Radiation Biology, Protection and Applications

(PHYS-450)

Quiz No. 5

Week 14

Problem 1:

- When a cell is damaged by radiation:
  - **a** it always causes death to the cell
  - **b** **it may repair the damage and operate normally**
  - **c** it induces radiation poisoning
  - **d** there is a high probability of cancer

- If radiation causes damage to a cell, and the cell is not effectively repaired:
  - **a** the outcome is always cancer
  - **b** any future offspring of the person will carry the mutation
  - **c** **the cell may be removed by the immune system**
  - **d** the cell will die

- Prenatal exposure refers to radiation dose received:
  - **a** during childhood
  - **b** **by an embryo/fetus during pregnancy**
  - **c** by an adult female prior to her becoming pregnant
  - **d** during adulthood

Problem 2:

- The mechanism that causes damage to cells from radiation exposure is **ionization**.
- The most radiosensitive cells in the body are those that divide **rapidly**, and are relatively ~~**specialized /**~~ **unspecialized**.
- A large dose of radiation in a short period of time is called ~~a/~~ **an acute** dose.
- A burn to the skin is an example of a **prompt somatic** effect.
- Induction of cancer due to radiation exposure is an example of a **delayed somatic** effect.

Problem 3:

- If a person received a dose of 10 mSv/yr for 50 years, what effects are expected to be seen?

none

- The risks of heritable genetic effects occurring from radiation are estimated to be ~~**greater /**~~ **less** than the risk for cancer induction.

- The risk to a developing embryo/fetus from radiation exposure is greater than for an adult because its cells are ~~**specialized /**~~ **unspecialized** and **rapidly** ~~**/ slowly**~~ dividing.

Problem 4:

Humans are radioactive by nature. Give two examples of a radioisotope that can be found in the human body under « normal circumstances ».

For example : ^{40}K, ^{14}C, ^{87}Rb, ^{210}Pb, … , ^{238}U, ^{232}Th, and their decay products …

Problem 5:

Why radiation with a linear energy transfer (LET) of 100 keV/μm has the greatest relative biologic effectiveness for cell killing, mutagenesis, or oncogenic transformation?

For this transfer, the average separation between ionizing events coincides with the diameter of the DNA double helix (i.e., about 2 nm). Radiation of this quality is most likely to produce a double-strand break from one track for a given absorbed dose.

Problem 6:

Direct ~~**/ indirect**~~ action of radiation dominates for more densely ionizing radiations, such as neutrons, ***because the secondary charged particles produced (protons, α-particles, and heavier nuclear fragments) result in a dense column of ionizations more likely to interact with the DNA.*** ~~**Direct /**~~ **indirect** action is dominant for sparsely ionizing radiation, such as X-rays.