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 : 06-12-15**

TIME : 02:00 AM TO 05: 00 PM | **2013_P2 MODEL** | **MAX MARKS : 180**

KEY & SOLUTIONS

PHYSICS

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

CHEMISTRY

21	ABC	22	BCD	23	AB	24	ABCD	25	ABC	26	BC
27	ABC	28	ABCD	29	C	30	D	31	A	32	A
33	A	34	B	B	A	36	B	37	A	38	D
39	B	40	B								

MATHEMATICS

41	ABCD	42	D	43	ABD	44	ABCD	45	BC	46	ABCD
47	ABD	48	ABD	49	D	50	D	51	A	52	B
53	A	54	B	55	B	56	C	57	A	58	A
59	A	60	A								

PHYSICS

1. Conceptual
2. Conceptual
3. $\phi = 4t^n + 6$

$$\frac{d\phi}{dt} = 4n.t^{n-1}$$

$$|e| = 4nt^{n-1}$$

$$|e| = \frac{4n}{t^{1-n}}.$$

4. As initially the capacitor is uncharged so it doesn't oppose the current to be established in circuit and hence initially current is maximum and for a to be the current in circuit decreases from maximum to zero value.

For b to c, capacitor starts discharging as at b, the current is zero and reverses the direction of current.

5. The emf induced across the ends of rod is given by

$$e = \left(\vec{v} \times \vec{B}\right).\vec{I}$$

Using this expression we can easily find the correct options.

6. $V = \sqrt{(V_1 - V_3)^2 + V_2^2}$

As $V_1 = V_3$, so $V_2 = V = 200V$

As $V_1 = V_3$, i.e., voltage drop across inductor and capacitor are equal.

So, $X_L = X_C$ and the circuit is in resonance an resonant frequency is 50Hz.

7. As the rod is moving up it is acted upon by two forces first one gravitational force acting downward and second one magnetic force again acting down. Here magnetic force is velocity dependent.

As F_{net} and velocity are in opposite direction the speed of particle decreases and becomes zero at highest point. At highest point only gravity force is acting on rod. Under the influence of gravity force the rod starts moving down and hence magnetic force also comes into existence but this time the magnetic force is acting up. As velocity of rod starts increasing in downward direction, the magnetic force also starts increasing and at one moment $F_{net} = 0$ and then onwards the rod moves with constant velocity.

8. For a — As the magnetic approaches or recedes away from the coil, the flux linked with the coil is increasing or decreasing respectively due to the change in the magnetic field with time and hence emf induced is field induced emf.

For b —As area of loop is changing which causes the emf to induced, so it is a case motional emf.

For c —As resistance of coil changes the current through it and hence magnetic field changes with time.

For d—As current carrying wire is approaching a conducting ring, magnetic field at the location of ring is changing with time.

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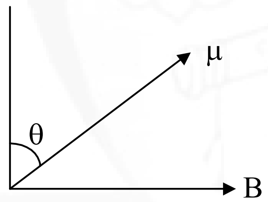

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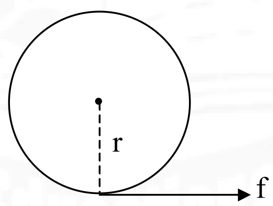


$\mu B\cos\theta - fr = I\alpha$ ......(A)

$f = ma_{cm} = m\,r\,\alpha$ ......(B)

$\alpha = \frac{5}{7}\pi\frac{niB}{m}\cos\theta$

10.

$f = m\,r\,\alpha$

$\mu mg = m\,r\left(\frac{5}{7}\frac{\pi niB}{m}\right)$

$\mu = \frac{5\pi}{7g}\left(\frac{niB}{m}\right)r$

11. Magnitude of emf in this circuit

$$\varepsilon = \left|\frac{d\phi}{dt}\right| = \frac{\mu_0 a(\ln 2)}{\pi}\left|\frac{dI}{dt}\right|$$

$$\varepsilon = \frac{\mu_0 a \ln 2}{\pi} I_0 \omega \sin \omega t \, .$$

12. $I = \dfrac{\mu_0 a \ln 2 I_0 \omega}{\pi\sqrt{R^2 + \omega^2 L^2}} \sin(\omega t - \phi)$.

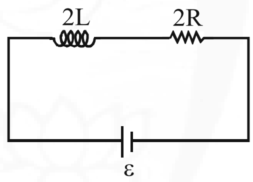
13. $\phi = BA$

$= B(\ell^2 + b^2)$

$$|\varepsilon| = \left|\frac{d\phi}{dt}\right| = \frac{dB}{dt}(\ell^2 + b^2)$$

$= 0.5$ volt.

14. . $$i = \frac{\varepsilon}{2R}\left[1 - e^{-\frac{t2R}{2L}}\right]$$



$$= \frac{0.5}{20}\left[1 - e^{-t}\right]$$

$$i = \frac{1}{40}\left[1 - e^{-t}\right]$$

15 & 16.

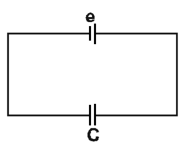
In time t the semi circular coil rotates by ωt and at this instant flux linked with coil is given by

$$\phi = B \times \frac{\pi a^2}{2} \cos \omega t$$

Emf induced across the ends of coil is,

$$e = -\frac{d\phi}{dt} = \frac{B\pi a^2}{2} \times \omega \sin \omega t$$

This time varying emf across OO’ causes the capacitor to charge, the equivalent circuit may be drawn as



From KVL, q/C = e where q is the charge on capacitor at any time t.

$q = Ce = \frac{B\omega a^2 \times \pi C}{2}\sin\omega t$

$q = Q_0\sin\omega t$

$I = dq/dt = Q_0\omega\cos\omega t$

Instantaneous power required to rotate the semi-circular coil with constant angular velocity is $P = eI = Q_0^2\omega\sin\omega t\,\cos\omega t.$

17.

For P —Magnetic field at the location of circuit containing R is into the plane of paper and is decreasing as I rapidly decreases to zero. So, induced current try to aid the original flux and hence direction of current in from a to b.

For Q—As seen from the side of magnet the magnetic field linked with solenoid is towards right and is decreasing, so induced current in coil is in clockwise direction as seen from the side of magnet, so current in R is from a to b.

For R—As switch S is closed the magnetic flux linked with coil containing R is increasing and magnetic field is towards right and hence from Lenz's law the induced current in resistor as from a to b.

For S—As switch is closed flux linked with circuit increases and induced current in resistor would be from b to a to weaker the original flux.

18. **For A**—If rod is non-conducting, magnetic field can be constant or time varying.

For constant B, emf induced = 0 and hence induced current = 0.

For time varying B, emf induced ≠ 0 but induced current = 0.

So, voltmeter reading may be zero but galvanometer reading must be zero.

Similarly, you can think in all possible ways for all remaining cases.

19. **For A**—$V_R^2 + V_2^2 = V^2 \Rightarrow V_R = 150V;$

$V_R^2 + V_L^2 = V_1^2 \Rightarrow V_L = 50V$

$|V_L - V_C| = V_2 \Rightarrow V_C = 250V,$

$\cos\phi = \frac{V_R}{V} = \frac{150}{250} = \frac{3}{5}$

For B — $V_C = V = 250^2$

and $V_R^2 + V_L^2 = 250^2$

$V_R = V_1 = 150V$ so $V_L = 200V$

Power factor can be computed by determining the net reactance.

For C— $V_R = V_3 = 150V$;

$V_1^2 = V_R^2 + V_L^2 \Rightarrow V_L = 50V$

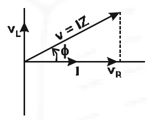
$V_2^2 = V_C^2 + V_R^2 \Rightarrow V_C = 250V$

$\cos\phi = 150/250 = 3/5$

For D— $V_R = V = 250V$

20. Depending on the value of L, C and R, circuit would be either capacitative, inductive or purely resistive.

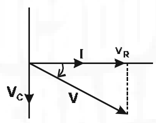
For LR series circuit, the phasor diagram is as shown below:



I lags voltage by an angle $\phi(<\pi/2)$

I lags V_L by an angle $\pi/2$.

For RC series AC circuit, the phasor diagram is as:



I leads V by an angle less than $\pi/2$.

For LCR series AC circuit, the phasor of diagram is as: