

UNIT 13

CHEMISTRY IN THE WORLD

Answers

*Lesson 1 – What is the difference between science and technology?*



**Test your knowledge 1.1: Understanding science and scientific enquiry**

- (a) Eg amino acids joining together to make proteins and proteins breaking up into amino acids etc
- (b) Eg attraction between opposite charges (electrostatic law), conservation of energy etc
- (c) Experimental and observational study of physical and natural world with the purpose of obtaining a systematic body of facts and general laws



**Test your knowledge 1.2: Understanding technology and development**

- (a) Science: study of the natural and material world; technology: application of scientific knowledge for useful purposes; science is used in technology and technology is used in science
- (b) Greater automation allows people to be more productive; technology allows information to be shared more quickly and openly
- (c) Endogenous technology is developed in the same context in which it is used; exogenous technology is developed in a different context from that in which it is used
- (d) Using endogenous technology reduces import costs, creates local employment and skills; endogenous technologies are usually quicker and easier to maintain

*Lesson 2 – What are the different types of industry in West Africa?*



**Summary Activity 2.1: Extraction of Metals and Refining of Crude Oil**

- By chemical reaction using carbon as a reducing agent
- By electrolysis
- By concentration, then dissolving in cyanide ions, then reforming on a carbon surface
- A useful chemical made from crude oil; by fractional distillation, then by cracking and reforming the different fractions



**Test your knowledge 2.2: Understanding the role of heavy industry in West Africa**

- (a) Bauxite, rutile, diamonds, iron ore/haematite/limonite
- (b) By processing the raw materials into higher value materials before exporting; problems with transport infrastructure, skilled labour and energy security
- (c) Crude oil / bauxite / diamonds / gold / kaolin
- (d) Crude oil
- (e) Dangerous conditions for miners; loss of scenic beauty; increased pollution and traffic
- (f) Heavy chemical: produced in large quantities, low purity, low cost per kg; fine chemical: produced in smaller quantities, high purity, high cost per kg
- (g) Availability of sea or rail transport; availability of labour; not area of high population density or natural beauty

**Lesson 3 – What are the main small-scale industries in West Africa?**



**Summary Activity 3.1: Small-scale chemical industries in West Africa**

- sodium salt of a fatty acid; it is made by breaking down a fat or oil with sodium hydroxide
- By evaporating off the water
- By fermentation of sugar, usually in fruit; distillation concentrates the alcohol



**Test your knowledge 3.2: Understanding the role of small-scale industries in West Africa**

- (a) Using microorganisms to make useful products; (i) fermentation of sugar by yeast into ethanol and carbon dioxide; (ii) fermentation of sugar by yeast into carbon dioxide, which make bread rise; (iii) same as with bread but with cassava flour and more yeast; (iv) fermentation of lactose by bacteria into lactic acid, which clots the milk
- (b) Pump water down into the salt deposit and back up again; the water dissolves the salt; the water can then be removed by evaporation



**Test your knowledge 3.3: Understanding the hazards associated with working in industry**

- (a) Inhalation of dust – limit time working in mine and ensure miners wear protective filters; fire/toxic fumes – ensure mines are well ventilated and have more than one exit; have equipment to monitor level of toxicity in air
- (b) Eye protection; protective clothing, limit time exposed to chemicals; access to emergency treatment
- (c) Many chemicals are flammable and temperatures can be high; have good monitoring equipment; shut down production if temperature gets too high; train staff to reduce risk of fire; abundant fire extinguishers such as sprinkler systems
- (d) Nuclear power generation; limit time workers can be on site; ensure good protective clothing (eg containing lead)

## UNIT 13 – CHEMISTRY IN THE WORLD

### Lesson 4 – How are we polluting the environment?



#### Summary Activity 4.1: Burning crude oil

- Because more fossil fuels are being burned, which produce carbon dioxide; carbon dioxide is a greenhouse gas and too much of it can lead to global warming and climate change
- Many fossil fuels contain sulphur; when the fuel burns the sulphur also burns to form sulphur dioxide; it is acidic and dissolves in water to form acid rain, which damages trees, buildings and marine life
- The nitrogen in the air reacts with oxygen in the air in the conditions of a combustion engine, producing oxides of nitrogen; nitrogen dioxide is also acidic and dissolves in water to form acid rain
- Not broken down in nature; most addition polymers are non-biodegradable



#### Test your knowledge 4.2: Understanding the atmosphere and how it can be polluted

- (a) Troposphere, stratosphere, mesosphere, thermosphere
- (b) Nitrogen (80%) and oxygen (20%)
- (c) Stratosphere; absorbs harmful UV rays from the sun and stops them reaching ground level
- (d) Halons (from refrigerators and aerosols) and oxides of nitrogen (from combustion engines)
- (e) A gas which absorbs the IR radiation emitted by the earth and hence contributes to global warming
- (f) Ozone, formed by the reaction of nitrogen oxides (released from combustion engines) with unburned hydrocarbons (released when petrol is burned)
- (g) Lead used to be added to petrol to increase its octane number; it causes neurological damage, especially to children

### Lesson 5 – What career paths are open to you if you study Chemistry?



#### Test your knowledge 5.1: Understanding water and soil pollution

- (a) Fertilisers run off into water supply causing eutrophication; problem can be reduced by using less fertiliser, or using organic fertilisers which are less water soluble
- (b) Human sewage, industrial sewage, plastic



#### Test your knowledge 5.2: Understanding how studying chemistry can lead to a career

- (a) Chemistry teacher (or lab technician)
- (b) Medical analyst/laboratory technician
- (c) Research chemist; manufacturing chemist; quality control chemist
- (d) Environmental scientist
- (e) Medicine, Nursing, Chemical Engineering etc

## UNIT 13 – CHEMISTRY IN THE WORLD

### 5.3 END-OF-TOPIC QUIZ

#### UNIT 13 – CHEMISTRY IN THE WORLD



1. Application of scientific knowledge for useful purposes; exogenous technology is not developed in the society in which it is used (eg motor vehicles, refrigerators); endogenous technology is developed in the community in which it is used (fish smokers)
2. Fine chemicals are high purity, high value chemicals produced in limited quantities; heavy chemicals are low purity, low value chemicals produced in large quantities; fine chemicals use more highly skilled labour with higher salaries, and there is less environmental impact due to the smaller scale
3. Dust inhalation, toxic fume inhalation, risk of fire or explosion
4. Use of microorganisms to create a product; brewing and breadmaking use yeast to ferment glucose; yoghurt production uses bacteria to ferment lactose
5. Carbon dioxide (burning fossil fuels), methane (cows)
6. NO or NO<sub>2</sub> (from combustion engines) and halons (from refrigerators and aerosols)
7. Quality Control Analyst; Development Chemist; Manufacturing Chemist