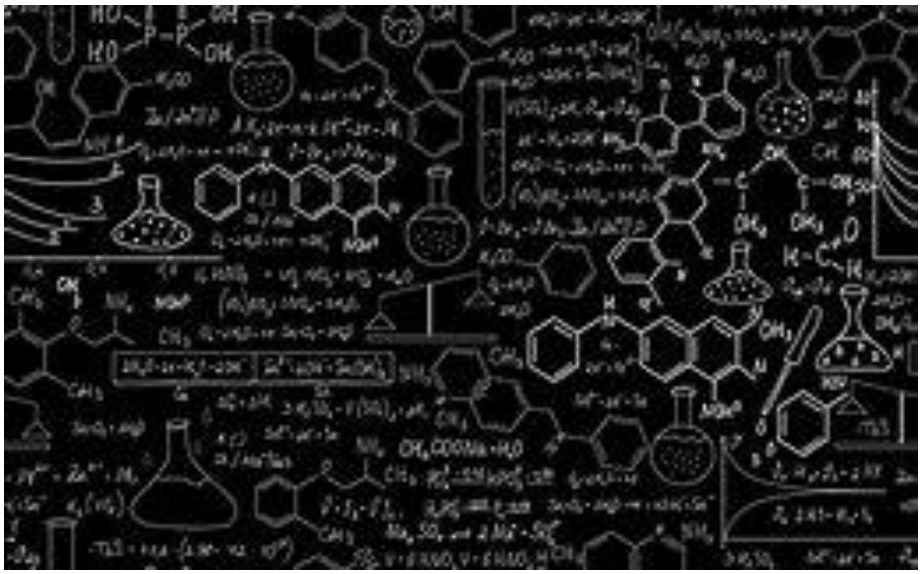
Chemistry post -16 induction task



Name _____

GCSE Chemistry/Science grade ____
GCSE Maths grade ____

What is the subject about?
Chemistry is the study of how the elements and their compounds behave. It overlaps with Physics and Biology as chemical principles underpin the physical environment in which we live, as well as all biological systems. In this course you will develop essential knowledge and understanding of fundamental chemical concepts, as well as a variety of areas of chemistry, and you will get to grips with how these relate to each other. You will also develop a deeper appreciation of how chemistry plays a major role in providing the comfortable modern lifestyle we appreciate and how it contributes to the success of the economy and to society more broadly.

What can the course lead to in terms of higher education and future careers?
This course is an excellent foundation (and indeed essential) for further study of chemistry, chemical engineering, medicine, veterinary science, dentistry, physiotherapy and related subjects such as pharmacy, pharmacology and biomedical sciences. It is also highly recommended for other sciences. This course also provides a valuable education if you take chemistry no further but wish to pursue a career in, for example, finance, publishing, patent law.

What are the formal entry requirements for this course?
A level Chemistry is both a theory and practical based course that is assessed by exams and builds directly on GCSE work in Chemistry and Maths. National evidence suggests it is difficult to succeed unless you have an appropriate base of knowledge and a good track-record of success in exam based courses at GCSE. A level 6 in science and or chemistry as well as a level 6 in mathematics is essential.

Why should I consider taking an A level in Chemistry?
It will enable you to develop a wide range of transferable skills. It will also help develop your interest and enthusiasm for chemistry, including developing your interest in further study and careers in chemistry. It will help you appreciate how society makes decisions about scientific issues and how the sciences contribute to the success of the economy and society. Chemistry has a great capacity to solve many of the global challenges that society faces in the 21st Century, including energy, food, climate change and health care. A new generation of chemists and scientists will be involved in tackling these global challenges. If you want to enhance your understanding and be in a position to make a difference, then Chemistry is for you.

Course prerequisite:
In order to ensure you have the required academic ability and work ethos required to succeed on the A-level chemistry course you must complete the tasks below and bring your completed answers to the first chemistry lesson in September.

The way you study should change in Year 12, both in terms of the amount of independent study you do for each subject and the strategies you use/develop when studying – if it doesn't you are likely to be at risk of underperforming! You MUST keep on top of the workload from the start making regular summaries along the way and not leave revision until the end of year before the exams.

To show a positive attitude to learning in completing the following tasks you MUST:

- <u>avoid leaving gaps</u> - a big difference from GCSE to AS Level is how YOU take ownership for your learning. If you find a question difficult or challenging YOU must take action by researching the topic to help overcome any misunderstanding.

- <u>be thorough</u> – avoid cutting corners e.g. you MUST show full working in any calculations, never just give the final answer; write in full sentences so your work is meaningful during times of revision.

- <u>be independent</u> – there is a place for 'peer learning' but this can also limit your progress if you become too reliant on others to explain how to approach a question or regularly complete tasks working together. Make sure you try to overcome any barriers yourself first by being resourceful and carrying our further reading on difficult topics, then use your peers to check if you reached the same answer.

- <u>prepare for lessons</u> – arrive to lessons ready to submit any work due in and refresh your memory of the work covered in the previous lesson by reading through your notes and possibly re-attempting one or two questions/tasks.

Amount of substance

Introduction

Often learners have very different levels of understanding when it comes to chemical calculations and the mole. This activity will probe your understanding of the words used to describe chemical quantities and amounts, and how they relate to the symbols (balanced equations), calculations and observations that happen in chemical reactions. You may find that your ideas change and evolve as you discuss the activity, so don't be concerned if you find some of the concepts difficult.

Task 1

Read through each of the ten statements below. With a partner or in a small group, discuss whether you think each statement is true or false and make a note of your answers.

1. The total number and type of atoms present are the same at the start and end of a reaction.

2. The amount of substance, measured in moles, is the same at the start and end of a reaction.

3. The total mass of reactants is equal to the total mass of products for any reaction.

4. The total volume of gas is the same at the start and the end of a reaction.

5. The amount in moles is proportional to the number of particles for that substance.

6. One mole of methane molecules (CH_4) contains 1/5 mole of carbon atoms and 4/5 mole of hydrogen atoms.

7. One mole of methane molecules (CH_4) contains 1 mole of carbon atoms and 4 moles of hydrogen atoms.

8. 100 cm^3 of methane gas contains the same number of molecules as 100 cm^3 hydrogen gas at room temperature and pressure.

9. 100 cm^3 of methane gas at room temperature and pressure has the same mass as 100 cm^3 of hydrogen gas under the same conditions.

10. If 0.1 mol of magnesium atoms reacts with a solution containing 0.1 mol of hydrochloric acid, 0.1 mol of hydrogen molecules will be produced. (Hint – you may need to look up or work out the balanced equation for this reaction.)

Task 2

Now for the difficult bit! For each of the statements you will need to justify your true/false answer with an explanation or example. If you have decided that a statement is true, try to give an explanation using the chemical concepts and definitions you know. If you have decided that a statement is false, you could find an example of a chemical process, reaction or balanced equation where it is not the case. You are free to look up information using whatever resources you have available to assist you with your explanations.

Bonding and structure

Introduction

In your study of Bonding and Structure at A Level, you will be building a lot on ideas that you have already covered previously. Because bonding is a complex subject that is often simplified at GCSE, many learners can have unclear ideas or misconceptions about the topic. This activity will encourage you to explore what you already understand about chemical bonding, and to identify those areas that you still struggle with or require refinement at A Level.

Task 1

Here are twenty statements about chemical bonding. Separate the statements into two piles – always true or usually true. It is more important to think carefully about each statement than to get to the end of the activity.

Task 2

For the statements that you think are not always true, try to think up some exceptions to the rule. You could use an equation or example element or compound to illustrate the ‘exception to the rule’. Feel free to consult textbooks or other resources to help you with this.

Statements for use in activity

A. The atoms of Group 2 elements have two electrons in their outer shell.	**B. Noble gases do not form any types of bonds because they have full outer shells.**
C. Ionic substances have higher melting points than covalent substances.	**D. Oppositely charged ions attract.**
E. Delocalised electrons are more stable than electrons in fixed atomic orbitals.	**F. Energy is released when ionic bonds form.**
G. In an ionic compound, ions are combined in proportions which balance out the electrical charges.	**H. Energy is needed to break covalent bonds.**
I. Energy is required to form positive ions from atoms.	**J. Energy is released when negative ions are formed from atoms.**

Statements for use in activity

K. Bonding within compounds is either ionic or covalent.	**L. Electrons shared between atoms (in molecular orbitals) are more stable than electrons in atomic orbitals.**
M. Electrons that are closer to the nucleus experience less shielding and are more strongly attracted than electrons further away.	**N. A covalent bond is formed from a shared pair of electrons; one electron comes from each atom within the bond.**
O. Compounds are more stable than elements.	**P. Elements always react to form ions with noble gas electron configurations.**
Q. Ionic compounds are formed when metals react with non-metals.	**R. Covalent compounds are formed when non-metals react with other non-metals.**
S. Hydrogen atoms form ions by losing one electron and becoming H^+.	**T. Within a covalent compound, all elements except hydrogen have eight electrons in their outer shells.**

Enthalpy changes

Exothermic reactions

1. Write a definition of an exothermic reaction.

2. Draw an enthalpy profile diagram for an exothermic reaction.

   Label the axes, ΔH and the activation energy.

3. Give an example of an exothermic reaction.

Endothermic reactions

4. Write a definition of an endothermic reaction.

5. Draw an enthalpy profile diagram for an endothermic reaction.

   Label the axes, ΔH and the activation energy.

6. Give an example of an endothermic reaction.

Bond enthalpy

7. Write a definition of bond enthalpy. (You might know this term as ‘bond energy’.)

8. In a chemical reaction, bonds in the reactants are broken, and new bonds are formed to make the products. Complete the following sentences.

   Energy is _____ to break bonds.

   Energy is _____ when bonds are formed.

   The overall energy change of a reaction is the

Calculations

Remember:

enthalpy change = energy required to break bonds – energy released in making bonds

or

$\Delta_r H$ = Σ(bond enthalpies in reactants) – Σ(bond enthalpies in products)

9. Use bond enthalpies to calculate the enthalpy change for the following reaction.

$H_2(g) + Br_2(g) \rightarrow 2HBr(g)$

Bond	H–H	Br–Br	H–Br
Bond enthalpy / kJ mol^{-1}	438	193	366

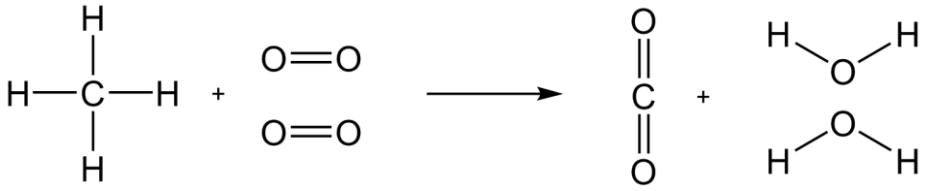
Energy required to break bonds:

Energy released in forming new bonds:

Enthalpy change:

10. Use bond enthalpies to calculate the enthalpy change for the combustion of methane.

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$



Bond	C–H	C–C	O–H	C=O	O=O
Bond enthalpy / kJ mol^{-1}	413	347	464	805	498

Energy required to break bonds:

Energy released in forming new bonds:

Enthalpy change:

11.

Bond	C–H	C–C	H–H	C=C
Bond enthalpy / kJ mol^{-1}	413	347	436	612

Use the bond energies above to calculate

a) the enthalpy change for the hydrogenation of ethene

$$H_2C{=}CH_2(g) + H_2(g) \rightarrow CH_3CH_3(g)$$

b) the enthalpy change for the cracking of decane

$$C_{10}H_{22}(g) \rightarrow H_2C{=}CH_2(g) + C_8H_{18}(g)$$

12. Explain in terms of bond breaking and bond formation why combustion reactions are exothermic but cracking reactions are endothermic.