WEEKLY TEST MEDICAL PLUS - 01 R
SOLUTION Date 02 -02-2020

[PHYSICS]

1. **(a)** $e = -\dfrac{N(B_2 - B_1)A\cos 0°}{\Delta t}$

$\Rightarrow 0.1 = \dfrac{-50 \times (0 - 2\times 10^{-2}) \times 100 \times 10^{-4} \times \cos 0°}{t}$

$\Rightarrow \quad t = 0.1$ sec.

2. **(d)** $e = -\dfrac{NBA(\cos\theta_2 - \cos\theta_1)}{\Delta t}$

$= -\dfrac{800 \times 4 \times 10^{-5} \times 0.05\,(\cos 90° - \cos 0°)}{0.1}$

$= 0.016$ V

3. **(a)** $|e| = L\dfrac{di}{dt} \Rightarrow I = \dfrac{L \times \{10 - (-10)\}}{0.5}$

$\Rightarrow L = 25$ mH

4. **(d)** $U = \dfrac{1}{2}Li^2 = U = \dfrac{1}{2} \times 5 \times \left(\dfrac{100}{10}\right)^2 = 250$ J

5. **(d)** $e = -\dfrac{d\varphi}{dt} = -\dfrac{d}{dt}\,3(t^2 + 4t + 9) = -(6t + 4)$

$= -[6(2) + 4] = -16 \Rightarrow |e| = 16$ volt

6. **(a)** $e = Bvl = 5 \times 10^{-5} \times \dfrac{360 \times 1000}{3600} \times 20 = 0.1$ V

7. **(b)** The emf induced in the circuit $e = \dfrac{\Delta\varphi}{\Delta t}$

If R is the resistance of the circuit, then

$i = \dfrac{e}{R} = \dfrac{\Delta\varphi}{R\Delta t}$

Thus, charge passes through the circuit,

$Q = i \times \Delta t$

$\Rightarrow Q = \dfrac{\Delta\varphi}{R\Delta t} \times \Delta t$

$\Rightarrow Q = \dfrac{\Delta\varphi}{R}$

8. **(a)** Induced emf

work done in taking a charge

$= \dfrac{Q \text{ once along the loop}}{\text{charge } Q}$

i.e., is $V = \dfrac{W}{Q}$

$\Rightarrow \quad W = VQ$

9. **(c)** When the total flux associated with one coil links with the other, *i.e.*, a case of maximum flux linkage, then

$M_{12} = \dfrac{N_2\phi_{B_2}}{i_1}$ and $M_{21} = \dfrac{N_1\phi_{B_1}}{i_2}$

Similarly, $L_1 = \dfrac{N_1\phi_{B_1}}{i_1}$ and $L_2 = \dfrac{N_2\phi_{B_2}}{i_2}$

If all the flux of coil 2 links coil 1 and vice versa, then

$\phi_{B2} = \phi_{B1}$

Since, $M_{12} = M_{21} = M$, hence we have

$M_{12}M_{21} = M^2 = \dfrac{N_1N_2\phi_{B_1}\phi_{B_2}}{i_1i_2} = L_1L_2$

$M_{max} = \sqrt{L_1L_2}$

Given, $L_1 = 2$ mH, $L_2 = 8$ mH

$M_{max} = \sqrt{2 \times 8} = \sqrt{16} = 4$ mH

10. **(c)** Inductance of a coil is numerically equal to the emf induced in the coil when the current in the coil changes at the rate of 1 As^{-1}.

If I is the current flowing in the circuit, then flux linked with the circuit is observed to be proportional to I, i.e.,

$\phi \propto I$

or $\phi = LI$ ... (i)

Where L is called the self-inductance or coefficient of self-inductance or simply inductance of the coil.

Net flux through solenoid,

$\phi = 500 \times 4 \times 10^{-3} = 2$ Wb

or $2 = L \times 2$ [after putting values in Eq. (*i*)]

or $L = 1$ H

11. **(b)** Area coming out per second from the magnetic field is not constant for elliptical and circular loops, so induced emf, during the passage of these loops, out of the field region will not remain constant for the circular and the elliptical loops.

12. **(a)** According to Faraday's second law of electromagnetic induction, the induced emf is given by the rate of change of magnetic flux linked with the circuit.

Here, $B = 0.04\ T$ and $\frac{-dr}{dt} = 2\ \text{ms}^{-1}$

Induced emf, $e - \frac{d\phi}{dt} = \frac{-BdA}{dt} = -B\frac{d(\pi r^2)}{dt}$

$= -B\pi 2r\frac{dr}{dt}$

Now, $r = 2$ cm

$e = -0.04 \times \pi \times 2 \times 2 \times 10^{-2} \times 2 \times 10^{-3}$

$= 3.2\ \pi\mu\text{V}$

13. **(b)** Magnetic flux $\phi = B.A$

$= B.\ \pi r^2$

Induced emf, $|e| = \frac{d\phi}{dt} = B\pi 2r\frac{dr}{dt}$

$= 0.025 \times \pi \times 2 \times 2 \times 10^{-2} \times 1 \times 10^{-3}$

$= \pi\mu\text{V}$

14. **(d)** We know induced emf $e = -L\frac{di}{dt}$

During 0 to $\frac{T}{4}, \frac{di}{dt}$ = constant

So, induced emf e = –ve

For $\frac{T}{4}$ to $\frac{T}{2}, \frac{di}{dt} = 0$

Induced emf $e = 0$

For $\frac{T}{2}$ to $\frac{3T}{4}, \frac{di}{dt}$ = constant

So induced emf e = +ve

15. **(b)** Induced emf of coil $E = \left|-\frac{d\phi}{dt}\right|_t$

Given, $\phi = 50t^2 + 4$ and $R = 400\Omega$

$E = \left|-\frac{d\phi}{dt}\right|_{t=2} = |100t|_{t=2} = 200\ \text{V}$

Current in the coil $i = \frac{E}{R} = \frac{200}{400} = \frac{1}{2} = 0.5\ \text{A}$

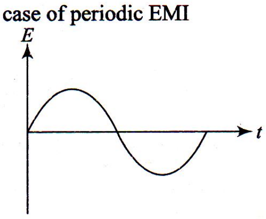
16. **(b)** $I = \left|\frac{1}{2}\frac{d\phi}{dt}\right|$

$|d\phi| = |IRdt|$

$d\phi$ = (area of triangle) × R

$= \left(\frac{1}{2} \times 4 \times 0.1\right) \times 10 = 2\ Wb$

17. **(b)** This is the case of periodic EMI

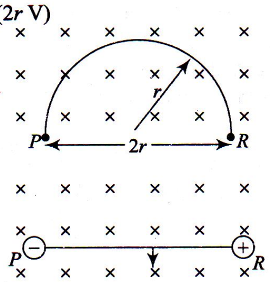


From graph, it is clear that direction is changing once in $\frac{1}{2}$ cycle.

18. **(d)** The semicircular conducting ring (PQR) can be replaced with a straight rod of length $2r$.

Hence motional emf induced across the rod

$e = B\ (2r\ \text{V})$

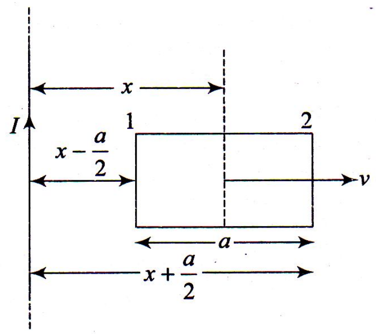


19. **(d)** The emf induced in side 1 of frame $e_1 = B_1 V\ell$

$B_1 = \frac{\mu_0 I}{2\pi(x - a/2)}$

The emf induced in side 2 of frame $e_2 = B_2 V\ell$

$B_1 = \frac{\mu_0 I}{2\pi(x + a/2)}$



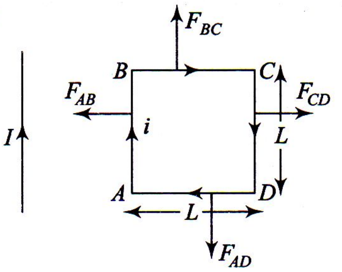
Net emf induced in square frame $e = B_1 V\ell - B_2 V\ell$

$$= \frac{\mu 0 I}{2\pi(x - a/2)} \ell v - \frac{\mu 0 I}{2\pi(x + a/2)} \ell v$$

or, $e \propto \frac{1}{(2x - a)(2x + a)}$

20. **(d)** First current develops in the direction of ***abcd* but** when electron moves away, then magnetic field inside loop decreases and current changes its direction.

21. **(a)**



$F_{AB} = i\ell B$ (Attractive)

$$F_{AB} = i(L).\frac{\mu_0 I}{2\pi\left(\frac{L}{2}\right)}(\leftarrow) = \frac{\mu_0 il}{\pi}(\leftarrow)$$

$F_{BC}(\uparrow)$ and $F_{AD}(\downarrow) \Rightarrow$ These cancel each other

$F_{CD} = i\ell B$ (Repulsive)

$$F_{CD} = i(L)\frac{\mu_0 I}{2\pi\left(\frac{3L}{2}\right)}(\rightarrow) = \frac{\mu_0 il}{3\pi}(\rightarrow)$$

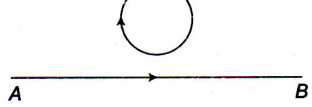
$$\Rightarrow F_{net} = \frac{\mu_0 il}{\pi} - \frac{\mu_0 il}{3\pi} = \frac{2\mu_0 il}{3\pi}$$

22. **(a)** Flux linked with each turn = 4×10^{-3} *Wb*

$\therefore$ Total flux linked = $1000[4 \times 10^{-3}]$ *Wb*

$f_{total} = 4 \Rightarrow Li = 4 \Rightarrow L = 1$ H

23. **(a)** The direction of the induced emf or current is such as to oppose the charge that produces it, this is also known as Lenz's law. If electron is moving from left to right, the flux linked with the loop (which is into the page) will first increase and then decrease as the electron passes by. So the induced current in the loop will be first anticlockwise and will change direction as the electron passes by.



24. **(c)** Choke coil is a high inductance coil made of thick insulated copper wire wound closely in a large number of turns over a soft-iron laminated core. Since, the wire is of copper and is thick, its resistance (*R*) is almost zero, but due to large number of turns and high permeability of iron core its inductance is quite high. The coil, therefore offers a large reactance and contributes to the impedance of the circuit. This reduces alternating current appreciably. Thus, current in an alternating circuit is reduced by means of a choke coil.

25. **(c)** Coefficient of mutual induction of two coils is equal to the number of magnetic flux (ϕ) linkages in one coil when a unit current (i) flows in the other.

Therefore, $M = \frac{\phi}{i}$

Given, $\phi = 2 \times 10^{-2}$ Wb, $i = 0.01$ A

$\therefore \quad M = \frac{2 \times 10^{-2}}{0.1} = 2$ H

26. **(b)** $P = \frac{1}{2} V_o i_o \cos\phi \Rightarrow P = P_{Peak}.\cos\phi$

$$\Rightarrow \frac{1}{2}(P_{peak}) = P_{peak}\cos\phi$$

$$\Rightarrow \cos\pi = \frac{1}{2} \Rightarrow \phi = \frac{\pi}{3}$$

27. **(c)** From Faraday's law of electromagnetic induction the induced emf is equal to negative rate of change of magnetic flux.

That is $e = -\frac{\Delta\phi}{\Delta t}$

Flux induced = $2BA\cos\phi$

where B is magnetic field, A is area.

Given, $\theta = 0° = \Delta t = \frac{1}{100}$ s

$\Delta f = 2 \times 0.01 \times \pi \times (1)^2 \times 200 \times \cos 0°$

$$\therefore \quad e = \frac{-2 \times 0.01 \times \pi \times (1)^2 \times 200}{100} = -4\pi \text{ volt}$$

Circumference of a circle of radius r is $2\pi r$.

$\therefore$ Induced electric field E is

$$E = \frac{|e|}{2\pi r} = \frac{4\pi}{2\pi r} = \frac{2}{1} = 2 \text{ V/m}$$

28. **(a)** When north pole of magnet approaches the one face of coil, then the force of the coil becomes a north pole to oppose this motion and current flows anticlockwise. Thus, in this case emf is developed in the coil and when it completes one half motion it is momentarily at rest and no emf is present. Now south pole approaches the other face of coil making this face a south pole. The current now flows in clockwise direction and again an emf is developed in the coil. This variation is shown in figure (a).

29. **(b)** In a constant magnetic field conducting ring oscillates with a frequency of 100 Hz.

i.e. $T = 1/100$ s, in time $T/2$ flux links with coil changes from BA to zero.

$\therefore$ Induced emf $= \dfrac{\text{change in flux}}{\text{time}}$

$$= \frac{BA}{T/2} = \frac{2BA}{T}$$

$$= \frac{2B \times \pi r^2}{T}$$

$$= \frac{2 \times 0.01 \times \pi \times 1^2}{1/100} = 4\pi \text{ V}$$

Induced electric field along the circle, using Maxwell equation $\oint E.dl = -\dfrac{d\phi}{dt} = A\dfrac{dB}{dt} = e$

$$\therefore\ E = \frac{1}{2\pi r} \times \left(\pi r^2 \times \frac{dB}{dt}\right) = \frac{e}{2\pi r} = \frac{4\pi}{2\pi r} = 2 \text{ V/m}$$

30. **(d)** During free fall of ring through a magnetic field, when ring enters the constant and horizontal magnetic field, the induced current flows in the ring in such a direction that opposes the cause producing it. Now when ring leaves the magnetic field, again current is induced in the ring but in opposite direction. Also during the stay of ring completely in the field there is no induction. Hence, correct graph will be (d).

31. **(a)** $|dq| = \dfrac{d\phi}{R} = i\,dt =$ Area under $i - t$ graph

$\therefore\ d\phi =$ (Area under $i - t$ graph) R

$$= \frac{1}{2} \times 4 \times 0.1 \times (10) = 2 \text{ Wb.}$$

32. **(a)** $\dfrac{N_s}{N_p} = \dfrac{V_s}{V_p} \Rightarrow \dfrac{200}{100} = \dfrac{V_s}{120} \Rightarrow V_s = 240$ V

Also $\dfrac{V_s}{V_p} = \dfrac{i_p}{i_s} \Rightarrow \dfrac{240}{120} = \dfrac{10}{i_s} \Rightarrow i_s = 5$ A

33. **(d)** Conductor cuts the flux only when, if it moves in the direction of M.

34. **(c)** If the current increases with time in loop A, then magnetic flux in B will increase. According to Lenz's law, loop-B is repelled by loop-A.

35. **(d)** Mutual inductance between two coils in the same plane with their centers coinciding is given by

$$M = \frac{\mu_0}{4\pi}\left(\frac{2\pi^2 R_2^2 N_1 N_2}{R_1}\right)$$

36. **(c)** $e = B_v vl = 0.2 \times 10^{-4} \times \left(\dfrac{180 \times 1000}{3600}\right) \times 1$

$$= 10^{-3} \text{ V}$$

37. **(c)** Inductors obey the laws of parallel and series combination of resistors.

38. **(b)** There will be self-induction effect when soft iron core is inserted.

39. **(c)** When loop is entering in the field, magnetic flux linked with the loop increases so induced emf in it $e = Bvl = 0.6 \times 10^{-2} \times 5 \times 10^{-2} = 3 \times 10^{-4}$ V (Negative).

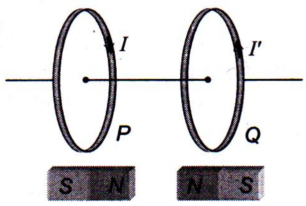
When loop completely entered in the field (after 5 sec) flux linked with the loop remains constant so $e = 0$.

After 15 sec, loop begins to exit out, linked magnetic flux decreases so induced emf $e = 3 \times 10^{-4}$ V (Positive).

40. **(a)** With rise in current in coil A flux through B increases. According to Lenz's law repulsion occurs between A and B.

41. **(d)** $e = B.\dfrac{dA}{dt} = L\dfrac{di}{dt} \Rightarrow 1 \times \dfrac{5}{10^{-3}} = L \times \dfrac{(2-1)}{2 \times 10^{-3}} \Rightarrow L =$ 10 H

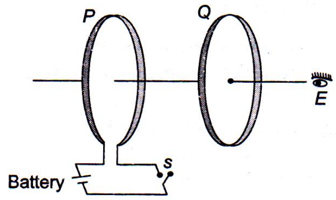
42. **(b)**



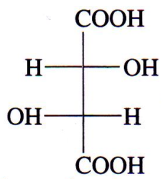
43. **(b)** $i = \dfrac{e}{R} = \dfrac{-N\ (\varphi_2 - \varphi_1)}{R \quad \Delta t} = \dfrac{-n(W_2 - W_1)}{5Rt}$

44. **(d)** Both AD and BC are straight conductors moving in a uniform magnetic field and emf will be induced in both. This will cause electric fields in both, but no net current flows in the circuit.

45. **(d)** When switch S is closed magnetic field lines passing through Q increases in the direction from right to left. So, according to Lenz's law induced current in Q *i.e.*, I_{Q_1} will flow in such a direction so that the magnetic field lines due to I_Q passes from left to right through Q. This is possible when I_{Q_3} flows in anticlockwise direction as seen by E. Opposite is the case when switch S is opened i.e., I_{Q_2} will be clockwise as seen by



[CHEMISTRY]

46. Starch is a natural polymer.
47. A
48. Orlon is a chain-growth polymer.
49. B
50. Isoprene (2-methyl-1, 3-butadiene) is the monomer of natural rubber.
51. B
52. Saran is a copolymer.
53. C
54. B
55. Terylene has ester linkages.
56. A
57. Polymerization of caprolactam yields nylon-6.
58. D
59. B
60. Natural rubber is an elastomer. The irregular geometry of the molecules involves weak van der Waals force of attraction.
61. C
62. A
63. B
64. B
65. For monosaccharides, the value of n in $C_nH_{2n}O_n$ varies from 3 to 7.
66. The number of monosaccharides in oligosaccharides varies from 2 to 10.
67. The prefix L in L-glyceraldehyde implies the absolute configuration of asymmetric carbon.
68. The number of optical isomers in an aldose containing n asymmetric carbon atoms is 2^n.
69. Both glucose and fructose are reducing sugars. Sucrose is a non-reducing sugar.
Pentanal contains —CHO group. it shows the test. Acetophenone does not contain —CHO group. it does not show the test.
70. A
71. L-Tartaric acid is 

. The L isomer has —OH on the left of the last asymmetric carbon placed at the bottom of the molecule.
72. An amino acid contains an amino group attached to α-carbon atom.
73. The amino acids are basic units of protei
74. The number of amino acids commonly found in proteins is 20.
75. The number of essential amino acids is 10.
76. Isoleucine contains nonpolar $—CH(CH_3)CH_2CH_3$ group.
77. Zwitterion is a doubly-charged species.
78. At low pH, an amino acid exists as $H_3\overset{+}{N}CHRCOOH$.
79. At high pH, an amino acid exists as $H_2NCHRCOO^-$.
80. **Glycine does not contain chiral carbon atom. Hence, it is not optically active.**
81. **Proteins contains exclusively L isomers of amino acids.**

82. The amino acid $H_2N\underset{\displaystyle |\atop\displaystyle COOH}{CH}(CH_2)_4NH_2$ at low pH exists as $H_3\overset{+}{N}\underset{\displaystyle |\atop\displaystyle COOH}{CH}(CH_2)_4NH_3$.

83. The pH of the solution at which amino acids exist as Zwetterion follows the order
acidic side chain < neutral chain < basic side chain.

84. The amino acid $H_2N\underset{\displaystyle |\atop\displaystyle COOH}{CH}(CH_2)_2COOH$ at low pH exists as $H_3\overset{+}{N}\underset{\displaystyle |\atop\displaystyle COOH}{CH}(CH_2)_2COOH$.

85. The amino acid $H_2N\underset{\displaystyle |\atop\displaystyle COOH}{CH}(CH_2)_2COOH$ at high pH exists as $H_2N\underset{\displaystyle |\atop\displaystyle COO^-}{CH}(CH_2)_2COO^-$.

86. In the representation of a dipeptide, amino group is present at the left end.

87. At pH = 2, alanine is protonated to NH_2 and at pH = 10, —COOH group ionizes to —COO^-

88. Initial amount of H^+ = VM = $(0.06025\ dm^3)\ (0.1\ mol\ dm^{-3})$ = 0.006025 mol
Remaining amount of H^+ = $(0.01625\ dm^3)\ (0.1\ mol\ dm^{-3})$ = 0.00125 mol
Amount of H^+ reacted = (0.006025 – 0.001625) mol = 0.0044 mol
Mass of NH_3 produced = (Amount of H^+) (M_{NH_3}) = (0.0044 mol) $(17\ g\ mol^{-1})$ = 0.0748 g

$$\text{Per cent of nitrogen} = \left(\frac{M_N}{M_{NH_3}}\right)(m_{NH3})\left(\frac{100}{m_{compound}}\right) = \left(\frac{14}{17}\right)(0.0748)\left(\frac{100}{0.156}\right) = 39.5$$

89. $$\text{Per cent of sulphur} = \left(\frac{M_S}{M_{BaSO_4}}\right)(m_{BaSO_4})\left(\frac{100}{m_{compound}}\right) = \left(\frac{32}{233}\right)(0.9336)\left(\frac{100}{0.244}\right) = 52.5$$

90. C