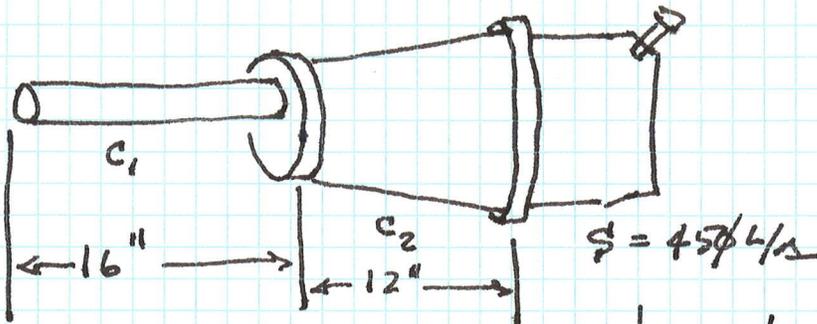


1)

(10)



- KF-4φ means that the nominal tube ID is 4φ mm

$$C_1 = a A \frac{11.6 L}{d \cdot \text{cm}^2} \quad A = \pi (2.0 \text{ cm})^2$$

$$d = 12.6 \text{ cm}^2$$

a from figure in O'Hanlon 3.5
also

$$\frac{L}{R} = \frac{16 \times 2.54}{2 \cdot \phi} \frac{\text{cm}}{\text{cm}} = 2\phi.3 \quad \text{too large for figure}$$

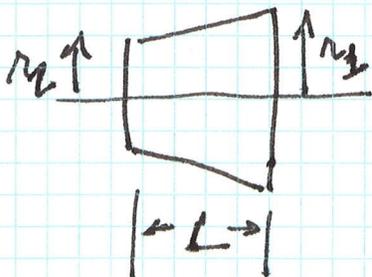
for Nitrogen

$$C_1 = \frac{\pi}{12} \sqrt{\frac{d^3}{L}} = \frac{\pi}{12} \left(\frac{475 \text{ m}}{\text{s}} \right) \frac{(\phi \cdot \phi 4 \phi \text{ m})^3}{16 \times 2.54 \times 10^2 \text{ m}} = 1.96 \times 10^{-2} \frac{\text{m}^3}{\text{s}}$$

$$C_1 = 19.6 \text{ L/s}$$

$$\frac{1}{S_{\text{eff}}} = \frac{1}{19.6} + \frac{1}{45\phi} = 5.33 \times 10^{-2} \frac{\text{s}}{\text{L}} \Rightarrow S_{\text{eff}} = 18.8 \text{ L/s}$$

just to check, O'Hanlon figure 3.11 has a for the frustum of a cone...



$$\frac{r_1}{r_2} = \frac{6}{4} = \frac{3}{2}, \quad \frac{L}{r_2} = \frac{12}{6} = 2 \quad a \sim \phi.34$$

$$C_2 = \phi.34 \left(\pi \left(\frac{6 \times 2.54 \text{ cm}}{2} \right)^2 \right) \frac{11.6 L}{d \cdot \text{cm}^2} = 719. \frac{\text{L}}{\text{s}}$$

182 cm²

2a)

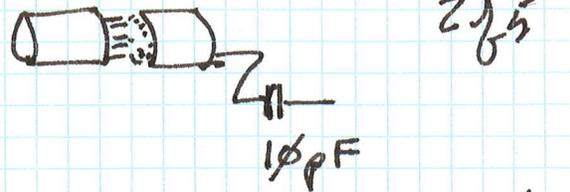
$$I_{\text{dark}} \sim 4.7 \text{ nA} = \frac{dQ}{dt}$$

⑤

$$V \sim \frac{Q}{C} \text{ for AC-coupled detectors}$$

$$V \sim \left(\frac{dQ}{dt} \Delta t \right) / C = \frac{dQ}{dt} \frac{RC}{C} = \frac{dQ}{dt} R \quad [V = IR!]$$

$$V \sim 4.7 \times 10^{-9} \text{ A} \times 50 \Omega = 2.3 \times 10^{-7} \text{ V}, \quad \phi.23 \mu\text{V}$$



AC-coupled - no current

$$\tau = 10 \text{ pF} \times 10^7 \Omega = 50 \text{ ns}$$

$$\tau = \phi.5 \text{ nA}$$

b) $G = S^N$ from spec's $N=8$ for XP3462

⑤

$$\textcircled{1} \quad 1\phi^6 = S^8 \rightarrow S = 5.62$$

$$\textcircled{2} \quad 5 \times 1\phi^6 = S^8 \rightarrow S^8 = 6.88$$

$$\eta_{\text{diff}} = 1\phi \times \frac{6.88 - 5.62}{5.62}$$

$$= 22.3\%$$

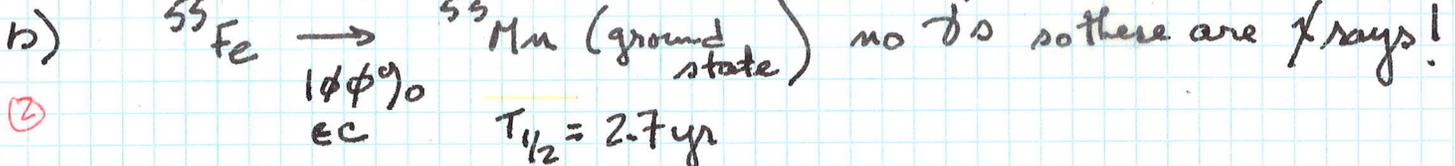
3a)

$$\text{FWHM} = 145 \text{ eV in Silicon} \quad W = 3.65 \text{ eV/IP in Si}$$

②

$$\text{ENC} = 145 \text{ eV} / (2.354 * 3.65 \text{ eV/IP}) = 17 \text{ IP}$$

(ENC is a "σ" and not FWHM)



②

$$I/I_0 = e^{-\mu x}$$

$$x = 5\phi\phi \mu\text{m of Si} \quad \rho = 2.33 \text{ g/cm}^3$$

$$I/I_0 = e^{-147 \times 2.33 \times \phi. \phi 5}$$

$$\mu/\rho = 147. \frac{\text{cm}^2}{\text{g}} \text{ at } 6. \phi \text{ keV from NIST web table}$$

$$I/I_0 = e^{-17.1} = 3.7 \times 10^{-8}$$

(fully absorbed!)

4b) defines the ground plane for the proportional region

c) deexcitation of atomic excited states of Helium

d) ① quench the excited states of helium and convert that energy into ionization through collisions

② absorb the uv-radiation that gets emitted by the unquenched He^* states

5a) Pirani gauge works by reading the change in resistance of a heated wire that is cooled convectively by the residual gas. A thermal couple gauge works by reading the temperature of the wire directly with a thermocouple bimetal junction.

Both fail at low pressure because the convective cooling by the residual gas goes to zero

b) most likely damage is due to (n, n') collisions that cause a dislocation in the lattice. The dislocated atoms can be driven back and lattice repaired by heating - i.e. annealing of crystal. The detector holder is pumped during heating to remove off-gases that might coat the crystal on cooling.

5c)

(2)

Plastic scint are basically $(CH_2)_N$ so the major interaction process for photons is Compton scattering — very little photoelectric effect — so the full energy peak for a γ is very weak.

Better material ~~also~~ would have a high Z to increase photoelectric interactions and increase the yield of the full energy peak.

d) • 2V range is rather common for an ADC, not special

(2) • 100 MSPS \rightarrow 10 ns to process ^{a sample} the peak. This is rather fast and so the best ADC is probably a flash ADC. A pipeline ADC might be able to reach this speed.

e) • shortest cable detector to preamp \rightarrow lowest capacitance and lowest degradation of small signal

(2)

• twisted pair out from preamp \rightarrow differential signal is best for suppressing noise, particularly induced noise from loops, etc.