

Name: _____

This exam is subject to the terms and conditions of the NKU Honor Code. You are not to give or receive assistance during this exam. No programmable or graphing calculators are permitted during this exam. Remember to report all answers to the correct number of significant digits and show all work as appropriate to receive partial credit!

By signing below, I signify that I have adhered to the NKU Honor Code and did not give or receive assistance during this exam. I recognize that failure to adhere to the Honor Code will result in a zero grade for this exam.

Constants and Conversion Factors:

$$N_A = 6.022 \times 10^{23}$$

$$s_{\text{H}_2\text{O}} = 4.184 \frac{\text{J}}{\text{g} \cdot ^\circ\text{C}}$$

$$R = 0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}$$

$$1 \text{ atm} = 760 \text{ mm Hg} = 1.01325 \times 10^2 \text{ kPa}$$

$$R = 8.314 \frac{\text{J}}{\text{mol} \cdot \text{K}}$$

Exam Grade (Completed by Instructor):

P2 / **21**

P3 / **27**

P4 / **56**

P5 / **48**

P6 / **34**

P7 / **14**

Total / **200**

Activity Series

Li	Displace hydrogen from acids
K	
Ba	
Ca	Displace hydrogen from steam
Na	
Mg	
Al	Displace hydrogen from cold water
Zn	
Cr	
Fe	
Cd	
Co	
Ni	
Sn	
Pb	
H	
Cu	
Hg	
Ag	
Pt	
Au	

ΔH_f° Values

Compound	ΔH_f°
H ₂ O(l)	-285.8
H ₂ O(g)	-241.8
O ₃ (g)	+142.2
CO(g)	-110.5
CO ₂ (g)	-393.5
Pb(s, white)	0
Pb(s, red)	-18.4

True/False (2 pts each):

- From the following equation, we can deduce that one hundred P₄O₁₀ molecules would react with six hundred H₂O molecules. $P_4O_{10}(s) + 6H_2O(l) \rightarrow 4H_3PO_4(aq)$
- Chemical reactions in a bomb calorimeter occur at constant pressure.
- A weak acid or base does not ionize completely when dissolved in water.

Fill in the Blank (2 pts each, 6 pts for question 7):

- The _____ half-reaction involves the loss of electrons in a redox reaction.
- In an _____ process, heat is absorbed by the system.
- The SI unit of energy is the _____.
- At STP, which is at _____ K and _____ atm, 1 mole of gas occupies _____ L.

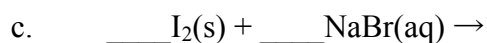
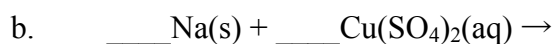
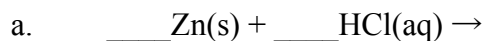
Multiple Choice (3 points each):

- Which of the following compounds is a weak electrolyte?
 - HCl
 - O₂
 - C₆H₁₂O₆ (glucose)
 - CH₃COOH (acetic acid)
 - NaCl

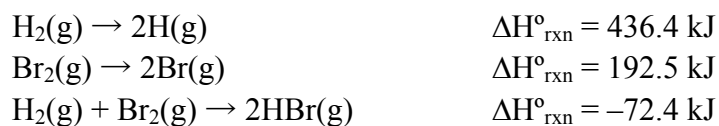
- 9 ___ The oxidation number of Mn in KMnO_4 is
a. +8
b. +7
c. +5
d. -7
e. -8
- 10 ___ If the pressure of a gas sample is quadrupled and the absolute temperature is doubled, by what factor does the volume of the sample change?
a. 8
b. 2
c. 1/2
d. 1/4
e. 1/8
- 11 ___ For a substance that remains a gas under the conditions listed, deviation from the ideal gas law would be most pronounced at
a. 100°C and 2.0 atm
b. 0°C and 2.0 atm
c. -100°C and 2.0 atm
d. -100°C and 4.0 atm
e. 100°C and 4.0 atm
- 12 ___ How much heat is required to raise the temperature of 1,500 g of water from 25°C to 52°C ?
a. 169 kJ
b. 1,500 kJ
c. 372 kJ
d. 6.27 kJ
e. 40.5 kJ
- 13 ___ How many molecules of N_2 gas can be present in a 2.5 L flask at 50°C and 650 mmHg?
a. 2.1×10^{23} molecules
b. 4.9×10^{22} molecules
c. 3.1×10^{23} molecules
d. 3.6×10^{25} molecules
e. 1.9×10^{27} molecules

Short Answer (points listed by problem, show all work on the exam to obtain partial credit):

14(12) Based on the activity series provided on page 2 and your knowledge of halides, predict the outcome of the reactants below and balance the equations. Write N/R if no reaction occurs.



19(14) You are given the following data:



Calculate $\Delta H_{\text{rxn}}^{\circ}$ for the following reaction: $\text{H}(\text{g}) + \text{Br}(\text{g}) \rightarrow \text{HBr}(\text{g})$

20(10) Which molecule is faster at 40.0°C, N_2 or CO_2 , based on their root-mean-square speeds? Back up your answer with numerical calculations.

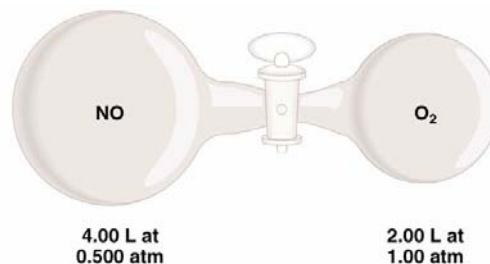
21(12) Calculate $\Delta H_{\text{f}}^{\circ}$ for methanol (CH_3OH) from the constants provided on page 1 and the equation below.
 $2\text{CH}_3\text{OH}(\text{l}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{l}) \quad \Delta H_{\text{rxn}}^{\circ} = -1452.8 \text{ kJ}$

22(12) A 21.4 g sample of copper is burned in a constant volume calorimeter that has a heat capacity of 2107 J/°C. The calorimeter contains 500. g of water, and its temperature increases by 2.865°C during the reaction. Calculate the heat given off by the copper in kJ/g *and* kJ/mol

23(16) a. Calculate the volume in mL of a 1.580 M NaOH solution required to titrate 25.00 mL of a 4.200 M H₂SO₄ solution.

b. If you started with 200.0 mL of the 1.580 M NaOH solution in part a and diluted the remaining portion (i.e., the amount you *didn't* use to titrate the acid) to obtain a volume of 175.0 mL, what is the *maximum* number of moles of H₂SO₄ you can titrate with this new solution?

24(18) Nitric oxide (NO) reacts with molecular oxygen based on the equation $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$. Initially NO and O₂ are separated as shown below. When the valve is opened, the reaction quickly goes to completion. Determine the moles of each gas (NO, O₂, and NO₂) remaining at the end of the reaction. Assume that the temperature remains constant at 25°C.



25(14) Imagine that you're teaching a CHE120 class and have to prepare an explanation of Boyle's Law for your lecture. Teach me the law in words, equations, *and* graphs. Be sure to include any necessary proportionality constants. You might even want to do a sample problem!