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 <u>EXACTLY</u> 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); <u>fill in the circles completely and firmly</u>. <u>Erasures must be complete</u>. 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 <u>VERY IMPORTANT!</u> Under IDENTIFICATION NUMBER, 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); be sure to fill in the correct circles (a common error to be avoided is mistaking "0" for "1").												
TEST FORM:	Fill in the "3" blank in the J column under IDENTIFICATION NUMBER (to indicate Hour Examination III).												
SPECIAL	Use for course and section	n number; in position	ns K-P write in one of the following:										
CODES:	Dr	. Woodrum	105-001, 105-002										
	Mı	r. 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 MUST sign the exa your printed name. Use y		eet (bubble sheet) on the line directly above										

Answering Questions:

Starting with answer "1" on SIDE 1, fill in the circle indicating the <u>one best answer</u> for each of the **33 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.

BE SURE THAT YOUR TEST HAS **33** QUESTIONS, A PERIODIC TABLE, AND ONE SHEET 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.

1.	What is the final temperature of 1.00×10^2 g of water, initially at 27 °C, after absorbing
	5.00 kJ of heat? The specific heat capacity of water is 4.18 J/g°C.

2. A 20.0 g block of a metal, initially at 80.0 °C, was added to 100.0 g of water initially at 22.0 °C. After thermal equilibrium was reached, the temperature of the metal and water was 23.0 °C. What is the specific heat capacity of the unknown metal? The specific heat capacity of water is 4.18 J/g•°C.

3. A balloon is inflated from 0.0100 L to 0.500 L against an external pressure of 10.00 atm. How much work is done in joules?

4. Which one of the following statements is **<u>not</u>** true with regard to a chemical reaction occurring under conditions of constant pressure?

- A. ΔH is a measure of heat exchange between the surroundings and the system under conditions of constant pressure.
- B. ΔE is a measure of all the energy exchanged between the system and the surroundings.
- C. ΔH and ΔE are equal if a large volume change accompanies the reaction.
- D. ΔE is a measure of the heat and work exchanged between the surroundings and the system.

- 5. Based upon your understanding of combustion reactions, which one of the following statements is true?
 - A. Combustion reactions are exothermic and enthalpy change is positive.
 - B. Combustion reactions are exothermic and enthalpy change is negative.
 - C. Combustion reactions are endothermic and enthalpy change is positive.
 - D. Combustion reactions are endothermic and enthalpy change is negative.
- 6. According to the following thermochemical equation, what mass of HF (in grams) must react in order to produce 345 kJ of energy? Assume that SiO₂ is in excess.

$$SiO_2(s) + 4 HF(g) \rightarrow SiF_4(g) + 2 H_2O(l)$$
 $\Delta H_{rxn}^0 = -184 \text{ kJ}$

7. What is $\Delta H_{\rm rxn}$ for the reaction:

$$CS_2(l) + 3 Cl_2(g) \rightarrow CCl_4(l) + S_2Cl_2(l)$$

Use appropriate data from the following set of reactions and their given ΔH values.

$$CS_2(l) + 3 O_2(g) \rightarrow CO_2(g) + 2 SO_2(g)$$
 $\Delta H = -1077.0 \text{ kJ}$
 $2 S(s) + Cl_2(g) \rightarrow S_2Cl_2(l)$ $\Delta H = -58.2 \text{ kJ}$
 $C(s) + 2 Cl_2(g) \rightarrow CCl_4(l)$ $\Delta H = -135.4 \text{ kJ}$
 $S(s) + O_2(g) \rightarrow SO_2(g)$ $\Delta H = -296.8 \text{ kJ}$
 $SO_2(g) + Cl_2(g) \rightarrow SO_2Cl_2(g)$ $\Delta H = +97.3 \text{ kJ}$
 $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -393.5 \text{ kJ}$
 $CCl_4(l) + O_2(g) \rightarrow COCl_2(g) + Cl_2O(g)$ $\Delta H = -5.2 \text{ kJ}$

8. Which chemical equation listed below has an enthalpy change equal to the standard enthalpy of formation of
$$CH_4(g)$$
?

A.
$$CO(g) + 3 H_2(g) \rightarrow CH_4(g) + H_2O(g)$$
.

B.
$$C(s, graphite) + 2 H_2(g) \rightarrow CH_4(g)$$
.

C.
$$C(s, diamond) + 2 H_2(g) \rightarrow CH_4(g)$$
.

D.
$$C(g, graphite) + 2 H_2O(g) \rightarrow CH_4(g) + O_2(g)$$
.

9. Use the
$$\Delta H_{\rm f}^{\rm o}$$
 and $\Delta H_{\rm rxn}^{\rm o}$ information provided below to calculate $\Delta H_{\rm f}^{\rm o}$ for SO₃(g).

$$2 SO_2(g) + O_2(g) \rightarrow 2 SO_3(g)$$
 $\Delta H_{rxn}^0 = -198 \text{ kJ}$

$$\Delta H_{\rm f}^{\rm o}$$
 of SO₂ (g) = -297 kJ

10. Which one of the following is **not true** regarding the wave nature of <u>light</u>?

- A. The amplitude of the wave determines the intensity of the light.
- B. Light is electromagnetic radiation.
- C. Visible light comprises only a small fraction of all the wavelengths of light.
- D. For visible light, the wavelength does not determine the visual color.

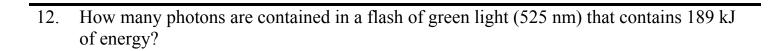
11. What is the wavelength, in meters, associated with electromagnetic radiation at 4.50 kHz?

A.
$$1.67 \times 10^{-4}$$
 m

C.
$$6.67 \times 10^4 \text{ m}$$

B.
$$1.50 \times 10^{-8}$$
 m

D.
$$6.67 \times 10^7 \text{ m}$$



A.
$$5.67 \times 10^{23}$$
 photons

B.
$$4.99 \times 10^{23}$$
 photons

C.
$$2.01 \times 10^{24}$$
 photons

D.
$$1.25 \times 10^{31}$$
 photons

13. What is the wavelength, in nm, of the photon emitted when an electron in the hydrogen atom makes a transition from the energy level n = 7 to the energy level n = 4?

A.
$$2.17 \times 10^3 \text{ nm}$$

C.
$$1.10 \times 10^3 \text{ nm}$$

14. Calculate the wavelength of an electron (m = 9.11×10^{-28} g) moving at 3.66×10^{6} m/s.

A.
$$5.03 \times 10^9 \,\mathrm{m}$$

B.
$$1.99 \times 10^{-13} \text{ m}$$

C.
$$1.99 \times 10^{-7} \text{ m}$$

D.
$$1.99 \times 10^{-10} \text{ m}$$

15. How many different values of *l* are possible in the third principal energy level?

16. How many different values of m_l are possible in the 3d sublevel?

17. Which of the following is an allowed set of quantum numbers $[n, l, m_l]$ for a d orbital?

A.
$$[2, 2, -1]$$

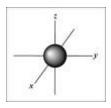
C.
$$[4, 3, -2]$$

B.
$$[3, 2, -1]$$

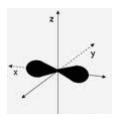
D.
$$[5, 2, -3]$$

$$n = 5, l = 2$$

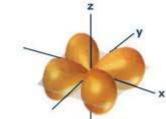
A.



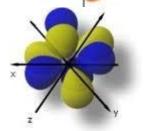
B.



C.



D.



19. Which of the following is a possible set of quantum numbers for the last electron added to complete an atom of antimony in its ground state?

A.
$$n = 5$$
, $l = 1$, $m_l = 0$, $m_s = 1/2$

C.
$$n = 4$$
, $l = 1$, $m_l = -1$, $m_s = -1/2$

B.
$$n = 5$$
, $l = 2$, $m_l = -1$, $m_s = 1/2$

D.
$$n = 4$$
, $l = 3$, $m_l = 0$, $m_s = -1/2$

20. Which of the following statements is **false**?

A. The 3s orbital is lower in energy than the 3p orbitals.

B. The 5f orbitals are higher in energy than the 6p orbitals.

C. The 3d orbitals are lower in energy than the 4s orbital.

D. The 4f orbitals are higher in energy than the 6s orbital.

21. Which of the listed elements has the following ground state electron configuration?

$$[Ar]4s^23d^{10}4p^5$$

A. chlorine

C. selenium

B. krypton

D. bromine

- 22. Give the complete ground state electronic configuration for chromium.
 - A. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^5$
 - B. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4$

- C. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^5$
- D. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$
- 23. Which of the following pairs has the atom with the larger atomic radius listed first?
 - A. Cl, Si
 - B. N, As

- C. O, Si
- D. Ga, P
- 24. Which ion does not have a noble gas configuration in its ground state?
 - A. Ga^{3+}

C. As^{3-}

B. Sc^{3+}

- D. Al³⁺
- 25. Place the following elements in order of increasing ionic radius.

$$Na^+$$
 Mg^{2+} F^-

- A. $Mg^{2+} < Na^{+} < F^{-}$
- B. $Mg^{2+} < F^{-} < Na^{+}$

- C. $Na^+ < Mg^{2+} < F^-$
- D. $F^- < Na^+ < Mg^{2+}$
- 26. Place the following in order of increasing first ionization energy.

- A. N < As < F
- B. As < N < F

- C. F < N < As
- D. As < F < N
- 27. Which of the following elements has the most exothermic electron affinity?
 - A. B
 - B. C

- C. N
- D. F

28. Which one of the following elements is most likely to have the following ionization energies (in kl/mol)? 1st = 738.1 2nd = 1450 3rd = 7730 4th = 10500 5th = 13600 6th = 18000 A. magnesium B. potassium C. neon B. potassium D. selenium 29. In general, which group of elements has the most metallic character? A. alkali metals B. noble gases D. alkali earth metals C. halogens D. alkali earth metals C. lonic bonds are formed between two nonmetals. C. Ionic bonds are formed between two monmetals. D. Potassium fluoride contains ionic bonds. 31. Use Lewis theory to determine the chemical formula for the compound formed between Rb and S. A. RbS B. RbS ₂ D. Rb ₂ S ₃ 32. Identify the compound with the highest magnitude lattice energy value. A. LiCl B. KCl D. CsCl 33. Identify the compound with the highest magnitude lattice energy value C. KCl B. KBr D. SrO														
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B. KBr D. SrO		A.	CaO	C.	KCl									
		B.	KBr	D.	SrO									

CHE 105								Exam 3							November 11, 2010																		
Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Corrrect Answer	В	В	В	С	В	С	D	В	Α	D	С	В	Α	D	С	D	В	С	Α	С	D	D	D	Α	Α	В	D	Α	Α	С	С	Α	Α
Partial																																	
Credit																																	