KENDRIYA VIDYALAYA SANGATHAN, LUCKNOW REGION

CUMMULATIVE EXAMINATION - 2023-24

CLASS - XI PHYSICS (THEORY) Set - 3

Max.Marks: 70 **TIME: 3 hours**

Instructions:

i) The Question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
ii) Section A has sixteen questions 12 MCQ and 4 Assertion-Reason questions of 1 mark each.
iii) Section B contains five questions of two marks each.
iv) Section C contains seven questions of three marks each.
v) Section D contains two case study-based questions of 4 marks each.
vi) Section E contains three long answer questions of five marks each.
vii) There is no overall choice. However, an internal choice has been provided in 1 question in section B, 1 question in section C, 1 question in each case Based question in section D and in all 3 questions of section E. You have to attempt only one of the choices in such questions.
viii) Use of calculator is not allowed.

SECTION-A

1. The number of significant figures in 0.0005013 Kg is
a) 8 b) 4
c) 5 d) 3

2. In SI system the fundamental units are
a) metre, kilogram, second, ampere, kelvin, mole and candela
b) metre, kilogram, second, coulomb, kelvin, mole and candela
c) metre, newton, second, ampere, kelvin, mole and candela
d) metre, kilogram, second, Ampere, kelvin mole and lux

3. The following v-t graph represents

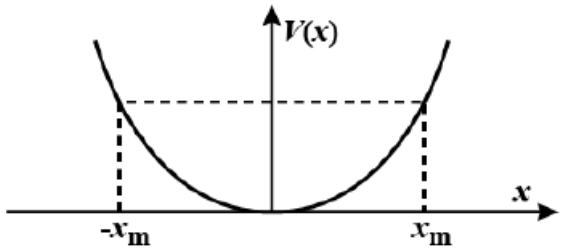
a) Zero acceleration
b) Variable acceleration
c) Constant acceleration
d) None of these

4. For a particle performing uniform circular motion, choose the correct statement(s) from the following:
a) speed remains constant

b) velocity of particle remains directed perpendicular to radius vector.
c) direction of acceleration keeps changing as the particle moves
d) all above.

5. A body of mass 2kg is acted upon by two perpendicular forces 3N and 4N. The acceleration of the body is
a) 1 m/s^2 b) 2 m/s^2
c) 0.1 m/s^2 d) 2.5m/s^2

6. The potential energy function for a particle executing linear SHM is given by ½ kx^2 where k is the force constant of the oscillator (Fig.). For k = 0.5 N/m, the graph of V(x) versus x is shown in the figure. A particle of total energy E turns back when it reaches $x = x_m$. If V and K indicate the P.E. and K.E., respectively of the particle at $x = +x_m$, then which of the following is correct?



a) V=0, K=E
b) V=E, K=0
c) V<E, K=0
d) V=0, K<E

7. What is the power utilized when work of 1000 J is done in 2 s?
a) 100 W b) 200 W
c) 400 W d) 500 W

8. When a wheel is rolling on a level road, the direction of friction force between the wheel and road is in
a) backward direction b) forward direction
c) depends on speed d) cannot say.

9. A body in pure rotational motion possesses rotational kinetic energy given by
a) K E = $\frac{1}{2} I \omega^{-1}$
b) K E = $\frac{1}{2} I \omega$
c) K E = $\frac{1}{2} I \omega^{-2}$
d) K E = $\frac{1}{2} I \omega^{2}$

10. Linear velocities of all the particles of the body in a pure rotational motion is (except the particles present on the axis of rotation):
a) 1 b) 0
c) Same d) Different

11. Which law describes the orbits of planets around the sun?

a) Newton's law
b) Faraday's law
c) Kepler's law
d) Galileo's Law

12. The time period of revolution of a geostationary satellite around the earth is:
a) 1 year
b) 24 hour
c) 6 hour
d) 84.6 minute

Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to questions 13 to 16 from the codes (a), (b), (c) and (d) as given below.
a) Both A and R are 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 and R is false
d) A is false and R is also false

13. Assertion: A spring has potential energy, both when it is compressed or stretched.
Reason: In compressing or stretching, work is done on the spring against the restoring force.

14. Assertion: For the motion of electron around nucleus, Newton's second law is used.
Reason: Newton's second law is used only for circular motion of the objects.

15. Assertion: A body is momentarily at rest when it reverses the direction.
Reason: A body cannot have acceleration if its velocity is zero at a given instant of time.

16. Assertion: Orbit of a satellite is within the gravitational field of earth whereas escaping is beyond the gravitational field of earth.

Reason: Orbital velocity of a satellite is greater than its escape velocity.

SECTION-B

17. The Vander Wall`s equation for a gas is
$(P + a/V^2)(V-b) = RT$ where P is pressure, V is volume.
Determine the dimensions of a and b.

OR

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

18. The displacement (in metre) of a particle moving along x-axis is given by $x=18t + 5t^2+2$. Calculate:
(i) the instantaneous velocity at t=2 s,
(ii) instantaneous acceleration.

19. State and prove Law of conservation of linear momentum.

20. Define conservative and non-conservative force. Write one example of each.

21. Derive the expression for the acceleration due to gravity at a depth d from the surface of earth if earth is considered a sphere of uniform mass density ρ.

SECTION-C

22. Two masses 8 kg and 12 kg are connected at two ends of a light inextensible string that goes over a frictionless pulley. find the acceleration of masses and the tension in the string ($g=10\ m/s^2$).

OR

Derive the relation of tension and acceleration when two object of mass m_1 and m_2 are connected at two ends of a light inextensible string that goes over a frictionless pulley. ($m_1 > m_2$).

23. State and prove work energy theorem. Write the relation between kinetic energy and linear momentum.

24. Define torque and derive the expression of torque in Cartesian coordinates. State and Explain the rule to find direction of torque.

25. A drunkard walking in a narrow lane takes 5 steps forward and 3 steps backward, followed again by 5 steps forward and 3 steps backward, and so on. Each step is 1 m long and requires 1 s. Plot the position- time graph of his motion. Determine graphically and otherwise how long the drunkard takes to fall in a pit 13 m away from the start.

26. Experiments show that frequency (n) of a tuning fork depends on length (l) of the prong, density (d) and Young's modulus(Y) of its material. On the basis of dimensional analysis, derive an expression for frequency of tuning fork.

27. What is escape speed? Obtain an expression for it and state the factors on which it depends.

28. A body of mass 0.25 kg moving with velocity 12 m/s is stopped by applying a force of 0.6 N. Calculate the time taken to stop the body. Also calculate the impulse of this force.

SECTION-D

Read the following passage and choose appropriate answers of questions 29 to 30.

29. In the absence of air resistance, all bodies fall with same acceleration near the surface of the earth. This motion of a body falling towards the earth from a small height is called free fall. The acceleration with which a body falls is called acceleration due to gravity and it is denoted by g.

(i) For a freely falling body, which of the following equation is incorrect?
a) $h-ut = (1/2)\ gt^2$
b) $v^2 - u^2 = 2gh$
c) $h = (1/2)\ ut + gt^2$
d) $(v-u)/g = t$

(ii) The maximum height attained by a body thrown vertically upward with initial velocity u is
a) $h=u^2/2g$
b) $h=u/2g$
c) $h=u^2/g$
d) $h=2u^2/g$

(iii) The time of ascent of a body thrown vertically upward with initial velocity u is
a) $t= u/2g$ b) $t= u/g$
c) $t= u^2/g$ d) $t= u/g^2$

iv) Velocity of fall at the point of projection of a body thrown vertically upward with initial velocity u is (in magnitude)
a) $v = u$ b) $v = 2u$
c) $v = 3u$ d) $v = 4u$

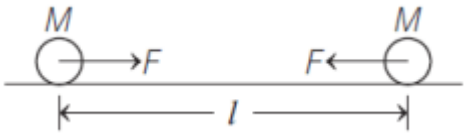
OR

The total time of flight to come back to the point of projection of a body thrown vertically upward with initial velocity u is

a) $t= 2u/3g$ b) $t= u/2g$
c) $t= 2u/g$ d) $t= u^2/2g$

30. Centre of Mass
The centre of mass of a body or a system of bodies is the point which moves as though all of the mass were concentrated there and all external forces were applied to it. Hence, a point at which the entire mass of the body or system of bodies is supposed to be concentrated is known as the centre of mass.
If a system consists of more than one particle (or bodies) and net external force on the system in a particular direction is zero with centre of mass at rest. Then, the centre of mass will not move along that direction. Even though some particles of the system may move along that direction.
(i) Two point masses 1 kg and 2 kg are lying in xy-plane at (-1, 2) and (2, 4), respectively. What are the coordinates of the centre of mass?
a) 1, 10/3 b) (1,0)
c) (0,1) d) None of these

ii) Two balls of same masses start moving towards each other due to gravitational attraction, if the initial distance between them is L. Then, they meet at



a) L/2 b) L
c) L/3 d) L/4

(iii) The centre of mass of a system of two particles divides, the distance between them
a) in inverse ratio of square of masses of particles
b) in direct ratio of square of masses of particles
c) in inverse ratio of masses of particles
d) in direct ratio of masses of particles

(iv) All the particles of a body are situated at a distance R from the origin. The distance of centre of mass of the body from the origin is
a) = R b) ≤ R
c) > R d) ≥ R

OR

Two particles A and B initially at rest move towards each other under a mutual force of attraction. At the instant, when the speed of A is v and the speed of B is 2v, the speed of centre of mass of the system is
(a) zero (b) v
(c) 1.5 v (d) 3v

SECTION-E

31. (i) Define elastic and inelastic condition.
(ii) Obtain the expression for velocity of two bodies when two objects collide to each other in one dimension

OR

(i) Derive the relation of potential energy for a spring attached to a block of mass m and moving horizontally on frictionless surface. and also find the relation of total mechanical energy in such motion.

(ii) To simulate car accidents, auto manufacturers study the collision of moving cars with mounted spring of different spring constants. Consider a typical simulation with a car with 1000 kg mass moving with a speed 18km/h on a smooth road and colliding with a horizontally mounted spring of spring constant 6.25x103 N/m . what is the maximum compression of the spring.

32. What is meant by baking of roads? What is the need for banking a road? Obtain an expression for the maximum speed with which a vehicle can safely negotiate a curved road banked at an angle θ. The coefficient of friction between the wheels and the road is μ.

OR

(i) Explain the difference between static, limiting, and kinetic friction.
(ii) Plot a graph between applied force and force of friction.
(iii) Why is friction called self adjusting force? Discuss any 2 methods for increasing the friction.

33. (i) Prove that path of the projectile is parabolic.
(ii) Obtain the expression-
(a) time of flight
(b) maximum height

OR

(i) Derive the expression of centripetal acceleration in case of uniform circular motion.
(ii) A stone tied to the end of a string 80 cm long is whirled in a horizontal circle with a constant speed. If the stone makes 14 revolutions in 25 second, what is the magnitude and direction of acceleration of the stone?

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