NAME: KEY

Lab Section: __1 __2 __3

CHM 114
20 points, 30 mins.

Quiz #7

Chemistry, 7th ed., Zumdahl & Zumdahl, sections 18.1-18.4

Spring 2009
week 11

revised 06/17/2009

Wallace

Unless otherwise specified, each question is worth 5 points.

Note that there is a Periodic Table of the Elements and some other possibly helpful information on the last page of this quiz.

1. Write a balanced equation for each of the nuclear processes described below. (*2 points each*)

   a. Uranium-238 decays by alpha emission to form thorium-234 (^{234}Th).

   $${}^{238}_{92}U \longrightarrow {}^{4}_{2}\alpha + {}^{234}_{90}Th \qquad \left({}^{4}_{2}\alpha \equiv {}^{4}_{2}He\right)$$

   b. Carbon-14 decays by beta emission to form a new element.

   $${}^{14}_{6}C \longrightarrow {}^{0}_{-1}e + {}^{14}_{7}N \qquad \left({}^{0}_{-1}e \equiv {}^{0}_{-1}\beta\right)$$

   c. Oxygen-15 decays by positron emission to form a new element.

   $${}^{15}_{8}O \longrightarrow {}^{0}_{+1}e + {}^{15}_{7}N$$

   d. Mercury-201 captures an electron to form a new element.

   $${}^{201}_{80}Hg + {}^{0}_{-1}e \longrightarrow {}^{201}_{79}Au$$

2. In each of the following nuclear reactions, supply the missing particle. (*2 points each*)

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

   b. ${}^{95}_{43}Tc \rightarrow {}^{95}_{42}Mo + {}^{\cancel{45}\ 0}_{1}e$

   c. ${}^{40}_{19}K + {}^{0}_{-1}e \rightarrow {}^{40}_{18}Ar$

   d. ${}^{9}_{4}Be + {}^{4}_{2}He \rightarrow {}^{12}_{6}C + {}^{1}_{0}n$

Unless otherwise specified, each question is worth 5 points.

3. The most stable isotope of zirconium (Zr, atomic number 40) is zirconium-90 (^{90}Zr). Based on this zirconium isotope stability, which of the following isotopes is/are most likely to be stable? (*Circle your answer; TWO points*)

(BEST ANSWERS)

n/p

a. $^{75}_{36}$Kr 1.08 (SOME AMBIGUITY HERE; NO POINTS DEDUCTED UNLESS BLANK)

[✓ b. $^{79}_{36}$Kr] 1.19

[✓ c. $^{80}_{36}$Kr] 1.22 (≈ STABLE RATIO AROUND ATOMIC # 40)

d. $^{90}_{36}$Kr 1.50

STABLE Zr-90: $n/p = \frac{90-40}{40} = 1.25$

4. The half-life for ^{210}Bi is 5.0 days. If you start with a 100.-g sample that is pure Bismuth-210, how much (what mass) of ^{210}Bi will you have after 10.0 days? (*2 points*)

EASY WAY: 10.0 DAYS = 2 ½-LIVES : $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

$\frac{1}{4} \times 100 = \boxed{25g}$

LONG WAY: $\ln\left(\frac{N}{N_0}\right) = -k \times t = \ln\left(\frac{\text{MASS}}{100.g}\right) = -kt$

$k = \frac{\ln 2}{t_{1/2}} = \frac{0.693}{\cancel{10.0}\ 5} =$ ~~0.0~~ ~~0.0693 DAYS~~$^{-1}$ 0.1386 DAYS^{-1}

$\ln\left(\frac{\text{MASS}}{100.}\right) = -$ 0.1386 ~~0.0693~~ DAYS × 10.0 DAYS = 1.386

$\frac{\text{MASS}}{100.} = \cancel{e}$ ~~-0.693~~ $= e^{-1.386} = 0.2500$

$100.g \times 0.250 = \boxed{25g}$

Unless otherwise specified, each question is worth 5 points.

Generic Grading Rubric for Chemistry @ LTCC: (*rev. 11/21/08*)

In general, incorrect answers will be assigned pro-rated partial credit proportional to the amount of the supporting work that is correct. Pro-rated points will typically be rounded to whole numbers. Other deductions will be assigned per question as described below:

a) any combination of wrong significant figures and/or missing or incorrect units and/or "dumb" math error(s).. –1 point

b) no answer provided / blank ....–100%

c) incorrect answer; no work shown...–100%

d) correct answer, but no supporting work is shown when complex, multi-step calculations are required (*This looks suspiciously like cheating.*) ....–100%

e) completely incorrect concept or approach, but some correct calculations associated with this type of problem are shown... – ~60-80%

f) description and/or outline of correct approach or concept, but calculations performed or answers calculated are missing or incomplete.................................. – ~30-40%

Unless otherwise specified, each question is worth 5 points.

Abbreviated Periodic Table of the Elements

1 1A																	18 8A
1 H 1.01	2 2A											13 3A	14 4A	15 5A	16 6A	17 7A	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	71 Lu 175.0	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226	103 Lr (262)	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub	113	114	115			

57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61	62	63	64	65	66	67	68	69	70
89 Ac (227)	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97	98	99	100	101	102

<u>POSSIBLY HELPFUL INFORMATION:</u>

$\text{Rate} = k \times N$

$\ln(N/N_0) = - k \times t$

$\ln(\text{Rate}/\text{Rate}_0) = - k \times t$

$t_{1/2} = \ln 2 / k$

$1 \text{ mol} = 6.022 \times 10^{23}$