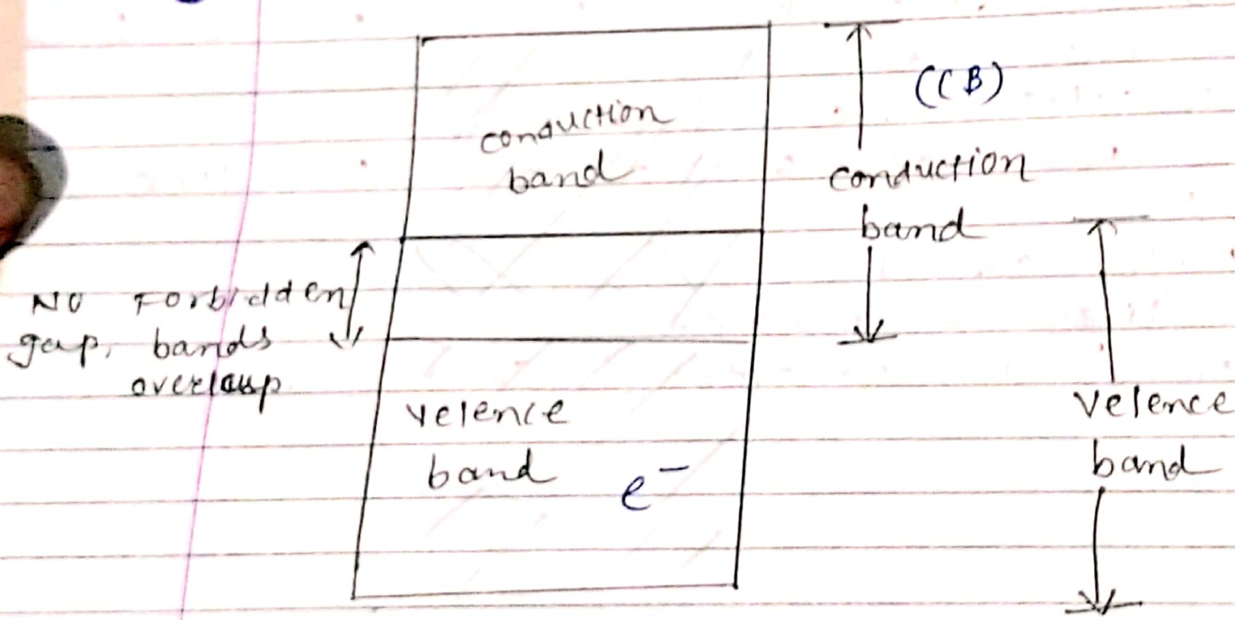
Introduction:- Electronic Material

* Conductor:

The material which allow current to flow easily through them is, known as conductor.

Examples: copper, Aluminium, sillicon, gold, metals

Energy band diagram for conductors:-



- There is electrons in velence band
- At where electrons are conducted that band is known as conduction band.
- There is no forbidden or energy gap

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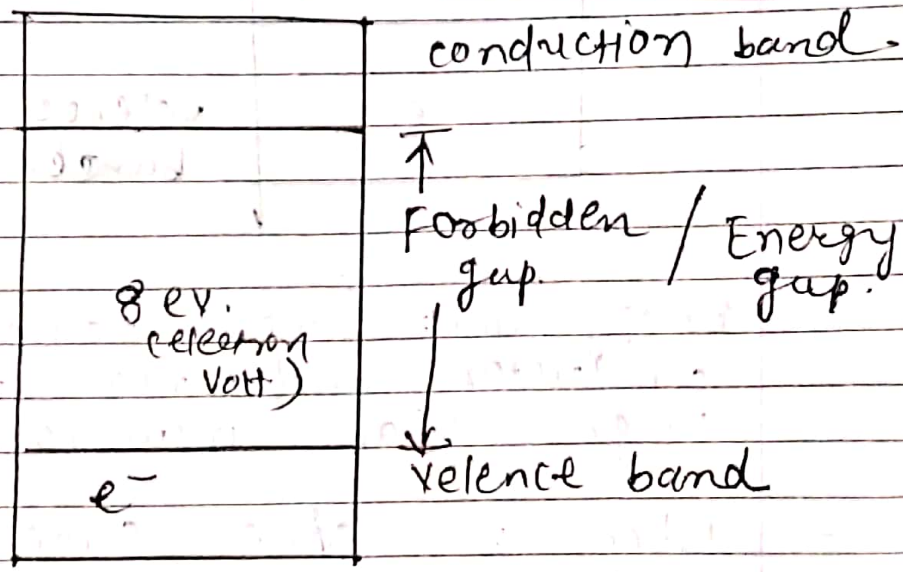
→ In conductor material electrons can easily move from velence band to conduction band because there is no energy gap or Forbidden gap.

→ so, velence band and conduction band are overlapped.

Application:- Used to Flow electric current.

* Insulator:- The material which do not allow current to Flow through them is known as insulator.
examples:- Plastic, Rubber, dry wood, etc.

Energy band diagram For Insulator:-

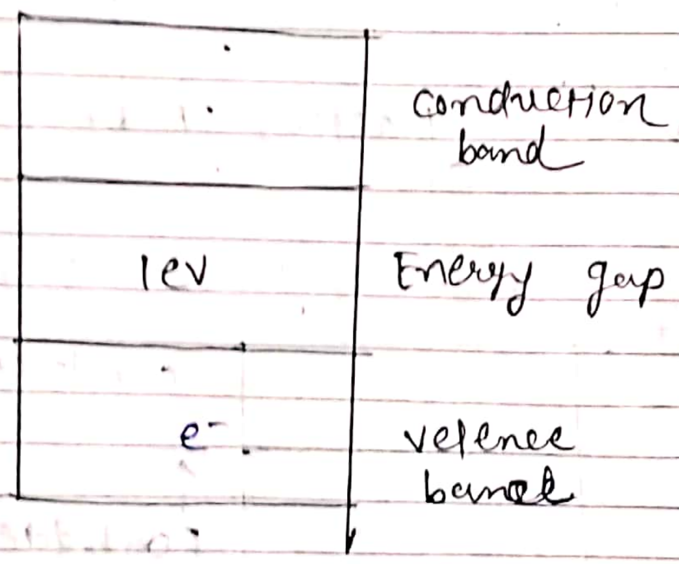


The energy gap in insulator material is 8 eV. so electrons can not move from velence band to conduction band.

Application: Used in coating on electric wire.

* **Semiconductor:** The material which do not allow easily current to flow easily like conductor and do not oppose the current like insulator is known as semiconductor material.
Examples: silicon, germenium.

Energy band diagram of semiconductor



Energy gap is not overlapped like conductor and not too much larger than insulator.

→ When we give some energy to semiconductor material electrons from velence band can move to conduction band.

Application:- It can be used electronic circuit and in D.C power supply.

* Energy band in silicon:-

Atomic No. = 14

2, 8, 4 ← 3rd orbit

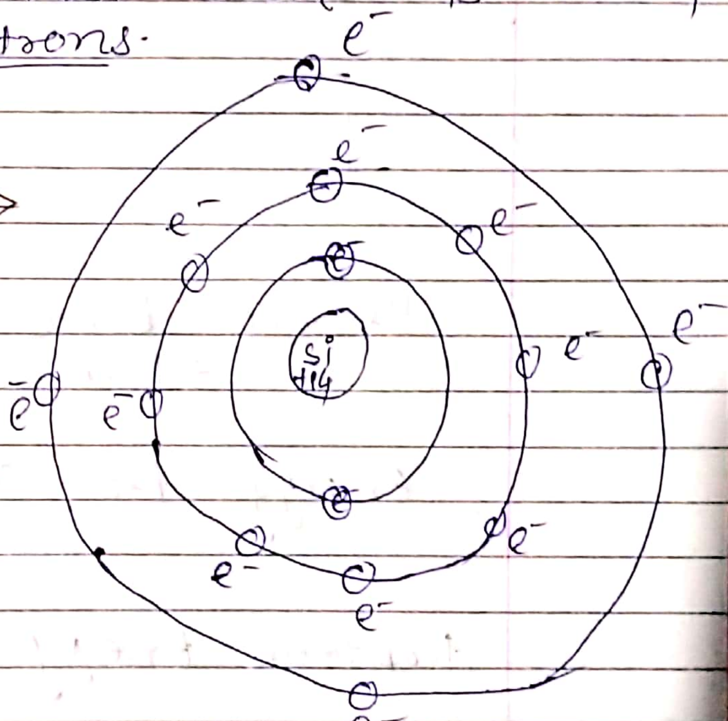
↑ 1st orbit ↑ 2nd orbit

valance e^- - 4

electrons in outermost orbit is known as velence electrons.

This is only for one silicon →

but if we study energy band it is off whole silicon solid.



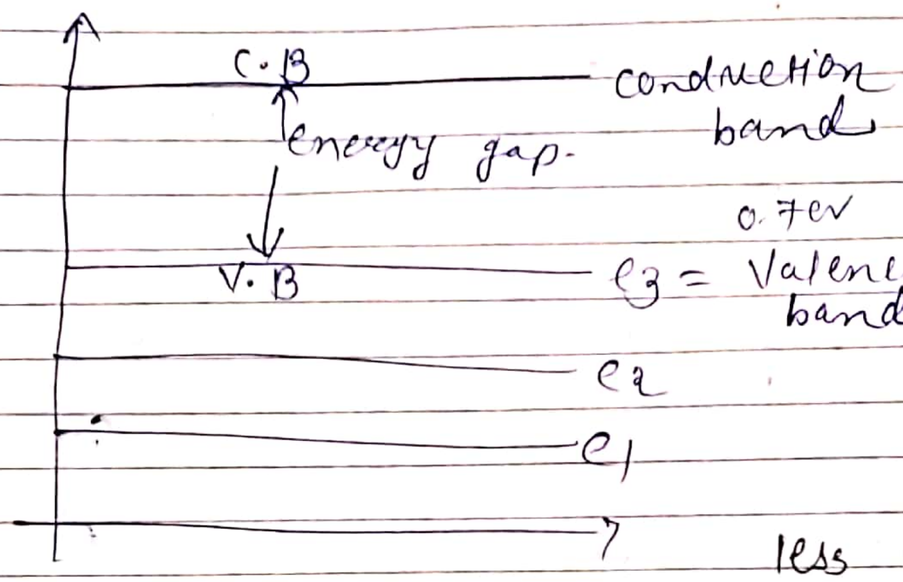
Atomic structure

Thus In silicon solids there are so many atoms of silicon and so many veleance electrons in outer orbit.

Distance increase from Nucleus.
Energy increase for that orbit

e_1 = energy band for 1^{st} orbit
e_2 = " " 2^{nd} "
e_3 = " " 3^{rd} orbit

e_3 = Velence band



less conductivity.

Velance band energy for silicon = 0.7 ev

energy for conduction band = 1.8ev

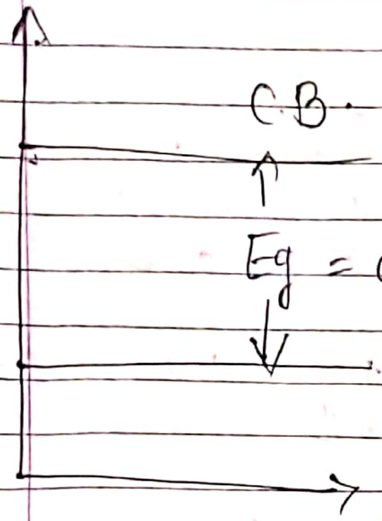
forbidden energy /
Energy gap = 1.8 − 0.7
$\boxed{= 1.1 ev.}$

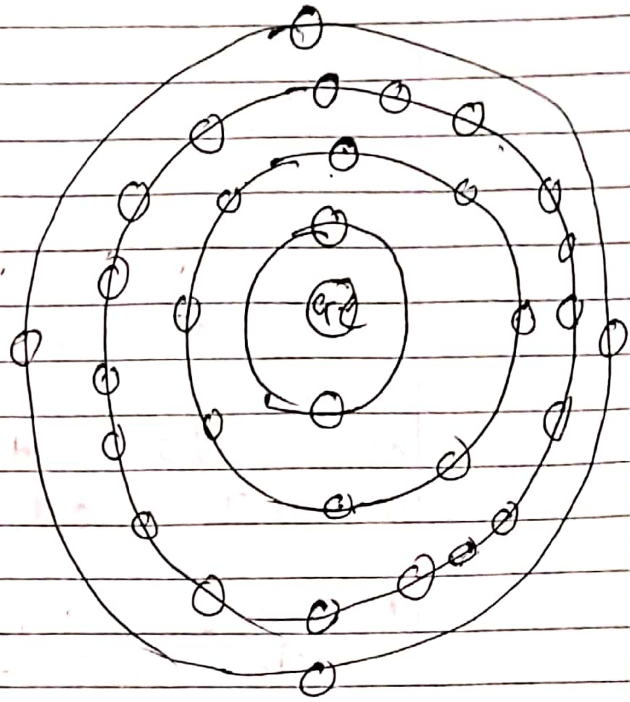
⇒ <u>Meaning</u>! If we gives 1.1 ev energy then electrons from velence band can moves to the conduction band and electrons behaves as free electrons.

Germanium (Ge.)

Atomic NO. -32

2, 8, 18, 4





more conductivity

Silicon has less conductivity than Ge.

	Si	Ge
Reason:	Eg = 1.1eV	Eg = 0.72eV

energy gap in silicon is 1.1eV which is more than Ge.

more energy is required to electrons to move from V.B to C.B as compared to Ge.

so. Si has less conductivity and Ge has more conductivity.

NOTE:

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* covalent bonds & silicon crystals:

→ Bonds in semi conductors:

bonding can be done in outermost (valence) orbit.

Atom has tendency to take $8e^-$ in there outermost orbit.

It can give one or two e^-. It can take electrons or share electrons to their neighbouring atoms.

- In semiconductor there is $4e^-$ in there outermost orbit. so It shares one one electrons from their neighbour and make a bond that is known as covalent bond.

Silicon,

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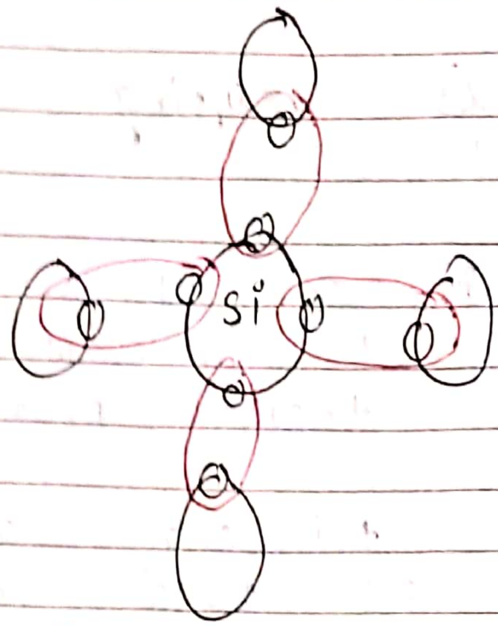
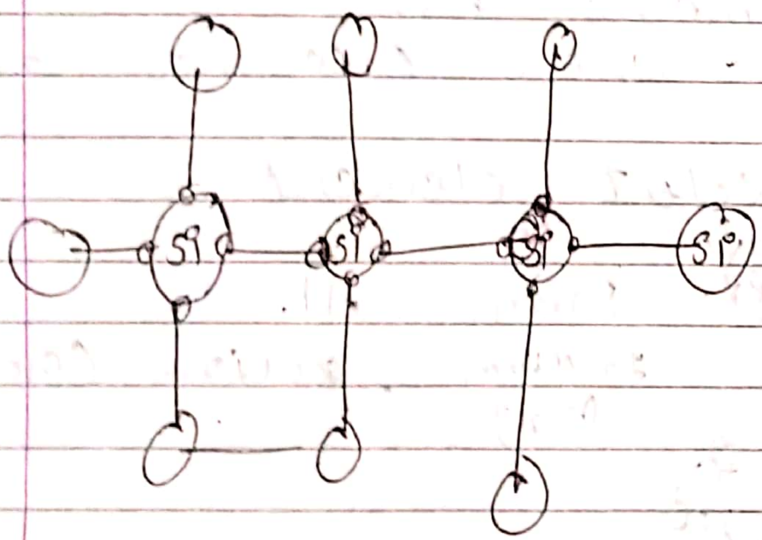
silkon



By sharing ~~it~~ ~~an~~ there is 8e^- in outer most orbit. so there is co valent band.

Crystline structure of (Si) semiconductor.



this pattern is repeated which is known as crystalline structure of semiconductor.

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* Doping in a semiconductor.

* What is dopping in a semi-conductor?

→ Doping is a process of adding impurities to intrinsic semiconductors to alter their properties.

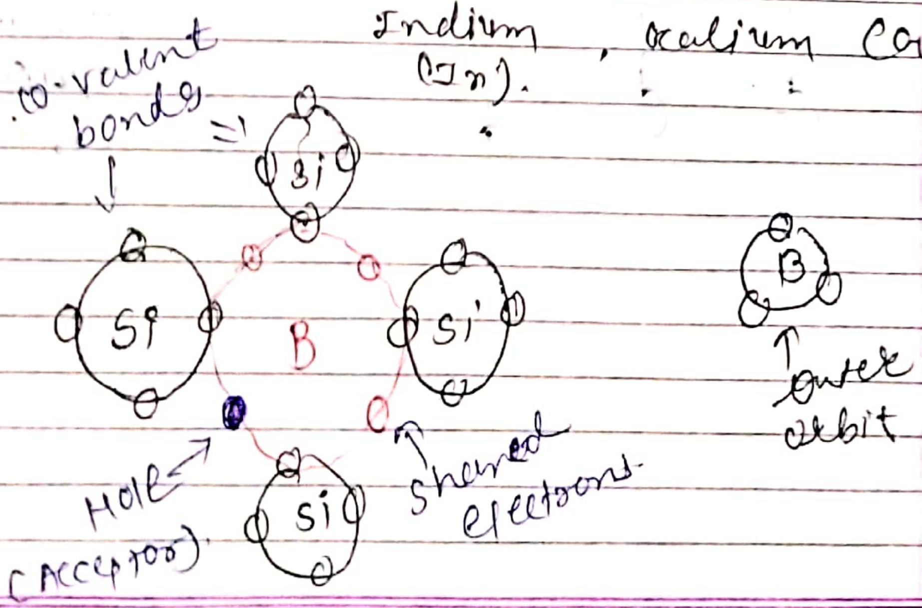
— Normally trivalent and pentavalent elements are used as dopping element to dope silicon and ge.

Trivalent means atoms has 3 electrons in there outermost orbit

Pentavalent means atom has 5 electrons in there outermost orbit

* Adding Trivalent element.

Silicon - (14)   ex. Boron, Al. Indium (In), Galium (Ga)



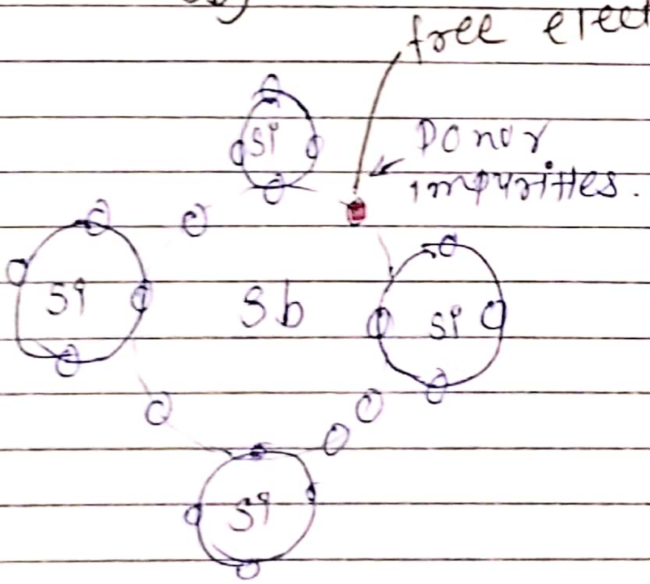
- Si have 4 e^- in their outermost orbit.
- We dopped Boron (trivalent) element in to the silicon so there will be total 7 electrons.

But still one electron is required. That one electron is known as hole.

This is known as p type semi-conductor.

* Adding pentavalent element.

ex. Antimony (Sb) 2, 8, 18, 5.

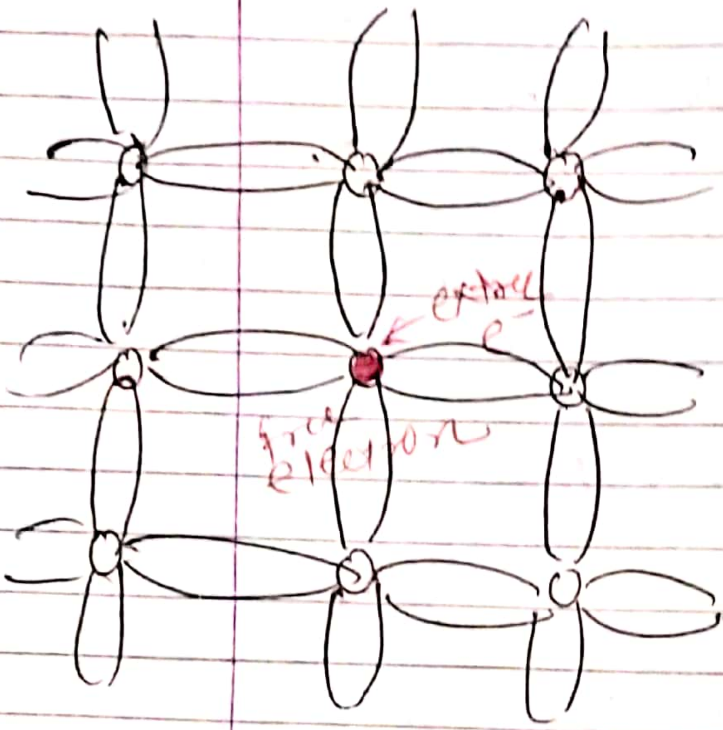


- Si have 4 e^- in outer-orbit
- Sb is dopper have 5 e^- in outer orbit.

So, there is total 9 e^- in outer orbit but we needed only 8 e^-.

- So this is known as N-type semiconductor.

n- doped sillcon



p-dopped silicon.