PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 51

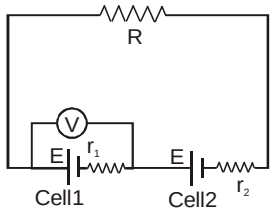
Total Marks : 25

Max. Time : 25 min.

Topics : Current Electricity, Capacitance, Sound, Electrostatics

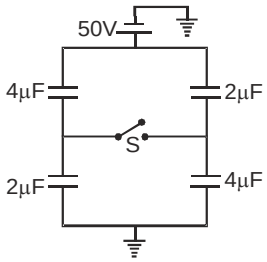
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Multiple choice objective ('–1' negative marking) Q.4	(4 marks, 4 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.5 to Q.8	(3 marks, 3 min.)	[12, 12]

1. In the circuit shown, cells are of equal emf E but of different internal resistances $r_1 = 6\Omega$ and $r_2 = 4\Omega$. Reading of the ideal voltmeter connected across cell 1 is zero. Value of the external resistance R in ohm is equal to-



(A) 2 (B) 2.4 (C) 10 (D) 24

2. The circuit was in the shown state for a long time. Now if the switch S is closed then the net charge that flows through the switch S, will be



(A) $\frac{400}{3}\ \mu C$ (B) 100 μC

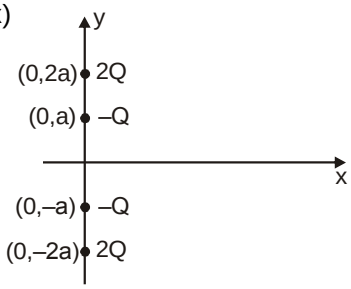
(C) $\frac{100}{3}\ \mu C$ (D) 50 μC

3. The equation of displacement due to a sound wave is $s = s_0 \sin^2(\omega t - kx)$. If the bulk modulus of the medium is B, then the equation of pressure variation due to that sound is

(A) $B k s_0 \sin(2\omega t - 2kx)$ (B) $-B k s_0 \sin(2\omega t - 2kx)$

(C) $B k s_0 \cos^2(\omega t - kx)$ (D) $-B k s_0 \cos^2(\omega t - kx)$

4. Four point charges are fixed on y-axis as shown in figure. When a positive test charge at origin is given a finite impulse along positive x-axis,



which of the following is/are correct option/options :

(A) Test charge may pass through origin with same momentum once again.

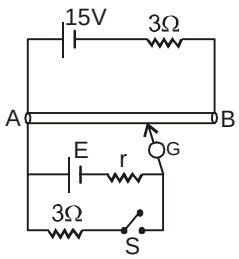
(B) Test charge must return at origin at least once.

(C) Test charge may perform SHM on x-axis.

(D) Test charge may reach upto infinite distance on positive x-axis.

COMPREHENSION

A wire AB (of length 1m , area of cross section πm^2) is used in potentiometer experiment to calculate emf and internal resistance (r) of battery. The emf and internal resistance of driving battery are 15 V and 3Ω respectively. The resistivity of wire AB varies as $\rho = \rho_0 x$ (where x is distance from A in meters and $\rho_0 = 24\pi\ \Omega$)



The distance of null point from A is obtained at $\sqrt{\frac{2}{3}}$ m when switch 'S' is open and at $\frac{1}{\sqrt{2}}$ m when switch is closed.

5. The resistance of whole wire AB is -

(A) 6Ω (B) 12Ω (C) 18Ω (D) 24Ω

6. The current through 15 V battery (with $I_G = 0$)

(A) is 1 A only when switch S is closed (B) is 1A only when switch S is open

(C) is 1A in both cases (D) can not be calculated.

7. The emf (E) of battery is -

(A) 4V (B) 6V (C) 8V (D) 10V

8. Internal resistance of battery E is -

(A) 4Ω (B) 3Ω (C) 2Ω (D) 1Ω

Answers Key

1.	(A)	**2.**	(D)	**3.**	(A)	**4.**	(A) (C) (D)
5.	(B)	**6.**	(C)	**7.**	(C)	**8.**	(D)

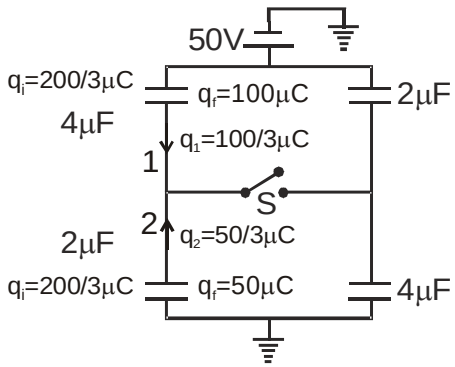
Hints & Solutions

1. $E - ir_1 = 0 \Rightarrow i = \dfrac{E}{r_1}$ and $i = \dfrac{2E}{r_1 + r_2 + R}$

Therefore $R = r_1 - r_2$

$= 2\ \Omega$

2.

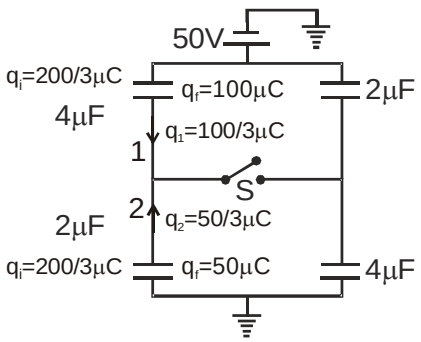


Initial and final charges are marked on 4μf and 2μf capacitors as shown.

Hence charge passing through segment 1 and 2 are

$q_1 = \dfrac{100}{3}\mu C$ $\qquad$ $q_2 = \dfrac{50}{3}\mu C$

$\therefore$ charge through switch = $q_1 + q_2 = 50\ \mu C$.

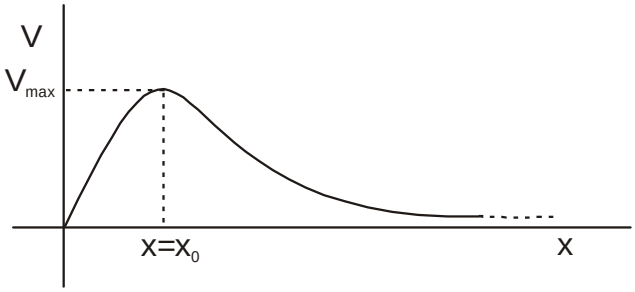


3. The equation of pressure variation due to sound is

$$p = -B\frac{ds}{dx} = -B\frac{d}{dx}[s_0 \sin^2(\omega t - kx)]$$

$$= B k s_0 \sin(2\omega t - 2kx)$$

4.



$x = x_0$ is the point where potential is maximum. So, if the impulse is sufficient enough and point charge crosses the maximum PE barrier than point charge will move to infinity otherwise it will perform oscillatory motion and for very small impulse the motion may be SHM.

Sol.(69-72)

Resitance of wire AB is -

$$R_{AB} = \left(\frac{\rho_0 \ell}{2}\right)\frac{\ell}{A} = \frac{24\pi}{2\pi} = 12\Omega \qquad \left\{R = \int_0^1 \frac{\rho dx}{A}\right\}$$

Current in wire AB is $I = \frac{15}{12+3} = 1A$

when switch is open, null point at C (AC = x)

$$R_{AC} = \left(\frac{\rho_0 x}{2}\right)\left(\frac{x}{A}\right) = \frac{\rho_0 x^2}{2A} = \frac{24\pi\frac{2}{3}}{2\pi} = 8\Omega$$

EMF E = 1 × 8 = 8 V

when switch closed null point at D (AD = x)

$$R_{AD} = \left(\frac{\rho_0 x}{2}\right)\left(\frac{x}{A}\right) = \frac{\rho_0 x^2}{2A} = \frac{24\pi\frac{1}{2}}{2\pi} = 6\Omega$$

$\Delta V_{\text{battery}} = 6 \times 1$

$\Delta V_{\text{बैटरी}} = 6 \times 1$

$$8 - \frac{8}{r+3}r = 6$$

$r = 1\ \Omega$