

QUESTION 2

You are a medical health physicist at a teaching hospital. You are preparing to give a class on basic radiobiology. The following questions relate to tissue or total body response to exposure to external whole body radiation.

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- Fatal Cancer Risk = 0.05 Sv^{-1}
- $f(x) = \frac{I^x e^{-I}}{x!}$
 - $f(x)$ = probability of observing x occurrences (fatal cancer)
 - $0!$ = 1 [by definition]
 - x = number of observations (fatal cancer)
 - I = mean rate = np
 - n = population affected
 - p = product of fatal cancer risk and actual dose equivalent received

STATE ALL ASSUMPTIONS**POINTS**

- 16** A. Each of 160 average individuals receive an acute dose equivalent of 0.25 Sv whole body x-ray radiation.
1. What is the expected number of fatal radiogenic cancers? **Show all calculations.**
 2. What is the probability of at least one fatal radiogenic cancer? **Assume the probability of occurrence follows Poisson statistics. Show all calculations.**
- 12** B. If a person received a 2-Gy acute whole body dose, what four symptoms would you expect without medical intervention (select only 4)?
1. Vomiting and nausea within six hours
 2. Disorientation within four hours
 3. Some decrease in white blood cell count
 4. Death within three months
 5. General fatigue
 6. A temporary decrease in the sperm count (if the person is a male).
 7. A decrease in fertility over the individual's lifetime.
 8. Severe confusion and disorientation within four hours
- 12** C. Identify **six** factors (physical, biological and other) that affect a tissue's response to ionizing radiation. **Number your responses. Only the first six numbered responses will be graded.**

10 D. The oxygen enhancement ratio (OER) is the ratio of the dose without oxygen to the dose with oxygen present that produces the same biological effect.

1. Calculate, using the data in the graph below, the OER for x-rays for the system. Assume 15% mortality. **Show all calculations.**
2. The basis for this OER is (select one and explain your answer):
 - (a) Oxygen affects chromosomal damage from radiation.
 - (b) Oxygen modifies the direct action of the radiation.
 - (c) Oxygen modifies the indirect action of the radiation.
 - (d) Oxygen interferes with repair mechanisms.

The Effect of Oxygen on Cell Mortality versus Radiation Dose from X-rays

