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NUCL 3100

Hw 6

1) $R = \frac{FWHM}{H_0}$ $FWHM = 490 - 435 = 55$

$\therefore R_{435} = \frac{55}{435} = 0.126$

$R_{490} = \frac{55}{490} = 0.112$ ← Smaller

$\therefore \boxed{R = 11.2\%}$

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2) - Ion Saturation region ⓐ
- Proportional region ⓑ
- Limited proportional region – Not useful
- Grieger Mueller region ⓒ
- recombination region — Not useful

a) well suited for γ exposure and high dose rate measurements
- Not well suited for lower energies because there is no charge amplification

b) - Good for lower energy because it amplifies the charge
- Good for mixed radiation environment
- Bad because it requires stable power supply to keep voltage constant

c) - Good for producing a Strong signal
- Bad because it has a lower energy resolution
- Bad ~~because~~ for mixed radiation

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3) $M = \exp\left(2\left(\frac{D N_m V_0 a}{\ln(b/a)}\right)^{1/2}\left(\left(\frac{V_0}{V_t}\right)^{1/2} - 1\right)\right)$

$M = 1000$
$b = 3.5$ cm
$a = 12 \times 10^{-4}$ cm
$V_t = 500$ V
$D = 0.11 \times 10^{-17}$ $\frac{cm^2}{V}$

$N_m = \frac{\rho N_A}{M} = \frac{0.001251 \frac{g}{cm^3} \cdot 6.022 \times 10^{23} \frac{a}{mol}}{14 \text{ g/mol}}$

$= 5.38 \times 10^{19} \frac{1}{cm^3}$

$\rightarrow \boxed{V_0 = 1755.4 \text{ V}}$

4) The Geiger discharge is when gas molecules are excited by collision withe electrons and then release a photon as they return to ground state. The photon then is absorbed and releases an electron. This causes a butterfly affect and the detector needs to be quenched to be able to actually detect the source.

5) For γ the efficiency of GM depends on probability of interaction with wall and probability that electron will reach gas before the end of its track.

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6) Activators are needed because excited e^- will move from the valence to conduction band but when it returns to valence shell, it releases a photon that is too high in energy. The activator creates electronic levels in the forbidden gap so the electrons can release a photon in the correct wavelength

Organic scintillators don't need impurities because their fluorescence mechanism comes from the transition of energy level of a single molecule and can be observed independently of the physical state.

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7) a.) organic
b.) inorganic
c.) organic
d.) inorganic
e.) organic

8.) Inorganic scintillators shouldn't be dissolved because they are dependent on the crystal lattice so when it's dissolved, the lattice is broken up

Organic scintillators can be dissolved because they are made of organic molecules with a certain electronic structure.

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9) Inorganic

- NaI
- CsI
- LiI
- BaF_2
- C_sF

Organic

- Pure Crystals -
  - anthracene
  - Stilbene
  - naphtalene
- Liquid scintillators
- Plastic