Exam 2 form A
C101 Fall 2002

Name _____
Recit. Day _____
Recit. Time _____
Recit. Instructor _____

Directions:

1. Both your **name** and **identification number** must be included and balloons properly darkened on the scan form. Any errors may result in a point penalty. Only the scan form will be graded.

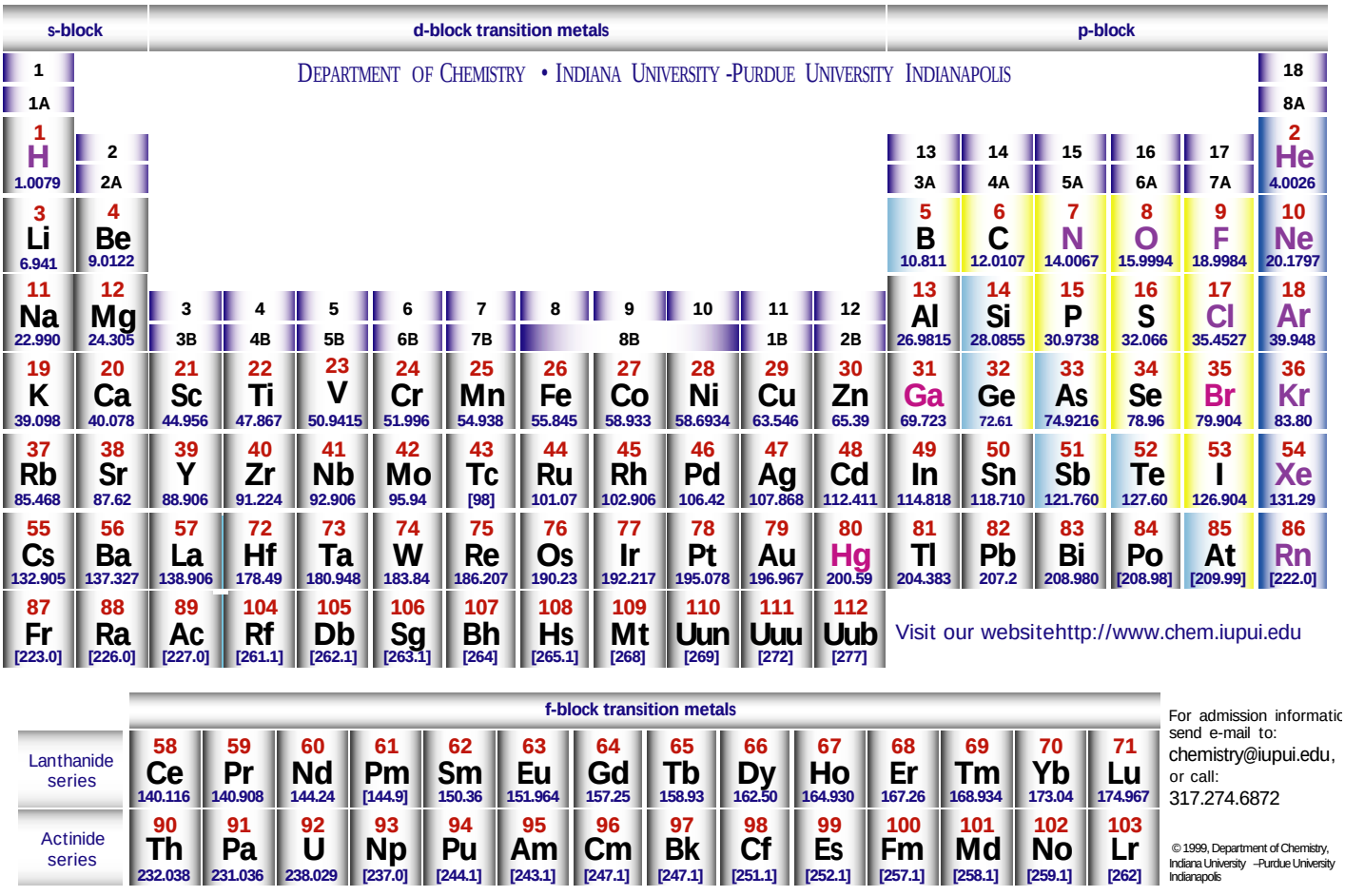
2. Choose the **best** answer in each of the following questions. Using a #2 pencil, fill in the corresponding balloon on your scan form.

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. The ion, NH_4^+, is called

   a. ammonia ion.
   b. ammonium ion.
   c. hydrammonium ion.
   d. hydronitride ion.
   e. nitride ion.

2. Based on its position in the periodic table, which of the following is the ***least*** electronegative element?

   a. Zn
   b. B
   c. O
   d. Al
   e. Cl

3. Which of the following anions is ***always soluble*** in water regardless of its associated cation (positive ion)?

   a. NO_3^-
   b. S^{2-}
   c. SO_4^{2-}
   d. OH^-
   e. Cl^-

4. The compound potassium sulfate has the formula

   a. KSO_3
   b. K_3SO_3
   c. $K(SO_4)_2$
   d. KSO_4
   e. K_2SO_4

5. Chromium (II) nitrate has the formula

   a. Cr_2NO_3
   b. $Cr_2(NO_3)_2$
   c. $Cr(NO_3)_2$
   d. $CrNO_3$
   e. $Cr_3(NO_3)_2$

6. Sulfuric acid has the formula

   a. HSO_3
   b. HSO_4
   c. H_2SO_2
   d. H_2SO_3
   e. H_2SO_4

7. $BaCl_2$ can be formed in a ***neutralization*** reaction solely from which of the following pairs of compounds?

   a. $Ba(NO_3)_2$ and $Ba(OH)_2$
   b. $Ba(NO_3)_2$ and $CaCl_2$
   c. $Ba(OH)_2$ and HCl
   d. $Ba(NO_3)_2$ and HCl
   e. NH_4Cl and NH_4OH

8. Which of the following molecules has ***exactly*** one lone pair of electrons?

   a. NH_3
   b. Cl_2
   c. CO_2
   d. BF_3
   e. CS_2

9. Neutral nonmetal 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. The energy required to remove electrons from a neutral atom and create an ion, e.g., Na becoming Na^+, is called the

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

11. Carbon dioxide contains two double bonds, each from carbon to an oxygen atom. The shape of carbon dioxide is best described by the term

    a. bent.
    b. linear.
    c. T-shaped.
    d. tetrahedral.
    e. trigonal planar.

12. The ionic compound formed from Ca^{2+} and PO_4^{3-} ions has the formula

    a. $CaPO_4$
    b. $Ca(PO_4)_2$
    c. $Ca_2(PO_4)_2$
    d. $Ca_2(PO_4)_3$
    e. $Ca_3(PO_4)_2$

13. BF_3 is a trigonal planar molecule. What is the F–B–F angle?

a. 90°
b. 105°
c. 109°
d. 120°
e. 180°

14. How many total valence electrons are involved in the correctly-drawn Lewis structure of the phosphate ion?

a. 18
b. 24
c. 29
d. 32
e. 36

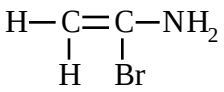
15. Which of the following is best described as a covalently-bonded molecule?

a. $CaCl_2$
b. NaCl
c. NaF
d. Cs_2O
e. CS_2

16. In ethanol, CH_3CH_2OH, how many bonds connect to oxygen and how many lone pairs of electrons reside on the oxygen?

a. One single bond and two lone pairs
b. Two single bonds and no lone pairs
c. Two single bonds and one lone pair
d. Two single bonds and two lone pairs
e. Two double bonds and no lone pairs

17. Given the molecule below,



which of the following angles is about 120°? *(Caution: Lone pairs can be important!)*

a. H–C–H
b. C–N–H
c. H–N–H
d. ***b and c, but not a***
e. ***a, b, and c***

18. Which of the following molecules likely has ***no*** dipole moment ($\mu=0$)?

a. CO_2
b. CS_2
c. CF_4
d. BF_3
e. All have zero dipole moments.

19. How many moles of SO_3 are in a 24 gram sample of SO_3?

a. 0.30
b. 0.60
c. 1.0
d. 2.0
e. 3.3

20. One mole of water (H_2O) and one mole of carbon dioxide (CO_2)

a. have the same mass in grams.
b. contain the same number of oxygen atoms.
c. contain the same mass of oxygen atoms.
d. contain the same number of molecules.
e. none of the above.

21. In a graph of potential energy versus internuclear distance (bond length) for a diatomic molecule, the energy is

a. lowest when separation of the atoms is equal to the equilibrium bond length.
b. highest when separation of the atoms is equal to the equilibrium bond length.
c. lowest when the atoms are too close together.
d. lowest when the atoms are too far apart.
e. highest when the atoms are too far apart.

22. Potassium reacts with element X to produce an ionic compound having the formula K_2X. Which one of the following elements could be identified as element X based on knowledge of the usual charges of monatomic ions?

a. Ga
b. N
c. Br
d. S
e. C

23. Which one of the following ions has a –1 charge?

a. oxide
b. carbonate
c. phosphate
d. nitride
e. nitrate

24. Which one of the following ions ***is not*** isoelectronic with Kr?

a. Sr^{2+}
b. Br^{-}
c. Rb^{+}
d. As^{3+}
e. Se^{2-}

25. The stable ions formed by calcium and chlorine are:

a. Ca^{+} and Cl^{-}

b. Ca^{2+} and Cl^{-}

c. Ca^{3+} and Cl^{2-}

d. $Ca^{-}$and Cl^{+}

e. Ca^{2-} and Cl^{2+}

26. Balance the chemical equation for the combustion of propane.

$$CH_3CH_2CH_3 + O_2 \rightarrow CO_2 + H_2O$$

When correctly balanced, the coefficients of propane and carbon dioxide are respectively

a. 1 and 2

b. 1 and 3

c. 2 and 5/2

d. 2 and 4

e. 2 and 9/2

27. The following reaction occurs in an automobile catalytic converter. What is the coefficient on ammonia when the following equation is correctly balanced with integer coefficients? *(Hint: You might want to start with hydrogen and do nitrogen last.)*

$$NH_3 + NO \rightarrow N_2 + H_2O$$

a. 1

b. 2

c. 3

d. 4

e. 5

28. Which are spectator ions in the redox reaction shown here?

$$Fe\ (s) + CuCl_2\ (aq) \rightarrow Cu\ (s) + FeCl_2\ (aq)$$

a. Fe and Cu only

b. Fe^{2+} and Cu^{2+} only

c. Cu^{2+} and Cl^{-} only

d. Fe^{2+} and Cl^{-} only

e. Cl^{-} only

29. 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°

Refer to the balanced chemical reaction shown below for questions 30 - 34.

$$6\ HCl\ (aq)\ +\ 2\ Al\ (s)\ \rightarrow\ 2\ AlCl_3\ (aq)\ +\ 3\ H_2\ (g)$$

30. What best describes this reaction?

    a. It is a neutralization reaction.
    b. It is a precipitation reaction.
    c. It is an oxidation-reduction reaction.
    d. It is a net ionic reaction.
    e. It is an example of the combustion of albumin.

31. How many moles of hydrogen gas, H_2, will be formed from reaction of 1 mole of aluminum metal with excess HCl?

    a. 1 mole
    b. 1.5 moles
    c. 2 moles
    d. 2.5 moles
    e. 3 moles

32. About how many moles of aluminum chloride would be formed from complete reaction of 54 grams of aluminum metal?

    a. 27 moles
    b. 54 moles
    c. 1.0 moles
    d. 2.0 moles
    e. 73 moles

33. If 2.7 grams of aluminum metal reacts completely with excess HCl, how many grams of hydrogen gas are produced?

    a. 2.7 g H_2
    b. 4.1 g H_2
    c. 0.30 g H_2
    d. 0.13 g H_2
    e. 2.0 g H_2

34. How many moles of aluminum chloride would be produced if 0.6 moles of HCl and 0.4 moles of aluminum metal were combined? (*Hint: Something might be limiting!)*

    a. 2 mol $AlCl_3$
    b. 1 mol $AlCl_3$
    c. 0.6 mol $AlCl_3$
    d. 0.4 mol $AlCl_3$
    e. 0.2 mol $AlCl_3$

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

$$V_2O_5 + 2\,H_2 \rightarrow V_2O_3 + 2\,H_2O$$

a. +2 to –2
b. +10 to +6
c. +5 to +3
d. –5 to –3
e. none of the above

36. What is the oxidation number of sulfur in the SO_3^{2-} ion?

a. +3
b. +4
c. +8
d. –1
e. –2

37. The combination of ions most likely to produce a precipitate is

a. Li^+ and phosphate ion
b. Pb^{2+} and nitrate ion
c. copper (II) ion and Cl^-
d. ammonium ion and Br^-
e. iron (III) and CO_3^{2-}

38. What is the oxygen-phosphorus-oxygen angle in the phosphate ion? *(Hint: No lone pairs on phosphorus.)*

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

39. How many molecules of water are in 0.20 moles of water?

a. 1.2×10^{23}
b. 3.0×10^{22}
c. 4.8×10^{25}
d. 6.0×10^{23}
e. 7.5×10^{21}

40. Describe the bonding in sodium nitrate, $NaNO_3$.

a. The compound is ionic and contains no significant covalent bonding.
b. The compound is ionic, but contains a nitrate ion with internal covalent bonds.
c. The compound contains two ions covalently bonded together.
d. Sodium nitrate is wholly covalently bonded.
e. Sodium nitrate is wholly ionically bonded.