(P) At = 18.9 sec, THE TRANSVERSE DISPLACEMENT y of THE ELEMENT of THE STRING AT $x = 0.255$ m IS 1.92 mm

(a) WHAT IS u, THE TRANSVERSE VELOCITY of THE SAME ELEMENT of THE STRING AT THAT TIME?

(b) WHAT IS THE TRANSVERSE ACCELERATION a_y of THE SAME ELEMENT AT THAT TIME?

(a)

$$y(x,t) = y_m \sin(kx - \omega t)$$

$$u = \frac{dy}{dt} = \frac{d}{dt} y_m \sin(kx - \omega t)$$

$$= y_m (-) \cos(kx - \omega t) \times \omega$$

$$u = -y_m \omega \cos(kx - \omega t)$$

(b)

$$a_y = \frac{du}{dt} = \frac{d}{dt}(-y_m \omega \cos(kx - \omega t))$$

$$= -\omega^2 y_m \sin(kx - \omega t)$$

DETERMINE

If $\omega =$

$k =$

y_m

x

$u = -y$

$= -$

$=$

ENERG

ALONG

KIN

ELA

EN

RATE

DETERMINING THE NUMERICAL VALUE

If $\omega = 2.72$ RAD/s

$k = 72.1$ RAD/m

$y_m = 1.92$ mm

$x = 0.255$ m

$$u = -y_m \omega \cos(kx - \omega t)$$

$$= -1.92 \times 2.72 \cos(72.1 \times 0.255 - 72.1\, t)$$

$=$

ENERGY AND POWER OF A WAVE TRAVELLING ALONG A STRING

KINETIC ENERGY

ELASTIC POTENTIAL ENERGY

ENERGY TRANSPORT

RATE OF ENERGY TRANSMISSION

$$\boxed{dk = \frac{1}{2}\, dm\, u^2}$$

$$\left(\frac{dk}{dt}\right)_{avg} = \frac{1}{4} \mu v \omega^2 y_m^2$$

$$P_{avg} = 2\left(\frac{dk}{dt}\right)_{avg}$$

$$\boxed{P_{avg} = \frac{1}{2} \mu v \omega^2 y_m^2}$$

SOUND

A SOUND WAVE IS DEFINED ROUGHLY AS ANY LONGITUDINAL WAVE

LONGITUDINAL WAVE — OSCILLATION PARALLEL TO THE DIRECTION OF WAVE TRAVEL.

$\longleftrightarrow$ OSCILLATION
$\longrightarrow$ WAVE
$\Big\}$ LONGITUDINAL WAVE

$\updownarrow$ OSCILLATION
$\longrightarrow$ WAVE
$\Big\}$ TRANSVERSE WAVE

$V =$

$\uparrow$ SPEED

STR

$V =$

$+2.1\,t)$

AVELLING

$$\left(\frac{dK}{dt}\right)_{avg} = \frac{1}{4}\mu v \omega^2 y_m^2$$

$$P_{avg} = 2\left(\frac{dK}{dt}\right)_{avg}$$

$$\boxed{P_{avg} = \frac{1}{2}\mu v \omega^2 y_m^2}$$

SOUND

A SOUND WAVE IS DEFINED ROUGHLY AS ANY LONGITUDINAL WAVE

LONGITUDINAL WAVE — OSCILLATION PARALLEL TO THE DIRECTION OF WAVE TRAVEL.

$\longleftrightarrow$ OSCILLATION
$\longrightarrow$ WAVE
} LONGITUDINAL WAVE

$\updownarrow$ OSCILLATION
$\longrightarrow$ WAVE
} TRANSVERSE WAVE

$$v = \sqrt{\frac{\tau}{\mu}} = \sqrt{\frac{\text{ELASTIC PROPERTY}}{\text{INERTIAL PROPERTY}}}$$

↑ SPEED OF TRANSVERSE WAVE ALONG THE STRING.

$$v = \sqrt{\frac{B}{\rho}}$$ SPEED OF SOUND

B = BULK MODULUS

$$B = -\frac{\Delta p}{\Delta V / V}$$

Δp ← CHANGE IN PRESSURE

$\Delta V / V$ ← SPECIFIC VOLUME CHANGE

LIGHT

LIGHT

pb THE

A,

BETW

(a) WHAT

THE

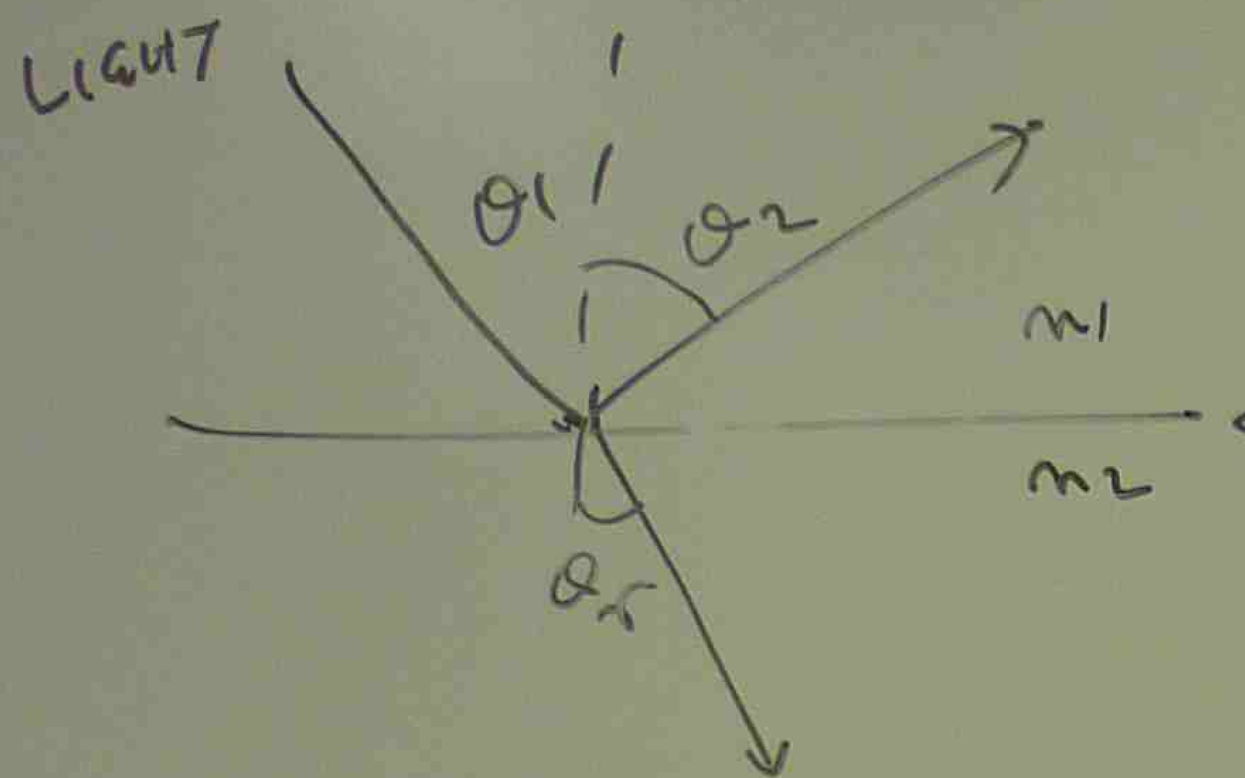
1

2

3

Y
TY
G THE
UND
ANGE
PRESSURE
CIFIC
UME
ANGE

LIGHT PHOTON



θ_1 = INCIDENCE ANGLE

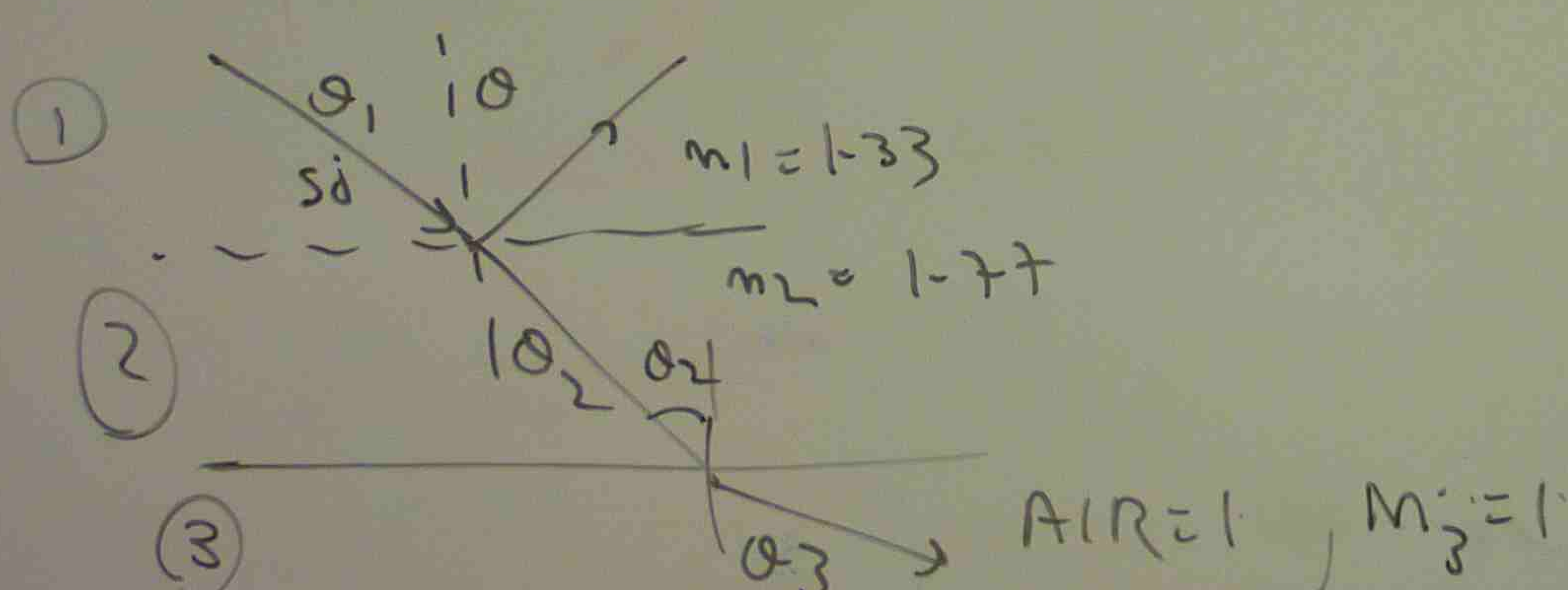
θ_2 = REFLECTION ANGLE

θ_r = REFRACTION ANGLE

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

pb THE LIGHT THAT ENTERS MATERIAL '2' AT POINT A, THEN REACHED POINT B ON THE INTERFACE BETWEEN MATERIAL 2 AND MATERIAL 3.

(a) WHAT IS ANGLE OF REFLECTION (b) WHAT IS THE ANGLE OF REFRACTION IN TO THE AIR?



θ_1 = INCIDENCE ANGLE = 90 − 50 = 40°

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

$1.33 \sin 50 = 1.77 \sin\theta_2$

$\sin\theta_2 = \frac{1.33}{1.77} \sin 50$

$\theta_2 = \sin^{-1} \frac{1.33}{1.77} \sin 50$

$= 29^\circ$

$n_2 \sin\theta_2 = n_3 \sin\theta_3$

$1.77 \times \sin 29 = 1 \quad \sin\theta_3$

$\sin\theta_3 = 1.77 \sin 29$

$\theta_3 = \sin^{-1}\left[1.77 \times \sin 29\right]$

$= 59^\circ$

THE PHOTON, QUANTUM OF LIGHT

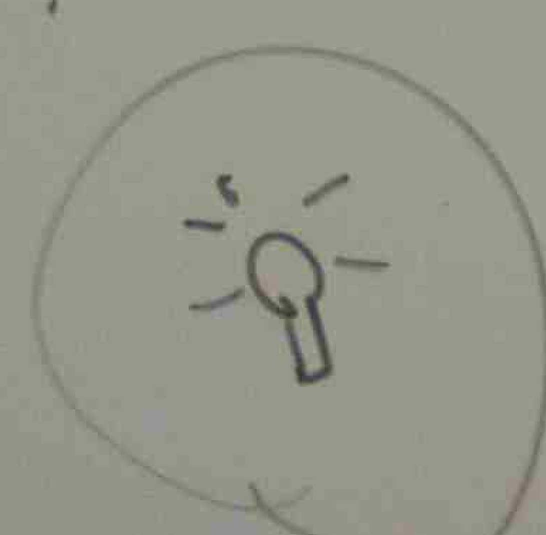
$$f = \frac{c}{\lambda}$$

f = WAVE FREQUENCY
c = VELOCITY OF LIGHT
λ = WAVE LENGTH

$$E = hf$$

E = PHOTON ENERGY
h = PLANK CONSTANT
$= 6.63 \times 10^{-34}$ J-S

pb A SODIUM VAPOR LAMP IS PLACED AT THE CENTRE OF A LARGE SPHERE THAT ABSORBS ALL THE LIGHTS REACHING IT. THE RATE AT WHICH THE LAMP EMITS ENGRGY IS 100W. ASSUME THAT THE EMISSION IS ENTIRELY AT A WAVELENGTH OF 590 mm. AT WHAT RATE ARE PHOTONS ABSORBED BY THE SPHERE?



$$R_{emit} = \frac{\text{RATE OF ENERGY EMISSION}}{\text{ENERGY / EMITTED PHONTON}}$$

$$= \frac{P_{emit}}{hf}$$

$$= \frac{P_{emit}}{h \times \frac{c}{\lambda}}$$

$$= \frac{P_{emit} \times \lambda}{h\ c}$$

$$= \frac{100 \times 590 \times 10^{-9}}{6.63 \times 10^{-34} \times 3 \times 10^{8}}$$

$$= 2.97 \times 10^{20} \text{ PHONTONS / Sec}$$

PHOTO ELECTRIC EQUATION

$$hf = K_{max} + \phi$$

ϕ = MINIMUM ENERGY REQUIRED TO EMIT THE ELECTRON.

V_{stop} = STOPPING POTENTIAL

$$V_{stop} = \left(\frac{h}{e}\right) f - \frac{\phi}{e}$$

$$h = 4.1 \times 10^{-15}\ V \cdot s \times 1.6 \times 10^{-19}\ C$$

$$= 6.6 \times 10^{-34}\ J/s$$

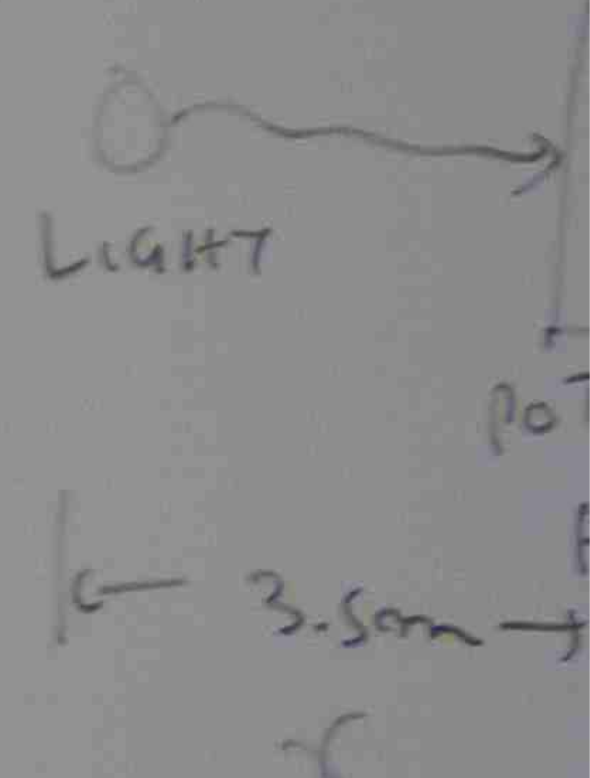
Pb A POTASSIUM

THAT EMITS ENER

IS 2.2 eV. (a) HO

ENERGY TO EJ

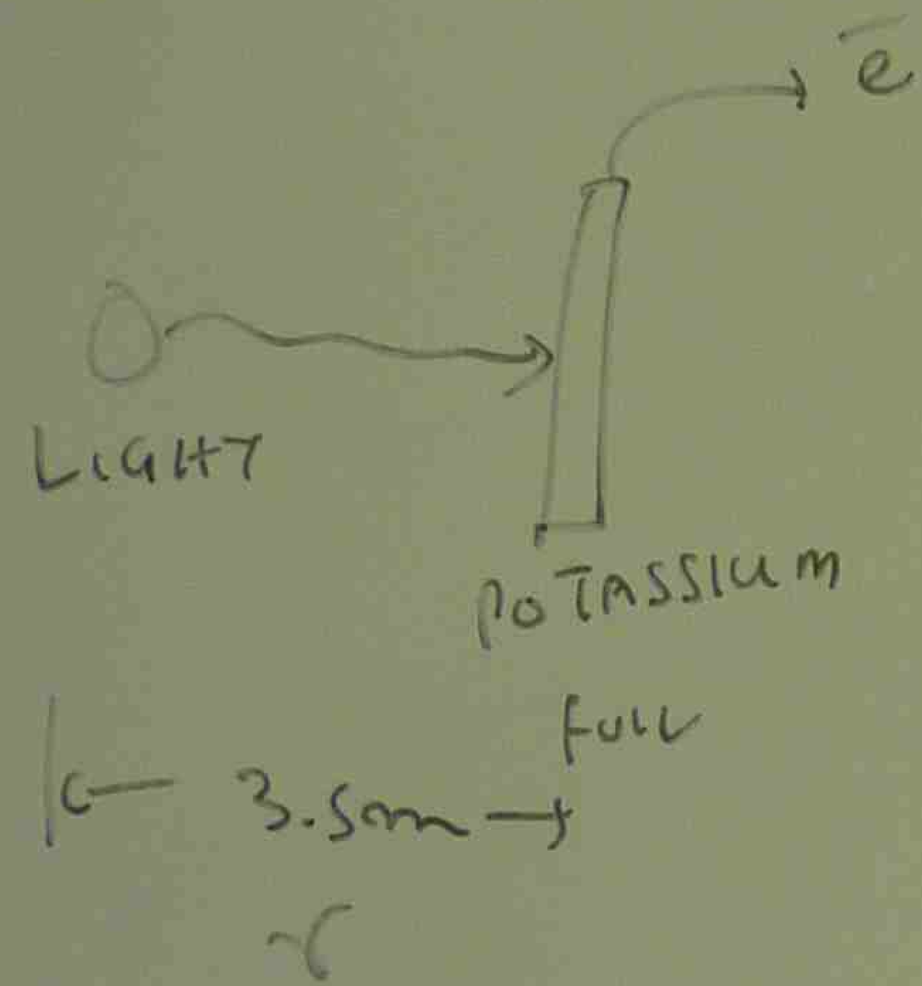
5×10^{-11} m. (b)



$\phi = 3.5$

$A = 7.3$

Pb A POTASSIUM FOIL IS A DISTANCE $r = 3.5\,m$ FROM AN ISOTROPIC LIGHT SOURCE THAT EMITS ENERGY AT THE RATE $P = 1.5\,W$. THE WORK FUNCTION ϕ OF POTASSIUM IS 2.2 eV. (a) HOW LONG WOULD IT TAKE FOR THE FOIL TO ABSORB ENOUGH ENERGY TO EJECT AN ELECTRON? THE CIRCULAR PATCH OF FOIL RADIUS IS $5\times10^{-11}\,m$. (b) FIND THE WORK FUNCTION ϕ OF SODIUM.



$$\Delta t = \frac{\Delta E}{P_{abs}}$$

ΔE — CHANGE OF ENERGY = MINIMUM ENERGY REQUIRED TO EMIT THE ELECTRON ϕ

P_{abs} — ABSORBED POWER

$$\Delta t = \frac{\phi}{P_{abs}}$$

$$\Delta t = \frac{\phi}{I \cdot A}$$

I = LIGHT INTENSITY

A = AREA

$$I = \frac{P_{EMIT}}{4\pi r^2}$$

$$\phi = 3.5\times10^{-19}\,J$$

$$A = 7.85\times10^{-21}\,m^2$$

$$\Delta t = \frac{\phi}{\frac{P_{EMIT}}{4\pi r^2}\times A}$$

$$\Delta t = \frac{4\pi r^2 \phi}{P_{EMIT}\times A} = \frac{4\times3.1416\times(3.5)^2\times3.5\times10^{-19}}{1.5\times7.85\times10^{-21}}$$

$$= 4580\,s \approx 1.3\,hr$$

AN ISOTROPIC LIGHT SOURCE

K FUNCTION ϕ OF POTASSIUM

- TO ABSORB ENOUGH

TCH OF FOIL RADIUS IS

um.

GE OF

ERGY = MINIMUM ENERGY REQUIRED TO EMIT THE ELECTRON

RBED

VER

LIGHT INTENSITY

= AREA

$$= \frac{P_{EMIT}}{4\pi r^2}$$

$$\frac{4 \times 3.1416 \times (3.5)^2 \times 3.5\times10^{-19}}{1.5 \times 7.85\times10^{-21}}$$

$= 45805 = 1.3\ hr$

$$\phi = h f_0 = 6.63\times10^{-34}\ J\text{-}s \times 5.5\times10^{14}\ Hz$$

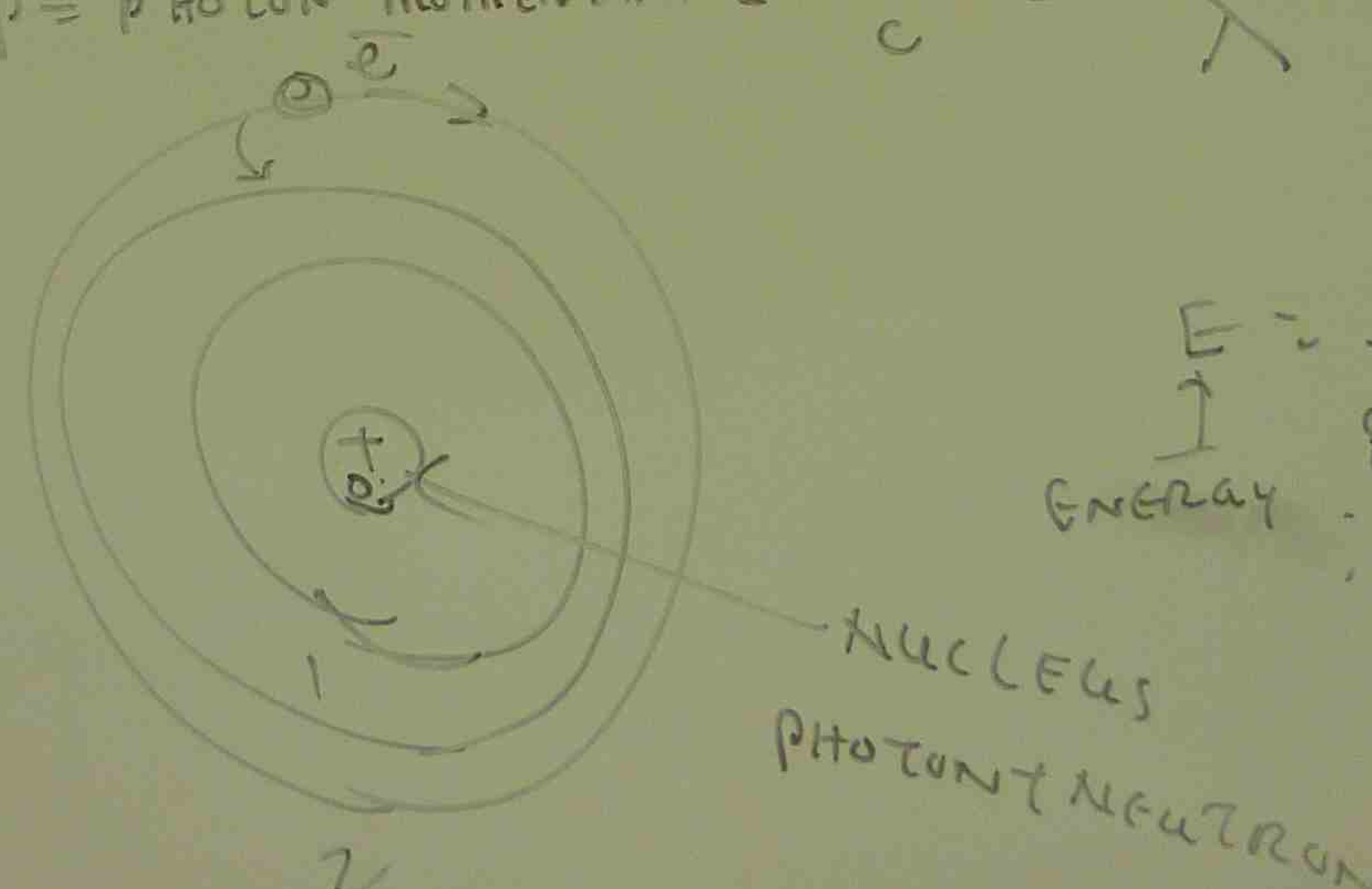
$$= 3.6\times10^{-19}\ J$$

$$1\ J = 1.6\times10^{-19}\ eV$$

$$\therefore\ = \frac{3.6\times10^{-19}}{1.6} = 2.3\ eV$$

MOMENTUM OF PHOTON

$$p = \text{PHOTON MOMENTUM} = \frac{hf}{c} = \frac{h}{\lambda}$$



$$E = \frac{h^2}{8mL^2} n^2$$

ENERGY

$n = 1, 2, 3$

$$L = \frac{n\lambda}{2} \quad n = 1, 2, 3$$

ΔE = ENERGY CHANGE =

$\Delta E = hf = E$

P1. AN ELECTRON IS

DEEP POTENTIAL ENE

(a) WHAT IS THE S

CAN HAVE?

(b) HOW MUCH EN

ELECTRON IF

FROM GROUND

(c) IF THE ELECTR

FROM ENERGY LE

ABSORBING LIGH

SN 5.5x10^14 Hz

-3eV

$= \frac{h}{\lambda}$

$E = \frac{h^2}{8ml^2} n^2$

ENERGY

$n = 1, 2, 3$

LEVELS

NEUTRON

$L = \frac{n\lambda}{2}$ $n = 1, 2, 3$

$\Delta E = \underset{\text{CHANGE}}{\text{ENERGY}} = E_{HIGH} - E_{LOW}$

$\Delta E = hf = E_{HIGH} - E_{LOW}$

P1. AN ELECTRON IS CONFINED TO A ONE DIMENSIONAL, INFINITELY DEEP POTENTIAL ENERGY WELL OF L = 100 pm.

(a) WHAT IS THE SMALLEST AMOUNT OF ENERGY THE ELECTRON CAN HAVE?

(b) HOW MUCH ENERGY MUST BE TRANSFERRED TO ELECTRON IF IT IS TO MAKE A QUANTUM JUMP FROM GROUND STATE TO SECOND EXCITED STATE?

(c) IF THE ELECTRON GAINS THE ENERGY FOR THE JUMP FROM ENERGY LEVEL E_1 TO ENERGY LEVEL E_3 BY ABSORBING LIGHT. WHAT LIGHT WAVE LENGTH IS REQUIRED?

$E = \frac{h^2}{8ml^2} n^2$

$n = 1 \rightarrow$ GROUND

$E_1 = \frac{(6.63 \times 10^{-34}}{8(9.11 \times 10^{-31}}$

$= 6.031 \times 10^{-13}$

$e.v = \frac{E_1}{1.6 \times 10^{-19}} =$

(b) GROUND

2nd EXCITE

$E_3 = \frac{h^2}{8ml^2}$

$\Delta E_{31} = E_3 -$

ENSIONAL, INFINITELY
m.
ERGY THE ELECTRON
FERRED TO
QUANTUM JUMP
EXCITED STATE?
FOR THE JUMP
LEVEL E_3 BY
ENGTH IS REQUIRED?
$=1$

$$E = \frac{h^2}{8ml^2} n^2$$

$n = 1 \longrightarrow$ GROUND STATE

$$E_1 = \frac{(6.63 \times 10^{-34})^2 \times 1^2}{8\,(9.11 \times 10^{-31})\,(100 \times 10^{-12})^2}$$

$$= 6.031 \times 10^{-18}\ J$$

$$e.v = \frac{E_1}{1.6 \times 10^{-19}} = \frac{6.031 \times 10^{-18}}{1.6 \times 10^{-19}}$$

$$= 37.7\ eV$$

(b) GROUND E_1

2nd EXCITED $-$ E_3

$$E_3 = \frac{h^2}{8ml^2} \times 3^2$$

$$\Delta E_{31} = E_3 - E_1 = \frac{h^2}{8ml^2} 3^2 - \frac{h^2}{8ml^2} \times 1^2$$

$$\Delta E_{31} = \frac{h^2}{8ml^2}(3^2 - 1^2)$$

$$= 6.031 \times 10^{-18} \times 8$$

$$= 4.83 \times 10^{-17}\ J$$

$$\Delta E_{31\,eV} = \frac{4.83 \times 10^{-17}}{1.6 \times 10^{-19}}$$

$$= 301\ eV$$

(c) $$\lambda = \frac{hc}{\Delta E}$$

$$= \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{4.83 \times 10^{-17}}$$

$$= 4.12 \times 10^{-9}\ m$$

$(\ldots^2 - 1^2)$

8

J

$\ldots 10^{-17}$

$\ldots 10^{-19}$

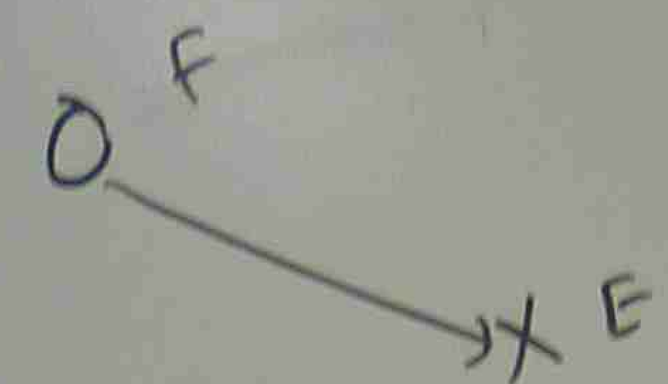
eV 3

$\frac{\ldots c}{\Delta E}$

$\frac{\ldots 63\times10^{-34} \times 3\times10^{8}}{4.83\times10^{-17}}$

4.12×10^{-9} m

ELECTRIC FIELD

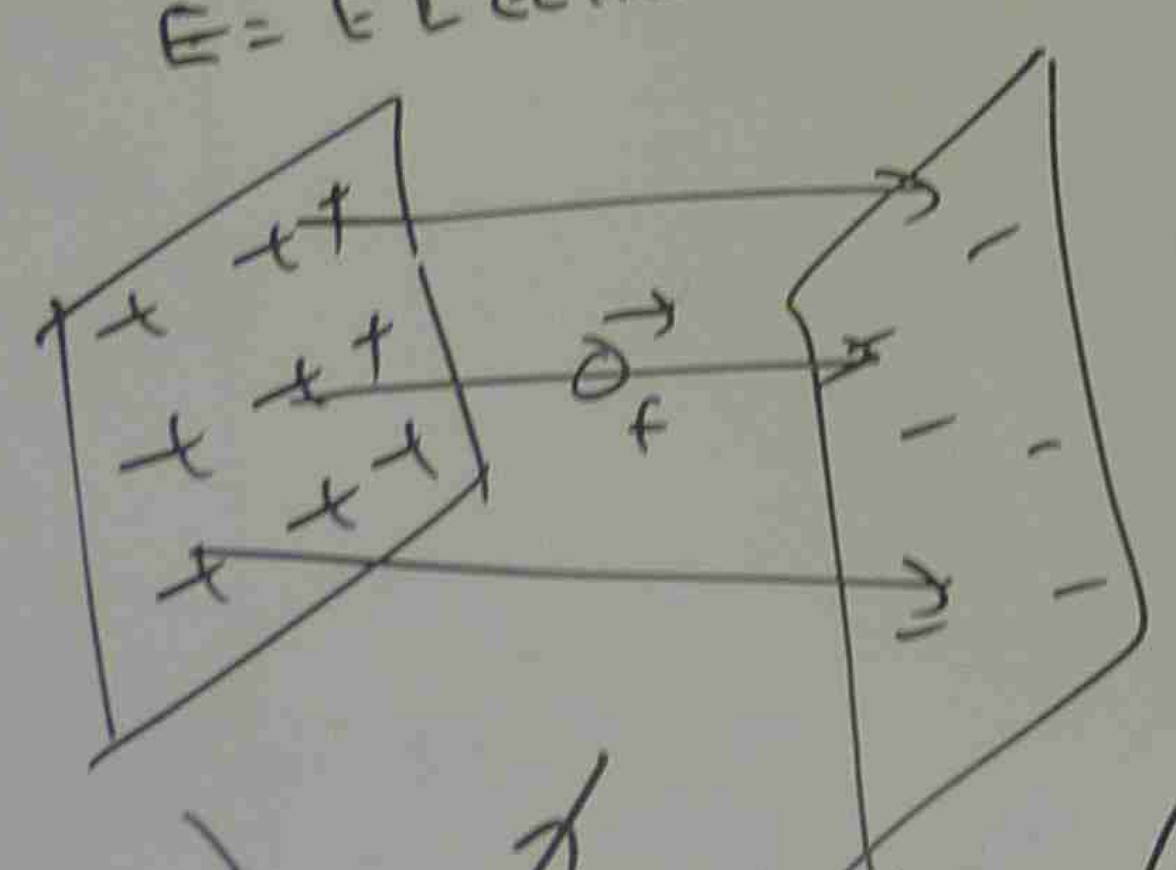


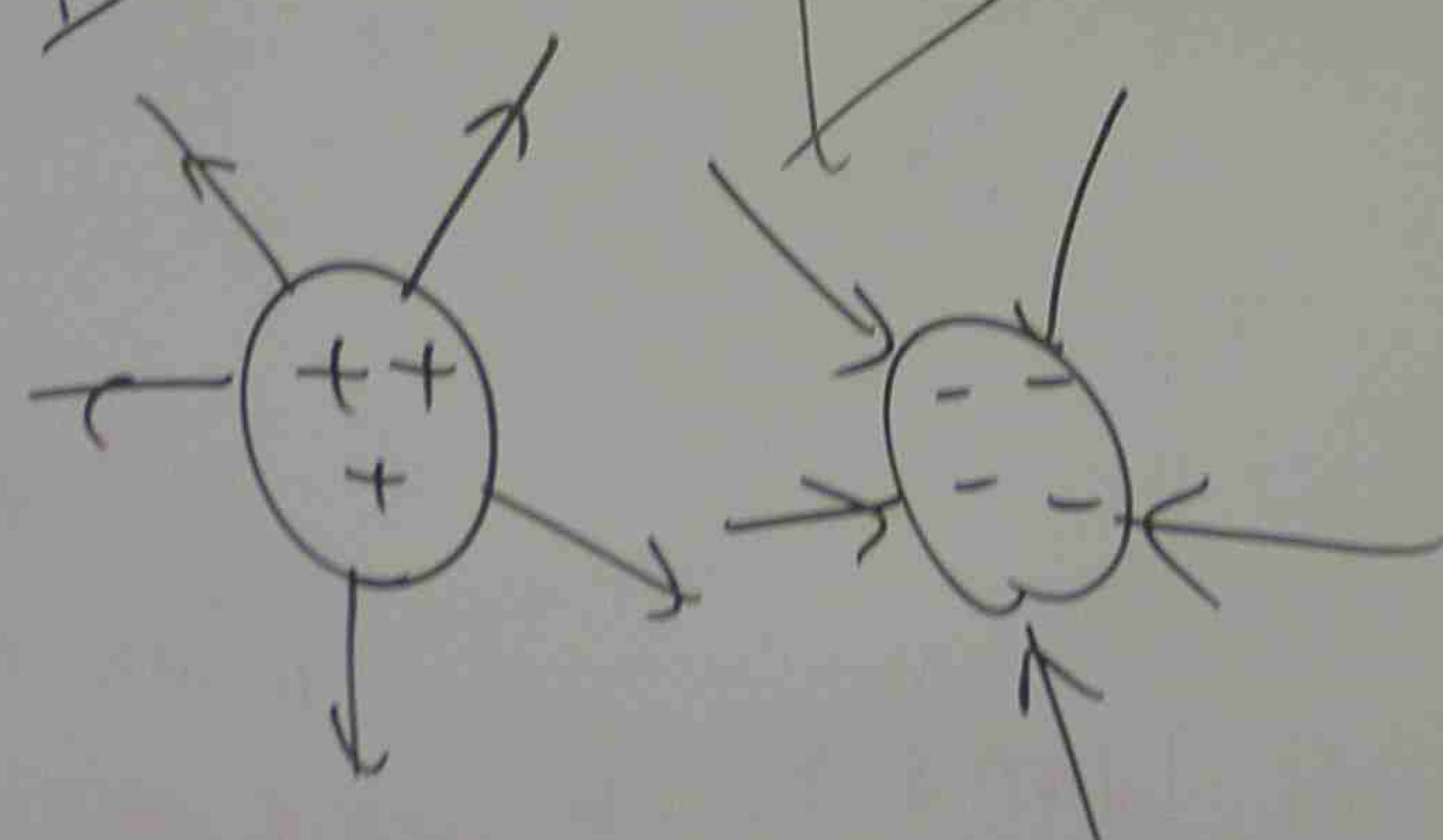
$E = \frac{F}{q}$

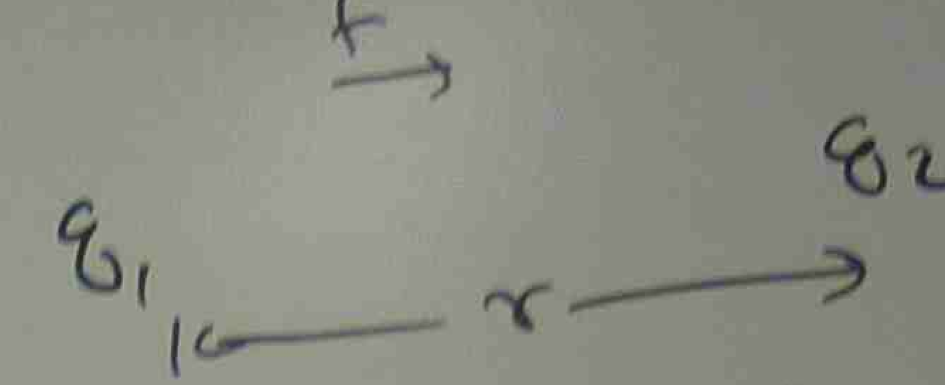
F = ELECTRIC FORCE

q = CHARGE

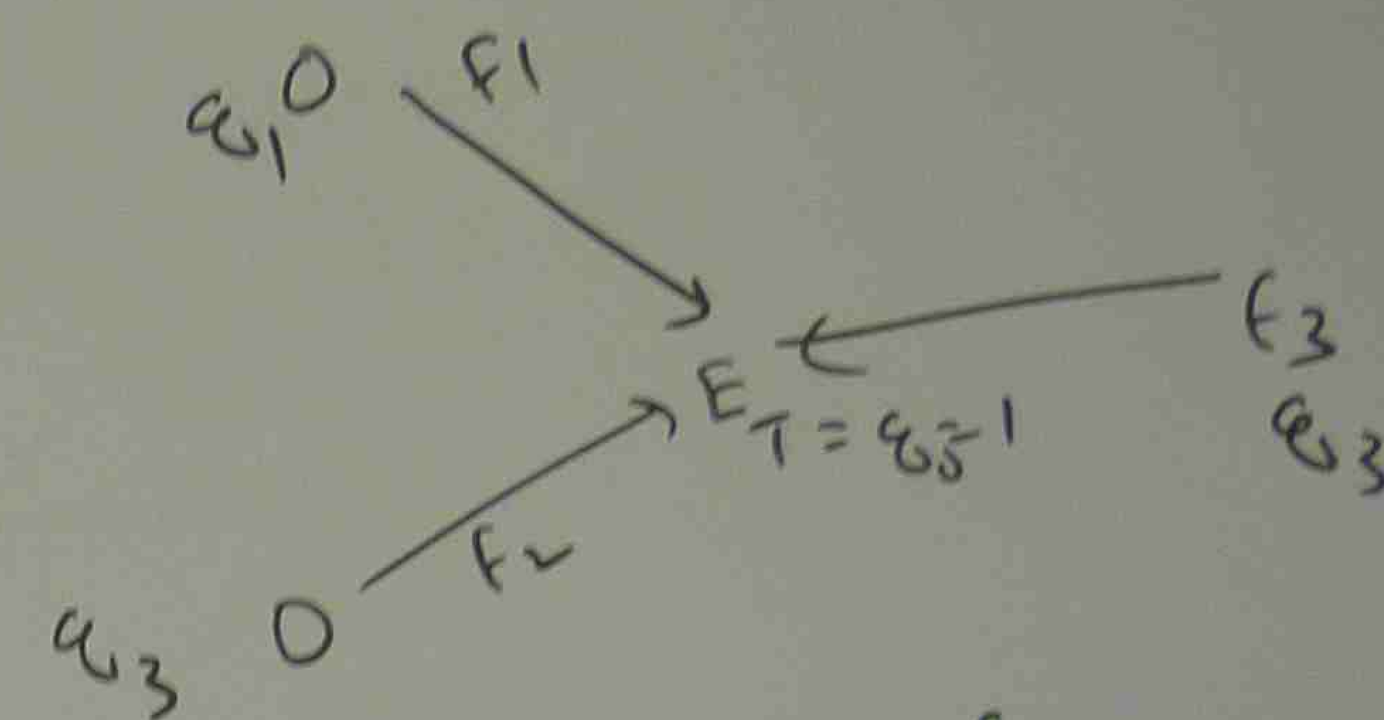
E = ELECTRIC FIELD







$\vec{F} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$



$\vec{F}_T = F_1 + F_2 + F_3$

$\vec{E}_T = \frac{F_1}{q_1} + \frac{F_2}{q_2} + \frac{F_3}{q_3}$

$\vec{E}_T = \overline{E_1} + \overline{E_2} + \overline{E_3}$

LIGHT

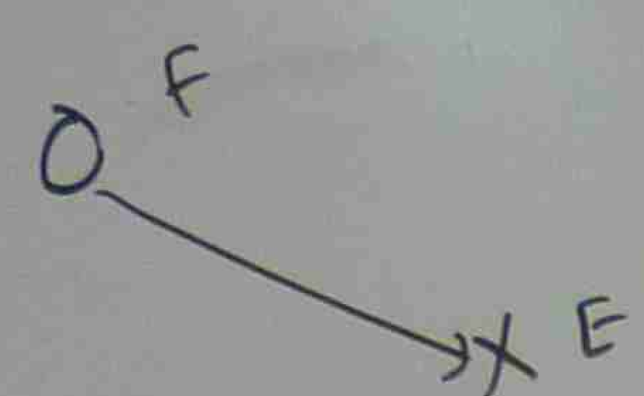
8

x10

7

m

ELECTRIC FIELD

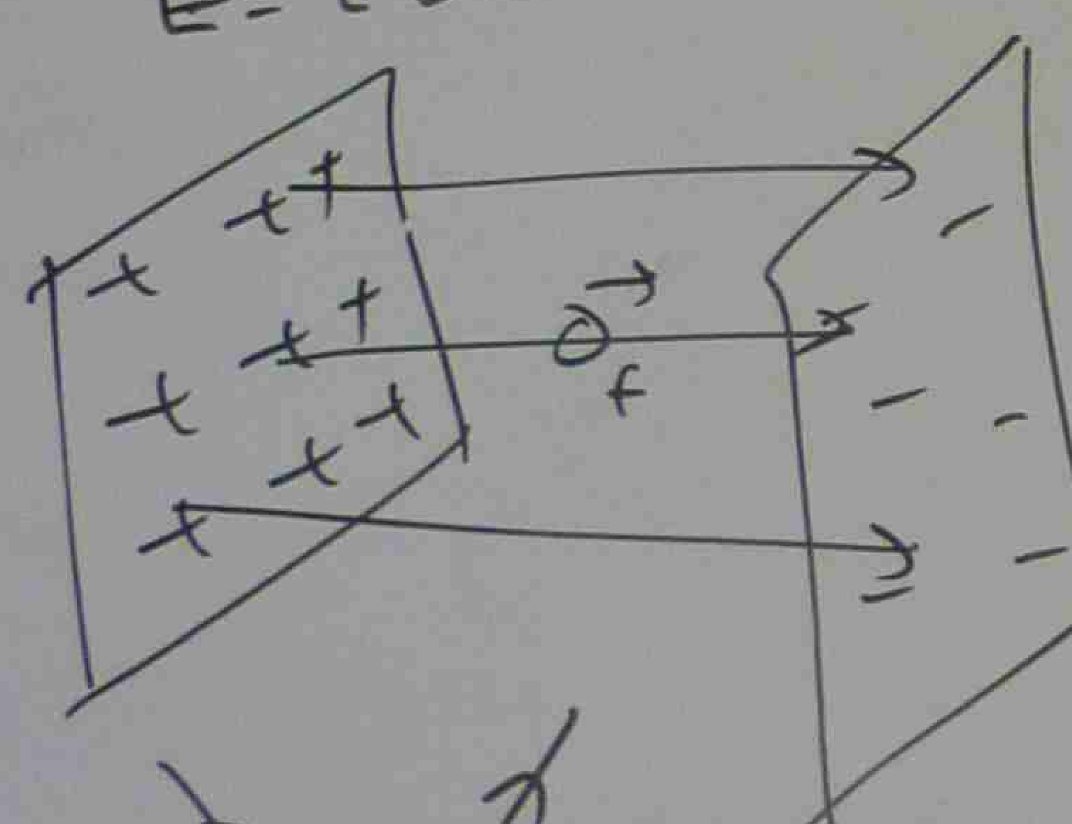


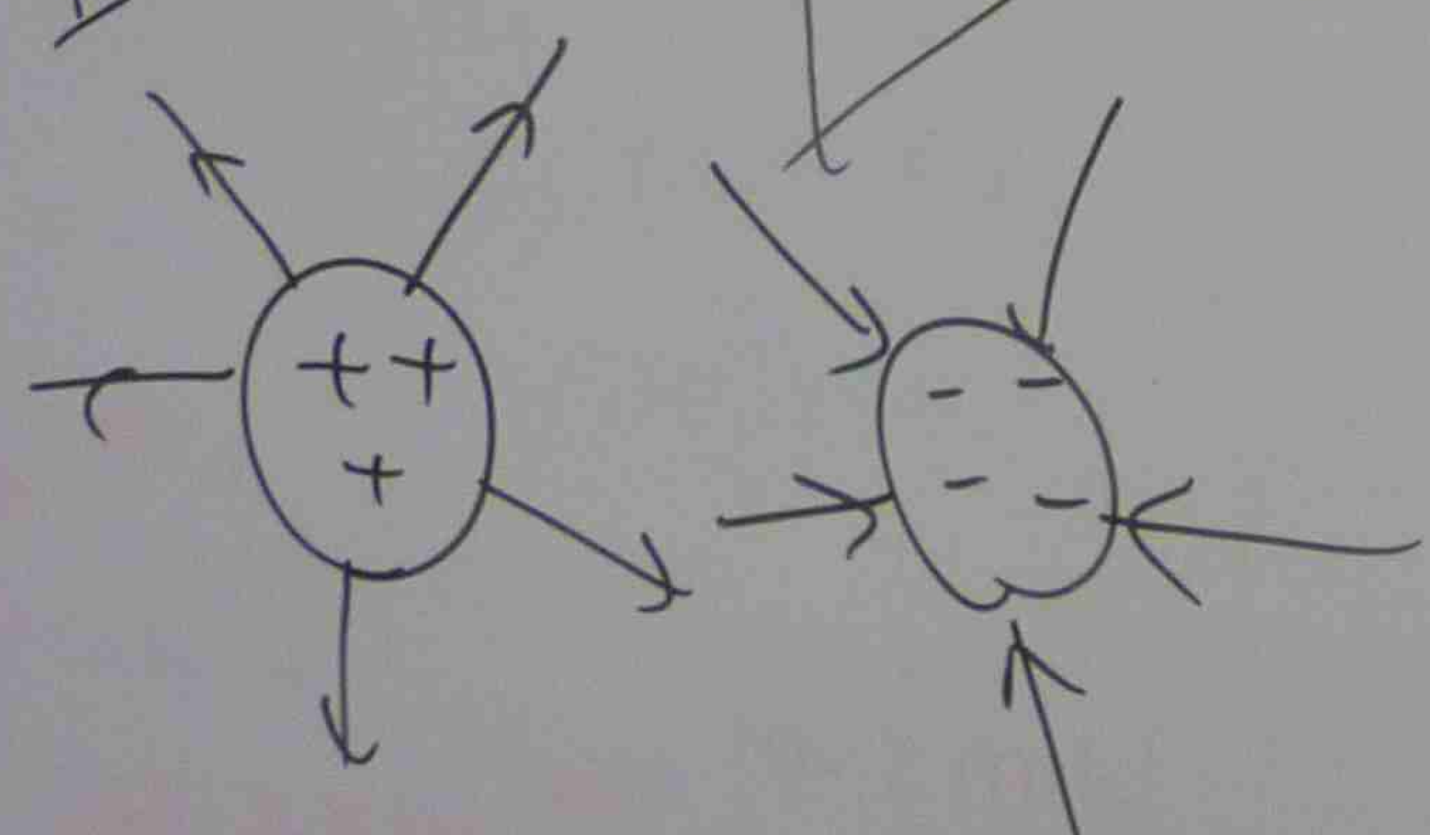
$$E = \frac{F}{q}$$

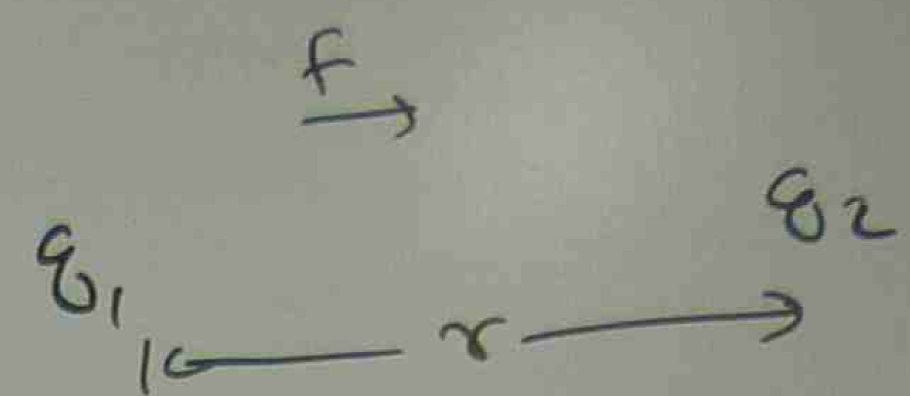
F = ELECTRIC FORCE

q = CHARGE

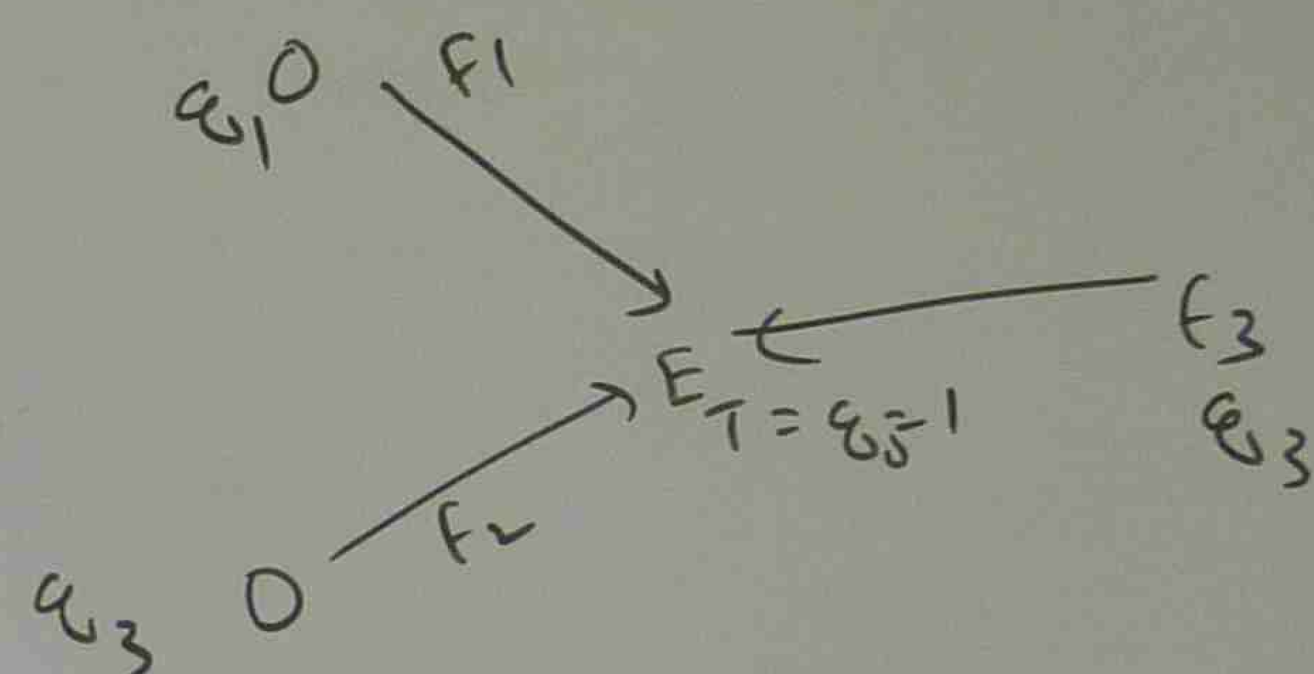
E = ELECTRIC FIELD







$$\vec{F} = \frac{1}{4\pi\varepsilon_0}\,\frac{q_1 q_2}{r^2}$$



$$\vec{F_T} = f_1 + f_2 + f_3$$

$$\vec{E_T} = \frac{f_1}{q_1} + \frac{f_2}{q_2} + \frac{f_3}{q_3}$$

$$\vec{E_T} = \overline{E_1} + \overline{E_2} + \overline{E_3}$$

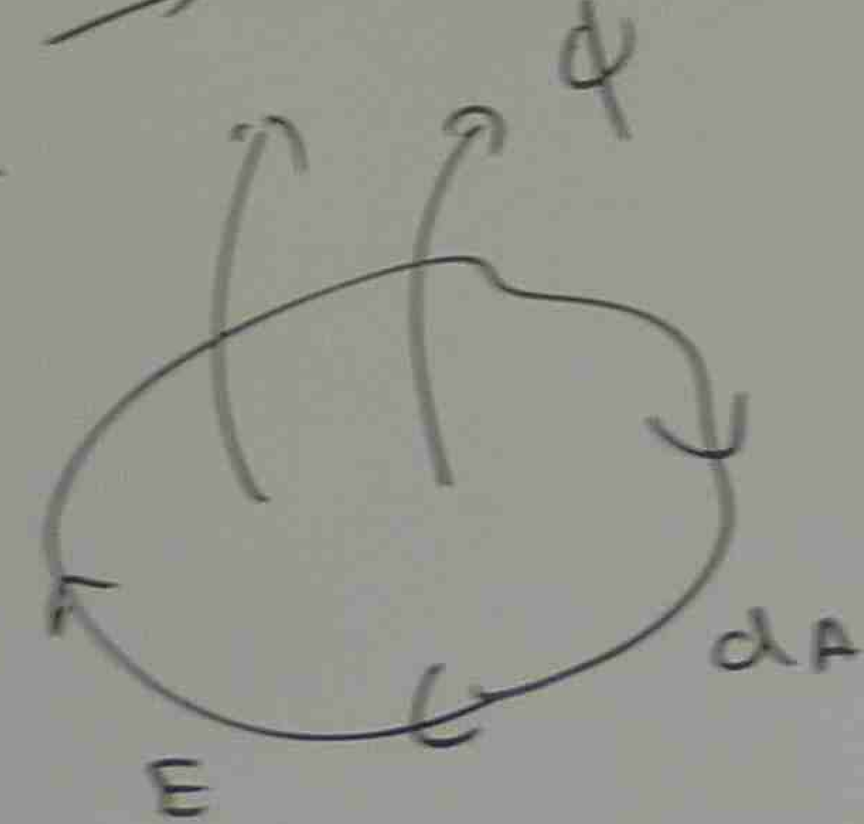
FLUX OF AN ELECTRIC FIELD

$$\phi = \sum E \times \Delta A$$

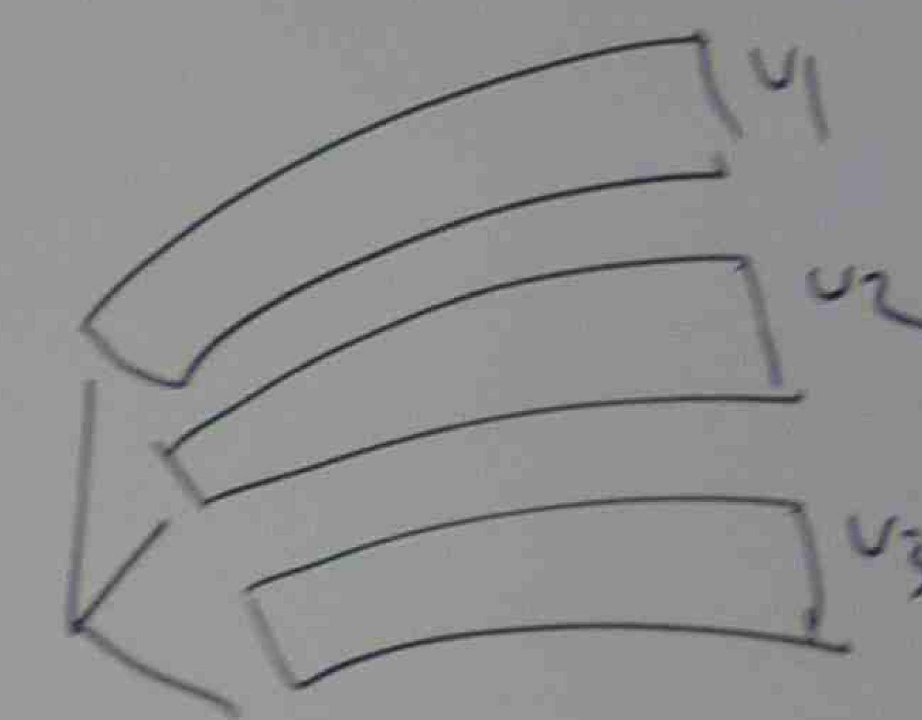
$$\phi = \oint E \, \Delta A$$

SURFACE INTEGRAL

ELECTRIC FLUX THROUGH A GAUSSIAN SURFACE



EQUIPOTENTIAL SURFACES



EQUIPOTENTIAL SURFACE $V_1 = V_2 = V_3$

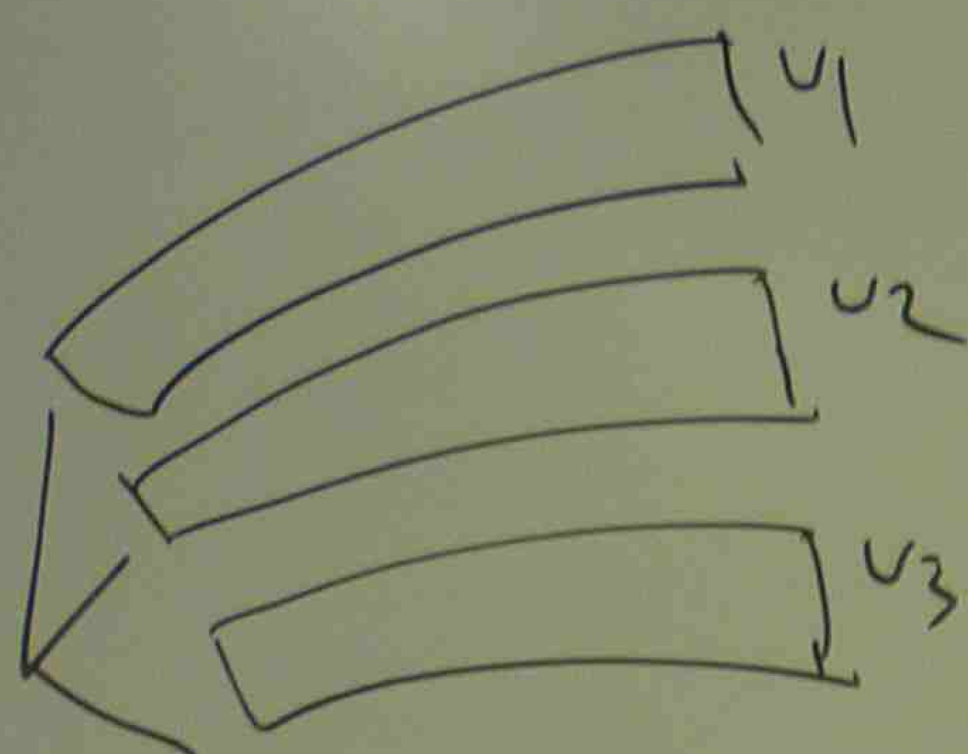
CALCULATING THE POTENTIAL

$V_f - V_i$ f

$$V_f - V_i = -\int_i^{f} \vec{E} \, ds$$

...CTRIC FLUX
...ROUGH A
... SSIAN
...RFACE

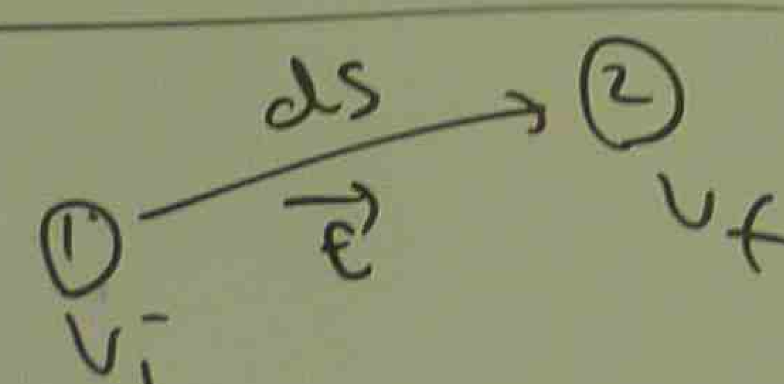
EQUIPOTENTIAL SURFACES



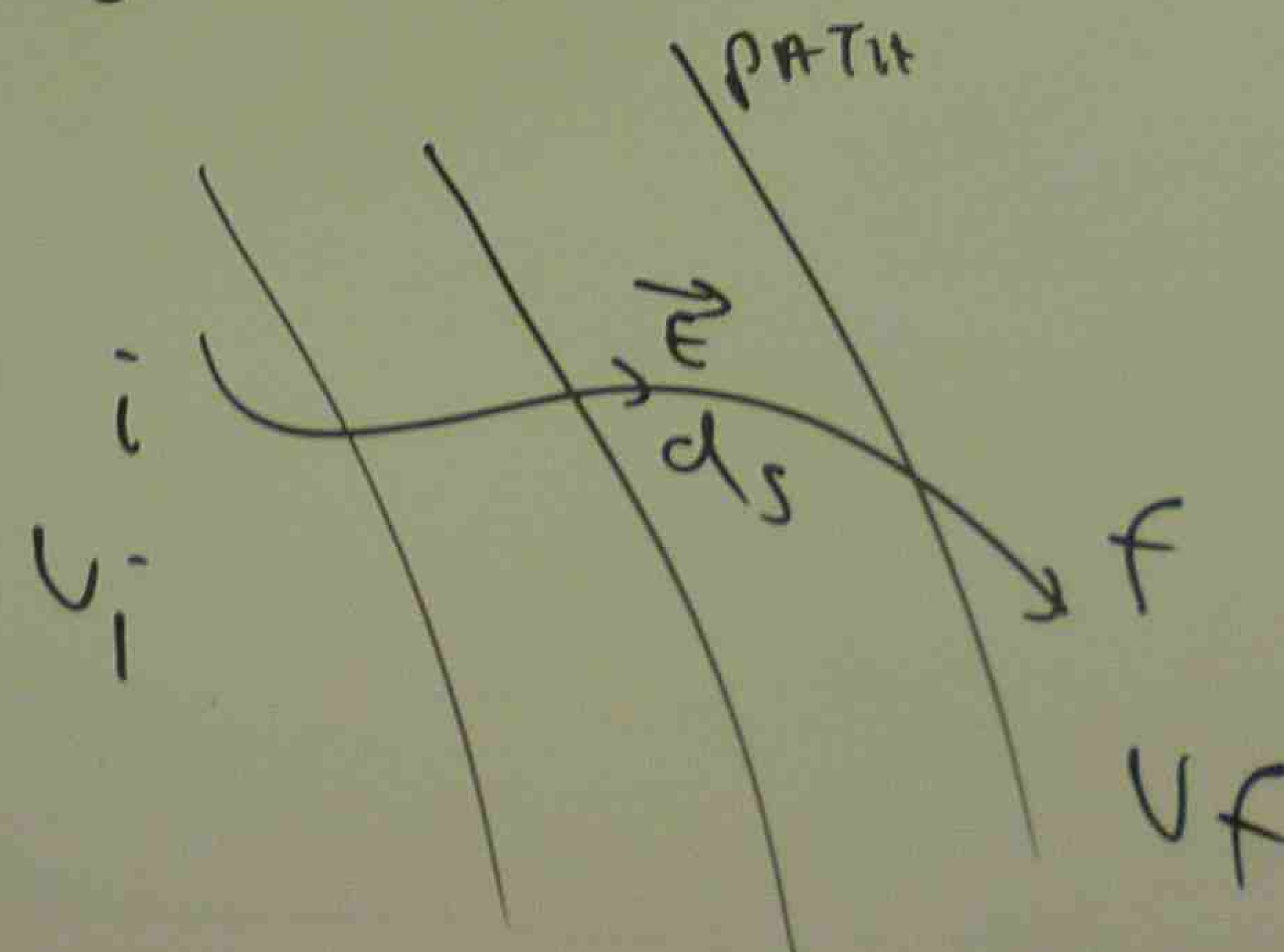
EQUIPOTENTIAL SURFACE $V_1 = V_2 = V_3$

CALCULATING THE POTENTIAL FROM THE FIELD

$V_f - V_i$



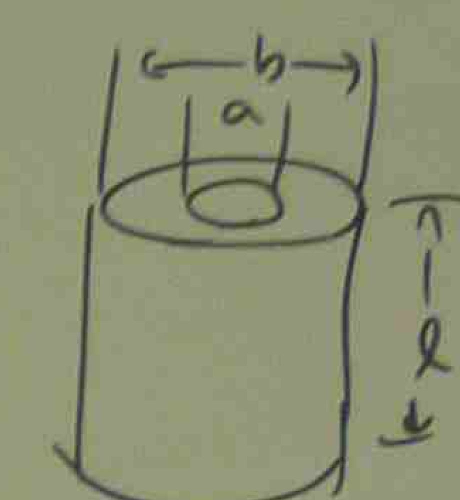
$$V_f - V_i = -\int_i^f \vec{E}\, ds$$



SPERICAL CAPACITOR

$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$$

CYLINDERICAL CAPACITOR



$$V = \frac{q}{4\pi\varepsilon_0} \times \frac{b-a}{ab}$$

$$C = 4\pi\varepsilon_0 \frac{ab}{b-a}$$

CAPACITORS STORE THE ELECTRIC CHARGE THEY PRODUCE THE ELECTRIC FIELD.

C...

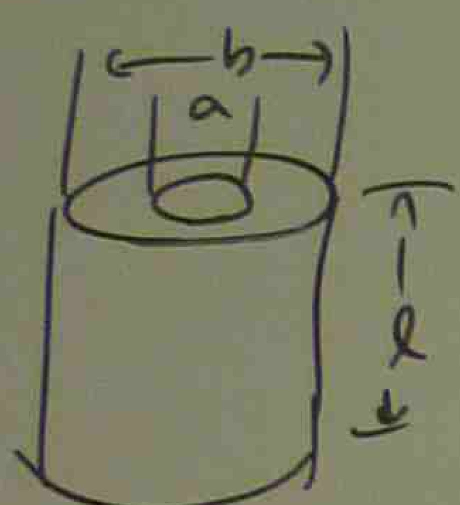
CAP...

E

CAL CAPACITOR

$E = \frac{1}{4\pi \varepsilon_0} \frac{\varepsilon}{r^2}$

LICAL



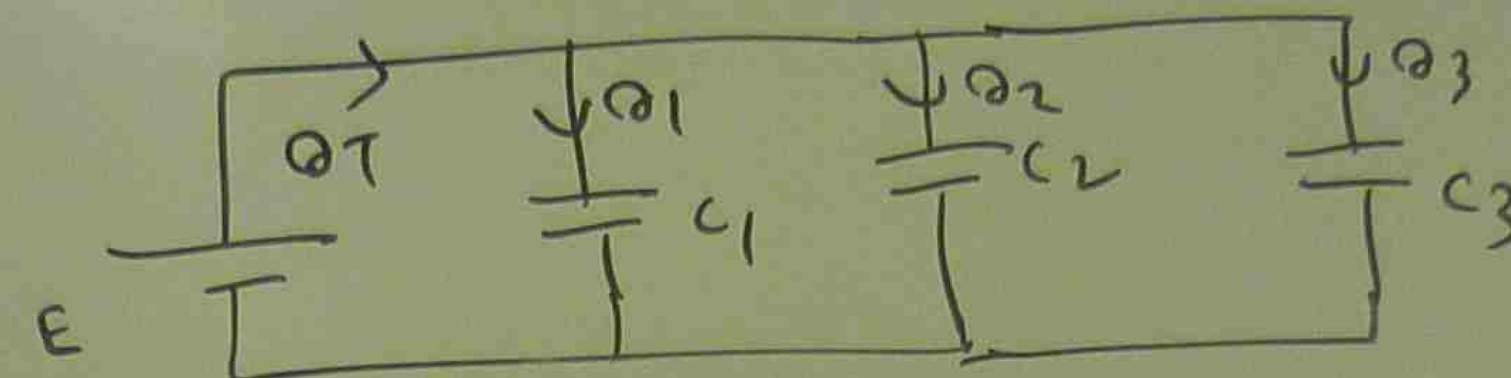
$V = \frac{\varepsilon}{4\pi\varepsilon_0} \times \frac{b-a}{ab}$

$c = 4\pi\varepsilon_0 \frac{ab}{b-a}$

CAPACITORS STORE THE ELECTRIC CHARGE THEY PRODUCE THE ELECTRIC FIELD.

Uf

CAPACITORS IN PARALLEL



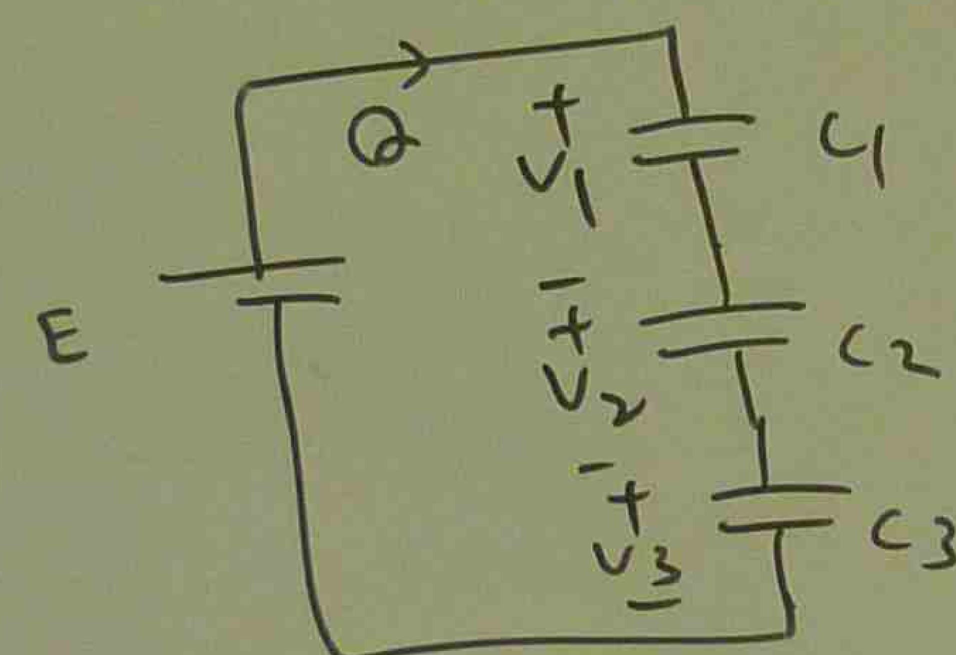
$C_T = C_1 + C_2 + C_3$

$Q_T = Q_1 + Q_2 + Q_3$

$Q_1 = C_1 V$, $Q_2 = C_2 V$

$Q_3 = C_3 V$

CAPACITORS IN SERIES



Q = SAME CHARGE

$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

$\Delta E =$ EN

$\Delta E =$ h

Pb. AN ELEC
DEEP POTEN
(a) WHAT I
CAN HAVE
(b) HOW
ELECT
FROM
(c) IF T
FROM E
ABSORB

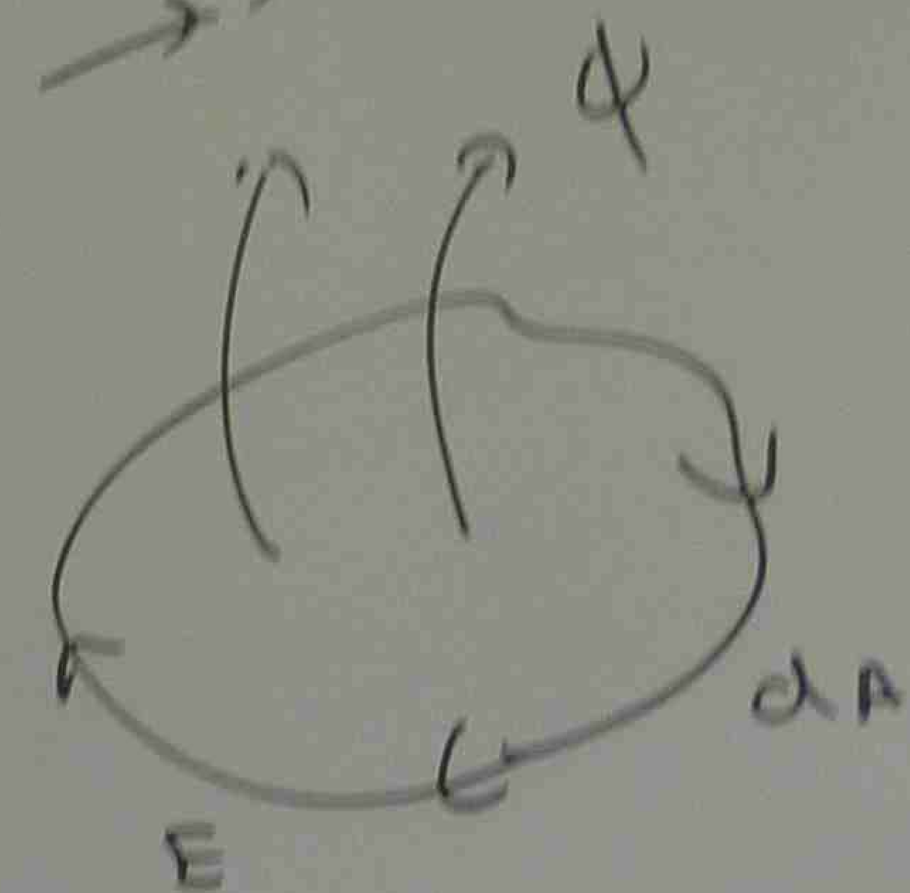
FLUX OF AN ELECTRIC FIELD

$$\phi = \sum E \times \Delta A$$

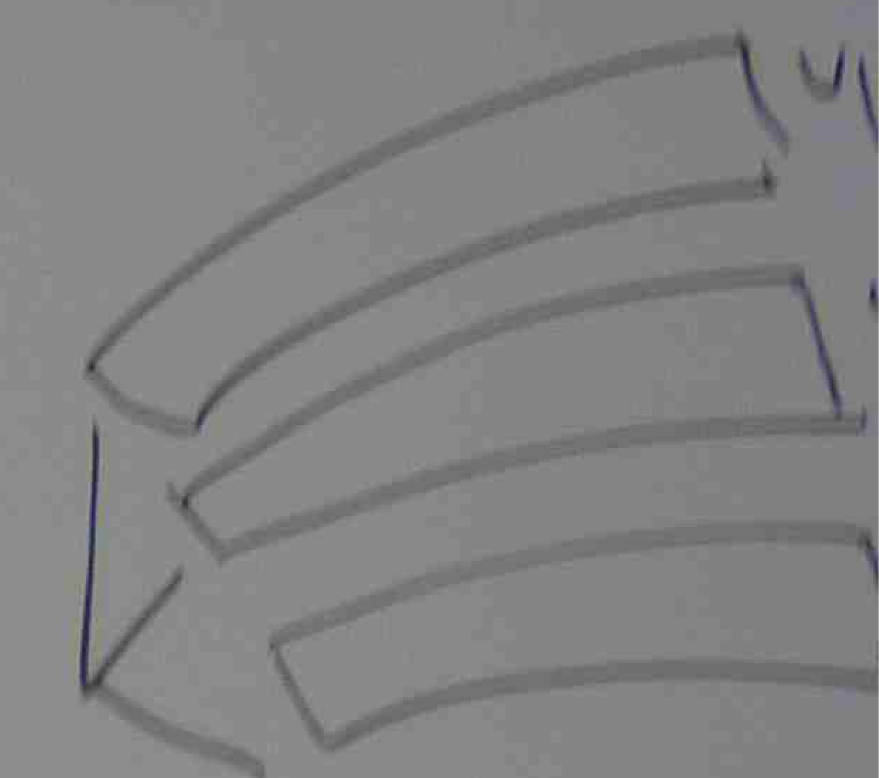
$$\phi = \oint E \, \Delta A$$

ELECTRIC FLUX THROUGH A GAUSSIAN SURFACE

SURFACE INTEGRAL



EQUIPOTENTIAL SURFACES



EQUIPOTENTIAL SURFACE $V_1 =$

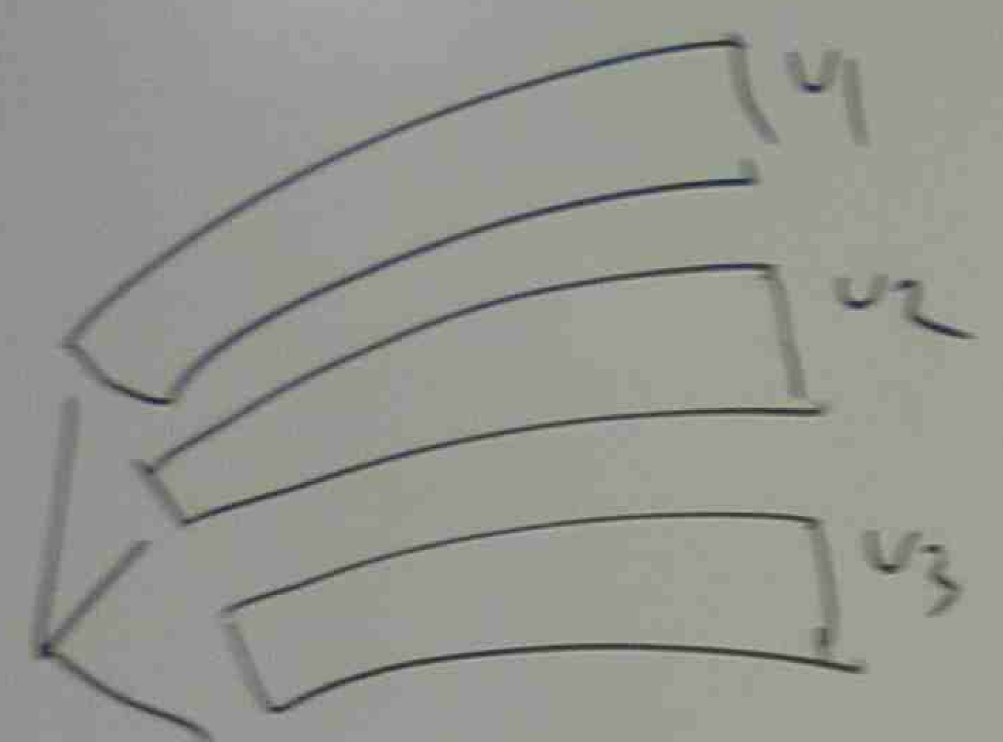
CALCULATING THE

$$V_f - V_i$$

$$V_f - V_i = -$$

...ECTRIC FLUX
...ROUGH A
...USSIAN
...RFACE

EQUIPOTENTIAL SURFACES



EQUIPOTENTIAL SURFACE $V_1 = V_2 = V_3$

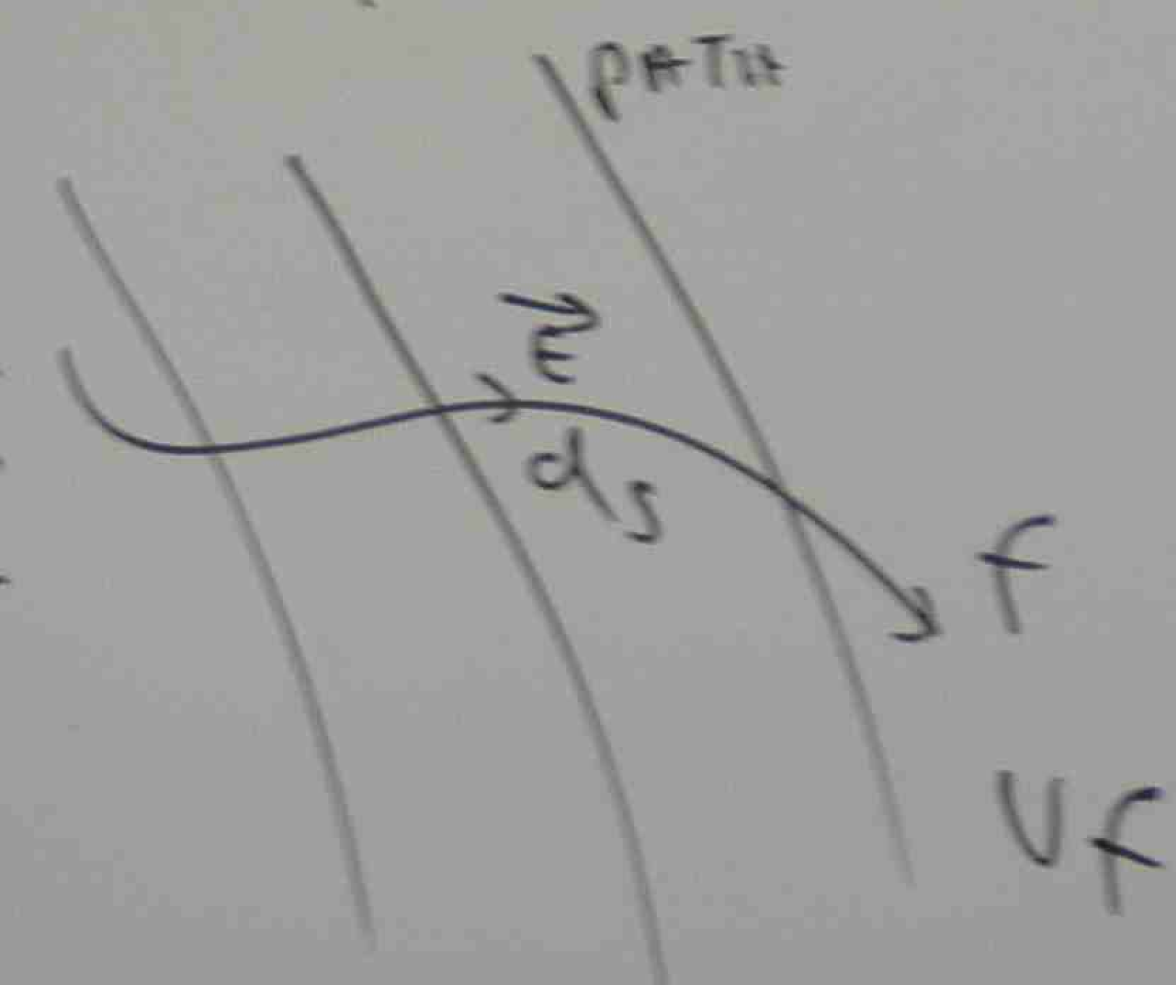
CALCULATING THE POTENTIAL FROM THE FIELD

$V_f - V_i$

① V_i $\xrightarrow{ds}$ ② V_f

$\vec{E}$

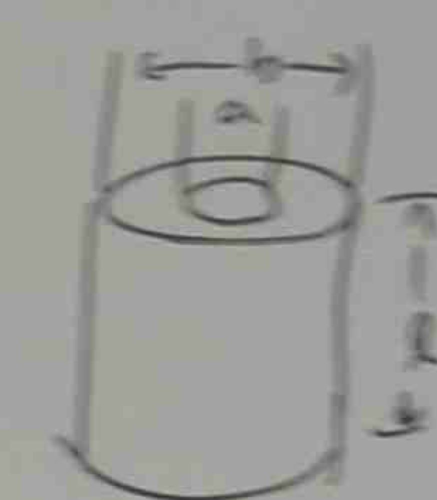
$$V_f - V_i = -\int_i^f \vec{E}\, ds$$



SPERICAL CAPACITOR

$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$$

CYLINDERICAL CAPACITOR



$$V = \frac{q}{4\pi\varepsilon_0} \times \frac{b-a}{ab}$$

$$C = 4\pi\varepsilon_0 \frac{ab}{b-a}$$

CAPACITORS STORE THE ELECTRIC CHARGE THEY PRODUCE THE ELECTRIC FIELD.

CAP...

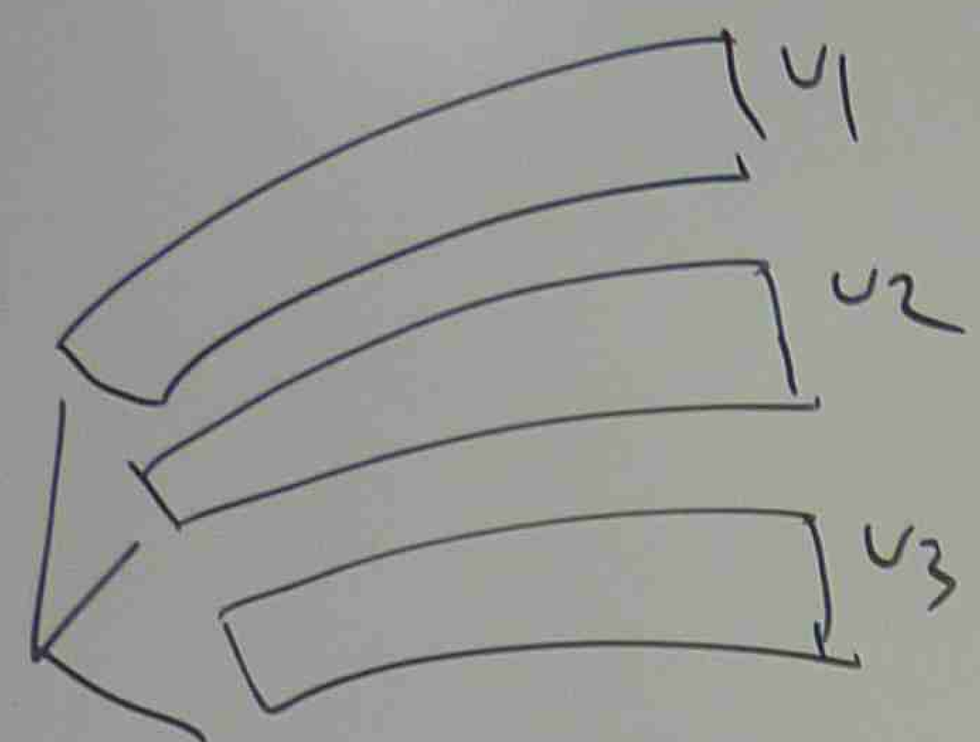
E

CAPAC...

E

= flux
h A
AW
E

EQUIPOTENTIAL SURFACES



EQUIPOTENTIAL SURFACE $\quad V_1 = V_2 = V_3$

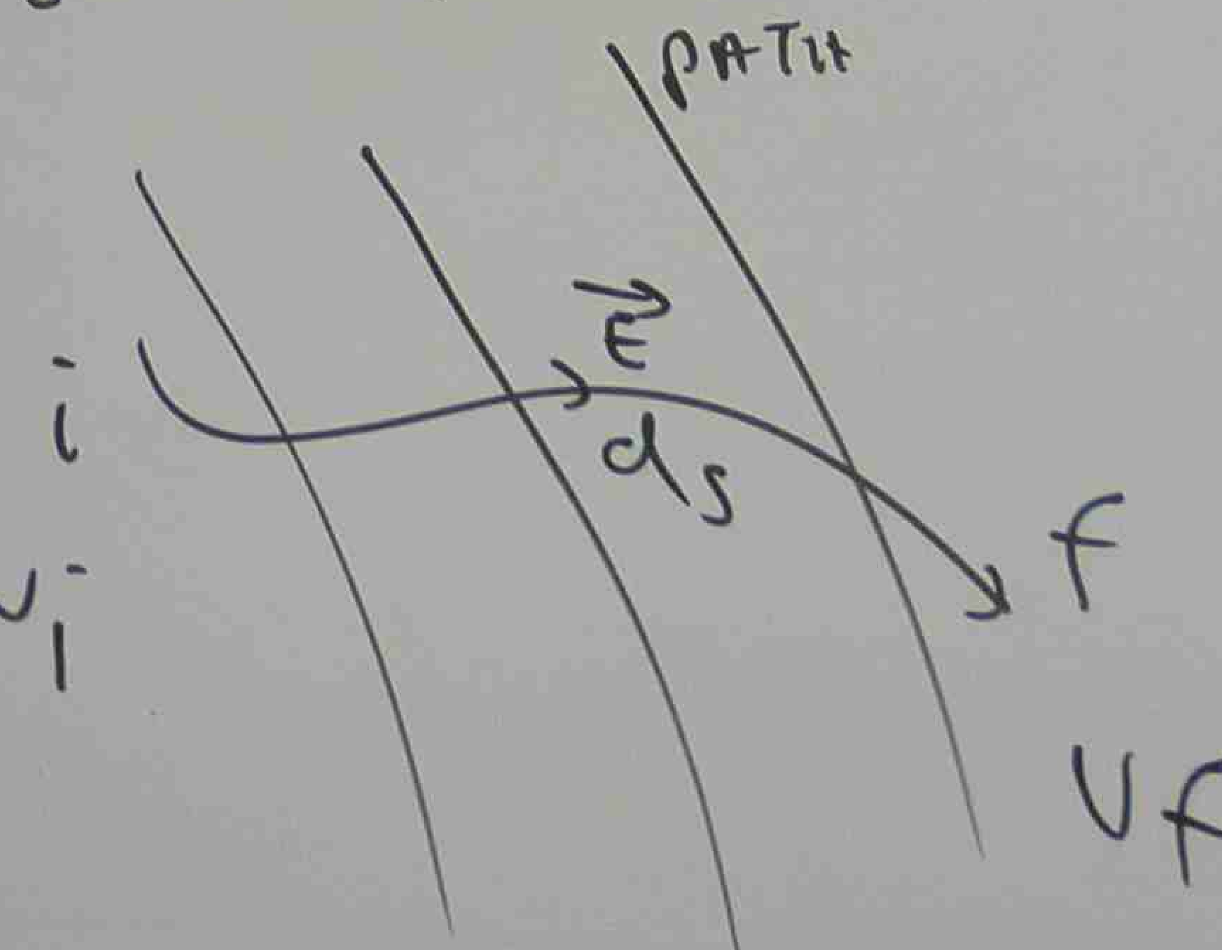
CALCULATING THE POTENTIAL FROM THE FIELD

$V_f - V_i$

$$① \xrightarrow[\vec{E}]{ds} ②$$

$V_i \qquad V_f$

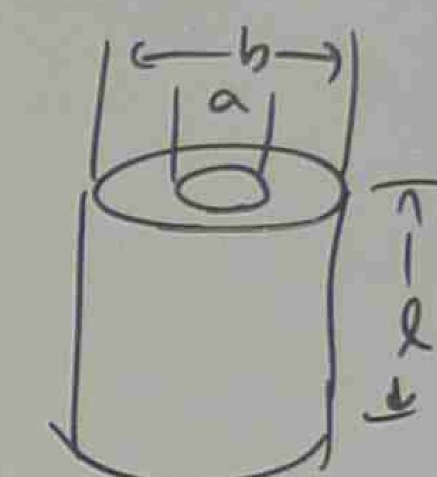
$$V_f - V_i = -\int_i^f \vec{E}\, ds$$



SPERICAL CAPACITOR

$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$$

CYLINDERICAL CAPACITOR



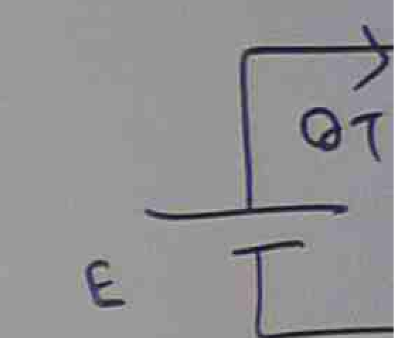
$$V = \frac{q}{4\pi\varepsilon_0} \times \frac{b-a}{ab}$$

$$C = 4\pi\varepsilon_0 \frac{ab}{b-a}$$

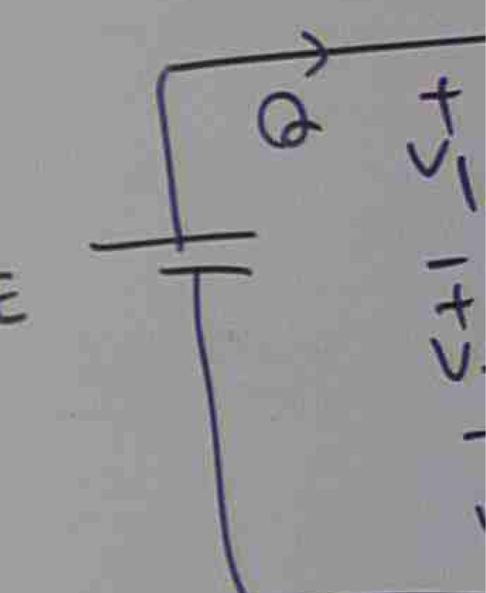
CAPACITORS STORE THE ELECTRIC CHARGE

THEY PRODUCE THE ELECTRIC FIELD.

CAPACITORS

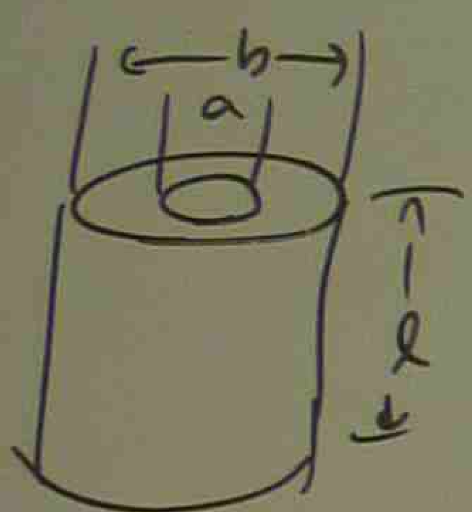


CAPACITORS



CAPACITOR

$$\frac{1}{4\pi\varepsilon_0}\ \frac{q}{r^2}$$



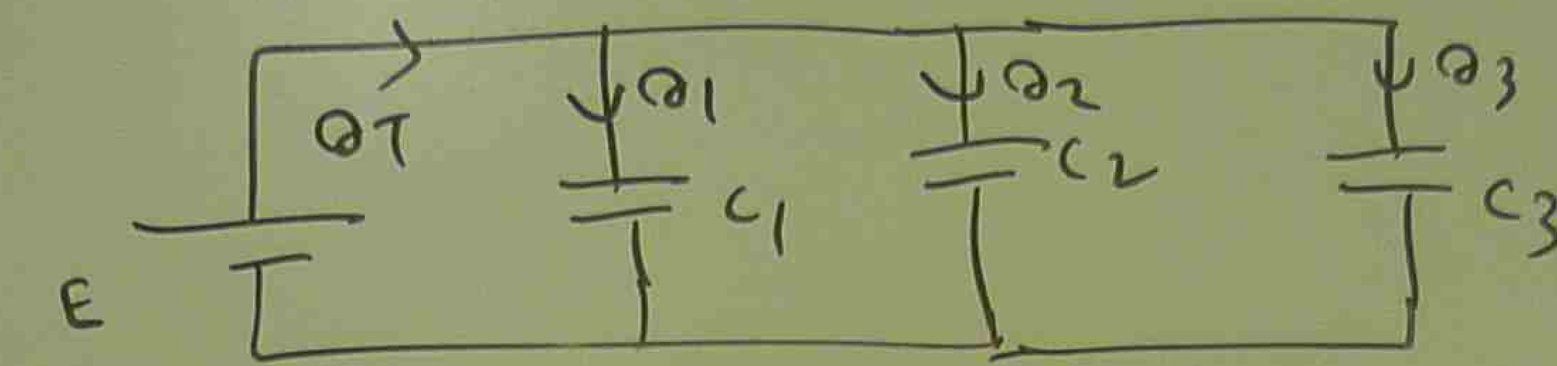
$$V = \frac{q}{4\pi\varepsilon_0} \times \frac{b-a}{ab}$$

$$c = 4\pi\varepsilon_0 \frac{ab}{b-a}$$

CAPACITORS STORE THE ELECTRIC CHARGE

THEY PRODUCE THE ELECTRIC FIELD.

CAPACITORS IN PARALLEL



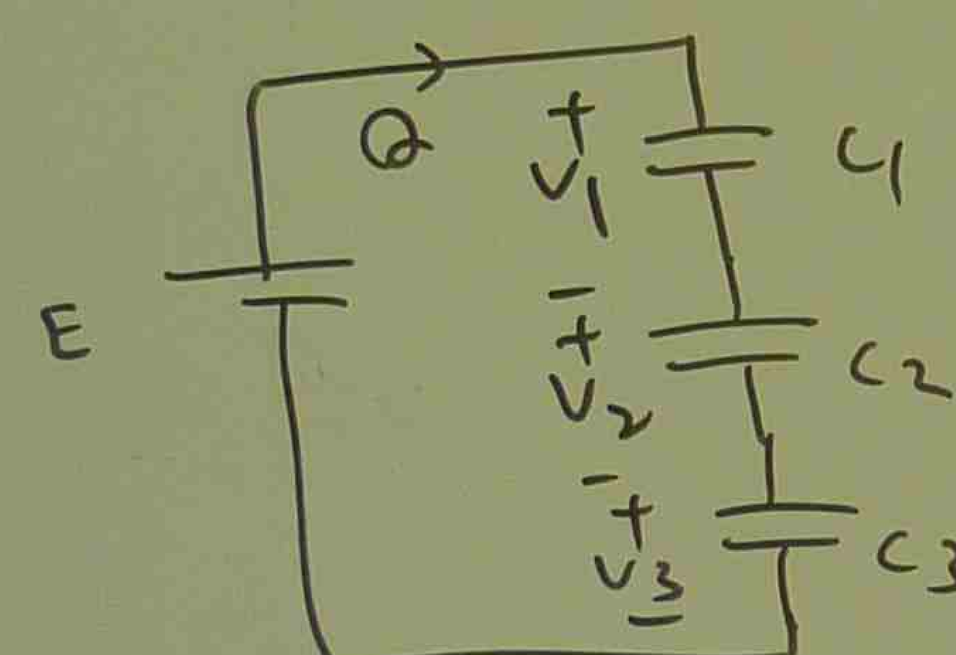
$$C_T = C_1 + C_2 + C_3$$

$$Q_T = Q_1 + Q_2 + Q_3$$

$$Q_1 = C_1 V,\quad Q_2 = C_2 V$$

$$Q_3 = C_3 V$$

CAPACITORS IN SERIES



Q = SAME CHARGE

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

MAG

$B = m$

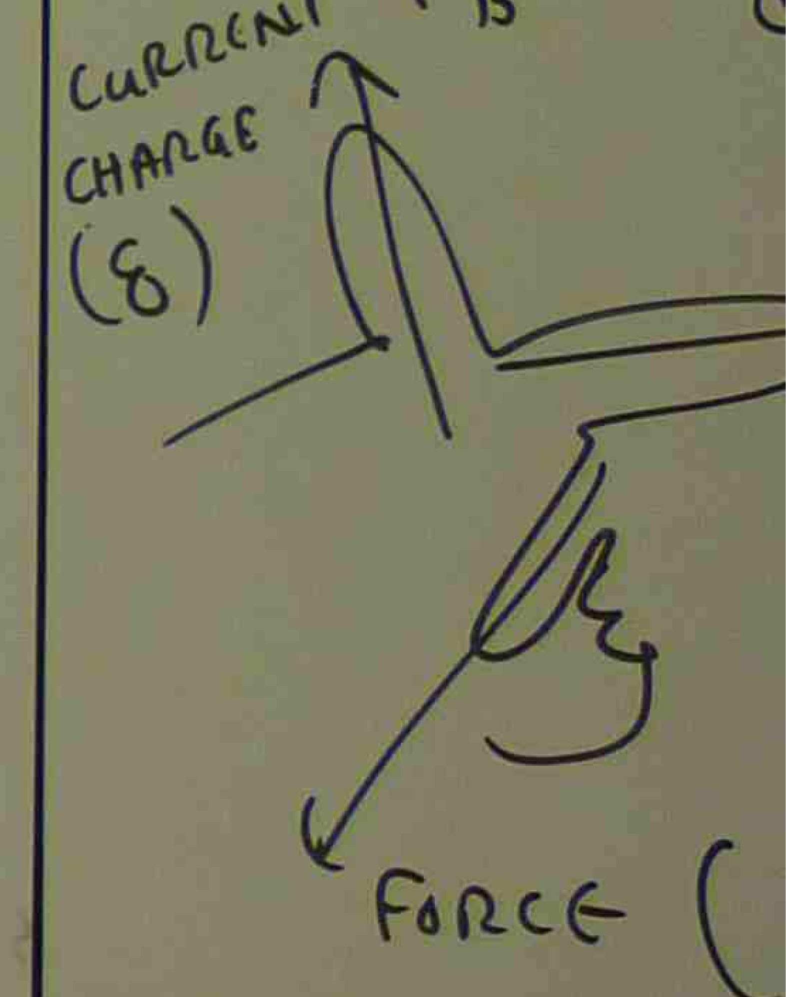
$F_B = $

$q = $

$V = ve$

$B = $

$\vec{F}_B = q$



$C_T = C_1 + C_2 + C_3$

$Q_T = Q_1 + Q_2 + Q_3$

$C_1 V, \quad Q_2 = C_2 V$

$Q_3 = C_3 V$

$+ \frac{1}{C_3}$

MAGNETIC FIELD — PRODUCED BY MAGNETIC CHARGES

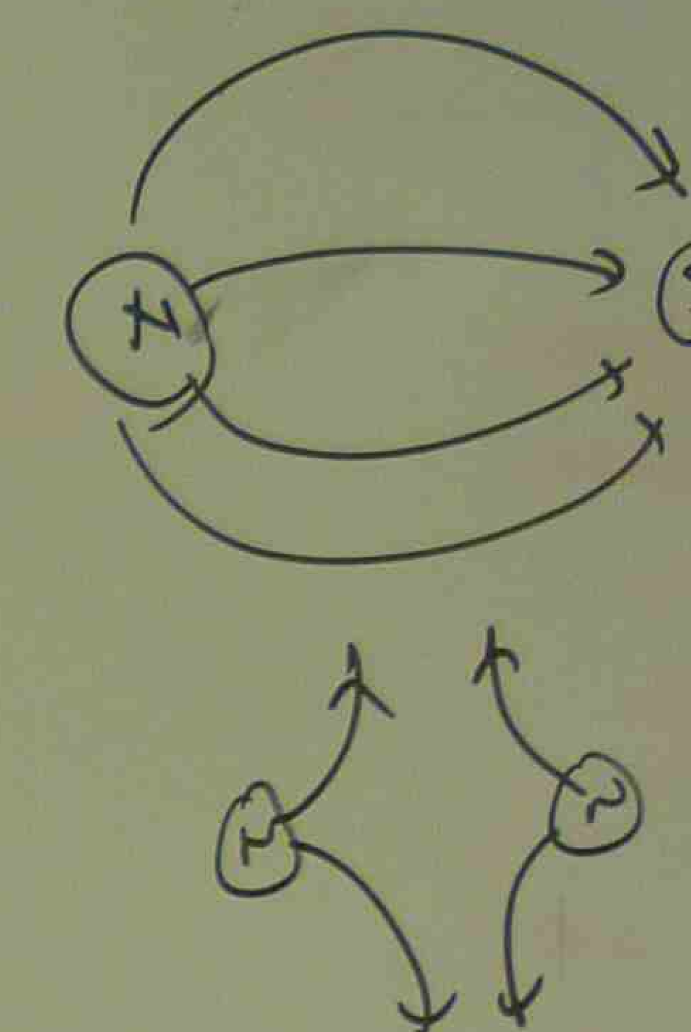
B = MAGNETIC FIELD DENSITY

F_B : MAGNETIC FORCE

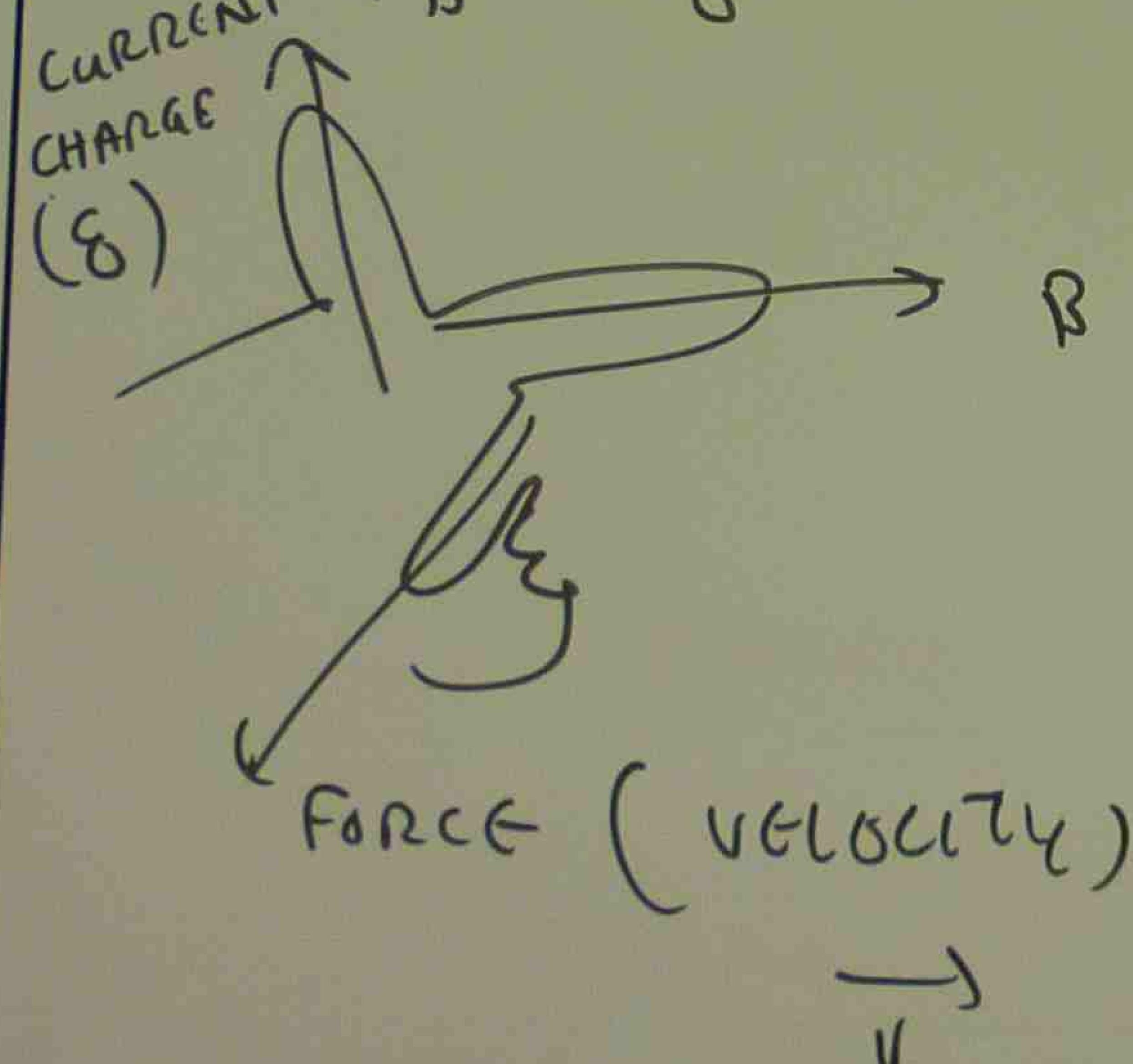
q = CHARGE OF PARTICLE

V = VELOCITY OF PARTICLE

$$B = \frac{F_B}{|q| \times V}$$



$$\vec{F_B} = q\vec{V} \times \vec{B}$$



$$F_B = |q| V \times B \sin\phi$$

pn

A UNIFORM MAGN

DIRECTED VERTICALLY

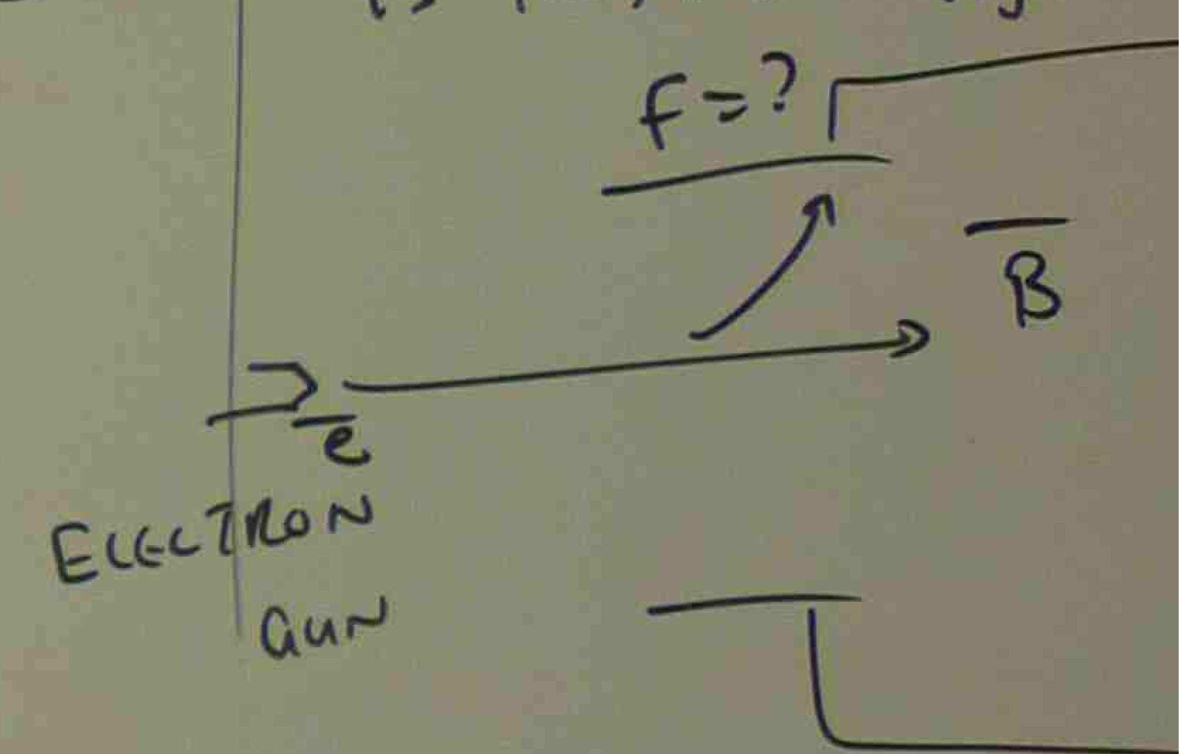
LABORATORY CHAMBE

5.3 MeV ENTERS

SOUTH TO NORTH. WH

THE PROTON AS IT

IS 1.67×10^{-27} kg.

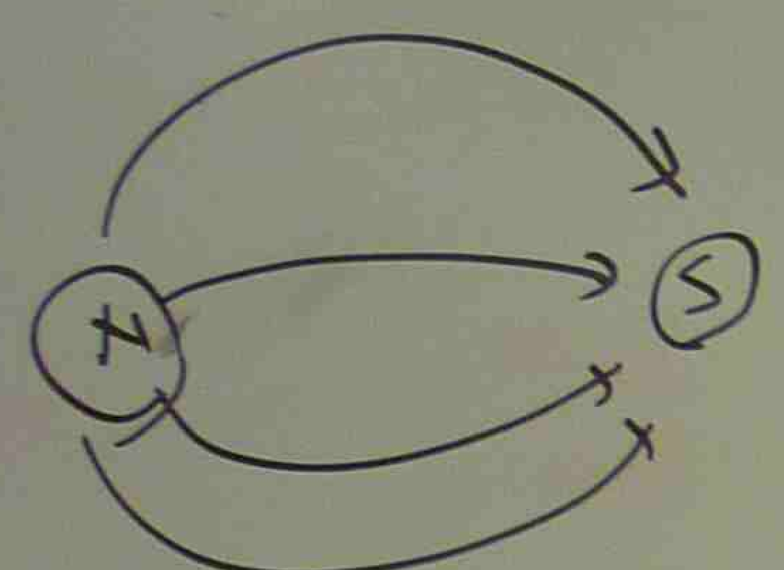


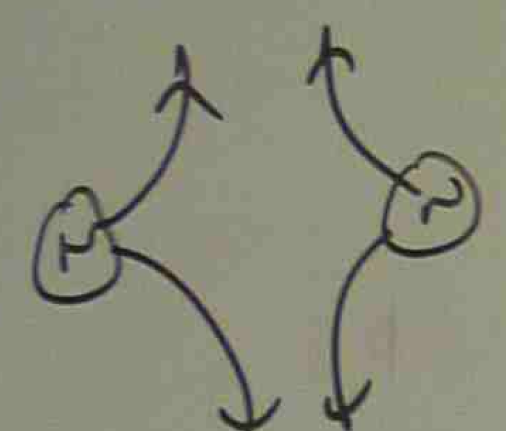
$F_B = |q| V B$

$= (1.6 \times 10^{-19} C)$

$= 6.1 \times 10^{-15}$

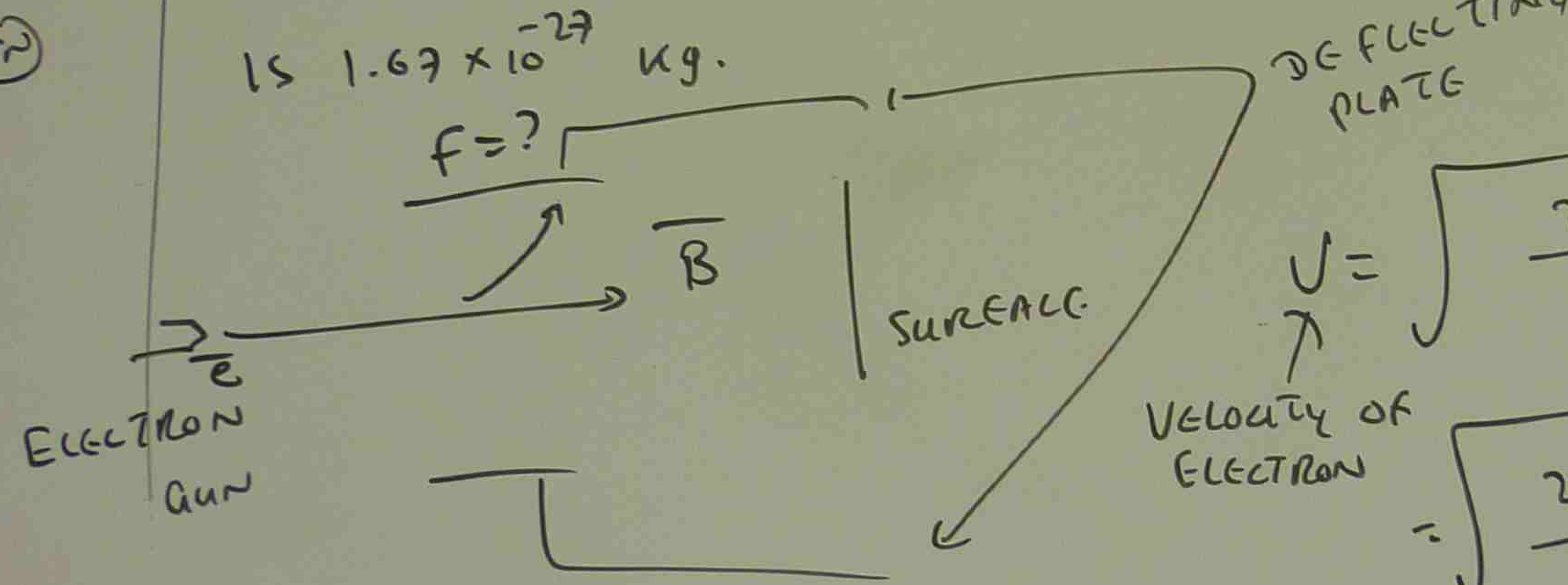
BY MAGNETIC
GES





$\ldots B \sin\phi$

pn/ A UNIFORM MAGNETIC FIELD $\vec{B}$ WITH MAGNITUDE 1.2 mT IS DIRECTED VERTICALLY UPWARD THROUGHOUT THE VOLUME OF A LABORATORY CHAMBER. A PROTON WITH KINETIC ENERGY 5.3 MeV ENTERS THE CHAMBER, MOVING HORIZONTALLY FROM SOUTH TO NORTH. WHAT MAGNETIC DEFLECTING FORCE ACTS ON THE PROTON AS IT ENTERS THE CHAMBER? THE PROTON'S MASS IS 1.67×10^{-27} kg.



$$V = \sqrt{\frac{2K}{m}}$$

VELOCITY OF ELECTRON

$$= \sqrt{\frac{2 \times 5.3 \times 1.6 \times 10^{-13}}{1.67 \times 10^{-27}\ \text{kg}}}$$

$$= 3.2 \times 10^{7}\ \text{m/s}$$

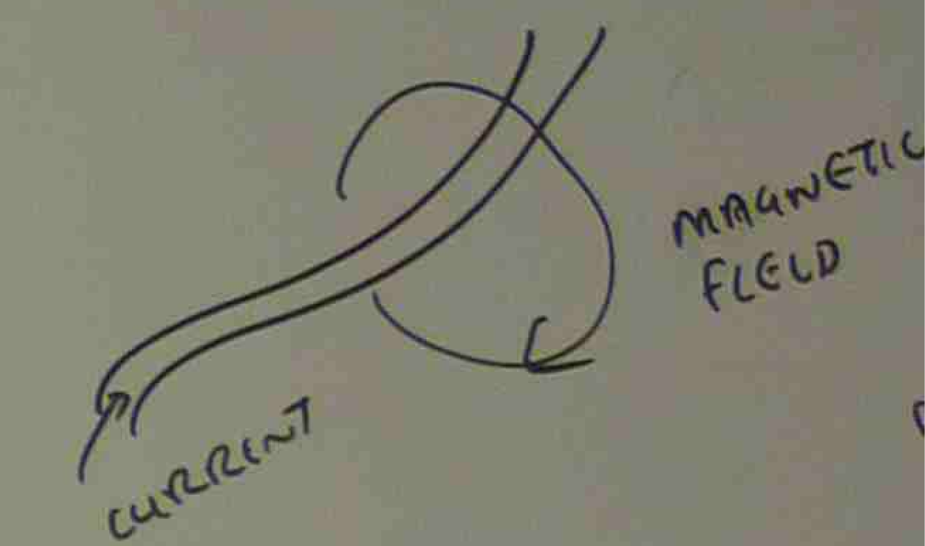
$$F_B = |q|\, V\, B \sin\phi$$

$$= (1.6 \times 10^{-19}\ \text{C}) \times (3.2 \times 10^{7}) \times 1.2 \times 10^{-3}\ \text{T} \sin 90$$

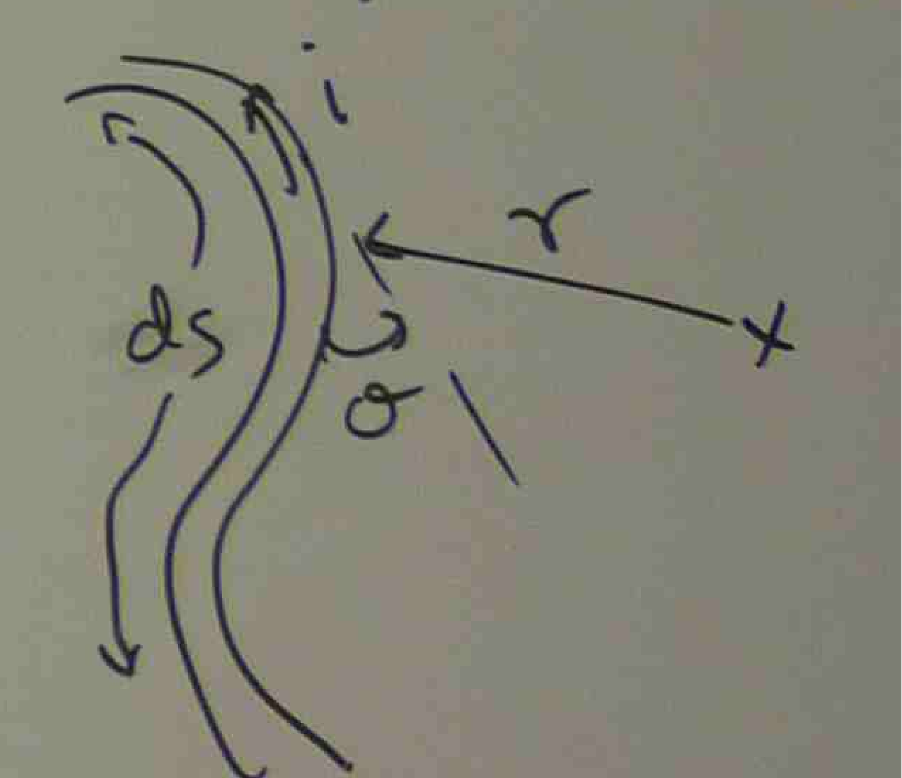
$$= 6.1 \times 10^{-15}\ \text{N}$$

$$a = \frac{F_B}{m} = \frac{6.1 \times 10^{-15}\ \text{N}}{1.67 \times 10^{-27}\ \text{kg}} = 3.7 \times 10^{12}\ \text{m/s}^2$$

CALCULATING MAGNETIC FIELD



$$dB = \frac{\mu_0}{4\pi} \frac{i\, ds}{r \ldots}$$



IS

A

FROM

ON

S MASS

1.6×10^{-13}

kg

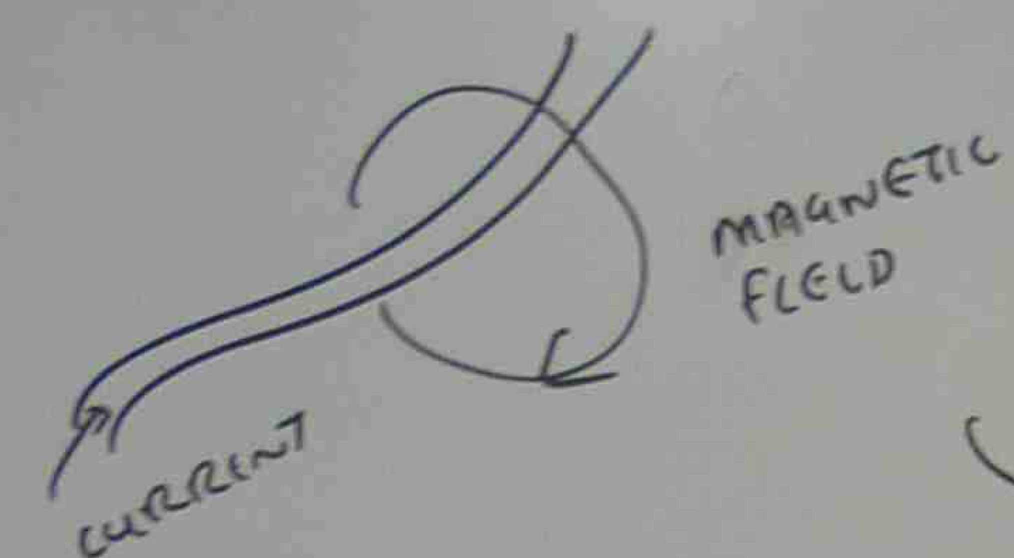
m/s

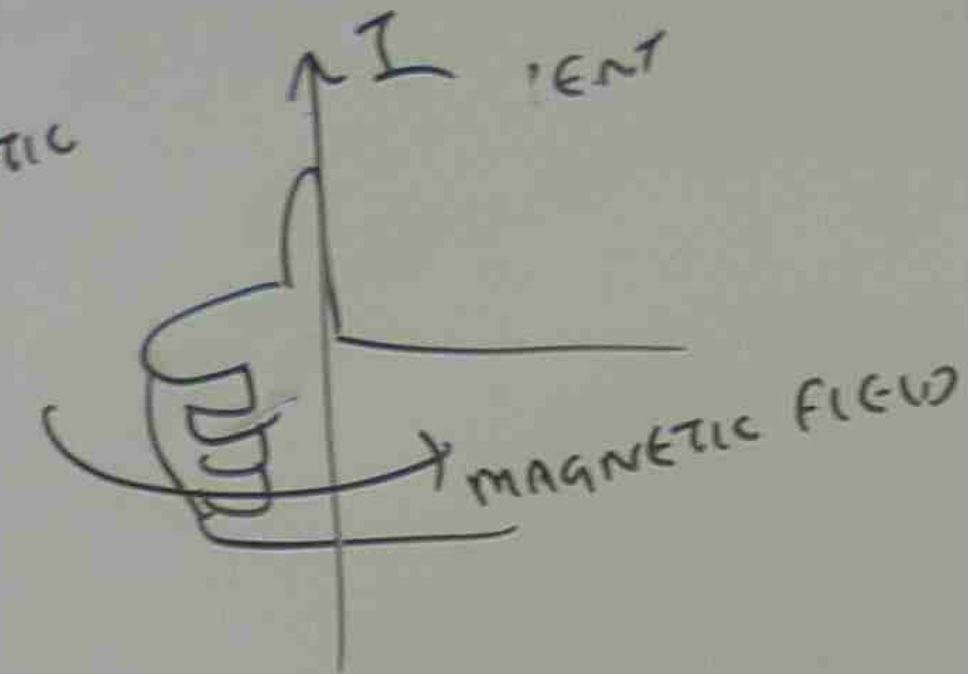
12

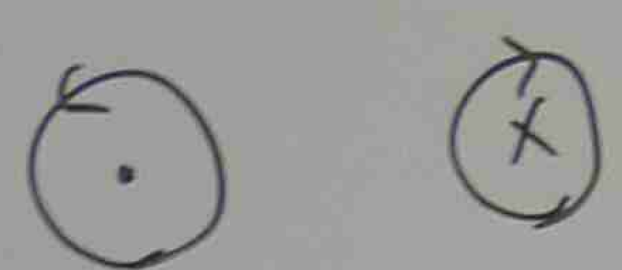
$= 3.7 \times 10$

kg m/s^2

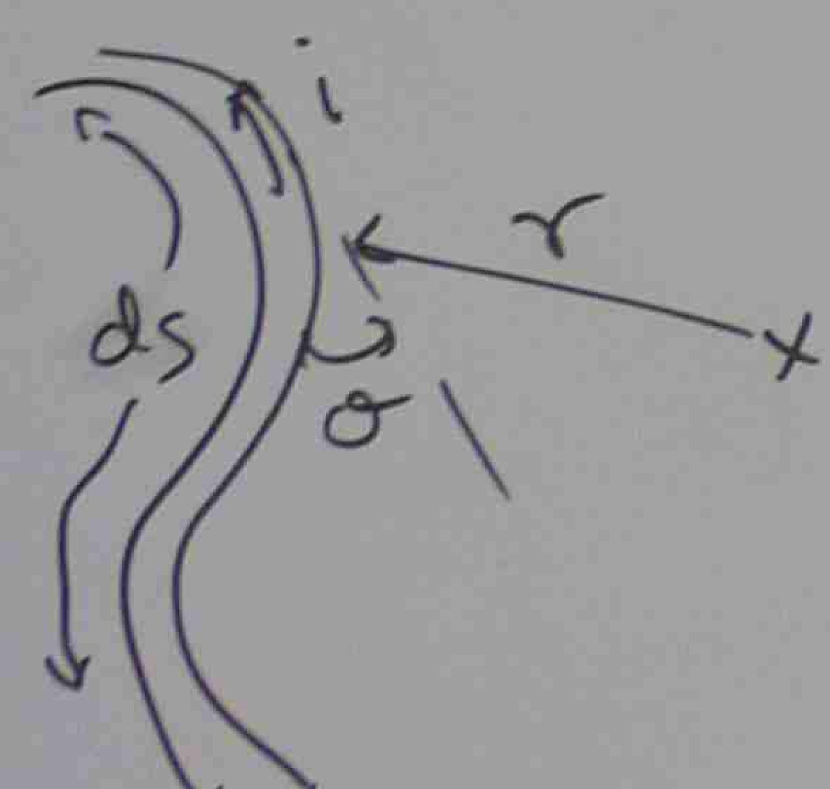
CALCULATING MAGNETIC FIELD DUE TO CURRENT







$$dB = \frac{\mu_0}{4\pi} \frac{i\, ds \sin\theta}{r^2}$$



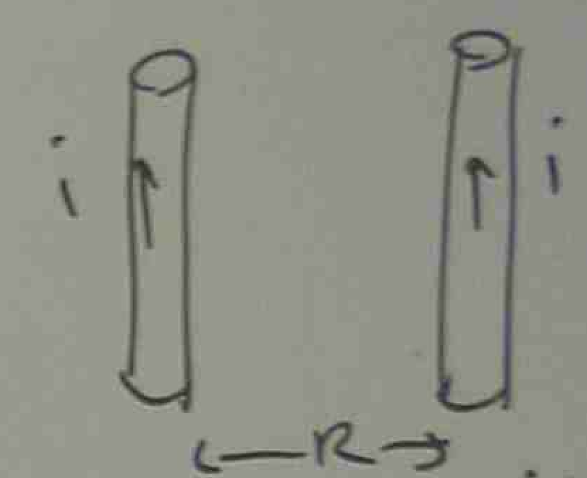
μ_0 = AIR PERMEABILITY
$4\pi \times 10^{-7}$

i = CURRENT

ds = CURVE LENGTH

r = DISTANCE FROM REFERENCE

MAGNETIC FIELD DUE TO A CURRENT IN A LONG STRAIGHT WIRE



$$B = \frac{\mu_0\, i}{2\pi R}$$

AMPERE'S LAW

NET MAGNETIC FIELD DUE TO ANY DISTRIBUTION OF CHARGES.

$$\oint \vec{B} \cdot ds = \mu_0\, i$$

MAGNETIC FIELD INSIDE A LONG STRAIGHT WIRE WITH CURRENT

$$B = \left(\frac{\mu_0 I}{2\pi R^2}\right) r$$

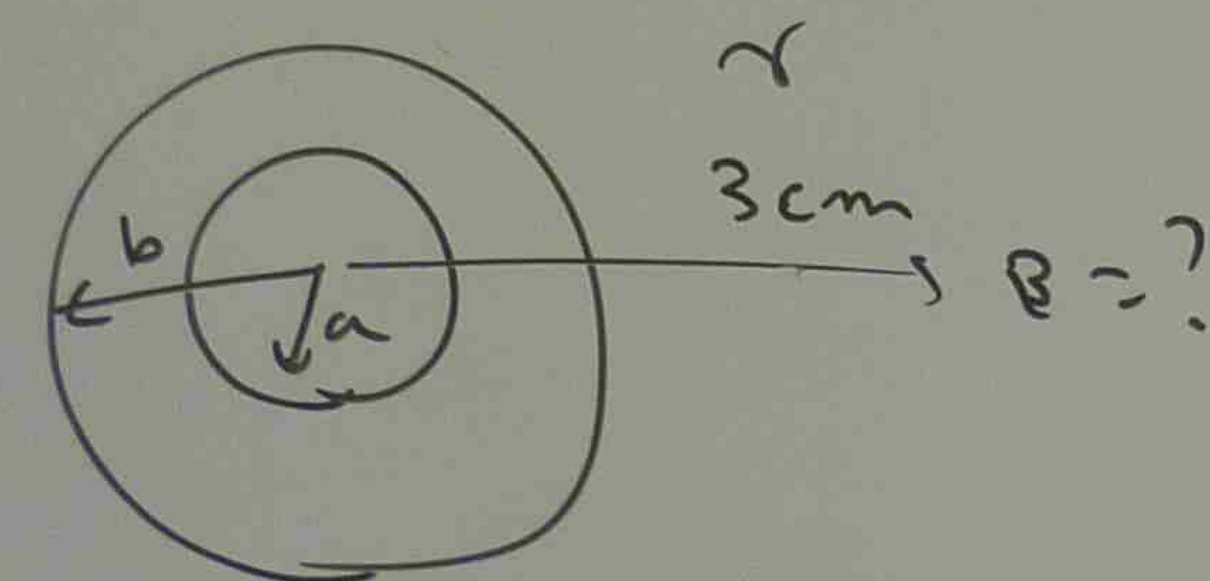
MAGNETIC FIELD OUTSIDE A LONG STRAIGHT WIRE WITH CURRENT

$$B = \frac{\mu_0 I}{2\pi r}$$

PN THE FIGURE SHOWS THE CROSS SECTION OF A LONG CONDUCTING CYLINDER WITH INNER RADIUS $a = 2$ cm AND OUTER RADIUS $b = 4$ cm. THE CYLINDER CARRIES A CURRENT OUT OF THE PAGE. THE CURRENT DENSITY IS $J = c\,r^2$, $c = 3 \times 10^6$ A/m^4

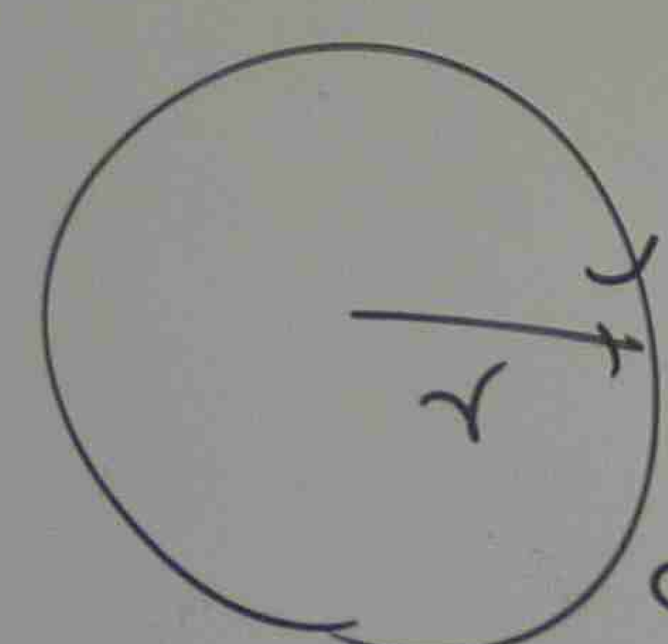
r IN METER

WHAT IS THE MAGNETIC FIELD $\vec{B}$ AT A POINT THAT IS 3 cm FROM THE CENTRAL AXIS OF THE CYLINDER?



$$i = \int J\, dA$$

$$i = \frac{\pi c\,(r^4 - a^4)}{2}$$



$$\oint B\,ds = \mu_0\, i$$

CIRCUMFERENCE $\oint = 2\pi r$

$$2\pi r \times B = \mu_0\, i$$

$2\pi r\ B = \mu_0$

$2\pi \times 3 \times B =$

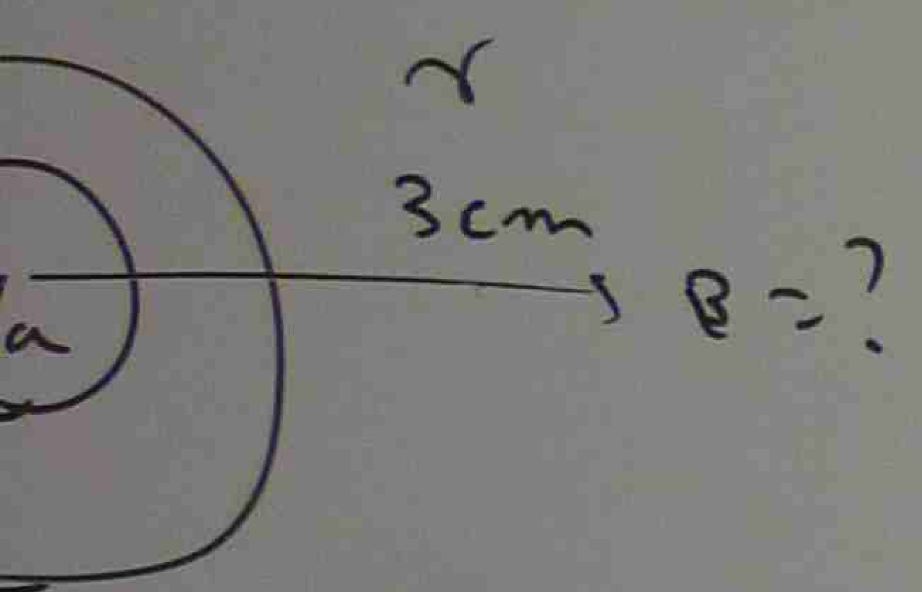
$B =$

AT 3cm

$|B| =$

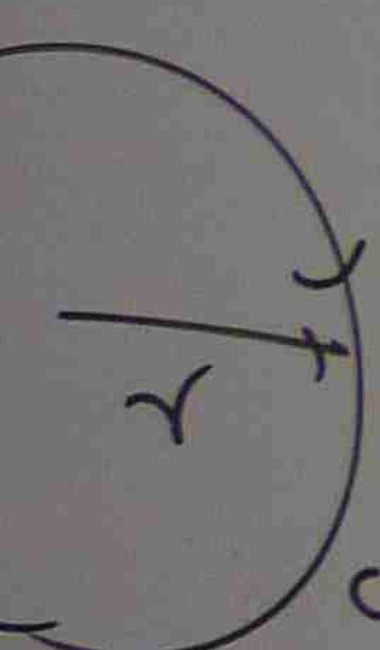
...HOWS THE CROSS SECTION OF A LONG CONDUCTING
... INNER RADIUS $a = 2$ cm AND OUTER RADIUS
...E CYLINDER CARRIES A CURRENT OUT OF THE
...RRENT DENSITY IS $J = c r^2$, $c = 3\times10^6$ A/m^4
r IN METER

... MAGNETIC FIELD $\vec{B}$ AT A POINT THAT IS 3 cm
...TRAL AXIS OF THE CYLINDER?



$$i = \int J \, dA$$

$$i = \frac{\pi c (r^4 - a^4)}{2}$$



$$\oint B\,ds = \mu_0 i$$

CIRCUMFERENCE

$$\oint = 2\pi r$$

$$2\pi r \times B = \mu_0 i$$

$$2\pi r B = \mu_0 \frac{\pi c (r^4 - a^4)}{2}$$

$$2\pi \times 3 \times B = \frac{4\pi\times10^{-7} \times \pi \times 3\times10^{6} (3^4 - 2^4)}{2}$$

$$B = -2 \times 10^{-5}\,T$$

AT 3cm

$$|B| = 2\times10^{-5}\,T$$

...TION OF A LONG CONDUCTING
... 2 cm AND OUTER RADIUS
... A CURRENT OUT OF THE
... $J = c r^2$, $c = 3\times10^6\ A/m^4$
r IN METER
... $\vec{B}$ AT A POINT THAT IS 3 cm
... CYLINDER?

$$i = \int J\, dA$$

$$i = \frac{\pi c (r^4 - a^4)}{2}$$

$$\oint B\,ds = \mu_0 i$$

...NCE $2\pi r \times B = \mu_0 i$

$$2\pi r\, B = \mu_0 \frac{\pi c (r^4 - a^4)}{2}$$

$$2\pi \times 3 \times B = \frac{4\pi\times10^{-7} \times \pi \times 3\times10^{6} (3^4 - 2^4)}{2}$$

$$B = -2\times10^{-5}\,T$$

AT 3 cm

$$|B| = 2\times10^{-5}\,T$$

CA...

CAP...

E