CHM 152 Qz # 12 25 Pts Spring 2005 Name: Key

Formulas: $\ln \frac{N_t}{N_0} = -kt$ $\quad t_{1/2} = 0.693/k$ $\quad e = mc^2$

1. (4 Pts) Gold-198 has a half-life of 2.69 days (not a good gift). If one starts with a 100 gram sample of gold-198, how many grams will be left after 3 half lives?

12.5 g $\quad (100 \rightarrow 50 \rightarrow 25 \rightarrow 12.5) = 3$ half lives

(or could be calculated like #4)

2. (10 Pts) Complete each of the following nuclear equations:

a. The Alpha decay of

$^{226}_{88}Ra \rightarrow {}^{4}_{2}He + {}^{222}_{86}Rn$

b. The Beta decay of:

$^{14}_{6}C \rightarrow {}^{0}_{-1}e + {}^{14}_{7}N$

c. The gamma emission of:

$^{99}_{43}Tc^{*} \rightarrow {}^{99}_{43}Tc + \gamma$

d. Electron capture for:

$^{7}_{4}Be + {}^{0}_{-1}e \rightarrow {}^{7}_{3}Li +$ X-ray

e. Positron emission for:

$^{8}_{5}B \rightarrow {}^{0}_{+1}e + {}^{8}_{4}Be$

3 (6 Pts) a. Which type of radiation (Alpha, Beta, or Gamma) would be the most dangerous to person occupying the same room as the source. Explain why and describe what type of shielding that person would need to protect herself.

gamma - most penetrating, require Pb & concrete to shield.

b. If each type of radioactive material shown in 3a were ingested, which would be the most dangerous and WHY? Alpha - can't escape (not very penetrating) and is highly ionizing.

c. Which would be the least dangerous if ingested and WHY?

gamma - "comes right out" (highly penetrating)

4. (5 Pts) The half life of carbon1-14 is 5730 years. If a tree dies and lies undisturbed for 18,400 years, what percentage of the carbon-14 remains?

$\ln \frac{N_t}{N_0} = -kt \qquad k = \frac{0.693}{t_{1/2}} = \frac{0.693}{5730} = 1.21 \times 10^{-4}\ yr^{-1}$

$\ln \frac{N_t}{N_0} = (-1.21 \times 10^{-4}\ yr^{-1})(18400\ yr) = -2.225 \qquad \frac{N_t}{N_0} = e^{-2.225} \times 100 = 10.8\%$