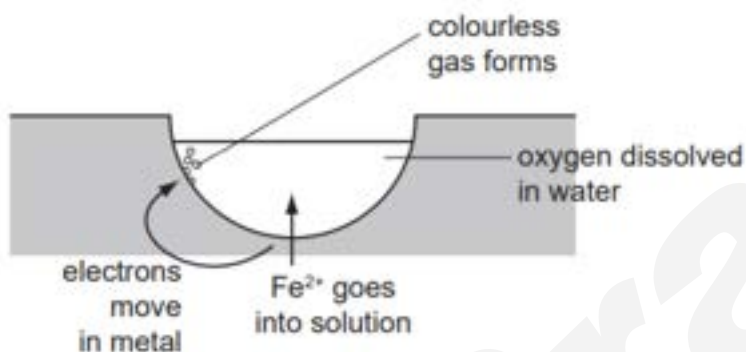


Chemistry Of The Environment

(Past Year Topical Questions 2010-2015)

May/June 2010 (32)/Q3

(b) Iron and steel in the presence of water and oxygen form rust.



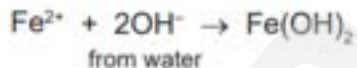
The reactions involved are:

reaction 1



The electrons move through the iron on to the surface where a colourless gas forms.

reaction 2



reaction 3



The water evaporates to leave rust.

(i) What type of reaction is **reaction 1**? [1]

(ii) Deduce the name of the colourless gas mentioned in **reaction 1**.

..... [1]

(iii) What is the name of the iron compound formed in **reaction 2**?

..... [1]

(iv) Balance the equation for **reaction 3**.



(v) Explain why the change Fe(OH)_2 to Fe(OH)_3 is oxidation.

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

(vi) Explain why iron in electrical contact with a piece of zinc does not rust.

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

Oct/Nov 2010 (31)

4 Ammonia is an important industrial chemical.

(a) (i) Give the electron structure of an atom of nitrogen.

..... [1]

(ii) Use this electronic structure, rather than the valency of nitrogen, to explain why the formula of ammonia is NH_3 not NH_4 .

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

Oct/Nov 2011 (31)

2 Two important greenhouse gases are methane and carbon dioxide.

(a) Methane is twenty times more effective as a greenhouse gas than carbon dioxide. The methane in the atmosphere comes from both natural and industrial sources.

(i) Describe **two** natural sources of methane.

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

(ii) Although methane can persist in the atmosphere for up to 15 years, it is eventually removed by oxidation. What are the products of this oxidation?

..... [2]

- (b) How do the processes of respiration, combustion and photosynthesis determine the percentage of carbon dioxide in the atmosphere?

.....
.....
.....
..... [4]

[Total: 8]

Oct/Nov 2011 (33)

- 3 Fertilisers are used to promote plant growth.
Two fertilisers are ammonium phosphate, $(\text{NH}_4)_3\text{PO}_4$, and calcium dihydrogenphosphate, $\text{Ca}(\text{H}_2\text{PO}_4)_2$.

- (a) Describe a test to distinguish between these two fertilisers.

test
..... [2]

result
..... [1]

- (b) Many fertilisers are manufactured from ammonia. Describe how ammonia is made in the Haber process. Give the essential conditions and an equation for the process.

.....
.....
.....
..... [4]

- (c) State the essential plant nutrient not supplied by ammonium phosphate.

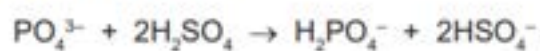
..... [1]

(d) The soluble compound, calcium dihydrogenphosphate is made by heating the insoluble mineral rock phosphate, $\text{Ca}_3(\text{PO}_4)_2$, with sulfuric acid.

(i) Why would rock phosphate not be effective as a fertiliser?

..... [1]

(ii) The phosphate ion, PO_4^{3-} , from the rock phosphate is changed into the dihydrogenphosphate ion, H_2PO_4^- .



What type of reagent is the phosphate ion? Give a reason for your choice.

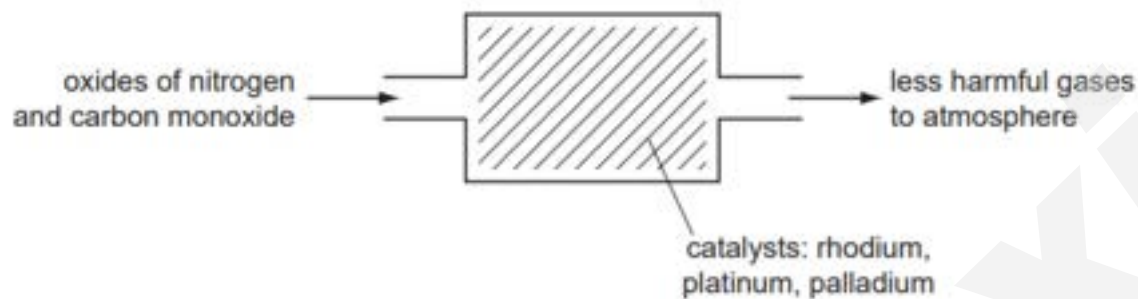
.....
..... [2]

(e) The extensive use of fertilisers and possibly the effect of acid rain tend to increase the acidity of the soil. State why it is necessary to control soil acidity and explain how this can be done.

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

Oct/Nov 2012 (31)/Q3

(c) Catalytic converters reduce the pollution from motor vehicles.



(i) Describe how carbon monoxide and the oxides of nitrogen are formed in car engines.

.....

.....

.....

..... [4]

(ii) Describe the reaction(s) inside the catalytic converter which change these pollutants into less harmful gases. Include at least one equation in your description.

.....

.....

..... [3]

Oct/Nov 2012 (33)

2 (a) State a use for each of the following gases.

(i) chlorine [1]

(ii) argon [1]

(iii) ethene [1]

(iv) oxygen [1]

(b) Describe how oxygen is obtained from air.

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

[Total: 6]

7 Ammonia is made by the Haber process.



(a) State **one** major use of ammonia.

..... [1]

(b) Describe how hydrogen is obtained for the Haber process.

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

(c) This reaction is carried out at a high pressure, 200 atmospheres.
State, with an explanation for each, **two** advantages of using a high pressure.

.....
.....
.....
.....
..... [5]

(d) (i) What is the difference between an endothermic and an exothermic reaction?

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

May/June 2013 (31)/Q6

- (b) Ammonia is manufactured by the Haber Process. The economics of this process require that as much ammonia as possible is made as quickly as possible. Explain how this can be done using the following information.

The conditions for the following reversible reaction are:

- 450 °C
- 200 atmospheres pressure
- iron catalyst



.....

.....

.....

.....

.....

.....

..... [5]

May/June 2013 (32)

- 1 Air is a mixture of gases. The main constituents are the elements oxygen and nitrogen.

(a) (i) Name another element in air.

..... [1]

(ii) Give the formula of a compound in unpolluted air.

..... [1]

(b) Common pollutants present in air are the oxides of nitrogen and sulfur dioxide.

(i) How are the oxides of nitrogen formed?

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

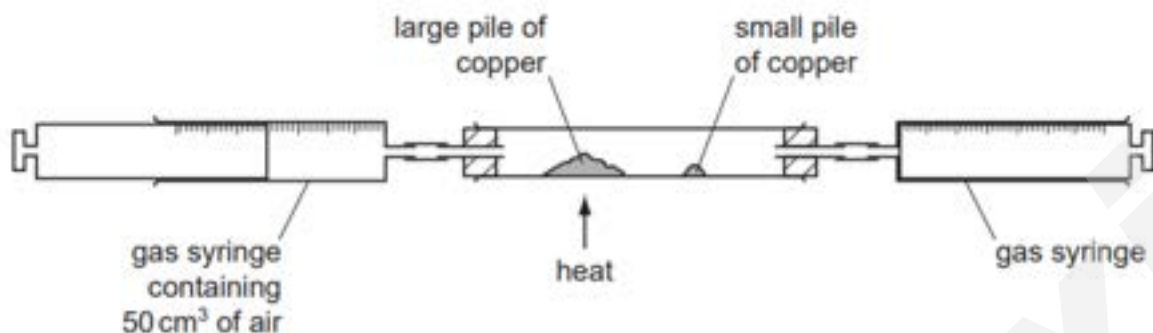
(ii) How is sulfur dioxide formed?

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

(iii) These oxides are largely responsible for acid rain.
State **two** harmful effects of acid rain.

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

(c) The percentage of oxygen in air can be determined by the following experiment.



The gas syringe contains 50 cm³ of air. The large pile of copper is heated and the air is passed from one gas syringe to the other over the hot copper. The large pile of copper turns black. The gas is allowed to cool and its volume measured.

The small pile of copper is heated and the remaining gas passed over the hot copper. The copper does not turn black. The final volume of gas left in the apparatus is less than 50 cm³.

(i) Explain why the copper in the large pile turns black.

.....
 [2]

(ii) Why must the gas be allowed to cool before its volume is measured?

..... [1]

(iii) Explain why the copper in the small pile did not turn black.

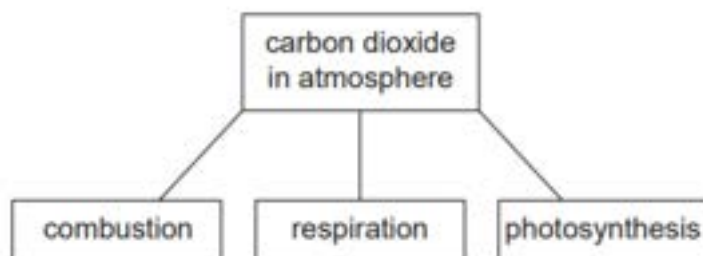
..... [1]

(iv) What is the approximate volume of the gas left in the apparatus?

..... [1]

[Total: 13]

- 3 The diagram shows some of the processes which determine the percentage of carbon dioxide in the atmosphere.



- (a) Explain how the following two processes alter the percentage of carbon dioxide in the atmosphere.

(i) combustion

.....

.....

..... [3]

(ii) respiration

.....

.....

..... [3]

- (b) Photosynthesis reduces the percentage of carbon dioxide in the atmosphere.

(i) Complete the word equation for photosynthesis.



(ii) State **two** essential conditions for the above reaction to occur.

.....

..... [2]

[Total: 10]

May/June 2014 (31)

2 (a) Water is needed for industry and in the home.

(i) Rain water is collected in reservoirs. How is it treated before entering the water supply?

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

(ii) State **two** industrial uses of water.

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

(iii) State **two** uses of water in the home.

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

(b) In many regions, drinking water is obtained by the distillation of sea-water. Explain how distillation separates the water from sea-water.

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

[Total: 7]

May/June 2014 (32)

3 Plant growth is improved by the availability of essential elements, such as nitrogen, and by the soil having a suitable pH.

(a) Nitrogen-based fertilisers are made from ammonia. Ammonia is manufactured by the Haber process.

(i) Describe the Haber process giving reaction conditions and a balanced equation. (Do not discuss reaction rate and yield.)

.....
.....
.....
.....
..... [5]

(ii) Fertilisers contain nitrogen. Name the other two elements essential for plant growth commonly found in fertilisers.

..... [2]

(b) Crops do not grow well if the soil is too acidic.

(i) One cause of acidity in soil is acid rain. Explain how acid rain is formed.

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

(ii) Name two bases which are used to increase the pH of acidic soils.

..... [2]

[Total: 12]

May/June 2014 (33)

- 1 Choose a gas from the following list to answer the questions below. Each gas may be used once, more than once or not at all.

ammonia carbon dioxide carbon monoxide fluorine
hydrogen krypton nitrogen propene sulfur dioxide

- (a) It is a product of respiration. [1]
(b) It polymerises to form a poly(alkene). [1]
(c) It is a noble gas. [1]
(d) It is the main component of air. [1]
(e) It is a very reactive non-metal. [1]
(f) It is used to kill micro-organisms in fruit juice. [1]
(g) It burns to form water as the only product. [1]

[Total: 7]

Oct/Nov2014(31)

- 5 Three common pollutants in the air are carbon monoxide, the oxides of nitrogen, NO and NO₂, and unburnt hydrocarbons. They are all emitted by motor vehicles.

(a) Describe how the oxides of nitrogen are formed.

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

(b) Describe how a catalytic converter reduces the emission of these three pollutants.

.....
.....
.....
.....
..... [4]

(c) Other atmospheric pollutants are lead compounds from leaded petrol.
Explain why lead compounds are harmful.

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

[Total: 7]

May/June 2015 (31)

- 1 (a) Coal is a solid fossil fuel.

Name **two** other fossil fuels.

..... [2]

- (b) Two of the elements present in a sample of coal are carbon and sulfur.

A sample of coal was heated in the absence of air and the products included water, ammonia and hydrocarbons.

Name **three** other elements present in this sample of coal.

..... [2]

- (c) Sulfur, present in coal, is one major cause of acid rain. Sulfur burns to form sulfur dioxide which reacts with rain water to form sulfuric acid.

- (i) Describe how the high temperatures in vehicle engines are another cause of acid rain.

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

- (ii) Give **two** harmful effects of acid rain.

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

- (d) In 2010, a large coal-burning power station in the UK was converted to burn both coal and wood.

Explain why the combustion of wood rather than coal can reduce the effect of the emissions from this power station on the level of carbon dioxide in the atmosphere.

.....

.....

.....

..... [3]

[Total: 12]

May/June 2015 (32)

- 6 The Atacama desert in Chile has deposits of the salt sodium nitrate. Very large amounts of this salt were exported to Europe for use as a fertiliser. After the introduction of the Haber process in 1913, this trade rapidly diminished.

- (a) (i) Explain why the introduction of the Haber process reduced the demand for sodium nitrate.

.....

..... [2]

- (ii) Suggest why surface deposits of sodium nitrate only occur in areas with very low rainfall such as desert areas.

..... [1]

- (iii) The desert has smaller surface deposits of potassium nitrate.

Suggest why potassium nitrate is a better fertiliser than the sodium salt.

..... [1]

May/June 2015 (33)

4 (a) (i) Coal is a solid fossil fuel.

(b) The burning of fossil fuels is largely responsible for the formation of acid rain. Two of the acids in acid rain are sulfuric acid and nitric acid.

(i) Explain how the combustion of coal can form sulfuric acid.

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

(ii) High temperatures generated by the combustion of fossil fuels can lead to the formation of nitric acid. Explain.

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

(iii) Nitric acid contains nitrate ions.

Describe a test for nitrate ions.

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

(iv) Explain how you could determine which one of two samples of acid rain had the higher concentration of hydrogen ions.

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

Oct/Nov 2015 (32)

2 (a) Polluted air contains two oxides of carbon and two oxides of nitrogen. A major source of these pollutants is motor vehicles.

(i) Describe how carbon dioxide and carbon monoxide are formed in motor vehicle engines.

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

(ii) State one adverse effect of each of these gases.

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

(iii) Nitrogen monoxide, NO, is released by motor vehicle exhausts.

Explain how nitrogen monoxide is formed in motor vehicle engines.

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

(iv) When nitrogen monoxide is released into the atmosphere, nitrogen dioxide, NO₂, is formed.

Suggest an explanation why this happens.

..... [1]

- (b) Predict the possible adverse effect on the environment when this non-metal oxide, NO_2 , reacts with water and oxygen.

.....
 [2]

- (c) How are the amounts of carbon monoxide and nitrogen monoxide emitted by modern motor vehicles reduced? Include an equation in your answer.

.....

 [3]

[Total: 13]

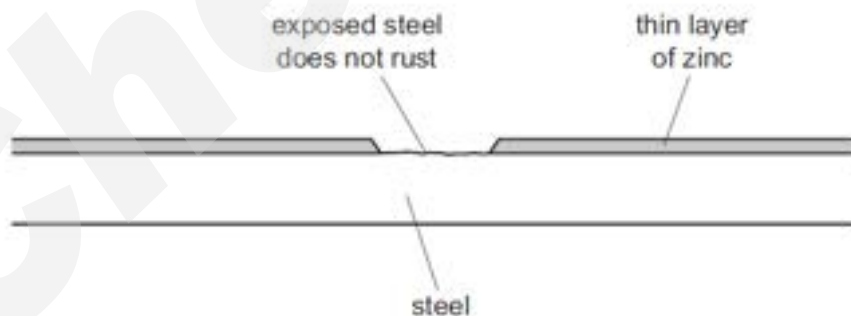
Oct/Nov 2015 (32)/Q3

- (e) In an experiment to investigate the rate of rusting of steel, three pieces of steel were used. One piece of steel was completely coated with copper, one piece completely coated with zinc and the third piece was left uncoated. All three pieces were left exposed to the atmosphere.

- (i) Explain why the uncoated piece started to rust.

.....
 [1]

- (ii) The coating on both of the other two pieces was scratched, exposing the steel.



The piece of steel coated with zinc still did not rust but the copper-coated piece of steel rusted very rapidly.

Explain these observations in terms of the formation of ions and the transfer of electrons.

.....
.....
.....
.....
..... [4]

Oct/Nov 2015 (33)

1 (a) Describe a chemical test which shows the presence of water.

test

colour change if water is present

..... [3]

(b) How could you show that a sample of water is pure?

..... [1]

(c) Describe how water is treated before it is supplied to homes and industry.

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

(d) State **two** industrial uses of water.

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

[Total: 8]