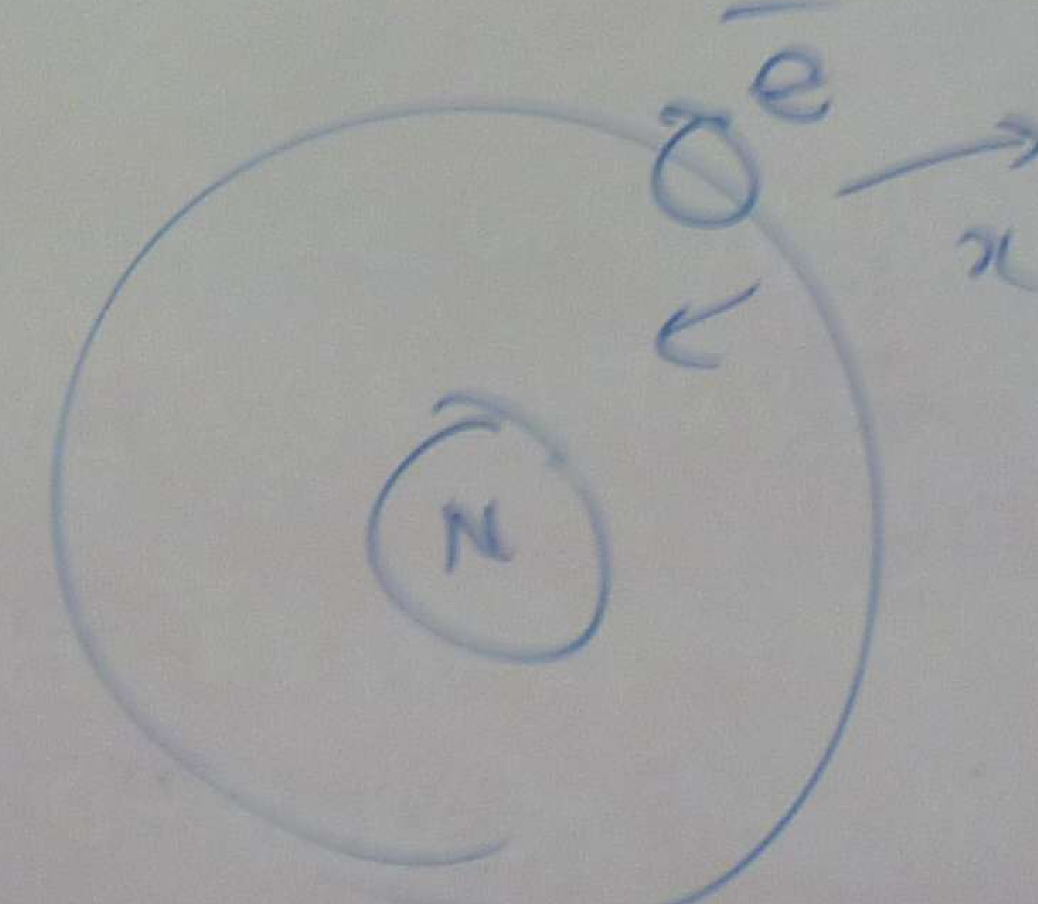
THE ENERGY OF TWO PARTICLES IN THE FIELD OF EACH OTHER

$$W(r) = -\frac{\alpha}{r} + \frac{\beta}{r^2}$$

ATTRACTION FORCE

REPULSION FORE

POTENTIAL ENERGY



ENERGY TR

FORCE = $\frac{\;}{4\pi}$

ENERGY = FORCE

Q 45

SUPPOSE

ENERGY OF

ELECTRON ATT

A AND B

WHAT IS THE

AN ELECTRON

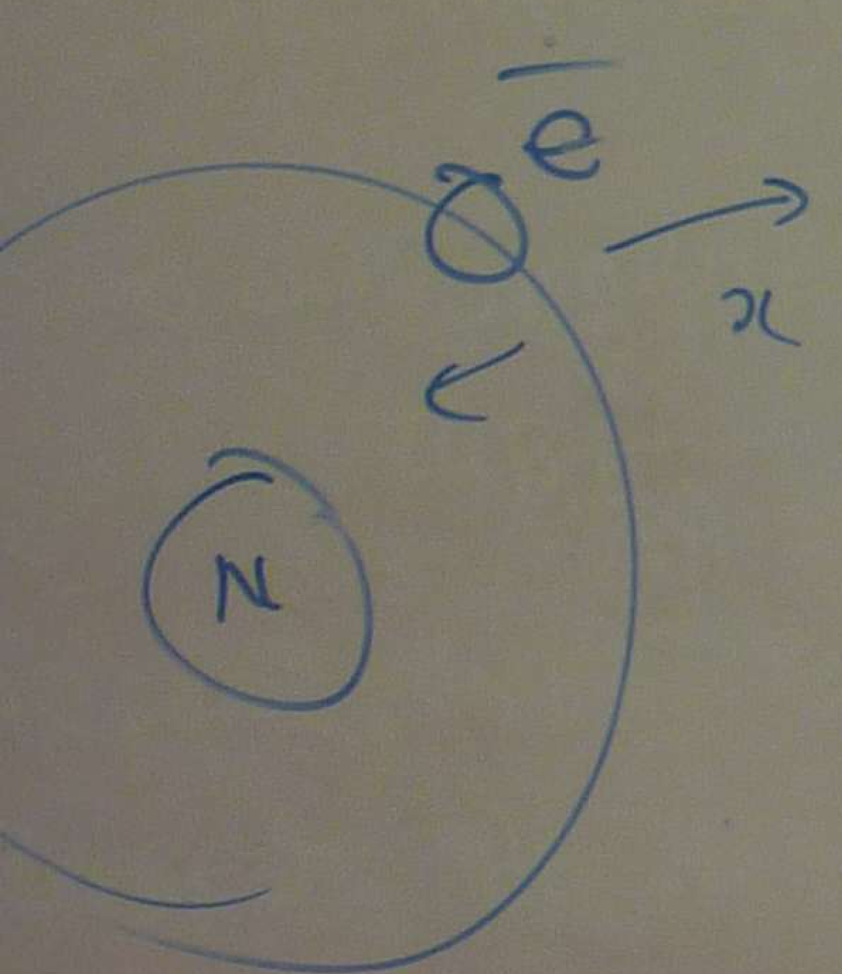
o PARTICLES IN THE
ER

$$+ \frac{\beta}{r^2}$$

ACTION

REPULSION FORCE

ENTIAL ENERGY



ENERGY TRANSFER FROM ATOM TO ELECTRON

$$\text{FORCE} = \frac{e^2}{4\pi \varepsilon_0 r^2}$$

ENERGY = FORCE × DISTANCED MOVE

Q45 SUPPOSE AN ATOM 'A' HAS AN IONIZATION ENERGY OF 5 eV AND ATOM 'B' HAS AN ELECTRON ATTAINING OF 4 eV. SUPPOSE ATOM A AND B ARE 5 ARMSTRONG APART.

WHAT IS THE ENERGY REQUIRED TO TRANSFER AN ELECTRONS FROM A TO B?

FORCE BETWEEN A

ENERGY REQUIRED
THE ATOM

DI ELECT

ATOM TO ELECTRON

MOVE

HAS AN IONIZATION

TOM 'B' HAS AN

EV. SUPPOSE ATOM

TRONG APART.

UIRED TO TRANSFER

B?

FORCE BETWEEN A. AND B $= \dfrac{e^2}{4\pi E_0 r^2}$

$$= \frac{(1.6\times 10^{-19})^2}{4\times 3.1416\times 8.854\times 10^{-12}\times (5\times 10^{-10})^2}$$

$$F = 9.2\times 10^{-10}\ \text{N}$$

ENERGY REQUIRED TO MOVE THE ATOM $W = F \times x$

$$= 9.2\times 10^{-10} \times 5\times 10^{-10}$$

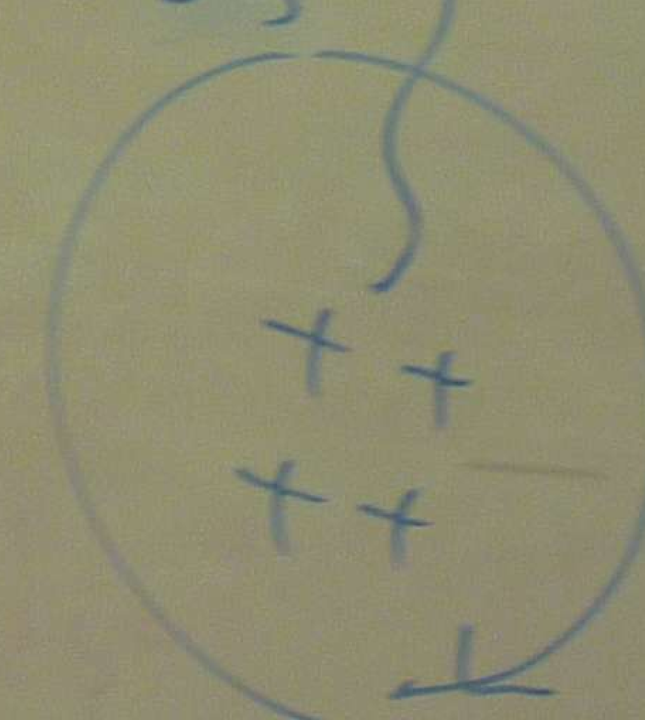
$$= 4.502\times 10^{-19}\ \text{J}$$

DIELECTRIC PROPERTIES OF INSULATORS IN STATIC FIELD

$$\oint D\, ds = \Sigma Q$$

ds

FIELD DENSITY ('D')



D = ELECTRIC DENSIT

ds = CURVATU

ΣQ = SUM O CHARG

CHARE

NEAR THE C

HIGHER PO

$10^{-12} \times (5 \times 10^{-10})^2$

-10

0

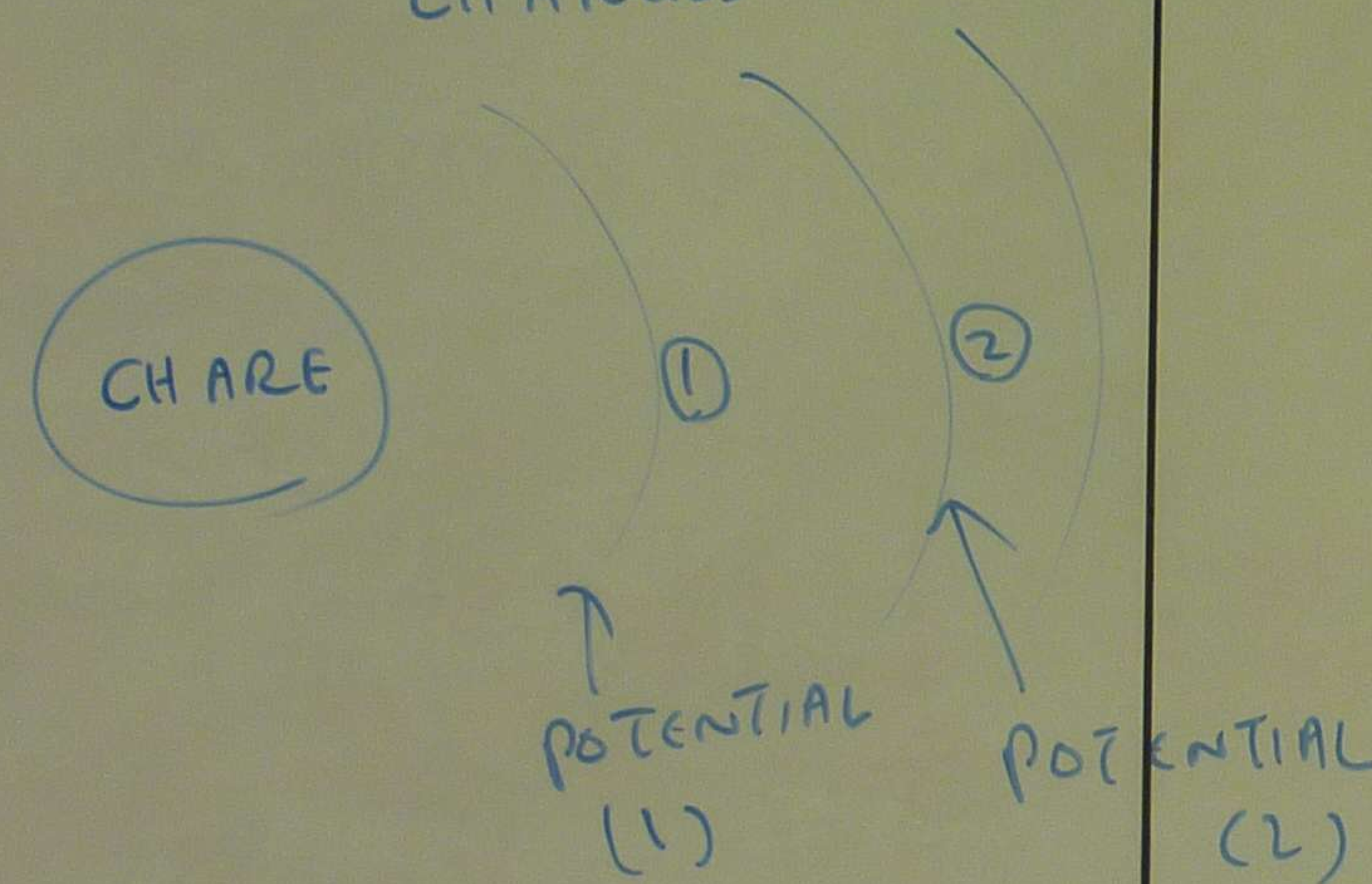
ATORS IN

FIELD DENSITY (D)

D = ELECTRIC FIELD DENSITY

ds = CURVATURE

$\sum Q$ = sum of ELECTRIC CHARGES



NEAR THE CHARGE, HIGHER POTENTIAL

ELECTRICITY INTENSITY DEPENDS ON THE DISTANCE FROM THE ELECTRIC CHARGE

$$V_1 - V_2 = -\int E \, dr$$

$$U(r) = \frac{Q}{4\pi E_0 r}$$

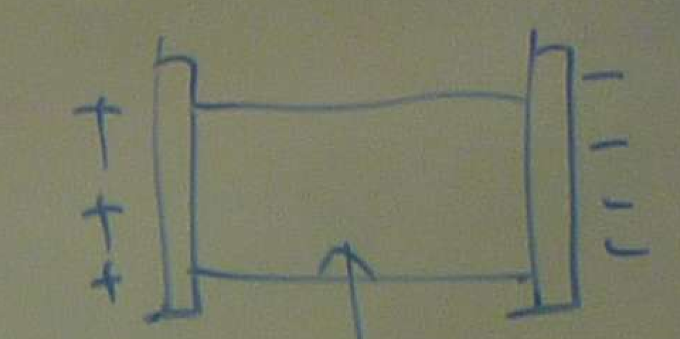
Q = ELECTRIC CHARGE (C)

$E_0 = 8.854 \times 10^{-12}$

r = DISTANCE

$U(r)$ = POTENTIAL

CAPACITOR



CAPACITOR CAN ST[ORE] CHARGE & ENE[RGY]

$$V = \frac{E}{d}$$

$$C = \frac{Q}{V}$$

$$C = \frac{\varepsilon_0 \varepsilon_r}{d}$$

A – AREA

d – DISTA[NCE]

ITY INTENSITY DEPENDS ON
STANCE FROM THE ELECTRIC CHARGE

$$V_2 = -\int E \, dr$$

$$\text{-)} = \frac{Q}{4\pi \varepsilon_0 r}$$

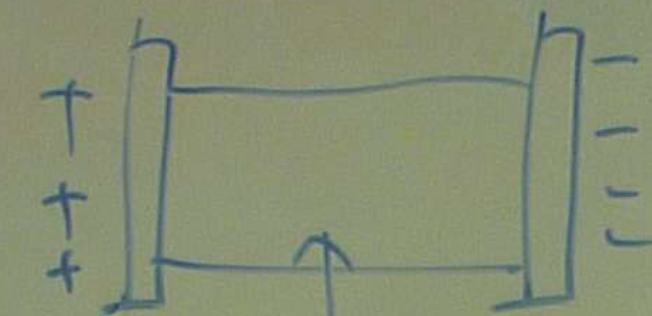
ELECTRIC CHARGE (C)

8.854×10^{-12}

DISTANCE

r) = POTENTIAL

CAPACITOR



INSULATION
(DIELECTRIC)

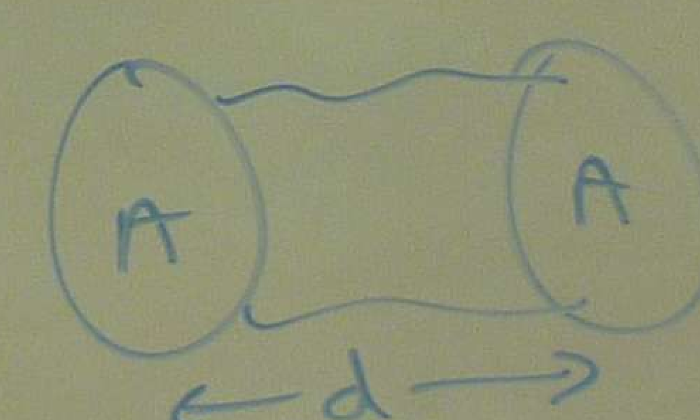
CAPACITOR CAN STORE THE ELECTRIC CHARGE & ENERGY

$$V = \frac{E}{d}$$

$$C = \frac{Q}{V}$$

C = CAPACITANCE
Q = CHARGE
V = VOLTAGE

$$C = \frac{\varepsilon_0 \varepsilon_r A}{d}$$



A – AREA OF PLATE
d – DISTANCE

ε_0 = PERMITIVITY
ε_r = RELATIVE PERMITIVITY

CURRENT = RATE OF
ELECTRIC

$$\boxed{I = J \times A}$$

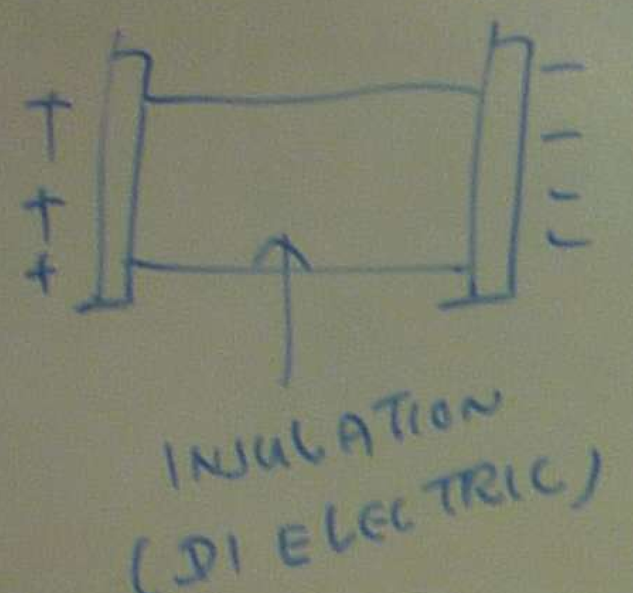
I = ELECTRIC CURREN
J = CHARGE DENSIT
A = AREA (m^2)

ELECTRICAL CON
CONDUCTOR

$mvr =$

m = MASS OF AT
V = VELOCITY
r = DISTANCE

CAPACITOR



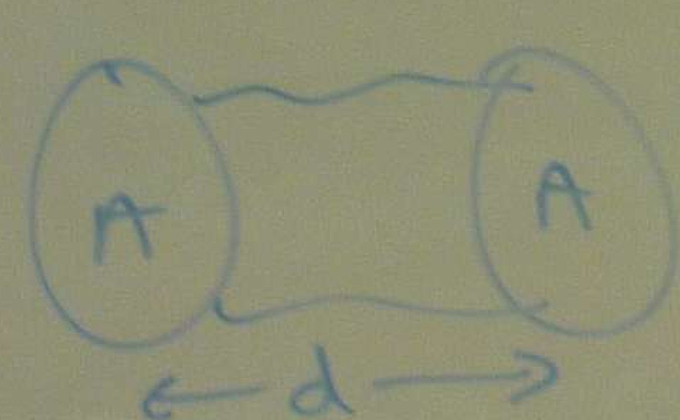
CAPACITOR CAN STORE THE ELECTRIC CHARGE & ENERGY

$$V = \frac{E}{d}$$

$$C = \frac{Q}{V}$$

C = CAPACITANCE
Q = CHARGE
V = VOLTAGE

$$C = \frac{\varepsilon_0 \varepsilon_r A}{d}$$



A – AREA OF PLATE
d – DISTANCE

ε_0 = PERMITIVITY
ε_r = RELATIVE PERMITIVITY

CURRENT = RATE OF CHANGE OF ELECTRIC CHARGE

$$\boxed{I = J \times A}$$

I = ELECTRIC CURRENT (Amp)
J = CHARGE DENSITY / CURRENT DENSITY Amp/m^2
A = AREA (m^2)

ELECTRICAL CONDUCTION IN SEMI CONDUCTORS

$$mvr = \frac{nh}{\pi}$$

m = MASS OF ATOM
v = VELOCITY
r = DISTANCE

n = ORBIT NUMBER
h = PLANK CONSTANT

V

V = VOL

E = E

046 A
HAS
WHAT
6 V

$$V = \mu E$$

V = VOLTAGE , μ = CONSTANT

E = ELECTRIC FIELD INTENSITY

Q46 A GERMASIUM CRYSTAL SPECIMEN 1 mm HAS A TOTAL OF 2.5×10^{7} ELECTRONS IN IT'S CONDUCTION BOND. WHAT ELECTRON CURRENT FLOWS WHEN THERE IS A FIELD OF $6\ V\ cm^{-1}$ PARALLEL TO ONE FACE OF CUBE.

$\mu = 3900$ FOR GERMASIUM

$$V = \mu E = 3900 \times 6 = 23400\ V$$

$$\boxed{J_n = n e V}$$

J_n = ELECTRON CURRENT DENSITY Amp/cm

e = ELECTRON CHARGE

V = VOLT

$$J_n = 2.5 \times 10^{7} \times 1.601 \times 10^{-19} \times 23400 = 9.36 \times 10^{-8}\ \text{Amp}/\text{cm}$$

ENSITY

m^2

ml

RBIT

NUMBER

LANK

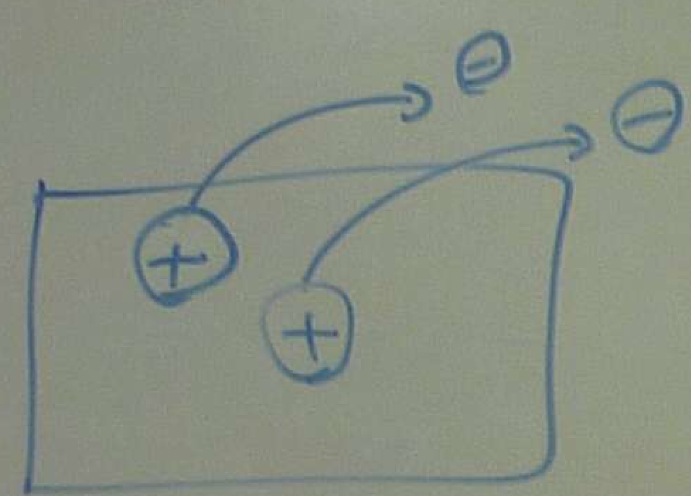
ONSTANT

, =

oma 2013

m Share.com

ELECTRONS & HOLES IN SEMI CONDUCTOR



ELECTRON MOVES OUT

$$\frac{1}{2} m u^2 = E - E_F$$

FERMI LEVEL

$$f(E) = \frac{1}{1 + e^{\frac{E - E_F}{273}}}$$

Q47 DETERMINE THE AVERAGE ENERGY OF AN ELECTRON IN CONDUCTION BAND OF METAL AT 0̄K AS A FUNCTION OF FERMI LEVEL.

$f(E) = \frac{1}{1+}$

AT 0̄K,

$$f(E) = \frac{1}{1 + e^{\frac{E - E_f}{273}}}$$

AT 0°K, $E = \frac{2}{3} E_f$

LAGE

RON

F METAL

N OF

Pb. A METAL HAS IT'S FERMI LEVEL 8.95 eV ABOVE THE BOTTOM OF CONDUCTION BAND. WRITE THE EQUATION FOR MOMENTUM OF ELECTRON.

$$\frac{1}{2} m v^2 = E - E_f$$

$$\text{ENERGY STATE} / \text{VOL} = \frac{2^{9/2}\, m^{3/2}\, \pi\, (E - E_f)^{3/2}}{3 h^3}$$

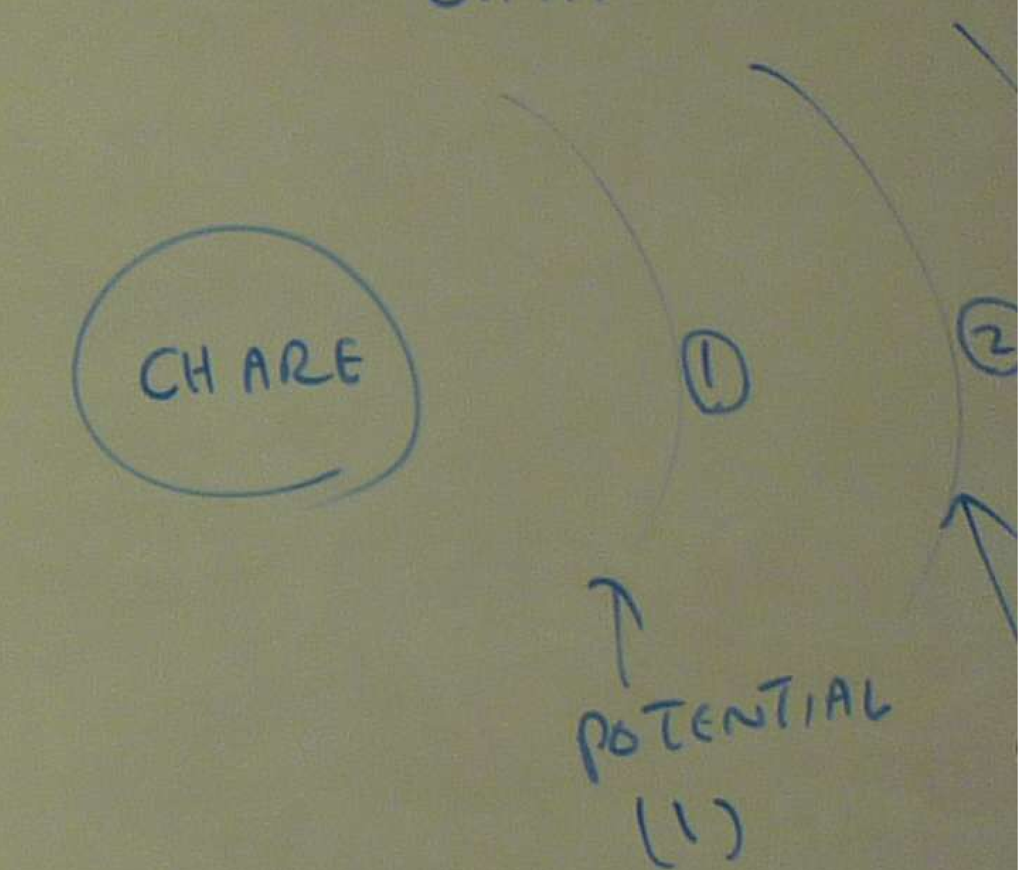
$$= \frac{2^{9/2} \times (9.1 \times 10^{-21})^{3/2} \times 3.14 \times 8.95^{3/2}}{3\left[6.624 \times 10^{-34}\right]^3}$$

$$=$$

D = ELECTRIC FIELD DENSITY

ds = CURVATURE

ΣQ = SUM OF ELECTR[illegible] CHARGES



NEAR THE CHARGE,

HIGHER POTENTIAL

$$e^{\frac{E-E_f}{273}}$$

NE THE AVERAGE
OF AN ELECTRON
CTION BAND OF METAL
AS A FUNCTION OF
LEVEL.

$$f(E) = \frac{1}{1 + e^{\frac{E-E_f}{273}}}$$

AT $0^\circ K$, $E = \frac{2}{3} E_F$

Ph A METAL HAS IT'S FERMI LEVEL 8.95 eV ABOVE THE BOTTOM OF CONDUCTION BAND. WRITE THE EQUATION FOR MOMENTUM OF ELECTRON.

$$\frac{1}{2} m v^2 = E - E_f$$

$$\text{ENERGY STATE}\Big|_{VOL} = \frac{2^{9/2}\, m^{3/2}\, \pi\, (E - E_F)^{3/2}}{3h^3}$$

$$= \frac{2^{9/2} \times (9.1 \times 10^{-21})^{3/2} \times 3.14 \times 8.95^{3/2}}{3\left[6.624 \times 10^{-34}\right]^3}$$

$$=$$

D = ELECT
DE

ds = CUR

ΣQ = SU
CH

CHARE

NEAR T

HIGHE

DETERMINE THE AVERAGE ENERGY OF AN ELECTRON IN CONDUCTION BAND OF METAL AT $0^\circ K$ AS A FUNCTION OF FERMI LEVEL.

$$e^{\frac{E-E_f}{273}}$$

$$f(E) = \frac{1}{1 + e^{\frac{E-E_f}{273}}}$$

AT $0^\circ K$, $E = \frac{2}{3} E_F$

Pb/ A METAL HAS IT'S FERMI LEVEL 8.95 eV ABOVE THE BOTTOM OF CONDUCTION BAND. WRITE THE EQUATION FOR MOMENTUM OF ELECTRON.

$$\frac{1}{2} m v^2 = E - E_f$$

$$\text{ENERGY STATE}\Big|_{VOL} = \frac{2^{9/2}\, m^{3/2}\, \pi\, (E - E_F)^{3/2}}{3 h^3}$$

$$= \frac{2^{9/2} \times (9.1 \times 10^{-21})^{3/2} \times 3.14 \times 8.95^{3/2}}{3\left[6.624 \times 10^{-34}\right]^3}$$

$=$

D =

ds

ΣO