

## Part A

Follow the directions and select the **BEST** answer for each section. Mark your answers on the scantron answer sheet carefully. Make sure your scantron answer sheet is filled out properly- do so before you begin! You must use pencil. Clearly indicate which Scantron form is the **PRIMARY** and **SECONDARY** ones by writing "**PRIMARY**" and "**SECONDARY**" on the top-right hand corner of each Scantron (over your name).

There are 29 questions/problems for 100 pts. total.

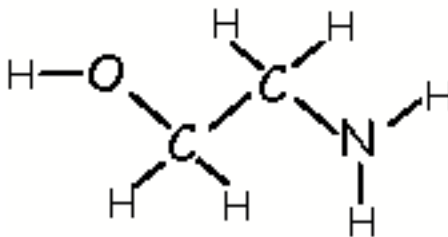
A. Match or fill in the blank. Remember to choose the "**BEST**" answer!

3 pts. each

1. What elements tend to form ionic compounds?
  - A. any two elements of the same phase
  - B. those found in the upper right hand side of the periodic table
  - C. metallic elements
  - D. elements found on opposite sides of the periodic table\*
  - E. elements found next to each other in the periodic table
2. Atoms of a covalent bond are held together by which factor?
  - A. electrical attraction two nuclei have for shared electrons\*
  - B. nuclear attraction between two nuclei
  - C. gravitational attraction between the two atoms
  - D. electrical attraction two nuclei have for unevenly shared electrons
  - E. electrical attraction between shared electrons
3. An individual carbon-oxygen bond is polar. Why is carbon dioxide, CO<sub>2</sub>, non-polar?
  - A. the two carbon-oxygen bonds in CO<sub>2</sub> are oriented 180° from each other\*
  - B. any molecule containing two polar bonds is always non-polar
  - C. at low temperatures carbon dioxide solidifies into dry ice
  - D. the two carbon-oxygen bonds in CO<sub>2</sub> are oriented 360° from each other
  - E. none of the above
4. Which of the following compounds is polar?
  - A. CCl<sub>4</sub>
  - B. BF<sub>3</sub>
  - C. H<sub>2</sub>CCH<sub>2</sub>
  - D. CO<sub>2</sub>
  - E. NH<sub>3</sub>\*
5. The \_\_\_\_\_ is used to determine electronic shape while the \_\_\_\_\_ is used to determine molecular shape.
  - A. valence electrons & valence electrons
  - B. number of bonds & symmetry
  - C. number of bonding electron pairs & number of nonbonding electron pairs
  - D. number of nonbonding electron pairs & number of bonding electron pairs\*
  - E. symmetry & polarity

6. Which is the most polar bond in the chemical structure shown below?

- A. H-N
- B. N-C
- C. C-O
- D. C-C
- E. O-H\*



7. The following molecule is polar. In which direction is the dipole arrow pointing (tail to head)?

- A. O to S
- B. S to O\*
- C. O to C
- D. C to O
- E. S to C



8. Which of the following compounds would you expect to dissolve as ions in water?

- A.  $\text{SO}_2$
- B.  $\text{N}_2\text{O}$
- C.  $\text{K}_2$
- D.  $\text{O}_2$
- E.  $\text{Na}_2\text{O}^*$

9. How many moles of salt,  $\text{NaCl}$ , are required to make 2.0 liter of saline (salt in water) solution with a concentration of 0.25 moles per liter?

- A. 0.125 mol
- B.  $5 \times 10^1$  mol
- C. 0.50 mol\*
- D. 0.5 mol
- E. 8.0 mole

10. Which concept best explains why you can make a highly salty cup of water, but only a slightly sweet cup of sugar at room temperature?

- A. opposites attract
- B. like dissolves like\*
- C. table salt has covalent bonds and sugar has ionic bonds
- D. you can make a supersaturated salt solution, but not with sugar
- E. non of the above

11. Water is polar and table sugar ( $C_{12}H_{23}O_{12}$ ) is made up of many polar bonds. So why is sugar not very soluble in water?
- A. sugar is very soluble in water
  - B. the polar bonds in sugar cancel each other out and the sugar molecule is not polar overall
  - C. sugar molecules are much larger than water molecules\*
  - D. salt is very soluble because it has ionic bonding
  - E. sugar is very soluble because it has covalent bonding
12. Which is not an attractive intermolecular force?
- A. electrostatic (charge-charge)
  - B. dipole-dipole
  - C. hydrogen bonding
  - D. London Force
  - E. solubility\*
13. Fish breathe oxygen,  $O_2$ , dissolved in the water. Since water is a polar substance and oxygen is a non-polar substance, how can there be any oxygen,  $O_2$ , in the water?
- A.  $O_2$  gets caught in the spaces between the water molecules, and only the weight of the water above keeps the oxygen from floating away
  - B. the plants in water produce  $O_2$  during photosynthesis and the  $O_2$  released by the plants floats to the surface in small pockets that fish capture
  - C. normally there isn't  $O_2$  in the water, but the gills of fish, however, are equipped to break water down into  $O_2$ , which stays in the water for short periods of time by dipole-induced dipole molecular interactions
  - D. oxygen is saturated in water and can be easily absorbed by the fish
  - E. Water induces a dipole in  $O_2$  and the two attract one another by dipole-induced dipole molecular interactions\*
14. A polar "head" and non-polar tail comprise detergent/soap molecules. How does soap clean dirt off skin?
- A. it grabs the polar dirt with its tail and gets carried away by the non-polar covalent water at its head
  - B. it grabs the non-polar covalent dirt with its tail and gets carried away by the water attracted to its head\*
  - C. the charged "head" is attracted to the polar water molecules
  - D. the non-polar covalent tail is attracted to the non-polar covalent dirt molecules
  - E. "like dissolves like"
15. A steam burn from the condensation of 1 gram of  $100^\circ C$  water vapor is more damaging than a burn caused by 1 gram of  $100^\circ C$  boiling water because the steam \_\_\_\_\_.
- A. gives up additional energy when it condenses\*
  - B. has more kinetic energy (faster moving molecules)
  - C. both of these
  - D. neither of these
  - E. is less dense than liquid water

16. An increase in the air pressure on the surface of hot water (vapor pressure) tends to \_\_\_\_\_.
- A. increase the boiling point
  - B. decrease the vapor pressure
  - C. prevent boiling\*
  - D. promote boiling
  - E. none of these
17. Perspiration helps on a hot day because \_\_\_\_\_.
- A. the water carries away heat as it evaporates off the skin\*
  - B. the water carries away heat as it forms bubbles of sweat
  - C. it makes you thirsty
  - D. it carries salt to your skin
  - E. it helps make you less tired
18. On a hot day, on which bench is it less painful to sit on: a wooden or metal one- both are out in the hot sun and why?
- A. metal because it has a smaller specific heat capacity
  - B. metal because it has a larger specific heat capacity
  - C. wooden because it has no specific heat capacity
  - D. wooden because it has a larger specific heat capacity
  - E. wooden because it has a smaller specific heat capacity\*
19. When salt is dissolved in water, which of the following is true?
- A. the melting point goes down while the boiling point goes up\*
  - B. the melting point goes down while the boiling point goes down
  - C. the melting point goes up while the boiling point goes down
  - D. the melting point goes up while the boiling point goes up
  - E. none of these are true
20. Solutes are \_\_\_\_\_ soluble at higher temperatures while gases are \_\_\_\_\_ soluble at higher temperatures.
- A. more & more
  - B. more & less\*
  - C. less & less
  - D. less & more
  - E. not & not
21. Which of the following statements is true?
- A. the solute is the minor component and the solvent is the major component
  - B. water is the solvent in an aqueous solution
  - C. the solute is that which is dissolved
  - D. the solvent is that which does the dissolving
  - E. they are all true\*

## PART B

Solve the following problems. Be sure to show all of your work if you want any credit- *i.e.*

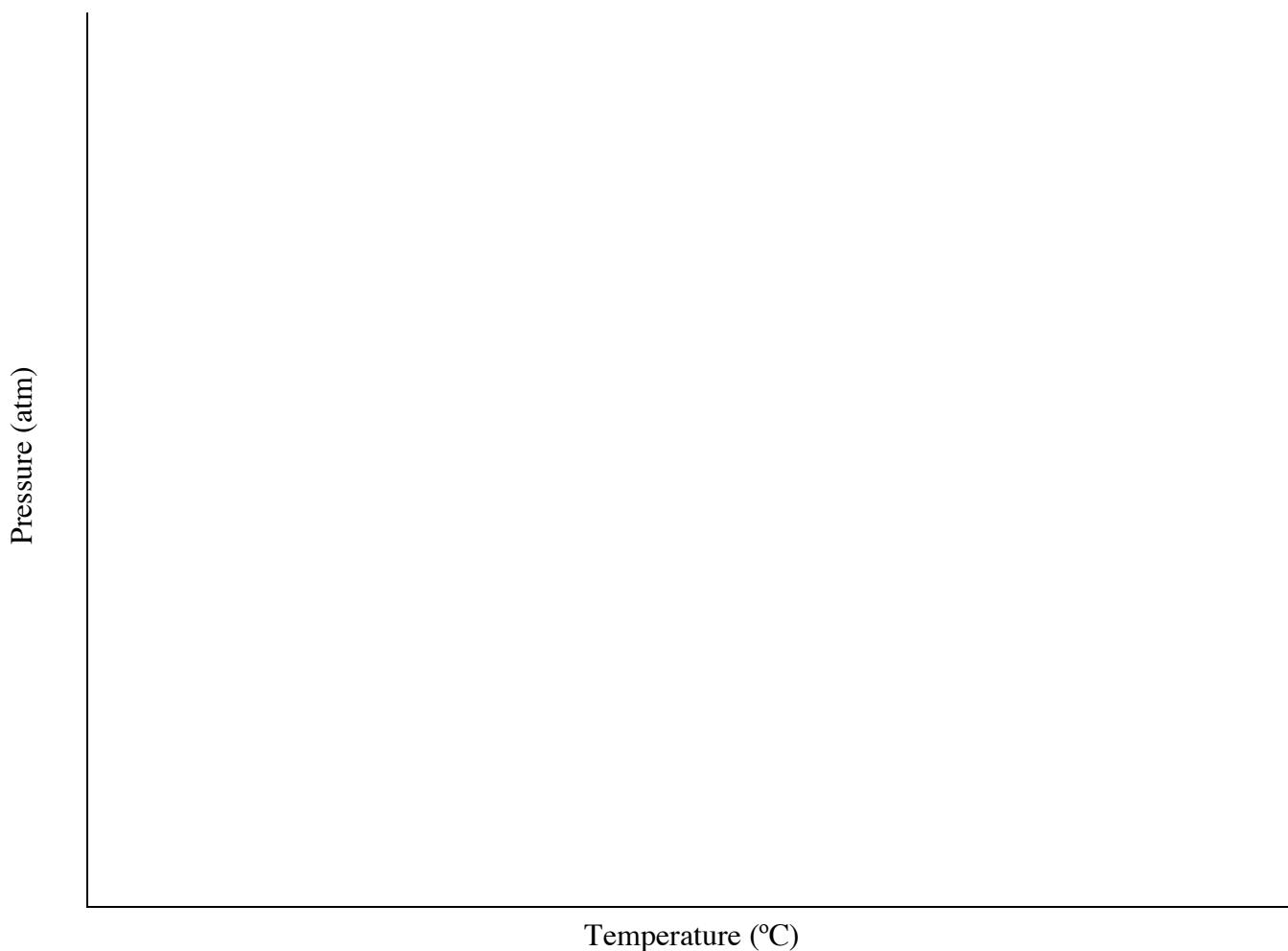
**NO WORK = NO CREDIT!**

22. How many moles of acetic acid,  $\text{CH}_3\text{COOH}$ , are required to make 0.25 liter of an acidic solution with a concentration of 2.0 moles per liter? /5 pts.

Answer goes here! 

0.50 mol

23. Draw the phase diagram for water. Label its three (3) phases of matter- clearly label where they generally are found. Label the triple point and all three (3) phase transition lines. /9 pts.



/14 pts. Total

24. When table salt, sodium chloride (NaCl), dissolves in water, the ions separate from each other. Draw the individual ions of salt as they are solvated by water molecules /4 pts.

25. The Basilisk (*aka* Jesus Christ lizard- below) can escape predators by running across water. Concisely explain how it can do this. /4 pts.



<http://www.reptilianagenda.com/img/i010205a.shtml>

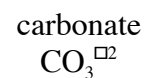
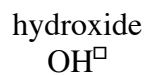
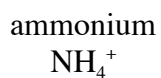
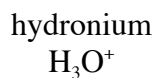
26. What is the chemical formula for the product for each of the chemical reactions below?

/4 pts.



27. Draw the electron dot structure for the following polyatomic ions.

/5 pts.

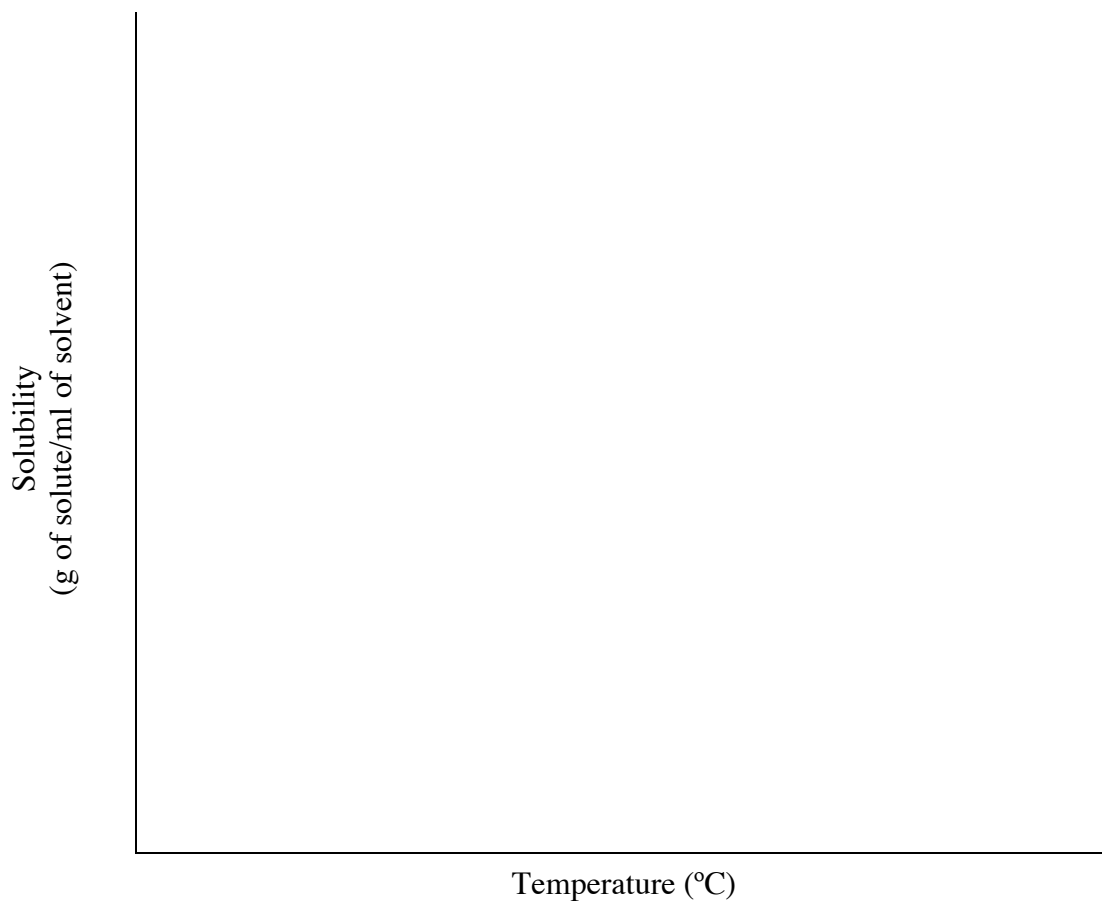


28. Using the concepts of cohesion and adhesion, explain how water is drawn up to the top of very tall trees inside its narrow tubes (xylem) in the wood, branches and leaves. (Hint: This is also called capillary action!) /3 pts.

/12 pts. Total

29. Draw the general trend for the solubility for a solid solute versus that for a gaseous solute.

/3 pts.



/14 pts. Total

/ 8 pts. Total

/12 pts. Total

/ 3 pts. Total

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/37 pts. Total