M – 2024

Register Number :

Subject Code : 33

PHYSICS

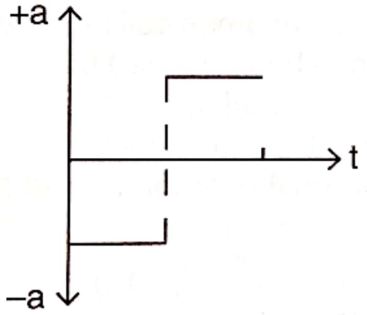
Time : 3 Hours 15 Minutes] [Total No. of questions : 48] [Max. Marks : 70

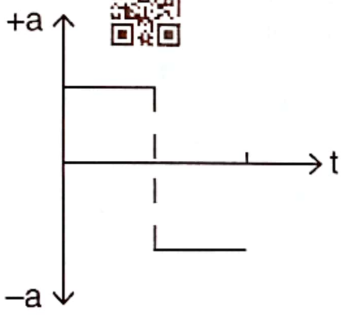
Instructions :
1) ***All** Parts are **compulsory**.*
2) *For Part – **A** questions, **first** written answers will be considered for awarding marks.*
3) *Answers without relevant diagram/figure/circuit, **wherever** necessary will **not** carry **any** marks.*
4) *Direct answers to the numerical problems without detailed solution will **not** carry **any** marks.*

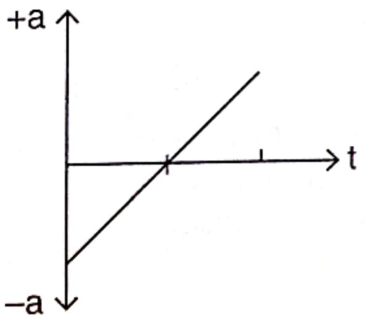
PART – A

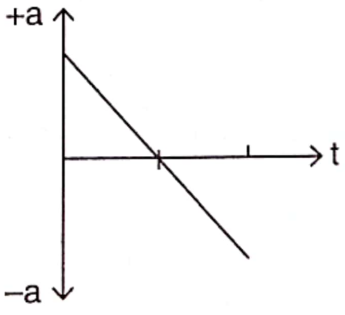
I. Pick out the correct option among the four given options for **all** of the following questions : **(15×1=15)**

1) The dimensional formula of pressure is
   a) $[MLT^{-2}]$ b) $[ML^2T^{-2}]$ c) $[ML^{-1}T^{-2}]$ d) $[MLT^{-3}]$
2) A ball is thrown vertically upward and allowed to move freely under gravity, the a-t graph of the motion of ball is

a)


b)


c)


d)


P.T.O.

3) In a projectile motion, the horizontal range is maximum for angle of projection

a) 0° b) 45° c) 60° d) 90°

4) The product of force and time is

a) Force b) Torque c) Impulse d) Acceleration

5) The recoil of a gun is an example for conservation of

a) Mass b) Charge c) Energy d) Momentum

6) The scalar product two vectors is zero $\left(\vec{A}.\vec{B} = 0\right)$, the angle between two vectors is

a) 0° b) 45° c) 90° d) 180°

7) Consider a system of two identical particles, one of the particle is at rest and other has an acceleration 'a'. The centre of mass has an acceleration

a) zero b) $\frac{a}{2}$ c) a d) 2a

8) The value of gravitational constant is

a) $6.67 \times 10^{-10}\ Nm^2\ kg^{-2}$ b) $6.67 \times 10^{-11}\ Nm^2\ kg^{-2}$

c) $6.67 \times 10^{-12}\ Nm^2\ kg^{-2}$ d) $6.67 \times 10^{-13}\ Nm^2\ kg^{-2}$

9) Which of the following materials is/are close to ideal plastic ?

(i) Putty
(ii) Mud
(iii) Steel

a) (i) and (ii) b) (i) and (iii) c) (ii) and (iii) d) (i), (ii) and (iii)

10) Dynamic lift due to spinning of a ball is

a) Magnus effect b) Doppler's effect
c) Pascal's effect d) Torricelli effect

11) When a piece of iron is heated in a hot flame, it first becomes dull red, then reddish yellow and finally white hot. This phenomenon can be explained by

a) Stefan's – Boltzmann's law b) Green house effect
c) Wien's displacement law d) Newton's law of cooling

12) The efficiency of a Carnot's engine working between the temperatures 127°C and 27°C is

a) 0.25 b) 0.5 c) 0.75 d) 1.0

13) The total internal energy of a mono atomic gas is

a) $\frac{1}{2}K_BT$ b) $\frac{1}{3}K_BT$ c) $\frac{3}{2}K_BT$ d) $\frac{5}{2}K_BT$

14) The motion which repeats itself at regular intervals of time is called

a) Projectile motion b) Curvilinear motion
c) Periodic motion d) Non-periodic motion

15) The longitudinal waves in a medium propagates due to

a) Shear modulus b) Bulk modulus
c) Young's modulus d) Both Shear and Bulk modulus

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II. Fill in the blanks by choosing appropriate answer given in the brackets for all the following questions : (5×1=5)

(Surface tension, 180°, Vector, Elliptical, 90°, Absolute temperature)

16) A physical quantity having both magnitude and direction is called _____

17) All planets move in _____ orbits with sun situated at one of the foci.

18) The spherical shape of a liquid drop is due to _____

19) At constant pressure, the volume of a gas is directly proportional to its _____

20) At rigid boundary, there is a phase difference of _____ between incident and reflected wave.

PART – B

III. Answer **any five** of the following questions : (5×2=10)

21) Write any two rules of writing significant figures.

22) A stone tied at one end of a string 80 cm long and is whirled in a horizontal circle with constant speed. If the frequency of revolution of stone is 2 Hz., then calculate magnitude of tangential velocity.

23) Write any two advantages of friction.

24) What are conservative and non-conservative forces ?

25) Mention the expression for kinetic energy of a rotating body and explain the terms.

26) State and explain Newton's law of gravitation.

27) Mention any two factors on which thermal capacity of a body depends.

28) State and explain first law of thermodynamics.

29) Draw a graph of kinetic energy and potential energy of an oscillating particle with displacement.

PART – C

IV. Answer **any five** of the following questions : (5×3=15)

30) Derive an expression for time taken to reach maximum height by a projectile.

31) Prove law of conservation of linear momentum using Newton's laws of motion.

32) Derive an expression for potential energy of a spring by graphical method.

33) To maintain a rotor at a uniform angular speed of 120 $rads^{-1}$. Engine needs to transmit a torque of 180 Nm. What is the power required by the engine ?

34) Define :
   i) Longitudinal strain
   ii) Shear strain
   iii) Volume strain.

35) Distinguish between streamline flow and turbulent flow.

36) On what factors does the rate of transfer of heat through a conductor depends ?

37) State and explain Boyle's law.

38) Write Newton's formula for speed of sound in gas and give Laplace correction to Newton's formula.

PART – D

V. Answer **any three** of the following questions : **(3×5=15)**

39) Derive the kinematic equation of uniformly accelerated motion, $v^2 = v_0^2 + 2ax$, using v-t graph, where terms have their usual meaning.

40) Derive an expression for magnitude and direction of resultant of two vectors acting at a point.

41) Prove law of conservation of mechanical energy in case of freely falling body.

42) a) Define torque. 1

b) Obtain the relation $\bar{\tau} = \frac{d\bar{L}}{dt}$. 4

43) a) What is isothermal process ? 1

b) Obtain an expression for work done in isothermal process. 4

44) Show that a stretched string vibrates with all harmonics.

VI. Answer **any two** of the following questions : **(2×5=10)**

45) A ship of mass 3×10^7 kg initially at rest is pulled by a force of 5×10^4 N through a distance of 3 m. Assuming that resistance of water is negligible, find the speed of the ship after travelling 3 m distance.

46) Calculate the orbital velocity and period of revolution of an artificial satellite of the earth moving at an altitude of 200 km.

Given,

Radius of the earth = 6400 km

Mass of the earth = 6×10^{24} kg

$G = 6.7 \times 10^{-11}$ $Nm^2 kg^{-2}$.

47) A body cools from 80°C to 50°C in 5 minute. Calculate the time it takes to cool from 60°C to 30°C. The temperature of surrounding is 20°C.

48) A body oscillates with SHM according to the equation, $x = 5\cos\left(2\pi t + \frac{\pi}{4}\right)$ m.

At t = 1.5 s, calculate (a) displacement, (b) speed and (c) acceleration of the body.
