

QUESTION 5

A thin window, pancake GM instrument is labeled with an efficiency value of 0.20 cpm/dpm. This instrument was calibrated with a ^{137}Cs source of one inch diameter on an aluminum planchet in a calibration jig at your calibration facility. The nominal window diameter for the detector is 1.75 inches.

GIVEN

| Isotope | $t_{1/2}$ | Max Beta Energy (MeV) | % Beta Intensity | Gammas (MeV) | % Gamma Intensity |
|-------------------|-----------|-----------------------|------------------|--------------|-------------------|
| ^{99}Tc | 2 E 5 y | 0.293 | 100 | none | N/A |
| ^{137}Cs | 30 y | 0.511 1.173 | 95 5 | 0.661 | 85 |
| ^{90}Sr | 29 y | 0.546 | 100 | none | N/A |
| ^{90}Y | 64 h | 2.283 | 100 | none | N/A |

POINTS

- 10** A. A $1.0\ \mu\text{Ci}$ ^{99}Tc source of 1.75" diameter on a thin plastic backing is counted in the field. Using the quoted efficiency, calculate the expected count rate. **Show all work.**
- 20** B. Assume that an observed net count rate of 3×10^5 cpm for the ^{99}Tc is lower than the calculated count rate. Provide four possible reasons for the discrepancy. **Number your responses. Only the first four will be graded.**
- 10** C. The background count rate for this detector system is 50 cpm. What is the MDA, in dpm, at the 95 % confidence level, for ^{137}Cs using the instrument's scaler and a one-minute count? Assume the same counting geometry as used for calibration. **Show all work. State any Assumptions.**
- 10** D. The GM tube has a dead time of 50 μs . If the observed count rate is 100,000 cpm, what is the true count rate? **Show all work.**