"כימיאדה"

האולימפיאדה הארצית לתלמידי כיתות י"א-י"ב

שלב הגמר, 19.03.2014

פתרון

1.

i) FeO -(416 + 759 + 1561 + 249 + 657) + (-278) = **-3920 kJ mol^{-1}**
CaO -(178 + 590 + 1145 + 249 + 657) + (-635) = **-3454 kJ mol^{-1}**

ii) **iron(II) oxide** (FeO)

iii) -(-278) + (-635) = **-357 kJ mol^{-1}**

2.

i) Ratio 1:2:3:7 i.e. **$YBa_2Cu_3O_7$**

ii) oxidation state 14-(3+4)/3 = 7/3 Cu = **2.33**

iii) 84.2/666.19 = x/658.19. x = **83.19 mg**

3.

a) $NaNO_{3(s)} \rightarrow NaNO_{2(s)} + ½\ O_{2(g)}$

$Mg(NO_3)_{2(s)} \rightarrow MgO_{(s)} + 2NO_{2(g)} + ½\ O_{2(g)}$

b) $2MnO_4^-{}_{(aq)} + 6H^+_{(aq)} + 5NO_2^-{}_{(aq)} \rightarrow 2Mn^{2+}_{(aq)} + 5NO_3^-{}_{(aq)} + 3H_2O_{(l)}$

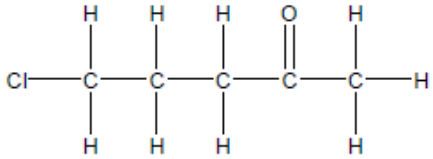
c) $2MnO_4^-{}_{(aq)} + 5(COO)_2^{2-}{}_{(aq)} + 16H^+_{(aq)} \rightarrow 2Mn^{2+}_{(aq)} + 10CO_{2(g)} + 8H_2O_{(l)}$

d) $NaNO_3$ = 4.25g $Mg(NO_3)_2$ = 11.1g

e) 1 : 2.4 (5:12) O_2:NO_2

4.

A =



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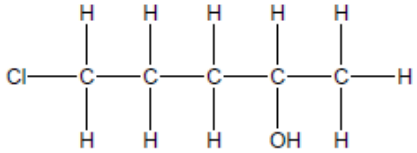

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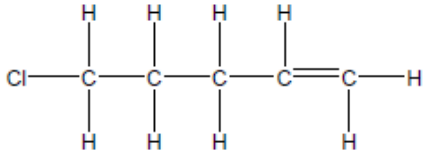

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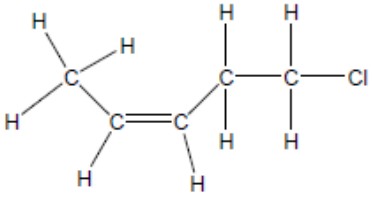

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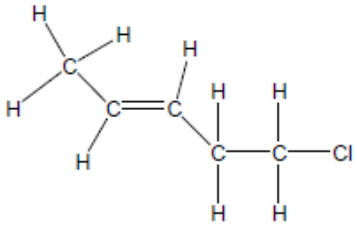

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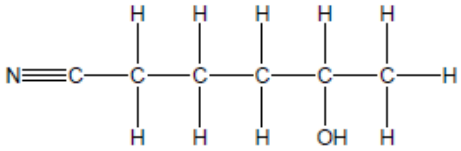

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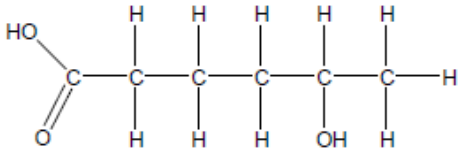

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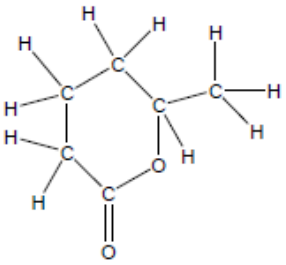

5.

(a) $BrO_3^- + 5Br^- + 6H^+ = 3Br_2 + 3H_2O$

(b) (i) 1
(ii) 1
(iii) 2

(c) $1.48 \times 10^{-2} - 1.50 \times 10^{-2}$ $mol^{-3}\ dm^{9}\ s^{-1}$

(d) [ethanoic acid] = 0.0300 ($mol\ dm^{-3}$)
$[H^+] = 7.22 \times 10^{-4}$ ($mol\ dm^{-3}$)
9.91×10^{-11} ($mol\ dm^{-3}\ s^{-1}$)

6.

a) A = $^{+}NH_3 . CH_2 COOH$

B = $^{+}NH_3 . CH_2 COO^{-}$

C = $NH_2 . CH_2 COO^{-}$

b) $^{+}NH_3 . CH_2 COOH$

9.78 2.35

c) At X : pH = 2.35

Y : pH = 9.78

[acid] = [salt]
pH = pKa

d)(i) $H_3N^{+} . CH_2 COOH \rightleftharpoons H_3N^{+} . CH_2 . COO^{-} + H^{+}$ Ka_1

$H_3N^{+} . CH_2 COO^{-} \rightleftharpoons H_2N . CH_2 COO^{-} + H^{+}$ Ka_2

(ii) $Ka_1 = \dfrac{[H^{+}] [H_3N^{+} . CH_2 COO^{-}]}{[H_3N^{+} . CH_2 COOH]}$

$Ka_2 = \dfrac{[H^{+}] [H_2N . CH_2 COO^{-}]}{[H_3N^{+} . CH_2 COO^{-}]}$

e) $Ka_1 = \dfrac{[H^{+}] [^{+}NH_3 . CH_2 . COO^{-}]}{[^{+}NH_3 . CH_2 COOH]}$

$10^{-2.35} = \dfrac{10^{-4} [^{+}NH_3 \ CH_2 \ COO^{-}]}{[^{+}NH_3 \ CH_2 \ COOH]}$

$\dfrac{[^{+}NH_3 \ CH_2 \ COO^{-}]}{[^{+}NH_3 \ CH_2 \ COOH]} = 44.6$