

Q. No. 2 Part (i) If the length of simple pendulum is doubled, what will be the change in its time period?

Ans. * **Time Period:** Time Period of simple pendulum is given by,

$$T = 2\pi \sqrt{\frac{l}{g}}$$

If we double the length i.e. $L = 2l$

$$T = 2\pi \sqrt{\frac{2l}{g}}$$

$$T = 2\pi \sqrt{2} \sqrt{\frac{l}{g}}$$

$$T = \sqrt{2} \left(2\pi \sqrt{\frac{l}{g}} \right)$$

$$T = 1.414 \left(2\pi \sqrt{\frac{l}{g}} \right)$$

Hence, if length is doubled, time period becomes 1.4 times the original time.

$$T = 1.414T \quad [1l \text{ shows } T \propto \sqrt{l}]$$

Q. No. 2 Part (ii) What is meant by noise pollution? Write its harmful effects?

Ans. * **Noise Pollution:** The unpleasant and jarring effect of noise sound on human ears is called noise. Any noise / sound that disrupts normal human activities is called noise pollution. Noise has frequency greater than 4000 Hz . Changes of sound waves are non-periodic. Causes: Heavy machines, sirens, horns.

- * **Harmful effects:** Harmful effects on humans include, (85-
- Noise causes hearing loss if exposed to higher noise levels (90dB)
 - It causes hypertension and aggression in humans.
 - Noise can result in insomnia in humans especially those who work in industries near machineries.
 - It can cause high stress levels of brain.

Q. No. 2 Part (iii) Intensity of loud singing is $3.2 \times 10^{-5} \text{ Wm}^{-2}$.
Express intensity level in decibel.

Ans. • Given data: Intensity = $I = 3.2 \times 10^{-5} \text{ Wm}^{-2}$

Intensity of faintest sound = $I_0 = 1 \times 10^{-12} \text{ Wm}^{-2}$

Intensity level = $\beta = ?$

• Solution:

$$\beta = 10 \log \frac{I}{I_0} \text{ dB}$$

$$\beta = 10 (7.51)$$

$$\beta = 75.1 \text{ dB}$$

$$\beta = 10 \log \left(\frac{3.2 \times 10^{-5}}{1 \times 10^{-12}} \right) \text{ dB}$$

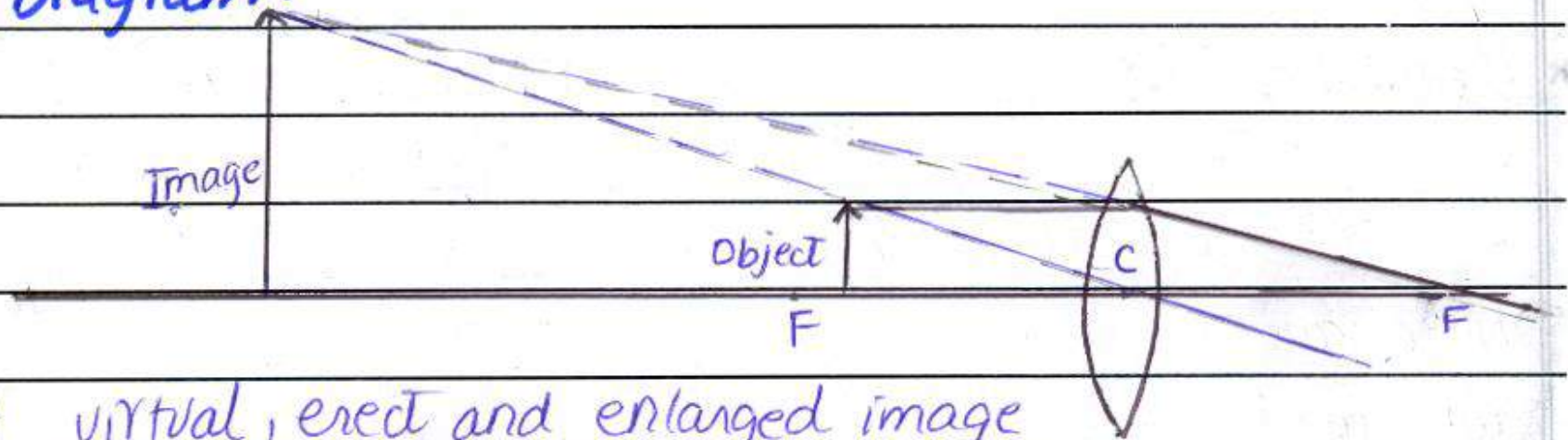
$$\beta = 10 [\log (3.2 \times 10^{-5}) - \log (1 \times 10^{-12})]$$

$$\beta = 10 [-4.49 - (-12)]$$

Q. No. 2 Part (iv) Under what conditions will a converging lens form virtual image?

Ans. • **Convex lens:** A convex lens (converging) would form virtual and erect image of real object if object is placed between its optical centre and focal point. i.e. inside lens's focal length. A large virtual image would form behind lens.

• **Ray Diagram:**



A virtual, erect and enlarged image is formed behind lens.

Q. No. 2 Part (vi) — what is electrostatic potential? write its formula and SI unit?

Ans. • **Electrostatic Potential:** The amount of work done in bringing a positive charge from infinity to a point in electric field is called electrostatic potential at that point. It is measured relative to some reference point.

• **Formula:**

$$\text{Electrostatic Potential} = \frac{\text{Work}}{\text{charge}} = \frac{J}{C}$$

↳ **SI Unit:** $V = J C^{-1}$ / 1 volt [Scalar Quantity]

• **Definition:** If 1 Joule of work is done in bringing 1 Coulomb positive charge from infinity to a point in electric field, electrostatic potential at that point is 1 volt.

Q. No. 2 Part (vii) Two charges $q_1 = 5 \mu\text{C}$ and $q_2 = 10 \mu\text{C}$ repel with 0.2 N force. what is the separation between charges?

Ans - • Given: Force = $F = 0.2 \text{ N}$

$$\text{Charge}_1 = q_1 = 5 \mu\text{C} = 5 \times 10^{-6} \text{ C}$$

$$\text{Charge}_2 = q_2 = 10 \mu\text{C} = 10 \times 10^{-6} \text{ C}$$

$$\text{Distance} = r = ?$$

• Solution:

$$F = \frac{k q_1 q_2}{r^2}$$

$$0.2 \text{ N} = \frac{9 \times 10^9 \text{ Nm}^2 \text{ C}^{-2} \times 5 \times 10^{-6} \text{ C} \times 10 \times 10^{-6} \text{ C}}{r^2}$$

$$0.2 = \frac{0.45}{r^2}$$

$$r^2 = 2.25$$

$$\sqrt{r^2} = \sqrt{2.25}$$

$$r^2 = 0.45 / 0.2$$

$$r = 1.5 \text{ m}$$

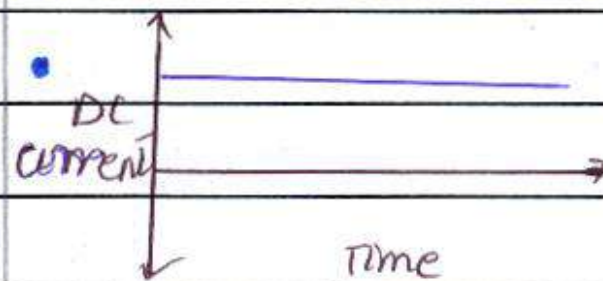
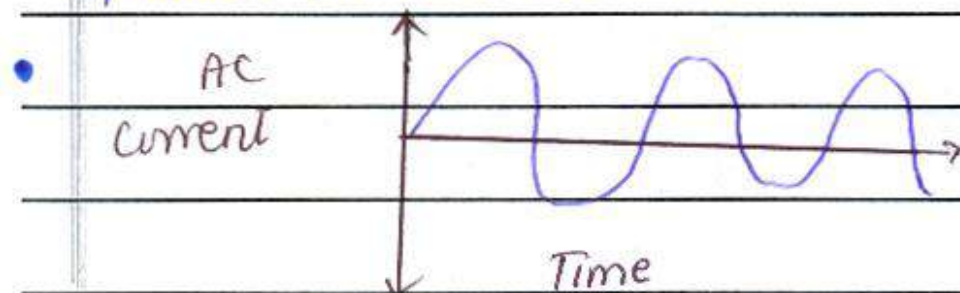
Q. No. 2 Part (viii) Differentiate b/w alternating and direct current.

Ans.

Alternating Current (AC)

Direct current (DC)

- | | |
|---|--|
| <ul style="list-style-type: none"> The current which changes its polarity ^{& distance} after equal intervals of time is ^{called} alternating current. It contains positive and negative half cycles of current. Generators produce A.C. It is used to supply main power in our homes. | <ul style="list-style-type: none"> The current which has fixed polarity is called direct current (unidirectional). It only contains positive half cycles of current. Batteries, cells produce D.C. It is used in D.C. motors to produce mechanical energy. |
|---|--|



Q. No. 2 Part (xi) Can a transformer operate on direct current?

Ans. * **Transformer:** A transformer is a device that changes A-C voltages into by principle of mutual induction.

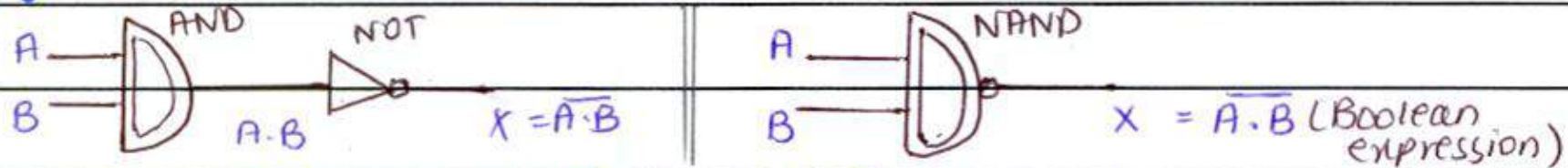
* **D.C supply:**

- Transformer only works by alternating current.
- If direct current is applied on primary coil of transformer, there would be no induced emf in secondary coil.
- Direct current produces constant magnetic field.
- Current / emf can only be induced by changing magnetic field as in alternating current.
- Thus, current can't be transferred on secondary coil in D.C, so transformer can't operate either because it changes voltage but no voltage could be changed by DC.

Q. No. 2 Part (xiii) How is NAND gate made? Draw its symbol and truth Table.

Ans. **NAND gate:** NAND operation is the inverse of AND operation. NAND gate is made by combining NOT gate with the out-put terminal of AND gate.

• **Symbol:**



(inputs) A B X = $\overline{A \cdot B}$ (output)

• **Truth table:**

0	0	1
0	1	1
1	0	1
1	1	0

Q. No. 2 Part (xii) Enlist uses of internet.

Ans • **INTERNET:** Internet is a combination of large networks of computers all across the globe to communicate with each other.

* **USES:**

- 1) **Web-Browser:** A browser provides window to view web-sites. They allow users to view pages of information on web-sites. Examples: Chrome, Mozilla Firefox, Internet explorer.
- 2) **E-mail:** An electronic-mail is cost-free service to send messages to any site on internet in a rapid and secure ^{manner}.
- 3) **Versatile :-** Internet provides sources of entertainment, social media, information etc. People can open online businesses (like Amazon) and also get education on internet.

Q. No. 2 Part (ix) Resistance of bulb is $500\ \Omega$. Find power of bulb when potential difference of 250V ---

Ans- • Given: Resistance = $R = 500\ \Omega$

Potential Diff = $V = 250\text{V}$

Power = $P = ?$

• Solution:

$$P = IV$$

$$[\text{Ohm's law: } V = IR]$$

$$P = \left(\frac{V}{R}\right)V$$

$$P = \frac{V^2}{R}$$

$$P = \frac{62500}{500}$$

$$P = \frac{(250)^2}{500}$$

$$P = 125 \text{ Watt}$$

Q. No. 2 Part (xii) Briefly describe construction and working of electron gun.

Ans. • **Electron gun:** An electron gun is used to investigate the properties of electrons.

- **Construction:**
 - Electron source (tungsten filament)
 - Evacuated glass tube
 - Anodes

→ **Working:**

Tungsten filament is provided 6 volt and 0.3A current. On heating, it ejects electrons. Positive potential of thousands volt is applied on anode. This causes electrons to accelerate through hole of anode in a fine beam of electrons. It takes place in evacuated glass tube to prevent electron ionization.

Q. No. 4 Part (a) (Page 1/2) What is capacitor? Describe capacitance and its SI unit. Determine equivalent capacitance of capacitors in series?

Ans. • **Capacitor:**

- A capacitor is a device that stores charge between its metal plates in form of potential energy.
- It consists of two metal plates placed parallel to each other with some insulating medium (dielectric) in between them.
- When voltage is applied on plates, potential difference is set up and charges on both plates attract each other.
- Thus, charge remains bound within the plates.

• **Formula:** $V \propto Q$ Q = charge
V = Voltage.

$\therefore Q = CV$

- **Capacitance:** Capacitance is the constant of proportionality and is defined as the ability of capacitor to store charge. Its SI unit is Farad.

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

- **SI unit:** If 1 volt voltage is applied across plates of capacitor and 1 coulomb charge stores in plate, its capacitance is 1 farad. (µfarad & pico-farad are nanofarad. used.)

* **Capacitor in series combination:**

Capacitors in series combination are connected side by side i.e. The right plate of one capacitor is connected with left ~~cap~~ plate of next capacitor and so-on.

(Page 2/2) *Change:

If the charge developed on one plate due to the voltage supply is negative, the right plate gets positive charge by electrostatic induction, and the left plate of next capacitor gets negative charge and so on. So charge remains same in series combination.

$$Q = Q_1 = Q_2 = Q_3$$

* Voltage:

Voltage applied on each capacitor is different due to different values of capacitances.

$$V = V_1 + V_2 + V_3$$

It is equal to the total voltage supplied by battery.

$$[Q = CV, \quad V = Q/C]$$

$$V = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3}$$

$$V = Q \left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \right)$$

$$\frac{V}{Q} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

We can replace combination of capacitors by reciprocal of equivalence capacitance

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

If n number of capacitors are connected in series, their equivalence capacitance would be,

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots + \frac{1}{C_n}$$

↳ The equivalence capacitance decreases with the number of capacitors being added and is smaller than smallest value of individual capacitor.

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Q. No. 4 Part (b) (Page 1/2) A transformer converts 240V A-C mains into 12V. It has 4000 turns on primary coil. How many ---?

Ans. • Given:

$$\text{Primary voltage} = V_p = 240V$$

$$\text{Secondary voltage} = V_s = 12V$$

$$\text{No. of turns on primary coil} = N_p = 4000$$

$$\text{Current in secondary coil} = I_s = 0.4A$$

$$\text{No. of turns in secondary coil} = N_s = ?$$

$$\text{Current in primary coil} = I_p = ?$$

• Solution:

$$\hookrightarrow \text{No. of turns on} \quad \frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$\text{Secondary coil} \quad \frac{12V}{240V} = \frac{N_s}{4000}$$

$$N_s = \frac{(4000)(12)}{240}$$

$$N_s = \frac{48000}{240}$$

$$N_s = 200 \text{ Turns}$$

↳ Current in Primary coil:

$$P_p = I_p$$

$$V_p I_p = V_s I_s$$

$$I_p = \frac{V_s I_s}{V_p}$$

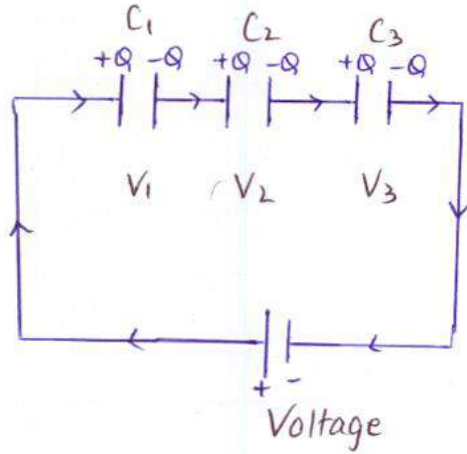
$$I_p = \frac{(12)(0.4)}{240}$$

$$I_P = \frac{4.8}{240}$$

$$I_P = 0.02 \text{ A}$$

space for diagram
(Section C)

Q. No. 4 Part (a)

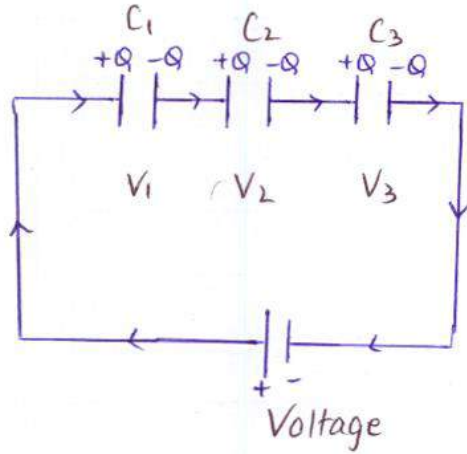


Capacitors connected in series

combination

space for diagram
(Section C)

Q. No. 4 Part (a)



Capacitors connected in series

combination

Q. No. 5 Part (a) (Page 1/2) Describe construction and working of CRO.

Ans * **CRO:-**

Cathode Ray Oscilloscope (CRO) is used for displaying changing currents and potential differences.

* **Construction:**

- A CRO consists of
- A circular or rectangular screen on which centimetre graph is super-imposed.
- An electron gun.
- Deflecting plates
- Fluorescence screen.

* **Working:**

1) **ELECTRON GUN:-**

An electron gun consists of electron source which is a heated cathode that gives out electrons.

* **Grid:** A grid is a negative electrode (connected to negative potential) that controls flow of electrons.

- The more negative the potential, more electron will be repelled by grid, and less electrons would reach anodes and screen.

- It is a brightness control tool, the more the electrons fall on screen, more the brightness of screen and vice versa.

* **Anode:** The anodes are connected to positive potential (of thousands V). They accelerate electrons towards deflecting plates in a fine beam.

2) DEFLECTING PLATES:

* **Horizontal Plates:** The electrons pass through horizontal plates. They are connected with voltage and thus have a potential difference.

- They are responsible for Y-axis or vertical movement of electrons on the screen.

* **Vertical Plates:** Then electrons pass through vertical plates. Potential difference is also applied between them.

- They are responsible for X-axis or horizontal movement of electrons on screen.

3) FLUORESCENCE SCREEN:

The screen is covered with a thin layer of phosphor. When electron hit them, they emit light energy in form of photons which makes the screen glow.

* Uses of CRO:

- CRO is used to display heartbeats.
- It is used for measuring voltages.
- It is used to display waveforms.
- It is used in radar system.
- It is used in echo-sounding method (to measure depth of seabeds).

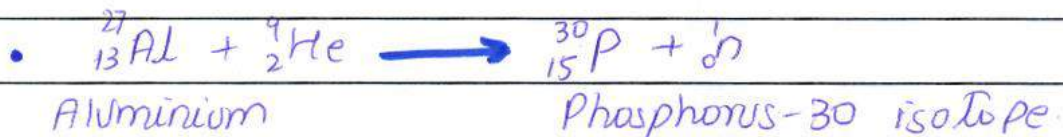
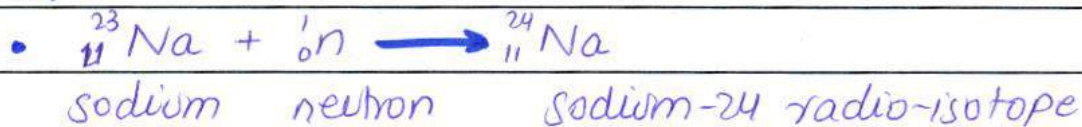
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Q. No. 5 Part (b) (Page 1/2) What are radio-isotopes? Explain their uses.

Ans. *** Radio-isotopes:**

- Radio-isotopes are artificially created radioactive elements by bombarding them with alpha particles, electrons, neutrons etc.
- They have atomic number less than 82.
- They start emitting radiations and are useful.

*** Examples:**



*** USES OF RADIODISOTOPES:-**

1) **Agriculture:**

- In agriculture, different tracers (compounds with small amount of radio-isotopes) are used to detect the amount of fertilizer consumed by plants.
- Phosphorus-32 is used for this purpose. It is mixed with fertilizer and applied to plants.
- Radio-detectors identify the fertilizer taken by plants.

2) **Medicine:**

- In medicine field, Cobalt-60 is used to kill cancerous cells. They kill the malignant tumor part.

- Phosphorus-32 is used to diagnose brain tumor. The malignant part shows different activity than other tissues when radio-isotopes are applied to them.
- This detects the tumor.
- Iodine-131 is used to ~~get~~ ~~pic~~ monitor functioning of thyroid gland by accumulating in thyroid gland.

3) Industry:

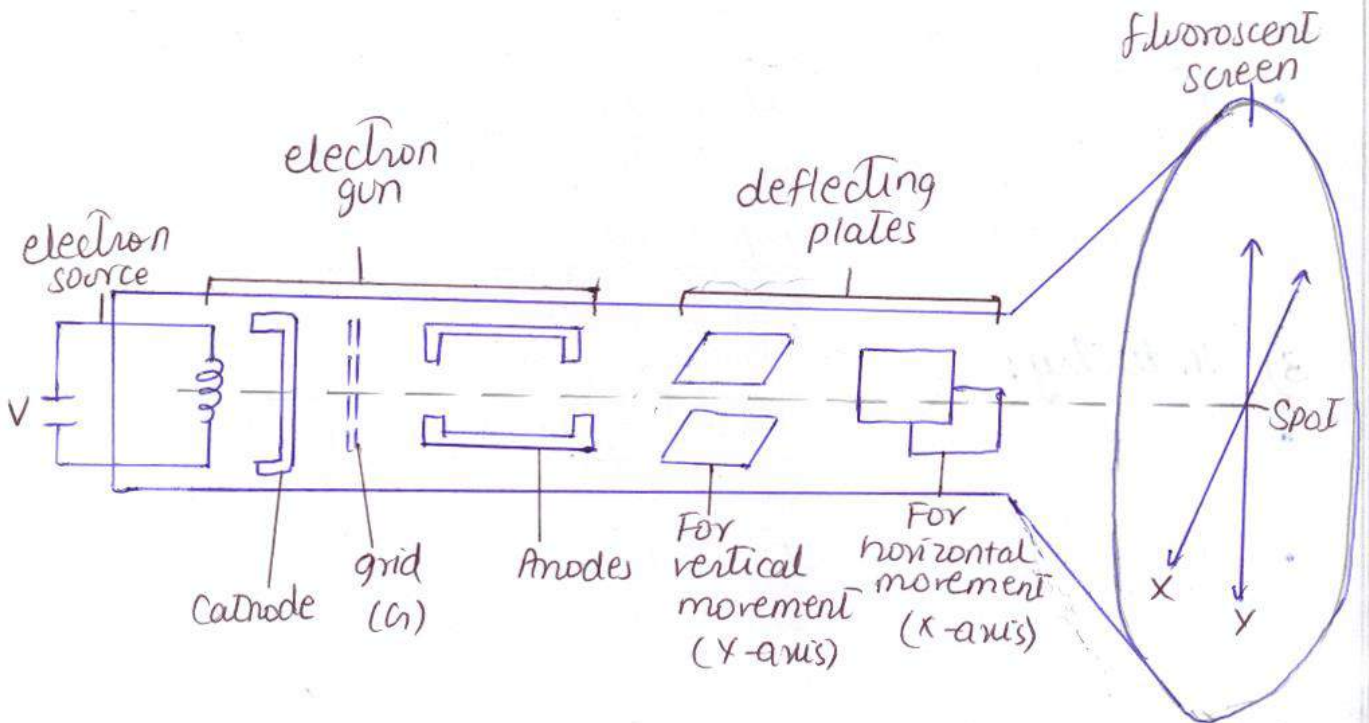
- The radio-isotopes are used to detect leak in underground pipes.
- They identify cracks in parts of heavy machinery which could be very dangerous.

4) Carbon-dating:

- Carbon-14 in air forms CO_2 , when plants and animals take in ^{thus} CO_2 , they become radio-active.
- When plants die, they stop taking in C-14 and it begins to decay.
- In live plants, C-14 is almost constant because it is being replenished.
- Thus, knowing the half-life of C-14 (5730 years), we estimate the age of dead plant by comparing its C-14 activity with that of live plant.

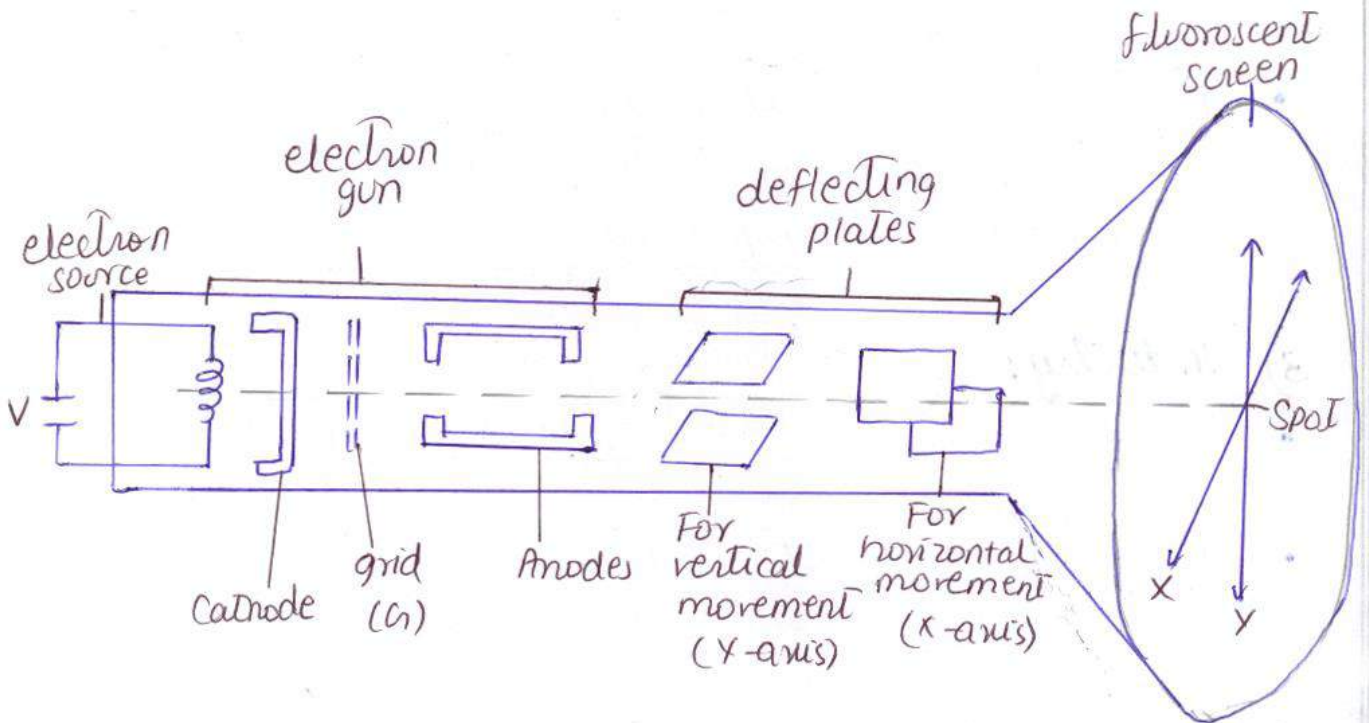
- 5) Other ancient relics: It is used to measure age of rocks. When ^{40}P (radio-active) in rocks decays into Ar-40 , the age of rock is estimated by measuring their concentrations & comparing them. Half life of P-40 is 2.4×10^8 years.

Q. No.5 Part (a)



Cathode Ray Oscilloscope

Q. No.5 Part (a)



Cathode Ray Oscilloscope