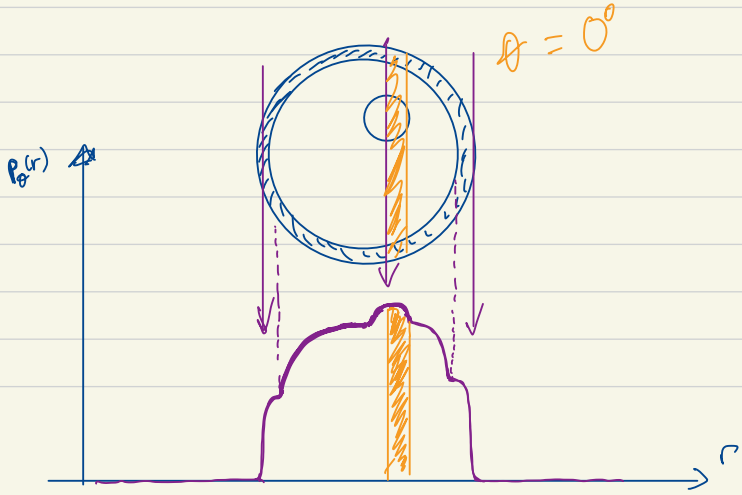
1a) Since we neglect scatter, no photons get lost passing through the tissue

$$(600 \times 10^9) \times 16 \times 1 \times (100 \times 10^{-2}) \times \frac{1}{128} = 7.5 \times 10^9 \text{ (photons)}$$

1b)



Question 4:

a)

		40 keV		80keV	
	ρ (g/cm^3)	μ/ρ (cm^2/g)	μ (cm^{-1})	μ/ρ (cm^2/g)	μ (cm^{-1})
Bone	1.920	0.6655	1.27776	0.2229	0.4279
Water	1.00	0.2683	0.2683	0.1837	0.1837

At 40keV: $\frac{\mu - \mu_{H_2O}}{\mu_{H_2O}} \times 1000 = 3761.83$ (HU)

At 80keV: CT number = 1329.34 (HU)

b) 3 sources of noise in CT are:
- quantum noise (dominates – due to Poisson nature of X-rays)
- round-off/quantization noise
- electronic noise

c) Voltage

If voltage doubles, the energy of electrons doubles, 8 times less chance of photoelectric absorption. Thus contrast decreases.

d) Current

Number of electrons hitting anode thus number of emitted photons doubles. Therefore contrast increases.

e) Primary factor for larger effective dose in abdominal CT vs head CT is the weighting factor W_i of each tissue. ($W_{brain} = 0.01$ while $W_{liver} = 0.04$, $W_{colon} = 0.12$)

$$E = \sum W_i H_i = \sum W_i (D_i Q_i)$$
$$= \sum W_i D_i \quad (Q_i = 1 \text{ for photons})$$