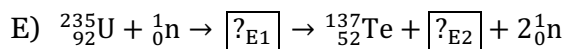
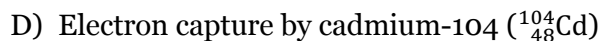
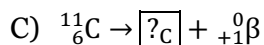
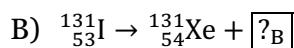
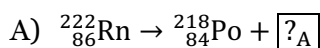


1. Consider a radioactive nuclide of element X with mass number A and atomic number Z. Write a general nuclear equation for each type of decay in the table below.

Decay Type	General Nuclear Equation	Description
$\beta$ decay	${}^A_ZX \rightarrow {}^A_{Z+1}Y + {}^0_{-1}\beta$	Neutron-rich
positron emission	${}^A_ZX \rightarrow$	Neutron-poor
electron capture	${}^A_ZX \rightarrow$	Neutron-poor
$\alpha$ decay	${}^A_ZX \rightarrow$	Neutron-rich ( $Z > 83$ )

2. Complete each nuclear reaction given below.



3. Both carbon-14 and potassium-40 can be used for radiometric dating. The half-life of  ${}^{14}\text{C}$  is 5730 years and the half-life of  ${}^{40}\text{K}$  is  $1.28 \times 10^9$  years.

$$\text{Rate} = kN \quad t_{1/2} = \frac{\ln 2}{k} \quad t = -\frac{1}{k} \ln \frac{N_t}{N_0}$$

- A) Which radioisotope is preferred for radiodating a rock that is 20,000 years old?
- B) Neither method is good for a 200,000-year-old rock. Calculate the fraction of  ${}^{14}\text{C}$  and  ${}^{40}\text{K}$  remaining in the rock to determine why this is so.

4. Mercury-197 has a half-life of 65 hours. What fraction of a mercury sample remains after 6 days?

$$\text{Rate} = kN \quad t_{1/2} = \frac{\ln 2}{k} \quad t = -\frac{1}{k} \ln \frac{N_t}{N_0}$$

5. Iron-56 is often considered the most stable nuclide although it is actually the third-most stable. Nickel-62 is the most stable nuclide. Given the mass of a proton, neutron, and measured mass of  ${}^{62}_{28}\text{Ni}$  below, calculate the binding energy *per* nucleon for  ${}^{62}_{28}\text{Ni}$ .

$$m_{\text{proton}} = 1.0073 \text{ amu}$$

$$m_{\text{neutron}} = 1.0087 \text{ amu}$$

$$m_{{}^{62}_{28}\text{Ni}} = 61.9283 \text{ amu}$$

Recall  $\Delta E = \Delta mc^2$  where  $c = 3.00 \times 10^8 \text{ m/s}$ ,  $1 \text{ amu} = 1.66 \times 10^{-27} \text{ kg}$ , and  $1 \text{ J} = 1 \text{ kg} \cdot (\text{m/s})^2$ .

6. Silicon-28 can be made by many different nuclear fusion reactions. Which of the two fusion reactions, A or B, releases the greater amount of energy?



Propose an alternative fusion reaction to produce  ${}^{28}\text{Si}$ .