Sri Chaitanya IIT Academy, India

A.P, TELANGANA, KARNATAKA, TAMILNADU, MAHARASHTRA, DELHI, RANCHI

A right Choice for the Real Aspirant

ICON CENTRAL OFFICE, MADHAPUR-HYD

Sec: Sr. IPLCO	JEE ADVANCED	DATE : 08-11-15
TIME : 3:00	2013_P1 MODEL	MAX MARKS : 180

KEY & SOLUTIONS

PHYSICS

1	C	2	A	3	B	4	B	5	B
6	C	7	B	8	D	9	D	10	C
11	ABC	12	ABC	13	ACD	14	ABC	15	ABCD
16	2	17	6	18	2	19	6	20	6

CHEMISTRY

21	C	22	D	23	D	24	C	25	C
26	C	27	C	28	D	29	B	30	A
31	ABCD	32	BC	33	ABC	34	ABCD	35	ABCD
36	8	37	4	38	5	39	6	40	3

MATHEMATICS

41	D	42	B	43	A	44	B	45	B
46	A	47	B	48	A	49	D	50	C
51	BCD	52	BCD	53	BD	54	B	55	ABC
56	2	57	3	58	8	59	2	60	4

PHYSICS

1. [Sol. (C) $E_1 = \frac{I}{A}\rho_1$

$E_2 = \frac{I}{A}\rho_2$

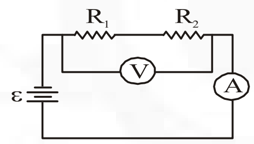
$E_0 + \frac{\sigma}{2\varepsilon_0} = \frac{I}{A}\rho_1$

$-E_0 + \frac{\sigma}{2\varepsilon_0} = -\frac{I}{A}\rho_2$

$\frac{\sigma}{\varepsilon_0} = \frac{I}{A}(\rho_1 - \rho_2)$

$\sigma A = I\varepsilon_0(\rho_1 - \rho_2)$]

2. [Sol.(A) Voltmeter can't be in series & ammeter can't be in parallel. Only (A)



gives correct arrangement.]

3. [Sol. (B) $\left(\frac{\epsilon_0\, klx}{d} + \frac{\epsilon_0\,(2A - lx)}{d}\right) V = Q$

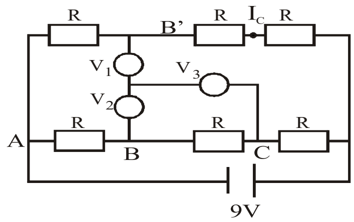
$i = \left(\frac{\epsilon_0\, klx}{d} + \frac{-\epsilon_0\, l}{d}\right)\frac{dx}{dt}$ = constant

as the dielectric leaves $c\downarrow \Rightarrow Q\downarrow \Rightarrow$ i is -ve.]

4. [SOL. (B)]

5. [Sol.(B)

Taking potential at A to be zero potential at B = 3V and potential at B' = 3V and potential at C = 6V so reading of V_3 = 3V



]

6. [Sol.(C)

7. [Sol (b) $V = E - ir = -\frac{Er}{R+r} = E\left[\frac{R+r-r}{R+r}\right]$

$V = \frac{ER}{(R+r)} \Rightarrow V = 0$ at $R = 0$

$V = E$ at $R = \infty$

so (B) is correct option.

8. [sol (D).Voltage across each bulb will be

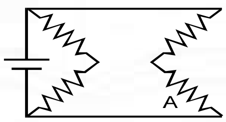
$V_1 - iR = \frac{V}{nR} \cdot R\ (V/n)$

so power developed by each bulb

$= iV_1 = \frac{V}{nR} \cdot \frac{V}{n} = \frac{V^2}{n^2R}$

so power consumed by one bulb $= \frac{P}{n^2}$

9. [sol.(D) This is a DC circuit because the battery is the only source of voltage. Hence the capacitors behave like open circuits. An equivalent circuit is then two parallel sets of two identical series resistors, see figure. The voltage drop across each parallel branch must be the battery voltage of 3V. Since the resistors are identical there is an equal voltage drop of 1.5V across each resistor. In particular there is a drop of 1.5 V across resistor A.



10. [sol. (C) $E = \frac{\lambda}{2\pi\varepsilon_0 r}$, where λ is the linear charge density on the inner cylinder.

and $V = \int_a^b \mathbf{E.d\ell} = \frac{\lambda}{2\pi\varepsilon_0}\ell n\left(\frac{b}{a}\right)$ .... (1)

Now ; $I = \int \vec{J}.\overrightarrow{dA} = \sigma \int \vec{E}.\overrightarrow{dA}$

$= \sigma \int \frac{\lambda}{2\pi\varepsilon_0 r}.2\pi r\,dr$

Current per unti length will be : $I = \frac{\sigma\lambda}{\varepsilon_0}$ .... (2) From (1) :

$$I = \frac{2\sigma\pi\varepsilon_0}{\varepsilon_0 \ell n(b/a)} v = \frac{2\pi\sigma}{\ell n(b/a)} v$$]

ONE OR MORE THAN ONE ANSWER TYPE:

11. [SOL (A,B,C)]

12. [Sol. (a,b,c)Just after closing switch no current flows through R_2 so $I_1 = 3mA$

Long time after closing switch no current flows through C so $I_2 = 2mA$

Directly after re-opening the switch no current flows through R_1 and the capacitor will discharge through R_2 so $I_3 = 2mA$]

13. [SOL. A,C,D)]

14. [SOL. (A,B,C) First arrangement is a parallel combination.

$C_1' = \frac{K_1\varepsilon_0(A/2)}{d} = \frac{1}{2}\frac{K_1\varepsilon_0 A}{d} = \frac{\varepsilon_0 A}{d}$ ($K_1 = 2$)

and $C'_2 = \frac{1}{2}\frac{K_2\varepsilon_0 A}{d} = \frac{3}{2}\frac{\varepsilon_0 A}{d}$ ($K_2 = 3$)

$C_1 = C'_1 + C'_2 = \frac{5}{2}\frac{\varepsilon_0 A}{d}$ (parallel combination)

Second one is a series combination :

$C_1'' = \frac{K_1\varepsilon_0 A}{d/2} = \frac{2K_1\varepsilon_0 A}{d} = \frac{4\varepsilon_0 A}{d}$

$C_2'' = \frac{K_2\varepsilon_0 A}{d/2} = \frac{2K_2\varepsilon_0 A}{d} = \frac{6\varepsilon_0 A}{d}$

$$\Rightarrow C_2 = \frac{C_1''C_2''}{C_1''+C_2''} = \frac{6\times 4}{6+4}\frac{\varepsilon_0 A}{d} = \frac{12}{5}\frac{\varepsilon_0 A}{d} \Rightarrow \frac{C_1}{C_2} = \frac{\frac{5}{2}\frac{\varepsilon_0 A}{d}}{\frac{12}{5}\frac{\varepsilon_0 A}{d}} = \frac{25}{24}$$ Ans.

15. [SOL. (A,B,D) $V_0 = I_0 R = 10 \times 10 = 100$ volts

(since, $I_0 = 10\ \Omega$ from figure)

Also : $I = I_0 e^{-t/RC}$

Taking log ; $\log\left(\frac{I_0}{I}\right) = \frac{t}{RC} \Rightarrow C = \frac{t}{R\log(I_0/I)}$

At ; t = 2 sec, I = 2/5 A

$$C = \frac{2}{10\log\left(\frac{10}{2.5}\right)}$$

$$\Rightarrow C = \frac{2}{10\log 4} = \frac{2}{10\times 2\log 2} = \frac{1}{10\ell n2} \quad C = \frac{1}{10\ell n2}$$

Heat produced $= \frac{1}{2}CV^2 = \frac{1}{2}\left(\frac{1}{10\ell n2}\right)(100^2) = \frac{500}{\ell n2}$ joules

INTEGER TYPE QUESTIONS:

16. [Sol. (2) Charge on capacitor = $5 \times 10^{-6} \times 200 = 10^{-3}$

Total heat generated = $\frac{10^{-6}}{2\times5\times10^{-6}} = 10^{-1}$

The fraction lost in 500 Ω is $\frac{5}{8}$ of total so H = $\frac{5}{8} \times \frac{1}{10} = \frac{1}{16}$J

$32 \times \frac{1}{16} = 2$ Ans.]

17. [Sol. (6) $\frac{Cq_1}{k} = (Q_0 - q_1) \Rightarrow q_1 = \frac{Q_0}{\left(1+\frac{C}{K}\right)} \Rightarrow \frac{Cq_2}{K} = K(q_1 - q_2)$

$q_2 = \frac{q_1}{\left(1+\frac{C}{K}\right)} \Rightarrow q_{10} = \frac{Q_0}{\left(1+\frac{C}{K}\right)^{10}} \Rightarrow \frac{Q_0}{2} = \frac{Q_0}{\left(1+\frac{C}{K}\right)^{10}}$

$\left(1+\frac{C}{K}\right) = 10\sqrt{2} \Rightarrow \frac{Q_0}{3} = \frac{Q_0}{\left(1+\frac{C}{K}\right)^{10+n}}$

$10\sqrt{2} = 10 + n\sqrt{3}$ $\frac{\ln 2}{10} = \frac{\ln 3}{\ln 2}$]

18. [Sol. (2) $13(2x) + R = 200$

$13(2(10 - x) + R = 100$

$260 + 2R = 300$

R = 20 Ω]

19. [Sol: (6) Let λ is resistance per unit length of wire AB. When k is opened

$I(\lambda x_1) = E_1$ ....(1) k is closed $I\lambda x_2 = E_1 - ir$ ....(2)

$i = \frac{E_1}{R+r}$ ....(3) $\Rightarrow r = \left(\frac{x_1}{x_2} - 1\right) R = \left(\frac{0.75}{0.60} - 1\right) 24$ r = 6 Ω

20. [Sol. (6) $q_2 = q_0 C_2 / (C_1 + C_2)(1 - e^{-t/\tau})$

where τ is $\frac{RC_1C_2}{C_1 + C_2}$]