

Name Key Name _____
 print _____ sign _____

NA = not attempted NW = no work

For long answer type questions, you must show all work for partial credit. If your work is not near the question that you are answering (or the work location is not clearly marked), I will not include the work in the grading. Please write legibly. (I cannot grade what I cannot read.) Please print your name on the top back of the exam so that I can return the quiz in a self serve fashion. (1 pts. for writing name on the back, 1 pt for printing and signing your name on the front of the exam) You may remove the periodic table to use it during the exam but please staple it back and return it with the exam. Reminder: mandatory ACS final exam and teaching evaluation on 12/13/11 T at 1:30 pm

$K = ^\circ C + 273.15$ $P = 760 \text{ mm Hg} = 760 \text{ torr} = 1 \text{ atm}$ $1000 \text{ mL} = 1 \text{ L}$ $R = 0.08206 \text{ (L atm)/(mol K)}$ $N_A = 6.02 \times 10^{23}$

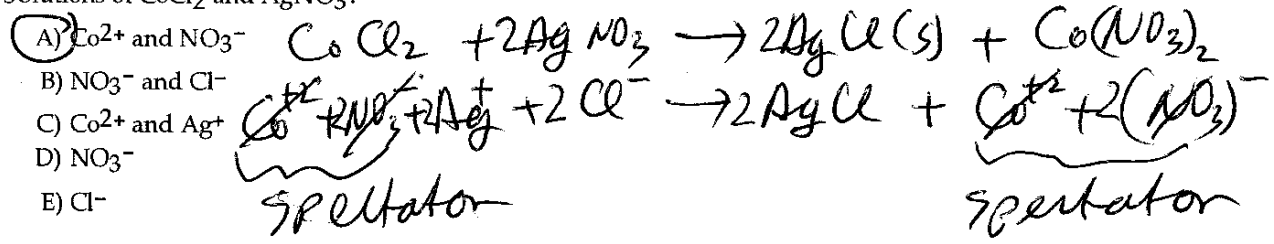
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (3 pts each, 33 pts total)

Sr, Gr II (+2) Gr VI (8-6 = -2)

1) What is the formula of the compound formed between strontium ions and oxygen ions? 1) _____
 A) Sr₂O B) SrO C) SrO₂ D) Sr₂O₃ E) SrO₃

2) At maximum, an f-subshell can hold 14 electrons, a d-subshell can hold 10 electrons, and a p-subshell can hold 6 electrons. 2) _____
 A) 2, 6, 10 B) 2, 8, 18 C) 14, 10, 6 D) 2, 12, 21 E) 14, 8, 2

3) Which ion(s) is/are spectator ions in the formation of a precipitate of AgCl via combining aqueous solutions of CoCl₂ and AgNO₃? 3) _____



4) The density of NO₂ of at 760.0 torr and 25.0 °C is _____ g/L. [d = (P M) / (RT) derived from the idea gas law (M = MW = 46.01 g / mol NO₂)] 4) _____

A) 3.27 B) 1.64 C) 1.88 D) 9.30 E) 1.68
 $d = \left\{ \left(\frac{760}{760} \right) (46.01) (0.08206) (25 + 273.15) \right\} = 1.88$

5) What are the respective concentrations (M) of Na⁺ and SO₄²⁻ afforded by dissolving 0.500 mol Na₂SO₄ in water to make a 1.33 L solution? 5) _____

A) 0.376 and 0.752
 B) 0.752 and 0.376 $\frac{0.500 \text{ mol}}{1.33 \text{ L}} = 0.376 \text{ M Na}_2\text{SO}_4$ 0.376 SO_4^{2-}
 C) 1.33 and 0.665
 D) 0.665 and 1.33
 E) 0.665 and 0.665
 $\downarrow \times 2 = 0.752 \text{ Na}^+$

6) A pressure of 1.25 atm is the same as a pressure of _____ of mm Hg. 6) _____
 A) 760. B) 193 C) 33.0 D) 29.9 E) 950.

$1.25 \times 760 = 950$

7) Horizontal rows of the periodic table are known as _____ 7) _____
 A) nonmetals B) metals C) periods D) groups E) metalloids

no partial credit MC

8) Which of the following is soluble in water at 25 °C?

- A) Fe(OH)₂
- B) FeCO₃
- C) Fe₃(PO₄)₂
- D) Fe(NO₃)₂
- E) FeS

all nitrates are water soluble
OH⁻, CO₃²⁻, PO₄³⁻, S²⁻ are insoluble
except for exceptions

8) _____

9) Which pair of elements is most apt to form an ionic compound with each other?

- A) N, H
- B) O, F
- C) Ca, Na
- D) S, F
- E) Ba, Br

opposite side of periodic table

9) _____

10) The balanced reaction between aqueous nitric acid and aqueous strontium hydroxide is

- A) HNO₃ (aq) + SrOH (aq) → H₂O (l) + SrNO₃ (aq)
- B) 2HNO₃ (aq) + Sr(OH)₂ (aq) → Sr(NO₃)₂ (aq) + 2H₂ (g)
- C) HNO₃ (aq) + Sr(OH)₂ (aq) → H₂O (l) + Sr(NO₃)₂ (aq)
- D) HNO₃ (aq) + Sr(OH)₂ (aq) → Sr(NO₃)₂ (aq) + H₂ (g)
- E) 2HNO₃ (aq) + Sr(OH)₂ (aq) → 2H₂O (l) + Sr(NO₃)₂ (aq)

H bonding
H directly attached to F, O, N

10) _____

11) Of the following substances, only _____ has London dispersion forces as its only intermolecular force.

- A) HF — H bonding
- B) CH₃COOH — H bonding
- C) PH₃ — H bonding
- D) CCl₄
- E) H₂O — H bonding

dipole
vector sum ≠ 0 of dipole

11) _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question. (37 pts total)

12) A molecule of SO₂ has 1 atoms of S and 2 atoms of O and weighs 64 amu. (3 pts)

32 + 2(16) = 64
math - 2 pts

12) _____

13) If you have 15.2 g of the molecule CaCl₂ (MW=111.1 g/mol) and dissolve it to make up 325 mL of solution, what is the molarity? Set up the answer by filling in the blanks. (4 pts)

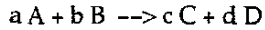
$$M = \frac{(15.2 \text{ g} / 111.1 \text{ g/mol})}{(325 \text{ mL}) \times (1 / 1000 \text{ mL})}$$

1 pt each blank
or if reversed bc both divide 15.2

13) _____

14) To calculate standard enthalpy for a reaction (4 pts)

14) _____



where the little letters represent moles and where the capital letters are the formula for the reactants and products:

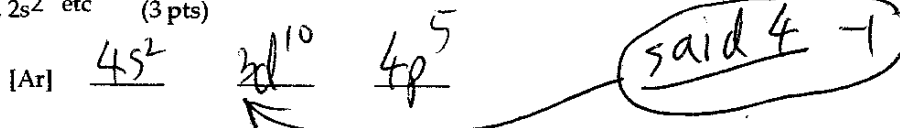
$$(a) \Delta H^\circ = (c \Delta H_f^\circ C + d \Delta H_f^\circ D) - (a \Delta H_f^\circ A + b \Delta H_f^\circ B)$$

$$(b) \Delta H^\circ = (a \Delta H_f^\circ A + b \Delta H_f^\circ B) - (c \Delta H_f^\circ C + d \Delta H_f^\circ D)$$

[choose either (a) or (b)]

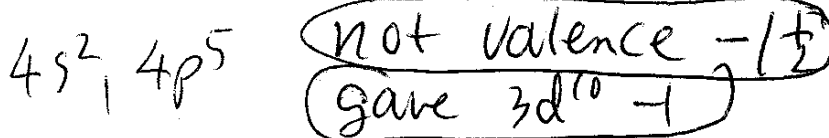
15) Show the complete electron configuration for the element Br by filling in the format $1s^2, 2s^2$ etc (3 pts)

15) _____



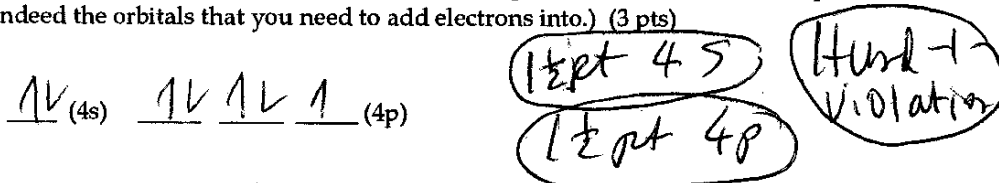
16) Show the valence electron configuration for the element Br in the same format (3 pts)

16) _____



17) Show the valence electron configuration orbital diagram for the element Br by drawing in electrons (as arrows) into the blank provided (Yes unlike the quiz these are indeed the orbitals that you need to add electrons into.) (3 pts)

17) _____



18) In the periodic table, group IA to group IIA fills the (s, p, d, f) (circle one) subshell (3 pts)

18) _____

19)

19)

a. For the molecule ClCOH what is the number of valence electrons for the molecule (3 pts)

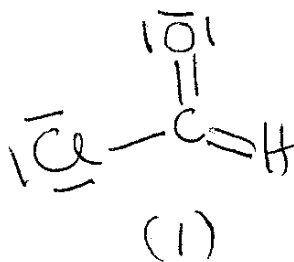
$$\begin{array}{ccccccc} 7 & + & 4 & + & 6 & + & 1 & = & 18 \\ \text{Cl} & & \text{C} & & \text{O} & & \text{H} & & \end{array}$$

partial credit - math - 1

No points
off NW
here - could

have directly
put into
calculator

b. Which of the following is the correct Lewis Dot structure? (circle one of the two numbers) (4 pts)



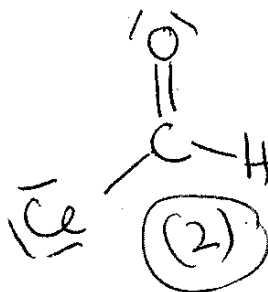
$$- 11 \times 2 = 22 \bar{e}$$

- 600 wrong \bar{e}

- H with 4 \bar{e}

- C with
expanded octet

Incorrect

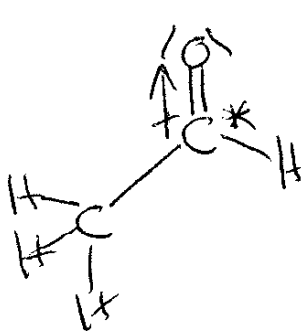


$$9 \times 2 = 18 \bar{e}$$

Correct

20) For the following molecule for which I have provided a Lewis Dot Structure (7 pts, 1 pt per blank) _____

- a. How many (VSEPR) electron pairs around the atom with the * 3
- b. How many lone pairs on the atom with the * 0
- c. What is the geometry of the electrons around the atom with the * trigonal planar
- d. What is the geometry of the molecule around the atom with the * trigonal planar
- e. What is the hybridization of the atom with the * sp²
- f. Is the molecule as a whole (1) polar or (2) non polar (circle one of the two numbers) 1
vector sum ≠ 0
- g. The intermolecular interaction for the molecule is (1) dispersion forces (2) dipole-dipole interaction or (3) hydrogen bonding (circle one of the 3 numbers to answer this letter) 2



dipole-dipole

graded c, d, e - match my blank or consistent with your @ + @
whichever gave better answer

Long Answer. Write your answer in the space provided. Please show work for full credit and to receive partial credit for incorrect final answers. (Write legibly please.) (30 pts)

21) For the reaction $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{l})$

if you start the reaction with 5.4 mol of ammonia and excess oxygen at 30 °C, 750 mm Hg, what volume of NO (g) will you collect? (15 pts)

$$5.4 \text{ mol NH}_3 \times \frac{4 \text{ mol NO}}{4 \text{ mol NH}_3} = 5.4 \text{ mol NO}$$

3 pt

$$PV = nRT$$

$$V = \frac{nRT}{P}$$

$$T = 30^\circ\text{C} + 273.15 = 303.15$$

3 pt

$$P = 750 \text{ mmHg} \times \frac{1 \text{ atm}}{760 \text{ mmHg}} = 0.987 \text{ atm}$$

3 pt

$$V = \frac{(5.4 \text{ mol NO})(0.08206 \frac{\text{L atm}}{\text{mol K}})(303.15 \text{ K})}{0.987 \text{ atm}}$$

$$V = 136.1 \text{ L}$$

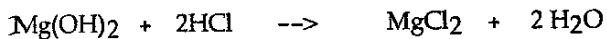
3 pt

NW but correct final # 15 pt

math - 1 pt

-10 attempt

22) For the following reaction:



a. If you combine 130 mL of 2.5 M of HCl and an excess of magnesium hydroxide, assuming complete reaction, how many grams of MgCl_2 will you make? (MW of magnesium chloride = 95.3 g/mol) (10 pts)

$$130 \text{ mL} \times \frac{2.5 \text{ mol HCl}}{1000 \text{ mL HCl soln}} \times \frac{1 \text{ mol MgCl}_2}{2 \text{ mol HCl}} \times \frac{95.3 \text{ g MgCl}_2}{1 \text{ mol MgCl}_2} = 15.4 \text{ g MgCl}_2$$

2 pt.

2 pt.

2 pt.

2 pt.

math -1

NW but final # correct -10 pt

-6 attempt

1 pt

2 pt

b. How many chloride ions are you generating as a part of the magnesium chloride product? (5 pts)

$$15.4 \text{ g MgCl}_2 \times \frac{1 \text{ mol MgCl}_2}{95.3 \text{ g MgCl}_2} \times \frac{2 \text{ mol Cl}}{1 \text{ mol MgCl}_2} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol Cl}} = 1.95 \times 10^{23} \text{ atoms Cl}$$

NW but final # correct -5 pt

$$130 \text{ mL} \times \frac{2.5 \text{ mol HCl}}{1000 \text{ mL HCl}} \times \frac{1 \text{ mol MgCl}_2}{2 \text{ mol HCl}} \times \frac{2 \text{ mol Cl}}{1 \text{ mol MgCl}_2} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol Cl}} = 1.96 \times 10^{23} \text{ atoms Cl}$$

attempt -3

math -1

Name _____

Name _____

print

sign

NA = not attempted

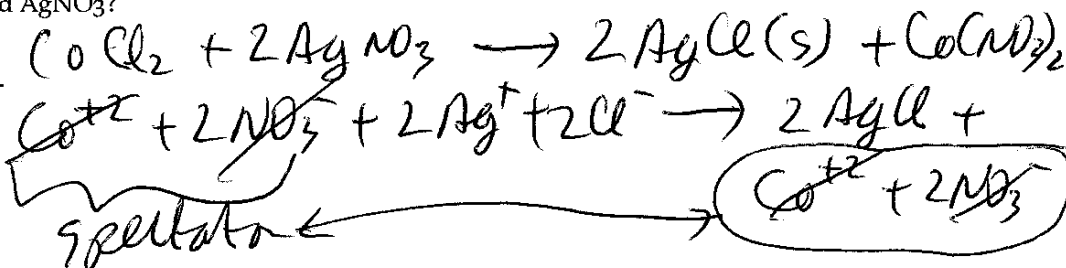
NW = no work

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$$K = ^\circ\text{C} + 273.15 \quad P = 760 \text{ mm Hg} = 760 \text{ torr} = 1 \text{ atm} \quad 1000 \text{ mL} = 1 \text{ L} \quad R = 0.08206 \text{ (L atm)/(mol K)} \quad N_A = 6.02 \times 10^{23}$$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (3 pts each, 33 pts total)

- 1) Which ion(s) is/are spectator ions in the formation of a precipitate of AgCl via combining aqueous solutions of CoCl_2 and AgNO_3 ? 1) _____

A) NO_3^- and Cl^- B) Co^{2+} and NO_3^- C) Co^{2+} and Ag^+ D) Cl^- E) NO_3^- 

- 2) Horizontal rows of the periodic table are known as _____ 2) _____
 A) nonmetals B) periods C) metals D) groups E) metalloids

- 3) The balanced reaction between aqueous nitric acid and aqueous strontium hydroxide is _____ 3) _____

A) $2\text{HNO}_3(\text{aq}) + \text{Sr}(\text{OH})_2(\text{aq}) \rightarrow \text{Sr}(\text{NO}_3)_2(\text{aq}) + 2\text{H}_2(\text{g})$ B) $\text{HNO}_3(\text{aq}) + \text{Sr}(\text{OH})_2(\text{aq}) \rightarrow \text{Sr}(\text{NO}_3)_2(\text{aq}) + \text{H}_2(\text{g})$ C) $2\text{HNO}_3(\text{aq}) + \text{Sr}(\text{OH})_2(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{Sr}(\text{NO}_3)_2(\text{aq})$ D) $\text{HNO}_3(\text{aq}) + \text{Sr}(\text{OH})_2(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{Sr}(\text{NO}_3)_2(\text{aq})$ E) $\text{HNO}_3(\text{aq}) + \text{SrOH}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{SrNO}_3(\text{aq})$

- 4) What is the formula of the compound formed between strontium ions and oxygen ions? 4) _____

A) Sr_2O B) SrO_3 C) Sr_2O_3 D) SrO E) SrO_2

- 5) At maximum, an f-subshell can hold _____ electrons, a d-subshell can hold _____ electrons, and a p-subshell can hold _____ electrons. 5) _____

A) 2, 6, 10

B) 14, 8, 2

C) 2, 8, 18

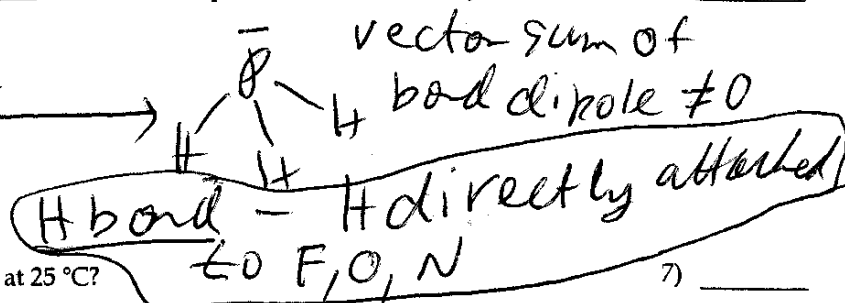
D) 14, 10, 6

E) 2, 12, 21

no partial credit MC

6) Of the following substances, only _____ has London dispersion forces as its only intermolecular force. 6) _____

- A) CCl_4
- B) CH_3COOH — H bonding
- C) PH_3 — H bonding
- D) H_2O — H bonding
- E) HF — H bonding



7) Which of the following is soluble in water at 25 °C? 7) _____

- A) $\text{Fe}_3(\text{PO}_4)_2$
- B) FeS
- C) $\text{Fe}(\text{NO}_3)_2$
- D) FeCO_3
- E) $\text{Fe}(\text{OH})_2$

all nitrates are water soluble
 OH^- , CO_3^{2-} , PO_4^{3-} , S^{2-} are insoluble except for exceptions

8) Which pair of elements is most apt to form an ionic compound with each other? 8) _____

- A) Ba, Br
- B) O, F
- C) Ca, Na
- D) S, F
- E) N, H

opposite side of periodic table

9) The density of NO_2 at 760.0 torr and 25.0 °C is _____ g/L. [$d = (P \cdot M) / (RT)$ derived from the ideal gas law ($M = \text{MW} = 46.01 \text{ g/mol NO}_2$)] 9) _____

10) A pressure of 1.25 atm is the same as a pressure of _____ of mm Hg. 10) _____

A) 1.88 B) 9.30 C) 1.64 D) 1.68 E) 3.27

$$d = [(760/760)(46.01)] / [(0.08206)(25 + 273.15)] = 1.88$$

11) What are the respective concentrations (M) of Na^+ and SO_4^{2-} afforded by dissolving 0.500 mol Na_2SO_4 in water to make a 1.33 L solution? 11) _____

- A) 1.33 and 0.665
- B) 0.376 and 0.752
- C) 0.752 and 0.376
- D) 0.665 and 1.33
- E) 0.665 and 0.665

$0.500 \text{ mol} = 0.376 \text{ M Na}_2\text{SO}_4$
 $1.33 \text{ L} \times 2 = 0.752 \text{ Na}^+$
 $+ 0.376 \text{ M SO}_4^{2-}$

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question. (37 pts total)

12) A molecule of PCl_5 has 1 atoms of P and 5 atoms of Cl and weighs _____ amu. (3 pts) 12) _____

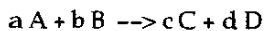
$30.97 + 5(35.5) = 208.47$
 math - 1/2 pt

13) If you have 31.2 g of the molecule NaCl (MW=58.5 g/mol) and dissolve it to make up 152 mL of solution, what is the molarity? Set up the answer by filling in the blanks. (4 pts) 13) _____

$M = (31.2 \text{ g} / 58.5 \text{ g/mol}) / (0.152 \text{ L}) \times (1000 \text{ mL})$
 1 pt each blank
 OK if reversed bc both divide 31.2

14) To calculate standard enthalpy for a reaction (4 pts)

14) _____



where the little letters represent moles and where the capital letters are the formula for the reactants and products:

$$(a) \Delta H^\circ = (c \Delta H_f^\circ C + d \Delta H_f^\circ D) - (a \Delta H_f^\circ A + b \Delta H_f^\circ B)$$

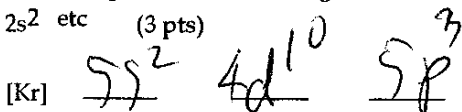
$$(b) \Delta H^\circ = (a \Delta H_f^\circ A + b \Delta H_f^\circ B) - (c \Delta H_f^\circ C + d \Delta H_f^\circ D)$$

[choose either (a) or (b)]

15) Show the complete electron configuration for the element Sb by filling in the format

15) _____

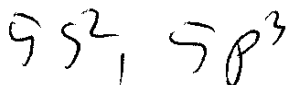
1s², 2s² etc (3 pts)



said 5 - 1

16) Show the valence electron configuration for the element Sb in the same format (3 pts)

16) _____

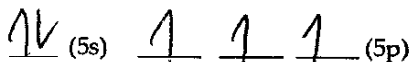


not valence - 1/2

gave 4d¹⁰ - 1

17) Show the valence electron configuration orbital diagram for the element Sb by drawing in electrons (as arrows) into the blank provided (Yes unlike the quiz these are indeed the orbitals that you need to add electrons into.) (3 pts)

17) _____



1/2 pt 5s

1/2 pt 5p

Hand violation - 1

18) In the periodic table, group IA to group IIA fills the (s, p, d, f) (circle one) subshell (3 pts)

18) _____

19)

19)

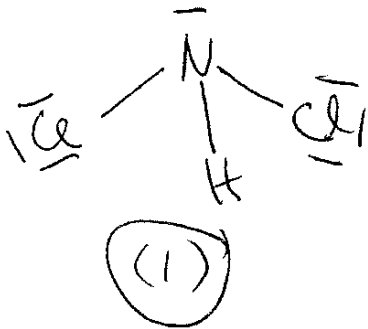
a. For the molecule HNCl_2 what is the number of valence electrons for the molecule (3 pts)

$$1 + 5 + 2(7) = 20$$

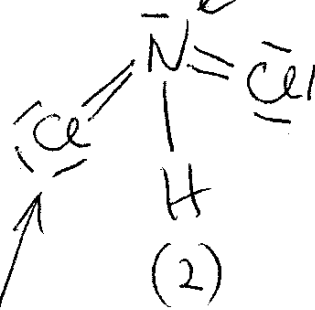
Partial Credit Math - $\frac{1}{2}$

no pts off NW here - could directly put into calculator

b. Which of the following is the correct Lewis Dot structure? (circle one of the two numbers) (4 pts)



$$10 \times 2 = 20e^-$$



expanded octet not allowed for 2nd period

$$12 \times 2 = 24e^-$$

too many e^-

expanded octet

20) For the following molecule for which I have provided a Lewis Dot Structure (7 pts, 1 pt per blank) _____

a. How many (VSEPR) electron pairs around the atom with the * 4

b. How many lone pairs on the atom with the * 2

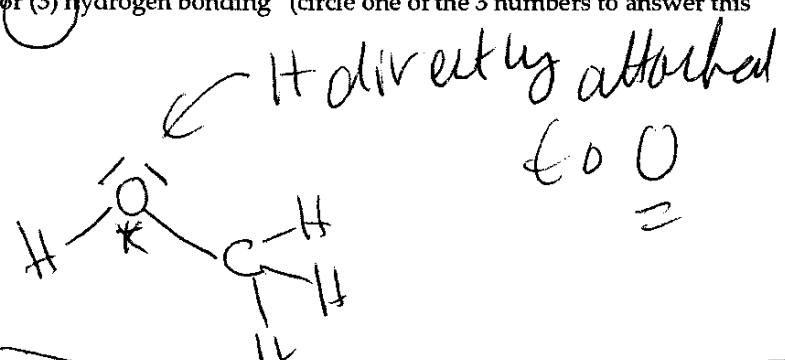
c. What is the geometry of the electrons around the atom with the * Tetrahedral

d. What is the geometry of the molecule around the atom with the * trig

e. What is the hybridization of the atom with the * sp³

f. Is the molecule as a whole (1) polar or (2) non polar (circle one of the two numbers) vector sum ≠ 0

g. The intermolecular interaction for the molecule is (1) dispersion forces (2) dipole-dipole interaction or (3) hydrogen bonding (circle one of the 3 numbers to answer this letter) (3)



Graded side - match my blank or consistent with your @ + ~~2~~ whichever gives better outcome

Long Answer. Write your answer in the space provided. Please show work for full credit and to receive partial credit for incorrect final answers. (Write legibly please.) (30 pts)

- 21) For the reaction $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{l})$
 if you start the reaction with 3.2 mol of ammonia and excess oxygen at 28 °C, 770 mm Hg, what volume of NO (g) will you collect? (15 pts)

$$3.2 \text{ mol NH}_3 \times \frac{4 \text{ mol NO}}{4 \text{ mol NH}_3} = 3.2 \text{ mol NO} \quad (3 \text{ pts})$$

$$T = 28^\circ\text{C} + 273.15 = 301.15 \quad (3 \text{ pts})$$

$$P = 770 \text{ mmHg} \times \frac{1 \text{ atm}}{760 \text{ mmHg}} = 1.01 \quad (3 \text{ pts})$$

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{(3.2 \text{ mol}) \left(0.08206 \frac{\text{L atm}}{\text{mol K}} \right) (301.15 \text{ K})}{(1.01 \text{ atm})} \quad (3 \text{ pts})$$

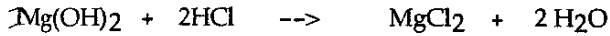
$$V = 78.3 \text{ L}$$

NW but correct final # - (-15)

math -1 pt

-10 attempt

22) For the following reaction:



a. If you combine 125 mL of 1.5 M of HCl and an excess of magnesium hydroxide, assuming complete reaction, how many grams of MgCl_2 will you make? (MW of magnesium chloride = 95.3 g/mol) (10 pts)

$$125 \text{ mL HCl soln} \times \frac{1.5 \text{ mol HCl}}{1000 \text{ mL HCl soln}} \times \frac{1 \text{ mol MgCl}_2}{2 \text{ mol HCl}} \times \frac{95.3 \text{ g}}{1 \text{ mol MgCl}_2}$$

2pt = 8.93 g MgCl_2

math -1
-6 attempt

NW but final correct -10 pt

NW but final correct -5

attempt -3 math -1

b. How many chloride ions are you generating as a part of the magnesium chloride product? (5 pts)

$$125 \text{ mL HCl soln} \times \frac{1.5 \text{ mol HCl}}{1000 \text{ mL HCl soln}} \times \frac{1 \text{ mol MgCl}_2}{2 \text{ mol HCl}} \times \frac{2 \text{ mol Cl}}{1 \text{ mol MgCl}_2}$$

$$\times \frac{6.02 \times 10^{23} \text{ atoms Cl}}{1 \text{ mol Cl}} = 1.13 \times 10^{23} \text{ atoms Cl}$$

or

$$8.93 \text{ g MgCl}_2 \times \frac{1 \text{ mol MgCl}_2}{95.3 \text{ g MgCl}_2} \times \frac{2 \text{ mol Cl}}{1 \text{ mol MgCl}_2} \times \frac{6.02 \times 10^{23} \text{ atoms Cl}}{1 \text{ mol Cl}} =$$

Name Key Name _____
 print _____ sign NW = no work

For long answer type questions, you must show all work for partial credit. If your work is not near the question that you are answering (or the work location is not clearly marked), I will not include the work in the grading. Please write legibly. (I cannot grade what I cannot read.) Please print your name on the top back of the exam so that I can return the quiz in a self serve fashion. (1 pts. for writing name on the back, 1 pt for printing and signing your name on the front of the exam) You may remove the periodic table to use it during the exam but please staple it back and return it with the exam. Reminder: mandatory ACS final exam and teaching evaluation on 12/13/11 T at 1:30 pm

$K = ^\circ C + 273.15$ $P = 760 \text{ mm Hg} = 760 \text{ torr} = 1 \text{ atm}$ $1000 \text{ mL} = 1 \text{ L}$ $R = 0.08206 \text{ (L atm) / (mol K)}$ $N_A = 6.02 \times 10^{23}$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (3 pts each, 33 pts total)

- 1) A pressure of 1.25 atm is the same as a pressure of _____ of mm Hg. 1) D
 A) 760. B) 33.0 C) 29.9 D) 950. E) 193

$1.25 \times 760 = 950$

- 2) The density of NO_2 at 780.0 torr and 37.0°C is _____ g/L. [$d = (Pm) / (RT)$ derived from the 2) B
 idea gas law ($m = \text{MW} = 46.01 \text{ g/mol NO}_2$)

- A) 1.64 B) 1.86 C) 9.30 D) 2.92 E) 3.27

$d = [(780/760)(46.01)/(0.08206)(37 + 273.15)] = 1.86$ 3) C

- 3) Vertical columns of the periodic table are known as _____. 3) C
 A) periods B) nonmetals C) groups D) metalloids E) metals

- 4) Which pair of elements would you expect to exhibit the greatest similarity in their physical and 4) C
 chemical properties?

- A) As, Br B) Br, Kr C) I, At D) N, O E) Mg, Al

I & At in same group

- 5) Which of the following is insoluble in water at 25°C ? 5) E

- A) $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2$ CO_3^{2-} , OH^- , S^- - insoluble except for NH_4^+ & alkali metal ions, OH^- exception
 B) $(\text{NH}_4)_2\text{CO}_3$
 C) $\text{Ca}(\text{OH})_2$
 D) Na_2S
 Ca^{+2} , all acetate ($\text{C}_2\text{H}_3\text{COO}^- = \text{C}_2\text{H}_3\text{O}_2$) soluble

Mg^{+2} is not alkali metal & is insoluble

- 6) At maximum, an f-subshell can hold 14 electrons, a d-subshell can hold 10 6) A
 electrons, and a p-subshell can hold 6 electrons.

- A) 14, 10, 6 B) 2, 8, 18 C) 2, 6, 10 D) 14, 8, 2 E) 2, 12, 21

- 7) The elements in the _____ period of the periodic table have a core-electron configuration 7) E
 that is the same as the electron configuration of neon.

- A) fifth B) first C) second D) fourth E) third

2nd group end = [Ne]

every element in 3rd group has [Ne] core

No partial credit MC

- 8) What are the respective concentrations (M) of K^+ and PO_4^{3-} afforded by dissolving 0.800 mol K_3PO_4 in water to make a 1.63 L solution? 8) D
- A) 0.800 and 0.491
 B) 0.491 and 0.491
 C) 0.489 and 0.163
 D) 1.44 and 0.491
 E) 0.800 and 0.800
- $0.800 \text{ mol} / 1.63 \text{ L} = 0.491 \text{ M} \rightarrow 3K^+ + PO_4^{3-}$
 $3(0.491) = 1.473 = K^+$
 $PO_4^{3-} = 0.491$

- 9) Which one of the following is most likely to lose electrons when forming an ion? 9) A
- A) Na B) F C) N D) P E) S
- metals - elements on left side of periodic table

- 10) Potassium is a _____ and chlorine is a _____. 10) A
- A) metal, nonmetal
 B) metal, metal
 C) nonmetal, metal
 D) metal, metalloid
 E) metalloid, nonmetal
- K left side periodic table - metal
- Cl right side periodic table nonmetal

- 11) Of the following substances, only _____ has London dispersion forces as its only intermolecular force. 11) D
- A) CH_3OH B) H_2O C) NH_3 D) CH_4 E) HCl
- H bond H bond H bond
tetrahedral
- dipole-dipole polar

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question. (37 pts total)

- 12) A molecule of SF_6 has 1 atoms of S and 6 atoms of F and weighs 146.1 amu. (3 pts) 12) _____
- $32.1 + 6(19.0) = 146.1$
- H directly attached to F, O, N H bonding math - 2pt

- 13) If you have 31.2 g of the molecule $NaCl$ (MW=58.5 g/mol) and dissolve it to make up 152 mL of solution, what is the molarity? Set up the answer by filling in the blanks. (4 pts) 13) _____
- 1pt each blank

$$M = \frac{31.2 \text{ g} / 58.5 \text{ g/mol}}{(152 \text{ mL}) \times (1 / 1000 \text{ mL})}$$

OK if reversed bc both divide 31.2

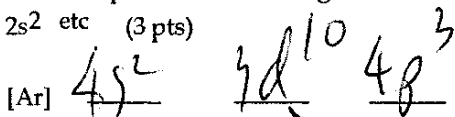
- 14) To calculate standard enthalpy for a reaction (4 pts) 14) _____
- $aA + bB \rightarrow cC + dD$

(where the little letters represent moles and where the capital letters are the formula for the reactants and products:

(a) $\Delta H^\circ = (c\Delta H_f^\circ C + d\Delta H_f^\circ D) - (a\Delta H_f^\circ A + b\Delta H_f^\circ B)$
 (b) $\Delta H^\circ = (a\Delta H_f^\circ A + b\Delta H_f^\circ B) - (c\Delta H_f^\circ C + d\Delta H_f^\circ D)$
 [choose either (a) or (b)]

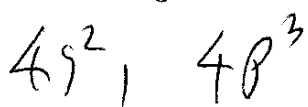
15) Show the complete electron configuration for the element As by filling in the format 15) _____

1s², 2s² etc (3 pts)



Said 4d¹⁰ -1

16) Show the valence electron configuration for the element As in the same format (3 pts) 16) _____

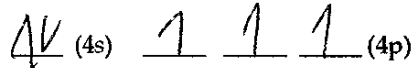


Not valence - 1/2

gave 3d¹⁰ -1

17) Show the valence electron configuration orbital diagram for the element As by 17) _____

drawing in electrons (as arrows) into the blank provided (Yes unlike the quiz these are indeed the orbitals that you need to add electrons into.) (3 pts)



1/2 pt 4s

Hand violat in -1

1/2 pt 4p

18) In the periodic table, group IIIB to group IIB fills the (s, p, d, f) (circle one) subshell (3 pts) 18) _____

19) a. For the molecule Cl₂C₂H₂ what is the number of valence electrons for the molecule (3 pts) 19) _____

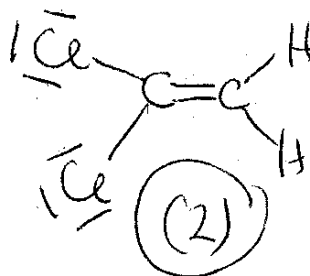
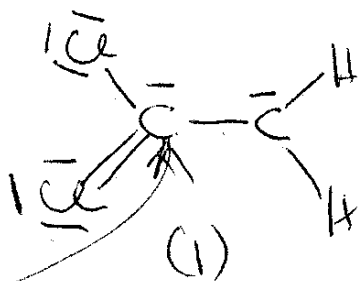
$$(7)2 + (4)2 + (1)2 = 24$$



partial credit - math - 5

NO pts off NW - could have put into calculator

b. Which of the following is the correct Lewis Dot structure? (circle one of the two numbers) (4 pts)



$$14 \times 2 = 28$$

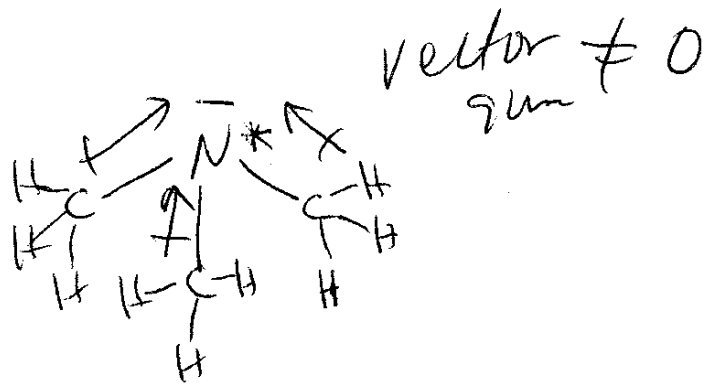
600 more e

C cannot expand octet - 2nd period

$$12 \times 2 = 24e$$

20) For the following molecule for which I have provided a Lewis Dot Structure (7 pts, 1 pt per blank) _____

- a. How many (VSEPR) electron pairs around the atom with the * 4
- b. How many lone pairs on the atom with the * 1
- c. What is the geometry of the electrons around the atom with the * Tetrahedral
- d. What is the geometry of the molecule around the atom with the * trigonal pyramidal
- e. What is the hybridization of the atom with the * sp³
- f. Is the molecule as a whole (1) polar or (2) non polar (circle one of the two numbers)
- g. The intermolecular interaction for the molecule is (1) dispersion forces (2) dipole dipole interaction or (3) hydrogen bonding (circle one of the 3 numbers to answer this letter)



Graded c, d, e - match my blank
or consistent with your @ + @
which ever better outcome

Long Answer. Write your answer in the space provided. Please show work for full credit and to receive partial credit for incorrect final answers. (Write legibly please.) (30 pts)

- 21) For the reaction $\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$ if you start the reaction with 2.3 mol of HCl at 34.5 °C and collect the CO_2 in a container with a rigid volume of 255 mL what will be the pressure of the CO_2 in the container? You should assume that the reaction goes to completion and that you have a large excess of the calcium carbonate. (15 pts)

$$2.3 \text{ mol HCl} \times \frac{1 \text{ mol CO}_2}{2 \text{ mol HCl}} = 1.15 \text{ mol CO}_2 \quad (3 \text{ pt})$$

$$T = 34.5^\circ\text{C} + 273.15 = 307.65 \text{ K} \quad (3 \text{ pt})$$

$$V = 255 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 0.255 \text{ L} \quad (3 \text{ pt})$$

$$PV = nRT$$

$$P = \frac{nRT}{V} = \frac{(1.15 \text{ mol CO}_2)(0.08206 \frac{\text{L atm}}{\text{mol K}})(307.65 \text{ K})}{(0.255 \text{ L})}$$

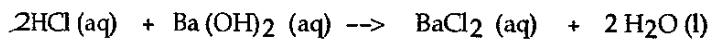
$$P = 113 \text{ atm} \quad (3 \text{ pt})$$

NW but final correct # -15.

(math -1 pt)

(-10 attempt)

22) For the following reaction:



a. If you combine 150 mL of 1.5 M of HCl and an excess of barium hydroxide, assuming complete reaction, how many grams of water will you make? (MW of water = 18.02 g/mol) (10 pts)

$$\begin{array}{l} 150 \text{ mL} \\ \text{HCl} \\ \text{soln} \end{array} \times \frac{1.5 \text{ mol HCl}}{1000 \text{ mL HCl soln}} \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol HCl}} \times \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}}$$
$$= 4.05 \text{ g H}_2\text{O}$$

b. How many H^+ ions (as a part of the water product molecule) are you generating? (5 pts)

$$\begin{array}{l} 150 \text{ mL} \\ \text{HCl} \\ \text{soln.} \end{array} \times \frac{1.5 \text{ mol HCl}}{1000 \text{ mL HCl soln.}} \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol HCl}} \times \frac{2 \text{ mol H}^+}{1 \text{ mol H}_2\text{O}}$$
$$\times \frac{6.02 \times 10^{23} \text{ atoms H}^+}{1 \text{ mol H}^+} = 2.71 \times 10^{23} \text{ atoms H}^+$$

Name Key Name _____
 print NA = not attempted sign NW = no work

For long answer type questions, you must show all work for partial credit. If your work is not near the question that you are answering (or the work location is not clearly marked), I will not include the work in the grading. Please write legibly. (I cannot grade what I cannot read.) Please print your name on the top back of the exam so that I can return the quiz in a self serve fashion. (1 pts. for writing name on the back, 1 pt for printing and signing your name on the front of the exam) You may remove the periodic table to use it during the exam but please staple it back and return it with the exam. Reminder: mandatory ACS final exam and teaching evaluation on 12/13/11 T at 1:30 pm

$K = ^\circ C + 273.15$ $P = 760 \text{ mm Hg} = 760 \text{ torr} = 1 \text{ atm}$ $1000 \text{ mL} = 1 \text{ L}$ $R = 0.08206 \text{ (L atm)/(mol K)}$ $N_A = 6.02 \times 10^{23}$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (3 pts each, 33 pts total)

1) The density of NO₂ at 780.0 torr and 37.0 °C is _____ g/L. [$d = (Pm) / (RT)$ derived from the ideal gas law ($m = MW = 46.01 \text{ g/mol NO}_2$)] 1) B

A) 9.30 B) 1.86 C) 3.27 D) 1.64 E) 2.92
 $d = \frac{(780/760)(46.01)}{(0.08206)(37+273.15)} = 1.86$

2) Vertical columns of the periodic table are known as _____ 2) D

- A) metalloids B) periods C) metals D) groups E) nonmetals

Not directly attached to F, O, N - H bond

3) Of the following substances, only _____ has London dispersion forces as its only intermolecular force. 3) B

- A) HCl B) CH₄ C) CH₃OH D) NH₃ E) H₂O
dipole tetrahedral H bond H bond H bond

4) Which of the following is insoluble in water at 25 °C? 4) A

- A) Mg₃(PO₄)₂ - Mg is alkaline earth & insoluble
 B) (NH₄)₂CO₃
 C) Ba(C₂H₃O₂)₂
 D) Ca(OH)₂
 E) Na₂S
all acetates [CH₃COO⁻ = C₂H₃O₂] soluble
 CO₃²⁻, OH⁻, S²⁻ insoluble except for NH₄⁺ & alkali metals, OH⁻ exception Ca²⁺

5) Potassium is a _____ and chlorine is a _____ 5) B

- A) metal, metal
 B) metal, nonmetal
 C) nonmetal, metal
 D) metal, metalloid
 E) metalloid, nonmetal
left side - metal (K⁺)
 right side - nonmetal (Cl⁻)

6) What are the respective concentrations (M) of K⁺ and PO₄³⁻ afforded by dissolving 0.800 mol K₃PO₄ in water to make a 1.63 L solution? 6) C

A) 0.491 and 0.491
 B) 0.800 and 0.491
 C) 1.44 and 0.491
 D) 0.489 and 0.163
 E) 0.800 and 0.800
 $\frac{0.800 \text{ mol}}{1.63 \text{ L}} = 0.491 \text{ M}$
 $K_3PO_4 \rightarrow 3K^+ + PO_4^{3-}$
3(0.491) (0.491)
 1.473 = K⁺ (PO₄³⁻)

No partial credit MC

7) Which pair of elements would you expect to exhibit the greatest similarity in their physical and chemical properties?

- (A) I, At B) As, Br C) N, O D) Br, Kr E) Mg, Al

7) A

8) A pressure of 1.25 atm is the same as a pressure of _____ of mm Hg.

- A) 760. B) 33.0 C) 193 (D) 950. E) 29.9

8) D

same group

$1.25 \times 760 = 950$

9) Which one of the following is most likely to lose electrons when forming an ion?

- (A) Na B) F C) S D) P E) N

9) A

metal - left side periodic table

10) At maximum, an f-subshell can hold 14 electrons, a d-subshell can hold 10 electrons, and a p-subshell can hold 6 electrons.

- A) 2, 8, 18 B) 14, 8, 2 C) 2, 12, 21 (D) 14, 10, 6 E) 2, 6, 10

10) D

11) The elements in the _____ period of the periodic table have a core-electron configuration that is the same as the electron configuration of neon.

- A) first B) fifth C) fourth D) second (E) third

11) E

(Ne) end of 2nd period → all 3rd period elements have (Ne) core
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question. (37 pts total)

12) A molecule of NO₂ has 1 atoms of N and 2 atoms of O and

12) _____

weighs 46.01 amu. (3 pts)

$14.01 + 2(16.0) = 46.01$

math - 2

13) If you have 15.2 g of the molecule CaCl₂ (MW= 111.1 g/mol) and dissolve it to make up 235 mL of solution, what is the molarity? Set up the answer by filling in the blanks (4 pts)

13) _____

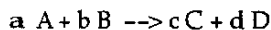
$M = \frac{15.2 \text{ g} / 111.1 \text{ g/mol}}{(235 \text{ mL}) \times (1 \text{ L} / 1000 \text{ mL})}$

1 pt each blank

OK if reversed bc both divide 15.2

14) To calculate standard enthalpy for a reaction (4 pts)

14) _____



(where the little letters represent moles and where the capital letters are the formula for the reactants and products:

(a) $\Delta H^\circ = (c \Delta H_f^\circ C + d \Delta H_f^\circ D) - (a \Delta H_f^\circ A + b \Delta H_f^\circ B)$

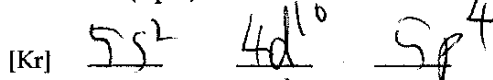
(b) $\Delta H^\circ = (a \Delta H_f^\circ A + b \Delta H_f^\circ B) - (c \Delta H_f^\circ C + d \Delta H_f^\circ D)$

[choose either (a) or (b)]

15) Show the complete electron configuration for the element Te by filling in the format

15) _____

1s², 2s² etc (3 pts)

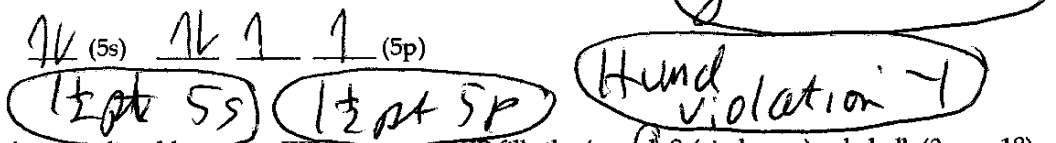


said 5d¹⁰ - 1

16) Show the valence electron configuration for the element Te in the same format (3 pts) 16)



17) Show the valence electron configuration orbital diagram for the element Te by drawing in electrons (as arrows) into the blank provided (Yes unlike the quiz these are indeed the orbitals that you need to add electrons into.) (3 pts) 17)



18) In the periodic table, group IIIA to group IIB fills the (s, p, d, f) (circle one) subshell (3 pts) 18)

19) a. For the molecule HOCH₃ what is the number of valence electrons for the molecule (3 pts)

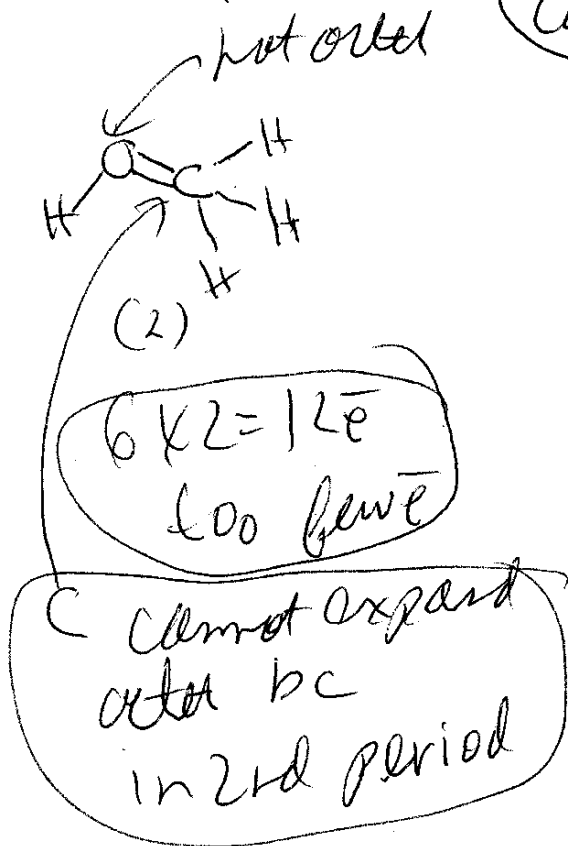
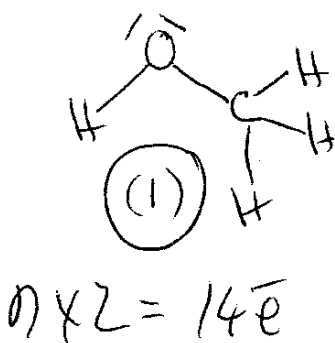
math - 1/2 pt

$$1 + 6 + 4 + 3(1) = 14e^-$$

H O C H

no pts off NW - could have put into calculator

b. Which of the following is the correct Lewis Dot structure? (circle one of the two numbers) (4 pts)



20) For the following molecule for which I have provided a Lewis Dot Structure (7 pts, 1 pt per blank) _____

a. How many (VSEPR) electron pairs around the atom with the * 3

b. How many lone pairs on the atom with the * 0

c. What is the geometry of the electrons around the atom with the * trigonal planar

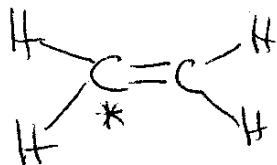
d. What is the geometry of the molecule around the atom with the * trigonal planar

e. What is the hybridization of the atom with the * SP²

f. Is the molecule as a whole (1) polar or (2) non polar (circle one of the two numbers)

g. The intermolecular interaction for the molecule is (1) dispersion forces (2) dipole-dipole interaction or (3) hydrogen bonding (circle one of the 3 numbers to answer this letter)

vector sum = 0



graded c, d, e - match my blank or consistent with your @ + (b) whichever gives better outcome

Long Answer. Write your answer in the space provided. Please show work for full credit and to receive partial credit for incorrect final answers. (Write legibly please.) (30 pts)

- 21) For the reaction $\text{CaCO}_3(s) + 2\text{HCl}(aq) \rightarrow \text{CaCl}_2(aq) + \text{H}_2\text{O}(l) + \text{CO}_2(g)$ if you start the reaction with 3.3 mol of HCl at 22.5 °C and collect the CO_2 in a container with a rigid volume of 125 mL what will be the pressure of the CO_2 in the container? You should assume that the reaction goes to completion and that you have a large excess of the calcium carbonate. (15 pts)

$$3.3 \text{ mol HCl} \times \frac{1 \text{ mol CO}_2}{2 \text{ mol HCl}} = 1.65 \text{ mol CO}_2 \quad (3 \text{ pt})$$

$$T = 22.5 + 273.15 = 295.65 \text{ K} \quad (3 \text{ pt})$$

$$V = 125 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 0.125 \text{ L} \quad (3 \text{ pt})$$

$$PV = nRT$$

$$P = \frac{nRT}{V} = \frac{(1.65 \text{ mol CO}_2)(0.08206 \frac{\text{L atm}}{\text{mol K}})(295.65 \text{ K})}{(0.125 \text{ L})}$$

$$P = 320.2 \text{ atm}$$

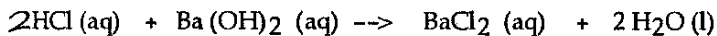
(3 pt)

NW but correct final # -15 pt.

math -1 pt

-10 attempt

22) For the following reaction:



a. If you combine 130 mL of 2.5 M of HCl and an excess of barium hydroxide, assuming complete reaction, how many grams of water will you make? (MW of water = 18.02 g/mol) (10 pts)

$$130 \text{ mL HCl soln} \times \frac{2.5 \text{ mol HCl}}{1000 \text{ mL HCl soln}} \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol HCl}} \times \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 5.86 \text{ g H}_2\text{O}$$

2 pt (circled) 2 pt (circled) 2 pt (circled)

Math -1

NW but final # correct -10 pts

-6 attempt

Math -1 attempt -3

NW but final correct # -5

b. How many H⁺ ions (as a part of the water product molecule) are you generating? (5 pts)

$$130 \text{ mL HCl soln} \times \frac{2.5 \text{ mol HCl}}{1000 \text{ mL HCl soln}} \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol HCl}} \times \frac{2 \text{ mol H}^+}{1 \text{ mol H}_2\text{O}} = 3.91 \times 10^{23} \text{ atoms H}^+$$

$$\times \frac{6.02 \times 10^{23} \text{ atoms H}^+}{1 \text{ mol H}^+} = 3.91 \times 10^{23} \text{ atoms H}^+$$

or

$$5.86 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \times \frac{2 \text{ mol H}^+}{1 \text{ mol H}_2\text{O}} \times \frac{6.02 \times 10^{23} \text{ atoms H}^+}{1 \text{ mol H}^+} = 3.91 \times 10^{23} \text{ atoms H}^+$$

1 pt (circled) 2 pt (circled) 2 pt (circled)

Name _____
print

Name _____
sign

For long answer type questions, you must show all work for partial credit. If your work is not near the question that you are answering (or the work location is not clearly marked), I will not include the work in the grading. Please write legibly. (I cannot grade what I cannot read.) Please print your name on the top back of the exam so that I can return the quiz in a self serve fashion. (1 pts. for writing name on the back, 1 pt for printing and signing your name on the front of the exam) You may remove the periodic table to use it during the exam but please staple it back and return it with the exam. Reminder: mandatory ACS final exam and teaching evaluation on 12/13/11 T at 1:30 pm

$$K = ^\circ C + 273.15 \quad P = 760 \text{ mm Hg} = 760 \text{ torr} = 1 \text{ atm} \quad 1000 \text{ mL} = 1 \text{ L} \quad R = 0.08206 \text{ (L atm)/(mol K)} \quad N_A = 6.02 \times 10^{23}$$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (3 pts each, 33 pts total)

- 1) What is the formula of the compound formed between strontium ions and oxygen ions? 1) _____
 A) Sr₂O B) SrO C) SrO₂ D) Sr₂O₃ E) SrO₃

- 2) At maximum, an f-subshell can hold _____ electrons, a d-subshell can hold _____ electrons, and a p-subshell can hold _____ electrons. 2) _____
 A) 2, 6, 10 B) 2, 8, 18 C) 14, 10, 6 D) 2, 12, 21 E) 14, 8, 2

- 3) Which ion(s) is/are spectator ions in the formation of a precipitate of AgCl via combining aqueous solutions of CoCl₂ and AgNO₃? 3) _____
 A) Co²⁺ and NO₃⁻
 B) NO₃⁻ and Cl⁻
 C) Co²⁺ and Ag⁺
 D) NO₃⁻
 E) Cl⁻

- 4) The density of NO₂ of at 760.0 torr and 25.0 °C is _____ g/L. [d = (P *m*) / (RT) derived from the idea gas law (*m* = MW = 46.01 g / mol NO₂)] 4) _____
 A) 3.27 B) 1.64 C) 1.88 D) 9.30 E) 1.68

- 5) What are the respective concentrations (M) of Na⁺ and SO₄²⁻ afforded by dissolving 0.500 mol Na₂SO₄ in water to make a 1.33 L solution? 5) _____
 A) 0.376 and 0.752
 B) 0.752 and 0.376
 C) 1.33 and 0.665
 D) 0.665 and 1.33
 E) 0.665 and 0.665

- 6) A pressure of 1.25 atm is the same as a pressure of _____ of mm Hg. 6) _____
 A) 760. B) 193 C) 33.0 D) 29.9 E) 950.

- 7) Horizontal rows of the periodic table are known as _____. 7) _____
 A) nonmetals B) metals C) periods D) groups E) metalloids

- 8) Which of the following is soluble in water at 25 °C? 8) _____
 A) Fe(OH)₂
 B) FeCO₃
 C) Fe₃(PO₄)₂
 D) Fe(NO₃)₂
 E) FeS
- 9) Which pair of elements is most apt to form an ionic compound with each other? 9) _____
 A) N, H B) O, F C) Ca, Na D) S, F E) Ba, Br
- 10) The balanced reaction between aqueous nitric acid and aqueous strontium hydroxide is 10) _____

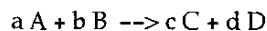
 A) HNO₃ (aq) + SrOH (aq) → H₂O (l) + SrNO₃ (aq)
 B) 2HNO₃ (aq) + Sr(OH)₂ (aq) → Sr(NO₃)₂ (aq) + 2H₂ (g)
 C) HNO₃ (aq) + Sr(OH)₂ (aq) → H₂O (l) + Sr(NO₃)₂ (aq)
 D) HNO₃ (aq) + Sr(OH)₂ (aq) → Sr(NO₃)₂ (aq) + H₂ (g)
 E) 2HNO₃ (aq) + Sr(OH)₂ (aq) → 2H₂O (l) + Sr(NO₃)₂ (aq)
- 11) Of the following substances, only _____ has London dispersion forces as its only 11) _____
 intermolecular force.
 A) HF
 B) CH₃COOH
 C) PH₃
 D) CCl₄
 E) H₂O

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question. (37 pts total)

- 12) A molecule of SO₂ has _____ atoms of S and _____ atoms of O and 12) _____
 weighs _____ amu. (3 pts)
- 13) If you have 15.2 g of the molecule CaCl₂ (MW=111.1 g/mol) and dissolve it to make 13) _____
 up 325 mL of solution, what is the molarity? Set up the answer by filling in the blanks. (4
 pts)
- $$M = \left(\frac{\quad}{\quad} \right) \times \left(\frac{1}{\quad} \right)$$

14) To calculate standard enthalpy for a reaction (4 pts)

14) _____



where the little letters represent moles and where the capital letters are the formula for the reactants and products:

$$(a) \Delta H^\circ = (c \Delta H_f^\circ C + d \Delta H_f^\circ D) - (a \Delta H_f^\circ A + b \Delta H_f^\circ B)$$

$$(b) \Delta H^\circ = (a \Delta H_f^\circ A + b \Delta H_f^\circ B) - (c \Delta H_f^\circ C + d \Delta H_f^\circ D)$$

[choose either (a) or (b)]

15) Show the complete electron configuration for the element Br by filling in the format $1s^2, 2s^2$ etc (3 pts)

15) _____

[Ar] _____

16) Show the valence electron configuration for the element Br in the same format (3 pts)

16) _____

17) Show the valence electron configuration orbital diagram for the element Br by drawing in electrons (as arrows) into the blank provided (Yes unlike the quiz these are indeed the orbitals that you need to add electrons into.) (3 pts)

17) _____

_____ (4s) _____ (4p)

18) In the periodic table, group IA to group IIA fills the (s, p, d, f) (circle one) subshell (3 pts)

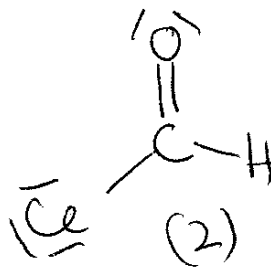
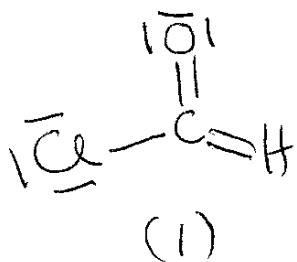
18) _____

19)

19) _____

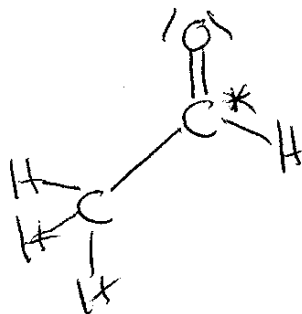
a. For the molecule ClCOH what is the number of valence electrons for the molecule (3 pts)

b. Which of the following is the correct Lewis Dot structure? (circle one of the two numbers) (4 pts)

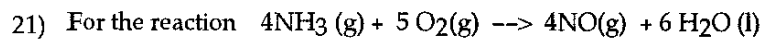


20) For the following molecule for which I have provided a Lewis Dot Structure (7 pts, 1 pt per blank) _____

- How many (VSEPR) electron pairs around the atom with the * _____
- How many lone pairs on the atom with the * _____
- What is the geometry of the electrons around the atom with the * _____
- What is the geometry of the molecule around the atom with the * _____
- What is the hybridization of the atom with the * _____
- Is the molecule as a whole (1) polar or (2) non polar (circle one of the two numbers)
- The intermolecular interaction for the molecule is (1) dispersion forces (2) dipole dipole interaction or (3) hydrogen bonding (circle one of the 3 numbers to answer this letter)

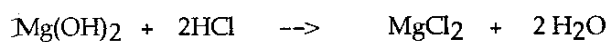


Long Answer. Write your answer in the space provided. Please show work for full credit and to receive partial credit for incorrect final answers. (Write legibly please.) (30 pts)



if you start the reaction with 5.4 mol of ammonia and excess oxygen at 30 °C, 750 mm Hg, what volume of NO (g) will you collect? (15 pts)

22) For the following reaction:



a. If you combine 130 mL of 2.5 M of HCl and an excess of magnesium hydroxide, assuming complete reaction, how many grams of MgCl_2 will you make? (MW of magnesium chloride = 95.3 g / mol) (10 pts)

b. How many chloride ions are you generating as a part of the magnesium chloride product? (5 pts)

Name _____
printName _____
sign

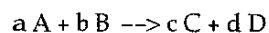
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$$K = ^\circ C + 273.15 \quad P = 760 \text{ mm Hg} = 760 \text{ torr} = 1 \text{ atm} \quad 1000 \text{ mL} = 1 \text{ L} \quad R = 0.08206 \text{ (L atm)/(mol K)} \quad N_A = 6.02 \times 10^{23}$$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (3 pts each, 33 pts total)

- 1) Which ion(s) is/are spectator ions in the formation of a precipitate of AgCl via combining aqueous solutions of CoCl_2 and AgNO_3 ? 1) _____
- A) NO_3^- and Cl^-
 B) Co^{2+} and NO_3^-
 C) Co^{2+} and Ag^+
 D) Cl^-
 E) NO_3^-
- 2) Horizontal rows of the periodic table are known as _____. 2) _____
- A) nonmetals B) periods C) metals D) groups E) metalloids
- 3) The balanced reaction between aqueous nitric acid and aqueous strontium hydroxide is _____. 3) _____
- A) $2\text{HNO}_3(\text{aq}) + \text{Sr}(\text{OH})_2(\text{aq}) \rightarrow \text{Sr}(\text{NO}_3)_2(\text{aq}) + 2\text{H}_2(\text{g})$
 B) $\text{HNO}_3(\text{aq}) + \text{Sr}(\text{OH})_2(\text{aq}) \rightarrow \text{Sr}(\text{NO}_3)_2(\text{aq}) + \text{H}_2(\text{g})$
 C) $2\text{HNO}_3(\text{aq}) + \text{Sr}(\text{OH})_2(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{Sr}(\text{NO}_3)_2(\text{aq})$
 D) $\text{HNO}_3(\text{aq}) + \text{Sr}(\text{OH})_2(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{Sr}(\text{NO}_3)_2(\text{aq})$
 E) $\text{HNO}_3(\text{aq}) + \text{SrOH}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{SrNO}_3(\text{aq})$
- 4) What is the formula of the compound formed between strontium ions and oxygen ions? 4) _____
- A) Sr_2O B) SrO_3 C) Sr_2O_3 D) SrO E) SrO_2
- 5) At maximum, an f-subshell can hold _____ electrons, a d-subshell can hold _____ electrons, and a p-subshell can hold _____ electrons. 5) _____
- A) 2, 6, 10 B) 14, 8, 2 C) 2, 8, 18 D) 14, 10, 6 E) 2, 12, 21

14) To calculate standard enthalpy for a reaction (4 pts) 14) _____



where the little letters represent moles and where the capital letters are the formula for the reactants and products:

$$(a) \Delta H^\circ = (c \Delta H_f^\circ C + d \Delta H_f^\circ D) - (a \Delta H_f^\circ A + b \Delta H_f^\circ B)$$

$$(b) \Delta H^\circ = (a \Delta H_f^\circ A + b \Delta H_f^\circ B) - (c \Delta H_f^\circ C + d \Delta H_f^\circ D)$$

[choose either (a) or (b)]

15) Show the complete electron configuration for the element **Sb** by filling in the format $1s^2, 2s^2$ etc (3 pts) 15) _____

[Kr] _____

16) Show the valence electron configuration for the element **Sb** in the same format (3 pts) 16) _____

17) Show the valence electron configuration orbital diagram for the element **Sb** by drawing in electrons (as arrows) into the blank provided (Yes unlike the quiz these are indeed the orbitals that you need to add electrons into.) (3 pts) 17) _____

_____ (5s) _____ (5p)

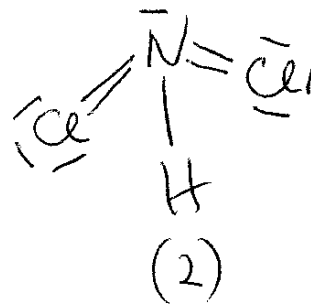
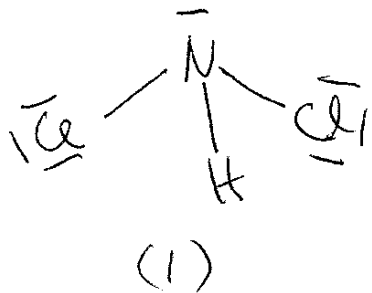
18) In the periodic table, group IA to group IIA fills the (s, p, d, f) (circle one) subshell (3 pts) 18) _____

19)

19) _____

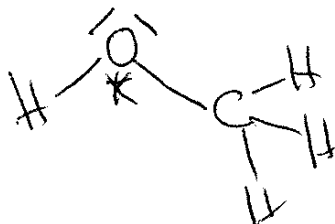
a. For the molecule HNCl_2 what is the number of valence electrons for the molecule (3 pts)

b. Which of the following is the correct Lewis Dot structure? (circle one of the two numbers) (4 pts)

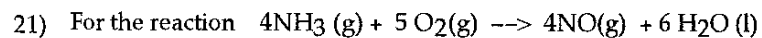


20) For the following molecule for which I have provided a Lewis Dot Structure (7 pts, 1 pt per blank) _____

- How many (VSEPR) electron pairs around the atom with the * _____
- How many lone pairs on the atom with the * _____
- What is the geometry of the electrons around the atom with the * _____
- What is the geometry of the molecule around the atom with the * _____
- What is the hybridization of the atom with the * _____
- Is the molecule as a whole (1) polar or (2) non polar (circle one of the two numbers)
- The intermolecular interaction for the molecule is (1) dispersion forces (2) dipole dipole interaction or (3) hydrogen bonding (circle one of the 3 numbers to answer this letter)

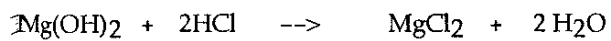


Long Answer. Write your answer in the space provided. Please show work for full credit and to receive partial credit for incorrect final answers. (Write legibly please.) (30 pts)



if you start the reaction with 3.2 mol of ammonia and excess oxygen at 28 °C, 770 mm Hg, what volume of NO (g) will you collect? (15 pts)

22) For the following reaction:



a. If you combine 125 mL of 1.5 M of HCl and an excess of magnesium hydroxide, assuming complete reaction, how many grams of MgCl_2 will you make? (MW of magnesium chloride = 95.3 g/mol) (10 pts)

b. How many chloride ions are you generating as a part of the magnesium chloride product? (5 pts)

Name _____
print

Name _____
sign

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$K = ^\circ C + 273.15$ $P = 760 \text{ mm Hg} = 760 \text{ torr} = 1 \text{ atm}$ $1000 \text{ mL} = 1 \text{ L}$ $R = 0.08206 \text{ (L atm)/(mol K)}$ $N_A = 6.02 \times 10^{23}$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (3 pts each, 33 pts total)

- 1) A pressure of 1.25 atm is the same as a pressure of _____ of mm Hg. 1) _____
 A) 760. B) 33.0 C) 29.9 D) 950. E) 193
- 2) The density of NO₂ at 780.0 torr and 37.0 °C is _____ g/L. [$d = (Pm) / (RT)$ derived from the 2) _____
 idea gas law ($m = MW = 46.01 \text{ g / mol NO}_2$)]
 A) 1.64 B) 1.86 C) 9.30 D) 2.92 E) 3.27
- 3) Vertical columns of the periodic table are known as _____. 3) _____
 A) periods B) nonmetals C) groups D) metalloids E) metals
- 4) Which pair of elements would you expect to exhibit the greatest similarity in their physical and 4) _____
 chemical properties?
 A) As, Br B) Br, Kr C) I, At D) N,O E) Mg, Al
- 5) Which of the following is insoluble in water at 25 °C? 5) _____
 A) Ba(C₂H₃O₂)₂
 B) (NH₄)₂CO₃
 C) Ca(OH)₂
 D) Na₂S
 E) Mg₃(PO₄)₂
- 6) At maximum, an f-subshell can hold _____ electrons, a d-subshell can hold _____ 6) _____
 electrons, and a p-subshell can hold _____ electrons.
 A) 14, 10, 6 B) 2, 8, 18 C) 2, 6, 10 D) 14, 8, 2 E) 2, 12, 21
- 7) The elements in the _____ period of the periodic table have a core-electron configuration 7) _____
 that is the same as the electron configuration of neon.
 A) fifth B) first C) second D) fourth E) third

- 8) What are the respective concentrations (M) of K^+ and PO_4^{3-} afforded by dissolving 0.800 mol K_3PO_4 in water to make a 1.63 L solution? 8) _____
- A) 0.800 and 0.491
 B) 0.491 and 0.491
 C) 0.489 and 0.163
 D) 1.44 and 0.491
 E) 0.800 and 0.800
- 9) Which one of the following is most likely to lose electrons when forming an ion? 9) _____
- A) Na B) F C) N D) P E) S
- 10) Potassium is a _____ and chlorine is a _____. 10) _____
- A) metal, nonmetal
 B) metal, metal
 C) nonmetal, metal
 D) metal, metalloid
 E) metalloid, nonmetal
- 11) Of the following substances, only _____ has London dispersion forces as its only intermolecular force. 11) _____
- A) CH_3OH B) H_2O C) NH_3 D) CH_4 E) HCl

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question. (37 pts total)

- 12) A molecule of SF_6 has _____ atoms of S and _____ atoms of F and weighs _____ amu. (3 pts) 12) _____
- 13) If you have 31.2 g of the molecule $NaCl$ ($MW=58.5$ g/mol) and dissolve it to make up 152 mL of solution, what is the molarity? Set up the answer by filling in the blanks. (4 pts) 13) _____
- $M = \left(\frac{\quad}{\quad} \right)$
 $\left(\quad \right) \times \left(1/ \quad \right)$
- 14) To calculate standard enthalpy for a reaction (4 pts) 14) _____
- $a A + b B \rightarrow c C + d D$
- (where the little letters represent moles and where the capital letters are the formula for the reactants and products:
- (a) $\Delta H^\circ = (c \Delta H_f^\circ C + d \Delta H_f^\circ D) - (a \Delta H_f^\circ A + b \Delta H_f^\circ B)$
 (b) $\Delta H^\circ = (a \Delta H_f^\circ A + b \Delta H_f^\circ B) - (c \Delta H_f^\circ C + d \Delta H_f^\circ D)$
 [choose either (a) or (b)]

15) Show the complete electron configuration for the element As by filling in the format $1s^2, 2s^2$ etc (3 pts) 15) _____

[Ar] _____

16) Show the valence electron configuration for the element As in the same format (3 pts) 16) _____

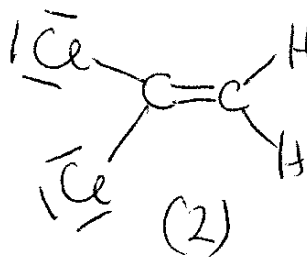
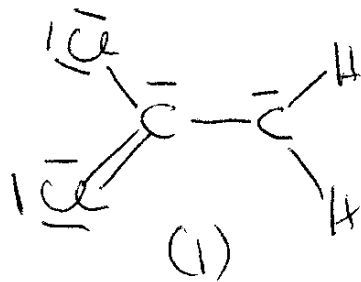
17) Show the valence electron configuration orbital diagram for the element As by drawing in electrons (as arrows) into the blank provided (Yes unlike the quiz these are indeed the orbitals that you need to add electrons into.) (3 pts) 17) _____

_____ (4s) _____ (4p)

18) In the periodic table, group IIIB to group IIB fills the (s, p, d, f) (circle one) subshell (3 pts) 18) _____

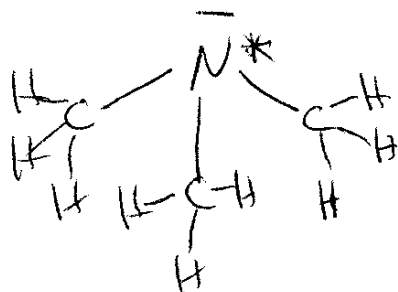
19) a. For the molecule $\text{Cl}_2\text{C}_2\text{H}_2$ what is the number of valence electrons for the molecule (3 pts) 19) _____

b. Which of the following is the correct Lewis Dot structure? (circle one of the two numbers) (4 pts)



20) For the following molecule for which I have provided a Lewis Dot Structure (7 pts, 1 pt per blank) _____

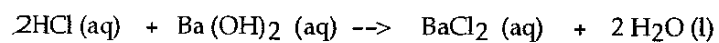
- a. How many (VSEPR) electron pairs around the atom with the * _____
- b. How many lone pairs on the atom with the * _____
- c. What is the geometry of the electrons around the atom with the * _____
- d. What is the geometry of the molecule around the atom with the * _____
- e. What is the hybridization of the atom with the * _____
- f. Is the molecule as a whole (1) polar or (2) non polar (circle one of the two numbers)
- g. The intermolecular interaction for the molecule is (1) dispersion forces (2) dipole dipole interaction or (3) hydrogen bonding (circle one of the 3 numbers to answer this letter)



Long Answer. Write your answer in the space provided. Please show work for full credit and to receive partial credit for incorrect final answers. (Write legibly please.) (30 pts)

- 21) For the reaction $\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$ if you start the reaction with 2.3 mol of HCl at 34.5 °C and collect the CO_2 in a container with a rigid volume of 255 mL what will be the pressure of the CO_2 in the container? You should assume that the reaction goes to completion and that you have a large excess of the calcium carbonate. (15 pts)

22) For the following reaction:



a. If you combine 150 mL of 1.5 M of HCl and an excess of barium hydroxide, assuming complete reaction, how many grams of water will you make? (MW of water = 18.02 g/mol) (10 pts)

b. How many H⁺ ions (as a part of the water product molecule) are you generating? (5 pts)

Name _____
print

Name _____
sign

For long answer type questions, you must show all work for partial credit. If your work is not near the question that you are answering (or the work location is not clearly marked), I will not include the work in the grading. Please write legibly. (I cannot grade what I cannot read.) Please print your name on the top back of the exam so that I can return the quiz in a self serve fashion. (1 pts. for writing name on the back, 1 pt for printing and signing your name on the front of the exam) You may remove the periodic table to use it during the exam but please staple it back and return it with the exam. Reminder: mandatory ACS final exam and teaching evaluation on 12/13/11 T at 1:30 pm

$K = ^\circ C + 273.15$ $P = 760 \text{ mm Hg} = 760 \text{ torr} = 1 \text{ atm}$ $1000 \text{ mL} = 1 \text{ L}$ $R = 0.08206 \text{ (L atm)/(mol K)}$ $N_A = 6.02 \times 10^{23}$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (3 pts each, 33 pts total)

- 1) The density of NO₂ at 780.0 torr and 37.0 °C is _____ g/L. [$d = (Pm) / (RT)$ derived from the ideal gas law ($m = MW = 46.01 \text{ g/mol NO}_2$)] 1) _____
 A) 9.30 B) 1.86 C) 3.27 D) 1.64 E) 2.92

- 2) Vertical columns of the periodic table are known as _____. 2) _____
 A) metalloids B) periods C) metals D) groups E) nonmetals

- 3) Of the following substances, only _____ has London dispersion forces as its only intermolecular force. 3) _____
 A) HCl B) CH₄ C) CH₃OH D) NH₃ E) H₂O

- 4) Which of the following is insoluble in water at 25 °C? 4) _____
 A) Mg₃(PO₄)₂
 B) (NH₄)₂CO₃
 C) Ba(C₂H₃O₂)₂
 D) Ca(OH)₂
 E) Na₂S

- 5) Potassium is a _____ and chlorine is a _____. 5) _____
 A) metal, metal
 B) metal, nonmetal
 C) nonmetal, metal
 D) metal, metalloid
 E) metalloid, nonmetal

- 6) What are the respective concentrations (M) of K⁺ and PO₄³⁻ afforded by dissolving 0.800 mol K₃PO₄ in water to make a 1.63 L solution? 6) _____
 A) 0.491 and 0.491
 B) 0.800 and 0.491
 C) 1.44 and 0.491
 D) 0.489 and 0.163
 E) 0.800 and 0.800

- 7) Which pair of elements would you expect to exhibit the greatest similarity in their physical and chemical properties? 7) _____
 A) I, At B) As, Br C) N, O D) Br, Kr E) Mg, Al
- 8) A pressure of 1.25 atm is the same as a pressure of _____ of mm Hg. 8) _____
 A) 760. B) 33.0 C) 193 D) 950. E) 29.9
- 9) Which one of the following is most likely to lose electrons when forming an ion? 9) _____
 A) Na B) F C) S D) P E) N
- 10) At maximum, an f-subshell can hold _____ electrons, a d-subshell can hold _____ electrons, and a p-subshell can hold _____ electrons. 10) _____
 A) 2, 8, 18 B) 14, 8, 2 C) 2, 12, 21 D) 14, 10, 6 E) 2, 6, 10
- 11) The elements in the _____ period of the periodic table have a core-electron configuration that is the same as the electron configuration of neon. 11) _____
 A) first B) fifth C) fourth D) second E) third

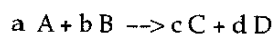
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question. (37 pts total)

- 12) A molecule of NO₂ has _____ atoms of N and _____ atoms of O and weighs _____ amu. (3 pts) 12) _____

- 13) If you have 15.2 g of the molecule CaCl₂ (MW= 111.1 g/mol) and dissolve it to make up 235 mL of solution, what is the molarity? Set up the answer by filling in the blanks. (4 pts) 13) _____

$$M = \frac{(\quad) / (\quad)}{(\quad) \times (1 / \quad)}$$

- 14) To calculate standard enthalpy for a reaction (4 pts) 14) _____



(where the little letters represent moles and where the capital letters are the formula for the reactants and products:

$$(a) \Delta H^\circ = (c \Delta H_f^\circ C + d \Delta H_f^\circ D) - (a \Delta H_f^\circ A + b \Delta H_f^\circ B)$$

$$(b) \Delta H^\circ = (a \Delta H_f^\circ A + b \Delta H_f^\circ B) - (c \Delta H_f^\circ C + d \Delta H_f^\circ D)$$

[choose either (a) or (b)]

- 15) Show the complete electron configuration for the element Te by filling in the format 1s², 2s² etc (3 pts) 15) _____

[Kr] _____

16) Show the valence electron configuration for the element **Te** in the same format (3 pts) 16) _____

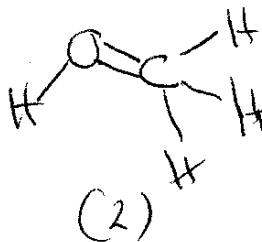
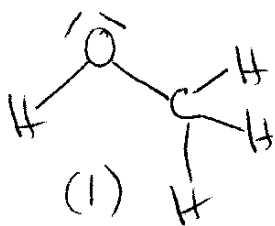
17) Show the valence electron configuration orbital diagram for the element **Te** by drawing in electrons (as arrows) into the blank provided (Yes unlike the quiz these are indeed the orbitals that you need to add electrons into.) (3 pts) 17) _____

_____ (5s) _____ (5p)

18) In the periodic table, group **IIIB** to group **IIB** fills the (s, p, d, f) (circle one) subshell (3 pts) 18) _____

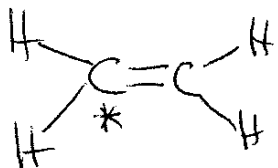
19) a. For the molecule **HOCH₃** what is the number of valence electrons for the molecule (3 pts) 19) _____

b. Which of the following is the correct Lewis Dot structure? (circle one of the two numbers) (4 pts)



20) For the following molecule for which I have provided a Lewis Dot Structure (7 pts, 1 pt per blank) _____

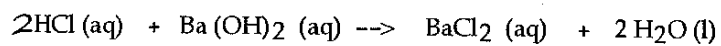
- a. How many (VSEPR) electron pairs around the atom with the * _____
- b. How many lone pairs on the atom with the * _____
- c. What is the geometry of the electrons around the atom with the * _____
- d. What is the geometry of the molecule around the atom with the * _____
- e. What is the hybridization of the atom with the * _____
- f. Is the molecule as a whole (1) polar or (2) non polar (circle one of the two numbers)
- g. The intermolecular interaction for the molecule is (1) dispersion forces (2) dipole dipole interaction or (3) hydrogen bonding (circle one of the 3 numbers to answer this letter)



Long Answer. Write your answer in the space provided. Please show work for full credit and to receive partial credit for incorrect final answers. (Write legibly please.) (30 pts)

- 21) For the reaction $\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$ if you start the reaction with 3.3 mol of HCl at 22.5 °C and collect the CO_2 in a container with a rigid volume of 125 mL what will be the pressure of the CO_2 in the container? You should assume that the reaction goes to completion and that you have a large excess of the calcium carbonate. (15 pts)

22) For the following reaction:



a. If you combine 130 mL of 2.5 M of HCl and an excess of barium hydroxide, assuming complete reaction, how many grams of water will you make? (MW of water = 18.02 g/mol) (10 pts)

b. How many H⁺ ions (as a part of the water product molecule) are you generating? (5 pts)