



Limestone



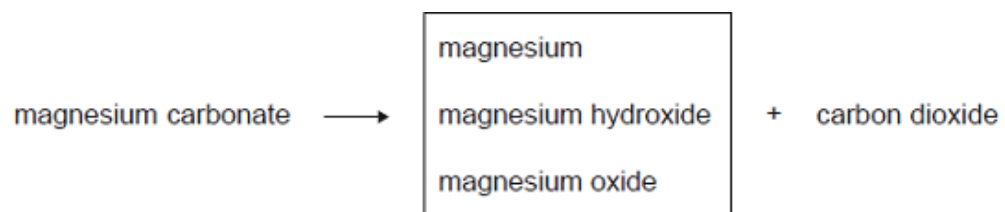
72 minutes



72 marks

Q1. Carbon dioxide is produced when metal carbonates are heated.

(a) (i) Draw a ring around the correct answer to complete the word equation.



(1)

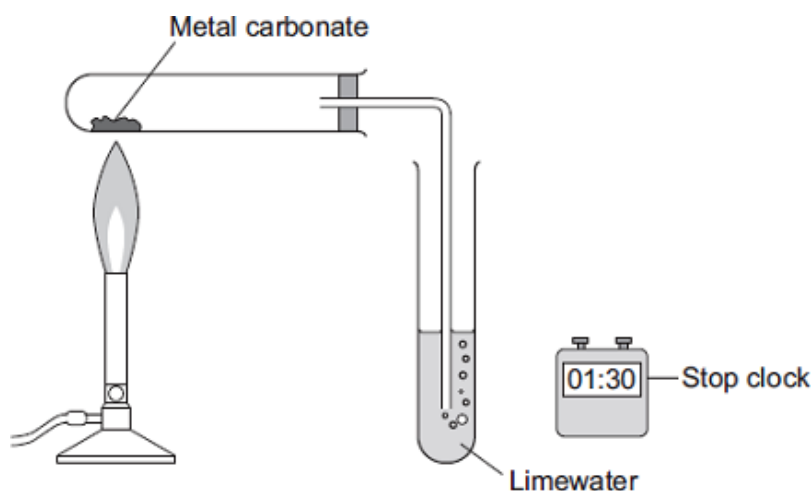
(ii) Draw a ring around the correct answer to complete the sentence.

The reaction to produce carbon dioxide from magnesium carbonate is

combustion.
decomposition.
fermentation.

(1)

(b) A student investigated what happens when metal carbonates are heated.



The student:

- used the apparatus to investigate heating four metal carbonates
- started the stop clock at the same time as he began to heat the metal carbonate
- stopped the stop clock when carbon dioxide was produced.

The student's results are shown in the table.

Metal carbonate	Time taken for the production of carbon dioxide to start in seconds
Calcium carbonate	163
Copper carbonate	24
Magnesium carbonate	92
Zinc carbonate	67

(i) Tick (✓) the type of graph the student should draw from these results.

Type of graph	Tick (✓)
Bar chart	
Line graph	
Scatter graph	

(1)

(ii) Use the Chemistry Data Sheet to help you to answer this question.

Draw a ring around the correct answer to complete the sentence.

The more reactive the metal in the carbonate the

less
more
same

time is taken for the

production of carbon dioxide to start.

(1)

(iii) How did the student know that carbon dioxide was produced?

Use the diagram of the apparatus to help you to answer this question.

.....

.....

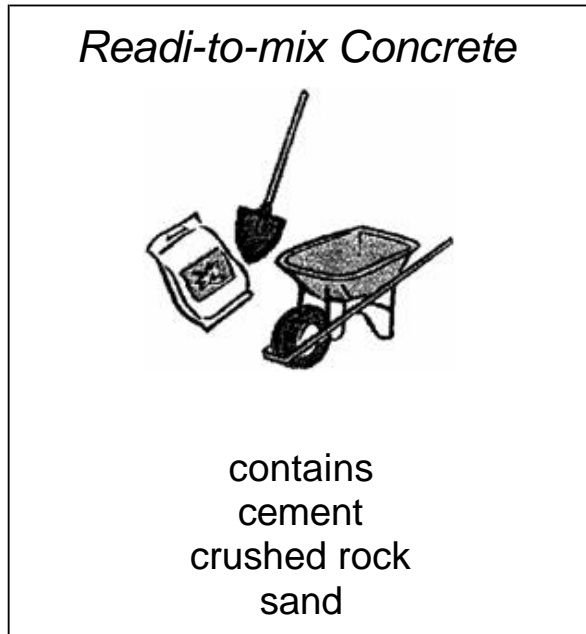
.....

.....

(2)

(Total 6 marks)

Q2. Bags of readi-to-mix concrete contain three ingredients.



Complete each sentence by choosing the correct words from the box.

clay	limestone	salt	slaked lime	water
------	-----------	------	-------------	-------

Cement is made by heating..... and in a rotary kiln.

To make concrete, the contents of the bag of readi-to-mix concrete must be mixed with

.....

(Total 3 marks)

Q3. Limestone contains calcium carbonate.

(a) Calcium carbonate has the formula CaCO_3 .

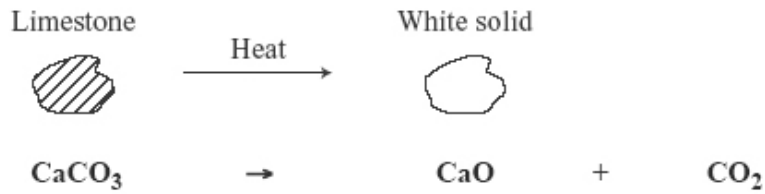
Complete the sentence by writing in the correct numbers.

The formula of calcium carbonate is made up of 1 calcium atom, carbon atom(s)

and oxygen atom(s).

(2)

(b) When limestone is heated it forms two other compounds.



(i) State **one** safety precaution that you should take when heating limestone.

..... (1)

(ii) Name the white solid produced.

..... (1)

(iii) Why does a piece of limestone lose mass as it is heated?

.....
..... (1)

(d) A company wants to quarry limestone. There are some houses near the quarry.



Residents in the houses say that they do not want a quarry next to them.

(i) Suggest **two** reasons why they do not want the quarry next to them.

1

.....

2

.....

(2)

(ii) Suggest **one** possible benefit to the residents of having a quarry near their houses.

.....
.....

(1)
(Total 8 marks)

Q4. Limestone has been called the Earth's most useful rock.

(a) Limestone contains calcium carbonate, CaCO_3 .

(i) Complete the table to show the number of atoms of each element in the formula of calcium carbonate.

Calcium has been done for you.

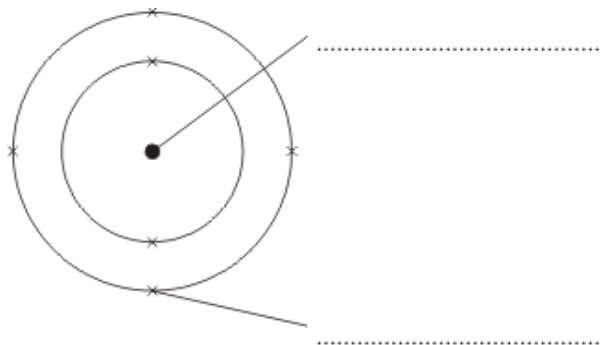
Element	Number of atoms in the formula CaCO_3
Calcium, Ca	1
Carbon, C	
Oxygen, O	

(2)

(ii) The diagram below represents a carbon atom.

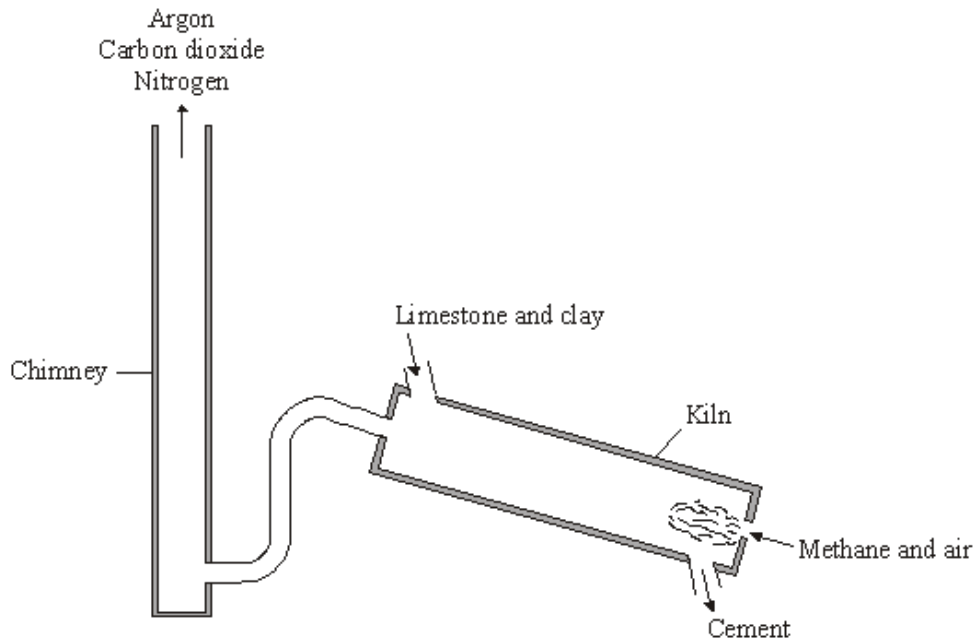
Use words from the box to label the parts of this atom.

bond electron molecule nucleus



(2)

(b) At a cement works, limestone is mixed with clay and heated in a kiln.



Use the information in the diagram to answer these questions.

(i) Name the fuel that is used to heat the limestone and clay.

.....

(1)

(ii) Limestone contains calcium carbonate, CaCO_3 .

Draw a ring around the correct gas in the box to complete the sentence.

The gas formed when calcium carbonate decomposes is	argon. carbon dioxide. nitrogen.
---	--

(1)

(c) The cement works starts to burn a different fuel.

Local residents are concerned because more children are suffering asthma attacks. Residents have also noticed that parked cars are becoming dirty because of smoke particles from the chimney.

The table shows the possible medical risk from smoke particles.

Particle size in mm	Medical effect
Larger than 0.4	No medical risks known
0.3 and smaller	Causes asthma attacks
0.2 and smaller	May cause cancer

(i) Give **two** reasons why local residents are concerned about the cement works burning a different fuel.

1

.....

2

.....

(2)

(ii) The company operating the cement works stated that smoke particles from the chimney had not changed since it started burning the different fuel.

If you were a local resident, what evidence would you like to see to help you decide if the company's statement is true or not?

.....

.....

.....

.....

(2)

(Total 10 marks)

Q5. Limestone and the products of limestone have many uses.

(a) Limestone is quarried.



Photograph © Lonny Kalfus / Getty Images

Quarrying limestone has impacts that cause environmental problems.

Tick (✓) **two** impacts that cause environmental problems.

Impact of quarrying	Tick (✓)
Puts off tourists	
Causes dust pollution	
Increases jobs	
Increases traffic	

(2)

- (b) Limestone contains calcium carbonate, CaCO_3 . When it is heated calcium carbonate produces calcium oxide and carbon dioxide.

The word equation for this reaction is:

calcium carbonate \rightarrow calcium oxide + carbon dioxide

- (i) Complete the sentence.

The reaction when calcium carbonate is heated is called

thermal

(1)

- (ii) 100 g of calcium carbonate was heated and produced 56 g of calcium oxide. Calculate the mass of carbon dioxide produced.

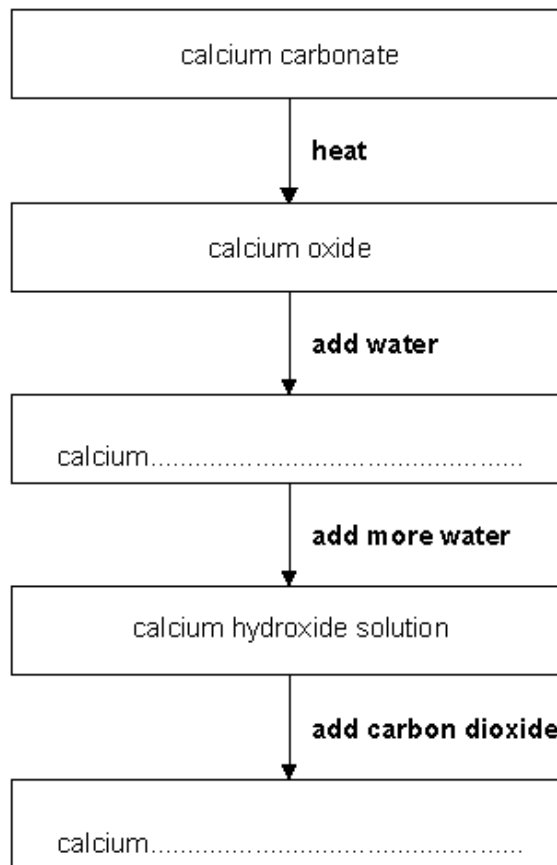
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..... g

(1)

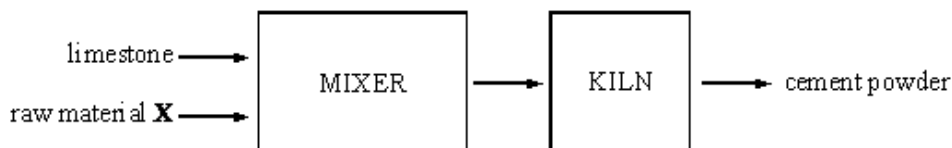
(c) The flow chart shows the stages in the limestone cycle.

Complete the names of the calcium compounds formed in the flow chart.



(2)
(Total 6 marks)

Q6. 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

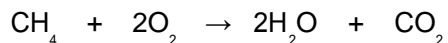
(2)

(Total 5 marks)

Q7. Cement is made by heating a mixture of clay and limestone in a kiln.

(a) Many kilns are heated by burning natural gas (methane) in air.

A chemical equation for the burning of methane is:



Describe this reaction in words.

Give the names of the molecules **and** the numbers of each molecule in this chemical equation.

.....
.....
.....
.....

(2)

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Limestone contains calcium carbonate.

There is a large deposit of limestone under an area of natural beauty.

A company wants to quarry this limestone and build a kiln near to the quarry to make cement.

Area of natural beauty



Evelyn Simak [CC-BY-SA-2.0], via Wikimedia Commons

A quarry

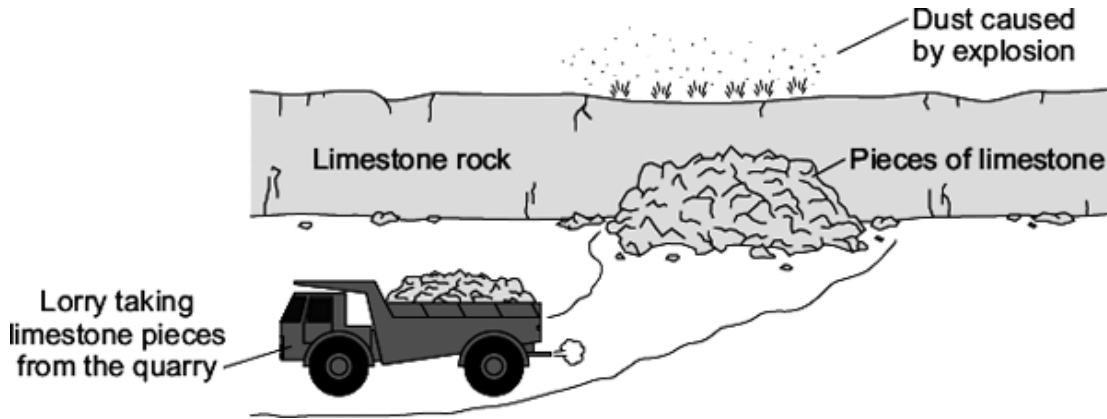


By Thomas Bjørkan (Own work) [CC-BY-SA-3.0],
via Wikimedia Commons

Explosives will be used to extract the limestone out of the ground.
Heavy machinery will be used to lift and crush the limestone.
Lorries will be used to transport the limestone to the kiln to make cement.
The lorries and the heavy machinery will use diesel fuel.

Quarrying limestone and making cement will have an impact on everything near the area.

Q8. In a quarry, limestone is blasted into pieces by explosives.
The pieces of limestone are taken from the quarry by lorries.



(a) Draw a ring around the correct word in the box to complete the sentence.

Limestone can be used as a

building
plastic
smart

 material.

(1)

(b) Tick (✓) **one** possible advantage for people who live near to the limestone quarry.

Advantage	Tick (✓)
causes more traffic	
provides jobs	
attracts tourists to the area	

(1)

(c) Give **two** types of pollution that would be caused by the limestone quarry.

1

2

(2)

- (d) Limestone contains calcium carbonate (CaCO_3).

Complete the **two** empty boxes in the table about the formula of calcium carbonate.

Name of element	Symbol for the element	Number of atoms in the formula
calcium	Ca	1
carbon	C	1
oxygen

(2)

- (e) Lorries take some of the limestone to be heated in a lime-kiln. Calcium carbonate, in the limestone, decomposes when heated.

Use the balanced chemical equation to help you complete the word equation for the decomposition of calcium carbonate.

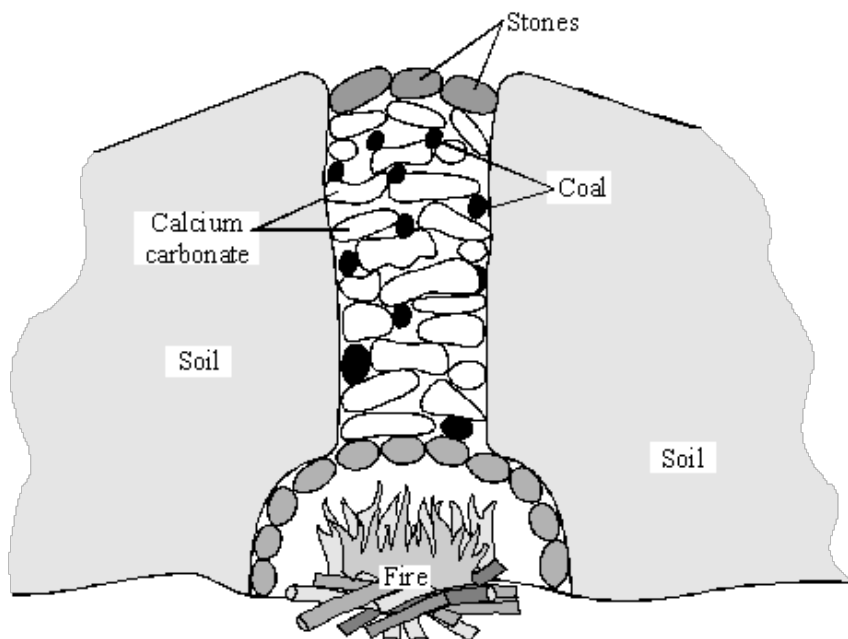


calcium carbonate \rightarrow + carbon dioxide

(1)

(Total 7 marks)

- Q9.** An old lime kiln made in the ground is shown.



(a) The *thermal decomposition* of calcium carbonate makes a white solid and carbon dioxide.

(i) Name a naturally occurring form of calcium carbonate.

.....
.....

(1)

(ii) What does *thermal decomposition* mean?

.....
.....

(2)

(iii) Suggest and explain the purpose of the coal.

.....
.....
.....

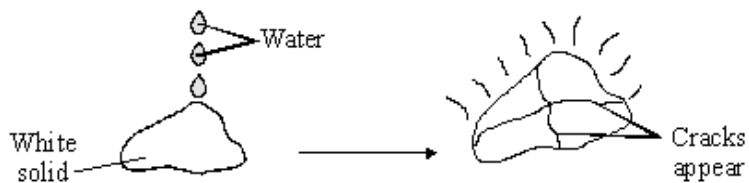
(2)

(iv) Write a word equation for the thermal decomposition of calcium carbonate.

..... → +

(2)

(b) The diagrams show what happens when drops of cold water are added to the white solid formed by heating calcium carbonate.



(ii) What type of chemical reaction takes place?

.....

(1)

(ii) Give the chemical name of the solid formed. Give a use of this solid.

Name

Use

(2)

(Total 10 marks)

Q10. Calcium carbonate is found in limestone.
Limestone is used as a building material.
Limestone is also used to make calcium oxide and calcium hydroxide.

(a) Limestone is heated to make calcium oxide.

(i) Calcium oxide reacts with a substance to produce calcium hydroxide.
Name the substance.

.....

(1)

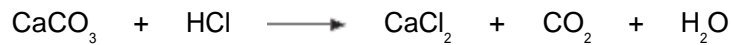
(ii) Calcium hydroxide reacts with a substance to produce calcium carbonate.
Name the substance.

.....

(1)

(b) Limestone reacts with acids.

(i) Balance the chemical equation for the reaction of calcium carbonate with hydrochloric acid.



(1)

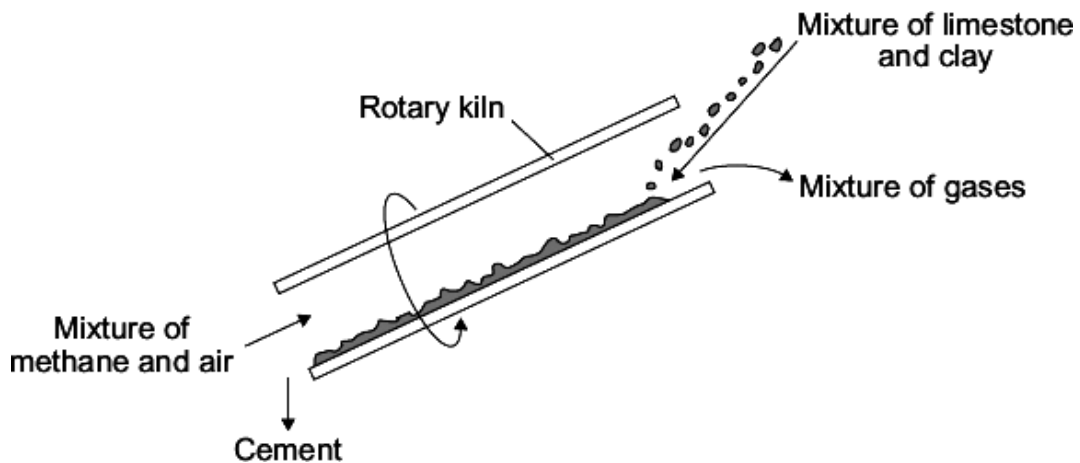
(ii) Buildings made from limestone are affected by the products from burning fossil fuels containing sulfur.

Explain why.

.....
.....
.....
.....

(2)

- (c) When a mixture of limestone and clay is heated in a rotary kiln cement is produced.
 Burning a mixture of methane and air heats the kiln.
 Clay does not decompose in the kiln.



- (i) Carbon dioxide is one of the main gases in the mixture of gases coming out of the kiln.

Give **two** reasons why.

.....

.....

.....

.....

(2)

- (ii) Name the other main gas in the mixture of gases coming out of the kiln.

Give a reason why there is a high percentage of this gas in the mixture of gases coming out of the kiln.

Name of gas

Reason

.....

.....

(2)

(Total 9 marks)

M1. (a) (i) magnesium oxide 1

(ii) decomposition 1

(b) (i) bar chart 1

(ii) more 1

(iii) limewater 1

turns cloudy / milky
accept forms a white precipitate 1

[6]

M2. clay 1

limestone 1

water 1

[3]

M3. (a) 1 / one 1

3 / three 1

(b) (i) (wear safety) glasses / masks / gloves
*accept do not handle hot objects / use
tongs or accept other safety points
such as, 'tie hair back'* 1

(ii) calcium oxide
accept quicklime 1

(iii) carbon dioxide / CO₂ is given off
accept a gas is given off 1

- (d) (i) any **two** from:
- dust / atmospheric pollution
 - noise
 - eyesore
 - destroys habitats
 - (extra) traffic
 - any other named pollution or description of pollution
- 2

- (ii) any **one** from:
- employment
 - increases local trade / makes money
 - future development of quarry recreation / park / lake / reservoir
*do **not** accept cheaper houses / land /
new roads*
- 1

[8]

- M4.** (a) (i) 1
- 1
- 3
- 1
- (ii) nucleus
- 1
- electron
- 1
- (b) (i) methane / CH₄
- accept natural gas*
- ignore air*
- do **not** allow other gases*
- 1
- (ii) carbon dioxide
- 1

- (c) (i) any **two** from:
- medical risks
 - asthma
 - cancer
 - dirt
 - causes global warming / global dimming / greenhouse effect / acid rain
ignore death
accept effect on health
accept difficulty breathing/ lung disease
allow smoke particles
allow harmful for the environment
- 2

- (ii) any **two** from:
- have a test done / scientific evidence
 - independent (evidence)
 - comparison of smoke particles / when different fuels used
 - medical evidence **or** more / less asthma attacks **or** cancer **or** dirt on cars
- 2

[10]

- M5.** (a) causes dust pollution 1
- increases traffic 1
- (b) (i) decomposition 1
- (ii) 44(g) 1
- (c) (calcium) hydroxide 1
- (calcium) carbonate 1
- substances must be in the order shown*

[6]

- M6.** (a) (i) clay
for one mark
- (ii) calcium oxide / quicklime / CaO
for one mark
- (iii) sensible answers such as cost of fuel etc. / *accept* a wide range of appropriate answers
for one mark
- 3

- (b) sand
gravel (owtte) e.g. crushed rock
water
- any two for 1 mark each*
- 2

[5]

- M7.** (a) • one / 1 (molecule of) methane (reacts with) two / 2 (molecules of) oxygen
- 1

- two / 2 (molecules of) water / steam / hydrogen oxide and one / 1 (molecule of) carbon dioxide (are produced)
- if no other marks awarded all four names correct*
- or**
- correct number **and** name for two molecules*
- or**
- 4 correct numbers gains 1 mark*
- allow all four names correct **and** correct number of atoms in each substance for 2 marks*
- 1

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1-2 marks)

There is a simple description of a positive **and / or** a negative impact caused by the plan to quarry limestone and / or make cement.

Level 2 (3-4 marks)

There is a clear description of both a positive **and** a negative impact caused by the plan to quarry limestone and / or make cement.

Level 3 (5-6 marks)

There is a detailed description of both positive impacts **and** negative impacts caused by the plan to quarry limestone and / or make cement.

examples of the chemistry points made in the response

Positive impacts:

- Limestone / cement is used for building
- Limestone needed for industrial processes
- Company landscapes / provides recreation facilities in the quarry after use
- Provides employment
- Improves local economy
- Improved transport links

Negative impacts:

- Destruction of habitats
- Fewer plants / trees to absorb carbon dioxide
- Example of visual pollution
- Example of noise pollution
- Example of atmospheric pollution
- More traffic

6

[8]

M8. (a) building

1

(b)	provides jobs	1
(c)	any two from: <i>ignore references to water</i>	
	• noise <i>allow sound pollution</i>	
	• dust / visual pollution <i>accept global dimming</i> <i>ignore smoke</i>	
	• air / atmospheric	
	• exhaust gases <i>accept acid rain / global warming / named gaseous pollutants</i>	
	• (more) traffic <i>accept <u>more</u> lorries</i>	2
(d)	O <i>ignore any numbers</i>	1
	3 / three	1
(e)	calcium oxide <i>accept quicklime</i> <i>do not accept calcium dioxide</i>	1
		[7]
M9.	(a) (i) limestone / chalk / marble	1
	(ii) breakdown / splits up	1
	with heat	1
	(iii) to burn / react with air / oxygen	1
	release energy / heat / exothermic / keeps temperature high	1

(iv) calcium carbonate → calcium oxide + carbon dioxide

calcium oxide

1

correct equation

1

(b) (i) exothermic / slaking / hydration
not hydrolysis

1

(ii) calcium hydroxide / slaked lime

1

mortar / neutralise acidity in soil / neutralise acid lake water / soften
hard water / to make cement

not in agriculture

not to make lime water

1

[10]

M10.

(a) (i) water

accept hydrogen oxide

allow H₂O

1

(ii) carbon dioxide

allow CO₂

accept any soluble carbonate or carbonic acid

1

(b) (i) $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$

1

(ii) because sulfur reacts with oxygen / air to produce sulfur dioxide
or sulfur burns to produce sulfur dioxide

accept correct equation

1

and (sulfur dioxide) causes acid rain that reacts with/erodes limestone/
calcium carbonate

ignore wears away

1

(c) (i) *it = carbon dioxide*

ignore references to carbon dioxide is in the air

because carbon dioxide is produced from burning methane

accept correct equation

1

because carbon dioxide is produced from decomposing calcium carbonate/limestone

accept correct equation

*do **not** accept carbon in calcium carbonate reacting with air*

1

(ii) nitrogen

1

this is the main gas / 75 – 80% / of air

allow there is a lot of this gas in air

1

[9]

