Chem 112 **Spring 2020** **Quiz 9** **Whelan**

SID | | | | | | | | | **Last** Key **First** Answer

Question 1 (3 Points)

Write a **balanced nuclear equation** for the following:

a) $^{28}_{15}P$ undergoing positron emission: $^{28}_{15}P = {}^{0}_{+1}e + {}^{28}_{14}Si$

b) $^{41}_{20}Ca$ undergoing electron capture: $^{41}_{20}Ca + {}^{0}_{-1}e = {}^{41}_{19}K$

c) $^{60}_{27}Co$ is **one of many radioactive isotopes** that **initially** can undergo **only one type** of emission: $^{60}_{27}Co = {}^{0}_{-1}e + {}^{60}_{28}Ni$

Question 2 (5 Points)

What is the **binding energy** in **kJ/mol nucleons** for **nitrogen-14**?

The required masses (g/mol) are: $^{1}_{1}H$ = 1.00783 ; $^{1}_{0}n$ = 1.00867 ; $^{14}_{7}N$ = 14.00307

Remember the mass of $^{1}_{1}H$ also includes the mass of the electron.

$c = 2.998 \times 10^{8}\ m.s^{-1}$

$^{14}_{7}N = 7(^{1}_{1}H + {}^{0}_{-1}e) + 7(^{1}_{0}n)$
$= 7(1.00783) + 7(1.00867)$
$= 14.1155\ g.mol^{-1}$

$\Delta m = 14.1155 - 14.00307$
$= 0.11243\ g.mol^{-1}$
$= 1.1243 \times 10^{-4}\ kg.mol^{-1}$

$E = \Delta mc^2$
$= 1.1243 \times 10^{-4}(2.998 \times 10^{8})^2$
$= 1.0105 \times 10^{13}\ J.mol^{-1}$
$= 1.0105 \times 10^{10}\ kJ.mol^{-1}$

$^{14}_{7}N$: $7(^{1}_{1}H) + 7(^{1}_{0}n)$
Nucleons = 7+7 = 14

$E_b = 1.0105 \times 10^{10}/14$
$= 7.218 \times 10^{8}\ kJ.mol^{-1}.nucleon^{-1}$

Question 3 (2 Points)

Radioactive **radon-222**, found in many homes, is a potential health hazard. The **half-life** of radon-222 is **3.82 days**. **How much time** is required for the activity of a sample of radon-222 to **fall to 8.82 percent of its original value?**

$$t_{1/2} = \frac{Ln\ 2}{k}$$

$$k = \frac{Ln\ 2}{t_{1/2}}$$

$k = Ln\ 2/3.82$
$= 0.1815$

$$Ln\ \frac{[N]_t}{[N]_0} = -kt$$

$[N]_t = 0.0882$: $[N]_0 = 1$

$Ln\ 0.0882 - Ln\ 1 = -0.1815t$
$-2.428 - (0) = -0.1815t$

$t = -2.418/-0.1815 = 13.38$ days