PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 57

Total Marks : 26

Max. Time : 28 min.

Topics : Heat, Simple Harmonic Motion, Current Electricity, Kinematics, Capacitance

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Subjective Questions ('–1' negative marking) Q.3 to Q.4	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1' negative marking) Q.5 to Q.8	(3 marks, 3 min.)	[12, 12]

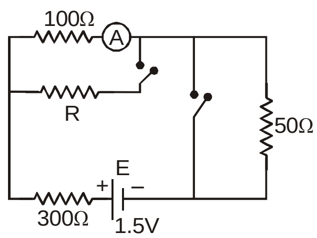
1. A wall has two layer A and B each made of different material, both the layers have the same thickness. The thermal conductivity of the material A is twice that of B. Under thermal equilibrium the temperature difference across the wall B is 36^0C. The temperature difference across the wall A for the flow of heat through its thickness is

(A) 6^0C (B) 12^0C (C) 18^0C (D) 24^0C

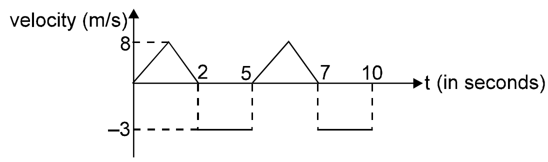
2. If the length of a simple pendulum is doubled then the % change in the time period is :

(A) 50 (B) 41.4 (C) 25 (D) 100

3. In the circuit shown, the reading of the ammeter (ideal) is the same with both switches open as with both closed. Find the value of resistance R in ohm.

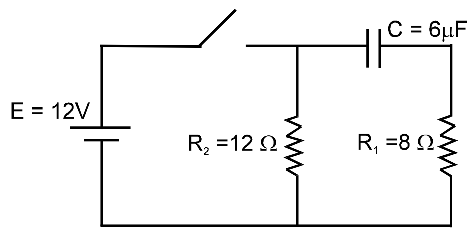


4. A particle moves along X axis. At t = 0 it was at x = – 1. It's velocity varies with time as shown in the figure. Find the number of times the particle passes through the origin in t = 0 to t = 10 sec.



COMPREHENSION

The circuit contains ideal battery E and other elements arranged as shown. The capacitor is initially uncharged and switch S is closed at t = 0. (use $e^2 = 7.4$)



5. Time constant of the circuit is

(A) 48 μs (B) 28.8 μs (C) 72 μs (D) 120 μs

6. The potential difference across the capacitor in volts, after two time constants, is approximately :

(A) 2 (B) 7.6 (C) 10.4 (D) 12

7. The potential difference across resistor R_1 after two time constants, is approximately :

(A) 1.6 V (B) 7.6 V (C) 10 V (D) 12 V

8. The potential difference across resistor R_2 after two time constants, is :

(A) 2V (B) 7.6V (C) 10V (D) 12 V

Answers Key

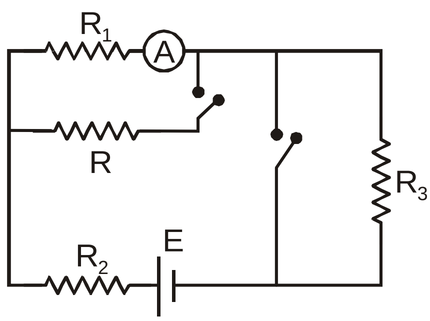
1.	(C)	**2.**	(B)	**3.**	600	**4.**	4 times
5.	(A)	**6.**	(C)	**7.**	(A)	**8.**	(D)

Hints & Solutions

2. $\frac{\Delta T}{T}\times 100 = \frac{1}{2}\frac{\Delta \ell}{\ell}\times 100$ is not valid as $\Delta\ell$ is not small.

$T_1 = 2\pi\sqrt{\frac{\ell}{g}}$ $T_2 = 2\pi\sqrt{\frac{2\ell}{g}}$ % change = $\frac{T_2 - T_1}{T_1}$ × 100 = $(\sqrt{2}-1)\times 100$ = 41.04.

3. Switches open :



$$I_A = \frac{E}{R_1 + R_2 + R_3}$$

Switches closed :

There will be no current through R_3.

Current through E and R_2

$$I' = \frac{E}{R_2 + \frac{RR_1}{R + R_1}}$$

Current through the ammeter

$$I'_A = \frac{RI'}{R + R_1} = \frac{RE}{(R + R_1)R_2 + RR_1}$$

$$= \frac{E}{R_1 + R_2 + \frac{R_2R_1}{R}}$$

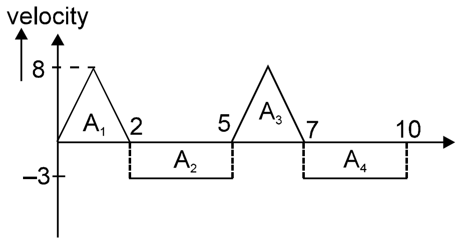
As $I_A = I'_A$

$$R = \frac{R_1 R_2}{R_3} = \frac{100 \times 300}{50} = 600\ \Omega$$

4. 4 times

$A_1 = A_3 = 8$ (area)
$A_2 = A_4 = 9$
Position of the particle at any time t is given by

$$X = X_0 + \int_0^t V dt \qquad X_0 = \text{Initial position}$$



$$\int_0^t V dt = \text{Area under the curve}$$

Now at t = 0 $X = X_0 = -1$
at t = 2 $X = X_0 + A_1 = -1 + 8 = 7$
at t = 5 $X = X_0 + A_1 - A_2 = -1 + 8 - 9$
$= -2$
t = 7 $X = X_0 + A_1 - A_2 + A_3 = -1 + 8 - 9 + 8$
$= 6$
t = 10 $X = X_0 + A_1 - A_2 + A_3 - A_4 = -1 + 8 - 9 + 8 - 7 = 3$
As during 10 seconds four times the position of the particle changed in sign. Particles passes 4 times the origin

5. Once the switch is closed, the capacitor is charged through resistance R_1 by the battery's e.m.f. Time constant is R_1 C.

6. Using $V_c = E(1 - e^{-t/RC})$
$\Rightarrow V_c = 12(1 - e^{-2})$
$= 10.4$ V

7. At any moment in the circuit –

$V_c + V_{R_1} = 12$ V

$\Rightarrow V_{R_1} = 12\text{ V} - 10.4\text{ V}$
$= 1.6$ V

8. If loop law is applied to the left hand loop in clockwise direction

$E - V_{R_2} = 0$

$V_{R_2} = E = 12$ V

i.e. V_{R2}
does not change during the charging process.