CHM 1025 Summer 2020 Find Review 8/11/2020

① $\boxed{4}$ Some sig fig rules:

1) any zeroes in front of any non-zero number is not a sig fig even if there is a decimal.

2) Any trailing zeroes after a non-zero number are not sig figs if there is no decimal point; if there is a decimal point, then all trailing zeroes must be counted as sig figs

Examples:

#	# of sig figs:
700	1 (no decimal)
50.	2 (count the 0)
50.0	3
0.032	2 (don't count 0's in front)
0.004	1
0.000430	3 (the "430" part counts but none of the 0's in front.)

②

base		acid		
NaOH	+	HBr	→	NaBr + H_2O
57mL		22mL		
0.50 M		x M		

to neutralize, the moles of the acid and base should be the same.

$$0.057\,L \times \frac{0.50\,mol\,NaOH}{1\,L} \times \frac{1\,mol\,HBr}{1\,mol\,NaOH} = 0.0285\,mol\,HBr$$

↓ divide by 22mL to get M

$$\boxed{1.3\,M} = \frac{0.0285\,mol\,HBr}{0.022\,L}$$

③ $\boxed{2}$ (amu of Z)(100%) = (amu of Z-45)(Z-45 %) + (amu of Z-44)(Z-44%)

$$(44.3026\ \text{amu})(1) = (44.9757\ \text{amu})(1-y)^{*} + (43.899\ \text{amu})(y)$$

$$44.3026\ \text{amu} = 44.9757\ \text{amu} - 1.0767\ \text{amu}(y)$$

$$-0.6731\ \text{amu} = -1.0767\ \text{amu}(y)$$

$$y = 0.6252 \times 100 = \boxed{62.5\%}$$

* we know that the %'s of both Z-45 and Z-44 will equal 100% or just 1. We want to find % of Z-44 so assign its % abundance as variable y, the other percent of Z-45 must then be 1-y.

④ $Na_3(PO_4)$: sodium phosphate

$Ca(NO_3)_2$: calcium nitrate

insolable ↓

complete ionic equation

$$2\,Na_3(PO_4)_{(aq)} + 3\,Ca(NO_3)_{2\,(aq)} \rightarrow 6\,NaNO_{3\,(aq)} + Ca_3(PO_4)_{2\,(s)}$$

$$6\cancel{Na^+}_{(aq)} + 2PO_4^{3-}{}_{(aq)} + 3Ca^{2+}_{(aq)} + 6\cancel{NO_3^-}_{(aq)} \rightarrow 6\cancel{Na^+}_{(aq)} + 6\cancel{NO_3^-}_{(aq)} + \text{[illegible]}\ Ca_3(PO_4)_{2\,(s)}$$

net ionic equation

$$\boxed{2PO_4^{3-}{}_{(aq)} + 3Ca^{2+}_{(aq)} \rightarrow Ca_3(PO_4)_{2\,(s)}}$$

⑤ $\boxed{15}$ $C_xH_y + O_2 \rightarrow H_2O + CO_2$

H_2O: 3.2g CO_2: 4.5g

$$3.2g \times \frac{1\ \text{mol}\ H_2O}{18\ g\ H_2O} \times \frac{2\ \text{mol H}}{1\ \text{mol}\ H_2O} = 0.356\ \text{mol H} / 0.1022 = 3.5$$

$$4.5g \times \frac{1\ \text{mol}\ CO_2}{44.01g\ CO_2} \times \frac{1\ \text{mol C}}{1\ \text{mol}\ CO_2} = 0.1022\ \text{mol C} / 0.1022 = 1$$

double to get whole numbers ↓

empirical formula: C_2H_7

molar mass = 31.076g/mol

$$\frac{124.3g/mol}{31.076g/mol} \approx 4 \rightarrow$$

C_8H_{28}

$\boxed{\text{so 8 carbons in the molecular formula}}$

⑥ $\boxed{1}$ C_8H_{28} molecular mass: 124.3 g/mol

$$\%\text{mass of H} = \frac{28 \times (1.008\,g/mol\ H)}{124.3\,g/mol\ C_8H_{28}} = 0.22706 \times 100 = \boxed{22.7\%}$$

⑦ $\boxed{4}$ $(NH_4)_2CO_3\,(aq) + MgSO_4\,(aq) \rightarrow (NH_4)_2SO_4\,(aq) + MgCO_3\,(s)$

10.2 mL	14.2 mL
0.30 M	0.45 M

$$0.0102L \times \frac{0.30\,mol\ (NH_4)_2CO_3(aq)}{1L} \times \frac{1\,mol\ MgCO_3\,(s)}{1\,mol\ (NH_4)_2CO_3\,(aq)} = 0.00306\,mol\ MgCO_3(s) \leftarrow$$

less product, $(NH_4)_2CO_3$ is the limiting reactant

$$0.0142L \times \frac{0.45\,mol\ MgSO_4(aq)}{1L} \times \frac{1\,mol\ MgCO_3(s)}{1\,mol\ MgSO_4\,(aq)} = 0.00639\,mol\ MgCO_3(s)$$

$$\boxed{0.125M\ MgCO_3(s)} \leftarrow \frac{0.00306\,mol\ MgCO_3(s)}{(0.0102L + 0.0142L)}$$

⑧ Subtract the two $MgCO_3(s)$ calculations and then convert that back to moles of $MgSO_4(aq)$ since that was our excess reactant.

$\boxed{2}$ $0.00639\,mol - 0.00306\,mol = 0.00333\,mol\ MgCO_3(s)$

↓ since it's all 1:1 ratio...

$0.00333\,mol$ excess $MgSO_4(aq)$

$$0.00333\,mol\ MgSO_4 \times \frac{120.366\,g}{1\,mol\ MgSO_4} = \boxed{0.401\,g\ MgSO_4}$$

⑨ A higher boiling point corresponds to a greater amount of intermolecular forces.

$\boxed{2}$ A: CH_3CH_2OH beats CH_3CH_2Br because it can hydrogen bond with itself thanks to the hydroxy group (-OH)

B: H_2O beats H_2S since it can hydrogen bond by H_2S cannot

C: Decane beats Propane because it has a greater mass which leads to more van der Waals interactions.

$\boxed{CH_3CH_2OH,\ H_2O,\ \text{Decane}}$

(10) $\boxed{2}$ A high vapor pressure corresponds to [illegible] <u>less</u> or <u>weaker</u> intermolecular forces. Number (2) only has van der Waals forces which are the weakest IMF. The rest have too strong of IMF's like ~~dip~~ dipole forces [illegible] or hydrogen bonding capabilities.

<u>Ranking of IMF strength</u>:

☆ van der Waals/London Dispersion < Dipole < H bonding

↑ IMF → inc. boiling pt. & dec. vapor pressure

↓ IMF → dec. boiling pt. & inc. vapor pressure

(11.) $\boxed{3}$ 43% m/m of $CHBr_3$ in C_3H_6O find mL of both using densities.

↳ assume a 1g sample so...

$$0.43g\ CHBr_3 \times \frac{1mL}{2.89g} = 0.149\ mL\ CHBr_3$$

+ → [illegible] 0.8696 mL

(1-0.43) ↘

$$0.57g\ C_3H_6O \times \frac{1mL}{0.791g} = 0.721\ mL\ C_3H_6O$$

We want a 400 mL solution, so make a proportion!

$$\frac{0.149mL\ CHBr_3}{0.8696mL\ solution} = \frac{x\ mL\ CHBr_3}{\underbrace{400mL\ solution}_{\text{what we need to make}}} \Big\}\text{what we want}$$

$$\boxed{x = 68.5 mL\ CHBr_3}$$

(12.) $\boxed{1}$ $\Delta H_{rxn} = \Sigma mol \cdot \Delta H_f\ (products) - \Sigma mol \cdot \Delta H_f\ (reactants)$

ΔH of $N_{2(g)}$ and $O_{2(g)}$ are not given since they are in their natural states, so they are 0 kJ/mol

$$-6132kJ = [(12mol\ CO_2)(-393.5kJ/mol) + (10mol\ H_2O)(-241.82kJ/mol)] - [\overbrace{(4mol)(x\ kJ/mol)}^{\text{nitroglycerin}}]$$

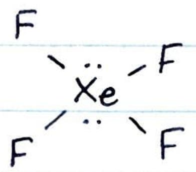
$$-4x = 1008.2kJ$$

$$\boxed{x = -252.05\ kJ/mol}$$

⑬ $\boxed{4}$ Ar has 18 electrons so Ca^{2+} would be isoelectronic because it's missing 2 electrons from its normal 20 electrons.

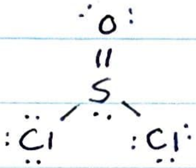
Ne has 10
F^- has 10 (9 + 1)
O^{2-} has 10 (8 + 2)
Mg^{2+} has 10 (12 - 2)

⑭ XeF_4:



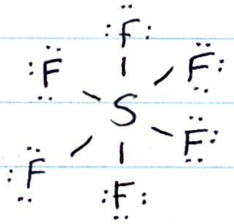
square planar

$SOCl_2$:



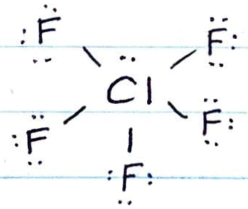
trigonal pyramidal

SF_6:



octahedral

ClF_5



square pyramidal

[redacted]

[redacted]

H_2O

$H - \underset{..}{\ddot{O}} - H$ bent

⑮ $\boxed{3}$

$\Delta H = q = \underset{\text{use mass of solution}}{\underset{\uparrow}{m}}C\Delta T$

$25mL \times \frac{1g}{1mL} = 25g$ of soln

$$\Delta H = (25g)(4.184\ J/g°C)(21.3°C - 26.5°C)$$

$$= \underbrace{-543.92\ J}_{\text{this is }\Delta H\text{ of the solution (it released heat)}} \rightarrow \underbrace{0.54392\ kJ}_{\text{this is the actual }\Delta H\text{ of the reaction, you need to put energy in.}}$$

$2.45g\ KNO_3 \times \frac{1\ mol\ KNO_3}{101.11g\ KNO_3} = 0.0242\ mol\ KNO_3$

$$\frac{0.54392kJ}{0.0242mol\ KNO_3} \rightarrow \boxed{22.4\ kJ/mol\ KNO_3}$$

⑯ $\boxed{15}$ $\Delta E = \frac{hc}{\lambda} = \frac{(6.626\times10^{-34}J\cdot s)(3\times10^{8}m/s^2)}{(640nm \times \frac{1m}{10^9nm})}$

$$= 3.106\times10^{-19}\ J/1\ photon$$

$q = mC\Delta T \rightarrow q = (13.5g)(0.127J/°Cg)(327°C - 25°C)$

$q = 517.779\ J$

$$\frac{517.779J}{3.106\times10^{-19}J/photon} = \boxed{1.67\times10^{18}\ photons}$$

⑰ Gold, remember that the atoms in column 6 (except Tungsten & Sg) and 11 transfer one of their s electrons to the d orbital. So the atom should actually correspond to the element in the 5d⁹ slot, not 5d¹⁰.

W: $[Xe]\,6s^2\,4f^{14}\,5d^4$ it ends in the 5d orbital as the 4th element. For column 6, only Cr and Mo have the weird exception.

⑱ $\boxed{4}$

$$4.0g \times \frac{1\,mol\ S_7O_2}{256.49g} \times \frac{7mol\ S}{1\,mol\ S_7O_2} \times \frac{6.022\times10^{23}\ atoms\ S}{1\,mol\ S} = \boxed{6.57\times10^{22}\ atoms}$$

⑲

$$HBr + H_2O \rightarrow \underset{\text{conj. acid}}{\underline{H_3O^+}} + \underset{\text{conj. base}}{\underline{Br^-}}$$

⑳ $\boxed{5}$

$$Fe_2O_3 + \underline{3}\,CO \rightarrow \underline{2}\,Fe + \underline{3}\,CO_2$$

$$88.32g\ Fe_2O_3 \times \frac{1\,mol\ Fe_2O_3}{159.69g} \times \frac{3\,mol\ CO_2}{1\,mol\ Fe_2O_3} = \underset{\uparrow\ \text{limiting}}{1.659\,mol\ CO_2} \times \frac{44.01g\ CO_2}{1\,mol\ CO_2} = 73.01g\ CO_2$$

$$102.3g\ CO \times \frac{1\,mol\ CO}{28.01g} \times \frac{3\,mol\ CO_2}{3\,mol\ CO} = 3.652\ mol\ CO_2$$

$$\frac{43.5g}{73.01g} \times 100 = \boxed{59.58\%}$$