

# Decay

**Q:1** Read the passage below about biogas production in Sri Lanka, which is a country with a much warmer climate than the UK.

Mr Ratnayake is a farmer. Using nothing more than cow dung, he has enough power to cook and provide heat and light for his home without using a single piece of wood. He collects the manure from his cows in their cattle shed. He then mixes the manure with water and leaves it to ferment in a large concrete pit. The gas produced is collected in a simple storage tank and is piped into his house for use.

The dried manure left after this biogas is generated is richer than ordinary manure. It makes a good organic fertiliser for Mr Ratnayake's crops. He can then sell his crops at a higher price as they are organic produce.

**(a)(i)** What is the fuel gas present in biogas?

\_\_\_\_\_

**(1 mark)**

**(ii)** Name the process which produces biogas.

\_\_\_\_\_

**(1 mark)**

**(b)(i)** Give two ways in which Mr Ratnayake benefits from making biogas as described in the passage.

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

**(2 marks)**

(ii) This design of biogas generator works well in Sri Lanka. It would not work so well in the UK.

Explain why.

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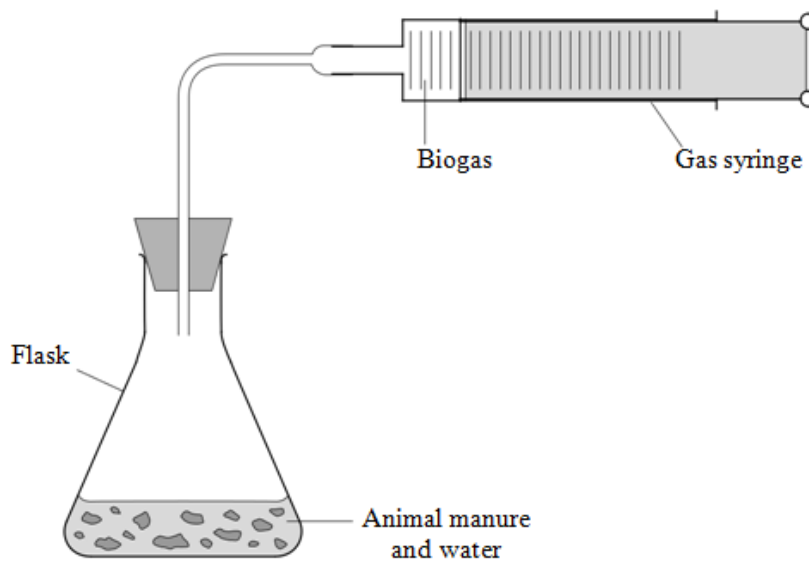
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(2 marks)

**Q:2** Some students investigated the production of biogas from animal manure. They used the apparatus shown in the diagram.



In their first investigation, the students collected the biogas in the gas syringe.

The table shows the percentage composition of the biogas.

<b>Gas</b>	<b>Percentage composition</b>
Methane	55
Carbon dioxide	40
Water vapour	5

**(a)** To make the biogas a more efficient fuel, the percentages of two of the gases in the table should be reduced.

Which two gases should these be?

1 \_\_\_\_\_

2 \_\_\_\_\_

**(1 mark)**

**(b)** The students then used the apparatus for a second investigation.

They bubbled oxygen through some fresh manure and water for one hour.

They then set up the apparatus again and collected a second sample of biogas in the gas syringe.

Predict the effect of this procedure on the composition of the second sample of biogas.

Explain your answer.

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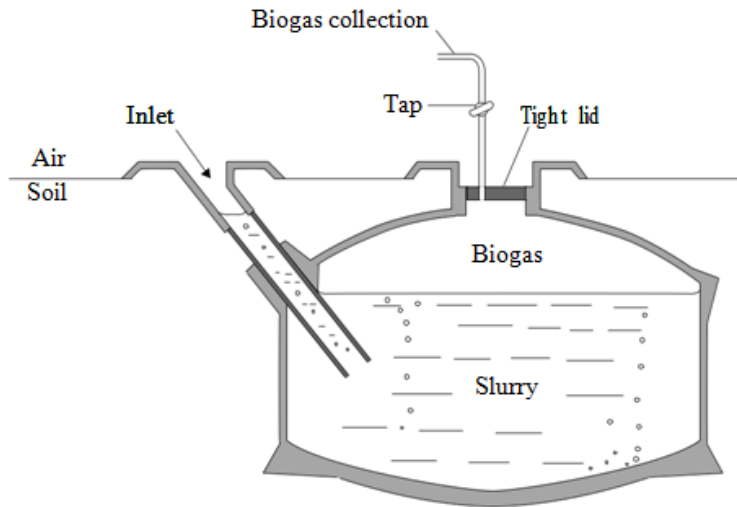
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**(4 marks)**

**Q:3** The diagram shows one type of biogas generator.



**(a)** Give two advantages of having the biogas generator underground. Tick (☑) two boxes.

- It allows the digested slurry to soak into the soil.
- The biogas produced will be at a lower pressure.
- Very little of the biogas generator will be seen.
- It prevents unpleasant smells escaping.
- The temperature inside will not change much.

**(2 marks)**

**(b)** The table shows the percentages of the different gases found in this biogas.

Gas	Percentage
Carbon dioxide	35.0
Hydrogen sulfide	1.5
Ammonia	1.5
Water vapour	2.0
Gas X	

Gas X is the main fuel gas found in biogas.

**(b)(i)** What is the name of gas X?

Draw a ring around one answer.

hydrogen      methane      oxygen

**(1 mark)**

**(b)(ii)** What is the percentage of gas X in the biogas?

Show clearly how you work out your answer.

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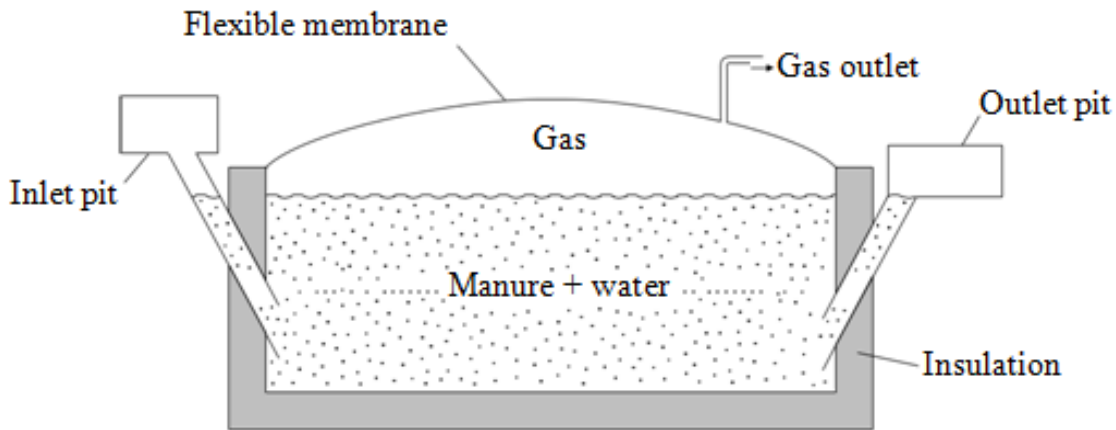
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Percentage of gas X = \_\_\_\_\_

**(2 marks)**

**Q:4** The diagram shows one design of biogas generator used on a large dairy farm in the USA.



**(a)** What is the main, useful gas in biogas? Draw a ring around one answer.

carbon dioxide      hydrogen      methane

(1 mark)

**(b)** The insulation is installed so that biogas is produced at a faster rate. Why is biogas produced at a faster rate?

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(1 mark)

**(c)** The table shows costs and income for this generator.

<b>Item</b>	<b>Yearly costs in dollars</b>	<b>Yearly income in dollars</b>
Electricity generated from biogas		22 800
Heating from burning biogas		4 200
Sale of fibre after biogas production		8 000
Operation and maintenance costs	10 000	

(c)(i) Calculate the yearly profit from the biogas generator. Show your working.

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(2 marks)

(c)(ii) It cost 200 000 dollars to build the generator. Use your answer to part (c)(i) to calculate how many years it would take to pay back this cost.

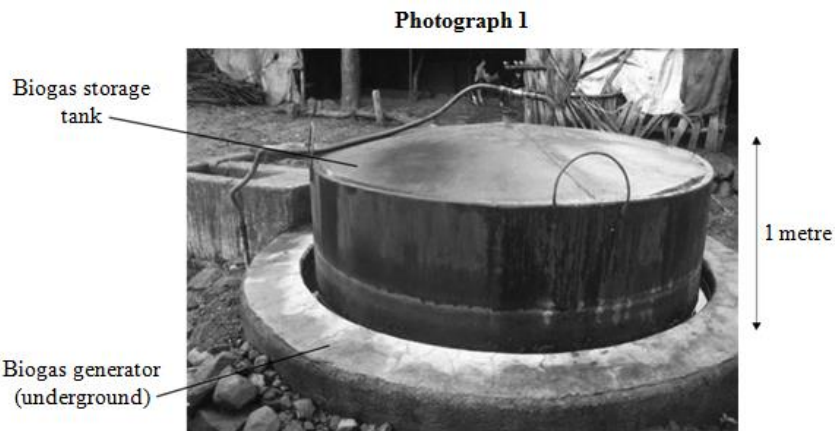
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(2 marks)

Q:5 Photograph 1 shows a biogas generator on a farm in India.



(a) Name the fuel gas present in biogas.

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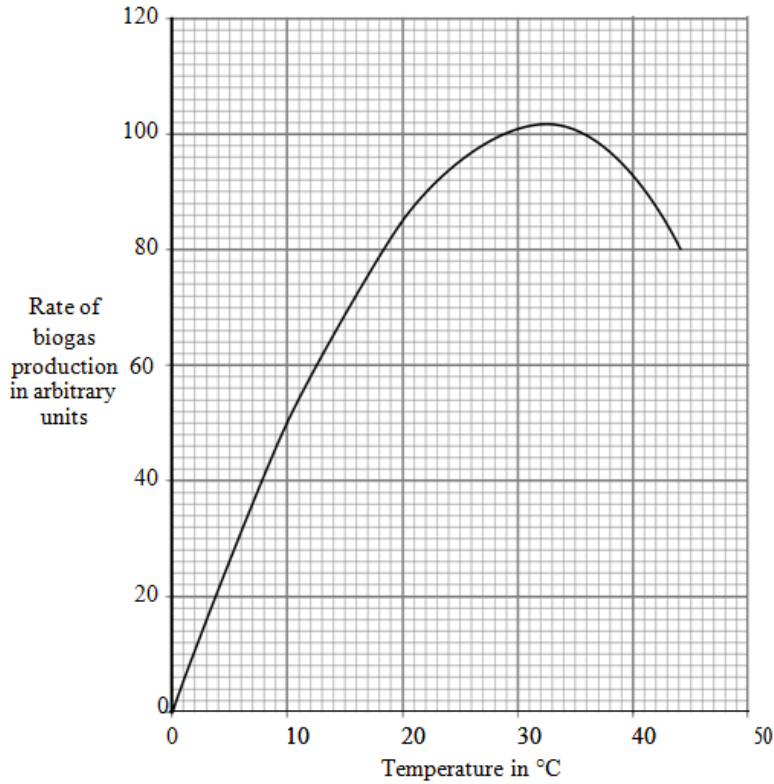
(1 mark)

(b) Name the process that produces biogas.

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(1 mark)

(c) The graph shows the effect of temperature on the rate of biogas production.



(c)(i) What is the best temperature for biogas production?

\_\_\_\_\_ °C

(1 mark)

(c)(ii) In India, daytime temperatures can sometimes be higher than 40 °C.

It is useful to place the biogas generator underground.

Use information from the graph to suggest why.

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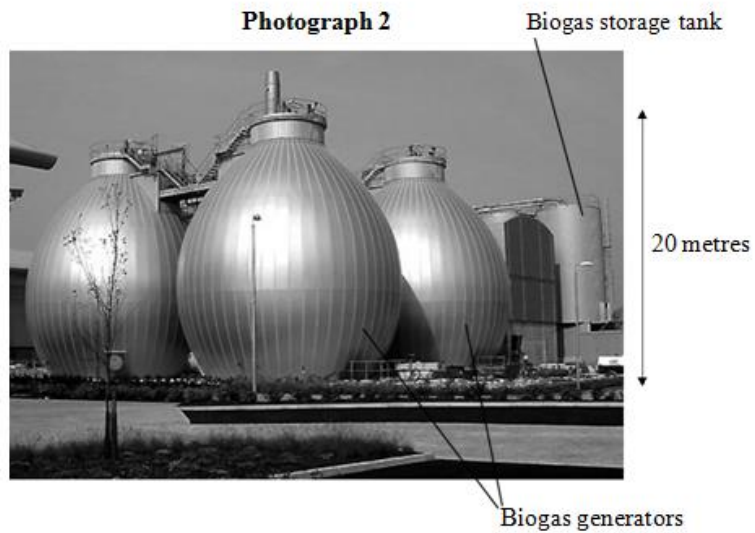


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(2 marks)

(d) Photograph 2 shows a set of three biogas generators built at a sewage works in the UK in 2004.



Temperatures at the UK sewage works vary between 0 °C and 25 °C.

The UK biogas generator has concrete walls, 60 cm thick.

How does the thickness of the walls affect the rate of biogas production?

Give a reason for your answer.

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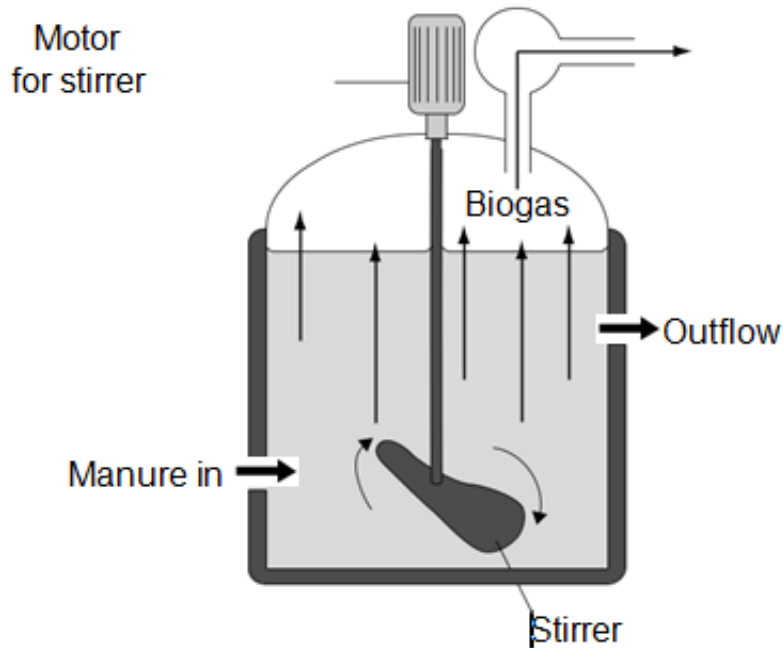
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(2 marks)

**Q:6** The diagram shows one type of biogas generator.



**(a)** With this type of biogas generator, the concentration of solids fed into the reactor must be kept very low. Suggest one reason for this.

Tick (☑) one box.

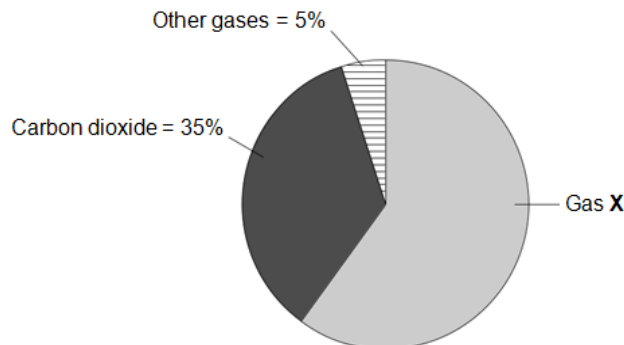
A higher concentration contains too little oxygen.

A higher concentration would be difficult to stir.

A higher concentration contains too much carbon dioxide.

**(1 mark)**

**(b)** The pie chart shows the percentages of the different gases found in this biogas.



Gas X is the main fuel gas found in this biogas.

**(b) (i)** What is the name of gas X?

Draw a ring around one answer.

methane      nitrogen      oxygen

**(1 mark)**

**(b) (ii)** What is the percentage of gas X in the biogas?

Show clearly how you work out your answer.

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Percentage of gas X = \_\_\_\_\_

**(2 marks)**

**(c)** If the biogas generator is not airtight, the biogas will contain a much higher percentage of carbon dioxide.

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

**(c) (i)** The air that leaks in will increase the rate of

aerobic respiration.
anaerobic respiration.
fermentation.

**(1 mark)**

**(c) (ii)** The process in part (c)(i) occurs because the air contains

ammonia.
nitrogen.
oxygen.

**(1 mark)**

**TOTAL MARKS=35**