CHE 105 **FINAL EXAMINATION** **May 4, 2010**

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 **correct** 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 **very important.** Put in your **8 digit student ID number** (do not **use the 9 at the beginning of your number**) beginning in column A and continuing through column H, column I will be blank, (do NOT use column J at this time) under IDENTIFICATION NUMBER; be sure to fill in the correct circles (a common error to be avoided is mistaking "0" for "1").
TEST FORM:	Fill in the "4" blank in the J column under IDENTIFICATION NUMBER (to indicate Hour Examination IV).
SPECIAL CODES:	Use for course and section number; in positions K-P write in one of the following: Dr. H. Ades 105-001, 105-002 Ms. E. Ferguson 105-401
SIGNATURE:	You **must** 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 60 questions in this examination. Your score is the sum of the appropriate credit for each response. Soon 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.

Be sure that your test has 60 questions, a periodic table, and two sheets of scratch paper. You may **not** use your own scratch paper during this examination. Cell phones and pagers are to be turned off and out of sight during the exams. **All** exam paper, scratch paper, and scantrons must be handed in at the end of the exam. You may **not** take any exam materials away from the exam room.

Questions 1 thru 15 cover Exam I material.

1. Which of the following describes a chemical property?

A. Sodium metal can be cut with a knife.
B. A match ignites when struck on a flint.
C. Ice melts when heated.
D. Frost forms on a cold night.

2. The state(s) of matter that has/have molecules that are close together is/are ____.

A. solid only
B. solid and liquid
C. liquid only
D. gas only

3. Which of the following is smaller than 1.2×10^{3} μm?

A. 1.8×10^{-2} mm
B. 4.0 km
C. 9.6×10^{9} nm
D. 5.0×10^{-1} cm

4. How many significant figures can be reported in the answer of the following calculation?

$$5.143 \times 10^{-5} + 8 \times 10^{-7}$$

A. 1
B. 2
C. 3
D. 4

5. What mass of steel has a volume of 14.5 cm^3? The density of steel is 7.91 g/cm^3.

A. 8.72×10^{-3} g
B. 0.546 g
C. 1.83 g
D. 115 g

6. What is the mass of air, in grams, in a box that has a volume of 375 ft^3? The density of air at the temperature of the box is 1.19 g/L. (1 ft = 12 in)

A. 9.61×10^{5} g
B. 8.92×10^{2} g
C. 1.26×10^{3} g
D. 0.272 g

7. The mass number indicates:

A. The number of neutrons in the nucleus.
B. The number of atoms in one (1) gram of the element.
C. The number of protons and electrons in a neutral atom.
D. The number of neutrons and protons in the nucleus.

8. What is the formula for nickel(II) oxide?

A. NiO_2
B. Ni_2O
C. NiO
D. NiO_4

9. What is the symbol for the ion that has a mass number 82, and 48 neutrons? The ion derived from the isotope has 36 electrons.

A. Se^{2-}
B. Cd^{2+}
C. Pd^{2+}
D. Kr^{-}

10. Which of the following is an ionic compound?

A. CO_2
B. H_2O
C. N_2
D. CaF_2

11. What is the mass, in grams, of one atom of phosphorus?

A. 5.143×10^{-23} g/atom
B. 6.634×10^{-23} g/atom
C. 1.94×10^{22} g/atom
D. 1.865×10^{25} g/atom

12. What is the mass, in grams, of potassium in 25.0 g of potassium oxide? Potassium is in Group IA and oxygen is in Group VIA.

A. 17.8 g
B. 7.22g
C. 4.20 g
D. 20.8 g

13. How many hydrogen atoms are in 129 g of $Na_3C_6H_5O_7$? (Molar mass of $Na_3C_6H_5O_7$ = 258 g/mol)

A. 6.02×10^{22} atoms
B. 1.51×10^{24} atoms
C. 4.15×10^{-24} atoms
D. 3.01×10^{23} atoms

14. One of the steps in preparing nitric acid (HNO_3) from ammonia (NH_3) is shown in the reaction below.

$$4NH_3(g) + 5O_2(g) \rightarrow 4\ NO(g) + 6H_2O(g)$$

What mass of NH_3 (molar mass 17.0 g) must react completely to form 75.0 g of H_2O? (molar mass 18.0 g)

A. 106 g
B. 50.0 g
C. 47.2 g
D. 70.8 g

15. How many moles of H_2O are produced when 0.850 mol $Al(OH)_3$ and 1.65 mol H_2SO_4 react according to the following reaction?

$$2Al(OH)_3(s) + 3H_2SO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 6H_2O(l)$$

A. 2.55 mol
B. 0.283 mol
C. 3.30 mol
D. 0.825 mol

Questions 16 thru 30 cover Exam II material.

16. Which of the following is a **nonelectrolyte** in aqueous solution?

A. NH_4NO_3
B. $Ba(OH)_2$
C. $Sr(NO_2)_2$
D. C_3H_7OH

17. In which one of the following does **no** precipitate form when the two aqueous solutions listed are mixed?

A. potassium sulfate and barium chloride
B. silver nitrate and sodium iodide
C. sodium phosphate and calcium chloride
D. cesium acetate and ammonium carbonate

18. Which of the following statements about the reaction below is **correct**?

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

A. Na is the oxidizing agent.
B. H_2O is reduced.
C. H_2 is the reducing agent.
D. NaOH is oxidized.

19. What volume, in mL, of 0.250 *M* NaCl is needed to provide 0.500 g of NaCl? (molar mass 58.5 g)

A. 125 mL
B. 34.2 mL
C. 2.00×10^2 mL
D. 2.14 mL

20. Which of the following sets of directions correctly describe the preparation of 0.200 L of 2.00 *M* NaOH from an 10.0 *M* stock solution?

A. Dilute 20.0 mL of 10.0 *M* NaOH to a final volume of 0.200 L.
B. Combine 40.0 mL of 10.0 *M* NaOH with 0.200 L of water.
C. Combine 20.0 mL of 10.0 *M* NaOH with 0.200 L of water.
D. Dilute 40.0 mL of 10.0 *M* NaOH to a final volume of 0.200 L.

21. What volume of a 0.500 *M* HCl solution is needed to neutralize 10.0 mL of a 0.200 *M* $Ba(OH)_2$ solution? Remember you have to have a balanced equation to do this problem.

A. 8.00 mL
B. 4.00 mL
C. 16.0 mL
D. 2.00 mL

22. How many **moles** of nitrate (NO_3^-) are present in 50.0 mL of 0.200 *M* $Al(NO_3)_3$solution?

A. 0.0100 mol
B. 0.0300 mol
C. 1.00 mol
D. 0.0600 mol

23. If the pressure of a confined gas is halved while the temperature changes from 5.00°C to 150.0°C, what change will be observed?

A. The volume of the gas will increase by a factor of 2.
B. The volume of the gas will decrease to about 1/3 its original value.
C. The volume of gas will increase to about 3 times its original value.
D. The volume of the gas will not change.

24. What volume will 50.0 g of $CO_2(g)$ (molar mass 44.0 g) occupy at a pressure of 3.00×10^2 mmHg and at a temperature of 25°C?

A. 4.08 L
B. 25.9 L
C. 70.4 L
D. 2.61 L

25. A sample of $SO_3(g)$ completely decomposes to $SO_2(g)$ and $O_2(g)$ when heated. What is the partial pressure of $\mathbf{O_2}$ produced if the total gas pressure after the reaction is complete is 462 mmHg?

$$2SO_3(g) \rightarrow 2SO_2(g) + O_2(g)$$

A. 154 mmHg
B. 231 mmHg
C. 308 mmHg
D. 115 mmHg

26. Under which of the following conditions of temperature and pressure is a gas most ideal?

A. 500°C and 5 atm
B. 500°C and 50 atm
C. 50°C and 5 atm
D. 50°C and 50 atm

27. Which one of the following gases diffuses the **slowest**? All are under the same conditions of temperature and pressure.

A. N_2
B. C_2H_4
C. O_3
D. SO_2

28. The work done when a gas expands is 125 J. At the same time 278 J of heat is released to the surroundings. What is the change in energy of the gas?

A. 403 J
B. –403 J
C. 153 J
D. −153 J

29. $\Delta H = -3351$ kJ for the reaction $4Al(s) + 3\ O_2(g) \rightarrow 2Al_2O_3(s)$. The reaction is _____, and therefore heat is _____by the reaction.

A. endothermic, released
B. endothermic, absorbed
C. exothermic, absorbed
D. exothermic, released

30. What is the heat evolved when 128 g of $O_2(g)$ reacts according to the reaction below?

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g) \qquad \Delta H = -904 \text{ kJ/mol}$$

A. 2.31×10^3 kJ
B. 3.62×10^3 kJ
C. 452 kJ
D. 723 kJ

Questions 31 thru 45 cover Exam III material.

31. What is the specific heat of an unknown compound if 1.58 kJ of heat is needed to raise the temperature of 62.0 g of the sample from 16.3°C to 38.5°C

A. 0.871 J/g·°C
B. 0.227 J/g·°C
C. 4.41 J/g·°C
D. 1.15 J/g·°C

32. A 50.0 g sheet of substance A (specific heat: 0.200 J/g·°C), initially at 25.0°C is placed on a 10.0 g sheet of substance B (specific heat: 0.500 J/g·°C), initially at 125.0°C. What is the final temperature of the combined substances? Assume no heat loss to the surroundings.

A. 58.3°C
B. 75.0°C
C. 175°C
D. 116°C

33. For which one of the following reactions does $\Delta H^{\circ}_{rxn} = \Delta H^{\circ}_{f}$ of the product?

A. $2/3O_3(g) \rightarrow 3/2O_2(g)$
B. $N_2(g) + 1/2O_2(g) \rightarrow N_2O(g)$
C. $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$
D. $CH_4(g) + 2O_2(g) \rightarrow 2H_2O(l) + CO_2(g)$

34. What is ΔH° for the reaction $IF_5(g) \rightarrow IF_3(g) + F_2(g)$ given that

$$IF(g) + F_2(g) \rightarrow IF_3(g) \quad \Delta H^{\circ} = -390 \text{ kJ/mol}$$

$$IF(g) + 2F_2(g) \rightarrow IF_5(g) \quad \Delta H^{\circ} = -745 \text{ kJ/mol}$$

A. 1135 kJ
B. −1135 kJ
C. −355 kJ
D. 355 kJ

35. The standard enthalpy change for the reaction below is −67.70 kJ. What is the standard enthalpy of formation of nitrogen dioxide (NO_2)?

$$2NO_2(g) \rightarrow N_2(g) + 2O_2(g)$$

A. 33.85 kJ/mol
B. 67.70 kJ/mol
C. −135.4 kJ/mol
D. 135.4 kJ/mol

36. What is the lattice energy for LiCl given that the ΔH_{soln} is –37 kJ/mol and the ΔH_{hyd} is –865 kJ/mol?

A. 828 kJ/mol
B. −828 kJ/mol
C. 902 kJ/mol
D. −902 kJ/mol

37. What is the energy (in kJ) of **1 mole** of photons whose frequency is 3.98×10^{14} Hz?

A. 2.64×10^{-19} kJ/mol
B. 167 k J/mol
C. 159 k J/mol
D. 4.38×10^{-40} kJ/mol

38. What is the wavelength, in nm, of electromagnetic radiation whose frequency is 8.50×10^{14} Hz?

A. 283 nm
B. 2.55×10^{15} nm
C. 2.55×10^{23} nm
D. 353 nm

39. Which of the following sets of quantum numbers is **not** an acceptable set for an electron in an atom?

A. (7,4,0,1/2)
B. (5,4,3,−1/2)
C. (2,2,−1,−1/2)
D. (3,2,−1,−1/2)

40. Which of the following sets of quantum numbers (n, l, m_l) correctly describes a 4*f* orbital?

A. (4, 3, −3)
B. (4, 1, 1)
C. (4, 2, 1)
D. (4, 0, 0)

41. How many **orbitals** in an atom can have $n = 3$ and $m_l = 1$?

A. 0
B. 1
C. 2
D. 3

42. How many unpaired electrons are in a ground-state atom of arsenic (As)?

A. 0
B. 1
C. 2
D. 3

43. Which of the following is not an acceptable set of quantum numbers for an electron in a ground-state bromine atom?

A. (3,2,0,−1/2)
B. (4,2,−2,1/2)
C. (2,0,0,1/2)
D. (4,1,−1,−1/2)

44. What group of elements has the valence electron configuration ns^2np^3?

A. IIA
B. VA
C. VIIIA
D. IIIA

45. Which +2 ion has the ground-state electron configuration [Ar]$3d^6$?

A. Cr^{2+}
B. Fe^{2+}
C. Ni^{2+}
D. V^{2+}

Questions 46 thru 60 cover the material after Exam III.

46. Which one of the following has the species with the **smaller** size listed **first**?

A. Al^{3+}, O^{2-}
B. Al, F
C. As, P
D. O^{2-}, O

47. In which of the following are the elements arranged in order of increasing first ionization energy?

A. F < Li < C < N
B. Cs < K < Na < Li
C. Na < Al< P < Si
D. Mg < Ca < Sr < Ba

48. The first ten ionization energies for an element are listed below. All values are in kJ/mol. The element with these ionization energies most likely is ___.

1251 2298 3822 5159 6542 9362 11,018 33,604 38,600 43,961

A. neon
B. carbon
C. arsenic
D. chlorine

49. Which one of the following is the **most basic** oxide?

A. N_2O_5
B. CO
C. K_2O
D. SO_3

50. Which one of the following has the compound with the **larger** lattice energy listed **first**?

A. $CaCl_2$, $MgCl_2$
B. RbI, NaCl,
C. MgO, CaS
D. RbI, Na_2O

51. Which of the following bonds with N exhibits the most ionic character?

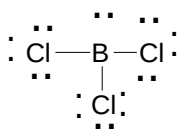
A. The Na-N bond inNaN_3
B. The N-O bond in H_2NO_3
C. The N-N bond in N_2
D. The N-Cl bond in NCl_3

52. Choose the answer that correctly classifies the C-H bond in CH_4.

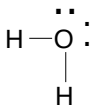
A. ionic
B. polar covalent
C. coordinate covalent
D. covalent

53. Which one of the following Lewis structures is not a correct Lewis structure?

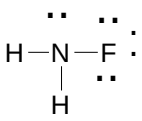
A. BCl_3



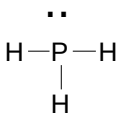
B. H_2O



C. NH_2F



D. PH_3



54. The CO_3^{2-} ion has ___ single bond(s), ___ double bond(s), and ___ lone electron pairs.

A. 2, 1, 8

B. 1, 2, 6

C. 2, 1, 10

D. 1, 2, 10

55. Which one of the following has a Lewis structure that **obeys** the octet rule?

A. ICl_4^-

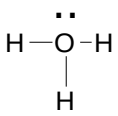
B. SF_6

C. NO_2

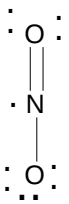
D. NO_2^-

56. Choose the Lewis structure that has a formal charge of -1 on the oxygen.

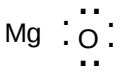
A.



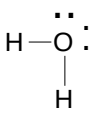
B.



C.



D.



57. Which one of the following can exhibit resonance?

A. C_2H_2
B. H_2S
C. $COBr_2$
D. NH_4^+

58. What is the molecular geometry of the ICl_4^- ion according to the VSEPR method?

A. tetrahedral
B. trigonal planar
C. seesaw
D. square planar

59. Using the VSEPR method, which species does **not** exhibit a trigonal planar molecular geometry?

A. NO_3^-
B. NH_3
C. SO_3
D. BF_3

60. Which of the following compounds is polar overall (has a nonzero dipole moment)?

A. C_2H_2
B. SO_3
C. PF_3
D. PF_5

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1. B
2. B
3. A
4. C
5. D
6. C
7. D
8. C
9. A
10. D
11. A
12. D
13. B
14. C
15. A
16. D
17. D
18. B
19. B
20. D
21. A
22. B
23. C
24. C
25. A
26. A
27. D
28. B
29. D
30. D
31. D
32. A
33. B
34. D
35. A
36. A
37. C
38. D
39. C
40. A
41. C
42. D
43. B

44. B
45. B
46. A
47. B
48. D
49. C
50. C
51. A
52. B
53. A
54. A
55. D
56. B
57. C
58. D
59. B
60. C