Instructor: Dr. Daniel Short Student: _____ /10

TEST 2 (of 3)

Show all of your work. Students should use significant figures and express their answers in scientific notation.

1. Write a complete balanced equation to show the reaction of sodium metal with water to form sodium hydroxide and hydrogen gas.

2. (a) Calculate the number of grams of strontium chloride (molar mass = 158.53 g/mol) needed to prepare 500 mL of 3.00 M $SrCl_2$.

   (b Using the dilution equation $M_1V_1 = M_2V_2$ (where M = molarity of solution, V = volume of solution) calculate the number of mL of this solution required to make 100 mL of a 1 M solution of $SrCl_2$.

3. Write a balanced **NET IONIC** equation for the following reactions:

   (a) $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

   (b) $AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$

   (c) Aqueous lead (II) nitrate with aqueous potassium sulfate to form solid lead (II) sulfate and aqueous potassium nitrate

4. 1 atm = 760 torr = 29.92 mm Hg = 10^5 Pa. Convert the following pressure measurements into the specified units.

   850 torr into atm = _____ 56.62 mm Hg into atm = _____

5. Match the following. Write the letter of the corresponding law in the space provided

1. Avogadro's Law	_____	(a) $P_1V_1 = P_2V_2$
2. Charles's Law	_____	(b) $\frac{V_1}{n_1} = \frac{V_2}{n_2}$
3. Boyle's Law	_____	(c) $P_T = P_1 + P_2 + P_3 \ldots$
4. Dalton's Law of Partial Pressures	_____	(d) $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

6. (a) Balance the following chemical reaction: $H_2O(l) \rightarrow H_2(g) + O_2(g)$

(b) Use the ideal gas law ($PV = nRT$, where $R = 0.082057$ L.atm/mol.K) to calculate the number of moles present in 1.4 L of O_2 at a temperature of 315 K and a pressure of 0.957 atm.

(c) Using the stoichiometry from part (a) calculate the number of moles of H_2O required to form 1.4 L of O_2 at a temperature of 315 K and a pressure of 0.957 atm.

(d) Calculate the mass of H_2O required to form 1.4 L of O_2 at a temperature of 315 K and a pressure of 0.957 atm.

7. (a) Write down the relationship between the speed of light ($c = 3.00 \times 10^8$ m/s), frequency (v) and wavelength (λ).

(b) The Einstein plank equation relates Energy to frequency as follows:

$$E = h\,v$$

Where E = energy (J), h = planks constant (6.626×10^{-34} Js) and v = frequency (s^{-1}).

Write down the equation relating energy to wavelength and calculate the energy of a single photon with a wavelength of 532 nm.

(c) A laser pulse containing a large number of photons of this wavelength contains a total of 4.67 mJ of energy. How many photons are there in the laser pulse?

8. An electron in a hydrogen atom is excited with electrical energy to an excited state with $n = 2$. The atom then emits a photon. What is the value of n for the electron following the emission?

9. Ultraviolet radiation of shorter wavelengths can damage biological molecules because they carry enough energy to break bonds within the molecules. A carbon-carbon bond requires 348 kJ/mol of photons to break.

(a) Avogadro's number = 6.022×10^{23} photons per mole. Calculate the number of joules provided by one photon of the correct wavelength to break the bond.

(b) What is the longest wavelength of radiation with enough energy to break carbon-carbon bonds?

10. (a) The number sublevels in an energy level (n) is equal to n, the principal quantum number. The number of orbitals in a level is equal to _____.

(b) Match the following orbitals with their quantum numbers (n, l, m_l):

1. 1s	_____	(a) 2, 1, 0
2. 3d	_____	(b) 3, 2, 0
3. 2p	_____	(c) 1, 0, 0
4. 3p	_____	(d) 3, 1, 0

(c) Write down the quantum numbers n, l and m_l for all 3 of the 2p sublevel atomic orbitals, p_x, p_y and p_z

$2p_x$: n = l = m_l =

$2p_y$: n = l = m_l =

$2p_z$: n = l = m_l =

BONUS:

Methane gas, CH_4, reacts with oxygen according to the following balanced chemical reaction:

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

If 2 moles of methane gas (molar mass = 16.0425 g/mol) are allowed to react, how many grams of water (molar mass = 18.01528) will be formed?