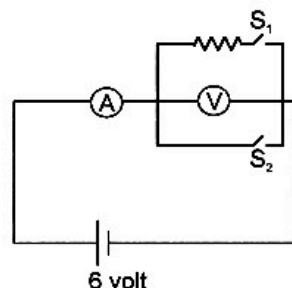
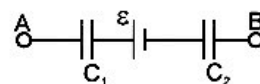


1. An ammeter and a voltmeter are initially connected in series to a battery of zero internal resistance. When switch S_1 is closed the reading of the voltmeter becomes half of the initial, whereas the reading of the ammeter becomes double. If now switch S_2 is also closed, then reading of ammeter becomes:

(A) $3/2$ times the initial value
 (B) $3/2$ times the value after closing S_1
 (C) $3/4$ times the value after closing S_1
 (D) $3/4$ times the initial value

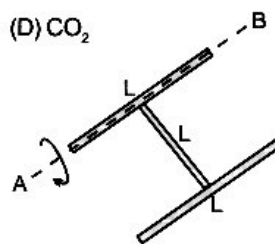


2. A circuit has a section AB shown in the figure. The emf of the source equals $\varepsilon = 10V$, the capacitance as of the capacitors are equal to $C_1 = 1.0 \mu F$ and $C_2 = 2.0 \mu F$, the potential difference $\phi_A - \phi_B = 5.0V$. The voltage across capacitor C_1 & C_2 is respectively :



- (A) $10/3 V$, $5/3 V$ (B) $10/3 V$, $10/3 V$ (C) $5/3 V$, $5/3 V$ (D) $0 V$, $0 V$
3. Under similar conditions of temperature and pressure, In which of the following gases the velocity of sound will be largest.
 (A) H_2 (B) N_2 (C) He (D) CO_2

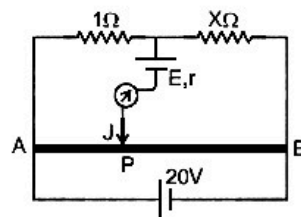
4. A rigid body is made of three identical thin rods fastened together in the form of letter H. The body is free to rotate about a fixed horizontal axis AB that passes through one of the legs of the H. The body is allowed to fall from rest from a position in which the plane of H is horizontal. What is the angular speed of the body when the plane of H is vertical. Top View of the figure in the initial position.



5. A man holding a flag is running in North-East direction with speed 10 m/s . Wind is blowing in east direction with speed $5\sqrt{2} \text{ m/s}$. Find the direction in which flag will flutter.

COMPREHENSION

AB is a uniform wire of meter bridge, across which an ideal 20 volt cell is connected as shown. Two resistor of 1Ω and $X \Omega$ are inserted in slots of metre bridge. A cell of emf E volts and internal resistance $r \Omega$ and a galvanometer is connected to jockey J as shown.



6. If $E = 16 \text{ volts}$, $r = 4 \Omega$ and distance of balance point P from end A is 90 cm , then the value of X is :
 (A) 3Ω (B) 6Ω (C) 9Ω (D) 12Ω
7. If $E = 16 \text{ volts}$, $r = 8 \Omega$ and $X = 9 \Omega$, then the distance of balance point P from end A is :
 (A) 10 cm (B) 30 cm (C) 60 cm (D) 90 cm
8. If $E = 12 \text{ volts}$, $X = 9 \Omega$, then distance of balance point P from end A is
 (A) 20 cm (B) 50 cm (C) 70 cm (D) Data insufficient

Answers Key

1. (B) 2. (A) 3. (A) 4. $\omega = \sqrt{\frac{9g}{4\ell}}$
 5. Flag will flutter in south direction. 6. (C)
 7. (D) 8. (C)

Hints & Solutions

1. Initially :-

$$V_v + V_A = 6 \quad \dots(1)$$

; V_v & V_A being the potential across voltmeter & ammeter respectively after closing S_1 .

$$\frac{V_v}{2} + 2V_A = 6 \quad \dots(2)$$

Solving (1) & (2)

$$V_v = 4, V_A = 2.$$

after closing S_2 :-

$$V_v = 0$$

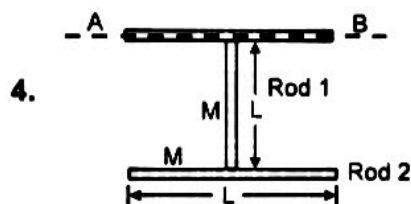
$$V_A = 6$$

So that value after closing S_2 is $3/2$ times the value after closing S_1 .

2. [Ans: $V_1 = \frac{10V}{3}$, $V_2 = \frac{5V}{3}$,]

3. The speed of sound in air is $v = \sqrt{\frac{\gamma RT}{M}}$

$\frac{\gamma}{M}$ of H_2 is least, hence speed of sound in H_2 shall be maximum.



Decrease in PE = Gain in rotational K.E.

$$Mg \frac{L}{2} + MgL = I_{R_3} = I_{R_1} + I_{R_2}$$

$$\frac{1}{2} \cdot \frac{4}{3} ML^2 \cdot \omega^2 = \frac{ML^2}{3} ML^2$$

$$\Rightarrow \frac{3}{2} MgL = \frac{2}{3} ML^2 \cdot \omega^2 = \frac{4ML^2}{3}$$

$$\Rightarrow \frac{9g}{4L} = \omega^2 \Rightarrow \omega = \sqrt{\frac{9g}{4L}}$$

[Ans.: $\omega = \sqrt{\frac{9g}{4\ell}}$]

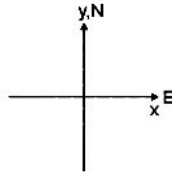
5. From given data

$$\vec{V}_M = 5\sqrt{2} \hat{i} + 5\sqrt{2} \hat{j}$$

velocity of man

Velocity of wind

$$\vec{V}_W = 5\sqrt{2} \hat{i}$$



The flag will flutter in the direction in which wind is blowing with respect to the man holding the flag.

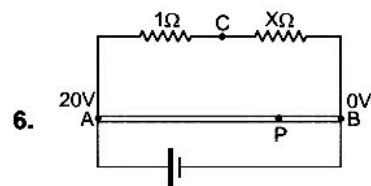
$$\Rightarrow \vec{V}_{WM} = \vec{V}_W - \vec{V}_M$$

$$\vec{V}_{WM} = (5\sqrt{2} \hat{i}) - (5\sqrt{2} \hat{i} + 5\sqrt{2} \hat{j})$$

$$\vec{V}_{WM} = -5\sqrt{2} \hat{j} = 5\sqrt{2} (-\hat{j})$$

This implies direction of wind with respect to man in south.

Flag will flutter in south direction. Ans.



Let reference potential of B be zero. No current shall flow through galvanometer.

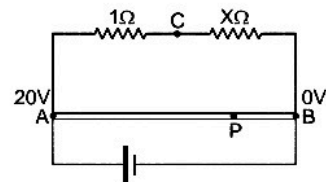
$$\text{If } V_C - V_P = 16 \text{ volts.}$$

$$\text{Now } V_P = 2 \text{ volts.}$$

$$\therefore V_C \text{ should be } 18 \text{ volts.}$$

$$\text{Now } \frac{V_A - V_C}{1} = \frac{V_C - V_B}{X}$$

$$\text{Solving } X = 9\Omega.$$



7. Balance point is independent of r . It can be seen for balance point at P, $V_C - V_P = E$ in absence of cell, jockey and galvanometer.

8. For balance point at P.

$$V_C - V_P = E = 12$$

$$\therefore V_C = 18, V_P \text{ should be } 6 \text{ volts.}$$

Therefore

$$\frac{V_A - V_P}{\ell} = \frac{V_P - 0}{100 - \ell} \text{ or } \ell = 70 \text{ cm.}$$