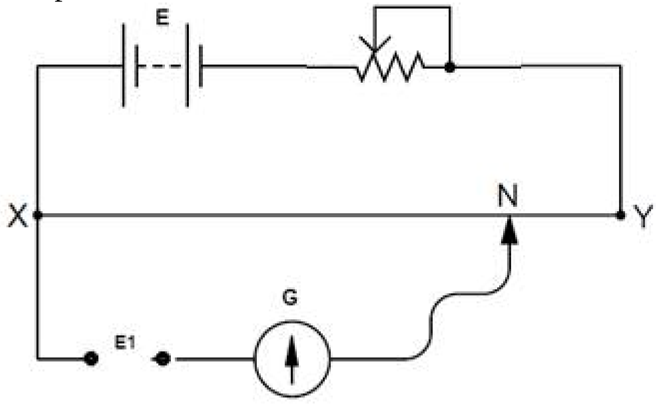
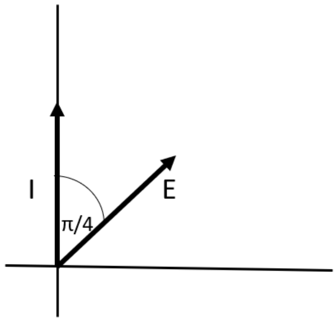
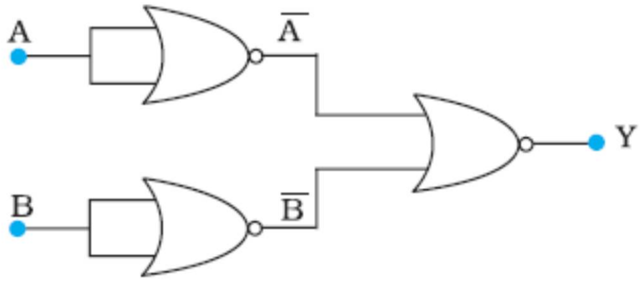
Class: XII
Physics (042)
Marking Scheme 2018-19

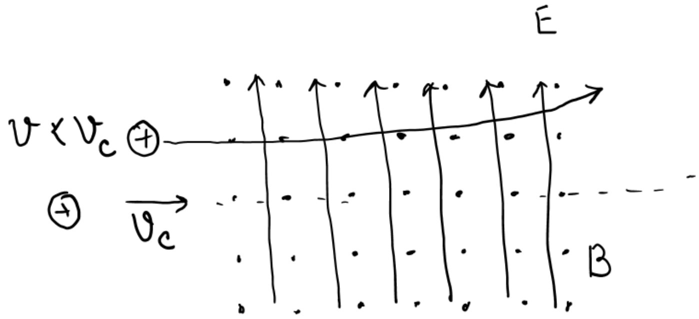
Time allowed: 3 hours | Maximum Marks: 70

Q No	SECTION A	Marks
1.	C/m^2	**1**
2.	Fractional change in resistivity per unit change in temperature.	**1**
3.	X-rays	**1**
	OR	
	Displacement current	**1**
4.	From the graph $\tan\Theta = \frac{\sin r}{\sin i}$ $\frac{\sin i}{\sin r} = \frac{v_1}{v_2}$ $\frac{v_1}{v_2} = \cot\theta$	**1/2** **1/2**
5.	$P_1 = P_2$ Ratio $\lambda 1/\lambda 2 = 1:1$	**1/2** **1/2**
	OR	
	Each photon has an energy ,$E=h.\nu$ $= (6.63 \times 10^{-34}$ J s$) (6.0 \times 10^{14}$ Hz$)$ $= 3.98 \times 10^{-19}$ J	**1/2** **1/2**
	SECTION B	
6.	Equivalent Resistance = R1.R2/ (R1+R2) +R3+ R4.R5/(R4+R5) = [(4 × 4)/(4 + 4)] +1+ [(12 × 6)/(12 + 6)] Ω = 7 Ω. **OR** $r = \frac{\varepsilon - V}{I}$ $= \frac{9\,V - 8\,V}{5\,A}$ $= 0.2\ \Omega$	**1** **1/2** **1/2** **1** **1/2** **1/2**

7.	The positive of E_1 is not connected to terminal X.  In loop PGJX, $E_1 - V_G + E_{XN} = 0$ $V_G = E_1 + E_{XN}$ $V_G = E_1 + k\,\ell$ So, V_G (or deflection) will be maximum when ℓ is maximum i.e. when jockey is touched near end Y. Also, V_G (or deflection) will be minimum when ℓ is minimum i.e. when jockey is touched near end X.	**1/2** **1/2** **1/2** **1/2**
	OR	
(a)	$X = (100 - \ell)\, R/\ell$	**1**
(b)	Balancing length will increase on increase of resistance R.	**1**
8.	Phasor diagram  Equal length of phasors current leads voltage phase difference is $\pi/4$	**1/2** **1/2** **1**
9.	(i) Radiation re-radiated by earth has greater wavelength (ii)Tanning effect is significant for direct UV radiation; it is negligible for radiation coming through the glass.	**1** **1**
10.	Angular width $2\Theta = 2\lambda/d$ Given $\lambda = 6000$ Å In Case of new λ (assumed λ' here), angular width decreases by 30% $= \left(\frac{100-30}{100}\right) 2\,\Theta$ $= 0.70\,(2\,\Theta)$	**1/2** **1/2** **1/2**

	$2\lambda'/d = 0.70 \times (2\lambda/d)$ $\therefore \lambda' = 4200$ Å	**1/2**
11.	Universal gates (like the NAND and the NOR gates) are gates that can be appropriately combined to realize all the three basic gates. 	**1** **1**
12.	Range $d = \sqrt{2hR} + \sqrt{2h_R R}$ $d = 33.9$ km	**1** **1**
	SECTION: C	
13.	From energy conservation, $U_i + K_i = U_f + K_f$ $kQq/r_i + 0 = kQq/r_f + K_f$ $K_f = kQq\,(1/r_i - 1/r_f)$	 **1/2** **1/2**
	When Q is +15 μC, q will move 15 cm away from it. Hence $r_f = 45$ cm $K_f = 9\times 10^9 \times 15 \times 10^{-6} \times 5 \times 10^{-6}\,[\,1/(30 \times 10^{-2}) - 1/(45 \times 10^{-2})]$ $= 0.75$ J	 **1/2** **1/2**
	When Q is -15 μC, q will move 15 cm towards it. Hence $r_f = 15$ cm $K_f = 9\times 10^9 \times (-15 \times 10^{-6}) \times 5 \times 10^{-6}\,[\,1/(30 \times 10^{-2}) - 1/(15 \times 10^{-2})]$ $= 2.25$ J	 **1/2** **1/2**
14.	**(a)** p_1: stable equilibrium p_2: unstable equilibrium The electric field, on either side, is directed towards the negatively charged sheet and its magnitude is independent of the distance of the field point from the sheet. For position p_1, dipole moment and electric field are parallel. For position p_2, they are antiparallel.	**1/2** **1/2+1/2**
	(b) The dipole will not be in equilibrium in any of the two positions. The electric field due to an infinite straight charged wire is non- uniform ($E \propto 1/r$). Hence there will be a net non-zero force on the dipole in each case.	**1/2** **1/2** **1/2**
15.	**(a)** Drift speed in B (n-type semiconductor) is higher Reason: $I = neAv_d$ is same for both n is much lower in semiconductors.	**1/2** **1/2**
	(b) Voltage drop across A will increase as the resistance of A increases with increase in temperature. Voltage drop across B will decrease as resistance of B will decrease with increase in temperature.	**1/2+1/2** **1/2+1/2**
16.	$\mathbf{E} = E\,\mathbf{j}$ and $\mathbf{B} = B\,\mathbf{k}$ Force on positive ion due to electric field $\mathbf{F_E} = qE\mathbf{j}$ Force due to magnetic field $\mathbf{F_B} = q\,(\mathbf{v_c} \times \mathbf{B})$	 **1/2** **1/2**
	For passing undeflected, $\mathbf{F_E} = -\mathbf{F_B}$ $qE\mathbf{j} = -q\,(\mathbf{v_c} \times B\mathbf{k})$ This is possible only if $q\mathbf{v_c} \times B\mathbf{k} = qv_cB\mathbf{j}$ or $\mathbf{v_c} = (E/B)\mathbf{i}$	 **1/2**

The trajectory would be as shown. **1/2**



Justification: For positive ions with speed $v < v_c$

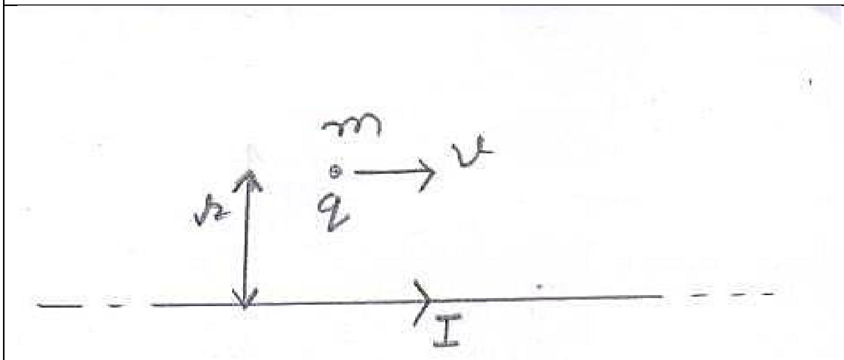
Force due to electric field = $F'_E = qE = F_E$

due to magnetic field $F'_B = qvB < F_B$ since $v < v_c$ **1/2**

Now forces are unbalanced, and hence, ion will experience an acceleration along **E**. **1/2**

Since initial velocity is perpendicular to E, the trajectory would be parabolic.

OR



1/2

For the charged particle to more undeflected

Net force $\overline{F} = \overline{F_E} + \overline{F_m} = 0$

$\grave{F}_E = - F_m$ (1)

$\overline{F_E}$ → electric force, $\overline{F_m}$ →magnetic force **1/2**

$|\overline{F_E}| = 1 - |\overline{F_m}|$ (2)

qE = Bqv sin90° = Bqv **1/2**

E = VB (3)

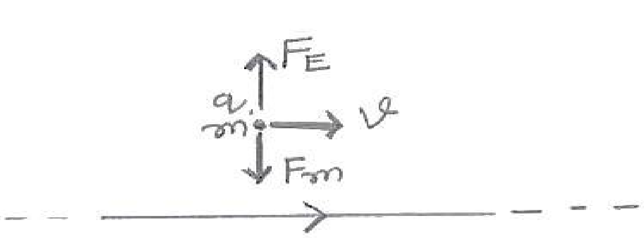
$B = \frac{MoI}{2\pi r}$ (4) **1**

Using (4) and (3)

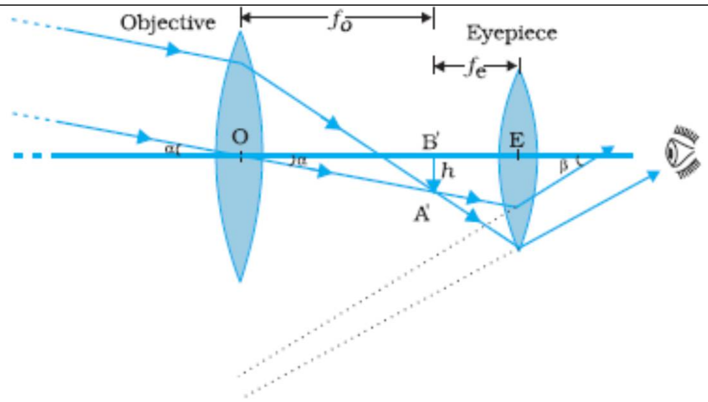
$E = \frac{VMoI}{2\pi r}$ (5) **1/2**

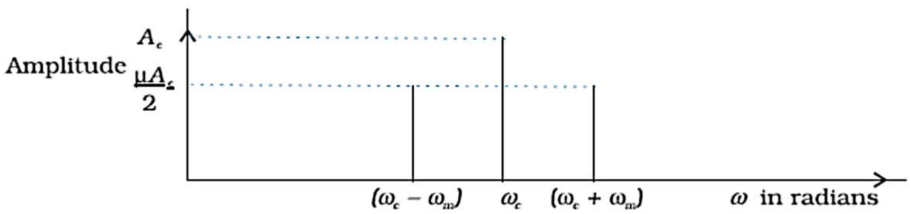
Magnetic force F_m is towards wire.

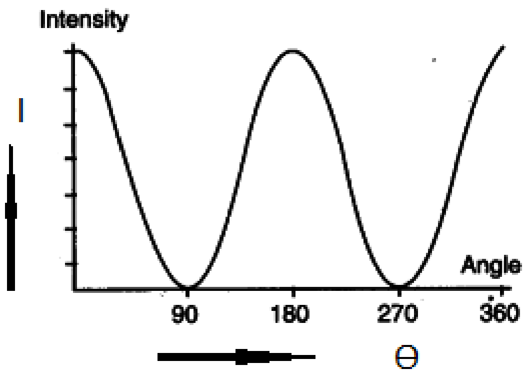
∴ Electric force and electric field should be away from the line.

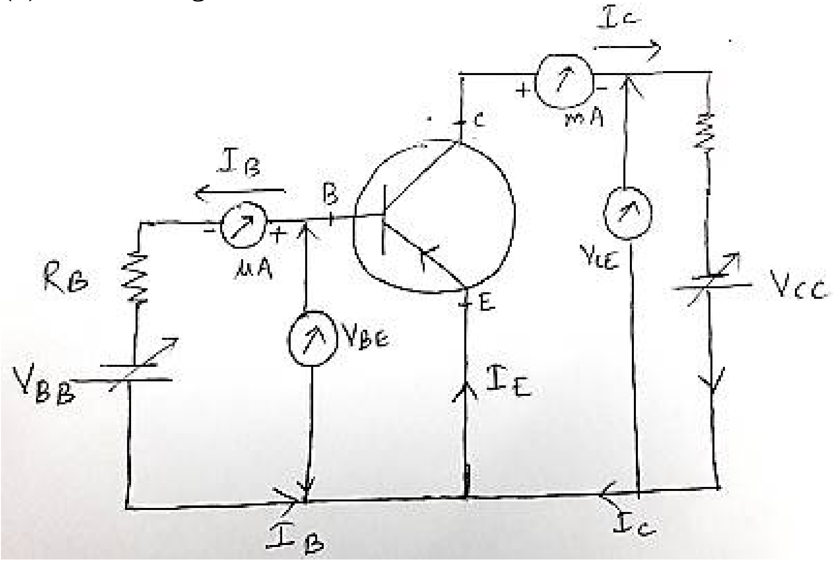
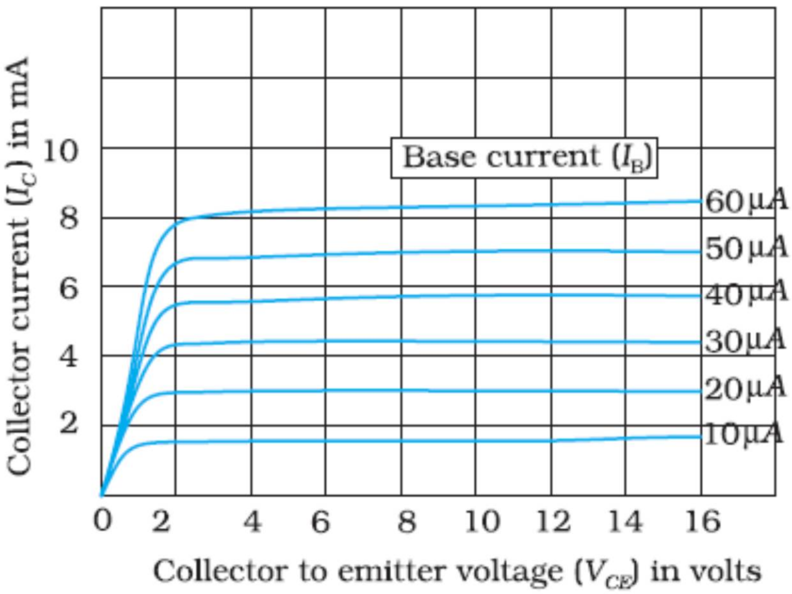


17.	$I_0 = V_0/R = 10/10 = 1$ A $\omega_r = 1/\sqrt{LC} = 1/\sqrt{(1 \times 1 \times 10^{-6})} = 10^3$ rad/s $V_0 = I_0 X_L = I_0 \omega_r L$ $= 1 \times 10^3 \times 1 = 10^3$ V $Q = \omega_r L/R$ $= (10^3 \times 1)/10 = 100$	**1/2** **1/2** **1/2** **1/2** **1/2** **1/2**
18.	**a)** Principle of transformer b) Laminations are thin, making the resistance higher. Eddy currents are confined within each thin lamination. This reduces the net eddy current. c) For maximum sharing of magnetic flux and magnetic flux per turn to be the same in both primary and secondary.	**1** **1** **1**
	OR	
	At an instant *t*, charge *q* on the capacitor and the current *i* are given by: $q(t) = q_0 \cos \omega t$ $i(t) = -q_0 \omega \sin \omega t$ Energy stored in the capacitor at time *t* is $U_E = \frac{1}{2} C V^2 = \frac{1}{2}\frac{q^2}{C} = \frac{q_0^2}{2C} \cos^2(\omega t)$ Energy stored in the inductor at time *t* is $U_M = \frac{1}{2} L i^2$ $= \frac{1}{2} L q_0^2 \omega^2 \sin^2(\omega t)$ $= \frac{q_0^2}{2C} \sin^2(\omega t) \quad (\because \omega = 1/\sqrt{LC})$ Sum of energies $U_E + U_M = \frac{q_0^2}{2C}\left(\cos^2 \omega t + \sin^2 \omega t\right)$ $= \frac{q_0^2}{2C}$ This sum is constant in time as q_0 and *C*, both are time-independent. 	**1** **1** **1**
19.	Ray diagram: (2)	

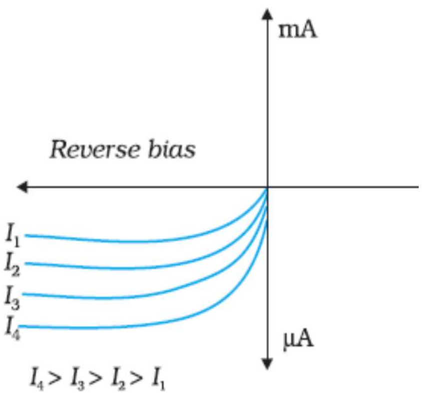
	 Drawbacks: (i)Large sized lenses are heavy and difficult to support (ii) large sized lenses suffer from chromatic and spherical aberration.	**1/2** **1/2**
	OR **(a)** Resolving power of a telescope is the reciprocal of the smallest angular separation between the two objects which can be just distinctly seen. Factors: diameter of the objective, wavelength of the incident light	**1** **1/2+1/2**
	(b) a telescope produces image of far objects nearer to our eye. Objects which are not resolved at far distance, can be resolved by telescope. A microscope, on the other hand magnifies objects nearer to us and produces their large image.	**1**
20.	Let d be the diameter of the disc. The spot shall be invisible if the incident rays from the dot at O, at the center of the disc, are incident at the critical angle of incidence Let i be the critical angle of incidence. Then Sin i = $\frac{1}{\mu}$ Now, $\frac{d/2}{h} = \tan i$ $\Rightarrow \frac{d}{2} = h \tan i = h\left[\sqrt{\mu^2 - 1}\right]^{-1}$ $\therefore d = \frac{2h}{\sqrt{\mu^2 - 1}}$	 **1** **1/2** **1/2** **1/2** **1/2**
21.	**(a)** No, it is not necessary that if the energy supplied to an electron is more than the work function, it will come out. The electron after receiving energy, may lose energy to the metal due to collisions with the atoms of the metal. Therefore, most electrons get scattered into the metal. Only a few electrons near the surface may come out of the surface of the metal for whom the incident energy is greater than the work function of the metal.	**1** **1**
	(b) on reducing the distance, intensity increases. Photoelectric current increases with the increase in intensity. Stopping potential is independent of intensity, and therefore remains unchanged.	**1/2** **1/2**
22.	Energy corresponding to the given wavelength: E (in eV) = $\frac{12400}{\lambda \text{ (in Å)}}$ = 12. 71 eV The excited state: $E_n - E_1$ = 12. 71 $\frac{-13.6}{n^2} + 13.6 = 12.71$ $\therefore$ n = 3.9 ≈ 4 Total no. of spectral lines emitted: $\frac{n\,(n-1)}{2} = 6$ Longest wavelength will correspond to the transition	 **1** **1/2** **1/2** **1/2**

	n = 4 to n = 3	**1/2**
23.	**(a)** S,W,X	**1**
	(b) Z = Z1 + Z2 A = A1 + A2	**1/2** **1/2**
	(c) Reason for low binding energy:- In heavier nuclei, the Coulombian repulsive effects can increase considerably and can match/ offset the attractive effects of the nuclear forces. This can result in such nuclei being unstable.	**1**
	OR	
	Nuclear force binds the protons inside the nucleus. For Graph and explanation, refer to NCERT page no 445 Significance of negative potential energy: Force is attractive in nature	**1/2** **2** **1/2**
24.	The modulated signal: $C_m(t) = (A_c + A_m \sin\omega_m t)\sin\omega_c t$ $= A_c\left(1 + \frac{A_m}{A_c}\sin\omega_m t\right)\sin\omega_c t$ $C_m(t) = A_c \sin\omega_c t + \mu A_c \sin\omega_m t \sin\omega_c t$ $C_m(t) = A_c \sin\omega_c t + \frac{\mu A_c}{2}\cos(\omega_c - \omega_m)\, t - \frac{\mu A_c}{2}\cos(\omega_c + \omega_m)\, t$ Frequency Spectrum :- 	**1/2** **1/2** **1/2** **1/2** **1**
	SECTION: D	
25.	**(a)** The equivalent magnetic moment is given by μ = NiA The direction of **μ** is perpendicular to the plane of current carrying loop. It is directed along the direction of advance of a right-handed screw rotated along the direction of flow of current derivation of expression for **μ** of electron revolving around a nucleus	**1/2** **1/2** **2**
	(b) for the loop, $\boldsymbol{\mu} = N(\pi r^2)\, i\, (\pm\mathbf{k})$ Magnetic potential energy = **μ.B** $= N(\pi r^2)\, i\, (\pm\mathbf{k}).(B_x\,\mathbf{i} + B_y\,\mathbf{j} + B_z\,\mathbf{k})$ $= \pm\pi r^2 N I B_z$	**1/2** **1/2** **1/2** **1/2**
	OR	
	(a) Derivation H = nI The direction of **H** is along the axis of the solenoid, directed along the direction of advance of a right-handed screw rotated along the direction of flow of current	**2.5** **1/2**
	(b) (i) Not necessarily. Reason: material is diamagnetic. After removal of magnetising field, no magnetisation will remain in the material and hence earth's magnetic field	**1/2** **1/2**

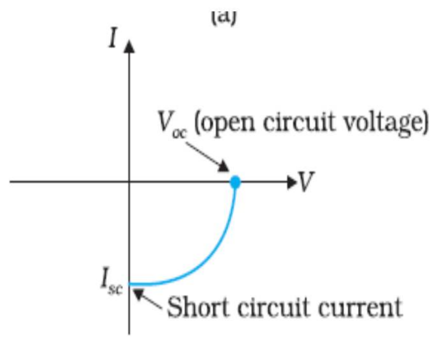
	will not affect it. (ii) Yes Reason: The material is ferromagnetic. It will remain magnetised even after removal from the solenoid and hence align with magnetic meridian.	 **1/2** **1/2**
26.	**(a)** Set A: stable interference pattern, the positions of maxima and minima does not change with time. Set B : positions of maxima and minima will change rapidly with time and an average uniform intensity distribution will be observed on the screen.	**1** **1**
	(b) Expression for intensity of stable interference pattern in set –A If the displacement produced by slit S1 is $y_1 = a \cos \omega t$ then, the displacement produced by S_2 would be $y_2 = a \cos (\omega t + \phi)$ and the resultant displacement will be given by $y = y_1 + y_2$ $= a [\cos \omega t + \cos (\omega t + \phi)]$ $= 2\, a \cos (\phi/2) \cos (\omega t + \phi/2)$ The amplitude of the resultant displacement is $2a \cos (\phi/2)$ and therefore the intensity at that point will be $I = 4\, I_0 \cos^2 (\phi/2)$ $\Phi = 0$ $\therefore I = 4\, I0$ In set B, the intensity will be given by the average intensity $< I > = 4I_0 < \cos^2 (\phi/2) >$ $I = 2\, I_0$	**2** **1**
	OR	
	(a) Refer to NCERT example 10.8 on page no. 378 	**2** **1**
	(b) Expression for incident angle: $\mu = \frac{\sin i_B}{\sin r} = \frac{\sin i_B}{\sin(\pi/2 - i_B)}$ $= \frac{\sin i_B}{\cos i_B} = \tan i_B$ Nature of polarisation: Reflected light: Linearly polarised	**1** **1/2**

	Refracted light: Partially polarised	**1/2**
27.	**(a)** Circuit diagram  	**2**
	(b) output characteristics is the variation of collector current with collector -emitter voltage for different fixed value of I_B. If VBE is increased by a small amount, both the hole current and electron current in the base region increases. As a result, both I_B and I_C increases proportionately.  Output resistance is the ratio of change in collector-emitter voltage to the change in collector current. Current amplification factor is ratio of change in collector current to the change in base current at constant collector- emitter voltage.	**1** **1/2** **1/2**
	OR	
	(a) The fractional change in majority charge carriers is very less compared to the fractional change in minority charge carriers on illumination.	**1**
	(b) The difference in the working of two devices:	

<table>
<tr><th></th><th>Photodiode</th><th>Solar cell</th></tr>
<tr><td>Biasing</td><td>Used in Reverse biasing (½)</td><td>No external biasing is given (½)</td></tr>
<tr><td>Junction Area</td><td>Small (½)</td><td>Large for solar radiation to be incident on it.
(½)</td></tr>
<tr><td>I-V characteristics</td><td>



(1)</td><td>



(1)</td></tr>
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