Q1. Lime (calcium oxide) is used in agriculture to reduce the acidity of soils.

Describe, as fully as you can, the reaction by which lime is made.

Name any other product(s).

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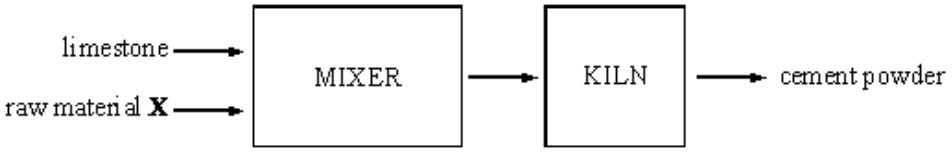
(Total 3 marks)

Q2. Portland cement was invented by Joseph Aspdin, a builder from Leeds. The flow diagram shows how cement is made.



(a) (i) Name the raw material **X** used to make cement.

.....

(1)

(ii) In the kiln the raw materials are heated to about 1500°C.
The limestone (calcium carbonate) is broken down at this temperature.
Complete the word equation for this reaction.

calcium carbonate → ..... + carbon dioxide

(1)

(iii) Suggest **one** major cost of this process other than the cost of the raw materials.

.....

(1)

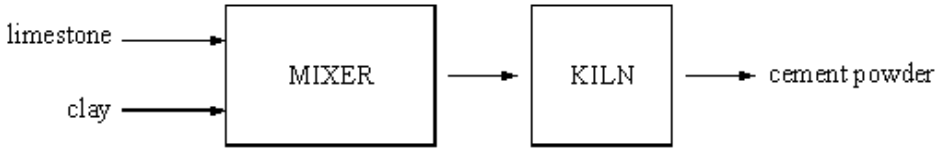
(b) Cement can be used to make concrete.
Name **two** substances that must be mixed with cement to make concrete.

1 .....

2 .....

(2)
(Total 5 marks)

Q3. Portland cement was invented by Joseph Aspdin, a builder from Leeds. The flow diagram shows how cement is made.



(a) What are the **two** raw materials used to make cement?

1 .....

2 .....

(1)

(b) Cement is mixed with three substances to make concrete.
Choose from the list the **three** substances used.

crushed rock **iron ore** **quicklime** **sand**

slag **soda** **water**

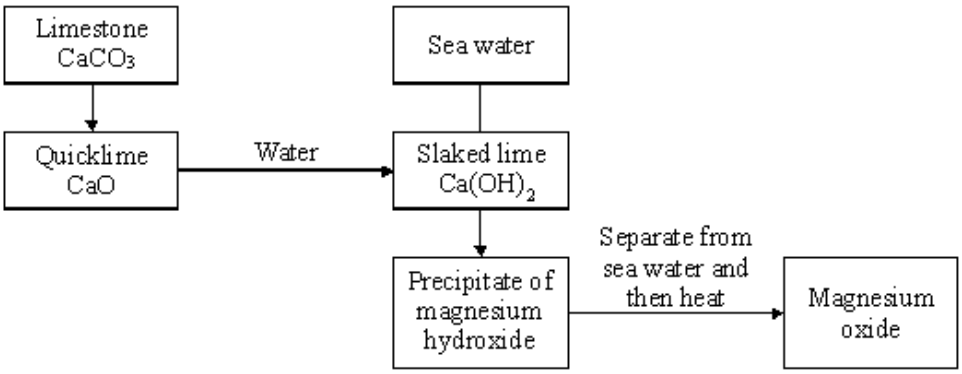
1 .....

2 .....

3 .....

(3)
(Total 4 marks)

Q4. Sea water contains magnesium ions. Magnesium oxide can be obtained from sea water using the following process.



(a) State the chemical name for limestone.

.....

(1)

(b) Write a word equation for the action of heat on limestone.

.....

(2)

(c) State the chemical name for slaked lime.

.....

(1)

(d) Write a balanced chemical equation for the addition of water to quicklime.

.....

(2)

(e) How can magnesium hydroxide be separated from sea water?

.....

(1)

(f) Suggest and explain how magnesium could be obtained from magnesium oxide.

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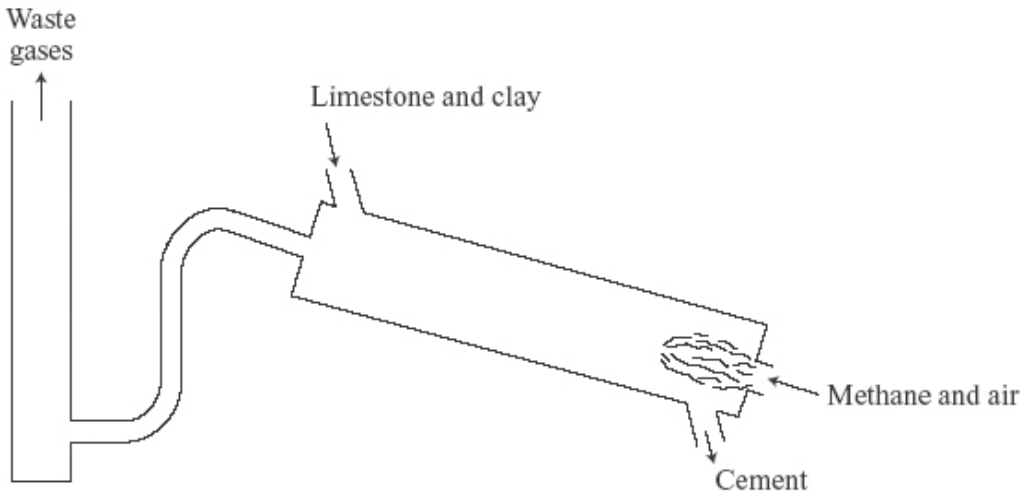
(2)
(Total 9 marks)

Q5. Limestone contains the compound calcium carbonate, $CaCO_3$.

(a) Limestone is used to make cement in a rotary kiln.



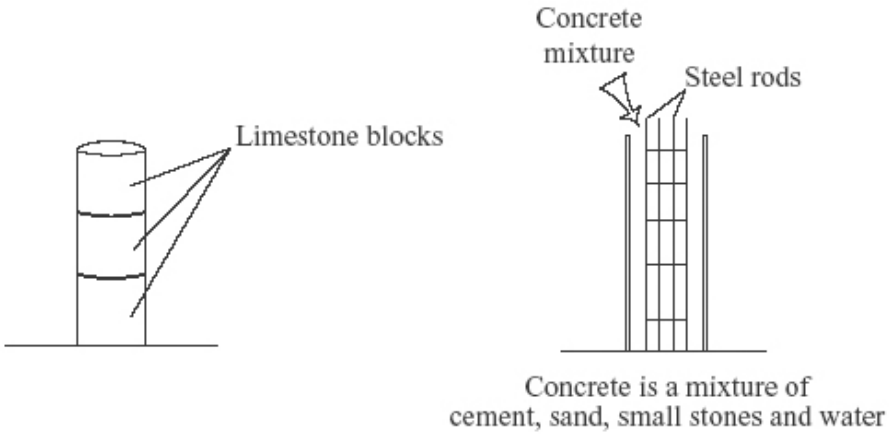
Use the information in the diagram to name the **two** main waste gases from this rotary kiln.

1 .....

2 .....

(2)

(b) Columns used as supports for buildings can be made from materials such as limestone blocks or concrete.



From the diagrams, name which you think is the better material for making a column.

.....

Give **three** advantages for your choice of material.

1 .....

.....

2 .....

.....

3 .....

.....

(3)
(Total 5 marks)

Q6. Limestone is mainly calcium carbonate.

(a) Quicklime is produced by heating limestone.

(i) Complete the word equation for this reaction by writing the chemical name of the solid and the gas produced.

calcium carbonate → ..... + ...

(2)

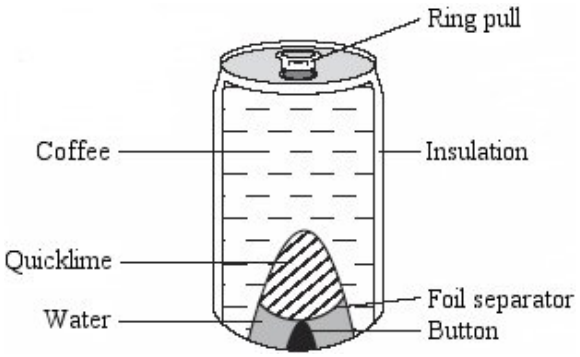
(ii) What is the name for this type of chemical reaction?

.....

(1)

(b) Quicklime is used in self-heating cans.

The diagram shows a self-heating can designed to raise the temperature of coffee to 60 °C.



The button on the base of the can is pushed. The foil separator breaks, allowing water to mix with the quicklime. After about 3 minutes, the can is opened by the ring pull. Insulating materials are used inside the walls of the can to prevent either the lips or the fingers from being burned.

(i) Explain why the coffee becomes hot.

.....

.....

.....

.....

(2)

(ii) Suggest **two** reasons why it is **not** possible to re-use this self-heating can.

1 .....

.....

2 .....

.....

(2)
(Total 7 marks)

Q7. (a) Limestone is a hard rock that is used as a building material.
Limestone was used by the Egyptians to make plaster.

Reaction 1 – calcium carbonate, $CaCO_3$, was decomposed by heating limestone

$$CaCO_3 \rightarrow CaO + CO_2$$

Reaction 2 – water was added to the solid produced to make slaked lime

$$CaO + H_2O \rightarrow Ca(OH)_2$$

Reaction 3 – a mixture of slaked lime and water was used as plaster. After the plaster had set it became even harder with age

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$

(i) Name the solid formed when calcium carbonate decomposed.

.....

(1)

(ii) Use the reactions to explain how the plaster became even harder with age.

.....

.....

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.....

.....

.....

.....

(3)

(b) A gardener wanted to make a step up to his greenhouse door. He decided to use a mixture of cement and sand to make mortar.

He experimented using mixtures with different cement to sand ratios.

- The mortar mixtures were put in the same sized mould.
- Each mortar mixture was allowed to set hard.
- He then dropped a metal ball from increasing heights until the set mortar cracked.
- He recorded his results in a table.

Volume of sand in cm^3	**Volume of cement in cm^3**	**Height the metal ball dropped to crack the set mortar in cm**
800	100	17
700	100	24
600	100	30
500	100	36
400	100	37
300	100	48
200	100	54

(i) What is the relationship between the volume of sand and the strength of the mortar?

.....

.....

(1)

(ii) The gardener was not sure about some of his results.

Use the results to explain why.

.....

.....

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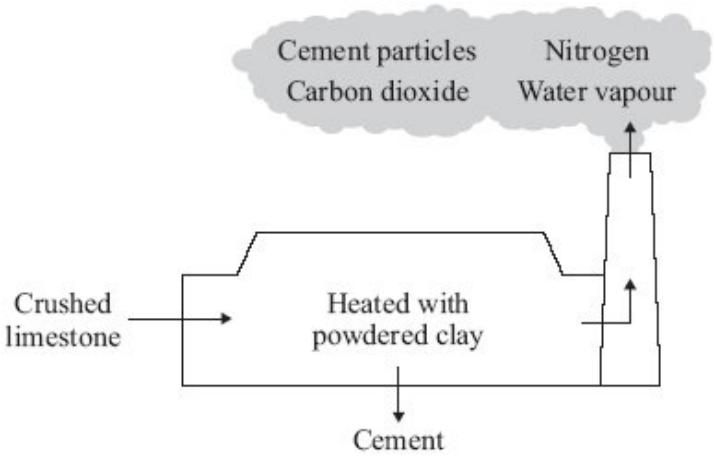
.....

.....

(2)
(Total 7 marks)

Q8. A limestone quarry is in an area of natural beauty and near several villages.
The company operating the quarry wants planning permission to build a new cement works in the quarry.

The diagram shows some of the substances used and produced at a cement works.



(a) Limestone is mainly calcium carbonate, $CaCO_3$.
Write the correct number in the box to complete each sentence.

(i) The formula shows that calcium carbonate, $CaCO_3$,

contains ☐ different elements.

(1)

(ii) Calcium carbonate, $CaCO_3$, contains a total number of ☐ atoms.

(1)

(b) The company wants the new cement works because the nearest cement works is 100 km from the quarry. The company argues that a new cement works sited inside the quarry would reduce carbon dioxide emissions.

Suggest why the new cement works might reduce carbon dioxide emissions.

.....

.....

.....

(1)

(c) Residents from the villages near the quarry are concerned that there will be atmospheric pollution from the new cement works.

(i) Name and explain how **one** of the emissions from the chimney causes atmospheric pollution.

Name of emission: .....

Explanation: .....

.....

(2)

(ii) Suggest what the company could do to reduce this atmospheric pollution.

.....

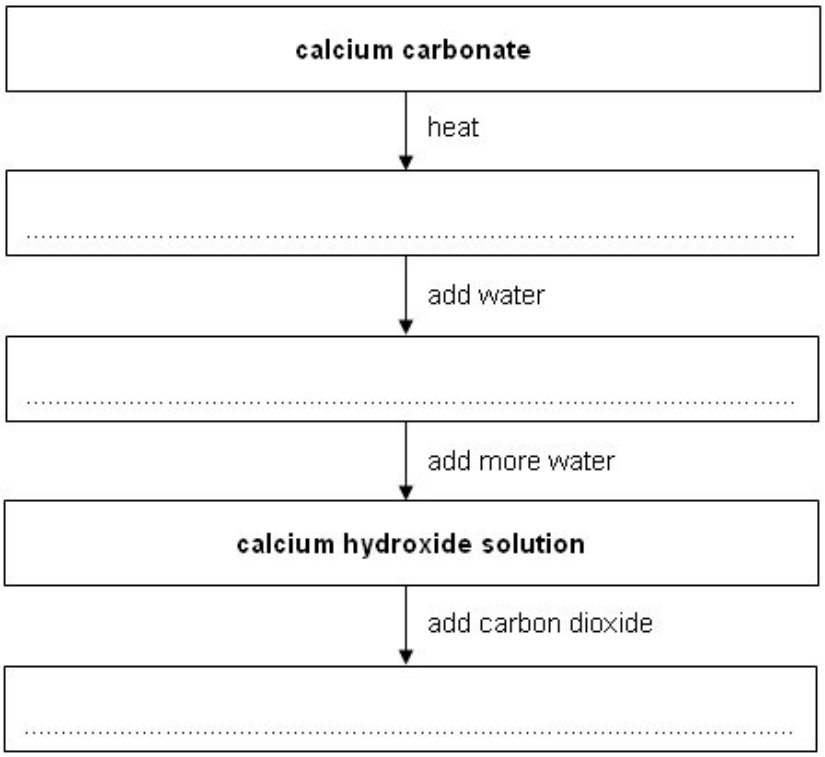
.....

(1)
(Total 6 marks)

Q9. Limestone contains calcium carbonate, $CaCO_3$

(a) The flow chart shows the stages in the *limestone cycle*.

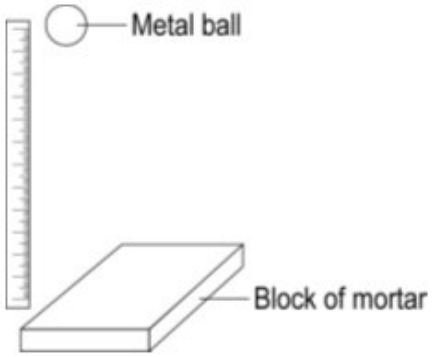
Write the name of the correct calcium compound in each empty box to complete the flow chart.



(3)

(b) Limestone is heated with clay to make cement.
Cement is mixed with sand to make mortar.

A student investigated the strength of six mortar mixtures. Each mortar mixture contained $100cm^3$ cement but each contained a different volume of sand.



To do the investigation the student:

- added and stirred water into each mortar mixture
- put each mixture into the same sized moulds
- left each mixture to set hard
- dropped a metal ball from increasing heights until the mortar cracked
- recorded the results in a table.

Volume of sand in cm^3	**Volume of cement in cm^3**	**Height the metal ball was dropped from to crack the mortar in cm**
700	100	24
600	100	30
500	100	36
400	100	37
300	100	48
200	100	54

(i) What happens to the strength of the mortar as the volume of sand increases?

.....

(1)

(ii) The student was worried about an anomalous result.

Which result was anomalous?

Volume of sand = ... cm^3

Explain why you have chosen this result.

.....

.....

.....

.....

(2)

(c) The student repeated the investigation but used six concrete mixtures.

From the results the student concluded correctly that concrete was stronger than mortar.

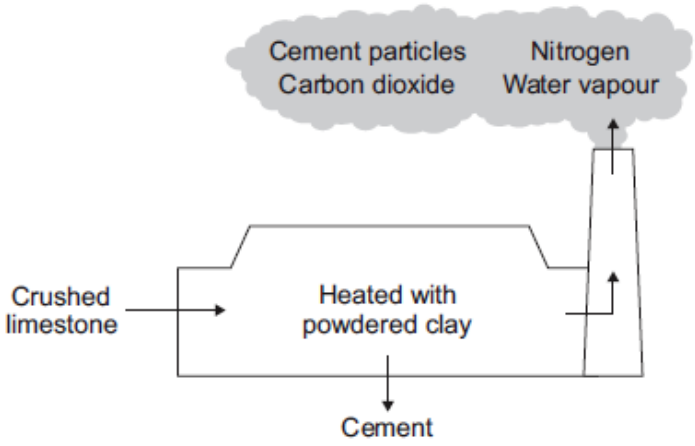
Suggest **one** reason why concrete is stronger than mortar.

.....

.....

(1)
(Total 7 marks)

Q10. The diagram shows some of the substances used and produced at a cement works.



(a) Limestone is mainly calcium carbonate ($CaCO_3$).

Write the correct answer in each box.

(i) The formula shows that calcium carbonate ($CaCO_3$) contains ☐ different elements.

(1)

(ii) The total number of atoms in the formula $CaCO_3$ is ☐ .

(1)

(b) Name **one** of the substances produced at the cement works that causes atmospheric pollution.

State **one** effect of this atmospheric pollution.

Name .....

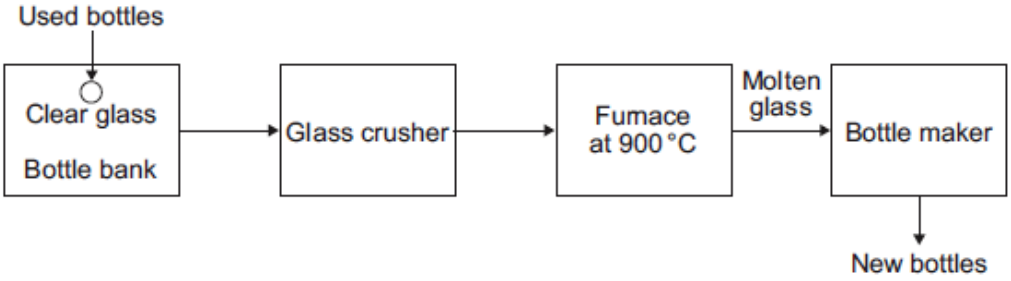
Effect .....

.....

.....

(2)

(c) Limestone is used to produce glass bottles.
In recent years we have become more aware of the need to recycle glass bottles. Used glass bottles can be recycled if they are put into bottle banks.



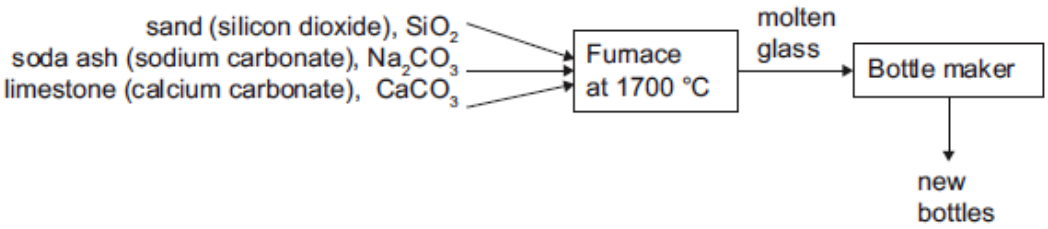
(i) Suggest **two** reasons why light bulbs should **not** be put into bottle banks.

1 .....

2 .....

(2)

(ii) New glass bottles can also be produced by heating a mixture of raw materials:



Suggest **two** environmental reasons why we should recycle glass bottles to make new glass bottles.

1 .....

.....

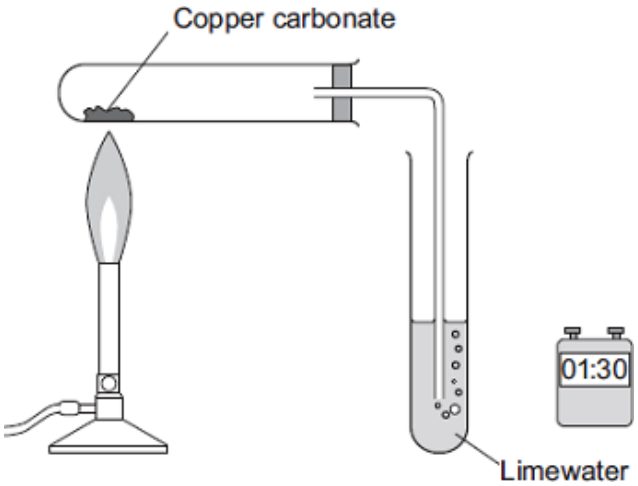
2 .....

.....

(2)
(Total 8 marks)

Q11. Carbon dioxide is produced when copper carbonate is heated.

A student investigated heating copper carbonate.
The student used the apparatus to measure how long it took for carbon dioxide to be produced.
The student also noted what happened during each minute for three minutes.



(a) The student used changes to the limewater to measure how long it took for carbon dioxide to be produced.

Describe how.

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.....

.....

(2)

(b) The student wrote down her observations.

Time interval in minutes	Observations
Between 0 and 1	A slow release of gas bubbles. The limewater did not change. The solid in the test tube was green.
Between 1 and 2	A fast release of gas bubbles. The limewater changed at 1 minute 10 seconds.
Between 2 and 3	No release of gas bubbles. The solid in the test tube was black.

(i) Suggest the reason for the student's observations between 0 and 1 minute.

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.....

.....

(2)

(ii) Explain the student's observations between 1 and 2 minutes.

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(2)

(iii) Explain the student's observations between 2 and 3 minutes.

.....

.....

.....

.....

(2)