Key - Spring 2018 H. Chemistry Final Review

(1) A. honeybees are dying
B. a pathogen is killing honeybees.
C. set up 2 healthy honeybee hives (keep them separate from each other.) Introduce suspected pathogen to one hive and observe.
D. The data would show that the suspected pathogen is indeed killing honeybees.
E. Either both hives would be alive or both hives would be dead.

(2) A. loose clothing, hair, or dangling jewelry can get chemicals on them or knock over glassware with chemicals in it.
B. to protect your eyes from chemicals getting splashed into them.
C. to protect your feet from falling chemicals and/or falling glassware.
D. So that the food/drink does not get contaminated with chemicals
E. so chemicals or glassware do not get knocked over.

(3) beaker thermometer funnels

graduated cylinder electronic balance Beaker (the muppet) Erlenmeyer flask.

(4) A. 0.00000678 s → 6.78×10^{-6} s
B. 19100000 J → 1.91×10^{7} J
C. 0.000546 g → 5.46×10^{-4} g
D. 12110000000 °C → 1.211×10^{10} °C
E. 8.76×10^{4} atm → 87600 atm
F. 3.42×10^{-4} mol → 0.000342 mol

(5) nuclear fusion
- fusing smaller particles into larger atoms
a. produces most elements
c. fuel for stars & d. high temps.

nuclear fission
- splitting a large nucleus into smaller parts
b. used in nuclear reactors

(6) (1) b. liquid
(2) c. gas
(3) a. solid
(4) d. plasma
(5) a. solid
(6) c. gas & d. plasma
(7) b. liquid

(7) A. physical
B. chemical
C. physical
D. physical
E. chemical
F. chemical
G. physical
H. chemical

(8) A. element
B. homogeneous mixture
C. compound
D. heterogeneous mixture
E. element
F. homogeneous mixture

(9) A. chemical
B. physical
C. physical
D. chemical
E. physical
F physical

(10) It's a liquid between 29.78°C and 2403.0°C, so if your hand is 37°C, it would be a liquid.

(11) A. Na^{1+} S^{2-}
Na_2S

B. hydrochloric acid

C. Au^{3+} F^{1-}
AuF_3

D. diphosphorous pentoxide

E. H^+ CO_3^{2-}
H_2CO_3

F. calcium nitrate

G. H_2O

H. phosphorous acid

I. Pb^{4+} SO_4^{2-}
$Pb_2(SO_4)_4$
⇓
$Pb(SO_4)_2$

J. iron (III) oxalate

(12) A. $NaCl(s) + F_2(g) \rightarrow NaF(s) + Cl_2(g)$ ← single-replacement

B. $KClO_3(s) \rightarrow KCl(s) + O_2(g)$ ← decomposition

C. $S_8(s) + O_2(g) \rightarrow SO_3(s)$ ← synthesis

D. $HCl(aq) + CaCO_3(s) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$ ← double-replacement

E. $C_3H_8(l) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$ ← combustion

(13) A. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ ← synthesis

B. $2AlBr_3(aq) + 3K_2SO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 6KBr(aq)$ ← double-replacement

C. $C_5H_{12}(l) + 8O_2(g) \rightarrow 5CO_2(g) + 6H_2O(g)$ ← combustion

D. $2Ag_2O(s) \rightarrow 4Ag(s) + O_2(g)$ ← decomposition

E. $3Na(s) + Fe(NO_3)_3(aq) \rightarrow Fe(s) + 3NaNO_3(aq)$ ← single-replacement

(15) A. $CuBr_2$

1 Cu × 63.55g = 63.55g
2 Br × 79.90g = 159.80g
+ **223.35g** ← molar mass

$\%Cu = \frac{63.55g}{223.35g} \times 100 = $ **28.45%**

$\%Br = \frac{159.80g}{223.35g} \times 100 = $ **71.55%**

B. $Co_2(CO_3)_3$

2 Co × 58.93g = 117.86g
3 C × 12.01g = 36.03g
9 O × 16.00g = 144.00g
+ **297.89g** ← molar mass

$\%Co = \frac{117.86g}{297.89g} \times 100 = $ **39.56%**

$\%C = \frac{36.03g}{297.89g} \times 100 = $ **12.10%**

$\%O = \frac{144.00g}{297.89g} \times 100 = $ **48.34%**

(16) $\frac{34.5\,g\ H_2O \mid 1\,mol}{\mid 18.02\,g}$ = **1.91 mol H_2O**

molar mass
2 H × 1.01 g = 2.02 g
1 O × 16.00 g = 16.00 g
18.02 g

(17) $\frac{.456\,L\ H_2O \mid 1\,mol \mid 6.02 \times 10^{23}\ molecules}{\mid 22.4\,L \mid 1\,mol}$ = **1.23×10^{22} molecules H_2O**

(18) $\frac{21.1\,g\ CaCl_2 \mid 1\,mol}{\mid 110.98\,g}$ = **.190 mol $CaCl_2$**

molar mass
1 Ca × 40.08 g = 40.08 g
2 Cl × 35.45 g = 70.90 g
110.98 g

(19) $\frac{6.789 \times 10^{22}\ f.units\ CaCl_2 \mid 1\,mol}{\mid 6.02 \times 10^{23}\ f.units}$ = **.1128 mol $CaCl_2$**

(20) $\frac{99.99\,g\ HNO_3 \mid 1\,mol \mid 6.02 \times 10^{23}\ f.units}{\mid 63.02\,g \mid 1\,mol}$ = **9.552×10^{23} f.units HNO_3**

molar mass
1 H × 1.01 g = 1.01 g
1 N × 14.01 g = 14.01 g
3 O × 16.00 g = 48.00 g
63.02 g

(21) $\frac{7.87 \times 10^{25}\ molecules\ SO_3 \mid 1\,mol \mid 22.4\,L}{\mid 6.02 \times 10^{23}\ molecules \mid 1\,mol}$ = **2930 L SO_3**

(22) A. $C_6H_{14} \rightarrow C_3H_7$ B. $C_3H_8 \rightarrow$ already empirical

C. $C_6H_{12}O_6 \rightarrow CH_2O$ D. $Co_2(CO_3)_3 \rightarrow$ already empirical

(23) $66.611\%\ C = \frac{66.611\,g\ C \mid 1\,mol}{12.01\,g} = \frac{5.5463\,mol\ C}{1.38656\,mol} = 4\ C$

$11.204\%\ H = \frac{11.204\,g\ H \mid 1\,mol}{1.01\,g} = \frac{11.09307\,mol\ H}{1.38656\,mol} = 8\ H$

$22.185\%\ O = \frac{22.185\,g\ O \mid 1\,mol}{16.00\,g} = \frac{1.38656\,mol\ O}{1.38656\,mol} = 1\ O$

Empirical Formula

C_4H_8O

Molar Mass of Empirical Formula

$4\ C \times 12.01\,g = 48.04\,g$
$8\ H \times 1.01\,g = 8.08\,g$
$1\ O \times 16.00\,g = 16.00\,g$
$72.12\,g$

$\frac{144.24}{72.12} = \sim 2$

Molecular Formula

$2\ (C_4H_8O) = C_8H_{16}O$

The other
(23) $3\ K(s) + Au(NO_3)_3(aq) \rightarrow Au(s) + 3\ KNO_3(aq)$

A. $\frac{21.0\,mol\ K \mid 3\,mol\ KNO_3}{3\,mol\ K} = 21.0\,mol\ KNO_3$

B. $\frac{1.50\,mol\ K \mid 1\,mol\ Au \mid 196.97\,g\ Au}{3\,mol\ K \mid 1\,mol\ Au} = 98.5\,g\ Au$

C. $\frac{50.00\,g\ Au(NO_3)_3 \mid 1\,mol\ Au(NO_3)_3 \mid 3\,mol\ KNO_3 \mid 101.11\,g\ KNO_3}{383.00\,g\ Au(NO_3)_3 \mid 1\,mol\ Au(NO_3)_3 \mid 1\,mol\ KNO_3} = 39.6\,g\ KNO_3$

Molar Mass

$1\ Au \times 196.97\,g = 196.97\,g$
$3\ N \times 14.01\,g = 42.03\,g$
$9\ O \times 16.00\,g = 144.00\,g$
$383.00\,g$

Molar Mass

$1\ K \times 39.10\,g = 39.10\,g$
$1\ N \times 14.01\,g = 14.01\,g$
$3\ O \times 16.00\,g = 48.00\,g$
$101.11\,g$

(23) D. $\frac{9.00 \text{ mol } Au(NO_3)_3 \mid 1 \text{ mol } Au}{\mid 1 \text{ mol } Au(NO_3)_3} = 9.00 \text{ mol } Au$

$\frac{30.00 \text{ mol } K \mid 1 \text{ mol } Au}{\mid 3 \text{ mol } K} = 10.0 \text{ mol } Au$

The limiting reactant is $Au(NO_3)_3$, it produced the least amount of product.

E. $\frac{1173 g\ K \mid 1 \text{ mol } K \mid 1 \text{ mol } Au}{\mid 39.10 g\ K \mid 3 \text{ mol } K} = 10.0 \text{ mol } Au$

$\frac{3447 g\ Au(NO_3)_3 \mid 1 \text{ mol } Au(NO_3)_3 \mid 1 \text{ mol } Au}{\mid 383.00 g\ Au(NO_3)_3 \mid 1 \text{ mol } Au(NO_3)_3} = 9.00 \text{ mol } Au$

The limiting reactant is $Au(NO_3)_3$

(24)

Element	atomic #	mass #	# protons	# electrons	# neutrons
sulfur	16	32	16	16	16
cadmium	48	112	48	48	64
tantalum	73	181	73	73	108
einsteinium	99	252	99	99	153

(25) A. Ti - $22e^-$ $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2$

B. Ni - $28e^-$ $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$

C. Br - $35e^-$ $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

D. Sr - $38e^-$ $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2$

(26) $c = \lambda \cdot \nu$ λ for violet light is 4.00×10^{-7} m.

$$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m/s}}{4.00 \times 10^{-7} \text{ m}} = \boxed{7.50 \times 10^{14} \text{ 1/s}}$$

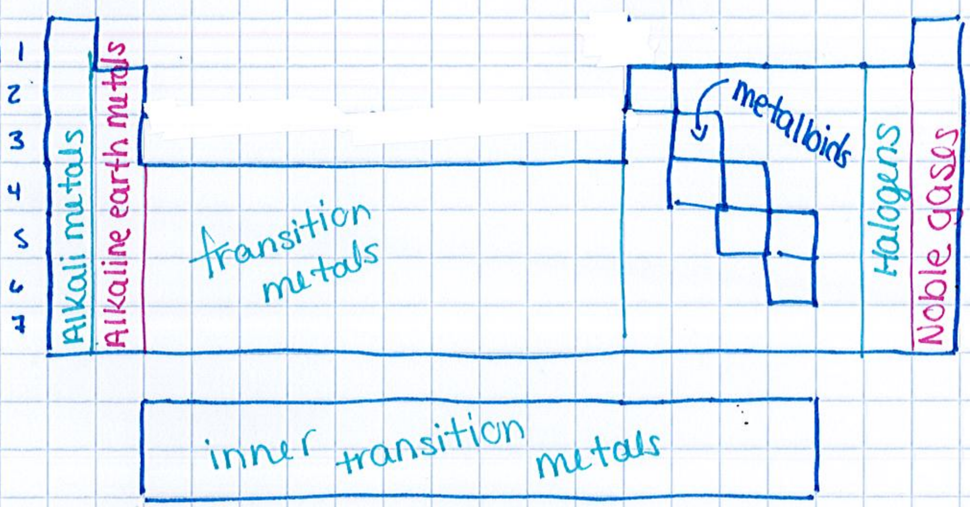
$$E = h \cdot \nu = (6.626 \times 10^{-34} \text{ J} \cdot \text{s})(7.50 \times 10^{14} \text{ 1/s}) = \boxed{4.97 \times 10^{-19} \text{ J}}$$

(27) $c = \lambda \cdot \nu \quad \nu = \frac{c}{\lambda} = \frac{3.00 \times 10^{8}\ m/s}{1.00 \times 10^{1}\ m} = 3.00 \times 10^{7}\ 1/s$

$E = h \cdot \nu = (6.626 \times 10^{-34}\ J \cdot s)(3.00 \times 10^{7}\ 1/s) = 1.99 \times 10^{-26}\ J$

(28) A. covalent
B. ionic
C. covalent
D. ionic
E both
F both

(29)



(30) groups are vertical columns, there are 18 groups.

(31) periods are horizonal row; there are 7 periods

(32) A. Br < Ni < Sc
B. Sc > Ni > Br
C. Sc < Ni < Br
D. Br > Ni > Sc

(33) A. F < Se < Pb
B. Pb > Se > F
C. Pb < Se < F
D. F > Se > Pb

(34) A. reaction would speed up
B. reaction would speed up
C. reaction would slow down
D. reaction would speed up because the catalyst lowers the amount of activation energy needed.

(35) A. $K_{eq} = \frac{[HCl]^2}{[H_2]\cdot[Cl_2]}$

B. $K_{eq} = \frac{[H_2]\cdot[MgSO_4]}{[H_2SO_4]}$

C. $K_{eq} = \frac{[CO_2]^3\cdot[H_2O]^4}{[C_3H_8]\cdot[O_2]^5}$

(36) A. $K_{eq} = \frac{[NO_2]^2}{[NO]^2\cdot[O_2]} = \frac{[.129]^2}{[.106]^2\cdot[.122]} = \boxed{12.1}$

B. $K_{eq} = \frac{[H_2O]\cdot[CO]}{[CO_2][H_2]} = \frac{[.44]\cdot[.44]}{[.056]\cdot[.041]} = \boxed{84.3}$

(37) i. right
ii. right
iii no shift
iv right
v. left
vi. left
vii right

(38) A. exothermic
B. endothermic

(39) exothermic

(40) endothermic

(41) A. $P_4(s) + 6Cl_2(g) \rightarrow 4PCl_3(g)$ $\Delta H_a = -2439\ kJ$
B. $4PCl_5(g) \rightarrow P_4(g) + 10Cl_2(g)$ $\Delta H_b = +3438\ kJ$

$4PCl_5(g) \rightarrow 4PCl_3(g) + 4Cl_2$ $\Delta H_{TOT} = 999\ kJ$
(÷ 4) (÷ 4)

$PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$ $\Delta H_{TOT} = +249.75\ kJ$

(42) a. $NaH_4(l) + CH_4O(l) \rightarrow CH_2O(g) + N_2(g) + 3H_2(g)$ $\Delta H_a = -37 kJ$

b. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ $\Delta H_b = -46 kJ$

c. $CH_2O(g) + H_2(g) \rightarrow CH_4O(l)$ $\Delta H_c = +65 kJ$

$NaH_4(l) + H_2(g) \rightarrow 2NH_3(g)$ $\Delta H_{TOT} = -18 kJ$

(43) $4\ 2CO_2(g) + 6\ 3H_2O(l) \rightarrow 2C_2H_6O(l) + 6\ 3O_2(g)$ (10 2(g)) $2(\Delta H_a = +685.5 kJ)$

$2\ C_2H_4O(l) + \frac{5}{2}O_2(g) \rightarrow 4\ 2CO_2(g) + 4\ 2H_2O(l)$ $2(\Delta H_b = -583.5 kJ)$

$2C_2H_4O(l) + 2H_2O(l) \rightarrow 2C_2H_6O(l) + O_2(g)$ $\Delta H_{TOT} = +204 kJ$

(44) $q = mC\Delta T$ $\Delta T = \frac{q}{mC} = \frac{1086.75 J}{(15.75 g \cdot 150.°C)} = .460 J/g°C$

$\Delta T = 175°C - 25°C = 150.°C$

(45) $q = mC\Delta T = (2300.g)(.90 J/g°C)(14°C) = 28980 J = 29000 J$

$\Delta T = 16°C - 2°C = 14°C$

(46) $q = (454 g)(.386 J/g°C)(-68.0°C) = -11916.592 J = -11900 J$

$\Delta T = 28.0°C - 96.0°C = -68.0°C$

(47) M = ?

$n = 15.0 g\ Mg(OH)_2 \times \frac{1 mol}{58.33 g} = .257157552 mol$

$V = 400 mL = .400 L$

$M = \frac{.257157552 mol}{.400 L} = .643 M$

(48) $V = \frac{n}{M}$

$M = .76$ mol/L

$n = 5.00\text{g HCl} \times \frac{1\text{mol}}{36.46\text{g}} = .137136588\text{mol}$

$V = ?$

$V = \frac{.137136588\text{mol}}{.76\text{ mol/L}} =$ **.18L**

(49) $M = 1.23$ mol/L

$n = ?$

$V = 1.00L$

$n = M \cdot V = (1.23\text{ mol/L})(1.00L)$

$n = 1.23\text{mol } NH_3 \times \frac{17.04\text{g}}{1\text{mol}} =$ **21.0g**

(50) A. the boiling point would increase

B. the freezing point would decrease

(51) Arrhenius acid - releases H^+ ions in solution

Arrhenius base - releases OH^- ions in solution

(52) Bronsted-Lowry acid - donates H^+ ions in solution

Bronsted-Lowry base - accepts H^+ ions in solution

conjugate base - substance left after acid donates H^+

conjugate acid - substance base becomes after getting an H^+ ion

(53) A. $H_2O + H_2SO_4 \rightarrow H_3O^+ + HSO_4^-$

B A CA CB

B. $H_2O + NH_3 \rightarrow OH^- + NH_4^+$

A B CB CA

(54) strong acids - ionize 100%

HCl, HBr, HI, HNO_3, $HClO_3$, $HClO_4$, H_2SO_4

weak acids - ionize 10% or less

strong bases

$LiOH$, $NaOH$, KOH, $RbOH$, $CsOH$, $Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$

(55) A. basic
B. acidic
C. acidic
D. basic