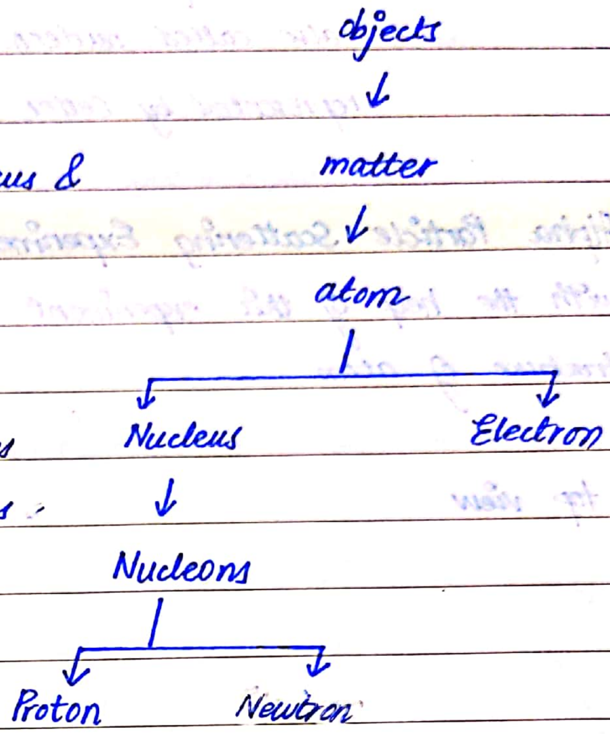
Date: 18/8/20

NUCLEAR PHYSICS



atom : the smallest part of matter further divided into 2 parts, nucleus & electrons

nucleus : the central part of atom it consists of nucleons and electrons nucleons have protons and newtrons in them

proton : a particle which lies inside the nucleus and carries a positive charge

nuetron : a particle which lies inside the nucleus and carries no charge

electron : a particle which revolves around the nucleus and carries a negative charge

→ the magnitude of +ve & -ve charge on proton and electron is equal, same

Particle	Position	Charge	Mass
proton	inside	$+1.6 \times 10^{-19}$ C	1.66×10^{-27} kg
nuetron	inside	zero	1.66×10^{-27} kg
electron	outside	-1.6×10^{-19} C	9.1×10^{-31} kg

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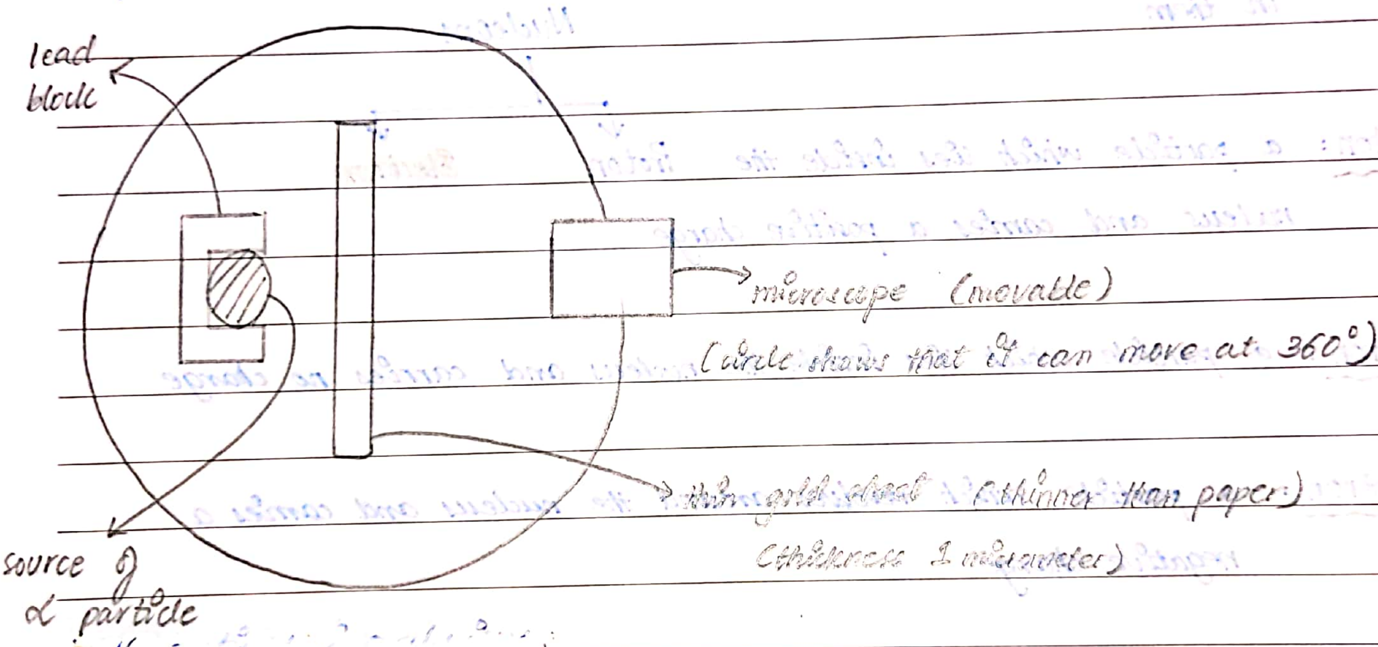
mass number : total no. of protons and nuetrons in an atom
also called nucleon number
represented by letter A

Alpha Particle Scattering Experiment

→ with the help of this experiment we determine how to describe the structure of atom

top view



*. α particle is a radioactive particle
↳ has a +ve charge

* 3 types of radiations : alpha, beta & gamma
↳ none of them can pass through the lead block

→ source of α particles is placed in a lead block and since the radiations can't move to the sides, they come out in straight lines

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★ α particle can not be seen using a microscope

↳ the lens of microscope is coated with zinc sulphide to detect their presence

when charged particles hit zinc sulphide a spot of light is produced

Observations :

1. most of α particles passed undeflected through the gold sheet

2. some of α particles were deflected while passing through the gold sheet

3. few α particles were deflected in an almost backward direction

Conclusions :

1. major part of an atom is empty

2. the nucleus carries positive charge

3. the size of nucleus is negligible when compared to size of an atom

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(ionization aur penetration opposite hain)
(tukray karna) (pair karna) baghair toray

α (helium nucleus) (deflects)
(8-10cm) (+2 charge) b/c no electron
(↑ionization power b/c ↑mass) (stopped by paper) (10% c)

difference in deflection b/c of mass, speed & charge

Helium atom

β (-1) (electron) (deflects)
(90% c) (1m)
(i.p less th α) (penetr. ↑ than alpha) (stopped by aluminium)

γ (waves/ray)
(infinite)
(no charge) (no mass)
~~also~~ not (won't deflect ~~deflects~~) b/c not charged
(3×10^8 m/s)
×not a particle (stopped by lead block)

radioactive decay: a process in which an unstable ~~element~~ nucleus emits radiations to become stable

normally isotopes that want to stabilize

also called nuclear decay or radioactivity
↓
b/c radiations are coming from nucleus of element & the size of nucleus also reduces b/c of that

* ~~elements~~ nucleus immiting these radiations ⟹ radioactive elements
* immitted radiations ⟹ radioactive radiations
* particles in alpha + beta radiations

(called decay b/c size of element decreases when it emits radiations)

properties of radioactive decay:-

i). Random ~~process~~ Nature of Decay

→ radiations randomnly come out of radioactive element
→ no. of radiations coming out of the element does not remain constant
→ their direction can't be figured out + which nucleus will decay first

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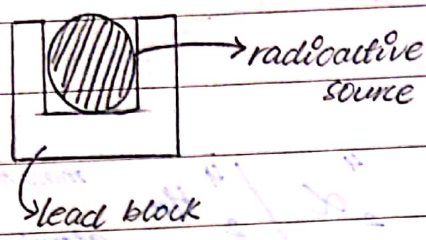
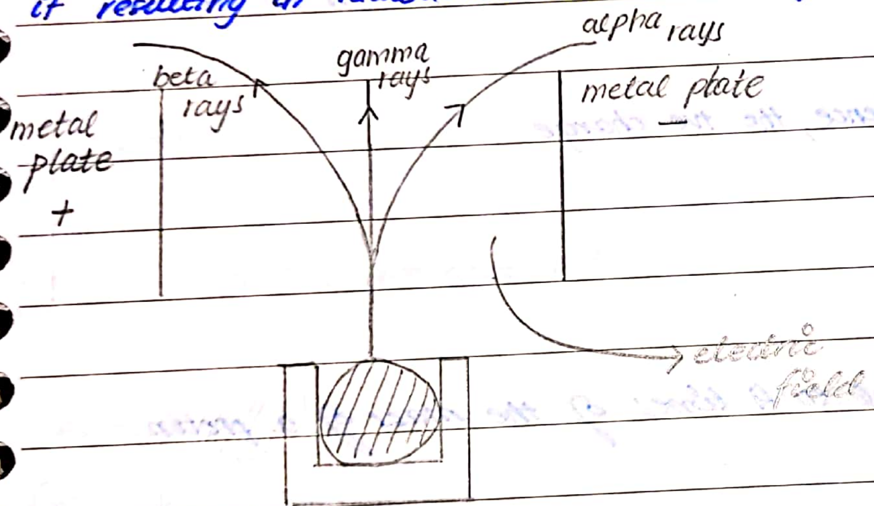
ii) Spontaneous process

→ rate of radioactive decay is not affected by change in physical conditions such as temperature and pressure or chemical change

(kuch bhi hojaye)



→ the lead block does not allow any radioactive radiations to pass through it resulting in radioactive radiations only moving in straight direction



→ when radiations pass through electric field, they split in 3 directions

1. undeflected — Gamma
2. deflected towards +vely charged plates — Beta
3. deflected towards −vely charged plates — Alpha

→ radioactive elements can emit 1, 2, 3 (at most) radiations

→ different types of elements emit different types of radiations

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→ alpha particles = radioactive particles

→ alpha radiations come out of nucleus/element

Alpha radiations :

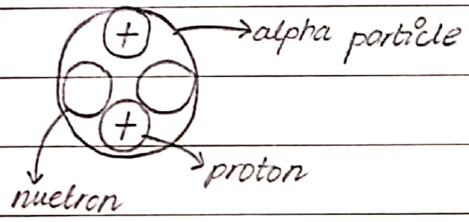
→ alpha radiations consist of particles which are called 'alpha particles'

→ alpha particles consist two protons & two nuetrons
(Helium)

→ alpha particle is also called Helium nucleus

→ alpha particle is represented by the symbol $_{2}^{4}\alpha$ / $_{2}^{4}He$ (mass no. / atomic no.)

→ alpha particles has a +ve charge as a whole b/c there is no electron



hence, the +ve charge

→ mass of alpha particle is equal to 4 times of the mass of a proton

(speed of light = C)

→ speed of alpha particle is equal to $\frac{1}{10}$ of speed of light ($\frac{1}{10}C$)

→ range of alpha particle in air is 5cm (at most they can cover 5cm in air after being emitted) & it can be stopped by a paper sheet (penetrating power is v. low)

→ alpha particle does ionization in gases (ionizing power is high)
↳ when it passes from a gas, it removes (not takes) e^- from gas atom and produces ions

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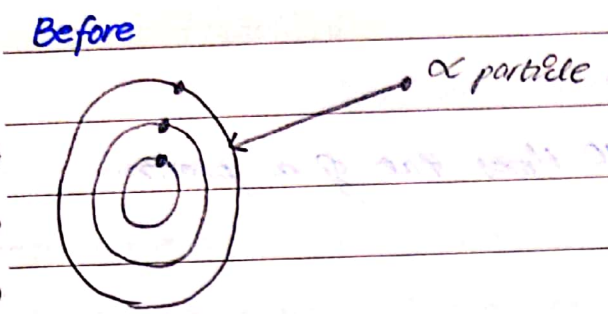
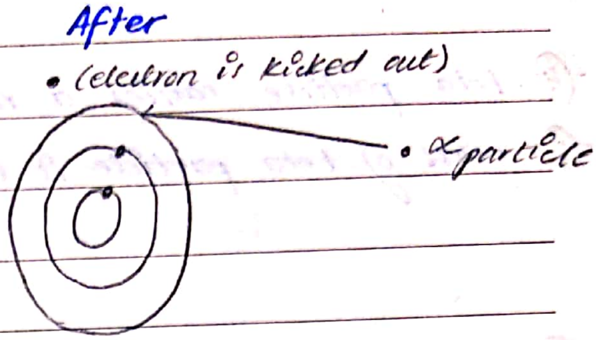
alpha particles when passed through air produce most ions as compared to beta and gamma rays





Ionizing power depends on:

i. Mass (directly proportional)
ii. Speed (inversely proportional)

→ alpha particles are deflected in both electric and magnetic fields

(deflection is supposed to happen b/c both electric & magnetic field exert forces on charged particles)

Beta radiations:

→ come out of nucleus

→ beta particles = electrons

the electrons are not emitted for the shells of an atom instead one of the atom nuetrons decays into a proton and an electron, the proton stays in the nucleus but the electron is emitted out at a high speed and these are called beta radiations or beta particles

Date: 24/8/20

→ Beta radiations consist of particles known as 'beta particle'

→ beta particle consists of an electron

→ " " is represented by the symbol ${}^{0}_{-1}e$ ${}^{0}_{-1}\beta$

→ beta particle carries a negative charge

→ mass of beta particle is equal to 1840 times that of a proton

→ speed of beta particle is equal to $\frac{9}{10}$ of speed of light

speed of beta particle $= \frac{9c}{10}$

↳ β particle has more kinetic energy than α particle
↳ β particle's mass is lower than that of α particle

} that is why β particle has a higher speed

→ range of beta particle in air is 50cm & it can be stopped using an aluminum sheet (more dense than paper)

→ β radiation results in ionization in air (ionizing power is less than that of α)

Ionizing power of β radiation depends on:

i. mass (directly proportional)

ii. speed (inversely proportional)

} hence, less ionizing power

→ beta particle is deflected in both electric & magnetic fields

* aluminum can stop both α & β but paper sheet only works on α

GLOBAL

Date: 24/8/20

★. β & α particles have energy but are not energy themselves while on the other hand, gamma rays are a form of energy

Gamma Radiations:

→ gamma radiations are electromagnetic waves

→ gamma radiations carry energy. (all types of waves carry energy)

→ gamma radiations are represented by the symbol γ

→ gamma radiations have no charge

(charge & mass are properties of a particle)

→ gamma radiations have no mass

→ gamma radiations travel at the speed of light

(all electromagnetic waves travel at the speed of light)

→ their range in air is infinite & can be stopped by a block of lead

↳ they pass straight through all bodies instead of colliding with them

★. a lead block will ~~all~~ block all 3 radiations b/c of its highest density

→ gamma radiations result in ionization in air (but ionization power is extremely low)

→ gamma radiations are not deflected by electric or magnetic fields. (b/c they deflect charged particles & gamma has no charge)

Gamma radiations are harmful for us: (have ↑ energy & can penetrate through our body)

- can damage tissues & cause cancer
- can effect/destroy organs

Date: 26/8/20

Radioactive Decay: process is completely random

1. Alpha Decay
2. Beta Decay
3. Gamma Decay

{in m.f beta has more deflection b/c of a smaller mass and greater speed}

1. Alpha Decay

→ when an element emits an alpha particle, its mass number decreases by 4 units & atomic number decreases by 2 units

X = element

$$_{Z}^{A}X = _{Z-2}^{A-4}Y + _{2}^{4}\alpha + \text{Energy}$$

{more deflection of alpha in e.f b/c alpha has double charge as compared to beta}

e.g/ pollonium transfers into lead after emitting α particle

$$_{84}^{208}Po \longrightarrow _{82}^{204}Pb + _{2}^{4}\alpha$$

{we're changin names from X to Y b/c atomic & proton no. are changing so the element is changin as well}

2. Beta Decay

→ when an element emits a β particle, its mass no. remains the same but atomic no. increases by 1 unit b/c a nuetron splits into a proton & an electron, electron is emitted
↳ proton no. increases by 1

X = element   Z = atomic no.

A = mass no.

$$_{Z}^{A}X \longrightarrow _{Z+1}^{A}Y + _{-1}^{0}\beta$$

$$_{Z}^{A}X - _{-1}^{0}\beta \longrightarrow _{Z+1}^{A}Y$$

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e.g/ $^{14}_{6}C \longrightarrow ^{14}_{7}N + ^{0}_{-1}\beta$

$^{46}_{20}Ca \longrightarrow ^{46}_{21}Sc + ^{0}_{-1}\beta$

(26 nuetrons) (25 nuetrons)

③. Gamma Decay

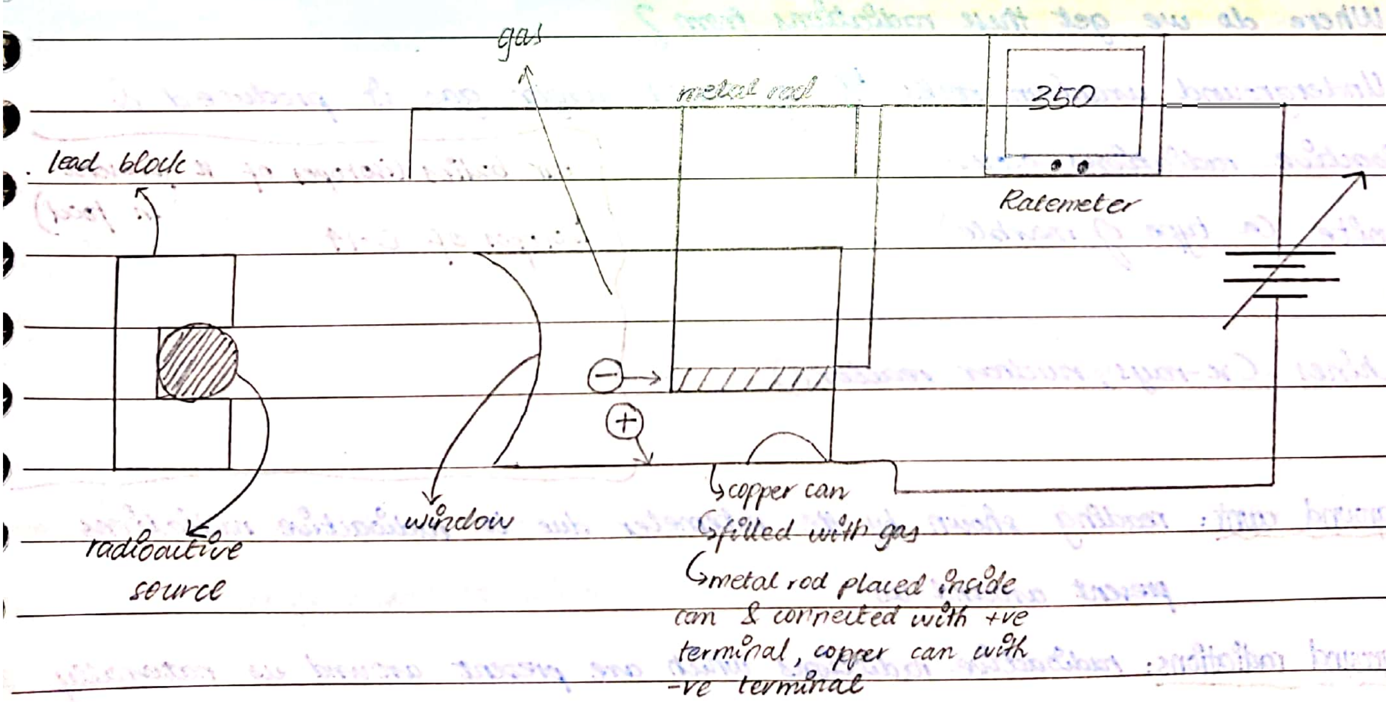
→ when element emits gamma radiations its mass no. and atom no. remain unchanged

$^{A}_{z}X \longrightarrow ^{A}_{z}X + \gamma$

e.g/ $^{27}_{13}Si^{0} \longrightarrow ^{27}_{13}Si^{0} + \gamma$

→ gamma decay always happens after alpha & beta decays, the excess energy comes out of nucleus in form of gamma radiations

Gieger Muller Tube (GM Tube):



Date: 27/8/20

→ a device which is used to detect the presence of radioactive source or radioactive radiation is called a GM tube

★. radioactive radiation from radioactive source passes through the window
★. they ~~ionize~~ produce ionization in the gas
↳ +ve ions attracted to copper can → connected to -ve terminal
↳ -ve ions attracted to metal rod → connected to +ve terminal
why?

★ when -ve ions pass through the ratemeter, you here a 'click' or a 'beep' indicating ↑ no. of ions
★ ↑ intensity of radioactive radiations ⟹ ↑ reading
↓ intensity of radioactive radiations ⟹ ↓ reading

→ there is always presence of radioactive radiations around us
→ to find the actual count you have to take background count before placing radioactive source and then a count after placing it

Q). Where do we get these radiations from?
A). Underground uranium rocks, b/c of which argon gas is produced & radioactive radiations occur
Granite (a type of marble)
Sun
Machines (x-rays, nuclear reactors)

our bodies (isotopes of K present in food)
isotopes of C-14

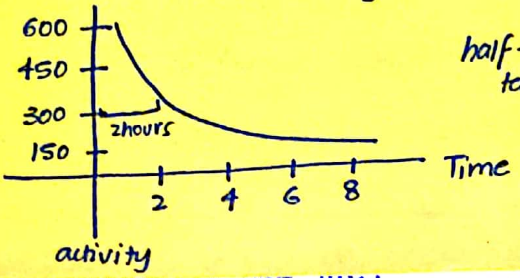
background count: reading shown by the ratemeter due to radioactive radiations present around us

background radiations: radioactive radiations which are present around us naturally (cosmic rays, polluted air & water, nuclear reactor in surrounding, earth's crust)

Actual Count = Count rate − b.c

activity : overall decay rate of all the isotopes in our sample
measured in bacquerels
1 Bq = 1 decay / second

→ it is not possible to calculate half life of a single isotope so we use a sample with a large no. of the same isotopes
→ as more & more of the particles decay, the no. of unstable particles decreases and so the activity also decreases



half-life : time taken for activity to halve

Date: 31/8/20

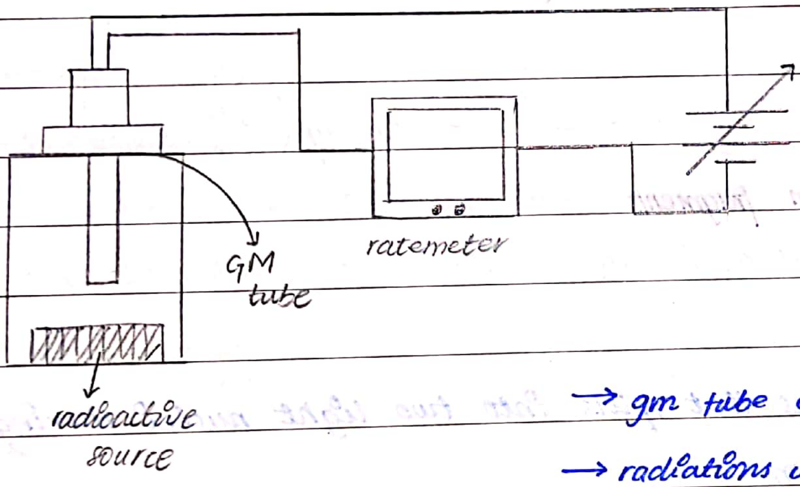
... radioactive element decay is called ...

...ain, toll haum half of atoms pata
...e time use kartay hai)

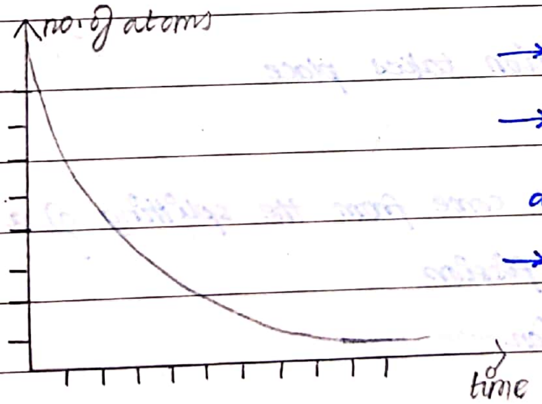
fixed half-life but theirs is if

★ half life is the time it takes
...ears :

for the number of the nuclei to decrease by half (the no. of atoms are halving)



→ gm tube and the ratemeter are connected
→ radiations will ionize gas in GM tube
→ ratemeter detects ions
→ the reading on ratemeter is inderictly determining the no. of atoms
→ note the readings after a certain time interval & plot them on a graph



nuclide ⇒ atom he hota hai
a fancy name for atom

nucleons ⇒ collective term for protons & nuetrons

Date: 31/8/20

half-life: time in which half of atoms of a radioactive element decay is called half-life of radioactive element

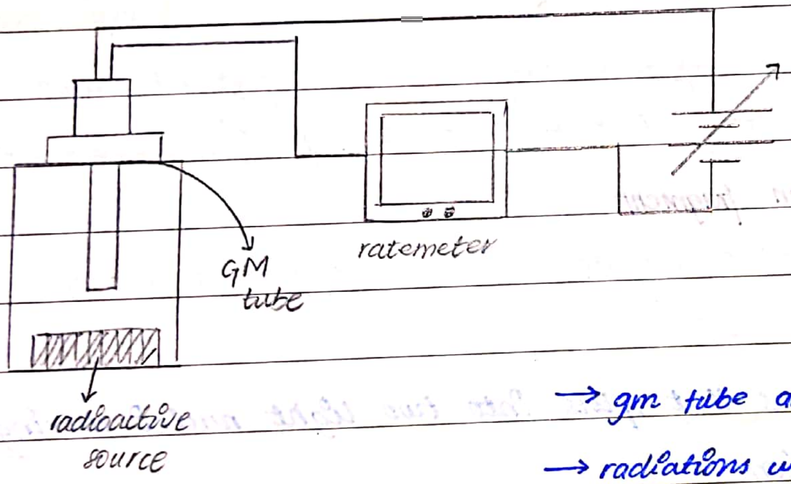
(jabsay dunia bani hai atoms decay horahay hain, tou hum half of atoms pata lagaanay kaylie no. of atoms present in current time use kartay hai)

all radioactive elements have a fixed half-life but theirs is different from other elements

★ half life is the time it takes for the number of the nuclei to decrease by half (the no. of atoms are halving)

can be in seconds or even in years.

determination of half-life:



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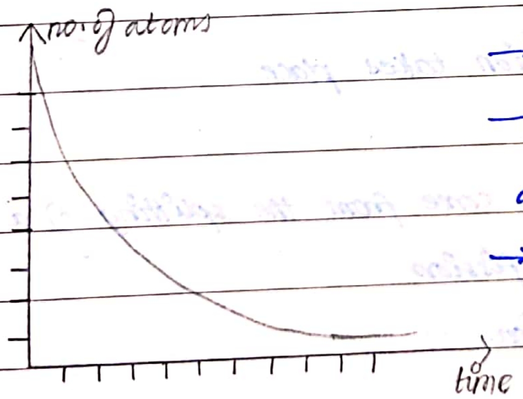


nuclide ⇒ atom he hota hai
a fancy name for atom

nucleons ⇒ collective term for protons & nuetrons

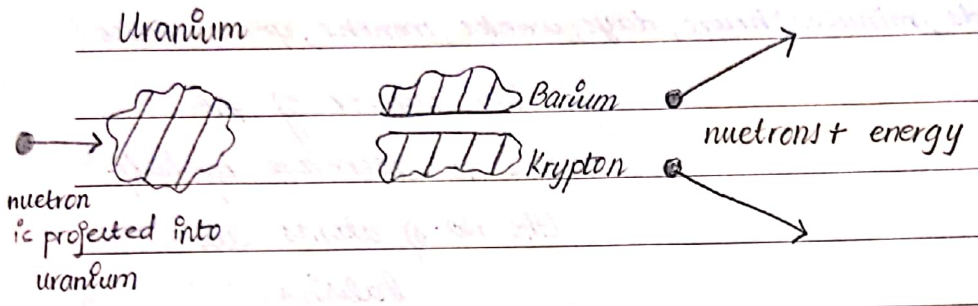
Date: 1/9/20

Nuclear Fission :

*in nuclear reactors

→ a process in which a heavy nucleus splits into two light nuclei with release of energy

→ there are two types : i. Spontaneous Fission (natural fission process)
ii. Nuetron induced fission (artificial fission process)
(it has radioactive products)



$$^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{144}_{56}Ba + ^{90}_{36}Kr + 2\,^{1}_{0}n + Energy$$

Energy → sound, heat, radioactive radiations

fission fragments

*remaining nuetrons come out as isolated nuetrons along with energy

parent nuclei : heavy nucleus that splits into two light nuclei during nuclear fission
nucleus before the reaction takes place

daughter nuclei : two lighter nuclei that come from the splitting of a heavy nucleus during nuclear fission
nucleus after the reaction

→ According to Einstein's mass & energy relation, mass can be converted into energy and energy can be converted into mass

→ proof: total mass of Ba & Kr < mass of U
↳ remaining mass converts into energy

$E = mc^2$ (E → energy, m → mass defect, c → speed of light)

Date: 1/9/20

→ nuclear fission is a chain reaction

Nuclear reactors : controlled chain reaction

Atomic bomb : uncontrolled chain reaction

(jo nuetrons bahir nikaltay hain wo uranium kay hotay hain, Ba/Kr ka unmein koi role nahin hota — aur jo nuetron hum daltay hain wo uranium ka part ban jata hai)

→ (insert n.f definition) on its own or automatically (spontaneous) ★unstable nucleus

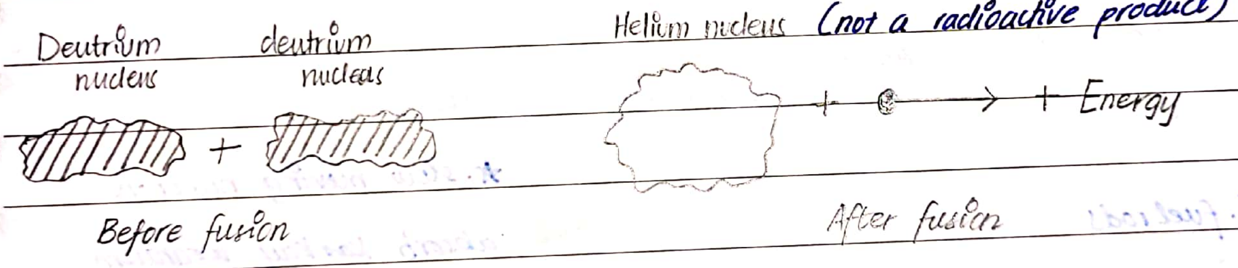
→ (insert n.f definition) by absorbing a slow moving nuetron (Nuetron induced)

Nuclear Fusion:

★ in the sun/star

→ a process in which two light nuclei combine to form a heavy nucleus with release of energy

→ (reverse reaction of nuclear fusion yet energy is released in both of them)



$$ {}^{2}_{1}H + {}^{2}_{1}H \longrightarrow {}^{3}_{2}He + {}^{1}_{0}n + \text{Energy} $$

→ total mass before fusion > mass after fusion

→ leftover mass converted into energy

★. stars, suns produce light & heat energy which happens because of nuclear fusion

→ condition : extremely high temperature

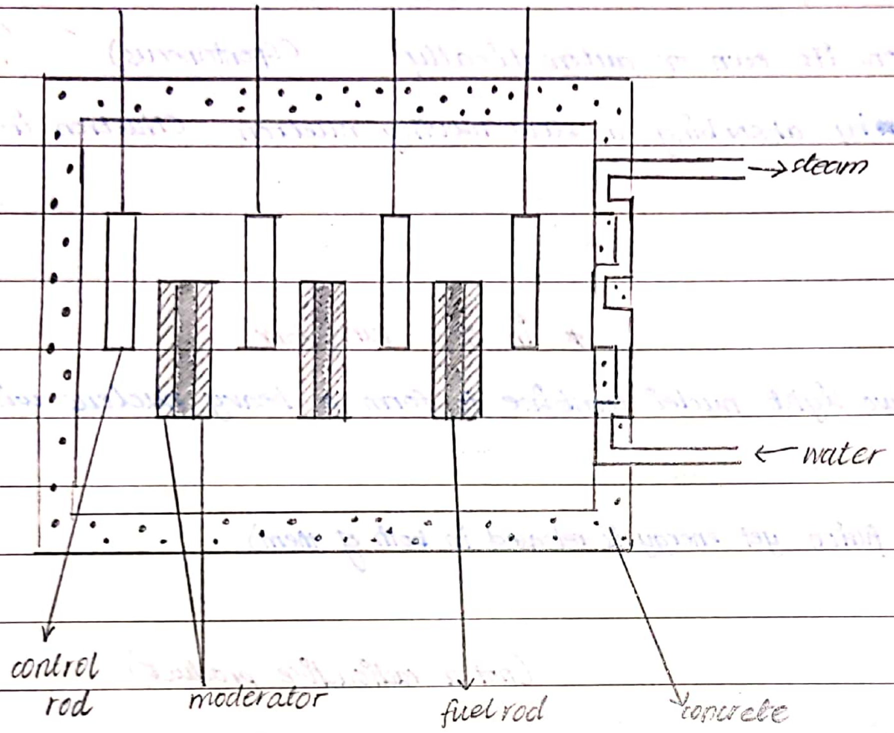
(needed to overcome repulsion b/w the 2 +ve nucleus and move them in a v. high speed to have them merge : ↑ temp. = ↑ energy)

Date: 3/9/20

Nuclear Reactor

→ it is used to produce thermal energy by using controlled fission reaction

→ thermal energy is then used to turn turbines which then produce electrical energy



Parts : i. fuel rods
ii. moderator
iii. control rods
iv. coolant (CO_2 gas)

★. slow moving nuetrons absorb kar kay uranium unstable hojata jiski vaja say agay wali cheezein hoti hain

→ fuel rods are made up of uranium used to produce fission reaction

→ they are surrounded by graphite blocks called moderators used to slow down nuetrons (the two extra nuetrons produced)

→ control rods are made up of boron that can easily absorb nuetrons

↳ strings attached help to move the rods up or down

Date: 3/9/20

↳ to increase rate of reaction, lift the rods to the top

↳ to decrease the rate of reaction, let them down

↳ if brought parallel to the fuel rods, the reaction stops altogether

↳ in other words control rods are used to control fission reaction

→ coolant — rotates inside the nucreal reactor and with it rotates the heat produced during the reaction

↳ the heat hits the water pipes and turns it into steam

↳ the steam is then used to run turbines

Nuclear Energy → Steam Energy → Kinetic Energy → Electrical Energy

Nuclear Reactor — Boiler — Turbine — Generator

HAZARDS OF RADIOACTIVE RADIATIONS:

1. Contamination
2. Irradiation

Radioactive Radiations
↓
Cell

- Cell → Ionisation ↓ (* destruction of cell) → burning of cell
- Cell → DNA ↓ → uncontrallable split (cell) ↓ → tumor
- Cell → Gamete ↓ → Sperm / Egg cell ↓ → Genetic disorder (* also called future matation)

Date: 7/9/20

1. Contamination

→ if radioactive source gets inside our body and damages the organ tissues or cells then we say that the body has been contaminated

→ for example through inhaling the air

→ the radioactive source after entering the body will produce radioactive radiations inside the body

2. Irradiation

→ if radioactive radiations produced by the radioactive source hit our body and then damage the organ tissues or cells, then we say that the human body has been irradiated

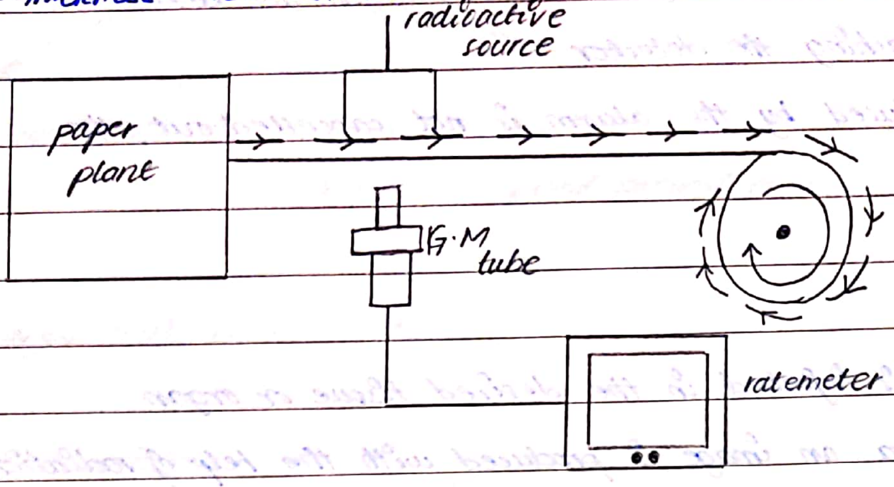
→ the radiations penetrate the body and get inside

turbines produce electric energy b/c the cut m.f.l and electromagnetic induction

Date: 7/9/20

USES OF RADIOACTIVE RADIATIONS:

1. Thickness Measurement



→ if ratemeter shows a constant reading throughout — ~~equal~~ the uniform thickness of paper throughout

2. Smoke Detector

→ the process produces current causing the alarm to ring
→ when radiations from radioactive source fall on the detector, it produces current as well
→ the current from the detector cancel outs the current from the process
→ ~~1~~ and the bell does not receive current nor does it ring
→ in case of fire, there is smoke

Date: 8/9/20

→ the smoke comes between the radioactive source and the detector resulting in no current produced by the detector b/c the smoke block the radiations from reaching the detector

→ since the current produced by the alarm is not cancelled out, the alarm rings

3. Medical Diagnosis

→ radioactive chemical is injected in the desired tissue or organ

→ using a special camera an image is produced with the help of radiations that helps to identify the problem

4. Radiation Therapy

→ gamma rays are directed towards tumor

→ & they destroy it

5. Food Irradiation

→ microbes decay food & can be destroyed using radioactive radiations
(microbes ↓ almost invisible bacteria)

→ low intensity radioactive radiations

6. Sterilisation

→ place medical instrument in a plastic bag and direct r.r towards it

7. Fault selection

→ for e.g/ agar ap ray 2 pipes ko weld kia aur uskay upar photographic

Date: 8/9/20

film wrap kardia,

→ radioactive source ko pipe mein rakh dein aur radiations ke waja say film dark hojaye ge

→ agar dark ho : * welding mein flaw hai
* films wrapped around pipe
* r.s in pipe

→ agar dark na ho : * no flaws

8. Carbondating

$^{12}_{6}C$ $^{13}_{6}C$ $^{14}_{6}C$ * 3 isotopes of carbon

$^{12}_{6}C$, $^{13}_{6}C$ → stable

$^{14}_{6}C$ ↓ instable or radioactive isotope

→ every living thing inhales C ($^{12}_{6}C$ & $^{14}_{6}C$)

→ when they die, they stop

→ for e.g/dead animal

↳ the amount of $^{12}_{6}C$ inhaled remains the same after death

↳ $^{14}_{6}C$ decay hojaye ga

↳ dono ka mass lay kay compare karaein gay jis say pata chalay ga kay death kab hue

$^{14}_{6}C$ → half life = 5400 years

Date:

Precautions of handling radioactive sources/radiations:

- → store radioactive material in a lead box
- → wear lead lined gloves and suits in radioactive labs
- → shift the radioactive material with tongs and forceps
- → avoid drinking and eating during the lab experiment with radioactive nuclei
- → hang radioactive precautionary symbols in the region where radiations are present

STAR FORMATION

- → a star is formed out of cloud of cool, dense molecular gas
- → in order for it to become a potential star, the cloud needs to callapse and increase in density
- → for this to happen, it can either collide with another dense molecular cloud or it can be near enough to encounter the pressure caused by a giant supernova
- → several stars can be born at once with the collision of two galaxies
- → in both cases, heat is needed to fuel this reaction which comes from the mutual gravity pulling all the material inward
- → what happens next is dependant upon the size of the newborn star, called a protostar
- → small prostars will never have enough energy to become anything but a brown dwarf
- → medium to large prostars can take one of two paths depending upon their size

Date:

→ if they are smaller than the sun, they undergo a proton-proton chain reaction to convert hydrogen to helium

→ if they are larger than the sun, they undergo a carbon-nitrogen-oxygen cycle to convert hydrogen to helium

↳ the difference is the amount of heat involved, the CNO cycle happens at a much higher temperature

* whatever the route — a star has been formed

→ the life cycle of a star is dependant upon how quickly it consumes hydrogen

→ for example, a small red ~~star~~ dwarf stars can last hundreds of billions of years, while large super giants can consume most of their hydrogen with comparably short few million years

→ once the star has consumed maximum hydrogen, it has reached its mature state

This is how a star forms.