Directions:

1. Each student is responsible for following directions. Read this page carefully.

2. Write your name and other requested information on this page and on the separate answer sheet.

3. CODE your name on the answer sheet using an ordinary (#2) pencil.

4. CODE your correct 10-digit identification number (PUID) on the answer sheet. THIS IS VERY IMPORTANT!

5. CODE your section number on the answer sheet. Please use all four digits, 0101, 0102, 0201, etc. This is also very important!

6. Put all calculations on the examination pages. DO NOT PUT ANY EXTRA MARKS ON THE COMPUTER ANSWER SHEET!

7. This exam consists of 25 multiple-choice questions worth 5 points each. Choose the one best or correct answer for each question and write it both on your exam paper and on the computer answer sheet. The computer answer sheet is the only one that will be graded!

8. This exam consists of 6 pages plus a Periodic Table. Please check to be sure that you have them all!

Avogadro’s number = $6.022 \times 10^{23}$

END OF EXAM

1) Please make sure that you have entered 25 answers on your scan sheet.

2) Make sure that you have entered your name, ID number, and lab section number (4 digits).

3) You MUST turn the scan sheet in to your TA before leaving the exam!
C____ 1. How many atoms of carbon are present in 1.000 mg of carbon?

(a) \(2.507 \times 10^{16}\) atoms
(b) \(2.507 \times 10^{19}\) atoms
(c) \(5.014 \times 10^{19}\) atoms
(d) \(2.507 \times 10^{22}\) atoms
(e) \(5.014 \times 10^{22}\) atoms

A____ 2. Which of the following contains the largest number of hydrogen atoms?

(a) \(1.000\) mol \(H_2\)
(b) \(0.1000\) mol \(CH_4\)
(c) \(0.2000\) mol \(H_2O\)
(d) \(6.022 \times 10^{23}\) hydrogen atoms
(e) \(0.2000\) mol \(NH_4Cl\)

D____ 3. Determine the mass of \(1.27\) mol \(Mg(OH)_2\).

(a) \(47.6\) g
(b) \(52.5\) g
(c) \(66.1\) g
(d) \(74.1\) g
(e) \(82.4\) g

C____ 4. How many grams of \(KCl\) (M.M = 74.6 g/mol) are needed to prepare 500. mL of a 0.200 M \(KCl\) solution?

(a) \(5.31\) g
(b) \(6.78\) g
(c) \(7.46\) g
(d) \(8.52\) g
(e) \(9.34\) g

D____ 5. Which of the following solutions contains the greatest amount of \(NaCl\)?

(a) 500. mL of 0.100 M \(NaCl\) solution
(b) 100. mL of 0.500 M \(NaCl\) solution
(c) 1.00 L of 0.0800 M \(NaCl\) solution
(d) 0.200 L of 2.00 M \(NaCl\) solution
(e) 50.0 mL of 5.00 M \(NaCl\) solution
D 6. Which of the following stock solutions can be diluted to be 200. mL of a 0.100 M HCl by adding water?

(a) 10.0 mL of a 1.00 M HCl  
(b) 20.0 mL of a 0.900 M HCl  
(c) 40.0 mL of a 0.800 M HCl  
(d) 50.0 mL of a 0.400 M HCl  
(e) 100. mL of a 0.300 M HCl

D 7. During Rutherford's gold foil experiment, the following observations were made:

(i) Most of the alpha particles went through the gold foil.  
(ii) Some alpha particles were deflected as they went through the foil.  
(iii) A small number of the alpha particles bounced backward.

This experiment proved that:

(a) alpha particles are positively charged.  
(b) electrons have wave-like characters.  
(c) the nucleus is composed of protons and neutrons.  
(d) an atom's mass is nearly all in its tiny, positively charged nucleus.  
(e) electrons of an atom exist only in specific spherical orbits.

A 8. The following picture shows electromagnetic waves for the red light and the blue light. Based on this picture, choose a correct statement.

![Image of electromagnetic waves]

(a) The blue light has a higher frequency than the red light.  
(b) The blue light has a lower energy than the red light.  
(c) The blue light has a longer wavelength than the red light.  
(d) The blue light can be considered as a particle (photon) but the red light cannot.  
(e) The blue light travels faster than red light.

C 9. Which of the following statements regarding electronic structure is NOT true?

(a) The third energy level (n = 3) has three sublevels and nine orbitals.  
(b) The second energy level (n = 2) can accommodate a maximum of 8 electrons.  
(c) The 1s and 2s orbital have the same energy but different sizes.  
(d) The d sublevel has 5 orbitals that have the same energy.  
(e) Only two electrons with opposite spin are allowed per orbital.

E 10. Which of the following shows the correct Lewis symbol (that is, the number of valence electrons and their arrangement) for the given element?

(a) Mg  
(b) Si  
(c) S  
(d) Al  
(e) N
E 11. The electron configuration of Element A is 1s\(^2\)2s\(^2\)2p\(^4\). How many valence and unpaired electrons does Element A have? (Hint: Draw Lewis symbols or orbital diagrams).

<table>
<thead>
<tr>
<th>Valence electrons</th>
<th>Unpaired electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 2</td>
<td>1</td>
</tr>
<tr>
<td>(b) 4</td>
<td>1</td>
</tr>
<tr>
<td>(c) 4</td>
<td>2</td>
</tr>
<tr>
<td>(d) 6</td>
<td>1</td>
</tr>
<tr>
<td>(e) 6</td>
<td>2</td>
</tr>
</tbody>
</table>

B 12. Which of the following has the correct name for the given formula?

(a) P\(_4\)O\(_{10}\), tetraphosphorous dodecoxide
(b) N\(_2\)O\(_5\), dinitrogen pentoxide
(c) SF\(_6\), hexafluoro sulfide
(d) PCl\(_3\), phosphorous tetrachloride
(e) CBr\(_4\), carbon tetradecabromide

A 13. Manganese has the highest oxidation state in which of the following?

(a) MnO\(_4\)\(^-\)
(b) MnO\(_4\)\(^{2-}\)
(c) MnO\(_3\)\(^-\)
(d) MnO\(_2\)
(e) Mn\(^{3+}\)

B 14. Which of the following is a salt?

(a) LiAlH\(_4\)
(b) CaCl\(_2\)
(c) Cl\(_2\)
(d) CCl\(_4\)
(e) H\(_2\)SO\(_4\)

B 15. Which of the following statements is true?

(a) Carbonic acid, H\(_2\)CO\(_3\), is a strong acid.
(b) Carbonic acid can be obtained by dissolving CO\(_2\) in water.
(c) Acetic acid, CH\(_3\)COOH, is a polyprotic acid.
(d) Acetic acid is a strong acid.
(e) Hydrochloric acid, HCl, is a polyprotic acid.
B 22. How is it possible to deduce the identity of an element from its electron configuration?

(a) The number of filled orbitals corresponds to the atom's atomic number.
(b) If the atom is electrically neutral, the number of electrons corresponds to the atom's atomic number.
(c) Using the periodic table, the outermost filled orbital indicates the group while the number of occupied orbitals indicates the period.
(d) The electron configuration of an element cannot be exactly the same as the electron configuration of any other element or ion.

D 23. Which of the following substances contains fluoride ions?

(a) PF₃
(b) F₂
(c) CF₄
(d) CaF₂
(e) all of the above

D 24. Which of the following ionic compounds has an **incorrect** formula?

(a) NH₄NO₂
(b) (NH₄)_2CO₃
(c) LiHSO₄
(d) LiSO₃
(e) Ca(ClO₃)₂

E 25. Which formula/name pair is **incorrect**?

(a) FeSO₄ iron(II) sulfate
(b) Fe₂(SO₃)₃ iron(III) sulfite
(c) FeS iron(II) sulfide
(d) FeSO₃ iron(II) sulfite
(e) Fe₂(SO₄)₃ iron(III) sulfide
D 16. There are _____ sulfur atoms in 25 molecules of \( \text{C}_4\text{H}_4\text{S}_2 \).

(a) \( 1.5 \times 10^{25} \)
(b) \( 4.8 \times 10^{25} \)
(c) \( 3.0 \times 10^{25} \)
(d) 50
(e) \( 6.02 \times 10^{23} \)

D 17. Which of the following best describes a 2 M sucrose solution?

(a) 1 mole of sucrose dissolved in 2 liters of solution
(b) 2 liters of solution that contains 1 mole of sucrose
(c) 1 liter of solution that contains 2 moles of water
(d) 1 liter of solution that contains 2 moles of sucrose
(e) 1 liter of solution that contains \( 6.02 \times 10^{23} \) molecules of sucrose

A 18. There are _________ moles of \( \text{AlBr}_3 \) in 0.500 L of a 0.300 M solution of \( \text{AlBr}_3 \).

(a) 0.150
(b) 0.300
(c) 0.450
(d) 0.167
(e) 0.500

E 19. Which of the following elements has six valence electrons?

(a) Be
(b) B
(c) C
(d) N
(e) O

C 20. The valence electrons are the electrons that are:

(a) closest to the nucleus and therefore unreactive.
(b) closest to the nucleus and available for chemical reactions.
(c) farthest from the nucleus and available for chemical reactions.
(d) farthest from the nucleus and therefore unreactive.
(e) None of these answers is correct.

E 21. In a ground-state sodium atom, the _________ sublevel is partially filled.

(a) 2s
(b) 2p
(c) 3p
(d) 3d
(e) 3s