Determine the number of grams of the indicated products and/or starting materials as requested:

1. The combustion of 1.2 grams of C_4H_8 produces how many grams of water.

$$\_1\_\ C_4H_8 \quad + \quad \_6\_\ O_2 \quad \rightarrow \quad \_4\_\ CO_2 \quad + \quad \_4\_\ H_2O$$

W_{C4H8} = 1.2 g [Note: There are only 2 Significant Figures for this datum]

W_{H20} = ???

MW_{C4H8} = (4 x 12.01) + (8 x 1.008) = 56.104 g/mole

MW_{H20} = (2 x 1.008) + (1 x 16.00) = 18.016 g/mole

n = W / MW & W = MW x n

n_{C4H8} = W_{C4H8}/ MW_{C4H8} = 1.2 g/56.104 g/mole = 0.0213888 moles

n_{H20} = ???

n_{H20} = 4 x n_{C4H8} = 4 x 0.0213888 moles = 0.0855553 moles

W_{H20} = MW_{H20} x n_{H20}

W_{H20} = 18.016 g/mole x 0.0855553 moles

W_{H20} = ~~1.541366~~ grams = 1.5 grams

[Note: Only 2 Significant Figures are allowed for this answer]

2. When 0.024 grams of HF are reacted as follows, how many grams of $C_2H_4F_2$ are produced?

$$\_1\_\ C_2H_2 \quad + \quad \_2\_\ HF \quad \rightarrow \quad \_1\_C_2H_4F_2$$

W_{HF} = 0.024 g [Note: There are only 2 Significant Figures for this datum]

W_{C2H4F2} = ???

MW_{HF} = (1 x 19.00) + (1 x 1.008) = 20.008 g/mole

MW_{C2H4F2} = (4 x 1.008) + (2 x 12.01) + (2 x 19.00) = 66.052 g/mole

n = W / MW & W = MW x n

$n_{HF} = W_{HF} / MW_{HF}$ = 0.024 g/20.008 g/mole = 0.00119952 moles

n_{C2H4F2} = ???

n_{C2H4F2} = 1/2 x n_{HF} = 1/2 x 0.00119952 moles = 0.00059976 moles

$W_{C2H4F2} = MW_{C2H4F2} \times n_{C2H4F2}$

W_{C2H4F2} = 66.052 g/mole x 0.00059976 moles

W_{C2H4F2} = ~~0.0396153~~ grams = 0.040 grams (or 4.0×10^{-2} grams)

[Note: Only 2 Significant Figures are allowed for this answer]

3. If a person burns 0.24 kilograms of C_9H_{20}, how many grams of CO_2 will be produced?

_1_ C_9H_{20} + _14_ O_2 → _9_ CO_2 + _10_ H_2O

W_{C9H20} = 0. 24 Kg [Note: There are only 2 Significant Figures for this datum]

W_{C9H20} = 0. 24 Kg x 1,000 g/Kg = 240 grams

W_{CO2} = ???

MW_{C9H20} = (20 x 1.008) + (9 x 12.01) = 128.25 g/mole

MW_{CO2} = (1 x 12.01) + (2 x 16.00) = 44.01 g/mole

n = W / MW & W = MW x n

n_{C9H20} = W_{C9H20}/ MW_{C9H20} = 240 g/128.25 g/mole = 1.87134 moles

n_{CO2} = ???

n_{CO2} = 9 x n_{C9H20} = 9 x 1.87134 moles = 16.8421 moles

W_{CO2} = MW_{CO2} x n_{CO2}

W_{CO2} = 44.01 g/mole x 16.8421 moles

W_{CO2} = ~~741.221~~ grams = 7.4×10^2 grams (or 0.74 Kg)

[Note: Only 2 Significant Figures are allowed for this answer]

4. When the following reaction consumes 234 grams of oxygen, how many kilograms of C_5H_5N are produced?

$$\_1\_\ C_5H_9N + \_1\_\ O_2 \rightarrow \_1\_\ C_5H_5N + \_2\_\ H_2O$$

W_{O2} = 234 g [Note: There are only 3 Significant Figures for this datum]

W_{C5H5N} = ??? (Kg)

MW_{O2} = (2 x 16.00) = 32.00 g/mole

MW_{C5H5N} = (5 x 12.01) + (5 x 1.008) + (1 x 14.01) = 79.10 g/mole

n = W / MW & W = MW x n

n_{O2} = W_{O2}/ MW_{O2} = 234 g/32.00 g/mole = 7.3125 moles

n_{C5H5N} = ???

n_{C5H5N} = 1 x n_{O2} = 1 x 7.3125 moles = 7.3125 moles

W_{C5H5N} = MW_{C5H5N} x n_{C5H5N}

W_{C5H5N} = 79.10 g/mole x 7.3125 moles

W_{C5H5N} = 578.41875 grams

W_{C5H5N} = 578.41875 grams / 1,000 grams/Kg = 0.5784187 Kg

W_{C5H5N} = ~~0.5784187~~ Kg = 0.578 Kg (or 5.78×10^{-1} Kg)

[Note: Only 3 Significant Figures are allowed for this answer]

5. How many tonnes of Oxygen does it take to burn 1.6 kilograms of C_2H_4?

_1_ C_2H_4 + _3_ O_2 → _2_ CO_2 + _2_ H_2O

W_{C2H4} = 1.6 Kg [Note: There are only 2 Significant Figures for this datum]

W_{C2H4} = 1.6 Kg x 1,000 g/Kg = 1,600 grams

W_{O2} = ??? (tonnes)

MW_{C2H4} = (4 x 1.008) + (1 x 12.01) = 28.052 g/mole

MW_{O2} = (2 x 16.00) = 32.00 g/mole

n = W / MW & W = MW x n

n_{C2H4} = W_{C2H4}/ MW_{C2H4} = 1,600 g/28.052 g/mole = 57.036931 moles

n_{O2} = ???

n_{O2} = 3 x n_{C2H4} = 3 x 57.036931 moles = 171.11079 moles

W_{O2} = MW_{O2} x n_{O2}

W_{O2} = 32.00 g/mole x 171.11079 moles

W_{O2} = 5,475.5454 grams = 5,475.5454 grams / 1,000,000 grams/tonnes [1]

W_{O2} = ~~0.00547554 tonnes~~ = 0.005,5 tonnes (5.5 x 10^{-3} tonnes)

[Note: Only 2 Significant Figures are allowed for this answer]

[1] Note: A tonnes (a metric ton) is equal to 1,000 Kg or 1,000,000 grams.

6. How many kilograms of NaOH are consumed in the following reaction to produce 0.22 tonnes of Na_2SO_4?

$$\_1\_\ H_2SO_4 + \_2\_\ NaOH \rightarrow \_1\_\ Na_2SO_4 + \_2\_\ H_2O$$

W_{Na2SO4} = 0.22 tonnes [Note: There are only 2 Significant Figures for this datum]

W_{Na2SO4} = 0.22 tonnes x 1,000,000 g/tonne = 220,000 grams

W_{NaOH} = ??? (Kg)

MW_{Na2SO4} = (2 x 22.99) + (1 x 32.07) + (4 x 16.00) = 142.05 g/mole

MW_{NaOH} = (1 x 22.99) + (1 x 1.008) + (1 x 16.00) = 39.998 g/mole

n = W / MW & W = MW x n

$n_{Na2SO4} = W_{Na2SO4} / MW_{Na2SO4}$ = 220,000 g/142.05 g/mole = 1,548.7504 moles

n_{NaOH} = ???

$n_{NaOH} = 2 \times n_{Na2SO4}$ = 2 x 1,548.7504 moles = 3,097.5009 moles

$W_{NaOH} = MW_{NaOH} \times n_{NaOH}$

W_{NaOH} = 39.998 g/mole x 3,097.5009 moles

W_{NaOH} = 123,893.84 grams

W_{NaOH} = 123,893.84 grams / 1,000 grams/Kg

W_{NaOH} = ~~123.89384~~ Kg = 1.2×10^2 Kg

[Note: Only 2 Significant Figures are allowed for this answer]

7. How many grams of C_6H_6 have to be burned to produce 6.06 grams of CO_2.

$\_1\_\ C_6H_6 + \_7.5\_\ O_2 \rightarrow \_6\_\ CO_2 + \_3\_\ H_2O$

W_{CO2} = 6.06 g [Note: There are only 3 Significant Figures for this datum]

W_{C6H6} = ???

MW_{CO2} = (2 x 12.01) + (1 x 16.00) = 44.01 g/mole

MW_{C6H6} = (6 x 12.01) + (6 x 1.008) = 78.108 g/mole

n = W / MW & W = MW x n

$n_{CO2} = W_{CO2} / MW_{CO2}$ = 6.06 g/44.01 g/mole = 0.1376959 moles

n_{C6H6} = ???

n_{C6H6} = 1/6 x n_{CO2} = 1/6 x 0.1376959 moles = 0.0229493 moles

$W_{C6H6} = MW_{C6H6} \times n_{C6H6}$

W_{C6H6} = 78.108 g/mole x 0.0229493 moles

W_{C6H6} = ~~1.7925262~~ grams = 1.79 grams

[Note: Only 3 Significant Figures are allowed for this answer]

8. If one wants to produce 17 kilograms of $Ca_3(PO_4)_2$, how many kilograms of H_3PO_4 should one use?

$$\_2\_\ H_3PO_4 + \_3\_\ Ca(OH)_2 \rightarrow \_1\_\ Ca_3(PO_4)_2 + \_6\_\ H_2O$$

$W_{Ca3(PO4)2}$ = 17 Kg [Note: There are only 2 Significant Figures for this datum]

$W_{Ca3(PO4)2}$ = 17 Kg x 1,000 g/Kg = 17,000 grams

W_{H3PO4} = ??? (Kg)

$MW_{Ca3(PO4)2}$ = (3 x 40.08) + (2 x 30.97) + (8 x 16.00) = 310.18 g/mole [2]

MW_{H3PO4} = (1 x 30.97) + (3x 1.008) + (4 x 16.00) = 97.994 g/mole

n = W / MW & W = MW x n

$n_{Ca3(PO4)2} = W_{Ca3(PO4)2} / MW_{Ca3(PO4)2}$ = 17,000 g/310.18 g/mole = 54.806886 moles

n_{H3PO4} = ???

$n_{H3PO4} = 2 \times n_{Ca3(PO4)2}$ = 2 x 54.806886 moles = 109.61377 moles

$W_{H3PO4} = MW_{H3PO4} \times n_{H3PO4}$

W_{H3PO4} = 97.994 g/mole x 109.61377 moles

W_{H3PO4} = 10,741.492 grams

W_{H3PO4} = 10,741.492 grams / 1,000 grams/Kg

W_{H3PO4} = ~~10.741492~~ Kg = 11 Kg

[Note: Only 2 Significant Figures are allowed for this answer]

[2] Note: A formula that says $Ca_3(PO_4)_2$ means that there are two (PO_4) groups and thus this material contains 3 atoms of Ca, 2 atoms of P, and 8 atoms of O.

9. The burning of 1.2 grams of C_4H_8 produces how many grams of CO_2.

$\_1\_\ C_4H_8 \quad + \quad \_6\_\ O_2 \quad \rightarrow \quad \_4\_\ CO_2 \quad + \quad \_4\_\ H_2O$

$W_{C4H8} = 1.2$ g [Note: There are only 2 Significant Figures for this datum]

$W_{CO2} = ???$

$MW_{CO2} = (2 \times 12.01) + (1 \times 16.00) = 44.01$ g/mole

$MW_{C4H8} = (4 \times 12.01) + (8 \times 1.008) = 56.104$ g/mole

$n = W / MW$ & $W = MW \times n$

$n_{C4H8} = W_{C4H8} / MW_{C4H8} = 1.2$ g/56.104 g/mole = 0.0213888 moles

$n_{CO2} = ???$

$n_{CO2} = 4 \times n_{C4H8} = 4 \times 0.0213888$ moles = 0.0855553 moles

$W_{CO2} = MW_{CO2} \times n_{CO2}$

$W_{CO2} = 44.01$ g/mole x 0.0855553 moles

$W_{CO2} =$ ~~3.765293~~ grams = 3.8 grams

[Note: Only 2 Significant Figures are allowed for this answer]

10. When 0.024 grams of HF are reacted as follows, how many grams of $C_6H_9F_3$ are produced?

$$\_1\_\ C_6H_6 + \_3\_\ HF \rightarrow \_1\_C_6H_9F_3$$

W_{HF} = 0.024 g [Note: There are only 2 Significant Figures for this datum]

W_{C6H9F3} = ???

MW_{HF} = (1 x 19.00) + (1 x 1.008) = 20.008 g/mole

MW_{C6H9F3} = (9 x 1.008) + (6 x 12.01) + (3 x 19.00) = 138.132 g/mole

n = W / MW & W = MW x n

$n_{HF} = W_{HF} / MW_{HF}$ = 0.024 g/20.008 g/mole = 0.00119952 moles

n_{C6H9F3} = ???

$n_{C6H9F3} = 1/3 \times n_{HF}$ = 1/3 x 0.00119952 moles = 0.000399833 moles

$W_{C6H9F3} = MW_{C6H9F3} \times n_{C6H9F3}$

W_{C6H9F3} = 138.132 g/mole x 0.000399833 moles

W_{C6H9F3} = ~~0.0552297~~ grams = 0.055 grams (or 5.5×10^{-2} grams)

[Note: Only 2 Significant Figures are allowed for this answer]

11. If a person combusts 0.24 grams of C_9H_{20}, how many grams of water will be produced?

_1_ C_9H_{20} + _14_ O_2 → _9_ CO_2 + _10_ H_2O

W_{C9H20} = 0.24 g [Note: There are only 2 Significant Figures for this datum]

W_{H2O} = ???

MW_{C9H20} = (20 x 1.008) + (9 x 12.01) = 128.25 g/mole

MW_{H2O} = (2 x 1.008) + (1 x 16.00) = 18.016 g/mole

n = W / MW & W = MW x n

n_{C9H20} = W_{C9H20}/ MW_{C9H20} = 0.24 g/128.25 g/mole = 0.001,871,34 moles

n_{H2O} = ???

n_{H2O} = 9 x n_{C9H20} = 9 x 0.001,871,34 moles = 0.0168421 moles

W_{H2O} = MW_{H2O} x n_{H2O}

W_{H2O} = 18.016 g/mole x 0.0168421 moles

W_{H2O} = ~~0.3034273~~ grams = 3.0×10^{-1} grams (or 0.30 Kg)

[Note: Only 2 Significant Figures are allowed for this answer]

12. For the following reaction, how many grams of C_5H_9N must be consumed to produce 2.2 grams of water?

$$\_1\_\ C_5H_9N + \_1\_\ O_2 \rightarrow \_1\_\ C_5H_5N + \_2\_\ H_2O$$

W_{H2O} = 2.2 g [Note: There are only 3 Significant Figures for this datum]

W_{C5H5N} = ??? (Kg)

MW_{H2O} = (2 x 1.008) + (1 x 16.00) = 18.016 g/mole

MW_{C5H5N} = (5 x 12.01) + (5 x 1.008) + (1 x 14.01) = 79.10 g/mole

n = W / MW & W = MW x n

n_{H2O} = W_{H2O}/ MW_{H2O} = 2.2 g/18.016 g/mole = 0.1221136 moles

n_{C5H5N} = ???

n_{C5H5N} = 1/2 x n_{H2O} = 1/2 x 0.1221136 moles = 0.0610568 moles

W_{C5H5N} = MW_{C5H5N} x n_{C5H5N}

W_{C5H5N} = 79.10 g/mole x 0.0610568 moles

W_{C5H5N} = ~~4.8295959~~ grams = 4.8 g

[Note: Only 3 Significant Figures are allowed for this answer]

13. How many kilograms of C_2H_4 does it take to consume 1.5 kilograms of oxygen in a combustion reaction?

$$\_1\_\ C_2H_4 \quad + \quad \_3\_\ O_2 \quad \rightarrow \quad \_2\_\ CO_2 \quad + \quad \_2\_\ H_2O$$

W_{O2} = 1.5 Kg [Note: There are only 2 Significant Figures for this datum]

W_{O2} = 1.6 Kg x 1,000 g/Kg = 1,600 grams

W_{C2H4} = ??? (Kg)

MW_{O2} = (2 x 16.00) = 32.00 g/mole

MW_{C2H4} = (4 x 1.008) + (1 x 12.01) = 28.052 g/mole

n = W / MW & W = MW x n

$n_{O2} = W_{O2} / MW_{O2}$ = 1,500 g/32.00 g/mole = 46.875 moles

n_{C2H4} = ???

$n_{C2H4} = 1/3 \times n_{O2}$ = 1/3 x 46.875 moles = 15.625 moles

$W_{C2H4} = MW_{C2H4} \times n_{C2H4}$

W_{C2H4} = 28.052 g/mole x 15.625 moles

W_{C2H4} = 438.3125 grams = 438.3125 grams / 1,000 grams/Kg

W_{C2H4} = ~~0.4383125 Kg~~ = $0.44\ Kg\ (4.4 \times 10^{-1}\ Kg)$

[Note: Only 2 Significant Figures are allowed for this answer]

14. How many grams of BH_3 are consumed in the following reaction to produce 12 grams of SiH_4?

$$\_4\_\ BH_3 + \_3\_\ SiCl_4 \rightarrow \_4\_\ BCl_3 + \_3\_\ SiH_4$$

W_{SiH4} = 12 grams [Note: There are only 2 Significant Figures for this datum]

W_{BH3} = ???

MW_{SiH4} = (1 x 28.09) + (4 x 1.008) = 32.112 g/mole

MW_{BH3} = (1 x 10.81) + (3 x 1.008) = 13.834 g/mole

n = W / MW & W = MW x n

$n_{SiH4} = W_{SiH4} / MW_{SiH4}$ = 12 g/32.112 g/mole = 0.373692 moles

n_{BH3} = ???

n_{BH3} = 4/3 x n_{SiH4} = 4/3 x 0.373692 moles = 0.4982561 moles

$W_{BH3} = MW_{BH3} \times n_{BH3}$

W_{BH3} = 13.834 g/mole x 0.4982561 moles

W_{BH3} = ~~6.8928749~~ grams = 6.9 grams

[Note: Only 2 Significant Figures are allowed for this answer]

15. How many grams of C_6H_6 have to be burned to produce 6.00 grams of water?

$\_1\_\ C_6H_6 \quad + \quad \_7.5\_\ O_2 \quad \rightarrow \quad \_6\_\ CO_2 \quad + \quad \_3\_\ H_2O$

W_{H2O} = 6.00 g [Note: There are only 3 Significant Figures for this datum]

W_{C6H6} = ???

MW_{H2O} = (2 x 1.008) + (1 x 16.00) = 18.016 g/mole

MW_{C6H6} = (6 x 12.01) + (6 x 1.008) = 78.108 g/mole

n = W / MW & W = MW x n

$n_{H20} = W_{H20} / MW_{H20}$ = 6.00 g/18.016 g/mole = 0.3330373 moles

n_{C6H6} = ???

$n_{C6H6} = 1/3 \times n_{H20}$ = 1/3 x 0.3330373 moles = 0.1110124 moles

$W_{C6H6} = MW_{C6H6} \times n_{C6H6}$

W_{C6H6} = 78.108 g/mole x 0.1110124 moles

W_{C6H6} = ~~8.6709591~~ grams = 8.67 grams

[Note: Only 3 Significant Figures are allowed for this answer]

16. If this reaction produces 6.0 grams of $Ca_3(PO_4)_2$, how many grams of water would be produced?

$$\_2\_\ H_3PO_4 + \_3\_\ Ca(OH)_2 \rightarrow \_1\_\ Ca_3(PO_4)_2 + \_6\_\ H_2O$$

$W_{Ca3(PO4)2}$ = 6.0 g [Note: There are only 2 Significant Figures for this datum]

W_{H2O} = ???

$MW_{Ca3(PO4)2}$ = (3 x 40.08) + (2 x 30.97) + (8 x 16.00) = 310.18 g/mole

MW_{H2O} = (2 x 1.008) + (1 x 16.00) = 18.016 g/mole

n = W / MW & W = MW x n

$n_{Ca3(PO4)2} = W_{Ca3(PO4)2} / MW_{Ca3(PO4)2}$ = 6.0 g/310.18 g/mole = 0.0193436 moles

n_{H2O} = ???

$n_{H2O} = 6 \times n_{Ca3(PO4)2} = 6 \times 0.0193436$ moles = 0.1160616 moles

$W_{H2O} = MW_{H2O} \times n_{H2O}$

$W_{H2O} = 18.016$ g/mole x 0.1160616 moles

W_{H2O} = ~~2.0909658~~ g = 2.1 grams

[Note: Only 2 Significant Figures are allowed for this answer]