SECOND YEAR HSE II TERMINAL EXAM - DEC - 2023

PHYSICS

1) only closed surfaces (5×1=5)
2) c) $B = \mu_0 n I$
3) Fig (a)
4) henry (H)
5) d) 90°
6) $c = 3 \times 10^8$ m/s / speed of light
7) True

8) $C_s = \frac{C_1 C_2}{C_1 + C_2} = \frac{2 \times 4}{2+4} = \frac{8}{6} = \frac{4}{3}$ μF
$= 1.33$ μF

9) It is the drift velocity per unit electric field. (5×2=10)

$$\mu = \frac{|V_d|}{E}$$

Unit → m^2/Vs (OR) Cs/kg (OR) $Cm/N/s$
(using $E = F/q$)

10) When a magnetic dipole placed in a uniform magnetic field, the two end poles experiences equal and opposite forces and the dipole rotates.

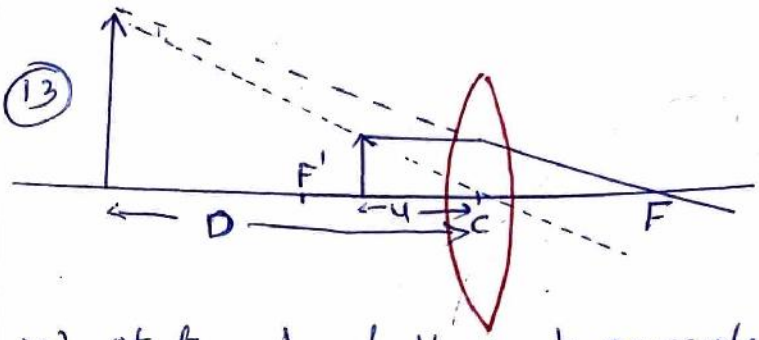
Torque, $\vec{\tau} = \vec{m} \times \vec{B}$

$\tau = mB\sin\theta$

11) Any 2 laws

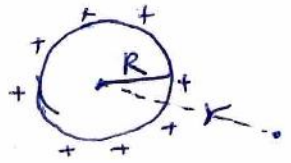
12) γ-rays, x-rays, ultraviolet rays, visible light, infrared rays, radio waves.

13)



14) statement of Huygen's principle

15)



a) Outside,

$$E_0 = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$$

The charged spherical shell behaves like a point charge and the intensity decreases with distance from the centre ($E \propto \frac{1}{r^2}$)

b) surface.

$$E_s = \frac{1}{4\pi\varepsilon_0}\frac{q}{R^2}$$, here also the charged shell behaves like a point charge.

c) Inside (6×3=18)

$E_{in} = 0$, electric field inside the shell is zero everywhere. (Electrostatic shielding)
(Equation/Explanation required)

16) When a polar or non-polar molecules placed in an external electric field, the dielectric develops a net dipole moment. The net dipole moment per unit volume is called dielectric - polarisation.

When a polar molecules are placed in a uniform electric field

the dipoles are arranged in the direction of $\vec{E}$ and acquire a net dipole moment

In the case of nonpolar molecules placed in external field, the charge centres will be displaced in opposite directions are are arranged in the direction of $\vec{E}$ and acquired a net dipole moment.

In both cases, polarisation

$P \propto E$

Non-polar → H_2, CO_2

polar → HCl, H_2O

(17) Any 2 properties of each substances with one example

dia → Cu, lead, H_2O, Nacl

para → Al, Na, Ca, Oxygen

ferro → Fe, Alnico

18) power in an ac circuit is determined by taking the average power over a cycle of ac.

$$P = V_{rms} I_{rms} \cos\phi$$

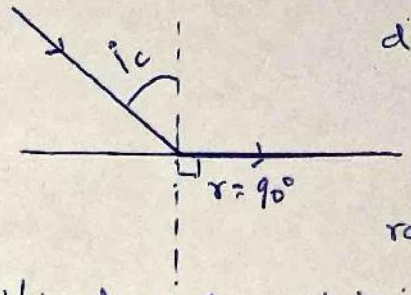
In ac circuit, the average power dissipated depends on cosine of the phase angle between voltage and current. The quantity $\cos\phi$ is called power factor.

(19) The current due to changing electric field is called displacement current.

$$i_d = \varepsilon_0 \frac{d\Phi_E}{dt}$$

Explanation of displacement current

20)



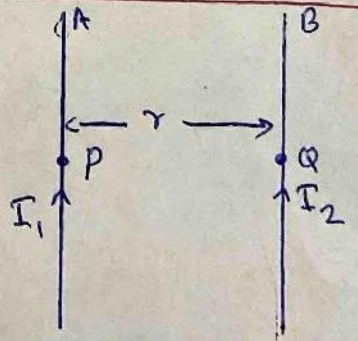
a) Critical angle – It is the angle of incidence in the denser medium for which the refracted ray passes through the surface of separation (OR) $r = 90$)

b) TIR → when $i > i_c$, instead of refraction, reflection takes place and is called TIR.

21) Sources of light having same frequency, wavelength and phase or having constant phase diference.

Coherent source can be produced by young's double slit arrangement, or Fresnel biprism method.

(22) a)



(3×4 = 12)

Magnetic field at Q due to I_1

$$B_1 = \frac{\mu_0 I_1}{2\pi r}, \text{ inward}$$

Force acting on B is,

$$F_2 = B_1 I_2 l_2$$

Force/unit length,

$$f_2 = \frac{F_2}{l_2} = B_1 I_2$$

$$= \frac{\mu_0 I_1 I_2}{2\pi r}, \text{ left}$$

Similarly force/unit length on A is,

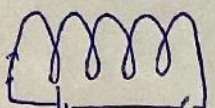
$$f_1 = \frac{\mu_0 I_1 I_2}{2\pi r}, \text{ right}$$

(b) ampere → is that steady current which when maintained in two long straight parallel conductors and placed one metre apart, would produce a force of 2×10^{-7} N/m of length.

23) a) It is the property of a circuit by which it opposes the growth and decay of current in the circuit.

b) $B = \mu_0 n I$

$= \mu_0 \frac{N}{l} I$ —①



Magnetic flux linked with the solenoid,

$$\phi = N B A$$

$$= N \times \mu_0 \frac{N}{l} I \times A$$

$$= \frac{\mu_0 N^2 A}{l} I$$

Self inductance, $L = \phi / I$

$$= \frac{\mu_0 N^2 A}{l}$$

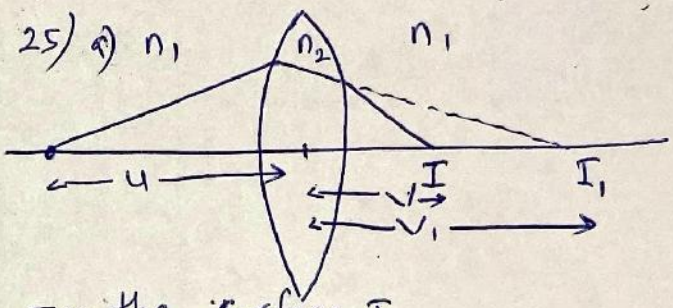
24) a) It is a device used to change the voltage of ac.

Step-up → $V_s > V_p$, $N_s > N_p$.

Step down → $V_s < V_p$, $N_s < N_p$.

b) Any 4 energy losses.

25) a)



For the surface I,

$$\frac{n_2}{V_1} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1} \quad \text{—①}$$

for the surface II, I, act as the virtual object and final image is formed at I.

For the surface II,

$$\frac{n_1}{V} - \frac{n_2}{V_1} = \frac{n_1 - n_2}{R_2}$$

$$= -\frac{(n_2 - n_1)}{R_2} \quad \text{—②}$$

① + ② ⇒

$$\frac{n_1}{V} - \frac{n_1}{u} = (n_2 - n_1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{V} - \frac{1}{u} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

when, $u = \infty$, $V = f$

$$\boxed{\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)}$$

b) $R_1 = +10\text{cm}$

$R_2 = -15\text{cm}$

$f = +12\text{cm}$

$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{12} = (n-1)\left(\frac{1}{10} - \frac{1}{-15}\right)$$

$$= (n-1)\left(\frac{15+10}{150}\right)$$

$$= (n-1) \times \frac{1}{6}$$

$$(n-1) = \frac{6}{12} = 0.5$$

$$n = 0.5 + 1 = 1.5$$

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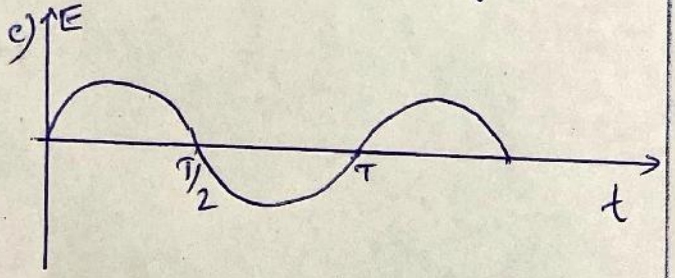
26) a) electromagnetic induction

b) Explanation of ac generator.

c)

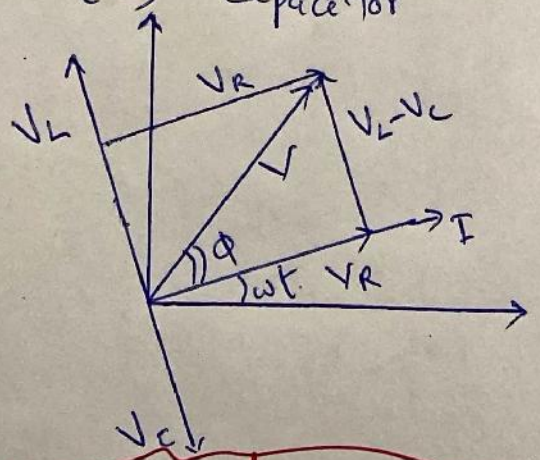


27) a) $I_{rms} = \frac{I_0}{\sqrt{2}} = 0.707 I_0$

b) A → Resistor

B → Inductor

C → Capacitor



c) Impedance,

$$Z = \frac{V}{I}$$

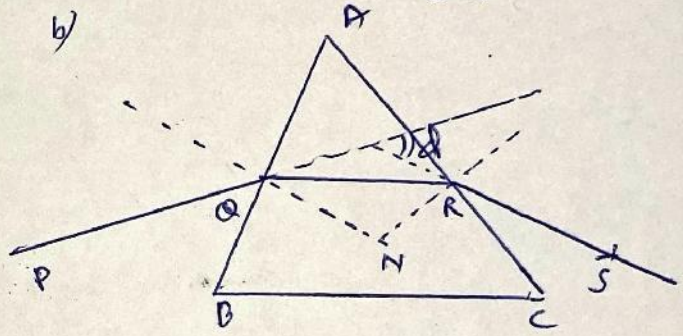
$$= \frac{\sqrt{V_R^2 + (V_L - V_C)^2}}{I}$$

$$= \frac{\sqrt{I^2R^2 + (IX_L - IX_C)^2}}{I}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

28) a) Statement (OR) $\frac{\sin i}{\sin r}$ = Constant

b)



c) Derivation of $n = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin(A/2)}$

29) a) when an ordinary or unpolarised light passes through certain crystals, its plane of vibration is restricted to a single plane. This is called polarisation.

b) $\beta = \frac{\lambda D}{d}$

λ → wavelength

d → distance of separation of slits

D → slit to screen distance

c) Interference

(i) Interference is produced due to light from 2 sources

(ii) Same band width

(iii) bands are having same intensity

Diffraction

(i) Due to interaction of waves from different parts of same wavefront

(ii) Band width varies.

(iii) Different intensity.

(Any 2 difference)