march 2017

5. Calculate EACH of the following:

(a) the amount of air to burn 0.9 kg of carbon to form carbon monoxide only; (5)

(b) the percentage increase in the air, used in Q5(a), to completely burn the carbon. (4)

Note: air contains 23% oxygen by mass relative
atomic mass of carbon = 12 relative
atomic mass of oxygen = 16

april 2014

3. An oil fuel consists of 87% carbon and 13% hydrogen by mass.

Calculate the minimum mass of air to completely burn 1 kg of fuel. (8)

Note: relative atomic masses: carbon = 12, oxygen = 16, hydrogen = 1
air contains 23% oxygen by mass

dec 2013

5. A mass of 4.5 kg of carbon is incompletely burned in the presence of 30 kg of air.

Calculate EACH of the following:

(a) the mass of carbon dioxide formed; (9)

(b) the mass of nitrogen in the exhaust gases. (3)

Note: relative atomic masses: carbon = 12, oxygen = 16, nitrogen = 14,
air contains 23% oxygen by mass

oct 2017

3. An oil fuel consists of 87% carbon and 13% hydrogen.

Calculate the Stoichiometric mass of air to completely burn 1 kg of fuel. (8)

Note: relative atomic masses: carbon = 12, oxygen = 16, hydrogen = 1
air contains 23% oxygen by mass

july 2017

6. Calculate EACH of the following:

(a) the amount of air to burn 0.75 kg of carbon to form carbon monoxide only; (4)

(b) the Stoichiometric air to burn 0.75 kg of carbon. (4)

Note: air contains 23% oxygen by mass.
Relative atomic mass of carbon = 12
relative atomic mass of oxygen = 16

july 2014

6. (a) Define the term *combustion.* (2)

(b) List the THREE conditions necessary for combustion to occur. (2)

(c) Calculate the mass of air required to completely burn EACH of the following:

(i) 0.6 kg of carbon; (3)

(ii) 1.75 kg of hydrogen. (3)

Note: relative atomic masses: carbon = 12, hydrogen = 1, oxygen = 16
air contains 23% oxygen by mass

july 2015

4. A mass of 1.5 kg of methane gas (CH_4) is completely burned in 28% excess air.

Calculate EACH of the following:

(a) the stoichiometric oxygen required; (6)

(b) the actual mass of air supplied. (4)

Note: relative atomic masses: carbon = 12, hydrogen = 1, oxygen = 16
air contains 23% oxygen by mass.

march 2015

4. Benzene (C_6H_6) is completely burned in 22.5% excess air.

Calculate EACH of the following:

(a) the mass of carbon dioxide in the exhaust gases per kg of fuel; (4)

(b) the mass of nitrogen in the exhaust gases per kg of fuel. (4)

Note: relative atomic masses: carbon = 12, hydrogen = 1, oxygen = 16
air contains 23% oxygen by mass.

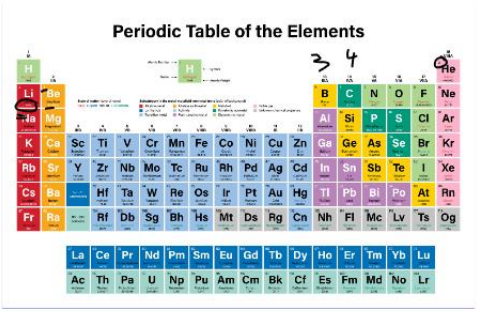
march 2017

5. Calculate EACH of the following:

(a) the amount of air to burn 0.9 kg of carbon to form carbon monoxide only; (5) ✓

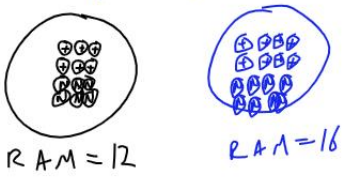
(b) the percentage increase in the air, used in Q5(a), to completely burn the carbon. (4)

Note: air contains 23% oxygen by mass relative atomic mass of carbon = 12 relative atomic mass of oxygen = 16



a) 0.9 kg Carbon

C + O = CO



$\frac{\text{Mass}}{\text{RAM}}$

$\frac{0.9}{12} = \frac{x}{16}$

$x = 1.2$ kg oxygen

b) $C + O_2$

RAM = 12 RAM = 32

$\frac{0.9}{12} = \frac{x}{32}$

2.4 kg oxygen

april 2014

3. An oil fuel consists of 87% carbon and 13% hydrogen by mass.

Calculate the minimum mass of air to completely burn 1 kg of fuel. (8)

Note: relative atomic masses: carbon = 12, oxygen = 16, hydrogen = 1
air contains 23% oxygen by mass

Carbon

$1kg \times 0.87 = 0.87kg$

$C + O_2 = CO_2$

$1 : 2$

Carbon Oxygen

$$\frac{Mass}{RAM} = \frac{Mass}{RAM}$$

$$\frac{0.87}{12} = \frac{x}{32}$$

$x = 2.32$ kg of oxygen to burn the Carbon

Hydrogen

$1kg \times 0.13 = 0.13kg$

$H_2 + O = H_2O$

$2 : 1$

Hydrogen Oxygen

$$\frac{Mass}{RAM} = \frac{Mass}{RAM}$$

$$\frac{0.13}{2} = \frac{x}{16}$$

$x = 1.04$ kg oxy we need to burn Hydrogen

total 3.36 kg of Oxygen to burn 1kg of fuel

Calculate Air Required

$x \times 0.23 = 3.36$

$$x = 14.6 kg$$

dec 2013

5. A mass of 4.5 kg of carbon is incompletely burned in the presence of 30 kg of air.

Calculate EACH of the following:

(a) the mass of carbon dioxide formed; (9)

(b) the mass of nitrogen in the exhaust gases. (3)

Note: relative atomic masses: carbon = 12, oxygen = 16, nitrogen = 14, air contains 23% oxygen by mass

Carbon + Oxygen =

$C + O_2 = CO_2$

Air → oxygen $30 \times 0.23 = 6.9$ kg oxygen

Carbon Oxygen

Mass / RAM $\frac{4.5}{12} = 0.375$ $\frac{6.9}{32} = 0.215625$

so we know we have an excess of carbon

Mass / RAM : $\frac{x}{12} = \frac{6.9}{32}$

$x = 2.5875$ kg — this is how much carbon we are going to burn

$C + O_2 = CO_2$

$2.5875 + 6.9 = 9.4875$ kg

b) Air = 23% oxy 77% Nitrogen

$30\text{kg} - 6.9\text{kg} = 23.1$ kg

oct 2017

3. An oil fuel consists of 87% carbon and 13% hydrogen.

Calculate the Stoichiometric mass of air to completely burn 1 kg of fuel. (8)

Note: relative atomic masses: carbon = 12, oxygen = 16, hydrogen = 1
air contains 23% oxygen by mass

Carbon

$1\ kg \times 0.87 = 0.87\ kg$

$C + O_2$

Mass / Ram

$\frac{0.87}{12} = \frac{x}{32}$

$x = 2.32\ kg$ oxy

Hydrogen

$1\ kg \times 0.13 = 0.13\ kg$

$H_2 + O = H_2O$

$\frac{0.13}{2} = \frac{x}{16}$

$x = 1.04\ kg$ oxy

$3.36\ kg$ of oxy to burn $1\ kg$ of fuel

$Air \times 0.23 = 3.36$

Air 14.6 kg

july 2017

6. Calculate EACH of the following:

(a) the amount of air to burn 0.75 kg of carbon to form carbon monoxide only; (4)

(b) the Stoichiometric air to burn 0.75 kg of carbon. (4)

Note: air contains 23% oxygen by mass.
Relative atomic mass of carbon = 12
relative atomic mass of oxygen = 16

$$C + O = CO$$

$$\frac{\text{Mass}}{\text{Ram}} \qquad \frac{0.75}{12} = \frac{x}{16}$$

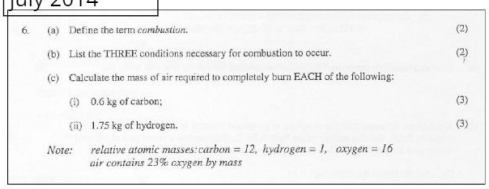
$x = 1$ kg oxygen to burn 0.75 kg of Carbon

$$\text{Air} \times 0.23 = 1$$

a) Air = 4.3478 kg

b) $2 \times 4.3478 =$ 8.6956 kg

july 2014



6. (a) Define the term *combustion*. (2)

(b) List the THREE conditions necessary for combustion to occur. (2)

(c) Calculate the mass of air required to completely burn EACH of the following:

(i) 0.6 kg of carbon; (3)

(ii) 1.75 kg of hydrogen. (3)

Note: relative atomic masses: carbon = 12, hydrogen = 1, oxygen = 16
air contains 23% oxygen by mass

Carbon

$C + O_2 = CO_2$

Mass / RAM $\quad \frac{0.6}{12} = \frac{x}{32}$

1.6 kg of oxy to burn Carbon

$Air \times 0.23 = 1.6$

$Air = 6.9565$ kg

$H_2 + O = H_2O$

$\frac{1.75}{2} = \frac{x}{16}$

$x = 14$ kg of oxygen to burn Hydrogen

$Air \times 0.23 = 14$

$Air = \frac{14}{0.23} = 60.8696$ kg

july 2015

4. A mass of 1.5 kg of methane gas (CH_4) is completely burned in 28% excess air.

Calculate EACH of the following:

(a) the stoichiometric oxygen required; (6)

(b) the actual mass of air supplied. (4)

Note: relative atomic masses: carbon = 12, hydrogen = 1, oxygen = 16
air contains 23% oxygen by mass.

CH_4

C : 4H

12 : 4

$1.5 \times \frac{12}{16}$ $1.5 \times \frac{4}{16}$

1.125 kg 0.375 Kg

Carbon 1.125

$C + O_2 = CO_2$

Mass / RAM $\frac{1.125}{12} = \frac{x}{32}$

3 kg of oxygen

Hydrogen 0.375

$H_2 + O = H_2O$

$\frac{0.375}{2} = \frac{x}{16}$

3kg of oxygen

a) 6 kg of oxygen

b) Air

$Air \times 0.23 = 6$

$\frac{6}{0.23} = 26.086956\overline{5} \times 1.28$

33.4 kg

march 2015

4. Benzene (C_6H_6) is completely burned in 22.5% excess air.

Calculate EACH of the following:

(a) the mass of carbon dioxide in the exhaust gases per kg of fuel; (4)

(b) the mass of nitrogen in the exhaust gases per kg of fuel. (4)

Note: relative atomic masses: carbon = 12, hydrogen = 1, oxygen = 16
air contains 23% oxygen by mass.

1kg fuel

6 C 6 H

RAM = 6(12) + 6(1) = 78

72 + 6 = 78

$1 \times \frac{72}{78}$ $1 \times \frac{6}{78}$

0.923kg 0.076923 kg

a)

Carbon

$C + O_2 = CO_2$

Hydrogen

$H_2 + O = H_2O$

$\frac{\text{Mass}}{\text{RAM}} = \frac{0.923}{12} = \frac{x}{32}$

$\frac{0.076923}{2} = \frac{x}{16}$

$x = 2.4613$ kg of ox

0.615384 kg of oxygen

$\frac{0.923}{12} = \frac{y}{44}$

$CO_2 = 3.38433$kg

b) $2.4613 + 0.615384 = 3.076684$ kg oxygen

$\frac{3.076684}{0.23} = 13.37688$ Kg of Air

$13.37688 \times 0.77 =$ 10.3 kg Nitrogen