PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 52

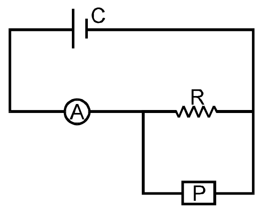
Total Marks : 25

Max. Time : 26 min.

Topics : Current Electricity, Sound, Fluids, Capacitor, Rotation

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.5	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

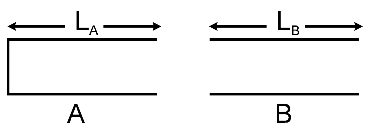
1. An ammeter A of finite resistance and a resistor R are joined in series to an ideal cell C. A potentiometer P is joined in parallel to R. The ammeter reading is I_0 & the potentiometer reading is V_0. P is now replaced by a voltmeter of finite resistance. The ammeter reading now is I and the voltmeter reading is V.



(A) $I > I_0$, $V > V_0$ (B) $I > I_0$, $V < V_0$

(C) $I = I_0$, $V < V_0$ (D) $I < I_0$, $V = V_0$.

2. The two pipes are submerged in sea water, arranged as shown in figure. Pipe A with length L_A = 1.5 m and one open end, contains a small sound source that sets up the standing wave with the second lowest resonant frequency of that pipe. Sound from pipe A sets up resonance in pipe B, which has both ends open. The resonance is at the second lowest resonant frequency of pipe B. The length of the pipe B is :



(A) 1 m (B) 1.5 m (C) 2 m (D) 3 m

3. A body of density ρ is dropped from rest from a height 'h' (from the surface of water) into a lake of density of water σ ($\sigma > \rho$). Neglecting all dissipative effects, the acceleration of body while it is in the lake is:

(A) $g\left(\frac{\sigma}{\rho}-1\right)$ upwards (B) $g\left(\frac{\sigma}{\rho}-1\right)$ downwards

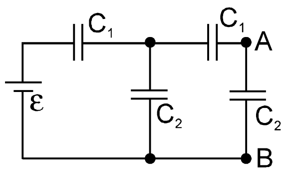
(C) $g\left(\frac{\sigma}{\rho}\right)$ upwards (D) $g\left(\frac{\sigma}{\rho}\right)$ downwards

4. In the above problem, the maximum depth the body sinks before returning is:

(A) $\frac{h\rho}{\sigma-\rho}$ (B) $\frac{h\rho}{\sigma+\rho}$

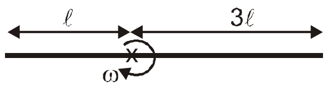
(C) $h\frac{\rho}{\sigma}$ (D) $h\frac{\sigma}{\rho}$

5. Find the potential difference between points A and B of the system shown in the figure, if the emf is equal to ε = 110V and the capacitance ratio $\frac{C_2}{C_1}$ = η = 2.0.



COMPREHENSION

A thin uniform rod having mass m and length 4ℓ is free to rotate about horizontal axis passing through a point distant ℓ from one of its end, as shown in figure. It is released, from the horizontal position as shown :



6. What will be acceleration of centre of mass at this instant

(A) $\frac{3g}{7}$ (B) $\frac{2g}{7}$ (C) $\frac{3g}{5}$ (D) $\frac{2g}{5}$

7. What will be normal reaction due to hinge at the instant of release

(A) mg (B) $\frac{mg}{2}$ (C) $\frac{4mg}{7}$ (D) $\frac{\sqrt{2}mg}{7}$

8. What will be angular velocity of rod when it becomes vertical

(A) $\sqrt{\frac{6g}{7\ell}}$ (B) $\sqrt{\frac{12g}{7\ell}}$ (C) $\sqrt{\frac{3g}{2\ell}}$ (D) $\sqrt{\frac{3g}{7\ell}}$

Answers Key

1. (B) **2.** (C) **3.** (A) **4.** (A)

5. $V_{AB} = \frac{\varepsilon}{(1+3\eta+\eta^2)}$ = 10V **6.** (A)

7. (C) **8.** (A)

2. (C) For pipe A, second resonant frequency is third harmonic thus $f = \frac{3V}{4L_A}$

For pipe B, second resonant frequency is second harmonic thus $f = \frac{2V}{2L_B}$

Equating, $\frac{3V}{4L_A} = \frac{2V}{2L_B}$

$\Rightarrow L_B = \frac{4}{3} L_A = \frac{4}{3}.(1.5) = \mathbf{2m.}$

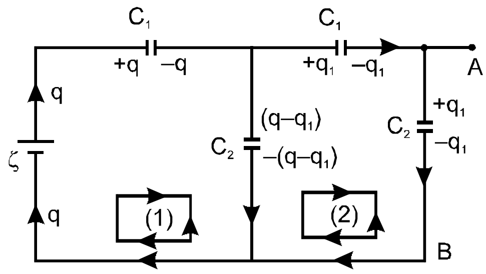
5. **[Ans: $V_{AB} = \frac{\varepsilon}{(1+3\eta+\eta^2)}$ = 10V]**

The distribution of charges is shown in fig. In closed loop (1)

$$\varepsilon - \frac{q}{C_1} - \frac{(q-q_1)}{C_2} = 0 \qquad ...(i)$$

In closed loop (2) $-\frac{q_1}{C_1} - \frac{q_1}{C_2} + \frac{q-q_1}{C_2} = 0$

or $q = \left(\frac{2C_1 + C_2}{C_1}\right) q_1$



From Eq. (i), $\varepsilon - \frac{q_1}{C_1} - \frac{q}{C_2} + \frac{q_1}{C_2} = 0$

or $\varepsilon + \frac{q_1}{C_2} = q\left(\frac{C_1+C_2}{C_1C_2}\right)$

or $\varepsilon + \frac{q_1}{C_2} = \left(\frac{2C_1+C_2}{C_1}\right) q_1 \left(\frac{C_1+C_2}{C_1C_2}\right)$

$$\therefore \quad q_1 = \frac{\varepsilon C_2 C_1^2}{C_1^2 + 3C_1C_2 + C_2^2}$$

$$\therefore \quad \phi_A - \phi_B = \left|\frac{-q_1}{C_2}\right| = \frac{q_1}{C_2}$$

$$= \frac{\varepsilon C_1^2}{C_1^2 + 3C_1C_2 + C_2^2}$$

$$= \frac{\varepsilon}{1 + 3\frac{C_2}{C_1} + \frac{C_2^2}{C_1^2}}$$

$$= \frac{\varepsilon}{1 + 3\eta + \eta^2} \qquad = 10V$$

$$\left(\because \frac{C_2}{C_1} = \eta = 2\right)$$

6. Torque equation

$$\tau_{Hinge} = I_{Hinge} \propto$$

$$mg\,\ell = \left(\frac{m(4\ell)^2}{12} + m\ell^2\right) \propto$$

$$\frac{3g}{7\ell} = \propto$$

Tangential acceleration = $\propto \ell = \frac{3g}{7\ell}$

Radial acceleration = $\omega^2 \ell = 0$

Ans. $\frac{3g}{7}$

7. $mg - N_1 = m\left(\frac{3g}{7}\right)$

$$N_1 = \frac{4mg}{7}$$

$$N_2 = 0$$

8. Energy conservation

$$mg\,\ell = \frac{1}{2} \cdot \frac{7}{3} m\ell^2 \omega^2$$

$$\sqrt{\frac{6g}{7\ell}} = \omega$$