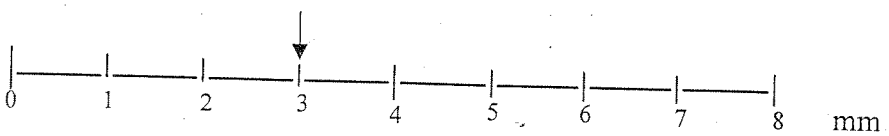
(1)



No, the smallest division is 1mm
so the tool can be read to 0.1mm
The correct reading is 3.0 mm

(2)

$$\frac{[(10.654 \times 10^0) + (23.2 \times 10^{-2})] \cdot 1.32 \times 10^5}{(2.00 \times 10^2 - 1.10 \times 10^2) \cdot 1999} = \frac{\left[(10.654 \times 10^0) + (0.232 \times 10^0)\right] \cdot 1.32 \times 10^5}{0.90 \times 10^2 \cdot 1999} =$$

$$\frac{10.886 \times 10^0 \cdot 1.32 \times 10^5}{0.90 \times 10^2 \cdot 1.999 \times 10^3} = \frac{\overset{5sf}{10.886} \cdot \overset{3sf}{1.32}}{\underset{2sf}{0.90} \cdot \underset{4sf}{1.999}} \times \frac{10^0 \cdot 10^5}{10^2 \cdot 10^3} = 7.9_{87} \times 10^0 = \boxed{8.0 \times 10^0}$$

(3)

2.54 cm = 1 inch
1 cup ≙ 8 fl. oz (exact)
128 fl. oz = 1 gallon (exact)
3.785 Liters = 1 gallon
2.205 kg = 1 lbs
1 cal = 4.184 J (exact)
1 mile = 5280 ft (exact)

concentration × volume = mass

$$\frac{\mu g}{mL} \times mi^3 = kg$$

μg	g	kg	mL	cm^3	in^3	ft^3	mi^3	$= kg$
mL	μg	g	cm^3	in^3	ft^3	mi^3		

$0.4\ \mu g$	$1000\ g$	$1\ kg$	$1\ mL$	$(2.54)^3\ cm^3$	$(12)^3\ in^3$	$(5280)^3\ ft^3$	$3.78 \times 10^{-1}\ mi^3$
mL	$10^6\ \mu g$	$10^3\ g$	$1\ cm^3$	$1^3\ in^3$	$1^3\ ft^3$	$1^3\ mi^3$	1
1sf	ex	ex	ex	ex	ex	ex	3sf

$$= 6.3 \times 10^5\ kg = \boxed{6 \times 10^5\ kg}$$

(4) White solid melts at 730.°C (physical change)

White solid $\xrightarrow{\text{electricity}}$ Brown gas + liquid metal

(electricity = energy)

(chemical rxn, permanent color change even though a liquid and gas is produced From a solid)

Brown Gas + Liquid Metal are not further decomposed with chemical methods

White Solid — Pure substance, compound

Brown Gas — Pure substance, element

Liquid Metal — Pure substance, element

(5) No, 12.011 amu (u) represents the weighted average mass of all naturally occuring isotopes of carbon ($^{12}_{6}C$, $^{13}_{6}C$). It is not the mass of just one atom of C.

$^{12}_{6}C$ weighs exactly 12 amu

$^{13}_{6}C$ weighs a bit more than 13 amu

(6)

Symbol	$^{75}_{33}As^{3-}$	$^{68}_{30}Zn$	$^{54}_{24}Cr^{6+}$	$^{15}_{7}N$
Protons (p^+)	33	30	24	7
Electrons (e^-)	36	30	18	7
Neutrons (n)	42	38	30	8
Atomic Number	33	30	24	7
Mass Number	75	68	54	15

(7)

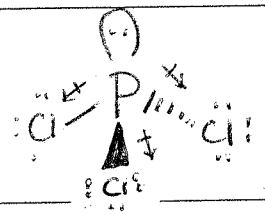
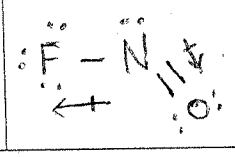
a) How many electrons remain in the ion? 18

b) What is the charge of the ion? Ti^{4+}

c) Is the ion a cation or anion? cation

$^{49}_{22}Ti \xrightarrow{-4e^-} {}^{49}_{22}Ti^{4+}$

(8)

Formula	Total **Number of Valence Electrons**	**Lewis Dot Structure (show all electrons pairs)**	**Number of Electron Clouds** Around Central Atom and **Family Geometry**	**Actual Geometry** of Molecule (tetrahedral, linear, bent, trigonal planar, trigonal pyramidal)
PCl_3	26		4 Tetrahedral	Trigonal Pyramid
NFO	18		3 trigonal planar	bent

(9)

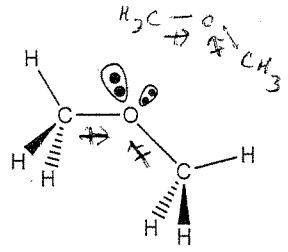
a) Show the polarity of the bonds, if indeed they are polar, using dipole moment arrows. ✓

b) Indicate whether the molecule is polar or non-polar. Explain your choice. PCl_3 is polar; the net dipole moment is toward and in between the chlorides. NFO is polar; the net dipole moment is between oxygen and Fluorine.

c) Indicate the dominant intermolecular force (dispersion force, H-bonding, dipolar force)

PCl_3, dipolar ; NFO, dipolar

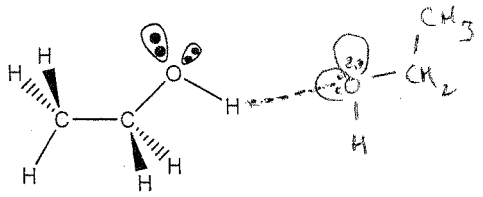
(10)



C_2H_6O

diethyl ether
boiling point = -23.7 °C

dipolar force between molecules



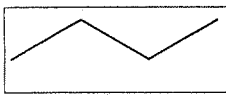
C_2H_6O

ethyl alcohol
boiling point = 78.5 °C

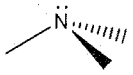
hydrogen bonding between molecules

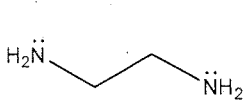
Hydrogen bonding will be a stronger force than dipolar especially since their is no difference in molar mass between ethanol + diethyl ether.

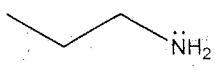
(11)

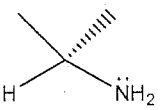
 = $CH_3CH_2CH_2CH_3$

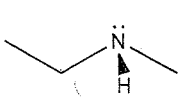
Lowest BP

A  59 g/mol C_3H_9N no h-bonding

B  60 g/mol $C_2H_8N_2$ Highest BP, most H-bonding (1 more e⁻ does not make the difference)

C  59 g/mol C_3H_9N

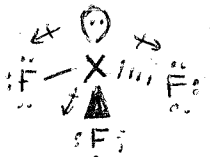
D  59 g/mol "

E  59 g/mol "

Since MM of each is similar
# of e⁻ is also similar and is not a factor

12

a) Complete the phrase with the term POLAR or NON-POLAR.



X = N, P, As
all molecules are trigonal pyramid w/ polar bonds. Each has a net dipole-moment

i) NF_3 is polar. ii) PF_3 is polar. iii) AsF_3 is polar.

b) What types of interparticle forces are present in each substance (H-bonding, Dispersion, Dipole-Dipole)?

i) NF_3 Dispersion, Dipole-Dipole ii) PF_3 Disp, D-D iii) AsF_3 Disp, D-D

c) Explain the differences in boiling point among the given molecules.

The Dipole-Dipole forces between NF_3 molecules is the weakest because NF_3 is the least polar molecule. The N-F bond (3.0, 4.0) is the least polar bond compared to the P-F (2.2, 4.0) and As-F (2.2, 4.0) bonds. Combining the structure of NF_3 with the polarity of the N-F bond, NF_3 has the weakest net dipole moment, is the least polar molecule, and has the weakest D-D force, and the lowest boiling point.

AsF_3 has the highest boiling point because it has the strongest dipole-dipole force and the strongest dispersion force. AsF_3 is the most polar molecule given its structure and bond polarity (greatest net dipole moment). It also has the most electrons which can give the strongest momentary dipoles and thus the strongest dispersion force.

13

a) Is glucose a mixture or pure substance? P.S.

b) What is the name of each element in glucose? carbon hydrogen oxygen

c) Write the number of atoms of each element present in 1 molecule of glucose. 6 12 6

d) How many moles of each element are in 1 mole of glucose? 6 12 6

e) Calculate the molar mass of glucose.

6×12.01 g/mol
$+ 12 \times 1.008$ g/mol
$+ 6 \times 16.00$ g/mol

72.06 g/mol
+ 12.096 g/mol
+ 96.00 g/mol

180.156 g/mol = **180.16 g/mol**

f) You are given a sample of glucose containing 1.807×10^{25} molecules. Calculate the mass (in grams) of glucose for this sample.

$$\frac{1.807 \times 10^{25} \text{ molecules of glucose}}{1} \left| \frac{1 \text{ mole of glucose molecules}}{6.022 \times 10^{23} \text{ molecules of glucose}} \right| \frac{180.15_6 \text{ g}}{1 \text{ mole of glucose molecules}}$$

4sf 4sf 5sf

$$5405.9 \text{ g} = \boxed{5.406 \times 10^{3} \text{ g}}$$

g) Calculate the mass of carbon in the same sample, i.e. 1.807×10^{25} molecules of glucose.

Since 1 mole of glucose contains 6 moles of carbon, the moles of carbon will be 6x the moles of glucose.

$$\frac{1.807 \times 10^{25} \text{ molecules of glucose}}{1} \left| \frac{1 \text{ mole of glucose molecules}}{6.022 \times 10^{23} \text{ molecules of glucose}} \right| \frac{6 \text{ mole C}}{1 \text{ mole glucose molecules}} \left| \frac{12.01 \text{ g}}{1 \text{ mol C}} \right.$$

(4sf) (4sf) (exact) (4sf)

$$= 2162.3 \text{ g} = \boxed{2.162 \times 10^{3} \text{ g}}$$

(14)

a) Write the balanced equation for this reaction. Be sure to include the states.

$2NaN_{3(s)} \longrightarrow 2Na_{(\ell)} + 3N_{2(g)}$

b) Is this reaction a redox reaction?

Yes, this is redox, compound → elements

c) What ~~type~~ class of reaction is this? Decomposition

d) Calculate the number of grams of sodium azide needed to inflate a 40. cm x 40. cm x 20. cm bag to a pressure of 1.25 atm at 20.°C?

$PV = nRT$

$V = (40.\text{ cm} \times 40.\text{ cm} \times 20.\text{ cm}) = 3.2 \times 10^4\ \text{cm}^3 = 3.2 \times 10^4\ \text{mL} = 3.2 \times 10^1\ \text{L}$

$P = 1.25\ \text{atm}$

$T = 20.\ ^\circ\text{C} + 273 = 293\ \text{K}$

$n = \frac{PV}{RT} = \frac{(1.25\ \text{atm})(3.2 \times 10^1\ \text{L})}{\left(0.0820 \frac{\text{L·atm}}{\text{mol·K}}\right)(293\ \text{K})}$

$n = 1.6_{63}$ moles N_2

e) What would be the pressure inside the bag on a hot Seattle summer day with a temperature of 90.0 °F = 32.2 °C?

$PV = nRT$ (n, R constant)

$\frac{P}{T} = \text{constant} = \frac{nR}{V}$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$P_2 = \frac{P_1}{T_1} \times T_2$

$P_2 = \frac{1.25\ \text{atm}}{293\ \text{K}} \cdot 305._2\ \text{K}$

$P_2 = 1.30_{20}\ \text{atm}$

$1.6_{63}\ \text{mol } N_2 \times \frac{2\ \text{mol } NaN_3}{3\ \text{mol } N_2} \times \frac{65.02\ \text{g Na}}{1\ \text{mol } NaN_3}$

$= 72._{09}\ \text{g } NaN_3$

15

a) Write the balanced equation for this reaction. $FeO_{(s)} + 2HCl_{(aq)} \longrightarrow FeCl_{2(aq)} + H_2O_{(l)}$

b) Calculate the grams of hydrochloric acid used? **10.1$_5$ g**

c) Calculate the grams of water produced. **2.50$_7$ g**

d) Using the given information and your answers from parts b & c, quickly calculate the grams of iron(II) chloride made. **17.6$_4$ g**

b)

$$\frac{10.0\text{ g FeO}}{1} \times \frac{1\text{ mol FeO}}{71.846_4\text{ g FeO}} \times \frac{2\text{ mol HCl}}{1\text{ mol FeO}} \times \frac{36.460_9\text{ g HCl}}{1\text{ mol HCl}} = 10.1_5\text{ g HCl}$$

3 sf; 5 sf; exact; 5 sf

c)

$$\frac{1\text{ mol H}_2\text{O}}{1\text{ mol FeO}} \times \frac{18.0152_8\text{ g H}_2\text{O}}{1\text{ mol H}_2\text{O}} = 2.50_7\text{ g H}_2\text{O}$$

exact; 6 sf

d) Conservation of mass: $X = 20.1_5\text{ g} - 2.50_7\text{ g} = 17.6_4\text{ g FeCl}_2$

mass of reactants = mass of products $\longrightarrow$ $10.0\text{ g (FeO)} + 10.1_5\text{ g (HCl)} = (2.50_7\text{ g (H}_2\text{O)} + X)$

16

a) $2Li_{(s)} + Pb(NO_3)_{2(aq)} \text{----------} > Pb_{(s)} + 2LiNO_{3(aq)}$ redox, single replacement

b) $Na_2S_{(aq)} + NiCl_{2(aq)} \text{----------} > 2NaCl_{(aq)} + NiS_{(s)}$ precipitation, double replacement

c) $CuO_{(s)} + 2HCl_{(aq)} \text{----------} > CuCl_{2\,(aq)} + H_2O_{(l)}$ acid-base neutralization, double replacement

17

a. Identify the solute. sugar

b. Identify the solvent. water

c. Describe the state of the clear honey with one of the following terms: *unsaturated, saturated, or* (*supersaturated*)

d. Describe the state of the cloudy honey with one of the following terms: *unsaturated,* (*saturated*) *or supersaturated.*

(18)

a) Fish need oxygen to live. Oxygen is a gas. Gases become less soluble as temperature increases. This is because the extra energy can break the weak bonds between H_2O and O_2 (hydration) very easily and allow O_2 into the gas phase.

b) Salt draws water out of the meat by osmosis. Water flows from the meat to the outside to dilute the salt. The ambient temperature outside dries the meat by evaporation until most of the water is removed. Without H_2O, offensive bugs don't survive.

(19)

a. Identify the solute. hemoglobin

b. Identify the solution. blood

c. Calculate the molarity of hemoglobin in blood. 0.00240 M

d. How many moles of hemoglobin are in a typical adult body? 0.014 mol

e. If the density of blood is 1.025 grams of blood per 1 mL of blood, calculate the percent by mass (%(w/w)) of hemoglobin in blood.

c) $$\frac{15.5\text{ g Hemoglobin}}{1} \left| \frac{1\text{ mole Hemoglobin}}{6.45\times10^4\text{ g}} \right| \frac{1}{100.\text{ mL}} \left| \frac{1000\text{ mL}}{\text{L}} \right| = 0.00240_{31}\text{ M}$$

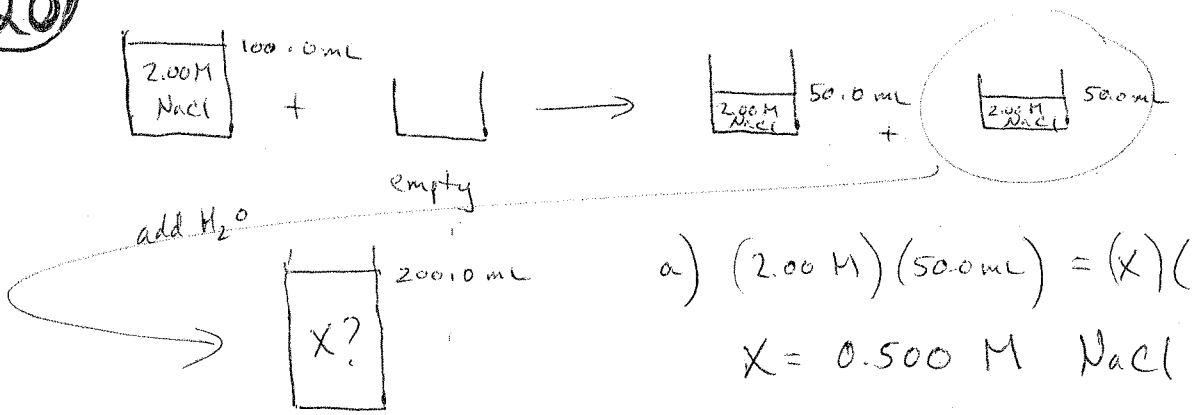
d) $$\frac{0.00240_{31}\text{ mol}}{1\text{L}} \left| \frac{6.0\text{ L}}{1} \right| = 0.014_{42}\text{ mol}$$

e) $$\frac{100.0\text{ mL blood}}{1} \left| \frac{1.025\text{ g blood}}{1\text{ mL blood}} \right| = 102.5\text{ g blood}$$

$$\%\text{ by mass Hemoglobin in Blood} = \frac{15.5\text{ g}}{15.5\text{ g} + 102.5\text{ g}} \times 100\% = \frac{15.5\text{ g}}{118.0\text{ g}} \times 100\%$$

$$= 13.1_{36}\%$$ (Hemoglobin) $$15.1_{22}\%$$

(20)



a) $(2.00\ M)(50.0\ mL) = (X)(200.0\ mL)$

$X = 0.500\ M\ NaCl$

b) Since $NaCl_{(aq)} \equiv Na^+_{(aq)} + Cl^-_{(aq)}$

the concentration of $Na^+ = [Cl^-] = 0.500\ M$

$[\text{total ions}] = 2 \times 0.500\ M = 1.000\ M$

(21)

$$2AgNO_{3(aq)} + MgI_{2(aq)} \longrightarrow 2AgI_{(s)} + Mg(NO_3)_{2(aq)}$$

b) Before the reaction takes place, the silver(I) nitrate solution has a concentration of 1.5%(w/w) and a density of 1.09 g/ml. Calculate the molarity of the silver(I) nitrate solution.

$$\frac{1.5\ g\ AgNO_3}{100\ g\ soln} \left| \frac{1.09\ g\ soln}{1\ mL\ soln} \right| \frac{1000\ mL}{1\ L} \left| \frac{1\ mol\ AgNO_3}{169.873\ g\ AgNO_3} \right. = 0.096_{24}\ M$$

c) Calculate the number of moles of silver(I) nitrate in 50.0 mL of the silver(I) nitrate solution.

$$\frac{0.096_{24}\ mol\ AgNO_3}{1\ L\ soln} \left| \frac{50.0\ mL}{1} \right| \frac{1\ L}{1000\ mL} = 0.0048_{12}\ mol\ AgNO_3$$

d) How many moles of magnesium iodide are needed to react with all the moles of silver(I) nitrate calculated in part c.?

$$\frac{0.0048_{12}\ mol\ AgNO_3}{1} \left| \frac{1\ mol\ MgI_2}{2\ mol\ AgNO_3} \right. = 0.0024_{06}\ mol\ MgI_2$$

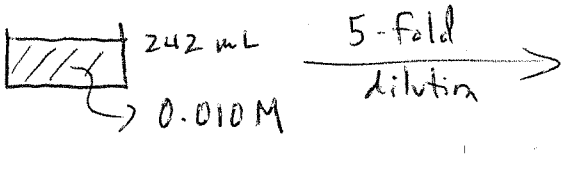
e) How many milliliters of 0.0125 M magnesium iodide solution are needed for a complete reaction based on your answer in part d?

$$\frac{0.0024_{06}\ mol\ MgI_2}{1} \left| \frac{1\ L}{0.0125\ mol\ MgI_2} \right| \frac{1000\ mL}{1\ L} = 192.5\ mL$$

$$= 1.9_{25} \times 10^2\ mL$$

a) What is the new concentration in molarity?

(22)



$(0.010\ M)(242\ mL) = X(1210\ mL)$

$X = 0.0020\ M$

or

$\frac{0.010\ M}{5} = 0.0020\ M$

b) What is the concentration of nitrate in the diluted solution, in molarity?

$Mg(NO_3)_{2(aq)} \rightarrow Mg^{2+}_{(aq)} + 2\,NO_{3(aq)}^-$

0.0020 M × 2 = 0.0040 M

(23)

a) If 8.0 g of baking soda is added to 100.0 g of H_2O at 0 °C, is the resulting mixture unsaturated, saturated, or supersaturated? saturated

b) Is the resulting mixture, homogeneous or heterogeneous? heterogeneous

c) Calculate the mass percent (%w/w) of a mixture that is 6.0 g of baking soda in 100.0 g of H_2O.

d) Calculate the molarity (M) 500.0 mL of an aqueous solution of baking soda that contains 3.0 g of baking soda.

c) $\frac{6.0\ g}{(100.0\ g + 6.0\ g)} \times 100\% = 5.6\%$

d) $\frac{3.0\ g}{1} \left| \frac{1\ mol}{83.99\ g} \right| \frac{1}{500.0\ mL} \left| \frac{1000\ mL}{1\ L} \right. = 0.071_{44}\ M$

2 sf 4 sf 4 sf exact

(24)

$HN_{3(aq)} + ClO^-_{(aq)} \rightleftharpoons HOCl_{(aq)} + N_3^-{}_{(aq)}$

Follow the H+

acid (H+ donor) — base (H+ acceptor) — conjugate acid — conjugate base

(25) HCl is a strong acid so $4.56\times10^{-6}\ M = 4.56\times10^{-6}\ M\ [H_3O^+]$

$pH = -\log(4.56\times10^{-6}) = 5.341_0$, $pOH = 14.000 - 5.341_0 = 8.658_{96}$

(26) Na_2CO_3 HCO_3^- / CO_3^{2-}