Name Mr. Shank Period AP 1, 2, 3

*Pre-AP Chemistry, Grade 10*
**Test 4**
Answer Sheet:

I. Multiple Choice

1. B
2. C
3. D
4. D
5. E
6. C
7. A
8. E
9. B
10. D

II. Free Response

1. a) 1 $N_2$ + 3 $H_2$ → 2 $NH_3$

b) 2 NaOH + 1 $H_2SO_4$ → 1 $Na_2SO_4$ + 2 $H_2O$

c) 1 $CH_4$ + 4 $Br_2$ → 1 $CBr_4$ + 4 HBr

2. a) $HCOOH = CH_2O_2$

$$CH_2O_2 + \tfrac{1}{2} O_2 \rightarrow CO_2 + H_2O$$

b) $C_6H_5CO_2H = C_7H_6O_2$

$$C_7H_6O_2 + \tfrac{15}{2} O_2 \rightarrow 7\,CO_2 + 3\,H_2O$$

c)

$$C_{18}H_{34}O_2 + \tfrac{51}{2} O_2 \rightarrow 18\,CO_2 + 17\,H_2O$$

3.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

36.032 g $H_2O$ = theoretical yield

actual yield $16.043\ g\ CH_4 \times \frac{1\ mol\ CH_4}{16.0426\ g\ CH_4} \times \frac{2\ mol\ H_2O}{1\ mol\ CH_4} \times \frac{18.0158\ g\ H_2O}{1\ mol\ H_2O} =$

$\frac{18.0156\ g\ H_2O}{36.032\ g\ H_2O} = 0.50 \Rightarrow$ % yield

**% yield = 50%**

4. $26.59\ g\ NO \times \frac{1\ mol\ NO}{30.007\ g\ NO} \times \frac{2\ mol\ NO_2}{2\ mol\ NO} = 0.886\ mol\ NO_2$

$16.10\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} \times \frac{2\ mol\ NO_2}{1\ mol\ O_2} = 1.006\ mol\ NO_2$

*NO is the limiting reagent*

**moles $NO_2$ produced = 0.886**

5. (0.611 moles) (75%) (75%)

$55\ g\ C_xH_yO_z + O_2 \rightarrow 24.75\ g\ H_2O + 60.46\ g\ CO_2$

theoretical yield $H_2O = 24.75/.75 = 33\ g\ H_2O$

$33\ g\ H_2O \times \frac{1\ mol\ H_2O}{18.0158\ g\ H_2O} \times \frac{2\ mol\ H}{1\ mol\ H_2O} = 3.663\ mol\ H \times \frac{1.0079\ g\ H}{1\ mol\ H} = 3.692\ g\ H$

theoretical yield $CO_2 = 60.46/.75 = 80.613\ g\ CO_2$

$80.613\ g\ CO_2 \times \frac{1\ mol\ CO_2}{44.011\ g\ CO_2} \times \frac{1\ mol\ C}{1\ mol\ CO_2} = 1.832\ mol\ C \times \frac{12.011\ g\ C}{1\ mol\ C} = 22.004\ g\ C$

$55\ g - (3.692\ g + 22.004\ g) = 29.304\ g\ O \times \frac{1\ mol\ O}{16\ g\ O} = 1.832\ mol\ O$

$C_{1.832}H_{3.663}O_{1.832} \rightarrow CH_2O$ => empirical molar mass = 30.027 g/mol

$\frac{\text{molecular molar mass}}{\text{empirical molar mass}} = \frac{(55\ g/.611\ moles)}{30.027\ g/mol} \approx 3$

**molecular formula = $C_3H_6O_3$**

Extra Credit

$X_g\ CuSO_4 \cdot 5H_2O + Y_g\ MgSO_4 \cdot 7H_2O = 5.020\ g$

$\begin{bmatrix} 1 & 1 & 5.020 \\ .639 & .488 & 2.988 \end{bmatrix} \rightarrow \begin{bmatrix} 1 & 1 & 5.020 \\ 0 & -.151 & -0.2198 \end{bmatrix}$

$\frac{m(CuSO_4)}{m(CuSO_4 \cdot 5H_2O)} = 0.639 \quad \frac{m(MgSO_4)}{m(MgSO_4 \cdot 7H_2O)} = 0.488 \rightarrow \begin{bmatrix} 1 & 1 & 5.020 \\ 0 & 1 & 1.455 \end{bmatrix} \rightarrow \begin{bmatrix} 1 & 0 & 3.565 \\ 0 & 1 & 1.455 \end{bmatrix}$

$0.639\ x_g\ CuSO_4 + 0.488\ y_g\ MgSO_4 = 2.988\ g$

$x = 3.565\ g$

$y = 1.455\ g$

$\frac{3.565\ g}{3.565\ g + 1.455\ g} = 0.71$

$x + y = 5.020$

$0.639x + 0.488y = 2.988$

**% $CuSO_4 \cdot 5H_2O$ = 71 %**