

Chemistry 11 Spring 2009
Examination #1 ANSWER KEY

For the first portion of this exam, select the best answer choice for the questions below and mark the answers on your scantron. Then answer the free response questions that follow (100 pts. total; multiple choice 2 pts. each).

1. Determine the number of protons, neutrons, and electrons present in $^{105}\text{Rh}^{+3}$.

- A. 105 protons, 45 neutrons, and 108 electrons
- B. 45 protons, 105 neutrons, and 102 electrons
- C. 45 protons, 60 neutrons, and 42 electrons**
- D. 45 protons, 60 neutrons, and 105 electrons
- E. 45 protons, 60 neutrons, and 48 electrons

2. Perform the following calculation and select the appropriate response:

$$\frac{2.92 \times 10^8}{(3.92 \times 10^{-3})(7.1 \times 10^{-5})}$$

- A. 5.3×10^6
- B. 5.29×10^6
- C. 1.0×10^{-1}
- D. 1.0×10^{15}**
- E. 1.05×10^{15}

3. What is the atomic symbol for palladium?

- A. Pa
- B. Pd**
- C. Pl
- D. Pm
- E. Pu

4. Which of the following statements is INCORRECT?

- A. The reaction of hydrogen gas plus oxygen gas to form water vapor is an example of a chemical change.
- B. Heat that is evolved by a system is energy lost and thus classified as exothermic.
- C. Isotopes differ in the number of neutrons present in an atom or ion.
- D. An orbit is a region in three-dimensional space where there is a probability of finding an electron.**
- E. Lanthanides are considered inner transition metals that are difficult to extract from their natural sources and hence separate from one another.

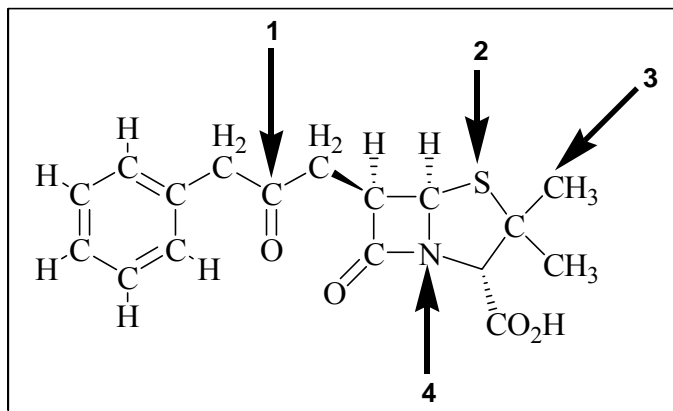
5. Convert 316 K to degrees Celsius and Fahrenheit, respectively.
- A. **43 °C, 109 °F**
 - B. 589 °C, 1092 °F
 - C. 601 °C, 874 °F
 - D. 298 °C, 552 °F
 - E. None of the above

For Questions 6 – 8, consider the following species: K, Ca, S, O, and F.

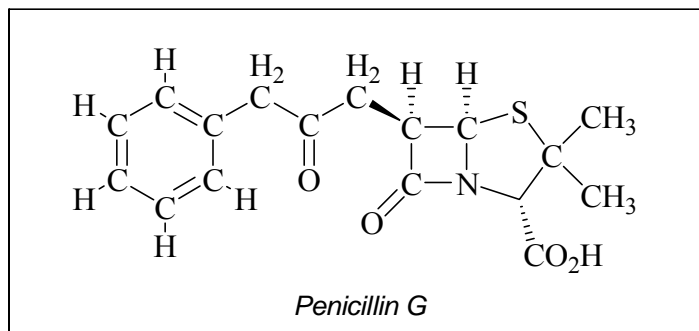
6. Rank the species in order of decreasing electronegativities.
- A. Ca > K > S > O > F
 - B. O > F > S > K > Ca
 - C. Ca > K > S > F > O
 - D. K > Ca > S > O > F
 - E. **F > O > S > Ca > K**
7. Determine the correct listing of the atoms in terms of increasing first ionization energies.
- A. Ca < K < S < O < F
 - B. O < F < S < K < Ca
 - C. Ca < K < S < F < O
 - D. **K < Ca < S < O < F**
 - E. F < O < S < Ca < K
8. What is the decreasing order of the radii?
- A. Ca > K > S > O > F
 - B. O > F > S > K > Ca
 - C. Ca > K > S > F > O
 - D. **K > Ca > S > O > F**
 - E. F > O > S > Ca > K
9. Determine the expected electronic configuration for Roentgenium, Rg ($Z = 111$):
- A. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^6 5s^2 5d^{10} 5p^6 6s^2 6f^{14} 6d^{10} 6p^6 7s^2 7f^{14} 7d^9$
 - B. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 5f^{14} 5d^{10} 6p^6 7s^2 6f^{14} 6d^9$
 - C. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 6f^{14} 5d^{10} 6p^6 7s^2 7f^{14} 6d^9$
 - D. **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{14} 6d^9$**
 - E. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 6f^{14} 4d^{10} 6p^6 7s^2 7f^{14} 5d^9$

10. How many millimeters are there in 0.010 km?
- A. **1.0×10^4**
 - B. 0.010
 - C. 10.
 - D. 1.0×10^{-8}
 - E. 1.0×10^{-5}
11. Determine the volume (in mL) of 1000.0 g of ethanol if its density is 0.789 g/mL.
- A. **1.27×10^3**
 - B. 789
 - C. 7.89×10^3
 - D. 0.789
 - E. 1.27
12. Which of the following is the correct formula for iron(III) oxide?
- A. Fe_3O
 - B. FeO_3
 - C. $\text{Fe}(\text{OH})_3$
 - D. **Fe_2O_3**
 - E. Fe_3O_2
13. In the laboratory, it is found that potassium metal and bromine react vigorously via a synthesis reaction to form potassium bromide. Based on your current knowledge of chemistry, one can conclude that:
- A. potassium loses an electron and is chemically converted into a neutral argon atom.
 - B. bromine gains an electron via oxidation.
 - C. potassium loses an electron via reduction to become isoelectronic with an argon atom.
 - D. **bromine gains an electron to become isoelectronic with a krypton atom.**
 - E. both potassium and bromine are chemically converted into different, more stable atoms.
14. How many total Lewis dot structures (including resonance if any) are possible for the NO_3^- ion?
- A. 1
 - B. 2
 - C. **3**
 - D. 4
 - E. 5

For Questions 15 – 20, consider the skeletal structure of *Penicillin G* shown below, a drug that inhibits the production of bacterial cell walls (lone pairs omitted).



15. What is the approximate bond angle associated with the carbon labeled “1”?
- 90°
 - 109.5°
 - 120°**
 - 180°
 - 360°
16. What is the shape associated with the sulfur labeled “2”?
- linear
 - trigonal planar
 - trigonal pyramidal
 - tetrahedral
 - bent**
17. What is the approximate bond angle associated with the carbon labeled “3”?
- 90°
 - 109.5°**
 - 120°
 - 180°
 - 360°
18. What is the shape associated with the nitrogen labeled “4”?
- linear
 - trigonal planar
 - trigonal pyramidal**
 - tetrahedral
 - bent



19. Select “A” for True OR “B” for False regarding the following statement:
Penicillin G does not possess any resonance.
20. Select “A” for True OR “B” for False regarding the following statement:
Penicillin G is a polar molecule.
21. Given the table of specific heat values below, what is the identity of a 13.8 g metal sample that increases by 6.2 °C when 20.1 J of energy is absorbed?

<u>Element</u>	<u>Specific Heat (J/g °C)</u>
Au	0.128
Ag	0.235
Cu	0.385
Fe	0.449
Al	0.903

- A. Fe
 B. Al
 C. Au
D. Ag
 E. Cu
22. An unsaturated solution of sand and copper(II) sulfate can best be first separated using _____, and the *wet* copper(II) sulfate solid can then be dried and isolated via _____ of the water.
- A. **filtration; evaporation**
 B. evaporation; filtration
 C. filtration; decantation
 D. decantation; evaporation
 E. evaporation; decantation

23. Choose the CORRECT statement below:
- A. Metals are generally poor conductors of heat and electricity.
 - B. Nonmetals generally possess high melting points.
 - C. Bromine is a solid at room temperature.
 - D. Metalloids are more easily oxidized than metals.
 - E. **Actinides are radioactive elements with fairly short half-lives.**
24. How many kJ are there in 95.0 nutritional Calories?
- A. 2.27×10^7
 - B. 3.97×10^{-4}
 - C. **397**
 - D. 22.7
 - E. None of the above
25. Perform the indicated operation, and express your final answer with the appropriate number of significant figures:

$$28.1 \text{ cm} + 0.53 \text{ cm} + 75.321 \text{ cm}$$

- A. 104 cm
- B. **104.0 cm**
- C. 103.95 cm
- D. 103.951 cm
- E. 103.9510 cm

END OF MULTIPLE CHOICE

26. (4 pts.) Convert 15 miles/hour (mi/hr) to centimeters/second (cm/s). Express your final answer in scientific notation in the box below. (*Note: 1 mile = 1.61 km*)

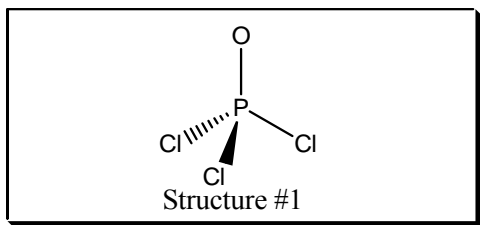
$$\frac{\text{cm}}{\text{s}} = \frac{15 \text{ miles}}{\text{hr}} \times \frac{1.61 \text{ km}}{1 \text{ mile}} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ hour}}{3600 \text{ s}} = \boxed{6.7 \times 10^2 \text{ cm/s}}$$

27. (28 pts. total; 7 pts. each) Consider each of the following ions/molecules shown below and write your final structures in the boxes provided:

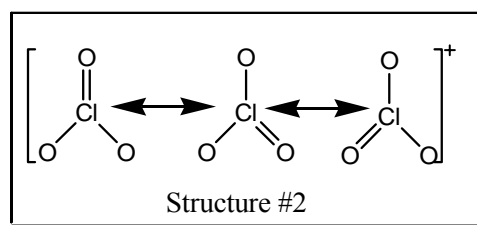
Terminal atoms are assumed to have an octet of electrons (excluding hydrogen)—omitted for the sake of clarity!

- A. Beginning with the best *Lewis dot structure*, use *VSEPR* theory to draw each of the listed species, including resonance where appropriate. Don't forget to include lone pairs!
- B. Describe the geometry about EACH central atom. Include both electronic and molecular geometries.

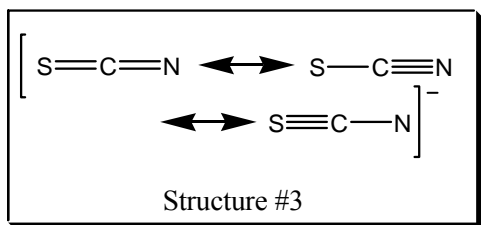
- C. Give the approximate bond angle(s) around each central atom.
 D. Determine whether the overall species is polar or nonpolar.



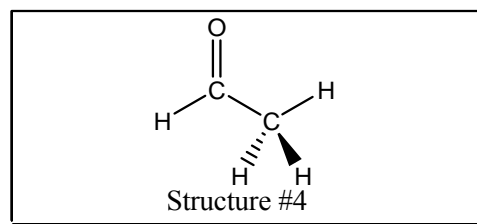
electronic geometry: **tetrahedral**
 molecular geometry: **tetrahedral**
 approx. bond angle: **109.5 degrees**
 polar or nonpolar? **polar**



electronic geometry: **trigonal planar**
 molecular geometry: **trigonal planar**
 approx. bond angle: **120 degrees**
 polar or nonpolar? **ionic (nonpolar)**



electronic geometry: **linear**
 molecular geometry: **linear**
 approx. bond angle: **180 degrees**
 polar or nonpolar? **polar**



electronic geometry: **trigonal planar; tetrahedral**
 molecular geometry: **(same!)**
 approx. bond angle: **120 & 109.5 degrees**
 polar or nonpolar? **polar**

28. (18 pts. total; 2 pts. each) Write the name/chemical formula for each of the following listed below:

A.	I_2O_7	diiodine heptoxide
B.	$\text{Pt}(\text{OH})_2$	platinum(II) hydroxide
C.	ammonium phosphite	$(\text{NH}_4)_3\text{PO}_3$
D.	GeO_2	germanium dioxide
E.	cadmium carbonate	CdCO_3
F.	silver cyanide	AgCN

- G. tin(IV) sulfate $\text{Sn}(\text{SO}_4)_2$
- H. $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$ **lead(II) acetate**
- I. tetraphosphorus decoxide P_4O_{10}

BONUS! (5 pts. graded ALL OR NONE) A cylindrical piece of metal is 2.03 inches high and has a diameter 17.0 mm wide and weighs 31.599 g. Determine its density. Will the object sink or float in water? Briefly explain. (Note: 1 in = 2.54 cm; $V_{\text{cylinder}} = \pi r^2 h$)

$$h = 2.03 \text{ in} \times \frac{2.54 \text{ cm}}{1 \text{ in}} = 5.16 \text{ cm}$$

$$\text{volume} = \pi r^2 h = \pi (1.70 \text{ cm}/2)^2 (5.16 \text{ cm}) = 11.7 \text{ cm}^3$$

density = mass/volume = $\boxed{2.70 \text{ g/mL}}$ (Object will **SINK** in water since density is greater than 1 g/mL at room temperature.)