1 Ammonium nitrate is present in many fertilisers.

Which **one** of these compounds is also present in many fertilisers?
Tick **one** box.

barium hydroxide	☐
potassium phosphate	☐
sodium chloride	☐
tin(II) sulfate	☐

[1]

[Total: 1]

2 State **one** use of chlorine.

..... [1]

[Total: 1]

3 Describe a chemical test for water.

test .....

observation ..... [2]

[Total: 2]

4 Oxides of nitrogen are formed when ammonia is heated with oxygen in the presence of a catalyst.

(a) Suggest why a catalyst is used.

..... [1]

(b) State **one** other process which puts oxides of nitrogen into the atmosphere.

..... [1]

(c) State **one** adverse effect of oxides of nitrogen on health.

..... [1]

[Total: 3]

5 Ammonia reacts with nitric acid to form a salt which is present in many fertilisers.

Name the salt formed when ammonia reacts with nitric acid.

..... [1]

[Total: 1]

6 Oxides of nitrogen are atmospheric pollutants.

State **one** adverse effect of oxides of nitrogen on health.

..... [1]

[Total: 1]

7 This question is about solids, liquids and gases.

(a) The list gives the names of nine substances which are solids at room temperature.

a ceramic

aluminium

anhydrous cobalt(II) chloride

anhydrous copper(II) sulfate

calcium oxide

graphite

iodine

iron

sodium

Answer the following questions about these substances.
Each substance may be used once, more than once or not at all.

State which substance:

(a) turns pink when water is added to it

..... [1]

(b) is a non-mental which is used as a lubricant

..... [1]

(c) is used to neutralise acidic industrial waste

..... [1]

(d) is extracted from bauxite

..... [1]

(e) is used as an electrical insulator.

..... [1]

[Total: 5]

8 This question is about solids and gases.

(a) The list gives the names of eight substances which are gases at room temperature.

ammonia

butane

carbon dioxide

carbon monoxide

chlorine

methane

propene

sulfur dioxide

Answer the following questions about these gases.
Each gas may be used once, more than once or not at all.

State which gas:

(a) is a poisonous product formed by the incomplete combustion of carbon

..... [1]

(b) is an alkene

..... [1]

(c) is formed when limestone is thermally decomposed

..... [1]

(d) is an element

..... [1]

(e) causes acid rain.

..... [1]

[Total: 5]

9 Carbon dioxide is formed:

- when an acid reacts with a carbonate
- as a product of the complete combustion of carbon-containing substances.

State **two** other sources of carbon dioxide.

1 .....

2 ..... [2]

[Total: 2]

10 Biogas is made by fermenting animal and vegetable waste.

The table shows the percentage composition of the gases present in a sample of biogas.

substance present	percentage present in biogas
carbon dioxide	36.8
hydrogen	0.6
methane	54.5
nitrogen	6.5
water vapour	
other substances	0.1
total	100.0

Deduce the percentage of water vapour present in this sample of biogas.

..... [1]

[Total: 1]

11 Biogas is made by fermenting animal and vegetable waste.

The table shows the percentage composition of the gases present in a sample of biogas.

substance present	percentage present in biogas
carbon dioxide	
hydrogen	1.0
methane	61.5
nitrogen	8.5
water vapour	2.2
other substances	0.1
total	100.0

Deduce the percentage of carbon dioxide present in this sample of biogas.

..... [1]

[Total: 1]

12 Biogas is made by fermenting animal and vegetable waste.

(a) The table shows the percentage composition of the gases present in a sample of biogas.

substance present	percentage present in biogas
carbon dioxide	28.5
hydrogen	1.0
methane	62.0
nitrogen	
water vapour	2.4
other substances	0.1
total	100.0

Deduce the percentage of nitrogen present in this sample of biogas.

..... [1]

[Total: 1]

13 Ammonia is used in the manufacture of fertilisers.

Name the **three** elements present in most fertilisers which improve plant growth.

1 .....

2 .....

3 ..... [3]

[Total: 3]

14 Sulfur dioxide is a toxic gas.

(a) State one **environmental** reason why sulfur dioxide should not be released into the atmosphere.

..... [1]

(b) Describe the test for sulfur dioxide.

test .....

.....

observations .....

..... [2]

[Total: 3]

15 Iron often rusts.

Name the **two** substances, other than iron, that must be present for iron to rust.

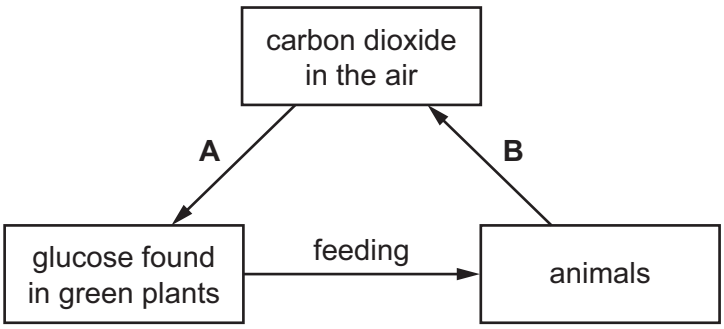
1 .....

2 ..... [1]

[Total: 1]

16 The CO_2 in air is part of the carbon cycle.

The scheme shows a simple representation of part of the carbon cycle.



State the scientific terms for each of process **A** and process **B**.

A .....

B ..... [2]

[Total: 2]

17 The gases Ar, CO_2, N_2 and O_2 are in clean, dry air.

CO, NO, NO_2 and SO_2 are gases commonly found in polluted air.

(a) What percentage of clean, dry air is N_2?

Give your answer to the nearest whole number.

..... % [1]

(b) Name the process used to separate O_2 from clean, dry air.

..... [2]

(c) State **one** major adverse effect of the pollutant SO_2.

..... [1]

(d) NO and NO_2 are produced in car engines.

Describe how oxides of nitrogen form in a car engine.

.....

.....

..... [2]

(e) Many cars have catalytic converters in their exhaust systems. In a catalytic converter, most of the CO and NO formed in a car engine is changed into less harmful products.

Identify these products and state the metal catalyst used.

products .....

catalyst ..... [3]

(f) CO is formed from the incomplete combustion of fossil fuels such as methane.

Write a chemical equation to show the incomplete combustion of methane.

..... [2]

[Total: 11]

18 Write a chemical equation for the **incomplete** combustion of C_4H_{10}.

..... [2]

[Total: 2]

19 Living organisms respire. Water is produced during respiration.

(a) Name the other product of respiration.

..... [1]

(b) Describe a chemical test for water.

test .....

observations..... [2]

[Total: 3]

20 When carbon burns in a limited supply of air, a poisonous gas is formed.

Name this gas.

..... [1]

[Total: 1]

21 This question is about Group IV elements and their compounds.

Lead compounds are pollutants in the air.

(a) State **one** source of lead compounds in the air.

..... [1]

(b) State **one** adverse effect of lead compounds on health.

..... [1]

[Total: 2]

22 Iron can be converted into steel in a basic oxygen converter.

Oxygen is blown into the impure molten iron to remove some of the impurities.

(a) Oxygen reacts with the carbon in the impure iron to form carbon dioxide.

Write a chemical equation for this reaction.

..... [2]

(b) Basic oxides in the lining of the converter react with impurities such as sulfur dioxide to form slag.

What type of oxide is sulfur dioxide?
Give a reason for your answer.

.....

..... [2]

[Total: 4]

23 Carbon dioxide is a greenhouse gas.

(a) Name **one** other major greenhouse gas.

..... [1]

(b) State **one** effect that greenhouse gases have on the environment.

..... [1]

[Total: 2]

24 Iron reacts with chlorine and other halogens.

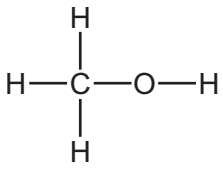
Name **two** other substances which react with iron.

1 .....

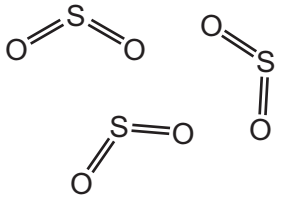
2 ..... [2]

[Total: 2]

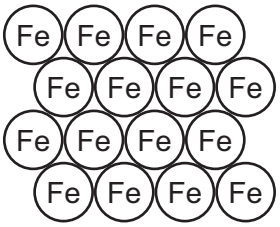
25 The diagrams show part of the structures of five substances, **A**, **B**, **C**, **D** and **E**.



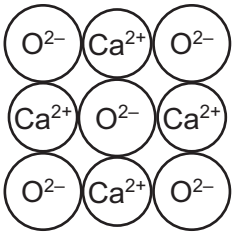
A



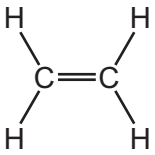
B



C



D



E

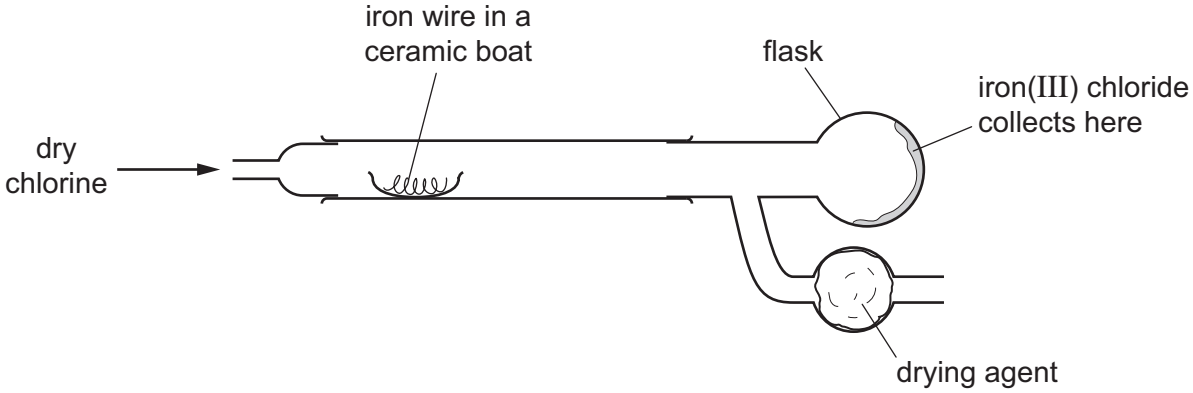
State which **one** of these structures, **A**, **B**, **C**, **D** or **E** contributes to acid rain.

..... [1]

[Total: 1]

26 Iron(III) chloride, Fe_2Cl_6, is produced when iron is heated with chlorine.
The diagram shows the apparatus used.

(a) Draw an arrow on the diagram to show where the apparatus is heated.



[1]

(b) Iron(III) chloride undergoes sublimation.

What is meant by the term *sublimation*?

.....

..... [1]

(c) Suggest why the iron(III) chloride is collected in the flask and **not** in the ceramic boat.

.....

..... [2]

(d) At higher temperatures, iron(III) chloride decomposes.

$$Fe_2Cl_6 \rightarrow 2FeCl_2 + Cl_2$$

Explain why this is a decomposition reaction.

.....

..... [1]

[Total: 5]

27 Sulfur dioxide is a pollutant in the air.

(a) State **one** source of sulfur dioxide in the air.

..... [1]

(b) Sulfur dioxide is oxidised to sulfur trioxide in the air.
Oxides of nitrogen act as catalysts for this reaction.

What is meant by the term *catalyst*?

.....

..... [1]

(c) Sulfur trioxide dissolves in rainwater to form acid rain.

Which **one** of the following pH values could be the pH of acid rain?
Draw a circle around the correct answer.

pH 4 pH 7 pH 9 pH 13 [1]

(d) State **one** adverse effect of acid rain on buildings.

..... [1]

[Total: 4]

28 The names of eight substances are given.

aluminium oxide **calcium oxide** **ethanol** **nitrogen**

iron(III) oxide **methane** **oxygen** **silicon(IV) oxide**

State which substance is a reactant in respiration.

..... [1]

[Total: 1]

29 The names of eight substances are given.

aluminium oxide **calcium oxide** **ethanol** **nitrogen**

iron(III) oxide **methane** **oxygen** **silicon(IV) oxide**

State which substance is a product of photosynthesis.

..... [1]

[Total: 1]

30 Carbon is an element which exists in different forms.

(a) Name **two** forms of the element carbon that have giant covalent structures.

..... and ..... [1]

(b) Name the oxide of carbon that is a toxic gas.

..... [1]

[Total: 2]

31 The names of eight substances are given.

aluminium oxide **calcium oxide** **ethanol** **nitrogen**

iron(III) oxide **methane** **oxygen** **silicon(IV) oxide**

State which substance is a greenhouse gas.

..... [1]

[Total: 1]

32 A compound of copper can be used to test for water.

(a) State the full name of this compound of copper.

..... [1]

(b) State the colour change that occurs when water is added to this compound of copper.

from ..... to ..... [2]

[Total: 3]

33 Methanol is made industrially by reacting carbon monoxide with hydrogen. The gases react at a temperature of 250 °C and a pressure of 75 atmospheres.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

The forward reaction is exothermic.

(a) Suggest a source of hydrogen for this industrial process.

..... [1]

(b) Complete the table using only the words *increases*, *decreases* or *no change*.

	effect on the rate of the reverse reaction	effect on the equilibrium yield of $CH_3OH(g)$
adding a catalyst		no change
increasing the temperature	increases	
decreasing the pressure		

[4]

[Total: 5]

34 Ammonia is used in the manufacture of some fertilisers.

Which **two** of these compounds are present in fertilisers?
Tick **two** boxes.

copper(II) oxide ☐

potassium chloride ☐

sodium phosphate ☐

strontium fluoride ☐

sulfur dioxide ☐

[2]

[Total: 2]

35 Bacteria in the soil are able to convert ammonium compounds into oxides of nitrogen.
The oxides of nitrogen can escape into the atmosphere.

(a) State **one** other source of oxides of nitrogen in the atmosphere.

..... [1]

(b) State **one** effect of oxides of nitrogen on health.

..... [1]

(c) Oxides of nitrogen are greenhouse gases which contribute to climate change.

Give the name of **one** other greenhouse gas which makes a major contribution to climate change.

..... [1]

[Total: 3]

36 Period 3 of the Periodic Table is shown.

sodium	magnesium	aluminium	silicon	phosphorus	sulfur	chlorine	argon

Answer the following questions using only these elements.

Each element may be used once, more than once or not at all.

State which element:

(a) is a gas at room temperature and pressure

..... [1]

(b) forms a basic oxide with a formula of the form X_2O

..... [1]

(c) is made of atoms which have a full outer shell of electrons

..... [1]

(d) forms an oxide which causes acid rain

..... [1]

(e) is extracted from bauxite

..... [1]

(f) forms an oxide which has a macromolecular structure

..... [1]

(g) consists of diatomic molecules.

..... [1]

[Total: 7]

37 Rust contains iron(III) oxide.

Phosphoric acid, H_3PO_4, can be used to remove rust from an iron object and prevent further rusting.

(a) Write a chemical equation for the reaction between iron(III) oxide and phosphoric acid to form iron(III) phosphate and water.

..... [2]

(b) Iron(III) phosphate is an insoluble salt.

Suggest how the formation of iron(III) phosphate prevents further rusting.

.....

..... [1]

[Total: 3]

38 Titanium is extracted from an ore called rutile. Rutile is an impure form of titanium(IV) oxide, TiO_2.

Rutile is mixed with coke and heated in a furnace through which chlorine gas is passed. The product is gaseous titanium(IV) chloride, $TiCl_4$.

$$TiO_2(s) + 2C(s) + 2Cl_2(g) \rightarrow TiCl_4(g) + 2CO(g)$$

The gaseous titanium(IV) chloride produced is condensed into the liquid state. The titanium(IV) chloride is then separated from liquid impurities.

(a) Suggest the name of the process by which liquid titanium(IV) chloride could be separated from the liquid impurities.

..... [1]

(b) Carbon monoxide, CO(g), is also produced in the reaction.

Why should carbon monoxide **not** be released into the atmosphere?

..... [1]

[Total: 2]

39 Cobalt is a transition element. Anhydrous cobalt(II) chloride is used to test for water.

State the colour change that occurs when water is added to anhydrous cobalt(II) chloride.

from ..... to ..... [2]

[Total: 2]

40 Iron is a transition element.

(a) Which **two** substances react with iron to form rust?

1 .....

2 ..... [2]

(b) Which metal is used to galvanise iron?

..... [1]

[Total: 3]