9 Metals and non-metals

Answers

Comparing density (PB page 109)

1 mercury, silver, copper, iron, zinc, iodine, bromine, aluminium, silicon, carbon, magnesium, calcium, oxygen, sodium, potassium, hydrogen
Metals are generally denser than non-metals.

2 Iodine and bromine are exceptional non-metals in that they are denser than some metals. Potassium and sodium are exceptional metals in that they are less dense than some non-metals.

Comparing melting point (PB page 109)

3 carbon, iron, silicon, copper, gold, silver, calcium, magnesium, zinc, iodine, sodium, potassium, bromine, mercury, nitrogen, oxygen, hydrogen
Metals tend to have higher melting points than non-metals.

4 Carbon is an exceptional non-metal because it has a higher melting point than all the metals in the list. Mercury is an exceptional metal because its melting point is below those of some non-metals in the list.

Silver (PB page 112)

5 Sterling silver is harder than pure silver and will be less easily scratched, and the prongs of forks will be less prone to bending. The blades on silver knives (apart from fish knives) are almost always made of steel.

Copper (PB pages 112 and 113)

6 concentration of the ore, roasting of the ore and electrolysis

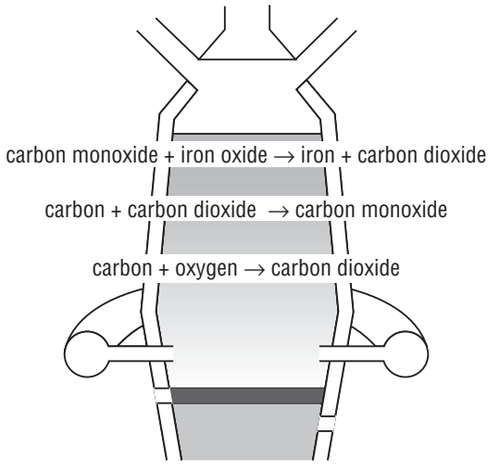
7 iron, silver and gold

8 It can be pulled into a wire and conducts electricity well.

9 It is stronger than copper and will not be damaged by being pushed into plug sockets and pulled out again.

Iron (PB pages 114 and 115)

10



11 The rocky substance, silicon oxide, does not melt at the temperature in the furnace. Limestone is added because it breaks down to form calcium oxide, which combines with silicon oxide to form calcium silicate or slag. This substance melts at the temperature in the furnace and flows out with the iron.

12 36 500 000 tonnes plus either 20 000 or 30 000 tonnes (depending on whether there were two or three leap years in the ten-year period).

13 Less fuel is needed to provide heat energy.

14 from the jet of air introduced into the bottom of the furnace

Early iron workers (PB page 116)

1 The armies of those countries that had iron would beat the armies of those countries that had bronze because the iron swords were stronger and the soldiers would not need to stop in battle to straighten them.

2 oxygen

3 It provided more oxygen to the hot metal ore.

4 iron and carbon

5 The Hittites discovered how to give wrought iron a steel coating. In Northern India it was discovered how to make wrought iron rustproof.

Iron (PB page 117)

For discussion A case could be made for us living in a 'steel world' as the uses of steel are so many and varied. It is used for car bodies, train wheels, railway tracks, ships, bed springs, wire fences and tools such as saws and chisels, and stainless steel is used for cutlery and kitchen sinks.

Carbon (PB pages 118 and 120)

15 It has more clay because graphite is a soft material and clay is harder.

16 Both are formed in igneous rock but graphite also forms in metamorphic rock. Both can be made artificially by heating; diamonds are made at a lower temperature but at a higher pressure.

The carbon atoms in graphite form hexagonal structures. In diamonds they form tetrahedral structures. The hexagonal structures are held together by strong forces.

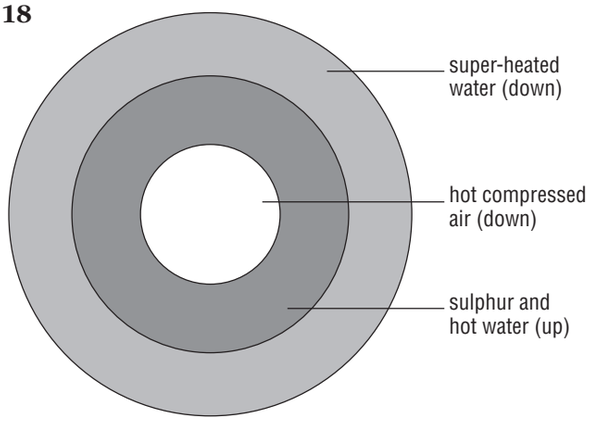
Graphite is used to make pencils and lubricants. Diamonds are used to make drills and jewellery.

Graphite and most diamonds are dark and opaque but some diamonds are transparent.

17 This statement is true. Carbon as graphite is used to make pencils for drawing and lubricants to make machinery run smoothly. Carbon as diamond is used to make drills to search for oil or to cut through concrete, glass and metals. Carbon as charcoal is used as a barbeque fuel where it provides heat without smoke, and in gas masks and aquarium filters where it removes harmful substances from the air and water respectively. Carbon as coke is used to extract some metals. It is alloyed with iron to make steel.

Sulphur (PB page 121)

18



Chemicals and the land environment (PB page 122)

19 Open cast mining destroys the habitat. In rainforests it also causes soil erosion which prevents the habitat re-forming when the mining has finished. Sinking mine shafts causes little damage but some damage will be done by making roads and living quarters for the miners.

Renewable and non-renewable materials (PB pages 123 and 124)

20 a) In planted forests there are few tree species and the trees are all the same age and regularly spaced out. In natural forests there are more tree species and the trees are different ages and irregularly spaced out.

b) The natural forests will support more wildlife as the greater number of tree species and wider range of ages will offer a wider variety of food (also setting up more food chains) and provide a wider variety of places where animals can make nests or hide away.

21 a) 40 years

b) This will depend on the year this work is studied.

Recycling (PB page 125)

22 a) 35.7 years

b) This will depend on the year this work is studied.

23 a) **i)** 200 years

ii) 125 years

b) It makes the reserves of the material last 160 years longer, or 89.3 years longer if the new product is produced.

24 This will depend on the year this work is studied.

25 It saves space, energy and raw materials.

Materials and energy (PB page 126)

26 No – they will not last so long, as the coal will be used to replace gas and oil.

27 It makes the stocks of fossil fuels last longer because less energy is used in recycling than in extraction.

Reaction with oxygen (PB page 128)

28 The product of the reaction of a metal with oxygen is a substance that dissolves in water to give a solution with a high pH. The product of the reaction of a non-metal with oxygen is a substance that dissolves to give a solution with a low pH.

29 Carbon is a non-metal because when it reacts with oxygen it produces carbon dioxide which dissolves in water to make a solution with a low pH: it is acidic. Magnesium is a metal because when it reacts with oxygen it produces a metal oxide which dissolves in water to make a solution with a high pH: it is alkaline.

Reaction with water (PB page 129)

30 potassium, sodium, calcium, magnesium, iron, copper

31 potassium, sodium, calcium, magnesium

32 potassium, sodium

33 a metal oxide

34 It would react with the hot water.

Reaction with acid (PB page 129)

35 magnesium, zinc, iron, lead, copper

36 There were more acid 'particles' (or ions) with which the metal could react.

37 It would react much faster.

38 metal + hydrochloric acid → metal chloride + hydrogen

End of chapter questions (PB page 132)

1 The table below shows examples of what could be included in the answer.

2 There should be strict controls on the use of pesticides so that they do not damage the health of humans and other animals which they were not intended to harm. Great care should also be taken to prevent radioactive chemicals escaping from nuclear power plants. Waste that cannot be recycled should be stored in tips and methane gas should be extracted from it to use as a fuel. All mining operations should attempt to do little long-term damage to the environment, and as many different kinds of materials as possible should be recycled to slow down the use of non-renewable materials. Where possible, renewable materials should be used in preference to non-renewable materials.

Substance	Sources	Extraction	Properties	Uses
silver	hydrothermal vents on its own or as silver glance (silver sulphide), recycled metals	in electrolysis as copper, zinc and lead are being purified	high reflectivity, soft, tarnishes in air	jewellery, cutlery, ornaments, coins, in photographic industry
copper	copper pyrites	concentration in flotation cell, roasted in furnace, electrolysis	soft, does not react with water, conducts heat and electricity well, corrodes slowly	water pipes, electrical wiring, kitchen pans
iron	haematite (iron oxide)	blast furnace with coke and limestone	can be cast into moulds	manhole covers in streets, car engine blocks
carbon (graphite)	pure form in igneous and metamorphic rocks, can be made artificially	mining	soft and opaque	pencils and lubricants
carbon (diamond)	pure form in igneous rocks, can be made artificially	mining	very hard, most opaque but some transparent	drills and jewellery
carbon (charcoal)	wood	heating wood in absence of air	absorbs gases	barbecue fuel, gas masks and water filters
carbon (coke)	coal	heating coal in absence of air	reducing agent	extraction of iron, zinc and lead
sulphur	some sedimentary rocks like limestone	super-heated water and compressed air	brittle yellow solid, poisonous to fungi	making sulphuric acid, fungicide, vulcanisation of rubber