CAREER POINT

MOCK TEST PAPER

CENTRAL BOARD OF SENIOR SECONDARY EXAMINATION

PHYSICS (Theory)

SOLUTIONS

Sol.1 Phase change = π.

Sol.2 As energy of X-ray photons is greater than UV. So KE increases.

Sol.3 It is the decay probability of a radioactive nucleus in next unit time.

Sol.4 $\lambda = \lambda_1 + \lambda_2$

$$\frac{\ln 2}{T} = \frac{\ln 2}{T_1} + \frac{\ln 2}{T_2}$$

$$\Rightarrow T = \frac{T_1 T_2}{T_1 + T_2}.$$

Sol.5 2 v

Sol.6 $P = \frac{E}{c} = \frac{3\times10^6 \times 1.6\times10^{-19}}{3\times10^8}$

$= 1.6 \times 10^{-21}$ kg-m/sec.

Sol.7 5Ω resistor is short circuited

$\therefore$ current in 3Ω resistor $= \frac{3}{3}$

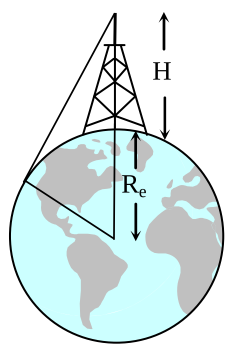
$= 1$ Amp

Sol.8 $\Delta I_B = 8 - 7.9 = 0.1$ mA

$$\alpha = \frac{\Delta I_C}{\Delta I_E} = 0.99$$

$$\& \ \beta = \frac{\Delta I_C}{\Delta I_B} = 79.$$

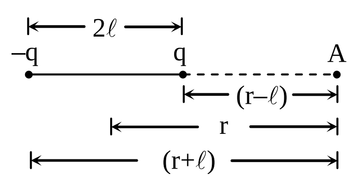
Sol.10



$d^2 + Re^2 = (R_e + H)^2$

$d = \sqrt{2HR_e}$.

Sol.11



$$\mathbf{V_A} = \frac{kq}{r-\ell} + \frac{k(-q)}{r+\ell}.$$

Sol.13 $P = Vi = V_0 \sin\omega t \, i_0 \sin\left(\omega t - \frac{\pi}{2}\right)$

$= V_0 \, i_0 \sin\omega t \cos\omega t$

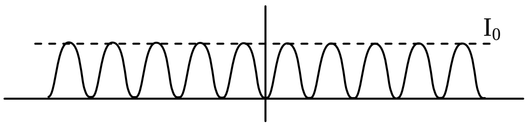
$$\langle P\rangle = \frac{\int_0^T P dt}{\int_0^T dt}.$$

Sol.14 The pattern shows a broader diffraction peak in which there appear several fringes of smaller width due to the double slit interference.

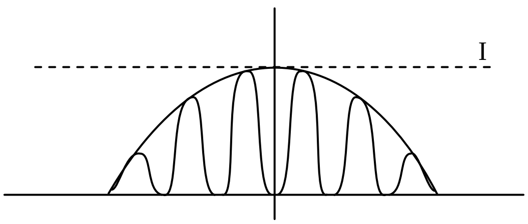
The number of interference fringes depends upon the ratio of the distance between the two slits to the width of a slit.

In the limit of width of a slit becoming very small, the diffraction pattern will become very flat and we will observe the two slit interference pattern.

(i)



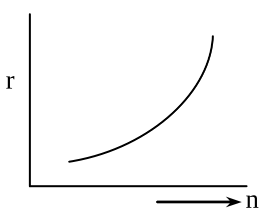
(ii)



Sol.15 $\frac{mV^2}{r} = \frac{Kq_1q_2}{r^2}$

$L = mVr = \frac{nh}{2\pi}$

$r = \frac{n^2h^2\varepsilon_0}{\pi mZe^2}$



OR

$$\nu = \frac{me^4}{(4\pi)^3\varepsilon_0^2}\left[\frac{1}{(x-1)^2} - \frac{1}{x^2}\right]$$

$$= \frac{me^4(2x-1)}{(4\pi)^3\varepsilon_0^2\left(\frac{h}{2\pi}\right)x^2(x-1)^2}$$

for large x,

$$v = \frac{me^4}{32\pi^3\varepsilon_0^2\left(\frac{h}{2\pi}\right)^3 x^2}$$

orbital frequency $v = \frac{V}{2\pi r}$

where $V = \frac{nh}{2\pi mr}$

and $r = \frac{4\pi\varepsilon_0\left(\frac{h}{2\pi}\right)^2 x^2}{me^2}$

This leads to

$$v = \frac{me^4}{32\pi^3\varepsilon_0^2\left(\frac{h}{2\pi}\right)^3 x^3}$$

which is same as v for large x.

Sol.16

(i) The resultant intensity, at any point on the screen, is given by

$I = 4I_0 \cos^2\frac{\phi}{2}$

For constructive interference

$\phi = 0, 2\pi, 4\pi$ and so on

For destructive interference

$\phi = \pi, 3\pi, 5\pi$ and so on

$\Rightarrow I = 0$ for minimum intensity,

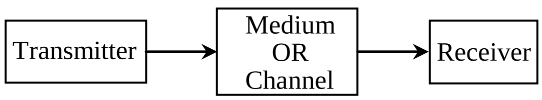
and $I = 4I_0$ for maximum intensity

Thus, intensity varies between zero and four times the intensity, due to each slit, in Young's double slit experiment.

(ii) The interference pattern due to different colours of white light overlap incoherently. The central bright fringes for different colours are at the same position. Therefore the central fringe is white and the fringes closest, on either side of central white fringe, are red and the farthest will appear blue. After a few fringes no clear fringe pattern is seen.

(iii) A polaroid consists of a long chain of molecules aligned in a particular direction. The electric vector (associated with the propagating light wave) along the direction of the aligned molecules get absorbed. Thus, if the light, from an ordinary source, passes through a polaroid, it is observed that its transmitted intensity gets reduced by half.

Sol.17

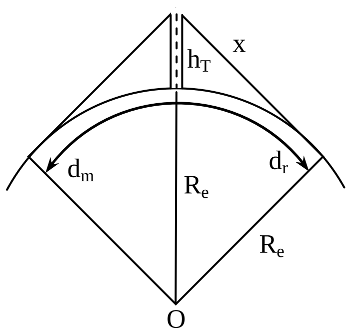


Two basic modes of transmission are (i) point-to-point and (ii) broad cast mode.

Point-to-point mode is used for Telephonic communication.

OR

No, it is not necessary to have the same height.



For transmitting antenna of height h_r,

$(h_r + R_e)^2 = x^2 + R_e^2$

$\because h_r << R_e \qquad \therefore x = d_T$

or $(h_T + R_e)2 = d_T^2 + R_e^2$

$h_T^2 + R_e^2 + 2h_TR_e = d_T^2 + R_e^2$ (h_T^2 is negligible)

$\Rightarrow d_T = \sqrt{2R_eh_T}$

d_T is also called the radio horizon of the transmitting antenna.

The maximum line-of-sight distance d_m between the two antennae is

$d_m = \sqrt{2R_eh_T} + \sqrt{2R_eh_R}$

where h_R is the height of the receiving antenna

(c) Curiosity, power of observation.

Sol.18 $v_d = \frac{e\tau}{m}E$

$i = neA\left(\frac{e\tau}{m}E\right)$

$i = neA\left(\frac{e\tau}{m}\frac{V}{\ell}\right)$

$V = \frac{m\ell}{ne^2\tau A} = \rho\frac{\ell}{A}$

$\therefore \rho = \frac{m}{ne^2\tau}$

Sol.19 (i) $\frac{\varepsilon_1}{\varepsilon_2} = \frac{\ell_1}{\ell_2}$;

$\varepsilon_2 = \frac{\ell_2}{\ell_1}.\varepsilon_1$ (put the values)

$\varepsilon_2 = 2$ volt

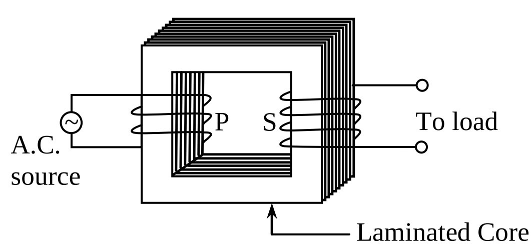
(ii) No

(iii) No

Sol.20 $\phi = BA\cos\theta$

SI unit $\rightarrow$ Weber.

Sol.21 Principle : It is a device which converts high voltage A.C. into low voltage A.C. and vice versa.



$\therefore \quad V_1 = -N_1 \dfrac{d\phi}{dt}$

and $V_2 = -N_2 \dfrac{d\phi}{dt}$

$\therefore \quad \dfrac{V_2}{V_1} = \dfrac{N_2}{N_1}$.

Sol.22 Characteristics of electromagnetic waves.

(I) They do not require any material medium for their propagation

(II) The oscillations of $\vec{E}$ and $\vec{B}$ are perpendicular to each other and are in same phase

(III) They are transverse in nature

(IV) They travel through vacuum with same speed, $c = 3 \times 10^8\ ms^{-1}$.

(i) Radiowaves are used

(a) in radiotransmission

(b) in radioastronomy

(ii) Microwaves are used

(a) in microwave-ovens

(b) in radar systems

Sol.23 (a) The metal detector works on the principle of resonance in ac circuit.

(b) When Sunita's friend is passed through a metal detector, her friend in fact, passing through a coil of many turns. The coil is connected to a capacitor tuned so that the circuit is in resonance. When she walk through the metal in her pocket, the impedance of the circuit changes-resulting in significant change in current in the circuit. The change in current is detected and the electric circuitry causes a sound to be emitted as an alarm.

Sol.25 (a) $\phi = \int \vec{E}.\vec{ds}$.

(b) (i) $\phi = -E_1.a^2 + E_2.a^2 = a^2 (E_2 - E_1)$

(ii) $\phi = \dfrac{q_{in}}{\epsilon_0}$

$\therefore q_{in} = a^2 \epsilon_0 (E_2 - E_1)$

Sol.26 $\phi = BA \cos \omega t$

$\varepsilon = -N \dfrac{d\phi}{dt} = NAB\omega \sin \omega t$

$\therefore \varepsilon = \varepsilon_{max} \sin \omega t$

where $\varepsilon_{max} = NAB\ \omega$.