PACE-IIT & MEDICAL

ANDHERI / BORIVALI / DADAR / CHEMBUR / THANE / NERUL / KHARGHAR / POWAI

FOR 2018 ASPIRANTS **Medical Droppers - Part Test - 6** **DATE: 11-03-2018**

SOLUTIONS
PHYSICS

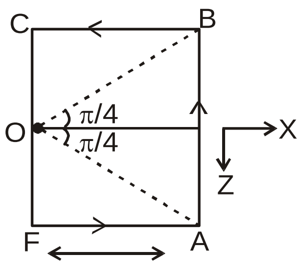
1. [2]

2. [3]

Due to FABC the magnetic feild at O is along y – axis and due to CDEF the magnetic feild is along x – axis. Hence the feild will be of the form A $\left[\hat{i}+\hat{j}\right]$

Calculating feild due to FABC :

due to AB :



$\vec{B}_{AB} = \dfrac{\mu_0 i}{4\pi\left(\dfrac{\ell}{2}\right)}$ (sin 45º + sin45º) $\hat{j}$ $= \sqrt{2}\dfrac{\mu_0 i}{2\pi\ell}\hat{j}$

Due to BC :

$\vec{B}_{AB} = \dfrac{\mu_0 i}{4\pi l\left(\dfrac{\ell}{2}\right)}\left(\sin 0^o + \sin 45^o\right) = \dfrac{\mu_0 i}{2\sqrt{2}\pi\ell}\hat{j}$

Similarly due to FA :

$\vec{B}_{FA} = \dfrac{\mu_0 i}{2\sqrt{2}\pi\ell}\hat{i}$

Hence $\vec{B}_{FABC} = \dfrac{\mu_0 i}{\pi\ell}\left[\dfrac{1}{2\sqrt{2}} + \dfrac{1}{2\sqrt{2}} + \dfrac{\sqrt{2}}{2}\right]\hat{i}$

$\vec{B}_{FABC} = \dfrac{\sqrt{2}\mu_0 i}{\pi\ell}\left(\hat{j}\right)$

Similarly due to CDEF :

$\vec{B}_{FABC} = \dfrac{\sqrt{2}\mu_0 i}{\pi\ell}\left(\hat{i}\right)$ $\Rightarrow \vec{B}_{net} = \dfrac{\sqrt{2}\mu_0 i}{\pi\ell}\left(\hat{i}+\hat{j}\right)$

3. [4]

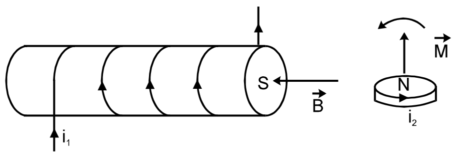
4. [1]

Let O and P be the end points of wire. Hence force on current (I) carrying wire placed in uniform magnetic field is $\vec{F} = I(\overrightarrow{OP} \times \vec{B})$.

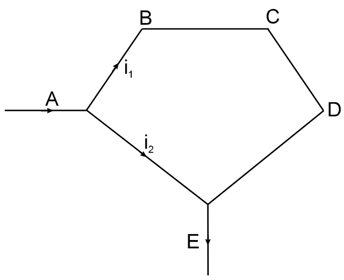
5. [2]

6. **[2]**

The loop rotates anticlockwise due to magnetic torque and as a result north and south poles will attract each other.



7. **[2]**



$B_{AB} = B_{BC} = B_{CD} = B_{DE} = B_{EA}$ $\quad \frac{i_1}{i_2} = \frac{1}{4}$ Beacuse from V = IR

So $\quad B_{centre} = 0$

8. [1]

9. **[3]**

field due to AA' = $\frac{\mu_0 i}{4\pi R}$

= field due to BB'

field due to CC' = field due to DD' = 0

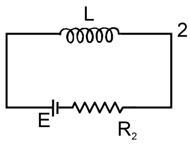
field due to BA = $\frac{\mu_0 i}{8R}$

field due to CD = $\frac{-\mu_0 i}{8R}$ $\quad \therefore$ net field at O = $\frac{\mu_0 i}{2\pi R}$.

10. **[3]**

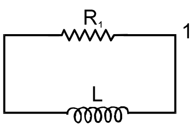
11. **[1]**

When the key is at position [2] for a long time ; the energy stored in the inductor is :



$$U_B = \frac{1}{2}Li_0^2 = \frac{1}{2}.L.\left(\frac{E}{R_2}\right)^2 = \frac{L.E.^2}{2R_2^2}$$

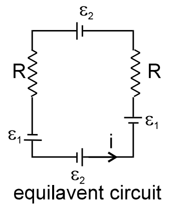
This whole energy will be dissipated in the form of heat when the inductor is connected to R_1 and no source is connected.



12. [3]

$$i = \frac{2\varepsilon_1 + 2\varepsilon_2}{R_1 + R_2} = \frac{\varepsilon}{R_1 + R_2}$$

Where $\varepsilon = \frac{d\varphi}{dt}$ is the net emf in the circuit.



equilavent circuit

$$\therefore V_1 - V_2 = (\varepsilon - iR_1) - (\varepsilon - iR_2) = \frac{\varepsilon(R_2 - R_1)}{R_1 + R_2}$$

13. [3]

$B = C - KT$; At $t = 0$, $B = C \therefore$ initial flux $= C\pi a^2$, final flux = 0

Total charge flown $= \frac{\text{Change in flux}}{\text{Resistance}} = \frac{C\pi a^2}{R}$

14. [3]

Flux through a closed circuit containing an inductor does not change instantaneously.

$\therefore \quad L\left(\frac{E}{R}\right) = \frac{L}{4}(i) \quad \Rightarrow \quad i = \frac{4E}{R}$

15. [2]

$e = (\vec{v} \times \vec{B}).\ell$

$e = [\hat{i} \times (3\hat{i} + 4\hat{j} + 5\hat{k})].5\hat{j} \quad \Rightarrow \quad e = 25$ volt **Ans.**

16. [1]

$\phi = \vec{B}.\vec{A} = BA\cos\omega t$ and $e = BA\omega\sin\omega t$

for maximum emf $\sin\omega t = 1 \quad \Rightarrow \quad \cos\omega t = 0$

$\Rightarrow \quad \omega t = 90°$, this is the angle between area vector and $\vec{B}$.

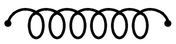
$\therefore \quad$ angle between $\vec{B}$ and plane is 0° at that time.

17. [4]

(A or D) $\quad \Delta q = \frac{\Delta\phi}{R}$

Answer will be [1] if rotated about its diameter, and [4] if rotated about its axis.

18. [2]

[2] 

Using ; $V_A - V_B = RI + L\frac{dI}{dt}$

$140 = 5R + 10\,L$

$60 = 5R - 10\,L$

$\Rightarrow \quad L = 4H.$ **Ans.**

19. **[3]**

No change in the field occurs due to the described motion of the magnet.

Hence no current will be induced in the coil.

Hence [3].

20. [1]

Equation can be written as i = 2 sin 100 πt + 2 sin (100 πt + 120º)

so phase difference ϕ = 120º

$= \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\varphi}$

$= \sqrt{4+4+2\times2\times2\left(-\frac{1}{2}\right)}$ = 2 so effective value will rms. value = $2/\sqrt{2} = \sqrt{2}$ A

21. [2]

P = VI

For secondary :

$V_2 = \frac{P_2}{I_2} = \frac{500}{12.5}$ = 40 volts

For an ideal transformer (100% efficient)

$P_{input} = P_{output}$

$\Rightarrow$ $V_1I_1 = V_2I_2$

$\Rightarrow$ $I_1 = \frac{V_2I_2}{V_1} = \frac{40(12.5)}{40\times5}$ = 2.5 A $\quad\because \frac{n_1}{n_2} = \frac{V_1}{V_2} \Rightarrow \frac{5}{1} = \frac{V_1}{40}$ j

22. [1]

$X_C = \frac{1}{\omega C}$ and $X_L = \omega L$

At $\omega<\omega_{res}$, $X_C > X_L$ $\quad\therefore$ The circuit is capacitive

23. **[4]**

24. **[3]**

$X_L = X_C$ at resonance $\quad\therefore \frac{X_L}{X_C} = 1.$ for both circuits

25. [3]

Let; $V_S = V_s\sin\omega t$

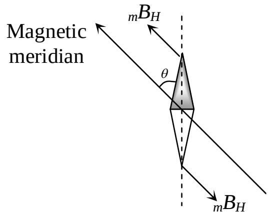
$I_1 = I_{01}\sin(\omega t - \pi/2)$

$I_2 = I_{02}\sin(\omega t + \theta)$

$\tan\theta = \frac{X_c}{R}$; So phase difference = $\theta + \frac{\pi}{2}$; $\tan^{-1}\left(\frac{X_c}{R}\right) + \frac{\pi}{2}$ **Ans.**

26. [1]

As the compass needle is free to rotate in a horizontal plane and points along the magnetic meridian, so when it is pointing along the geographic meridian, it will experience a torque due to the horizontal component of earth's magnetic field *i.e.* $\tau = MB_H \sin\theta$



where θ = angle between geographical and magnetic meridians called angle of declination

So, $\sin\theta = \dfrac{1.2\times10^{-3}}{60\times40\times10^{-6}} = \dfrac{1}{2} \Rightarrow \theta = 30^o$

27. [3]

In C.G.S. $B_{axial} = 9 = \dfrac{2M}{x^3}$ .....(i)

$B_{\text{equaterial}} = \dfrac{M}{\left(\dfrac{x}{2}\right)^3} = \dfrac{8M}{x^3}$ .....(ii)

From equation (i) and (ii) $B_{\text{equaterial}} = 36$ *Gauss*.

28. [3]

For short bar magnet in tan *A*-position

$\dfrac{\mu_0}{4\pi}\dfrac{2M}{d^3} = H\tan\theta$ .....(i)

When distance is doubled, then new deflection θ' is given by

$\dfrac{\mu_0}{4\pi}\dfrac{2M}{(2d)^3} = H\tan\theta'$ .....(ii)

$\therefore\ \dfrac{\tan\theta'}{\tan\theta} = \dfrac{1}{8} \Rightarrow \tan\theta' = \dfrac{\tan\theta}{8} = \dfrac{\tan 60^\circ}{8} = \dfrac{\sqrt{3}}{8}$

$\Rightarrow \theta' = \tan^{-1}\left(\dfrac{\sqrt{3}}{8}\right)$

29. [1]

$E = nAVt = nA\dfrac{m}{d}t = \dfrac{50\times250\times10\times3600}{7.5\times10^3} = 6\times10^4\ J$

30. [3]

$K = \dfrac{2rB_H}{\mu_0 n}$

or $n = \dfrac{2rB_H}{\mu_0 K} = \dfrac{2\times0.1\times3.6\times10^{-5}}{4\pi\times10^{-7}\times10\times10^{-3}} = \dfrac{1.8\times10^3}{3.14} = 570$

31. [1]

$W = MB(\cos\theta_1 - \cos\theta_2)$

When the magnet is rotated from 0° to 60°, then work done is 0.8 *J*

$0.8 = MB(\cos 0^\circ - \cos 60^\circ) = \dfrac{MB}{2}$

$\Rightarrow MB = 1.6\ N - m$

In order to rotate the magnet through an angle of 30°, *i.e.*, from 60° to 90°, the work done is

$W' = MB(\cos 60^\circ - \cos 90^\circ) = MB\left(\dfrac{1}{2} - 0\right)$

$$= \frac{MB}{2} = \frac{1.6}{2} = 0.8\,J = 0.8 \times 10^7\,ergs$$

32. [2]

$$T = 2\pi\sqrt{\frac{I}{MB_H}} \Rightarrow T \propto \frac{1}{\sqrt{M}} \Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{M_2}{M_1}}$$

If $M_1 = 100$ then $M_2 = (100 - 36) = 64$

So $\frac{T_1}{T_2} = \sqrt{\frac{64}{100}} = \frac{8}{10} \Rightarrow T_2 = \frac{10}{8} T_1 = 1.25\,T_1$

So % increase in time period = 25%

33. [1]

$$\frac{M_1}{M_2} = \frac{v_s^2 + v_d^2}{v_s^2 - v_d^2} \Rightarrow \frac{13}{5} = \frac{(15)^2 + v_d^2}{(15)^2 - v_d^2}$$

$\Rightarrow v_d = 10\ oscillations/min$

34. [2]

35. [3]

36. [2]

37. [4]

38. [1]

39. [1]

40. [3]

$$\lambda = \frac{c}{\nu} = \frac{3 \times 10^8}{40 \times 10^6} = 7.5\text{ m}$$

41. [1]

42. [2]

43. [4]

44. [3]

45. [1]

CHEMISTRY

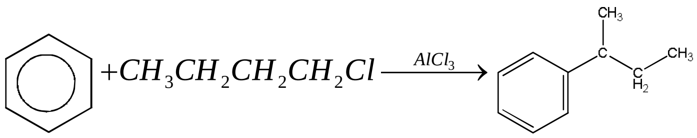
46. [4]
47. [2]
48. [2]
49. [3]
50. [3]
51. [3]
52. [3]
53. [1]
54. [3]
55. **[2]**
56. [3]

CE_3 is ring deactivating & Meta directing group.

57. [1]

EAS reaction single product. [2] Substitution Reaction is difficult in Aromic ring. [3] & [4] More than one product is possible.

58. [4]

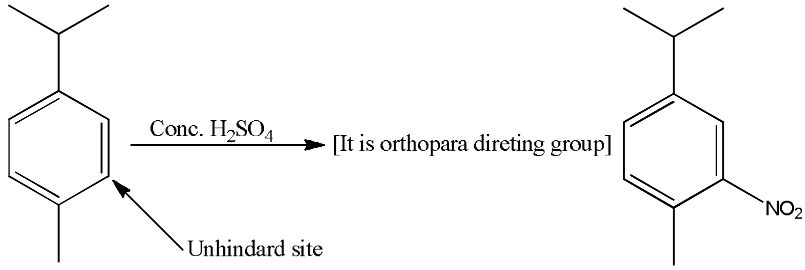


59. [2]

60. [3]

[3] is planar but [1] & [2] are non planar.

61. B



62. [3]
63. [1]
64. [3]
65. [4]
66. [1]
67. [3]

68. [2]
69. [3]
70. [3]
71. [3]
72. [2]
73. [2]
74. [2]
75. [1]
76. [2]
77. [1]
78. [2]
79. [1]
80. [4]
81. [2]
82. [3]
83. [1]
84. [3]
85. **[3]**
86. [2]
87. [1]
88. **[3]**
89. [1]
90. [1]