Answers Minerals

Year 8 Science Chapter 9

p193

1 **Rocks are made up of minerals** such as quartz, feldspars, micas, and calcite. Different rocks are made up of different combinations of minerals. Granite is a rock with many different minerals (feldspar, quartz, mica, and others).

2 **Minerals** are solid crystalline substances with a definite chemical composition. For example, quartz is silicon dioxide (SiO_2), calcite is calcium carbonate ($CaCO_3$).

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4 Minerals have properties that help identify them. Some properties are: Hardness, streak, lustre, cleavage.

5 **a)** Quartz will scratch orthoclase.
b) A knife will scratch calcite.
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p195

1 **Minerals** are solid crystalline substances with a definite chemical composition. For example, salt is sodium chloride (NaCl), calcite is calcium carbonate ($CaCO_3$).

2 Briefly describe each of the following methods of crystal formation:
a) **Crystals** can be formed as molten rock (magma) cools. The majority of the minerals in the Earth's crust have formed as the magma cooled (olivine, quartz, feldspar, mica).
b) **Crystals** can form from salt solutions. When a salt solution becomes saltier and saltier, such as water evaporating, crystals can begin forming (salt, sugar).
c) Temperature and pressure, caused by large land masses pushing against each other, can force the **crystallisation** of minerals (diamonds from coal).

3 Amethyst crystals, or purple quartz crystals are usually found with igneous rocks. This suggests the crystals were formed as molten rock (magma) cooled.

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1 Ores are rocks or minerals that contain elements, such as metals, that can be profitably mined.

2 An ore deposit or ore body is a collection of ore that is large enough to attract mining interests.

3 Examples of mineral ores: Haematite (source of iron), cassiterite (source of tin), sphalerite (source of zinc), coal (source of carbon), chalcocite (source of copper), bauxite (source of aluminium).

4 Mining is the extraction of minerals, and other materials, from an ore deposit or ore body.

5 Mining is either carried out by surface mining or underground mining. The majority of mining, some 85%, is carried out by surface mining. Surface mining usually strips the surface layer of rocks and vegetation to access the ore deposits. Underground mining is comparatively less common mainly because it is more expensive. Underground mining involves digging tunnels into the earth to reach ore deposits.

6 The mining process.
- Prospecting: Finding an ore deposit and a rough idea of the size of the ore deposit.
- Estimation: Estimating the size and quality of the deposit.
- Mine planning: Mining design, extraction, transport to market, economics (cost vs return).
- Mining: Building access to the mine, building the mine plant, operating the mine.
- Reclamation: Returning the mined area to its original natural state.

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1 The first stage of the metal extraction is to reduce the size of the mineral. The second stage is to concentrate the minerals. The third stage is the separation of the metal from the mineral. The final stage, metal refining, is purifying the final product.

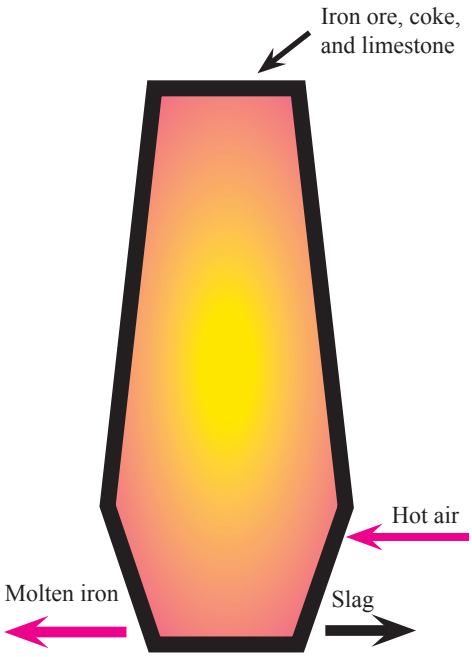
2 Briefly describe each of the following methods of extracting metals from minerals:

a) Electrolysis - using an electric current to separate the metal from the mineral. Electrolysis is used to extract aluminium (Al) from bauxite (Al_2O_3) and to purify copper (Cu).

b) Pyromettalurgy or smelting - using high temperatures to separate the metal from the mineral (smelting). Smelting is used to extract iron (Fe) from iron ore (Fe_2O_3).

c) Hydrometallurgy - adding a chemical to react with the mineral and produce the metal, then collecting the metal precipitate from the solution. Titanium (Ti) is produced by reacting titanium chloride ($TiCl_4$) with sodium (Na) or magnesium (Mg). Titanium ore (Rutile, TiO_2) is first converted to ($TiCl_4$).

3 Sketch and label a blast furnace for extracting iron from iron ore.



4 Brief description of the process of extracting copper from copper carbonate ore:

- Crush the copper ore to the size of sand.
- Make a copper concentrate by adding just dilute sulphuric acid (H_2SO_4) to convert the copper ore to blue copper sulphate ($CuSO_4$). Filter the concentrate to separate other materials from the concentrate.
- Add dilute sodium hydroxide (NaOH) to convert the blue copper sulphate ($CuSO_4$) to black copper oxide (CuO).
- Filter the black copper oxide (CuO) and then dry the copper oxide.
- Refine the copper by using electrolysis.

p200

1 Prospecting is traditionally the physical search for minerals, precious metals, or fossils.

2 Prospectors tend to concentrate on riverbeds and outcrops because the riverbed can collect minerals from a wide area and give an idea of the minerals in the area. Outcrops are favoured because they are not covered in sediments.

3 Briefly indicate how the following modern methods help find mineral deposits:
a) A geochemical analysis of a riverbed can detect the presence of desired minerals and suggest a mineral deposit further upstream. Carefully placed survey grids can then identify the position and the possible yield of the mineral deposit.
b) Satellites, mapping the light spectrum, can help identify minerals in a mineral exploration area.
c) Geophysical surveys, conducted from a plane, can provide information on variations in electromagnetism, magnetism, and gravity in a mineral exploration area.

p201

1 Drones or unmanned aerial vehicle (UAV) are aircraft without an onboard pilot. Drones are either controlled by remote pilots or onboard computers.

2 Another name for a drone is an unmanned aerial vehicle (UAV).

3 Drones, with sensors, are very useful for mineral exploration. Drones can produce: Visual surveys of the Earth's surface, geomagnetic surveys - variations in underground magnetic rock structure, infrared and ultraviolet surveys.

4 Drones are being increasingly used because they can perform boring surveillance, are cheaper, and less dangerous than piloted aircraft.

5 Policing, firefighting, checking of powerlines, checking pipelines, geological surveys.

6 Disadvantages of drones are that they are very expensive, and they can be considered an invasion of privacy in the sense that they are constantly surveilling.

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p204

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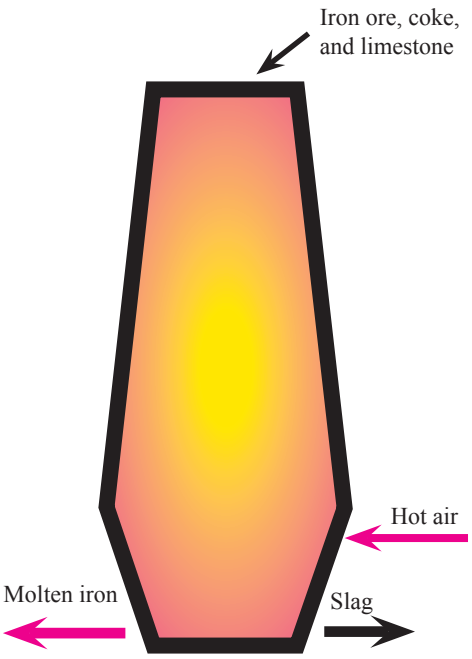

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p205

1 c) **2** d) **3** a)

p206

1 **a)** Fluorite can be scratched with a knife - True.
b) Quartz can be scratched with a knife - False.
c) Mineral that can be scratched with a knife but not with a fingernail has a hardness of around 6 - False.
d) Quartz will scratch Apatite - True.
e) Corundum will scratch glass - True.

2 Gneiss contains feldspar, quartz, hornblende, and mica.
a) Gneiss is a rock.
b) Feldspar is a mineral.

3 The following periods of time are from earliest to latest: Stone Age, Copper Age, Bronze Age, Iron Age, Silicon Age. The ages reflect the level of technology needed to extract the metal. For example, a higher level of technology and skill was needed to extract iron than copper.

4 The advantages of surface mining are: It is cheaper to extract the ore or metal than underground mining, less chance of workers dying from toxic fumes, therefore it is safer unlike underground mining, surface mining accesses the ore faster .

The disadvantages of surface mining are: That it destroys the landscape and environment, affects the habitats of fauna potentially affecting the existing ecosystem in that area, destroys the flora, causes noise, air and water pollution.

5 Advantages of Underground Mining are: It allows minerals to be extracted from deep underground, it doesn't create a mess like open cut or surface mining, does not affect the physical environment as much as surface mining.

The disadvantages of underground mining are: Underground mining is more expensive than surface mining, more dangerous than surface mining, susceptible to collapse and flooding, has extensive mulloch heaps.

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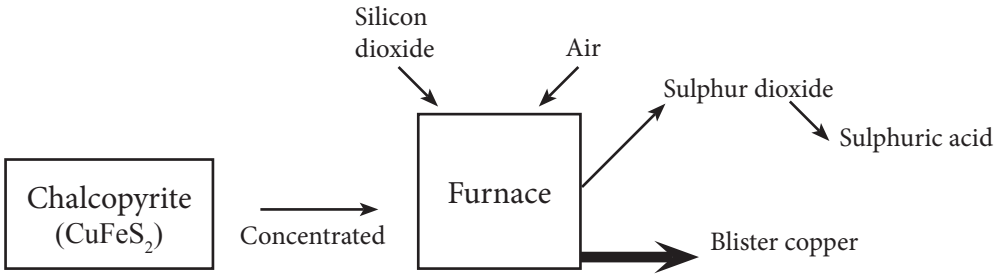
6 **a)** Iron from haematite, tin from cassiterite, zinc from spahlerite, copper from chalcocite, aluminium from bauxite.

b) Iron can be used to make many compounds which each have special uses such as: cast iron in engine blocks, galvanised iron in roofs, steel in buildings, stainless steel in hospitals and kitchens, tool steel in cutting tools.

7



8 Order of extraction of iron from iron order: Crushing, concentration, mixing with coke and limestone, smelting, purifying.