The Periodic Table

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB	VIIIB	VIIIB	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
H 1 1.01																	He 2 4.00
Li 3 6.94	Be 4 9.01											B 5 10.81	C 6 12.01	N 7 14.01	O 8 16.00	F 9 19.00	Ne 10 20.18
Na 11 22.99	Mg 12 24.31											Al 13 26.98	Si 14 28.09	P 15 30.97	S 16 32.07	Cl 17 35.45	Ar 18 39.95
K 19 39.10	Ca 20 40.08	Sc 21 44.96	Ti 22 47.88	V 23 50.94	Cr 24 52.00	Mn 25 54.94	Fe 26 55.85	Co 27 58.93	Ni 28 58.69	Cu 29 63.55	Zn 30 65.39	Ga 31 69.72	Ge 32 72.61	As 33 74.92	Se 34 78.96	Br 35 79.90	Kr 36 83.80
Rb 37 85.47	Sr 38 87.62	Y 39 88.91	Zr 40 91.22	Nb 41 92.91	Mo 42 95.94	Tc 43 (97.9)	Ru 44 101.07	Rh 45 102.91	Pd 46 106.42	Ag 47 107.87	Cd 48 112.41	In 49 114.82	Sn 50 118.71	Sb 51 121.76	Te 52 127.60	I 53 126.90	Xe 54 131.29
Cs 55 132.91	Ba 56 137.33	La 57 138.91	Hf 72 178.49	Ta 73 180.95	W 74 183.85	Re 75 186.21	Os 76 190.2	Ir 77 192.22	Pt 78 195.08	Au 79 197.97	Hg 80 200.59	Tl 81 204.38	Pb 82 207.2	Bi 83 208.98	Po 84 (209)	At 85 (210)	Rn 86 (222)
Fr 87 223.02	Ra 88 226.03	Ac 89 227.03	Rf 104 (261)	Db 105 (262)	Sg 106 263)	Bh 107 (262)	Hs 108 (265)	Mt 109 (266)	Ds 110 (271)	Rg 111 (272)	Uub 112 (285)	Uut 113 (284)	Uuq 114 (289)	Uup 115 (288)			

Ce 58 140.12	Pr 59 140.91	Nd 60 144.24	Pm 61 (145)	Sm 62 150.36	Eu 63 152.97	Gd 64 157.25	Tb 65 158.93	Dy 66 162.50	Ho 67 164.93	Er 68 167.26	Tm 69 168.93	Yb 70 173.04	Lu 71 174.97
Th 90 232.04	Pa 91 231.04	U 92 238.03	Np 93 237.05	Pu 94 (240)	Am 95 243.06	Cm 96 (247)	Bk 97 (248)	Cf 98 (251)	Es 99 252.08	Fm 100 257.10	Md 101 (257)	No 102 259.10	Lr 103 262.11

Some Useful (maybe) Constants:

a) $R = 8.314\ J.mol^{-1}K^{-1}$

b) Some Useful (maybe) Formula:

$$\ln \frac{P_2}{P_1} = \frac{\Delta H^\circ_{VAP}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$P_{solution} = \chi_{solvent} \times P^\circ_{solvent}$$

Integrated Rate Laws for Reactions of Type A → Products

Rate Law	Integrated Rate Law
rate = $k\,[A]^0 = k$	$[A]_t = [A]_0 - kt$
rate = $k[A]$	$\ln\frac{[A]_t}{[A]_0} = -kt$
rate = $k[A]^2$	$\frac{1}{[A]_t} = \frac{1}{[A]_0} + kt$

Zero Order	First Order	Second Order
$t_{1/2} = \frac{[A]_\circ}{2k}$	$t_{1/2} = \frac{\ln 2}{k}$	$t_{1/2} = \frac{1}{k\,[A]_\circ}$
Directly proportional to $[A]_\circ$	Constant	Inversely proportional to $[A]_\circ$

SID | | | | | | | | | Last _____ First _____

Question 1
10 Points

The **vapor pressure** of **bromoethane** is **40.1 mm Hg at 246K**. Assuming that its **molar heat of vaporization** is constant at **29.2 kJ/mol**, determine the **vapor pressure** of **bromoethane (C_2H_5Br)** at **263K**.

Must Show Work for Full Credit – R = 8.314 $J.mol^{-1}.K^{-1}$

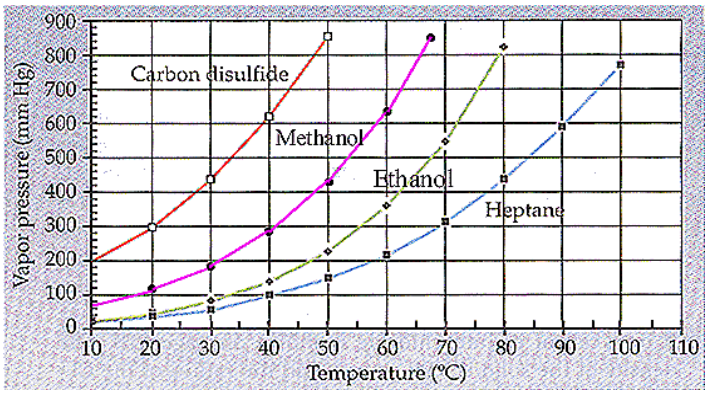
_____ **Mm Hg**

Question 2
6 Points

What **type(s)** of **intermolecular forces** are expected between **HFCO** molecules? Circle all those that apply. (**C** is the central atom)

- ☐ **Ion – Ion**
- ☐ **Dipole – Dipole**
- ☐ **Induced Dipole – Induced Dipole**
- ☐ **Ion – Dipole**
- ☐ **Hydrogen bonding**

Question 3
6 Points



A plot of **vapor pressures** vs **temperature**, is depicted **above**.

a) The molecule with the **weakest intermolecular forces?** _____

b) The **Normal Boiling Point** of **Methanol** is: (<60°C, ~65°C, >70°C) _____

Question 4
8 Points

An aqueous solution is **7.02 % by mass hydrochloric acid**, HCl. What is the **mole fraction** of **hydrochloric acid** in the solution?

Must Show Work for Full Credit: **Molar Masses, HCl = 36.5g.mol^{-1}, H_2O = 18.02g.mol^{-1}**

_____

Question 5
12 Points

Match the following aqueous solutions with the appropriate letter from the column on the right. **Assume complete dissociation of electrolytes.**

_____ 0.21 m $CrSO_4$	A. **Lowest** freezing point
_____ 0.16 m $CuCl_2$	B. **Second lowest** freezing point
_____ 0.13 m $Fe(NO_3)_3$	C. **Third lowest** freezing point
_____ 0.50 m Glucose (**nonelectrolyte**)	D. **Highest** freezing point

Question 6
6 Points

The **Vapor Pressure** of 4 substances was measured at **25°C** and they were found to be **143.0 mmHg**, **67.9 mm Hg**, **151.7 mmHg**, **514.4 mmHg**
The four substances measured are given below. Which one of the four **would you anticipate** having the **Vapor Pressure of 143.0 mm Hg?**

☐ CH_3OH	☐ C_6H_{14}
☐ C_5H_{12}	☐ CH_3CH_2OH

Question 7
7 Points

The **vapor pressure** of water (H_2O) is **23.8 mm Hg at 25°C**. What is the vapor pressure of a solution consisting of **8.55 mol of water** and **0.265 mol of a nonvolatile nonelectrolyte?**

Must Show Work for Full Credit

_____ **mm Hg**

Question 8
10 Points

The gas phase decomposition of hydrogen peroxide at 400°C is **second order** in H_2O_2.

$$H_2O_2(g) = H_2O(g) + \tfrac{1}{2} O_2(g)$$

In one experiment, when the initial concentration of H_2O_2 was **5.50×10^{-2} M**, the concentration of H_2O_2 dropped to **1.29×10^{-2} M** after **59.6 seconds had passed**. Based on this data, the **rate constant (k)** for the reaction is:

Must Show Work for Full Credit

_____ **$M^{-1}.s^{-1}$**

Question 9
12 Points

The following **initial rate data** are for the oxidation of nitrogen monoxide by oxygen at 25°C:

$$2\ NO + O_2 = 2\ NO_2$$

Experiment	$[NO]_0$ M	$[O_2]_0$ M	Initial Rate, $M.s^{-1}$
1	9.10×10^{-3}	5.61×10^{-4}	4.20×10^{-4}
2	1.82×10^{-2}	5.61×10^{-4}	1.68×10^{-3}
3	9.10×10^{-3}	1.12×10^{-3}	8.38×10^{-4}

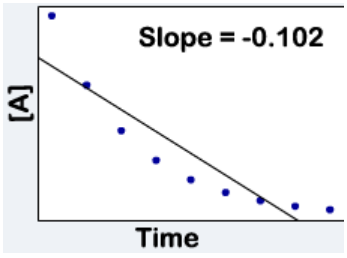
a) What is the **order of the reaction with respect to NO?** _____

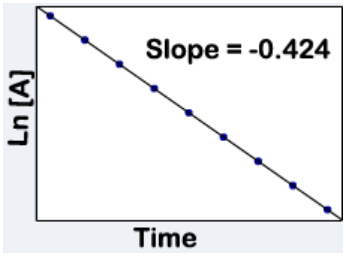
b) What is the **order of the reaction with respect to O_2?** _____

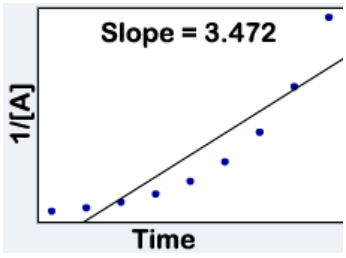
c) What is the **rate constant (k)?** _____

Question 10
4 Points

The following plots pertain to the reaction **A = B** in which the **concentration of A** was monitored over 8 minutes







From these plots the it can be determined that the **Rate** = _____[A]____

Question 11 10 Points	**Chromium-51 is a radioisotope** that is used to assess the lifetime of red blood cells **The half-life** of chromium-51 is **27.7 days**. If you **begin** with **41.7 mg** of this isotope, what **mass remains** after **77.6 days have passed? Since the decomposition is a radioactive decay reaction, it is first order.** **Must Show Work for Full Credit** _____ **mg**
Question 12 9 Points	In a study of the rearrangement of ammonium cyanate to urea in aqueous solution at **50°C** $NH_4NCO(aq) = (NH_2)_2CO(aq)$ the **concentration of NH_4NCO** was followed as a function of time. It was found that **a graph** of **1/[NH_4NCO] versus time in minutes** gave a **straight line** with a **slope of 1.47×10^{-2} $M^{-1}min^{-1}$** and a **y-intercept of 2.65 M^{-1}**. Based on this plot the: a) the reaction is _____order in **NH_4NCO** b) and the rate constant for the reaction is: _____ _____**(units)**

Only fill if your iClicker is incorrectly registered:- **iClicker ID**: _____

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Exam I Score	