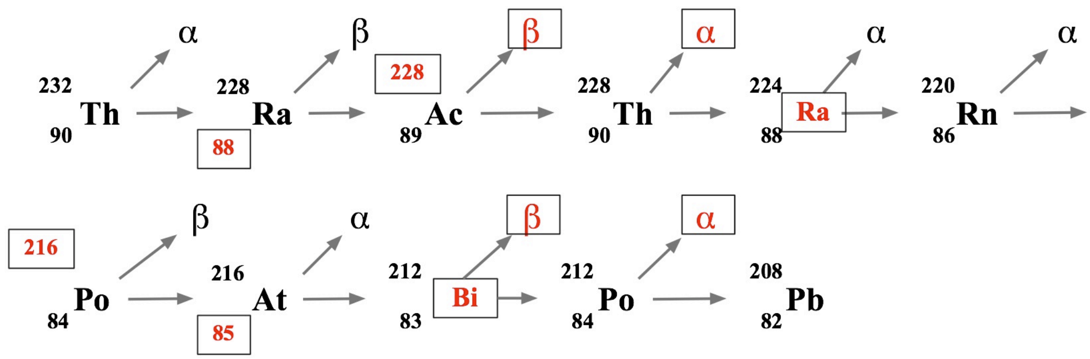
Chem 1 Dr. Casagrande / Mrs. Rinaldi

Chapter 25 Review Sheet Answer Key

1. Problems pg. 836-837 #38, 40, 42-46, 48, 51, 56, 57, 59, 62, 64-67, 69-72, 74 (determine what the other product is), 75 (determine what else is produced), 77, 79

Additional Problems:

1. Complete the following radioactive decay series:



2. Technetium-99, which has a half-life of 6.0 hrs, is used as a radiotracer in medical applications. If a patient has 100 mg of Tc-99 injected into her, how much time will pass until 6.25 mg remain in her system?

   $A = 6.25 \text{ mg} = 100 \text{ mg}\left(\frac{1}{2}\right)^n$; n = 4 half-lives; time = 4×6.0 hrs = 24 hrs

3. The half-life of radon-222 is 3.82 days. What was the original mass if 0.50 g Rn-222 remains after 11.46 days?

   $n = \frac{\text{Time}}{\text{Half-life}} = \frac{11.46 \text{ days}}{3.82 \text{ days}} = 3$ half-lives; $A = 0.50 \text{ g} = A_0\left(\frac{1}{2}\right)^3$; $A_0 = 0.50 \text{ g} \div (1/8) = 4.0 \text{ g}$

End-of-Chapter Review Questions

38. Match each numbered choice on the right with the correct radiation type on the left.

a. alpha	1. high speed electrons	b
b. beta	2. 2+ charge	a
c. gamma	3. no charge	c
	4. helium nucleus	a
	5. blocked very easily	a
	6. electromagnetic radiation	c

40. What is the difference between a positron and an electron?
Identical except for charge: electron has a 1– charge, positron has a 1+ charge.

42. What is the strong nuclear force? On what particles does it act?
The strong nuclear force binds nucleons together (protons & neutrons).

43. Explain the difference between positron emission and electron capture.
In positron emission, a proton turns into a neutron and emits a positron; in electron capture, a proton merges with an electron to form a neutron.

44. Explain the relationship between an atom's neutron-to-proton ratio and its stability.
For smaller atoms, the n/p ratio is about 1:1. As atoms become larger, the n/p ratio increases to about 1.5:1. Outside these ranges, an isotope is likely to be unstable.

45. What is the significance of the band of stability?
It shows the range of stable nuclei; nuclei outside its range are likely to be radioactive.

46. What is a radioactive decay series? When does the series end?
A family of decay reactions that continue until a stable, non-radioactive isotope is formed.

48. Define transmutation. Are all nuclear reactions also transmutation reactions? Explain.
Transmutation is the changing of an atom's nucleus such that a new element is formed. Most nuclear reactions are transmutation reactions, with the exception of those that only release gamma rays.

51. Using the band of stability diagram shown in **Figure 25-8**, would you expect $^{39}_{20}Ca$ to be radioactive? Explain.
Ca-39 is likely to be radioactive since it lies below the band of stability (n/p = 19/20 < 1). It should undergo positron emission or electron capture.

55. Describe some of the current limitations of fusion as a power source.
Sustained temperatures to maintain fusion and get more power out than put in; confinement of the plasma.

56. Describe some of the problems of using fission as a power source.
Disposal of waste; concerns over safety; safe handling of fuel; production of fissionable fuel.

57. What is a chain reaction? Give an example of a nuclear chain reaction.
A chain reaction occurs when a reaction produces one or more of the particles needed as a reactant (e.g. neutrons). An example is the fission of U-235 in a nuclear power plant.

59. Explain how binding energy per nucleon is related to fission and fusion reactions.
Fusion of light nuclei and fission of heavy nuclei both release energy and decrease the binding energy per nucleon of the product(s).

62. What is a breeder reactor? Why were breeder reactors developed?
A reactor that produces more fuel than it uses. They were developed because fissionable fuels are relatively scarce.

64. What is ionizing radiation?
Ionizing radiation is radiation powerful enough to strip electrons off molecules, forming ions.

65. What is the difference between somatic and genetic damage?
Somatic damage affects non-reproductive cells but does not affect offspring; genetic damage involves changing the DNA in reproductive cells and will affect offspring.

66. What property of isotopes allows radiotracers to be useful in studying chemical reactions?
Radiotracers have identical chemical properties to the stable isotopes of an element.

67. List several applications that involve phosphors.
TV and computer screens (CRTs only); scintillation counters; glow-in-the-dark watch dials.

69. Complete the following equations:
a. $^{214}_{83}Bi \rightarrow {}^{4}_{2}He + {}^{210}_{81}Tl$
b. $^{239}_{93}Np \rightarrow {}^{239}_{94}Pu + {}^{0}_{-1}\beta$

70. Write a balanced nuclear equation for the alpha decay of americium-241.

$^{241}_{95}\text{Am} \rightarrow ^{4}_{2}\text{He} + ^{237}_{93}\text{Np}$

71. Write a balanced nuclear equation for the beta decay of bromine-84.

$^{84}_{35}\text{Br} \rightarrow ^{0}_{-1}\beta + ^{84}_{36}\text{Kr}$

72. Write a balanced nuclear equation for the beta decay of selenium-75.

$^{75}_{34}\text{Se} \rightarrow ^{0}_{-1}\beta + ^{75}_{35}\text{Br}$

74. Write a balanced nuclear equation for the alpha particle bombardment of $^{253}_{99}\text{Es}$. One of the reaction products is a neutron.

$^{253}_{99}\text{Es} + ^{4}_{2}\text{He} \rightarrow ^{256}_{101}\text{Md} + ^{1}_{0}\text{n}$

75. Write a balanced nuclear equation for the induced transmutation of uranium-238 into californium-246 by bombardment with carbon-12.

$^{238}_{92}\text{U} + ^{12}_{6}\text{C} \rightarrow ^{246}_{98}\text{Cf} + 4\left(^{1}_{0}\text{n}\right)$

77. The half-life of tritium ($^{3}_{1}\text{H}$) is 12.3 years. If 48.0 mg of tritium is released from a nuclear power plant during the course of a mishap, what mass of the nuclide will remain after 49.2 years? After 98.4 years?

49.3 yrs: n=49.2 yrs/12.3 yrs = 4 half lives; Amount remaining = $48.0\text{ mg}\left(\frac{1}{2}\right)^{4} = 3.00\text{ mg}$

98.4 yrs: n=98.4 yrs/12.3 yrs = 8 half lives; Amount remaining = $48.0\text{ mg}\left(\frac{1}{2}\right)^{8} = 0.188\text{ mg}$

79. Manganese-56 decays by beta emission and has a half-life of 2.6 hours. How many half-lives are there in 24 hours? How many mg of a 20.0 mg sample will remain after five half-lives?

n=24 hrs/2.6 hrs = 9.23 half-lives;

After 5 half-lives, A = $20.0\text{ mg}\left(\frac{1}{2}\right)^{5} = 0.625\text{ mg}$