

Year 10 Science Knowledge Booklet

Term 3

Name:

Class:

Year 11 Knowledge and Pillars Test Timetable and Workbook Deadlines

Homework 1	14/01/2025	
Homework 2	28/01/2025	
Homework 3	11/02/2025	





Science Homework 1

Complete the section of the homework workbook identified on the front of this Knowledge organiser and learn the key knowledge questions and answers in this knowledge organiser ready for the knowledge quiz.

C5 Energy Changes

Big questions:

Why do fires give out thermal energy?

How do we represent energy changes in reactions?

How can we calculate energy changes experimentally?

How can we predict energy changes in reactions?

Key vocabulary

Activation Energy	The minimum energy required to two particles to collide and successfully react. (i.e. the minimum energy needed to start a reaction).
Bond breaking	Energy is needed to break bonds.
Bond energy	The energy needed to break the bond between two atoms.
Bond making	Energy is released making bonds.
Catalyst	A substance that increases the rate of reaction by lowering the activation energy.
Endothermic reaction	A reaction that takes in energy from the surroundings. This means the temperature will decrease.
Energy level diagram / reaction profile	A sketch graph that shows the energy of the reactants and products, the activation energy and the overall energy change.
Exothermic reaction	A reaction that releases energy to the surroundings. This means the temperature will increase.
Overall energy change	The difference in energy between the reactants and products. An endothermic reaction has a positive overall energy change, an exothermic reaction has a negative overall energy change.

Why do fires give out thermal energy?

An **exothermic reaction** gives out energy (heat) to the surroundings. The temperature increases.

Examples of exothermic reactions are combustion (burning) and neutralisation.

An **endothermic reaction** takes in energy (heat) from the surroundings. The temperature decreases.

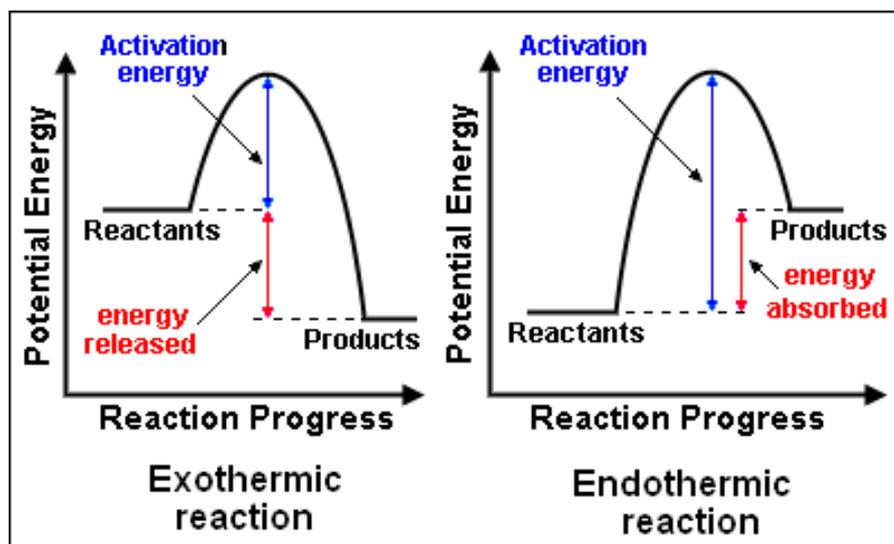
Examples of endothermic reactions are thermal decomposition and photosynthesis.

We can measure the temperature change during a reaction (final temperature – initial temperature) using a thermometer to determine if the reaction is exothermic (temperature increases) or endothermic (temperature decreases). Insulation is needed to reduce energy transfers to or from the surroundings.

How do we represent energy changes in reactions?

Energy profile diagrams can be used to show exothermic and endothermic reactions. You need to be able to label the reactants, products, activation energy and energy released/energy absorbed.

Activation energy is the minimum energy needed to start a reaction.

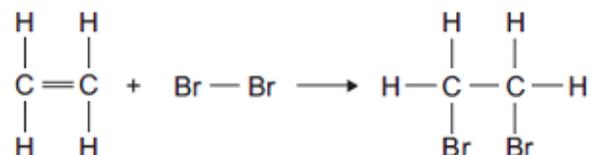


How can we calculate energy changes experimentally?

When an acid is added to an alkali drop by drop a neutralisation reaction takes place. The more acid that is added, the higher the temperature will be until the mixture is neutral i.e. equal amounts of acid and alkali (at the same concentration). When the acid is in excess, the temperature will decrease again.

How can we predict energy changes in reactions?

We can calculate the energy change for a reaction by calculating the energy needed to break bonds (Bond Breaking - BB) and the energy needed to make bonds (Bond Making - BM).



Count the number of each type of bond on the left hand side and multiple by the bond energy and add all the bond energies on the left hand side to calculate Bond Breaking - BB

Bond	Bond dissociation energy in kJ per mole
C—H	413
C=C	614
Br—Br	193
C—C	348
C—Br	276

Count the number of each type of bond on the right hand side and multiple by the bond energy and add all the bond energies on the right hand side to calculate Bond Making - BM

Calculate the Overall Energy Change = Bond Breaking – Bond Making

$$= \text{BB} - \text{BM}.$$



Science Homework 2

Complete the section of the homework workbook identified on the front and learn the key knowledge questions and answers for all of the areas covered in this knowledge organiser ready for the end of term test.

How to get the most out of your knowledge organiser:

- To get the most use out of the knowledge organisers you should be learning sections and then self-testing.
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Science Learning Tools and wider study:

The Oak Academy – Online Science lessons

BBC Bitesize science

You tube channels:

Fuse school

Ted talks

Free science lessons

Primrose Kitten

Key knowledge question	Answer
What is the definition of an exothermic reaction?	A chemical reaction where energy has been released to the surroundings
What is the definition of an endothermic reaction?	A chemical reaction where energy has been taken in from the surroundings
Is bond breaking exothermic or endothermic?	endothermic
What is the definition of temperature?	average kinetic energy of the particles
Draw an energy profile diagram of an exothermic reaction	energy of reactants higher than products
Define activation energy	the minimum energy required for a successful collision (or a chemical reaction) to take place
What is the overall energy change of a chemical reaction calculated?	bond breaking - bond making
How does adding a catalyst change an energy profile diagram?	lowers the activation energy
Is combustion is an exothermic or endothermic reaction?	exothermic
Name an endothermic reaction.	photosynthesis, thermal decomposition

P4 Atomic Structure

Big questions:

- What are atoms made of?
- How was the structure of the atom discovered?
- What is nuclear radiation?
- What are the properties of the nuclear radiations?
- How do we write decay equations?
- How long do sources stay radioactive?
- What is the difference between irradiation and contamination?

Key vocabulary

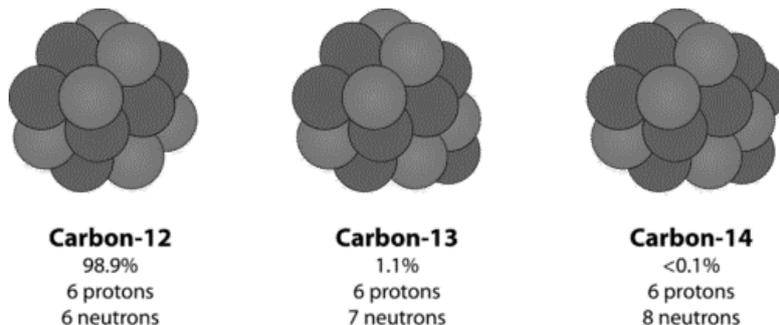
Alpha particle	A helium nucleus (two protons, two neutrons) emitted from some unstable nuclei during radioactive decay.
Alpha scattering experiment	An experiment carried out by Rutherford and others that showed that the atom has a nucleus.
Atomic structure	The atoms of an element are made of smaller, sub-atomic, particles. The number and arrangement of these particles is the atomic structure of the element.
Background radiation	Ionising radiation emitted by natural and man-made sources that is at a constant low level all over the Earth.
Beta particle	A fast moving electron emitted from the nucleus of some unstable nuclei during radioactive decay. Created by the decay of a neutron into a proton and electron.
Decay equation	A symbol equation representing the decay of a nucleus. Show the changes happening in the nucleus of radioactive isotopes.
Gamma ray	A photon (particle) of high energy electromagnetic radiation emitted from some unstable nuclei during radioactive decay.
Half Life	The time taken for one half of all remaining undecayed nuclei to decay. A measure of how long a sample will stay radioactive.
Ionising Radiation	Potentially harmful radiation emitted from the nucleus of an unstable isotope that can cause ionisation of other atoms.
Irradiation and contamination	Potentially harmful exposure to radiation either by radiation passing through (irradiation) or being in contact with radioactive material (contamination)
Isotope	Version of the same element with the same number of protons but different number of neutrons.
Radioactive decay	When an unstable isotope of an element undergoes a change in its nucleus and emits ionising radiation.

- **What are atoms made of?**

Atoms consist of a nucleus of protons and neutrons surrounded by electrons.

Isotopes of an element have the same number of **protons** and different number of **neutrons**. They have the same **Atomic number** and different **Mass number**.

Eg. Isotopes of carbon.



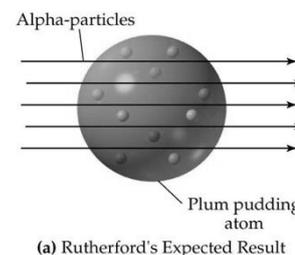
- **How was the structure of the atom discovered?**

Rutherford's alpha scattering experiment led to the modern model of the atom.

Thompson's plum pudding:

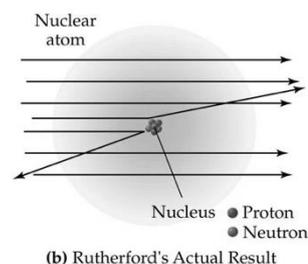
- Electrons scattered throughout.
- Positive charge spread everywhere.

Expect alpha particles to pass through mostly undeflected.



Rutherford's results:

- Many alpha particles pass through – must be lots of empty space.
- Some deflected through big angles – positive charge is in one place.



Rutherford concludes: nucleus in the centre, electrons on outside.

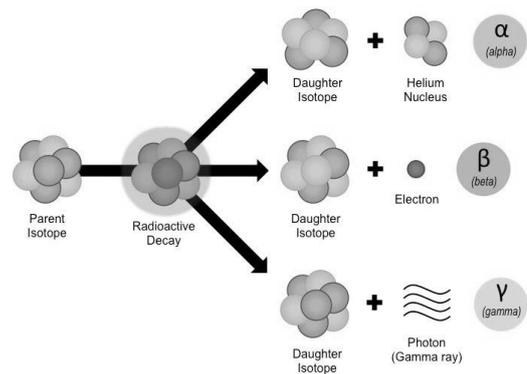
- **What is nuclear radiation?**

In **alpha decay** a nucleus loses two protons and two neutrons.

- Mass number down by 4
- Atomic number down by 2

In **beta decay** a neutron becomes a proton and an electron. The electron is emitted. It is the beta particle.

- Mass number stays the same
- Atomic number goes up by 1

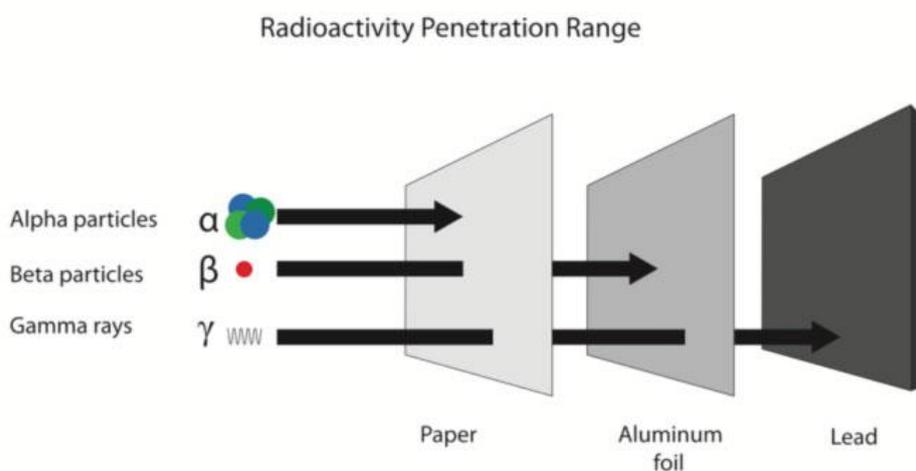


In **gamma decay** a photon of high energy electromagnetic radiation is emitted. The nucleus is unchanged.

- **What are the properties of the nuclear radiations?**

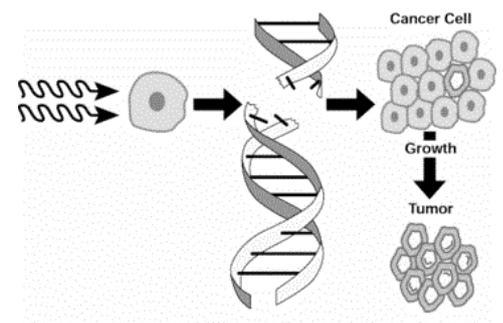
The penetrating power is a measure of how difficult it is to stop a radiation.

Alpha radiation has a low penetrating power. Beta is greater and gamma radiation is the most penetrating.

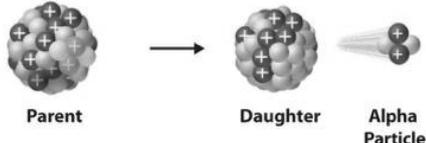
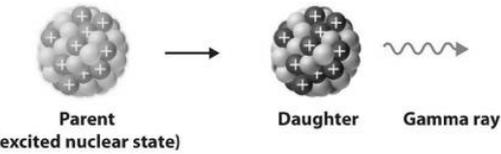


Nuclear radiations (alpha, beta, gamma) can cause **ionisation** (knock electrons out of other atoms).

This can damage human DNA and lead to cell damage or mutation that can lead to cancer.



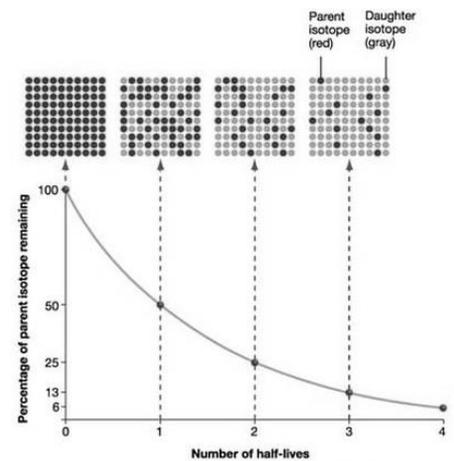
• How do we write decay equations?

Decay Type	Radiation Emitted	Generic Equation	Model
Alpha decay	${}^4_2\alpha$	${}^A_ZX \longrightarrow {}^{A-4}_{Z-2}X' + {}^4_2\alpha$	 <p>Parent → Daughter + Alpha Particle</p>
Beta decay	${}^0_{-1}\beta$	${}^A_ZX \longrightarrow {}^A_{Z+1}X' + {}^0_{-1}\beta$	 <p>Parent → Daughter + Beta Particle</p>
Gamma emission	${}^0_0\gamma$	${}^A_ZX^* \xrightarrow{\text{Relaxation}} {}^A_ZX' + {}^0_0\gamma$	 <p>Parent (excited nuclear state) → Daughter + Gamma ray</p>

• How long do sources stay radioactive?

Half life is: the time taken for the number of un-decayed atoms to fall by half. Equal to time for radioactive count to fall by half.

- Doesn't matter where you start counting – half life always the same.
- Half life for different isotopes very different.
- Half life useful for aging fossils and rocks – eg. carbon dating



• What is the difference between irradiation and contamination?

Contamination – you have a radioactive source material on you or in you.

Irradiation - ionising radiation strikes you or passes through you.



Science Homework 3

Complete the final section of the homework workbook identified on the front and learn the key knowledge questions and answers for all of the areas covered in this knowledge organiser ready for the end of term test.

Key knowledge question	Answer
Which model of the atom consists of a sphere of positive charge with electrons embedded inside?	Sphere (ball) of positive charge, (negative) electrons scattered throughout
Give two features of the Plum Pudding model of the atom	Positive charge concentrated in the centre (nucleus), (negative) electrons around the outside
Give two features of the Rutherford nuclear model of the atom	Orbitting the nucleus (in energy levels/shells)
Where are electrons found in the nuclear model of the atom?	${}^4_2\text{He}$ or a helium nucleus or 2 protons and 2 neutrons
Describe an alpha particle	${}^0_{-1}\text{e}$ or a fast moving/high energy electron
Describe a beta particle	${}^0_0\gamma$ or a high energy/frequency electromagnetic wave
Describe gamma	alpha, beta, gamma and neutron decay
State 3 type of nuclear radiation	the time taken for the activity to halve
Define half-life	contamination
What term means getting radioactive source on your skin, clothes or an object?	irradiation
What term means being exposed to the radiation emitted from a radioactive source?	mass number decreases by 4, atomic number decreases by 2
How do the mass number and atomic number change when a nucleus emits an alpha particle?	mass number stays the same, atomic number increases by 1

Wider reading

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