Names: _____ PHYS 7501, FS 2021

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Group Activity 6 **Due:** In class, September 9th

1. The August 2019 Nyonoksa radiation accident was purported by some nuclear policy experts to be a missile-based radionuclear thermal generator (RTG) gone awry. An RTG derives its power from a single radioactive isotope decaying and releasing its energy. Supposing a rocket can only carry 1000kg of payload, this needs to get to 1km altitude in 10s, and the decaying isotope releases 1MeV per decay, what is the half-life the isotope powering this RTG would need to have?

2. In September 2020, the Portsmouth Daily Times contacted me for a fact-check on an article about radioactivity concerns at the Portsmouth Gaseous Diffusion Plant. A source of theirs claimed that "as little as 1/1,000,000 a gram of plutonium is enough to cause fatalities when ingested or inhaled". The actual amount is more like 0.1 grams (Voelz, *Los Alamos Science*, 26, 2000). Suppose instead of Plutonium-239, their source was mistakenly thinking about Polonium-210, the poison used to assassinate Alexander Litvinenko in 2006. Assuming that the same activity of 210Po would achieve the same lethality as 239Pu, how much 210Po would be needed?

3. You were talked into partaking in a heist of a priceless piece of artwork. To get top dollar, you need to prove the painting is an original by showing it has the right age. You have determined the $^{14}C/^{12}C$ ratio is 1.1×10^{-12} for a 1mg sample. Since you know the pre-nuclear era specific activity of ^{14}C is 2.27×10^{-4} Bq/mg, how old is your sample? In other words, did you get talked into violating Section 668 of Title 18 of the US Code for nothing!?