AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.6.2 REVERSIBLE REACTIONS AND DYNAMIC EQUILIBRIUM (PACK 3)

SCORE	PERCENTAGE
/63	%

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Q1.

(a) What percentage of the Earth's atmosphere is nitrogen?

Tick **one** box.

5% ☐ 20% ☐ 50% ☐ 80% ☐

(1)

(b) During the first billion years of the Earth's existence the amount of nitrogen in the atmosphere increased.

Give **one** source of this nitrogen.

_____

(1)

(c) Nitrogen is used to make ammonia.

The word equation for the reaction is:

nitrogen + hydrogen _____ ammonia

Write the correct symbol in the equation to show that it is a reversible reaction.

(1)

(d) A reversible reaction can reach equilibrium.

Complete the sentence.

Equilibrium is reached when the forward reaction and the reverse reaction happen at the same _____ .

(1)

(e) Fertilisers are formulations containing nitrogen.

What is a formulation?

_____

_____

(1)

(f) The table below shows percentages of chemical elements in a fertiliser.

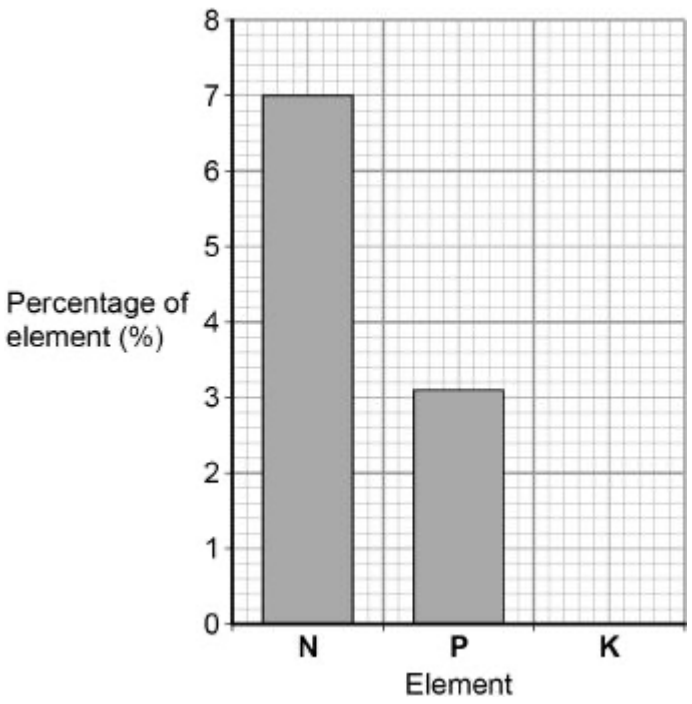
Element	**Percentage (%)**
Nitrogen (N)	7.0
Phosphorus (P)	3.1
Potassium (K)	5.8

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Draw the bar for potassium on **Figure 1**

Use the information in the table above.

Figure 1



(1)

(g) A fertiliser contains 0.225 g of iron per 3.0 g of fertiliser.

Which calculation gives the percentage of iron in the fertiliser?

Tick **one** box.

$\frac{0.225}{3.0 \times 100}$ ☐

$\frac{3.0 \times 100}{0.225}$ ☐

$\frac{0.225 \times 3.0}{100}$ ☐

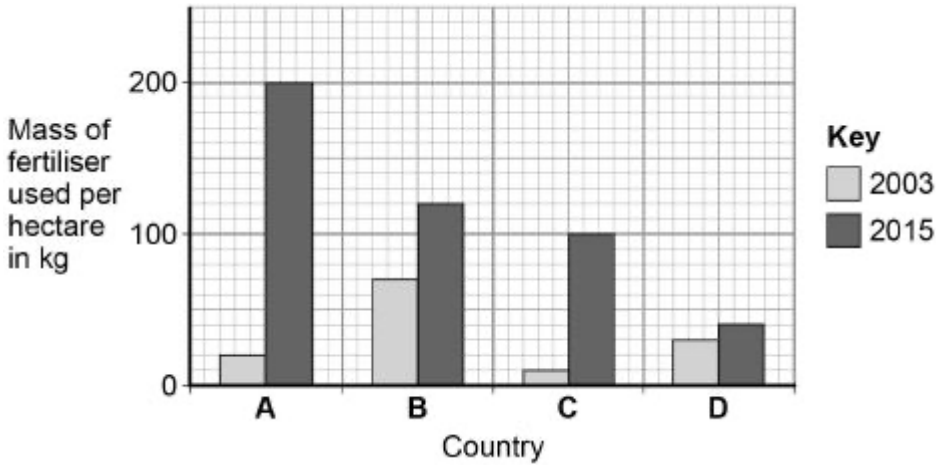
$\frac{0.225 \times 100}{3.0}$ ☐

(1)

(h) **Figure 2** shows the use of fertiliser in four different countries, **A**, **B**, **C** and **D**, in 2003 and 2015

Figure 2

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A student said:

'**much** more fertiliser was used in 2015 than in 2003'

Is the student correct?

Use data from **Figure 2** to justify your answer.

_____

_____

_____

_____

_____

_____

(3)

(Total 10 marks)

Q2.

Bleach is a solution of sodium hypochlorite (NaClO).

Chlorine gas is produced when bleach reacts with hydrochloric acid.

$$NaClO(aq) + 2HCl\ (aq) \rightleftharpoons NaCl(aq) + H_2O(l) + Cl_2(g)$$

(a) Give the test and result for chlorine gas.

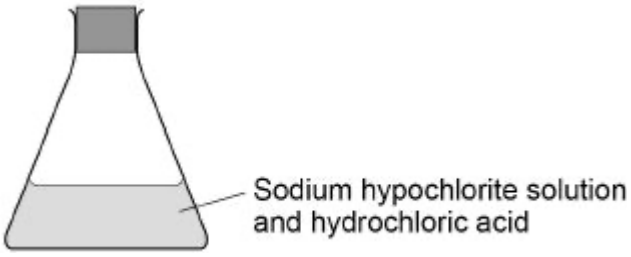
_____

_____

(2)

The diagram below shows a sealed flask of sodium hypochlorite and hydrochloric acid at equilibrium.

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(b) Explain why equilibrium is reached in this reaction.

(2)

(c) The stopper in the diagram above is removed and hydrochloric acid is added.

The stopper is replaced.

Explain what happens to the equilibrium.

(4)

Chlorine gas is also produced when hydrogen chloride decomposes.

$$2HCl(g) \rightleftharpoons H_2(g) + Cl_2(g)$$

The forward reaction is endothermic.

(d) Predict the effect of increasing the temperature on the amount of chlorine gas produced at equilibrium.

Explain your answer using Le Chatelier's Principle.

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_____

_____

_____

_____

(2)

(e) Explain the effect of increasing the pressure on this equilibrium.

_____

_____

_____

_____

(2)

(Total 12 marks)

Q3.

This question is about copper and its compounds.

(a) The table shows information about bioleaching and phytomining.

Bioleaching and phytomining are used to extract copper from low grade ores.

	Bioleaching	**Phytomining**
Metal extracted from	Waste from quarrying	Contaminated ground
Speed of process	Very slow	Slow, made more efficient using quick-growing plants
Pollution	Produces a solution of toxic chemicals which may run off into rivers Takes a long time to stop the process if river pollution occurs	Involves combustion of plants but decontaminates polluted ground

Compare phytomining and bioleaching.

Use the information in the table.

_____

_____

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(4)

(b) Describe how copper sulfate solution is obtained from the plants used in phytomining.

(2)

(c) Copper is displaced from a solution of copper sulfate using iron.

Write a balanced symbol equation for this reaction.

(2)

(d) How does this displacement reaction take place?

Tick **one** box.

Electron sharing	☐
Electron transfer	☐
Proton transfer	☐

(1)

(e) Describe how copper conducts electricity.

(2)

(f) Suggest how anhydrous copper sulfate is used to test for water.

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_____

_____

_____

_____

(2)

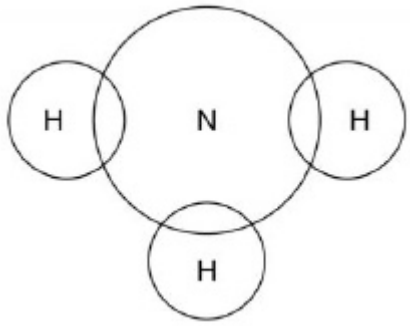
(Total 13 marks)

Q4.

This question is about ammonia (NH_3).

(a) Complete the diagram to show the bonding electrons in ammonia.

Show the outer electrons only.



(2)

Ammonia is produced from nitrogen and hydrogen.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.

(b) A low pressure is used.

Explain the effect on the yield of ammonia.

_____

_____

_____

_____

(2)

(c) A high temperature is used.

Explain the effect on the yield of ammonia.

_____

_____

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(2)

(d) Ammonia is removed from the reaction mixture.

Explain the effect on the position of equilibrium.

(2)

(Total 8 marks)

Q5.

Sulfur dioxide (SO_2) is used to manufacture sulfuric acid.

(a) Explain why sulfur dioxide has a low boiling point.

(3)

(b) The equation shows one stage in the manufacture of sulfuric acid from sulfur dioxide.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The reaction is exothermic in the forward direction.

Use Le Chatelier's Principle to predict the effect of increasing the temperature on the amount of sulfur trioxide (SO_3) produced at equilibrium.

Give a reason for your answer.

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(2)

(c) Use Le Chatelier's Principle to predict the effect of increasing the pressure on the amount of sulfur trioxide (SO_3) produced at equilibrium.

Give a reason for your answer.

(2)

(Total 7 marks)

Q6.

Ammonium nitrate (NH_4NO_3) is produced by reacting ammonia with nitric acid.

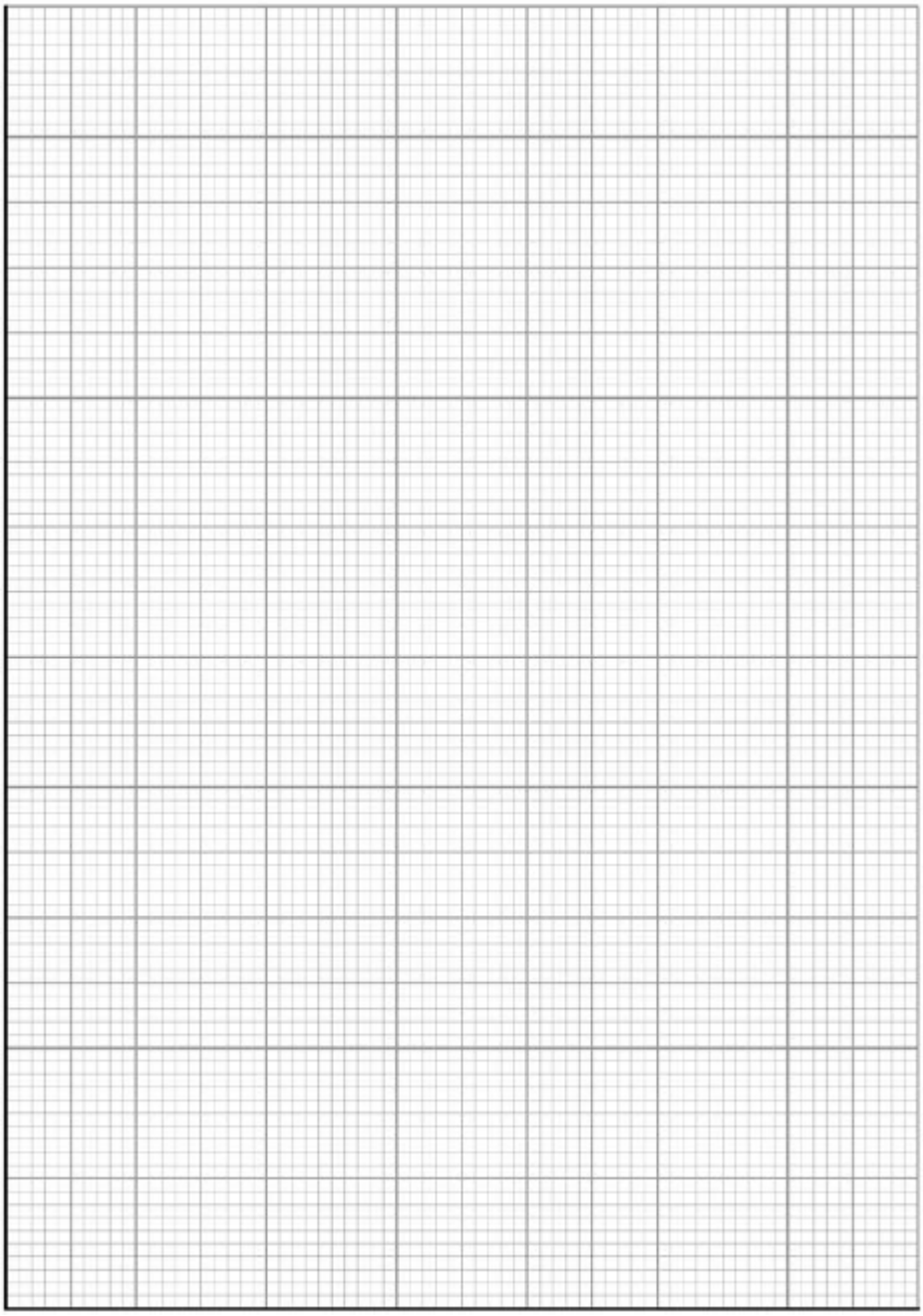
A student measured the mass of ammonium nitrate that dissolves in 100 cm^3 of water at different temperatures.

The table below shows the student's results.

Temperature in °C	0	20	40	60	80	100
Mass of ammonium nitrate in g that dissolves in 100 cm^3 water	119	190	286	321	630	1 024

(a) Use the table above to plot a graph of the solubility of ammonium nitrate on the figure below.

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(4)

(b) At 20 °C, 190 g of ammonium nitrate dissolves in 100 cm^3 of water.

Calculate the amount of ammonium nitrate (in moles) that dissolves in 1 dm^3 of water at 20 °C.

Relative atomic masses (A_r): H = 1; N = 14; O = 16

_____

_____

_____

_____

Amount of dissolved ammonium nitrate = _____ mol

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(3)

(c) Farmers use ammonium nitrate as a fertiliser.

Farmers want to slow down the rate at which ammonium nitrate fertiliser dissolves in the water in the soil.

Suggest why they spread the fertiliser in the form of small beads instead of a fine powder.

(2)

(d) Ammonia is needed to make ammonium nitrate.

The reaction used to make ammonia is:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.

At equilibrium, about 35% of the nitrogen and hydrogen are converted to ammonia at 450 °C and 200 atmospheres pressure.

Explain the effects of increasing the temperature, or increasing the pressure, on the amount of ammonia produced at equilibrium.

(4)

(Total 13 marks)

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