Formulas For Life

Relevant equations

- Similar triangles relation: $\frac{x_1}{x_2} = \frac{a_1}{d_2}$
- Magnification factor relation: $\frac{image\ size}{object\ size} = \frac{image\ distance}{object\ \ distance}$
- Gap formula: gap $= \left(\frac{FS_1}{2} X \frac{depth}{SSD}\right) + \left(\frac{FS_2}{2} X \frac{depth}{SSD}\right)$
- Inverse square law: $\frac{I_1}{I_2} = \left(\frac{d_2}{d_1}\right)^2$
- Percent error: $\frac{d_O^2 - d_E^2}{d_E^2}$ for observed and expected distance
  - OR we can use this formula: $\left(\frac{original\ SSD}{actual\ SSD}\right)^2 * 100\ - 100$
- Percent error: $\frac{final\ - initial}{initial} * 100$
- Average photon energy: $\frac{1}{3}$ × energy of incident photon beam
- Practical electron energy: $\frac{1}{2}$ × energy of incident electron beam
- Average electron depth: For each 1cm traveled, the beam looses 2MeV of energy

Useful range of electrons is : 1/3 x energy this gives the 80% isodose line

Relevant equations

- Equivalent square length (no blocking): $FS_{equiv} = 4 \times \frac{L \times W}{2(L+W)}$
- Equivalent square length (with blocking): $FS_{equiv} = \sqrt{A_{open} - \sum A_{blocked}}$
- Monitor Units (with PDD): $MU = \frac{D}{S_c \times S_p \times PDD \times RDD}$
- Monitor Units (with TAR/TMR): $MU = \frac{D}{S_c \times S_p \times TMR}$
- Gantry Speed: $\frac{MU}{degree\ of\ arc}$
- Beam weighting: If body components A and B share a: b ratio of x dose → then the dosage to $\mathrm{A}\ = \frac{x \times a}{a+b}$ and the dosage to $\mathrm{B}\ = \frac{x \times b}{a+b}$
- Wedge angle: $\mathrm{WA} = \ 90° - \frac{1}{2} HA,$
- Hinge angle: $HA = 180\ - 2 \times WA$
- Collimator rotation: $\tan^{-1}\left(\frac{1}{2}\frac{height}{SSD}\right)$ (make sure this is calculated in degrees)
- Given dose: $GD = \frac{TD}{PDD}$
- $A = A_0 0.5^{\frac{t}{t_{1/2}}}$, where $t_{1/2}$ is the half life
- Average time: $1.44 * t_{\frac{1}{2}} = t_{avg}$

Half life to average life (or vice versa)

Given half life, we can find the average lifespan :

$t_{avg} = 1.44 * t_{1/2}$

Given average lifespan, we can find half life:

$t_{1/2} = 0.694 * t_{avg}$

Given attenuation coefficient (u), we can find HVL (or vice versa):

$HVL = 0.694 \div u$ $u = 0.694 \div HVL$

$$EqD = \overset{\text{Absorbed Dose}}{D} \times \underset{\text{Radiation Weighting Factor}}{W_R}$$

$$EfD = D \times W_R \times \underset{\text{Tissue Weighting Factor}}{W_T}$$

INVERSE SQUARE FACTOR

(SAD/SSD + Dmax) ^2

This formula is used if your point in free space is defined at 100 cm from source, and you want To use pdd method, which requires that dose in free space to actually be 100 + dmax.
SAD assumes your point of interest is always going to be at 100 cm from the source. SSD Assumes your skin is at 100cm from the source, and since backscatter factor changes your measured dose in free space to being dose in tissue at dmax, you have to shift the free space point from being at skin to being at dmax.

T_new = T_old / wedge factor [same dose for patient]

Dose_new = Dose_old * (wedge factor) [same time]