Name: _____

Class: _____

Date: _____

Chemical Analysis part 4 AQA Triple Chemistry

Time: **70 minutes**

Marks: **69 marks**

Comments:

1. This question is about greenhouse gases and climate change.

Carbon dioxide and methane are greenhouse gases.

(a) Which of the following is also a greenhouse gas?

Tick (✓) **one** box.

Chlorine ☐

Nitrogen ☐

Oxygen ☐

Water vapour ☐

(1)

In the past 50 years, there has been an increase in:

- the world population
- the concentration of carbon dioxide in the atmosphere
- the concentration of methane in the atmosphere
- the mean temperature of the atmosphere at the Earth's surface.

Most scientists think this information can be used to explain climate change.

(b) Explain why the increase in world population may have caused the increase in the concentration of carbon dioxide in the atmosphere.

_____

_____

_____

_____

(2)

(c) Explain why the increase in world population may have caused the increase in the concentration of methane in the atmosphere.

_____

_____

_____

_____

(2)

(d) Describe **two** potential effects of the increase in the mean temperature of the atmosphere at the Earth's surface.

1 _____

_____

2 _____

_____

(2)

(e) The mean temperature of the atmosphere at the Earth's surface has increased.

Most scientists think that this has been caused by an increase in the concentration of greenhouse gases in the atmosphere.

Give **one** reason why some scientists do **not** accept this theory.

_____

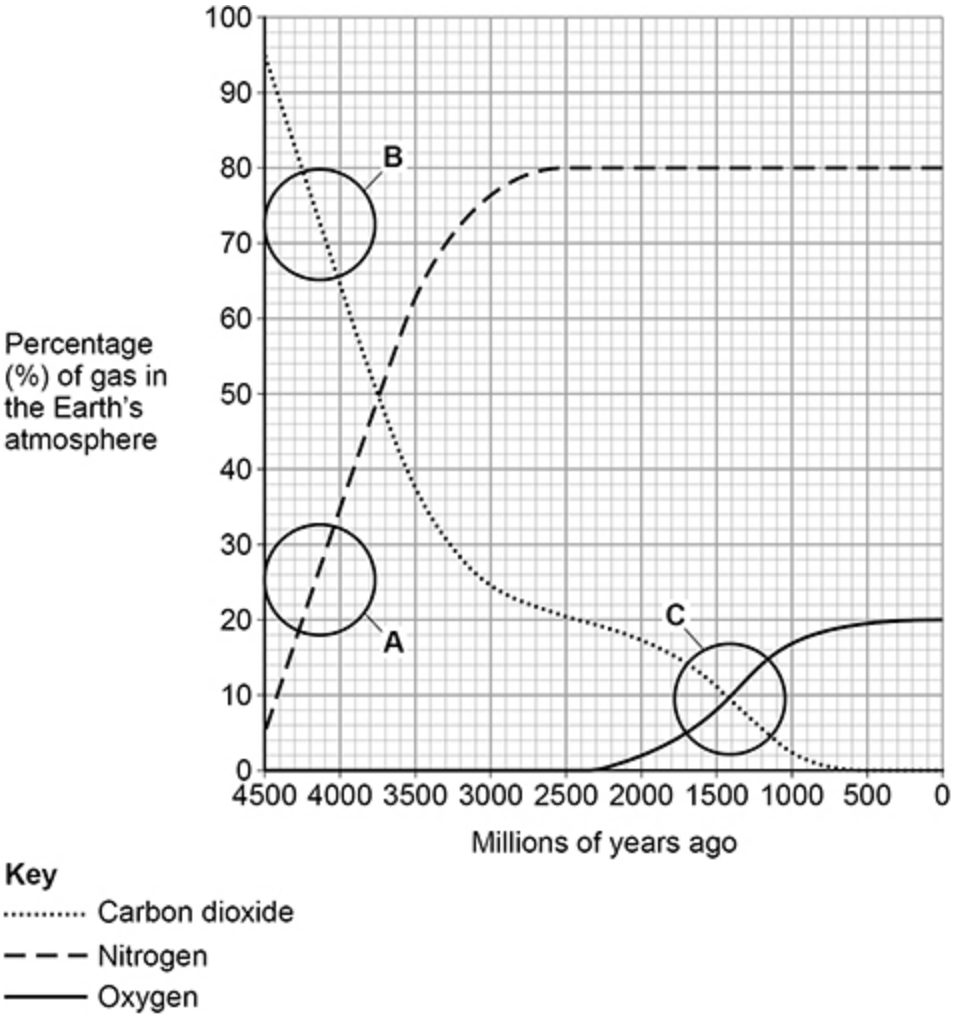
_____

(1)

(Total 8 marks)

2. This question is about the chemistry of the Earth's atmosphere.

The figure below shows how the percentages of gases in the Earth's atmosphere may have changed since the atmosphere was formed.



(a) Explain the change in the percentage of gas in the region labelled **A** on the figure above.

_____

_____

_____

_____

(2)

(b) Explain the change in the percentage of gas in the region labelled **B** on the figure above.

(2)

(c) Compare the changes in the percentages of gases in the region labelled **C** on the figure above.

(2)

(d) What process caused the changes in the percentages of gases in the region labelled **C** on the figure above?

(1)

(e) Natural gas is a fossil fuel.

Describe how deposits of natural gas were formed.

(3)

(Total 10 marks)

3. This question is about the Earth's atmosphere.

(a) How long ago was the Earth formed?

Tick (✓) **one** box.

4.6 billion years ago ☐

4.6 million years ago ☐

4.6 thousand years ago ☐

(1)

The table below shows the percentages of gases in the atmospheres of Mars and Earth today.

Gas	**Percentage of gas in atmosphere (%)**	
	Mars	**Earth**
Carbon dioxide	95.97	0.04
Nitrogen	1.89	78.09
Oxygen	0.15	20.95
Other gases	1.99	**X**

(b) Calculate the percentage **X** of other gases in the Earth's atmosphere.

Use the table above.

_____

X = _____ %

(1)

The atmosphere of the early Earth is thought to have been similar to the atmosphere of Mars today.

The percentages of nitrogen and of oxygen in the Earth's atmosphere today have changed from the percentages in the Earth's early atmosphere.

(c) Draw **one** line from each gas to the change in the percentage of that gas.

Use the table above.

Gas	Change in percentage of gas
	Increased by about 4 times
Nitrogen	Increased by about 21%
Oxygen	Increased by about 40 times
	Increased by about 96%

(2)

(d) The percentage of carbon dioxide in the Earth's early atmosphere decreased.

Which **two** processes caused this decrease?

Tick (✓) **two** boxes.

- Carbon dioxide dissolving in sea water ☐
- Combustion of fossil fuels ☐
- Farming of animals ☐
- Formation of sedimentary rocks ☐
- Volcanoes releasing carbon dioxide ☐

(2)

(e) Photosynthesis also decreased the percentage of carbon dioxide in the Earth's early atmosphere.

Photosynthesis increased the percentage of another gas.

Complete the word equation for photosynthesis.

_____ + water → glucose + _____

(2)

(f) Complete the sentence.

Scientists are not certain about the percentages of gases in the Earth's early atmosphere because there is a lack of _____.

(1)

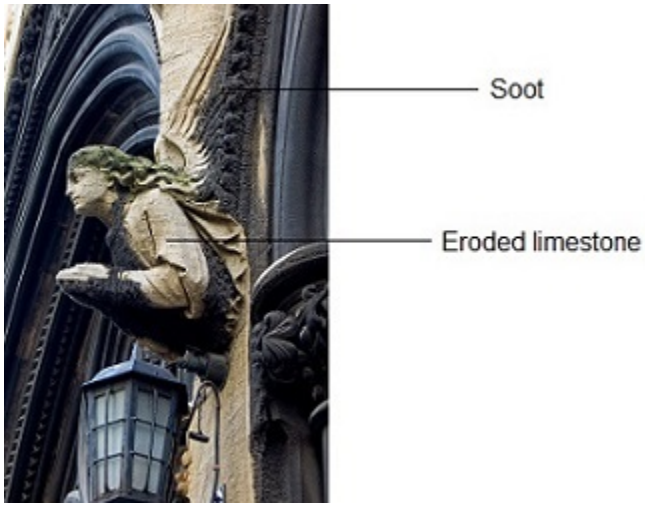
(Total 9 marks)

4. This question is about atmospheric pollution.

The image below shows a limestone carving which has been damaged by atmospheric pollution.

The carving has been:

- blackened by soot
- eroded where the limestone has reacted with atmospheric pollutants.



(a) What reacted with the limestone to cause the erosion?

Tick (✓) **one** box.

Acid rain	☐
Ammonia	☐
Carbon monoxide	☐
Oxygen	☐

(1)

(b) Soot is produced by the incomplete combustion of diesel oil.

Complete the sentences.

Choose answers from the box.

ammonia	**carbon**	**methane**
nitrogen	**oxygen**	

Incomplete combustion happens when there is not enough _____.

Incomplete combustion produces particles of _____.

(2)

(c) Complete the sentence.

Particles of soot in the atmosphere cause global _____.

(1)

(d) Carbon monoxide is produced by the incomplete combustion of methane.

Balance the equation for the reaction.

$$2\ CH_4 + 3\ O_2 \rightarrow \_\_\_\_\ CO + 4\ H_2O$$

(1)

(e) Car engines work at high temperatures.

Complete the sentences.

Choose answers from the box.

air	**methane**	**oxides of nitrogen**
oxygen	**petrol**	**sulfur dioxide**

In car engines, nitrogen is present.

The nitrogen in car engines comes from _____.

At high temperatures, the nitrogen reacts with _____.

This reaction produces _____.

(3)

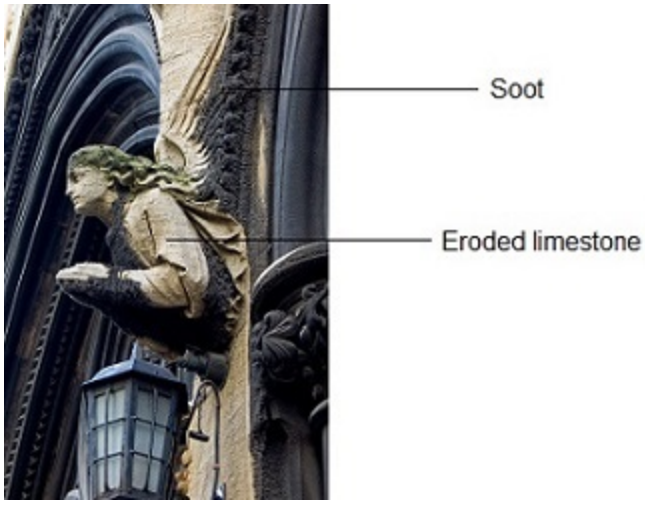
(Total 8 marks)

5. This question is about atmospheric pollution.

The image below shows a limestone carving which has been damaged by atmospheric pollution.

The carving has been:

- blackened by soot
- eroded where the limestone has reacted with atmospheric pollutants.



(a) Explain why soot is formed when some fossil fuels are burned.

_____

_____

_____

_____

(2)

(b) Fossil fuels are burned in car engines.

Explain how reducing the amount of sulfur in fossil fuels reduces the erosion of limestone.

(4)

(c) Oxides of nitrogen are atmospheric pollutants which are formed in car engines.

Explain why oxides of nitrogen are formed in car engines.

(2)

(Total 8 marks)

6. Titan is a moon of the planet Saturn.

The table below shows the percentages of some gases in the atmosphere of Titan and in the atmosphere of the Earth.

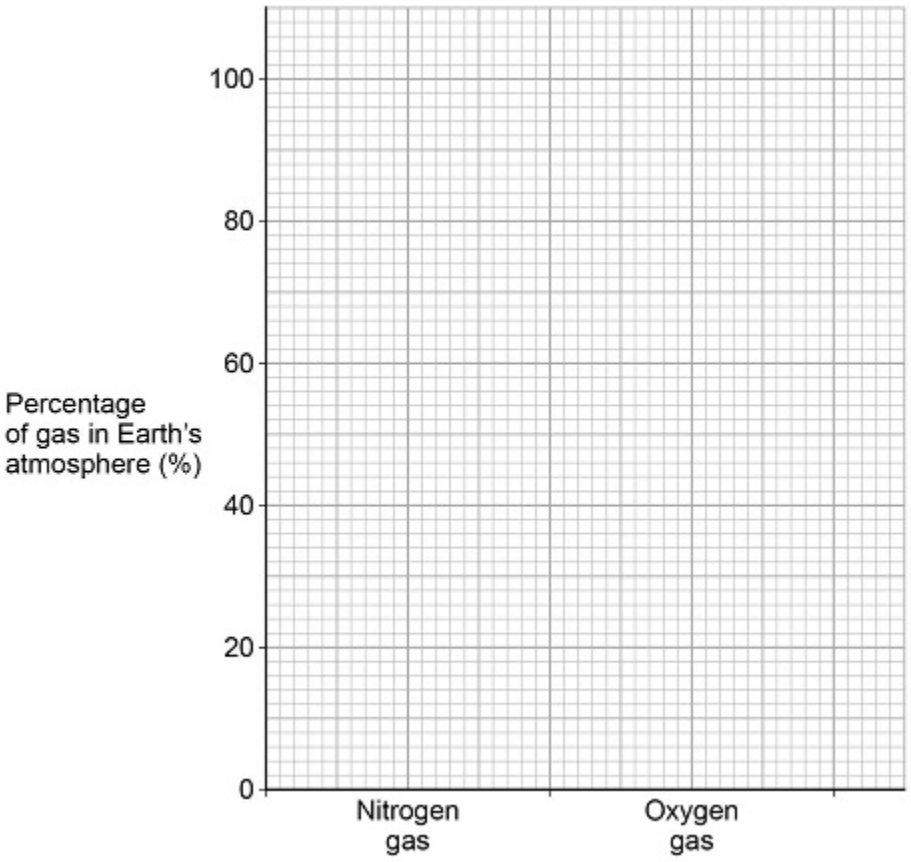
Gas	Percentage of gas in atmosphere (%)	
	Titan	**Earth**
Nitrogen	98	78
Oxygen	Zero	21
Methane	1.4	0.0002
Argon	0.14	0.9
Carbon dioxide	0.0001	0.04

(a) Which **two** gases are present in smaller percentages on the Earth than on Titan?

_____ and _____

(1)

(b) Complete the bar chart in the figure below to show the percentages of nitrogen gas and oxygen gas in the Earth's atmosphere.



(2)

(c) Why are algae less likely to photosynthesise on Titan than Earth?

Use the table above.

Tick (✓) **one** box.

Titan's atmosphere contains too little argon. ☐

Titan's atmosphere contains too little carbon dioxide. ☐

Titan's atmosphere contains too little methane. ☐

Titan's atmosphere contains too little nitrogen. ☐

(1)

(d) Titan is warmer than the other moons of Saturn because of the greenhouse effect.

How do greenhouse gases trap energy from the sun?

Tick (✓) **one** box.

All wavelengths of radiation are reflected back to the surface of Titan. ☐

Long wavelength radiation is reflected back to the surface of Titan. ☐

Short wavelength radiation is reflected back to the surface of Titan. ☐

(1)

As well as methane, the atmosphere of Titan contains small amounts of propene gas. Methane is an alkane and propene is an alkene.

(e) Bromine water is an orange solution used to identify alkenes.

Draw **one** line from each gas to its effect on bromine water.

Gas	Effect on bromine water
	Forms a blue solution
Methane	Forms a colourless solution
	Forms a green solution
Propene	Forms a white precipitate
	No effect

(2)

(f) Propene reacts with water (steam) to make propanol.

The ratio of the masses of propene and water that react is:

Propene : water

7 : 3

Calculate the mass of propene that reacts with 21 g water.

_____

_____

_____

_____

Mass = _____ g

(2)

(Total 9 marks)

7. Some central heating boilers use methane as a fuel.

Carbon monoxide detectors are placed near central heating boilers.

(a) Which **three** properties of carbon monoxide make it necessary to use carbon monoxide detectors?

Choose answers from the box.

acidic	**alkaline**	**colourless**	**corrosive**
insoluble	**odourless**	**toxic**	

1 _____

2 _____

3 _____

(3)

(b) Complete the sentence.

Methane produces carbon monoxide when burning in a limited supply of

_____.

(1)

(c) 8 g of methane has a volume of 12 dm^3 at room temperature and pressure.

Calculate the mass of 36 dm^3 of methane.

_____

_____

_____

_____

Mass = _____ g

(2)

(d) Most methane is obtained from natural gas, which is a fossil fuel.

Methane can also be produced renewably.

Which **two** are renewable sources of methane?

Tick (✓) **two** boxes.

Animal waste	☐
Food in landfill	☐
Nitrogen in the air	☐
Non-biodegradable plastics	☐
Scrap iron	☐

(2)

(Total 8 marks)

8. This question is about combustion of fuels.

(a) Some central heating boilers use wood as a fuel.

Suggest **two** reasons why wood is more sustainable than natural gas as a fuel for central heating boilers.

1 _____

_____

2 _____

_____

(2)

Natural gas is mainly methane.

When methane burns it can produce both carbon monoxide and carbon dioxide.

(b) Explain the process by which carbon monoxide can be produced when methane is burned.

_____

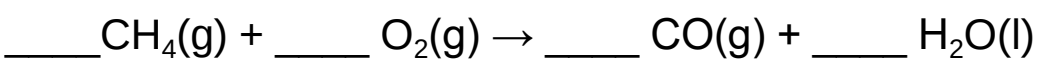
_____

_____

_____

(2)

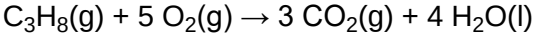
(c) Balance the equation for the combustion of methane to produce carbon monoxide.



(1)

(d) Propane burns to form carbon dioxide and water.

The equation for the reaction is:



3.60 dm^3 carbon dioxide is produced when a sample of propane is burned in 7.25 dm^3 oxygen.

Calculate the volume of unreacted oxygen.

Give your answer in cm^3

_____

_____

_____

_____

_____

_____

_____

_____

Volume of unreacted oxygen = _____ cm^3

(4)

(Total 9 marks)

1. (a) water vapour

1

(b) (increased population so) more energy required

allow (increased population so) more transport required

1

(so) more (fossil) fuels burned

allow a named fossil fuel

OR

(increased population so) more farmland required (1)

(so) more deforestation (1)

1

(c) (increased population so) more food required

1

(so) more methane-producing food production

allow more use of beef cattle (in food production)

allow more rice grown

OR

(increased population so) more waste produced (1)

(which) produces more methane on decomposition (1)

1

(d) any **two** from:

- melting ice
- rising sea levels
- flooding
- extremes of weather
- loss of habitats

ignore global warming

*do **not** accept acid rain*

*do **not** accept global dimming*

*do **not** accept references to ozone*

2

(e) there may be other reasons for changes in the (mean)

allow difficult to model

temperature (of the atmosphere at the Earth's surface)

allow the earth goes through cycles of temperature change

1

[8]

2. (a) (the percentage of) nitrogen increased

1

(because of intense) volcanic activity

1

(b) (the percentage of) carbon dioxide decreased

1

(because) carbon dioxide dissolved in oceans
or
(because of) formation of carbonate (precipitates / sediments)

*do **not** accept references to photosynthesis*

1

(c) (the percentage of) carbon dioxide decreased
and
(the percentage of) oxygen increased

1

the increase and decrease (in percentage) occur at the same / similar rate

allow the changes (in percentage) are the same / similar in the same period of time

1

(d) photosynthesis

allow a description of photosynthesis

1

(e) plankton (died)

allow tiny marine organisms (died)

1

and (the organisms) were covered by sediments

allow and (the organisms) were buried

allow and (the organisms) were in anaerobic conditions

1

and subjected to high temperature
and
high pressure (over millions of years)

1

[10]

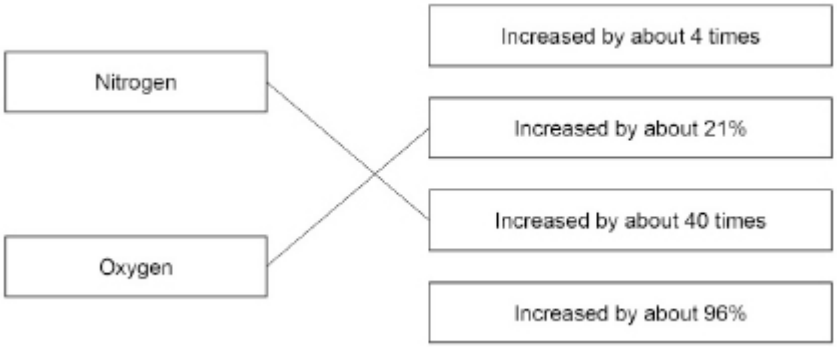
3. (a) 4.6 billion years ago

1

(b) 0.92 (%)

1

(c)



*do **not** accept more than one line from a box on the left*
1

1
1

(d) carbon dioxide dissolving in sea water

1

formation of sedimentary rocks

1

(e) carbon dioxide (+ water →)
allow CO_2

1

(→ glucose +) oxygen
allow O_2

1

(f) evidence / proof

1

[9]

4. (a) acid rain

1

(b) oxygen

1

carbon
must be in this order

1

(c) dimming

1

(d) 2 CH_4 + 3 O_2 → **2** CO + 4 H_2O
allow multiples

1

(e) air

1

oxygen

1

oxides of nitrogen

must be in this order

1

[8]

5. (a) incomplete combustion

*max **1** mark if soot wrongly identified*

1

(because of) insufficient oxygen

1

(b) sulfur reacts with oxygen to form sulfur dioxide

allow SO_2 for sulfur dioxide

allow sulfur burns to form sulfur dioxide

1

(so) less sulfur dioxide emitted

1

(so) less acid rain

1

(so less) limestone reacts with acid rain

1

(c) (car engines work at) high temperatures

1

(so in the engine) nitrogen (from air) reacts with oxygen (from air)

1

[8]

6. (a)

in either order, both required for mark

allow phonetic spellings

nitrogen

allow N_2 for nitrogen

and

methane

allow CH_4 for methane

1

(b)

ignore width of bars
ignore additional bars

nitrogen bar to 78%

1

oxygen bar to 21%

1

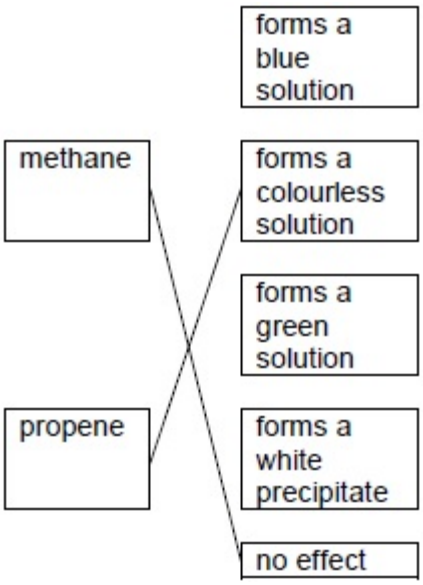
(c) Titan's atmosphere contains too little carbon dioxide.

1

(d) long wavelength radiation is reflected back to the surface of Titan.

1

(e)



an extra line from a gas to an effect on bromine water negates that mark

2

(f)

*an answer of 49 (g) scores **2** marks.*

$$\frac{7 \times 21}{3}$$

1

= 49 (g)

1

[9]

7. (a) colourless

1

odourless

1

toxic

1

any order

if more than three answers are given, apply the list principle as follows:

Number of answers	Number correct	Number incorrect	Mark awarded
4	3	1	2
	2	2	1
	1	3	0
5	3	2	1
	2	3	0
	1	4	0

(b) oxygen

allow air / O_2

1

(c)

*an answer of 24 (g) scores **2** marks*

$\frac{36}{12} \times 8$

1

= 24 (g)

1

(d) animal waste

1

food in landfill

1

[8]

8. (a) wood is renewable

or

(natural) gas is finite

1

(burning) wood produces the same amount of carbon dioxide as the trees absorbed

allow wood is carbon-neutral allow wood does not add to global warming

or

(burning natural) gas increases the amount of carbon dioxide (in the atmosphere)

allow (burning natural) gas adds to global warming

allow (burning natural) gas adds greenhouse gases (to the atmosphere)

ignore references to energy / cost

1

(b) not enough oxygen

allow not enough air

*do **not** accept no oxygen / air*

1

(so) incomplete combustion

1

(c) $\mathbf{2}CH_4(g) + \mathbf{3}O_2(g) \rightarrow \mathbf{2}CO(g) + \mathbf{4}H_2O(g)$

allow correct multiples / fractions

1

(d)

*an answer of 1250 (cm^3 oxygen unreacted) scores **4** marks*

ratio of $O_2 : CO_2 = 5 : 3$

1

(oxygen needed = $\frac{3.60 \times 5}{3}$)
= 6.0 (dm^3)

allow correct calculation using an incorrectly determined mole ratio

1

(oxygen unreacted = 7.25 − 6.0) = 1.25 (dm^3)

allow correct subtraction of an incorrectly calculated volume of oxygen

1

(oxygen unreacted = 1.25 × 1000)
= 1250 (cm^3)

allow correct conversion to cm^3 anywhere in response

1

alternative approach for MP1 and MP2

moles CO_2 = 0.15
and
moles O_2 = 0.25 (1)

(0.25 x 24 =) 6.0 (dm^3 oxygen needed) (1)

[9]