Teaching ideas for Option C, *Chemistry in industry and technology*

Questions

Two worksheets of questions are provided:
- the first worksheet deals with the Standard Level part of the syllabus
- the second worksheet is for Higher Level only.

There are also a large number of questions available in the Coursebook and on the accompanying CD-ROM.

Teaching ideas

- If possible, visits could be arranged to industrial plants in the local area.
- The different methods for the extraction of iron and aluminium could be related to the reactivity series.
- The different properties of aluminium and iron can be discussed, as well as why aluminium has replaced steel in many high-tech uses.
- The environmental effects of aluminium extraction could be discussed with reference to the Hungarian red mud disaster in 2010.
- The changing face of the iron and steel industry in Europe and the USA could be discussed. There was a vast increase in steel production during the 20th century, but this has been accompanied by a large decrease in the number of people employed in the industry. The growth of steel production in China and India could be discussed.
- The origins and processing of crude oil could be discussed.
- The environmental impact of the extraction and transportation of crude oil could be discussed with reference to the Amoco Cadiz, Sea Empress and Gulf of Mexico disasters, among others.
- The importance of the combustion of fossil fuels could be discussed, alongside the environmental problems associated with it.
- The importance of chemicals derived from crude oil (medicines, plastics, etc.) can be considered. Is crude oil too valuable to burn?
- The problems with disposal of polymers could be discussed, as well as the problems with recycling; this could be linked to Option E: *Environmental chemistry*. The nature of biodegradable polymers could be investigated.
- The so called **hydrogen economy** could be discussed. Information about hydrogen cars can be obtained at:
  http://www.hydrogencarinfo.com/
- Nanotechnology teaching ideas can be found at:
  http://mrsec.wisc.edu/Edetc/IPSE/educators/index.html
  http://www.nnin.org/nnin_k12teachers.html
  http://nanoyou.eu/en/about-nano.html

Practical activities

Safety

Extreme care must be exercised when carrying out any practical activities in the classroom and a risk assessment should be conducted before carrying out the experiments.

Demonstrations

- A simple test-tube demonstration of the extraction of a metal using carbon can be conducted by strongly heating a mixture of copper oxide and carbon in a small ignition tube with a loose plug of mineral wool in the end, then plunging the tube into a beaker of water.
- Alternatively, lead(II) oxide can be reduced on a carbon block using a Bunsen burner and blowpipe:
  http://wn.com/lead_oxide
- The discussion of the extraction of iron in the blast furnace could be linked to a historical discussion of the industrial revolution. Why was aluminium only discovered in 1825 but has iron been known since ancient times?
- Different samples of plastics could be examined and their properties investigated.
- A discussion of catalysis could be linked to Chapter 6: *Rates*. A good demonstration of heterogeneous catalysis is the oxidation of ammonia using a platinum catalyst:
  http://www.rsc.org/Education/EiC/issues/2009May/ExhibitionChemistry.asp
- It is possible to purchase small fuel cells for demonstration purposes.
- Details of experiments and other teaching ideas linked to liquid crystals can be found at:
  http://nanoyou.eu/component/content/article/19-hands-on-activities/500-experiment-with-liquid-crystals.html?directory=4&Itemid=4
  http://www.seefurtherfestival.org/resources/teachers-resource-liquid-crystals-living-cells-and-flat-screen-tvs
- Solar cells are fairly easy to get hold of nowadays and students could investigate various factors that affect the output current/voltage. The advantages/disadvantages for the large-scale use of solar cells could be discussed.
- A discussion of the chlor-alkali industry could be preceded by a demonstration of the electrolysis of brine.

ICT

There are many excellent websites available that are relevant to this topic.

- Chemical industries:
  http://www.rsc.org/Education/Teachers/Resources/Alchemy/
  http://www.nationalstemcentre.org.uk/elibrary/collection/202/chemical-industry-education-centre
- Iron and steel:
  http://www.bbc.co.uk/history/interactive/animations/blast_furnace/index_embed.shtml
  http://www.britishpathe.com/record.php?id=82164
  http://www.ltvsteel.com/htmfiles/diagram2.htm
  http://www.eef.org.uk/uksteel/About-the-industry/How-steel-is-made/process-diagrams/Production-of-molten-steel.htm
  http://www.tatasteeleurope.com/en/responsibility/education/resources/secondary/science_in_steel/
  http://www.timken.com/en-us/products/Steel/productlist/Pages/SteelMediaLibrary.aspx
- Aluminium:
  http://www.archive.org/details/Aluminum1956
  http://video.google.com/videoplay?docid=6617409595675883188

- The oil industry:
  http://www.archive.org/details/InsideSt1946
  http://www.archive.org/details/WhoKilledTheElectricCar2006
  http://resources.schoolscience.co.uk/Exxonmobil/infobank/4/flash/cracking.htm
- Polymers:
  http://www.tvo.org/iqm/plastic/animations.html
  http://www.uwsp.edu/chemistry/tzamis/condensationpolymer.html
  http://www.uwsp.edu/chemistry/tzamis/additionpolymer.html
- Catalysis:
  http://www.catalysis-ed.org.uk/
- Fuel cells:
  http://www1.eere.energy.gov/hydrogenandfuelcells/fuelcell_animation.html
  http://www.lanl.gov/orgs/mpa/mpa11/animation.htm
  http://www.fuelcells.org/info/fuelcell_omsi.swf
  http://www.nfcrc.uci.edu/2/FUEL_CELL_INFORMATION/FCexplained/FC_animation.aspx
  http://video.nationalgeographic.com/video/player/environment/energy-environment/fuel-cells.html
  http://www.guardian.co.uk/environment/interactive/2010/feb/22/hydrogen-taxi-black-cabs
- Liquid crystals:
  http://plc.cwru.edu/tutorial/enhanced/files/lc/phase/phase.htm
  http://plc.cwru.edu/tutorial/enhanced/files/lcd/tn/tn.HTM
  http://nobelprize.org/educational/physics/liquid_crystals/
- Nanotechnology:
  http://www.wisc-online.com/objects/ViewObject.aspx?ID=NAN105
  http://www.wisc-online.com/objects/ViewObject.aspx?ID=NAN205
  http://www.wisc-online.com/objects/ViewObject.aspx?ID=NAN305
  http://www.wisc-online.com/Objects/ViewObject.aspx?ID=NAN405
  http://www.wisc-online.com/objects/ViewObject.aspx?ID=NAN505
  http://www.wisc-online.com/Objects/ViewObject.aspx?ID=NAN605
  http://www.wisc-online.com/Objects/ViewObject.aspx?ID=NAN705
  http://nanohub.org/resources/91/
  http://www.virlab.virginia.edu/VL/SPM_operation.htm
  http://ngm.nationalgeographic.com/2006/06/nanotechnology/video-interactive
  http://ipt.arc.nasa.gov/
  http://community.nsee.us/
  http://www.nisenet.org/
  http://www.ucsd.tv/getsmall/
- Silicon and photovoltaic cells:
  http://www.jc-solarhomes.com/photo-voltaic.htm
  http://micro.magnet.fsu.edu/primer/java/solarcell/index.html
- The chlor-alkali industry:
  http://www.eurochlor.org/animations/mercury-cell.asp
  http://www.eurochlor.org/animations/membrane-cell.asp
  http://www.eurochlor.org/animations/diaphragm-cell.asp

Theory of knowledge (TOK)

The ethical and social issues associated with nanotechnology could be discussed.