

**QUESTION 3**

A 2" diameter hot liquid waste line carries  $10 \text{ L min}^{-1}$   $^{131}\text{I}$  waste, at a concentration of  $50 \mu\text{Ci L}^{-1}$ , through a closed room 3 m wide x 2 m deep x 3 m high to a shielded ion exchange unit in an adjacent laboratory. The ventilation rate in the closed room is  $5 \text{ m}^3 \text{ min}^{-1}$ . A supervisor who looks through the viewing port of the shielded door sees that a valve in the line is leaking at a rate of 10 drops per minute. (The volume of each drop is 0.05 mL, the drops evaporate immediately, and the iodine is immediately dispersed uniformly into the room air.) Another supervisor estimates that a single mechanic can repair the valve in 1 hour.

**GIVEN**

$$\bullet \quad C = \frac{G}{Q} \left( 1 - e^{-\frac{Q}{V} \times t} \right)$$

where

G is the release rate,  
Q is the ventilation rate, and  
V is the volume.

- Non-stochastic (thyroid) DAC for  $^{131}\text{I}$   $= 2 \times 10^{-8} \mu\text{Ci mL}^{-1}$
- $T_{1/2}$  ( $^{131}\text{I}$ )  $= 8.05 \text{ d}$
- $w_T$  (thyroid)  $= 0.03$

**POINTS****STATE ALL ASSUMPTIONS**

- 10**    A.    1) At what rate is  $^{131}\text{I}$  being introduced into the atmosphere of the room? **Show all calculations.**
- 2) If conditions remain the same, what is the maximum concentration that airborne  $^{131}\text{I}$  in the room could reach? **Show all calculations.**
- 10**    B.    What is the air turnover rate in the room, assuming complete, instantaneous mixing? **Show all calculations.**
- 10**    C.    Assume that the air turnover rate is  $0.1 \text{ min}^{-1}$ . How long will it take before the atmospheric  $^{131}\text{I}$  concentration is reduced to 1% of its value after the leak has been stopped? **Show all calculations.**

- 10 D. Assume that the room concentration is  $8 \times 10^{-9} \mu\text{Ci mL}^{-1}$ . What would be the mechanic's committed effective dose equivalent (CEDE) if he spends 1 hour in the room without respiratory protection (according to current US regulations per 10CFR20 and 10CFR835) with the room ventilation turned off for the duration? Assume that contributions to the CEDE from other organs is negligible. **Show all calculations.**
- 10 E. Based on the situation initially described above, what are two actions that you would recommend be taken prior to allowing the mechanic to enter the room? **Number your responses. Only the first two will be graded. Justify each answer.**