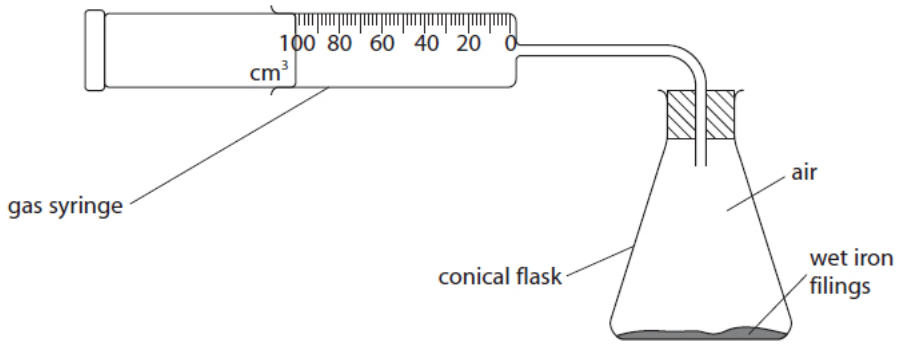
Name: _____
Recommended time = 30 mins

PPQu - Unit 4: Gases of the Atmosphere and Reactivity Revision

1. This question is about rusting.

(a) When iron rusts, it reacts with oxygen in the air.
A student uses the rusting of iron to find the percentage of oxygen in a sample of air.
The diagram shows the apparatus.



These are the student's results.

volume of air in conical flask and connecting tube = 265 cm^3

volume of air in gas syringe at start = 100 cm^3

volume of air in gas syringe at end = 25 cm^3

Calculate the percentage of oxygen in the sample of air using the student's results. (3)

percentage of oxygen = ... %

(b) (i) Cars are painted to prevent the iron in car bodies from rusting.
Explain how painting prevents the iron in car bodies from rusting. (2)

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(ii) Some car manufacturers use paint containing tiny particles of zinc.
Explain how particles of zinc prevent iron in car bodies from rusting even when this paint is scratched. (2)

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(Total for question = 7 marks)

2. This question is about the reactivity of metals.

(a) Table 1 shows whether a reaction occurs between a metal and an aqueous solution of a metal sulfate.

Metal	Metal sulfate	Does a reaction occur?
manganese	chromium sulfate	yes
tin	cadmium sulfate	no
chromium	cadmium sulfate	yes

Table 1

(i) Name the type of reaction that occurs between manganese and chromium sulfate. (1)

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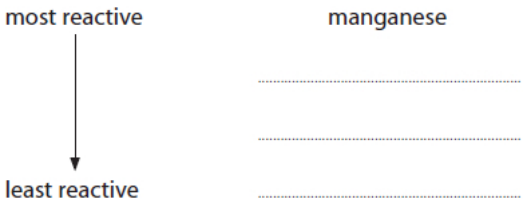
(ii) Use the information in Table 1 to complete the order of reactivity. (1)



(b) Table 2 shows the colours of four metals and the colours of their metal sulfate solutions.

Metal	Colour of metal	Colour of metal sulfate solution
copper	brown	blue
iron	dark grey	green
magnesium	silvery	colourless
zinc	light grey	colourless

Table 2

When a metal is added to a metal sulfate solution there may be a colour change on the surface of the metal and in the solution.
Use the information in Table 2 and your knowledge of the reactivity series to explain any colour changes in these two experiments. (5)

copper added to magnesium sulfate solution .....

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zinc added to iron sulfate solution .....

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(c) A different experiment can be used to place metals in order of reactivity.
This is the method.

Step 1 add 1 g of a metal to 25 cm^3 of dilute sulfuric acid
Step 2 measure the volume of gas produced in one minute

(i) Give two variables that should be controlled in this experiment. (2)

1 .....

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2 .....

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(ii) A small piece of calcium is added to some dilute sulfuric acid in a beaker.
One of the products of the reaction, calcium sulfate, is insoluble in water.
Suggest why the reaction stops after a short time, even though the beaker still contains calcium and dilute sulfuric acid. (1)

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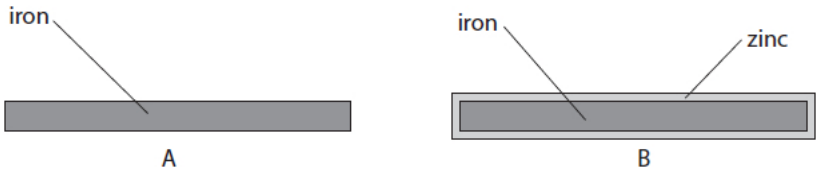
(Total for question = 10 marks)

3. The diagram shows two samples of iron, A and B.



Sample B is coated with a thin layer of zinc.

(a) Name the process used to coat iron with zinc. (1)

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(b) The two samples of iron are left outside for several weeks.
A brown solid containing hydrated iron(III) oxide forms on sample A.
(i) Give the common name for the brown solid. (1)

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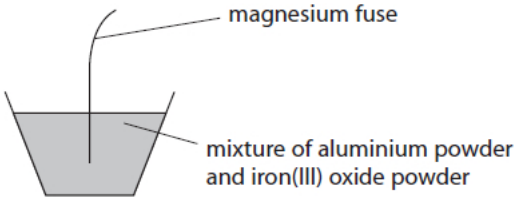
(ii) Give the names of the two substances that react with the iron to form the brown solid. (2)

1 .....

2 .....

(c) Iron can be formed by reacting aluminium powder with iron(III) oxide.
The diagram shows how this reaction can be demonstrated.



(i) The equation for the reaction between aluminium and iron(III) oxide is

$$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$$

Explain what this reaction shows about the relative reactivities of aluminium and iron. (2)

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(ii) Explain why the reaction between aluminium and iron(III) oxide is a redox reaction. (3)

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(Total for question = 9 marks)

4. This question is about gases in the atmosphere.

(a) The box gives the names of some gases in the atmosphere.

argon	carbon dioxide	helium	nitrogen	oxygen

Choose gases from the box to answer these questions.
Each gas may be used once, more than once or not at all.

(i) Identify a noble gas. (1)

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(ii) Identify a gas that makes up about 78% of the atmosphere. (1)

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(iii) Identify a greenhouse gas. (1)

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(iv) Identify a gas produced by the thermal decomposition of calcium carbonate. (1)

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(b) Sulfur reacts with oxygen to produce sulfur dioxide gas.

(i) Write a chemical equation for this reaction. (1)

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(ii) State an environmental problem caused when sulfur dioxide gas dissolves in water in the atmosphere. (1)

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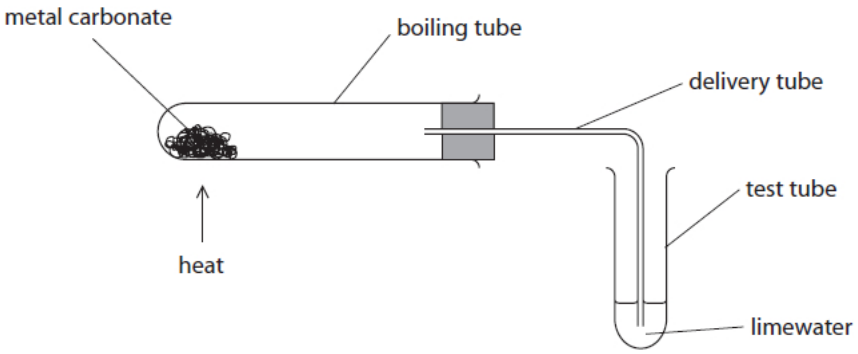
(Total for question = 6 marks)

Extension

5. A student uses this apparatus to investigate the effect of heat on different solid metal carbonates.



This is the student's method.

- use a spatula to put some metal carbonate in the boiling tube
- fit the delivery tube into position
- pour some limewater into the test tube
- start a timer and immediately begin to heat the metal carbonate
- record the time when a change first occurs in the limewater

The student repeats the method using different metal carbonates.
When a metal carbonate is heated a reaction sometimes occurs.
The equation for the reaction is

metal carbonate → metal oxide + carbon dioxide

(a) State the name given to this type of reaction. (1)

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(b) State two variables that the student should control in this investigation. (2)

1 .....

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2 .....

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(c) Suggest why bubbles appear in the limewater immediately after heating has started but before there is any change to the metal carbonate. (1)

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(d) Explain the purpose of limewater in this investigation. (2)

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(e) The table shows some of the results for the student's investigation.

Metal carbonate	Colour change of solid	Time taken for any change in limewater
calcium carbonate	remains white	90 seconds
sodium carbonate	remains white	no change
copper(II) carbonate		50 seconds

(i) State the colour change that occurs for copper(II) carbonate. (2)

from ..... to .....

(ii) Give a chemical equation for this reaction of copper(II) carbonate. (1)

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(f) (i) There is a relationship between the position of a metal in the reactivity series and how easily the metal carbonate reacts when heated.
Use the student's results and your own knowledge to deduce this relationship.
(2)

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(ii) State how you should extend the investigation to see if your deduction is correct. (1)

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(Total for question = 12 marks)

Total marks for questions = 32