There are 30 questions for 150 points. Good Luck!
Possibly Useful Information

\[ M = \text{mol solute} / \text{L soln} \]

\[ M_1 V_1 = M_2 V_2 \]

\[ \text{density} = \frac{\text{mass}}{\text{volume}} \]

\[ \lambda \nu = c \]

\[ \frac{\text{mass}}{\text{total mass}} \times 100 \]

\[ E = mc^2 \]

\[ E = h\nu \]

\[ \lambda = h/mv \]

\[ 1\text{Å} = 1 \times 10^{-10} \text{m} \]

A periodic table is also provided on the last page of this exam.

Q.1 Classify the reaction by giving all the reaction types that apply.

I. redox
II. combination
III. decomposition
IV. single displacement
V. double displacement

\[ \text{Zn (s) + 2HCl (aq) \rightarrow ZnCl}_2 (aq) + H}_2 (g) \]

- only II
- only V
- only I
- only III
- I and IV

Q.2 Determine the oxidation number of the underlined element in \( \text{Na}_2\text{MnO}_4 \).

\[ +7 \]

\[ +6 \]

\[ +3 \]

\[ +1 \]

\[ +5 \]

\[ +1 + 7 - 8 = 0 \]

Q.3 Which one of the following is not isoelectronic with neon?

- a. \( \text{O}^{2-} \)
- b. \( \text{Cr}^{-} \)
- c. \( \text{Ar}^{3+} \)
- d. \( \text{Mg}^{2+} \)
- e. \( \text{Na}^{+} \)
Q.4 The general shape of the region in space occupied by electrons is described by which quantum number?

a. \( m_\ell \)

b. \( \ell \)

c. \( n \)

d. \( m_s \)

e. \( \psi \)

Q.5 The amount of energy absorbed in a process in which an electron is added to a gaseous atom is defined as ...

a. standard reduction potential

b. first ionization energy

c. shielding effect

d. electron affinity

e. electronegativity

Q.6 Which statement regarding the "gold foil" experiment is false?

a. It was performed by Rutherford and his research group in the early 20th century.

b. It suggested that atoms are mostly empty space.

c. Most of the alpha particles passed through the foil undeflected.

d. The alpha particles were repelled by the electrons.

e. It suggested the nuclear model of the atom.

Q.7 Which two subatomic particles have approximately the same mass?

a. protons and neutrons

b. protons and electrons

c. electrons and nuclei

d. neutrons and electrons

e. protons and alpha particles

Q.8 Write net ionic equation for the complete neutralization of HBr by Ca(OH)\(_2\). Use \( H^+ \) rather than \( H_2O^+ \). Using the smallest integer coefficients, what is the sum of the balancing coefficients? Do not forget coefficients of one.

a. 6

b. 3

c. 4

d. 5

e. 7

\[ 2H^+ + Ca(OH)_2 \rightarrow Ca^{2+} + 2H_2O \] (A)

\[ 2H^+ + 2OH^- \rightarrow 2H_2O \] (B)

\[ H^+ + OH^- \rightarrow H_2O \]

1 + 1 + 1 = 3
Q.9 An electron of mass $9.11 \times 10^{-28}$ g is traveling at $2.50 \times 10^6$ m/s. Calculate its de Broglie wavelength (m Å).

\[
\lambda = \frac{h}{p} = \frac{6.626 \times 10^{-34} \text{kg m}^2 \text{s}^{-2}}{9.11 \times 10^{-28} \text{g} \times 10^{-3} \text{kg} \times 2.50 \times 10^6 \text{m/s}}
\]

a. 2.90 x 10^{-3} Å
b. 0.029 Å
c. 0.14 Å
d. 2.91 Å
e. 345 Å

Q.10 Which element has the smallest radius?

a. I
b. At
c. C^-
d. F
\(\text{all C, VII A}\)
e. Br

Q.11 Which of the following represents the net ionic equation for all strong acid/strong base reactions that produce a soluble salt and water?

a. \(\text{H}_2\text{O (l)} + \text{OH}^- (\text{aq}) \rightarrow \text{O}_2 (\text{g}) + 3/2 \text{H}_2 (\text{g})\)
b. \(2 \text{H}^+ (\text{aq}) + 2 \text{OH}^- (\text{aq}) \rightarrow 2 \text{H}_2\text{O (l)}\)
c. \(2 \text{H}^+ (\text{aq}) + \text{H}_2\text{O (l)} \rightarrow 4 \text{OH}^- (\text{aq})\)
d. \(2 \text{H}^+ (\text{aq}) + 2 \text{e}^- \rightarrow \text{H}_2 (\text{g})\)
e. \(\text{H}^+ (\text{aq}) + \text{OH}^- (\text{aq}) \rightarrow \text{H}_2\text{O (l)}\)

Q.12 Which of the following contains no ionic compounds?

a. \(\text{CH}_2\text{O}, \text{H}_2\text{S}, \text{NH}_3\)
b. \(\text{PCl}_5, \text{LiBr}, \text{Zn(OH)}_2\)
c. \(\text{KOH}, \text{CCl}_4, \text{SF}_4\)
d. \(\text{NaH}, \text{CaF}_2, \text{NaNH}_2\)
e. \(\text{HCN}, \text{NO}_2, \text{Ca(NO}_3)_2\)

Q.13 Which element has the largest atomic radius?

a. Rb
b. Na
c. I
d. Li
e. F
Q. 14 Which of the following has the lowest first ionization energy?

a. F  

b. B  

c. Sr  

d. S  

e. O

Q. 15 Diamagnetism is characteristic of systems containing...

a. one or more unpaired electrons
b. no unpaired electrons
c. only p electrons unpaired
d. only d electrons unpaired
e. only s electrons as valence electrons

Q. 16 Which statement is false?

a. The 4s orbitals are lower in energy than the 3d orbitals.
b. The third energy level has d orbitals.
c. The 5d and 4f orbitals are very close in energy.
d. A set of p orbitals in a given energy level are equal in energy.
e. An f set of orbitals is filled with 10 electrons.

Q. 17 If an element has the following electron configuration, what is the symbol for the element?

\[ 1s^2 2s^2 2p^6 3s^2 2p^6 \]

a. P  

b. C  

c. A  

d. S  

e. S

Q. 18 A tanning booth uses ultraviolet light at a wavelength of 1000 Å. What is the frequency of this light?

a. \( 3.3 \times 10^{15} \text{s}^{-1} \)  

b. \( 2.48 \times 10^{13} \text{s}^{-1} \)  

c. \( 3.0 \times 10^{15} \text{s}^{-1} \)  

d. \( 6.63 \times 10^{18} \text{s}^{-1} \)  

e. \( 1.5 \times 10^{16} \text{s}^{-1} \)  

\[ \nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{m/s}}{1000 \times 10^{-10} \text{m}} \]
Q.19  Classify the reaction by giving all of these reaction type(s) that apply.

   I.  redox ✓
   II. combination ✓
   III. decomposition ✓
   IV. single displacement
   V.  double displacement

   \[ 2 \text{Ag}_2\text{O} \text{(s)} \rightarrow 4 \text{Ag} \text{(s)} + \text{O}_2 \text{(g)} \]

   a.  I only
   b.  I and IV
   c.  III only
   d.  I, IV, and V
   e.  I and III

Q.20  Which of the following is a strong acid?

   a.  \( \text{H}_2\text{SO}_3 \)
   b.  \( \text{HNO}_2 \)
   c.  \( \text{HF} \)
   d.  \( \text{HC}_2\text{O}_4 \)
   e.  \( \text{HC}_2\text{O}_3 \)

Q.21  Arrange the following in order of decreasing atomic radii.

   Pb, P, Cl, F, Si

   a.  Pb > Si > P > F > Cl
   b.  Pb > Cl > F > Si > P
c.  Pb > Si > P > Cl > F
d.  Cl > F > Pb > Si > P
e.  Pb > Cl > P > Si > F
Q.22 Classify the reaction by giving all of these reaction type(s) that apply.

I. redox
II. combination
III. decomposition
IV. single displacement
V. double displacement ✔

\[ \text{Ba(OH)}_2 \text{(aq)} + \text{Na}_2\text{CO}_3 \text{(aq)} \rightarrow \text{BaCO}_3 \text{(s)} + 2 \text{NaOH} \text{(aq)} \]

a. only I
b. only IV
c. only II
d. only V
e. II and III

Q.23 Which element has the following electron configuration?

\[ 1s \quad 2s \quad 2p \quad 3s \quad 3p \]

\[ \uparrow \downarrow \quad \uparrow \downarrow \quad \uparrow \downarrow \quad \uparrow \downarrow \quad \uparrow \uparrow \]

a. P
b. Na
c. Mg
d. Cl

e. Br

Q.24 What is the acidic anhydride of \( \text{H}_2\text{CO}_3 \)?

a. H₂
b. CO
c. CO₂
d. CO₃
e. H₂O

Q.25 In the following reaction CO is ...

\[ \text{Fe}_2\text{O}_3 \text{(s)} + 3 \text{CO} \text{(g)} \rightarrow 2 \text{Fe} \text{(s)} + 3 \text{CO}_2 \text{(g)} \]

a. the oxidizing agent and is oxidized.
b. the reducing agent and is reduced.
c. the reducing agent and is oxidized.
d. the oxidizing agent and is reduced.
e. neither an oxidizing agent nor a reducing agent.
**Q.26** Which of these elements has the greatest attraction for electrons in a covalent bond?

- a. As  
- b. Ge  
- c. Se  
- d. Kr  
- e. Br

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<th>Reaction</th>
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<td>a. H₂(g) + Cl₂(g) → 2 HCl(g)</td>
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<td>b. 2 H₂O₂(aq) → 2 H₂O(l) + O₂(g)</td>
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<td>c. Mg(OH)₂(s) → MgO(s) + H₂O(g)</td>
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<td>d. 2 HgO(s) → 2 Hg(l) + O₂(g)</td>
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<td>e. NH₄NO₃(s) → N₂O(g) + 2 H₂O(g)</td>
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**Q.28** An element with outermost electron configuration ns²np³ would be in Group...

- a. IIIA  
- b. IIA  
- c. VA  
- d. VIIA  
- e. VIIIA

**Q.29** Which one of the following elements is paramagnetic in the ground state?

- a. Mg  
- b. Hg  
- c. He  
- d. Kr  
- e. Se

**Q.30** The total number of electrons in s orbitals in a germanium atom (Z=32) is...

- a. 8  
- b. 6  
- c. 15  
- d. 20  
- e. 18

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End of Test
Key for Exam 2
Magnuson 22 Oct 2003
30 questions each 5 points for a total of 150 points

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