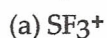Name_____

Read questions carefully to understand what is being asked. If you have doubt, do ask your instructor. Use the reverse side of your answer paper as scratch. Use attached periodic table and important constants chart. On your scantron, please start from number 10 to answer the multiple choice questions. (Total pts. $= 78 + 27 + 8 = 113$)

SHORT ANSWER: Show all your calcualtions using appropriate set up and units.

1) Identify the hybridization of the central atom in the following compounds (3 pts.   1) _____
   each; Total 12 pts.):
   (a) SF_3^+

   (b) SF_4

   (c) SO_4^{2-}

   (d) I_3^-

2) Draw the structures and name the isomers of $C_6H_3F_3$ (12 pts.)   2) _____

3) Write the condensed structure of 2-methyl-4-propylnonane (4 pts.).   3) _____

4) What is the name of the compound $CH_3CH_2CH(OH)CH_2CH_2CH_3$? (4 pts.)   4) _____

5) Draw the condensed structures of the reactants and product(s) of the reaction   5) _____
   between propionic acid and 1-propanol (8 pts.) and name the major product (2 pts.)
   and the functional group it conatins (2 pts.).

6) Draw the structures of the reactants and major product of the reaction between   6) _____
   2-methyl propene and hydrochloric acid (6 pts.) and name the major product (4 pts.)

7) The following experimental data were obtained at constant temperature for the
reaction:

$$2NO(g) + O_2 (g) \longrightarrow 2 NO_2(g)$$
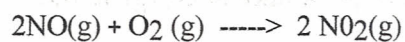
Experiment	Initial Concentrations		Initial Rate
	[NO]	[O2]	($M\,s^{-1}$)
1	0.0010	0.0010	7.0×10^{-6}
2	0.0010	0.0020	1.4×10^{-5}
3	0.0010	0.0030	2.1×10^{-5}
4	0.0020	0.0030	8.4×10^{-5}
5	0.0030	0.0030	1.9×10^{-4}

a. Calculate the order of the reaction with respect to each reactant (6 pts.).

b. Write the rate law for the reaction (2 pts.).

c. Calculate rate of NO_2 formation when [NO] = [O2] = 0.005 M (4 pts.)

3

8) If the rate of foramtion of oxygen gas is 6.0×10^{-5} M/s in the following conversion: 8) _____
   $2 O_3 (g) \text{-------} > 3 O_2$, then calculate the rate of disappearance of O_3 (g) at that
   same time. (4 pts.)

9) Carbon dating may be used to date (once living) materials that are between 100   9) _____
   and 40,000 years old. The half–life of the **first–order** decomposition of carbon–14
   is 5730 years. What percentage of carbon–14 remains (ratio of final to initial
   concentrations multiplied by 100) in a sample after 40,000 years (8 pts.).

**MULTIPLE CHOICE. Start on line 7 of your scantron paper. Select the one alternative that best completes the
statement or answers the question (3 pts each).**

10) The molecular geometry of the PF_4^+ ion is _____.   10) _____
    A) trigonal pyramidal
    B) octahedral
    C) trigonal bipyramidal
    D) tetrahedral
    E) trigonal planar

4

11) The angles between sp^2 orbitals are _____.
     A) 90°   B) 120°   C) 180°   D) 45°   E) 109.5°   11) _____

12) There are _____ σ and _____ π bonds in the $H_2C=C=CH_2$ molecule.   12) _____
     A) 2, 6   B) 6, 4   C) 6, 2   D) 4, 2   E) 2, 2

13) The general formula of an ester is _____.   13) _____
     A) R—O—R'
     B) R—CO—OR'
     C) R—OH
     D) R—CO—R'
     E) R—CO—OH

14) The compound below is an _____.   14) _____

$$H-C\equiv C - \overset{\displaystyle H}{\underset{\displaystyle H}{\overset{|}{\underset{|}{C}}}} - H$$
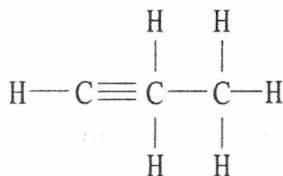
     A) aromatic compound
     B) alkyne
     C) olefin
     D) alkene
     E) alkane

15) The addition of HBr to 2–butene produces _____.   15) _____
     A) no reaction
     B) 2-bromobutane
     C) 2,3-dibromobutane
     D) 1-bromobutane
     E) 1,2-dibromobutane

16) The rate law for a reaction is   16) _____

$$rate = k\,[A][B]^2$$

Which one of the following statements is false?
     A) The reaction is second order overall.
     B) k is the reaction rate constant
     C) If [B] is doubled, the reaction rate will increase by a factor of 4.
     D) The reaction is second order in B.
     E) The reaction is first order in A.

17) Under constant conditions, the half-life of a first-order reaction _____.   17) _____
   A) is constant
   B) does not depend on the initial reactant concentration
   C) is the time necessary for the reactant concentration to drop to half its original value
   D) can be calculated from the reaction rate constant
   E) All of the above are correct.

18) The graph shown below depicts the relationship between concentration and time for the   18) _____
   following chemical reaction.

$$2A \longrightarrow C$$
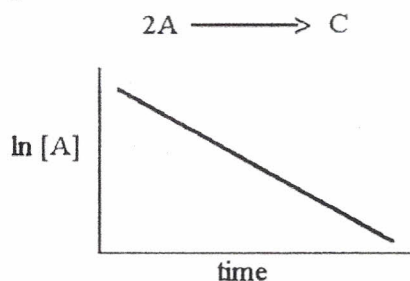
The slope of this line is equal to _____.
   A) –k   B) k   C) $\ln[A]_0$ D) –1/k   E) 1/k

TRUE/FALSE. In your scantron, fill up bubble A for true and bubble B for false answers (2 pts./question).

19) Possible shapes of AB_3 molecules are linear, trigonal planar, and T-shaped.   19) _____

20) XeF_4 is a polar molecule.   20) _____

21) Rates of reaction can be positive or negative.   21) _____

22) The half-life for a first order rate law depends on the starting concentration.   22) _____

PERIODIC TABLE OF THE ELEMENTS

1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 **H** 1.0079																	2 **He** 4.0026
3 **Li** 6.941	4 **Be** 9.0122											5 **B** 10.811	6 **C** 12.011	7 **N** 14.007	8 **O** 15.999	9 **F** 18.998	10 **Ne** 20.180
11 **Na** 22.990	12 **Mg** 24.305											13 **Al** 26.982	14 **Si** 28.086	15 **P** 30.974	16 **S** 32.066	17 **Cl** 35.453	18 **Ar** 39.948
19 **K** 39.098	20 **Ca** 40.078	21 **Sc** 44.956	22 **Ti** 47.867	23 **V** 50.942	24 **Cr** 51.996	25 **Mn** 54.938	26 **Fe** 55.845	27 **Co** 58.933	28 **Ni** 58.693	29 **Cu** 63.546	30 **Zn** 65.39	31 **Ga** 69.723	32 **Ge** 72.64	33 **As** 74.922	34 **Se** 78.96	35 **Br** 79.904	36 **Kr** 83.80
37 **Rb** 85.468	38 **Sr** 87.62	39 **Y** 88.906	40 **Zr** 91.224	41 **Nb** 92.906	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 - 71 La-Lu	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 -103 Ac-Lr	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (277)	109 **Mt** (268)	110 **Ds** (281)	111 **Uuu** (272)	112 **Uub** (285)		114 **Uuq** (289)				

	57 **La** 138.91	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 (145)	62 **Sm** 150.36	63 **Eu** 151.96	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
Lanthanide															
Actinide	89 **Ac** (227)	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (244)	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** (262)

Some Constants & Conversion Factors:

(1) Avogadro number: $N = 6.022 \times 10^{23}$/mole

(2) Planck's constant: $h = 6.626 \times 10^{-34}$ J.sec

(3) Gas Constant: $R = 0.0821$ atm L/mol K or $R = 8.3145$ J/mol K

(4) Speed of Light: $c = 2.997 \times 10^{8}$ m/sec

(5) Electronic Charge: $e = 1.602 \times 10^{-19}$ Coulomb

(6) π $\pi = 3.14159$

(7) 1 joule = 1 kg. m^2/s^2 = 0.239 calorie = (1 coulomb) x (1 volt); (8) 1 calorie = 4.184 joules

(9) Faraday's Constant: $F = 9.648 \times 10^{4}$ coulomb /mol electron;

(10) 1 pascal = 1 Newton / m^2 = 1 kg/m.s^2; (11) 1 atm = 760mm Hg = 760 torr

(12) K = °C + 273.15 °C; (13) °C /5 = (°F − 32) / 9

(14) 1 m = 100 cm; (15) 1 nm = 10^{-9} m; (16) 1 pm = 10^{-12} m; (17) 1 L = 1000 cm^3

(18) 1 kg = 10^{3} g; (19) 1 g = 10^{3} mg; (20) 1lb = 453.6g.