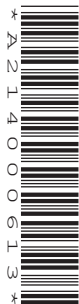


To be opened on receipt**GCSE TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A****A218/02** Unit 4: Ideas in Context (Higher Tier)**RESOURCE BOOKLET****JANUARY 2013****INSTRUCTIONS TO CANDIDATES**

- This booklet contains three articles.
- Take these articles away and read them through carefully.
- Spend some time looking up any technical terms or phrases you do not understand.
- For the examination on **Wednesday 9 January 2013** you will be given a fresh copy of these articles, together with a question paper.
- You will **not** be able to take your original copy into the examination with you.

INFORMATION FOR CANDIDATES

- This document consists of **8** pages. Any blank pages are indicated.

Help for patients with kidney failure

Within the human body, the blood is filtered by the kidneys. The kidneys play an important role in homeostasis. Waste urea is removed from the blood and other chemicals are balanced in the blood. Urea is harmful to the body if not removed. Water levels are balanced by producing dilute or concentrated urine as a response to the concentration of blood plasma. This process varies with a number of factors including external temperature, exercise level, and intake of fluids, salt and alcohol. This process is controlled by the hormone ADH.

Healthy kidneys can ...

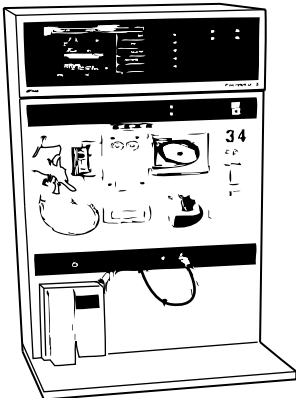
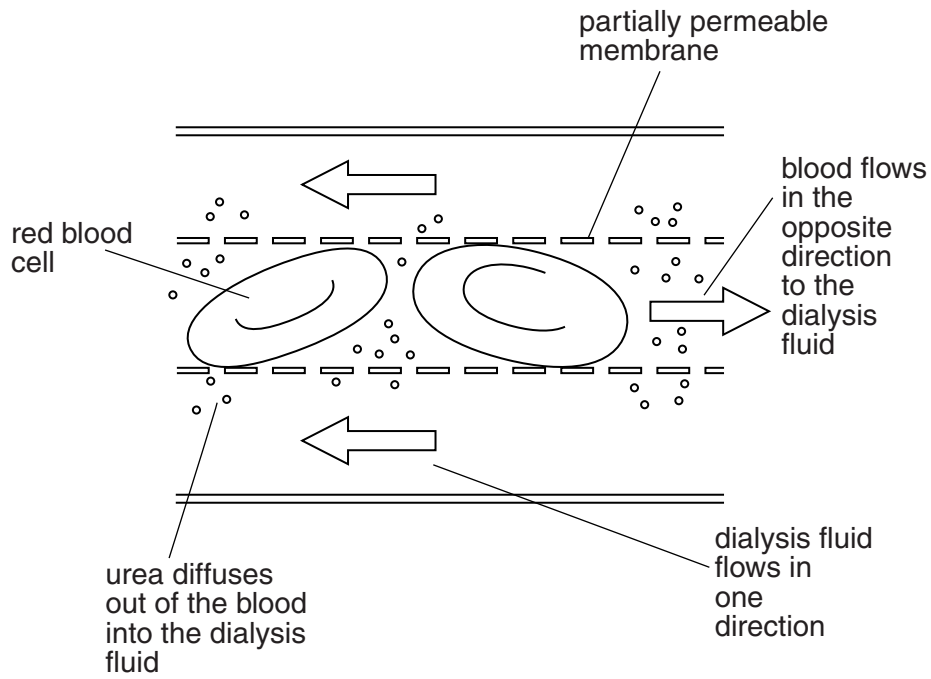
... filter small molecules and ions out of the blood (water, salt, sugar, urea).	✓
... reabsorb all the sugar back into the blood.	✓
... reabsorb as much salt as the body needs.	✓
... reabsorb as much water as the body needs.	✓
... excrete the remaining urine, which is stored in the bladder.	✓

The artificial kidney or dialysis machine is designed to act like a healthy kidney. It carries out the work of the kidney for patients with kidney failure. Without the machine, such patients can become very ill. Patients on dialysis are advised by their doctors not to drink alcohol because it affects the processes in the body that control urine production.

Read the information about what happens when a person is connected to a dialysis machine.

Life-saving dialysis

Dialysis works on the principle of the diffusion of molecules across a partially permeable membrane. Blood flows on one side of the partially permeable membrane, and dialysis fluid flows on the opposite side. Small molecules, like urea, sugar, water and salts can pass through the membrane. The red blood cells are too big to pass through the membrane and so they remain in the patient's blood. The blood flows in one direction and the dialysis fluid flows in the opposite direction. Constant replacement of the dialysis fluid means that the concentration of urea is kept very low on this side of the membrane. The 'cleansed' blood is returned via the circuit back to the patient's body.












Some more facts about dialysis

- The size of the UK population is 60 million.
- About 5000 patients a year in the UK develop chronic kidney failure.
- Each dialysis treatment may take 4 hours.
- The treatment sessions are often given 3 times per week but sometimes even 6 treatments are needed each week.

A time-line of scientific discoveries about light

The table shows some events that have helped scientists to understand the electromagnetic spectrum.

<p>1666</p>	<p>Isaac Newton observes what happens when white light passes through a prism. The light separates into different colours with red refracting least and violet refracting most. His letter explaining that different colours are refracted at different angles is published by the Royal Society in 1672.</p>	 <p>Isaac Newton (1643–1727)</p>
<p>1704</p>	<p>Isaac Newton puts forward a new theory of light in his publication 'Opticks'. He suggests that light might be made of particles.</p>	 <p>Christiaan Huygens (1629–1695)</p>
<p>1678</p>	<p>Christiaan Huygens first establishes his wave theory of light. He did not publish the theory until 1690. This theory can explain observations about light that Newton's theory could not. For example, light waves can pass through other light waves without being affected.</p>	 <p>Thomas Young (1773–1829)</p>
<p>1817</p>	<p>Thomas Young carries out many experiments on light. He discovers light interference patterns and suggests that light is a transverse wave, not a longitudinal wave.</p>	 <p>James Clerk Maxwell (1831–1879)</p>
<p>1861</p>	<p>James Clerk Maxwell produces the first colour photograph. He took the photograph through red, yellow and blue filters. He then recombined the images to give a single photograph.</p>	 <p>James Clerk Maxwell (1831–1879)</p>
<p>1865</p>	<p>James Clerk Maxwell uses mathematics to work out that electromagnetic waves travel at the speed of light. He doesn't believe this is a coincidence and concludes that light is a type of electromagnetic wave.</p>	 <p>James Clerk Maxwell (1831–1879)</p>

1888	Heinrich Hertz performs a series of experiments that support James Clerk Maxwell's conclusion that light is an electromagnetic wave. During the next 50 years many other types of electromagnetic radiation are discovered.	 <p>Heinrich Hertz (1857–1894)</p>
1900	Max Planck theorises that electromagnetic radiation is emitted in discrete packets of energy. He suggests that light is like both waves and particles. This is the start of theories now called 'quantum mechanics'.	 <p>Max Planck (1858–1947)</p>
1905	Albert Einstein publishes a paper presenting the idea that light radiation is made up of packets of energy, now called photons. Einstein also publishes a paper proposing the special theory of relativity in which the speed of all electromagnetic waves in a vacuum is always the same at 300 000 000 m/s for all observers.	 <p>Albert Einstein (1879–1955)</p>

Making useful salts

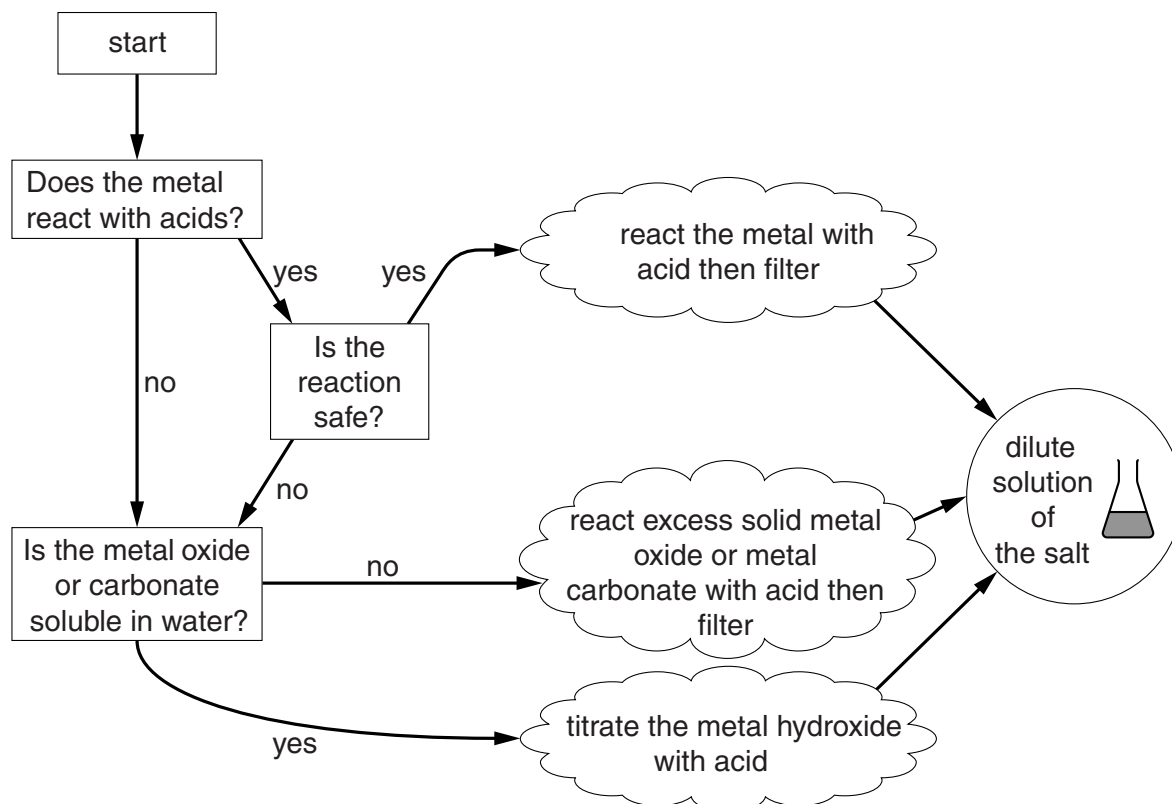
Salts are made on an industrial scale for a wide range of uses. The table shows information about some salts.

Name of salt	Uses	Parent acid
copper sulfate	fungicide	sulfuric acid
magnesium sulfate	medicines	sulfuric acid
sodium chloride	food additive	hydrochloric acid
sodium nitrate	fertilisers	nitric acid
calcium phosphate	washing powders	phosphoric acid

The 'parent acid' of a salt is the acid that is needed to make the salt, for example calcium phosphate is made using phosphoric acid. Common acids used in laboratories are nitric acid, hydrochloric acid and sulfuric acid.

Making salts

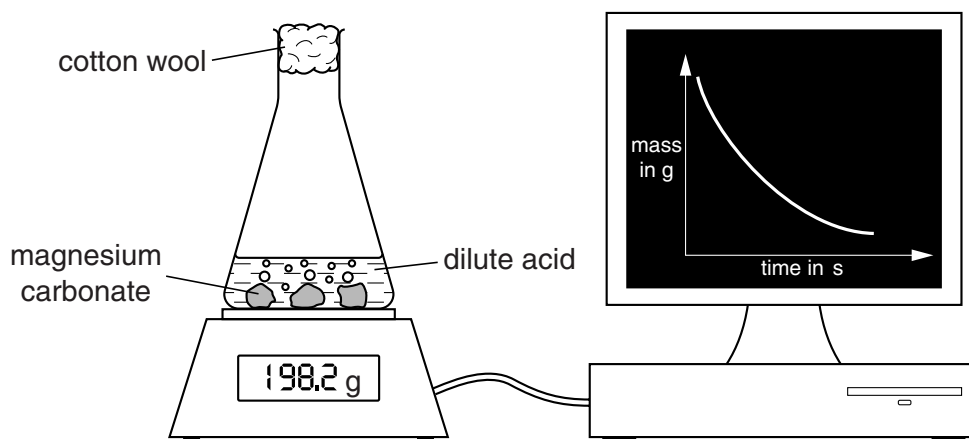
Chemists work in the chemical industry to find the best method to make salts. The chemists make salts on a small scale in the laboratory before thinking of ways to scale up the experiment so that it works on a factory scale. There are different starting chemicals that can be reacted with the parent acid to make the salt. The pure metal can sometimes be used. The metal cannot be used if it is too reactive. Instead, the chemists use the metal oxide, metal carbonate or metal hydroxide. The flow chart shows how to choose the best method for making a dilute solution of a particular salt.



Following the reaction

Chemists are interested in making salts as quickly as possible and also in getting the best yield possible. A fast process with a high yield will probably be the most profitable for the company. To find out about the rate of reaction and the yield, chemists use a range of methods of following the reaction.

For example, if a carbonate is being used to make the salt, the mass of the flask and its contents can be measured during the reaction. A data logger can collect the information and show the results on a graph. The results can be used to follow the rate of reaction during the experiment.



Another method of following the reaction can be used if a titration is being carried out. The pH of the reaction mixture can be measured so that the chemists can see when the solution is neutral.

Yield

At the end of the experiment, the crystals that are made can be dried in an oven or a desiccator and then weighed. The mass of the crystals can then be used to work out the percentage yield. Chemists work to adapt their experiments to get the highest yield possible.

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