ST MARY'S SCIENCE DEPARTMENT:

CHEMISTRY

H

GCSE CHEMISTRY **HOMEWORK BOOK**
TOPIC 3: QUANTITATIVE CHEMISTRY
STUDENT BOOK

YOU MUST ANSWER ALL THREE SECTIONS IN EACH PART OF THE HOMEWORK TASKS

NAME	
CLASS	
TEACHER	
FORM	

TASK	MARK	GRADE
1		
2		
3		
4		
5		
OVERALL		

GCSE CHEMISTRY

YEAR 10

TOPIC 1

HOMEWORK SCHEDULE

Please use the following table to ensure each homework task is completed and submitted on time.

Carrying out these homework tasks can only increase your ability to gain a high grade in the GCSE examinations.

Failure to hand in work on time will lead to sanctions to complete this work.

Task	Submission Date	Completed?	On Time?
Task 1 Conservation of Mass			
Task 2 Relative Formula Mass			
Task 3 Concentration			
Task 4 Titrations			
Task 5 Percentage Yield			

SCIENCE DEPARTMENT MARKING CODE

ID = Insufficient detail in answer
W = Wrong understanding of science
IR = Irrelevant information given.
V = This is too vague to get a mark.
AQ = Answer the question asked
R = Read the question/information
M = Maths mistake
BOD = Benefit of the doubt given.
E = Explain the answer further please.
U = Wrong units used.
SF = Wrong significant figures used.
SP = Wrong spelling of a technical term
SR = Same reason given more than once.
A circle means this lost you marks
An underline means this gained you marks

PLEASE READ

This homework booklet has made with custom selected examination questions and activities to assess your understanding in the concepts covered in class. This will increase your familiarity with the style of examination questions.

Carrying out these questions can only increase your ability to gain a high grade in the GCSE examination.

Thank you for your hard work in completing this book, and good luck.

Mr. Turnbull

TASK 1: CONSERVATION OF MASS

SPEC CHECK

Content	Achieved?
The law of conservation of mass states that no atoms are lost or made during a chemical reaction, so the mass of the products equals the mass of the reactants. This means that chemical reactions can be represented by symbol equations which are balanced in terms of the numbers of atoms of each element involved on both sides of the equation. Students should understand the use of the multipliers in equations in normal script before a formula and in subscript within a formula.	
Some reactions may appear to involve a change in mass but this can usually be explained because a reactant or product is a gas and its mass has not been taken into account. For example: when a metal reacts with oxygen the mass of the oxide produced is greater than the mass of the metal or in thermal decompositions of metal carbonates carbon dioxide is produced and escapes into the atmosphere leaving the metal oxide as the only solid product. Students should be able to explain any observed changes in mass in non-enclosed systems during a chemical reaction given the balanced symbol equation for the reaction and explain these changes in terms of the particle model.	
Whenever a measurement is made there is always some uncertainty about the result obtained. Students should be able to: • Represent the distribution of results and make estimations of uncertainty • Use the range of a set of measurements about the mean as a measure of uncertainty.	

Target Setting

In this assessed piece of work, what target should I look to achieve in completing this task? Please refer to your marking feedback for your target.

From your previous work, fill in the following boxes with your personal progress in Physics.

What Topics Do I Know Well?	What Topics Do I Need to Revise?

SECTION A

This is a revision question on a previous topic.

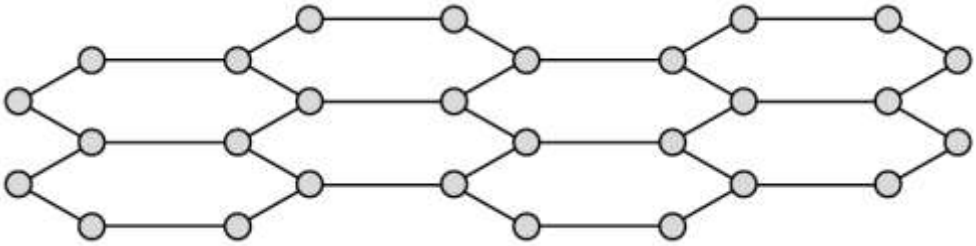
You should aim to spend **10 minutes** answering this section.

1. This question is about graphene and graphite.

Graphene is a single layer of graphite.

Figure 2 represents part of the structure of graphene.

Figure 2



1.1 Graphene is one atom thick. The diameter of the atom is 3.4×10^{-10} m

What is the thickness of a graphene layer in nanometres?

1 nm = 10^{-9} m

[1 mark]

Tick **one** box.

- 0.034 nm ☐
- 0.34 nm ☐
- 3.4 nm ☐
- 34 nm ☐

1.2 Which is one use of graphene?

[1 mark]

Tick **one** box.

As a detergent	☐
As a solvent	☐
In composites	☐
To produce polymers	☐

1.3 Graphene and graphite are used in electronics.

Suggest **one** reason why graphene is a more suitable material for use in electronics than graphite.

[1 mark]

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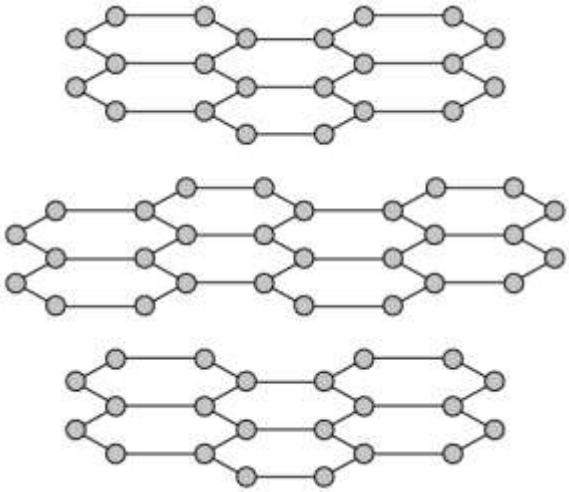
1.4 Figure 3 represents part of the structure of graphite.

Figure 3



Graphite is used as a contact in electric motors because graphite:

- conducts electricity
- is slippery.

Explain why graphite has these properties.

You should refer to the structure and bonding of graphite in your answer.

[6 marks]

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SECTION B

This is a question to revise understanding carried out in lesson.

You should aim to spend **10 minutes** answering this section.

1. A student investigated the reaction of magnesium with oxygen.

The student calculated that 4.8 g of magnesium would make 8.0 g of magnesium oxide.

The equation for the reaction is:

$$2Mg + O_2 \rightarrow 2MgO$$

1.1 What mass of oxygen is required to produce 8.0 g of magnesium oxide from 4.8 g of magnesium?

[1 mark]

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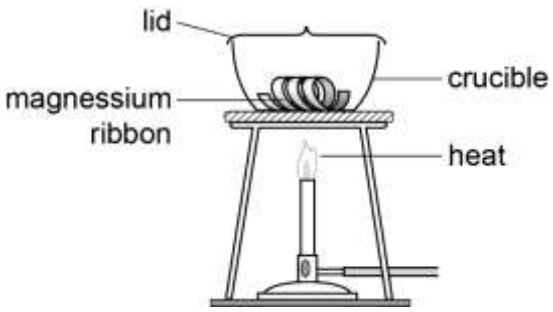
1.2 The student heated magnesium to produce magnesium oxide.

Figure 1 shows the apparatus the student used.

Figure 1



The student:

Weighed 2.40 g of magnesium.

Heated the crucible and magnesium.

When heating lifted up the lid slightly to let oxygen in but stopped magnesium oxide escaping.

Heated until all the magnesium formed a white powder.

Weighed the magnesium ribbon formed.

Table 1 shows the student's results.

Table 1

	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**
Mass of magnesium in g	2.40	2.40	2.40	2.40
Mass of magnesium oxide in g	7.36	7.06	7.38	7.38

Calculate the mean mass of magnesium oxide produced. Give your answer to 2 decimal places

[3 marks]

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1.3 The student produced less magnesium oxide than expected.

Suggest **two** reasons why.

[2 marks]

Reason **1**

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Reason **2**

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SECTION C

This is a challenge question to extend your understanding.

You should aim to spend **10 minutes** answering this section.

One mole of a substance contains the same number of atoms or molecules as one mole of any other substance.

1.1 Which contains more atoms: 56 g of Fe or 16 g of S? Show your working.

[2 Marks]

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1.2 Which contains more molecules: 340 g of NH_3 or 90 g of H_2O? Show your working.

[2 Marks]

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1.3 How many more atoms are there in 48 g of C compared to 48 g of Mg? Explain your answer.

[2 Marks]

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1.4 Explain why 2 g of H_2 contains more molecules than 2 g of O_2.

[2 Marks]

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FEEDBACK SHEET

Overall Mark:	**/23**	**GRADE ACHIEVED:**	
Section A: Mark	/9	**9** ☐	**5** ☐
Section B: Mark	/6	**8** ☐	**4** ☐
Section C: Mark	/8	**7** ☐	**3** ☐
		6 ☐	**U** ☐

Knowledge and understanding shown	Unsatisfactory	Satisfactory	Good	Outstanding

Strengths:	☐ Basic Knowledge of Concepts ☐ Quality of Written Communication ☐ Working Scientifically ☐ Answering Examination Questions ☐ Analytical Skills **Others** (Topic Specific)	☐ Applications of Concepts ☐ Mathematical Skills ☐ Experimental Technique ☐ Previous Topics ☐ Problem Solving
Areas to Improve:	☐ Basic Knowledge of Concepts ☐ Quality of Written Communication ☐ Working Scientifically ☐ Answering Examination Questions ☐ Analytical Skills **Others** (Topic Specific)	☐ Applications of Concepts ☐ Mathematical Skills ☐ Experimental Technique ☐ Previous Topics ☐ Problem Solving

Progress:	Unsatisfactory	Satisfactory	Good	Outstanding
Working:	Below	In line with	Above	**(your target)**
Effort:	Poor	Inconsistent	Good	Excellent

To improve further you need to:

☐ Carry out **independent** revision.	☐ Revise the equations.
☐ Complete outstanding work.	☐ Check the units on answers.
☐ Make corrections as indicated by the teacher.	☐ Check the correct amount of sig figs on answers.
☐ Attend intervention for this topic	☐ Check to convert values correctly.
☐ Include more information in responses.	☐ Show your full working out.
☐ Include more key words in responses.	☐ Check your calculations.
☐ Attend departmental revision sessions.	☐ Revise the science investigative skills.
☐ Read the questions carefully.	☐ Revise the key concepts of the topics.
☐ Explain your answers in more detail.	☐ Thoroughly check your work for mistakes.
☐ Carry out revision on Seneca Learning.	Other:

Student response

TASK 2: RELATIVE FORMULA MASS

SPEC CHECK

Content	Achieved?
The relative formula mass (M_r) of a compound is the sum of the relative atomic masses of the atoms in the numbers shown in the formula. In a balanced chemical equation, the sum of the relative formula masses of the reactants in the quantities shown equals the sum of the relative formula masses of the products in the quantities shown.	
(HT Only) Chemical amounts are measured in moles. The symbol for the unit mole is mol. The mass of one mole of a substance in grams is numerically equal to its relative formula mass. One mole of a substance contains the same number of the stated particles, atoms, molecules or ions as one mole of any other substance. The number of atoms, molecules or ions in a mole of a given substance is the Avogadro constant. The value of the Avogadro constant is 6.02×10^{23} per mole. Students should understand that the measurement of amounts in moles can apply to atoms, molecules, ions, electrons, formulae and equations, for example that in one mole of carbon (C) the number of atoms is the same as the number of molecules in one mole of carbon dioxide (CO_2).	
(HT Only) Students should be able to use the relative formula mass of a substance to calculate the number of moles in a given mass of that substance and vice versa.	

Target Setting

In this assessed piece of work, what target should I look to achieve in completing this task? Please refer to your marking feedback for your target.

From your previous work, fill in the following boxes with your personal progress in Physics.

What Topics Do I Know Well?	What Topics Do I Need to Revise?

SECTION A

This is a revision question on a previous topic.

You should aim to spend **10 minutes** answering this section.

1. Calculate the mass of the following:

1.1 3 moles of ammonia

[1 Mark]

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1.2 4.5 moles of methane

[1 Mark]

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1.3 0.2 moles of calcium carbonate

[1 Mark]

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1.4 1.4 moles of magnesium hydroxide.

[1 Mark]

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Calculate the number of moles in the following:

1.5 136 g of ammonia

[1 Mark]

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1.6 160 g of methane

[1 Mark]

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1.7 250 g of calcium carbonate

[1 Mark]

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1.8 2.9 g of magnesium hydroxide.

[1 Mark]

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1.9 15.3 g of an unknown substance was found to contain 0.15 moles.

Calculate the relative formula mass of the substance.

[1 Mark]

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SECTION B

This is a question to revise understanding carried out in lesson.

You should aim to spend **10 minutes** answering this section.

1. A student is preparing a sample of sodium nitrate, $NaNO_3$.
She mixes 17 g of sodium oxide with an excess of nitric acid. The equation for the reaction is:

$$Na_2O + 2HNO_3 \rightarrow 2NaNO_3 + H_2O$$

Relative atomic masses (A_r): Na = 23, O = 16, N = 14, H = 1.

1.1 Calculate the number of moles in 17 g of sodium oxide.

[2 Marks]

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1.2 Calculate the maximum mass of sodium nitrate that can be produced in this reaction.

[3 Marks]

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Aluminium and iron oxide (Fe_2O_3) react together to produce aluminium oxide (Al_2O_3). The equation for the reaction is:

$$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$$

1.3 Calculate the mass of iron that is produced by reacting 20 g of iron oxide with an excess of aluminium.

Relative atomic masses (A_r): Al = 27, O = 16, Fe = 56.

[4 Marks]

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SECTION C

This is a challenge question to extend your understanding.

You should aim to spend **10 minutes** answering this section.

1. Describe how you can calculate the relative formula mass of a compound.

[4 Marks]

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FEEDBACK SHEET

Overall Mark:	**/22**	**GRADE ACHIEVED:**	
Section A: Mark	/9	**9** ☐	**5** ☐
Section B: Mark	/9	**8** ☐	**4** ☐
Section C: Mark	/4	**7** ☐	**3** ☐
		6 ☐	**U** ☐

Knowledge and understanding shown	Unsatisfactory	Satisfactory	Good	Outstanding

Strengths:	☐ Basic Knowledge of Concepts ☐ Quality of Written Communication ☐ Working Scientifically ☐ Answering Examination Questions ☐ Analytical Skills **Others** (Topic Specific)	☐ Applications of Concepts ☐ Mathematical Skills ☐ Experimental Technique ☐ Previous Topics ☐ Problem Solving
Areas to Improve:	☐ Basic Knowledge of Concepts ☐ Quality of Written Communication ☐ Working Scientifically ☐ Answering Examination Questions ☐ Analytical Skills **Others** (Topic Specific)	☐ Applications of Concepts ☐ Mathematical Skills ☐ Experimental Technique ☐ Previous Topics ☐ Problem Solving

Progress:	Unsatisfactory	Satisfactory	Good	Outstanding
Working:	Below	In line with	Above	**(your target)**
Effort:	Poor	Inconsistent	Good	Excellent

To improve further you need to:

☐ Carry out **independent** revision.	☐ Revise the equations.
☐ Complete outstanding work.	☐ Check the units on answers.
☐ Make corrections as indicated by the teacher.	☐ Check the correct amount of sig figs on answers.
☐ Attend intervention for this topic	☐ Check to convert values correctly.
☐ Include more information in responses.	☐ Show your full working out.
☐ Include more key words in responses.	☐ Check your calculations.
☐ Attend departmental revision sessions.	☐ Revise the science investigative skills.
☐ Read the questions carefully.	☐ Revise the key concepts of the topics.
☐ Explain your answers in more detail.	☐ Thoroughly check your work for mistakes.
☐ Carry out revision on Seneca Learning.	Other:

Student response

TASK 3: CONCENTRATION

SPEC CHECK

Content	Achieved?
(HT Only) The concentration of a solution can be measured in mol/dm^3. The amount in moles of solute or the mass in grams of solute in a given volume of solution can be calculated from its concentration in mol/dm^3. If the volumes of two solutions that react completely are known and the concentration of one solution is known, the concentration of the other solution can be calculated. Students should be able to explain how the concentration of a solution in mol/dm^3 is related to the mass of the solute and the volume of the solution.	
Many chemical reactions take place in solutions. The concentration of a solution can be measured in mass per given volume of solution, e.g. grams per dm^3 (g/dm^3). Students should be able to: • Calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution • (HT only) explain how the mass of a solute and the volume of a solution is related to the concentration of the solution.	

Target Setting
In this assessed piece of work, what target should I look to achieve in completing this task? Please refer to your marking feedback for your target.

From your previous work, fill in the following boxes with your personal progress in Physics.

What Topics Do I Know Well?

What Topics Do I Need to Revise?

SECTION A

This is a revision question on a previous topic.

You should aim to spend **10 minutes** answering this section.

1. Calculate the amount in moles in each of the following solutions:

1.1 0.0350 dm^3 of a solution with a concentration of 0.108 mol/dm^3

[1 Mark]

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1.2 41.8 cm^3 of a solution with a concentration of 0.0501 mol/dm^3

[2 Marks]

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Calculate the concentration of each of the following solutions:

1.3 0.0250 dm^3 of a solution that contains 0.345 mol of substance

[1 Mark]

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1.4 18.90 cm^3 of a solution that contains 0.480 mol of substance

[2 Marks]

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SECTION B

This is a question to revise understanding carried out in lesson.

You should aim to spend **10 minutes** answering this section.

1. A student is investigating the effect of concentration on the colour of a solution of copper sulfate.

She wishes to make up 250 cm^3 of a solution of copper sulfate, $CuSO_4$, with a concentration of 0.50 mol/dm^3, that she can dilute.

1.1 State the colour of a solution of copper sulfate.

[1 mark]

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1.2 A solution with a concentration of 0.50 mol/dm^3 contains 0.50 mol of copper sulfate, $CuSO_4$, per decimetre cubed, dm^3, of solution.

Calculate the concentration of this solution in g/dm^3.

[3 marks]

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1.3 Describe how the student could make up 250 cm^3 of a solution of copper sulfate with the desired concentration.

Include the mass of copper sulfate that must be dissolved and details of the practical steps needed.

[4 marks]

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1.4 How much water must be added to 10 cm^3 of the 0.50 mol/dm^3 solution to produce a solution with a concentration of 0.25 mol/dm^3?

[1 mark]

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SECTION C

This is a challenge question to extend your understanding.

You should aim to spend **10 minutes** answering this section.

1. A student used a pipette to add 25.0 cm^3 of KOH of unknown concentration to a conical flask.

The student carried out a titration experiment to find the volume of 0.150 mol/dm^3 H_2SO_4 needed to neutralise the KOH.

The student found that, on average, 17.20 cm^3 of the H_2SO_4 solution was required for neutralisation.

1.1 Write a balanced symbol equation for the neutralisation reaction between H_2SO_4 and KOH.

[1 Mark]

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1.2 Calculate the concentration of the KOH solution.

[5 marks]

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FEEDBACK SHEET

Overall Mark:	**/21**	**GRADE ACHIEVED:**	
Section A: Mark	/6	**9** ☐	**5** ☐
Section B: Mark	/9	**8** ☐	**4** ☐
Section C: Mark	/6	**7** ☐	**3** ☐
		6 ☐	**U** ☐

Knowledge and understanding shown	Unsatisfactory	Satisfactory	Good	Outstanding

Strengths:	☐ Basic Knowledge of Concepts ☐ Quality of Written Communication ☐ Working Scientifically ☐ Answering Examination Questions ☐ Analytical Skills **Others** (Topic Specific)	☐ Applications of Concepts ☐ Mathematical Skills ☐ Experimental Technique ☐ Previous Topics ☐ Problem Solving
Areas to Improve:	☐ Basic Knowledge of Concepts ☐ Quality of Written Communication ☐ Working Scientifically ☐ Answering Examination Questions ☐ Analytical Skills **Others** (Topic Specific)	☐ Applications of Concepts ☐ Mathematical Skills ☐ Experimental Technique ☐ Previous Topics ☐ Problem Solving

Progress:	Unsatisfactory	Satisfactory	Good	Outstanding
Working:	Below	In line with	Above	**(your target)**
Effort:	Poor	Inconsistent	Good	Excellent

To improve further you need to:

☐ Carry out **independent** revision. ☐ Complete outstanding work. ☐ Make corrections as indicated by the teacher. ☐ Attend intervention for this topic ☐ Include more information in responses. ☐ Include more key words in responses. ☐ Attend departmental revision sessions. ☐ Read the questions carefully. ☐ Explain your answers in more detail. ☐ Carry out revision on Seneca Learning.	☐ Revise the equations. ☐ Check the units on answers. ☐ Check the correct amount of sig figs on answers. ☐ Check to convert values correctly. ☐ Show your full working out. ☐ Check your calculations. ☐ Revise the science investigative skills. ☐ Revise the key concepts of the topics. ☐ Thoroughly check your work for mistakes. Other:

Student response

TASK 4: TITRATIONS

SPEC CHECK

Content	Achieved?
The volumes of acid and alkali solutions that react with each other can be measured by titration using a suitable indicator. Students should be able to: • describe how to carry out titrations using strong acids and strong alkalis only (sulfuric, hydrochloric and nitric acids only) to find the reacting volumes accurately. • (HT Only) calculate the chemical quantities in titrations involving concentrations in mol/dm^3 and in g/dm^3.	

Target Setting
In this assessed piece of work, what target should I look to achieve in completing this task? Please refer to your marking feedback for your target.

From your previous work, fill in the following boxes with your personal progress in Physics.

What Topics Do I Know Well?	What Topics Do I Need to Revise?

SECTION A

This is a revision question on a previous topic.

You should aim to spend **10 minutes** answering this section.

1. In a titration experiment, 20.0 cm^3 of sodium hydroxide, NaOH, with an unknown concentration was placed in a conical flask. 25.10 cm^3 of a solution of hydrochloric acid, HCl, with a concentration of 0.128 mol/dm^3 was needed for neutralisation.

Give all your answers to the relevant questions below to three significant figures.

1.1 Sketch a diagram to show the titration set up at the point neutralisation is reached.

[2 marks]

1.2 Calculate the amount in moles of HCl in 25.10 cm^3 of a solution with a concentration of 0.128 mol/dm^3.

[2 marks]

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1.3 Write an equation for the neutralisation reaction between HCl and NaOH.

[1 mark]

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1.4 Use your answer to parts **1.2** and **1.3** to determine the amount of NaOH in 20.0 cm^3 of NaOH that is exactly neutralised by the HCl.

[1 mark]

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1.5 Calculate the concentration of the NaOH solution in the conical flask.

[2 marks]

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SECTION B

This is a question to revise understanding carried out in lesson.

You should aim to spend **10 minutes** answering this section.

1. A student titrated 25.0 cm^3 portions of dilute sulfuric acid with a 0.105 mol/dm^3 sodium hydroxide solution.

1.1 Table 4 shows the student's results.

Table 4

	Titration 1	Titration 2	Titration 3	Titration 4	Titration 5
Volume of sodium hydroxide solution in cm^3	23.50	21.10	22.10	22.15	22.15

The equation for the reaction is:

$$2\,NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2\,H_2O$$

Calculate the concentration of the sulfuric acid in mol/dm^3

Use only the student's concordant results.

Concordant results are those within 0.10 cm^3 of each other.

[5 marks]

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Concentration of Sulfuric Acid = ... mol/dm^3

1.2 Explain why the student should use a pipette to measure the dilute sulfuric acid and a burette to measure the sodium hydroxide solution.

[2 marks]

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1.3 Calculate the mass of sodium hydroxide in 30.0 cm^3 of a 0.105 mol/dm^3 solution.

Relative formula mass (M_r): NaOH = 40

[2 marks]

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Mass of Sodium Hydroxide = ...g

SECTION C

This is a challenge question to extend your understanding.

You should aim to spend **10 minutes** answering this section.

1. A student investigated the volume of sulfuric acid that reacted with 25 cm^3 sodium hydroxide.

Describe a titration method the student could use in this investigation.

[6 marks]

1.2 In the titration the student used 25.0 cm^3 of sodium hydroxide.

This volume reacted with exactly 20.0 cm^3 of 0.1 mol/dm^3 of sulfuric acid solution.

The equation for the reaction is:

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

What is the concentration in mol/dm^3 of the sodium hydroxide solution?

[4 marks]

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FEEDBACK SHEET

Overall Mark:	**/27**	**GRADE ACHIEVED:**	
Section A: Mark	/8	**9** ☐	**5** ☐
Section B: Mark	/9	**8** ☐	**4** ☐
Section C: Mark	/10	**7** ☐	**3** ☐
		6 ☐	**U** ☐

Knowledge and understanding shown	Unsatisfactory	Satisfactory	Good	Outstanding

Strengths:	☐ Basic Knowledge of Concepts ☐ Quality of Written Communication ☐ Working Scientifically ☐ Answering Examination Questions ☐ Analytical Skills **Others** (Topic Specific)	☐ Applications of Concepts ☐ Mathematical Skills ☐ Experimental Technique ☐ Previous Topics ☐ Problem Solving
Areas to Improve:	☐ Basic Knowledge of Concepts ☐ Quality of Written Communication ☐ Working Scientifically ☐ Answering Examination Questions ☐ Analytical Skills **Others** (Topic Specific)	☐ Applications of Concepts ☐ Mathematical Skills ☐ Experimental Technique ☐ Previous Topics ☐ Problem Solving

Progress:	Unsatisfactory	Satisfactory	Good	Outstanding
Working:	Below	In line with	Above	**(your target)**
Effort:	Poor	Inconsistent	Good	Excellent

To improve further you need to:

☐ Carry out **independent** revision.	☐ Revise the equations.
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☐ Include more key words in responses.	☐ Check your calculations.
☐ Attend departmental revision sessions.	☐ Revise the science investigative skills.
☐ Read the questions carefully.	☐ Revise the key concepts of the topics.
☐ Explain your answers in more detail.	☐ Thoroughly check your work for mistakes.
☐ Carry out revision on Seneca Learning.	Other:

Student response

TASK 5: PERCENTAGE YIELD

SPEC CHECK

Content	Achieved?
Even though no atoms are gained or lost in a chemical reaction, it is not always possible to obtain the calculated amount of a product because: • The reaction may not go to completion because it is reversible • Some of the product may be lost when it is separated from the reaction mixture • Some of the reactants may react in ways different to the expected reaction. The amount of a product obtained is known as the yield. When compared with the maximum theoretical amount as a percentage, it is called the percentage yield. $\% \text{ Yield} = \frac{\text{Mass of product actually made}}{\text{Maximum theoretical mass of product}} \times 100$ Students should be able to: • Calculate the percentage yield of a product from the actual yield of a reaction • (HT only) Calculate the theoretical mass of a product from a given mass of reactant and the balanced equation for the reaction.	
The atom economy (atom utilisation) is a measure of the amount of starting materials that end up as useful products. It is important for sustainable development and for economic reasons to use reactions with high atom economy. The percentage atom economy of a reaction is calculated using the balanced equation for the reaction as follows: $\frac{\text{Relative formula mass of desired product from equation}}{\text{Sum of relative formula masses of all reactants from equation}} \times 100$ Students should be able to: • Calculate the atom economy of a reaction to form a desired product from the balanced equation • (HT only) Explain why a particular reaction pathway is chosen to produce a specified product given appropriate data such as atom economy (if not calculated), yield, rate, equilibrium position and usefulness of by-products.	

Target Setting

In this assessed piece of work, what target should I look to achieve in completing this task? Please refer to your marking feedback for your target.

From your previous work, fill in the following boxes with your personal progress in Physics.

What Topics Do I Know Well?	What Topics Do I Need to Revise?

SECTION A

This is a revision question on a previous topic.

You should aim to spend **10 minutes** answering this section.

1.Calculate which substance in the following pairs is heavier:

1.1 1 mole of NaCl or 1 mole of Na_2CO_3

[2 marks]

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1.2 0.5 moles of Mg or 5 moles of H_2

[2 marks]

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1.3 10 moles of He or 1.5 moles of O_2.

[2 marks]

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SECTION B

This is a question to revise understanding carried out in lesson.

You should aim to spend **10 minutes** answering this section.

1. Aspirin, $C_9H_8O_4$, is a common painkiller.

Pharmaceutical companies make aspirin by reacting salicylic acid, $C_7H_6O_3$, with one of two chemicals:

salicylic acid can be reacted with ethanoyl chloride, C_2H_3OCl

$$C_7H_6O_3 + C_2H_3OCl \rightarrow C_9H_8O_4 + HCl$$

or salicylic acid can be reacted with ethanoic anhydride, $C_4H_6O_3$

$$C_7H_6O_3 + C_4H_6O_3 \rightarrow C_9H_8O_4 + C_2H_4O_2$$

Look at the table of relative formula masses:

Substance	**Relative formula mass, M_r**
$C_7H_6O_3$	138
C_2H_3OCl	78.5
$C_4H_6O_3$	102
HCl	36.5
$C_2H_4O_2$	60
$C_9H_8O_4$	180

Calculate the atom economy of making aspirin

1.1 from salicyclic acid and ethanoyl chloride

[2 marks]

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1.2 from salicyclic acid and ethanoic anhydride.

[2 marks]

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Relative atomic masses (A_r): C = 12; H = 1; O = 16

1.3 State which method of production has the higher atom economy.

[1 mark]

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1.4 Atom economy is not the only factor that must be considered when choosing the most appropriate chemical reaction for producing a product.

State **two** other factors that you might consider.

[2 marks]

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SECTION C

This is a challenge question to extend your understanding.

You should aim to spend **10 minutes** answering this section.

1. Industrially ethanol can be produced by two different methods.

Reaction 1: $C_2H_4 + H_2O \rightarrow C_2H_5OH$

Reaction 2: $C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH$

1.1 Explain why the atom economy in **reaction 1** is equal to 100%.

[2 Marks]

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1.2 Calculate the atom economy for **reaction 2**.

Use the equation.

$$\text{Atom economy} = \frac{\text{Relative formula mass of desired product from equation}}{\text{Sum of relative formula masses of all reactants from equations}} \times 100$$

Relative atomic masses A_r: C = 12, H = 1, O = 16

[5 Marks]

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FEEDBACK SHEET

Overall Mark:	**/20**	**GRADE ACHIEVED:**	
Section A: Mark	/6	**9** ☐	**5** ☐
Section B: Mark	/7	**8** ☐	**4** ☐
Section C: Mark	/7	**7** ☐	**3** ☐
		6 ☐	**U** ☐

Knowledge and understanding shown	Unsatisfactory	Satisfactory	Good	Outstanding

Strengths:	☐ Basic Knowledge of Concepts ☐ Quality of Written Communication ☐ Working Scientifically ☐ Answering Examination Questions ☐ Analytical Skills **Others** (Topic Specific)	☐ Applications of Concepts ☐ Mathematical Skills ☐ Experimental Technique ☐ Previous Topics ☐ Problem Solving
Areas to Improve:	☐ Basic Knowledge of Concepts ☐ Quality of Written Communication ☐ Working Scientifically ☐ Answering Examination Questions ☐ Analytical Skills **Others** (Topic Specific)	☐ Applications of Concepts ☐ Mathematical Skills ☐ Experimental Technique ☐ Previous Topics ☐ Problem Solving

Progress:	Unsatisfactory	Satisfactory	Good	Outstanding
Working:	Below	In line with	Above	**(your target)**
Effort:	Poor	Inconsistent	Good	Excellent

To improve further you need to:

☐ Carry out **independent** revision.	☐ Revise the equations.
☐ Complete outstanding work.	☐ Check the units on answers.
☐ Make corrections as indicated by the teacher.	☐ Check the correct amount of sig figs on answers.
☐ Attend intervention for this topic	☐ Check to convert values correctly.
☐ Include more information in responses.	☐ Show your full working out.
☐ Include more key words in responses.	☐ Check your calculations.
☐ Attend departmental revision sessions.	☐ Revise the science investigative skills.
☐ Read the questions carefully.	☐ Revise the key concepts of the topics.
☐ Explain your answers in more detail.	☐ Thoroughly check your work for mistakes.
☐ Carry out revision on Seneca Learning.	Other:

Student response

The Periodic Table of Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[97] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[267] **Rf** rutherfordium 104	[270] **Db** dubnium 105	[269] **Sg** seaborgium 106	[270] **Bh** bohrium 107	[270] **Hs** hassium 108	[278] **Mt** meitnerium 109	[281] **Ds** darmstadtium 110	[281] **Rg** roentgenium 111	[285] **Cn** copernicium 112	[286] **Nh** nihonium 113	[289] **Fl** flerovium 114	[289] **Mc** moscovium 115	[293] **Lv** livermorium 116	[293] **Ts** tennessine 117	[294] **Og** oganesson 118

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

Relative atomic masses for **Cu** and **Cl** have not been rounded to the nearest whole number.

Acknowledgements

This document has been produced by Mr J Turnbull.

All relevant information has been credited in the document.

This document has been produced for educational purposes only.

This document has been produced for the AQA GCSE Science Specification.