CHEM 220 – Quiz #1 – Spring 2018 Name: Key Lab: **Morning / Afternoon**

1. (4) What volume of 2.00 *M* nitric acid (HNO_3) should be diluted with water in order to make 250. mL of a 0.450 *M* solution?

$(2.00\ M)V_1 = (0.450\ M)(250.\ mL)$

$V_1 = 56.25\ mL = \boxed{56.3\ mL}$

2. (5) For the reaction: **BrO_3^- + 5 Br^- + 6 H^+ → 3 Br_2 + 3 H_2O**
at a particular time, $-\Delta[Br^-]/\Delta t = 0.0060$ *M*/s. What is $\Delta[Br_2]/\Delta t$ at the same instant?

$$\frac{\Delta[Br_2]}{\Delta t} = \left(\frac{3}{5}\right)\left(-\frac{\Delta[Br^-]}{\Delta t}\right) = \frac{3}{5}\left(0.0060\ \frac{M}{s}\right)$$

$$= \boxed{0.0036\ \frac{M}{s}}$$

3. (7) A 20.0 mL sample of a sulfuric acid (H_2SO_4) solution is titrated with 0.125 *M* NaOH and 28.23 mL of NaOH is required to reach the endpoint. What is the concentration of the sulfuric acid solution?

$H_2SO_4 + 2NaOH \rightarrow 2H_2O_{(\ell)} + Na_2SO_4$

20.0 mL | 0.125 M | 28.23 mL

$$28.23\ mL \left|\frac{0.125\ mol}{1\ L}\right|\frac{1\ mol\ H_2SO_4}{2\ mol\ NaOH} \Rightarrow 1.7644\ mmol$$

$$\frac{1.7644\ mmol}{20.0\ mL} = 0.08822\ M$$

$[H_2SO_4] = \boxed{0.0882\ M}$

4. (10) Nitric oxide gas (NO) reacts with bromine gas according to the equation: **2 NO + Br_2 → 2 NOBr**. The following initial rates of reaction have been measured for the given reagent concentrations. Determine the **differential rate law equation** and the **k value (including units)** for this reaction.

Expt. #	Rate (*M*/min)	[NO] (*M*)	[Br_2] (*M*)
1	0.20	0.50	0.50
2	1.80 (×9)	1.50 (×3)	0.50
3	1.80 (×1)	1.50	1.50 (×3)

[NO]: $3^x = 9$ $x = 1$

[Br_2]: $3^y = 1$ $y = 0$

$rate = k[NO]^2$

$$k = \frac{0.20\ M/min}{(0.50\ M)^2} = 0.80\ M^{-1}\cdot min^{-1}$$

$$\boxed{rate = 0.80\ M^{-1}\cdot min^{-1}[NO]^2}$$

5. (4) Complete the following table for the following reaction. Assume 100% yield.
Be sure to indicate + / – in the "moles REACTING" line. *You may ignore significant figures.*

12 $Cl_{2(g)}$ + $S_{8(s)}$ → 8 $SCl_{3(g)}$

Moles at the START	36	11	0
Moles REACTING (include +/-)	-36	-3	+24
Moles at the END	0	8	24

6) (10 points) For the reaction: $2\ N_2O_{5(g)} \rightarrow 4\ NO_{2(g)} + O_{2(g)}$

The time versus $[N_2O_5]$ data were collected below:

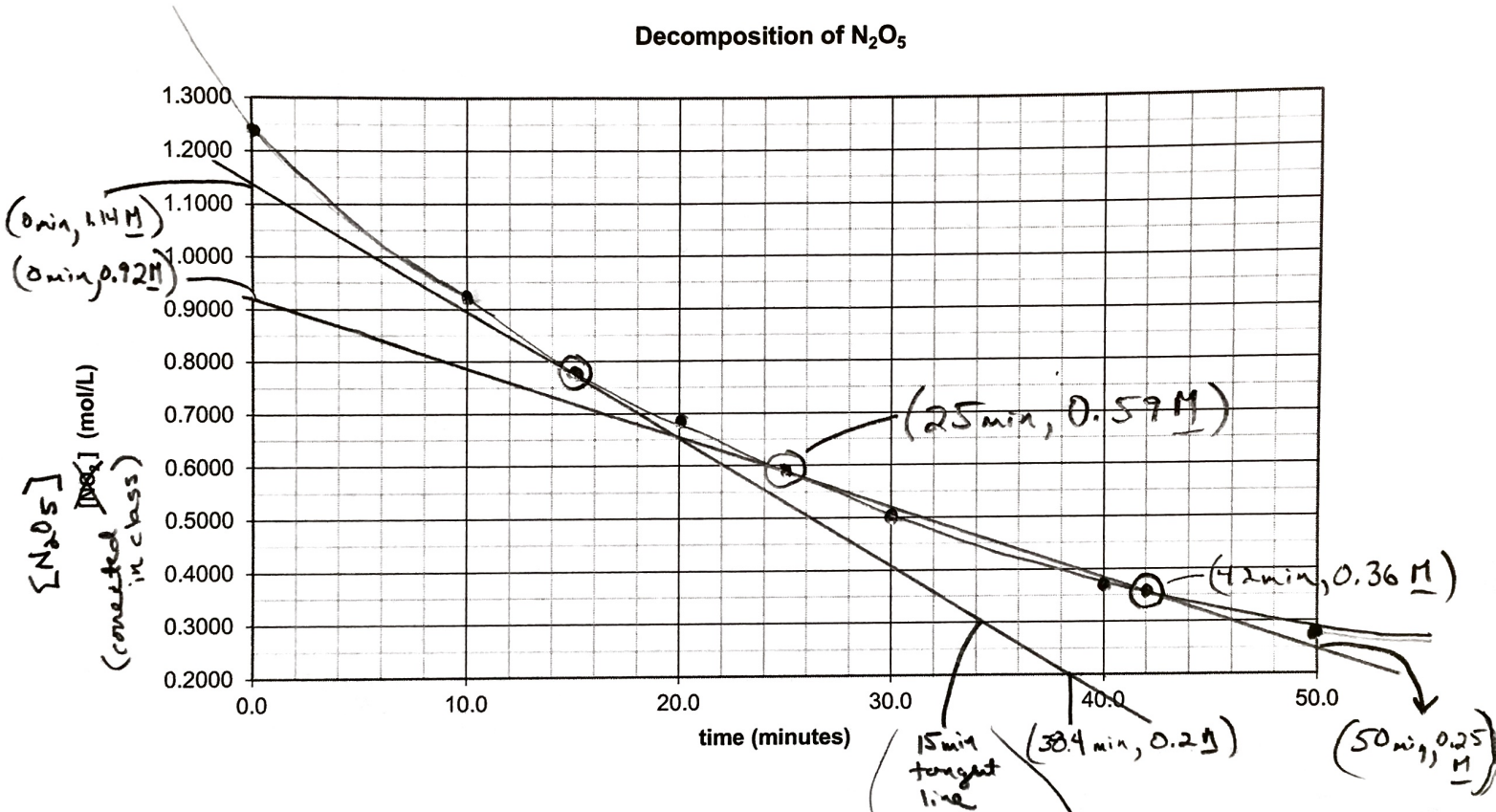
t (minutes)	$[N_2O_5]$ (mol/L)
0	1.24
10.0	0.92
20.0	0.68
30.0	0.50
40.0	0.37
50.0	0.28

A) Prepare a plot below (following rules of good graphing) to assist with rate calculations.

For parts B&C, Show the appropriate work on the graph and below. Include units and consider significant figures in final answers. Make appropriate selections from your graphing work to get the best estimate possible for the rates.

B) Calculate the average rate defined in terms of the N_2O_5 disappearance, over the range of 25.0 min to 42.0 min.

C) Determine the instantaneous rate of disappearance of N_2O_5 at time = 15.0 min.



B) $\frac{-\Delta[NO_2]}{\Delta t} = \frac{-(0.59-0.36)\ M}{(25-42)\ min} = \frac{-0.23\ M}{-17\ min} = 0.0135\ M/min$

or $\frac{-(0.25-0.92)\ M}{(50-0)\ min} = \frac{0.67\ M}{50\ min} = 0.134\ M/min$

C) $\frac{-\Delta[NO_2]}{\Delta t} = \frac{-(0.2-1.14\ M)}{38.4-0\ min} = \frac{-(-0.94\ min)}{38.4} = 0.02448\ M/min$

$\approx 0.024\ M/min$