Key to all Test Versions. There has been a significant improvement in scores for the class as a whole: Average ± standard deviation: 93 (62%)±32(21%)

Highest (2 people): 150; *Rough* Grading Scale for this test A≥127; B≥100; C≥70 ; D≥45

Part I. Multiple choice. (Choose the best answer). 5 points each (50 pts total).

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|---|---|
| 1. E<br>2. E<br>3. E solution: E mol Ti=16.12/47.9g/mol = .3365; mol Cl=47.72/35.45g/mol=1.346=> $Ti_{.3365}Cl_{1.346}$=> $TiCl_4$<br>4. C mol C=90.36/44=2.054<br>mol H = (46.23/18)(2/1)=5.137<br>$CH_{5.137/2.054}$ =$CH_{2.5}$ => $C_2H_5$ | 5. B<br>6. C<br>7. D solution: $2Al_2O_3$ → 4 Al + 3 $O_2$<br>#molec $O_2$=4 molec$Al_2O_3$ (3 molec $O_2$/2 molec $Al_2O_3$) = 6 molec $O_2$<br>8. D $C_p$ = (60.0J) / {(76.4g)(6.04°C)}) = 0.13 J/g°C<br>9. B, C, or E are all possible. |

Part II. Short problems:

1) solution: #g MgO = 365 g Mg (1mol/24.3g)(2/2)(40.3g/mol)=605.3g
%yield = 326x100%/605.3=**53.9%**

2) solution: #mL = 25.0g $BaCl_2$(1mol/208.3g)(1000mL/0.600mol)=**200. mL**

3) solution: #g AgCl=.037L(.280M)mol$AgNO_3$(1/1)(143.4g/mol)=**1.49 g AgCl**

4) solution: $q = mH_{fus}+mC_p\Delta T+mH_{vap}$=10g(333J/g +(4.18J/gK)(100K)+2260J/g)
=30,100J =**30.1 kJ**

5) solution: $\Delta H°$=-235.1-241.8 +2(110.5) + 4(0)= **-255.9kJ**

Part III.

1) solution: Write the balanced equation: $H_3PO_4$ + 3 XOH → $3H_2O$ + $X_3A$.
one way to solve: @ equivalence, # moles $H^+$ = # moles $OH^-$ . or, 3 x (#moles $H_3PO_4$) = #moles XOH. Or, 3 $M_{H3PO4}V_{H3PO4}=M_{XOH}V_{XOH}$ => $M_{H3PO4}= M_{XOH}V_{XOH} / 3V_{H3PO4}$
(1/3) (.150)(22.5mL)/(35.0mL) = **0.0321M $H_3PO_4$**

b)

solution: the goal is to get the atomic weight of X. First, we can get the MW of XOH by dividing mass by # moles. The mass is given as 0.189 g and the moles is obtainable by the simple multiplication of MV = (0.150M)(0.0225L) =.003375moles;
MW XOH = 0.189 g/ 0.003375moles = 56.0g/mol; If the atomic weight of X is x, then:
x + 16+1 = 56 g/mole or, x=39 g/mole. The alkali metal is **potassium, K** (39.1g/mole)

2) a) Solution: Get the MW's: $CuSO_4$ = 63.55+32.07+4(16.00) = 159.62g/mole;
$CuSO_4 \cdot 5H_2O$ = 63.55+32.07+4(16.00) + 5 ( 2.0+16.00) = 249.62g/mole
Write the reactions:
(i) $CuSO_4(s) \rightarrow CuSO_4(aq)$ $\Delta H_i$= **-15.6** kJ/mol (see below)
(ii) $CuSO_4 \cdot 5H_2O$ (s) $\Delta H_i$= **-15.1** kJ/mol (see below)

$\Delta H_i = -mC_p\Delta T/n = -(100.g)(4.18J/g°C)(22.2-21.5°C) = -292.6$ J
and # moles $CuSO_4(s)$= (3.0g $CuSO_4(s)$)(1mole/159.62g) 0.0188 moles
so that $\Delta H°$ (-292.6 J)/(0.0188 moles) = -15,570 J/mol = **-15.6 kJ/mol**

$\Delta H_{ii} = -mC_p\Delta T/n = -(80.g)(4.18J/g°C)(20.6 – 19.7°C) = -301.0$ J
and # moles $CuSO_4 \cdot 5H_2O(s)$= (5.0g $CuSO_4(s)$)(1mole/249.62g) = 0.0200 moles
so that $\Delta H°$ (-301.0 J)/( 0.0200 moles) = -15.050 J/mol = **- 15.1 kJ/mol**
b)
Solution: rewriting the 2 equations, we see:
(i) $CuSO_4(s) \rightarrow CuSO_4(aq)$ $\Delta H_i$= **-15.6** kJ/mol (see below)
(ii) $CuSO_4 \cdot 5H_2O$ (s) $\Delta H_i$= **-15.1** kJ/mol (see below)

To get $CuSO_4 \cdot 5H_2O$ (s) $\rightarrow CuSO_4(s) + 5\ H_2O(l)$, we subtract (ii) – (i):

$\Delta H_{ii} - \Delta H_i$=(-15.1 kJ/mole )-(-15.6 kJ/mole )= **+ 0.5 kJ/mole**