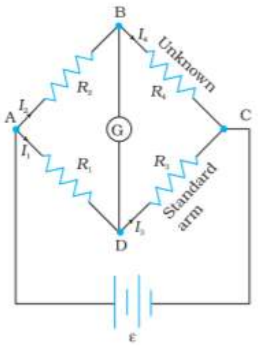
MARKING SCHEME: PHYSICS			
QUESTION PAPER CODE: 55/1/1			
Q.No.	**Value Points/Expected Answer**	**Marks**	**Total Marks**
SECTION A			
1	(A) no net charge is enclosed by the surface	1	1
2	(C) $-qLE$	1	1
3	(C) No current flows in the potentiometer wire at balance	1	1
4	(B) 3:2	1	1
5	(D) material of the turns of the coil	1	1
6	(A) increases the resolving power of telescope	1	1
7	(A) 1.47	1	1
8	(A) red colour	1	1
9	(D) The stability of atom was established by the model	1	1
10	(C) 1:3	1	1
11	0.15G	1	1
12	Eddy	1	1
13	Four times	1	1
14	Integral OR Nucleons	1	1
15	$\sqrt{3}$	1	1
16	$\oint B.dl = \mu_0(i_c + i_d)$	1	1
17	Decreases or reduce	1	1
18	4.8 fermi OR $\frac{1}{1836}$	1	1
19	M_2	1	1
20	Si & Ge cannot be used for fabrication of visible LED because their energy gap is less 1.8eV	1	1

<table>
<tr><th colspan="4">SECTION B</th></tr>
<tr><td>21</td><td>

(a) Principle 1 mark

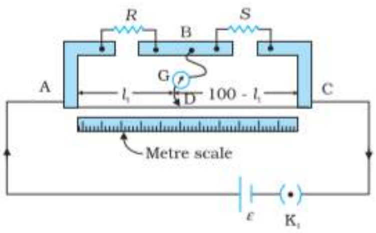
(b) Circuit diagram for determining unknown resistance of meter bridge 1 mark



Meter bridge works on the principle of a balanced wheatstone bridge.

$\frac{R_1}{R_2} = \frac{R_3}{R_4}$ at null point when Ig=0

(unknown)



</td><td>½
½
1</td><td>2</td></tr>
<tr><td>22</td><td>

Formula for parallel plate ½ mark

Calculation of effective capacitance of the combination 1 mark

Relation K, K_1 and K_2 ½ mark

$$C_1 = \frac{k\epsilon_0 A}{d}$$

Capacitor are connected in series

$$C_2 = \frac{C'C''}{C' + C''} = \left(\frac{2K_1K_2}{K_1 + K_2}\right)\frac{\epsilon_0\ A}{d}$$

$C_1=C_2$

$$K = \frac{2K_1K_2}{K_1 + K_2}$$

</td><td>½
1
½</td><td>2</td></tr>
</table>

<table>
<tr><td>23</td><td>

Definition of half life	1 mark
Determination of ratio R_1 and R_2	1 mark

The time interval in which the number of radioactive nuclei reduced / disintegrated to half of initial value

Let R_1 and R_2 be their activities then

$$R_1 = \lambda_1 N_1$$

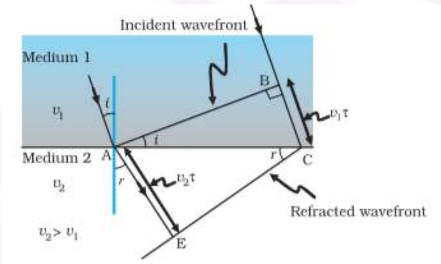
$$R_2 = \lambda_2 N_2$$

$$\frac{R_1}{R_2} = \frac{\lambda_1 N_1}{\lambda_2 N_2} = \frac{\frac{N_1}{T_1}}{\frac{N_2}{T_2}} = \frac{N_1 T_2}{N_2 T_1}$$

</td><td>1
½
½</td><td>2</td></tr>
<tr><td>24</td><td>

Definition of wavefront	½ mark
Figure	½ mark
Derivation of law of refraction	1 mark

Wavefront is defined as the surface of constant phase;
Alternatively
It is a locus of all the points in the same phase of disturbance



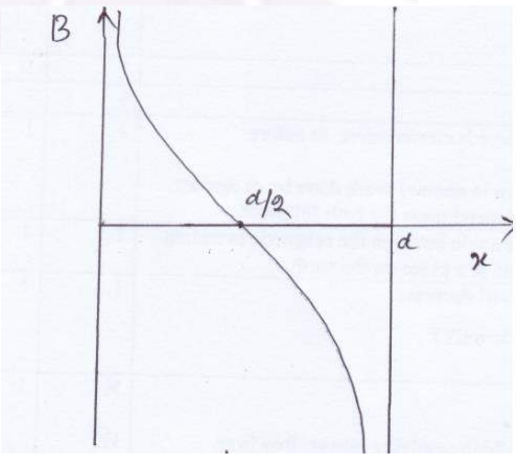
$$\sin i = \frac{BC}{AC} = \frac{v_1 t}{AC}$$

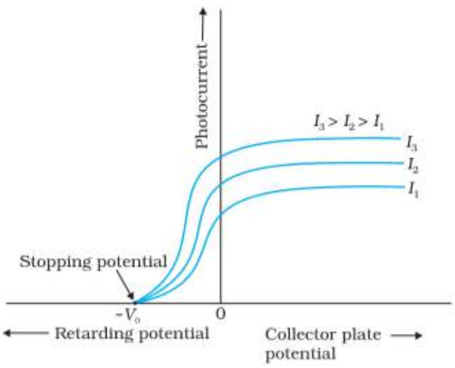
$$\sin r = \frac{AE}{AC} = \frac{v_2 t}{AC}$$

$$\frac{\sin i}{\sin r} = \frac{v_1}{v_2}$$

OR

</td><td>½
½
½
½</td><td>2</td></tr>
</table>

	Lens Maker's formula — 1 mark Derivation of focal length of three lenses — 1 mark		
	$\because \frac{1}{v}-\frac{1}{u}=(n-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)------1$	1	
	When u=∞ and $v=f$ $\frac{1}{f}=(n-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)----------2$ $\left[n=\frac{n_2}{n_1}\right]$	½	
	From Eq 1 and 2 $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}\ then\ lens\ formula$ [Even if the student derives $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$ for biconvex lens, award 1 ½ marks]	½	2
25	Magnetic field at point P — 1 ½ mark Curve — ½ mark		
	a) $B=\frac{\mu_o I}{2\pi x}$	½	
	$B_P=B_1-B_2=\frac{\mu_o I}{2\pi x}-\frac{\mu_0 I}{2\pi(d-x)}=\frac{\mu_o I(d-2x)}{2\pi(d-x)x}$	1	
	b)  	½	2

26	Electrostatic force= centripetal force ½ mark Angular momentum= $\frac{nh}{2\pi}$ ½ mark Formula for radius of nth orbit 1 mark		
	$F_c = F_E$ $\frac{m_e v_n^2}{r_n} = \frac{Kze^2}{r_n^2}$	½	
	$m_e v_n^2 r_n = Kze^2$ By Bohr's second postulate $L = m_e v_n r_n = \frac{nh}{2\pi}$	½	
	$r_n = \frac{n^2h^2}{4\pi^2 m_e k e^2 Z}$ $r_n = \frac{n^2h^2}{4\pi^2 m_e k e^2} \ (\because Z = 1)$	1	2
	OR		
	Two observations 1 mark Diagram 1 mark		
	a) (i) There exists a threshold frequency below which no photoelectron is ejected.	½	
	(ii) KE of electron depends linearly on frequency and is independent of intensity of radiation. [or any other correct observation]	½	
	b)  [only curve is essential to draw]	1	2

27

Explanation of depletion layer and potential barrier	½ + ½ mark
Effect on depletion layer	½ mark
Effect on Potential barrier	½ mark

The small region in the vicinity of the junction which is depleted of free charge carrier and has only immobile ions is called depletion region/ layer. ½

The accumulation of negative charges in p - region and positive charges in n- region set up a potential difference across the junction, which acts as a barrier and is called barrier potential. ½

In forward bias (a) width of depletion layer decreases ½

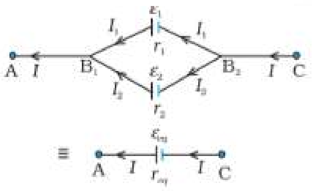
(b) value of potential decreases ½ 2

SECTION C

28

a) Internal resistance	1 ½ mark
b) Voltage across R	1 ½ mark

(a)



Current drawn from cell -1

$$I_1 = \frac{E_1 - V}{r_1}$$ ½

Current drawn from cell -2

$$I_2 = \frac{E_2 - V}{r_2}$$

Resultant current $I = I_1 + I_2$

On solving

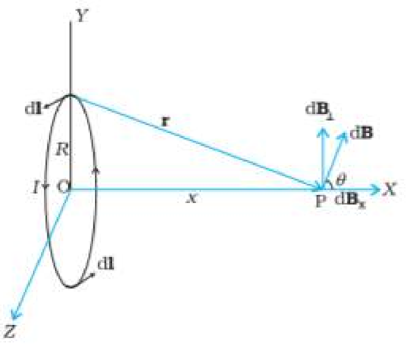
$$\therefore I = \frac{E_1 r_2 + E_2 r_1}{r_1 r_2} - V\left(\frac{r_2 + r_1}{r_1 r_2}\right)$$

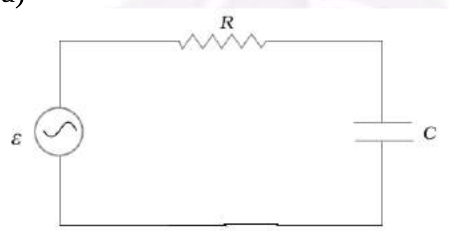
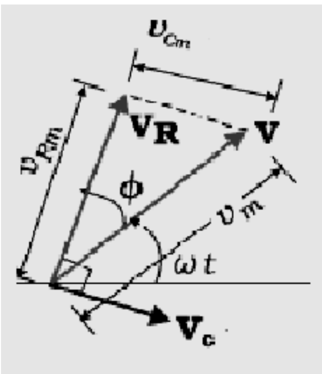
$$\therefore V = \frac{E_1 r_2 + E_2 r_1}{r_1 r_2} - I\left(\frac{r_1 r_2}{r_2 + r_1}\right)$$

$$V = E_{eq} - I r_{eq}$$

$$E_{eq} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$$ ½

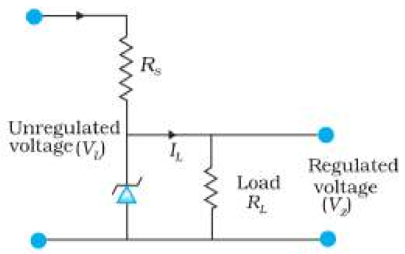
$$r_{eq} = \frac{r_1 r_2}{r_2 + r_1}$$ ½

	$$r_{eff} = \frac{r_1 r_2}{r_1 + r_2} = \frac{2 \times 2}{2+2} = 1\Omega$$ Current through R $$I = \frac{E_{effect}}{R + r_{eff}} = \frac{5}{10+1} = \frac{5}{11}A$$ P.D across R $$= \frac{5}{11} \times 10 = 4.54\ volt$$	½ ½ ½	3
29	a) Writing expression for magnetic moment — ½ mark b) Figure — ½ mark Magnetic field and calculation — 2 mark (a) magnetic moment = M= NIA $M = NI\pi r^2$  According to Biot-sevart law $$\overrightarrow{dB} = \frac{\mu_0 I}{4\pi}\frac{\lvert \vec{dl} \times \vec{r} \rvert}{r^3}$$ $$dB = \frac{\mu_0 I}{4\pi}\frac{dl}{r^2}$$ $dB_\perp$components due to diametrically opposite components cancel out. Only dB_x components refrain $$dB_x = \frac{\mu_0 Idl}{4\pi r^2}.cos\theta$$ $$B = \int dB_x$$ $$B = \frac{\mu_0 IR^2}{2(R^2+x^2)^{3/2}}\ (along\ x\ axis)$$	½ ½ ½ ½ 1	3

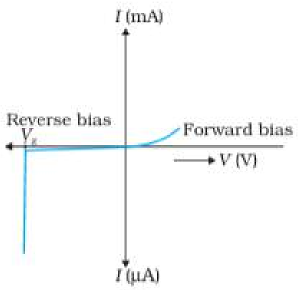
	OR a) Definition and expression 1 mark b) Conversion of Galvanometer (i) into ammeter 1 mark (ii) Effective resistance 1 mark a) Deflection per unit current $I_s = \frac{\theta}{I} = \frac{BNA}{K}$ b) (i) By connecting a low resistance (R_s) in parallel to galvanometer such that $(I_0 - I_g)R_s = I_g G$ (ii) effective resistance $\frac{1}{R_A} = \frac{1}{R_s} + \frac{1}{G} = \frac{G + R_s}{R_s G}$ $\therefore R_A = \frac{R_s G}{G + R_s}$	½ ½ ½ ½ 1	3
30	(a) Peak value of current and phasor 1 mark Potential across R ½ mark Potential across C ½ mark (b) Phase difference ½ mark Identification ½ mark (a)   	½	

	Peak value of current $$I_0 = \frac{V_0}{Z} = \frac{V_0}{\sqrt{X_c^2 + R^2}}$$ $$X_c = \frac{1}{\omega C}$$ (i) $$V_R = I_0 R = \frac{V_0 R}{\sqrt{X_c^2 + R^2}}$$ (ii) $$V_c = I_0 X_c = \left(\frac{V_0}{\sqrt{X_c^2 + R^3}}\right) X_c$$ (b) From phasor $$tan\phi = \frac{X_c}{R}$$ Current leads the applied voltage by phase ϕ	½ ½ ½ ½ ½	3
31	a) Dependence on distance D from slit — 1 mark b) Dependence on slit separation d — 1 mark c) Dependence on distance between source and slit — 1 mark (a) Fringe width increases, $\beta \propto D$ (b) Fringe width decreases, $\beta \propto \frac{1}{d}$ (c) Fringes disappear because $\frac{s}{S} < \frac{\lambda}{d}$ not satisfied	½ + ½ ½ + ½ ½ + ½	3
32	(a) Speed of light in material medium — 1 mark (b) (i) Identification and Range — ½ + ½ mark (ii) Identification and Range — ½ + ½ mark (a) Speed of light in medium $$\upsilon = \frac{1}{\sqrt{\mu\epsilon}} = \frac{1}{\sqrt{\mu_0\mu_r\epsilon_0\epsilon_r}}$$ (b) (i) Microwave range 0.1mt – 1mm $(10^{-3}m – 10^{-1}m)$ (ii) Infrared waves range $1\ mm - 700nm$	1 ½ +½ ½ + ½	3
33	KE of α particle — 1 mark Calculation — 2 marks KE of α particle $E_{k\alpha} = (m_y - m_x - m_\alpha)c^2$ $= m_y c^2 - m_x c^2 - m_\alpha c^2$ = (235 × 7.8 – 231 × 7.835 – 4 × 7.07) MeV = 1833 – 1809.885 – 28.28 = 1833 – 1838.165 = -5.165 MeV	½ ½ ½ ½ 1	3

<table>
<tr><td></td><td>$E_k < 0$ wrong information
[Award full marks till this step]</td><td></td><td></td></tr>
<tr><td>34</td><td>(a) Circuit diagram 1 mark
Working of Zener diode as DC voltage regulator 1 mark
V-I graph ½ mark
(b) Reason of heavy doping ½ mark

(a)


If the input voltage increases, the current through R_s and Zener diode also increases. This increases the voltage drop across R_s without any changes in the voltage across the Zener diode. This is because in the breakdown region, Zener voltage remains constant even though the current through that Zener diode changes.

(a)


(b)

(b) To decrease the width of depletion region which increases electric field at the junction.</td><td>1

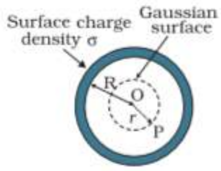
1

½

½</td><td>3</td></tr>
<tr><td colspan="4">SECTION D</td></tr>
<tr><td>35</td><td>(a) (i) Electric Field inside hollow sphere 1½ mark
(ii) Electric Field outside hollow sphere 1½ mark
(b) (i) The net outward flux through cylinder 1 mark
(ii) The net charge present inside the cylinder 1 mark</td><td></td><td></td></tr>
</table>

(a)

(i)



½

According to Gauss's Law

$$\oint \vec{E}.\overrightarrow{dA} = \frac{q_{in}}{\epsilon_0}$$ ½

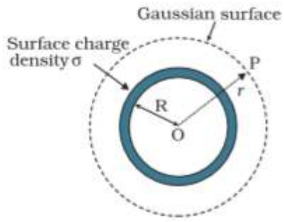
$$\because \textit{inside hollow sphere}$$

$$q_{in} = 0$$

$$\therefore \oint \vec{E}\,.\overrightarrow{dA} = 0$$

$$E = 0$$ ½

(ii)



½

$$q = \sigma 4\pi R^2$$ ½

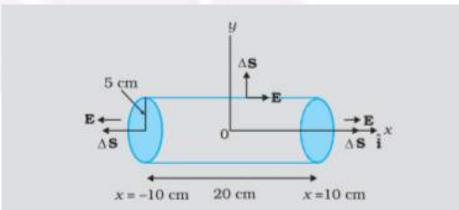
$$\oint \vec{E}.\overrightarrow{dA} = \frac{q}{\epsilon_0}$$

$$E \oint dA = \frac{q}{\epsilon_0}$$

$$E.4\pi x^2 = \frac{\sigma 4\pi R^2}{\epsilon_0}$$

$$E = \frac{\sigma R^2}{\epsilon_0 x}$$ ½

b)



(i) The net outward flux through cylinder

$$\phi = EA + EA = 2EA \qquad A = \pi r^2$$ ½

$$= 2 \times 200 \times 3.14 \times 0.05 \times 0.05$$

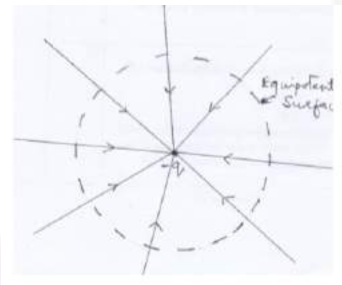
$$= 3.14 \frac{N}{C} m^2$$ ½

(ii) The net charge present inside the cylinder

$$q = \epsilon_0 \phi$$ ½

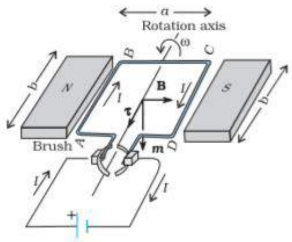
$$q = 8.854 \times 3.14 \times 10^{-12}$$

$$= 2.78 \times 10^{-11}\ C$$ ½ 5

	OR		
	a) Expression for potential energy 3 marks b) Equipotential surface due to isolated -ve charge 1 mark c) Work done in assembling the charge 1 mark		
	(a) Work done in bringing q from infinity against the field E= $q_1 V\lvert\vec{r_1}\rvert$	1	
	Work done on q_2 against the field E= $q_2 V\lvert\vec{r_2}\rvert$ Work done on q_2 against the field due to q_1 $= \frac{q_1 q_2}{4\pi\epsilon_0 (r_{12})}$	1	
	Potential energy of the system= Total work done in assembling the system	½	
	$= q_1 V(\vec{r_1}) + q_2 V(\vec{r_2}) + \frac{q_1 q_2}{4\pi\epsilon_0 r_{12}}$	½	
	b) 	1	
	c) Work done= charge in potential energy $= \frac{kq_1q_2}{r_{12}} + \frac{kq_1q_3}{r_{13}} + \frac{kq_2q_{31}}{r_{23}}$	½	
	$= \frac{9\times10^{9}\times10^{-12}}{0.1}[1 \times -1 + -1\times2+1 \times2]$ $= 9\times10^{-2}[-1-2+2]$ $= -9\times10^{-2}J$	½	5

36

a) Labelled diagram	1 mark
Derivation for torque	1 mark
Justification of radial magnetic field	1 marks
(b) Calculation of radius of the path	2 marks



(a) 1

Magnetic forces of AB and CD are equal and opposite and have different line of action so constitute torque

Force acting on current carrying arms AB and CD

$$F_1 = F_2 = BIl = F\ (say)$$

$$\therefore \tau = F\ \times perpendiclar\ distance\ between\ two\ force\ arm$$ ½

$$\therefore \tau = BIlbsin\theta$$

$$lb = A$$

$$\tau = BIA\ sin\theta$$

For N turn

$$\tau = BINA\ sin\theta$$ ½

Radial fields always produce maximum torque and removes the dependence of torque on θ 1

(b) Radius of circular path $= \frac{mv}{Bq} = \frac{\sqrt{2mE_k}}{Bq}$ 1

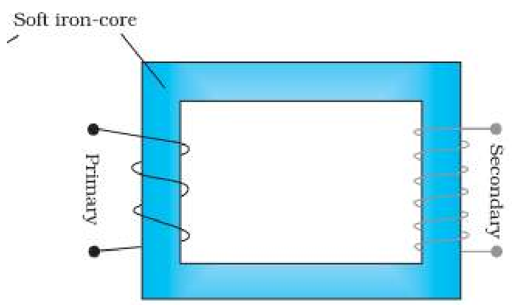
$$= \frac{1}{B}\sqrt{\frac{2mqV}{q^2}}$$

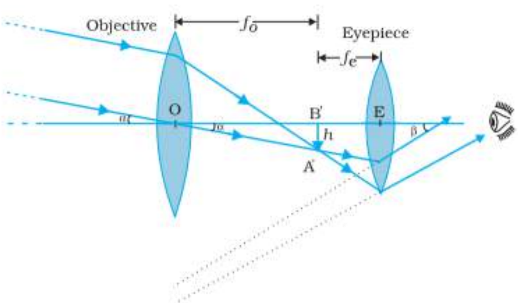
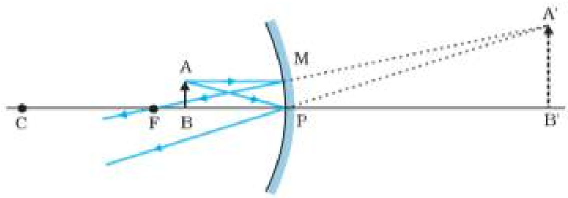
$$= \frac{1}{B}\sqrt{\frac{2mV}{q}} = \frac{1}{2 \times 10^{-3}}$$

r = 10m 1 5

OR

(a) Labelled diagram	1 mark
Working	1 mark
(i) & (ii) Reason/justification	½ + ½ mark
(b) (i) External force required	1 mark
(ii) Power required	1 mark

		1	
	[Note: Diagram with different windings can also be drawn] When an alternating voltage is applied to the primary, the resulting current produces an alternating magnetic flux which links the secondary and induces an emf		
	Induced emf across primary coil		
	$$e_P = -N_p \frac{d\emptyset}{dt}$$	½	
	Induced emf across secondary coil		
	$$e_s = -N_s \frac{d\emptyset}{dt}$$		
	$$\frac{e_s}{e_p} = \frac{N_s}{N_p} = r$$	½	
	(i) to minimise the eddy currents	½	
	(ii) To reduce the heat loss	½	
	(b) (i) F=BIl $I = \frac{E}{R} = \frac{Bvl}{R}$		
	$F = \frac{B^2vl^2}{R}$	½	
	$= \frac{0.4 \times 0.4 \times 0.1 \times 0.2 \times 0.2}{0.1}$		
	$= 6.4 \times 10^{-3}$ N	½	
	$P = F.v = 6.4 \times 10^{-3} \times 0.1$	½	
	$= .64 \times 10^{-3} W$	½	5

37	a) Labelled diagram — 2 marks Figure Expression for resolving power — 1 mark b) Calculation of angular magnification — 1 mark Diameter of image formed by objective lens — 1 mark		
	a) 	2	
	Resolving power of telescope = $\frac{D}{1.22\lambda}$	1	
	b) (i) Angular magnification $m = \frac{\beta}{\alpha} = \frac{f_o}{f_e} = \frac{20m}{10^{-2}m} = 2000$	1	
	(ii) $\frac{D}{d} = \frac{x}{f_o}$	½	
	$d = \frac{Df_0}{x} = \frac{3.5 \times 10^6 \times 20}{3.8 \times 10^8} = .18\text{m}$	½	5
	OR		
	(a) Labelled diagram — 1 mark Derivation of mirror relation — 2 marks (b) Position of image — 1 ½ marks Nature of image — 1 ½ marks		
	(a)	1	
	$\Delta ABP \sim A'B'P$ $\frac{A'B'}{AB} = \frac{PB'}{PB} - - - - - - - - - - 1$	½	
	Also $\Delta A'B'F \sim MNP$ (for small curvature)		

	$\therefore \frac{A'B'}{MP} = \frac{B'F}{PF}$ $\frac{A'B'}{AB} = \frac{B'F}{PF}$ ------------- 2 From 1 and 2 $\frac{PB'}{PB} = \frac{B'F}{PF}$ ------------- 3 $\frac{PB'}{PB} = \frac{B'P + PF}{PF}$ ---------4 $PB = -u \quad PB' = v \quad PF = -f$ $\frac{v}{-u} = \frac{v-f}{-f}$ $-vf = -vu + uf$ $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ (b) According to lens maker's formula $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ for plano convex lens $R_1 \rightarrow$ R and $R_2 \rightarrow \infty$ $\frac{1}{f} = \frac{(\mu - 1)}{R} = \frac{1.5 - 1}{20}$ ∴f=40 cm $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ $\frac{1}{40} = \frac{1}{v} - \frac{1}{-30}$ $v = -12\ cm$ Nature: virtual	½ ½ ½ ½ ½ ½ ½	5