energy along with kinetic energy. Potential energy depends on the force of interaction between the two objects.

1. A body is falling under the action of gravity alone in vacuum. Which of the following quantities remain constant during fall
   (a) KE (b) PE (c) Mechanical Energy (d) None of these
2. Work done by a conservative force
   (a) Depends on path (b) independent of path (c) zero (d) infinite
3. When does the PE of a spring increases
   (a) When it is stretched (b) When it is Compressed (c) both (d) none
4. A vehicle of mass 5000 kg climbs up a hill of 10 m. The PE gained by it is:
   (a) 5J (b) 500 J (c) 5×10^4 J (d) 5×10^5 J

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

When an object follows a circular path at a constant speed, the motion of the object is called uniform circular motion. Speed of the object is uniform throughout its motion. Since the velocity is changing continuously in direction Object is said to undergo acceleration.

1. The force acting towards the center of a circular path is _____.
2. SI unit of angular velocity ω is:
   (a) Rev/sec (b) m/s (c) m/s^2 (d) none of these
3. Linear velocity is related to angular velocity as _____.
4. Calculate the angular speed of a flywheel making 420 revolutions per minute.

SECTION-E

31. (a)What are Geostationary satellites? Obtain expression for total energy of a satellite around surface of earth. What is the significance of Negative sign in the above expression?
(b) Three-point masses each of mass m are placed at the vertices of an equilateral triangle of side l. What is the gravitational field due to three masses at the centroid of the triangle?

32.(a)Define Elastic collision in one dimension. Discuss it for two bodies and calculate their velocities after collision and show that two bodies of same mass just interchange their velocities after an elastic collision in one dimension.

(b)A block of mass 2 kg initially at rest is dropped from a height of 1m onto a vertical spring having force constant 490 N/m. Calculate the maximum distance through which the spring is compressed.

33. (a)Define the two types of accelerations of a body moving in a circular path. Obtain an expression for the centripetal force required to make a body of mass m , moving with a velocity v in a circular path of radius r.

(b)A mass of 200 kg is resting on a rough incline plane of 30^0. If the coefficient of friction is $1/\sqrt{3}$, find the least and greatest forces acting parallel to the plane to keep the mass in equilibrium.