Useful Information

$K = 273.15 + °C$

$PV = nRT$

$$E = h\nu = \frac{hc}{\lambda}$$

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\ln\left(\frac{N_0}{N_t}\right) = kt$$

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

$1\ ft^3 = 28.32\ L$

$R = 8.206 \times 10^{-2}\ L{\cdot}atm/(mol{\cdot}K)$

$c = 3.00 \times 10^8\ m/s$

$1\ amu = 1.661 \times 10^{-27}\ kg$

$h = 6.63 \times 10^{-34}\ J{\cdot}s$

$1\ amu = 931.5\ MeV$

$1\ MeV = 1.602 \times 10^{-13}\ J$

R_H (Rydberg constant) $= 1.096776 \times 10^7\ m^{-1}$

$1\ J = 1\ kg{\cdot}m^2/s^2$

Periodic Table of the Elements

1A (1)												3A (13)	4A (14)	5A (15)	6A (16)	7A (17)	8A (18)
1 H 1.008	2A (2)																2 He 4.003
3 Li 6.941	4 Be 9.012											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	3B (3)	4B (4)	5B (5)	6B (6)	7B (7)	|----- (8)	- 8B - (9)	----| (10)	1B (11)	2B (12)	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 65.39	31 Ga 69.72	32 Ge 72.61	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	57 La 138.9	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)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (285)				

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58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

_____ 1. Which is a renewable fuel?

(a) Oil
(b) Pu-239
(c) Coal
(d) Natural gas
(e) Ethanol

_____ 2. Calculate the mass of potassium iodide required to yield 45.4 g of mercury (II) iodide using the following balanced chemical equation.

$$2\ KI_{(aq)} + Hg(NO_3)_{2(aq)} - 2\ KNO_3(aq) + HgI_2(s)$$

(a) 16.6 g
(b) 31.5 g
(c) 33.2 g
(d) 46.0 g
(e) 66.3 g

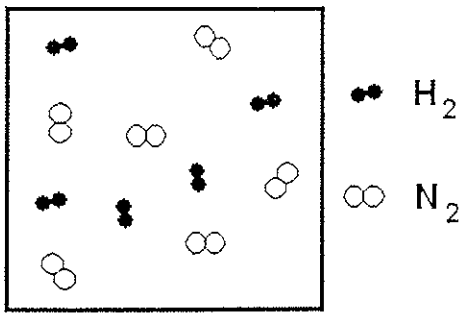
_____ 3. During the Three-mile Island incident zirconium from the fuel rods reacted with water to form hydrogen gas.

$$Zr + 2\ H_2O \rightarrow ZrO_2 + 2\ H_2$$

What mass of hydrogen gas, H_2, was present if the gas had a volume of 1568 cubic feet (1 ft^3 = 28.32 L) at a temperature of 349°C and a pressure of 50.0 atm?

(a) 2.74×10^3 g H_2
(b) 5.52×10^3 g H_2
(c) 4.35×10^4 g H_2
(d) 8.77×10^4 g H_2
(e) 1.56×10^5 g H_2

_____ 4. Hydrogen, H_2 , and hydrogen, N_2 , react to form ammonia, NH_3 . Which equation represents the reaction when the H_2 and N_2 in the mixture in the following closed container react as completely as possible?



(a) $N + 3H \rightarrow NH_3$

(b) $N_2 + H_2 \rightarrow NH_3$

(c) $N + H_3 \rightarrow NH_3$

(d) $N_2 + 3\ H_2 \rightarrow 2\ NH_3$

(e) $2\ N_2 + 6\ H_2 \rightarrow 4\ NH_3$

_____ 5. What is the nuclide resulting from the alpha decay of Ra-222 ?

(a) Po-218
(b) Rn-218
(c) Fr-222
(d) At-222
(e) Ra-226

_____ 6. Control rods in a nuclear reactor work by:

(a) absorbing uranium.
(b) absorbing heat from the reaction to keep it at the proper temperature.
(c) absorbing neutrons.
(d) absorbing gamma rays.
(e) maintaining the proper coolant level in the reactor.

_____ 7. The valence electron in a sodium atom is promoted from a 3s orbital to a 3p orbital. In this process the atom:

(a) absorbs electromagnetic radiation.
(b) emits electromagnetic radiation.
(c) undergoes β^+ decay.
(d) undergoes β^- decay.
(e) remains in the same energy state.

_____ 8. For the nuclear reaction: $^{6}_{3}Li + {}^{1}_{0}n \rightarrow {}^{4}_{2}He + {}^{3}_{1}H$ which of the following is true?

[$^{6}_{3}Li$ = 6.015122 amu; $^{1}_{0}n$ = 1.008666 amu; $^{4}_{2}He$ = 4.00260325 amu; $^{3}_{1}H$ = 3.01604927 amu]

(a) 0.513 MeV of energy is released.
(b) 4.8 MeV of energy is released
(c) 4.8 MeV of energy is absorbed.
(d) 6538 MeV of energy is released.
(e) 7.023788 MeV of energy is absorbed.

_____ 9. What is the half-life of an isotope if it decays to 12.5% of its radioactivity in 12 y?

(a) 0.21 years
(b) 4.0 years
(c) 8.0 years
(d) 12 years
(e) 30 years

_____ 10. How many total orbitals are available for the n = 3 energy level?

(a) 3
(b) 5
(c) 7
(d) 9
(e) 11

_____ 11. All of the following ions have a Noble Gas electron configuration except:

(a) Cs^{+}
(b) Sr^{2+}
(c) In^{4+}
(d) Te^{2-}
(e) I^{-}

_____ 12. We know that the energies of electrons in atoms are quantized because:

(a) atomic spectra are line spectra.
(b) atoms absorb light as they are excited.
(c) the energy of the lines in atomic spectra are much less than the energies of gamma-rays.
(d) electrons occupy discrete orbitals.
(e) at most only two electrons can occupy a single orbital.

_____ 13. Which lists the elements in order of increasing size?

(a) Al < In < S

(b) In < Al < S

(c) S < Al < In

(d) Al < S < In

(e) S < In < Al

_____ 14. The counts from a sample containing a radioactive nuclide drop from 876 counts per second to 544 counts per second in 3.000 days (2.592×10^5 seconds). What is the half life of the nuclide in seconds?

(a) 1.84×10^{-6} seconds

(b) 6.21×10^{-6} seconds

(c) 1.12×10^{5} seconds

(d) 3.77×10^{5} seconds

(e) 8.68×10^{5} seconds

_____ 15. A metastable isotope of lead results from the decay of bismuth. The metastable lead then decays via emission of a gamma ray, as follows:

$$^{207m}\text{Pb} \rightarrow {}^{207}\text{Pb} + \gamma$$

The ^{207}Pb nuclide has a mass of 206.975885 amu. The emitted gamma ray has an energy of 1.63 MeV. Which statement describes the mass of the metastable nuclide?

(a) The mass of ^{207m}Pb is greater than ^{207}Pb by 1.75×10^{-3} amu.

(b) The mass of ^{207m}Pb is greater than ^{207}Pb by 1.51×10^{3} amu.

(c) The mass of ^{207m}Pb is greater than ^{207}Pb by 571 amu.

(d) The mass of ^{207m}Pb is less than ^{207}Pb by 1.75×10^{-3} amu.

(e) The mass of ^{207m}Pb is less than ^{207}Pb by 571 amu.

_____ 16. Calculate the binding energy per nucleon of nitrogen-14.

[$^{14}_{7}N$ = 14.003075 amu; $^{1}_{1}H$ = 1.00783 amu; $^{1}_{0}n$ = 1.008666 amu]

(a) 1.42×10^{11} kJ/(mole nucleons)

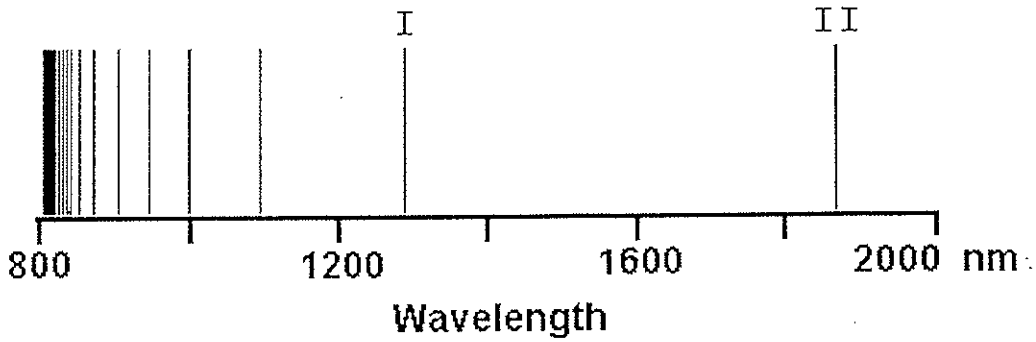
(b) 1.01×10^{10} kJ/(mole nucleons)

(c) 1.45×10^{9} kJ/(mole nucleons)

(d) 2.79×10^{-38} kJ/nucleon

(e) 1.20×10^{-15} kJ/nucleon

_____ 17. A portion of the emission spectrum of hydrogen is shown.



If the lines shown result from transitions to the n = 3 level, lines I and II correspond to which transitions?

(a) I: n = 3 to n = 2 II: n = 3 to n = 1

(b) I: n = 5 to n = 3 II: n = 4 to n = 3

(c) I: n = 3 to n = 5 II: n = 3 to n = 4

(d) I: n = 4 to n = 3 II: n = 5 to n = 3

(e) I: n = 5 II: n = 4

_____ 18. Which of the following could contain the SO_4^{2-} anion?

(a) $MgSO_4$

(b) Ca_2SO_4

(c) $Na(SO_4)_2$

(d) SO_4Cl_2

(e) $C(SO_4)_4$

_____ 19. Which is the correct electron configuration for Ca in its ground state?

(a) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$ with 3d filled as 

(b) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$ with 3d filled as 

(c) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ with 4s filled as 

(d) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ with 4s filled as 

(e) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^1$ in order to achieve a half-filled s-orbital

_____ 20. Which exhibits both ionic and covalent bonding?

(a) Na_2S
(b) LiI
(c) CH_2Cl_2
(d) SO_3NH_3
(e) Cs_3PO_4

- END OF EXAM -

Before you turn in your scan sheet, be sure you have the following information coded correctly on your scan sheet:

- Your name
- Your PUID number
- Your 4-digit section number
- The test number printed on the cover sheet in the upper right-hand corner.

Answers to the exam questions will be posted on the CHM 115 website sometime tomorrow morning (Tuesday, Sept 26), hopefully between 10 AM and Noon.