

**QUESTION 11**

You have been asked to perform risk estimates for a large, proposed residential development in an area of higher than normal radon levels. Measured radon emanation at the soil surface is approximately  $5 \text{ pCi m}^{-2}\text{s}^{-1}$ . Predicted radon flux in the first floor of a slab foundation home without any radon mitigation is  $2 \text{ pCi m}^{-2}\text{s}^{-1}$ .

**GIVEN**

- $J_i$  = radon flux into home =  $2 \text{ pCi m}^{-2}\text{s}^{-1}$
- $J_o$  = radon flux into soil surface =  $5 \text{ pCi m}^{-2}\text{s}^{-1}$
- Equilibrium factor,  $F_{eq} = 0.4$
- $A$  = Building area =  $200 \text{ m}^2$
- $H$  = Building room height =  $2.5 \text{ m}$
- $K_v$  = ventilation removal constant (ventilation flow rate/room volume) =  $0.5 \text{ hr}^{-1}$
- $R$  = lifetime excess cancer mortality risk per WLM =  $5.5 \times 10^{-4}/\text{WLM}$
- $F$  = Occupancy factor =  $0.7$
- $L$  = life expectancy =  $70 \text{ years}$

Nuclide	Alpha Energy (MeV)	Half-life
Radon 222	5.49	3.82 days
Polonium 218	6.00	3.1 minutes
Lead 214		26.8 minutes
Bismuth 214		19.7 minutes
Polonium 214	7.68	$1.6 \times 10^{-4} \text{ s}$

**POINTS**

- 25** A. Calculate the steady state indoor radon concentration (in  $\text{pCi L}^{-1}$ ) in the first floor living space.
- 10** B. Assume the answer to Part A was  $14 \text{ pCi L}^{-1}$ . What is the exposure to the short-lived radon progeny in Working Level Months (WLM) per year?
- 20** C. List four sources of uncertainty in the application of the results from epidemiological studies of populations of underground miners to health effects in the general population. **Number your responses. Only the first four numbered responses will be graded.**

- 20 D. The current radon risk model is based on empirical studies (i.e., developed from epidemiological studies of underground uranium miners). Another type of model could develop risk estimates based on radon's effects on the respiratory tract. List four sources of uncertainty in this dosimetric model for the respiratory tract as applied to risk estimates from radon exposures. **Number your responses. Only the first four numbered responses will be graded.**
- 20 E. List four methods to reduce the radon entry into a home or building. **Number your responses. Only the first four numbered responses will be graded.**
- 5 F. Of potential concern is the radon in the water supply to the homes. Which of the following statements represents the best estimate of the transfer factor for the reduction in concentration of radon in water (in pCi L<sup>-1</sup>) to the indoor air concentration (in pCi L<sup>-1</sup>).
- A. 10 to 1 reduction (i.e., a 10 pCi L<sup>-1</sup> water concentration results in a 1 pCi L<sup>-1</sup> air concentration);
  - B. 100 to 1 reduction;
  - C. 1,000 to 1 reduction;
  - D. 10,000 to 1 reduction.