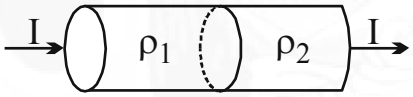
PHYSICS: **Max.Marks : 60**

SECTION I

Single Correct Answer Type

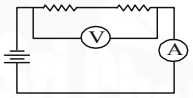
This section contains **10 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

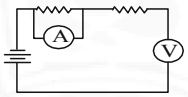
1. Two long straight cylindrical conductors with resistivities ρ_1 and ρ_2 respectively are joined together as shown in figure. The radius of each of the conductor is a. If a uniform total current I flows through the conductors, the magnitude of the total free charge at the interface of the two conductor is

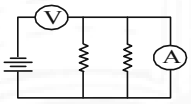


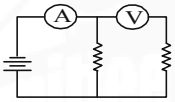
A) zero B) $\frac{(\rho_1-\rho_2)I\varepsilon_0}{2}$ C) $\varepsilon_0 I|\rho_1-\rho_2|$ D) $\varepsilon_0 I(\rho_1+\rho_2)$

2. It is required to measure equivalent resistance of circuit with ideal battery, ideal voltmeter & ideal ammeter. Which circuit diagram shows voltmeter V and ammeter A correctly positioned to measure the total resistance of circuit.

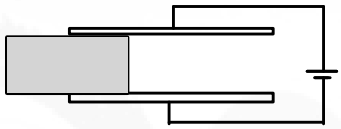
A) 

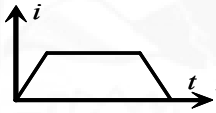
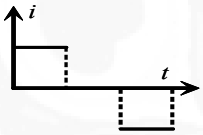
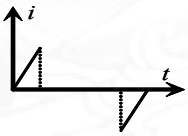
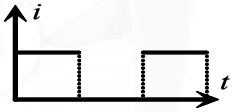
B) 

C) 

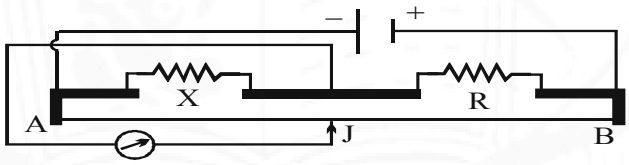
D) 

3. Dielectric slab of area A passes between the capacitor plates of area 2A with a constant speed v. The variation of current (i) through the circuit as function of time (t) can be qualitatively represented as (the length of dielectric slab is half the length of the capacitor plates.)



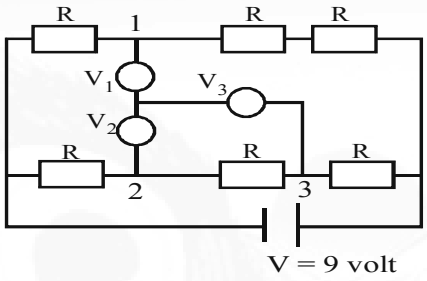
A)  B)  C)  D) 

4. The figure shows a meter-bridge circuit, $X = 12\Omega$ and $R = 18\Omega$. The jockey J is in the position of balance. If R is made 8Ω, through what distance will the jockey J have to be moved to obtain balance?



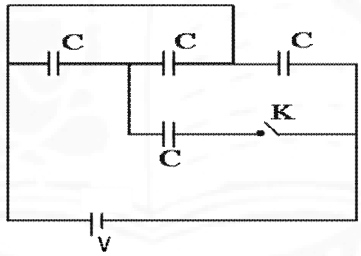
A) 10 cm B) 20 cm C) 30 cm D) 40 cm

5. In the circuit shown below, all three voltmeters are identical and ideal. Each resistor has the same given resistance R. Voltage V is also given to be 9V. Find the reading of voltmeter V_3 (in volts).



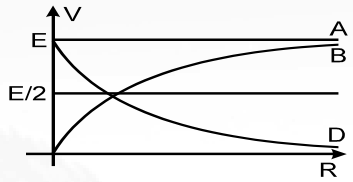
A) 1 B) 2 C) 3 D) 4

6. Find the amount by which the total energy stored in the capacitors will increase (in μJ) in the circuit shown in the figure after switch K is closed?
[C = 3μF, V = 10 Volt]



A) 50 μJ B) 75 μJ C) 100 μJ D) 125 μJ

7. A cell of emf E having an internal resistance 'r' is connected to an external resistance R. The potential difference 'v' across the resistance R varies with R as shown by the curve:

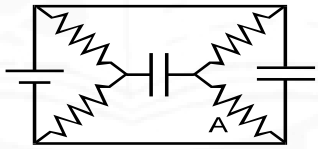


A) A B) B C) C D) D

8. ' n' identical light bulbs, each designed to draw P power from a certain voltage supply are joined in series and that combination is connected across that supply. The power consumed by one bulb will be

A) n p B) p C) p/n D) p/n^2

9. Each resistor in the following circuit has a resistance of 2MΩ and the capacitors have capacitances of 1μF. The battery voltage is 3V. The voltage across the resistor 'A' in the following circuit in steady state is :



A) 0 V B) 0.5 V C) 0.75 V D) 1.5 V

10. Two long coaxial and conducting cylinders of radius a and b are separated by a material of conductivity σ and a constant potential difference V is maintained between them, by a battery. Then the current, per unit length of the cylinder flowing from one cylinder to the other is :

A) $\frac{4\pi\sigma}{\ell n(b/a)}V$ B) $\frac{4\pi\sigma}{(b+a)}V$ C) $\frac{2\pi\sigma}{\ell n(b/a)}V$ D) $\frac{2\pi\sigma}{(b+a)}V$

SECTION II

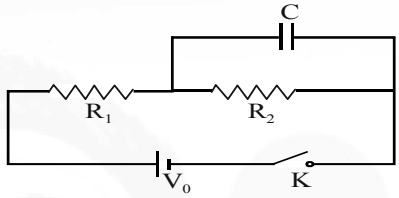
Multiple Correct Answer(s) Type

This section contains **5 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct.**

11. Different values of resistance can be obtained by connecting together three resistors $(1\Omega, 2\Omega \text{ and } 3\Omega)$ in all possible ways. Which of the following can be a possible value of the equivalent resistance?

A) $\frac{11}{3}\Omega$ B) $\frac{11}{4}\Omega$ C) $\frac{11}{5}\Omega$ D) $\frac{11}{6}\Omega$

12. In the connection shown in the *figure* the switch K is open and the capacitor is uncharged. Then we close the switch and let the capacitor charge up to the maximum and open the switch again. Then (Use the following data: V_0=30 V, R_1=10 kΩ, R_2=5 kΩ.)



A) the current through R_1 immediately after closing the switch is 3 mA

B) the current through R_2 a long time after the switch was closed is 2 mA

C) the current through R_2 immediately after reopening the switch 2 mA

D) the current through R_2 immediately after reopening the switch 0

13. A capacitor is charged fully using a cell. With the cell connected, the capacitor plates are slowly pulled apart so that new capacitance becomes half of the original capacitance. Let the work done by pulling agent be w.
Choose The Incorrect Option...

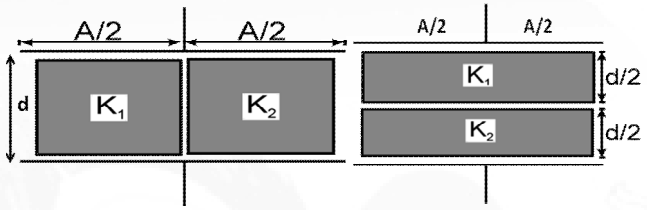
A) Energy absorbed by the cell will be less than w

B) Energy absorbed by the cell will be more than w

C) Energy stored in the capacitor will increase by w

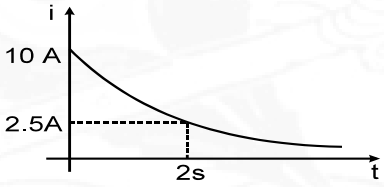
D) There will be heat loss in this process.

14. In the arrangement shown in figure, dielectric constant $K_1 = 2$ and $K_2 = 3$. If the capacitance are C_1 and C_2 respectively, then $\frac{C_1}{C_2}$ cannot be: (The gaps shown are negligible)



A) 1 : 1 B) 2 : 3 C) 9 : 5 D) 25 : 24

15. The figure shows, a graph of the current in a discharging circuit of a capacitor through a resistor of resistance 10 Ω.Choose The Wrong Statement / S



A) The initial potential difference across the capacitor is 100 volt.

B) The capacitance of the capacitor is $\frac{1}{10\,\ell n\,2}$ F.

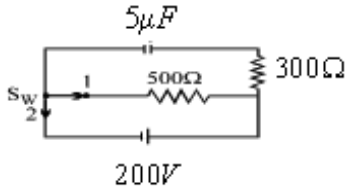
C) The total heat produced in the circuit will be $\frac{500}{\ell n2}$ joule.

D) The thermal power in the resistor will decrease with a time constant $\frac{1}{2\ell n2}$ second.

SECTION III
Integer Answer Type

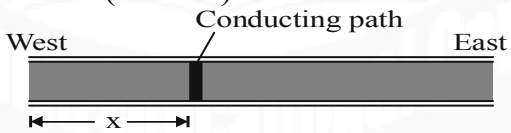
This section contains **5 questions.** The answer to each question is single digit integer, ranging from 0 to 9 (*both inclusive*).

16. A capacitor of capacitance 5μF is connected to a source of constant emf of 200V for a long time, then the switch was shifted to contact 1 from contact 2.The amount of heat generated in the 500Ω resistance is H. Find 32 H (in joule)

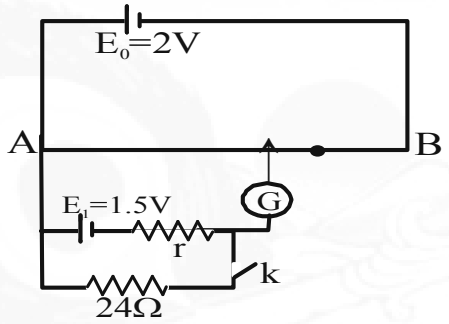


17. An electrometer is charged to 3 kV. Then the electrometer is touched with an-initially neutral-metal ball, mounted on an insulating rod, and then the metal ball is taken away and earthed. The process is done for 10 times, and finally the electrometer reads 1.5 kV. After this, at least how many times the above process must be repeated in order that the electrometer reads less than 1 kV?

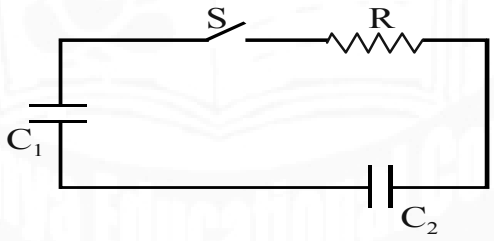
18. A 10-km-long underground cable extends east to west and consists of two parallel wires, each of which has resistance 13Ω/km. A short develops at distance x from the west end when a conducting path of resistance R connects the wires (figure). The resistance of the wires and the short is then 100Ω when the measurement is made from the east end, 200Ω when it is made from the west end. What is value of R/10 (in ohm).



19. For the arrangement of the potentiometer shown in the figure, the balance point is obtained at a distance 75 cm from A when the key k is open. The second balance point is obtained at 60 cm from A when the key k is closed. Find the internal resistance (in Ω) of the battery E_1.



20. Consider the shown network, the capacitor C_1 (= 6μF) has an initial charge $q_0 = \frac{30e}{e-1}\mu C$, C_2 = 4 μF and R = 80Ω. Initially C_2 is uncharged. At t = 0, the switch S is closed. The charge on C_2 (in μC) at t = 192 μs is x then find x/2.



CHEMISTRY: **Max.Marks : 60**

SECTION I

Single Correct Answer Type

This section contains **10 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

21. The overall formation constant of the $\left[Co(NH_3)_6\right]^{2+}$ ion in aqueous solution is 10^5 and the standard potentials for the reduction of $Co^{3+}(aq)$ and $\left[Co(NH_3)_6\right]^{3+}(aq)$ are as follows

$Co^{3+}(aq)+e^- \rightleftharpoons Co^{2+}(aq)$ $E^\circ = +1.9V$

$\left[Co(NH_3)_6\right]^{3+}(aq)+e^- \rightleftharpoons \left[Co(NH_3)_6\right]^{2+}(aq)$ $E^\circ = +0.1V$

Calculate the nearest overall formation constant of the $\left[Co(NH_3)_6\right]^{3+}$ ion

A) 10^{30} B) 10^{33} C) 10^{35} D) 10^{38}

22. A compound with empirical formula $Fe(H_2O)_4(CN)_2$ has a magnetic moment corresponding to $2\frac{2}{3}$ unpaired electrons per iron. The molecular formula of the complex may be

A)$[Fe(H_2O)_4(CN)_2]$ B) $[Fe(H_2O)_6][Fe(CN)_6]$

C) $[Fe(H_2O)_6]_4[Fe(CN)_6]_3$ D) $[Fe(H_2O)_6]_2[Fe(CN)_6]$