Total Marks 74/80

27. a)

$$m_{Al} = nM_{Al} = (3.2\ mol)\left(26.98\frac{g}{mol}\right) = 86.336\ g \approx 86.34\ g$$

$m_S = nM_S = (4.6\ mol)\left(32.06\frac{g}{mol}\right) = 147.476\ g \approx 147.48\ g$ 150 g (significant digits)

$$m_{Al} < m_S$$

b)

$m_{H_2O} = nM_{H_2O} = (3.1\ mol)\left(2\left(1.01\frac{g}{mol}\right) + 16\frac{g}{mol}\right) = 55.862\ g \approx g56g$

$m_{C_{12}H_{22}O_{11}} = nM_{C_{12}H_{22}O_{11}} = (0.1\ mol)\left(12\left(12.011\frac{g}{mol}\right) + 22\left(1.008\frac{g}{mol}\right) + 11\left(15.999\frac{g}{mol}\right)\right)$

$= (0.1\ mol)\left(\frac{(144.132 + 22.176 + 175.989)g}{mol}\right) = 34.2297\ g \approx 34.23\ g34g$

$m_{H_2O} > m_{C_{12}H_{22}O_{11}}$ 1.5/2 (significant figures)

c)

$$m_{Na} = nM_{Na} = \left(\frac{4.02\times10^{30}\ molecules}{6.02\times10^{23}\frac{molecules}{mol}}\right)\left(22.99\frac{g}{mol}\right) \approx (6.68\ mol\times10^{6}\ mol)\left(22.99\frac{g}{mol}\right)$$

$$= 153.5732\times10^{6}\ g \approx 153.58\times10^{6}\ g1.54\ (significant\ figures)$$

$m_{C_3H_8} = nM_{C_3H_8} = \left(\frac{3.9\times10^{30}\ molecules}{6.02\times10^{23}\frac{molecules}{mol}}\right)\left(3\left(12.01\frac{g}{mol}\right) + 8\left(1.01\frac{g}{mol}\right)\right) \approx (6.48\times$

$10^{6}\ mol)\left(44.11\frac{g}{mol}\right) = 285.8328\times10^{6}\ g \approx 285.83\times10^{6}\ g$ 2.86 significant figures 1.5/2

$$m_{Na} < m_{C_3H_8}$$

28. a)

$$m_{Na} = nM_{Na}$$

$n = \frac{m_{Na}}{M_{Na}} = \frac{0.73\ g}{22.99\frac{g}{mol}} = 0.032\ mol$ 2/2

b) $\frac{0.1\ mol}{0.032\ mol} = 3.125$; the average person may eat 3 of these hamburgers to fulfill their daily dietary needs for sodium. 3.1 (1.5/2) significant figures

29. a) Magnesium + Oxygen → Magnesium Oxide 1/1

b)

$1.6\ g + 2.6\ g = 4.2\ g$ 1/1

c)

$\frac{2.6\ g}{4.2\ g} = 61.9\%$ 62% (sig figures) 0.5/1

d)

$\frac{1.6\ g}{4.2\ g} = 38.1\%$ 38% 0.5/1 significant figures

e)

| Parent Composition | Mass (per 100 grams) | Moles | Divide | Mole Ratio |
|---|---|---|---|---|
| 61.9% Mg | $61.9\ g$ | $n_{\mathrm{Mg}} = \frac{61.9\ g}{24.3\ g/mol} = 2.55\ mol$ | $\frac{2.55}{2.38} = 1.07$ | 1 |
| 38.1% O | $38.1\ g$ | $n_{\mathrm{O}} = \frac{38.1\ g}{16\ g/mol} = 2.38\ mol$ | $\frac{2.38}{2.38} = 1$ | 1 |

4/4

f)

$200\ kg \times 0.619 = 123.8\ kg$ 120 kg (significant figures 1.5/2)

There would be 123.8 kg of magnesium ions.

30.

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ 2/2

| Mole Relationship | Mole Ratio |
|---|---|
| 1 mol $C_3H_8$ reacts with 5 mol $O_2$ | $C_3H_8 : O_2 = 1:5$ 1/1 |
| 1 mol $C_3H_8$ produces 3 mol $CO_2$ | $C_3H_8 : CO_2 = 1:3$ 1/1 |

31.

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

$$n_{C_3H_8} = \frac{m}{M} = \frac{50\ g}{(3(12.01) + 8(1.01))\frac{g}{mol}} = \frac{50\ g}{(36.03 + 8.08)\frac{g}{mol}} = \frac{50\ g}{44.11\frac{g}{mol}} \approx 1.13\ mol$$

$$z = (1.13\ mol)\left(\frac{3}{1}\right) = 3.4\ mol$$

$m_{CO_2} = (3.4\ mol)\left(12.01\frac{g}{mol} + 2\left(16\frac{g}{mol}\right)\right) = (3.4\ mol)\left(44.01\frac{g}{mol}\right) = 149.63\ g$ 149 g (3.5/4 significant figures)

32.

$$2Al_2O_3 \rightarrow 3O_2 + 4Al$$

$$n_{Al} = \frac{m}{M} = \frac{1000\ g}{26.98\frac{g}{mol}} = 37.06\ mol$$

$$z = (37.06\ mol)\left(\frac{2}{4}\right) = 18.53\ mol$$

$m_{Al_2O_3} = (18.53\ mol)\left(2\left(26.98\frac{g}{mol}\right)\right) = (18.53\ mol)\left(101.96\frac{g}{mol}\right) \approx 1889.32\ g \approx 1.89\ kg$ 1889g 3.5/4 significant figures

33.

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$

$$n_{C_8H_{18}} = \frac{m}{M} = \frac{500\ g}{\left(8(12.01) + 18(1.01)\right)\frac{g}{mol}} = \frac{500\ g}{96.08\frac{g}{mol} + 18.18\frac{g}{mol}} = \frac{500\ g}{114.26\frac{g}{mol}} = 4.38\ mol$$

$$z = (4.38\ mol)\left(\frac{25}{2}\right) = 54.75\ mol$$

$m_{O_2} = (54.75\ mol)\left(2\left(16\frac{g}{mol}\right)\right) = 1752\ g \approx 1.75\ kg$ 4/4

34.

$$C_2H_3O_2H + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$$

$n_{NaHCO_3} = \frac{m}{M} = \frac{25\ g}{(22.99+1.01+12.01+3(16))\frac{g}{mol}} = \frac{25\ g}{84.01\frac{g}{mol}} \approx 0.298\ mol$ then you need to determine how many grams of vinegar are required 2/4

35. a)

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

$$\frac{2}{2.75\ mol} = \frac{2}{z_{H_2O}}$$

$z_{H_2O} = 2.75\ mol$ 2/2

The Limiting Reagent is Na.

b)

$$\frac{2}{2.5\ mol} = \frac{2}{z_{SO_2}}$$

$$z_{SO_2} = 2.5\ mol$$

Of CaO and $SO_2$, CaO is the Limiting Reagent.

$$\frac{2}{2.5\ mol} = \frac{1}{z_{O_2}}$$

$$z_{O_2} = \frac{2.5\ mol}{2} = 1.25\ mol$$

Of CaO, $O_2$, and $SO_2$, CaO remains the Limiting Reagent. 2/2

36. a)

$$2Ca + O_2 \rightarrow 2CaO$$

$$\frac{2}{5.2\ mol} = \frac{1}{z_{O_2}}$$

$$z_{O_2} = 2.6\ mol$$

Oxygen is the Excess Reagent.

$e_{O_2} = 3.75\ mol - 2.6\ mol = 1.15\ mol$ 2/2

b)

$$Fe + S \rightarrow FeS$$

$$n_{Fe} = \frac{65\ g}{55.84\frac{g}{mol}} \approx 1.16\ mol$$

$$n_{\mathrm{S}} = \frac{40\ g}{32.06\frac{g}{mol}} \approx 1.25\ mol$$
$$\frac{1}{1.16\ mol} = \frac{1}{z_{\mathrm{S}}}$$
$$z_{\mathrm{S}} = 1.16\ mol$$

Sulphur is the Excess Reagent.

$e_{\mathrm{S}} = 1.25\ mol - 1.16\ mol = 0.09\ mol$ 2/2

37. A theoretical yield is the predicted maximum output produced from stoichiometry and the laws of conservation. The actual yield comes from an experimental or industrial reaction where the output is always less than the theoretical yield due to some loss. 2/2

38. a)

$\mathrm{Zn} + \mathrm{Pb(NO_3)_2} \rightarrow \mathrm{Pb} + \mathrm{Zn(NO_3)_2}$

$$n_{\mathrm{Zn}} = \frac{m}{M} = \frac{12.5\ g}{65.38\frac{g}{mol}} = 0.19\ mol$$

$$n_{\mathrm{Pb(NO_3)_2}} = \frac{m}{M} = \frac{51.5\ g}{\left(207.2 + 2\left(14.01 + 3(16)\right)\right)\frac{g}{mol}} = \frac{51.5\ g}{(207.2 + 124.02)\frac{g}{mol}} = \frac{51.5\ g}{331.22\frac{g}{mol}} =$$
$$= 0.16\ mol\ 0.155mol$$

$$\frac{1}{0.16\ mol} = \frac{1}{z_{\mathrm{Zn}}}$$
$$z_{\mathrm{Zn}} = 0.16\ mol$$

Zinc is the Excess Reagent. Yes but by how much? 3.5/4

b)

$m_{\mathrm{Pb}} = (0.16\ mol)\left(207.2\frac{g}{mol}\right) \approx 33.15\ g$ 2/2

c)

$y = \frac{y_a}{y_t} = \frac{21.7\ g}{33.15\ g} \approx 65.46\%$ 2/2

39. Bhopal: $2\mathrm{C_2H_3NO} + \mathrm{H_2O} \rightarrow \mathrm{C_3H_8N_2O} + \mathrm{CO_2}$ 1/1
Toulouse: $2\mathrm{NH_4NO_3} \rightarrow 2\mathrm{N_2} + 4\mathrm{H_2O} + \mathrm{O_2}$ 1/1
Toronto: $\mathrm{C_3H_8} + 5\mathrm{O_2} \rightarrow 3\mathrm{CO_2} + 4\mathrm{H_2O}$ 1/1

40. a) Bhopal: No proper housing, maintenance, or safety procedures.
Toulouse: Massive amounts of Ammonium Nitrate were being stored in close vicinities.
Toronto: Employees were not trained sufficiently in handling reactive chemicals.3/3

b) i) Employees could have been properly trained and their work areas made safe.2/2

ii) Chemical housing and maintenance should have been kept at par with their safety precautions and procedures.

c) i) Ensure all employees are properly trained and are not ignorant of safety hazards1/1

ii) Chemical housing and maintenance is at par with safety procedures.1/1

iii) Consideration for the geographical position of the pant and its products are strategically thought out for safer possible discharges. 1/1

41. a) Ontario's Cosmetic Pesticides Ban (OCPB) came into effect on Earth Day, April 22, 2009 and, through the Ontario Regulation 63/09 and Pesticides Act, "[pesticides] cannot be used for cosmetic purposes on lawns, vegetable and ornamental gardens, patios, driveways, cemeteries, and in parks and school yards" (Miinistry of the Environment) with over 250 pesticide products and over 95 ingredients for the products banned for sale or for cosmetic use (Miinistry of the Environment). However, the OCPB contains 9 exceptions which allows cosmetic pesticides to be used for protecting public health and safety and to sustain Ontario's agricultural economy (Miinistry of the Environment). Cosmetic Pesticides received an exception for public health and safety so that poisonous plants, such as poison ivy, can remained controlled as well as removing "insects that bite, sting, are venomous or are disease carrying… and animals, insects or plants that may cause damage to a structure or infrastructure, such as termites." [Reference] Ontario's rich agricultural system also received an exception which allows farmers to remain using the cosmetic pesticide since there are already many strict rules and guidelines that farmers are required to follow when handling, storing, and applying their pesticides, but they cannot use cosmetic pesticides on either their household vegetable garden or lawn (Miinistry of the Environment). The OCPB properly addresses the use of cosmetic pesticides and provides functional exceptions such as when an Ontario citizen is concerned about their public health and safety, and/or their agricultural production. 4/4

b) The Ontario Cosmetic Pesticide Ban which is detailed through the Ontario Regulation 63/09 explains that golf course may use cosmetic pesticides under certain conditions as to ensure public safety: they become accredited by the Integrated Pest Management (IPM), utilize IPM's many tools, and construct and present an annual cosmetic pesticide use report. For golf courses to be able to use cosmetic pesticides, they must first become accredited from the IPM by an approved accreditation body (Miinistry of the Environment). Golf courses must then utilize IPM's "best practices, mechanical and biological methods," (Miinistry of the Environment) as well as follow IPM's set conditions when they are using pesticides. Afterwards, the "[golf] courses must prepare an annual report on how they minimized their pesticide use" (Miinistry of the Environment), let their report be accessible to the public, and also hold an annual public meeting to present their report (Miinistry of the Environment). From becoming accredited, to following a set of guidelines and rules, and then to constructing and presenting detailed annual reports, the OCPB does allow a golf course to be able to use cosmetic pesticides, but only under the incredibly strict conditions that they have detailed as to ensure that public safety is properly met. 5/5

c)

# Bibliography 2/2

Miinistry of the Environment. *Newsroom: Ontario Cosmetic Pesticides Ban*. 4 March 2009. http://news.ontario.ca/ene/en/2009/03/ontarios-cosmetic-pesticides-ban.html. 9 September 2013.