HALF YEARLY EXAMINATION - 2024

CLASS : 11 **PHYSICS**

TIME : 3.00 HOURS **MAX MARKS: 70**

PART- I **(15 x 1 = 15)**

Note : (i) Answer all the questions. (ii) Choose the most appropriate answer from the given four alternatives and write the option code and the corresponding answer.

1. The dimension of $(\mu_0\varepsilon_0)^{-1/2}$ is
   A) Length B) Time C) Velocity D) Force
2. If an object is dropped from the top of a building and it reaches the ground at t = 2s then the height of the building is (ignoring air resistance)
   A) 77.3 m B) 78.4 m C) 19.6 m D) 79.2 m
3. An object of mass m begins to move on the plane inclined at an angle θ. The coefficient of static friction of inclined surface is μs. The maximum static friction experienced by the mass is
   A) mg B) $\mu_s$mg C) $\mu_s$mg sin θ D) $\mu_s$mg cos θ
4. If the potential energy of the particle is $\alpha - \frac{\beta x^2}{2}$, then force experienced by the particles is
   A) $F = \frac{\beta}{2}x^2$ B) $F = \beta x$ C) $F = -\beta x$ D) $F = -\frac{\beta}{2}x^2$
5. From a disc of radius R a mass M, a circular hole of diameter R, whose rim passes through the center is cut. What is the moment of inertia of the remaining part of the disc about the perpendicular axis passing through it
   A) $\frac{15MR^2}{32}$ B) $\frac{13MR^2}{32}$ C) $\frac{11MR^2}{32}$ D) $\frac{9MR^2}{32}$
6. If the distance between the Earth and Sun were to be double from its present value, the number of days in a year would be
   A) 64.5 B) 1032 C) 182.5 D) 730
7. If the temperature of the wire is increased, then the Young's modulus will
   A) remain the same B) decrease
   C) increase rapidly D) increase by the very a small amount
8. When a cycle tyre suddenly bursts, the air inside the tyre expands. This process is
   A) isothermal B) adiabatic C) isobaric D) isochoric
9. If the temperature and pressure of a gas is doubled the mean free path of the gas molecules
   A) remains same B) doubled C) tripled D) quadrapoled
10. The ionization formula which was useful in classifying stars was discovered by
    A) Chandrasekar B) Amal Kumar Raychaudhuri
    C) Meghnad Saha D) Jayant V Narlikar
11. In a simple harmonic oscillation, the acceleration against displacement for one complete oscillation will be
    A) an ellipse B) a circle C) a parabola D) a straight line
12. A spring of force constant k is cut into two pieces such that one piece is double the length of the other. Then, the long piece will have a force constant of
    A) $\frac{2}{3}k$ B) $\frac{3}{2}k$ C) $3k$ D) $6k$
13. If an object is thrown vertically up with initial speed u from the ground, then the time taken by the object to return back to ground is
    A) $\frac{u^2}{2g}$ B) $\frac{u^2}{g}$ C) $\frac{u}{2g}$ D) $\frac{2u}{g}$
14. If mass of an object 100 kg experiences a force of 5 N, then the acceleration of the object is
    A) 20 ms^{-2} B) 0.05 ms^{-2} C) 0.5 ms^{-2} D) 500 ms^{-2}

15. Which of the following gases will have least rms speed at a given temperature?
A) Hydrogen B) Nitrogen C) Oxygen D) Carbon dioxide

PART - II

6 X 2 = 12

Answer any SIX questions and Question No.20 is compulsory.

16. What you meant by random errors. How can you minimise it?
17. State the triangle law of addition of vectors.
18. Define 1 newton.
19. State work - energy theorem.
20. Consider two point masses m_1 =1 kg and m_2 = 2 kg which are separated by a distance of 10 m. Calculate the force of attraction between them.
21. State the zeroth law of thermodynamics.
22. List the factors affecting the mean free path.
23. Differentiate transverse and longitudinal wave.
24. Soldiers are not allowed to march on a hanging bridge. Why?

PART - III

6 X 3 = 18

Answer any SIX questions and Question No.29 is compulsory.

25. Explain the propagation of errors in the addition of two quantities.
26. Discuss the properties of vector product.
27. Explain the differences of centripetal and centrifugal forces.
28. Give the relation between momentum and kinetic energy.
29. A uniform disc of mass **100 g** has a diameter of **10 cm.** Calculate the total energy of the disc when rolling along a horizontal table with a velocity of **20** cms^{-1}.
30. State Kepler's laws of planetary motion.
31. Obtain the relation between surface tension and surface energy.
32. Deduce Avogadro's law based on kinetic theory.
33. Write short notes on two springs connected in parallel.

PART - IV

5 X 5 = 25

Answer ALL Questions.

34. (A) Derive the equation for a) Maximum height b) Time of flight and c) Horizontal range reached by the particle thrown at an oblique angle 'θ' with respect to the horizontal direction.

(OR)

(B) Describe Newton's formula for velocity of sound waves in air and also discuss Laplace correction.

35. (A) Obtain an expression for the time period T of a simple pendulum. The time period T depends on (i) mass '*m*' of the bob (ii) length '*l*' of the pendulum and (iii) acceleration due to gravity *g* at the place where the pendulum is suspended. (Constant k = 2π):

(OR)

(B) Discuss in detail the energy in simple harmonic motion.

36. (A) Prove the law of conservation of linear momentum. Use it to find the recoil velocity of a gun when a bullet is fired from it.

(OR)

(B) Explain in detail Newton's law of cooling.

37. (A) Write down the postulates of kinetic theory of gases.

(OR)

(B) State and explain the parallel axis theorem.

38. (A) Derive the expression for the terminal velocity of a sphere moving in a high viscous fluid using stokes force.

(OR)

(B) Explain the variation of "g" with depth.

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HALF-YEARLY EXAM - 2024

PHYSICS Std : XI

20/12/24

Answer Key :

PART - I

1)	ஆ) நேர வேகம்	c) Velocity
2)	அ) 19.6 m	c) 19.6 m
3)	ஈ) $\mu_s mg \cos\theta$	d) $\mu_s mg \cos\theta$
4)	ஆ) $F = Bx$	b) $F = Bx$
5)	ஆ) $\frac{13MR^2}{32}$	b) $\frac{13MR^2}{32}$
6)	ஆ) 1032	b) 1032
7)	ஆ) மாறுபடும்	b) decreases
8)	ஆ) வெப்ப இயக்கவியல்	b) adiabatic
9)	ஆ) மாறாது	b) remains Same
10)	அ) மேக்நாட் சுருள்	c) Meghnad Saga
11)	ஈ) நேர்க் கோடு	d) a straight line
12)	ஆ) $\frac{3}{2}k$	b) $\frac{3}{2}k$
13)	ஈ) $\frac{24}{9}$	d) $\frac{24}{9}$
14)	ஆ) $0.05\ ms^{-2}$	b) $0.05\ ms^{-2}$
15)	ஈ) கார்பன்-ஐ-ஆக்சைடு	d) Carbon dioxide

PART-II

16) **Random Errors:**

Random errors may arise due to random and unpredictable variations in experimental conditions like Pressure, temperature etc., its due to personal errors by the observer.

17) **Triangle law of addition of Vectors:**

Represent the vectors $\vec{A}$ and $\vec{B}$ by the two adjacent sides of a triangle taken in same order. Then the resultant is given by the third side of triangle in opposite order.

18) **1 Newton:** Force which acts on 1kg of mass to given acceleration $1 m s^{-2}$ in the direction of force.

19) **Work-Energy Theorem:-** Work- done by the force on the body changes the Kinetic Energy.

20) $$F = -\frac{G m_1 m_2}{r^2} = \frac{6.67 \times 10^{-11} \times 1 \times 2}{100} = 13.34 \times 10^{13} N$$

21) **Zeroth law:-** If two systems A and B are in thermal equilibrium with a third system C the A and B are in thermal equilibrium with each other.

22) Factors affecting mean free Path: i) $\lambda \propto T$ (ii) $\lambda \propto \frac{1}{Pd}$

23) Transver & longitudinal Waves: Any A difference.

24) i) To avoid resonant vibration of the bridge.
ii) When Soldiers march on bridge, their stepping frequency may match the natural frequency of bridge. iii) the bridge will vibrate large amplitude due to resonance.

PART-III

25) **Propagation of errors in addition:**

$A = A \pm \Delta A$; $B = B \pm \Delta B$

$Z = A + B$

$Z \pm \Delta Z = (A \pm \Delta A) + (B \pm \Delta B)$

$\boxed{\Delta Z = \Delta A + \Delta B}$

26) **Properties of Vector Product**

i) $\vec{A} \times \vec{B} \neq \vec{B} \times \vec{A}$

ii) $|\vec{A} \times \vec{B}| = |\vec{B} \times \vec{A}| = AB \sin\theta$

iii) $\vec{A} \times (\vec{B} + \vec{C}) = \vec{A} \times \vec{B} + \vec{A} \times \vec{C}$

iv) $(\vec{A} \times \vec{B})_{max} = AB\hat{n}$

v) $(\vec{A} \times \vec{B})_{min} = 0$

27) **Centripetal & Centrifugal force difference.**

Write any 5

28) **Relation b/w Momentum and Kinetic Energy**

$K.E = \frac{1}{2} m v^2$

$K.E = \frac{1}{2} m (\vec{v} \cdot \vec{v})$

$K.E = \frac{1}{2} m (\vec{v} \cdot \vec{v}) \frac{m}{m}$

$K.E = \frac{1}{2} \frac{m\vec{v} \cdot m\vec{v}}{m}$

$K.E = \frac{p^2}{2m}$

$p^2 = 2mK.E$

$\boxed{p = \sqrt{2mKE}}$

29) $E = \frac{1}{2} m v^2 + \frac{1}{2} I \omega^2$

$E = \frac{1}{2} (m v^2 + I \omega^2)$

$\frac{1}{2} = \frac{1}{2} m r^2$

$\boxed{E = 0.005\ J}$

30) **Kepler's law:-**

i) **Law of orbit:** Each Planet moves around the sun in elliptical orbit with sun one of its foci.

ii) **Law of Area:** The radial vector sweeps equal areas in equal interval of time.

iii) **Law of Periods:**

$T^2 \propto a^3$ $\quad \frac{T^2}{a^3} = \text{Constant}$

31) **Relation b/w Surface Tension & Energy:**

$W = F \times \Delta x$; $W = 2T\ell \times \Delta x$

$\Delta A = 2\ell \times \Delta x$, $S.E = \frac{T \times \Delta A}{2\ell \Delta x}$

$\boxed{S.E = S.T}$

32) **Avogadro's law:-**

$P = \frac{1}{3} \frac{N_1}{V} m_1 v_1^2 = \frac{1}{3} \frac{N_2}{V} m_2 v_2^2$

$\frac{1}{2} m_1 v_1^2 = \frac{1}{2} m_2 v_2^2$

$\boxed{N_1 = N_2}$

33) **Two Springs Connected in ||e**

$F = -K_p x$; $F_1 = -K_1 x_1$

$F_2 = -K_2 x_2$: $F = F_1 + F_2$

$K_p = K_1 + K_2$

$K_p = K_1 + K_2 + \ldots + K_n$ $\quad \boxed{K_p = nk}$

PART-IV

34) A) Oblique angle:

i) hmax: $v_y^2 = u_y^2 + 2a_y s$

$h_{max} = \frac{u^2 \sin^2\theta}{2g}$

ii) T_f:- $s_y = u_y t + \frac{1}{2} a_y t^2$

$\frac{1}{2} g T_f = u \sin\theta$

$T_f = \frac{2u\sin\theta}{g}$

iii) Rmax:- $R = u_x T_f$

$R = \frac{u^2 \sin 2\theta}{g}$

$\boxed{R_{max} = u^2/g}$

B) Newton's - Laplace Correction:

$P dv + V dP = 0$

$P dv = -V dP$

$P = -\frac{dP}{dv/v} = B_T$

$V_T = \sqrt{P/\rho} = 280 ms^{-1}$

Laplace:- $V^\gamma dP + P\gamma V^{\gamma-1} dV = 0$

$P\gamma = -V\frac{dP}{dV}$

$P\gamma = -\frac{dP}{dV/V} = B_A$

$V_A = V_T\sqrt{\gamma}$

$V_A = 331.3 ms^{-1}$

35) A) $T \propto m^a l^b g^c$

$T = k m^a l^b g^c$

$[M^0 L^0 T^1] = [M^a L^{b+c} T^{-2c}]$

a = 0
b = 1/2
c = -1/2

$a = 0$

$b + c = 0$

$-2c = 1$

$T = k m^0 l^{1/2} g^{-1/2}$

$T = k\sqrt{l/g}$; $T = 2\pi\sqrt{l/g}$

B) $F = -\frac{dV}{dx}$; $\frac{dV}{dx} = kx$

$dV = kx\,dx$; $U = \frac{1}{2} m\omega^2 x^2$

K.E:- $K.E = \frac{1}{2} m v^2$

$v^2 = \omega^2(A^2 - x^2)$

$K.E = \frac{1}{2} m\omega^2 A^2 - \frac{1}{2} m\omega^2 x^2$

T.E:- $E = U + K.E$

$E = \frac{1}{2} m\omega^2 x^2 + \frac{1}{2} m\omega^2 A^2 - \frac{1}{2} m\omega^2 x^2$

$\boxed{E = \frac{1}{2} m\omega^2 A^2}$

36) A) $\vec{F}_{12} = -\vec{F}_{21}$

$\frac{d\vec{P}_1}{dt} = -\frac{d\vec{P}_2}{dt}$

$\frac{d\vec{P}_1}{dt} + \frac{d\vec{P}_2}{dt} = 0$

$\frac{d}{dt}(\vec{P}_1 + \vec{P}_2) = 0$

$\vec{P}_1 + \vec{P}_2 =$ Constant

Explain recoil of gun.

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36) B) Newton's law of Cooling:

$$\frac{dQ}{dt} \propto -(T-T_s)$$

$$\frac{dQ}{dt} = -a(T-T_s)$$

$$dQ = ms\,dT$$

$$\frac{dT}{(T-T_s)} = -a\frac{dt}{ds}$$

$$\int_0^x \frac{dT}{T-T_s} = -\int_0^t a\frac{dt}{ds}$$

$$T = T_s + b_2 e^{-\frac{at}{ms}}$$

37) A) Postulates of Kinetic theory of gases:

i) Write 10 Postulates

37) B) Parallel axes theorem:

Statement:

$$I = \Sigma m(x+d)^2$$

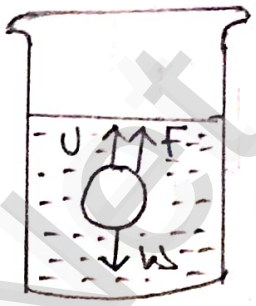
$$I = \Sigma m(x^2+d^2+2xd)$$

$$I = \Sigma mx^2 + \Sigma md^2 + \Sigma mx2d$$

$$\boxed{\Sigma mx = 0}$$

$$\boxed{I = I_c + Md^2}$$

38) A) Terminal Velocity



$$F_G = mg = \frac{4}{3}\pi r^3 \rho g$$

$$U = \frac{4}{3}\pi r^3 \sigma g$$

$$F = 6\pi\eta r v_t$$

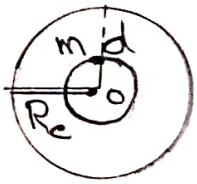
$$F_G = U + F$$

$$v_t = \frac{2}{9} \times r^2 \frac{(\rho-\sigma)g}{\eta}$$

$$\boxed{v_t \propto r^2}$$

38) B) Variation of g with depth:

$$g' = \frac{GM'}{(R_e-d)^2}$$



$$\boxed{\rho = \frac{m}{v}} \qquad \boxed{\rho = \frac{M'}{v'}}$$

$$M' = \frac{M}{R_e^3}(R_e-d)^3$$

$$g' = GM\frac{R_e\left[1-\frac{d}{R_e}\right]}{R_e^3}$$

$$g' = GM\frac{\left(1-d/R_e\right)}{R_e^2}$$

$$\boxed{g' = g\left(1-\frac{d}{R_e}\right)}$$

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