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GENERAL CERTIFICATE OF SECONDARY EDUCATION **A218/02/RB**

TWENTY FIRST CENTURY SCIENCE

ADDITIONAL SCIENCE A

Unit 4: Ideas in Context (Higher Tier)

RESOURCE BOOKLET

JUNE 2008

To be opened and given to candidates upon receipt

CUP/T57859

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 **Friday 23 May 2008** 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.

This document consists of **6** printed pages and **2** blank pages.

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Tufa towers at Mono Lake, California

Mono Lake in California is very salty. Hot springs flow up from underground and carry salts into the lake. Rainfall also adds water to the lake, but there is no outlet for the water. The hot sun evaporates the water, so the lake behaves like a huge evaporating basin and salt crystals form around the edges of the water. The crystals are a mixture of salts that form from the ions in the lake. They include chlorides and sulfates of sodium and magnesium.

The water in the lake usually contains about $81\,g/dm^3$ of salts – this is about three times as much as the sea! The concentration of salts in the water varies depending on how much rain has fallen and how hot and sunny the weather has been. The solid salts from the lake are a valuable source of many minerals.

The table shows the main ions that are in the solid salts.

ion	percentage
sodium	46.4
carbonate	23.3
chloride	19.0
sulfate	8.0
potassium	1.5
magnesium	0.1

The salts also make the water very alkaline. The water feels soapy to the touch, but this is because alkalis in the water are reacting with fat in the skin to make soap.

The hot springs flow up into the lake. The spring water contains calcium ions. These ions react with carbonate ions in the lake water when they flow into the lake to make solid calcium carbonate, which collects to form solid rock called tufa. Over many years, the rock forms high towers under the water. The towers can be up to 10 m tall. The level of the lake has dropped over the last 30 years, and these towers can be seen sticking up like fingers out of the water.

Park rangers are concerned about erosion of the towers. One ranger says 'it takes thousands of years for these towers to form, but they are very easily damaged by acidic rainfall. It is especially worrying here, because the rate of the erosion is fast because the weather is so hot'.

You can make fake lake water by mixing together some household salts with tap water.

Fake Lake Water

Get a bucket of tap water and add…

18 tablespoons of washing soda (Na_2CO_3)
10 tablespoons of common salt ($NaCl$)
8 teaspoons of Epsom salts ($MgSO_4$)

Give it a stir – you have made some water that is almost exactly like the real thing!

Bendy lampposts save lives

Collisions with rigid metal posts often result in death. In 2003, 126 people were killed and more than 3600 were injured in crashes involving lampposts and road signs.

Rigid steel lampposts can prove fatal if hit by a car, as the vehicle buckles around the structure and comes to an abrupt halt. The crumple zone of the car is not always enough to save the driver.

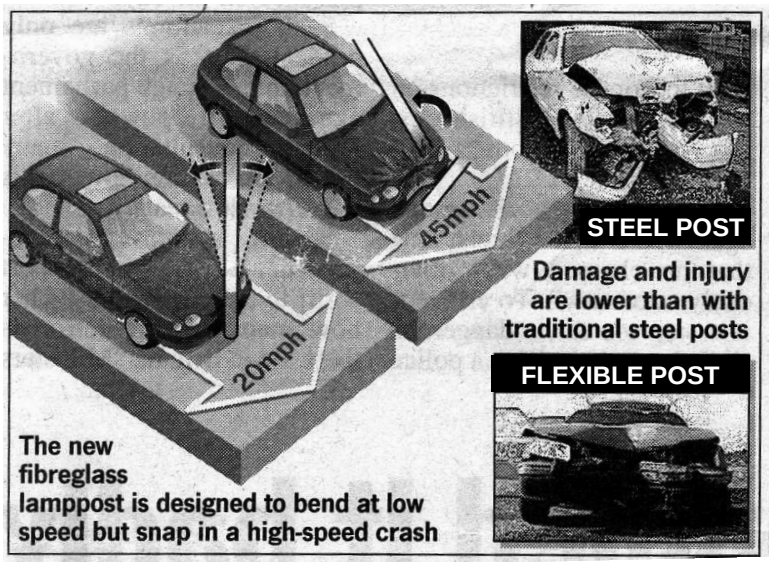
But hitting a flexible lamppost will cause it to bend underneath the car. This makes the collision take longer and cause less damage.

Lampposts that bend and break on impact have gone into use on Britain's roads in the hope of reducing the number of deaths from car accidents.

When hit by a car travelling at more than 22 mph, the breakable post snaps at the point of impact and is tossed into the air while the vehicle continues forward with about 30% of its momentum having been absorbed.

This breakable lamppost is used in the countryside, where it is highly unlikely to be near pedestrians.

'We've had four crashes already on the roadside involving our lighting columns, and I'm pleased to say no major injuries – including one crash which was at 90 miles an hour,' a company spokesman stated. 'Under normal circumstances, if they'd hit the steel pole it would almost certainly have resulted in death.'



In a recent development to minimise any risk to passers-by from lampposts breaking in collisions, a different kind of post has been developed.

This is designed for the city. It is hinged, and it buckles, so it does not break and fly off.

'The car will ride up along the length of the column,' the company spokesman said. 'This converts kinetic energy into gravitational potential energy.'

'The likelihood would be that we will have at least slowed the car down and not killed the occupants of the car.'

'At the same time, it does not allow the car itself to run into pedestrians.'

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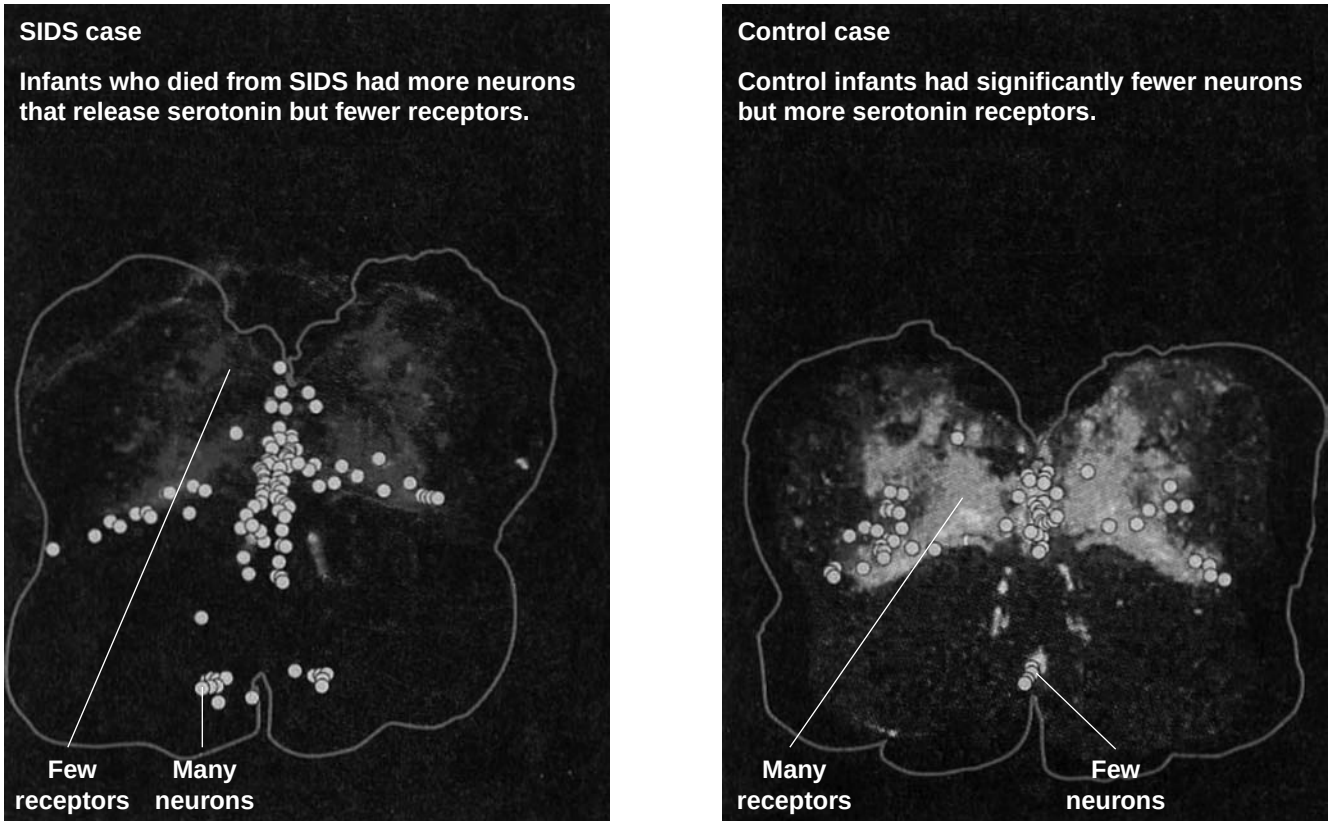
Cot deaths linked to brain abnormality

Cot deaths, or Sudden Infant Death Syndrome (SIDS), may be linked to abnormalities in the structure of a baby's brain. Hannah Kinney and David Paterson of the Boston Children's Hospital examined the brains of 31 babies who had died from SIDS. They compared them with the brains of 10 babies who had died from other causes.

They found that the medulla, the part of the brain that regulates breathing and blood pressure, had neurons that released a chemical called serotonin. The number of these neurons was greater than normal in 55% of the brains of the babies who had died of SIDS. They also found that these babies had fewer receptors for serotonin.



The pictures show scans through the brains of two babies, one who died from SIDS and one who did not.

When babies sleep, their breathing slows down, reducing the amount of oxygen in the blood. Normally, babies recover by gasping for air. Kinney and Paterson already knew that serotonin is involved in gasping and recovery. They knew that serotonin is released into synapses and that it stimulates receptors on other neurons. They produced a theory that a lack of receptors in the medulla's serotonin system was preventing the babies from gasping and recovering when asleep in the cot.

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