

1. 5070/21/M/J/16 QA4a

Ammonia is manufactured by the reaction between hydrogen and nitrogen in the Haber process.

(a) State the conditions used in the Haber process.

- temperature
- pressure
- catalyst [2]

2. 5070/21/M/J/16 A6

The atmosphere contains a large number of gases including oxygen, nitrogen, carbon dioxide, sulfur dioxide, oxides of nitrogen, methane and chlorofluorocarbons (CFCs).

(a) Carbon dioxide, methane and CFCs are greenhouse gases.

(i) State **one** effect of an increase in the atmospheric concentration of carbon dioxide and methane.

-
- [1]

(ii) State **one** source of methane gas.

- [1]

(iii) State one **other** environmental effect of the presence of CFCs in the atmosphere.

- [1]

(b) The formula of one chlorofluorocarbon is CFCl_3 .

Draw the 'dot-and-cross' diagram to show the bonding in a molecule of CFCl_3 . Only draw the outer-shell electrons.

[1]

(c) Oxides of nitrogen are produced during the combustion of petrol (gasoline) in a car engine.

(i) Describe the chemical reaction that takes place within a car engine to form nitric oxide, NO.

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

(ii) Most of the nitric oxide and other pollutants present in the exhaust gases of a car are removed in a catalytic converter.

Describe the redox reactions that happen within a catalytic converter.

.....
.....
.....
..... [2]

(d) Nitrogen dioxide is one of the causes of acid rain.

Two moles of nitrogen dioxide react with one mole of water to make an aqueous solution of two acids only.

One of these acids is nitric acid.

Deduce the formula of the other acid.

..... [1]

3. 5070/21/M/J/16 B9d

(d) The reaction between carbon and steam is a possible source of hydrogen.

(i) Suggest one disadvantage of using this reaction as a source of hydrogen.

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

(ii) Another source of hydrogen is the cracking of hydrocarbons from crude oil.

Give one advantage of manufacturing hydrogen from the reaction of carbon with steam rather than from crude oil.

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

4. 5070/22/M/J/16 QA4a

Sulfuric acid is manufactured by the contact process.

(a) State the conditions used in the contact process.

temperature

pressure

catalyst

[2]

5. 5070/22/M/J/16 QA6

River water contains dissolved minerals and gases.

- (a)** Carbon dioxide is one of the gases dissolved in river water.

Draw the 'dot-and-cross' diagram to show the bonding in a molecule of carbon dioxide. Only draw the outer-shell electrons.

[1]

- (b)** River water often contains dissolved compounds such as ammonium nitrate and calcium phosphate.

- (i)** State **one** source of both of these compounds.

..... [1]

- (ii)** Describe and explain the environmental effect of the presence of these dissolved compounds in river water.

.....
.....
.....
.....
.....
.....
.....
..... [3]

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(c) River water is often purified for use as drinking water.

Describe **three** processes involved in the purification of river water.

process 1

.....

.....

process 2

.....

.....

process 3

.....

.....

[3]

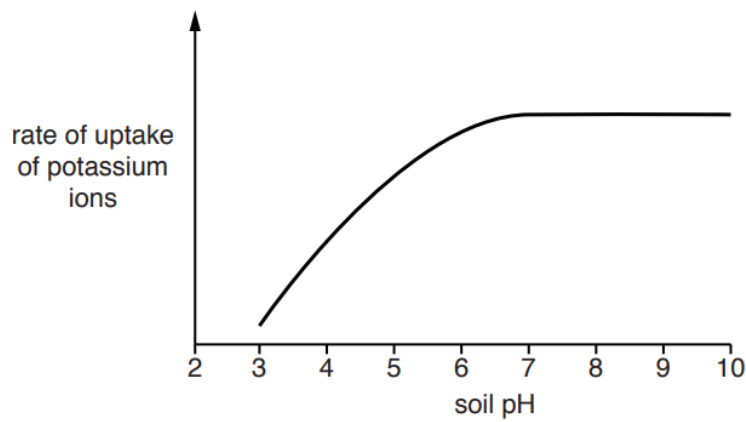
6. 5070/21/0/N/16 QA2 b to c

(b) Many plants cannot grow in soils which are too acidic.

Describe and explain how soils which are too acidic can be treated to reduce the acidity.

.....
.....
.....[2]

(c) The graph shows the effect of soil pH on the rate of uptake of potassium ions by plant roots.



Describe how the rate of uptake of potassium ions varies with soil pH.

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

7. 5070/21/0/N/16 QA6

Dry air contains nitrogen, oxygen, argon and other gases.

(a) State the percentage compositions by volume of nitrogen and oxygen present in dry air.

nitrogen %

oxygen %

[1]

(b) The formula for oxygen gas is O₂.

(i) Draw a 'dot-and-cross' diagram of an oxygen molecule.

Show only the outer shell electrons.

[1]

(ii) What is the formula of argon gas?

.....[1]

(c) Titanium is extracted from titanium(IV) chloride by reduction with molten sodium in an argon atmosphere and not in air.

Suggest why this reaction is carried out in an argon atmosphere and not in air.

.....
.....[2]

(d) State one other use of argon.

.....[1]

8. 5070/21/0/N/16 QB7e

(e) State **two** pollution problems caused by non-biodegradable plastics.

.....
.....[2]

9. 5070/22/0/N/16 QA3d

(d) (i) Construct the equation for the complete combustion of pentane, C_5H_{12} .

.....[2]

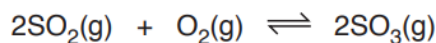
(ii) Name the products of the incomplete combustion of pentane and explain why the incomplete combustion of hydrocarbons is hazardous to health.

.....

.....[2]

10. 5070/22/0/N/16 B7

In the contact process, sulfur trioxide is made by the catalytic oxidation of sulfur dioxide. In a closed container the following equilibrium is set up.

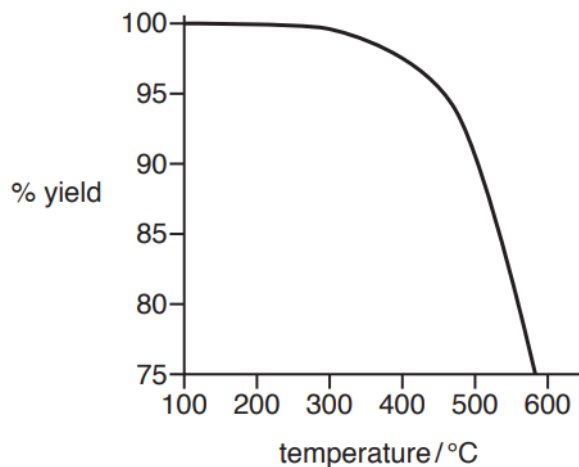


The reaction is exothermic.

(a) Name the catalyst used in this reaction.

.....[1]

(c) The graph shows the percentage yield of sulfur trioxide at different temperatures.



(ii) Suggest why the reaction is carried out at 450°C and not at 250°C.

.....

.....

.....[2]

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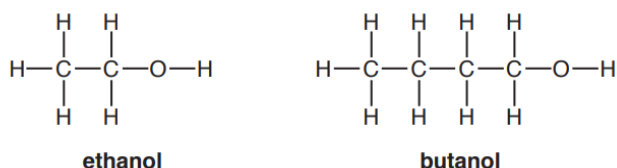
(e) Sulfur trioxide oxidises hydrogen bromide to form sulfur dioxide, bromine and water.

Construct the equation for this reaction.

.....[1]

11. 5070/21/M/J/17 A5b(ii)

Ethanol and butanol are both alcohols.



(ii) Construct an equation to show the **incomplete** combustion of ethanol.

.....[2]

f (ii) Poly(butene) is non-biodegradable.

What does the term *non-biodegradable* mean?

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

12. 5070/22/M/J/17 A5d(ii)

(ii) This polyester is biodegradable.

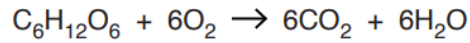
Suggest an advantage of a polymer being biodegradable.

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

13. 5070/22/M/J/17 QA6c

Respiration is a reaction that takes place in living cells to release energy.

The overall reaction involves the oxidation of glucose.



(c) Respiration, combustion and photosynthesis are important processes in the carbon cycle.

Describe how the carbon cycle regulates the amount of carbon dioxide in the atmosphere.

.....
.....
.....
.....[3]

14. 5070/22/M/J/17 QB9

Methane, ethane and propane are all gases at room temperature.

(a) State a use of methane.

.....[1]

(b) Describe one source of methane in the atmosphere.

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

(c) State one possible environmental consequence of the presence of methane in the atmosphere.

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

15. 5070/22/0/N/17 QB8c

- (c) Explain why nitrates in solid fertilisers spread onto soil are able to leach through the soil easily.

.....[1]

- (d) Nitrates are responsible for eutrophication.

What is meant by the term *eutrophication*?

.....
.....
.....[2]

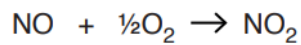
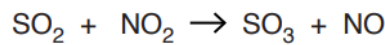
16. 5070/22/0/N/17 QB9b

- (b) Sulfur dioxide is an atmospheric pollutant.

- (i) Describe one source of the sulfur dioxide in the atmosphere.

.....[1]

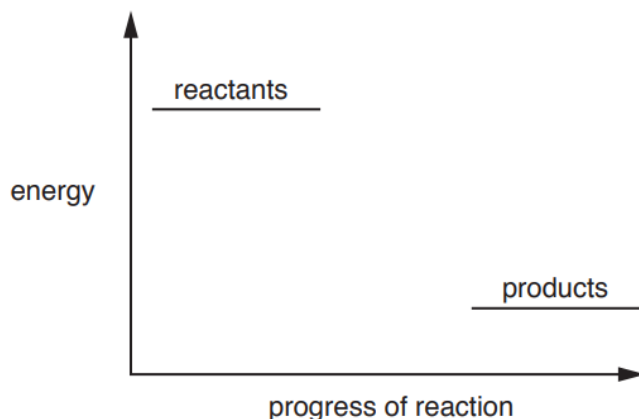
- (ii) The oxidation of sulfur dioxide to sulfur trioxide in the atmosphere is catalysed by nitrogen(IV) oxide.



Nitrogen(IV) oxide speeds up the rate of reaction. Which other property of a catalyst is shown by these equations?

.....[1]

- (c) (i) An incomplete energy profile diagram for the oxidation of sulfur dioxide to sulfur trioxide is shown.



On the diagram:

- draw and label the pathway for the uncatalysed reaction,
- draw and label the pathway for the catalysed reaction. [2]

- (ii) Is the reaction in (c)(i) exothermic or endothermic?

Explain your answer.

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

17. 5070/21/O/N/18 Q6d

- (d) Nitrogen is present in dry air.

- (i) State the percentage by volume of nitrogen in dry air.
.....[1]

- (ii) Nitrogen oxides are atmospheric pollutants.

The concentration of nitrogen oxides in the exhausts from car engines is decreased by using a catalytic converter.

Describe the reactions that occur in a catalytic converter which help to remove nitrogen oxides from car exhausts.

.....
.....
.....[2]

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

.....[1]

18. 5070/21/0/N/18 Q7

The products of respiration are carbon dioxide and water.

(a) Complete the equation for respiration.



(b) Carbon dioxide and methane are greenhouse gases which contribute to global warming.

(i) State one effect on the environment of an increase in global warming.

.....[1]

(ii) Describe how the carbon cycle regulates the amount of carbon dioxide in the atmosphere.

.....
.....
.....
.....[2]

19. 5070/22/0/N/18 Q6d

(d) Sulfur dioxide is an atmospheric pollutant.

(i) State one source of the sulfur dioxide in the atmosphere.

.....[1]

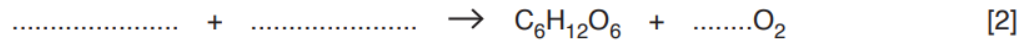
(ii) Describe and explain how sulfur dioxide contributes to acid rain.

.....
.....
.....[2]

20. 5070/22/0/N/18 Q7

Plants remove carbon dioxide from the air during photosynthesis.

(a) (i) Complete the equation for photosynthesis.



(ii) State two conditions required for photosynthesis to happen.

1.

2. [2]

(iii) Explain how photosynthesis can provide a renewable energy source.

.....

..... [1]

21. 5070/21/M/J/19 Q4

Air is a source of many gases.

(a) What is the percentage by volume of nitrogen in dry air?

..... [1]

(b) Outline the separation of oxygen, nitrogen and the noble gases from liquid air.

.....
.....
.....
.....
.....
.....
..... [3]

(c) State one large scale use of nitrogen.

..... [1]

(d) Air contains gaseous pollutants.

(i) Name one gas that contributes to acid rain.

..... [1]

(ii) State one environmental consequence of an increase in the percentage of carbon dioxide in the air.

..... [1]

(iii) Describe the source of carbon monoxide in air.

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

22. 5070/21/M/J/19 Q9c

(c) Some plastics are biodegradable.

(i) Suggest an advantage of a plastic that is biodegradable.

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

23. 5070/22/M/J/19 Q6

Drinking water is obtained by purification of sea water and river water.

(a) Desalination is used to convert sea water into drinking water.

What is desalination?

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

(b) River water is often polluted by phosphates and nitrates.

(i) Give the source of these two pollutants.

..... [1]

(ii) Name one environmental effect caused by these pollutants in river water.

..... [1]

(c) River water can be converted into drinking water.

(i) Describe how insoluble solids are removed from river water.

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

(ii) Name the substance used to remove bad tastes and odours from river water.

..... [1]

(iii) Name the substance used to disinfect river water so it is safe to drink.

..... [1]

24. 5070/21/O/N/19 Q4f

(f) Chlorofluorocarbons (CFCs) diffuse into the atmosphere.

Describe the effect of CFCs on the atmosphere and explain why this is a problem.

effect

.....

explanation

.....

[2]

25. 5070/21/O/N/19 Q9d

(d) Poly(ethene) is made from ethene monomers.

(i) Draw the structure of ethene, showing all of the atoms and all of the bonds.

[1]

(ii) Poly(ethene) is a non-biodegradable plastic.

What is meant by the term *non-biodegradable*?

.....

..... [1]

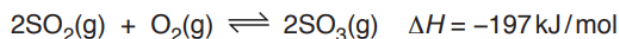
(iii) Describe one pollution problem caused by the disposal of non-biodegradable plastics.

.....

..... [1]

26. 5070/22/0/N/19 Q7

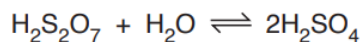
Sulfuric acid is made by the Contact process.



(a) Name the catalyst used in the Contact process.

..... [1]

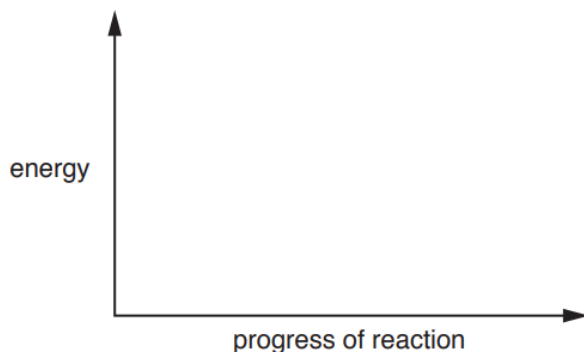
(c) The final step in the manufacture of sulfuric acid is an exothermic reaction.



On the axes, draw a labelled energy profile diagram for this exothermic reaction.

Show:

- the reactants and product
- the enthalpy change for the reaction
- the activation energy of the reaction.



[3]

(d) Air is a raw material used in the manufacture of sulfuric acid.

Name one other raw material used in the manufacture of sulfuric acid.

..... [1]

(e) State one major use of sulfuric acid.

..... [1]

27. 5070/21/M/J/20 Q7a

Carbon dioxide is a colourless gas found in air.

(a) The percentage of carbon dioxide in the air is increasing.

State one environmental problem caused by this increase.

..... [1]

28. 5070/22/M/J/20 Q9

Sulfur dioxide is a colourless gas which can be found in air.

(a) State one environmental problem caused by the presence of sulfur dioxide in air.

..... [1]

(b) When heated in air iron pyrite, FeS_2 , reacts with oxygen.

Sulfur dioxide and iron(III) oxide, Fe_2O_3 , are the products of this reaction.

Construct the equation for this reaction.

..... [2]

(c) Give one use for sulfur dioxide.

..... [1]

29. 5070/21/O/N/20 Q8c

(c) Nitrogen dioxide is an atmospheric pollutant which causes 'acid rain'.

Describe one effect of acid rain on buildings.

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

30. 5070/22/O/N/20 Q4

(e) A fuel cell generates electricity when hydrogen and oxygen react on platinum electrodes.

(i) Name a process used in industry to produce hydrogen.

..... [1]

(ii) Some cars use a hydrogen–oxygen fuel cell instead of a petrol (gasoline) engine as a source of energy.

Describe two advantages of a hydrogen–oxygen fuel cell compared with a petrol (gasoline) engine.

1.

2.

[2]

31. 5070/21/M/J/21 Q5

(b) Describe one environmental problem caused by sulfur dioxide in the air.

..... [1]

(c) Describe how sulfur dioxide is converted into sulfuric acid in the contact process.

.....
.....
.....
.....
..... [3]

(d) State one **other** use of sulfur dioxide.

..... [1]

32. 5070/21/M/J/21 Q6

Carbon dioxide and water vapour are greenhouse gases found in air.

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

..... [1]

(ii) State **one** environmental problem that may be caused by an increase in the percentage of carbon dioxide in the air.

..... [1]

33. 5070/22/M/J/21 Q3 a and b

(iii) This polymer is often disposed of by combustion.

Suggest one problem associated with this method of disposal.

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

(b) Lactic acid is used to make poly(lactic acid), a biodegradable polymer.

(i) Suggest what is meant by the term *biodegradable*.

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

34. 5070/22/M/J/21 Q5 c and d

(c) Describe how hydrogen is converted into ammonia in the Haber process.

Include the conditions used in the Haber process.

.....
.....
.....
.....
..... [3]

(d) State one **other** use for hydrogen.

..... [1]

35. 5070/22/M/J/21 Q6

Sulfur dioxide and oxides of nitrogen are pollutants found in air.

(a) State one environmental problem caused by the presence of sulfur dioxide in the air.

..... [1]

(b) Coal-fired power stations produce sulfur dioxide as a pollutant.

The sulfur dioxide produced is prevented from entering the air by a process called flue gas desulfurisation, FGD.

Name the compound used in FGD that reacts with the sulfur dioxide.

..... [1]

(c) Coal-fired power stations also produce oxides of nitrogen such as NO.

NO is produced when nitrogen, N₂, reacts with oxygen.

(i) Construct the equation for this reaction.

..... [1]

36. 5070/21/O/N/21 Q2

Dry air contains nitrogen, oxygen, noble gases and carbon dioxide.

(a) State the percentage of oxygen present in dry air.

..... [1]

(c) Describe how oxygen, nitrogen and the noble gases are separated from each other after carbon dioxide has been removed.

..... [2]

(e) Ozone, O₃, is formed in the atmosphere by the reaction of nitrogen dioxide with oxygen in the presence of ultraviolet light.

(i) State the type of chemical reaction that takes place when ozone is formed in this way.

..... [1]

(ii) Nitrogen dioxide is formed in internal combustion engines.

State one other source of nitrogen dioxide in the atmosphere.

..... [1]

(f) A layer of ozone is present high in the atmosphere.

State one problem for humans that can arise if the ozone layer is depleted by CFCs.

..... [1]

37. 5070/21/O/N/21 Q9

This question is about ammonia and nitrates.

(a) State the source of the hydrogen and nitrogen used in the manufacture of ammonia by the Haber process.

source of hydrogen

source of nitrogen

[2]

(e) Nitrates from fertilisers cause eutrophication when they are leached from soils into rivers.

Describe the process of eutrophication.

.....
.....
.....
.....
..... [3]

38. 5070/22/0/N/21 Q2

(a) Hydrocarbons such as octane are used as fuels for cars.
The list shows the gases present in a car exhaust.

- carbon dioxide
- carbon monoxide
- nitrogen
- nitrogen dioxide
- octane
- water vapour

State which two gases in the list show that incomplete combustion has taken place in this car engine.

1

2 [2]

(c) Two natural sources of methane in the atmosphere are from leaks of natural gas and waste gases from animals.

Give one other natural source of methane in the atmosphere.

..... [1]

(d) Complete this sentence about the effect of an increase in the concentration of methane in the atmosphere.

Methane is a gas because it absorbs and then re-emits infrared radiation. This contributes to an increase in temperature of the atmosphere which is called

..... [2]

(e) Cars are fitted with catalytic converters to reduce the amount of harmful pollutant gases from car exhausts.

Describe how catalytic converters remove pollutant gases from car exhausts.

.....

.....

.....

.....

..... [3]

39. 5070/22/0/N/21 Q9a

This question is about sulfuric acid and sulfates.

- (a) (i) Sulfur is one of the raw materials used in the Contact process to make sulfuric acid. Name two other raw materials used to make sulfuric acid.

..... and [1]

- (ii) Name the catalyst used in the Contact process.

..... [1]

40. 5070/21/M/J/22 Q9

Ammonia, NH_3 , is used to make nitrogenous fertilisers.

- (a) Ammonia is manufactured using the reversible reaction between nitrogen and hydrogen.

Construct the equation for this reversible reaction.

..... [2]

- (c) Nitrogenous fertilisers such as ammonium nitrate leach from farmland and cause water pollution problems in rivers and lakes.

- (i) Name the process caused by this type of water pollution.

..... [1]

- (ii) Explain why this type of water pollution problem is increased when nitrate fertilisers are used instead of other fertilisers.

.....

..... [1]

- (d) A farmer adds ammonium nitrate, NH_4NO_3 , to soil. The farmer then adds calcium hydroxide, $\text{Ca}(\text{OH})_2$, to the same soil.

- (i) State the purpose of adding calcium hydroxide to soil.

..... [1]

- (ii) Construct the equation for the reaction between ammonium nitrate and calcium hydroxide.

Using your equation, explain why the ammonium nitrate fertiliser is less effective after calcium hydroxide is added.

.....

.....

.....

..... [2]

41. 5070/22/M/J/22 Q10c

(c) Fertilisers leach into rivers and cause water pollution problems.

(i) Name one **other** pollutant found in river water.

..... [1]

(ii) State **three** processes used in the purification of river water to produce drinking water.

.....
.....
..... [3]

42. 5070/21/O/N/22 Q2 b

(b) The main processes in the carbon cycle are combustion, respiration and photosynthesis.

(i) Name the products of photosynthesis.

..... and [1]

43. 5070/21/O/N/22 Q3d

(d) Carbon monoxide is formed when alkenes undergo incomplete combustion.

State **one** effect of carbon monoxide on health.

..... [1]

44. 5070/21/O/N/22 Q4a(i)

This question is about ammonia and ammonium salts.

(a) Ammonia is manufactured by the Haber process.

(i) Name the catalyst used in the Haber process.

..... [1]

45. 5070/22/O/N/22 Q2

a (ii) State **one** use of chlorine.

(d) Chlorofluorocarbons (CFCs) are atmospheric pollutants which deplete the ozone layer.

Explain the importance of the ozone layer.

Describe **one** problem caused by the depletion of the ozone layer.

importance

.....

problem

.....

[2]

46. 5070/22/O/N/22 Q4

- (a) Ammonium sulfate is a fertiliser.

Explain why farmers put fertilisers on soil where crops are grown.

..... [1]

- (b) Explain why farmers do **not** add calcium hydroxide to the soil immediately after adding ammonium sulfate.

.....
..... [2]

47. 5070/22/O/N/22 Q5d

- (iii) State **one** advantage of recycling metals such as aluminium and copper.

..... [1]

48. 5070/22/O/N/22 Q6

6 This question is about nitrogen and oxides of nitrogen.

- (a) State the percentage of nitrogen by volume in dry air.

..... [1]

- (d) Nitrogen oxides are pollutants in the atmosphere.

- (i) State **one** source of nitrogen oxides in the atmosphere.

..... [1]

- (ii) Nitrogen oxides contribute to acid rain.

State **one** effect of acid rain on buildings.

..... [1]

49. 5070/21/M/J/23 Q9

- (b) Nitrogen and oxygen react to make nitrogen monoxide inside a car engine.

Construct the equation for this reaction.

..... [1]

- (c) State **one** adverse effect of oxides of nitrogen as pollutants in the air.

..... [1]

- (d) Describe how oxides of nitrogen formed in a car engine are removed by a catalytic converter.

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

50. 5070/21/M/J/23 Q10

- (b) Poly(propene) is a polymer used to make plastic food containers.

The diagram in Fig. 10.2 shows the structure of poly(propene).

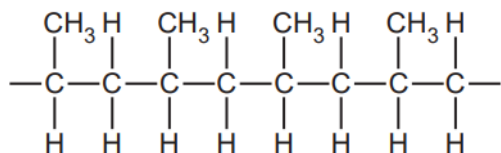


Fig. 10.2

- (i) Some waste poly(propene) plastic is disposed of by burning.

This makes a toxic gas because of incomplete combustion.

Name this toxic gas.

..... [1]

- (ii) State one **other** environmental challenge caused by the disposal of waste poly(propene) plastic.

Explain how this challenge is related to the properties of poly(propene).

environmental challenge

explanation

[2]

51. 5070/22/M/J/23 Q9c

(c) Higher levels of atmospheric carbon dioxide lead to increased global warming.

(i) Give **one** adverse effect of global warming.

..... [1]

(ii) Describe how the presence of gases such as carbon dioxide in the atmosphere causes global warming.

.....
.....
..... [2]

(d) Carbon dioxide is removed from the atmosphere by photosynthesis.

State the word equation for photosynthesis.

..... [1]

52. 5070/22/M/J/23 Q10c

PET is a polymer used to make plastic bottles.

(c) Describe **two** environmental challenges caused by the disposal of plastics such as PET.

1

.....

2

..... [2]