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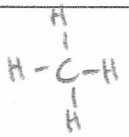
Chem30A, Fall 12, FH College, LecExam2 Name KEY Section 6

Read questions carefully to understand it before answering it. No outside paper is allowed. Use the reverse side of your answer paper as scratch. Use the attached periodic table for constants . Total points = 56 + 26 x 3 = 134.

SHORT ANSWER. Write the set-up equation for calculation, put raw data with units and then calculate. Be clear in your answer to get full points. Write clearly. If I don't understand your writing, I cannot give points.

1) Draw the structure or write the answer in the cells of the table below : 1) _____

Molecule	Lewis Structure (4 pts each)	Geometric shape of molecule (2 pts each)	Bond angle between atoms around the central atom (2 pts each)
H_2O		bent	108° ✓
CH_4		tetrahedral	109.5° ✓

2) An organic compound has the molecular formula $C_{10}H_{16}NOCl$. 2) _____

(a) Calculate its molar mass (4 pts.)

mass of 1 molecule of $C_{10}H_{16}NOCl$

$= 5(10 \times 12\text{amu}) + (16 \times 1\text{amu}) + (1 \times 14\text{amu}) + (1 \times 16\text{amu}) + (1 \times 35.5\text{amu})$

$= 202\text{ amu}$ ∴ molar mass = 202 g/mol

(b) How many moles of this compound is in 60.0 mg of it? (6 pts.)

$$60.0\text{ mg} \times \left(\frac{1\text{ g}}{1000\text{ mg}}\right)\left(\frac{1\text{ mol}}{202\text{ g}}\right) = 2.97 \times 10^{-4}\text{ moles of } C_{10}H_{16}NOCl.$$

3) In the reaction between Fe_2O_3 (s) and Al (s) to produce Fe (s) and Al_2O_3 (s), 23.5 g of Fe_2O_3 was reacted with 13.2 g of Al. (a) Show all your calculations to find out the limiting reagent (10 pts.) (Hints: First balance the reaction)

3) $Fe_2O_3(s)$

* balanced eqn: $Fe_2O_3(s) + 2Al(s) \longrightarrow 2Fe(s) + Al_2O_3(s)$

↳ molar mass: $(2\times56 + 3\times16)\ g/mol = 160\ g/mol$

* $23.5\ g\ Fe_2O_3 \times \left(\frac{1\ mol\ Fe_2O_3}{160\ g\ Fe_2O_3}\right) = 0.147\ mol\ Fe_2O_3$

* $13.2\ g\ Al \left(\frac{1\ mol\ Al}{27\ g\ Al}\right) = 0.489\ mol\ Al$

* molar ratio = 2 mole Al : 1 mole Fe_2O_3 ∴ to react w/ 0.147 mol of Fe_2O_3, $0.147\ mol\ Fe_2O_3 \left(\frac{2\ mol\ Al}{1\ mol\ Fe_2O_3}\right) = 0.294$ moles Al needed but have 0.489 mol. (ie. Al in excess)

∴ Limiting reagent is Fe_2O_3 (s)

4) An inflated baloon has a volume of 6.0 L at 1.0 atm pressure and at 22°C. Calculate its volume when it ascends to an altitude where the pressure is 0.45 atm and the temperature is –21°C. (6 pts.)

4) 11. L

$V_1 = 6.0\ L$ | $V_2 = ?$

$P_1 = 1.0\ atm$ | $P_2 = 0.45\ atm$

$T_1 = (22 + 273.15)K = 295\ K$ | $T_2 = (-21 + 273.15)K = 252\ K$

★ Combined gas law: $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ → ∴ $V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{(1.0\ atm)(6.0\ L)(252\ K)}{(295\ K)(0.45\ atm)} = 11.\ L$

(n is constant)

5) A gas tank is is maintained at 2.20 atm pressure. If the volume of the gas in the tank is 3250.0 m^3, at –15°C then what is the volume (in m^3) of the same quantity of the gas at 31°C. (6 pts.)

5) $3.830 \times 10^3\ m^3$

$P_1 = 2.20\ atm$ ⟶ $P_2 = 2.20\ atm$ (constant)

$V_1 = 3250.0\ m^3$ ⟶ $V_2 = ?$

$T_1 = (-15 + 273.15)K = 258\ K$ ⟶ $T_2 = (31 + 273.15)K = 304\ K$

★ Charles Law: $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ (n & P constant)

∴ $V_2 = \frac{V_1T_2}{T_1} = \frac{(3250.0\ m^3)(304\ K)}{258\ K} = 3.830 \times 10^3\ m^3$

6) In separating a mixture of sand and salt, a student had with following data: 6) _____

(a) 1.11 g salt
(b) 1.11 g sand
(c) The mass of an empty beaker where he would collect the salt sample = 71.60 g
(d) The mass of the beaker with the dry salt residue = 72.61 g
(e) The mass of a empty watch glass + clean filter paper = 43.45 g
(f) The mass of a the watch glass + filter paper + dry sand = 44.55 g

Show all your calculations to find out the (1) the % recovery of salt (4 pts.) and (2) the % recovery of sand (4 pts.).

(1) % recovery of salt?

$$\% \text{ recovery} = \frac{\text{expt}}{\text{theo}} \times 100\%$$

"expt" = $(72.61 - 71.60)\,g = 1.01\,g$

"theo" = starting mass of salt = $1.11\,g$

$$\therefore \%\ \text{recovery of salt} = \left(\frac{1.01\,g}{1.11\,g}\right) \times 100\% = \boxed{91.0\%}$$

(2) % recovery of sand?

$$\% \text{ recovery} = \frac{\text{expt}}{\text{theo}} \times 100\%$$

experimental mass of recovered sand = $(44.55 - 43.45)\,g = 1.10\,g$

theoretical mass of sand = original starting mass of sand = $1.11\,g$

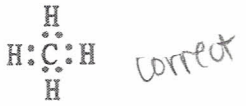
(recovered)

$$\therefore \%\ \text{recovery of sand} = \frac{1.10\,g}{1.11\,g} \times 100\% = \boxed{99.1\%}$$

MULTIPLE CHOICE. On scantron start from #7. Choose the one alternative that best completes the statement or answers the question (3 pts. each).

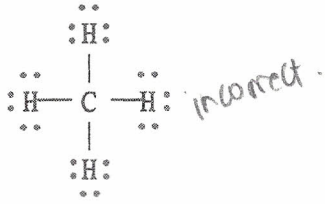
7) Which representation of a methane molecule is **not** correct? (A methane molecule is composed of one carbon atom and four hydrogen atoms.) 7) B

A)



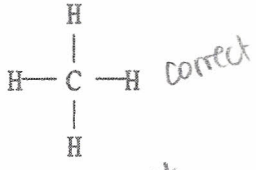
correct

B)



incorrect.

C)

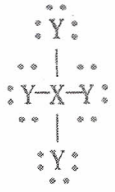


correct

D) CH_4 correct

E) none of the above

8) For the dot structure shown the most likely elements are X =_____ and Y =_____. 8) D



A) hydrogen; carbon
B) fluorine; carbon
C) carbon; hydrogen
D) carbon; fluorine
E) carbon; oxygen

9) In forming covalent bonds where the octet rule is obeyed, sulfur usually forms 2 bonds and chlorine usually forms 1 bonds. 9) D

A) two; two B) one; two C) six; seven D) two; one E) one; one

10) A chemical bond formed when two atoms share four electrons is a _____ bond; it is best described as _____. 10) _____

A) single; covalent
B) double; ionic
C) double; covalent
D) triple; covalent
E) single; ionic

11) The VSEPR model or molecular structure requires a knowledge of _____ to predict the geometry of an atom in a molecule. 11) _____

A) the number of atoms bonded to the atom of interest
B) the total number of atoms in the molecule
C) the number of electron pairs on the atom of interest
D) both A and C
E) none of the above

12) A molecule in which the central atom has no lone pairs and forms four single bonds is said to have a _____ shape. 12) _____

A) pyramidal
B) linear
C) planar
D) bent
E) tetrahedral

13) Which sample contains the largest number of **atoms**? 13) _____

A) 2.5 mol Au
B) 3.0 mol Cl_2
C) 1.5 mol NaCl
D) 2.0 mol CH_4
E) 1.0 mol H_2O

14) Which statement concerning the mole concept is **not** true? 14) _____

A) One mole of any compound contains one mole of atoms.
B) One mole of sodium contains the same number of atoms as one mole of carbon.
C) One mole of water contains the same number of molecules as one mole of ammonia.
D) The molar mass of a metal is its atomic weight expressed in grams.
E) The mole concept makes a connection between the mass of a substance and the number of particles or units of that substance.

15) Determine the number of moles of water produced when one mole of NH_3 reacts according to the balanced reaction shown. 15) _____

$$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$$

A) 1.50 B) 0.67 C) 1.33 D) 1.25 E) 1.00

16) Which is **not** a correct statement of Boyle's Law? 16) E

A) $P_1V_1 = P_2V_2$ True.

B) For a gas sample at constant temperature, pressure and volume are inversely proportional. True.

C) pressure α 1/volume true

D) pressure × volume = a constant true

E) none of the above

D Vacn

17) Avogadro's Law is expressed as: 17) C

A) V is proportional to $\frac{1}{n}$ ✗ V_1

B) n is proportional to $\frac{1}{T}$ ✗

C) V is proportional to n

D) P is proportional to n ✗

E) none of the above

18) Which of the following statements is TRUE for gases? 18) B

1. The temperature of a gas is inversely proportional to its pressure. ✗
2. The volume of a gas is directly proportional to the pressure in torr. ✗
3. The pressure of a gas is due to collisions of the gas molecules.

~~A) 2 only~~

B) 3 only

~~C) 1 only~~

~~D) 1 and 2 only~~

~~E) 1 and 3 only~~

19) At 570. mm Hg and 25°C, a gas sample has a volume of 2270 mL. What is the final pressure (in mm Hg) at a volume of 1250 mL and a temperature of 175°C? 19) B

A) 470 mm Hg

B) 1560 mm Hg

C) 7000 mm Hg

D) 210 mm Hg

E) 690 mm Hg

$V_1 = 2270\,mL$ $V_2 = 1250\,mL$

$T_1 = 25+273 = 298\,K$ $T_2 = 175+273 = 448\,K$

$P_1 = 570\,mmHg$ $P_2 = x$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \therefore P_2 = \frac{P_1V_1T_2}{T_1V_2} = \frac{(570\,mmHg)(2270\,mL)\,448\,K}{298\,K\,(1250\,mL)} = 1556\,mmHg$

20) How many moles of neon occupy a volume of 14.3 L at STP? 20) A

A) 0.638 moles

B) 36.7 moles

C) 1.57 moles

D) 6.45 moles

E) 32.0 moles

$14.3\,L\,Ne\left(\frac{1\,mol\,Ne}{22.414\,L}\right) = 0.6384\,mol.$

21) If the temperature of a 1.75 liter sample of gas is changed from 30.0° C to 20.0° C at constant pressure, what will be the new volume? 21) C

A) 1.17 L B) 1.57 L C) 1.69 L D) 1.81 L E) 2.63 L

$V_1 = 1.75\,L$ $V_2 = ?$

$T_1 = \frac{30+273}{303}\,K$ $T_2 = \frac{20+273}{293}\,K$

$\frac{V_1}{T_1} = \frac{V_2}{T_2} \therefore V_2 = \frac{V_1T_2}{T_1} = \frac{(1.75)(293)}{303} = 1.69\,L$

22) Which of the following is NOT part of the kinetic theory of gases? 22) B

A) Gas particles do not attract or repel one another.
B) There is very little empty space in a gas ←
C) Gas particles move faster when the temperature increases. true
D) Gas particles move rapidly.
E) A gas is composed of very small particles.

23) A 5.00–L tank contains helium gas at 1.50 atm. What is the pressure of the gas in mm Hg? 23) D

A) 7.5 mm Hg
B) 507 mm Hg
C) 1.50 mm Hg
D) 1140 mm Hg
E) 760 mm Hg

$1.50\ atm \left(\frac{760\ mm\ Hg}{1\ atm}\right) = 1140\ mm\ Hg$

TRUE/FALSE. On scantron, select 'A' if the statement is true and 'B' if the statement is false (3 pts. each).

24) Gas particles act independently of each other. 24) A

25) The pressure exerted by a gas on its container is inversely related to its Kelvin temperature. False 25) B

26) Gases fill the entire volume of their container. true 26) A

27) The following reaction IS balanced: $AgNO_3 + 2NH_4Cl \rightarrow AgCl + (NH_4)_2NO_3$ 27) B

False

28) One mole of nitrogen gas contains (2) × (6.022×10^{23}) nitrogen atoms. 28) A

↳ N_2 → true

29) One mole of I_2 has more atoms in it than one mole of Na. 29) A

true

30) One mole of chlorine gas has a mass of 35.45 grams. 30) B

Cl_2 False

31) The chemical formula $CuBr_2$ indicates that this compound is composed of 1 gram of copper and 2 grams of bromine. 31) B

False

32) The key to predicting a precipitation reaction is the formation of an insoluble compound from soluble compounds. 32) A

true