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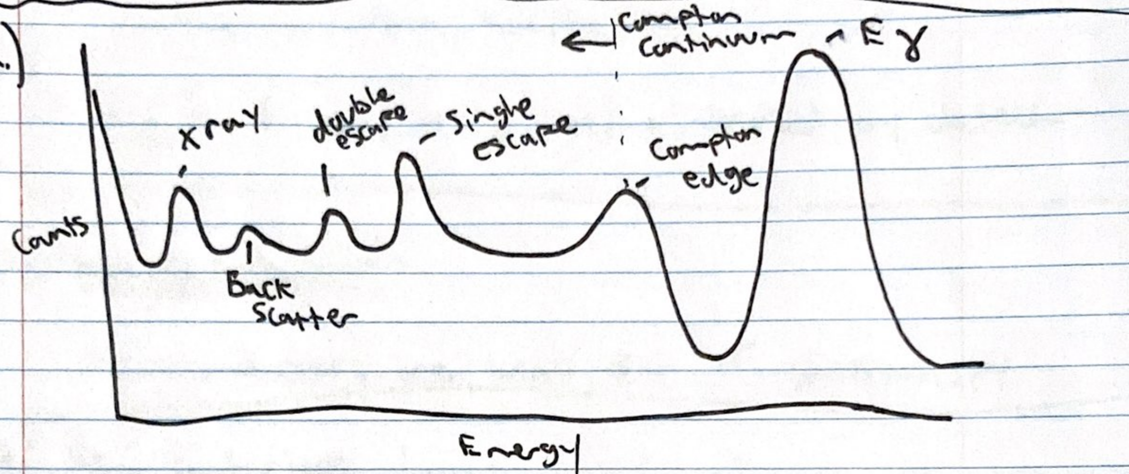
Nucl 3100

Hw 7

1) n-type semiconductors are doped with phosphorus which has one extra valence electron.
P-type semiconductors are doped with Boron which has one less valence e^- so there's one more hole.

2.)



- **X-ray**: Produced when γ interacts with shield (high Z material), much lower energy

- **Back scatter**: Produced when γ hits the shield and bounces off to detector. Most of the energy is lost due to scattering event

- **Escape peaks**: If incident γ has an energy > 1.022 MeV, it can produce an electron positron pair. The particles can then be annihilated to produce two more γ which can escape or be detected. A double escape peak means that both γ escape but a single escape peak shows that one γ was absorbed by detector and the other escaped.

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- <u>Compton Edge</u>: Produced by Compton Scattering @ different angles

- <u>Compton Continuum</u>: Corresponds to distribution of energy between incident γ and scattered e^- during compton scattering

- <u>E_γ</u>: Energy of γ being absorbed by detector

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3) ~~[illegible]~~

Semiconductors are best for γ spectroscopy

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4) Semiconductors have better Energy resolution than Scintillators because the steps to Convert radiation to light to electrical signal are inefficient and there is a small number of carriers created. The variation of pulse height in Semiconductor is much smaller because the energy needed to produce electron-hole-pairs is relatively low.

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5) SCAs discriminate pulses based on set thresholds or within a certain range and has an analog output. MCAs are similar to SCAs but have multiple bins to sort ~~[illegible]~~ pulses in different thresholds so the output is more digital.

SCAs can be used to measure intensity of a certain type of radiation (x-rays for example).

MCAs can be used to analyze ~~[illegible]~~ different types of radiation.

HW 7

6.) γ: 15 mGy $W_\alpha = 20$
α: 1 mGy $W_\gamma = 1$

$$H_T = \sum_R W_R D_{T,R}$$

$$= 1(15) + 20(1) \boxed{= 35 \text{ mSv}}$$

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7) Skin: 0.20 W_{skin}: 0.01
Stomach: 0.05 W_{stom}: 0.12

$$E = W_T H_T$$

~~$E_{skin} = 35 \text{ mSv} (0.01) = 0.35 \text{ mSv}$~~

~~$E_{stom} = 35$~~

$$E_{skin} = 0.2(35) \cdot 0.01 \boxed{= 0.07 \text{ mSv}}$$

$$E_{stom} = 0.05(0.12)(35) \boxed{= 0.21 \text{ mSv}}$$

total = 0.28 mSv

8.) $\text{Exposure} = \Gamma \frac{\lambda_d N t}{r^2}$

$\lambda_d N = 23 \text{ Ci} = 23000 \text{ mCi}$
$t = 10 \text{ min} = 0.167 \text{ hrs}$
$r = 5 \text{ m} = 500 \text{ cm}$
$\Gamma = 3.3 \frac{R \text{ cm}^2}{\text{mCi h}}$

$$= \frac{3.3(23000)(0.167)}{500^2} \boxed{= 0.051 \text{ R}}$$

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9.) total = 0.5 Gy = 500 mGy

$W_{R\,x\text{-}ray} = 1$

$W_{T\,brain} = 0.01$

$H_T = 500(1) = 500\ mSv$

$E = W_T H_T = 0.01(500) = \boxed{5\ mSv}$

10.) a.) m = 22 g

A = 1.85×10^5 Bq ~~[illegible]~~

$D = \frac{1.6\times10^{-10}\ A\ E}{m}$ $\qquad$ $E = \frac{1\ MeV}{disintegration}$

∴ ~~$D = 1.6\times10^{-10}(1.8$~~

~~AE~~

$D = \frac{1.6\times10^{-10}(1.85\times10^5)(1)}{22} = \boxed{1.345\times10^{-6}\ Gy}$

b.) m = 25

E = 5MeV

$D = \frac{1.6\times10^{-10}(1.85\times10^5)(5)}{25} = \boxed{5.92\times10^{-6}\ Gy}$

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1) 25R ~~1R = 0.00877 Gy~~

$t = 3h$

$r = 5.5\ cm$

^{60}Co

$$\cancel{A = \frac{D(Gy)}{1.6\times10^{-10}\, E\, \Delta t} = \frac{25(0.00877)}{1.6\times10^{-10}(1)}}$$

$$\text{Exposure} = \frac{\Gamma A t}{r^2} \rightarrow A = \frac{\text{Exp}\, r^2}{\Gamma t}$$

a.) $A = \frac{25(5.5)^2}{13.2(3)} = \boxed{19.09722\ mCi}$

b.) $A = \frac{25(5.5)^2}{3.3(3)} = \boxed{76.38889\ mCi}$