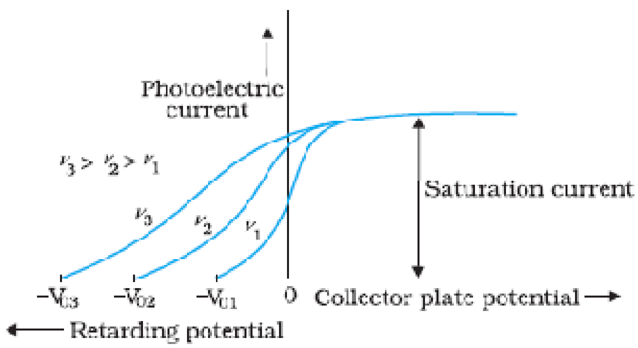
Q18

(a) Identification of X	½
(b) Identification of point A	½
(c) Graph for three different frequencies	1
(d) Graph for three different intensities.	1

a) X is collector plate potential. ½

b) A is stopping potential. ½

c) Graph for different frequencies



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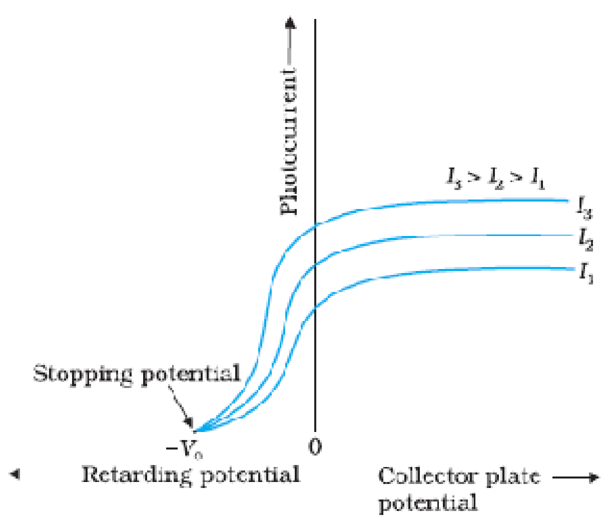
d) Graph for three different Intensities



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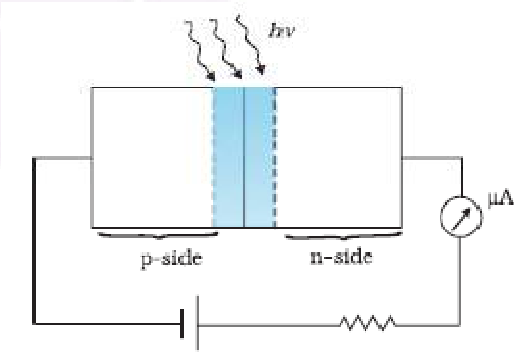
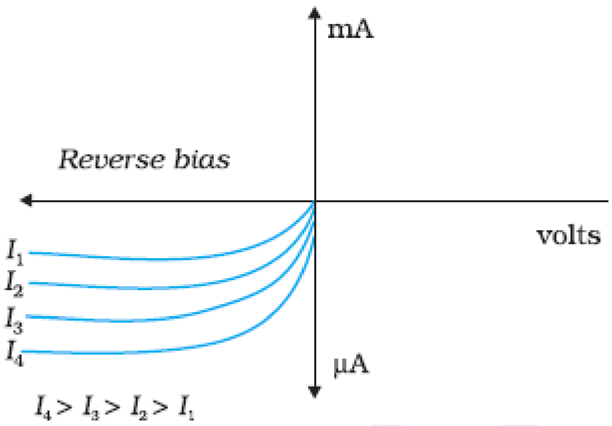
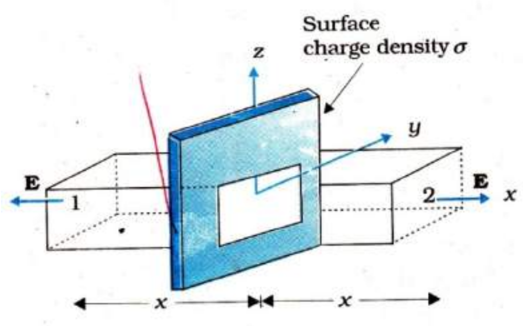
3

Q19	Formula for energy stored ½ Energy stored before 1 Energy stored after 1 Ratio ½		
	Energy stored = $\frac{1}{2}CV^2$ $\left(= \frac{1}{2}\frac{Q^2}{C}\right)$	½	
	Net capacitance with switch S closed $= C + C = 2C$	½	
	$\therefore$ Energy stored $= \frac{1}{2} \times 2C \times V^2 = CV^2$	½	
	After the switch S is opened, capacitance of each capacitor$= KC$		
	$\therefore$ Energy stored in capacitor A $= \frac{1}{2}KCV^2$		
	For capacitor B,	½	
	Energy stored $= \frac{1}{2}\frac{Q^2}{KC} = \frac{1}{2}\frac{C^2V^2}{KC} = \frac{1}{2}\frac{CV^2}{K}$		
	$\therefore$ Total Energy stored $= \frac{1}{2}KCV^2 + \frac{1}{2}\frac{CV^2}{K} = \frac{1}{2}CV^2\left(K + \frac{1}{K}\right)$ $= \frac{1}{2}CV^2\left(\frac{K^2+1}{K}\right)$	½	
	$\therefore$ Required ratio $= \frac{2CV^2.K}{CV^2(K^2+1)} = \frac{2K}{(K^2+1)}$	½	3
Q20	Formula for energy stored ½ Energy stored before 1 Energy stored after 1 Ratio ½		
	Energy stored = $\frac{1}{2}CV^2$ $\left(= \frac{1}{2}\frac{Q^2}{C}\right)$	½	
	Net capacitance with switch S closed $= C + C = 2C$	½	
	$\therefore$ Energy stored $= \frac{1}{2} \times 2C \times V^2 = CV^2$	½	
	After the switch S is opened, capacitance of each capacitor$= KC$		

	$\therefore$ Energy stored in capacitor A = $\frac{1}{2}KCV^2$ For capacitor B, Energy stored $= \frac{1}{2}\frac{Q^2}{KC} = \frac{1}{2}\frac{C^2V^2}{KC} = \frac{1}{2}\frac{CV^2}{K}$ $\therefore$ Total Energy stored $= \frac{1}{2}KCV^2 + \frac{1}{2}\frac{CV^2}{K} = \frac{1}{2}CV^2\left(K + \frac{1}{K}\right)$ $= \frac{1}{2}CV^2\left(\frac{K^2+1}{K}\right)$ $\therefore$ Required ratio $= \frac{2CV^2.K}{CV^2(K^2+1)} = \frac{2K}{(K^2+1)}$	½ ½ ½	3
Q21	a) Correct Choice of *R* ½ Reason ½ b) Circuit Diagram **1** Working ½ *I-V* characteristics ½ a) R would be increased. Resistance of S (a semi conductor) decreases on heating. b) Photodiode diagram  When the photodiode is illuminated with light (photons) (with energy $(h\nu)$ greater than the energy gap (E_g) of the semiconductor), then electron-hole pairs are generated due to the	½ ½ 1	

	absorption of photons. Due to junction field, electrons and holes are separated before they recombine. Electrons are collected on n-side and holes are collected on p-side giving rise to an emf. When an external load is connected, current flows.	½	
	V-I Characteristics of the diode  	½	**3**
Q22	(a) Statement of Biot Savart law — 1 Expression in vector form — ½ (b) Magnitude of magnetic field at centre — 1 Direction of magnetic field — ½		
	(a) It states that magnetic field strength, $d\vec{B}$, due to a current element, $Id\vec{l}$, at a point, having a position vector **r** relative to the current element, is found to depend (i) directly on the current element, (ii) inversely on the square of the distance |**r**| , (iii) directly on the sine of angle between the current element and the position vector **r**.	**1**	
	In vector notation, $$\overrightarrow{dB} = \frac{\mu_0}{4\pi}\frac{Id\vec{l} \times \vec{r}}{\|\vec{r}\|^3}$$ **Alternatively**, $$\left(d\vec{B} = \frac{\mu_0}{4\pi}\frac{Id\vec{l} \times \hat{r}}{\|\vec{r}\|^2}\right)$$	½	

	a)		
		½	
	$$\oint E.ds = \frac{q}{\varepsilon_0}$$	½	
	The electric field E points outwards normal to the sheet. The field lines are parallel to the Gaussian surface except for surfaces 1 and 2. Hence the net flux = $\oint E.ds = EA + EA$ where A is the area of each of the surface 1 and 2.	1	
	$\therefore \oint E.ds = \frac{q}{\varepsilon_0} = \frac{\sigma A}{\varepsilon_0} = 2EA;$ $E = \frac{\sigma}{2\varepsilon_0}$	1	
	b)		
	$$W = q\int_{\infty}^{r} \vec{E}.d\vec{r}$$	½	
	$$= q\int_{\infty}^{r}(-Edr)$$	½	
	$$= -q\int_{\infty}^{r}\left(\frac{\sigma}{2\epsilon_0}\right)dr$$	½	
	$$= \frac{q\sigma}{2\in}\lvert\infty - r\rvert$$		
	$$\Longrightarrow (\infty)$$	½	
			5