Chemistry C101 **Spring 2002 KA**

Examination 2

Directions:

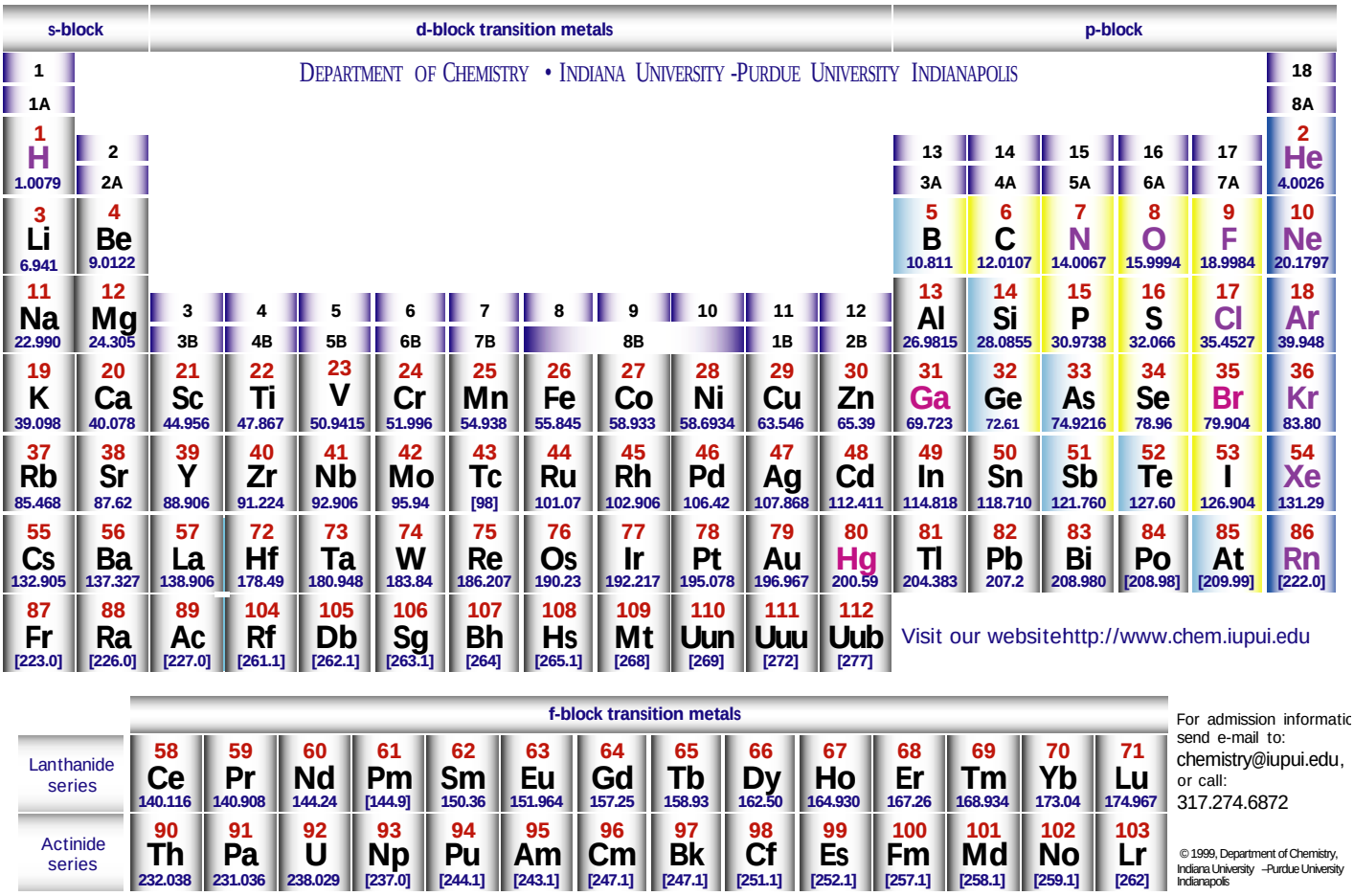
1. Both your **name** and **identification number** must be included and balloons properly darkened. Any errors may result in a point penalty.
2. Choose the **best** answer in each of the following. Using a #2 pencil, fill in the corresponding balloon on your scoring sheet.
3. Print your name and your recitation time and day on the top of this exam booklet. **YOU MUST TURN IN THIS BOOKLET WITH YOUR ANSWER SHEET!**

Potentially Useful Information

Electronegativities

H	2.1	Cl	3.0
C	2.5	K	0.8
N	3.0	Ca	1.0
O	3.5	Rb	0.8
F	4.0	I	2.5

Avogadro's number: $N_A = 6.02 \times 10^{23}$



Each question is worth 4 points. Choose the BEST answer.

1. Bromine forms the stable monatomic ion:
   a. Br^{3-}
   b. Br^{2-}
   c. Br^{-}
   d. Br^{+}
   e. Br^{2+}

2. The ionic compound formed from Al^{3+} and $Cr_2O_7^{2-}$ (dichromate) ions is
   a. $AlCr_2O_7$
   b. $Al(Cr_2O_7)_2$
   c. $Al_2Cr_2O_7$
   d. $Al_2(Cr_2O_7)_3$
   e. $Al_3(Cr_2O_7)_2$

3. When comparing single, double and triple bonds between carbon and nitrogen, the carbon-nitrogen single bond (C—N) is
   a. strongest and shortest.
   b. strongest and longest.
   c. weakest and shortest.
   d. weakest and longest.
   e. intermediate in both strength and length.

4. Which of the following is ***always soluble*** in water regardless of its associated anion?
   a. Sr^{2+}
   b. Rb^{+}
   c. Ba^{2+}
   d. Fe^{2+}
   e. Fe^{3+}

5. Iron (III) oxide has the formula
   a. Fe_2O_3
   b. Fe_3O_2
   c. $(FeO_2)_3$
   d. FeO_3
   e. FeO

6. The phosphate ion is
   a. P^{3-}
   b. PO_3^{2-}
   c. PO_4^{-}
   d. PO_4^{2-}
   e. PO_4^{3-}

7. Potassium ion, K^+, is isoelectronic with
   a. Ca^{2+}
   b. Ti^{4+}
   c. S^{2-}
   d. Cl^-
   e. ***all of the above***

8. Which of the following is the most electronegative?
   a. Sr
   b. S
   c. Si
   d. Sn
   e. Se

9. Neutral metal atoms tend to
   a. lose electrons to form cations.
   b. lose electrons to form anions.
   c. gain electrons to form cations.
   d. gain electrons to form anions.
   e. gain protons to form cations.

10. Which of the following behaves as an acid when dissolved in water?
   a. CH_4
   b. LiOH
   c. CH_3CH_2OH
   d. H_2SO_4
   e. NH_4OH

11. In a diatomic molecule, the equilibrium bond distance corresponds to
   a. that of a noble gas.
   b. that of a single bond.
   c. that of a double bond.
   d. the highest energy.
   e. the lowest energy.

12. The total number of valence electrons in the sulfite ion, SO_3^{2-} is
   a. 2
   b. 8
   c. 24
   d. 26
   e. 40

13. In covalent compounds, carbon generally forms _____ bonds, while oxygen generally forms _____ bonds and has _____ lone pair(s).
   a. 4, 2, 2
   b. 4, 3, 1
   c. 4, 3, 2
   d. 2, 3, 1
   e. 2, 2, 2

14. Dichloromethane, CH_2Cl_2, is a molecule that could reasonably be represented by twisting together two balloons. What is the approximate Cl–C–Cl angle?

a. 90°
b. 109°
c. 120°
d. 150°
e. 180°

15. The energy released to add electrons to a neutral atom and create an ion, e.g., F becoming F^-, is called the

a. ionization energy.
b. resonance energy.
c. electron affinity.
d. bonding energy.
e. kinetic energy.

16. The Lewis structure of the formate ion, HCO_2^-, has carbon as the central atom, with a bond to hydrogen, a single bond to one oxygen and a double bond to the other oxygen. What is the shape of the formate ion?

a. linear
b. trigonal bipyramidal
c. octahedral
d. tetrahedral
e. trigonal planar

17. Which of the following contains a ***triple*** bond?

a. ammonia
b. cyanide ion
c. diatomic bromine
d. oxygen gas
e. sulfur trioxide

18. Chlorine reacts with a metal "M" to produce an ionic compound with formula MCl_2. Which one of the following elements could be the mystery element M?

a. Sr
b. Rb
c. Al
d. Si
e. Li

19. A neutral atom in which of the following groups would have 7 valence electrons?

a. group 6A
b. group 7A
c. group 8A
d. alkali metals
e. alkaline earth metals

20. Which of the following will react in a ***neutralization*** reaction with sodium hydroxide to produce sodium nitrate?

a. sulfuric acid
b. nitric acid
c. hydrochloric acid
d. sodium sulfate
e. barium nitrate

21. Suppose a molecule has an AB_3 structure (with A central), and the B's consist of two atoms and one lone pair. What is the shape of the molecule and what is the B–A–B angle?

a. bent, 90°
b. bent, 109°
c. bent, 120°
d. linear, 180°
e. trigonal planar, 120°

22. Which of the following is best described as a covalently bonded molecule?

a. K_3N
b. KBr
c. $CaBr_2$
d. $CoBr_2$
e. CBr_4

23. Which of the following electron configurations is correct for an ***excited*** fluoride ion?

a. [Ne]
b. $[Ne]3s^1$
c. $1s^2 2s^2 2p^6$
d. $1s^2 2s^2 2p^5 3s^1$
e. $1s^2 2s^2 2p^5 3s^2 3p^1$

24. When a valid Lewis structure can be drawn more than one way for an ion or molecule, as in the case of sulfur dioxide, the true structure is

a. the structure where $\mu = 0$.
b. the structure that has a net dipole.
c. determined by application of the octet rule.
d. an average of the possible resonance structures.
e. the structure with the least number of lone pairs on the central atom.

25. Which of the following molecules has $\mu = 0$?

a. PCl_3
b. NH_3
c. BH_3
d. ***all have zero dipole moments***
e. ***none have zero dipole moments***

26. Beryllium chloride doesn't have any lone pairs on the central atom and is an "electron deficient" compound. The octet rule is satisfied on each chlorine atom and the molecule doesn't contain any multiple bonds. What is the shape of $BeCl_2$?

a. bent
b. linear
c. trigonal planar
d. trigonal pyramidal
e. ***none of the above***

27. The formula weight of calcium bisulfate, $Ca(HSO_4)_2$ is about

a. 69 g/mol.
b. 137 g/mol.
c. 201 g/mol.
d. 234 g/mol.
e. 274 g/mol.

28. Balance the following chemical equation: $CH_3CH_2CH_2CH_3 + O_2 \rightarrow CO_2 + H_2O$
When correctly balanced, the coefficients of carbon dioxide and H_2O are respectively:

a. 4 and 5
b. 8 and 5
c. 8 and 10
d. 13/2 and 5
e. 13 and 10

29. Aluminum metal reacts with diatomic fluorine gas to form a trigonal planar compound of aluminum and fluorine (24 total valence electrons). In the balanced chemical equation for this reaction, the sum of all of the coefficients is:

a. 3
b. 4
c. 5
d. 6
e. 7

30. 0.250 mol of elemental bromine, Br_2, has a mass of approximately

a. 0.250 g.
b. 8.75 g.
c. 20.0 g.
d. 40.0 g.
e. 79.9 g.

31. How many *atoms* are in 4.2×10^{-5} moles NH_3 gas?

a. 6.0×10^{23}
b. 1.2×10^{23}
c. 1.0×10^{20}
d. 2.4×10^{24}
e. 1.0×10^{-5}

32. Balance the chemical equation:

$$K_2CrO_4(aq) + Pb(NO_3)_2(aq) \rightarrow KNO_3(aq) + PbCrO_4(s)$$

When correctly balanced, the coefficient of lead nitrate is

a. 1
b. 2
c. 3
d. 4
e. none of the above

33. Identify the spectator ion or ions in the reaction shown here.

$$2\ NaI\ (aq) + Br_2\ (\ell) \rightarrow 2\ NaBr\ (aq) + I_2\ (s)$$

a. Na^+
b. I^-
c. Br^-
d. Na^+ ***and*** Br^-
e. Na^+ ***and*** I^-

34. What is the oxidation number of nitrogen in lithium nitrate?

a. +1
b. –1
c. +3
d. –3
e. +5

35. In the reaction shown, the change in oxidation number for iron (from left to right) is

$$2\ Fe\ (s) + 3\ Cl_2\ (g) \rightarrow 2\ FeCl_3\ (s)$$

a. –2 to +2
b. 0 to +3
c. 0 to +6
d. +2 to +6
e. The oxidation number of iron does not change in this reaction.

36. How many moles of $FeCl_3$ would be produced if 0.8 moles of iron metal and 0.9 moles of chlorine gas were combined? *Hint: Something might be limiting!*

$$2\ Fe\ (s) + 3\ Cl_2\ (g) \rightarrow 2\ FeCl_3\ (s)$$

a. 1 mol $FeCl_3$
b. 2 mol $FeCl_3$
c. 0.6 mol $FeCl_3$
d. 0.8 mol $FeCl_3$
e. 0.1 mol $FeCl_3$

Use the balanced reaction below for the next three problems, 37 - 39:

$$2AuCl_3 + 3Sn \rightarrow 3SnCl_2 + 2Au$$

37. How many moles of tin (II) chloride are produced when 3 moles of gold (III) chloride react with plenty of tin metal present?

a. 2.0 mol
b. 3.0 mol
c. 4.5 mol
d. 6.0 mol
e. 9.0 mol

38. If 1.2 mol of tin metal and excess gold (III) chloride are used, how many moles of gold metal are produced?

a. 0.67 mol
b. 0.80 mol
c. 1.2 mol
d. 2.0 mol
e. 2.4 mol

39. If 60 g of tin metal are used with excess gold (III) chloride, how many moles of tin (II) chloride are produced?

a. 0.5 mol
b. 0.75 mol
c. 0.83 mol
d. 1.0 mol
e. 1.2 mol

40. What will happen when aqueous solutions of silver nitrate, sodium sulfate and barium chloride are combined?

a. A precipitate of $BaSO_4$ will form; all other ions will remain in solution.
b. A precipitate of AgCl will form; all other ions will remain in solution.
c. A precipitate of $AgSO_4$ will form; all other ions will remain in solution.
d. $BaSO_4$ and AgCl will both precipitate from the solution.
e. No precipitate will form, i.e., all ions will remain in solution.