

University of Kentucky

Department of Chemistry

READ THESE DIRECTIONS CAREFULLY BEFORE STARTING THE EXAMINATION!

It is *extremely* important that you fill in the answer sheet EXACTLY as indicated, otherwise your test may not be processed; ALL entries are to be made on SIDE 1 of the answer sheet. Use a #2 pencil (or softer); fill in the circles completely and firmly. Erasures must be complete. Use only the following categories:

|                 |  |             |                  |            |                  |          |         |            |         |           |                  |            |         |
|-----------------|--|-------------|------------------|------------|------------------|----------|---------|------------|---------|-----------|------------------|------------|---------|
| NAME:           | Print your name starting at the first space, LAST NAME first, then a space, followed by your FIRST NAME, then another space, followed by your MIDDLE INITIAL. Fill in the <u>correct</u> circles below your printed name corresponding to the letters of your name; for the spaces, fill in the top blank circle.  |             |                  |            |                  |          |         |            |         |           |                  |            |         |
| STUDENT NUMBER: | This is <b><u>VERY IMPORTANT!</u></b> Under IDENTIFICATION NUMBER, put in your <b>8 DIGIT STUDENT ID NUMBER (do not use the 9 at the beginning of your number)</b> beginning in column A and continuing through column H, column I will be blank, (do NOT use column J at this time); be sure to fill in the correct circles (a common error to be avoided is mistaking "0" for "1").  |             |                  |            |                  |          |         |            |         |           |                  |            |         |
| TEST FORM:      | Fill in the "2" blank in the J column under IDENTIFICATION NUMBER (to indicate Hour Examination II).   |             |                  |            |                  |          |         |            |         |           |                  |            |         |
| SPECIAL CODES:  | Use for course and section number; in positions K-P write in one of the following:<br><br><table style="margin-left: auto; margin-right: auto;"> <tr> <td>Dr. Woodrum</td> <td>105-001, 105-002</td> </tr> <tr> <td>Mr. Harris</td> <td>105-003, 105-006</td> </tr> <tr> <td>Dr. Ades</td> <td>105-004</td> </tr> <tr> <td>Dr. Knecht</td> <td>105-005</td> </tr> <tr> <td>Dr. Testa</td> <td>105-008, 105-009</td> </tr> <tr> <td>Dr. Guzman</td> <td>105-401</td> </tr> </table> | Dr. Woodrum | 105-001, 105-002 | Mr. Harris | 105-003, 105-006 | Dr. Ades | 105-004 | Dr. Knecht | 105-005 | Dr. Testa | 105-008, 105-009 | Dr. Guzman | 105-401 |
| Dr. Woodrum     | 105-001, 105-002   |             |                  |            |                  |          |         |            |         |           |                  |            |         |
| Mr. Harris      | 105-003, 105-006   |             |                  |            |                  |          |         |            |         |           |                  |            |         |
| Dr. Ades        | 105-004  |             |                  |            |                  |          |         |            |         |           |                  |            |         |
| Dr. Knecht      | 105-005  |             |                  |            |                  |          |         |            |         |           |                  |            |         |
| Dr. Testa       | 105-008, 105-009   |             |                  |            |                  |          |         |            |         |           |                  |            |         |
| Dr. Guzman      | 105-401  |             |                  |            |                  |          |         |            |         |           |                  |            |         |
| SIGNATURE:      | You <b><u>MUST</u></b> sign the examination answer sheet (bubble sheet) on the line directly above your printed name. Use your legal signature.  |             |                  |            |                  |          |         |            |         |           |                  |            |         |

Answering Questions:

Starting with answer "1" on SIDE 1, fill in the circle indicating the one best answer for each of the 28 questions in this examination. Your score is the sum of the appropriate credit for each response. The day after the examination is finished, an examination key will be posted on Blackboard.

Grading and Reporting:

The examination scores will be posted in Blackboard as soon as possible after the examination. If an error has been made in scoring your answers, tell your instructor within 48 hours of the posting of your score.

|   |
|---|
| <p><b><u>BE SURE THAT YOUR TEST HAS 28 QUESTIONS, A PERIODIC TABLE, AND ONE SHEET OF SCRATCH PAPER.</u></b> You may <u>NOT</u> use your own scratch paper during this examination. Cell phones and pagers are to be turned off and out of sight during the exams.</p> |
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1. Determine the mass percent of lithium in  $\text{Li}_2\text{CO}_3$ .

- A. 21.3%                                      C. 9.7%  
B. 5.9%                                        D. 18.8%
- 

2. How many sodium atoms are contained in 99.6 mg of  $\text{Na}_2\text{SO}_3$ ?

- A.  $1.52 \times 10^{27}$  sodium atoms      C.  $4.76 \times 10^{20}$  sodium atoms  
B.  $2.10 \times 10^{21}$  sodium atoms      D.  $9.52 \times 10^{20}$  sodium atoms
- 

3. A 3.48 g sample of rhenium reacts with sulfur to form 5.58 g of the rhenium sulfide. What is the empirical formula of the sulfide?

- A.  $\text{ReS}_3$                                         C.  $\text{Re}_3\text{S}_2$   
B.  $\text{Re}_2\text{S}_7$                                         D.  $\text{Re}_2\text{S}_3$
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4. Choose the correct **balanced** equation to show the reaction of aqueous aluminum acetate with aqueous ammonium phosphate to form solid aluminum phosphate and aqueous ammonium acetate.

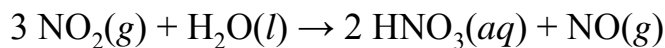
- A.  $\text{Al}(\text{C}_2\text{H}_3\text{O}_2)_2 (aq) + (\text{NH}_4)_2\text{PO}_4 (aq) \rightarrow \text{AlPO}_4 (s) + 2 \text{NH}_4\text{C}_2\text{H}_3\text{O}_2 (aq)$   
B.  $\text{Al}(\text{C}_2\text{H}_3\text{O}_2)_2 (aq) + (\text{NH}_3)_2\text{PO}_4 (aq) \rightarrow \text{AlPO}_4 (s) + 2 \text{NH}_3\text{C}_2\text{H}_3\text{O}_2 (aq)$   
C.  $\text{Al}(\text{C}_2\text{H}_3\text{O}_2)_3 (aq) + (\text{NH}_3)_2\text{PO}_4 (aq) \rightarrow \text{AlPO}_4 (s) + 2 \text{NH}_3\text{C}_2\text{H}_3\text{O}_2 (aq)$   
D.  $\text{Al}(\text{C}_2\text{H}_3\text{O}_2)_3 (aq) + (\text{NH}_4)_3\text{PO}_4 (aq) \rightarrow \text{AlPO}_4 (s) + 3 \text{NH}_4\text{C}_2\text{H}_3\text{O}_2 (aq)$
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5. How many moles of molecular oxygen are required to produce 2.33 moles of water in the reaction below? Assume that there is excess  $C_3H_7SH$  present.



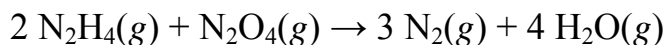
- A. 1.55 moles  $O_2$                       C. 2.33 moles  $O_2$   
B. 3.50 moles  $O_2$                       D. 6.21 moles  $O_2$

- 
6. Consider the following balanced reaction. How many grams of water are required to form 75.9 g of  $HNO_3$ ? Assume that there is excess  $NO_2$  present.



- A. 38.0 g  $H_2O$                       C. 21.7 g  $H_2O$   
B. 10.9 g  $H_2O$                       D. 43.4 g  $H_2O$

- 
7. Consider the balanced equation:



How many moles of the excess reactant remain if 15.0 g of  $N_2H_4$  reacts with 20.0 g of  $N_2O_4$ ?

- A. 0.033 mol                      C. 0.086 mol  
B. 0.435 mol                      D. 0.219 mol

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8. What volume of a 0.184 M  $NaNO_3$  solution contains 0.113 moles of  $NaNO_3$ ?

- A. 543 mL                      C. 614 mL  
B. 163 mL                      D. 885 mL
-

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9. What volume of 0.750 M  $\text{FeCl}_2$  is needed to completely react with  $1.00 \times 10^2$  mL of 0.250 M  $\text{KMnO}_4$  in the reaction below?



- A. 167 mL  
B. 66.7 mL  
C. 33.3 mL  
D. 60.0 mL

- 
10. 42.3 mL of a 0.266 M  $\text{LiNO}_3$  solution is diluted to a final concentration of 0.0750 M. What approximate volume of water was added to reach the final concentration?

- A. 108 mL  
B. 150. mL  
C. 11.9 mL  
D. 30.4 mL

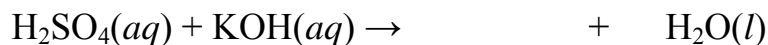
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11. Which of the following is insoluble in water?

- A.  $\text{LiOH}$   
B.  $\text{Na}_2\text{SO}_4$   
C.  $\text{HNO}_3$   
D.  $\text{Mg}(\text{OH})_2$

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12. Write the molecular equation for the precipitation reaction that occurs (if any) when solutions of lead(II) nitrate and ammonium sulfate are mixed.

- A.  $\text{Pb}(\text{NO}_3)_2(aq) + (\text{NH}_4)_2\text{SO}_4(aq) \rightarrow 2 \text{NH}_4\text{NO}_3(s) + \text{PbSO}_4(aq)$   
B.  $2 \text{Pb}(\text{NO}_3)_2(aq) + 2 (\text{NH}_4)_2\text{SO}_4(aq) \rightarrow 4 \text{NH}_4\text{NO}_3(aq) + \text{PbSO}_4(s)$   
C.  $\text{Pb}(\text{NO}_3)_2(aq) + (\text{NH}_4)_2\text{SO}_4(aq) \rightarrow 2 \text{NH}_4\text{NO}_3(aq) + \text{PbSO}_4(s)$   
D. No reaction occurs.
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13. Complete and balance the following reaction. Determine the formula for the missing product and the coefficient of *water* when balanced.

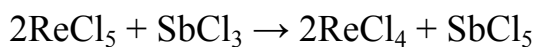


- A.  $\text{K}_2\text{SO}_4(aq)$ ; 2                      C.  $\text{K}_2\text{SO}_4(aq)$ ; 1  
B.  $\text{KSO}_4(aq)$ ; 2                      D.  $\text{KSO}_4(aq)$ ; 1

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14. The titration of 25.0 mL of an unknown concentration of  $\text{H}_2\text{SO}_4$  solution requires 83.6 mL of 0.12 M LiOH solution. What is the concentration of the  $\text{H}_2\text{SO}_4$  solution? It might be helpful to write and balance the chemical equation.

- A. 0.20 M                                  C. 0.40 M  
B. 0.10 M                                  D. 0.36 M

- 
15. Which species acts as the reducing agent in the reaction below?



- A.  $\text{ReCl}_5$                                   C.  $\text{ReCl}_4$   
B.  $\text{SbCl}_3$                                   D.  $\text{SbCl}_5$

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16. What is the oxidation number of the chromium atom in  $\text{K}_2\text{CrO}_4$ ?

- A. +6    C. +3  
B. +2    D. +7
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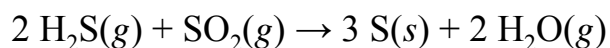
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22. A syringe contains 589 mL of CO gas at 325 K and 1.2 atm of pressure. A second syringe contains 473 mL of N<sub>2</sub> gas at 298 K and 2.6 atm. What is the final pressure if the contents of these two syringes are injected into an empty 1.00 L container at 273 K?

- A. 0.59 atm    C. 1.7 atm  
B. 1.1 atm    D. 1.9 atm

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23. What volume of H<sub>2</sub>S gas is required to produce 55.0 g of sulfur? Assume that excess SO<sub>2</sub> is present and that the reaction is conducted at 375 K and 1.20 atm.



- A. 44.0 L    C. 22.7 L  
B. 29.3 L    D. 34.1 L

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24. Which statement is TRUE about kinetic molecular theory?

- A. Gas molecules do not move in a straight line.  
B. The average kinetic energy of a gas molecule is not proportional to the temperature.  
C. The volume of a gas molecule is large compared to the total volume occupied by the gas.  
D. The collisions of gas molecules with one another are completely elastic.

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25. A gas expands and absorbs 35 kJ of heat. What are the signs for work and heat for the system, respectively?

- A. Work ( $w$ ) is positive (+); heat ( $q$ ) is positive (+)  
B. Work ( $w$ ) is negative (-); heat ( $q$ ) is negative (-)  
C. Work ( $w$ ) is negative (-); heat ( $q$ ) is positive (+)  
D. Work ( $w$ ) is positive (+); heat ( $q$ ) is negative (-)
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26. Calculate the change in internal energy ( $\Delta E$ ) for a system that releases 45.0 kJ of heat and does 855 J of work on the surroundings.

A. 44.1 kJ

C. -45.9 kJ

B. -44.1 kJ

D. 45.9 kJ

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27. Energy that is associated with the position or composition of an object is called

A. potential energy

C. kinetic energy

B. thermal energy

D. mechanical energy

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28. Under what conditions would  $N_2$  gas be the most ideal?

A. High pressure and low temperature

B. Low pressure and high temperature

C. High pressure and high temperature

D. Low pressure and low temperature

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