# OXFORD CAMBRIDGE AND RSA EXAMINATIONS
## GENERAL CERTIFICATE OF SECONDARY EDUCATION

# A323/02/RB

# TWENTY FIRST CENTURY SCIENCE

# CHEMISTRY A

## Unit 3: Ideas in Context plus C7 (Higher Tier)

## RESOURCE BOOKLET

## To be opened on receipt

## JUNE 2011

## SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

## READ INSTRUCTIONS OVERLEAF

DC (CW) 11MEP06230 47023

## INSTRUCTIONS TO CANDIDATES

- **This booklet contains the article required to answer question 1.**
- **Take this article away and read it through carefully.**
- **Spend some time looking up any technical terms or phrases you do not understand.**
- **For the examination on FRIDAY 27 MAY 2011 you will be given a fresh copy of this article, together with a question paper.**
- **You will NOT be able to take your original copy into the examination with you.**

# BOLIVIAN BONANZA

## LITHIUM-ION BATTERIES FOR CARS

**Concerns about air pollution and global warming mean that electrically-powered cars are already on our streets. Today's electric vehicles are powered by nickel-metal hydride batteries. The small amount of charge that these batteries can store means that the distance a car can travel before recharging is quite short.**

**Lithium-ion batteries have already been developed for use in laptops, cameras and mobile phones. These are much lighter, more powerful and keep their charge longer when switched off than nickel-metal hydride batteries. Soon lithium-ion batteries may be the power source for electric cars, allowing them to travel faster and further.**

## MEETING LITHIUM DEMAND

**Between 2003 and 2007, the battery industry doubled its consumption of lithium carbonate, the most common ingredient in lithium-based products. A vehicle battery requires 100 times as much lithium carbonate as its laptop equivalent, so the green-car revolution could make lithium one of the planet's most sought after elements. To make just 60 million plug-in hybrid vehicles a year containing a small lithium-ion battery would need 420 000 tonnes of lithium carbonate, which is six times the current world production. Cars powered by electricity only would need even bigger lithium-ion batteries.**

**Bolivia has nearly half of all the reserves of lithium ore in the world. Extracting and processing all of the ore from Bolivia would produce about 5 million tonnes of lithium metal. At today's prices this amount of lithium metal is worth about £20000 million.**

## EXTRACTION OF LITHIUM

**In Bolivia, lithium chloride is one of the compounds present in large deposits of rock salt. The salt is dissolved in water and the solution pumped to the surface. Some of the water is allowed to evaporate naturally producing a concentrated solution from which solid lithium chloride is made. Lithium metal is extracted by electrolysis of molten lithium chloride.**

## ENVIRONMENTAL PROBLEMS

**Battery-powered cars do not release pollutant gases into the atmosphere when they are driven. But generating the electricity used to recharge the batteries may still cause pollution. The lithium-powered car will not be a true zero-emission vehicle until all of the electricity used to charge the battery comes from renewable sources. Another environmental problem is that lithium compounds are extremely toxic, so the materials in lithium-ion batteries need to be recycled rather than disposed of in landfill. There may also be pollution caused by the mining of lithium ore and extraction of lithium metal.**

## PROPERTIES OF LITHIUM

**Lithium, sodium and potassium are elements in Group 1 of the Periodic Table. All of these alkali metals are very reactive and require careful storage to prevent reaction with oxygen in the air. They react vigorously with water. The reactivity of the elements in Group 1 increases as their atomic number increases.**

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