Test 4 – Additional Review Problems – Answers

1. $20_g\ Z + O_2 \rightarrow 29.314\ g\ CO_2 + 12.000\ g\ H_2O$

$$29.314\ g\ CO_2 \times \frac{1\ mol\ CO_2}{44.011\ g\ CO_2} \times \frac{1\ mol\ C}{1\ mol\ CO_2} = \boxed{0.666\ mol\ C} \times \frac{12.011\ g\ C}{1\ mol\ C} = \boxed{8.000\ g\ C \text{ in } Z}$$

$$12.000\ g\ H_2O \times \frac{1\ mol\ H_2O}{18.0158\ g\ H_2O} \times \frac{2\ mol\ H}{1\ mol\ H_2O} = \boxed{1.332\ mol\ H} \times \frac{1.0079\ g\ H}{1\ mol\ H} = \boxed{1.343\ g\ H \text{ in } Z}$$

$$20\ g - (8.000\ g + 1.343\ g) = \boxed{10.657\ g\ O \text{ in } Z} \times \frac{1\ mol\ O}{16\ g\ O} = \boxed{0.666\ mol\ O}$$

$$C_{0.666}H_{1.343}O_{0.666} \rightarrow C_{\frac{0.666}{0.666}}H_{\frac{1.343}{0.666}}O_{\frac{0.666}{0.666}} \rightarrow \boxed{CH_2O}$$ empirical formula

$$\frac{\text{molecular molar mass}}{\text{empirical molar mass}} = \frac{60.056\ g/mol}{30.027\ g/mol} \approx 2 \Rightarrow \boxed{C_2H_4O_2}$$ molecular formula

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2. (0.357 mol) $46\ g\ Z + O_2 \rightarrow$ (80% yield) $75.379\ g\ CO_2$ + (80% yield) $15.428\ g\ H_2O$

Theoretical yield $CO_2 = \frac{75.379\ g}{0.8} = 94.224\ g\ CO_2$

$94.224\ g\ CO_2 \times \frac{1\ mol\ CO_2}{44.011\ g\ CO_2} \times \frac{1\ mol\ C}{1\ mol\ CO_2} = 2.141\ mol\ C \times \frac{12.011\ g\ C}{1\ mol\ C} = \underset{\text{in } Z}{25.715\ g\ C}$

Theoretical yield $H_2O = \frac{15.428\ g}{0.8} = 19.285\ g\ H_2O$

$19.285\ g\ H_2O \times \frac{1\ mol\ H_2O}{18.0158\ g\ H_2O} \times \frac{2\ mol\ H}{1\ mol\ H_2O} = 2.141\ mol\ H \times \frac{1.0079\ g\ H}{1\ mol\ H} = \underset{\text{in } Z}{2.158\ g\ H}$

$46\ g - (25.715\ g + 2.158\ g) = \underset{\text{in } Z}{18.127\ g\ O} \times \frac{1\ mol\ O}{16\ g\ O} = 1.133\ mol\ O$

$C_{2.141}H_{2.141}O_{1.133} \rightarrow C_{\frac{2.141}{1.133}}H_{\frac{2.141}{1.133}}O_{\frac{1.133}{1.133}} \rightarrow \underset{\text{empirical formula}}{C_2H_2O}$

$\frac{\text{molecular molar mass}}{\text{empirical molar mass}} = \frac{(46\ g / 0.357\ mol)}{42.0378\ g/mol} \approx 3 \Rightarrow \underset{\text{molecular formula}}{C_6H_6O_3}$

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