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**GENERAL CERTIFICATE OF SECONDARY EDUCATION**

# TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

**A218/01/RB**

Unit 4: Ideas in Context (Foundation Tier)

**RESOURCE BOOKLET**

**JUNE 2011**

**To be opened on receipt**

*A217770611*

## 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 **Tuesday 7 June 2011** 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.


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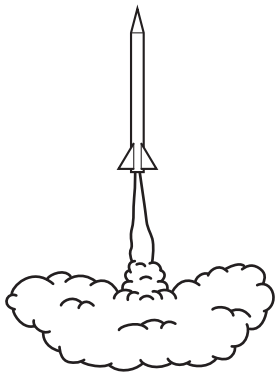
# Rocket science

Rocket science is not so hard. Many people around the world build and launch small and not so small rockets. It is a popular hobby.



To understand how rockets work you need to know about forces, momentum and energy.

There are three main forces involved in a rocket flight. These are the thrust, the weight of the rocket and air resistance.

| | |
|---|---|
| ⇧ | **Thrust**<br>This is the force produced by the rocket engine. It lifts the rocket off the ground and moves it upwards. It causes an increase in the momentum of the rocket. |
| ⇩ | **Weight**<br>The Earth's gravity pulls the rocket towards the ground. |
| ⇩ | **Air resistance**<br>This force is caused by moving through the air. The faster the rocket goes, the greater the air resistance. Air resistance always acts as a counter force to the motion. |

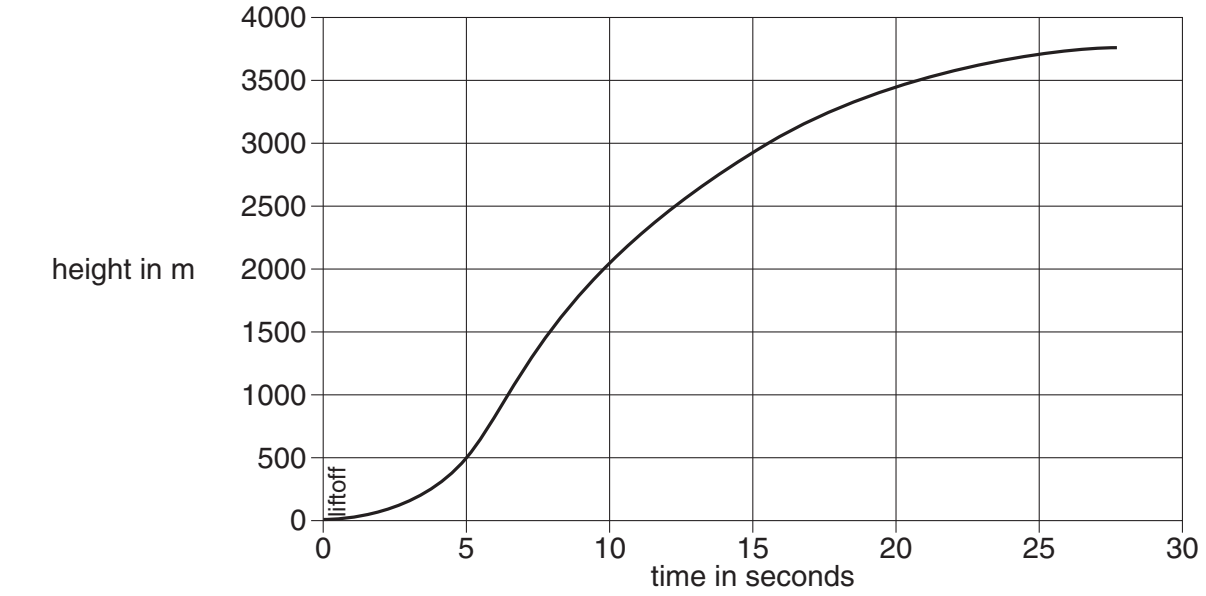
The rocket engine sends exhaust gases, from a burning fuel, out from the back of the rocket at a very high speed. This provides a force that causes the change in momentum of the rocket. As the fuel is burnt up, the mass of the rocket decreases. This makes the force more effective in changing the velocity of the rocket.

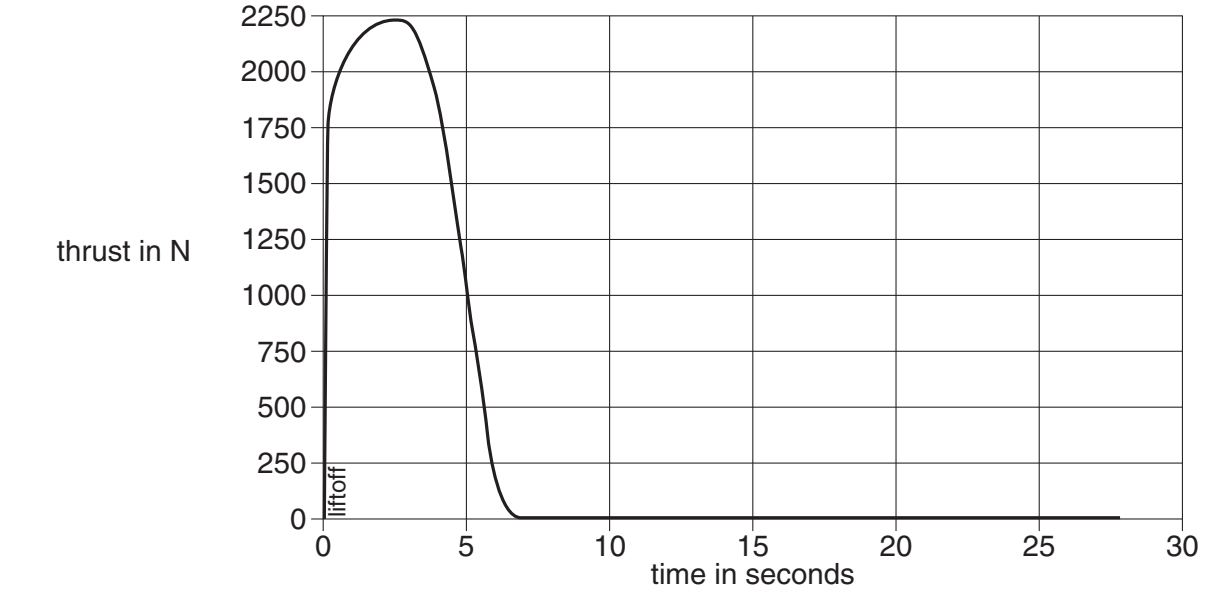
Another way of looking at what a rocket does is to think about the energy changes. The chemical energy of the rocket engine is used to propel the rocket upwards, which increases the gravitational potential energy of the rocket. As long as the rocket is moving, it also has kinetic energy. Some energy is lost from the rocket as it does work against air resistance.

The page opposite shows some graphs for the first part of a particular rocket flight.

They show how the height of this rocket changes with time, how the thrust changes with time and how the air resistance changes with time.

Before launching, the total weight of this rocket with fuel is about 90 N.


height in m
4000
3500
3000
2500
2000
1500
1000
500
0
liftoff
0
5
10
15
20
25
30
time in seconds


thrust in N
2250
2000
1750
1500
1250
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750
500
250
0
liftoff
0
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15
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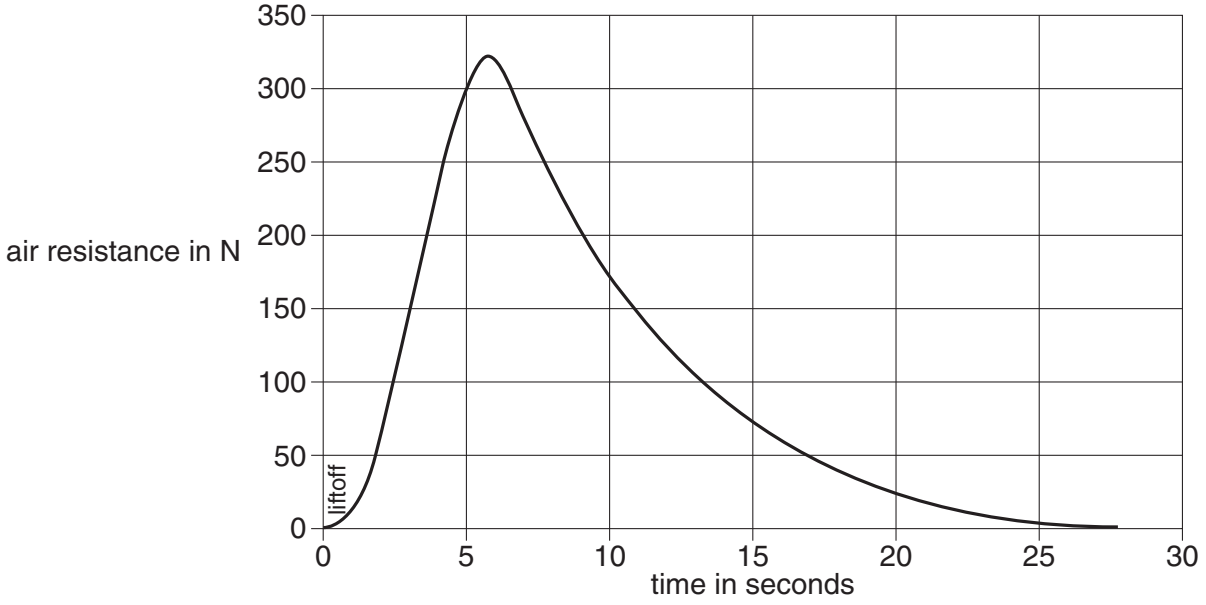
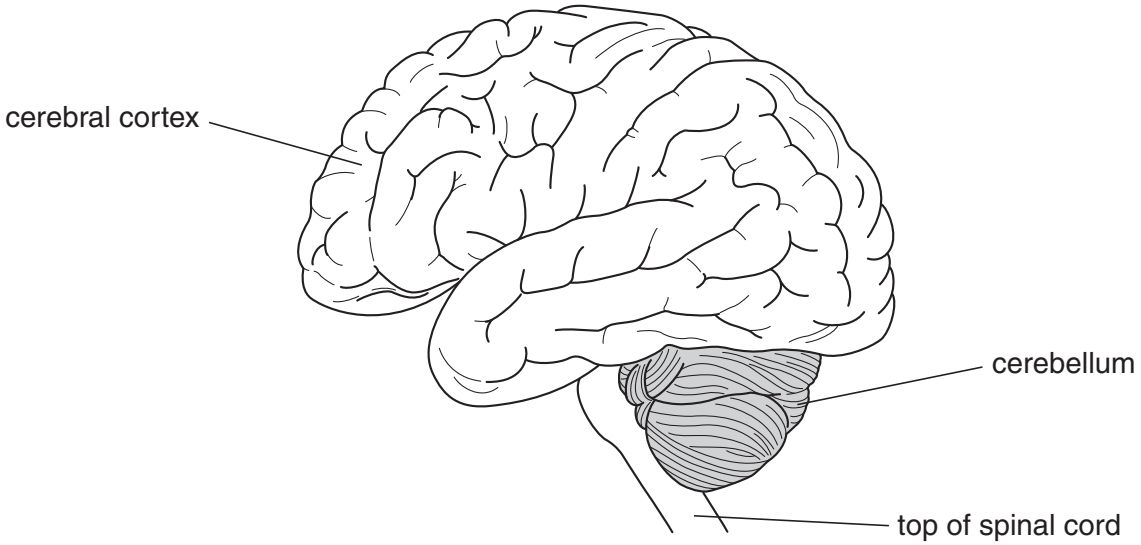
25
30
time in seconds


air resistance in N
350
300
250
200
150
100
50
0
liftoff
0
5
10
15
20
25
30
time in seconds

# Brain power – the frontier of medical research into ageing

**The human brain**




Humans have a central nervous system and a peripheral nervous system. Both systems contain nerve cells called neurons. The neurons in the peripheral nervous system carry impulses to and from the central nervous system.

The central nervous system has two major parts. One of these is the brain.

The brain contains the cerebral cortex and the cerebellum. They do different things

- the cerebral cortex is involved in intelligence, memory, language and consciousness
- the cerebellum regulates basic processes such as balance, heartbeat and breathing.

Researchers have found that these two areas change by different amounts as a person gets older

- the cerebral cortex undergoes many changes with age
- the cerebellum undergoes fewer changes with age.

The brain is made from billions of neurons. There are microscopic gaps between one neuron and the next. The brain neurons form pathways and may release the chemical serotonin.

When we learn a new skill some pathways become more likely to transmit impulses.

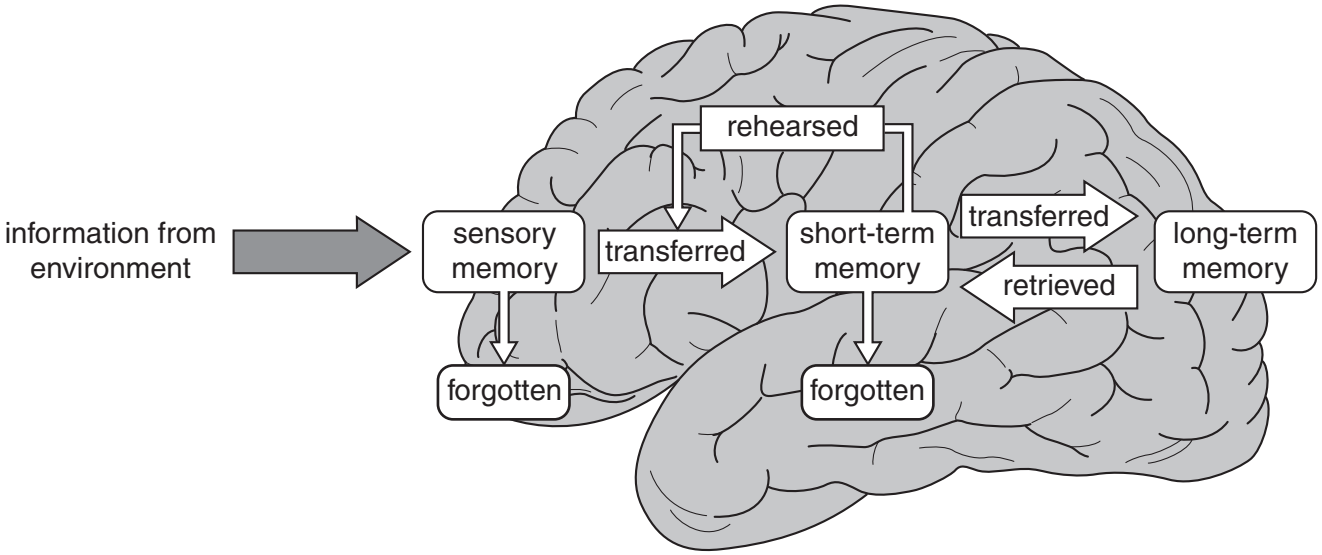
As people get older they find it harder to learn new skills and to create short-term memories. The neuron pathways in the brain do not seem to function as well as in younger people. This means that older people often lose the ability to refresh recently processed information.

Scientists have produced different models to explain how memory works. The models try to show how the brain processes information and how we remember things.

One type of brain model is called the **information processing model**. This model assumes that memory is created in a series of stages. We can rehearse information so that it becomes part of our short-term memory. Eventually, this information may become part of the long-term memory.

Sometimes information does not get transferred from one stage to the next. When this happens, a memory cannot form. We forget the information.

**The information processing model**




Bruce Yankner, a professor of neurology at Harvard Medical School in the USA, has investigated how human brains change as people get older. Professor Yankner and his research team studied brain tissue from thirty people.

They found evidence of increasing damage in the brains of older people. Brains of people who were 26 to 40 years old showed little damage. Brains of people who were 73 years old or older showed more damage. This damage reduces the number of neurons and also the number of neuron pathways. Some impulses can no longer be transmitted along the original neuron pathways.

When Professor Yankner studied brains of people between 40 and 70 years old he found that some brains had little damage, like younger people, and other brains had a lot of damage, like older people.

'In other words, people in their middle-age years show variable rates of brain ageing', says Professor Yankner.

# Copper – not just in mobile phones

Did you know that your mobile phone contains about 4 g of copper?

And not just that... the battery probably contains lithium and the casing is made from aluminium. Other metals such as iron and zinc are in the components inside. All of these metals are extracted from ores – some by heating with carbon, some by electrolysis. These metal ores are fast running out. The price of copper has rocketed up – in 2008, copper cost four times as much as it did five years earlier. Ores with lower and lower percentages of copper are being mined as the ores with more copper in them are running out.

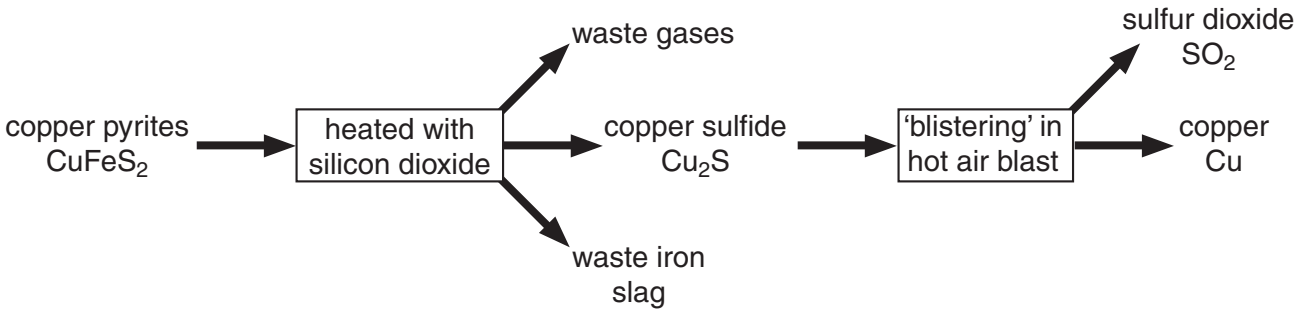
## Extracting copper

Copper ore is mined in huge, open cast mines. These create enormous holes (for example, Bingham Canyon Mine in the USA is so big, it can be clearly seen from space). Mining is very noisy and creates dust and traffic problems. Mining companies limit the hours that lorries can come to the site. They build banks of earth and plant trees around the mines. They use water hoses on the machinery to keep the dust down. Even so, mines are still not great places to look at from your bedroom window.

After mining, the ore is separated from the waste rock. The ore is processed to make copper. Two methods of making copper are the 'blister' process and the 'electrolysis' process. Both of these methods use large amounts of energy, but the energy inputs are used for different reasons.

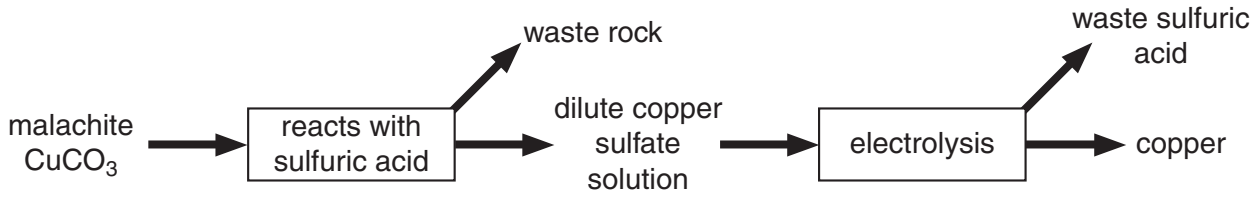
## The 'blister' process

This process is used for ores such as copper pyrites, $CuFeS_2$. Bubbles of sulfur dioxide gas escape, causing 'blisters' on the copper – this is why it is called the 'blister' process. The copper made is not very pure.



**The 'electrolysis' process**

This uses oxidised ores such as malachite, $CuCO_3$. The ore reacts with dilute sulfuric acid to form a solution of copper sulfate.




**Using copper**

So why does copper end up in your mobile phone? Well, after it has been purified, copper is an excellent electrical conductor. Copper has many other properties that make it useful for other things from water pipes to jewellery. That is why it is in such high demand. Although it has been extracted for thousands of years, 95% of the total extraction of copper has been carried out in the last 100 years, and we are running out of fresh supplies fast! So if you want to keep using mobile phones, think about how you dispose of your old one – we need to make sure as much copper as possible is recycled so that we do not run out too fast.

**properties of copper**

| | |
|---|---|
| melting point | 1083 °C |
| electrical conductivity | very good |
| thermal conductivity | very good |
| malleability | very malleable |