Essential Pre-Uni Chemistry B3.1

GCSE C C C A Level P P P

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.

Essential Pre-Uni Chemistry B3.2

GCSE A Level

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 $18\,\mathrm{ml}$.

Essential Pre-Uni Chemistry B3.3

GCSE C C C A Level P P P

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 number of molecules of gas (at RTP) in $36\,\mathrm{dm}^3$.

Part B (b)

Calculate the number of molecules of gas (at RTP) in $300\,\mathrm{cm}^3$. Give your answer to 2 significant figures.

Gameboard:

STEM SMART Chemistry Week 14

Essential Pre-Uni Chemistry B3.4

GCSE C C C A Level P P P

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 number of **atoms** (at RTP) in $60\,\mathrm{cm}^3$ of argon.

Part B (b)

Calculate the number of **atoms** (at RTP) in $1.2\,\mathrm{dm}^3$ of N_2.

Part C (c)

Calculate the number of **atoms** (at RTP) in $8.0\,\mathrm{m}^3$ of carbon dioxide.

Part D **(d)**

Calculate the number of **atoms** (at RTP) in $420\,\mathrm{cm}^3$ of ethene. Give your answer to 2 significant figures.

Gameboard:

STEM SMART Chemistry Week 14

Essential Pre-Uni Chemistry B3.5

GCSE C C C A Level P P P

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 14

Essential Pre-Uni Chemistry B5.2

GCSE C C C A Level P P P

Calculate the mass of solute in grams of each of the following:

Part A **(a)**

$500\,\text{ml}$ of $0.010\,\text{mol}\,\text{dm}^{-3}$ NaOH

Part B **(b)**

$150\,\text{ml}$ of $4.0\,\text{mol}\,\text{dm}^{-3}$ HCl

Part C **(c)**

$1.00\,\text{ml}$ of $10.0\,\text{mol}\,\text{dm}^{-3}$ H_2SO_4

Part D **(d)**

$25.0\,\text{ml}$ of $0.50\,\text{mol}\,\text{dm}^{-3}$ FeSO_4

Part E **(e)**

21.8 ml of 0.0050 mol dm^{-3} $KMnO_4$

Part F **(f)**

2.0 dm^3 of 0.10 mol dm^{-3} NaCl

Part G **(g)**

100 ml of limewater with a concentration of 0.00020 mol dm^{-3}

Gameboard:

STEM SMART Chemistry Week 14

Essential Pre-Uni Chemistry B6.3

GCSE C C C A Level P P P

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 14

Essential Pre-Uni Chemistry F1.7

A Level

Specific heat capacity of water $= 4.18\,\mathrm{J\,g^{-1}\,K^{-1}}$.

$25.0\,\mathrm{cm^3}$ of sulfuric acid at $1.00\,\mathrm{mol\,dm^{-3}}$ and $19.10\,^\circ\mathrm{C}$ is placed in an insulated polystyrene cup. When $25.0\,\mathrm{cm^3}$ of sodium hydroxide at $2.00\,\mathrm{mol\,dm^{-3}}$ and $19.10\,^\circ\mathrm{C}$ is added, the temperature rises to $32.45\,^\circ\mathrm{C}$.

Assuming that no heat is lost, that the specific heat capacity of water may be used, and that the solutions have a density of $1.00\,\mathrm{g\,cm^{-3}}$ at $19.10\,^\circ\mathrm{C}$, find the enthalpy change of the reaction per mole of water produced by neutralisation.

Gameboard:

STEM SMART Chemistry Week 14

Step and Overall Yield

A Level

A synthesis from phenol (C_6H_6O) to give **G** ($C_8H_8O_2$) was carried out as shown below.

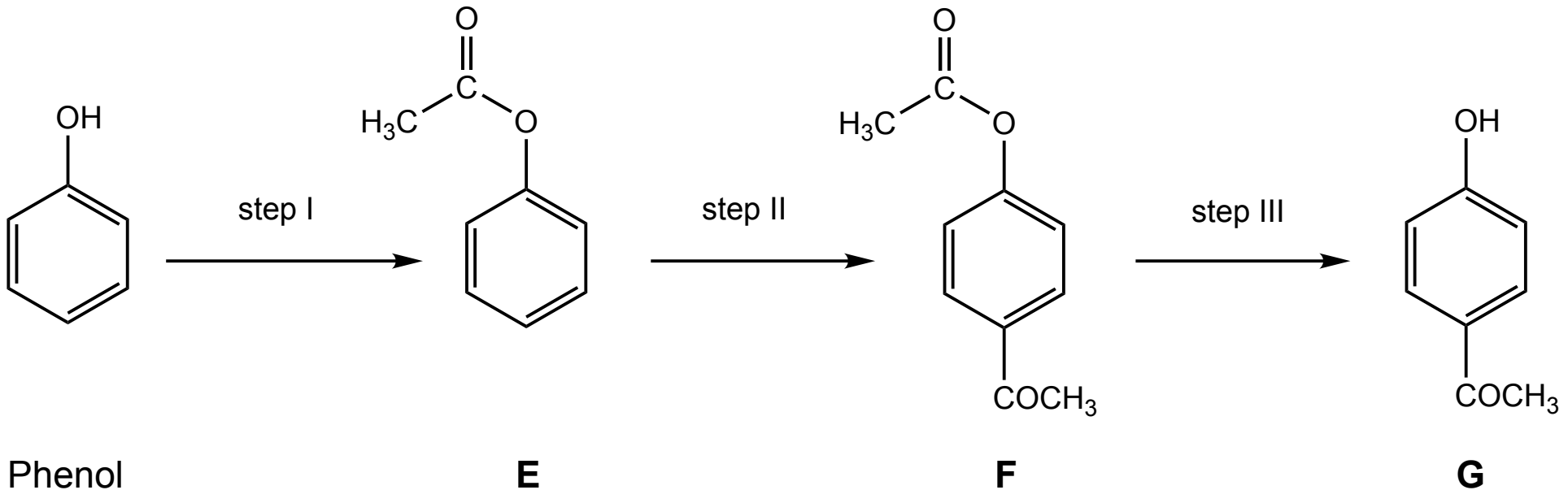

Figure 1: Three-step synthesis starting from phenol.

Part A Overall yield

$47.0\,\mathrm{g}$ of phenol (C_6H_6O) gave $44.5\,\mathrm{g}$ of the final product **G** ($C_8H_8O_2$). What is the overall percentage yield of **G** from phenol? Give your answer to the nearest integer.

Part B Step II yield

The yield for step I, for the conversion of phenol to **E** ($C_8H_8O_2$), was $75\,\%$, and the yield for the hydrolysis of **F** ($C_{10}H_{10}O_3$) to **G** ($C_8H_8O_2$) in step III was $100\,\%$. What is the percentage yield for step II? Give your answer to the nearest integer.

Adapted with permission from OCR, A Level Chemistry, June 1999, Further Organic Paper, Question 4

Compounds TBC

A Level

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.

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

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