PHYSICS WALLAH

JEE MAINS 2024

Session - 1

Detailed Paper Analysis

MEMORY BASED QUESTIONS

LIVE

JEE MAIN 2024

ATTEMPT – 01 , 29^{TH} JAN 2024 , SHIFT - 02

PAPER DISCUSSION

PHYSICS

A physical quantity Q is described by the relation $Q = a^4b^3/c^2$. If the relative errors in the measurement of a, b and c is 3%, 4% and 5% respectively, then the percentage error in Q will be :

(A) 34 Ans

(B) 14

(C) 24

(D) 36

$$Q = \frac{a^4 b^3}{c^2}$$

$$\%Q = 4(\%a) + 3(\%b) + 2(\%c)$$

$$= 4(3) + 3(4) + 2(5)$$

$$= 24 + 10$$

$$= 34\%$$

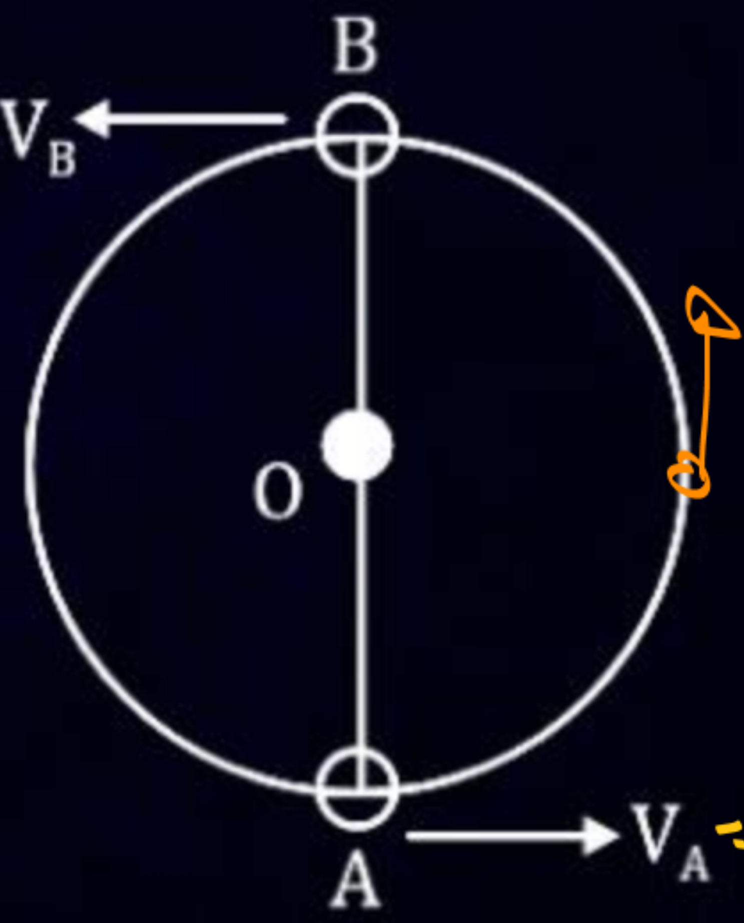
A particle is tied to a rope. It is moving such that it just completes the vertical circle. Find the ratio of kinetic energy at lower most point and upper most point respectively.

(A) 4 : 1

(B) 5 : 1

(C) 2 : 1

(D) 3 : 1



The displacement of a particle changing with time as $x = 6t^3 - 12t^2 + 20\,t + 30$. Find the velocity (in m/s) of the particle when its acceleration became zero. (t is time in s)

$a = 0 \quad v = ?$

$x = 6t^3 - 12t^2 + 20t + 30$

$v = \frac{dx}{dt} = 18t^2 - 24t + 20$

$a = \frac{dv}{dt} = 36t - 24$

$0 = 36t - 24$

$t = \frac{24}{36} = 2/3$

$v = 18 \times \frac{4}{9} - 24 \times \frac{2}{3} + 20$

$= 8 - 16 + 20$

$= 28 - 16 = 12$

In the given circuit, find the best suitable value of R in ohms

A) $30\,\Omega$ Ans

B) $40\,\Omega$

C) $20\,\Omega$

D) $10\,\Omega$

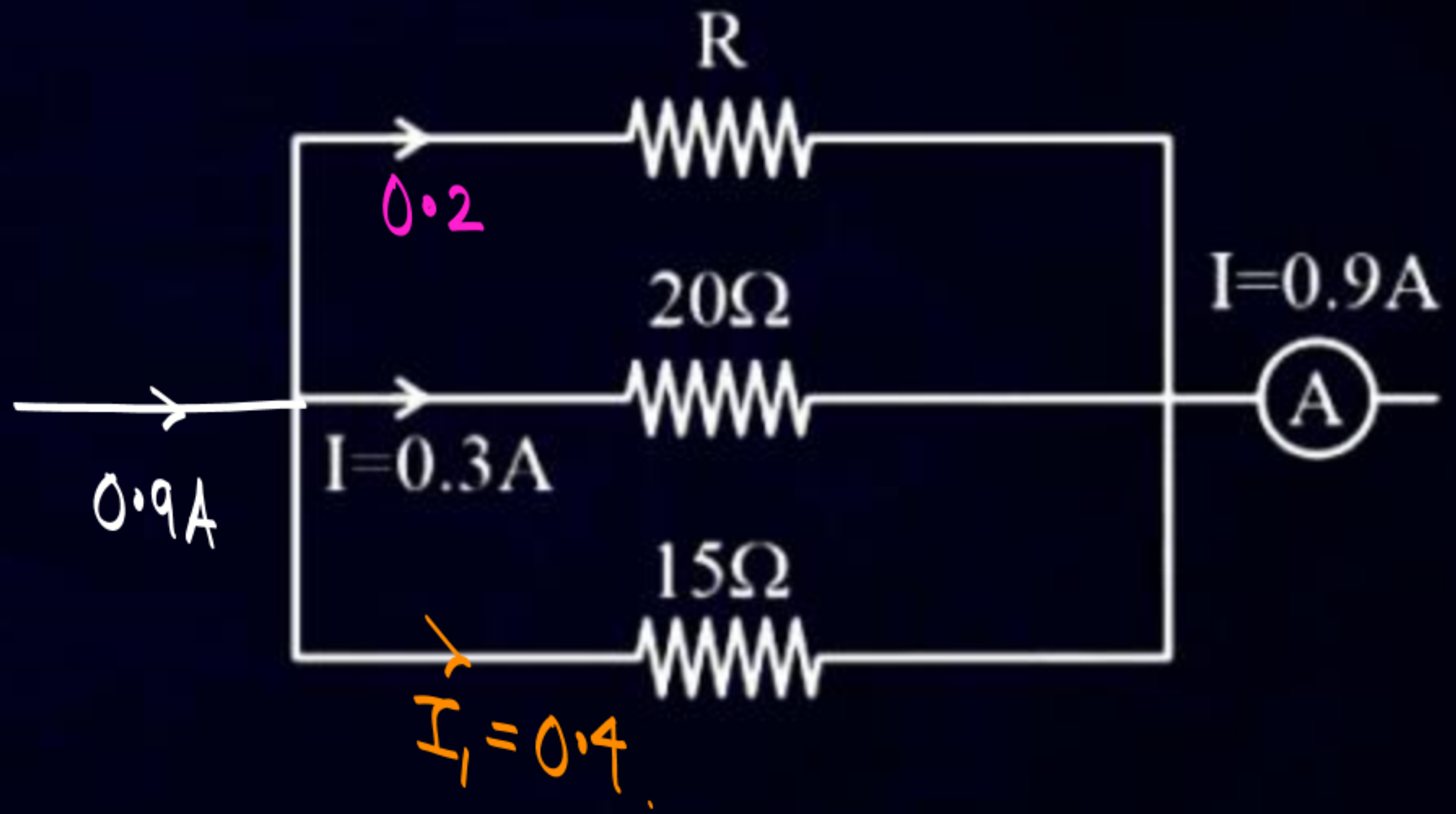
$20 \times 0.3 = I_1 \times 15$

$\frac{6}{15} = I_1 = 0.4$

$R \times 0.2 = 20 \times 0.3$

$R \frac{2}{10} = 6$

$R = 30\,\Omega$



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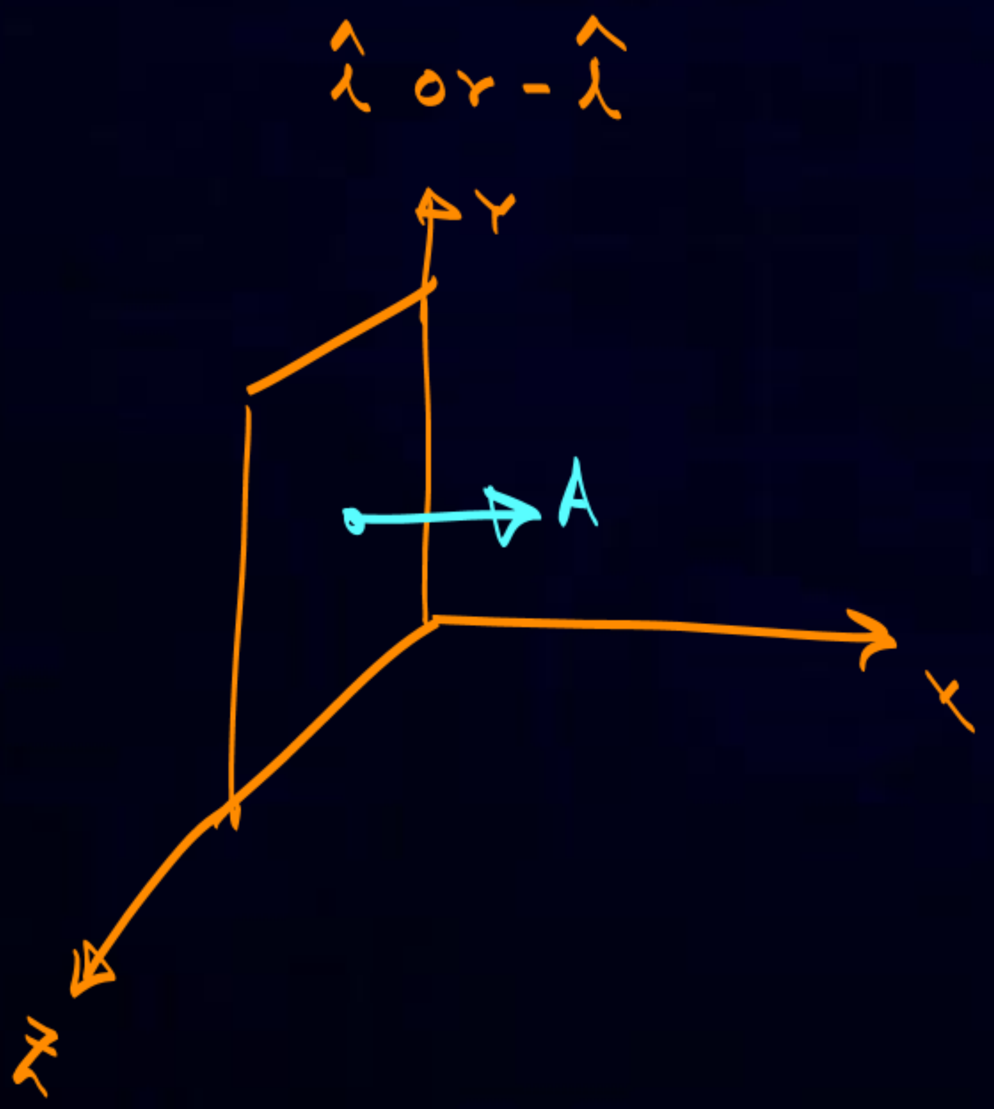
Electric field in a region is given by $(6\hat{i} + 5\hat{j} + 3\hat{k})N/c$, find flux passing through a surface of area 30 m^2 which is in y - z plane.



(A) 120

(B) 140

(C) 150

(D) 180 Ans

$E = 6\hat{i} + 5\hat{j} + 3\hat{k}$.

$A = 30\hat{i}$

$\phi = \vec{E} \cdot \vec{A} = 30 \times 6 = 180$

Consider a rod moving in an uniform magnetic field as shown in the diagram below. The induced emf across the ends of the rod is

(A) 3 mV Ans

(B) 6 mV

(C) 0 mV

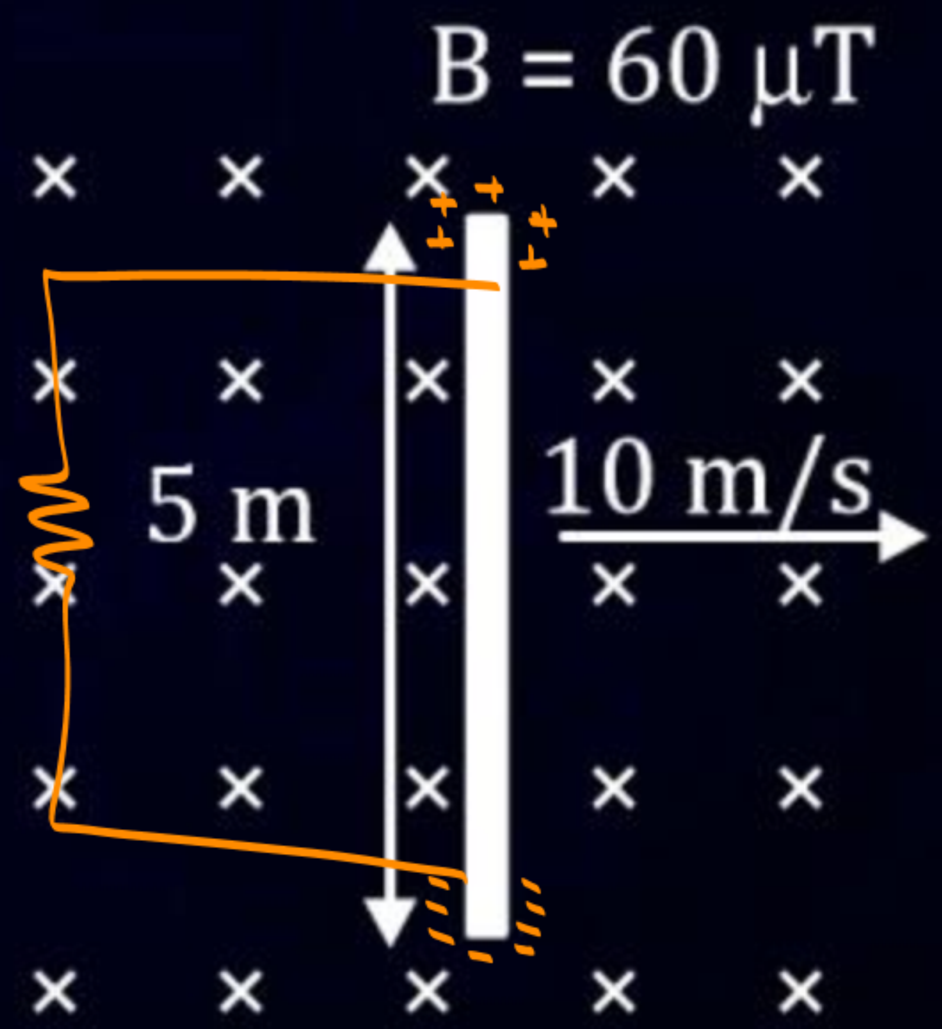
(D) 1 mV

$\vec{v} \times \vec{B}$ = +ve Terminal

$E = Blv$

$= 60 \times 10^{-6} \times 5 \times 10$

$= 3 \times 10^{-3} = 3\,mV$



In a simple pendulum of length 10 m, string is initially kept horizontal and the bob is released. 10% of energy is lost till the bob reaches lowermost position. Then find speed of bob at lowermost position.,

(A) 6 m/s

(B) $6\sqrt{5}$ m/s ✓ Ans

(C) $7\sqrt{5}$ m/s

(D) $4\sqrt{2}$ m/s

$90\% \, E_i = KE$

$\frac{90}{100} \times mgl = \frac{1}{2} m v^2$

$90 = v^2$

$v = \sqrt{90 \times 2} = \sqrt{9 \times 5 \times 4}$

$= 6\sqrt{5}$

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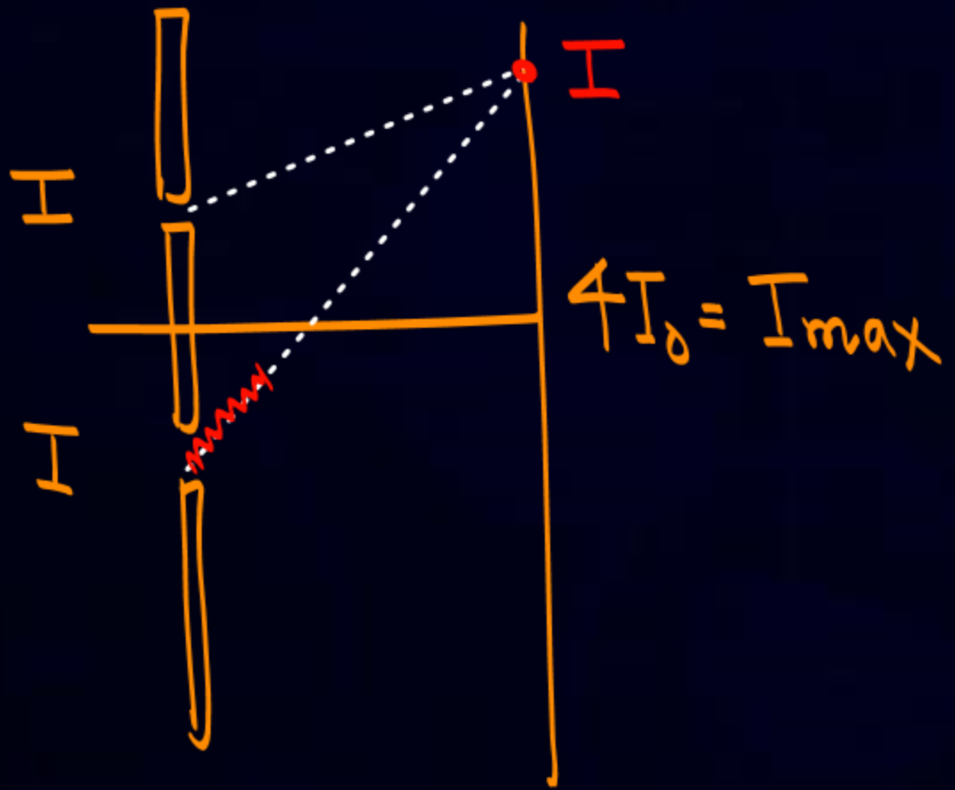
The intensity at each slit are equal for a YDSE and it is maximum I_{max} at central maxima. If I is intensity for phase difference $7\pi/2$ between two waves at screen. Then I/I_{max} is ?

Ans
(A) 1/2 ✓

(B) 1/4

(C) 3/8

(D) $1/\sqrt{2}$



$\phi = \frac{7\pi}{2}$

$I = 4I_0 \cos^2\left(\frac{\phi}{2}\right)$

$I = I_{max}\left(\cos\frac{7\pi}{4}\right)^2$

$I = I_{max}(\cos 315)^2$

$I = I_{max}\left(\frac{1}{2}\right)$

$I/I_{max} = 1/2$

If in Ques path diff is mentioned $\boxed{\Delta\phi = \frac{2\pi}{\lambda}\cdot\Delta x}$

dir of B = $(\hat{K})$

dir of EF = Y

An electromagnetic wave has electric field given by $\vec{E} = (9.6\hat{j})\sin\left[2\pi\left\{30 \times 10^6 t - \frac{1}{10}x\right\}\right]$ where, x and t are in S.I units. The max magnetic field is :

E_0

dir of Prop = +x

(A) 3.2×10^{-8} Ans

(B) 9.6×10^{-8}

(C) 1.7×10^{-8}

(D) 10^{-7}

$E_0 = B_0 c$

$B_0 = \frac{E_0}{c} = \frac{9.6}{3 \times 10^8} = 3.2 \times 10^{-8}$

$\bar{E} \cdot \bar{B} = 0$

$\bar{B} \cdot \bar{K} = 0$

$\bar{E} \cdot \bar{K} = 0$

$\vec{E} \times \vec{B} = \vec{K}$

$E_0 = B_0 C$

Same Phase of E & B

A planet at distance r from sun take 200 days to complete one revolution around the sun. what will be time period for a planate at distance r/4 from the sun ?

(A) 50 days

(B) 25 days ✓ Ans

(C) 100 days

(D) 12.5 days

$$\frac{T_2}{T_1} = \left(\frac{R_2}{R_1}\right)^{3/2}$$

$$T_2 = \left(\frac{r}{4 \cdot r}\right)^{3/2} \cdot 200$$

$$T_2 = \frac{1}{8} \times 200 = 25$$

$$T \propto R^{\frac{n+1}{2}}$$

Kepler's Law.

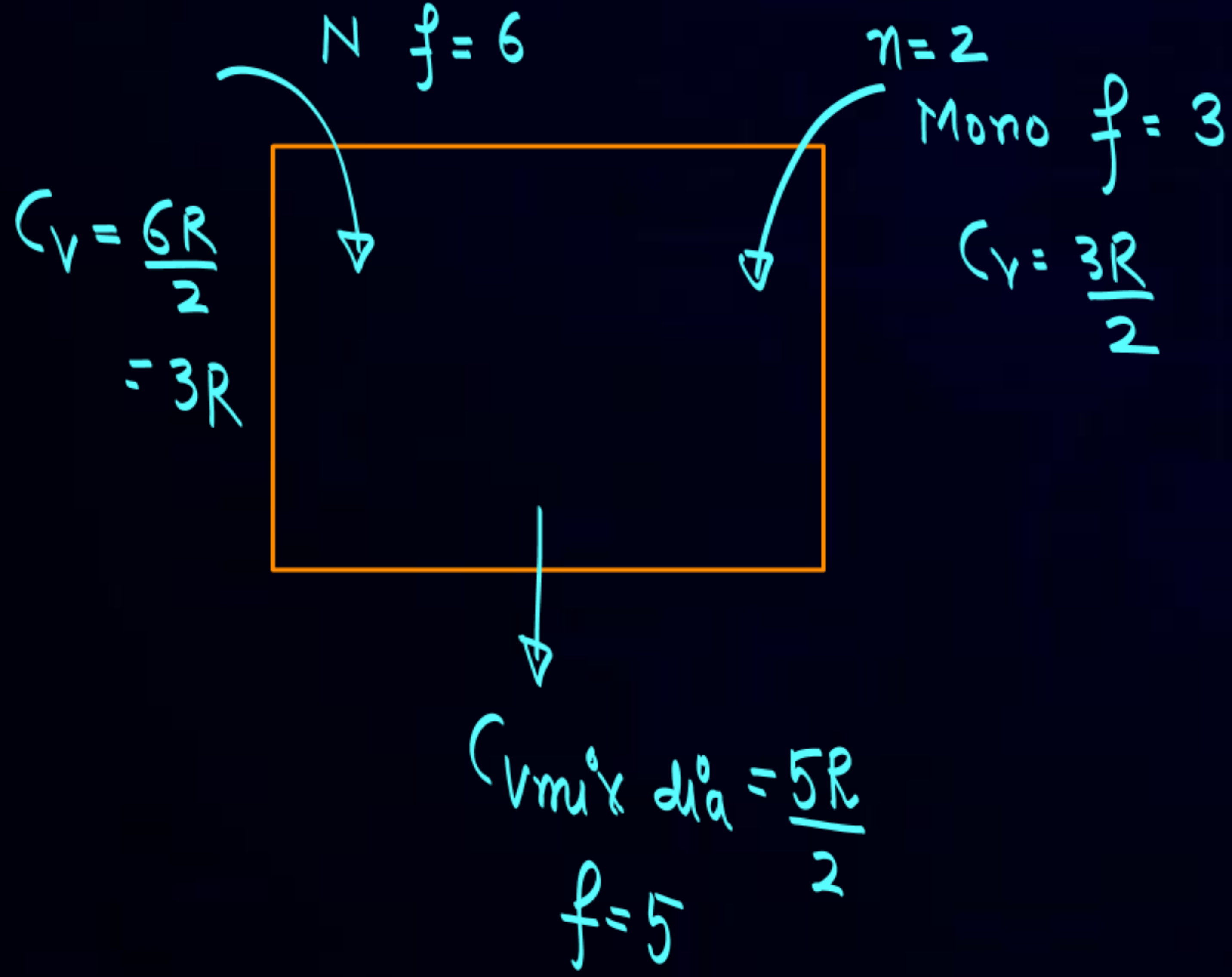
- $\frac{dA}{dt} = \frac{L}{2m}$
- $T^2 \propto R^3$ ⊛

⊛ valid only for $f \propto \frac{1}{r^2}$

$$f = mr\omega^2 = \frac{K}{r^n}$$

$$\frac{4\pi^2}{T^2} = \omega^2 \propto \frac{1}{r^{n+1}}$$

N moles of non – linear polyatomic gas (degree of freedom = 6) is mixed with 2 moles of monatomic gas. the resultant mixture has molar specific heat capacity at constant volume equal to that of a diatomic gas, then N is ....



$$C_{v\,mix} = \frac{n_1 C_{v_1} + n_2 C_{v_2}}{n_1 + n_2}$$

$$\frac{5R}{2} = \frac{N(3R) + 2\left(\frac{3R}{2}\right)}{N+2}$$

$$\frac{5}{2} = \frac{3N+3}{N+2}$$

$$5N + 10 = 6N + 6$$

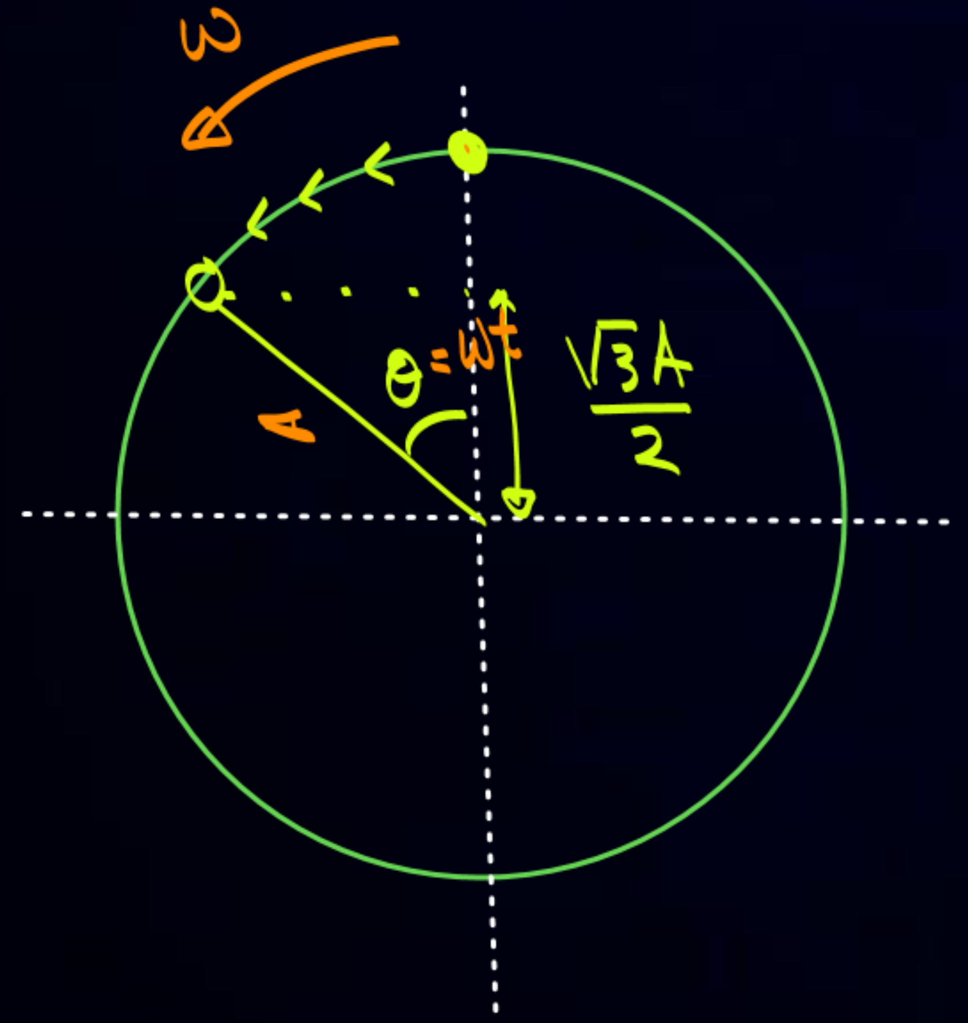
$$N = 4$$

$$C_{p\,mix} = \frac{n_1 C_{p_1} + n_2 C_{p_2}}{n_1 + n_2}$$

$$\gamma_{mix} = \frac{C_{p\,mix}}{C_{v\,mix}}$$

$$= \_\_\_\_$$

A particle starts oscillation from origin about x – axis with period of oscillation 6 s and amplitude A. If time take by particle to reach from $x = A$ to $x = \sqrt{3}A/2$ for the first time is τ. Then value of 6τ is __________ s.



$T = 6$ sec.

A

$\cos\theta = \frac{B}{H} = \frac{\sqrt{3}}{2}$

$\theta = 30^\circ = \frac{\pi}{6}$ Rad.

$\omega t = \frac{\pi}{6}$

$\frac{2\pi}{6} \cdot t = \frac{\pi}{6}$

$t = 1/2$

$6t = 6 \times \frac{1}{2} = 3$ Sec

In the circuit below, the charge on 6 μF when A and B are shorted is ___36___ μC.

"Steady state"

Open ckt

$R = 9\,\Omega$

$V = 9$

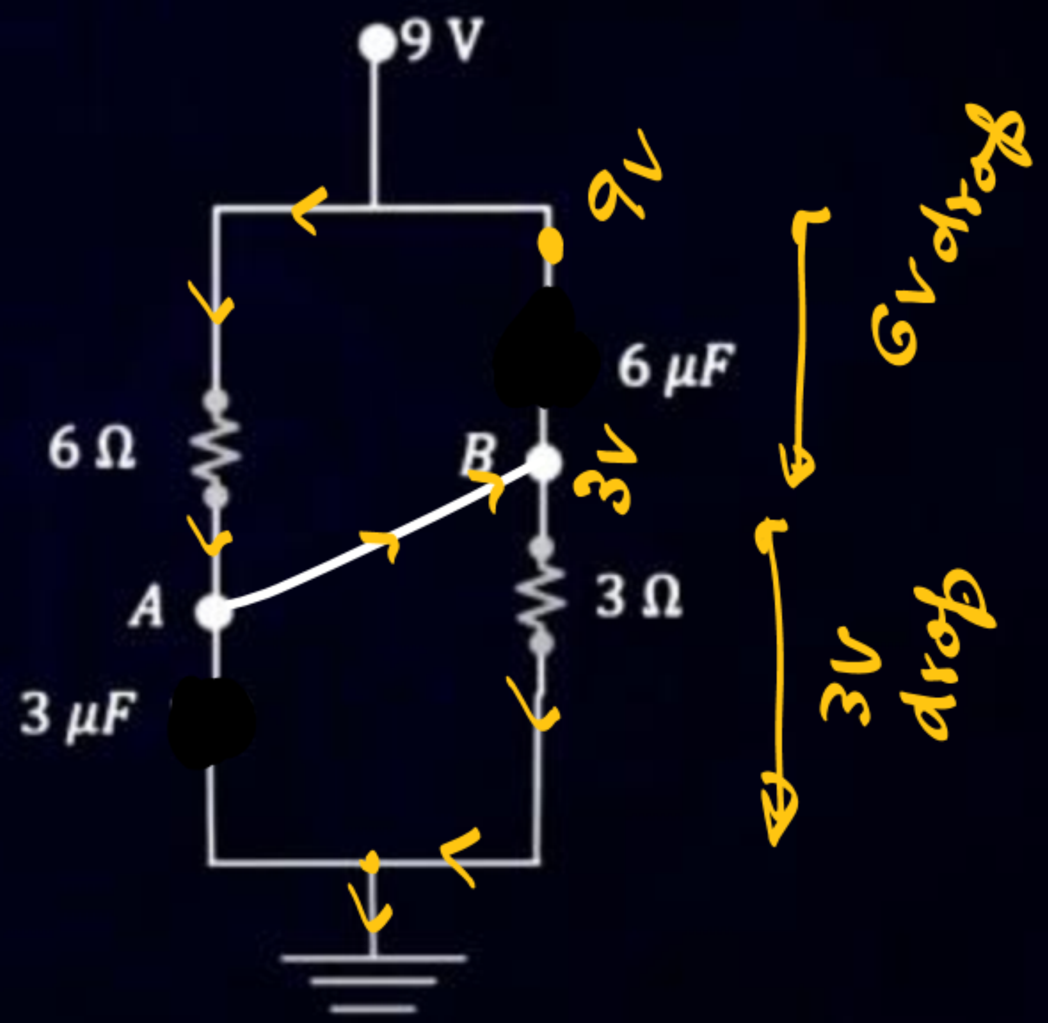
$I = 1\,A$

$Q = C(V_A - V_B)$

$= 6\,\mu F \times 6$

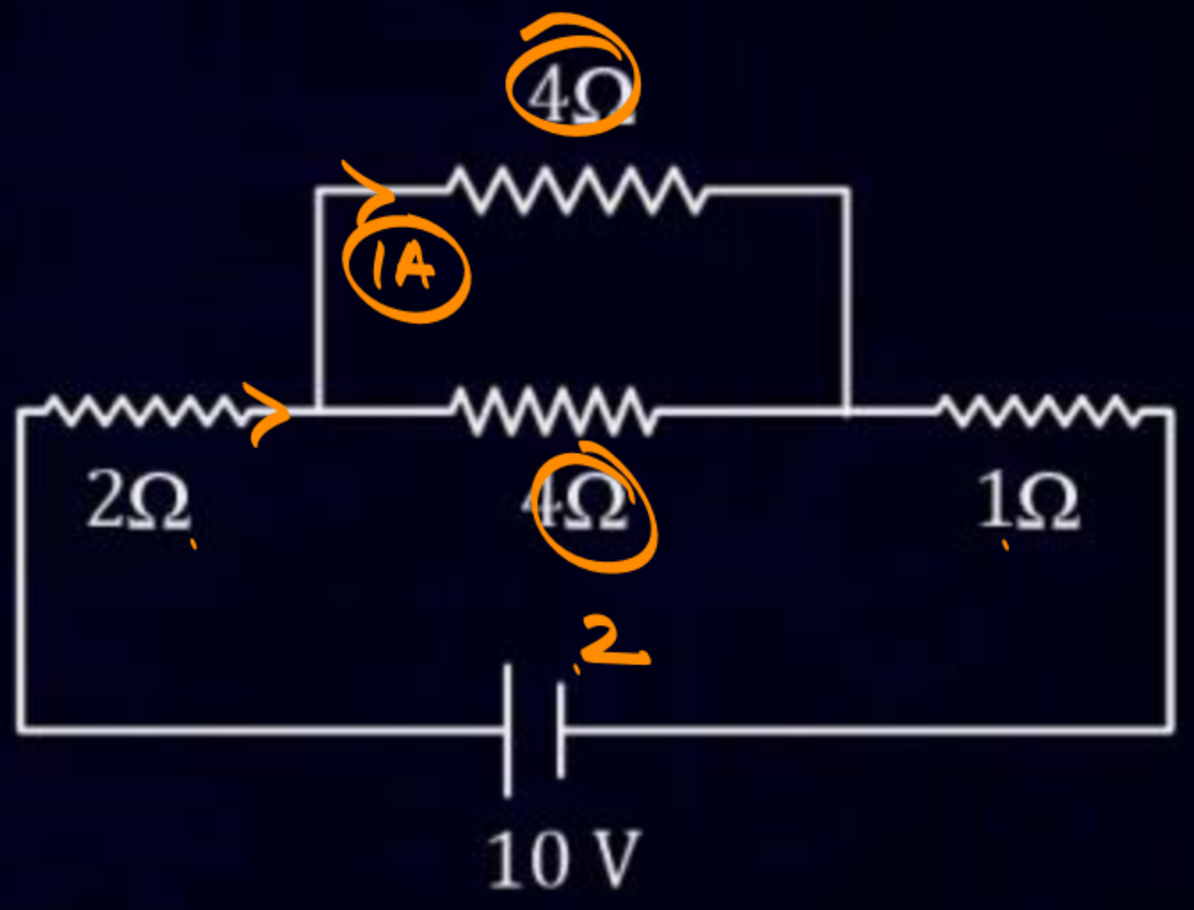
$= 36\,\mu C.$

$V = IR = 6V$



Find current in 4Ω resistor.

$I = 2A$



$KE = q\Delta V = qV$

Two particle X and Y having same charge are accelerated through same potential, and enters a uniform magnetic field perpendicular to it and perform circular motion with radius R_1 and R_2, then the ratio of their respective masses is :

(A) $(R_1/R_2)^2$ Ans

(B) $(R_2/R_1)^2$

(C) R_2/R_1

(D) R_1/R_2

q	q
V	V
R_1	R_2

$$R = \frac{mv}{qB} = \frac{P}{qB} = \frac{\sqrt{2mKE}}{qB} = \frac{\sqrt{2mV}}{qB} = R$$

$$R \propto \sqrt{m}$$

$$\frac{R_1}{R_2} = \left(\frac{m_1}{m_2}\right)^{1/2} \Rightarrow \frac{m_1}{m_2} = \left(\frac{R_1}{R_2}\right)^2$$

Two rods of same material and same volume with ratio of their radius 2 : 1 produce same extension on applying force F_1 and F_2 respectively, then find F_1/F_2.

(A) 16 : 1 ✓ Ans

(B) 1 ; 1

(C) 8 : 1

(D) 4 : 1

Y	Y
V	V
r_1	r_2
ΔL	ΔL
F_1	F_2

$$\frac{r_1}{r_2} = \frac{2}{1}$$

$$Y = \frac{FL}{A\Delta L}$$

$$F = \left(\frac{YA}{L}\right)\Delta L$$

$$\frac{F_1}{F_2} = \frac{A_1}{A_2} \times \frac{L_2}{L_1}$$

$$\pi r_1^2 L_1 = \pi r_2^2 L_2$$

$$\frac{L_1}{L_2} = \frac{r_2^2}{r_1^2}$$

$$\frac{F_1}{F_2} = \left(\frac{r_1}{r_2}\right)^2 \times \frac{L_2}{L_1} = \left(\frac{r_1}{r_2}\right)^2 \times \left(\frac{r_1}{r_2}\right)^2$$

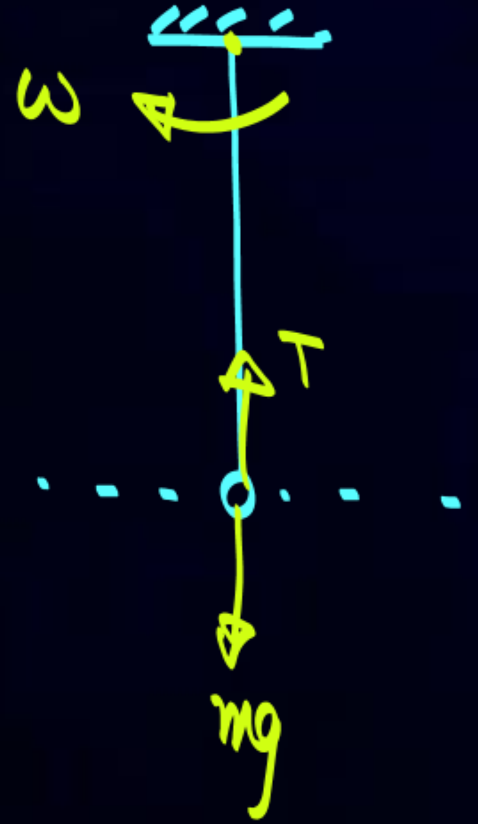
A bob of mass 900 gm of length 1 m is released from horizontal. Find the tension at its lowest point if it moves at 10 revolutions per minute there ($g = 9.8\ m/s^2$)

(A) 9.8 Ans

(B) 19.2

(C) 17.6

(D) 10



$T - mg = mr\omega^2$

$T = mg + mr\omega^2$

$= m\left[9.8 + \frac{\pi^2}{9}\right]$

$= \frac{900}{1000} \times 9.8 \times \frac{10}{9} = 9.8$

$\nu = 10\ rpm = \frac{10}{60}\ rps$

$\omega = 2\pi\nu = 2\pi \times \frac{1}{6} = \frac{\pi}{3}$

Determine the work required to split a drop of radius R into 27 identical smaller drops. surface tension is T.

(A) $8\pi R^2T$ ✓

(B) $4\pi R^2T$

(C) $2\pi R^2T$

$U_i = T(4\pi R^2)$

$U_f = 27\,T(4\pi r^2)$

$= 27\,T \cdot 4\pi \left(\frac{R}{3}\right)^2$

$= 3(4\pi T R^2)$

$W = U_f - U_i = 2(4\pi T R^2) = 8\pi T R^2$

$A = 4\pi R^2$ $\quad A_f = 27(4\pi r^2)$

$\frac{4}{3}\pi R^3 = 27\left(\frac{4}{3}\pi r^3\right)$

$R = 3r$

$r = R/3$

Find the output Y of the following logic gate.

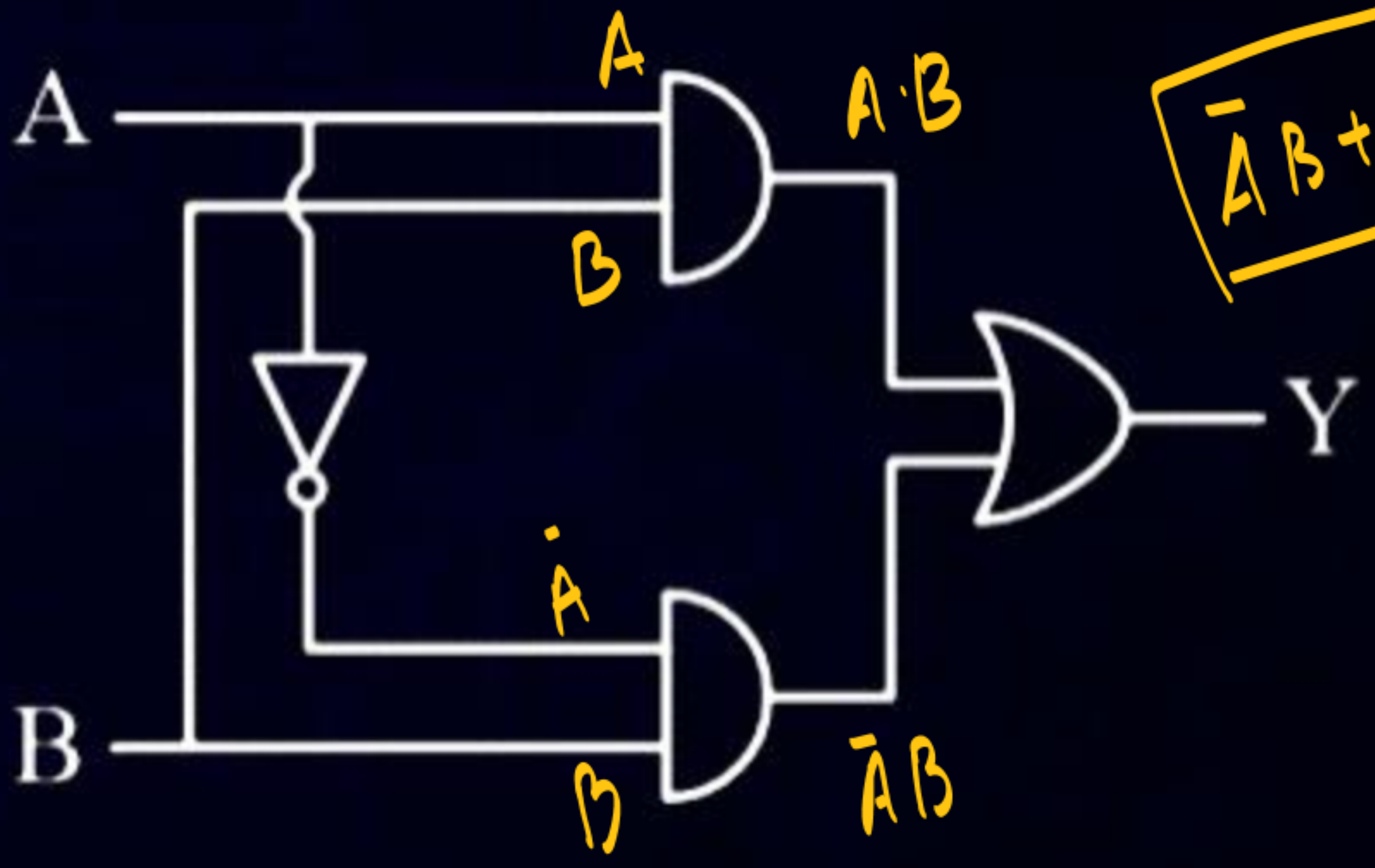
(A) $A \cdot B + \bar{A} \cdot B$ $= B[A + \bar{A}] = B$

(B) B $A \cdot B + \overline{\bar{A} \cdot B}$

(C) $A \cdot B + \bar{A} \cdot \bar{B}$

(D) $A.B + \overline{A \cdot B}$

A	B	Y
0	0	0
0	1	1
1	0	0
1	1	1



$\bar{A}B + AB$

The voltage and current for an AC sources is given by

$V = 100 \sin(\omega t)$ volt

$I = 100 \sin(\omega t + \pi/3)$ mA

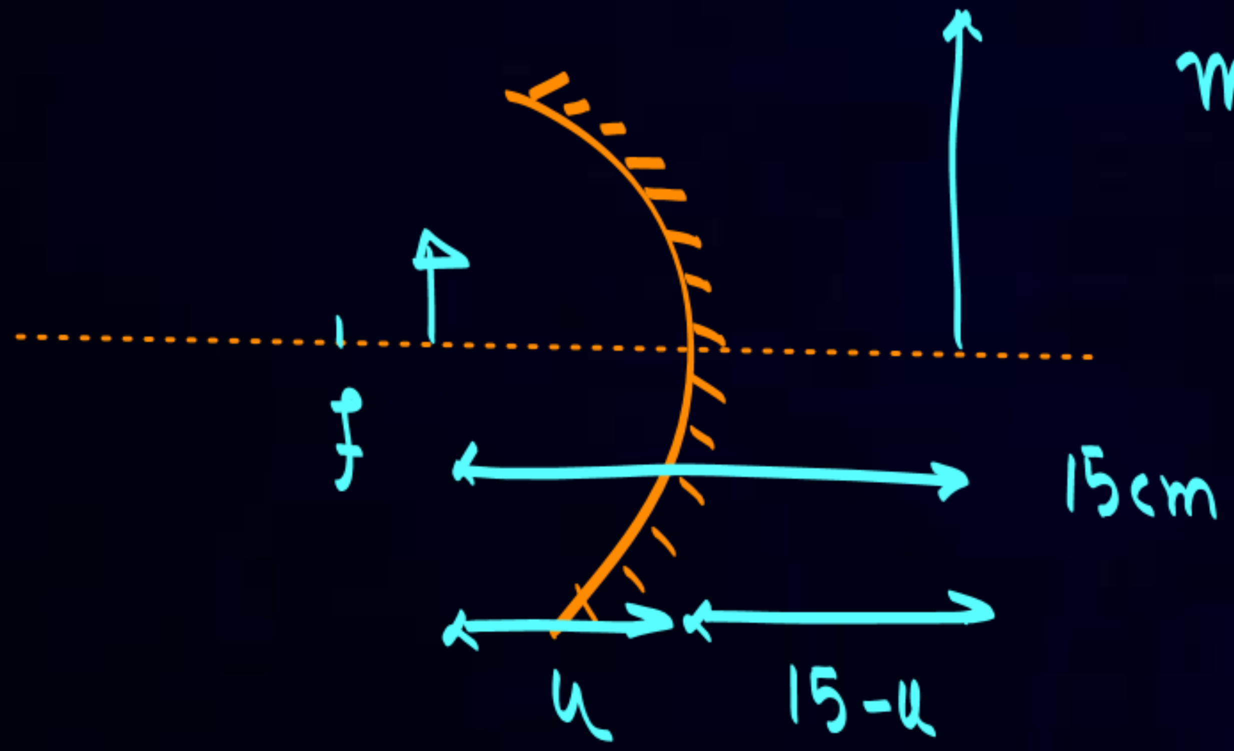
Calculate the average power loss.

$$P = V_{rms} I_{rms} \cos\phi$$

$$= \frac{100}{\sqrt{2}} \times \frac{100}{\sqrt{2}} \times 10^{-3} \times \cos\left(\frac{\pi}{3}\right)$$

$$=$$

A setup having concave mirror forms a virtual magnified image (m = 2). the separation between image and object is 15 cm. find the focal length of the mirror.



$m = +2 =$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{f} = \frac{1}{10} - \frac{1}{5}$

$f = -10$

$2 = -\frac{(15-u)}{-u}$

$2u = 15 - u$

$3u = 15$

$u = 5$

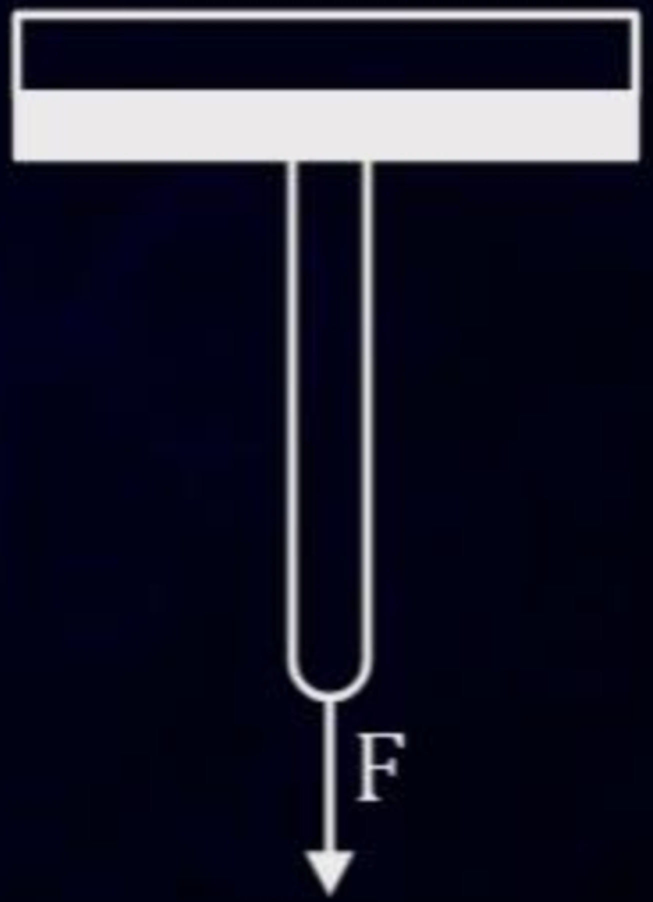
Two radiation of wavelength 300 nm and 500 nm are emitted from two identical source of power 25 watt. Find the ratio of number of photons emitted per second from each sources.

$\lambda_1 = 300 nm$ P
$\lambda_2 = 500 nm$. P.

$$n_p = \frac{P\lambda}{hc}$$

$$\frac{n_1}{n_2} = \frac{\lambda_1}{\lambda_2} = \frac{3}{5}$$

A uniform wire has length L and radius r. it is acted on by a force F as shown. the elongation is Δl. If F & r are both halved keeping L constant, the new elongation will be



(A) $\Delta l/2$

(B) Δl

(C) $4\Delta l$

(D) $2\Delta l$ ✓

$$Y = \frac{FL}{A\Delta L}$$

$$\Delta l \propto \frac{F}{A} \propto \frac{F}{r^2} \propto \frac{1}{2} \times 4 \propto 2$$

$$\Delta l_{new} = 2\Delta L$$

THANK YOU