

# **KUMAR PHYSICS CLASSES**

E 281 BASEMENT M BLOCK MAIN ROAD GREATER KAILASH 2 NEW DELHI

**9958461445,01141032244**

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## **NEET PHYSICS**

## **PAPER**

## **SOLUTION**

## **2017**

**EASY AND CONCEPTUAL PAPER**

**ANGLE OF DIP QUESTION**

**All Based On Basic Concepts Of  
Physics**

1. A potentiometer is an accurate and versatile device to make electrical measurements of E.M.F. because the method involves
- (1) cells
  - (2) potential gradients
  - ✓ (3) a condition of no current flow through the galvanometer
  - (4) a combination of cells, galvanometer and resistances

2. A gas mixture consists of 2 moles of  $O_2$  and 4 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

- (1) 4 RT
- (2) 15 RT
- (3) 9 RT
- ✓ (4) 11 RT

ANS-1

Because potentiometer never draws current from the external circuit.

ANS-2

$$\begin{aligned}
 U &= n_1 \frac{f_1}{2} RT + n_2 \frac{f_2}{2} RT \\
 &\quad \downarrow \qquad \qquad \qquad \downarrow \\
 &\quad \text{mole} \qquad \qquad \qquad \text{mole} \\
 &= 2 \times \frac{5}{2} RT + 4 \times \frac{3}{2} RT \\
 &= 5 RT + 6 RT \\
 &= 11 RT
 \end{aligned}$$

3. Radioactive material 'A' has decay constant ' $8\lambda$ ' and material 'B' has decay constant ' $\lambda$ '. Initially they have same number of nuclei. After what time, the ratio of number of nuclei of material 'B' to that 'A' will be  $\frac{1}{e}$ ?

- (1)  $\lambda$   
1  
 $7\lambda$   
1  
(3)  $8\lambda$   
1  
(4)  $9\lambda$

ANS-3

$$\frac{N_A}{N_B} = \frac{1}{e}$$

$$N = N_0 e^{-\lambda t}$$

$$N_A = N_0 e^{-\lambda_1 t}, \quad N_B = N_0 e^{-\lambda_2 t}$$

$$\frac{1}{e} = \frac{N_0 e^{-\lambda_1 t}}{N_0 e^{-\lambda_2 t}}$$

$$\lambda_1 = 8\lambda$$

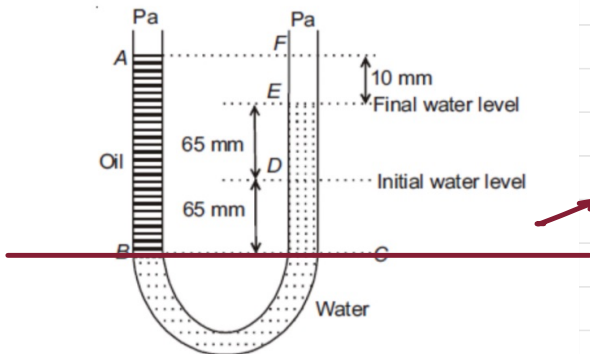
$$\lambda_2 = \lambda$$

$$\frac{1}{e} = \frac{e^{-8\lambda t}}{e^{-\lambda t}} \Rightarrow \frac{1}{e} = e^{-7\lambda t}$$

$$e^1 = e^{-7\lambda t} \Rightarrow 1 = 7\lambda t$$

$$t = \frac{1}{7\lambda}$$

4 A U tube with both ends open to the atmosphere, is partially filled with water. Oil, which is immiscible with water, is poured into one side until it stands at a distance of 10 mm above the water level on the other side. Meanwhile the water rises by 65 mm from its original level (see diagram). The density of the oil is !



- (1)  $650 \text{ kg m}^{-3}$
- (2)  $425 \text{ kg m}^{-3}$
- (3)  $800 \text{ kg m}^{-3}$
- ✓ (4)  $928 \text{ kg m}^{-3}$

consider this level

Pressure should be equal at B & C.

$$P_B = P_C$$

$$\rho_{\text{oil}} \times h_{\text{oil}} = \rho_{\text{water}} \times h_{\text{water}}$$

$$140 \rho_{\text{oil}} = 130 \times \rho_{\text{water}}$$

$$\rho_{\text{oil}} = \frac{13}{14} \times 10^3 \text{ kg/m}^3$$

$$\rho_{\text{oil}} = 928 \text{ kg/m}^3$$

5. A 250-Turn rectangular coil of length 2.1 cm and width 1.25 cm carries a current of 85  $\mu$ A and subjected to a magnetic field of strength 0.85 T. Work done for rotating the coil by 180° against is:

- (1) 9.1  $\mu$  J  
 (2) 4.55  $\mu$  J  
 (3) 2.3  $\mu$  J  
 (4) 1.15  $\mu$  J

6. The de-Broglie wavelength of a neutron in thermal equilibrium with heavy water at a temperature T (Kelvin) and mass m, is:

- (1)  $\frac{h}{\sqrt{mkT}}$   
 (2)  $\frac{h}{\sqrt{3mkT}}$   
 (3)  $\frac{2h}{\sqrt{3mkT}}$   
 (4)  $\frac{2h}{\sqrt{mkT}}$

ANS-5

$$U = -MB \cos \theta$$

$$\text{WORK DONE} = V_f - V_i$$

$$V_f = -MB \cos 180^\circ, \quad V_i = -MB \cos 0$$

$$= MB \quad \quad \quad = -MB$$

$$W.D = MB - (-MB) = 2MB$$

$$= 2 (NI A) B$$

$$= 2 (250) (85 \times 10^{-6}) (2.1 \times 10^{-2} \times 1.25 \times 10^{-2}) \cdot 0.85$$

$$= 9.1 \mu J$$

ANS-6

$$KE = \frac{3}{2} kT = \frac{1}{2} m v^2 \Rightarrow v = \sqrt{\frac{3kT}{m}}$$

$$\lambda = \frac{h}{mv} = \frac{h}{m \sqrt{\frac{3kT}{m}}} = \frac{h}{\sqrt{3mkT}}$$

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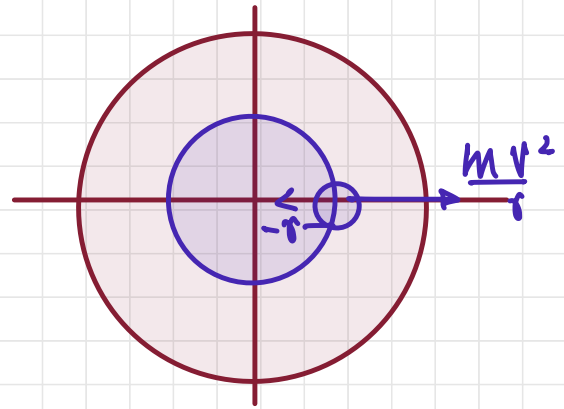
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7. One end of string of length  $l$  is connected to a particle of mass ' $m$ ' and the other end is connected to a small peg on a smooth horizontal table. If the particle moves in circle with speed ' $v$ ', the net force on the particle (directed towards center) will be (T represents the tension in the string)

$\Delta N \leq -T$

$T = \frac{mv^2}{r}$



(1) ✓ T

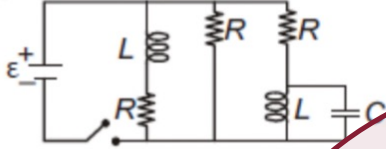
(2)  $T + \frac{mv^2}{l}$

(3)  $T - \frac{mv^2}{l}$

(4) Zero

Read the question properly  
(some students got confused)

- 8 Figure shows a circuit that contains three identical resistors with resistance  $R = 9.0 \Omega$  each, two identical inductors with inductance  $L = 2.0 \text{ mH}$  each, and an ideal battery with emf  $\epsilon = 18 \text{ V}$ . The current 'i' through the battery just after the switch closed is,....



- (1) 2 mA
- (2) 0.2 A
- (3) 2 A
- (4) 0 ampere

**ANS-4A**

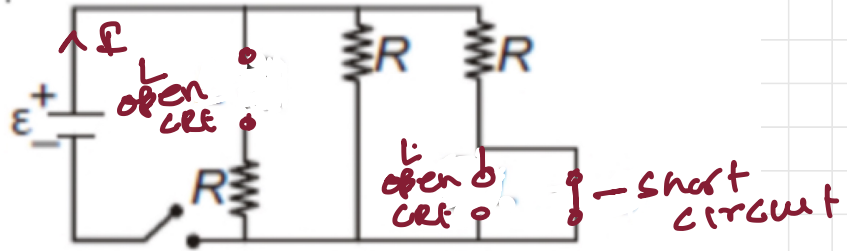
NO-OPTION

NGGT MISTAKE

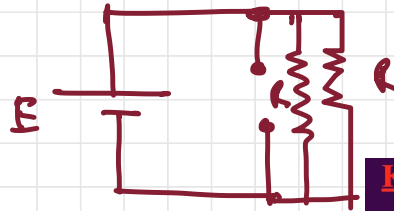
ANS-8

When switch is closed at  $t=0$ , Inductor will act open circuit and capacitor will act short circuit.

then circuit becomes



CIRCUIT-BECOME



$$I = \frac{\epsilon}{R/2} = \frac{2\epsilon}{R}$$

$$= \frac{2 \times 18}{9} = 4 \text{ A}$$

9. The  $x$  and  $y$  coordinates of the particle at any time are  $x = 5t - 2t^2$  and  $y = 10t$  respectively, where  $x$  and  $y$  are in meters and  $t$  in seconds. The acceleration of the particle at  $t = 2$  s is

- (1) 0  
 (2)  $5 \text{ m/s}^2$   
 ✓ (3)  $-4 \text{ m/s}^2$   
 (4)  $-8 \text{ m/s}^2$

ANS-9

$$x = 5t - 2t^2$$

$$v_x = \frac{dx}{dt} = 5 - 4t$$

$$a_x = \frac{dv_x}{dt} = -4$$

Acceleration of particle is  $-4 \text{ m/s}^2$  at  $t = 2 \text{ s}$

$$y = 10t$$

$$\frac{dy}{dt} = 10 = v_y$$

$$a_y = \frac{dv_y}{dt} = 0$$

10. Suppose the charge of a proton and an electron differ slightly. One of them is  $-e$ , the other is  $(e + \Delta e)$ . If the net of electrostatic force and gravitational force between two hydrogen atoms placed at a distance  $(\text{much greater than atomic size})$  apart is zero, then  $\Delta e$  is of the order of [Given mass of hydrogen  $m_h = 1.67 \times 10^{-27} \text{ kg}$ ]

- (1)  $10^{-20} \text{ C}$   
 (2)  $10^{-23} \text{ C}$   
 ✓ (3)  $10^{-37} \text{ C}$   
 (4)  $10^{-47} \text{ C}$

ANS-10

$$F_E = F_{\text{gravitational}}$$

$$\frac{1}{4\pi\epsilon_0} \frac{(\Delta e)^2}{r^2} = \frac{G m^2}{r^2}$$

$$(\Delta e)^2 = 4\pi\epsilon_0 G m^2 = \frac{G m^2}{\frac{1}{4\pi\epsilon_0}}$$

$$= \frac{6.67 \times 10^{-11} \times (1.67 \times 10^{-27})^2}{9 \times 10^9}$$

$$\Delta e = 10^{-37}$$

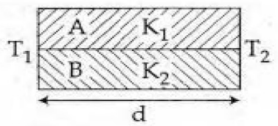
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11. Two rods A and B of different materials are welded together as shown in figure. Their thermal conductivities are  $K_1$  and  $K_2$ . The thermal conductivity of the composite rod will be:

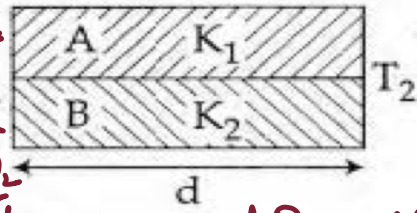


ANS-11

$$\frac{dQ}{dt}$$

$$\frac{dQ_1}{dt}$$

$$\frac{dQ_2}{dt}$$



$$\frac{dQ}{dt} = \frac{dQ_1}{dt} + \frac{dQ_2}{dt}$$

$$k_{eq} (2A) (T_1 - T_2) = \frac{k_1 A (T_1 - T_2) d}{d} + \frac{k_2 A (T_1 - T_2) d}{d}$$

$$k_{eq} = \frac{k_1 + k_2}{2}$$

ANS-12

$$dW = q (\Delta V) = q (V_f - V_i)$$

$$V_f = V_c = V$$

$dW = 0$  (work done is same for all cases)

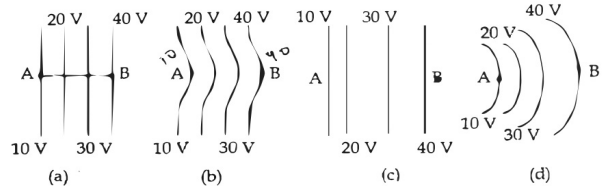
FORMULA

$$\frac{dQ}{dt} = k A \frac{dT}{dx}$$

The same current

- (1)  $\frac{K_1 + K_2}{2}$
- (2)  $\frac{3(K_1 + K_2)}{2}$
- (3)  $K_1 + K_2$
- (4)  $2(K_1 + K_2)$

12. The diagrams below show regions of equipotentials.



A positive charge is moved from A to B in each diagram.

- (1) Maximum work is required to move q in figure (c).
- (2) In all the four cases the work done is the same.
- (3) Minimum work is required to move q in figure (a).
- (4) Maximum work is required to move q in figure (b).

13. The ratio of wavelengths of the last line of Balmer series and the last line of Lyman series is :

- (1) 2
- (2) 1
- (3) 4
- (4) 0.5

14. Young's double slit experiment is first performed in air and then in a medium other than air. It is found that 8<sup>th</sup> bright fringe in the medium lies where 5<sup>th</sup> dark fringe lies in air. The refractive index of the medium is nearly :

- (1) 1.25
- (2) 1.59
- (3) 1.69
- (4) 1.78

$$\frac{n_1}{\mu} = \frac{(2n_2 - 1)}{2}$$

$$\frac{8}{\mu} = \frac{(10 - 1)}{2}$$

$$\frac{8}{\mu} = \frac{9}{2} \Rightarrow \mu = \frac{16}{9} = 1.78$$

$$x'_n = \frac{x_n}{\mu}$$

$$\frac{n_1 \lambda \mu}{d \mu} = \frac{(2n_2 - 1) \lambda \mu}{2d}$$

**Qul-13**

for last balmer series

$$\frac{1}{\lambda_b} = R \left[ \frac{1}{2^2} - \frac{1}{\infty^2} \right] \Rightarrow \lambda_b = \frac{4}{R}$$

for last lyman series

$$\frac{1}{\lambda_l} = R \left[ \frac{1}{1^2} - \frac{1}{\infty^2} \right] \Rightarrow \lambda_l = \frac{1}{R}$$

$$\frac{\lambda_b}{\lambda_l} = 4$$

**Qu-14**

for bright  $\frac{x_{nd}}{d} = n\lambda$

$$x_n = \frac{n\lambda d}{d}, \quad \frac{x_n}{x'_n} = \frac{\lambda}{\lambda'} = \mu$$

for dark

$$\frac{x_{nd}}{d} = \frac{(2n-1)\lambda}{2}$$

$$n_1 = 8, \\ n_2 = 5$$

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15. A particle executes linear simple harmonic motion with an amplitude of 3 cm. When the particle is at 2 cm from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then its time period in seconds is

- (1)  $\frac{\sqrt{5}}{\pi}$   
 (2)  $\frac{\sqrt{5}}{2\pi}$   
 (3)  $\frac{4\pi}{\sqrt{5}}$   
 (4)  $\frac{2\pi}{\sqrt{3}}$

ANS-15

$$v = \omega \sqrt{a^2 - x^2}$$

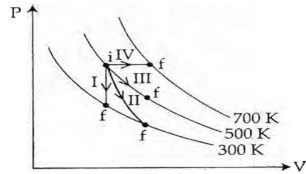
$$Acc^n = -\omega^2 x$$

$$|\omega \sqrt{a^2 - x^2}| = |-\omega^2 x|$$

$$\sqrt{3^2 - 2^2} = 2 \left( \frac{2\pi}{T} \right) \Rightarrow \sqrt{5} = \frac{4\pi}{T}$$

$$T = \frac{4\pi}{\sqrt{5}}$$

16. Thermodynamic processes are indicated in the following diagram.



Match the following

**Column-1**

- P. Process I  
 Q. Process II  
 R. Process III  
 S. Process IV

**Column-2**

- a. Adiabatic  
 b. Isobaric  
 c. Isochoric  
 d. Isothermal

- (1) P → a, Q → c, R → d, S → b  
 (2) P → c, Q → a, R → d, S → b  
 (3) P → c, Q → d, R → b, S → a  
 (4) P → d, Q → b, R → a, S → c

ANS-16

Process - I → Volume is constant (Isochoric)

Process - II → Adiabatic

Process - III → Isothermal

Process - IV → Isobaric

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17. A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system

- (1) increases by a factor of 4
- (2) decreases by a factor of 2
- (3) remains the same
- (4) increases by a factor of 2

ANS-17



$$q_1 = CE \quad \text{--- (1)}$$

$$U_i = \frac{1}{2} CE^2$$

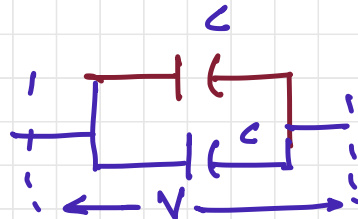
Since charge is conserved

$$q_1 = q_1' \Rightarrow CE = V(2C) \Rightarrow V = \frac{E}{2}$$

$$U_f = \frac{1}{2} (2C) \left(\frac{E}{2}\right)^2 = \frac{1}{4} CE^2$$

$$= \frac{1}{2} \left(\frac{1}{2} CE^2\right)$$

↓  
decreases by  
factor 2. with  $U_i$



common potential

$$q_1' = CV + CV \quad \text{--- (2)}$$

$$U_f = \frac{1}{2} (2C) (V^2)$$

18. The photoelectric threshold Wave length of silver is  $3250 \times 10^{-10} \text{ m}$ . The velocity of the electron ejected from a silver surface by ultraviolet light of wavelength  $2536 \times 10^{-10} \text{ m}$  is :

(Given  $h = 4.14 \times 10^{-15} \text{ eVs}$  and  $c = 3 \times 10^8 \text{ ms}^{-1}$ )

- (1)  $\approx 6 \times 10^5 \text{ ms}^{-1}$
- (2)  $\approx 0.6 \times 10^6 \text{ ms}^{-1}$
- (3)  $\approx 61 \times 10^3 \text{ ms}^{-1}$
- (4)  $\approx 0.3 \times 10^6 \text{ ms}^{-1}$

$$9.1 \times 10^{-31} \text{ kg}$$

$$\frac{1}{2} m v^2 = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{10^{-10}} \left( \frac{1}{2536} - \frac{1}{3250} \right)$$

$$v = 0.6 \times 10^6 \text{ m/s}$$

ANS - 18  $\rightarrow$

$$\lambda_0 = 3250 \times 10^{-10} \text{ m}$$

$$\lambda = 2536 \times 10^{-10} \text{ m}$$

$$(KE)_{\text{max}} = h\nu - h\nu_0$$

$$= hc \left( \frac{1}{\lambda} - \frac{1}{\lambda_0} \right)$$

19. A physical quantity of the dimensions of length that can be formed out of  $c$ ,  $G$  and  $\frac{e^2}{4\pi\epsilon_0}$  is [ $c$  is velocity of light,  $G$  is universal constant of gravitation and  $e$  is charge]:

(1)  $\frac{1}{c^2} \left[ G \frac{e^2}{4\pi\epsilon_0} \right]^{1/2}$

(2)  $c^2 \left[ G \frac{e^2}{4\pi\epsilon_0} \right]^{1/2}$

(3)  $\frac{1}{c^2} \left[ G \frac{e^2}{4\pi\epsilon_0} \right]^{1/2}$

(4)  $\frac{1}{c} G \frac{e^2}{4\pi\epsilon_0}$

ANS-19-

$$l = k (c)^a (G)^b \left( \frac{e^2}{4\pi\epsilon_0} \right)^c$$

Dim of  $l = L$

Dim of  $c = LT^{-1}$

Dim of  $\frac{e^2}{4\pi\epsilon_0} = ML^2T^{-2}$   
L for CGxmt<sup>2</sup>

$$F = \frac{GM_1M_2}{r^2}$$

$$G = \frac{F r^2}{M_1M_2}$$

$$= \frac{MLT^{-2}L^2}{M^2}$$

$$= M^{-1}L^3T^{-2}$$

$$M^0T^0L = k [LT^{-1}]^a [M^{-1}L^3T^{-2}]^b [ML^2T^{-2}]^c$$

$-b + c = 0, a + 3b + 3c = 1, -a - 2b - 2c = 0$

solving  $a = -2, b = 1/2, c = 1/2$

$$l = k (c)^{-2} (G)^{1/2} \left( \frac{e^2}{4\pi\epsilon_0} \right)^{1/2}$$

$$= \frac{k}{c^2} \sqrt{\frac{G e^2}{4\pi\epsilon_0}}$$

20. Two cars moving in opposite directions approach each other with speed of 22 m/s and 16.5 m/s respectively. The driver of the first car blows a horn having a frequency 400 Hz. The frequency heard by the driver of the second car is [velocity of sound 340 m/s]:

- (1) 350 Hz  
(2) 361 Hz  
(3) 411 Hz  
 (4) 448 Hz

ANS-20 (Doppler effect)

$$f_A = f \left( \frac{v + v_o}{v - v_s} \right)$$

$$= 400 \left( \frac{340 + 16.5}{340 - 22} \right) = 448 \text{ Hz}$$

21. In a common emitter transistor amplifier the audio signal voltage across the collector is 3 V. The resistance of collector is 3 k $\Omega$ . If current gain is 100 and the base resistance is 2 k $\Omega$ , the voltage and power gain of the amplifier is:

- (1) 200 and 1000  
(2) 15 and 200  
 (3) 150 and 15000  
(4) 20 and 2000

ANS-21

Current gain  $\beta = 100$

Voltage gain  $A_v = \beta \left( \frac{R_{\text{output}}}{R_{\text{input}}} \right)$

$$= 100 \left( \frac{3}{2} \right) = 150$$

Power gain =  $A_v \beta$

$$= 150 \times 100 \\ = 15000$$

22. Which one of the following represents forward bias diode ?



23. A spring of force constant  $k$  is cut into lengths in ratio  $1 : 2 : 3$ . They are connected in series and the new force constant is  $k'$ . Then they are connected in parallel and force constant is  $k''$ . Then  $k' : k''$  is :

(1) 1 : 6

(2) 1 : 9

(3) 1 : 11

(4) 1 : 14

ANS-22

FORWARD-BIAS → type at higher potential.  
with respect to n type

ANS-23

$$k \propto \frac{1}{l}$$

Let  $k_1 = 6k, k_2 = 3k, k_3 = 2k$

$$\frac{1}{k_{\text{SERIES}}} = \frac{1}{6k} + \frac{1}{3k} + \frac{1}{2k} \Rightarrow k_{\text{SERIES}} = k' = k$$

PARALLEL

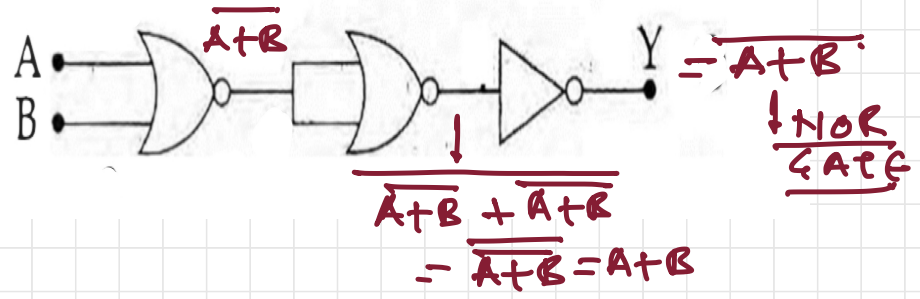
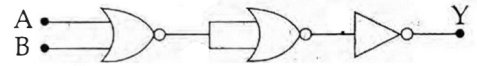
$$k_{\text{PARALLEL}} = 6k + 3k + 2k = 11k = k''$$

$$\frac{k'}{k''} = \frac{k}{11k} \Rightarrow k' : k'' = 1 : 11$$



24. The given electrical network is equivalent to :

ANS 24 →



- (1) AND gate
- (2) OR gate
- (3) NOR gate
- (4) NOT gate

25. The acceleration due to gravity at a height 1 km above the earth is the same as at a depth d below the surface of earth. Then :

ANS-25

$$g_{\text{above}} = g \left(1 - \frac{2h}{R}\right), \quad g_{\text{down}} = g \left(1 - \frac{d}{R}\right)$$

$$g_{\text{above}} = g_{\text{down}}$$

$$g \left(1 - \frac{2h}{R}\right) = g \left(1 - \frac{d}{R}\right)$$

$$\frac{2h}{R} = \frac{d}{R} \Rightarrow d = 2(1) = 2 \text{ km}$$

- (1)  $d = \frac{1}{2} \text{ km}$
- (2)  $d = 1 \text{ km}$
- (3)  $d = \frac{3}{2} \text{ km}$
- (4)  $d = 2 \text{ km}$

26. Which of the following statements are correct?

- (a) Centre of mass of a body always coincides with the centre of gravity of the body.
- (b) Centre of mass of a body is the point at which the total gravitational torque on the body is zero.
- (c) A couple on a body produce both translational and rotational motion in a body.
- (d) Mechanical advantage greater than one means that small effort can be used to lift a large load.

D (b) and (d)

- (2) (a) and (b)
- (3) (b) and (c)
- (4) (c) and (d)

KN 5-26 → Centre of mass may or may not coincide with centre of gravity.

Centre of mass → At a point where whole mass of the body is concentrated if an external force is applied at COM then torque will be zero.

CENTRE OF GRAVITY → point where torque of gravitational force is zero

Mechanical Advantage → =  $\frac{\text{output force}}{\text{input force}}$

if  $MA > 1$   
output  $>$  input  
means less effort is required to lift larger mass.

(4)

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27. A Carnot engine having an efficiency of  $\frac{1}{10}$  as a heat engine, is used as a refrigerator. If the work done on the system is  $10\text{ J}$ , the amount of energy absorbed from the reservoir at lower temperature is :

(1) 1 J

(2) 90 J

(3) 99 J

(4) 100 J

ANS-27

$$\beta = \frac{1-\eta}{\eta} = \frac{1-\frac{1}{10}}{\frac{1}{10}}$$

$$\beta = \frac{9}{10} \times \frac{10}{1} = 9 = \frac{Q_2}{W}$$

$$Q_2 = 9 \times 10$$

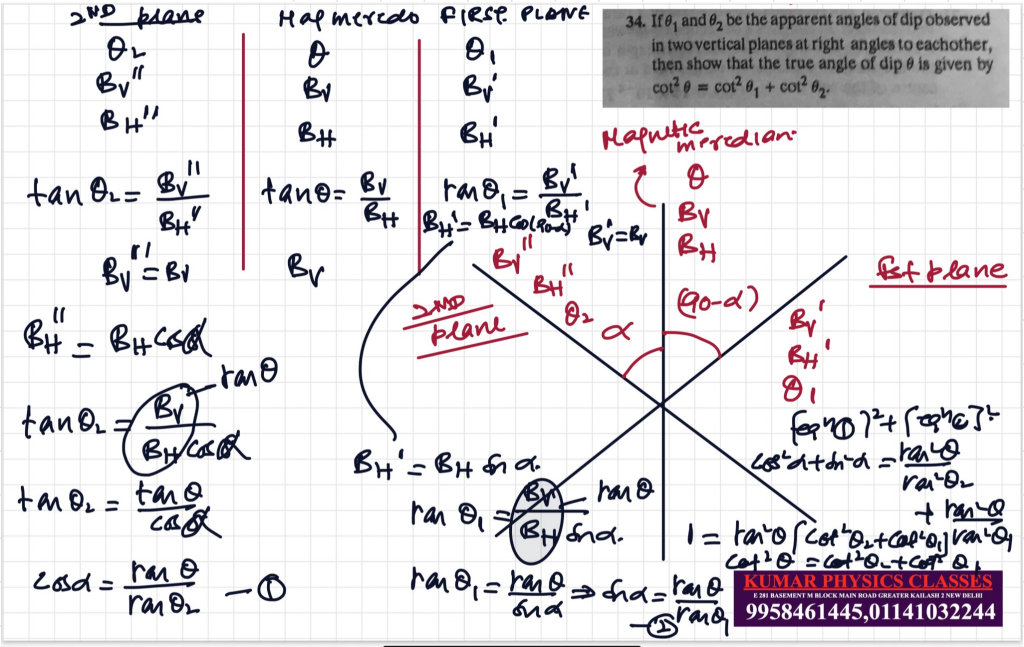
$$= 90\text{ J}$$

28. If  $\theta_1$  and  $\theta_2$  be the apparent angles of dip observed in two vertical planes at right angles to each other, then the true angle of dip  $\theta$  is given by :

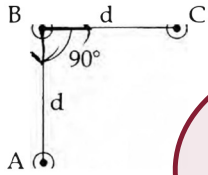
- (1)  $\cot^2\theta = \cot^2\theta_1 + \cot^2\theta_2$
- (2)  $\tan^2\theta = \tan^2\theta_1 + \tan^2\theta_2$
- (3)  $\cot^2\theta = \cot^2\theta_1 - \cot^2\theta_2$
- (4)  $\tan^2\theta = \tan^2\theta_1 - \tan^2\theta_2$

**VERY. IMP QUESTION**  
**ALSO ASKED IN CBSE BOARD**

34. If  $\theta_1$  and  $\theta_2$  be the apparent angles of dip observed in two vertical planes at right angles to each other, then show that the true angle of dip  $\theta$  is given by  $\cot^2\theta = \cot^2\theta_1 + \cot^2\theta_2$ .



29. An arrangement of three parallel straight wires placed perpendicular to plane of paper carrying same current 'I' along the same direction is shown in Fig. Magnitude of force per unit length on the middle wire 'B' is given by:



(1)  $\frac{\mu_0 i^2}{2\pi d}$

(2)  $\frac{2\mu_0 i^2}{\pi d}$

(3)  $\frac{\sqrt{2}\mu_0 i^2}{\pi d}$

✓ (4)  $\frac{\mu_0 I^2}{\sqrt{2}\pi d}$

$$\frac{F}{l} = \frac{\mu_0}{4\pi} \frac{2I_1 I_2}{a}$$

FOR MULA

30. Two astronauts are floating in gravitational free space after having lost contact with their spaceship. The two will:

(1) keep floating at the same distance between them.

✓ (2) move towards each other.

(3) move away from each other.

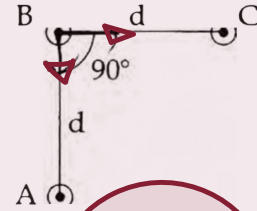
(4) will become stationary.

ANS-29

$$F_{BC} = F_{BA} = \frac{\mu_0 I^2}{2\pi d}$$

$$F_{NET} = \sqrt{2} F_{BC}$$

$$= \sqrt{2} \left( \frac{\mu_0 I^2}{2\pi d} \right) = \frac{\mu_0 I^2}{\sqrt{2}\pi d}$$



ANS-30 → Both astronauts are in the state of weightlessness

Therefore due to attraction they will move towards each other

31. In an electromagnetic wave in free space the root mean square value of the electric field is  $E_{\text{rms}} = 6 \text{ V/m}$ . The peak value of the magnetic field is:

- (1)  $1.41 \times 10^{-8} \text{ T}$
- (2)  $2.83 \times 10^{-8} \text{ T}$
- (3)  $0.70 \times 10^{-8} \text{ T}$
- (4)  $4.23 \times 10^{-8} \text{ T}$

32. The bulk modulus of a spherical object is 'B'. If it is subjected to uniform pressure 'p', the fractional decrease in radius is

- (1)  $\frac{p}{B}$
- (2)  $3p$
- (3)  $\frac{3p}{B}$
- (4)  $\frac{p}{3B}$

ANS-31

$$C = \frac{E_{\text{rms}}}{B_{\text{rms}}} = \frac{E_0}{B_0}$$

$$B_{\text{rms}} = \frac{E_{\text{rms}}}{C} = \frac{6}{3 \times 10^8} = 2 \times 10^{-8} \text{ T}$$

$$B_0 = \sqrt{2} B_{\text{rms}} = \sqrt{2} \times 2 \times 10^{-8}$$

$$= 2.83 \times 10^{-8} \text{ T}$$

ANS-32 Bulk modulus =  $\frac{P}{(-\Delta V/V)}$

$$V = \frac{4}{3} \pi r^3$$

$$\frac{\Delta V}{V} = 3 \cdot \frac{\Delta r}{r} \Rightarrow \frac{P}{B}$$

$$\frac{\Delta r}{r} = \frac{P}{3B}$$

33. The ratio of resolving powers of an optical microscope for two wavelengths  $\lambda_1 = 4000 \text{ \AA}$  and  $\lambda_2 = 6000 \text{ \AA}$  is:

- (1) 8 : 27  
 (2) 9 : 4  
 (3) 3 : 2  
 (4) 16 : 81

Resolving power  $\propto \frac{1}{\lambda}$   
 Remember

ANS-33

$$\frac{RP_1}{RP_2} = \frac{\lambda_2}{\lambda_1} = \frac{6000}{4000} = \frac{3}{2}$$

34. Consider a drop of rain water having mass 1g falling from a height of 1 km. It hits the ground with a speed of 50 m/s. Take 'g' constant with a value  $10 \text{ m/s}^2$ . The work done by the (i) gravitational force and the (ii) resistive force of air is:

- (1) (i) -10J (ii) -8.25J  
 (2) (i) 1.25J (ii) -8.25J  
 (3) (i) 100J (ii) 8.75J  
 (4) (i) 10J (ii) -8.75J

ANS-34

Work done by gravitational force  
 $= mgh$   
 $= 1 \times 10^{-3} \times 10 \times 10^3$   
 $= 10 \text{ J}$

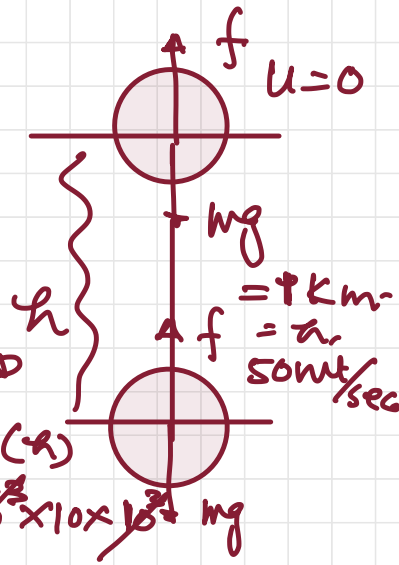
—  $K_f - K_i = \text{Total w.o}$

$$\frac{1}{2} m (50)^2 - \frac{1}{2} m (0)^2 = mgh - f(h)$$

$$-f(h) = \frac{1}{2} \times 10^{-3} \times 2500 - 10^{-3} \times 10 \times 10^3$$

$$= 1.25 - 10$$

$$= -8.75 \text{ J}$$



35. A spherical black body with a radius of 12 cm radiates 450 watt power at 500 K. If the radius were halved and the temperature doubled, the power radiated in watt would be:

- (1) 225  
 (2) 450  
 (3) 1000  
 ✓ (4) 1800

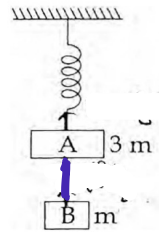
ANS-35 Rate of power loss

$$r_1 \propto R^2 T^4$$

$$\frac{r_1}{r_2} = \frac{R_1^2 T_1^4}{R_2^2 T_2^4} = 4 \times \frac{1}{16} = \frac{1}{4}$$

$$\frac{450}{r_2} = \frac{1}{4} \Rightarrow r_2 = 1800 \text{ watt}$$

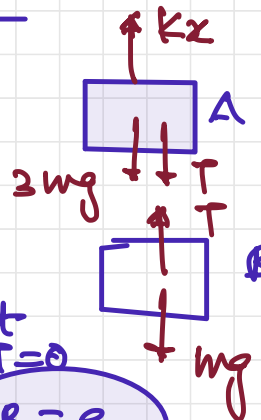
36. Two blocks A and B of masses 3m and m respectively are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in figure. The magnitudes of acceleration of A and B immediately after the string is cut, are respectively:



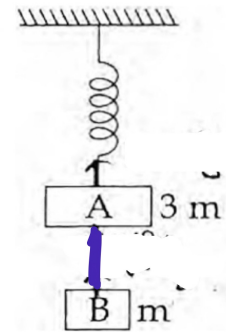
- (1)  $\frac{g}{3}, \frac{g}{3}$   
 ✓ (2)  $\frac{g}{3}, g$   
 (3)  $g, g$   
 (4)  $\frac{g}{3}, \frac{g}{3}$

ANS-36

FOR BLOCK A  
 $kx = T + 3mg$   
 FOR BLOCK B  
 $T = mg$



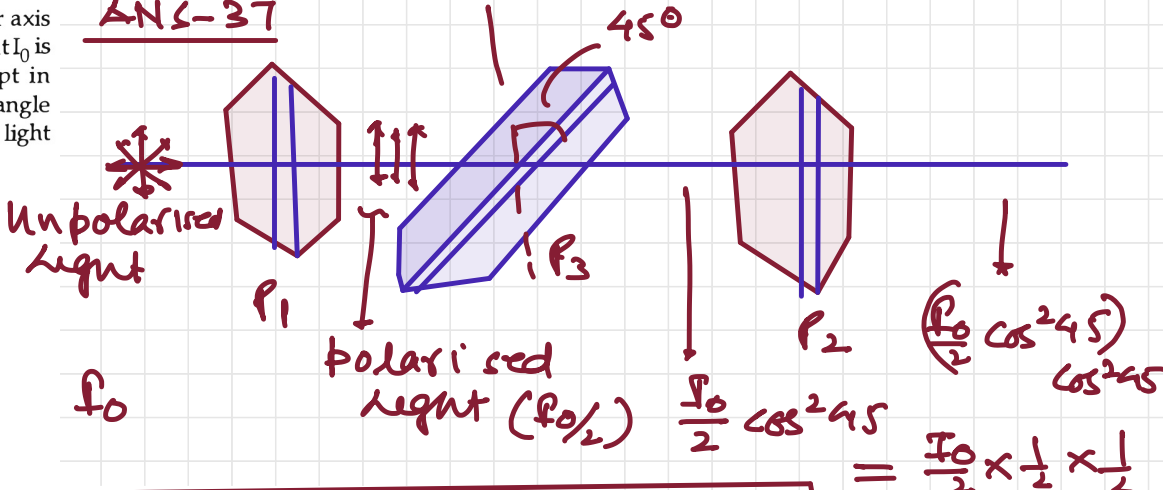
After string is cut  
 $kx = 4mg$   
 $T = 0$   
 $mg = m a_B \Rightarrow a_B = g$   
 $3mg - kx = 3m a_a$   
 $3mg - 4mg = 3m a_a \Rightarrow a_a = -\frac{g}{3} \uparrow$





ANS-37

37. Two Polaroids  $P_1$  and  $P_2$  are placed with their axis perpendicular to each other. Unpolarised light  $I_0$  is incident on  $P_1$ . A third polaroid  $P_3$  is kept in between  $P_1$  and  $P_2$  such that its axis makes an angle  $45^\circ$  with that of  $P_1$ . The intensity of transmitted light through  $P_2$  is



- (1)  $\frac{I_0}{2}$
- (2)  $\frac{I_0}{4}$
- ✓ (3)  $\frac{I_0}{8}$
- (4)  $I_0$

ANS-38

38. A long solenoid of diameter 0.1 m has  $2 \times 10^4$  turns per meter. At the centre of the solenoid, a coil of 100 turns and radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0A from 4 A in 0.05 s. If the resistance of the coil is  $10 \pi^2 \Omega$ , the total charge flowing through the coil during this time is :

$$e = -N \frac{d\phi}{dt}$$

$$\left| \frac{e}{R} \right| = \left| \frac{N}{R} \frac{d\phi}{dt} \right| = \left| \frac{dQ}{dt} \right|$$

$$dQ = \frac{N}{R} d\phi = \frac{d\phi_{TOTAL} (N)}{R}$$

$$= \frac{NBA}{R} = \frac{\mu_0 n i \pi r^2}{R}$$

$$= \frac{4\pi \times 10^{-7} \times 100 \times 4 \times \pi (0.01)^2}{10 \pi^2} = 32 \mu C$$

- ✓ (1)  $32 \pi \mu C$
- (2)  $16 \mu C$
- (3)  $32 \mu C$
- (4)  $16 \pi \mu C$

39. Two discs of same moment of inertia rotating about their regular axis passing through centre and perpendicular to the plane of disc with angular velocities  $\omega_1$  and  $\omega_2$ . They are brought into contact face to face coinciding the axis of rotation. The expression for loss of energy during this process is

ANS - 39  
↳ Theory For Your Understanding

व्यंजक होगा

(1)  $\frac{1}{2} I (\omega_1 + \omega_2)^2$

✓ (2)  $\frac{1}{4} I (\omega_1 - \omega_2)^2$

(3)  $I (\omega_1 - \omega_2)^2$

(4)  $\frac{1}{8} I (\omega_1 - \omega_2)^2$

$$\Delta K = \frac{1}{2} I \cdot I (\omega_1 \cup \omega_2)^2$$

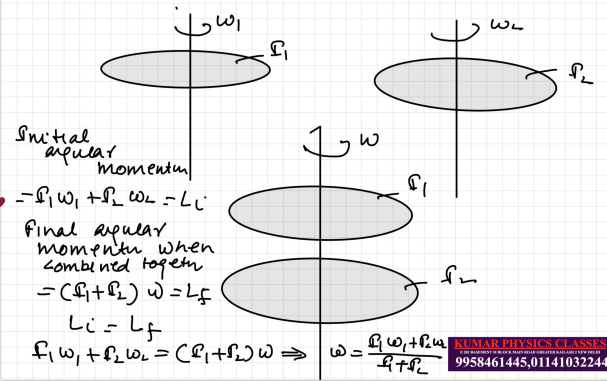
$$\Delta K = \frac{1}{4} I (\omega_1 \cup \omega_2)^2$$

$$= \frac{1}{2} \left[ \frac{I_1 I_2 (\omega_1^2 + \omega_2^2 - 2\omega_1 \omega_2)}{(I_1 + I_2)} \right]$$

$$= \frac{1}{2} \left[ \frac{I_1 I_2 (\omega_1 - \omega_2)^2}{(I_1 + I_2)} \right]$$

Hence  $(KE)_i > (KE)_f$   
 Hence loss of energy will be taking place.

↓  
 goes to in the form of heat ✓



$(KE)_{INITIAL} = \frac{1}{2} I_1 \omega_1^2 + \frac{1}{2} I_2 \omega_2^2$

$(KE)_{FINAL} = \frac{1}{2} (I_1 + I_2) \omega^2$

$(KE)_i - (KE)_f$

$= \frac{1}{2} I_1 \omega_1^2 + \frac{1}{2} I_2 \omega_2^2 - \frac{1}{2} (I_1 + I_2) \left( \frac{I_1 \omega_1 + I_2 \omega_2}{I_1 + I_2} \right)^2$

$= \frac{1}{2} \left[ I_1 \omega_1^2 + I_2 \omega_2^2 - \frac{(I_1 \omega_1 + I_2 \omega_2)^2}{(I_1 + I_2)} \right]$

$= \frac{1}{2} \left[ \frac{(I_1 \omega_1^2 + I_2 \omega_2^2)(I_1 + I_2) - (I_1 \omega_1 + I_2 \omega_2)^2}{(I_1 + I_2)} \right]$

$= \frac{1}{2} \left[ \frac{I_1^2 \omega_1^2 + I_1 I_2 \omega_1^2 + I_1 I_2 \omega_2^2 + I_2^2 \omega_2^2 - I_1^2 \omega_1^2 - 2 I_1 I_2 \omega_1 \omega_2 - I_2^2 \omega_2^2 - I_1 I_2 \omega_1^2 - I_1 I_2 \omega_2^2}{(I_1 + I_2)} \right]$

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40. Preeti reached the metro station and found that the escalator was not working. She walked up the stationary escalator in time  $t_1$ . On other days, if she remains stationary on the moving escalator, then the escalator takes her up in time  $t_2$ . The time taken by her to walk up on the moving escalator will be:

(1)  $\frac{t_1 + t_2}{2}$

(2)  $\frac{t_1 t_2}{t_2 - t_1}$

(3)  $\frac{t_1 t_2}{t_2 + t_1}$

(4)  $t_1 - t_2$

41. A rope is wound around a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force of 30 N?

(1) 25 m/s<sup>2</sup>

(2) 0.25 rad/s<sup>2</sup>

(3) 25 rad/s<sup>2</sup>

(4) 5 m/s<sup>2</sup>

ANS-40

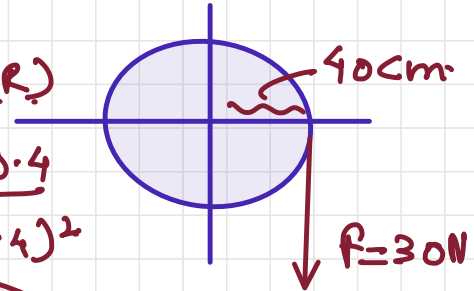
Velocity of preeti w.r.t elevator  
 $= \frac{d}{t_1} = v_{pe}$   
 Velocity of elevator w.r.t ground

$v_{eg} = \frac{d}{t_2}$   
 $v_{pe} = v_{pe} + v_{eg}$   
 $\frac{d}{t} = \frac{d}{t_1} + \frac{d}{t_2} \Rightarrow t = \frac{t_1 t_2}{t_1 + t_2}$

ANS-41

$\tau = I(\alpha) = F(R)$   
 $\alpha = \frac{FR}{I} = \frac{30 \times 0.4}{\frac{1}{2}(0.4)^2}$

$\alpha = 25 \text{ rad/sec}^2$



42. A beam of light from a source L is incident normally on a plane mirror fixed at a certain distance  $x$  from the source. The beam is reflected back as a spot on a scale placed just above the source L. When the mirror is rotated through a small angle  $\theta$ , the spot of the light is found to move through a distance  $y$  on the scale. The angle  $\theta$  is given by :

- (1)  $\frac{y}{2x}$   
 (2)  $\frac{y}{x}$   
 (3)  $\frac{x}{2y}$   
 (4)  $\frac{x}{y}$

43. The two nearest harmonics of a tube closed at one end and open at other end are 220 Hz and 260 Hz. What is the fundamental frequency of the system?

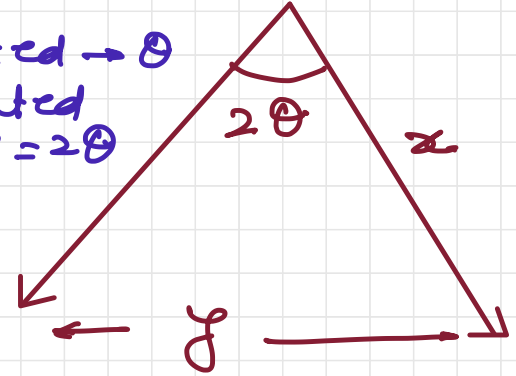
- (1) 10 Hz  
 (2) 20 Hz  
 (3) 30 Hz  
 (4) 40 Hz

ANS-42

Mirror  $\rightarrow$  rotated  $\rightarrow \theta$   
 Reflected ray rotated by  $= 2\theta$

$$2\theta = \frac{y}{x}$$

$$\theta = \frac{y}{2x}$$



ANS-43

$$\frac{n\lambda}{4l} = 220, \quad \frac{(n+2)\lambda}{4l} = 260$$

$$\frac{n+2}{n} = \frac{260}{220} = \frac{13}{11} \Rightarrow n = 11$$

$$11 \left( \frac{\lambda}{4l} \right) = 220, \quad \frac{\lambda}{4l} = 20$$

fundamental frequency = 20 Hz

44. A thin prism having refracting angle  $10^\circ$  is made of glass of refractive index 1.42. This prism is combined with another thin prism of glass of refractive index 1.7. This combination produces dispersion without deviation. The refracting angle of second prism should be:

- (1)  $4^\circ$   
 (2)  $6^\circ$   
 (3)  $8^\circ$   
 (4)  $10^\circ$

ANS-44  
FOR DISPERSION WITHOUT  
DEVIATION

$$(\mu_1 - 1) A_1 = (\mu_2 - 1) A_2$$

$$(1.42 - 1) \times 10^\circ = (1.7 - 1) A_2$$

$$A_2 = \frac{(0.42)(10)}{(0.7)} = 6^\circ$$

45. The resistance of a wire is 'R' ohm. If it is melted and stretched to 'n' times its original length, its new resistance will be:

- (1) nR  
 (2) R  
 (3)  $n^2R$   
 (4)  $\frac{R}{n^2}$

ANS-45

$$R = \frac{\rho l_1}{A_1} \quad | \quad R' = \frac{\rho l_2}{A_2}$$

Volume will remain constant

$$A_1 l_1 = A_2 l_2$$

$$A_1 (\cancel{l_1}) = A_2 (n)(\cancel{l_1}) \Rightarrow \frac{A_1}{A_2} = n \Rightarrow \frac{A_2}{A_1} = \frac{1}{n}$$

$$\frac{R}{R'} = \frac{\rho l_1 A_2}{A_1 \rho l_2} = \left(\frac{l_1}{n l_1}\right) \left(\frac{1}{n}\right)$$

$R' = n^2 R$

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