REVIEW FOR UNIT 5 EXAM FITCH ①

1. $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

$(2.25\,g\ Ag)\frac{(1\,mol)}{(107.87\,g)} = .021\,mol\ Ag$

$(.021\,mol\ Ag)\frac{(1\,mol\ Cu(NO_3)_2)}{(2\,mol\ Ag)} = .011\,mol\ Cu(NO_3)_2$

$(.011\,mol\ Cu(NO_3)_2)\frac{(187.57\,g)}{(mol)} = 2.06\,g\ Cu(NO_3)_2$

2. $Sn + 2PbClO_3 \rightarrow Sn(ClO_3)_2 + 2Pb$

$(7.14\,g\ Pb)\frac{(1\,mol)}{(207.19\,g)} = .034\,mol\ Pb$

$(.034\,mol\ Pb)\frac{(1\,mol\ Sn(ClO_3)_2)}{(2\,mol\ Pb)} = .017\,mol\ Sn(ClO_3)_2$

$(.017\,mol\ Sn(ClO_3)_2)\frac{(285.59\,g)}{mol} = 4.86\,g\ Sn(ClO_3)_2$

3. $H_2SO_4 + 2NaHCO_3 \rightarrow 2CO_2 + Na_2SO_4 + 2H_2O$

$(233\,g\ H_2SO_4)\frac{(1\,mol)}{(98.07\,g)} = 2.376\,mol\ H_2SO_4$

a. $(2.376\,mol\ H_2SO_4)\frac{(2\,mol\ NaHCO_3)}{(1\,mol\ H_2SO_4)} = 4.752\,mol\ NaHCO_3$ (≈4.76 mol)

b. $(4.752\,mol\ NaHCO_3)\frac{(84.01\,g)}{(mol)} = 399.22\,g\ NaHCO_3$

c. $(4.752\,mol\ CO_2)\frac{(44.01\,g)}{mol} = 209.14\,g\ CO_2$

$(2.376\,mol\ Na_2SO_4)\frac{(142.04\,g)}{mol} = 337.49\,g\ Na_2SO_4$

$(4.752\,mol\ H_2O)\frac{(18.02\,g)}{mol} = 85.63\,g\ H_2O$

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4. $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

$$\frac{(474\,g\ CO_2)(1\ mol)}{(44.01\,g)} = 10.770\ mol\ CO_2$$

$$\frac{(10.770\ mol\ CO_2)(2\ mol\ NaOH)}{(1\ mol\ CO_2)} = \boxed{21.54\ mol\ NaOH}$$

$$\frac{(10.77\ mol\ CO_2)(1\ mol\ Na_2CO_3)}{1\ mol\ CO_2} = \boxed{10.77\ mol\ Na_2CO_3}$$

$$\frac{(10.77\ mol\ CO_2)(1\ mol\ H_2O)}{(1\ mol\ CO_2)} = \boxed{10.77\ mol\ H_2O}$$

5. SEE BOOK FOR DEF'NS

H-OH

6. $3H_2SO_4 + 2Al(OH)_3 \rightarrow Al_2(SO_4)_3 + 6H_2O$

a. $$\frac{(80\,g\ H_2SO_4)(1\ mol)}{(98.08\,g)} = .816\ mol\ H_2SO_4$$

$$\frac{(.816\ mol\ H_2SO_4)(1\ mol\ Al_2(SO_4)_3)}{3\ mol\ H_2SO_4} = .272\ mol\ Al_2(SO_4)_3$$

$$\frac{(.75\,g\ Al(OH)_3)(1\ mol)}{(78.01\,g)} = .961\ mol\ Al(OH)_3$$

$$\frac{(.961\ mol\ Al(OH)_3)(1\ mol\ Al_2(SO_4)_3)}{2\ mol\ Al(OH)_3} = .481\ mol\ Al_2(SO_4)_3$$

$\boxed{\therefore\ H_2SO_4\ \text{IS LIMITING}}$

b. $$\frac{(.816\ mol\ H_2SO_4)(2\ mol\ Al(OH)_3)}{(3\ mol\ H_2SO_4)} = .544\ mol\ Al(OH)_3\ \text{USED}$$

$.961\ mol\ Al(OH)_3$ GIVEN $- .544\ mol$ USED $= .417\ mol\ Al(OH)_3$ IN EXCESS

6-b. $(.417 \text{ mol } Al(OH)_3)\left(\frac{78.01 g}{mol}\right) = $ **32.53 g $Al(OH)_3$ IN EXCESS**

e. $\frac{(.816 \text{ mol } H_2SO_4)(1 \text{ mol } Al_2(SO_4)_3)}{(3 \text{ mol } H_2SO_4)} = .272 \text{ mol } Al_2(SO_4)_3$

$(.272 \text{ mol } Al_2(SO_4)_3)\left(\frac{342.14 g}{mol}\right) = $ **93.06 g $Al_2(SO_4)_3$**

$\frac{(.816 \text{ mol } H_2SO_4)(6 \text{ mol } H_2O)}{(3 \text{ mol } H_2SO_4)} = 1.632 \text{ mol } H_2O$

$(1.632 \text{ mol } H_2O)\left(\frac{18.02 g}{mol}\right) = $ **29.41 g H_2O**

7. a. $Sn(NO_3)_4 + 4NaCl \rightarrow SnCl_4 + 4NaNO_3$

b. $\frac{(3 \text{ mol } Sn(NO_3)_4)(1 \text{ mol } SnCl_4)}{(1 \text{ mol } Sn(NO_3)_4)} = 3 \text{ mol } SnCl_4$

$\frac{(5 \text{ mol } NaCl)(1 \text{ mol } SnCl_4)}{(4 \text{ mol } NaCl)} = 1.25 \text{ mol } SnCl_4$

∴ NaCl is LIMITING!

C. & D. $\frac{(5 \text{ mol } NaCl)(1 \text{ mol } Sn(NO_3)_4)}{4 \text{ mol } NaCl} = 1.25 \text{ mol } Sn(NO_3)_4$ USED

$3 \text{ mol } Sn(NO_3)_4 - 1.25 \text{ mol} = $ **1.75 mol $Sn(NO_3)_4$ IN EXCESS**

E. $\frac{(5 \text{ mol } NaCl)(4 \text{ mol } NaNO_3)}{(4 \text{ mol } NaCl)} = $ **5.0 mol $NaNO_3$ & 1.25 mol $SnCl_4$ ← FROM "b"**

REVIEW FOR U5 EXAM (CONT)

8. a. $3AgNO_3 + AlCl_3 \rightarrow 3AgCl + Al(NO_3)_3$

b. $(6\ \text{mol}\ AgNO_3)\left(\frac{3\ \text{mol}\ AgCl}{3\ \text{mol}\ AgNO_3}\right) = 6\ \text{mol}\ AgCl$

$(5\ \text{mol}\ AlCl_3)\left(\frac{3\ \text{mol}\ AgCl}{1\ \text{mol}\ AlCl_3}\right) = 15\ \text{mol}\ AgCl$

∴ $AgNO_3$ IS LIMITING

c. $AlCl_3$ IS IN EXCESS

d. $(6\ \text{mol}\ AgNO_3)\left(\frac{1\ \text{mol}\ AlCl_3}{3\ \text{mol}\ AgNO_3}\right) = 2\ \text{mol}\ AlCl_3$ USED

5 mol $AlCl_3$ (GIVEN) − 2 mol USED = 3 mol $AlCl_3$ IN EXCESS

e. $(6\ \text{mol}\ AgNO_3)\left(\frac{1\ \text{mol}\ Al(NO_3)_3}{3\ \text{mol}\ AgNO_3}\right) = 2\ \text{mol}\ Al(NO_3)_3$

+ 6 mol AgCl (FROM 'b')

9. a. $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$

b. C_4H_{10} MUST BE LIMITING AS THE O_2 COMES FROM AIR.

c. $(.25\ \text{mol}\ C_4H_{10})\left(\frac{8\ \text{mol}\ CO_2}{2\ \text{mol}\ C_4H_{10}}\right) = 1\ \text{mol}\ CO_2$

$(.25\ \text{mol}\ C_4H_{10})\left(\frac{10\ \text{mol}\ H_2O}{2\ \text{mol}\ C_4H_{10}}\right) = 1.25\ \text{mol}\ H_2O$

d. $(1\ \text{mol}\ CO_2)\left(\frac{44.01\ g}{\text{mol}}\right) = 44.01\ g\ CO_2$

$(1.25\ \text{mol}\ H_2O)\left(\frac{18.02\ g}{\text{mol}}\right) = 22.53\ g\ H_2O$

10a. $3CaCl_2 + 2Na_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6NaCl$

b. $(50\,g\,CaCl_2)\left(\frac{1\,mol}{110.98\,g}\right) = .451\,mol\,CaCl_2$

$(.451\,mol\,CaCl_2)\left(\frac{1\,mol\,Ca_3(PO_4)_2}{3\,mol\,CaCl_2}\right) = .150\,mol\,Ca_3(PO_4)_2$

$(100\,g\,Na_3PO_4)\left(\frac{1\,mol}{163.94\,g}\right) = .610\,mol\,Na_3PO_4$

$(.61\,mol\,Na_3PO_4)\left(\frac{1\,mol\,Ca_3(PO_4)_2}{2\,mol\,Na_3PO_4}\right) = .305\,mol\,Ca_3(PO_4)_2$

∴ $CaCl_2$ IS LIMITING

c. Na_3PO_4 IS IN EXCESS

d. $(.451\,mol\,CaCl_2)\left(\frac{2\,mol\,Na_3PO_4}{3\,mol\,CaCl_2}\right) = .301\,mol\,Na_3PO_4$ USED

$.610\,mol\,Na_3PO_4$ (GIVEN) $- .301\,mol$ USED $= .309\,mol\,Na_3PO_4$ IN EXCESS

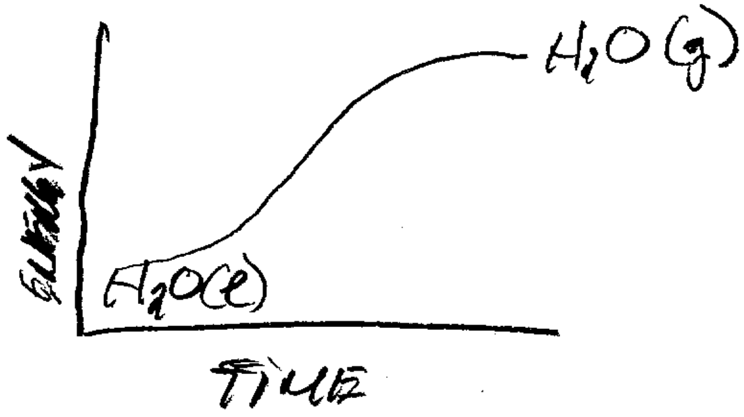
e. $(.451\,mol\,CaCl_2)\left(\frac{6\,mol\,NaCl}{3\,mol\,CaCl_2}\right) = .902\,mol\,NaCl$ + $.15\,mol\,Ca_3(PO_4)_2$ PRODUCED

FROM 'b'

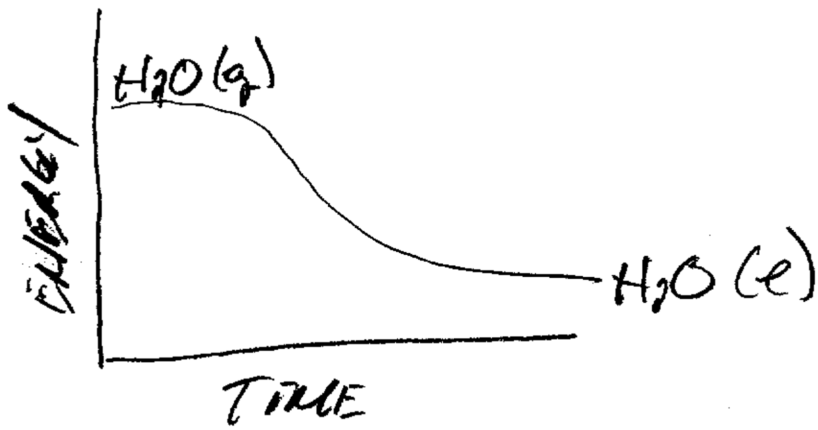
11. a. EXOTHERMIC (MORE ENERGY IN REACTANTS THAN IN PRODUCTS)

b. ENDOTHERMIC (MORE ENERGY IN PRODUCTS THAN IN REACTANTS)

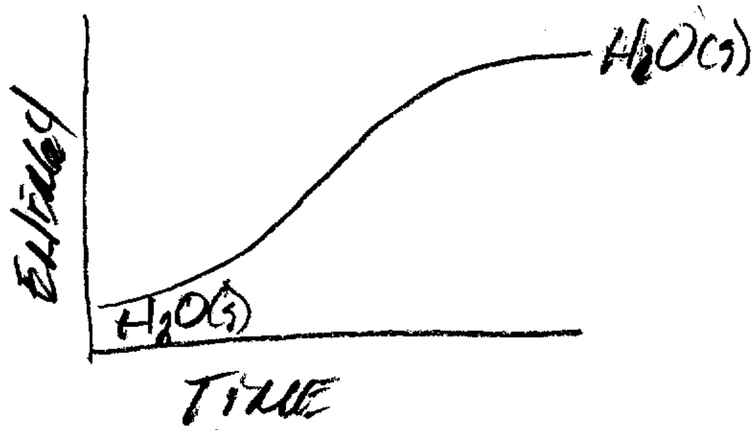
12. a.



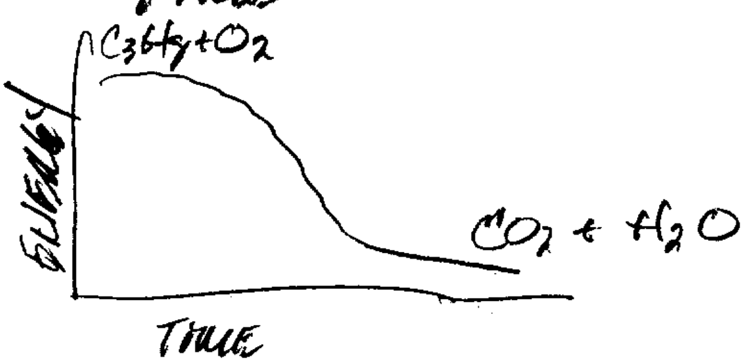
b.



c.



d.



13. $\Delta H = \frac{-950\ KJ}{mol}$ $30\,g\ C_2H_5OH = ?\ KJ$

$(30\,g)\left(\frac{1\ mol}{46.08\,g}\right) = .651\ mol\ C_2H_5OH$

$(.651\ mol\ C_2H_5OH)\left(\frac{-950\ KJ}{mol}\right) = \boxed{-618.45\ KJ}$

14. $(1.5\ L)\left(\frac{1000\ ml}{(L)}\right) = 1500\ ml\ C_2H_5OH$

$(1500\ ml)\left(\frac{.789\,g}{(ml)}\right) = 1183.5\,g\ C_2H_5OH$

$(1183.5\,g)\left(\frac{1\ mol}{(46.08\,g)}\right) = 25.684\ mol$

$(25.684\ mol)\left(\frac{-950\ KJ}{mol}\right) = \boxed{-24399.8\ KJ}$

15. $(100\,g\ C_3H_8)\left(\frac{1\ mol}{(44.11\,g)}\right) = 2.267\ mol\ C_3H_8$

$(2.267\ mol\ C_3H_8)\left(\frac{-2200\ KJ}{(1\ mol)}\right) = \boxed{-4987.4\ KJ}$

16. $H_2O(l) \rightarrow H_2O(g) + 6.03\ KJ$

$(5000\ ml)\left(\frac{1\,g}{ml}\right) = (5000\,g)\left(\frac{1\ mol}{(18.02\,g)}\right) = 277.469\ mol\ H_2O(l)$

$(277.469\ mol\ H_2O)\left(\frac{6.03\ KJ}{1\ mol\ H_2O(l)}\right) = \boxed{1673.14\ KJ\ \text{(ABSORBED)}}$

U5 REVIEW (CONT)

17.+18. $2Al_2O_3(s) \rightarrow 4Al(s) + 3O_2(g)\ \Delta H = +3352\ KJ$

18. $100g\ Al \rightarrow ?g\ Al_2O_3$

$$(100g\ Al)\left(\frac{1\ mol\ Al}{26.98g}\right) = 3.706\ mol\ Al$$

$$(3.706\ mol\ Al)\left(\frac{2\ mol\ Al_2O_3}{4\ mol\ Al}\right) = 1.853\ mol\ Al_2O_3$$

$$(1.853\ mol\ Al_2O_3)\left(\frac{101.96g}{1\ mol}\right) = \boxed{188.93g\ Al_2O_3}$$

$$(1.853\ mol\ Al_2O_3)\left(\frac{+3352\ KJ}{2\ mol\ Al_2O_3}\right) = \boxed{3105.63\ KJ}$$

$$\frac{3352\ KJ}{2\ mol\ Al_2O_3} = \boxed{1676\ \frac{KJ}{mol\ Al_2O_3}}$$

19. $H_2O(s) \rightarrow H_2O(l)\ \Delta H = 1.44\ Kcal$

$50g\ H_2O(s) \rightarrow 50g\ H_2O(l) = ?\ KJ$

$$(50g\ H_2O)\left(\frac{1\ mol}{18.02g}\right) = 2.775\ mol\ H_2O$$

$$(2.775\ mol\ H_2O)\left(\frac{1.44\ Kcal}{mol}\right) = \boxed{3.996\ Kcal\ (\text{ABSORBED})}$$

20. $50g\ H_2O$ from $50°C \Rightarrow 100°C = ?\ KJ$ $\quad Q = m \cdot c \cdot \Delta t$

$$Q = (50g)\left(1\ cal/g°C\right)(50°C) = \boxed{2500\ CAL}$$

21. $50g\ H_2O(l)\ 100°C \rightarrow 50g\ H_2O(g)\ @\ 100°C \quad \Delta H = 9.7\ KCAL$

$(2.775\ mol\ H_2O)\left(\frac{9.7\ KCAL}{mol}\right) = $ **26.92 KCAL (ABSORBED)**

22. $770g\ Al\ 20° \rightarrow 95°C \quad C_{Al} = .22\ CAL/g°C \quad Q = m \cdot c \cdot \Delta t$

$Q = (770g)\left(\frac{.22 CAL}{g°C}\right)(75°C) = $ **12,705 CAL**

23. $770g\ H_2O\ 20 \rightarrow 95°C \quad C_{H_2O} = \frac{1 CAL}{g°C} \quad Q = m \cdot c \cdot \Delta t$

$Q = (770g)\left(\frac{1 CAL}{g°C}\right)(75°C) = $ **57,750 CAL**

24. TAKES MORE ENERGY TO CHANGE THE TEMP. OF H_2O THAN IT DOES Al. SPECIFIC HEATS SHOW THAT:

$C_{H_2O} = \frac{1 CAL}{g°C} \quad C_{Al} = \frac{.22 CAL}{g°C}$

25. 57.3 CAL ; 100g ; $5°C = \Delta t$; $c = ?$

$Q = m \cdot c \cdot \Delta t$

$\frac{Q}{m \Delta t} = c$

$\frac{57.3 CAL}{(100g)(5°C)} = $ **$.17 \frac{CAL}{g°C}$**

26. 1 L H_2O 1400 CAL $c = 1 CAL/g°C$ $t_i = 22°C$ $t_f = ?$

$\frac{Q}{mc} = \Delta t \quad \frac{1400 CAL}{(1000g)\left(\frac{1 CAL}{g°C}\right)} = 1.4°C = \Delta t$

$\Delta t = t_f - t_i \Rightarrow \Delta t + t_i = t_f \Rightarrow 1.4°C + 22°C = $ **23.4°C**

27. 2000g Fe 45000 J $t_i = 22°C$ $C_{Fe} = \frac{.45 J}{g°C}$

$$\Delta t = \frac{Q}{m \cdot c} = \frac{45000 J}{(2000g)(.45 \frac{J}{g°C})} = 50°C$$

$$\Delta t = t_f - t_i \Rightarrow 50°C = t_f - 22°C$$

$$50° + 22°C = t_f \qquad \boxed{t_f = 72°C}$$

28. $$(45000 J)\left(\frac{1 CAL}{4.184 J}\right) = \boxed{10755.26 CAL}$$

29. 42g 2865 CAL $\Delta t = 344° - 22° = 322°C$ $C = ?$

$$\frac{Q}{m\Delta t} = C \qquad \frac{2865 CAL}{(42g)(322°C)} = \boxed{.21 \frac{CAL}{g°C}}$$

30. COASTAL AREAS ARE BY WATER. WATER HAS A RELATIVELY HIGH SPECIFIC HEAT. THIS MEANS THAT IT TAKES ALOT OF HEAT TO RAISE THE TEMPERATURE OF WATER. SO COASTAL AREAS WILL BE COOLER BECAUSE ALOT OF THE HEAT THAT RAISES THE TEMPERATURE INLAND IS SORT OF ABSORBED BY WATER AS IT TAKES ALOT OF HEAT TO CHANGE WATER'S TEMP.