GREEN CHEMISTRY

What is it?
- it encourages environmentally conscious behaviour
- it reduces and prevents pollution and the destruction of the planet.

Basics
- it is better to prevent waste than to treat or clear it up afterwards
- aim for maximum atom economy
- use processes which require fewer chemicals
- don't make products that are toxic to human health
- don't make products that are toxic to the environment
- reduce the energy requirements of processes
- use alternative energy resources
- use renewable raw materials rather than deplete finite resources
- use catalysts where possible
- waste products should be designed to be biodegradable
- reduce the risk of explosions and fires

RECYCLING

Definition Recovering resources by collecting, separating, and processing scrap materials and using them as raw materials for manufacturing new products."

Why do it?
- the world's resources are running out and are non-renewable
- we need to reduce the waste of valuable resources
- reduces the expense of disposal
- reduces the expense of creating new products from raw materials
- avoids environmental problems posed by waste and its storage
  - landfill sites
  - greenhouse gases (mainly methane)
  - destroying habitats
  - deforestation leads to climate change and destruction of ecosystems

Renewable resources
- can be replenished by natural processes
- their rate of replenishment is equal or greater than the rate of consumption
- often do not contribute to global warming
- often far more environmentally friendly
- lead to more sustainable use of materials; resources can be used indefinitely

Renewable energy
- plant-based substances such as wood
- solar energy
- tidal energy
- biomass
- hydro-electric power (HEP)
- wind power

Examples

CFC's Apparent benefits were offset by unexpected side effects.

good
- created in 1928 as a non-toxic, non-flammable refrigerant
- also used as solvents and in air conditioners
- low reactivity and volatility

bad
- UV light in the upper atmosphere easily breaks the C-Cl bonds
- free radicals formed speeded up the depletion of the ozone layer

Biofuels
- fuels made from a living things or the waste produced by them
- renewable and potentially carbon neutral.

Carbon neutral refers to "an activity that has no net annual carbon (greenhouse gas) emissions to the atmosphere". Ethanol is a well-known biofuel.

Ethanol

good
- bio-ethanol is made from crops (corn and sugar cane)
- takes in carbon as carbon dioxide in the atmosphere
- when burnt returns the carbon dioxide to the atmosphere
- appears to be carbon neutral

bad
- energy is required to
  - grow the crops (plant and harvest machinery)
  - convert plant material to ethanol
- fertiliser and pesticides used are pollutants
- crops compete for land with other food crops / animal grazing / forests
- could destroy natural habitats and reduce biodiversity

Plastics & polymers Plastics have made life much easier.

good
- many are chemically inert
- non-toxic
- waterproof
- easy to mould
- non-biodegradable
- lightweight

bad
- made from crude oil which is a finite resource
- non-biodegradable so take hundreds of years to decompose
- can form toxic products during incineration
- a lot of energy is used in their formation
- disposal in landfill sites is
  - a waste of resources
  - environmentally unsound
  - takes up valuable space

Catalysts
- can be used to lower the energy required for a reaction to take place
- can reduce the CO_2 emissions from burning of fossil fuels
- can give a better atom economy

INTERNATIONAL CO-OPERATION

Kyoto protocol
- an agreement signed in 1997 by over 50 developed countries
- countries pledged to cut greenhouse gas emissions
- gases included

carbon dioxide	CO_2
methane	CH_4
hydrofluorocarbons	HFC's
perfluorocarbons	PFC's
sulphur hexafluoride	SF_6

- some countries agreed to make larger cuts
- developing countries were not required to cut emissions
- the US did not sign up as it would have significantly affected their economy

But... Many experts say that the protocol is futile without US support as they are the world's largest emitter of greenhouse gases.

Countries such as India and China are going through great industrial change and they do not have to cut emissions.

Cuts were not big enough according to many climate scientists, who say that a 60% cut is required to avoid the risks global warming presents.

Q.1 *How much has the Kyoto protocol affected climate change?*