Solids 3

GCSE C C C

A Level P P P

Essential Pre-Uni Chemistry B4.3

Calculate the amount of substance in:

Part A **(a)**

$1.001\,\mathrm{g}$ of $\mathrm{CaCO_3\,(s)}$, to 3 significant figures

Part B **(b)**

$197\,\mathrm{kg}$ of $\mathrm{Au\,(s)}$, to 3 significant figures

Part C **(c)**

$1.4\,\mathrm{g}$ of $\mathrm{CO\,(g)}$, to 2 significant figures

Part D **(d)**

$2.006\,\mathrm{kg}$ of $\mathrm{Hg\,(l)}$, to 4 significant figures

Part E **(e)**

$11.1\ \mathrm{g}$ of lithium carbonate, to 3 significant figures

Part F **(f)**

$10.0\ \mathrm{mg}$ of lead(II) iodide, to 3 significant figures

Reactions 1

GCSE P P P A Level P P P

Essential Pre-Uni Chemistry B6.1

Calculate the amount of oxygen needed, and amount of carbon dioxide produced, in each of the cases below.

Part A $\mathrm{C_3H_8 + 5\,O_2 \longrightarrow 3\,CO_2 + 4\,H_2O}$

$\mathrm{C_3H_8 + 5\,O_2 \longrightarrow 3\,CO_2 + 4\,H_2O}$, using $1.0\,\mathrm{mol}$ of $\mathrm{C_3H_8}$

Calculate the amount of oxygen needed.

Calculate the amount of carbon dioxide produced.

Part B $\mathrm{C_2H_6O + 3\,O_2 \longrightarrow 2\,CO_2 + 3\,H_2O}$

$\mathrm{C_2H_6O + 3\,O_2 \longrightarrow 2\,CO_2 + 3\,H_2O}$, using $0.2\,\mathrm{mol}$ of of $\mathrm{C_2H_6O}$

Calculate the amount of oxygen needed.

Calculate the amount of carbon dioxide produced.

Part C $2\,CO + O_2 \longrightarrow 2\,CO_2$

$2\,CO + O_2 \longrightarrow 2\,CO_2$, using $4.0\,\text{moles of } CO$

Calculate the amount of oxygen needed:

Calculate the amount of carbon dioxide produced:

Part D $C_6H_{12}O_6 + 6\,O_2 \longrightarrow 6\,CO_2 + 6\,H_2O$

$C_6H_{12}O_6 + 6\,O_2 \longrightarrow 6\,CO_2 + 6\,H_2O$, using $0.040\,\text{moles of } C_6H_{12}O_6$

Calculate the amount of oxygen needed:

Calculate the amount of carbon dioxide produced:

Part E $C_2H_4O_2 + 2\,O_2 \longrightarrow 2\,CO_2 + 2\,H_2O$

$C_2H_4O_2 + 2\,O_2 \longrightarrow 2\,CO_2 + 2\,H_2O$, using $0.10\,\text{moles of } C_2H_4O_2$

Calculate the amount of oxygen needed:

Calculate the amount of carbon dioxide produced:

Reactions 2

GCSE C C C A Level P P P

Essential Pre-Uni Chemistry B6.2

By considering a balanced equation each time, calculate the amount of water produced by complete combustion of the following in oxygen.

Part A **(a)**

$1\,\text{mole}$ of pentane, C_5H_{12}

Part B **(b)**

$2.5\,\text{moles}$ of heptane, C_7H_{16}

Part C **(c)**

$200\,\text{moles}$ of hydrogen, H_2

Part D **(d)**

$4.0\,\text{moles}$ of butane

Part E **(e)**

$0.0030\,\text{moles}$ of methane

Gameboard:

STEM SMART Chemistry Week 5

Reactions 3

GCSE C C C A Level P P P

Essential Pre-Uni Chemistry B6.3

Consider the equation for each reaction and hence calculate the amount of acid required for complete reaction in each of the following cases.

Part A **(a)**

$0.10\,\text{mol}$ NaOH reacting with H_2SO_4. Give your answer to 2 significant figures.

Part B **(b)**

HCl reacting with $20\,\text{g}$ of CaCO_3. Give your answer to 2 significant figures.

Part C **(c)**

$24\,\text{g}$ CuO reacting with HNO_3. Give your answer to 2 significant figures.

Part D **(d)**

$5.6\,\text{g}$ Fe reacting with HCl. Give your answer to 2 significant figures.

Part E **(e)**

$14.8\,\mathrm{g}$ of calcium hydroxide reacting with $\mathrm{H_2SO_4}$. Give your answer to 3 significant figures.

Part F **(f)**

$10\,\mathrm{g}$ of magnesium oxide reacting with nitric acid. Give your answer to 2 significant figures.

Gameboard:

STEM SMART Chemistry Week 5

Balancing Equations

A Level

P P P

Part A Be and O

Balance the following equation, reducing coefficients to the smallest possible integers:

$\mathrm{Be} + \mathrm{O_2} \longrightarrow \mathrm{BeO}$

Part B Ce and O

Balance the following equation, reducing coefficients to the smallest possible integers:

$\mathrm{Ce} + \mathrm{O_2} \longrightarrow \mathrm{CeO_2}$

Part C Cr and Cl

Balance the following equation, reducing coefficients to the smallest possible integers:

$\mathrm{Cr} + \mathrm{Cl_2} \longrightarrow \mathrm{CrCl_3}$

Part D C and $\mathrm{CO_2}$

Balance the following equation, reducing coefficients to the smallest possible integers:

$\mathrm{C} + \mathrm{CO_2} \rightarrow \mathrm{CO}$

Part E NaCl and $\mathrm{CaCO_3}$

Balance the following equation, reducing coefficients to the smallest possible integers:

$\mathrm{NaCl} + \mathrm{CaCO_3} \longrightarrow \mathrm{Na_2CO_3} + \mathrm{CaCl_2}$

Part F $\mathrm{Fe_2O_3}$ and CO

Balance the following equation, reducing coefficients to the smallest possible integers:

$\mathrm{Fe_2O_3} + \mathrm{CO} \longrightarrow \mathrm{Fe} + \mathrm{CO_2}$

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Gameboard:

STEM SMART Chemistry Week 5

TNT

A Level

TNT is used as an explosive. It can decompose according to the following equation:

$$2\,C_7H_5N_3O_6\,(s) \longrightarrow 7\,CO\,(g) + 7\,C\,(s) + 5\,H_2O\,(g) + 3\,N_2\,(g)$$

Part A RMM

Calculate the relative molecular mass of TNT, rounding your answer to an integer.

Part B Moles of gas

The volume of gas produced at $400\,^\circ C$, when $10\,g$ of TNT explode, is to be calculated.

How many moles of gas are produced from $1\,mol$ of TNT?

Part C Volume of gas

At $400\,^\circ C$ and $1\,atm$, $1\,mol$ of gas occupies $55\,dm^3$.

Calculate the volume of gas produced under these conditions from $10\,g$ of TNT.

Adapted with permission from UCLES, A Level Chemistry, November 1992, Paper 3, Question 1

Gases 1

GCSE C C C

A Level P P P

Essential Pre-Uni Chemistry B3.1

RTP = room temperature and pressure.

Any gas occupies $24\,\mathrm{dm}^3$ per mole at RTP.

Avogadro's number, $N_\mathrm{A} = 6.02 \times 10^{23}\,\mathrm{mol}^{-1}$.

Part A (a)

Calculate the volume occupied by $4.0\,\mathrm{moles}$ of gas at RTP.

Part B (b)

Calculate the volume occupied by $0.030\,\mathrm{moles}$ of gas at RTP.

Part C (c)

Calculate the volume occupied by 5.0×10^{18} atoms of helium gas at RTP.

Part D **(d)**

Calculate the volume occupied by 1.2×10^{24} molecules of ozone at RTP.

Part E **(e)**

Calculate the volume occupied by $8.0\,\mathrm{g}$ of $\mathrm{O_2}$ at RTP.

Part F **(f)**

Calculate the volume occupied by $1.1\,\mathrm{kg}$ of carbon dioxide at RTP.

Gameboard:

STEM SMART Chemistry Week 5

Gases 2

GCSE A Level

Essential Pre-Uni Chemistry B3.2

RTP = room temperature and pressure.

Any gas occupies $24\,\mathrm{dm}^3$ per mole at RTP.

Avogadro's number, $N_\mathrm{A} = 6.02 \times 10^{23}$.

Part A (a)

Calculate the amount of gas (at RTP) in $4.8\,\mathrm{dm}^3$.

Part B (b)

Calculate the amount of gas (at RTP) in $12\,\mathrm{m}^3$.

Part C (c)

Calculate the amount of gas (at RTP) in $400\,\mathrm{cm}^3$. Give your answer to 2 significant figures.

Part D **(d)**

Calculate the amount of gas (at RTP) in $18\,\mathrm{ml}$.

Gameboard:

STEM SMART Chemistry Week 5

Gases 5

GCSE C C C A Level P P P

Essential Pre-Uni Chemistry B3.5

RTP = room temperature and pressure.

Any gas occupies $24\,\mathrm{dm}^3$ per mole at RTP.

Avogadro's number, $N_\mathrm{A} = 6.02 \times 10^{23}$.

Part A (a)

Calculate the the mass of $1.0\,\mathrm{m}^3$ of neon at RTP.

Part B (b)

Calculate the the mass of $20\,\mathrm{cm}^3$ of $(\mathrm{CH_3})_2\mathrm{O}$ at RTP.

Part C (c)

Calculate the the mass of $420\,\mathrm{cm}^3$ of ammonia at RTP. Give your answer to 2 significant figures.

Gameboard:
STEM SMART Chemistry Week 5

Compounds TBC

A Level

C C C

When calcium oxide is heated with carbon, an ionic compound, **D**, containing 62.5% of calcium and 37.5% of carbon (by mass), is formed. Under similar conditions, aluminium metal and carbon produce compound **E** which contains 75% of aluminium and 25% of carbon.

When treated with cold water:

- compound **D** produces a gaseous hydrocarbon **F** containing 92.3% of carbon
- compound **E** produces another gaseous hydrocarbon **G** containing 75% of carbon

Part A D

Determine the empirical formula of compound **D**.

Part B E

Determine the empirical formula of compound **E**.

Part C F

Determine the empirical formula of compound **F**.

Part D G

Determine the empirical formula of compound **G**.

Part E Reaction to form D

Write a balanced equation for the reaction of calcium oxide with carbon, using the empirical formula for **D** you have previously deduced.

$$\mathrm{CaO} + \square\,\mathrm{C} \longrightarrow \square + \mathrm{CO}$$

Items:

1 2 3 4 5 D 2D 3D 4D 5D

Part F Reaction to form E

Write a balanced equation for the reaction of aluminium metal and carbon to form **E** (do not include state symbols).

Part G Reaction of E with water

Assuming the empirical formula you deduced for **G** is also its molecular formula, write a balanced equation for the reaction when compound **E** is treated with water.

E + [ ] H_2O ⟶ [ ] $Al(OH)_3$ + [ ] **G**

Items:

1 2 3 4 6 8 12

Adapted with permission from UCLES, A Level Chemistry, November 1990, Special Paper, Question 5