G.C.E. (Advanced Level) Examination - August 2001

PHYSICS - I

Provisional Scheme of Marking

2001 - Answers

01	2	21	2	41	2
02	3	22	1	42	2
03	1	23	3	43	4
04	4	24	2	44	2
05	5	25	4	45	1
06	4	26	4	46	3
07	3	27	3	47	1
08	1	28	4	48	5
09	4	29	5	49	1
10	5	30	3	50	5
11	3	31	5	51	3
12	3	32	1	52	2
13	2	33	2	53	5
14	4	34	5	54	1
15	2	35	1	55	1
16	1	36	4	56	3
17	4	37	2	57	5
18	3	38	5	58	4
19	3	39	5	59	1
20	5	40	4	60	1

G.C.E. (Advanced Level) Examination - August 2001
PHYSICS - II
Provisional Scheme of Marking

A - PART

01. (a) 0.15 kg

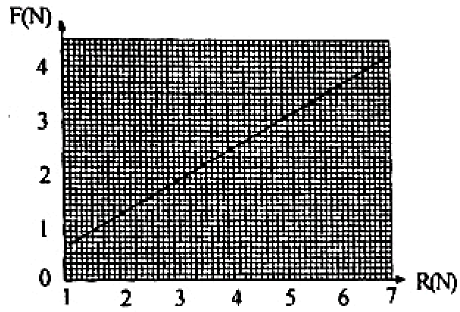
(b) $F = \mu R$

(c) (i)

	R(N)	l(mn)	F(N)
block wthout ony weight	1.5	25	1.0
block + 0.1 kg weight	2.5	30	1.5
block + 0.2 kg weight	3.5	35	2.0
block + 0.3 kg weight	4.5	41	2.6 ± 0.1
block + 0.4 kg weight	5.5	48	3.3 ± 0.1
block + 0.5 kg weight	6.5	55	4.0

For the correct list of R values 01
For the correct list of F values 02
(all correct - 02, any three correct 01)

(ii) Marking points correctly on the graph. 01



(iii) Drawing the best straight line 01

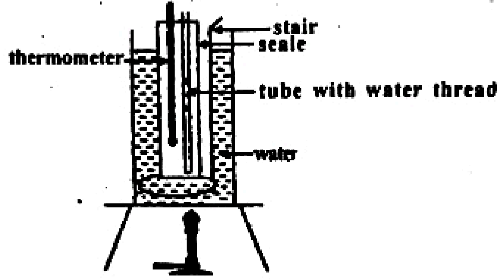
(iv) Gradient $= \left(\frac{3.3 - 1.5}{5.5 - 2.5}\right)$
$= 0.6$
(0.5 - 0.7) 01
$\mu = 0.6$ 01

(d) Place a Convenient scale [illegible]ark (e.g zero) of the ruler at the end of spring attached [illegible] the hook and take the reading of the other end.

OR

Place the ruler by the side of the spring and take readings at both ends of it. 01

(02) (a) tube with water thread, fixed for a scale a thermometer 01



01

(b) Heat the tube dip the open end in water and allow it to cool down. 01

(c) middle of the tube 01

reasons - length of the air column is reasonably long and it will remain inside the water bath as well

OR

the water thread has to remain inside the tube 01

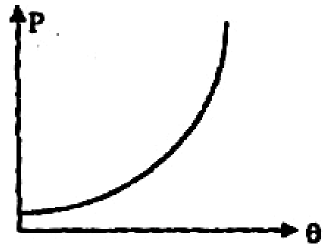
(d) Increase - the temperature of water slowly and measure the temperature of the water bath and the Corresponding length of the air column. - 01

(e) (i) $P - P_1$ and $P - P_2$

(ii) $\frac{(p - p_1)l_1}{\theta_1 + 273} = \frac{(p - p_2)l_2}{\theta_2 + 273}$ 02

(273 is not added of θ 01 mark)

(f)



01

03. (a) (i) Place the pin Q Close to the face AB
(ii) Place P and Q Pins suffcently apart.

any one 01

(b) (i) look through the face AC and fix two pins to be in line with the images of P and Q. 01

(ii) The emergent ray Cannot be traced with one pin

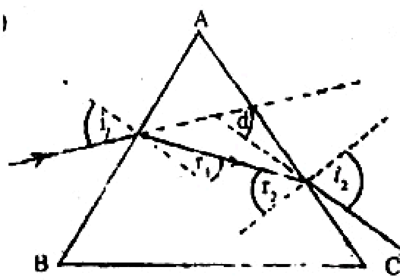
OR

to draw a straight line at least two points are required

OR

large nember of lines Can be drawn through a Single point. 01

(c)



all Carrect - 01

(d) $d = (i_1 - r_1)$ [illegible] $(i_2 - r_2)$ [illegible])R
$d = (i_1 + i_2) - (r$ [illegible] 01

(e) (i) $n = \frac{\text{Sin } 10^0}{\text{Sin } 6^0}$ 01

$n = 1.6$

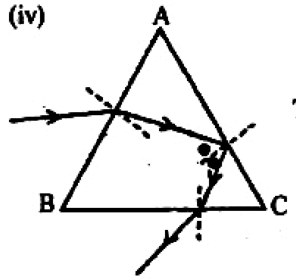
(ii) $r_1 + r_2 = A$

$r_2 = 60° - 6°$

$r_2 = 54°$ 01

(iii) No r_2 Is greater than the critical angle of glass.
OR $r_2 > C$ 01

(iv)



Total internal reffaction - 01
Rest of the path - 01

(04) (a) From one side to the other OR
From left to right OR
From negative to positive OR
the deflection passes through zero 01

(b) (i) I_1 and I_2 01

(ii) Zero 01

(iii) $V_{AB} = V_{AD}$

$V_{BC} = V_{DC}$ 01

(iv) $V_{AB} = I_1R_1$ $V_{BC} = I_1R_3$

$V_{AD} = I_2R_2$ $V_{DC} = I_2R_4$ 01

(v) $I_1R_1 = I_2R_2$ and $IR_3 = I_2R_4$

$\frac{R_1}{R_3} = \frac{R_2}{R_4}$

$\Rightarrow R_4 = \frac{R_3}{R_1} \times R_2$ 01

(vi) $R_4 = \frac{50}{100} \times 82$

$= 41\ \Omega$ 01

(c) For R_1 1000Ω resister
For R_2 0 - 100Ω resistance box
For R_3 10Ω resister (all - 02)
(any two - 01)

(d) zero OR No change 01

B - PART

01. (a) (i) nonviscous
Steamline / steady
Incompressible 03

(ii) Dimensions of $P = \frac{MLT^{-2}}{L^2}$

$[PV^2] = ML^{-3}(LT^{-1})^2$

$= ML^{-1}T^{-2}$ 01

$[Pgh] = ML^{-3}LT^{-2}L$

$= ML^{-1}T^{-2}$ 01

Equation is dimensionally Correct

(b) (i) P_1 and P_2 - Pressures at points A (B) & C
V - the minimum speed with which the plunger should be pushed
V_1 - the speed of air at point C

Bernoulli's equation : (A and C)

$P_1 + 1/2\,\rho V^2 = P_2 + 1/2\,\rho V_1^2$ 02

(ρ - Density of air) [OR $P_1 + 1/2 \times 2V^2 = P_2 + 1/2 \times 2V_1^2$]

But $P_1 - P_2 = h\rho_1 g$ (ρ_1 - Dansity of liquid)

OR

$P_1 - P_2 = 90 \times 10^{-3} \times 10^3 \times 10$ 02

From equation of Continuity

$A_1V_1 = A_2V_2$

$60^2V = 2^2V_1$ OR $\left(\frac{60}{2}\right)^2 V = (2/2)^2 V_1$ OR $\pi\left(\frac{60}{2}\right)^2 V = \pi\,(2/2)^2 V_1$

02

$V_1 = 30^2V$

Form the first two equ

$P_1 - P_2 = \frac{1}{2}\rho\left(V_1^2 - V^2\right)$

$900 = 1/2 \times 3\,(30^4V^2 - V^2)$ 01

$30^4V^2 >>> V^2$

$900 = 30^4V^2$

$V^2 = \frac{900}{30^4}$

$V = \frac{1}{30}$ ms^{-1} (or 3.3 cms^{-1}) 01

(ii) Since the plurger is moving at a Constant Velocity the applied force is equal to the resrstive force

The required force = 20 N 01

(02) (i) 20Hz - 20,000 Hz

(ii) Advantages
- Ultrasound is not knowns to produce any damage OR undesirable Side - effects to humans.
- Ultra sound does not ionize atoms OR molecues in human cells.
- Ultrasound is reflected by objects of small size

any two 01

(iii) Ultrasound is a longitudinal wave 01

(iv) Ultrasound are sound waves whose frequencies are above 20kHz OR
above the audible range OR
not audible to humans 01

(v) ultrasound is not an electromagnetic wave 01
Reason :
It is a mechamical wave OR
the speed of it is not equal to the speed of light in air OR
needs a medium to travel 01

(vi) (a) wevelength - λ

$V = f\lambda$

$\lambda = \dfrac{1500}{15 \times 10^6}$

$\lambda = 10^{-4}$ m 01

(b) The value of the wave length is comparable to the size of the object concern. 01

(vii)(a) $V\cos\theta$ 01

(b) $f^1 = f_i \dfrac{(u + v\cos\theta)}{u}$ 01

(c) $f_r = f^1 \dfrac{u}{(u - v\cos\theta)}$ 01

$f_d = f_r - f_i = f_i \left(\dfrac{u + v\cos\theta}{(u - v\cos\theta)} - 1\right)$ 01

$f_d = f_i \left(\dfrac{u + v\cos\theta - u + v\cos\theta}{u - v\cos\theta}\right)$

$f_d = f_i \dfrac{2v\cos\theta}{(u - v\cos\theta)}$

(viii) $8 \times 10^3 = \dfrac{2 \times 15 \times 10^6\, V}{1500}$

$V = 0.4\ ms^{-1}$ 01
$(0.39 - 0.41 ms^{-1})$

(ix) To achieve a bigger value for f_b OR
to achieve a practically measurable for f_d OR
if θ is large f_d will be small 01

(x) To mini-mize the reflection of ultrasound from the skin
OR
to maximze the transmission of ultrasound through the skin OR
to provide a close coupling between the device and the skin OR
to exclude air between the device and the skin 01

03. (i) Induced charge on the inner surface $= -1\mu C$
Induced charge on the outer surface $= +1\mu C$ 01

(ii) $E_P = \dfrac{Q}{4\pi\varepsilon_0(OP)^2} = \dfrac{(1 \times 10^{-6}) \times (9 \times 10^9)}{0.2^2}$ 01

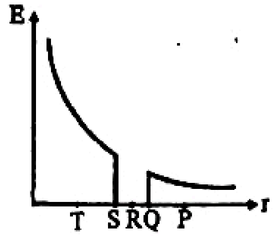
$= 2.25 \times 10^5\ NC^{-1}$ 01

$E_R = \dfrac{Q(=0)}{4\pi\varepsilon_0(OQ)^2}$

$= 0$ - 01

$E_T = \dfrac{Q}{4\pi\varepsilon_0(OT)^2} = \dfrac{(1 \times 10^{-6}) \times (9 \times 10^9)}{0.05^2}$

$= 3.6 \times 10^6\ NC^{-1}$ 01



(iii) (a) $V_P = \dfrac{Q}{4\pi\varepsilon_0(OP)} = \dfrac{(1 \times 10^{-6}) \times (9 \times 10^9)}{0.2}$

$= 4.5 \times 10^4\ V$ - 01

$V_Q = \dfrac{Q}{4\pi\varepsilon_0(OQ)} = \dfrac{(1 \times 10^{-6}) \times (9 \times 10^9)}{0.15}$

$= 6.0 \times 10^4\ V$ - 01

Since the electric field inside the conductor is zero

$V_R = V_Q = 6.0 \times 10^4\ V$
$V_S = V_Q = 6.0 \times 10^4\ V$ - 01

(b) Potential difference between T and S

$\Delta V = V_T - V_S = \dfrac{Q}{4\pi\varepsilon_0}\left(\dfrac{1}{OT} - \dfrac{1}{OS}\right)$ 01

$= (1 \times 10^{-6}) \times (9 \times 10^9)\left[\dfrac{1}{0.05} - \dfrac{1}{0.1}\right]$

$= 9.0 \times 10^4\ V$ 01

$\therefore V_T = (6.0 + 9.0) \times 10^4$

$= 15.0 \times 10^4\ V$ 01

Alternative methed

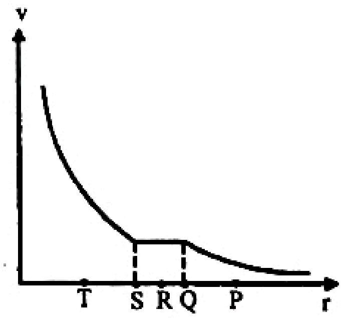
$V_T = \left[\dfrac{Q}{4\pi\varepsilon_0 \times (0.05)} - \dfrac{Q}{4\pi\varepsilon_0 \times (0.10)} + \dfrac{Q}{4\pi\varepsilon_0 \times (0.15)}\right]$ - 01

$V_T = (1 \times 10^{-6})(9 \times 10^9)[0.05 + \dfrac{1}{0.15} - \dfrac{1}{0.1}]$

$V_T = 15 \times 10^4 V$ - 01

$\Delta V = V_T - V_S = 15.0 \times 10^4 - 6.0 \times 10^4\ V$
$= 9.0 \times 10^4\ V$ - 01

(c)



(iv) Added charge does not reside on the inner surface
$\therefore$ induced charge density of inner surface $= \dfrac{-1}{4\pi(OS)^2}$

$= -7.96\ \mu cm^{-2}$
$= [-7.96 - 8.0\ \mu cm^{-2}]$

Induced charqe density of outer surface = 0 01

(04) (i) $F = \eta A \frac{v}{d}$ 01

(ii)

02

(iii)(a) $F = \eta A V/d$

$0.05 = \eta \times 10^{-2} \times \frac{0.01}{10^{-3}}$ 01

$\eta = 0.5\ Nsm^{-2}\ (kgm^{-1}s^{-1})$

(Deduct 01 mark .... the unit is wrong)

(b) $F = \mu R$ 01

$R = mg$ OR $R = 0.5 \times 10$ 01

$\mu = \frac{0.05}{5}$ 01

$\mu = 0.01$ 01

(c) Rate of work done = Fv 01

Energy that can be saved in one second

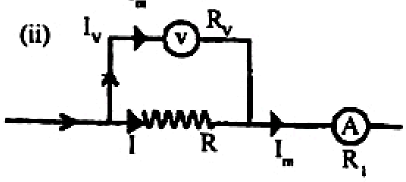
$= 0.25 \times 0.01 - 0.05 \times 0.01$ 01

$= 0.002\ J$ 01

(d) Additional downward force is acted on the block due to the Surface tension forces. (02 or zero)

05. (a) (i) $R = \frac{V_m}{I_m}$ 01

(ii)



$I = I_m - I_V$ 01

$R = \frac{V_m}{I_m - I_V}$ 01

$R = \frac{V_m}{I_m - \frac{V_m}{R_V}}$ OR $R = \frac{V_m R_V}{I_m R_V - V_m}$ 01

[Alternative Method

Let Re be the equivalent resistance of R and Rv

$V_m = I_m R_e$ - 01

$R_e = \frac{R_V R}{R_V + R}$ - 01

$V_m = \frac{I_m R_V R}{R_V + R}$ → $R = \frac{V_m R_V}{I_m R_V - V_m}$ - 01]

(iii) At 30°C $V_m = 4.0\ V$ and $I_m = 0.02\ A$

$\therefore R = \frac{4.0 \times 1000}{0.02 \times 1000 - 4.0}$ 01

$= 250\ \Omega$ 01

At 430°C $V_m = 4.05\ V$ and $I_m = 0.018A$

$\therefore R = \frac{4.05 \times 1000}{0.018 \times 1000 - 4.05}$

$= 290\Omega\ (290.3\Omega)$ 01

Temperature Cofficient of resistivity α is given by

$R_\theta = R_0 (1 + \alpha (\theta - 0))$

$250 = R_0 (1 + \alpha (30 - 0))$ 01

$290 = R_0 (1 + \alpha (430 - 0))$ 01

$\frac{250}{290} = \frac{1 + 30\alpha}{1 + 430\alpha}$

$\alpha = 4.0 \times 10^{-4}\ {}^\circ C^{-1}$

$(4.0 - 4.1 \times 10^{-4}\ {}^\circ C^{-1})$ 02

(iv) Applying Kirchhoff's low for the circuit

$E = V_m + I_m R_1$ 01

At 30°C $V_m = 4.0V$ and $I_m = 0.02\ A$

$E = 4.00 + 0.02\ R_1$ 01

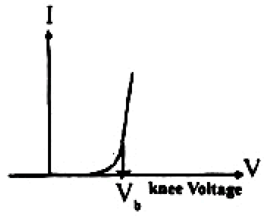
At 430°C $V_m = 4.05V$ and $I_m = 0.018A$

$E = 4.05 + 0.018R_1$

$R_1 = 25\ \Omega$ 01

$E = 4.5\ V$ 01

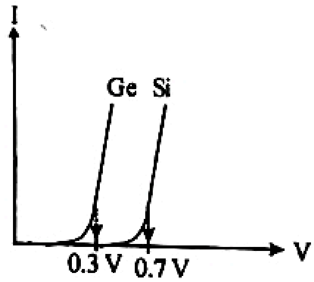
(b) (i)



01

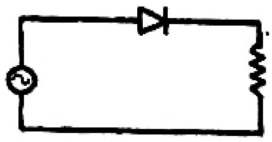
Knee voltage of si is 0.7 V (0.5V - 0.7V)

Knee voltage of Ge is 0.3V (0.2V - 0.3V)

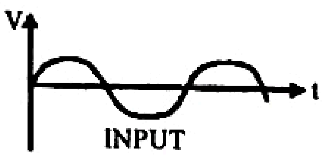


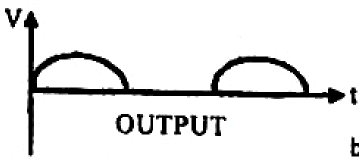
01

(ii)



01





both correct -01

(iii) Peak current $I = \frac{25 - 0.7}{640}$ $\left[OR\ I = \frac{25 - 0.6}{640}\right]$ 01

$= 38mA$ OR $40.5mA$

Peak output Voltaqe $= 600\ I$ OR $25 - 0.7$ 01

$= 22.8V$ or $24.3V$

(iv) Current through the potential divider

$I = \frac{12}{(10+2)} \times 10^{-3}$

$= 1.0\ mA$

$I_B = I/20 = \frac{1}{20}\ mA$

$= (50 \pm 1)\mu A$ 01

$V_B = 1 \times 10^{-3} \times 2 \times 10^3$ 01

$= 2.0\ V$

$V_E = 2.0 - 0.7$ OR $2.0 - 0.6$ 01

$= 1.3\ V$ OR $1.4V$

$I_E = \frac{1.3}{1 \times 10^3}$ OR $\frac{1.4}{1 \times 10^3}$

$I_E = 1.3\ mA$ (1.2 - 1.5mA) 01

$I_C \approx I_E = 1.3\ mA$ 01

$V_C = V_{CC} - I_C R_C$ 01

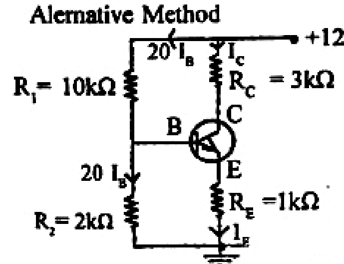
$= 12 - 1.3 \times 10^{-3} \times 3 \times 10^3$ 01

$= 8.1\ V\ (7.8\ V)$

$V_{CE} = V_C - V_E = 8.1 - 1.3$ OR $7.8 - 1.4$

$= 6.8\ V\ (6.4V)\ [\pm 0.5V]$ 01

Alernative Method



$20I_B \times R_1 + 19I_B \times R_2 = 12$ 01

OR $20I_B \times 10 \times 10^3 + 19I_B \times 2 \times 10^3 = 12$

$I_B = (50 \pm 1)\ \mu A$ - 01

$20I_B \times R_2 = 0.7 + I_E R_E$

$20I_B \times 2 \times 10^3 = 0.7 + I_E \times 10^3$ 02

[01mark for the L.H. S Other mark for the correct eq)

$I_E = (1.2 \pm 0.2)\ mA$ 01

$I_C \approx I_E = (1.2 \pm 0.2)mA$ 01

OR $I_E = I_C + I_B$

$I_C R_C + V_{CE} + I_E R_E = 12$ OR 02

$(1.2 \pm 0.2) \times 10^{-3} \times 3 \times 10^3 + V_{CE} + (1.2 \pm 0.2) \times 10^{-3} \times 10^3 = 12$

$V_{CE} = (7.2 \pm 0.5)\ V$ 01

06. (a) (i) Steam Producfron Rafe $= \frac{20 \times 10^3}{2.3 \times 10^6}$ 01

$= 8.7 \times 10^{-3}\ kgs^{-1}$ 01

(or 8.7gs-1)

(8.7 ± 0.1)

(ii) Applying $\frac{Q}{t} = kA\frac{(\theta_1 - \theta_2)}{d}$ 01

Lat θ be the temperature of the outer Surface

$20 \times 10^{+3} = \frac{400 \times 500 \times 10^{-4}(\theta - 100)}{2 \times 10^{-2}}$ 03

$\theta = 120^0C$ - 01 One mark for R. H.S one mark for equating one mark taking Temperature of the boiling water as 100)

(iii) Seteam Production is same as above OR $8.7 \times 10^{-3}\ kgs^{-1}$ 01

(iv) Let θ^1 be the new temperature of the outer surface and θ_I be the temperature of the interface

$20 \times 10^{+3} = \frac{400 \times 500 \times 10^{-4}(\theta^1 - \theta_I)}{2 \times 10^{-2}}$

$20 \times 10^3 = \frac{10 \times 500 \times 10^{-4}(\theta_I - 100)}{10^{-3}}$ 01

$\theta_I = 140^0C$

Then $20 \times 10^3 = \frac{400 \times 500 \times 10^{-4}(\theta^1 - 140)}{2 \times 10^{-2}}$ 01

$\theta^1 = 160^0C$ 02

(v) (1) No

Water will boil because all the qenerated heat will be absorbed by water at the steady state.

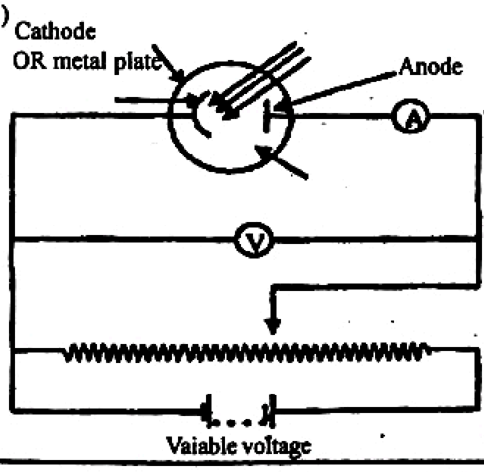
OR

There will be no loss of heat and therefore if is impossible to maintain the temperatare at 50°C.

(2) yes

Part of the generated heat will be lost to the sorroundings and steady state could be reached so that the temperature of water is 50°C.

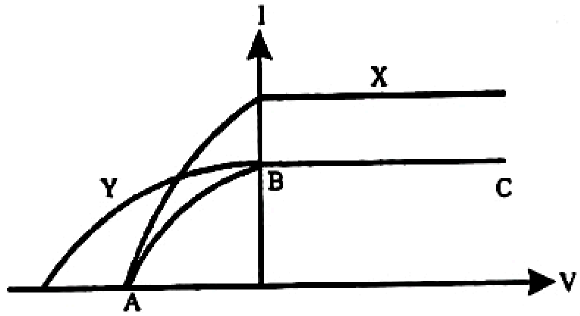
(b) (i)



Circuit 01

labeling 01

(i)



AB part of the curve	01
BC part of the curve	01
Curve X	01
Curve Y	01

(ii) (1) $hf_0 = \phi$ 01

$C = f\lambda$ 01

OR $\left[\frac{hc}{\lambda max} = \phi\right]$ 02

$\lambda_{max} = \frac{6.63 \times 10^{-34} \times 3.0 \times 10^8}{4.08 \times 1.6 \times 10^{-19}}$ 01

$\lambda_{max} = 305\ nm \quad (3.05 \times 10^{-7} m)$ 01

$(305 \pm 2) nm$

(2) Stopping potential Vs is given by

$ev_s = \frac{1}{2} m V^2_{max}$ (1/2 mv^2) 01

But $\frac{1}{2} m V^2 = \frac{hc}{\lambda} - \phi$ 01

$V_s = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{220 \times 10^{-9} \times 1.6 \times 10^{-19}} - 4.08$ 01

$V_s = 1.6\ V \ (1.6 \pm 0.1)\ V$ 01

$\frac{1}{2} m V^2_{max} = eVs$

$V^2_{max} = \frac{2eVs}{m}$

$V^2 = \frac{2 \times 1.6 \times 10^{-19} \times 1.6}{9.11 \times 10^{-31}}$

$V = 7.4 \times 10^5\ ms^{-1}$

[OR $V^2 = 2/m\,(hc/\lambda - \phi)$

$V^2 = \frac{2}{9.11 \times 10^{-31}} \left[\frac{6.63 \times 10^{-34} \times 3 \times 10^8}{220 \times 10^{-9}} - 4.08 \times 1.6 \times 10^{-19}\right]$

$= 7.4 \times 10^5\ ms^{-1}$]