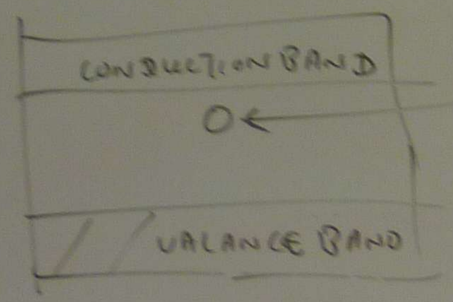
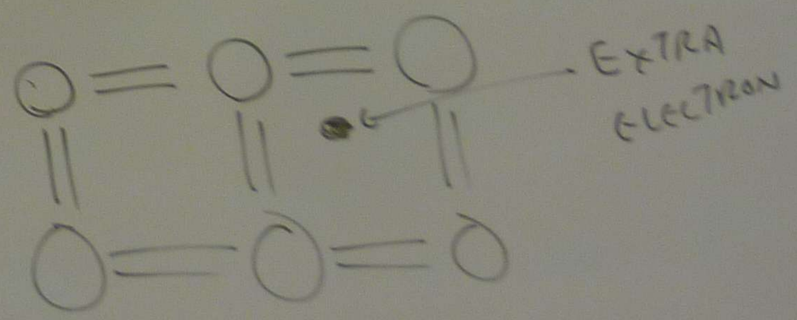
P AND N TYPE SEMI CONDUCTORS

- IMPURITIES EFFECT THE CONDUCTIVITY
- ELECTRON AND POSITIVE HOLE MOTION MAKE TO TOTAL CONDUCTIVITY





$E_m^1 = -$

$8m^2$

m = NO. OF PAT

m = MASS OF A

e = CHARGE OF

q_0 = INITIAL STA

q_n = CHARGE

h = PLANK

E_m^1 = ENER

CONDUCTION

OF FREE

$V = \mu$

$$E_n^1 = \frac{-me^4}{8n^2h^2\varepsilon_0^2 q_r^2}$$

n = NO. OF PATH

m = MASS OF ATOM

e = CHARGE OF ELECTRON

ε_0 = INITIAL STATE CHARGE

q_r = CHARGE AT r^{th} STATE

h = PLANK CONSTANT

E_n^1 = ENERGY

- EXTRA ELECTRON

CONDUCTION DEPENDS ON MOBILITY OF FREE ELECTRONS.

$$V = \mu\delta$$

V = DRIFT VELOCITY $cm\,s^{-1}$

δ = FIELD STRENGTH

μ = MOBILITY $cm^2\,V^{-1}\,sec^{-1}$

$$\delta = \delta_n + \delta_p$$

δ_n = N-TYPE SEMI CONDUCTOR FIELD STRENGTH

δ_p = P-TYPE SEMI CONDUCTOR FIELD STRENGTH

$$\delta = e(n_i\mu_n + n_i\mu_p)$$

$p = n = n_i$

μ_p = MOBILITY OF 'P' TYPE SEMI CONDUCTOR

μ_n = MOBILITY OF 'N' TYPE SEMI CONDUCTOR

GENER

BECAUSE
AT ROOM
BEING
GENERAT
- ELECTRO
TO PRO

VAL

IT IS
HOLE

MI CONDUCTOR
ENGTH
EMI CONDUCTOR
TRENGTH
$n + n_i \mu_p$)
1
TY of 'P' TYPE
MI CONDUCTOR
BILITY of 'N' TYPE
SEMI CONDUCTOR

GENERATION & RECOMBINATION

BECAUSE of VIBRATIONAL ENERGY of CRYSTAL LATTICE AT ROOM TEMPERATURE, COVALENT BONDS ARE CONTINUALLY BEING BROKEN. THIS PROCESS IS ELECTRON-HOLE PAIR GENERATION.

- ELECTRONS ARE BEING RECAPTURED BY UNFILLED BONDS TO PRODUCE THE RECOMBINATION OF $\bar{e}$ - HOLE PAIRS.

VALANCE

IT IS SETUP BETWEEN GENERATION AND RECOMBINATION HOLES AND ELECTRON DENSITY ⟶ THERMAL EQUILIBRIUM.

DENSITY of STATES IN ENERGY BAND

THE PASSAGE of ELECTRON FROM TOP of VALANCE BAND TO BOTTOM of CONDUCTION BAND REQUIRES THE EXPENDITURE OF LEAST AMOUNT OF ENERGY.

NUMBER of ELECTRONS MO
DEPEND ON TEMPERATURE
ENERGY DIFFERENCE
RATE of CHANGE OF
ENERGY DIFFERENC
ENERGY DENSITY S(
F(E)=
N(E)

TAL LATTICE
CONTINUALLY
- HOLE PAIR
FILLED BONDS
POLE PAIRS.

RECOMBINATION
RMAL
ULIBRIUM.
ND
M TOP OF
UCTION
OF

NUMBER OF ELECTRONS MOVING BETWEEN TWO BANDS DEPEND ON TEMPERATURE & ENERGY.

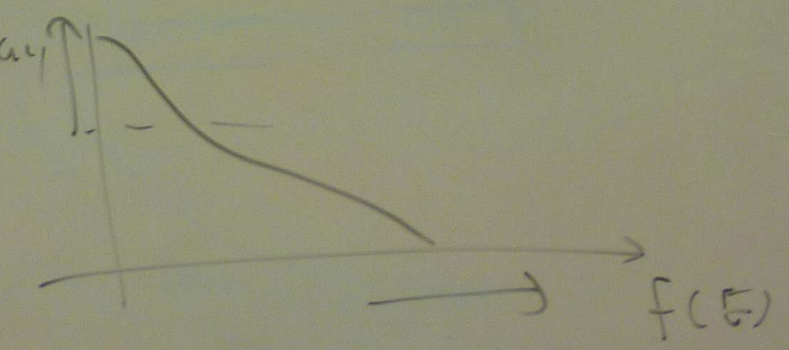
ENERGY DIFFERENCE $m = \dfrac{2^{9/2}\, m^{3/2}\, \pi}{3h^2} (E - E_V)^{3/2}$

RATE OF CHANGE OF ENERGY DIFFERENCE $S(E) = \dfrac{dm}{dE} = \dfrac{2^{7/2}\, m^{3/2}\, (E - E_V)^{1/2}}{h^2}$

ENERGY DENSITY $S(E) \times dE = dm$ = TOTAL NUMBERS of AVAILABLE STATES IN ENERGY RANGE dE

$F(E)$ = PROBABILITY of THE STATES. = FERMI FACTOR

$N(E)$ = SMALL ENERGY RANGE



FERMI LEVEL

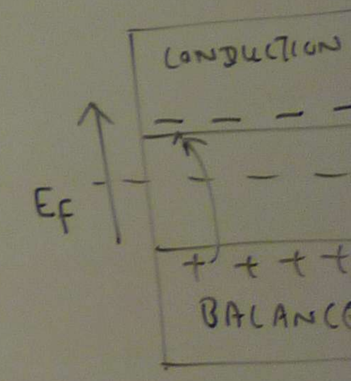
ENERGY WHE
STATES ARE

CONDUCTION B

$1 - F(E) =$

VARIATION of

INTRINSIC



$)^{3/2}$

$(E-E_V)^{1/2}$

RS of AUALLABLE
ENERGY RANGE

S. = FERMI FACTOR

→ f(E)

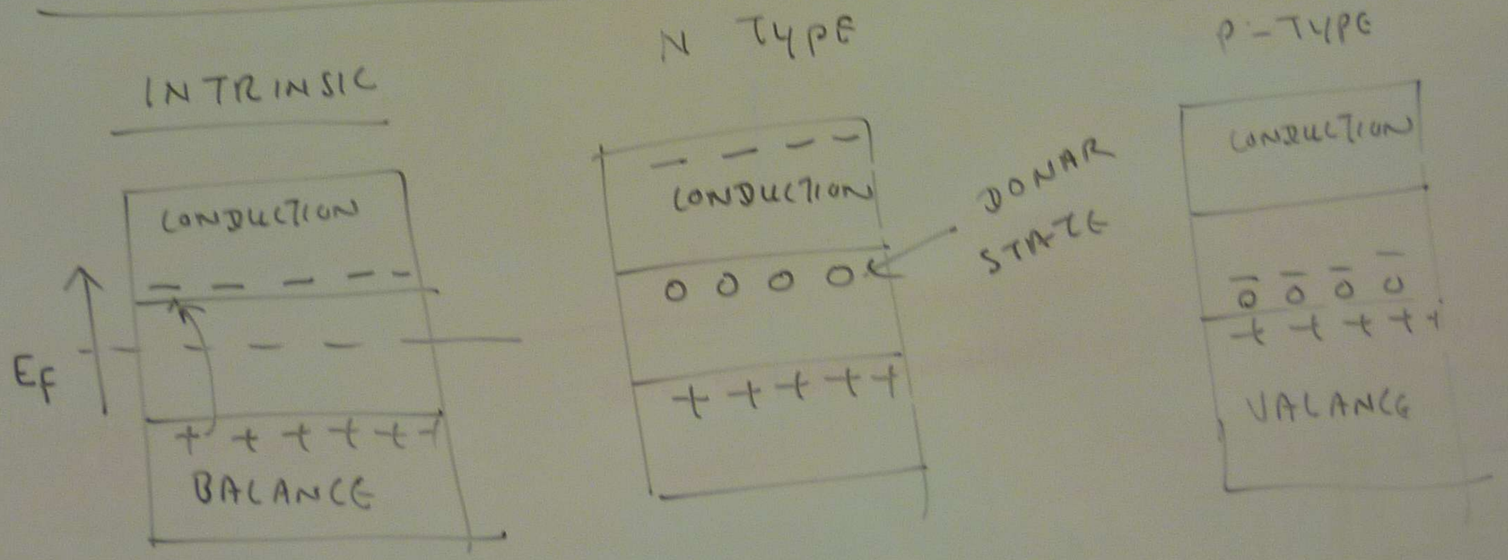
FERMI LEVEL

ENERGY WHERE THE PROBABILITY of ELECTRON STATES ARE OCCUPIED

CONDUCTION BAND

1— F(E) = PROBABILITY OF POSITIVE HOLES.

VARIATION of FERMI LEVEL WITH TEMPERATURE



TUTORIAL

Q 38

EXPLAIN THE ATOMIC STRUCTURE OF SEMI CONDUCTOR

Q39.

SKETCH ATOMIC STRUCTURE AND ENERGY MODEL OF P AND N TYPE SEMI CONDUCTORS

Q40

WRITE ENERGY DENSITY EQUATION FOR SEMI CONDUCTOR

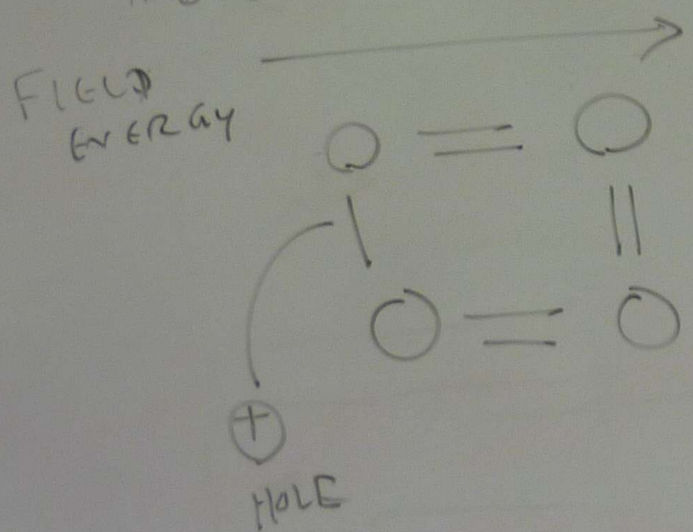
Q41

ACCORDING TO THE KINETIC THEORY OF GASES, THE AVERAGE KINETIC ENERGY OF GAS MOLECULE AT AN ABSOLUTE TEMPERATURE T IS EQUAL TO $\frac{3kT}{2}$ WHERE k IS BOLTZAMAN'S CONSTANT, WHAT IS AVERAGE ENERGY

$T = 300k$

038 AT ROOM TEMPERATURE, VALANCE BAND IS COMPLETELY FULL.
CONDUCTION BAND IS EMPTY.

AT OTHER TEMPERATURE FEW ELECTRONS GAIN ENERGY
TO TRANSVERSE THE FORBIDDEN GAP TO CONDUCTION BAND
AND LEAVE .POSITIVE HOLES IN VALANCE BAND



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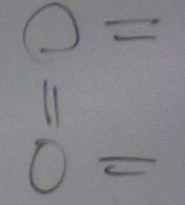

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M

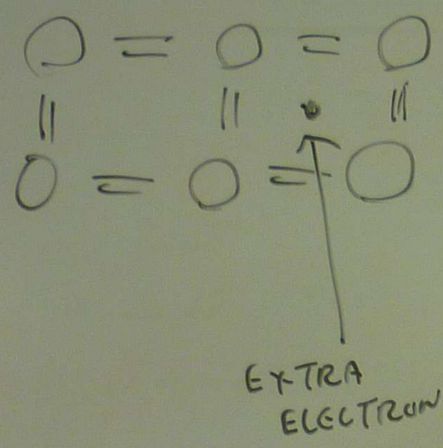
...PLETELY FULL.

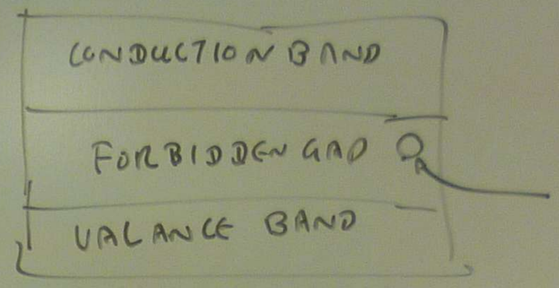
...N ENERGY

...LCTION BAND

...D

39





$$E_n^1 = \frac{-me^4}{8m^2h^2\varepsilon_0^2\varepsilon_r^2}$$

40

$$n = \frac{2^{9/2}\, m^{3/2}\, \pi\, (E - E_V)^{3/2}}{3h^3}$$

n = ENERGY DENSITY

m = MASS OF ATOM

h = PLANK CONSTANT

E = ENERGY AT ANY STATE

E_V = VALANCE STATE ENERGY

41

ELECTRON

KINETIC ENG...

ENERGY =

ELECTRON

KIN...

NERGY
STATE of
XTRA ELECTRON

NUMBER of ELECTRONS
DEPENDS ON TEMPERAT

ENERGY DIFFEREN

RATE of CHANGE
ENERGY DIFF

ENERGY DENSITY

F

Q 41

$$\text{ELECTRON ENERGY} = \frac{\text{ENERGY}}{1.6 \times 10^{-19}} \qquad 1eV = 1.6 \times 10^{-19}\ J$$

$$\text{KINETIC ENERGY} = \frac{1}{2} m U^2 \quad | \quad U = \text{VELOCITY}$$

$$\text{ENERGY} = \frac{3}{2} kT = \frac{3}{2} \times 1.38 \times 10^{-23} \times 300 = 6.21 \times 10^{-21}\ J$$

$$\text{ELECTRON ENERGY} = \frac{6.21 \times 10^{-21}}{1.6 \times 10^{-19}} = 0.0388\ eV$$

$$\text{KINETIC ENERGY} = \frac{1}{2} mv^2 = 6.21 \times 10^{-21}$$

$$\frac{1}{2} \times 9.107 \times 10^{-31} \times v^2 = 6.21 \times 10^{-21}$$

$$v = 2725\ ms^{-1}$$