JEE EXPERT

ANSWER KEY & SOLUTIONS
Module Test - [MT - 01]
JEE ADV. Paper - 01
Batch : 12th (Zenith- 1820 - X01 & X02)
Date :[04.08.2019]

PHYSICS

1	(C)	2	(A)	3	(B)	4	(B)
5	(B, C)	6	(B, C)	7	(A, B, C)	8	(A, C)
9	(A, D)	10	(B)	11	(B)	12	(C, D)
13	(7)	14	(4)	15	(3)	16	(2)
17	(5)	18	(3)				

CHEMISTRY

19	(A)	20	(A,D)	21	(B)	22	(D)
23	(B, C)	24	(B, C)	25	(B, C, D)	26	(B, C, D)
27	(A, B)	28	(C, D)	29	(B, C, D)	30	(A, B, D)
31	(4)	32	(8)	33	(4)	34	(6)
35	(4)	36	(2)				

MATHEMATICS

37	(C)	38	(D)	39	(A)	40	(A)
41	(A, C)	42	(A, C)	43	(B, C)	44	(A, B)
45	(B, D)	46	(A)	47	(A, B)	48	(A, B)
49	(2)	50	(2)	51	(0)	52	(0)
53	(5)	54	(9)				

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SOLUTIONS
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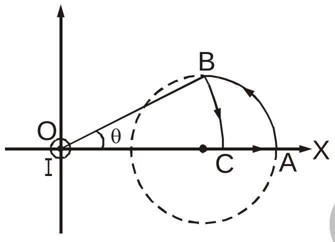
PHYSICS

1. **(C) Sol.** Let segment OB = OC and arc BC is a circular arc with centre at origin. Since the shown closed path ABCA encloses no current, the path integral of magnetic field over this path is zero.



Hence $\int_A^B \vec{B}.\overrightarrow{d\ell} + \int_B^C \vec{B}.\overrightarrow{d\ell} + \int_C^A \vec{B}.\overrightarrow{d\ell} = 0.$

Because $\vec{B}$ is perpendicular to segment AC at all point, therefore $\int_C^A \vec{B}.\overrightarrow{d\ell} = 0.$

Hence $\int_A^B \vec{B}.\overrightarrow{d\ell} = \int_C^B \vec{B}.\overrightarrow{d\ell} = \frac{\mu_o I}{2\pi}\frac{OB(\theta)}{OB} = \frac{\mu_o I}{2\pi}\tan^{-1}\frac{1}{2}$

2. **(A) Sol.** $B_{p_1} = \frac{\mu_0 i}{4\pi\ell}\left[0 + \frac{1}{\sqrt{2}}\right] \times 2 + \frac{\mu_0 i}{4\pi\ell}\left[\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right]$

$B_{p_2} = \frac{\mu_0 i}{4r}$

$4\ell = \pi r \Rightarrow r = \frac{4\ell}{\pi}$

$B_{p_2} = \frac{\mu_0 i}{4\left(\frac{4\ell}{\pi}\right)}$

PK **(B) Sol.** $\frac{V_1}{V_2} = \frac{l_1}{l_2} = \frac{E'R_1/(R_1+r')}{E'R_2/(R_2+r')} = \frac{R_1(R_2+r')}{R_2(R_1+r')} \Rightarrow \frac{2}{3} = \frac{5(10+r')}{10(5+r')} \Rightarrow$ r' = 10Ω

4. **(B) Sol.** $C_{eq} = 3/2$ F

Charge flow $q = C_{eq}\left(10-\frac{15}{3}\right) = \frac{3}{2}\times 5 = 7.5\ \mu C$

SECTION-2

5. **Sol. (B, C)**

Applying Gauss theorem to volume containing cuboid indicated by ABCD $\frac{E}{k}A + \frac{0}{A} = \frac{q_{enc}}{\varepsilon_0}$ or $q_{enc} = \frac{EA\varepsilon_0}{A}$

Electrostatic energy stored in dielectric medium $= \frac{1}{2}k\varepsilon_0\left(\frac{E}{k}\right)^2 At = \frac{\varepsilon_0 E^2 At}{2k}$

6. **Sol. (B, C)**

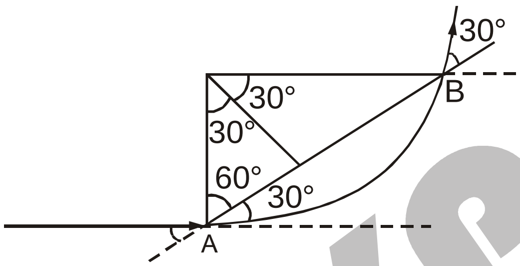
All elements are moving radially away with velocity K so.

Force = $d\theta$ kB

torque = $d\theta kBr$

torque on ring = $dQkBr = 2\pi\lambda Bkr^2$

7. **Sol. (A, B, C)**

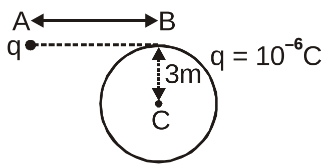


Arc AB $= \frac{\pi}{3}r = \frac{\pi mV}{3qB}$ Time 't' $= \left(\frac{T}{2\pi}\right)\cdot\left(\frac{\pi}{3}\right) = \frac{T}{6} = \frac{\pi m}{3qB}$.

8. **Sol. (A,C)**

Solid neutral conducting sphere

Potential at center $= \frac{9\times10^9\times10^{-6}}{5} = 1.8$ kV



$\Rightarrow$ Potential at B = 1.8 kV

V_{At} B = $V_{\text{due to A}} + V_{\text{due to induced charges}}$

$V_{\text{due to induced charge}}$ = 1.8 kV – 2.25 kV = –0.45 kV

9. **Sol. (A, D)**

$$2T = F = \frac{\lambda q}{2\pi\epsilon_0 R}$$

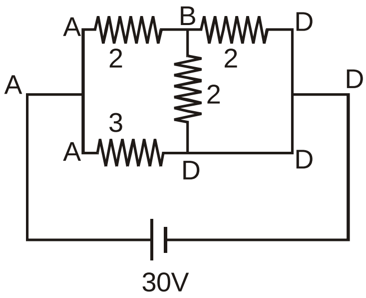
10. **(B)**

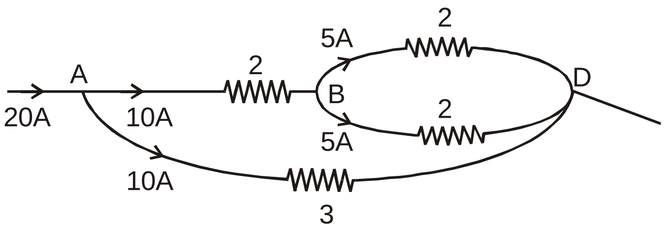
11. **(B),**

12. **(C), (D)**

SECTION - 3

13. Sol. (7)

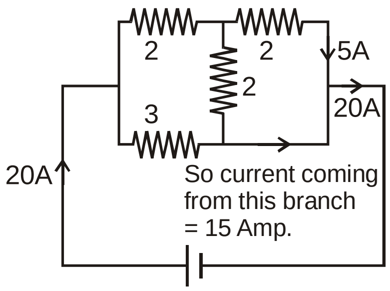




$\Rightarrow R_{eq} = \frac{3}{2}$

$i = \frac{30}{3/2} = 20$ Amp.

From figure current through B $\rightarrow$ D branch = 5 Amp.



therefore current in bd is 15 A = n + 8.

=> n = 7

14. Sol. (4)

Assume positive and negative charge of density ρ in cavity. The electric field due to cylinder is $\frac{\rho r}{2\varepsilon_0}\left(\text{where } r = \frac{R}{2}\right)$ and field due to spherical charge (– ve) is zero.

15. Sol. (3)

Resistance of cylinder $R = \int_0^1 \frac{1}{\sigma}\frac{dx}{a} = \frac{2\sqrt{l}}{3a\sigma_0}$

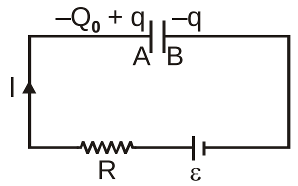
$I = \frac{E}{R}$

Electric field $= \frac{J}{\sigma} = \frac{I}{a\sigma} = \frac{E\sqrt{x}}{Ra\sigma_0 l} = \frac{E(\sqrt{l})}{\frac{2\sqrt{l}}{3a\sigma_0}a\sigma_0 l} = \frac{3E}{2l}$

16. Sol. (2)

Let at any time t charge flown through the plate B to plate A is q and instantaneous current is ℓ.

From loop theorem $\left(\frac{2q-Q_0}{2C}\right)+\ell R-\varepsilon=0$



$$\Rightarrow R\frac{dq}{dt}=\frac{-2q+2\varepsilon C+Q_0}{2C}$$

$$\Rightarrow \frac{dq}{2\varepsilon C+Q_0-2q}=\frac{dt}{2RC}$$

Now for charge on plate A to be zero $q = Q_0$.

Integrating $\int_0^{Q_0}\frac{dq}{2\varepsilon C+Q_0-2q}=\int_0^t\frac{dt}{2RC}$

$$= \; t=RC\ln\left[\frac{2\varepsilon C+Q_0}{2\varepsilon C-Q_0}\right]$$

Putting the value of C, Q_0, ε and R

We get t = 2 seconds.

17. Sol. (5)

At terminal stage, torque applied on the smaller disc by the rope = mga

current to the disc = $\frac{B\omega r^2}{2R}$ (where ω is terminal angular velocity)

Torque applied by magnetic field = $\frac{B^2\omega r^4}{4R}$

So, $\frac{B^2\omega r^4}{4R}$ = mga

ω = 100 rad/sec

18. Sol. (3)

$R_{Voltmeter} = 6$, $R_{ammeter} = 0.5$

$R_{eq} = 10$

$I = \frac{30}{10} = 3A$

Reading of voltmeter = 1 × 3 = 3 volt.