Shri Shankaracharya Institute of Professional Management & Technology, Raipur

April-May-2021- Class Test-1 (July-2021)

Date: 08/07/2021

Student Name: V OM SAI NAGESHWAR SHARMA

Roll No.: 3 0 3 3 0 2 2 2 0 0 2 0

Enrollment No.: B J 4 5 9 9

Course: B.Tech **Semester:** 2nd

Branch: COMPUTER SCIENCE AND ENGINEERING

Subject Name: PHYSICS - I

Subject Code: A 0 0 0 1 1 1 (0 1 5)

Mobile No.: 8602727389

Email id: om.sharma@ssipmt.com

Signature:

Unit - I

Q1>

Sol → (a) 55 eV to Joule (J)

$1\ eV = 1.6 \times 10^{-19}\ J$

$55\ eV = 55 \times 1.6 \times 10^{-19}\ J$

$= 88 \times 10^{-19}\ J$

$= \underline{8.8 \times 10^{-18}\ J}$ Ans

(b) 3.26 Ly (Light year) = 1 par sec.

$1\ Ly = \frac{1}{3.26}$ par sec

$\boxed{1\ Ly = 0.305 \text{ par sec}}$ Ans

(c) $0.02340\ Nm^{-1}$

=> It has 4 significant figures because zero(s) after decimal & before decimal (no. less than 1) will not be significant. And in decimal terminal zero will be significant.

(d) 1 inch = 2.54 cm.

$1\ \text{inch}^3 = 2.54^3\ \text{cm}^3 = 16.387\ \text{cm}^3$

Therefore 1.84 cubic inches is $1.84 \times 16.387\ \text{cm}^3$ or 30.152

$2.54\ \text{cm} = 0.0254$ m.

$(0.0254\ \text{m})^3 = 0.000016387064\ \text{m}^3$.

Therefore 1.84 cubic inches $= 1.84 \times 0.000016387064\ \text{m}^3$

$= 0.000030152197776\ \text{m}^3$

Ans

Q2>

Sol→(i) Position vector:

Consider a particle moving in the xy plane. Suppose at any instant of time t it is at the point P. Let x and y be the cartesian coordinates of point P at that time. Then,

$$x = OQ \quad \text{and} \quad y = QP \qquad -(1)$$

If $\hat{i}$ and $\hat{j}$ are the unit vectors along the positive x and y directions respectively, then,

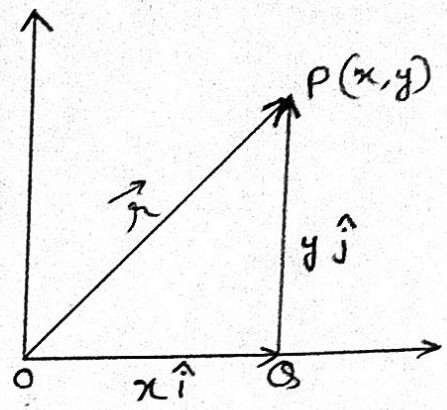
$$\overrightarrow{OQ} = OQ\,\hat{i} = x\,\hat{i} \quad -(2)$$

$$\overrightarrow{QP} = QP\,\hat{j} = y\,\hat{j} \quad -(3)$$

From the triangle OQP, we can write

$$\overrightarrow{OP} = \overrightarrow{OQ} + \overrightarrow{QP} \quad -(4)$$

$$\overrightarrow{OP} = x\,\hat{i} + y\,\hat{j} \quad -(5)$$



But $\overrightarrow{OP} = \vec{r}$ is the instantaneous position vector of the particle. Thus, the position vector of a particle in two dimensional cartesian coordinates is,

$$\vec{r} = x\,\hat{i} + y\,\hat{j} \quad -(6)$$

The magnitude of the position vector of ~~the particle. Thus the~~ p is given by,

$$|\vec{r}| = r = \sqrt{x^2 + y^2}$$

In three dimension, the position vector $\vec{r}$ is represented as,

$$\boxed{\vec{r} = x\,\hat{i} + y\,\hat{j} + z\,\hat{k}}$$

Velocity: The velocity of a particle is defined as the time rate of change of its position vector. Hence,

$$\vec{v} = \frac{d\vec{r}}{dt} = \frac{d}{dt}[x\hat{i} + y\hat{j}] \quad -(7)$$

or,
$$\vec{v} = \frac{dx}{dt}\hat{i} + \frac{dy}{dt}\hat{j} = \dot{x}\hat{i} + \dot{y}\hat{j} \quad -(8)$$

$$\frac{dx}{dt} = \dot{x} \quad \text{and} \quad \frac{dy}{dt} = \dot{y}$$

Acceleration: The acceleration $\vec{a}$ of a particle is defined as the time rate of change of its velocity vector. Therefore,

$$\vec{a} = \frac{d\vec{v}}{dt} = \frac{d}{dt}(\dot{x}\hat{i} + \dot{y}\hat{j}) \quad -(9)$$

$$\vec{a} = \ddot{x}\hat{i} + \ddot{y}\hat{j} \quad -(10)$$

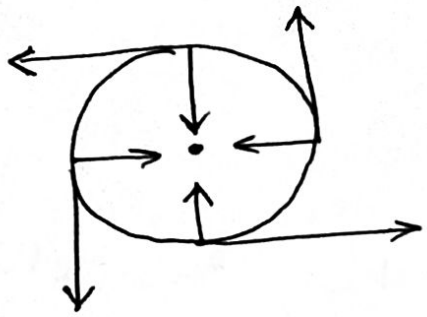
where, $\ddot{x} = \frac{d^2x}{dt^2}$ and $\ddot{y} = \frac{d^2y}{dt^2}$

Position vector: Straight line having one end fixed to a body and the other end attached to a moving point and used to describe the position of point relative to the body.

(ii) Uniform circular motion:

★ Uniform circular motion can be described as the motion of an object in a circle at a constant speed.

★ As an object moves in a circle, it is constantly changing its direction.



$$a = \frac{mv^2}{R}, \quad v = R\omega, \quad T = \frac{2\pi}{\omega}$$

$$a = \frac{mv^2}{R}$$

$$= \frac{m(R^2\omega^2)}{R}$$ $\left[\because v = R\omega\right]$

$$= mR\omega^2$$

$$= mR\left(\frac{2\pi}{T}\right)^2$$ $\left[\because T = \frac{2\pi}{\omega} \Rightarrow \omega = \frac{2\pi}{T}\right]$

$$= mR\left(\frac{4\pi^2}{T^2}\right)$$

$$\boxed{a = \frac{4\pi^2 mR}{T^2}}$$

Q4)

Sol^n → (ii) Given: $V = 28\ m/s$

$\theta = 30^\circ$

~~And,~~

And; $\phi = 2\theta = 2(30^\circ) = 60^\circ$

(a) Maximum height (H) = $\frac{V^2 \sin^2\theta}{2g}$

$= \frac{28 \times 28 (\sin 30)^2}{2 \times 9.8}$

$= 10\ m.$

(b) Time taken to return to same level

$T = \frac{2v \sin\theta}{g}$

$= \frac{2 \times 28 \times \sin 30}{9.8}$

$= \frac{2 \times 28 \times 1}{9.8 \times 2}$

$= 2.9\ sec.$

(c) Distance from thrower to where ball returns,

$d = \frac{v^2 \sin^2 2\theta}{g}$

$= \frac{28 \times 28 \times \sin 60}{9.8}$

$= \underline{69.3\ m.}$

(i) $V_a \rightarrow$ velocity of aircraft relative to air = 280 km/h

$\vec{V_w} \rightarrow$ velocity of wind = 90 km/h

$\vec{V} \rightarrow$ velocity relative to earth

$$\vec{V} = \vec{V_a} + \vec{V_w}$$

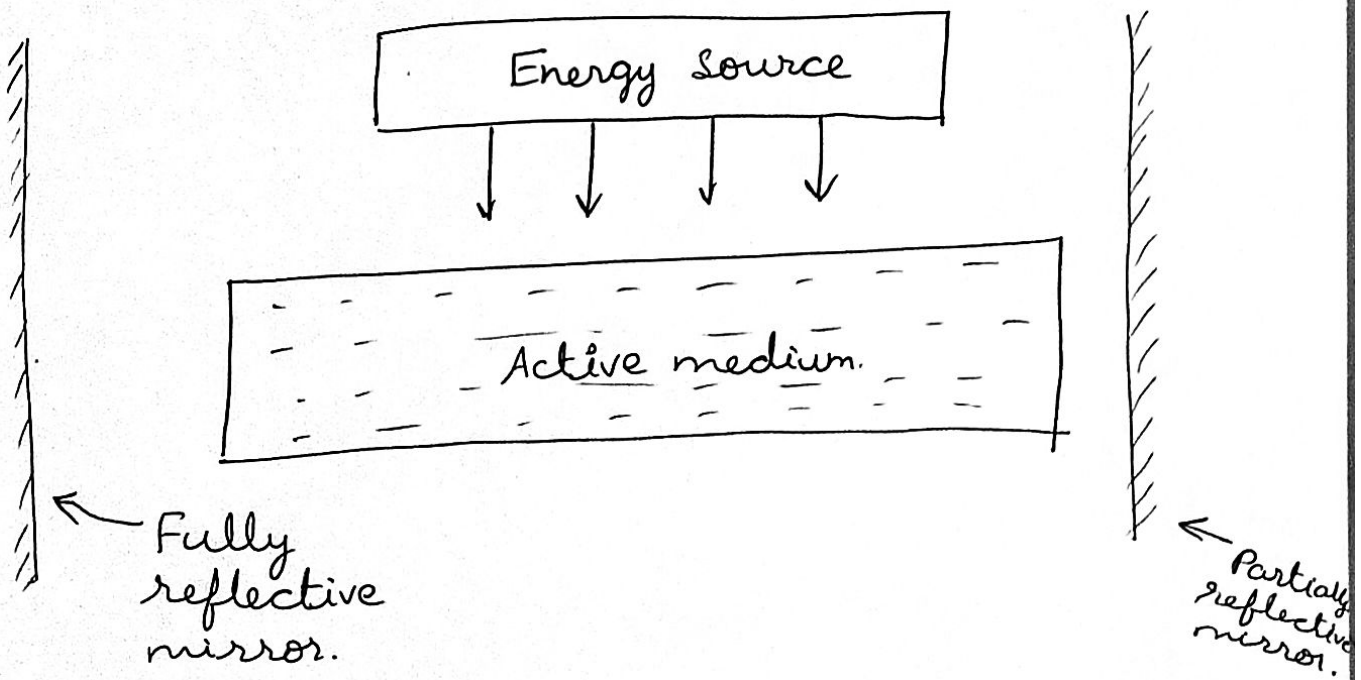
$$\Rightarrow \quad V = \sqrt{V_a^2 + V_w^2} = \sqrt{(280)^2 + (90)^2}$$

$$= 294.1 \text{ km/h}$$

Unit - II

Q1)

Ans → **Optical Resonator:** It essentially consists of two mirrors facing each other. The active medium is enclosed by this cavity. One of the mirror is fully reflective while other mirrors partially transparent. The optical cavity is made use of to make simulated emission possible in more no. of atoms in the active medium. This naturally increases the intensity of the laser beam.

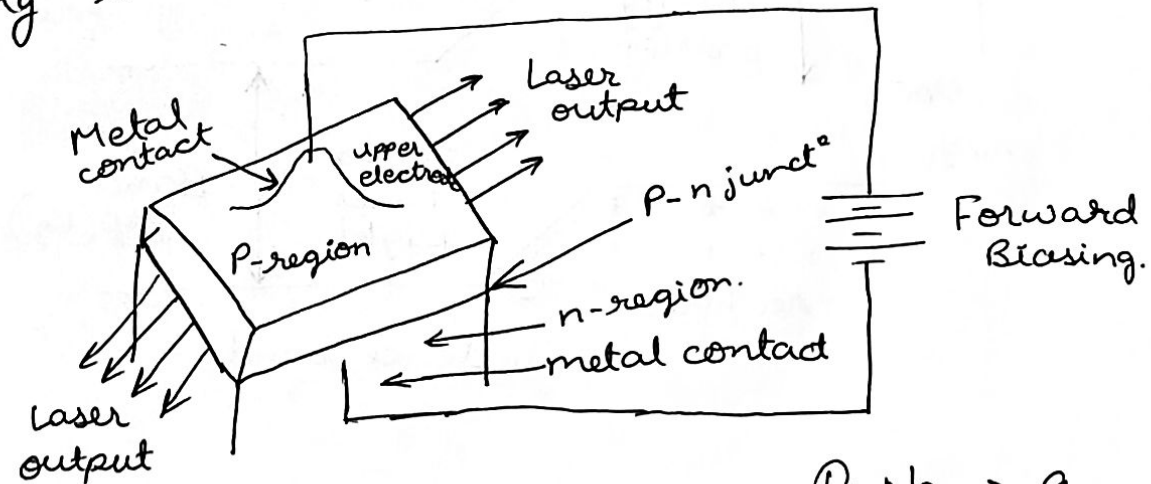


Population Inversion: It is the redistributio of atomic energy levels that takes place in a system so that laser action can occur. Normally, a system of atoms is in temperature equillibrium and there are always more atoms in low energy states than in higher ones. Although absorption and emission of energy is a continuous process, the statistical distribution (population) of atoms in the various energy states is constant.

Q3>

Ans => **Semiconductor Laser:**

The active medium is a p-n junction diode made from the single crystal of gallium arsenide. This crystal is cut in the form of a pletter having thickness of 0.5 mm.



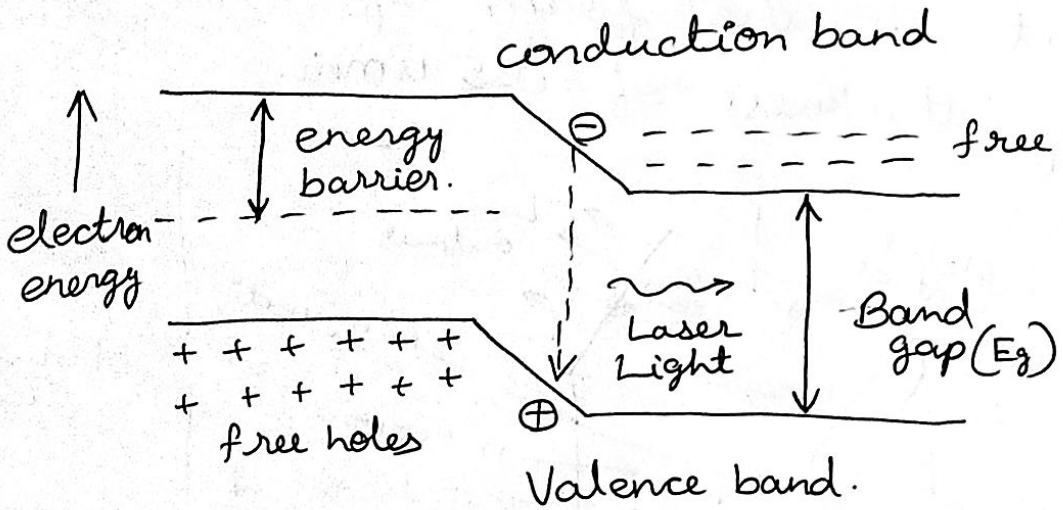
The pallet consists of two parts having an electron conductivity (n-type) and hole conductivity (p-type).

The photon emission is stimulated in a very thin layer of PN junction (in order of few microns). The electrical voltage is applied to the crystal through the electrode fixed on the upper surface.

The end faces of the junction diode are well polished and parallel to each other. They act as an optical resonator through which the emitted light comes out.

Working:

Figure shows the energy level diagram of semiconductor laser.



When the PN junction is forward biased with large applied voltage, the electrons and holes are injected into junction region in considerable concentration.

The region around the junction contains a large amount of electrons in the conduction band and a large amount of holes in the valence band.

After gaining enough strength, it gives out the laser beam of wavelength 8400 Å. The wavelength of laser light given by.

$$E_g = h\nu = h\frac{c}{\lambda}$$

$$\lambda = \frac{hc}{E_g}$$

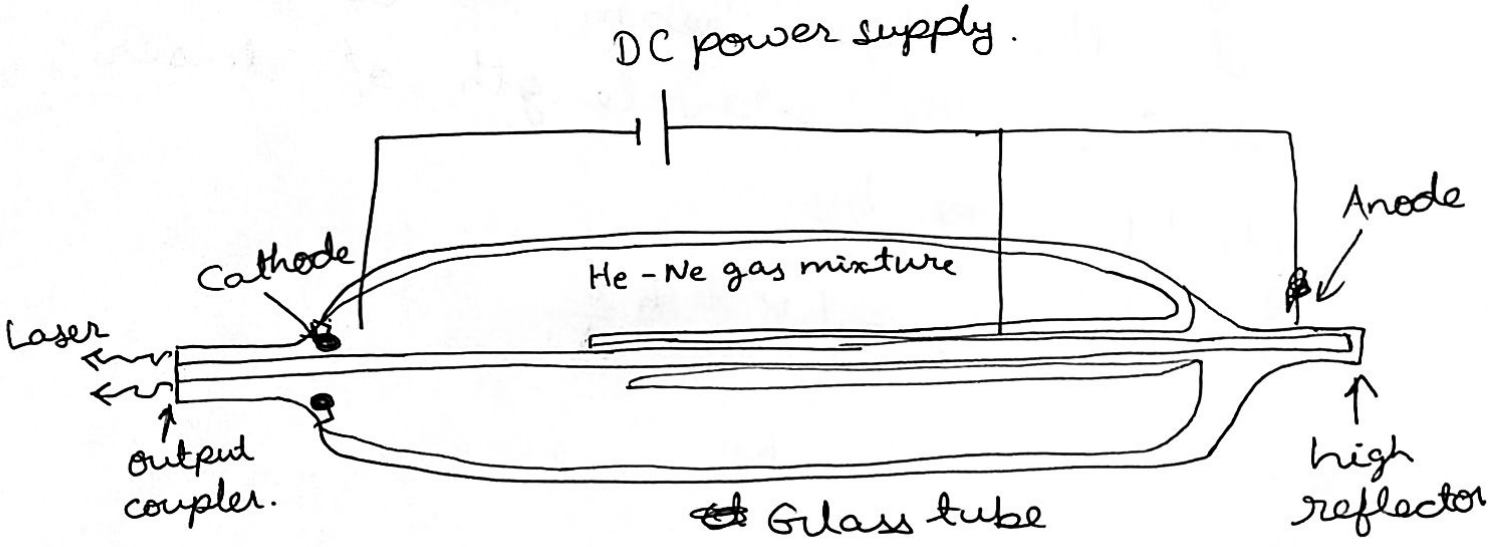
Where E_g is the band gap energy in joule.

Q4>

Ans=> He-Ne Laser construction:

The helium-neon laser consists of three essential components:

- ☆ Pump source (high voltage power supply)
- ☆ Gain medium (Laser glass ~~tay~~ tube or discharge glass tube).
- ☆ Resonating cavity.



Pump Laser: In order to produce the laser beam, it is essential to achieve population inversion. Population inversion is the process of achieving more electros in the higher energy state as compared to the lower energy state.

☆ Gain medium: The gain medium of a helium-neon laser is made up of the mixture of He and Ne gas contained in a glass tube at low pressure. The partial pressure of He is 1 mbar whereas that of neon is 0.1 mbar.

☆ Resonating cavity:

The glass tube is placed between two parallel mirrors. These two mirrors are silvered or optically coated.

The fully silvered mirror will completely reflect the light where as the partially silvered mirror will reflect the most part of light but allows some part of the light to produce the laser beam.

☆ Working of He-Ne Laser:

It is a four energy level laser system. The electrons produce from electric discharge collide with He and Ne atom and excite them to the higher energy levels He_2 and Ne_4 at 20.61 eV and 20.66 eV respectively.

These two states are metastable so that the atoms may stay there for a longer time.

They are very close to each other thus some of the atoms at He_2 states may transfer their energy to ground state Ne atoms through collisions and excite them to higher energy level Ne_4. ~~This~~

Thus, He atoms help to achieve population inversion in Ne atoms.