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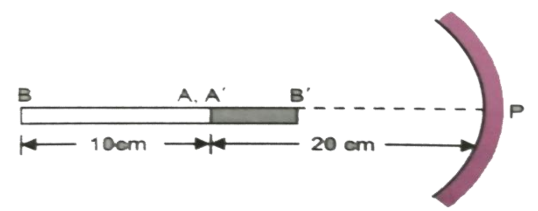
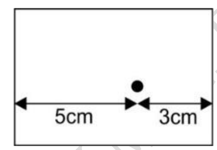
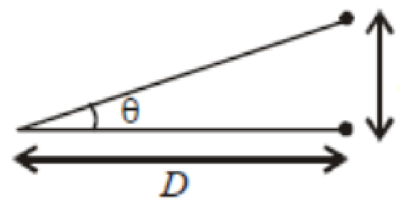
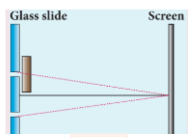
PHYSICS BOOK BACK ONEMARK QUESTIONS WITH SOLUTION-VOLUME 2

S.	QUESTIONS	SOLUTION/ANSWER
	UNIT 6 : OPTICS	
1.	The speed of light in an isotropic medium depends on, (a) its intensity (b)its wavelength (c) the nature of propagation (d) the motion of the source w.r.to medium	**ANSWER : (b)its wavelength**
2.	A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that its end closer to the pole is 20 cm away from the mirror. The length of the image is, (a) 2.5 cm (b) 5cm (c) 10 cm (d) 15cm	F=-10cm, R=-20 cm; Length of the rod AB=10 cm Rod is placed from pole is 20cm Distance of end A from the pole is 20cm,Since image form at C. Distance of end B from the pole is (20+10cm)=30 cm U=-30cm; f=-10 cm;v=? $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$; $\frac{1}{v}=\frac{1}{f}-\frac{1}{u}=\frac{1}{v}=\frac{1}{-10}-\frac{1}{-30}=\frac{1}{-10}+\frac{1}{30}$ $\frac{1}{v}=\frac{-20}{300}$; v=-15cm Length of the image A'B' is 20-15= 5cm  **ANSWER : (b) 5cm**
3.	An object is placed in front of a convex mirror of focal length of *f* and the maximum and minimum distance of an object from the mirror such that the image formed is real and Magnified a)2f and c (b) c and ∞ (c) f and 0 (d) None of these	In Convex mirror, erect and virtual image only formed **ANSWER : (d) None of these**

4.	For light incident from air onto a slab of refractive index 2. Maximum possible angle of refraction is, (a) 30° (b) 45° (c) 60° (d) 90°	$\mu = \frac{\sin i}{\sin r}$ =>$\sin r = \frac{\sin i}{\mu}$ For maximum possible angle of refraction sini = 1; Sinr=$\frac{1}{2}$;r=30° **ANSWER : (a) 30°**
5.	If the velocity and wavelength of light in air is V_a and λ_a and that in water is V_w and λ_w, then the refractive index of water is, a)$\frac{V_W}{V_a}$ b) $\frac{V_a}{V_w}$ c) $\frac{\lambda_w}{\lambda_a}$ d) $\frac{V_a\lambda_a}{V_w\lambda_w}$	$\mu = \frac{V_a}{V_w} = \frac{\lambda_a}{\lambda_w}$ **ANSWER : b) $\frac{V_a}{V_w}$**
6.	Stars twinkle due to, (a) reflection (b) total internal reflection (c) refraction (d) polarisation	**ANSWER : (c) refraction**
7.	When a biconvex lens of glass having refractive index 1.47 is dipped in a liquid, it acts as a plane sheet of glass.This implies that the liquid must have refractive index, (a) less than one (b) less than that of glass (c) greater than that of glass (d) equal to that of glass	$\frac{1}{f} = \left(\frac{n_g}{n_l} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ μ_g - the refractive index of the material of the lens μ_L - the refractive index of the liquid in which lens is dipped. As the biconvex lens dipped in a liquid acts as a plane sheet of glass, f=∞; $\frac{1}{f} = 0$ $\left(\frac{n_g}{n_l} - 1\right) = 0$; $n_g = n_L$ **ANSWER :(d) equal to that of glass**
8.	The radius of curvature of curved surface at a thin Plano convex lens is 10 cm and the refractive index is 1.5. If the plane surface is silvered, then the focal length will be, (a)5 cm (c)15 cm (b)10 cm (d)20 cm	The silvered Plano convex lens behaves as a concave mirror whose focal length is given by $\frac{1}{F} = \left(\frac{2}{f_1} + \frac{1}{f_m}\right)$ If the plane surface is silvered, $f_m = \frac{R_2}{2}$;$R_2 = \infty$; $f_m = \infty$ $\frac{1}{f_1} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ $\frac{1}{f_1} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right)$

		$\frac{1}{f_1} = (\mu - 1)\left(\frac{1}{R}\right)$ $\frac{1}{F} = \left(\frac{2(\mu-1)}{R}\right)$ $F=\left(\frac{R}{2(\mu-1)}\right)=\left(\frac{10}{2(1.5-1)}\right)=10cm$ **ANSWER : (b)10 cm**
9.	An air bubble in glass slab of refractive index 1.5 (near normal incidence) is 5 cm deep when viewed from one surface and 3 cm deep when viewed from the opposite face. The thickness of the slab is, (a) 8 cm (b)10 cm (c) 12 cm (d)16 cm	Relation between real depth and apparent depth is $\frac{n_i}{d}=\frac{n_r}{d'}$  n_i = Refractive index of medium of incident. n_r = Refractive index of medium of refraction. d = distance of object. d' = apparent depth Apparent depth=5cm from one side ∴ Real depth =1.5x5=7.5 cm apparent depth=3cm from other side ∴ Real depth from other side =3x1.5cm=4.5 ∴ Thickness of slab=7.5cm+4.5cm=12cm **ANSWER : (c) 12 cm**
10.	A ray of light travelling in a transparent medium of refractive index n falls, on a surface separating the medium from air at an angle of incidents of 45°. The ray can undergo total internal reflection for the following *n*, (a) n = 1.25 (b) n = 1.33 (c) n = 1.4 (d) n = 1.5	For total internal reflection Sin i> sin c i= angle of incidence; C –critical angle Sin $C=\frac{1}{n}$ Sin i> $\frac{1}{\mu}$ **or n >** $\frac{1}{\text{Sin i}}$ i=45° $n>\frac{1}{\text{Sin } 45°}= n>\sqrt{2}$ **ANSWER : (d) n = 1.5**
11.	A plane glass is placed over a various coloured letters (violet, green, yellow,red) The letter which	Violet –low wavelength; red – high wavelength;

	appears to be raised more is, (a) red (c) green b) yellow (d) violet	violet - higher refractive index than red.  $\mu=\frac{h}{h'}$; $h'=\frac{h}{\mu}$ **ANSWER : (d) violet**
12.	Two point white dots are 1 mm apart on a black paper. They are viewed by eye of pupil diameter 3 mm approximately. The maximum distance at which these dots can be resolved by the eye is, [take wavelength of light, λ = 500 nm] (a) 1 m (b) 5 m (c) 3 m (d) 6m	**Resolution limit=$\frac{1.22\lambda}{d}$**  Resolution limit =sin**θ** =**θ**=$\frac{y}{D}$ $\frac{1.22\lambda}{d}=\frac{y}{D}$ D=$\frac{yd}{1.22\lambda}=\frac{10^{-3}x3x10^{-3}}{1.22x5x10^{-7}}=\frac{30}{6.1}\cong$ 5m. **ANSWER : (b) 5 m**
13.	In a Young's double-slit experiment, the slit separation is doubled. To maintain the same fringe spacing on the screen, the screen-to-slit distance *D* must be changed to, (a) 2*D* (b) $\frac{D}{2}$ c)$\sqrt{2}$ D d) $\frac{D}{\sqrt{2}}$	Distance between slit d'=2d Fringe width $\beta'=\beta$ Distance between slit and screen D'=? $\beta'=\frac{\lambda D'}{d'}$; $\beta=\frac{\lambda D}{d}$ $\frac{\lambda D'}{d'}=\frac{\lambda D}{d}$ D'=$\frac{Dd'}{d}=\frac{D2d}{d}$=2D **ANSWER : (a) 2*D***
14.	Two coherent monochromatic light beams of intensities I and 4I are superposed. The maximum and minimum possible intensities in the resulting beam are (a) 5I and I (b) 5I and 3I (c) 9I and I (d) 9I and 3I	$I_{max}=\left(\sqrt{I_1}+\sqrt{I_2}\right)^2$;= $(\sqrt{I}+\sqrt{4I})^2$ =9I $I_{min}=\left(\sqrt{I_1}-\sqrt{I_2}\right)^2=\left(\sqrt{I}-\sqrt{4I}\right)^2$=I **ANSWER : (c) 9I and I**
15.	When light is incident on a soap film of thickness 5×10^{-5} cm, the wavelength of light reflected maximum in the visible region is 5320 Å. Refractive index of the film will be, (a) 1.22 b) 1.33 (c) 1.51(d) 1.83	2**μ**d=(2n+1)$\frac{\lambda}{2}$ For visible region n=2 **μ**=$\frac{(2n+1)}{2d}\frac{\lambda}{2}=\frac{(2x2+1)}{2x2}\frac{5320x10^{-10}}{5x10^{-7}}$= 1.33 **ANSWER : b) 1.33**

16.	First diffraction minimum due to a single slit of width 1.0×10^{-5} cm is at 30°. Then wavelength of light used is, (a) 400 Å(b) 500 Å(c) 600 Å(d) 700 Å	For single slit asin**θ**=n**λ** **λ**=$\frac{a\,sin\theta}{n}=\frac{1x10^{-5}x10^{-2}\,sin30°}{1}$ =500A° **ANSWER : (b) 500 Å**
17.	A ray of light strikes a glass plate at an angle 60°. If the reflected and refracted rays are perpendicular to each other, the refractive index of the glass is, a)$\sqrt{3}$ b)$\frac{3}{2}$ c) $\sqrt{\frac{3}{2}}$ d)2	**μ**=tani_p **μ**=tan60° =$\sqrt{3}$ **ANSWER : a)**$\sqrt{3}$
18.	One of the of Young's double slits is covered with a glass plate as shown in figure. The position of central maximum will,  (a) get shifted downwards (b) get shifted upwards (c) will remain the same (d) data insufficient to conclude	The position of central maximum Get shifted in the side of slits in which glass plate is covered, as the distance travelled from the slit is more. The position of central maximum gets shifted upward. **ANSWER : (b) get shifted upwards**
19.	Light transmitted by Nicol prism is, (a) partiallypolarised (b) unpolarised (c) plane polarized (d) elliptically polarised	**ANSWER : (c)Plane polarised**
20.	The transverse nature of light is shown in,(a) interference (b) diffraction (c) scattering (d) polarisation	**ANSWER : (d)polarisation**

UNIT 7.DUAL NATURE OF RADIATION AND MATTER

1.	The wavelength λ_e of an electron and λ_p of a photon of same energy *E* are related by a) $\lambda_p \propto \lambda_e$ b) $\lambda_p \propto \sqrt{\lambda_e}$ c) $\lambda_p \propto \frac{1}{\sqrt{\lambda e}}$ d) $\lambda_p \propto \lambda_e^2$	Wavelength of electron $\lambda_e=\frac{h}{\sqrt{2mE}}$ Wavelength of photon $\lambda_p=\frac{hc}{E}$ =>E=$\frac{hc}{\lambda p}$ $\lambda_e^2=\frac{h^2}{2mE}$ => $\frac{h^2}{2m\frac{hc}{\lambda_p}}=\frac{h^2\lambda_p}{2mhc}$ $\lambda_e^2 \propto \lambda_p$ **ANSWER : d)** $\lambda_p \propto \lambda_e^2$
2.	In an electron microscope, the electrons are accelerated by a voltage of 14 *kV*. If the voltage is changed to 224	$\lambda=\frac{12.27}{\sqrt{V}}$

	kV, then the de Broglie wavelength associated with the electrons would a. increase by 2 times b. decrease by 2 times c. decrease by 4 times d. increase by 4 times	$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{V_2}{V_1}}$ $\lambda_1 = \lambda_2\sqrt{\frac{V_2}{V_1}}$ $\lambda_1 = \lambda_2\sqrt{\frac{14}{224}} = \lambda_2\sqrt{\frac{1}{16}}$ $\lambda_1 = \frac{\lambda_2}{4}$ **ANSWER : c. decrease by 4 times**
3.	A particle of mass 3×10^{-6} g has the same wavelength as an electron moving with a velocity $6 \times 10^6 ms^{-1}$. The velocity of the particle is a) $1.82 \times 10^{-18} ms^{-1}$ b) $9 \times 10^{-2} ms^{-1}$ c) $3 \times 10^{-31} ms^{-1}$ d) $1.82 \times 10^{-15} ms^{-1}$	$\lambda = \frac{h}{p}$ ---→ $\lambda_e = \frac{h}{p_e}$ $\lambda = \lambda_e$ $p = p_e$ $mv = m_e v_e$ $v = \frac{m_e v_e}{m} = \frac{9.1x10^{-31}x6x10^{6}}{3x10^{-9}} = 18.2 \times 10^{-16}$ **ANSWER : d) $1.82 \times 10^{-15} ms^{-1}$**
4.	When a metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential is $V/4$. The threshold wavelength for the metallic surface is a. 4λ b. 5λ c. $\frac{5}{2}\lambda$ d. 3λ	$ev = h\nu - h\nu_0 = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$ ------1 $\frac{ev}{4} = \frac{hc}{2\lambda} - \frac{hc}{\lambda_0}$ ➔ $ev = \frac{4hc}{2\lambda} - \frac{4hc}{\lambda_0}$ ---2 from 1,2 $\frac{hc}{\lambda} - \frac{hc}{\lambda_0} = \frac{4hc}{2\lambda} - \frac{4hc}{\lambda_0}$ ➔ $\frac{1}{\lambda} - \frac{1}{\lambda_0} = \frac{2}{\lambda} - \frac{4}{\lambda_0}$ $\lambda_0 = 3\lambda$ **ANSWER : d. 3λ**
5.	If a light of wavelength 330 nm is incident on a metal with work function 3.55 eV, the electrons are emitted. Then the wavelength of the emitted electron is (Take h $= 6.6 \times 10^{-34}$ Js) a. $<2.75 \times 10^{-9}$m b. $\geq 2.75 \times 10^{-9}$m c. $\leq 2.5 \times 10^{-12}$m d. $<2.5 \times 10^{-10}$m	$E = \phi_0 + ev$ $\frac{hc}{\lambda} = \phi_0 + ev = 3.55 + eV$ $E = \frac{6.626x10^{-34}x3x10^{8}}{330x10^{-9}} = \frac{19.8x10^{-26}}{330x10^{-9}}$ J $= 0.06\,x10^{-17} = \frac{0.06\,x10^{-17}}{1.6x10^{-19}}$ ev $= 0.0375x10^{2} ev = 3.75 ev$ $KE_{max} = E - \phi_0$ $3.75ev - 3.55ev = 0.2ev$ De Broglie wavelength of electron is $\lambda_{min} = \frac{12.27}{\sqrt{k_{max}}}$ $= \frac{12.27}{\sqrt{0.2}} = 2.743 \times 10^{-9}$m $\lambda \geq \lambda_{min}$ i.e, $2.75x10^{9}$m $\geq 2.743 \times 10^{-9}$m **ANSWER : b. $\geq 2.75 \times 10^{-9}$m**

6.	A photoelectric surface is illuminated successively by monochromatic light of wavelength λ and λ/ 2 . If the maximum kinetic energy of the emitted photo electrons in the second case is 3 times that in the first case, the work function at the surface of material is a) $\frac{hc}{\lambda}$ b) $\frac{2hc}{\lambda}$ c) $\frac{hc}{3\lambda}$ d) $\frac{hc}{2\lambda}$	$kE_1 = \frac{hc}{\lambda} - \phi$ ------------1 $3kE_1 = \frac{2hc}{\lambda} - \phi$ $kE_1 = \frac{2hc}{3\lambda} - \frac{\phi}{3}$ ------------2 (Equating (1) and (2)) $\frac{hc}{\lambda} - \phi = \frac{2hc}{3\lambda} - \frac{\phi}{3}$ $\frac{hc}{\lambda}(1-\frac{2}{3}) = \phi(1-\frac{1}{3}) = \frac{hc}{\lambda}\frac{1}{3} = \phi\frac{2}{3}$ $\phi = \frac{hc}{2\lambda}$ **ANSWER :** d) $\frac{hc}{2\lambda}$
7.	In photoelectric emission, a radiation whose frequency is 4 times threshold frequency of a certain metal is incident on the metal. Then the maximum possible velocity of the emitted electron will be a) $\sqrt{\frac{h\nu_0}{m}}$ b) $\sqrt{\frac{6h\nu_0}{m}}$ c) $2\sqrt{\frac{h\nu_0}{m}}$ d) $\sqrt{\frac{h\nu_0}{2m}}$	$h\nu - h\nu_0 = \frac{1}{2}mv_{max}^2$ $h4\nu_0 - h\nu_0 = \frac{1}{2}mv_{max}^2$ $3h\nu_0 = \frac{1}{2}mv_{max}^2$ $v_{max}^2 = = \frac{6h\nu_0}{m}$ $v_{max} = \sqrt{\frac{6h\nu_0}{m}}$ **ANSWER : b)** $\sqrt{\frac{6h\nu_0}{m}}$
8.	Two radiations with photon energies 0.9 *eV* and 3.3 *eV* respectively are falling on a metallic surface successively. If the work function of the metal is 0.6 *eV*, then the ratio of maximum speeds of emitted electrons will be a) 1:4 b) 1:3 c) 1:1 d)1:9	$\frac{1}{2}mv_1^2 = \frac{hc}{\lambda} - \phi$ $\frac{1}{2}mv_1^2 = (0.9 - 0.6)ev = 0.3ev$ $\frac{1}{2}mv_1^2 = (3.3 - 0.6)ev = 2.7ev$ Divide 1 by 2 $\frac{\frac{1}{2}mv_1^2}{\frac{1}{2}mv_2^2} = \frac{0.3}{2.7} = \frac{1}{9}$ $\frac{v_1^2}{v_2^2} = \frac{1}{9}$ ➔ $\frac{v_1}{v_2} = \frac{1}{3}$ ➔ 1:3 **ANSWER : b) 1:3**
9.	A light source of wavelength 520 *nm* emits 1.04×10^{15} photons per second while the second source of 460 *nm* produces 1.38×10^{15} photons per second. Then the ratio of power of second source to that of first source is a) 1.00 b) 1.02 c) 1.5 d) 0.98	$n_1 = 1.04 \times 10^{15}$ $n_2 = 1.38 \times 10^{15}$ $\lambda_1 = 520\ nm$; $\lambda_2 = 460\ nm$; $n = \frac{P}{\frac{hc}{\lambda}}$ then $P = \frac{nhc}{\lambda}$ $\frac{P_2}{P_1} = \frac{n_2\lambda_1}{n_1\lambda_2} = \frac{1.38x10^{15}x520x10^{-9}}{1.04x10^{15}x460x10^{-9}}$ $\frac{P_2}{P_1} = 1.5$; **ANSWER : c) 1.5**

10.	The mean wavelength of light from sun is taken to be 550 nm and its mean power is $3.8 \times 10^{26} W$. The number of photons received by the human eye per second on the average from sunlight is of the order of a) 10^{45} b) 10^{42} c) 10^{54} d) 10^{51}	E=$\frac{hc}{\lambda}=\frac{6.6x10^{-34}x3x10^{8}}{5.5x10^{-7}}=\frac{18}{5}x10^{-19}$ $=3.6x10^{-19}$ The number of photons received by the human eye per second n=$\frac{P}{E}$ n=$\frac{3.8\times10^{26}}{3.6x10^{-19}}$= $1.05x10^{45} \cong 10^{45}$ **ANSWER : a) 10^{45}**
11.	The threshold wavelength for a metal surface whose photoelectric work function is 3.313 eV is a)4125Å b)3750Å c)6000Å d)2062 5 . Å	$\phi=\frac{hc}{\lambda_o}$ $\lambda_o=\frac{hc}{\phi}$ $=\frac{6.6x10^{-34}x3x10^{8}}{3.313x1.6x10^{-19}}=\frac{19.876x10^{-26}}{5.3x10^{-19}}$ =3750Å ANSWER : b)3750Å
12.	A light of wavelength 500 nm is incident on a sensitive plate of photoelectric work function 1.235 eV. The kinetic energy of the photo electrons emitted is be (Take $h = 6.6 \times 10^{-34} Js$) a) 0.58 eV b) 2.48 eV c) 1.24 eV d) 1.16 eV	h$\nu=\phi$+K.E $K.E=\frac{hc}{\lambda}-\phi$ K.E=$\left(\frac{6.6x10^{-34}x3x10^{8}}{500X10^{-9}x1.6x10^{-19}}-1.235\right)eV$ K.E=2.472-1.235=1.24eV **ANSWER : c) 1.24 eV**
13.	Photons of wavelength λ are incident on a metal. The most energetic electrons ejected from the metal are bent into a circular arc of radius R by a perpendicular magnetic field having magnitude B. The work function of the metal is a) $\frac{hc}{\lambda}-m_e+\frac{e^2B^2R^2}{2m_e}$ b) $\frac{hc}{\lambda}+2m_e\left(\frac{eBR}{2m_e}\right)^2$ c) $\frac{hc}{\lambda}-m_ec^2-\frac{e^2B^2R^2}{2m_e}$ d) $\frac{hc}{\lambda}-2m_e\left(\frac{eBR}{2m_e}\right)^2$	$\frac{1}{2}m_ev^2=\frac{hc}{\lambda}-\phi$ $\phi=\frac{hc}{\lambda}-\frac{1}{2}m_ev^2$ w.k.t $\frac{m_ev^2}{R}$=Bev v=$\frac{BeR}{m_e}$ $\phi=\frac{hc}{\lambda}-\frac{1}{2}m_ev^2$ $\phi=\frac{hc}{\lambda}-\frac{1}{2}\frac{e^2B^2R^2}{m_e}$ or $\frac{hc}{\lambda}-2m_e\left(\frac{eBR}{2m_e}\right)^2$ **ANSWER : d) $\frac{hc}{\lambda}-2m_e\left(\frac{eBR}{2m_e}\right)^2$**
14.	The work functions for metals A, B and C are 1.92 eV, 2.0 eV and 5.0 eV respectively. The metals which will	$(\lambda_0)_A=\frac{hc}{\phi_A}$ = $\frac{6.6x10^{-34}x3x10^{8}}{1.92x1.6x10^{-19}}=\frac{19.8x10^{-26}}{3.072x10^{-19}}$=6445A°

	emit photoelectrons for a radiation of wavelength 4100Å is/are a. *A* only b. both *A* and c. all these metals d. none	$(\lambda_0)_B=\frac{hc}{\phi_B}$ = $\frac{6.6x10^{-34}x3x10^8}{2x1.6x10^{-19}}=\frac{19.8x10^{-26}}{3.2X10^{-19}}$=6100A° $(\lambda_0)_C=\frac{hc}{\phi_C}$ = $\frac{6.6x10^{-34}x3x10^8}{5.0x1.6x10^{-19}}=\frac{19.8x10^{-26}}{8.0x10^{-19}}$=2480A° FOR photoelectric effect $\lambda<\lambda_0$; $\lambda<(\lambda_0)_A$; $\lambda<(\lambda_0)_B$; $\lambda>(\lambda_0)_C$ **ANSWER : b. both *A* and *B***
15.	Emission of electrons by the absorption of heat energy is called………emission. a. photoelectric b. field c. thermionic d. secondary	**ANSWER : c. thermionic**
	UNIT 8: ATOMIC AND NUCLEAR PHYSICS	
1.	Suppose an alpha particle accelerated by a potential of *V* volt is allowed to collide with a nucleus whose atomic number is *Z*, then the distance of closest approach of alpha particle to the nucleus is a) 14.4 $\frac{Z}{V}$ A b) 14.4 $\frac{V}{Z}$ A^0 c) 1.44 $\frac{Z}{V}$ A^0 d) 1.44 $\frac{V}{Z}$ A^0	$\frac{1}{2}mv^2$=e$_a$V=2eV $r_0=\frac{1}{4\pi\varepsilon_0}\frac{2Ze^2}{\frac{1}{2}mv^2}$= $r_0=\frac{1}{4\pi\varepsilon_0}\frac{2Ze^2}{2eV}$= $9x10^9x1.6x10^{-19}\frac{Z}{V}=14.4\frac{Z}{V}$ **ANSWER : a) 14.4 $\frac{Z}{V}$ A**
2.	In a hydrogen atom, the electron revolving in the fourth orbit, has angular momentum is equal to a)h b) $\frac{h}{4}$ c) $\frac{4h}{\pi}$ d) $\frac{2h}{\pi}$	The angular momentum (mvr) of electron in nth orbit is equal to nh/2π. $\frac{nh}{2\pi}$=mvr =L n =4 ; $\frac{4h}{2\pi}$=L L=$\frac{2h}{\pi}$ **ANSWER : d) $\frac{2h}{\pi}$**
3.	Atomic number of H like atom with ionization potential 122.4V for n=1 is (a) 1 (b) 2 (c) 3 (d) 4	$V_n=\frac{-13.6\ X\ Z^2}{n^2}$ eV $Z^2=\frac{V_n\ X\ n^2}{13.6}=\frac{122.4\ X\ 1^2}{13.6}$= 9 **Z =3 ANSWER : (c) 3**
4.	The ratio between the first three orbits of hydrogen atom is	$r_n \alpha\ n^2$ r_1: r_2: r_3 = 1:4:9 **ANSWER :** (c) 1:4:9

	(a) 1:2:3 (b) 2:4:6 (c) 1:4:9 (d)1:3:5	
5.	The charge of cathode rays is (a) positive (b) negative (c) neutral (d) not defined	**ANSWER : (b) negative**
6.	In J.J. T omson e/m experiment, a beam of electron is replaced by that of muons(particle with same charge as that of electrons but mass 208 times that of electrons). No deflection condition is achieved only if (a) B is increased by 208 times (b) B is decreased by 208 times (c) B is increased by 14.4 times (d) B is decreased by 14.4 times	For deflected position For electron $\frac{1}{2}mv^2=eV$ => $mv^2=2eV$ $\frac{e}{m}=\frac{v^2}{2V}$; $v=\frac{E}{B}$ $\frac{e}{m}=\frac{E^2}{2vB^2}$ =>$B^2=\frac{E^2m}{2eV}$; $B_1^2=\frac{E^2m_1}{2eV}=\frac{E^2 208\, m}{2eV}$ $B_1^2=208\, B^2$ $B_1=\sqrt{208}\, B = 14.4\, B$ **ANSWER : (c) B is increased by 14.4 times**
7.	The ratio of the wavelengths for the transition from n=2 to n=1 in Li^{++},He^{+} and H is ________ (a) 1:2:3 (b) 1:4:9 (c) 3:2:1 (d)4:9:36	$\bar{\nu}=\frac{1}{\lambda}=Z^2R\left(\frac{1}{n_2^2}-\frac{1}{n_1^2}\right)$ $\frac{1}{\lambda}\propto Z^2$; $\lambda\propto\frac{1}{Z^2}$ Hence atomic number of Li^{+}, He^{+} and H are 3,2,1 respectively. $\lambda_{Li}:\lambda_{He}:\lambda_H=\frac{1}{3^2}:\frac{1}{2^2}:\frac{1}{1}=\frac{1}{9}:\frac{1}{4}:\frac{1}{1}=\frac{1}{9}:\frac{1}{4}:\frac{1}{1}$ $\frac{4}{36}:\frac{9}{36}:\frac{36}{36}$; 4 : 9 :36 **ANSWER : (d)4:9:36**
8.	The electric potential between a proton and an electron is given by $V = V_0 \ln\left[\frac{r}{r_0}\right]$ where, r_0 is a constant. Assuming that bohr atom model is applicable to potential, then vaiation of radius of n^{th} orbit r_n with the principal quantum number n is ______ (a) $r_n\propto\frac{1}{n}$ (b) $r_n\propto n$ (c) $r_n\propto\frac{1}{n^2}$ (d) $r_n\propto n^2$	$F=-\frac{dU}{dr}=\frac{mv^2}{r}$ $F=\frac{-dV}{dr}=\frac{-d}{dr}\left[V_0\ln\left[\frac{r}{r_0}\right]\right]=-V_0\frac{r_0}{r}\frac{1}{r_0}=-\frac{V_0}{r}$ $\frac{mv^2}{r}=-\frac{V_0}{r}$ ➔ $mv^2=-V_0$ From bohr postulates $mvr=\frac{nh}{2\pi}$ ➔ $m^2v^2r^2=\frac{n^2h^2}{4\pi^2}$ $r^2=\frac{n^2h^2}{4\pi^2m^2v^2}$ ➔ $r_n^2\propto n^2$ $r_n\propto n$ **ANSWER : (b) $r_n\propto n$**
9.	If the nuclear radius of ^{27}Al is 3.6 fermi, the approximate	$r=R_0A^{1/3}$

	nuclear radius of ^{64}Cu is (a)2.4 (b) 1.2 (c) 4.8 (d) 3.2	$\frac{r_2}{r_1}=\left[\frac{A_2}{A_1}\right]^{1/3}=\left[\frac{64}{27}\right]^{1/3}=\frac{4}{3}$ $r_2=\frac{4}{3}\,xr_1=\frac{4}{3}\,x3.6$ =4.8 F **ANSWER : (c) 4.8**
10.	The nucleus is approximately, spherical in shape , then the surface area of nucleus having mass number A varies as (a) $A^{2/3}$ (b) $A^{4/3}$ (c) $A^{1/3}$ (d) $A^{5/3}$	$r=R_0A^{1/3}$ $A = 4\pi r^2 = 4\pi(R_0A^{1/3})^2 = 4\pi R_0^2A^{2/3}$ $A\propto A^{2/3}$ **ANSWER : (a) $A^{2/3}$**
11.	The mass of a $^{7}_{3}Li$ nucleus is 0.042u less than the sum of the masses of all its nuclons. The binding energy per nucleon of $^{7}_{3}Li$ nucleus is nearly (a)46 MeV (b) 5.6 MeV (c) 3.9 MeV (d) 23 MeV	BE= Δmx931MeV =0.042x931MeV $\frac{BE}{A}=\frac{0.042x931MeV}{7}$ =5.6 MeV **ANSWER : (b) 5.6 MeV**
12.	M_p denotes the mass of the proton and M_n denotes mass of a neutron. A given nucleus of binding energy B, contains Z protons and N neutrons. The mass M(N,Z) of the nucleus is given by(where c is the speed of light) a) $M(N,Z)=NM_n+ZM_p-Bc^2$ b) $M(N,Z)=NM_n+ZM_p+Bc^2$ c) $M(N,Z)=NM_n+ZM_p-\frac{B}{c^2}$ (d) $M(N,Z)=NM_n+ZM_p+\frac{B}{c^2}$	$B=[NM_n+ZM_p-M(N,Z)]c^2$ $\Rightarrow \frac{B}{c^2}=(NM_n+ZM_p-M(N,Z)$ $\Rightarrow M(N,Z)=NM_n+ZM_p-\frac{B}{c^2}$ **ANSWER : c) $M(N,Z)=NM_n+ZM_p-\frac{B}{c^2}$**
13.	A radioactive nucleus (initial mass number A and atomic number Z) emits 2α and 2 positrons. The ratio of number of neutrons to that of proton in the final nucleus will be a) $\frac{A-Z-4}{Z-2}$ b) $\frac{A-Z-2}{Z-6}$ c) $\frac{A-Z-4}{Z-6}$ d) $\frac{A-Z-12}{Z-4}$	$_ZX^A=_{Z'}Y^{A'}+2\alpha+2\beta^+$ $_ZX^A=_{Z'}Y^{A'}+2(_2He^4)+2(_1e^0)$ Compare the mass no. A=A'+8; A'=A-8 Compare the proton Z=Z'+4+2=Z'+6=>Z'=Z-6 For neutrons ; N'=A'-Z'= (A-8)- (Z-6)=A-Z-2 The ratio of number of neutrons to that of proton in the final nucleus $\frac{N'}{Z'}=\frac{A-Z-2}{Z-6}$ **ANSWER : b) $\frac{A-Z-2}{Z-6}$**
14.	The half-life period of a radioactive element A is same as the mean life time of another radioactive element B.Initially both have the same number of Atoms. Then	**Half – life** $T_{\frac{1}{2}}=\frac{0.6931}{\lambda}$ Mean life time $(\tau)=\frac{1}{\lambda}$

	(a) A and B have the same decay rate initially (b) A and B decay at the same rate always (c) B will decay at faster rate than A (d) A will decay at faster rate than B.	$\left[T_{\frac{1}{2}}\right]_A = [\tau]_B$ $\left[\frac{0.6931}{\lambda_A}\right] = \left[\frac{1}{\lambda_B}\right]$ $\lambda_A = 0.6931\lambda_B$ $\lambda_A < \lambda_B$ **ANSWER : (c) B will decay at faster rate than A**
15.	A system consists of N_0 nucleus at t=0. The number of nuclei remaining after half of a half-life (that is, at time t= $\frac{1}{2}T_{\frac{1}{2}}$) a) $\frac{N_0}{2}$ b) $\frac{N_0}{\sqrt{2}}$ c) $\frac{N_0}{4}$ d) $\frac{N_0}{8}$	$\frac{N}{N_0} = \left[\frac{1}{2}\right]^n = \left[\frac{1}{2}\right]^{1/2} = \frac{1}{\sqrt{2}}$ Here n $= \frac{t}{T_{\frac{1}{2}}} = \frac{1}{2}$ $\frac{N}{N_0} = \frac{1}{\sqrt{2}}$ ➔ N$= \frac{N_0}{\sqrt{2}}$ **ANSWER : b)** $\frac{N_0}{\sqrt{2}}$

UNIT 09: SEMICONDUCTOR ELECTRONICS

1.	The barrier potential of a silicon diode is approximately, a. 0.7 V b. 0.3V c. 2.0 V d. 2.2V **ANSWER : a. 0.7 V**
2.	Doping a semiconductor results in a. The decrease in mobile charge carriers b. The change in chemical properties c. The change in the crystal structure d. The breaking of the covalent bond **ANSWER : c. The change in the crystal structure**
3.	A forward biased diode is treated as a. An open switch with infinite resistance b. A closed switch with a voltage drop of 0V c. A closed switch in series with a battery voltage of 0.7V d. A closed switch in series with a small resistance and a battery. **ANSWER : d. A closed switch in series with a small resistance and a battery.**
4.	If a half –wave rectified voltage is fed to a load resistor, which part of a cycle the load current will flow? a. 0^0–90^0 b. 90^0–180^0 c. 0^0–180^0 d. 0^0–360^0 **ANSWER : c. 0^0–180^0**
5.	The primary use of a zener diode is a. Rectifier b. Amplifier c. Oscillator d. Voltage regulator **ANSWER : d. Voltage regulator**
6.	The principle in which a solar cell operates

a. Diffusion b. Recombination c. Photovoltaic action d. Carrier flow

ANSWER : c. Photovoltaic action

7. The light emitted in an LED is due to

a. Recombination of charge carriers b. Reflection of light due to lens action

c. Amplification of light falling at the junction d. Large current capacity.

ANSWER : a. Recombination of charge carriers

8. When a transistor is fully switched on, it is said to be

a. Shorted b. Saturated c. Cut-off d. Open **ANSWER : b. Saturated**

9. The specific characteristic of a common emitter amplifier is

a. High input resistance b. Low power gain c. Signal phase reversal d. Low current gain

ANSWER : c. Signal phase reversal

10. To obtain sustained oscillation in an oscillator,

a. Feedback should be positive b. Feedback factor must be unity

c. Phase shift must be 0 or 2π d. All the above **ANSWER : d. All the above**

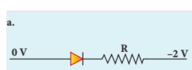
11. If the input to the NOT gate is A =1011, its output is

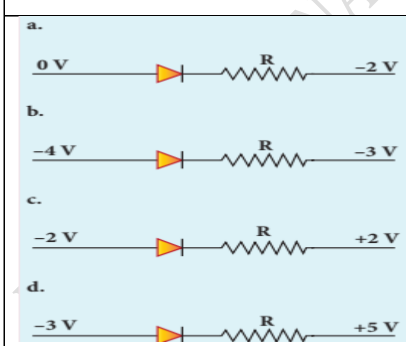
a. 0100 b. 1000 c. 1100 d. 0011 **ANSWER : a. 0100**

12. The electrical series circuit in digital form is

a. AND b. OR c. NOR d. NAND **ANSWER : a. AND**

13. Which one of the following represents forward bias diode?

In forward bias:p-type semiconductor is at higher potential and n-type semiconductor is at lower potential. **ANSWER :a)** 



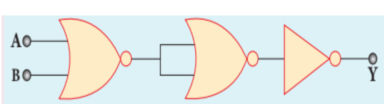
a)0>-2

b)-4 <-3

c)-2< +2

d)-3<+5

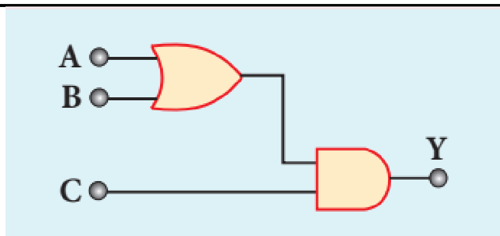
14. The given electrical network is equivalent to



Solution : NOR+ NOT=OR+NOT= NOR

a. AND gate b. OR gate c. NOR gate d. NOT gate **ANSWER : c. NOR gate**

15. The output of the following circuit is 1 when the input ABC is



A	B	C	Y=(A+B). C
1	0	1	1
1	0	0	0
1	1	0	0
0	1	0	0

a. 101 b. 100 c. 110 d. 010 **ANSWER : a. 101**

UNIT 10: COMMUNICATION SYSTEMS

1.	The output transducer of the communication system converts the radio signal into (a) Sound (b) Mechanical energy (c) Kinetic energy (d) None of the above **ANSWER : (a) Sound**
2.	The signal is affected by noise in a communication system (a) At the transmitter (b) At the modulator (c) In the channel (d) At the receiver **ANSWER : (c) In the channel**
3.	The variation of frequency of carrier wave with respect to the amplitude of the modulating signal is called (a) Amplitude modulation (b) Frequency modulation (c) Phase modulation d) Pulse width modulation **ANSWER : (b) Frequency modulation**
4.	The internationally accepted frequency deviation for the purpose of FM broadcasts. The internationally accepted frequency deviation for the purpose of FM broadcasts. (a) 75 kHz (b) 68 kHz (c) 80 kHz (d) 70 kHz **ANSWER : (a) 75 kHz**
5.	The frequency range of 3 MHz to 30 MHz is used for (a) Ground wave propagation (b) Space wave propagation (c) Sky wave propagation (d) Satellite communication **ANSWER : (c) Sky wave propagation**

UNIT 11 : RECENT DEVELOPMENTS IN PHYSICS

1.	The particle size of ZnO material is 30 nm. Based on the dimension it is classified as a) Bulk material b) Nanomaterial c) Soft material d) Magnetic material **ANSWER : b) Nanomaterial**
2.	Which one of the following is the natural nanomaterial. a) Peacock feather b) Peacock beak c) Grain of sand d) Skin of the Whale **ANSWER : a) Peacock feather**
3.	The blue print for making ultra-durable synthetic material is mimicked from (a)Lotus leaf b) Morpho butterfly c) Parrot fish d) Peacock feather

	ANSWER : c) Parrot fish
4.	The method of making nanomaterial by assembling the atoms is called a) Top down approach b) Bottom up approach c) Cross down approach d) Diagonal approach **ANSWER :b) Bottom up approach**
5.	"Sky wax" is an application of Nano product in the field of a) Medicine b) Textile c) Sports d) Automotive industry **ANSWER : c) Sports**
6.	The materials used in Robotics are a) Aluminum and silver b) Silver and gold c) Copper and gold d) Steel and aluminum **ANSWER : d) Steel and aluminum**
7.	The alloys used for muscle wires in Robots are a) Shape memory alloys b) Gold copper alloys c) Gold silver alloys d) Two dimensional alloys **ANSWER : a) Shape memory alloys**
8.	The technology used for stopping the brain from processing pain is a) Precision medicine b) Wireless brain sensor c) Virtual reality d) Radiology **ANSWER : c) Virtual reality**
9.	The particle which gives mass to protons and neutrons are a) Higgs particle b) Einstein particle c) Nanoparticle d) Bulk particle **ANSWER : a) Higgs particle**
10.	The gravitational waves were theoretically proposed by a) Conrad Rontgen b) Marie Curie c) Albert Einstein d) Edward Purcell **ANSWER : c) Albert Einstein**

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+2 PHYSICS

VOL 1 & VOL 2

SHORT TYPE QUESTIONS &ANSWER

STUDY MATERIAL

NAME : ____

CLASS :_________________SEC:__________________

REG. NO.:_______________ROLL NO.:__________________

SCHOOL:____

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UNIT 1: ELECTROSTATICS

1. What is meant by quantization of charges?

The charge q on any object is equal to an integral multiple of this fundamental unit of charge e.

FORMULA	UNIT	QUANTITY
q = ne	Coulomb (C)	Scalar quantity

n is any integer (0, ±1, ±2, ±3,±4……….). This is called quantization of electric charge.

2. Write down Coulomb's law in vector form and mention what each term represents.

According to Coulombs law, $\vec{F}_{21} = \frac{kq_1q_2}{r^2}\hat{r}_{12}$

$\vec{F}_{12}$ -Force between charge q_1 and q_2 & r-Distance between two charges

$\hat{r}_{12}$ – Unit vector directed from charge q_1 to charge q_2 &

k- The proportionality constant.

3. What are the differences between Coulomb force and gravitational force?

S.	COULOMB FORCE	GRAVITATIONAL FORCE
1.	Coulomb force between two charges can be attractive or repulsive, depending on the nature of charges.	The gravitational force between two masses is always attractive
2.	The value of the constant k in Coulomb law is $k = 9 \times 10^9$ N m^2 C^{-2}	The value of the gravitational constantG = 6.626×10^{-11} N m^2 kg^{-2}
3.	force between two charges depends upon the nature of the medium	The gravitational force between two Masses are independent of the medium.
4.	If the charges are in motion, Lorentz force comes into play in Addition to coulomb force.	The gravitational force between two point masses is the same whether two masses are at rest or in motion

3. Write a short note on superposition principle.

The total force acting on a given charge is equal to the vector sum of forces exerted on it by all the other charges. Consider a system of n charges, namely $q_1, q_2, q_3 .. q_n$.

$\overrightarrow{F_{21}}$	$\overrightarrow{F_{13}}$	$\overrightarrow{F_{n1}}$
The force on q_1 exerted by the charge q_2	The force on q_1 exerted by the charge q_3	The force on q_1 exerted by the charge q_n
$\overrightarrow{F_{21}}=\frac{kq_1q_2}{r_{21}^2}\hat{r}_{12}$	$\overrightarrow{F_{31}}=\frac{kq_1q_3}{r_{31}^2}\hat{r}_{13}$	$\overrightarrow{F_{n1}}=\frac{kq_1q_n}{r_{n1}^2}\hat{r}_{1n}$
$\hat{r}_{12}$ is the unit vector directed from charge q_1 to charge q_2	$\hat{r}_{12}$ is the unit vector directed from charge q_1 to charge q_3	$\hat{r}_{1n}$ is the unit vector directed from charge q_1 to charge q_n
r_{21} is the distance between the charges q_1 and q_2	r_{21} is the distance between the charges q_1 and q_3	r_{21} is the distance between the charges q_1 and q_n

Total force acting on the charge q_1 due to all other charges is given by

$$\overrightarrow{F^{net}} = \overrightarrow{F_{21}} + \overrightarrow{F_{31}} + \ldots + \overrightarrow{F_{n1}}$$

$$\overrightarrow{F_{21}}=\frac{kq_1q_2}{r_{21}^2}\hat{r}_{12} + \overrightarrow{F_{31}}=\frac{kq_1q_3}{r_{31}^2}\hat{r}_{13} + \ldots\ldots + \overrightarrow{F_{n1}}=\frac{kq_1q_n}{r_{n1}^2}\hat{r}_{1n}$$

4. Define 'Electric field'.

The electric field at the point P at a distance r from the point charge q is the force experienced by a unit charge.

FORMULA	UNIT	QUANTITY
$\vec{E}=\frac{\vec{F}}{q_o} \Rightarrow \vec{E} = \frac{kq}{r^2}\hat{r} = \frac{1}{4\pi\varepsilon_o}\frac{q}{r^2}\hat{r}$	NC^{-1}	Vector quantity

5. What is mean by 'Electric field lines'?

- Electric field vectors are visualized by the concept of electric field lines.
- They form a set of continuous lines which are the visual representation of the electric field in some region of space.

6. The electric field lines never intersect. Justify.

- No two electric field lines intersect each other. If two lines cross at a point, then there will be two different electric field vectors at the same point.

- if some charge is placed in the intersection point, then it has to move in two different directions at the same time, which is physically Impossible. Hence, electric field lines do not intersect.

8. Define 'Electric dipole'

Two equal and opposite charges separated by a small distance constitute an electric dipole.

9. What is the general definition of electric dipole moment?

The magnitude of the electric dipole moment is equal to the product of the magnitude of one of the charges and the distance between them

FORMULA	UNIT	QUANTITY
p = 2qa	Cm	Vector quantity

10. Define 'electrostatic potential".

Electric potential at a point P is equal to the work done by an external force to bring a unit positive charge with constant velocity from infinity to the point P in the region of the external electric field $\vec{E}$

FORMULA	UNIT	QUANTITY
$V_p = -\int_{\infty}^{p} \vec{E}.\vec{dr}$	Vm	Scalar quantity

11. What is an equipotential surface?

An equipotential surface is a surface on which all the points are at the same potential.

12. What are the properties of an equipotential surface?

- The work done to move a charge q between any two points A and B, $W = q(V_B - V_A)$. If the points A and B lie on the same equipotential surface, work done is zero.
- The electric field is normal to an equipotential surface.

13. Give the relation between electric field and electric potential.

Electric field is the negative gradient of potential

$$E = -\frac{dV}{dx}$$

E- Electric field , dV-Electric potential ,

dx -Small distance

14. Define 'electrostatic potential energy'.

- The electric potential at a point at a distance r from point charge q_1 is given by

$$V = \frac{1}{4\pi\mathcal{E}_o}\frac{q}{r}$$

- This potential V is the work done to bring a unit positive charge from infinity to the point.
- Now if the charge q_2 is brought from infinity to that point at a distance r from q_1
- The work done is the product of q_2 and the Electric potential at that point.

Thus we have $W= q_2V$.

- This work done is stored as the electrostatic potential energy U of a system.

FORMULA	UNIT	QUANTITY
$U=\frac{1}{4\pi\mathcal{E}_o}\frac{q_1q_2}{r}$	joule	Scalar quantity

15. Define 'electric flux'

The number of electric field lines crossing a given area kept normal to the electric field lines is called electric flux.

FORMULA	UNIT	QUANTITY
$\emptyset_E=EA\cos\theta$	Nm^2C^{-1}	Scalar quantity

16. What is meant by electrostatic energy density?

Electrostatic energy density is defined as The energy stored per unit volume of space

FORMULA	UNIT	QUANTITY
$u_E = \frac{U}{volume}$ or $u_E = \frac{1}{2}\varepsilon_0 E^2$	Joule m^{-3}	Scalar quantity

17. Write a short note on 'electrostatic shielding'.

- Whatever the charges at the surfaces and whatever the electrical disturbances outside, the electric field inside the cavity is zero.
- A sensitive electrical instrument which is to be protected from external electrical disturbance is kept inside this cavity. This is called electrostatic shielding.

18. . What is Polarisation?

Polarisation p is defined as the total dipole moment per unit volume of the dielectric.

$$\vec{P} = \chi_e\vec{E}_{ext}$$

19. **What is dielectric strength?**

The maximum electric field the dielectric can withstand before it breakdowns is called dielectric strength

20. Define ‘capacitance’. Give its unit.

The capacitance C of a capacitor is defined as the ratio of the magnitude of charge on either of the conductor plates to the potential difference existing between the conductors.

FORMULA	UNIT	QUANTITY
$C=\frac{Q}{V}$	Farad	Scalar quantity

21. What is corona discharge?

- The positive ions are repelled at the sharp edge and negative ions are attracted towards the sharper edge.
- This reduces the total charge of the conductor near the sharp edge.

This is called action at points or corona discharge.

UNIT 2 CURRENT ELECTRICITY

1. Why current is a scalar?

- For a physical quantity to be termed a vector quantity, having magnitude and direction is not enough. The quantity should obey the vector addition (triangle law or parallelogram law).
- From Kirchhoff’s current rule, if two current meet at a junction, the resultant current will be the algebraic sum of two current and not vector sum.

2. Distinguish between drift velocity and mobility

S.	DRIFT VELOCITY	MOBILITY
1	The drift velocity is the average velocity acquired by the electrons inside the conductor when it is subjected to an electric field.	The mobility is the magnitude of the drift velocity per unit electric field.
2	$\vec{v}_d=\vec{a}\tau$	$\mu = \frac{\vec{v}_d}{\vec{E}}$
3	Unit : ms^{-1}	Unit: $m^2V^{-1} s^{-1}$

3. State microscopic form of Ohm's law.

The relation between current and drift velocity is I = nAv_de

Current density $J = \frac{I}{A} = \frac{nAv_d e}{A}$

Current density is a vector quantity

$\vec{J} = ne\vec{v_d} = -\frac{ne^2\tau}{A}\vec{E}$ $\left(\sigma = \frac{ne^2\tau}{A}\text{E}\right)$

$\vec{J} = -\sigma\vec{E}$

The direction of (conventional) current density as the direction of electric field.

$\vec{J} = \sigma\vec{E}$

This equation called microscopic form of ohm's law

4. State macroscopic form of Ohm's law.

From microscopic form of ohm's law J=σE

J=$\sigma\frac{V}{l}$ ------(1) $\left(E = \frac{V}{l}\right)$

Current density $J = \frac{I}{A}$------(2)

From eq 1 and eq2, $\sigma\frac{V}{l} = \frac{I}{A}$

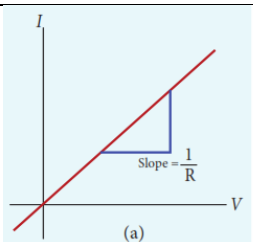
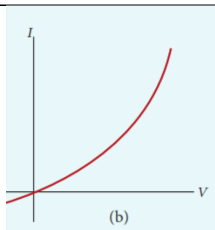
V=I$\left(\frac{l}{\sigma A}\right)$

Then V=IR $\left(R = \frac{l}{\sigma A}\right)$

The law states that at **constant temperature, the steady current** flowing through a conductor is directly proportional to the **potential difference between two ends of the conductor**. V α I

5. What are ohmic and non ohmic devices?

S	OHMIC DEVICES	NON OHMIC DEVICES
1	Materials for which the current against voltage graph is a straight line through the origin, are said to obey Ohm's law and their behavior is said to be ohmic.	Materials or devices that do not follow Ohm's law are said to be non ohmic. These materials have more complex relationships between voltage and current.

2		
3	Eg: Copper, aluminum, silver	Eg: Diode, transistor

6. Define electrical resistivity.

Electrical resistivity of a material is defined as the resistance offered to current flow by a conductor of unit length having unit area of cross section.

FORMULA	S.I UNIT	QUANTITY
$\rho = \frac{RA}{l}$	Ohm m *or Ω m*	Scalar

7. Define temperature coefficient of resistance.

Temperature coefficient of resistance is defined as the ratio of increase in resistance per degree rise in temperature to its resistance at T_o.

Temperature coefficient of resistance= $\frac{\text{increase in resistance per degree rise in temperature}}{\text{its resistance at To}}$

FORMULA	S.I UNIT	QUANTITY
$\alpha = \frac{R_T - R_0}{R_0(T - T_0)}$	Per ^{0}C	Scalar

8. What is superconductivity?

- The resistance of certain material become zero below certain temperature called critical or transition temperature (T_C)
- The materials which exhibit this property are known as super conductors.
- The property of conducting current with zero resistance is called super conductivity.

9. What is electric power and electric energy?

S.NO	ELECTRIC POWER	ELECTRIC ENERGY
1	The rate at which the electrical potential energy is delivered,	The electric energy used by any device Product of the power and duration of the time duration of the time when it is ON.
2	$P = \frac{dw}{dt}$ = or VI	E=Pxt or VIt

3	Si unit : watt	Si unit : joule
4	Practical unit :horse power (HP) 1 Hp=746 W	Practical unit :kilowatt hour (kWh) 1 kWh=3.6x10^6 joule

10. Define current density.

The current density (J) is defined as the current per unit area of cross section of the conductor.

FORMULA	S.I UNIT	QUANTITY
$J = \frac{I}{A}$	Am^{-2}	Vector

11. Derive the expression for power P=VI in electrical circuit.

- Electric power P =$\frac{dw}{dt}$

W=V x Q

- P=$\frac{d(VQ)}{dt}$=$V\frac{dQ}{dt}$

P=VI $\left(I = \frac{dQ}{dt}\right)$

12. Write down the various forms of expression for power in electrical circuit.

- Electric power P =VI

by using ohms law

- Electric power P =v $\frac{V}{R}$= $\frac{V^2}{R}$

P= $\frac{V^2}{R}$

- Electric power P =VI=(IR)I ;
- P=I^2R

13. State Kirchhoff's current rule.

The algebraic sum of the currents at any junction of a circuit is zero.

14. State Kirchhoff's voltage rule.

In a closed circuit the algebraic sum of the products of the current and resistance of each part of the circuit is equal to the total emf included in the circuit

15. State the principle of potentiometer.

For uniform cross-section and unit length of potentiometer wire, when constant current flow through a wire, then **potential difference between any two points of the wire is directly proportional to the length of the wire between two points**

ξ=Ir l

$\xi \propto l$

The emf of the cell is directly proportional to balancing length.

I is the current flowing through the wire, r is the resistance per unit length of the wire.

16. What do you mean by internal resistance of a cell?

A resistance is offered to current flow by the electrolyte inside the cell.

FORMULA	S.I UNIT	QUANTITY
$r=\left(\frac{\xi-V}{V}\right)R$	Ohm	scalar

17. State Joule's law of heating.

The heat developed in an electrical circuit due to the flow of current varies directly as (i) the square of the current (ii) the resistance of the circuit and (iii) the time of flow. $H=I^2RT$

18. What is Seebeck effect?

- In a closed circuit consisting of two dissimilar metals, when the junctions are maintained at different temperatures an emf (potential difference) is developed. (The two dissimilar metals connected to form two junctions is known as thermocouple.)
- The current that flows due to the emf developed is called thermoelectric current.

19. What is Thomson effect?

- If two points in a conductor are at different temperatures, the density of electrons at these points will differ and as a result the potential difference is created between these points. Thomson effect is also reversible.

20. What is Peltier effect?

When an electric current is passed through a circuit of a thermocouple, heat is evolved at one junction and absorbed at the other junction.

21. State the applications of Seebeck effect.

- Seebeck effect is used in thermoelectric generators (Seebeck generators). These thermoelectric generators are used in power plants to convert waste heat into electricity.
- This effect is utilized in automobiles as automotive thermoelectric generators for increasing fuel efficiency.
- Seebeck effect is used in thermocouples and thermopiles to measure the temperature difference between the two objects.

UNIT :03 MAGNETISM AND MAGNETIC EFFECTS OF ELECTRIC CURRENT

1. What is meant by magnetic induction?

The magnetic induction (total magnetic field) inside the specimen $\vec{B}$ is equal to the sum of the magnetic field B_o produced in vacuum due to the magnetising field and the magnetic field B_m due to the induced magnetisation of the substance.

FORMULA	S.I UNIT	QUANTITY
$\vec{B}=\vec{B}_o+\vec{B}_m=\mu_o\vec{H}+\mu_o\vec{M}$; $\vec{B}=\mu_o(\vec{H}+\vec{M})$	Tesla	Vector quantity

2. Define magnetic flux.

The number of magnetic field lines crossing per unit area is called magnetic flux Φ_B

FORMULA	S.I UNIT	QUANTITY
$\emptyset_B$=BA cosθ	weber	Scalar quantity

3. Define magnetic dipole moment.

The magnetic dipole moment is defined as the product of its pole strength and magnetic length.

FORMULA	S.I UNIT	QUANTITY
$\overrightarrow{P_m}=q_m\vec{d}$ or $P_m=q_m\,2l$	A m^2	vector quantity

4. State Coulomb's inverse law.

The force of attraction or repulsion between two magnetic poles is directly proportional to the product of their pole strengths and inversely proportional to the square of the distance between them. $\vec{F} = \frac{q_{mA} q_{mB}}{r^2} \hat{r}$

5. **What is magnetic susceptibility?**

Magnetic susceptibility is defined as the ratio of the intensity of magnetization $(\vec{M})$ induced in the material due to the magnetising field $(\vec{H})$ $\chi_e = \frac{|\vec{M}|}{|\vec{H}|}$

6. **State Biot-Savart's law**

Magnitude of magnetic field $\overrightarrow{dB}$ at a point P at a distance r from the small elemental length taken on a conductor carrying current varies

(i) directly as the strength of the current I

(ii) directly as the magnitude of the length element $\overrightarrow{dl}$

(iii) directly as the sine of the angle between $\overrightarrow{dl}$ and $\hat{r}$

(iv) inversely as the square of the distance between the point P and length element $\overrightarrow{dl}$

$$dB = \frac{\mu_0 \, I \, dl \, \sin\theta}{4\pi \, r^2}$$

7. **What is magnetic permeability?**

The magnetic permeability can be defined as the measure of ability of the material to allow the passage of magnetic field lines through it or measure of the capacity of the substance to take magnetisation or the degree of penetration of magnetic field through the substance.

8. **State Ampere's circuital law.**

The line integral of magnetic field over a closed loop is μ_0 times net current enclosed by the loop. $\oint_C \vec{B} \cdot \overrightarrow{dl} = \mu_0 I_{enclosed}$

9. **Compare dia, para and ferro-magnetism.**

Properties	**Diamagnetism**	**Paramagnetism**	**Ferromagnetism**
Magnetic susceptibility	Negative	Positive and small	Positive and large
Relative permeability	Is slightly less than unity.	Is greater than unity.	Large
Susceptibility	Is nearly temperature independent	Is inversely proportional to temperature	Is inversely proportional to temperature.

Examples	Bismuth, Copper and Water	Aluminium,Platinum, chromium.	Iron, Nickel and Cobalt.
The magnetic field lines	Are repelled or expelled by diamagnetic materials when placed in a magnetic field.	Are attracted into the paramagnetic materials when placed in a magnetic field.	Are strongly attracted into the ferromagnetic materials when placed in a magnetic field.

10. What is meant by hysteresis?

The phenomenon of lagging of magnetic induction behind the magnetizing field is called hysteresis

UNIT 4 ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENT

1. What is meant by electromagnetic induction?

Whenever the magnetic flux linked with a closed coil changes, an emf is induced and hence an electric current flows in the circuit. This current is called an induced current and the emf is called an induced emf. This phenomenon is known as electromagnetic induction.

2. **State Faraday's laws of electromagnetic induction.**

Faraday's first law :

Whenever **magnetic flux** linked with a closed circuit **changes**, an **emf** is induced in the circuit.

Faraday's second first law :

The magnitude of **induced emf** in a closed circuit is equal to the time **rate of change of magnetic flux** linked with the circuit.

$$\varepsilon = -\frac{d\phi_B}{dt} \text{ or } \varepsilon = -\frac{d(N\phi_B)}{dt}$$

3. State Lenz's law.

Lenz's law states that the direction of the **induced current** is such that it always **opposes the cause** responsible for its production.

4. State Fleming's right hand rule.

The thumb, index finger and middle finger of right hand are stretched out in mutually perpendicular directions. The **index finger** points the direction of the **magnetic field** and the **thumb finger** indicates the direction of **motion** of the conductor, then the **middle finger** will indicate the direction of the **induced current** .

5. How is Eddy current produced? How do they flow in a conductor?

Even for a conductor in the form of a sheet or plate, an emf is induced when magnetic flux linked with it changes. But the difference is that there is no definite loop or path for induced current to flow away. As a result, the induced currents flow in concentric circular paths. As these electric currents resemble eddies of water, these are known as Eddy currents. They are also called Foucault currents.

6. Mention the ways of producing induced emf.

Induced emf can be produced by changing magnetic flux in any of the following ways.

(i) By changing the magnetic field *B*

(ii) By changing the area *A* of the coil and

(iii) By changing the relative orientation θ of the coil with magnetic field

$$\varepsilon = -\frac{d}{dt}(BA\cos\theta)$$

7. What for an inductor is used? Give some examples.

Inductor is a device used to store energy in a magnetic field when an electric current flows through it. **Examples :** coils, solenoids and toroids

8. What do you mean by self-induction?

An electric current flowing through a coil will set up a magnetic field around it. Therefore, the magnetic flux of the magnetic field is linked with that coil itself. If this flux is changed by changing the current, an emf is induced in that same coil . This phenomenon is known as self-induction.

9. What is meant by mutual induction?

When an electric current passing through a coil changes with time, an emf is induced in the neighboring coil. This phenomenon is known as mutual induction and the emf is called mutually induced emf.

10. Give the principle of AC generator.

The principle of AC generator is electromagnetic induction. The relative motion between a conductor and a magnetic fied changes the magntic flux linked with the conductor which in turn, induces an emf.

11. List out the advantages of stationary armature-rotating field system of AC generator.

1) The current is drawn directly from fixed terminals on the stator without the use of brush contacts.

2) The insulation of stationary armature winding is easier.

3) The number of sliding contacts (slip rings) is reduced. Moreover, the sliding contacts are used for low-voltage DC Source.

4) Armature windings can be constructed more rigidly to prevent deformation due to any mechanical stress.

12. What are step-up and step-down transformers? .

S.No	step-up transformer	step-down transformers
1.	$N_s > N_p$ or $k>1$ or $V_s < V_p$ and $I_s > I_p$	$N_s < N_p$ or $k<1$ or $V_s > V_p$ and $I_s < I_p$
2.	voltage is increased and the corresponding current is decreased.	voltage is decreased and the current is increased.

13. Define average value of an alternating current.

The average value of alternating current is defined as the average of all values of current over a positive half-cycle or negative half-cycle.

$I_{av} = 0.637 I_m$ (or) $I_{av} = -0.637 I_m$

14. How will you define RMS value of an alternating current?

The root mean square value or effective value of an alternating current is defined as the square root of the mean of the squares of all currents over one cycle.

$I_{RMS} = \frac{I_m}{\sqrt{2}}$ (or) $I_{RMS} = 0.707 I_m$

15. **What are phasors?**

A sinusoidal alternating voltage (or current) can be represented by a vector which rotates about the origin in anti-clockwise direction at a constant angular velocity. Such a rotating vector is called a phasor.

16. Define electric resonance.

When the frequency of the applied alternating source is equal to the natural frequency of the RLC circuit, the current in the circuit reaches its maximum value. Then the circuit is said to be in electrical resonance.

17. What do you mean by resonant frequency?

The frequency at which resonance takes place is called resonant frequency.

$$\text{Resonant angular frequency } \omega_r = \frac{1}{\sqrt{LC}}$$

18. How will you define Q-factor?

Q-factor is defined as the **ratio of voltage across *L* or *C* to the applied voltage**.

$$\text{Q-factor} = \frac{\text{voltage across L or C}}{\text{applied voltage}}$$

19. What is meant by wattles current?

In inductor, the current component ($I_{RMS}\sin\phi$) which has a phase angle of $\frac{\pi}{2}$ with the voltage is called reactive component. The **power consumed is zero**. So that it is also known as 'Wattles' current.

20. Give any one definition of power factor.

Power factor is define as **ratio of true power to apparent power**

$$\text{power factor} = \frac{\text{True power}}{\text{Apparent power}}$$

21. What are LC oscillations?

Whenever energy is given to a circuit containing a pure inductor of inductance *L* and a capacitor of capacitance *C*, the energy oscillates back and forth between the magnetic field of the inductor and the electric field of the capacitor. Thus the electrical oscillations of definite frequency are generated. These oscillations are called *LC* oscillations.

UNIT 5: ELECTROMAGNETIC WAVES

1. What is displacement current?

Displacement current can be defined as 'the current which comes into play in the region in which the electric field and the electric flux are changing with time'

$$I_d = \varepsilon_0 \frac{d\phi_E}{dt}$$

2. What are electromagnetic waves?

- Electromagnetic waves are **non mechanical waves** which move with speed equals to the speed of light (in vacuum). It is a transverse wave.
- An electromagnetic wave is radiated by an **accelerated charge** which propagates through space as coupled electric and magnetic fields, oscillating perpendicular to each other and to the direction of propagation of the wave.

3. Write down the integral form of modified Ampere's circuital law.

$$\oint \vec{B}.\vec{dl} = \mu_0 I_{enclosed} + \mu_0 \varepsilon_0 \frac{d}{dt}\int_s \vec{E}.\vec{dA}$$

(Ampere-Maxwell's law)

$$\oint \vec{B}\,\vec{ds} = \mu_0 I = \mu_0 (I_c + I_d)$$

4. Explain the concept of intensity of electromagnetic waves.

The energy crossing per unit area per unit time and perpendicular to the direction of propagation of electromagnetic wave is called the intensity.

$$I = \frac{\text{Electromagnetic Energy (U)}}{\text{surface area (A) X time (t)}}$$

$$\text{Intensity } I = \frac{\text{power (P)}}{\text{surface area (A)}}$$

5. What is meant by Fraunhofer lines?

The spectrum obtained from the Sun is examined, it consists of large number of dark lines (line absorption spectrum). These dark lines in the solar spectrum are known as Fraunhofer lines.

UNIT 06: OPTICS

1. **State the laws of reflection**

- The incident ray, reflected ray and normal to the reflecting surface all are coplanar (ie. lie in the same plane).
- The angle of incidence (i) is equal to the angle of reflection(r) $\angle i = \angle r$

2. **What is angle of deviation due to reflection?**

The angle between the incident and deviated light ray is called angle of deviation of the light ray.

d=180-(i+r), i=r; d=180-2i

3. **Give the characteristics of image formed by a plane mirror.**

(i)The image formed by a plane mirror is virtual, erect, and laterally inverted.

(ii) The size of the image is equal to the size of the object.

(iii) The image distance far behind the mirror is equal to the object distance in front of it.

(iv) If an object is placed between two plane mirrors inclined at an angle θ, then the number of images n formed is as,

- If $\left(\frac{360}{\theta}\right)$ is EVEN n= $\left(\frac{360}{\theta} - 1\right)$for objects placed symmetrically or unsymmetrically,
- If $\left(\frac{360}{\theta}\right)$ is ODD then, n= $\left(\frac{360}{\theta} - 1\right)$for objects placed symmetrically
- If $\left(\frac{360}{\theta}\right)$ is ODD then, n= $\left(\frac{360}{\theta}\right)$for objects placed unsymmetrically,

4. **Derive the relation between f and R for a spherical mirror.**

- Let C be the centre of curvature of the mirror.
- Consider a light ray parallel to the principal axis is incident on the mirror at M and passes through the principal focus F after reflection.

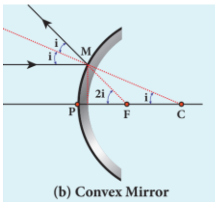
The geometry of reflection of the incident ray is shown in fig.

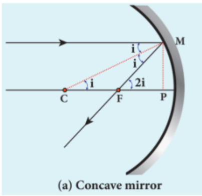
- The line CM is the normal to the mirror at M.

Let i be the angle of incidence and the same will be the angle of reflection.

- If MP is the perpendicular from M on the principal axis, then from the geometry,

The angles ∠MCP = i and ∠MFP = 2i





- From right angle riangles ΔMCP and Δ*MFP*,

tan $i=\frac{PM}{PC}$ And tan $2i=\frac{PM}{PF}$

As the angles are small, tan i≈i

$i=\frac{PM}{PC}$ And $2i=\frac{PM}{PF}$

Simplifying further

$2\frac{PM}{PC}=\frac{PM}{PF}$;

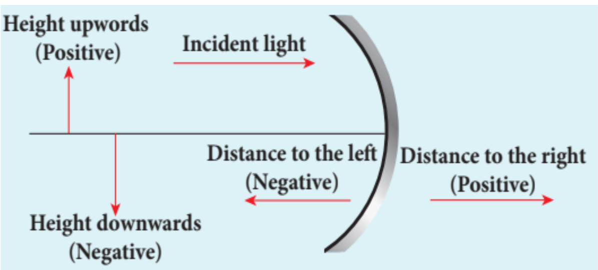
2PF=PC

PF is focal length f and PC is the radius of curvature R.

$2f=R$; $f=\frac{R}{2}$

5. What is the Cartesian sign convention for a spherical mirror?

- The Incident light is taken from left to right (i.e. object on the left of lens).
- All the distances are measured from the pole of the mirror (pole is taken as origin).
- The distances measured to the right of pole along the principal axis are taken as positive.
- The distances measured to the left of pole along the principal axis are taken as negative.
- Heights measured in the upward perpendicular direction to the principal axis are taken as positive.
- Heights measured in the downward perpendicular direction to the principal axis, are taken as negative.



6. What is optical path? Obtain the equation for optical path of a medium of thickness d and refractive index n.

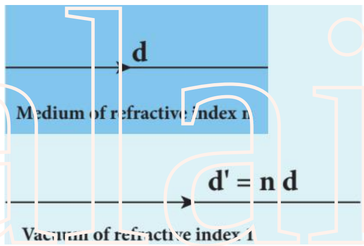
- Optical path of a medium is defined as the distance d' light travels in Vacuum in the same time it travels a distance d in the medium.

Light travel in medium	**Light travel in air medium**
Let us consider a medium of refractive index n and thickness d. Light travels with a speed v through the medium in a time t.	In the same time, light can cover a greater distance d' in vacuum as it travels with greater speed c in vacuum as shown in Fig
$v = \frac{d}{t}$; $t = \frac{d}{v}$	$c = \frac{d'}{t}$; $t = \frac{d'}{c}$

As the time taken in both the cases is the same, we can equate the time t as,

$$\frac{d'}{c} = \frac{d}{v}$$

optical path rewritten for the optical path(d') $d' = \frac{cd}{v}$



$$\frac{c}{v} = n$$

The optical path d'=nd

As n is always greater than 1, the optical path d' of the medium is always greater than d

7. State the laws of refraction.

a)The incident ray, refracted ray and normal to the refracting surface are all coplanar (ie. lie in the same plane).

b) The ratio of angle of incident i in the first medium to the angle of reflection r in the second medium is equal to the ratio of refractive index of the second medium n_2 to that of the refractive index of the first medium n_1

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$$

8. What is angle of deviation due to refraction?

- Angle between the incident and deviated light is called angle of deviation.

- When light travels from rarer to denser medium it deviates towards normal.

$d = i - r$

- if light travels from denser to rarer medium it deviates away from normal

$d = r - i$

9. What is principle of reversibility?

The principle of reversibility states that light will follow exactly the same path if its direction of travel is reversed.

10. What is relative refractive index?

The term $\frac{n_2}{n_1}$ is called relative refractive index of second medium with respect to the first medium. $n_{21} = \frac{n_2}{n_1}$

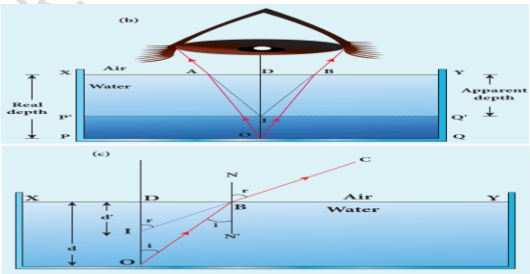
11. Obtain the equation for apparent depth.

- Light from the object O at the bottom of the tank passes from denser medium (water) to rarer medium (air) to reach our eyes.
- It deviates away from the normal in the rarer medium at the point of incidence B. The refractive index of the denser medium is n_1 and rarer medium is n_2. Here, $n_1 > n_2$
- The angle of incidence in the denser medium is i and the angle of refraction in the rarer medium is r.
- The lines NN′and OD are parallel. Thus angle ∠DIB is also r. The angles i and r are very small as the diverging light from O entering the eye is very narrow.
- The Snell's law in product form for this refraction is,

$n_1 \sin i = n_2 \sin r$

As the angles i and r are small, we can approximate, $\sin i \approx \tan i$;

$n_1 \tan i = n_2 \tan r$



In triangle **ΔDOB and ΔDIB**

$\text{Tan}(i) = \frac{DB}{DO}$ and $\tan(r) = \frac{DB}{DI}$

$n_1 \frac{DB}{DO} = n_2 \frac{DB}{DI}$

DB is cancelled on both sides, DO is the actual depth d and DI is the apparent depth d'.

$n_1 \frac{1}{d} = n_2 \frac{1}{d'}$

$\frac{d'}{d} = \frac{n_2}{n_1}$

$d' = \frac{n_2}{n_1} d$

As the rarer medium is air and its refractive index n_2 can be taken as 1, ($n_2=1$).And the refractive index n_1 of denser medium could then be taken as n, ($n_1=n$).

$d' = \frac{d}{n}$

$d - d' = d - \frac{d}{n}$ or

$d - d' = d\left(1 - \frac{1}{n}\right)$

12. Why do stars twinkle?

The stars actually do not twinkle. They appear twinkling because of the movement of the atmospheric layers with varying refractive indices which is clearly seen in the night sky.

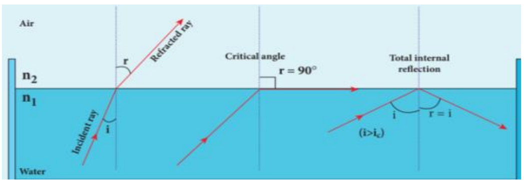
13. What is critical angle and total internal reflection?

- The angle of incidence in the denser medium for which the refracted ray graces the boundary is called critical angle i_c.
- The entire light is reflected back into the denser medium itself. This phenomenon is called total internal reflection.

14. Obtain the equation for critical angle.

Snell's law in the product form, equation for critical angle incidence becomes,

$n_1 \sin i_c = n_2 \sin 90^0$



$n_1 \sin i_c = n_2$

$\sin i_c = \frac{n_2}{n_1}$

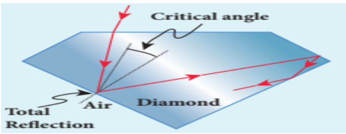
$n_1 > n_2$

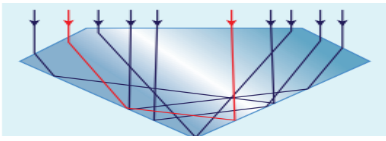
If the rarer medium is air, then its refractive index is 1 and can be taken as n itself. i.e. ($n_2=1$) and ($n_1=n$).

$\sin i_c = \frac{1}{n}$ or $i_c = \sin^{-1}(1/n)$

15. Explain the reason for glittering of diamond.

- Diamond appears dazzling because the total internal reflection of light happens inside the diamond. The refractive index of only diamond is about 2.417. It is much larger than that for ordinary glass which is about only 1.5. The critical angle of diamond is about 24.4°. It is much less than that of glass.
- A skilled diamond cutter makes use of this larger range of angle of incidence (24.4° to 90° inside the diamond), to ensure that light entering the diamond is total internally reflected from the many cut faces before getting out as shown in Fig. This gives a sparkling effect for diamond.





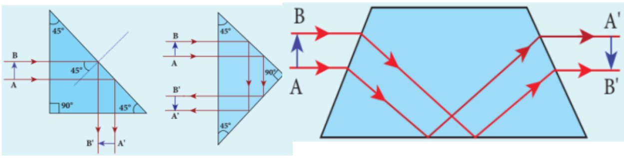
16. What are mirage and looming?

mirage	looming
The refractive index of air increases with its density. In hot places, air near the ground is hotter than air at a height. Hot air is less dense. Hence, in still air the refractive index of air increases with height. Because of this,light from tall objects like a tree, passes through a medium whose refractive index decreases towards the ground. Hence, a ray of light successively deviates away from the normal at different layers of air and undergoes total internal reflection when the angle of incidence near the ground exceeds the critical angle. This gives an illusion as if the light comes from somewhere below the ground. This phenomenon is called mirage.	In the cold places the refractive index increases towards the ground because the temperature of air close to the ground is lesser than the temperature above the surface of earth. Thus, the density and refractive index of air near the ground is greater than at a height. In the cold regions like glaciers and frozen lakes and seas, the reverse effect of mirage will happen. Hence, an inverted image is formed little above the surface as shown in Fig. This phenomenon is called looming.

17. Write a short notes on the prisms making use of total internal reflection.

➢ Prisms can be designed to reflect light by 90° or by 180° by making use of total internal reflection as shown in Fig(a & b). In the first two cases, the critical angle i_c for the material of the prism must be less than 45°.

➢ That this is true for both crown glass and flint glass. Prisms are also used to invert images without changing their size as shown fig (c)



18. What is Snell's window?

➢ When light entering the water from outside is seen from inside the water, the view is restricted to a particular angle equal to the critical angle i_c.

➢ The restricted illuminated circular area is called Snell's window

19. Write a note on optical fibre.

➢ Transmitting signals through optical fibres is possible due to the phenomenon of total internal reflection.

➢ Optical fibres consists of inner part called core and outer part called cladding (or) sieeving.

➢ The refractive index of the material of the core must be higher than that of the cladding for total internal reflection to happen.

➢ Signal in the form of light is made to incident inside the core-cladding boundary at an angle greater than the critical angle.

➢ Hence, it undergoes repeated total internal reflections along the length of the fibre without undergoing any refraction.

➢ The light travels inside the core with no appreciable loss in the intensity of the light

20. Explain the working of an endoscope.

➢ An endoscope is an instrument used by doctors which has a bundle of optical fibres that are used to see inside a patient's body.

➢ Endoscopes work on the phenomenon of total internal reflection.

- The optical fibres are inserted in to the body through mouth, nose or a special hole made in the body.
- Even operations could be carried out with the endoscope cable which has the necessary instruments attached at their ends.

21. What are primary focus and secondary focus of concex lens?

- The primary focus F_1 is defined as a point where an object should be placed to give parallel emergent rays to the principal axis.
- The secondary focus F_2 is defined as a point where all the parallel rays travelling close to the principal axis converge to form an image on the principal axis

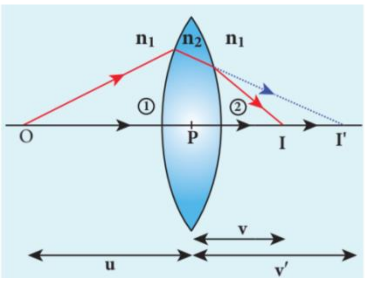
22. What are the sign conventions followed for lenses?

i. The sign of focal length is not decided on the direction of measurement of the focal length from the pole of the lens as they have two focal lengths, one to the left and another to the right (primary and secondary focal lengths on either side of the lens).

ii. The focal length of the thin lens is taken as positive for a converging lens and negative for a diverging lens.

23. Arrive at lens equation from lens maker's formula.

- Let us consider a thin lens made up of a medium of refractive index n_2 is placed in a medium of refractive index n_1.
- Let R_1 and R_2 be the radii of curvature of two spherical surfaces 1 and 2 respectively and P be the pole
- Consider a point object O on the principal axis. The ray which falls very close to P, after refraction at the surface 1 forms image at I'.
- before it does so, it is again refracted by the surface 2 . Therefore the final image is formed at I.
- The general equation for the refraction at a spherical surface is given from Equation



$$\frac{n_2}{v}-\frac{n_1}{u}=\frac{n_2-n_1}{R}$$

For the refracting surface 1, the light goes from n_1 to n_2

$\frac{n_2}{v'}-\frac{n_1}{u}=\frac{n_2-n_1}{R_1}$------1

For the refracting surface 2, the light goes from medium n_2 to n_1.

$\frac{n_1}{v}-\frac{n_2}{v'}=\frac{n_1-n_2}{R_2}$-------2

Adding the above two equations 1 and 2

$\frac{n_2}{v'}-\frac{n_1}{u}+\frac{n_1}{v}-\frac{n_2}{v'}=\frac{n_2-n_1}{R_1}+\frac{n_1-n_2}{R_2}$

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

both side divide by n_1

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

$\frac{1}{v}-\frac{1}{u}=\left(\frac{n_2}{n_1}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ If the object is at infinity, the image is formed at the focus of the lens. Thus, for u = ∞, v = f. Then the equation becomes

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

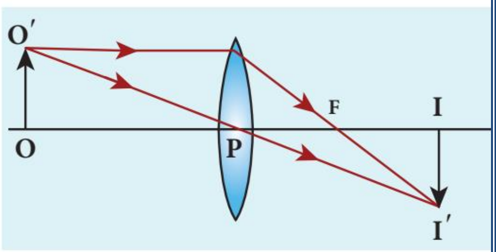
$\frac{1}{f}=\left(\frac{n_2}{n_1}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$------3

If the refractive index of the lens is n2 and bit is placed in air, then n2 = n and n1 = 1. So the equation (3) becomes,

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

The above equation is called the lens maker's formula,

24. Obtain the equation for lateral magnification for thin lens.



- Let us consider an object OO' of height h_1 placed on the principal axis with its height perpendicular to the principal axis as shown in Figure.
- The ray OP passing through the pole of the lens goes undeviated. The inverted real image II' formed has a height h_2.
- The lateral or transverse magnification is defined as the ratio of the height of the image to the height of the object.

$m=\frac{II'}{OO'}$-----(1)

From the two similar triangles Δ POO' and Δ PII' we can write,

$\frac{II'}{OO'}=\frac{PI}{PO}$-----(2)

Applying sign convention,

$\frac{-h_2}{h_1} = \frac{v}{-u}$------(3)

From above equations

$m = \frac{-h_2}{h_1} = \frac{v}{-u}$

After rearranging, $m=\frac{h_2}{h_1}=\frac{v}{u}$

The magnification is negative for real image and positive for virtual image

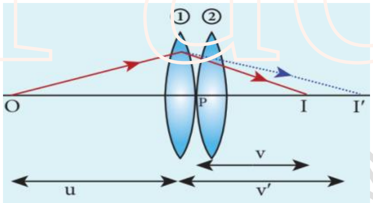
Magnification by combining the lens equation with the formula for magnification as,

$m=\frac{h_2}{h_1} = \frac{f}{f+u}$ or $m=\frac{h_2}{h_1} = \frac{f-v}{f}$

25. What is power of a lens?

- power of a lens is a measure of the degree of convergence or divergence of light falling on it.
- Power of the lens is inversely proportional to focal length. $P=\frac{1}{f}$ unit :dioptre

26. Derive the equation for effective focal length for lenses in contact.



- Let us consider two lenses 1 and 2 of focal length f_1 and f_2 are placed coaxially in contact with each other so that they have a common principal axis.
- For an object placed at O beyond the focus of the first lens 1 on the principal axis, an image is formed by it at I'.
- This image I' acts as an object for the second lens 2 and the final image is formed at I as shown in Figure.
- As these two lenses are thin, the measurements are done with respect to the common optical centre P in the middle of the two lenses.
- Let, PO be object distance u and PI' be the image distance (v′) for the first lens 1and object distance for the second lens 2 and PI=v be the image distance for the second lens 2.

Writing the lens equation for first lens 1,

$\frac{1}{v'} - \frac{1}{u} = \frac{1}{f_1}$------(1) Writing the lens equation for second lens 2

$\frac{1}{v} - \frac{1}{v'} = \frac{1}{f_2}$------(2)

Adding the above two equations

$$\frac{1}{v'} - \frac{1}{u} + \frac{1}{v} - \frac{1}{v'} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f_1} + \frac{1}{f_2} \text{-----}(3)$$

If the combination acts as a single lens of focal length f so that for an object at the position O it forms the image at I then,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{F} \text{--------}(4)$$

Comparing equations 3 and 4

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

The above equation can be extended for any number of lenses in contact as,

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + \frac{1}{f_4} + \ldots\ldots\ldots$$

27. What is angle of minimum deviation?

The minimum value of angle of deviation is called angle of minimum deviation D.

28. What is dispersion?

Dispersion is splitting of white light into its constituent colours. This band of colours of light is called its spectrum.

29. How are rainbows formed?

- When sunlight falls on the water drop suspended in air, it splits (or dispersed) into its constituent seven colours. Thus, water drop suspended in air behaves as a glass prism.
- Primary rain bow is formed when light entering the drop undergoes one total internal reflection inside the drop before coming out from the drop

30. What is Rayleigh's scattering?

If the scattering of light is by atoms and molecules which have size a very less than that of the wave length λ of light a<<λ, the scattering is called Rayleigh's scattering.

31. Why does sky appear blue?

- According to equation $I = \frac{1}{\lambda^4}$, violet colour which has the shortest wavelength gets much scattered during day time.

- The next scattered colour is blue. As our eyes are more sensitive to blue colour than violet colour the sky appears blue during day time

32. What is the reason for reddish appearance of sky during sunset and sunrise?

- During sunrise and sunset, the light from sun travels a greater distance through the atmosphere.
- Hence, the blue light which has shorter wavelength is scattered away and the less-scattered red light of longer wavelength manages to reach our eye.
- This is the reason for the reddish appearance of sky during sunrise and sunset.

33. Why do clouds appear white?

In clouds which contains large amount of dust and water droplets. Thus, in clouds all the colours get equally scattered irrespective of wavelength.

This is the reason for the whitish appearance of cloud.

34. What are the salient features of corpuscular theory of light?

- According this theory, light is emitted as tiny, massless (negligibly small mass) and perfectly elastic particles called corpuscles. As the corpuscles are very small, the source of light does not suffer appreciable loss of mass even if it emits light for a long time.
- On account of high speed, they are unaffected by the force of gravity and their path is a straight line in a medium of uniform refractive index. The energy of light is the kinetic energy of these corpuscles.
- When these corpuscles impinge on the retina of the eye, the vision is produced. The different size of the corpuscles is the reason for different colours of light.
- When the corpuscles approach a surface between two media, they are either attracted or repelled.The reflection of light is due to the repulsion of the corpuscles by the medium and refraction of light is due to the attraction of the corpuscles by the medium.

35. **What is wave theory of light?**

Light is a disturbance from a source that travels as longitudinal mechanical waves through the ether medium that was presumed to pervade all space as mechanical wave requires medium for its propagation

36. What is electromagnetic wave theory of light?

- Light is an electromagnetic wave which is transverse in nature carrying electromagnetic energy.
- No medium is Necessary for the propagation of electromagnetic waves.

37. Write a short note on quantum theory of light.

- Plank was able to explain photoelectric effect in which light interacts with matter as photons to eject the electrons.
- A photon is a discrete packet of energy. Each photon has energy E of, E = hv Where, h is Plank's constant and v is frequency of electromagnetic wave.
- As light has both wave as well as particle nature it is said to have dual nature.
- Light propagates as a wave and interacts with matter as a particle.

38. What is a wavefront?

A wave front is the locus of points which are in the same state or phase of vibration.

39. What is Huygens' principle?

According to Huygens principle, each point of the wavefront is the source of secondary wavelets emanating from these points spreading out in all directions with the speed of the wave. These are called as secondary wavelets.

40. What is interference of light?

The phenomenon of addition or superposition of two light waves which produces increase in intensity at some points and decrease in intensity at some other points is called interference of light.

41. What is phase of a wave?

- Phase is the angular position of a vibration.
- Phase is a particular point in time on the cycle of a waveform, measured as an angle in degrees

42. Obtain the relation between phase difference and path difference.

- Phase difference is the difference in phase angle between two waves, measured in degree or radian
- Path difference is the difference in path traversed by the two waves , measured in terms of Wavelength of the associated wave.

A path difference δ corresponds to a phase difference ϕ

$$\delta = \frac{\lambda}{2\pi} \times \phi \;;\; \textbf{or} \;\; \boldsymbol{\phi} = \frac{2\pi}{\lambda} \times \delta,$$

43. What are coherent sources?

Two light sources are said to be coherent if they produce waves which have same phase or constant phase difference, same frequency or wavelength (monochromatic), same waveform and preferably same amplitude.

44. What is intensity division?

- If we allow light to pass through a partially silvered mirror (beam splitter), both reflection and refraction take place simultaneously.
- As the two light beams are obtained from the same light source, the two divided light beams will be coherent beams. They will be either in-phase or at constant phase difference

45. How does wavefront division provide coherent sources?

- Wavefront division is the most commonly used method for producing two coherent sources. We know a point source produces spherical wavefronts.
- All the points on the wavefront are at the same phase. If two points are chosen on the wavefront by using a double slit, the two points will act as coherent sources.

46. How do source and images behave as coherent sources?

- Source and images: In this method a source and its image will act as a set of coherent source, because the source and its image will have waves in-phase or constant phase difference.
- The Instrument, Fresnel's biprism uses two virtual sources as two coherent sources and the instrument, Lloyd's mirror uses a source and its virtual image as two coherent sources.

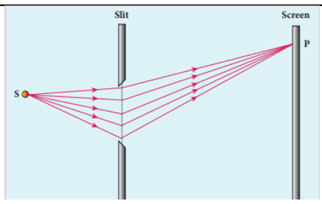
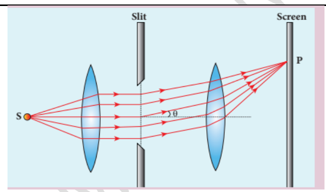
47. What is bandwidth of interference pattern?

The bandwidth (β) is defined as the distance between any two consecutive bright or dark fringes.

48. What is diffraction?

Diffraction is bending of waves around sharp edges into the geometrically shadowed region.

49. Differentiate between Fresnel and Fraunhofer diffraction.

S	Fresnel diffraction	Fraunhofer diffraction
1.	Spherical or cylindrical wave front undergoes diffraction	Plane wave front undergoes diffraction
2.	Light wave is from a source at finite distance	Light wave is from a source at infinity
3.	For laboratory conditions, convex lenses need not be used	In laboratory conditions, convex lenses are to be used
4.	difficult to observe and analyses	Easy to observe and analyses
5.		

50. Discuss the special cases on first minimum in Fraunhofer diffraction.

Let us consider the condition for first minimum with $(n = 1)$ $a \sin \theta = \lambda$

The first minimum has an angular spread of, $\sin \theta = \frac{\lambda}{a}$

special cases for above condition

➤ When $a < \lambda$, the diffraction is not possible,because $\sin\theta$ can never be greater than 1.

➤ When $a \geq \lambda$, the diffraction is possible. For $a = \lambda$, $\sin\theta = 1$ i.e, $\theta = 90^0$. That means the first minimum is at 90^o. Hence, the central maximum spreads fully in to the geometrically shadowed region leading to bending of the diffracted light to 90^0

➤ For $a >> \lambda$, $\sin\theta << 1$ i.e, the first minimum will fall within the width of the slit itself. The diffraction will not be noticed at all.

➤ When $a > \lambda$ and also comparable, say $a = 2\lambda$,

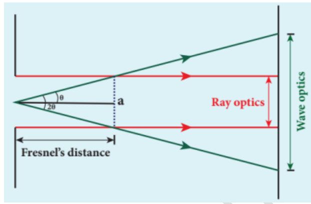
$\sin\theta = \frac{\lambda}{a} = \frac{\lambda}{2\lambda} = \frac{1}{2}$

$\theta = 30^0$ These are practical cases where diffraction could be observed effectively.

51. What is Fresnel's distance? Obtain the equation for Fresnel's distance.

➤ Fresnel's distance is the distance up to which the ray optics is valid in terms of rectilinear propagation of light.

- As there is bending of light in diffraction, the rectilinear propagation of light is violated.
- But, this bending is not significant till the diffracted ray crosses the central maximum at a distance z



- Hence, Fresnel's distance is the distance upto which ray optics is obeyed and beyond which ray optics is not obeyed but, wave optics becomes significant.

From the diffraction equation for first minimum,

$\sin\boldsymbol{\theta} = \frac{\lambda}{a}$; $\boldsymbol{\theta} = \frac{\lambda}{a}$-------(1)

From the definition of Fresnel's distance,

$\text{Sin}2\boldsymbol{\theta} = \frac{a}{z}$; $2\boldsymbol{\theta} = \frac{a}{z}$...., $\boldsymbol{\theta} = \frac{a}{2z}$....,(2)

From equation 1 and 2

After rearranging, we get Fresnel's distance z as

$\frac{\lambda}{a} = \frac{a}{2z}$; **Fresnel's distance** $z = \frac{a^2}{2\lambda}$

52. Mention the differences between interference and diffraction.

S.	INTERFERENCE	DIFFRACTION
1.	Superposition of two waves	Bending of waves around edges
2.	Superposition of waves from two coherent sources.	Superposition wavefronts emitted from various points of the same wavefront.
3.	Equally spaced fringes	Unequally spaced fringes
4.	Intensity of all the bright fringes is almost same	Intensity falls rapidly for higher orders
5.	Large number of fringes are obtained	Less number of fringes are obtained

53. What is a diffraction grating?

Grating has multiple slits with equal widths of size comparable to the wavelength of diffracting light. Grating is a plane sheet of transparent material on which opaque rulings are made with a fine diamond pointer.

54. What are resolution and resolving power?

- Optical resolution describes the ability of imaging system to resolve detail in the object that is being imaged.
- The inverse of resolution is called resolving power.
- The ability of an optical instrument to separate or distinguish small or closely adjacent objects through the image formation is said to be resolving power of the instrument.

55. What is Rayleigh's criterion?

According to Rayleigh's criterion, for two point objects to be just resolved,the minimum distance between their diffraction images must be in such a way that the central maximum of one coincides with the first minimum of the other and vice versa

56. What is polarisation?

The phenomenon of restricting the vibrations of light to a particular direction perpendicular to the direction of wave propagation motion is called polarization of light.

57. Differentiate between polarised and unpolarised light

S	Polarized light	unpolarised light
1.	Consists of waves having their electric field vibrations in a single plane normal to the direction of ray.	Consists of waves having their electric Field vibrations equally distributed in all directions normal to the direction of ray.
2.	Asymmetrical about the ray direction.	Symmetrical about the ray direction.
3.	It is obtained from unpolarised light with the help of polarisers.	Produced by conventional light sources.

58. Discuss polarisation by selective absorption.

- Selective absorption is the property of a material which transmits waves whose electric fields vibrate in a plane parallel to a certain direction of orientation and absorbs all other waves.

- The polaroids or polarisers are thin commercial sheets which make use of the property of selective absorption to produce an intense beam of plane polarised light. Selective absorption is also called as dichroism.

59. What are polariser and analyser?

- the Polaroid which plane polarises the unpolarised light passing through it is called a polarizer
- The polaroid which is used to examine whether a beam of light is polarised or not is called an analyser.

60. What are plane polarised, unpolarised and partially polarised light?

- Plane polarized: if the vibration of a wave are present in only one direction in a plane perpendicular to the direction of propagation of the wave is said to be polarized or plane polarised light
- Unpolarised : a transverse wave which has vibrations in all directions in a plane perpendicular to the direction of propagation is said to be unpolarised light.
- Partially polarised light: vibration is in all directions but the amplitude is more in one direction as compared to the other.

61. State and obtain Malus' law.

When a beam of plane polarised light of intensity I_0 is incident on an analyser, the light transmitted of intensity I from the analyser varies directly as the square of the cosine of the angle θ between the transmission axis of polariser and analyser .This is known as Malus' law.

$$I=I_o\cos^2\theta$$

62. List the uses of polaroids.

Polaroid's are used in

1. Goggles and cameras to avoid glare of light.
2. Three dimensional motion pictures i.e., in holography.
3. Improve contrast in old oil paintings.
4. Optical stress analysis.
5. Window glasses to control the intensity of incoming light
6. Polarised laser beam acts as needle to read/write in compact discs (CDs).
7. Polaroids produce polarised lights to be used in liquid crystal display (LCD).

63. State Brewster's law.

The tangent of the polarising angle for a transparent medium is equal to its refractive index. $n = \tan i_p$

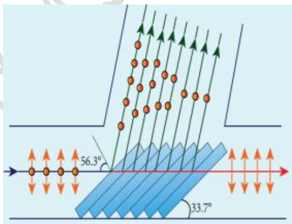
64. What is angle of polarisation and obtain the equation for angle of polarisation.

The angle of incidence at which a beam of unpolarised light falling on a transparent surface is reflected as a beam of plane polarised light is called polarising angle or Brewster's angle.

$r_p + i_p + 90^0 = 180^0$

$r_p = 90^0 - i_p$

65. Discuss about pile of plates.



- The phenomenon of polarisation by reflection is used in the construction of pile of plates.
- It consists of a number of glass plates placed one over the other in a tube as shown in Fig.
- The plates are inclined at an angle of 33.7^0 ($90^0 - 56.3^0$) to the axis of the tube.
- A beam of unpolarised light is allowed to fall on the pile of plates along the axis of the tube. So, the angle of incidence of light will be at 56.3^0 which is the polarising angle for glass.
- The vibrations perpendicular to the plane of incidence are reflected at each surface and those parallel to it are transmitted.
- The larger the number of surfaces, the greater is the intensity of the reflected plane polarised light.
- The pile of plates is used as a polarizer and also as an analyser.

66. What is double refraction?

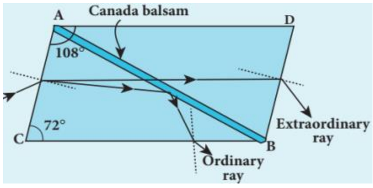
When a ray of unpolarised light is incident on a calcite crystal, two refracted rays are produced. Hence, two images of a single object are formed. This phenomenon is called double refraction

67. Mention the types of optically active crystals with example.

- Crystals like calcite, quartz, tourmaline and ice having only one optic axis are called uniaxial crystals.

Crystals like mica, topaz, selenite and aragonite having two optic axes are called biaxial crystals.

68. Discuss about Nicol prism.



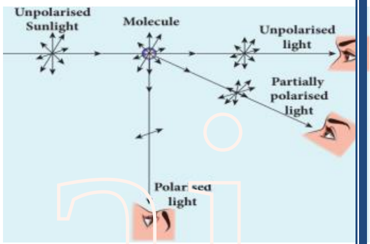
➢ Nicol prism is an optical device incorporated in optical instruments both for producing and analysing plane polarized light.

➢ The construction of a Nicol prism is based on the phenomenon of Double refraction and was designed by William Nicol

➢ One of the most common forms of the Nicol prism is made by taking a calcite crystal which is a double refracting crystal with its length three times its breadth.

➢ ABCD represents the principal section of a calcite crystal. It is cut into two halves along the diagonal so that their face angles are 72^0 and 108^0. The two halves are joined together by a layer of canada balsam, a transparent cement.

69. How is polarisation of light obtained by scattering of light?



➢ The light from a clear blue portion of the sky shows a rise and fall of intensity when viewed through a polaroid which is rotated.

➢ This is because of sunlight, which has changed its direction (having been scattered) on encountering the molecules of the earth's atmosphere.

➢ As Figure shows, the incident sunlight is unpolarised. The electric field of light interact with the electrons present in the air molecules.

➢ Under the influence of the electric field of the incident wave the electrons in the molecules acquire components of motion in both these directions.

➢ We have shown an observer looking at 90° to the direction of the sun. Clearly, charges accelerating parallel do not radiate energy towards this observer since their acceleration has no transverse component.

➢ The radiation scattered by the molecule is therefore polarized perpendicular to the plane

70. Discuss about simple microscope and obtain the equations for magnification for near point focusing and normal focusing.

➢ A simple microscope is a single magnifying (converging) lens of small focal length. To get an erect, magnified and virtual image of the object.

- For this the object is placed between F and P on one side of the lens and viewed from other side of the lens.

There are two magnifications to be discussed for two kinds of focusing

- magnification for near point focusing $m=1+\frac{D}{f}$
- magnification for normal focusing $m=\frac{D}{f}$

71. What are near point and normal focusing?

- Near point focusing – The image is formed at near point, i.e. 25 cm for normal eye. This distance is also called as least distance D of distinct vision. In this position, the eye feels comfortable but there is little strain on the eye.
- Normal focusing – The image is formed at infinity. In this position the eye is most relaxed to view the image.

72. Why is oil immersed objective preferred in a microscope?

- Oil immersion objectives are used only at very large magnifications that require high resolving power.
- Objectives with high power magnification have short focal lengths, facilitating the use of oil.

73. What are the advantages and disadvantages of using a reflecting telescope?

Advantages

- The main advantage is reflector telescope can escape from chromatic aberration because wavelength does not affect reflection.
- The primary mirror is very stable because it is located at the back of the telescope and can be support in the back.
- More cost effective than refractor of similar size.
- Easier to make a high quality mirror than lens because mirror need to only concern with one side of the curvature.

Disadvantages

- Optical misalignment can occur quite easily.
- Require frequent cleaning because the inside is expose to the atmosphere.
- Secondary mirror can cause diffraction of original incoming light rays causing the "christmas star effect" where bright objects have spikes.

74. What is the use of an erecting lens in a terrestrial telescope?

A terrestrial telescope has an additional erecting lens to make the final image erect.

75. What is the use of collimator?

The collimator is an arrangement to produce a parallel beam of light.

76. What are the uses of spectrometer?

- A spectrometer is a device for measuring a wavelengths of light over a wide range of the electromagnetic spectrum.
- spectrometer is used for measuring ray deviations and refractive indices.

77. What is myopia? What is its remedy?

- A person suffering from nearsightedness or myopia can see nearby object clearly but cannot see distant objects clearly beyond certain limit
- Myopia can be corrected by using a concave lens of suitable focal length.

78. What is hypermetropia? What is its remedy?

- A person suffering from long sightedness or hypermetropia can see distant object clearly but cannot see nearby objects clearly.
- Hypermetropia can be corrected by using a convex lens of suitable focal length

79. What is presbyopia?

This defect is similar to hypermetropia i.e., a person having this defect cannot see nearby objects distinctly, but can see distant objects without any difficulty. This defect occurs in elderly persons

80. What is astigmatism?

Astigmatism is the defect arising due to different curvatures along different planes in the eye lens. Astigmatic person cannot see all the directions equally well. The defect due to astigmatism is more serious than myopia and hyperopia.

CONCEPTUAL QUESTIONS

1. Why are dish antennas curved?

Dish antenna is curved so as it can receive parallel signal rays coming from same direction. These parallel signal rays reflect from parabolic dish, and gathered at main antenna part. This increases directivity of antenna, and gives sufficient amplitude signal.

2. What type of lens is formed by a bubble inside water?

Biconvex lens is the lens formed when an air bubble is inside water. The air bubble acts as a diverging lens (concave lens) in water. This makes it equivalent to two convex interfaces meeting each other with light entering from a medium with a higher refractive index. Therefore an air bubble in water acts in the same manner as a concave lens made of glass does in air.

3. It is possible for two lenses to produce zero power?

If one lens is converging lens with some focal length so that its power is P_1=P and the other lens diverging lens with the same focal length but with a negative sign so that its power is P_2=-P, then the combination of these two lenses will be zero

4. Why does sky look blue and clouds look white? (B.Q)

5. Why is yellow light preferred to during fog?

Yellow light supposedly penetrates further because of its long wavelength, but it's still much smaller than fog particles. The scattering effects of fog are essentially independent of wavelength.

6. Two independent monochromatic sources cannot act as coherent sources,why?

Two independent sources of light cannot be coherent. This is because light is emitted by individual atoms, when they return to ground state. Even the smallest source of light contains billions of atoms which obviously cannot emit light waves in the same phase

7. Does diffraction take place at the Young's double slit?

Both diffraction and interference occur in the double slit experiment. The wavefront is diffracted as it passes through each of the slits. The diffraction causes the wavefronts to spread out as if they were coming from light sources located at the slits.

8. Is there any difference between colored light obtained from prism and colours of soap bubble?

Unlike those seen in a rainbow, which arise from differential refraction, the colours seen in a soap bubble arise from interference of light reflecting off the front and back surfaces of the thin soap film. Depending on the thickness of the film, different colours interfere constructively and destructively

9. A small disc is placed in the path of the light from distance source. Will the center of the shadow be bright or dark?

Waves diffracted from the edge of circular obstacle interfere constructive at the center of the shadow resulting in the formation of a bright spot.

10. When a wave undergoes reflection at a denser medium, what happens to its phase?

When a wave undergoes a reflection at a denser medium then it's crest reflected as trough and vice versa. So, it's phase changes at 180 degree

Unit 7: DUAL NATURE OF RADIATION AND MATTER

1. Why do metals have a large number of free electrons?

- In metals, the electrons in the outer most shells are loosely bound to the nucleus. Even at room temperature, there are a large number of free electrons which are moving inside the metal in a random manner.
- They move freely inside the metal, they cannot leave the surface of the metal. They are attracted by the positive nuclei of the metal. It is this attractive pull which will not allow free electrons to leave the metallic surface at room temperature.

2. Define work function of a metal. Give its unit.

The minimum energy needed for an electron to escape from the metal surface is called work function of that metal.

FORMULA	UNIT
$\Phi_0 = h\nu_0$	**electron volt (eV).**

3. What is photoelectric effect?

The ejection of electrons from a metal plate when illuminated by light or any other electromagnetic radiation of suitable wavelength (or frequency) is called photoelectric effect.

4. How does photocurrent vary with the intensity of the incident light?

- When the frequency of the incident light and the accelerating potential V of the anode are kept constant.

- The photocurrent (number of electrons emitted per second) is directly proportional to the intensity of the incident light.

5. Give the definition of intensity of light and its unit.

Energy per unit area per unit time is called intensity of light. **Unit: Candela (cd)**

6. How will you define threshold frequency?

For a given surface, the emission of photoelectrons takes place only if the frequency of incident light is greater than a certain minimum frequency called the threshold frequency.

7. What is a photo cell? Mention the different types of photocells.

Photo electric cell or photo cell is a device which converts light energy into electrical energy. It works on the principle of photo electric effect.

Photo cells are classified into three types. They are

1. Photo emissive cell 2. Photo voltaic cell 3.Photo conductive cell

8. Write the expression for the de Broglie wavelength associated with a charged particle of charge q and mass m, when it is accelerated through a potential V.

An electron of mass m is accelerated through a potential difference of V volt.

The kinetic energy acquired by the electron is given by $\frac{1}{2}mv^2$ = eV

The speed υ of the electron is v= $\sqrt{\frac{2eV}{m}}$

de Broglie wavelength of the electron is $\lambda=\frac{h}{p}=\frac{h}{\sqrt{2emV}}$

9. State de Broglie hypothesis.

According to de Broglie hypothesis,

i. <u>All matter has both particle and wave nature.</u> Greatly influenced by the symmetry in nature, de Broglie suggested that if radiation like light can act as particles at times, then matter particles like electrons should also act as waves at times.

ii. All matter particles like electrons, protons, neutrons in motion are associated with waves. These waves are called de Broglie waves or matter waves.

10. Why we do not see the wave properties of a baseball?

Due to large mass of a baseball, the de Broglie wave length (λ=h/mv) associated with baseball is very small. So there are no discernible wave properties to be observed on the large scales.

11. A proton and an electron have same kinetic energy. Which one has greater de Broglie wavelength. Justify.

By de Broglie wavelength of a particle

$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mK}}$

The de Broglie wavelength of a particle is inversely proportional to its square root of mass ($\lambda \propto \frac{1}{\sqrt{m}}$)

As $m_e << m_p$, so $\lambda_e >> \lambda_p$

The electron has the longer wavelength.

12. Write the relationship of de Broglie wavelength λ associated with a particle of mass m in terms of its kinetic energy K.

The kinetic energy of the particle, $K = \frac{1}{2}mv^2 = \frac{p^2}{2m}$

$$p = \sqrt{2mK}$$

De Broglie wavelength of the particle is $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mK}}$

13. Name an experiment which shows wave nature of the electron. Which phenomenon was observed in this experiment using an electron beam?

i. The experiment that shows the wave nature of electron is Davisson and Germer experiment.

ii. They demonstrated that electron beams are diffracted when they fall on crystalline solids.

14. An electron and an alpha particle have same kinetic energy. How are the de Broglie wavelengths associated with them related?

The kinetic energy of the particle, $K = \frac{1}{2}mv^2$

$$= \frac{p^2}{2m} = \frac{h^2}{2m\lambda^2}$$

$$\lambda = \frac{h}{\sqrt{2mK}} \; ; \; \lambda \propto \frac{1}{\sqrt{m}}$$

$$\frac{\lambda_e}{\lambda_\alpha} = \sqrt{\frac{m_\alpha}{m_e}}$$

Unit 8: ATOMIC AND NUCLEAR PHYSICS

1. What are cathode rays?.

A cathode ray is a stream of electrons that are seen in vacuum tubes. The electrons are being emitted from the negative charged electrode in the vacuum tube are called cathode rays.

2. Write the properties of cathode rays.

i. Cathode rays possess energy and momentum and travel in a straight line with high speed of the order of $10^7 ms^{-1}$.

ii. It can be deflected by application of electric and magnetic fields. The direction of deflection indicates that they are negatively charged particles.

iii. When the cathode rays are allowed to fall on matter, they produce heat.

iv. They affect the photographic plates and also produce fluorescence when they fall on certain crystals and minerals.

v. When the cathode rays fall on a material of high atomic weight, x-rays are produced.

vi. Cathode rays ionize the gas through which they pass.

3. Give the results of Rutherford alpha scattering experiment.

(a) Most of the alpha particles are undeflected through the gold foil and went straight.

(b) Some of the alpha particles are deflected through a small angle.

(c) A few alpha particles are deflected through the angle more than 90°

(d) Very few alpha particles returned back that is, deflected back by 180°.

4. Write down the postulates of Bohr atom model.

(a) The electron in an atom moves around nucleus in circular orbits under the influence of Coulomb electrostatic force of attraction. This Coulomb force gives necessary centripetal force for the electron to undergo circular motion.

(b) Electrons in an atom revolve around the nucleus only in certain discrete orbits called stationary orbits where it does not radiate electromagnetic energy. Only those discrete orbits allowed are stable orbits.

(c) Energy of orbits are not continuous but discrete. This is called the quantization of energy. An electron can jump from one orbit to another orbit by absorbing or emitting a photon whose energy is equal to the difference in energy (ΔE) between the two orbital levels.

5.What is meant by excitation energy.

The energy required to excite an electron from the lower energy state to any higher energy state is known as excitation energy.

6. Define the ionization energy and ionization potential.

The minimum energy required to remove an electron from an atom which is in ground state is known as ionization energy.

Ex: ionization energy for hydrogen atom is $E_{ionization}$ =13.6eV

Ionization potential is defined as ionization energy per unit charge.

7. Write down the draw backs of Bohr atom model.

(a) Bohr atom model is valid only for hydrogen atom or hydrogen like-atoms but not for complex atoms.

(b) When the spectral lines are closely examined, individual lines of hydrogen spectrum is accompanied by a number of faint lines. These are often called fine structure. This is not explained by Bohr atom model.

(c) Bohr atom model fails to explain the intensity variations in the spectral lines.

(d) The distribution of electrons in atoms is not completely explained by Bohr atom model.

8. What is distance of closest approach?

The minimum distance between alpha particle and Centre of the nucleus just before it gets reflected back by 180° is defined as distance of closest approach.

9. Define impact parameter.

The impact parameter is defined as the perpendicular distance between the centre of the gold nucleus and the direction of velocity vector of alpha particle when it is at a large distance.

10. Write a general notation of nucleus of element X. What each term denotes?

A general notation of nucleus of element X is $^{A}_{Z}\mathrm{X}$

Where Z – Atomic number, A –Mass number

11. What is isotope? Give an example.

Isotopes are atoms of the same element having same atomic number Z, but different mass number A.

Ex : $^{1}_{1}$H (**Protium**) , $^{2}_{1}$H (**deutrium**), $^{3}_{1}$H (***tritium***)

12. What is isotone? Give an example.

Isotones are the atoms of different elements having same number of neutrons.

Ex : $^{12}_{5}$B , $^{13}_{6}$C are examples of isotones which 7 neutrons.

13. What is isobar? Give an example.

Isobars are the atoms of different elements having the same mass number A, but different atomic number Z.

Ex : $^{40}_{16}$S , $^{40}_{17}$Cl, $^{40}_{18}Ar$, $^{40}_{19}$K , $^{40}_{20}$Ca

14. Define atomic mass unit *u*.

One atomic mass unit (u) is defined as the 1/12 th of the mass of the isotope of carbon $^{12}_{6}$C.

16. Show that nuclear density is almost constant for nuclei with *Z* > 10.

Nuclear density (ρ) = $\frac{Mass\ of\ the\ nuclei}{Volume\ \ of\ the\ nuclei}$

$$=\frac{A.m}{\frac{4}{3}\pi R_0^3\,A} = \frac{m}{\frac{4}{3}\pi R_0^3}$$

$$\rho=\frac{1.67X10^{-27}}{\frac{4}{3}\pi X(1.2X10^{-15})^3} = 2.3X10^{17}\text{kgm}^{-3}$$

The above expression shows that the nuclear density is independent of the mass number A.

In other words, all the nuclei (Z > 10) have the same density and it is an important characteristics of the nuclei.

17. What is mass defect?

The mass of any nucleus is always less than the sum of the mass of its individual constituents. The difference in mass Δm is called mass defect. $\Delta m = (Zm_p + Nm_n) - M$

18. What is binding energy of a nucleus? Give its expression.

When proton and neutron combine to form a nucleus ,mass equal to mass defect disappears and the corresponding energy is released. This is called the binding energy of the nucleus (BE).

$B.E = \Delta mc^2 = (Zm_p + Nm_n - M)c^2$

19. Calculate the energy equivalent of 1 atomic mass unit.

$E = mc^2 = 1.67X10^{-27} X(3X10^8)^2 J$

$= \frac{1.67X10^{-27} X(3X10^8)^2}{1.6X10^{-19}} eV$

1 atomic mass unit = 931MeV

20. Give the physical meaning of binding energy per nucleon.

The average binding energy per nucleon is the energy required to separate single nucleon from the particular nucleus.

***21.* What is meant by radioactivity?**

Phenomenon of spontaneous emission of highly penetrating radiations such as α,β and γ rays an element is called radioactivity and the substances which emit these radiations are called radioactive elements.

22. Give the symbolic representation of alpha decay, beta decay and gamma decay.

Alpha decay (α) : $^A_ZX \rightarrow {}^{A-4}_{Z-2}Y + {}^4_2He$

Beta decay (β^-) : $^A_ZX \rightarrow {}_{Z+1}^{A}Y + e^- + \nu$

Beta decay (β^+) : $^A_ZX \rightarrow {}_{Z-1}^{A}Y + e^+ + \nu$

Gamma decay (γ) : $^A_ZX \rightarrow {}^A_ZX + \gamma$

23. In alpha decay, why the unstable nucleus emits nucleus? Why it does not emit four separate nucleons?

After all $^{4}_{2}He$ consists of two protons and two neutrons.

For example, if $^{238}_{92}U$ nucleus decays into $^{234}_{90}Th$ by emitting four separate nucleons (two protons and two neutrons), then the disintegration energy Q for this process turns out to be negative. It implies that the total mass of products is greater than that of parent ($^{238}_{92}U$) nucleus. This kind of process cannot occur in nature because it would violate conservation of energy.

In any decay process, the conservation of energy, and conservation of linear momentum and conservation of angular momentum must be obeyed.

24.What is mean life of nucleus? Give the expression.

The mean life time of the nucleus is the ratio of sum or integration of life times of all nuclei to the total number nuclei present initially. **Mean life time (τ)=**$\frac{1}{\lambda}$

24. What is half-life of nucleus? Give the expression.

Half- life of nucleus is defined as the time $T_{\frac{1}{2}}$ required for the number of atoms initially present to reduce to one half of the initial amount.

$$\text{Half} - \text{life } T_{\frac{1}{2}} = \frac{0.6931}{\lambda}$$

25. What is meant by activity or decay rate? Give its unit.

- Activity or decay rate is the number of nuclei decayed per second and it is denoted as $R = \frac{dN}{dt}$
- The SI unit of activity is **Becquerel.**

  Activity R is a positive quantity

26. Define curie.

One curie is defined as number of nuclei decayed per second in 1g of radium and is equal to 3.7×10^{10} decays/second.

27. What are the constituent particles of neutron and proton?

Protons and neutrons are Baryon which are made up of three Quarks. According to quark model, proton is made up of two up quarks and one down quark and neutron is made up of one up quark and two down quarks.

UNIT - 9 : SEMICONDUCTOR ELECTRONICS

1. Define electron motion in a semiconductor.

To move the hole in a given direction, the valence electrons move in the opposite direction. Electron flow in an N- Type semiconductor is similar to electrons moving in a metallic wire. The N-type dopant atoms will yield electron available for conduction.

2. Distinguish between intrinsic and extrinsic semiconductors.

S.No	Intrinsic semiconductors	Extrinsic semiconductors
1.	A semiconductor in its pure form Without impurity is called an intrinsic semiconductor.	These are semiconducting tetravalent crystals doped with impurity atoms of group III or V
2.	Their electrical conductivity is low.	Their electrical conductivity is high.
3.	In intrinsic semiconductors, the number of electrons in the conduction band is equal to the number of holes in the valence band.	In extrinsic semiconductors, the number of electrons in the conduction band is not equal to the number of holes in the valence band.
4.	Their electrical conductivity depends on temperature.	Their electrical conductivity depends on temperature as well as dopants concentration.

3. What do you mean by doping?

The process of adding impurities to the intrinsic semiconductor is called doping.

4. How electron-hole pairs are created in a semiconductor material?

A small increase in temperature is sufficient enough to break some of the covalent bonds and release the electrons free from the semiconductor lattice. As a result, some states in the valence band become empty and the same number of states in the conduction band will be occupied. The vacancies produced in the valence band are called holes. As the holes are deficiency of electrons, they are treated to possess positive charges. Hence, electrons and holes pairs are created in a semiconductors.

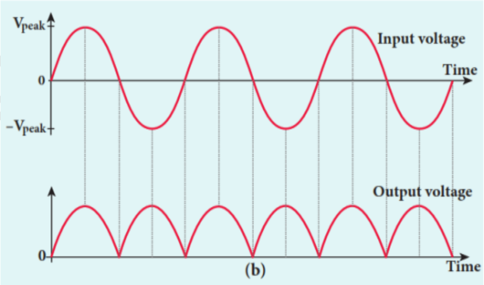
5. A diode is called as a unidirectional device. Explain

- When the positive half cycle of the ac input signal passes through diode, The diode is forward biased and hence it conducts.
- When the negative half cycle of the ac input signal passes through diode, diode is reverse biased and does not conduct and hence no current flows through diode.
- The current flows in only one direction(uni direction), when the diode is forward biased. Hence, A diode is called as a unidirectional device

6. What do you mean by leakage current in a diode?

The leakage current in a diode is the current that the diode will leak when reverse voltage is applied on it. Under Reverse bias, a very small current in µA, flows across the junction. This is due to the flow of the minority charge carriers called the leakage current.

7. Draw the output waveform of a full wave rectifier.



8. Distinguish between avalanche and zener breakdown.

S.No	Avalanche breakdown	Zener breakdown
1.	Avalanche breakdown occurs in lightly doped junctions which have wide depletion layers.	Zener breakdown occurs in Heavily doped junctions which have narrow depletion layers.
2.	Here, in this case, the electric field is not strong enough to produce breakdown.	Here, in this case, the electric field ($3 \times 10^7 V\ m^{-1}$) is strong enough to produce breakdown.

3.	Alternatively, the thermally generated minority charge carriers accelerated by the electric field gains sufficient kinetic energy, collide with the semiconductor atoms while passing through the depletion region. This leads to the breaking of covalent bonds and in turn generates electron-hole pairs.	This electric field is strong enough to break or rupture the covalent bonds in the lattice and there by generating electron-hole pairs. This effect is called **Zener effect**.
4.	The newly generated charge carriers are also accelerated by the electric field resulting in more collisions and further production of charge carriers. This cumulative process leads to an avalanche of charge carriers across the junction and consequently reduces the reverse resistance. The diode current increases sharply.	Even a small further increase in reverse voltage produces a large number of charge carriers. Hence the junction has very low resistance in the breakdown region. This process of emission of electrons due to the rupture of bands in from the lattice due to strong electric field is known as internal field emission or field ionization.

9. Discuss the biasing polarities in an NPN and PNP transistors.

In a NPN transistor, base and collector will be positive with respect to emitter indicated by the middle letter N whereas in an PNP transistor base and collector will be negative [indicated by the middle letter P]

10. Explain the current flow in a NPN transistor

- The conventional flow of current is based on the direction of the motion of holes.
- In NPN transistor, current enters from the base into the emitter.
- The emitter current I_E is due to electrons and the base current I_B is due to holes .
- However, the current through the external circuit is due to the flow of electrons.

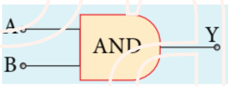
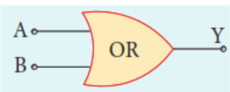
11. What is the phase relationship between the AC input and output voltages in a common emitter amplifier? What is the reason for the phase reversal?

In a common emitter amplifier, AC input and output voltages are 180^0 out of phase or in opposite phases. The **reason** for this can be seen from the fact that as the **input voltage** rises, so the current increases through the base circuit.

12. Explain the need for a feedback circuit in a transistor oscillator.

The circuit used to feedback a portion of the output to the input is called the feedback network. If the portion of the output fed to the input is in phase with the input, then the magnitude of the input signal increases. It is necessary for sustained oscillations.

13. Give circuit symbol, logical operation, truth table, and Boolean expression of AND, OR, NOT, NAND, NOR, and EX-OR gates

Logic gates	Symbol	Logical operation	Boolean expression	Truth table
AND		• The output of AND gate is high (1) only when all the inputs are high (1). • The rest of the cases the output is low.	$Y = A.B$	INPUTS: A, B; OUTPUT: Y=A.B 0 0 | 0 0 1 | 0 1 0 | 0 1 1 | 1
OR		• The output of OR gate is high (logic 1 state) when either of the inputs or both are high.	$Y = A+B$	INPUTS: A, B; OUTPUT: Y=A+B 0 0 | 0 0 1 | 1 1 0 | 1 1 1 | 1

<table>
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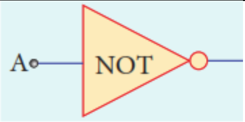
<td>NOT</td>
<td>
</td>
<td>The output is the Complement of the input. It is represented with an overbar. It is also called as inverter.
• The truth table infers that the output Y is 1 when input A is 0 and vice versa.</td>
<td>$Y = \overline{A}$</td>
<td>
<table>
<tr><th>INPUTS</th><th>OUTPUT</th></tr>
<tr><td>A</td><td>$Y = \overline{A}$</td></tr>
<tr><td>0</td><td>1</td></tr>
<tr><td>1</td><td>0</td></tr>
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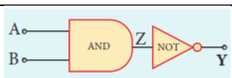
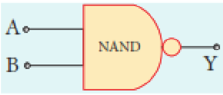
<tr>
<td>NAND</td>
<td>

(Or)

</td>
<td>The output Y equals the complement of AND operation. The circuit is an AND gate followed by a NOT gate. Therefore, it is summarized as NAND.
•The output is at logic zero only when all the inputs are high.
•The rest of the cases, the output is high (Logic 1 state).</td>
<td>$Y = \overline{A.B}$</td>
<td>
<table>
<tr><th colspan="2">INPUTS</th><th>OUTPUT (AND)</th><th>OUTPUT (NAND)</th></tr>
<tr><td>A</td><td>B</td><td>Z=A.B</td><td>$Y = \overline{A.B}$</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td></tr>
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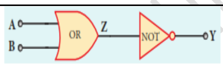
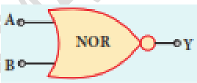
<td>

(Or)

</td>
<td>Y equals the complement of OR operation(A OR B). The circuit is an OR gate followed by a NOT gate and is summarized as NOR.
•The output is high when all the inputs are low.
•The output is low for all other combinations of inputs.</td>
<td>$Y = \overline{A + B}$</td>
<td>
<table>
<tr><th colspan="2">INPUTS</th><th>OUTPUT (OR)</th><th>OUTPUT (NOR)</th></tr>
<tr><td>A</td><td>B</td><td>Z=A+B</td><td>$Y = \overline{A + B}$</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td></tr>
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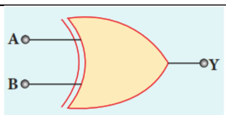
<td>EX-OR</td>
<td></td>
<td>• The output is high only when either of the two inputs is high.
• In the case of an Ex-OR gate with more than two inputs, the output will be high when odd number of inputs are high.</td>
<td>$Y=A.\bar{B}+\bar{A}.B$

$Y=A+B$</td>
<td>
<table>
<tr><td colspan="2">INPUTS</td><td>OUTPUT (EX-OR)</td></tr>
<tr><td>A</td><td>B</td><td>Y=A+B</td></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>1</td></tr>
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14. State De Morgan's first and second theorems.

- The first theorem states that the complement of the sum of two logical inputs is equal to the product of its complements.

$$\overline{A+B} = \bar{A}.\bar{B}$$

- The second theorem states that the complement of the product of two inputs is equal to the sum of its complements.

$$\overline{A.B} = \bar{A}+\bar{B}$$

UNIT - 10 : COMMUNICATION SYSTEMS

1. Give the factors that are responsible for transmission impairments.

1.Attenuation 2. Distortion 3. Noise

2. Distinguish between wireline and wireless communication? Specify the range of electromagnetic waves in which it is used.

S.No	Wireline communication	Wireless communication
1.	Wireline communication (point-point communication) uses mediums like wires, cables and optical fibers.	Wireless communication uses free space as a communication medium. The signals are transmitted in the form of electromagnetic waves with the help of a transmitting antenna.
2.	These systems cannot be used for long distance transmission as they are connected physically.	Hence wireless communication is used for long distance transmission

3.	Examples are telephone, intercom and cable TV.	Examples are mobile, radio or TV broadcasting, and satellite communication.
4.		The frequencies range of electromagnetic waves from 2 kHz to 400 GHz are transmitted through wireless communication

3. Explain centre frequency or resting frequency in frequency modulation.

When the frequency of the baseband signal is zero (no input signal), there is no change in the frequency of the carrier wave. It is at its normal frequency and is called as **centre frequency or resting frequency.** Practically this is the allotted frequency of the FM transmitter.

4. What does RADAR stand for?

Radar stands for **Ra**dio **D**etection **a**nd **R**anging System.

5. What do you mean by Internet of Things?

Internet of Things (IoT) is made possible to control various devices from a single device. **Example:** Home automation using a mobile phone.

UNIT – 11: RECENT DEVELOPMENTS IN PHYSICS

1. Distinguish between Nano science and Nanotechnology.

Nanoscience	Nanotechnology
Nanoscience is the science of objects with typical sizes of 1-100nm. One nano meter $=10^{-9}$ meter. If matter is divided into such small objects the mechanical, electrical, optical, magnetic and other properties change.	Nanotechnology is a technology involving the design, production, characterization, and application of nano structured materials.

2. What is the difference between Nano materials and Bulk materials?

S.NO	Nano materials	Bulk materials
1.	The solids are made up of	When the particle size exceeds 100

	particles. If the particles of a solid is of size less than 100nm , it is said to be a nano solid	nm, it is a bulk solid or bulk material.

- Nano and bulk solids may be of the same chemical composition.

  For eg: ZnO can be both in bulk and nano form.
- Though chemical composition is the same, nano form of the material shows strikingly different properties when compared to its bulk counterpart.

2. **Give any two examples for "Nano" in nature.**

Eg: Single strand of DNA, Peacock feathers, Morpho butterfly,Parrot fish and Lotus leaf surface.

Single strand of DNA: the building block of all living things, is about three nano meters wide.

Morpho butterfly: the scales on the wings of a morpho butterfly contain nanostructures that change the way light waves interact with each other,giving the wings brilliant metallic blue and green hues.

Mimic in laboratories-manipulation of colours by adjusting the size of nano particles with which the materials are made.

3. **Mention any two advantages and disadvantages of Robotics.**

Advantages of Robotics:

- The robots are much cheaper than humans.
- Robots never get tired like human.
- Robots are more precise and error free in performing the task.
- Stronger and faster than human.
- Robots can work in extreme environmental condition. That is extreme hot or cold, also bomb Detection and bomb deactivation.
- In warfare, robots can save human lives.
- Robots are significantly used in handling materials in chemical industries specially in nuclear plants which can lead to health hazards in human.

Disadvantages of Robotics:

- Robots have no sense of emotions or conscience.
- They lack empathy and hence create an emotionless workplace.

- Unemployment problem will increase.
- The robots are well programmed to do a job and if a small thing goes wrong it ends up in a big Loss to the company.
- Humans cannot be replaced by robots in decision making.
- If a robot malfunctions it takes time to identify the problem and rectify it.

4. Why steel is preferred in making Robots?

Steel is several times stronger. In any case, because of the inherent strength of metal, robot bodies are made using sheet, bar, rod, Channel and other shapes.

5. What are black holes?

- Black holes are end stage of stars which are highly dense massive object. Its mass ranges from 20 times mass of the sun to 1 million times mass of the Sun. It has very strong gravitational force such that no particle or even light can escape from it.
- The existence of black holes is studied when the stars or biting the black hole behave differently from the other stars.
- Every galaxy has black hole at its center. Sagittarius A* is the black hole at the center of the Milky Way galaxy. Black holes are the source of gravitational waves.

6. What are sub atomic particles?

- The three main subatomic particles that forms that form an atom are electron, proton and neutron.
- Subatomic particles are particles that are smaller than the atom, proton and neutron are made up of quarks which interact through gluons.
- Subatomic particle having two types of particles , they are elementary particle and composite particle.

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