Stewards Academy

Science KS4: Blended Learning Booklet

C3 Chemical quantities and calculations

Name:

Form:

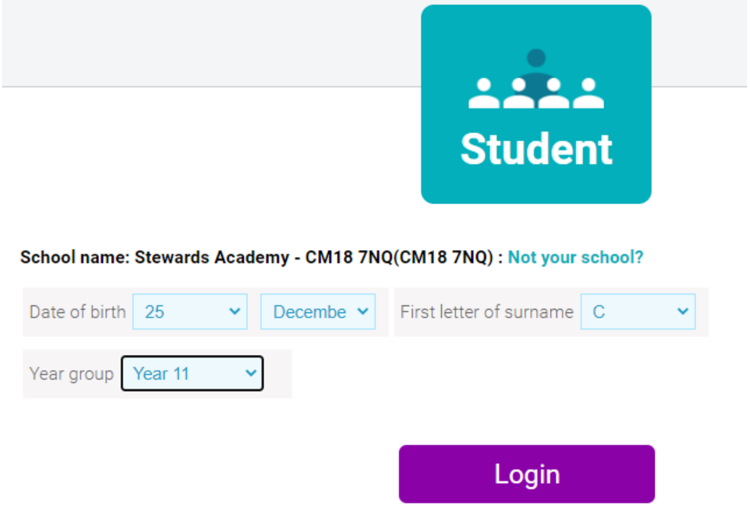
Aim to complete four lessons each week. Watch the videos and follow the four part lesson plan

All video clips are online using the ClassCharts link. Upload all work onto ClassCharts for feedback.

The online textbook has all the key information and vocabulary to help you with this unit

To log on to the online textbook:

- https://connect.collins.co.uk/school/portal.aspx
- Type in “stewards” and select Stewards Academy
- Login using your date of birth, initial of your surname and your academic year



Contents

Contents

(T) = Triple scientists only

Big Picture – Year 9 Overview
Science

Year 9

Cell Biology

I **will** be able to describe how scientists have developed their understanding cell structure and function. **I will** be able to explain how a fertilized egg develops into a complex organism. **I will** be able to explain how organisms get their energy from food. *I will be able to explain how microorganisms are grown in the lab and how their growth is affected by disinfectants and antibiotics (T).*

- UNIT B1
- Structure and function of cells
- Cell division and differentiation
- Stem cells
- Respiration
- *Microbes and antibiotics (T)*
- End of Unit Test

Atomic Structure

I **will** be able **to** use a model to represent and atom and explain how the model of an atom was developed. **I will** be able to explain how we can use radioactive atoms in carbon dating and why some elements are more reactive than others based on their atomic structure. ***I will** be able to describe properties of transition metals (T)*

- UNIT C1
- Atoms, element compounds & mixtures
- Sub-atomic structure
- The periodic table
- Groups 1,9, & 0
- *Transition metals (T)*
- End of Unit Test

Energy

I will be learning about the connections between energy and power, and energy and temperature**. I will** be able explain how energy is transferred and describe how different energy resources have an impact on the environment

- UNIT P1
- Energy
- Work done & Power
- Specific heat capacity
- *Energy transfer (T)*
- Energy Resources
- End of Unit Test

Photosynthesis

I will be able to explain how plants are adapted to survive and get what they need from the environment. **I will** be able to explain how factors affect photosynthesis . **I will** be able to describe how water moves through a plant and how other substances diffuse in/out of plant cells

- UNIT B2
- Investigating photo-synthesis
- Increasing food production
- Diffusion
- Transpiration
- Translocation
- End of Unit Test

Chemical Bonds

I will be able to explain what happens when substances change state and why some substances need a lot of energy for a change of state to occur. **I will** be able to describe different types of chemical bond and how they give different substances different properties.

- UNIT C2
- Chemical bond formation
- States of matter
- Bond properties
- Giant covalent structures
- *Nano particles (T)*
- End of Unit Test

Electricity

I will be able to explain *the principles behind static electricity (T)* and the key concepts in electricity. **I will** investigate and be able to describe the characteristics of electrical components. **I will** be able to explain how electricity is used safely in the home

- UNIT P2
- *Static electricity (T)*
- Series and parallel circuits
- Circuit components
- Investigating resistance
- Electricity in the home
- End of Unit Test

Moving materials

I will be able to explain the difference between diffusion and active transport. **I will** be able to explain why some organisms need organ systems and different organisms move things in different ways. **I will** be able to explain how enzymes work.

- UNIT B3
- Osmosis and active transport
- Enzymes and digestion
- Plants and minerals
- Heart and circulatory system
- Gas exchange
- End of Unit Test

Chemical Quantities

I will be able to explain and apply the law of conservation of mass. **I will be** able to explain how we measure amounts of substances and how we can use these values to in calculations. ***I will be** able to determine chemical yields (T)*

- UNIT C3
- Conservation of mass
- Apparent changes in mass
- Amounts of substance (moles)
- Percentage yield (T)
- *Volumes and concentrations (T)*
- End of Unit Test

Matter

I will be able calculate the specific heat capacity of water and be able to describe the difference between the specific latent heat of vaporization and the specific latent heat of fusion. **I will** be able to explain the effect heat energy has on gas particles *and how this is related to volume (T).*

- UNIT P3
- Density
- Changing state
- Specific heat capacity
- Specific latent heat
- *Particle motion in gases (T)*
- End of Year Exam
- Nest Year

ZOOM IN...

MY LEARNING JOURNEY:

Subject: Chemical quantities Year: 9 Unit: C3

AIMS

This unit will build on ideas about elements, compounds and chemical reactions; concepts that students have learned. Students will improve their ability to work with symbols and equations. They will learn to calculate relative formula masses and will be introduced to moles. Students will use moles to calculate reacting masses and to balance equations. They will find out how concentration is expressed and use this in simple titrations.

DEVELOPING COURAGE

C That it is possible to carry out chemical reactions extremely precisely

O To investiagete how quantities of chemicals are calculated.

U Understand why equations balance

R Carrying out calculations

A The skill of scientists who historically discovered the mole

G Work together and share our understanding

E Being able to calculate the world at a molecular level.

UP NEXT

Properties of matter

- Reactivity series
- Oxidation reactions
- Neutralisation
- Electrolysis
- Redox reactions

CAREERS

- Synthetic Chemist
- Industrial chemist
- Gas engineer

PREVIOUS LEARNING

Pupils will have some knowledge acquired at KS3 regarding how chemicals change during a reaction but are not destroyed. The idea that gases have a mass, being able to measure quantities such as mass in g, volume in cm3, and time in s. They will be used to recoding and presenting data as a graph and using it to carry out further calculations. They will have carried out experiments to make salt crystals.

WHAT WE KNOW/ REMEMBER

- ....
- ....
- ....
- ....
- ....

PERSONAL OBJECTIVES

- ....
- ....
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- ....

RECOMMENDED READING

1. Easy As: Basic Chemistry (Easy As: Human Physiology) by Janelle McAlpine
2. Easy As Measures of Concentration (Easy as Human Physiologyby Janelle McAlpine
3. Easy As: Calculating Concentration (Easy As: Human Physiology) by Janelle McAlpine

Lesson 1: C3.1 – Key concept: Conservation of mass and balanced equations

Connection

Have a look at the topic overview and the C3 zoom in.

Populate what you know and your personal objectives.

Activation

LI: Explain the law of conservation of mass and why chemical equations have numbers in them

1. https://www.youtube.com/watch?v=JCyjLPYXl1I
2. https://www.youtube.com/watch?v=vxCyzR6uETs
3. Make a note of the title and the LI
4. Read pages 98-99
5. List the key words
6. Explain why an element in a chemical formula may have a small number after it

Consolidation

Complete and self-assess the relevant past paper question for this topic - From the C3 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Demonstration

Attempt questions 1-5
In 15 mins answer as many questions as you can.
Self-mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Answers: C3.1 – Key concept

Connection

1 NA
2 NA
3 NA

Demonstration

1 ZY or YZ

2 4

3 Na = 2, S = 2, O = 3

4 Al = 2, S = 3, O = 12

5 a d = 2, e = 1, f = 1, g = 2

b d = 1, e = 5, f = 3, g = 4

Lesson 2: C3.2 Relative formula mass

Connection

Q1. List the elements and quantity of each in H_2SO_4

Q2. Balance the following equation:
$CH_4 + O_2 \longrightarrow CO_2 + H_2O$

Activation

LI: Identify the relative atomic mass of an element and use this to calculate the mass of a compound from its formula

1. https://www.youtube.com/watch?v=MGLrYaI_UfE
2. Make a note of the title and the LI
3. Read pages 100-101
4. List the key words
5. https://www.youtube.com/watch?v=it_fMQu5ivg
6. Describe how you calculate relative formula mass

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C3.2 – Relative formula mass

Connection

1. 2 x H 1 x S 4 x O
2. $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

Demonstration

1 80

2 Protons Neutrons

12C 6 6

13C 6 7

14C 6 8

3 Some elements have more than one isotope which have the same atomic number but different mass number (different number of neutrons). The atomic masses are averaged according to the proportion of each isotope in a naturally occurring sample.

4 120

5 187.5

6 $MgBr_2 + 2\ AgNO_3 \rightarrow Mg(NO_3)_2 + 2\ AgBr$

184 2 × 170 148 2 × 188

Reactants = 524

Products = 524

7 Molecular mass of R = 44. Molecular formula of R = C_3H_8

Lesson 3: C3.3 – Mass changes when gases are in a reaction

Connection

Q1. What is the relative atomic mass of hydrogen H, sulphur S and oxygen O?

Q2. Calculate the relative formula mass of sulphuric acid H_2SO_4.

Activation

LI: Explain the mass changes in reactions where gases are given off or taken in

1. https://www.youtube.com/watch?v=TV6n5MFH6IU
2. Make a note of the title and the LI
3. Read pages 102-103
4. List the key words
5. Describe how we can calculate the mass of gas given off or taken in by a reaction
6. Explain how reactions can end because of a limiting reactant (HT)

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Demonstration

Attempt questions 1-9 (6-9 HT).
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

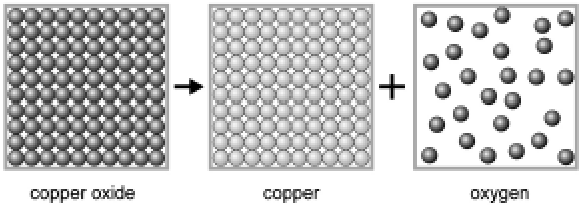
Answers: C3.3 – Mass changes when gases are in reactions

Connection

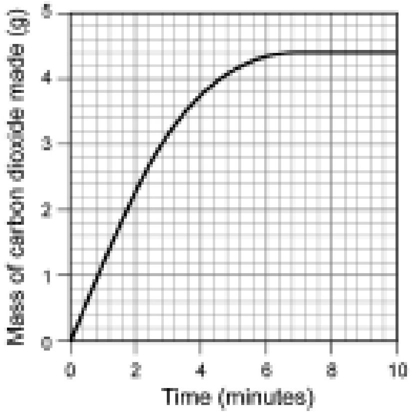
1 H – 1 S – 32 O – 16
2 2 x 1 1 x 32 4 x 16 = 98

Demonstration

1 Mass lost as carbon dioxide gas.
2 0.7 g
3 0.9 g
4



5 1.6 g
6 8 minutes. Graph is horizontal meaning no more mass is being lost so the reaction is finished. The acid was in excess and all the magnesium carbonate has been used up.
7



8 a Nitric acid. Zinc was left at the end of the reaction so was not the limiting reactant.
b 3.62 g of zinc and 6.97 g of nitric acid.
9 Mass of O2 gained = 2 × 32 = 64. Mass of CO2 lost = 2 × 44 = 88. So 88 – 64 = 24 g of mass lost overall.

Lesson 4: C3.4 – Chemical measurements and uncertainty

Connection

Q1. When calcium carbonate is heated it undergoes thermal decomposition in the reaction

$$CaCO_3 \longrightarrow CaO + CO_2$$

10g ? 4.4g

How much CaO is produced?

Q2. $2Mg + O_2 \longrightarrow 2MgO$

How much MgO is made from 24g of Mg?

Activation

LI: Be aware that any measurement cannot be guaranteed to be accurate and be able to estimate the degree of accuracy.

1. https://www.youtube.com/watch?v=ae4NMm763mM&feature=youtu.be
2. Make a note of the title and the LI
3. Read pages 104 – 105
4. List the key words
5. Describe how this uncertainty comes about
6. Describe what we mean by the range of a measurement

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Demonstration

Attempt questions 1-4.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C3.4 – Chemical measurements and uncertainty

Connection

Q1. 5.6g

Q2. 40g

Demonstration

1 Between 25.25 and 25.35 cm3

2 Group A

3 The range is the difference between the highest measurement and the lowest measurement. The mean is the sum of the measurements divided by the number of measurements

4 8%

Lesson 5: C3.5 – Moles (HT and T only)

Connection

Q1. What is range of values for the following measurement 25.6g ± 0.05

Q2. A set of measurements had a range of results from 12.2cm to 12.9cm with a mean of 12.5cm. Calculate the percentage uncertainty for this data.

Activation

LI: Describe how a mole is equal to a substance's relative formula mass in grams

1. https://www.youtube.com/watch?v=-_-fNVmDwJk
2. Make a note of the title and the LI
3. Read pages 106 – 107
4. List the key words
5. Describe what a mole is, the symbol for a mole and what Avogadro's number is
6. Explain how to calculate molar mass

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C3.5 – Moles

Connection

Q1. 25.55g – 25.65g

Q2. Range 0.7cm

Mean 12.5cm

Uncertainty (%) = Range ÷ Mean x 100

0.7 ÷ 12.5 x 100 = 5.6%

Demonstration

1 18 g

2 3 × (39 + 80) = 357 g

3 2 × 6.02 × 1023 = 1.204 × 1024

4 a 28 g/mol
b 81 g/mol
c 84 g/mol
d 132 g/mol

5 72/18 = 4 moles

6 a 2 moles
b 4 moles of H_2 = 4 × 2 = 8 g.

Lesson 6: C3.6 – Amounts of substances in equations (HT and T only)

Connection

Q1. What mass of oxygen is in 1 mole of the gas?

Q2. What mass of oxygen would you have if you had 2 moles?

Q3. What is the relative molar mass M_r of $ZnCO_3$?

Activation

LI: How to calculate the masses of reactants and products from a balanced symbol equation

1. https://www.youtube.com/watch?v=TV6n5MFH6IU&t=1s
2. Make a note of the title and the LI
3. Read pages 108 – 109
4. List the key words
5. Write down the worked examples for each subheading: Masses of substance from an equation, Measuring the number of moles in different ways and Predicting masses

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Demonstration

Attempt questions 1-5
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C3.6 – Amounts of substances in equations (HT and T only)

Connection

Q1. O_2 = 2 x 16 = 32g

Q2. 2 moles of O_2 = 32g x 2 = 64g

Q3. Zn = 65   C = 12   O = 16 x 3

65 + 12 + 48 = 125 g/mol

Demonstration

1 Moles Mg = 6.0/24 = 0.25. 1:1 ratio.
So 0.25 × 40 = 10 g.

2 Moles MgO = 2.0/40 = 0.05. 1:1 ratio.
So 0.05 × 24 = 1.2 g.

3 Ratio C_3H_8:H_2O = 1:4. So 6:24. 24 moles H_2O.

4 Moles $ZnCO_3$ = 1.25/125 = 0.01. 1:1 ratio.
So mass ZnO = 0.01 × 81 = 0.81 g.

5 Moles CuO = 7.95/79.5 = 0.1. 1:1 ratio.
So mass $CuCO_3$ = 0.1 × 123.5 = 12.35 g.

Lesson 7 C3.7 – Using moles to balance equations (T only)

Connection

Q1. Balance the following equation:

$C_2H_6 + O_2 \longrightarrow CO_2 + H_2O$

Q2. How many grams of carbon dioxide are produced for every **1 mole** of ethane burned?

Activation

LI: Use the molar ratios of reactants and products to balance an equation

1. https://www.youtube.com/watch?v=4wTSLBBBMo0
2. Make a note of the title and the LI
3. Read pages 110-111
4. List the key words
5. Write down the worked examples from the book

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Demonstration

Attempt questions 1-3
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C3.7 – Using moles to balance equations

Connection

Q1. **2** C_2H_6 + **7** $O_2 \longrightarrow$ **4** CO_2 + **6** H_2O

Q2. M_r of carbon dioxide is 12 + (2x16) = 44g/mol

2 moles of ethane produces 4 moles of carbon dioxide, so 1 mole of ethane produces 2 moles of carbon dioxide. 1 mole of CO_2 has a mass of 44g so 2 moles has a mass of 88g.

Demonstration

1 "Tonne" moles $MgCO_3$ = 84/84 = 1. 1:1 ratio. So mass of MgO = 1 × 40 = 40 tonnes.

2 Moles Al_2O_3 = 204/102 = 2.
Moles Al = 108/27 = 4

3 By conservation of mass, mass of O_2 = 204 – 108 = 96 g.
Moles O_2 = 96/32 = 3. Moles Al_2O_3 = 2. Moles Al = 4.
$2\ Al_2O_3 \rightarrow 4\ Al + 3\ O_2$

Lesson 8: C3.8 – Concentration of solutions

Connection

Q1. What is the state symbol for an aqueous solution?

Q2. What is the relative formula mass (M_r) for ethane C_2H_6 ?

Activation

•LI: Explain how we can relate mass, volume and concentration to calculate the mass of solute in solution

1. https://www.youtube.com/watch?v=kJBbu7_vYC8
2. Make a note of the title and the LI
3. Read pages 112-113
4. List the key words
5. Write down the units used in calculations and the worked examples
6. Make a highlighted note that 1 dm^3 = 1000cm^3 = 1000ml = 1 litre

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Demonstration

Attempt questions 1-10
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C3.8 – Concentration of solutions

Connection

Q1. (aq)

Q2. A_r for C – 12 for H – 1

(2 x 12) + (6 x 1) = 30g/mol

Demonstration

1 a) 200 g/dm^3
b) 20 g/dm^3
c) 160 g/dm^3
So b, c, a..

2 a) 32 g/dm^3 b) 12.8 g/dm^3 c) 12.8 g/dm^3

3 4.2 × (250/1000) = 1.05 g

4 5.4 × (35/100) = 1.89 g

5 1/2 = 0.5 dm^3

6 0.18/0.6 = 0.3 mol/dm^3

7 Moles = (500/1000) × 3 = 1.5

8 4.90/98 = 0.05 moles H_2SO_4
Concentration = 0.05 × (1000/200) = 0.25 mol/dm^3

9 a 0.0250 × (1000/125) = 0.200 mol/dm^3
b 0.200 × 63 = 12.6 g/dm^3

10 a 8.25/36.5 = 0.5 mol/dm^3
b 0.500 × 6.02 × 1023 = 3.01 × 1023

Lesson 9: C3.9 – Key concept: Percentage yield

Connection

Q1. How do you calculate 0.8 as a percentage?

Q2. If a pupil scored 35/50 in a test, what was their percentage score?

Q3. What is 72% of 1000?

Activation

LI: How to calculate the percentage yield from the actual yield and (HT + T) calculate theoretical product amounts from reactant amounts.

1. https://www.youtube.com/watch?v=hnawBsyZTc8
2. Make a note of the title and the LI
3. Read pages 114-115
4. Explain the reasons we get less products from chemical reactions than we would expect if they were 100%
5. Explain how we calculate percentage yield
6. Explain how we calculate theoretical yield (HT +T)

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C3.9 – Percentage yield

Connection

Q1. 0.8 x 100 = 80%

Q2. 35 ÷ 50 x 100 = 70%

Q3. 72 ÷ 100 = 0.72

0.72 x 1000 = 720

Demonstration

1 Loss in filtration; loss due to evaporation; loss in transferring liquids
2 30%
3 60%
4 63g
5 85%
6 **a** 35.5g
b 18.2g

Lesson 10: C3.10 – Atom economy (TRIPLE)

Connection

Q1. A chemical reaction gave us 26.4g of product when the theoretical yield was 35.2g. Calculate the percentage yield achieved.

Q2. The thermal decomposition of calcium carbonate yields calcium oxide. Calculate the theoretical yield for this reaction if we started with 50g of calcium carbonate.

$CaCO_3 \longrightarrow CaO + CO_2$

Activation

LI: Calculate the atom economy of a reaction to form a product and explain why a particular reaction pathway is chosen.

1. https://www.youtube.com/watch?v=h1-Vj6eh-mM
2. Make a note of the title and the LI
3. Read pages 116-117
4. Define the term "atom economy"
5. Explain how to calculate the atom economy for a chemical reaction
6. Consider the reasons why we might choose one chemical pathway over another

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C3.10 – Atom economy (TRIPLE)

Connection

Q1. 26.4 ÷ 35.2 x 100 = 75%

Q2. M_r for $CaCO_3$ is 100 so 50g is 0.5 of a mole of $CaCO_3$

1 mole of $CaCO_3$ produces 1 mole of CaO

M_r for CaO is 56 so 0.5 of a mole is 28g

So the theoretical yield of CaO from 50g of $CaCO_3$ is 28g

Demonstration

1 100 % (only one product)
2 b) Greater than 0 but less than 100 %
3 Method 1: (568/676) × 100 = 84 %
Method 2: (568/624) × 100 = 91 %
4 If there were 2 products and only 1 was the desired product, it could have an atom economy of 64 %. If both products were desired, then it has a 100 % atom economy.
5 The production of SO_2 is a by-product of burning coal. The atom economy is 100 % since there is only one product. This would suggest that there is no waste. However, SO_2 is a pollutant, forming acid rain in the presence of water.
6 Atom economy of the Haber process is 100 % since ammonia is the only product. For the ammonium chloride reaction, the atom economy is 19 %. The Haber process is more sustainable if atom economy is considered. However, there are other factors. For instance, if all the products were desirable for the ammonium chloride process then its atom economy would also be 100 %. Also, the following need to be taken into account: amount of energy consumed to make ammonia, whether the raw materials are finite and non-renewable and whether the process is polluting.

Lesson 11: C3.11 – Using concentrations of solutions (TRIPLE)

Connection

Q1. Why do we care about the atom economy of industrial reactions?

Q2. Why when we carry out school lab reactions not generally interested in atom economy?

Q3. How many cm^3 are there in $1dm^3$?

Activation

• **LI: Describe how to carry out titrations and calculate the concentrations in titrations in mol/dm^3 and in g/dm^3**

1. https://www.youtube.com/watch?v=3G3KQIyoZDI
2. Then watch https://www.youtube.com/watch?v=xsma3KjKPx8
3. and https://www.youtube.com/watch?v=Z93_atEmxNI
4. Make a note of the title and the LI
5. Read pages 118-119
6. List the key words
7. Write down the steps in a titration and draw how to read a burette
8. Describe how we calculate the unknown concentration of the solution after titration

Demonstration

Attempt questions 1-5
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C3.11 – Using concentrations of solutions (TRIPLE)

Connection

Q1. A poor atom economy is wasteful of expensive reactants and the cost of dealing with waste by-products in terms of money and environmental costs. Costs from transport of reactants or waste or their safe treatment add to costs.

Q2. The quantities of products made in labs is small and the costs are therefore less important than convenience.

Q3. 1000cm^3 in 1dm^3

Demonstration

1 To the bottom of the curve (meniscus). 42.5 cm^3

2 Pipette delivers a fixed volume. The burette delivers a variable volume.

3 Because it is used to give a rough idea of the end point. It is not meant to be accurate.

4 26.8 / 26.9 / 26.7. Average titre = 26.8 cm^3

5 Moles hydrochloric acid = (23.8/1000) × 0.11 = 0.002618.
Ratio HCl:NaOH = 1:1.
Concentration NaOH = 0.002618 × (1000/25) = 0.105 ml/dm^3

Lesson 12: C3.12 – Amounts of substance in volumes of gases (TRIPLE)

Connection

Q1. It took 37.5cm3 of 0.5M HCl to neutralise 25cm3 of an unknown concentration of NaOH. Calculate the concentration of the alkali solution.

Activation

LI: Explain that the same amount of any gas occupies the same volume at room temperature and pressure (rtp) and calculate the volume of a gas at rtp from its mass and relative formula mass

1. https://www.youtube.com/watch?v=Qn5CgfokdWkand this https://www.youtube.com/watch?v=tYE-1nywlFs
2. Make a note of the title and the LI and read pages 120-121
3. Explain how for a given volume of a gas it will have the same number of particles as any other type of gas, but may have a different mass due to the chemical composition of the gas particles themselves
4. State the volume of a mole of gas at rtp and how we can use this in calculations

Demonstration

Attempt questions 1-8
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C3.12 – Amounts of substance in volumes of gases (TRIPLE)

Connection

Q1. Number of moles of acid titrated:

37.5cm^3 ÷ 1000 = 0.0375dm^3

0.0375dm^3 x 0.5M = 0.01875 moles

Volume of alkali:

25cm^3 ÷ 1000 = 0.025dm^3

Using the following equation:

amount of moles = concentration x volume

Concentration of alkali = amount of moles of acid ÷ volume of alkali

Conc. of alkali = 0.01875 ÷ 0.025

= 0.75M

Demonstration

1 44 g

2 (8.8/44) × 24 = 4.8 dm^3

3 Moles NO_2 = 46/46 = 1.
Moles Kr = 84/84 = 1.
1 mole (molecular/formula mass) of any gas occupies 24 dm^3 at rtp.

4 1.5 × 24 = 36 dm^3

5 Moles N_2 = 7/28 = 0.25. Volume = 0.25 × 24 = 6 dm^3

6 Ratio C_3H_8 : H_2O = 1:4. Therefore 1.5:6 dm^3. So 6 dm^3 of H_2O is produced.

7 $C_5H_{12} + 8\ O_2 \rightarrow 5\ CO_2 + 6\ H_2O$
Ratio C_5H_{12} : CO_2 = 1:5. So for 2 dm^3 of C_5H_{12}, 10 dm^3 of CO_2 is formed.

8 Moles N_2 = 42/28 = 1.5. So 4.5 moles H_2 needed
(1:3 ratio). Volume = 4.5 × 24 = 108 dm^3.

Lesson 13: C3.13 – Key concept: Amounts in chemistry

Connection

Q1. State the law of conservation of mass in chemical reactions.

Q2. What is the volume taken up by:
1 mole of gas at rtp?
0.1 mole of a gas at rtp?
1 mole of gas at rtp in cm^3?

Activation

LI: Describe how to calculate formula mass, (HT+T) how this relates to moles and (T) quantities of substances

1. https://www.youtube.com/watch?v=kMak1TQ3YgU
2. Make a note of the title and the LI
3. Read pages 122-123
4. Draw diagrams which explain how you calculate formula mass
5. Describe what a mole is and how a molar mass is calculated from this
6. Describe, with examples of how we use moles in calculations involving titrations and gases

Demonstration

Attempt questions 1-8
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C3 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: C3.13 – Key concept: Amounts in chemistry

Connection

Q1. No matter is created or destroyed in a chemical reaction.

Q2. 24 dm^3
2.4dm^3
24,000cm^3

Demonstration

1 24 + 32 + (4 × 16) = 120
2 a 40 + ((14 + (3 × 16)) × 2) = 164
b (2 × 27) + ((32 + (4 ×16)) × 3) = 342
3 40 g/mol
4 2 × 6.02 × 1023 = 1.024 × 1024
5 Mass NaOH = 0.5 × 40 = 20 g
6 Moles H_2 = 4/2 = 2. 1 mole of any gas occupies 24 dm^3 at rtp. So 2 × 24 = 48 dm^3
7 Moles $ZnCO_3$ = 6.25/125 = 0.05. Moles ZnO = 0.05 since 1:1 ratio.
So mass ZnO = 0.05 × 81 = 4.05 g.
8 Moles C_3H_8 = 660/44 = 15. Moles CO_2 produced = 15 × 3 = 45 (1:3 ratio).
Mass CO_2 = 45 × 44 = 1,980 g.

P3 - Revision

Connection

Q1. State the relative atomic masses of an atom of Ca , C and O from the periodic table.
Q2. Calculate the relative formula mass of $CaCO_3$.
Q3. What mass is 0.25 moles of calcium carbonate?
Q4. What volume of CO_2 is given off if 0.25 moles of calcium carbonate are thermally decomposed?

$CaCO_3 \longrightarrow CaO + CO_2$

Activation

LI: Create a topic summary sheet

1. Fold an A3 sheet so it is divided into 8 sections
2. Look back over your lessons and group them into 8 main headings
3. Summarise the key points into each section, use keywords and diagrams and symbols rather than sentences

Demonstration

Test yourself by working with the person sitting next to you by talking though each box on your summary sheet and seeing how many key facts you can remember.

Consolidation

Look though the relevant past paper questions for this topic - From the C3 DIP file – see if you can complete any additional questions

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Connection Answers

1 Ca – 40 C – 12 O - 16

2 $CaCO_3$ Ca – 40 + C – 12 + 3 x O – 16 (48) = 100

3 100 x 0.25 = 25g

4 $24dm^3$ x 0.25 = $6dm^3$

C3 DART – The mole

Textbooks need an update after mole's definition changed

Although little will change in practice, Iupac's new definition of a mole has gained support from (almost) all sides

'A mole contains as many elementary entities as there are atoms in 12g of carbon-12' is what many chemists – and schoolchildren – would say when asked to define a mole. But this textbook definition is now set to be rewritten by the International Union of Pure and Applied Chemistry (Iupac).

Iupac's new definition relies solely on a fixed value of the Avogadro constant (named after Amadeo Avogadro) and describes the mole as containing exactly $6.02214076 \times 10^{23}$ elementary entities. The redefinition is part of efforts to modernise the international system of units (SI). The driving force for the change was to break the link between the kilogram artefact and the unit that it defines.

'It became clear during the international survey we did that many people did not like the current definition of the mole,' says Juris Meija from the National Research Council Canada and part of Iupac's mole task group. 'The previous definition has an indirect logic in that the mole is defined as having as many entities as there are in a specified mass of something else. The new definition simply cuts to the chase with its clear logic.'

In practice, however, the redefinition will have little impact. 'Currently, there is absolutely no technological benefit that the new definition provides,' says Meija. Although fixing the Avogadro constant could theoretically have impacts on high precision measurements, Meija explains that 'we are currently at least four orders of magnitude away from being able to take advantage of [this]'.

Those working in education welcome the change. 'The new definition is well aligned with what students already use in practice,' says chemistry education researcher Marcy Towns from Purdue University, US, also a member of Iupac's task group. 'It's not going to have a big impact on what people do in the classroom,' she says. 'Although of course textbooks have to change.'

However, some critical voices question the new definition's practicality. In a letter to Iupac, the French Committee for Chemistry wrote that by disconnecting the definition from a measurable mass, the mole's definition is too far removed from what is done in practice. After all, substances are weighed to determine the amount of moles contained within, they argue.

Article from chemistryworld.com

https://www.chemistryworld.com/news/textbooks-need-an-update-after-moles-definition-changed/3008537.article

Reference:

Questions

1a. How many particles does 1 mole contain?
b. What was the name of the scientist who came up with this number
c. What quantity is needed to determine the number of moles in a substance.

2a. Explain the difference between the old and new definition of the mole
b. Explain the implications of redefining the mole
c. Explain the impact on education of the new definition.

3a. Evaluate the usefulness of the new definition for the mole
b. A student said "the Avogadro number is too big" do you agree with her? Explain why.
c. What is your opinion of using a mole to measure amount of substances? What changes if any, would you make?

DART C3 The Mole: Answers

Answers

1a. $6.02214076 \times 10^{23}$ 1b. Amadeo Avogadro 1c. The mass of the substance and its molar mass

2a. From the text: ‘A mole contains as many elementary entities as there are atoms in 12g of carbon-12’

“Iupac’s new definition relies solely on a fixed value of the Avogadro constant (named after Amadeo Avogadro) and describes the mole as containing exactly $6.02214076 \times 10^{23}$ elementary entities.”

The first quote gives the old definition and the second gives the new definition by IUPAC. The main difference can be explained by using the following from the text:

‘The previous definition has an indirect logic in that the mole is defined as having as many entities as there are in a specified mass of something else. The new definition simply cuts to the chase with its clear logic.’

2b. From the text: “Although fixing the Avogadro constant could theoretically have impacts on high precision measurements, Meija explains that ‘we are currently at least four orders of magnitude away from being able to take advantage of [this]”

From this we can gather that the implications of the redefinition are minimal. This is because despite it theoretically having an impact on high precision measurements, at the present time, this is not something that we are able to do.

2c. From the text: ‘The new definition is well aligned with what students already use in practice,’ says chemistry education researcher Marcy Towns from Purdue University, US, also a member of Iupac’s task group. ‘It’s not going to have a big impact on what people do in the classroom,’ she says. ‘Although of course textbooks have to change.’

it will not have a big impact on the classroom as it is similar to what students presently use. The only major change will be that textbooks will need to be edited.

3a. The new definition of the mole provides a more precise method of using the Avogadro number without having to use it in the context of a specified mass of something else (atoms in 12g of Carbon-12). Logistically however, the redefinition means that textbooks will have to be changed which will provide challenges for teachers and schools.

3b. The size of the Avogadro number does present a few challenges when using it due to its enormous size. These challenges however, are minor when compared to its usefulness.

3c. Any logical opinion would be acceptable. Credit can be given to answers who propose a logical alternative to using moles. An example could be using mass or volume to measure the amount of a substance. More detailed answers may include why using moles is better than mass eg reacting masses in equations.

Attainment Band :	P3 Particle model of matter (AQA)
	Knowledge and Understanding
Yellow Plus/ Yellow	Link the particle model for solids, liquids and gases with density values in terms of the arrangements of the atoms or molecules. Explain how changes of state conserve mass. Explain that internal energy is the total kinetic energy and potential energy of all the particles that make up a system. Use the specific heat capacity equation to calculate mass, specific heat capacity or temperature change. Use the particle model to explain why the latent heat of vaporisation is much larger than the latent heat of fusion. Describe that the temperature of a gas is related to the average kinetic energy of the molecules.
Blue	Use particle diagrams to communicate ideas about relative densities of different states. Use the density equation to calculate mass and volume. State that mass is conserved when substances change state. Explain that changes of state are physical, not chemical, changes because the material recovers its original properties if the change is reversed. Describe that heating raises the temperature or changes the state of a system but not at the same time. Use the specific heat capacity equation to calculate the energy required to change the temperature of a certain mass of a substance. Describe the latent heats of fusion and of vaporisation. Use the equation $E = mL$ Use the particle model to explain the effect on temperature of increasing the pressure of a gas at constant volume.
Green	Use density = mass/volume to calculate density. Describe changes of state as physical changes. Describe how heating raises the temperature of a system. Describe the effect of an increase in temperature on the motion of the particles. State that when an object changes state there is no change in temperature. State that in the particle model the higher the temperature the faster the molecules move.
White	Some elements of the above have been achieved