INDIAN SCHOOL MUSCAT

SENIOR SECTION

ELECTRO MAGNETIC INDUCTION AND ALTERNATING CURRENT

1 Two identical loops ,one of copper and another of constantan are removed from a magnetic field with in the same interval , in which loop will the induced current be greater?
Copper wire as it is a conductor.

2 In an LR series circuit the pd across R is 60V and that along the inductor 80V what is the effective emf of the circuit?
$V = (V_R^2 + V_L^2)^{1/2} =$ (3600+ 6400) = 100V .

3 The power factor of an AC circuit is 0.5. What is the phase difference between the current and voltage?
$\cos\phi = 0.5 \quad \phi = \pi/3$ rad.

4 The instantaneous current and voltage of an ac circuit are given by i=10 sin314t A, v=50 sin314t V. What is the power dissipation in the circuit?

Current is in phase with Voltage, therefore $\cos\emptyset = 1$,Power $P = 1/2\ V_0 I_0 \cos\emptyset = ½ \times 50 \times 10 = 250$ W

5 The electric mains in a house is marked 220V, 50Hz. Write down the equation for instantaneous voltage.
$V = V0\sin\omega t$, $V_0 = 220\sqrt{2}$
$V = 220\sqrt{2} \sin 2\pi \times 50t = 310 \sin 314t$

6 The frequency of ac is doubled, what happens to i) inductive reactance ii) capacitive reactance?
i) inductive reactance $XL = 2\pi\nu L$, it is doubled
ii) capacitive reactance $XC = 1/2\ \pi\nu C$, it is halved

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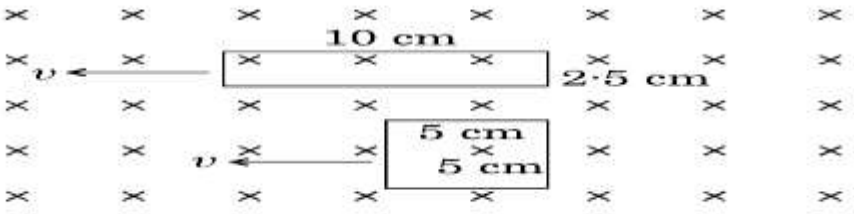
7 Two loops, one rectangular of dimensions 10 cm × 2·5 cm and second of square shape of side 5 cm are moved out of a uniform magnetic field $\vec{B}$ perpendicular to the planes of the loops with equal velocity υ as is shown in the figure.

(i) In which case will the emf induced be more ?

(ii) In which case will the current flowing through the two loops be less ?

Justify your answer.



Induced emf is the same in both the loops. Induced current is more in square loop.

Emf E depends on area of the loops . Current is less in rectangular loop as its resistance is more due to its length

8 .If the coefficient of mutual induction of a pair of coils is 6H and a current of 5 A is cut off in $\frac{1}{5000}$ of a second

$$e = -M\frac{dI}{dt} = -6 \times -\frac{1}{5000} \times 5 = 15 \times 10^4 \text{ V}$$

9 The resistance of a coil of number of turns for dc current is 10Ω. When an alternating current is passed through it will the opposition to the flow of current increase ,decrease or remain the same?

The coil has inductance also when AC is passed through it , it offers inductive reactance in addition to resistance .Therefore its opposition to the flow of current will increase .

10 The frequency of ac source is halved how does its i) capacitive reactance ii) inductive reactance change?

i) It will be doubled. ii) it will be halved

11 The south pole of a magnet is brought near a conducting loop. What is the direction of induced current as observed by a person on the other side of the loop?

Other side will be north pole according to Lenz law, therefore direction of the induced current is anticlockwise.

12 A lamp is connected in series with a capacitor predict your observations for DC and AC connections. What is the effect of i) increasing the frequency of AC ii) reducing the capacitance on the brightness of lamp?

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With dc the bulb will not glow as capacitive reactance for dc is infinity. With ac the bulb glows. i) As frequency increases capacitive reactance decreases and impedance decreases and the current increases so the bulb glows brighter. ii) as C decreases capacitive reactance increases and impedance increases and the current decreases so the bulb glows with less brightness.

13 A bulb B and an inductor L are connected in series to the AC mains. The bulb glows with some brightness. How will the glow of the bulb change when a i) a soft iron core ii) bismuth core is introduced inside the inductor? Give reasons.

i) inductive reactance increases as soft iron is ferromagnetic and impedance increases and the current decreases so the bulb glows with less brightness. ii) inductive reactance decreases as bismuth is diamagnetic , impedance decreases and the current increases so the bulb glows brighter

14 Mention any four power losses in a transformer.

Eddy current loss ,Copper loss , hysteresis loss , flux loss

15 Define the term 'wattless current'.

In an LCR circuit with pure inductor or capacitor there s a flow of current without dissipation of energy, Such a current is know as wattless ccurrent.

16 Current in a circuit falls from 5.0 a to 0 A in 0.1 s . If an average emf of 200 V is induced calculate the self inductance of the circuit.

$(dI/dt) = 50A/s$

$e = L\,(dI/dt)$ $L = e/(dI/dt) = 200/50 = 4$ H

17 The current flowing through a pure inductance of 2mH is i= 15 cos 300t A. What is the i) rms and ii) average value of current for complete cycle of AC?

$I_o = 15$ A

$I_{rms} = I_o/\sqrt{2} = 15//\sqrt{2}$ A , $I_{av} = 0$

Electromagnetic Waves

1 In a plane electromagnetic wave , the electric field oscillates with a frequency of 2 x 1010Hz , and amplitude of electric field is 40V/m, calculate its wavelength and amplitude of magnetic field.

$\lambda = C/\nu = 1.5$cm , B = 7.5 x 10 6 T

2 Identify the following electromagnetic waves as per the wavelengths given below a)10-3nm b)10^{-3}m c)1nm.Write one application for each of them.

a) gamma radiation ,treatment of cancer .b) microwaves , RADAR for air craft navigation c) X rays, detection of fracture of bones , concealed contra band goods at air ports.

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3 Name the following constituent radiations of electromagnetic spectrum which i) produce Intense heating effect ii) is absorbed by ozone layer in the atmosphere.iii) used to study crystal structure. Write one application of each of them.
i) infra red rays – used to relieve pain in Physio therapy, take photos in fog and Mist, night vision goggles
ii) UV rays –used to kill germs in water filters, surgical instruments ,to detect forged documents and fake currencies
iii) X- rays- they are used to detect fracture of bones, diagnostic tools in medical field

4 In a plane electromagnetic wave , the electric field oscillates with a frequency of 2×10^{10}Hz , and amplitude of electric field is 40V/m, calculate its wavelength and amplitude of magnetic field.
$\lambda = C/v = 1.5$cm , $B = E/C$ $B = 1.33 \times 10^{-6}$ T.

5 The Ozone layer on the top of stratosphere is crucial for human survival, why?

It absorbs the UV rays, and other low wavelength radiations which are harmful to living cells of human beings.

6 A radio can tune any station in the 7.5MHz to 12 MHz. What is the corresponding wavelength band?
$\lambda = C/v$ $\lambda 1 = 3 \times 10^8 / 7.5 \times 10^6 = 40$m , similarly $\lambda 2 = 25$m

Ray Optics and wave optics

1 Two telescopes have the same magnifying power, but the diameters of their apertures are different. Will there be a difference between the final images produced ?

yes. The final image produced in a telescope with more aperture will be bright and finer details of
the image can be seen as resolving power is more in it.

2 For which colour blue or red the focal length of a convex lens will be more? What will be your answer if the lens is concave?
The focal length is more for longer wavelength red in both convex and concave lenses.

3 An equi convex lens has a refractive index of 1.5 . write its focal length in terms of radius of curvature
R1 =R2 =R , for equi convex lens ,$1/f = (1.5 - 1)(1/R + 1/R) = 1/R$, ie f =R

4 What type of an air bubble inside water ?
Diverging lens, as $\mu_{lens} < \mu_{medium}$ from lens makers formula f will be negative.

5 State the essential condition required for diffraction to take place .
The width of the slit must be small are comparable with the wave length of light is used.

6 A convex lens of a material of refractive index μ is placed in a transparent liquid . What would be the value of refractive index of the liquid more, less or equal to μ ?

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Equal to μ. From lens makers formula.

7 Name the type of wave front from a i) line source ii) point source at infinite distance.
i) cylindrical wave front ii) plane wave front.

8 Can sound waves be polarized ? Justify.
No. Longitudinal waves cannot be polarized.

9 To get a sharp image, which concave mirror you will prefer one with small aperture or large aperture? To get a sharp image, which concave mirror you will prefer one with small aperture or large aperture?
The one with small aperture.

10 concave mirror & a convex lens are held under water. What would be the change in their focal lengths?
In concave mirror no change but in convex lens focal lens increases.

11 Mention advantages of total reflecting prism over mirrors or spherical metallic reflectors.
(i)The light is totally reflected so the image is bright.(ii)There is no tarnishing of reflecting surfaces.

12 How does the resolving power of a compound microscope change when i) cedar wood oil is filled in the space between object and objective lens? ii) If yellow light is replaced by blue light for illumination?

$R.P = 2\mu\sin\theta/1.22\,\lambda$, i) as μ increases .R.P increases ii) as λ decreases R.P increases

13 Why sunglasses have zero power even though their surfaces are curved?
Both the surfaces are curved in the same direction & the curvature is same for both the surfaces
Power is zero.

$P = (\mu-1)(1/R-1/R) = 0$

14 Name the phenomenon of light which could not be explained by wave theory.
Photoelectric effect.

15 Identify the phenomenon of light from the information given below.
i) principle of working of optic fibres ii) it proves transverse nature of light.
iii) bending of waves at the edges of obstacles iv) causes colours in thin films of oil on rain water
i) total internal reflection
ii) polarization of light
iii) diffraction
iv) interference of light.

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16 State Rayleigh's law of scattering.
Amount of light scattered is inversely proportional to the fourth power of wavelength of light.

17 What is the refractive index of the material of a biconvex lens if its focal length is numerically equal to of magnitude of radii of curvatures .
When n_1 =1.5. , f= R_1=R_2

18 Mention two advantages of reflecting telescope over refractive telescope.

Since the objective is mirror chromatic aberration is avoided
Mechanical equilibrium is ensured.

19 Why magnification by a simple microscope cannot exceed 9?

The convex lens cannot be designed below a particular focal length .

20 Why the sky appears reddish during sunrise and sunset?

As the sunlight travels a long distance during sun rise and sunset all the shorter wavelengths are scattered away.

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