



**The Leys School
Cambridge**

Specimen

Sixth Form Scholarship Examination

C H E M I S T R Y

Time allowed: 60 minutes

Instructions

- You should write your answers on LINED paper
- Write your name on any paper that you use
- The use of a dictionary is not allowed
- Answer as many questions as possible in the time allowed.

1. Read the following passage and answer the questions.

A disastrous experiment won Hideki Shirakawa the Nobel Prize. In 1967 he directed a visiting Korean chemist to make polyacetylene by the catalysed linking of acetylene molecules. It was a routine synthesis, but the visitor misunderstood the instructions and added one thousand times too much catalyst. The result was something that didn't look like polyacetylene at all.

Normally it was a black powder, but here was a rubbery film with a silvery metallic sheen. Shirakawa had never seen anything like it. But instead of throwing it into the bin and starting again, he decided to investigate. Might the metallic appearance betray metallic properties?

In fact, this material didn't turn out to be a particularly good conductor but in 1976 he added iodine to the films and created the world's first electrically conducting polymer.

(Adapted from 'Chemistry World' June 2006)

- a) Explain the term 'polymer'. (1)
- b) Ethene forms polymers. Draw the structure of an ethene molecule and the structure of a section of the polymer it forms. (3)
- Give the name of the polymer. (3)
- c) What structural feature does ethene have that enables it to polymerise? (1)
- d) What type of bonding is present in the polymer molecules? (1)
- e) Polymers have fairly high melting points. Explain why. (2)
- f) Explain how a catalyst works (2)
- g) Explain, in terms of their structure, why metals are good electrical conductors. (3)
- h) If the polymer was metallic, give two other properties it would have. (2)
- i) Iodine is in group 7 of the Periodic Table. Give examples of two properties which change as you go down the group from fluorine to iodine, saying how they change. (4)

2. Phosphorus burns with a yellow flame to give dense white clouds of phosphorus (V) oxide, P_2O_5 .
- Write a balanced equation for the reaction between phosphorus and oxygen (3)
 - What is the relative molecular mass of P_2O_5 ? (A_r for P = 31, O = 16) (1)
 - If 10 Kg of P_2O_5 are formed, how many moles is this? (2)
 - What mass of phosphorus would be required to form 10kg of P_2O_5 ? (3)
 - Phosphorus has an atomic number of 15. How many electrons does an atom of phosphorus have? (1)
 - Draw a diagram to show the arrangement of electrons in a phosphorus atom. (1)
3. In 1869 John Newlands, an English chemist, suggested that when atoms are arranged in order of their relative atomic masses there was a pattern with every element having similar properties to elements eight places in front and eight places behind it.

This gave the arrangement below.

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co and Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce and La	Zr	Di and Mo	Ro and Ru

- Choose two columns in Newlands' table. For each, say which elements are together in the same group of the modern Periodic Table and which ones do not belong. Explain why these elements do not belong. (8)
 - Newlands arranged his table in order of relative atomic mass. How are the elements arranged in the modern Periodic Table? (1)
 - Where would you find cobalt, nickel, titanium and iron in the Periodic Table? (1)
4. A group of compounds were discovered in the 1930s and were called chlorofluorocarbons (CFCs). Because of their inertness they found many uses, especially as propellants in aerosol cans and as refrigerants.
- Explain why CFCs are damaging to the environment. (3)
 - CFC's, along with carbon dioxide, are also 'greenhouse gases'. Explain what this means and say why it is a problem. (3)
 - Another environmental problem is acid rain. Which gases cause this? (3)
 - Give one measure that has been taken to reduce acid rain. (1)