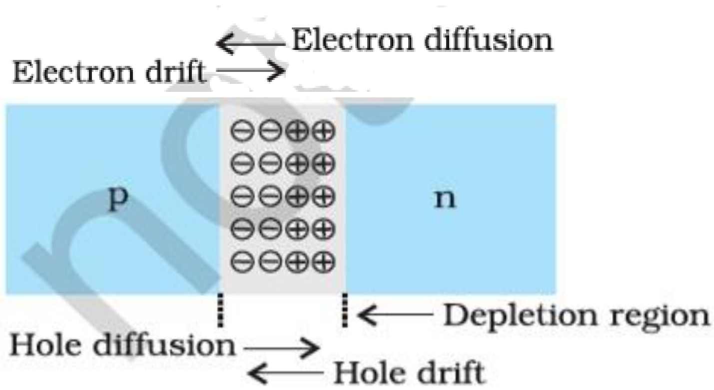
MS – SET 55/3/1

1	<u>Doping:</u> The deliberate addition of a desirable impurity is called doping. Types of atoms: 1. Pentavalent – Phosphorus (P) and 2. Trivalent – Boron (B)	½ ½
2	(a) (i) Isotopes<u>:</u> The nuclides having same number of protons (Z) but differing in mass number A are called isotopes. <u>Isobars:</u> All nuclides with same mass number A are called isobars. (ii) Not Necessarily, For different values of mass number (A), we can have different values of Atomic Number (Z). For example: $^{6}_{3}Li$ and $^{4}_{2}He$; they have different A and Z. OR (b) (i) Factors: 1.Work function of the metal 2. frequency of incident radiations (ii) it is the minimum frequency of incident radiation below which no photoelectric emission can take place.	½ ½ 1 1 1
3	 Due to the diffusion of electrons and holes, from their majority zone to minority zone, a layer of positive and negative space charge region on either side of the junction is formed. This is called the depletion region or layer. The loss of electrons, from n-region and gain of electrons by the p-region, causes a difference of potential across the junction. This tends to prevent the movement charge carriers across the junction and is, therefore, termed as barrier potential.	½ ½ 1 1
4	Bohr's postulate: (i) Bohr's first postulate was that an electron in an atom could revolve in certain stable orbits without the emission of radiant energy. (ii) Quantization of angular momentum: This postulate states that the electron revolves around the nucleus only in those orbits for which the angular momentum is some integral multiple of h/2π where h is the Planck's constant (= 6.6×10^{-34} J s). That is L = nh/2π (iii) When an electron makes a transition from one of its specified non-radiating orbits to another of lower energy, a photon is emitted having energy equal to the energy difference between the initial and final states. $h\nu = E_i - E_f$ Electrons are revolving around the nucleus because of centripetal force which is provided by electrostatic attraction between electron and positive nucleus	 1

$$\frac{mv^2}{r} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{(Ze) \times e}{r^2}$$

$$r = \frac{kZe^2}{mv^2}$$ ....(1) 1

According to quantization of angular momentum

$$mvr = \frac{nh}{2\pi}$$

$$r = \frac{nh}{2\pi mv}$$ ....(2)

From equation (1) and (2)

$$\frac{kZe^2}{mv^2} = \frac{nh}{2\pi mv}$$

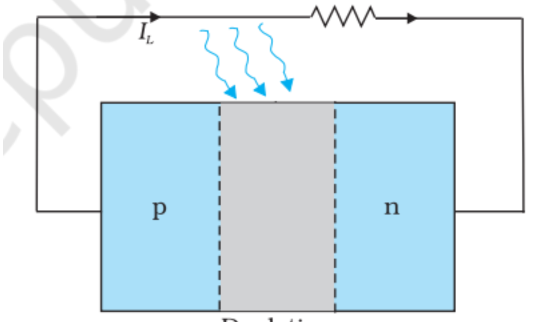
$$v = \frac{2\pi kZe^2}{nh}$$

All other values are constant except n

Hence

$$v \propto \frac{1}{n}$$ where n = principal quantum number 1

5



Working:

The generation of emf by a solar cell, when light falls on, it is due to the following three basic processes:

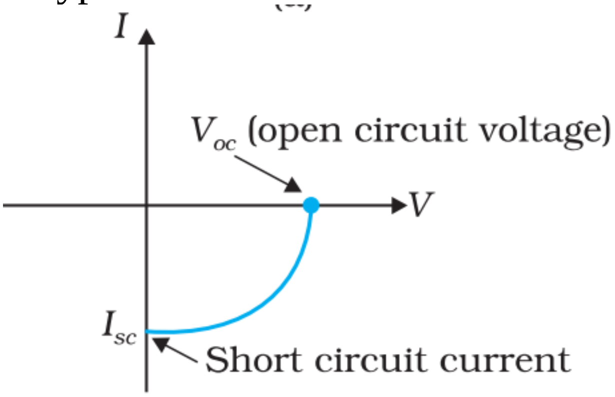
(i) **Generation :** Generation of e-h pairs due to light (with $h\nu > E_g$) close to the junction.

(ii) **Separation:** Separation of electrons and holes due to electric field of the depletion region. Electrons are swept to n-side and holes to p-side; 2

(iii) **Collection:** The electrons reaching the n-side are collected by the front contact and holes reaching p-side are collected by the back contact. Thus p-side becomes positive and n-side becomes negative giving rise to *photo-voltage*.

When an external load is connected as shown a photocurrent I_L flows through the load.

A typical *I-V* characteristics of a solar cell is shown in figure.



[Image source: NCERT textbook grade XII]

1

6 Energy of proton E = 4.1 MeV = 4.1 x 10^6 eV

(i) Speed of the proton = kinetic energy of proton = $\frac{1}{2}mv^2$

$$4.1 \times 10^6 \times 1.6 \times 10^{-19} = \frac{1}{2}mv^2$$

$$\frac{2 \times 4.1 \times 10^6 \times 1.6 \times 10^{-19}}{m} = v^2$$

$$v = \sqrt{\frac{2 \times 4.1 \times 10^6 \times 1.6 \times 10^{-19}}{m}}$$

$$v = \sqrt{\frac{2 \times 4.1 \times 10^6 \times 1.6 \times 10^{-19}}{1.6 \times 10^{-27}}}$$

$$v = 2.8636 \times 10^7 \text{ m/s}$$

1½

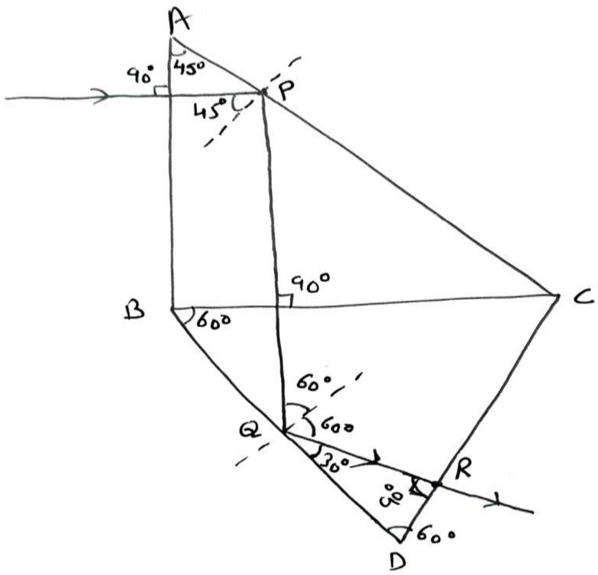
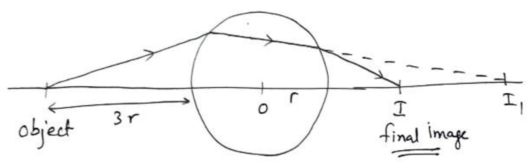
(ii) K.E. = P.E.

K.E. = $\frac{2kZe^2}{r}$

$$r = \frac{2kZe^2}{K.E.}$$

$$r = \frac{2 \times 9 \times 10^9 \times 82 \times (1.6 \times 10^{-19})^2}{4.1 \times 10^6 \times 1.6 \times 10^{-19}}$$

r = 576 x 10^{-16} m

	$r = 5.76 \times 10^{-14}$ m	1½
7	(I) $angular\ width\ of\ central\ maximum = \frac{2\lambda}{a}$ $\lambda_{orange} > \lambda_{green}$ Hence angular width of central maximum will increase. (II) $angular\ width\ of\ central\ maximum = \frac{2\lambda}{a}$ It does not depend of distance between slit and screen hence no change in angular width. (III) $angular\ width\ of\ central\ maximum = \frac{2\lambda}{a}$ If Slit width a *is decreased then* Angular width of central maximum will increase.	1 1 1
8	(a) 1. Light rays must travel from denser medium to rarer medium 2. angle of incidence must be greater than critical angle (b) For surface AC: at point P, $i > i_c$; hence ray will suffer total internal reflection. For surface BD: at point Q; again $i > i_c$; hence ray will suffer total internal reflection. For surface DC: ray will be normal to DC.  OR (c) (i) for negative: object should be placed at any point beyond focus (F). (ii) for positive: object should be placed between focus (F) and optical center. (b)  	½ ½
9	(i) $\lambda = \frac{12.27}{\sqrt{V}} \dot{A} = \frac{12.27}{\sqrt{100}} \dot{A} = 1.227\ \dot{A}$ (ii) Momentum, $p = h/\lambda = \frac{6.63 \times 10^{-34}}{0.1227 \times 10^{-9}}$ kg-ms^{-1} = 54.03×10^{-25} kg-ms^{-1}.	1 1

	Velocity acquired, $v = \frac{h}{m\lambda} = \frac{h}{\lambda} \times \frac{1}{m} = 54.03 \times 10^{-25} \times \frac{1}{9.1 \times 10^{-31}} = 5.937 \times 10^{6}$ m/s.	1
10	(i) $\beta = \lambda D/d = (600 \times 10^{-9} \times 1.6)/(0.8 \times 10^{-3}) = 1.2 \times 10^{-3}$ m = 1.2 mm.	1
	(ii) (a) Distance of third minimum, $y_3 = (n - ½) \lambda D/d = (3 - ½) \times 1.2$ mm = 3 mm.	1
	(b) Distance of the fifth maximum, $y_5 = n \lambda D/d = 5 \times 1.2$ mm = 6 mm.	1

11.

(a)

(i)

	Marks
Radar Systems- Microwave	½
Water purifiers- Ultra Violet Radiations (UV)	½
Remote switches of TV- Infrared Radiations (IR)	½

(ii)

Radiations	Source	Marks
Microwave	Klystron valve	½
Ultra Violet Radiations (UV)	Inner shell electrons in atoms moving from one energy level to another	½
Infrared Radiations (IR)	Oscillating atoms and molecules.	½

OR

(i) Two conditions for two light sources to be coherent:

- Same frequency. ½
- Constant (or zero) phase difference. ½
- Or any other valid reason.

(ii)

S.N.	Interference	Diffraction	Marks
1.	The interference pattern has number of equally spaced bright and dark bands.	The diffraction pattern has a central bright maximum which is twice as wide as the other maxima.	1
2.	Interference pattern is due to superposition two waves originating from the two narrow slits.	The diffraction pattern is a superposition of a continuous family of waves originating from each point of a wavefront from a single slit.	1
3.	At the same angle of λ/a, we get a maximum (not a null) for two narrow slits separated by a distance a.	For a single slit of width a, the first null of the interference pattern occurs at an angle of λ/a.	1

Note: Any two difference.

12.

			Marks
I	B	Real, Virtual	1
II	A	The aperture of the objective and the eye-piece.	1
III	D	The microscope can be used as a telescope by interchanging the two lenses.	1
IV	D	200	1
V	C	200	1