Exam 1

MULTIPLE CHOICE (3pts each): Write the ONE letter corresponding to the correct answer on the line next to each question. The LETTER ASSOCIATED WITH THE CORRECT ANSWER MUST BE WRITTEN ON THE LINE NEXT TO THE QUESTION in order to receive full credit.

1.) How many mm^3 are present in $3.47 \times 10^{-4} m^3$? 1.) B

a.) 3.47×10^{-1} mm (b.) 3.47×10^{5} mm c.) 3.47×10^{-13} mm d.) 3.47×10^{-7} mm

$3.47 \times 10^{-4} m^3 \left(\frac{1000mm}{1m}\right)^3 =$

2.) Which of the following is not an example of a pure substance? 2.) D

a.) CO_2 compound b.) table salt compound c.) water compound (d.) lemonade mixture/solution

3.) Which of the following would be an example of a chemical property? 3.) A

(a.) iron rusting c.) adding water to a powdered drink mix

b.) chopping wood d.) tearing up this exam

4.) Which of the following is an example of an intensive property? 4.) C

a.) mass b.) volume (c.) color d.) intensity of color

5.) Which response gives an acceptable set of quantum numbers for the last electron added to an atom of tin (Sn)? Answers are listed n, l, m_l, m_s. 5.) D

a.) ~~4~~ 1, -1, +1/2 b.) 5, 2, -1, -1/2 c.) ~~4~~ 2, +1, +1/2 (d.) 5, 1, +1, -1/2

5th row n=5 p block l=1

6.) How many kilograms are equal to 54800g? 6.) B

a.) 54800000 kg (b.) 54.8 kg c.) 0.548 kg d.) 54800000kg

$54800 g \left(\frac{1 kg}{1000 g}\right) =$

7.) Which of the following elements would be the most magnetic? 7.) C

a.) scandium 1 unpaired e⁻ b.) chlorine 1 unpaired e⁻ (c.) manganese 5 unpaired e⁻ d.) lithium 1 unpaired e⁻

8.) How many neutrons are present in chlorine-37? (37 is the mass number.) 8.) A

(a.) 20 b.) 17 c.) 37 d.) 35

37 - 17 = 20

9.) Which orbital shape are vanadium's valence electrons located in? 9.) A

(a.) s b.) p c.) d d.) f

highest E level

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$

10.) How many electrons are present in an atom of silver? 10.) C

a.) 61 b.) 11 (c.) 47 d.) 108

SHORT ANSWER (10 pts each): Completely answer all of the following questions. Read all questions carefully!!! SHOW ALL WORK. If your work is in a different location, you must make a note of this in the given work area for the problem in order for the work to be considered for partial credit. Make sure to include units and report all mathematical answers to the correct number of significant figures. Write final answers in designated locations when indicated.

1.) What mass, in kg, of ethanol would be present in a full 59.45 gallon wine barrel if the wine is 12.4% abv (meaning 12.4% of the 59.45 gallons is ethanol). The density of ethanol is 0.789g/cm^3. 1.00gal = 128oz; 1.00oz = 29.57mL

Answer: 22.0 kg

$59.45\text{gal}(0.124)$

$= 7.3718\text{gal}\left(\frac{128\text{ oz}}{1.00\text{gal}}\right)$

$= 943.5904\text{oz}\left(\frac{29.57\text{mL}}{1.00\text{ oz}}\right)$

$= 27901.968\text{ mL}\left(\frac{1\text{cm}^3}{1\text{mL}}\right)$

$= 27901.968\text{ cm}^3\left(\frac{0.789\text{g}}{\text{cm}^3}\right) = 22014.65\text{ g}\left(\frac{1\text{kg}}{1000\text{g}}\right)$

$= 22.014\,65\text{ kg} \rightarrow 22.0\text{ kg}$

2.) Write electron configurations for the following elements in the format indicated next to the element. Ignore any potential exceptions to the standard orbital filling order.

a.) Nitrogen (N) - orbital notation (arrows) 7e−

$\frac{\uparrow\downarrow}{1s}\ \frac{\uparrow\downarrow}{2s}\ \frac{\uparrow}{2p}\ \frac{\uparrow}{2p}\ \frac{\uparrow}{2p}$

b.) Phosphorus (P) - electron configuration notation (superscripts) 15e−

$1s^2 2s^2 2p^6 3s^2 3p^3$

c.) Scandium (Sc) - noble gas configuration, can use either arrow or superscript notation

$[Ar]\ 4s^2\ 3d^1$

d.) The Vanadium (III) ion (V^{3+}) - you can use any of the above notations

$23e^- - 3e^- = 20e^-$

$[Ar]\ \cancel{4s^2}\ 3d^{3-1}$

← highest Level

$[Ar]\ 3d^2$

3.) a.) How much energy is released or absorbed when an electron moves from the second to the sixth energy level?

$\Delta E = -2.18\times10^{-18}\,J\left(\frac{1}{6^2}-\frac{1}{2^2}\right)$

Answer: $+4.84\times10^{-19}\,J$

$= -2.18\times10^{-18}\,J\left(\frac{1}{36}-\frac{1}{4}\right)$

$= -2.18\times10^{-18}\,J(-0.22222) = 4.8444\times10^{-19}\,J$

b.) How energy would be released or absorbed if a mole of electrons moved from the second to the sixth energy level?

Answer: $2.92\times10^{5}\,J/mol$

$4.8444\times10^{-19}\,\frac{J}{e^-}\left(\frac{6.022\times10^{23}\,e^-}{mol}\right) = 2.9173\times10^{5}\,J/mol$

c.) Is the energy in the above processes released or absorbed?

Answer: absorbed

d.) Briefly explain your answer to part c.

The energy value is positive.

4.) a.) What wavelength, in nm, is associated with an energy of 8.64×10^{-19}J?

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

Answer: 230. nm or 2.30×10^{2} nm

$8.64\times10^{-19}\,J = \frac{(6.626\times10^{-34}\,J\cdot s)(3.00\times10^{8}\,m/s)}{\lambda}$

$\frac{(\lambda)(8.64\times10^{-19}\,J)}{8.64\times10^{-19}\,J} = \frac{1.9878\times10^{-25}\,J\cdot m}{8.64\times10^{-19}\,J}$

$\lambda = 2.3007\times10^{-7}\,m\left(\frac{1\times10^{9}\,nm}{1\,m}\right)$

$= 230.07\,nm$

b.) What is the energy of a wave that has a frequency of 7.43 kHz?

$7.43\,kHz\left(\frac{1000\,Hz}{1\,kHz}\right) = 7430\,s^{-1}$

$E = h\nu$

$= (6.626\times10^{-34}\,J\cdot s)(7430\,s^{-1})$

Answer: $4.92\times10^{-30}\,J$

$= 4.92312\times10^{-30}\,J$

MM Ni = 58.693 g/mol

5.) a.) What is the mass of 0.387mol of Nickel (Ni)? Answer: 22.7g

$0.387 \text{ mol} \left(\frac{58.693 \text{ g}}{\text{mol}}\right) = 22.7142 \text{ g}$

b.) How many moles are present in 128.6g Nickel? Answer: 2.19 mol

$128.6 \text{ g} \left(\frac{1 \text{ mol}}{58.693 \text{ g}}\right) = 2.19106 \text{ mol}$

c.) What is the mass of 5.97×10^{20} atoms of Nickel? Answer: 5.82×10^{-2} g or 0.0582 g

$5.97 \times 10^{20} \text{ atoms} \left(\frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}}\right)$

$= 9.91365 \times 10^{-4} \text{ mol} \left(\frac{58.693 \text{ g}}{\text{mol}}\right) = 5.81862 \times 10^{-2} \text{ g}$

6.) What is the average atomic mass of an element having three isotopes with the following masses and percentages:

Isotope A: 58.9974amu, 67.335%
Isotope B: 62.0049amu, 24.887%
Isotope C: 64.2287amu, 7.7780%

Answer: 60.153amu

0.67335(58.9974 amu) = 39.725899amu
0.24887(62.0049 amu) = 15.431159amu
0.077780(64.2287 amu) = 4.995708amu

60.153,116 amu

7.) a.) Which of the following atoms is the largest: gallium, arsenic, or bromine?

Answer: gallium

b.) Which of the following has the lowest ionization energy: magnesium, calcium, or barium?

Answer: barium

c.) Which of the following ions is the smallest: Ca^{2+}, Cr^{2+}, Se^{2-}, Br^{-}

Answer: Cr^{2+}

d.) Which of the following has the highest electronegativity: potassium, gallium, or arsenic?

Answer: arsenic

e.) Which of the following the least reactive: potassium, calcium, bromine, or krypton?

Answer: krypton