

*Phys 3550*  
*Spring 2019*  
*Assignment 7 – due May 8<sup>th</sup> 2019*

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*Note: You can use this assignment to replace the grade on any one previous assignment, including any assignment that you missed*

1. If you have 4.5  $\mu\text{g}$  of  $^{185}\text{Pb}$  what is its activity? Here are the steps you need to take.
  - a. Look up the half life of  $^{185}\text{Pb}$ , in seconds.
  - b. From the atomic mass calculate how many nuclei you have in 4.5  $\mu\text{g}$ .
  - c. Calculate the activity, that is the number of  $\alpha$  particles emitted per second.
  - d. If you stand 3 m (about 10 feet) from the source, what will be the dose rate that you receive?
  
2. What does the acronym SALT mean
  - a. What were the dates of SALT I and SALT II?
  - b. What was the goal of the two agreements with the Soviets?
  - c. What were their ultimate fates?
  
3. What does the acronym START mean
  - a. What were the dates of START I, START II, and START III?
  - b. What was the goal of these agreements with the Soviets?
  - c. What were their ultimate fates?
  
4. From Dr Strangelove: Having launched the attack on the Soviet Union, the only way to recall the bombers is to send the secret 3-letter code (OPE). Unfortunately only Ripper knows what it is, and he's not telling. The suggestion is made that they try all of the possible combinations until they get the right one, but the idea is discarded because of the impossibility of sending each combination in turn in the short time available.
  - a. The code comprised How many possible combinations would they have to try to find the right one? (Note: The quoted number is a slight approximation to the correct one.)
  - b. If you assume they try the combinations in order, that is starting with AAA and progressively increasing the first letter, the second, and finally the third how many combinations will they go through before hitting on the right one?
  
5. As a result of a hypothetical accident the inhabitants of the surrounding area receive an extra long term dose of radiation:
  - a. 50,000 people receive an extra 25 mrem per year
  - b. 80,000 people receive an extra 15 mrem per year
  - c. 200,000 people receive an extra 5 mrem per year
  - d. 2,000,000 people receive an extra 1 mrem per yearHow many extra deaths per year would expect as a result of this accident?

6. In an assignment last semester we looked at the total amount of nuclear waste generated by nuclear power plants, and envisioned that as corresponding to a pile covering a football field about 1 m deep.
  - a. Look up the amount of high level nuclear waste resulting from military applications.
  - b. If this waste is also piled 1 m high, how many football fields would it cover?
  
7. A sample contains  $\frac{1}{3}$   $^{137}\text{Cs}$  and  $\frac{2}{3}$   $^{60}\text{Co}$ .
  - a. How long will it take for the activity of the Cs to drop to  $\frac{1}{4}$  of its initial value?
  - b. How long will it take for the activity of the Co to drop to  $\frac{1}{4}$  of its initial value?
  - c. How long will it take for the activity of the whole sample to drop to  $\frac{1}{4}$  of its initial value?  
(Note: it might be easier to solve this question graphically. You can easily draw the relevant graph using a spreadsheet program such as Excel.)
  
8. A PET scan (positron emission tomography) works by injecting a molecule containing a  $\beta^+$  emitter, which emits a positron rather than a  $\beta^-$  emitter which emits an electron. The following are all isotopes which can be used. For each one what is the daughter isotope?
  - a.  $^{11}\text{C}$
  - b.  $^{13}\text{N}$
  - c.  $^{15}\text{O}$
  - d.  $^{18}\text{F}$
  
9. Give as many reasons as you can why ionization of DNA might be inconsequential.
  
10. Which do you think is the more likely, the scenario of *On the Beach*, or that of *Alas Babylon*? Explain your reasoning.