

1

Food security is when a population has enough food to stay healthy.

Lack of food security is a global problem.

One way to maintain food security is to increase the efficiency of food production.

The diagram below shows how some pigs are farmed using intensive methods.



© Ingram Publishing/Thinkstock

(a) Some people think the farming methods shown in the diagram above are unethical.

Suggest **two** other possible disadvantages of intensive farming methods.

- 1 .....
- .....
- 2 .....
- .....

(2)

(b) Explain how the intensive farming of pigs increases the efficiency of food production.

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**(4)**

(c) A newspaper reported that:

**‘Food security is a serious problem in remote communities in Canada. This is because Aboriginal communities are eating fewer traditional foods.’**

One traditional food eaten by Aboriginal communities in Canada is seal.

Look at the table below

Year	Number of seals caught in thousands
2004	362
2005	316
2006	348
2007	224
2008	215
2009	91
2010	67

Calculate the percentage (%) decrease in the number of seals caught from 2004 to 2010.

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Decrease in seals = ..... %

(2)

(d) The conclusion in the newspaper might **not** be correct.

Suggest **two** reasons why.

1 .....

2 .....

(2)  
 (Total 10 marks)

2

Figures 1 and 2 show battery chickens and free-range chickens.

**Figure 1**  
**Battery chickens**



© studiodr/iStock/Thinkstock

**Figure 2**  
**Free-range chickens**



© xlikovec/iStock/Thinkstock

Battery chickens are kept in cages indoors. Free-range chickens can walk around outside.

- (a) Give **one** way in which food production might be more efficient from battery chickens than from free-range chickens. Give a reason for your answer.

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(2)

(b) Some farms use waste from chickens to produce biogas in an anaerobic digester.

Microorganisms in the digester break down the waste by anaerobic respiration.

(i) What does **anaerobic** mean?

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(1)

(ii) One product of anaerobic respiration is methane.

Name **two** other products of anaerobic respiration.

1.....  
2.....

(2)

(c) The best temperature for anaerobic digesters is about 35 °C.

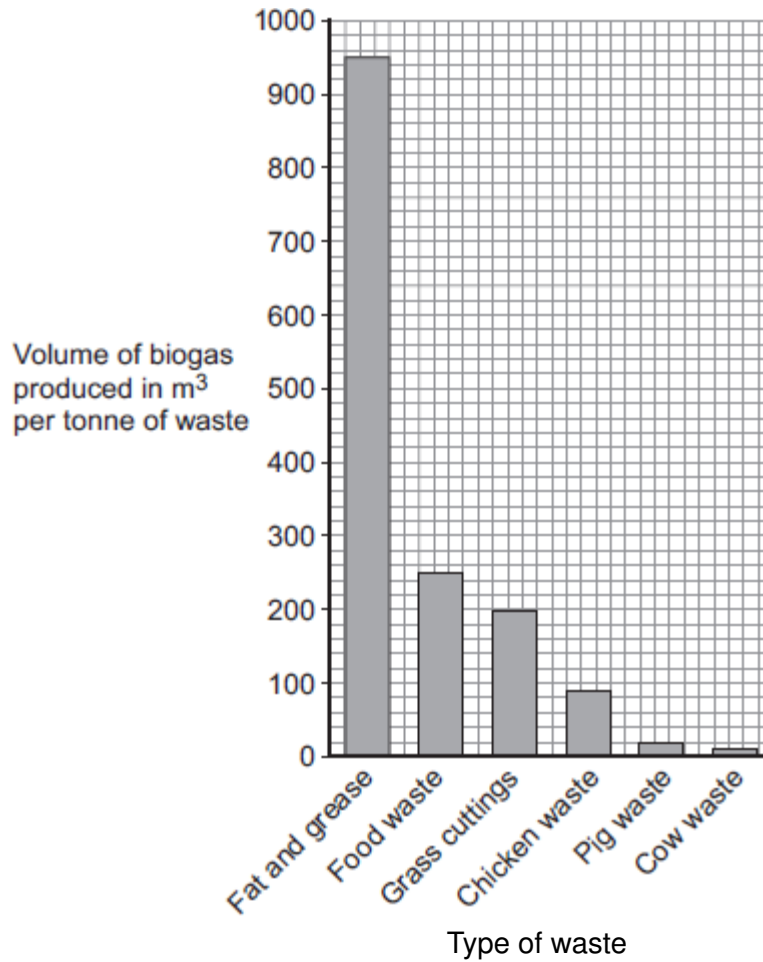
Explain why the volume of biogas produced would be **less** at higher temperatures.

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(2)

(d) **Figure 3** shows other types of waste that can be used in an anaerobic digester to produce biogas.

**Figure 3**



(i) What is the volume of biogas produced by a tonne of grass cuttings?

..... m<sup>3</sup>

**(1)**

(ii) Biogas is 60% methane.

Calculate the volume of methane gas produced per tonne of grass cuttings.

..... m<sup>3</sup>

**(1)**

(e) Why should biogas **not** be allowed to escape into the atmosphere?

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**(2)**  
**(Total 11 marks)**

3

The world population is increasing and the need for food is increasing.

Mycoprotein is a high-protein food made in fermenters using the organism *Fusarium*.

The process takes only a few weeks to produce a large amount of food.

(a) (i) What type of organism is *Fusarium*?

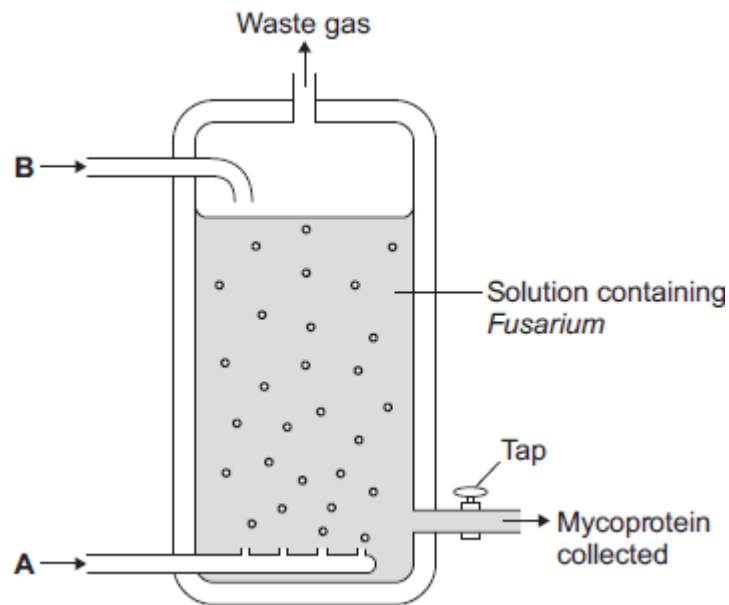
Draw a ring around the correct answer.

**bacterium**

**fungus**

**virus**

The diagram below shows a fermenter used in mycoprotein production.



(1)

(ii) *Fusarium* makes mycoprotein. *Fusarium* respire aerobically.

Suggest which gas is added to the fermenter at point **A**.

.....

(1)

(iii) Another substance is added to the fermenter at point **B**. This substance is used in aerobic respiration.

Name this substance.

.....

(1)



(b) People need to eat protein to grow and to be healthy.

Some people think that it would be an advantage to get more food from mycoprotein and less from farming animals.

Suggest **two** possible advantages of getting more food from mycoprotein.

1.....

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2.....

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(2)  
(Total 5 marks)

**4**

Herring are a type of fish found in the North Sea. Herring are caught using nets which are pulled by large boats.

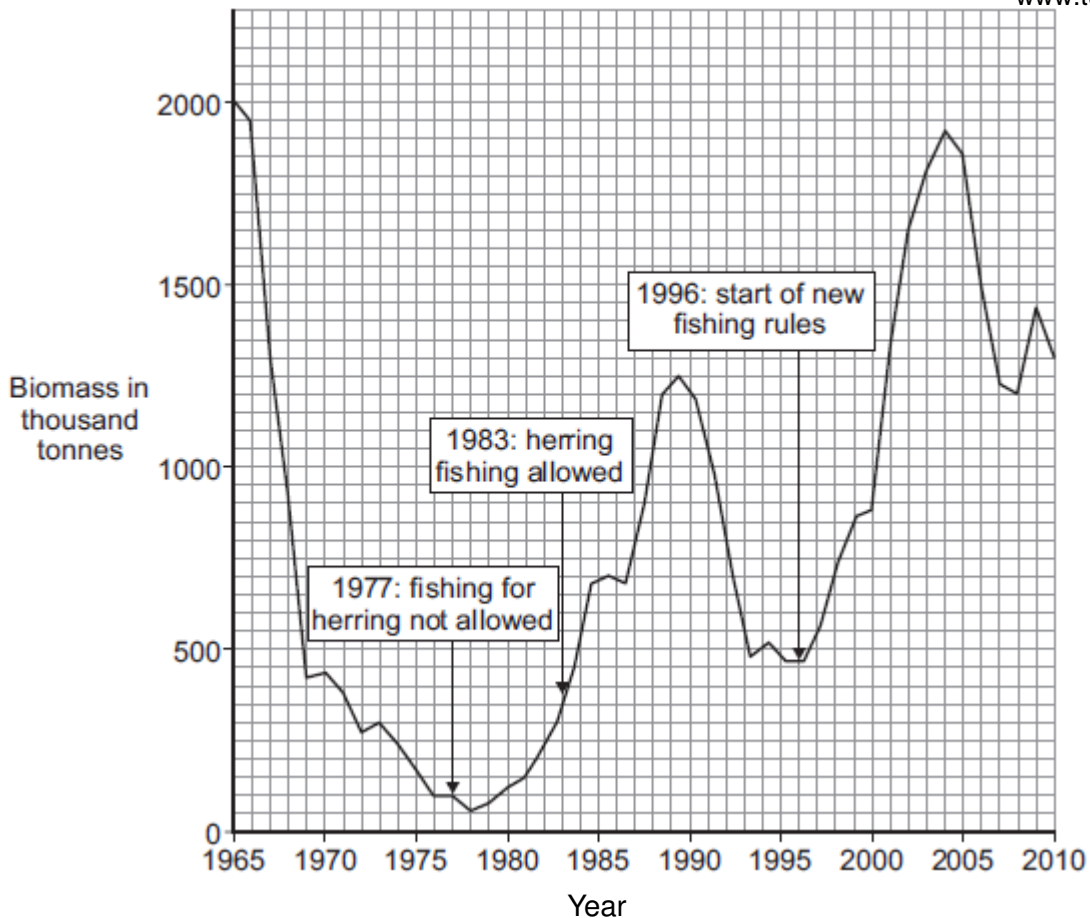
The photographs show a fishing boat and some herring.



By Atle Grimsby from Utsira, Norway (Herring Catch at Utsira) [CC-BY-2.0 (<http://creativecommons.org/licenses/by/2.0>)], via Wikimedia Commons.

The herring population in the North Sea has changed a lot in recent years.

The graph shows the estimated biomass of herring in the North Sea between 1965 and 2010.



(a) Suggest why the biomass can only be estimated.

Tick (✓) **one** box.

Scientists are not properly trained.

There are too many different types of fish in the sea.

It is impossible to weigh all the herring in the sea.

(1)

(b) (i) Describe the pattern shown in the graph from 1978 to 1983.

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 .....

(1)

(ii) Suggest a reason for the pattern you have described in part (b) (i).

.....  
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(1)

(c) In 1996 the Government brought in strict rules to help to conserve fish stocks.

(i) State **two** rules that would help to conserve fish stocks.

1 .....

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2 .....

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**(2)**

(ii) Were the Government's rules effective?

Use data from the graph to support your answer.

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.....

**(2)**

(iii) Why should fish stocks be kept above a certain minimum level?

.....

.....

**(1)**

(iv) The Government did not introduce rules about the amount of herring caught until 1977.

This was in response to a dramatic decrease in herring stocks.

What was the percentage decrease in herring stocks between 1965 and 1977?

.....

.....

Percentage decrease = .....

**(2)**

(d) Herring migrate to feed and spawn (lay eggs).

The eggs normally take about 3 weeks to hatch at 12 °C.

If the temperature of the water is higher the eggs will hatch more quickly.

But, if the temperature of the water is above 19 °C, the eggs will die.

Other fish, such as cod, feed on herring.

Suggest how climate change could affect North Sea fish.

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(4)  
(Total 14 marks)

**5**

The number of fish in the oceans is decreasing.

The table below shows information about the mass of fish caught by UK fishermen between 2002 and 2010.

Year	Mass of fish caught by UK fishermen from ALL SOURCES in thousands of tonnes	Mass of fish caught by UK fishermen from SUSTAINABLE SOURCES in thousands of tonnes	Percentage of fish caught from sustainable sources
2002	690.0	427.8	62.0
2004	655.0	396.6	60.5
2006	619.0	386.0	62.4
2008	589.0	436.1	74.0
2010	611.5	465.0	

(a) (i) Calculate the percentage of fish caught from sustainable sources in 2010.

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.....  
.....  
..... %

(2)

(ii) Describe the pattern in the table above for the mass of fish caught from all sources.  
Suggest reasons for this pattern.

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(4)

(iii) Suggest why the percentage of fish caught from sustainable sources is increasing.

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(1)

(b) Give **two** methods of maintaining fish stocks at a sustainable level.

1 .....  
2 .....

(2)

(c) The image below shows a fish farm.



© debsthelio/iStock/Thinkstock

In a fish farm, large numbers of fish are grown in cages in the sea.

Why do fish in the cages grow faster than fish of the same species that are free in the sea?  
You should refer to energy in your answer.

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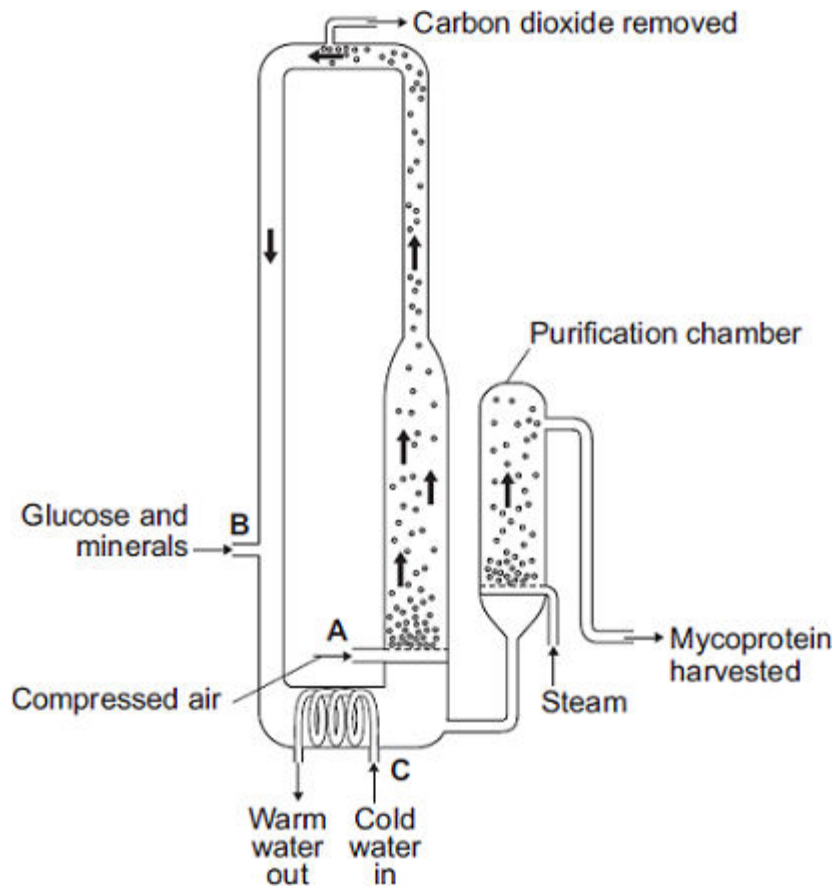
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**(4)**  
**(Total 13 marks)**

6

The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium*.

*Fusarium* is used to make mycoprotein.



(a) Bubbles of air enter the fermenter at **A**.

Give **two** functions of the air bubbles.

1.....

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2.....

.....

(2)

(b) Why is glucose added to the fermenter?

.....

.....

(1)

- (c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C**.

Name the process that causes the fermenter to heat up.

.....

(1)

- (d) It is important to prevent microorganisms other than *Fusarium* growing in the fermenter.

- (i) Why is this important?

.....

.....

(1)

- (ii) Suggest **one** way in which contamination of the fermenter by microorganisms could be prevented.

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(1)

- (e) Human cells cannot make some of the amino acids which we need. We must obtain these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

Name of amino acid	Amount of amino acid per 100 g in mg			Daily amount needed by a 70 kg human in mg
	Mycoprotein	Beef	Wheat	
Lysine	910	1600	300	840
Methionine	230	500	220	910
Phenylalanine	540	760	680	980
Threonine	610	840	370	490



A diet book states that mycoprotein is the best source of amino acids for the human diet.

Evaluate this statement.

Remember to include a conclusion in your evaluation.

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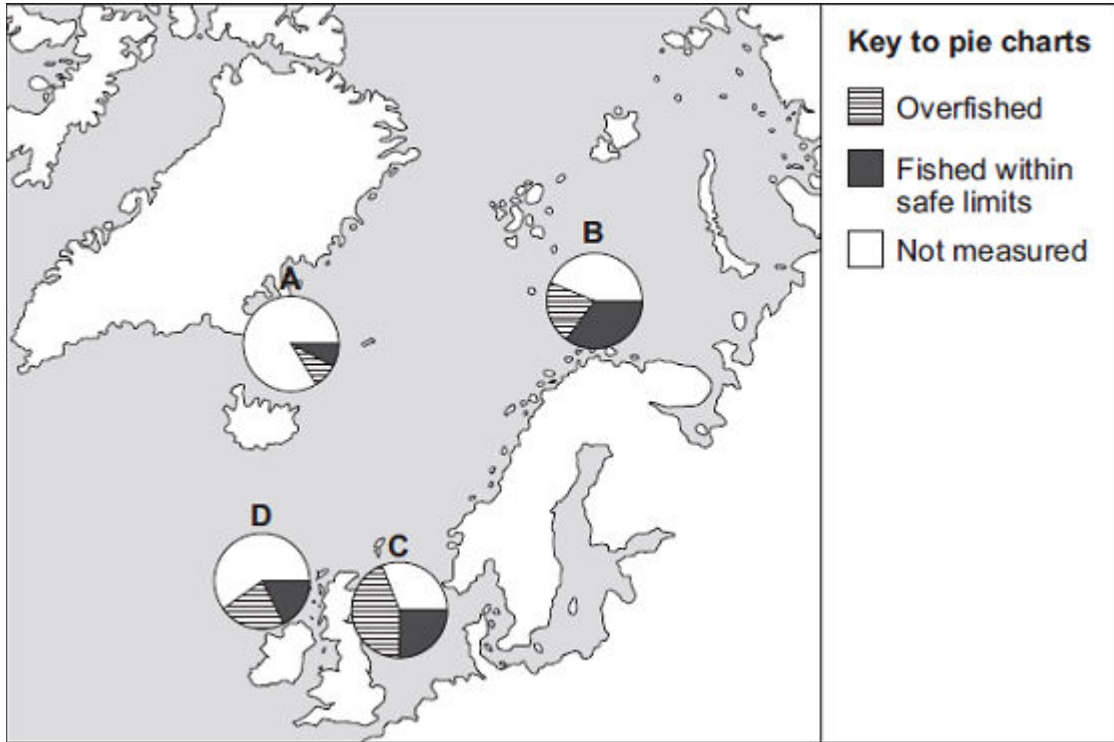
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**(4)**  
**(Total 10 marks)**

7

The map shows pie charts, **A**, **B**, **C** and **D**, that give information about fisheries in some of the seas around Europe.



© European Environment Agency

(a) Which pie chart, **A**, **B**, **C** or **D**, shows the fishery with the largest amount of overfishing?

(1)

(b) It is important to maintain fish stocks high enough for breeding to continue.

Give the reason why.

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(1)

(c) Give **two** ways fish stocks can be conserved.

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(2)

(Total 4 marks)

8

There are many ways to increase the efficiency of food production.

(a) The table shows the energy available to humans from two different food chains.

Food chain	Energy transferred to humans in kJ per hectare of crop
Wheat → humans	900 000
Wheat → pigs → humans	90 000

(i) Compare the amount of energy the two food chains transfer to humans.

.....  
 .....

(1)

(ii) Give **one** reason for the difference in the amount of energy the two food chains transfer to humans.

.....  
 .....

(1)

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

Give methods used in the factory farming of animals.  
Explain the advantages and disadvantages of these methods.

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**(6)**  
**(Total 8 marks)**

9

The photographs show four ways of farming.

**Growing wheat**



**Keeping sheep outside**



**Keeping pigs outside**

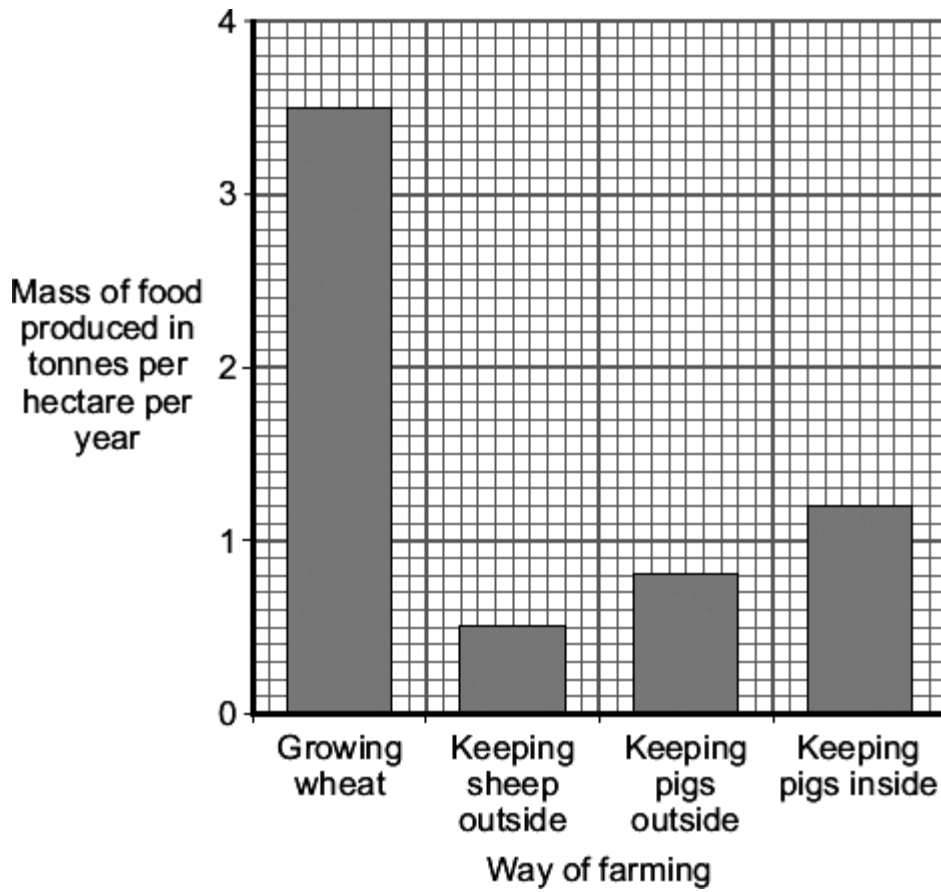


**Keeping pigs inside**



Growing wheat by Eileen Henderson [CC-BY-SA-2.0], via Wikimedia Commons. Keeping Sheep outside by Andrew Smith [CC-BY-SA-2.0], via Wikimedia Commons. Keeping Pigs outside by David Williams [CC-BY-SA-2.0], via Wikimedia Commons. Keeping Pigs inside supplied by iStockphoto/ Thinkstock.

The bar chart shows the amount of food produced from these four ways of farming.



- (a) How much extra food can be produced when farmers grow wheat, compared with keeping sheep outside?

Show clearly how you work out your answer.

.....  
.....

Answer ..... tonnes per hectare per year

(2)

- (b) Sheep eat grass.  
For every 1000 g of grass eaten, a sheep increases in mass by only 50 g.  
The other 950 g is lost.

How is the other 950 g lost?

Tick (✓) **two** boxes.

- As oxygen from photosynthesis
- As faeces
- As meat
- As carbon dioxide from respiration

**(2)**

- (c) (i) Pigs kept inside lose less energy than pigs kept outside.

Why?

Tick (✓) **two** boxes.

- Pigs kept inside are fed more.
- Pigs kept inside are kept in small pens.
- Pigs kept inside are kept warm in the winter.
- Pigs kept inside are healthier.

**(2)**

(ii) Meat from pigs kept inside is usually cheaper than meat from pigs kept outside.

Give **one** reason why.

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.....

(1)  
(Total 7 marks)



10

There are plans for a 'cattle factory' to be built in the UK.

Information about the cattle factory and traditional cattle farming in the UK is given below.



**Cattle factory**



**Traditional cattle farming**

Cattle factory by Pirhan [CC BY-SA 2.0], via Flickr. Traditional cattle farming by Mat Fascione[CC-BY-SA-2.0], via Wikimedia Commons

**Cattle factory**

- There will be over 8 000 cows in three large sheds.
- Each cow will be milked three times a day.
- Each cow will produce about 50 litres of milk every day.
- Waste will be collected and used to produce electricity for 2 000 homes.
- Cows are kept near to each other so disease can spread easily.

**Traditional cattle farming**

- Most farms have between 5 and 500 cows.
- The cows spend most of the time in fields.
- Cows are milked once or twice a day.
- Each cow produces up to 20 litres of milk a day.
- The waste is used as natural fertiliser for crops.

(a) Use the information to answer the questions.

(i) Give **two** reasons why some people think the cattle factory is a good idea.

1 .....

.....

2 .....

.....

(ii) Give **two** reasons why some people think traditional farming is better than the cattle factory.

1 .....

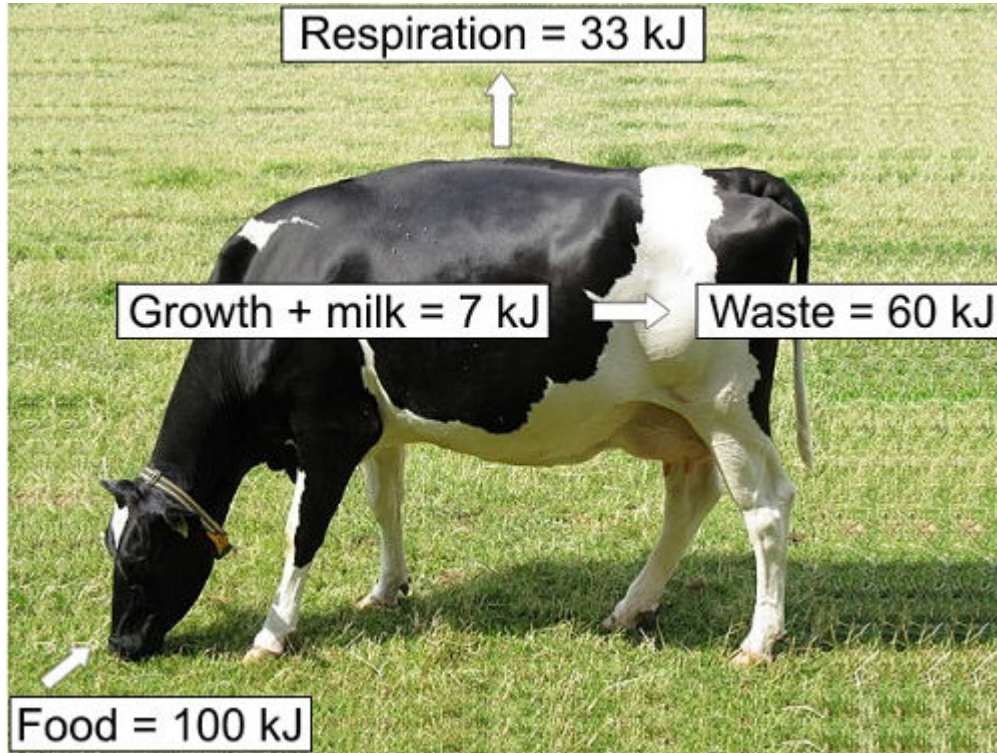
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2 .....

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(2)

- (b) The diagram shows what happens to 100 kJ of energy in the food eaten by a cow on a traditional farm.



By Dohduhdah (Own work) [Public domain], via Wikimedia Commons

Use your knowledge and the information in the diagram to answer this question.

Compare the transfer of energy from the food eaten by cows in the cattle factory with the energy transferred by cows on a traditional farm.

Use words from the box to complete the table.

<b>more</b>	<b>less</b>	<b>the same</b>
-------------	-------------	-----------------

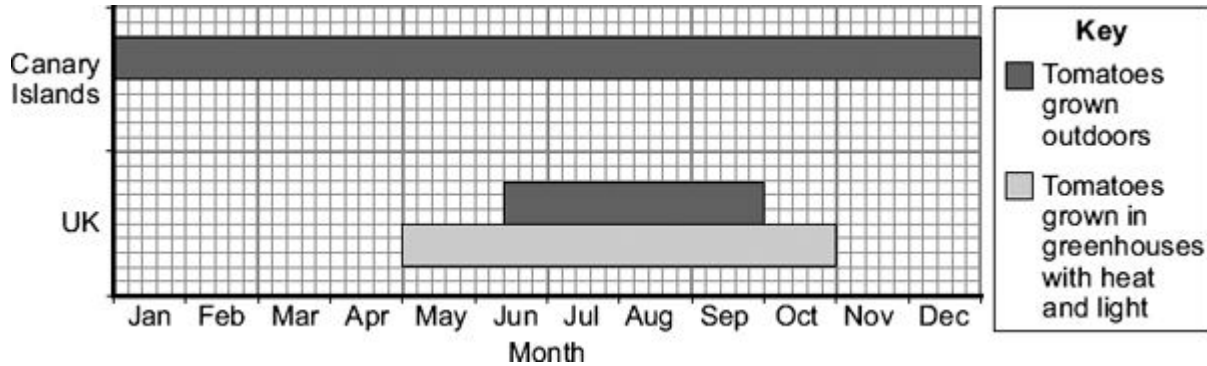
<b>Energy</b>	<b>Amount of energy transferred by cows in a cattle factory compared with cows on a traditional farm</b>
transferred for growth and milk	
transferred in respiration	

(2)  
(Total 6 marks)

11

Tomatoes are grown in greenhouses in the UK and outdoors in the UK and the Canary Islands.

The chart shows in which months these tomatoes can be bought in shops in the UK.



The Canary Islands are about 3000 km from the UK.

Some people prefer to buy tomatoes grown in the UK.

What are the **advantages** and **disadvantages** of buying tomatoes grown in the UK, instead of buying tomatoes grown in the Canary Islands?

**Advantages** of buying tomatoes grown in the UK

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.....

**Disadvantages** of buying tomatoes grown in the UK

.....

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.....

.....

(Total 3 marks)

12

Mycoprotein is produced from the fungus *Fusarium*. Mycoprotein is sometimes used instead of meat in foods for vegetarians.

(a) The table shows the amounts of some substances in mycoprotein and in chicken.

Substance	Mass in grams per 100 grams	
	Mycoprotein	Chicken
Protein	11.8	22.0
Dietary fibre	4.8	0.0
Fat	3.5	6.2
Carbohydrate	2.0	0.0
Cholesterol	0.0	0.1

(i) Draw a ring around the correct answers to complete the sentence.

Eating mycoprotein instead of chicken helps to lower the risk of heart disease because

mycoprotein contains no 

fat
carbohydrate
cholesterol

 and

mycoprotein contains less 

dietary fibre.
fat.
carbohydrate.

(2)

(ii) A body-builder ate 4 kilograms of chicken each week to help him build up his muscles.

If he ate mycoprotein instead of chicken, he would need to eat about twice as much to have the same effect.

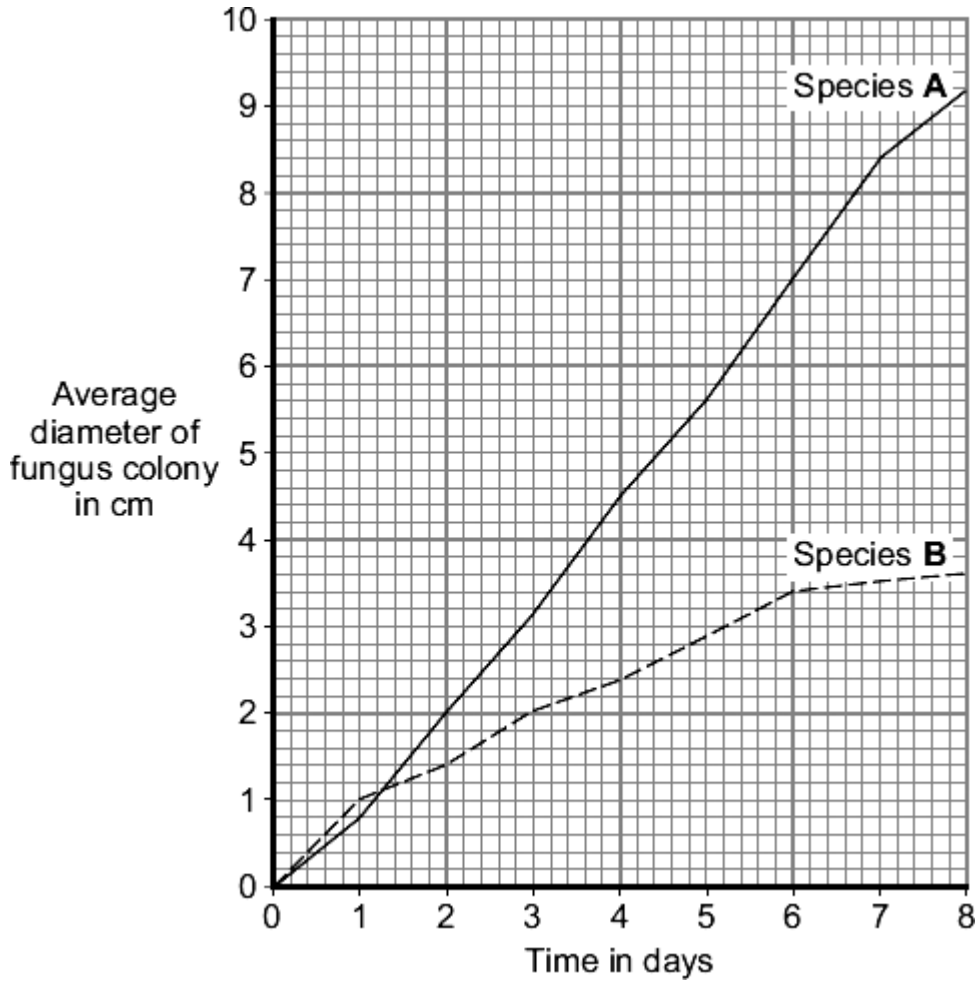
Use information from the table to give **one** reason why.

.....  
 .....

(1)

- (b) Scientists investigated the growth of two species, **A** and **B**, of the fungus *Fusarium*.  
The scientists grew the fungus on agar jelly in Petri dishes.  
They measured the diameter of a colony of each fungus every day for 8 days.

The graph shows the results.



- (i) Describe how the diameter of the colony of species **A** changed between day 0 and day 8.

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

(2)

- (ii) Give **one** difference between the results for species **A** and the results for species **B**.

.....  
.....

(1)

- (c) Both Petri dishes contained the same nutrients.  
Both Petri dishes were kept at 25 °C.

When *Fusarium* is grown in an industrial fermenter, other factors also need to be controlled.

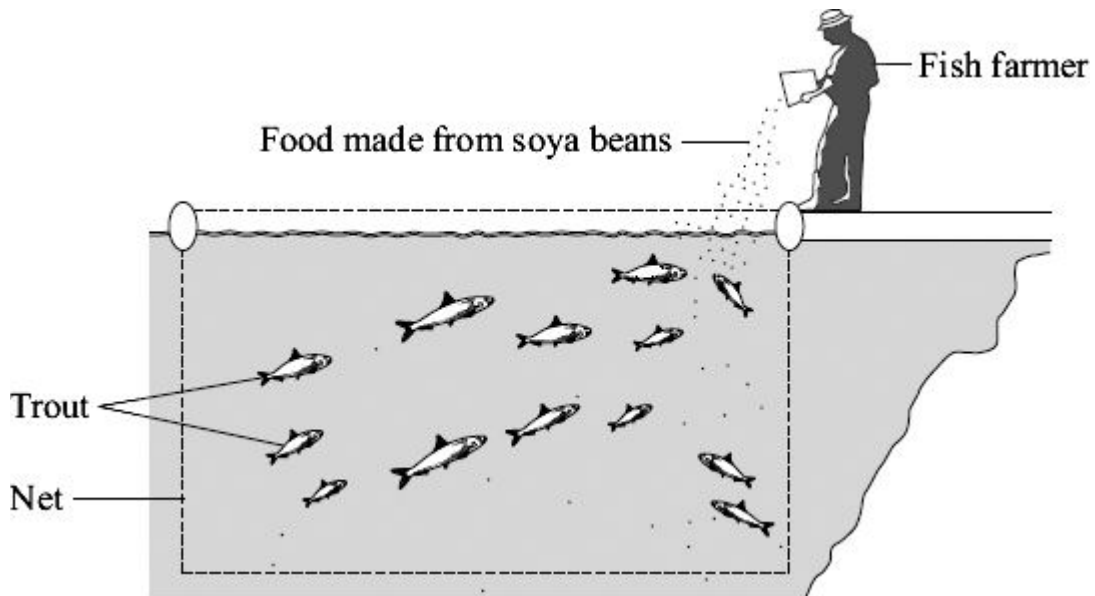
Give **two** of these other factors.

1 .....

2 .....

(2)  
(Total 8 marks)

- 13** A fish farmer keeps trout in a large net in a lake.



The fish farmer feeds the trout on food made from soya beans.

When the trout are large enough the farmer sells them for food for people.

- (a) Draw a pyramid of biomass for the three organisms in this food chain.

Label the pyramid.

(2)

(b) It would be more energy efficient if people ate the soya beans rather than eating the trout.

Which **two** of the following are reasons for this?

Tick (✓) **two** boxes.

- Some people do not like eating animals such as trout.
- The trout release energy when they respire.
- Soya bean plants release energy when they respire.
- Some energy will be lost in waste from the trout.
- Soya bean plants absorb energy during photosynthesis.

(2)

(c) Suggest **one** advantage to the fish farmer of keeping the trout in a large net instead of letting them swim freely in the lake.

.....  
.....

(1)

(d) Some trout die before they are large enough to be sold.  
The dead trout contain carbon.

Use your knowledge of the carbon cycle to describe how this carbon is returned to the atmosphere after the trout die.

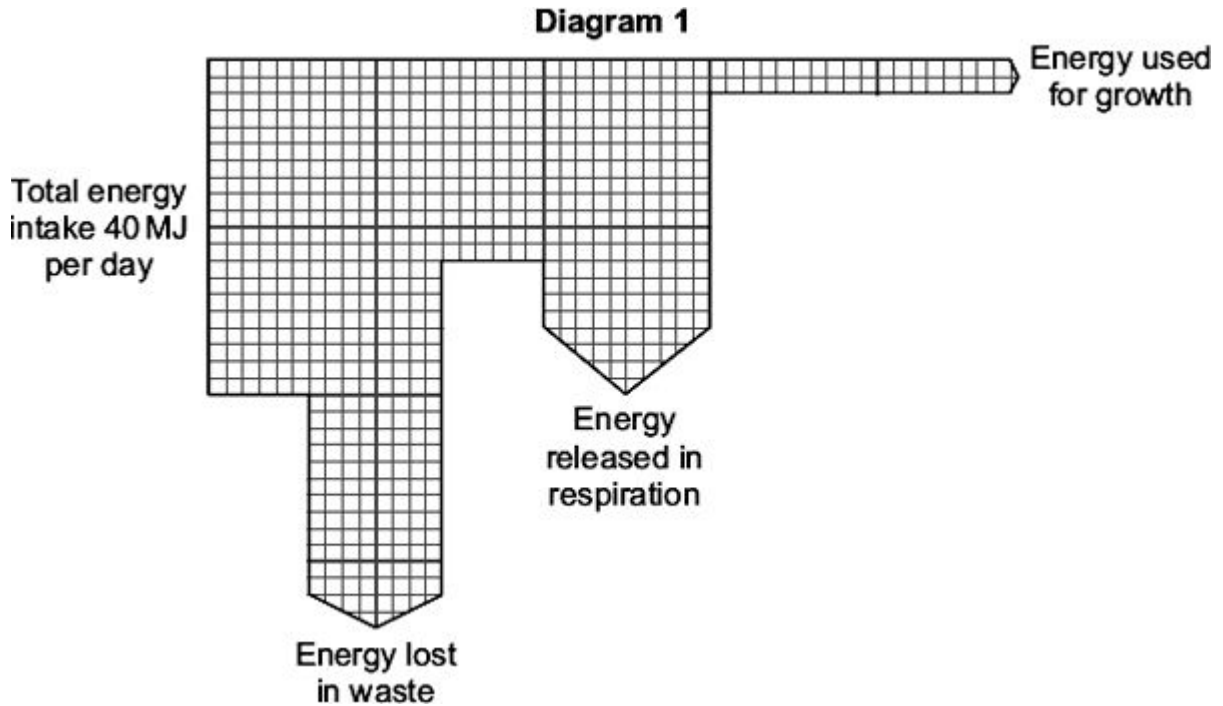
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(2)  
(Total 7 marks)



14

(a) **Diagram 1** represents what happens to the energy in the food eaten by a herbivore (an animal that eats plants).



(i) How much energy is released in respiration by the herbivore?

.....  
.....

Answer ..... MJ per day

(1)

(ii) What proportion of the total energy intake of the herbivore is used for growth?

Show clearly how you work out your answer.

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

Proportion .....

(2)

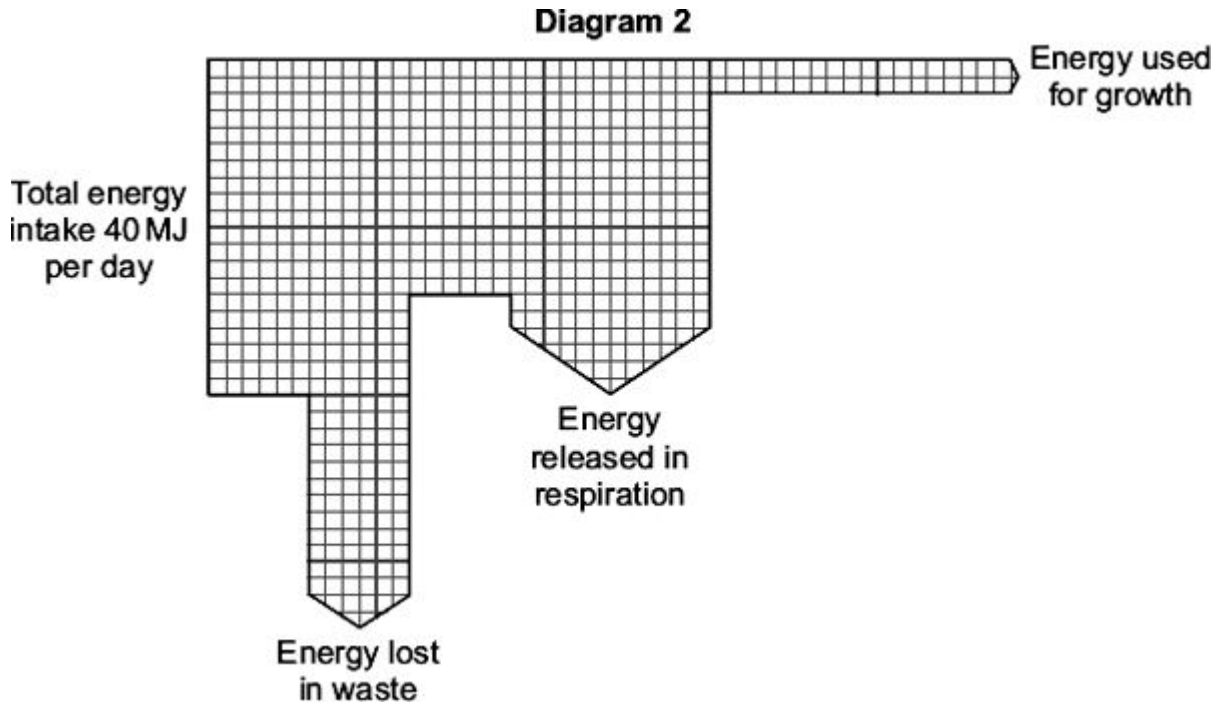
(b) Give **two** ways in which the energy, released in respiration, is used by a herbivore.

1 .....

2 .....

(2)

- (c) **Diagram 2** represents what happens to the energy in the food eaten by a carnivore (an animal that eats other animals).



The carnivore releases a greater proportion of energy in respiration than the herbivore.

Suggest **one** reason for this.

.....  
.....

(1)

- (d) Some farmers keep their animals outdoors. Other farmers keep their animals indoors.

Keeping farm animals indoors increases the proportion of energy in their food that is converted into growth.

Give **two** reasons why.

1 .....

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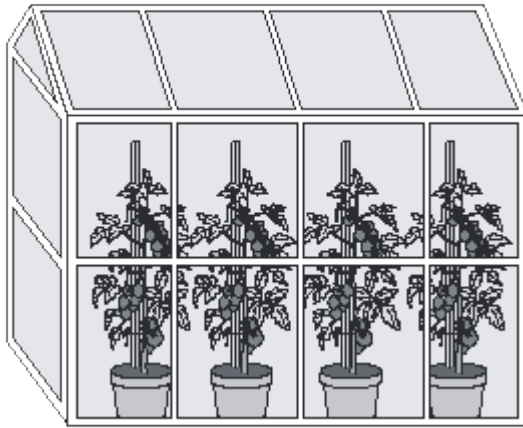
2 .....

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(2)  
(Total 8 marks)

15

In this country most tomatoes are grown in greenhouses.



(a) Suggest **one** way in which a grower could increase the yield of tomatoes from plants growing in his greenhouse.

.....  
 .....

(1)

(b) Large supermarkets often import tomatoes from overseas.

(i) Suggest **two** reasons why a supermarket might decide to import tomatoes rather than buy them from British growers.

1 .....

.....

2 .....

.....

(2)

(ii) Importing tomatoes may be more damaging to the environment than selling tomatoes grown in this country.

Explain why.

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.....

(2)

(Total 5 marks)

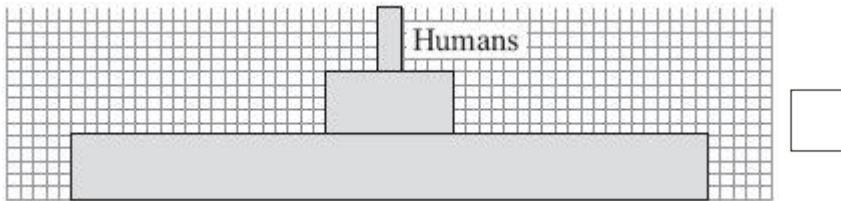
**16**

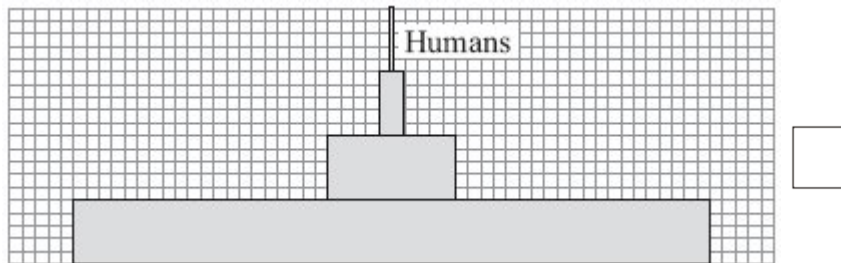
(a) The diagrams show three pyramids of biomass.

(i) Which pyramid would be the most efficient in providing food for humans?

Tick (✓) **one** box.








(1)

(ii) Give **one** reason for your choice.

.....

.....

(1)

(b) Pigs may be kept indoors or outdoors.

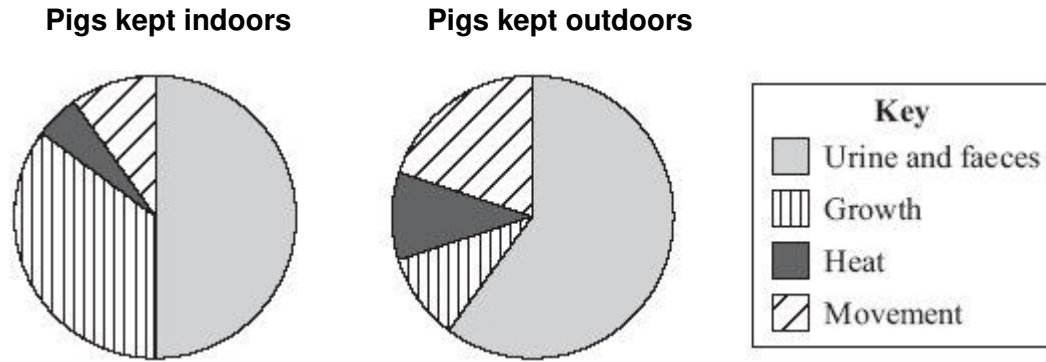
**Pigs kept indoors**



**Pigs kept outdoors**



The pie charts show what happens to the energy in the food eaten by pigs kept indoors and pigs kept outdoors.



(i) Farmers make more profit from keeping pigs indoors than from keeping pigs outdoors.

Use information from the pie charts to explain why.

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(2)

(ii) Meat from pigs kept outdoors may cost more than meat from pigs kept indoors.

Some people prefer to buy meat from animals that have been kept outdoors.

Suggest **one** reason why.

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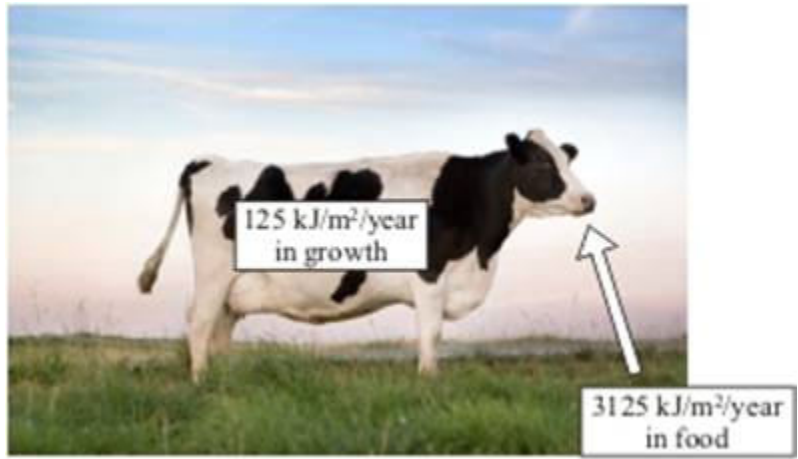
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(1)

(Total 5 marks)

17

The photograph shows what happens to some of the energy in the food that a cow eats.



- (a) Calculate the percentage of the energy in the cow's food that is transferred into new growth.

Show clearly how you work out your answer.

.....  
.....

Answer = .....%

(2)

- (b) The energy from the cow's food which is not transferred into new growth is lost.

Give **three** ways in which this energy is lost.

1 .....  
.....  
2 .....  
.....  
3 .....  
.....

(3)

- (c) The animals that we raise for food are usually herbivores (plant eaters) rather than carnivores (flesh eaters).

Explain why.

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(2)  
(Total 7 marks)

18

The table gives information about the growth of different types of organism. The figures were obtained during the period of fastest growth for each organism.

Organism	Time taken to double in mass
Bacteria	40 minutes
Yeasts	2 hours
<i>Fusarium</i>	4 hours
Algae	5 hours
Soybeans	1 week
Cattle	8 weeks

- (a) (i) Which type of organism grows the fastest? .....

(1)

- (ii) How many times faster than cattle do soybeans double in mass?

.....

(1)

- (iii) *Fusarium* grows at its fastest rate in a fermenter.  
Some scientists put **one tonne** of *Fusarium* into a fermenter.

Use data from the table to calculate how much *Fusarium* there would be in the fermenter after 8 hours.

Draw a ring around **one** answer.

**2 tonnes                      4 tonnes                      8 tonnes**

**(1)**

- (b) *Fusarium* is used to make mycoprotein.

Read the information about substances found in mycoprotein.

- Protein – can be used for making cells, enzymes and antibodies.
- Fats – are rich in energy but large amounts in the diet can cause circulatory problems.
- Dietary fibre – helps to reduce the risk of colon cancer.

The table compares the composition of mycoprotein and beef.

Substance	Percentage of dry mass	
	Mycoprotein	Beef
Protein	47.2	68.3
Fat	13.5	30.1
Dietary fibre	19.2	0.0

Use the information above to answer the questions.

- (i) Give **two** reasons why it would be better to eat mycoprotein instead of beef.

1 .....

.....

2 .....

.....

**(2)**



(ii) Give **one** reason why it would be better to eat beef instead of mycoprotein.

.....  
.....

(1)  
(Total 6 marks)

19

(a) Tuna fish are carnivores. In the wild they feed on smaller fish called herring. Herring feed on plankton. Tuna can be attacked by parasitic worms which feed on their flesh.

(i) In the space below sketch the appearance of a pyramid of biomass for this food chain.

Do not forget to label each section of the pyramid.

(2)

(ii) If a tuna eats 1 kg of herring, it gains about 65 g in mass.

Give **two** reasons why so little of the mass of the herring is converted into mass of the tuna.

1 .....

.....

2 .....

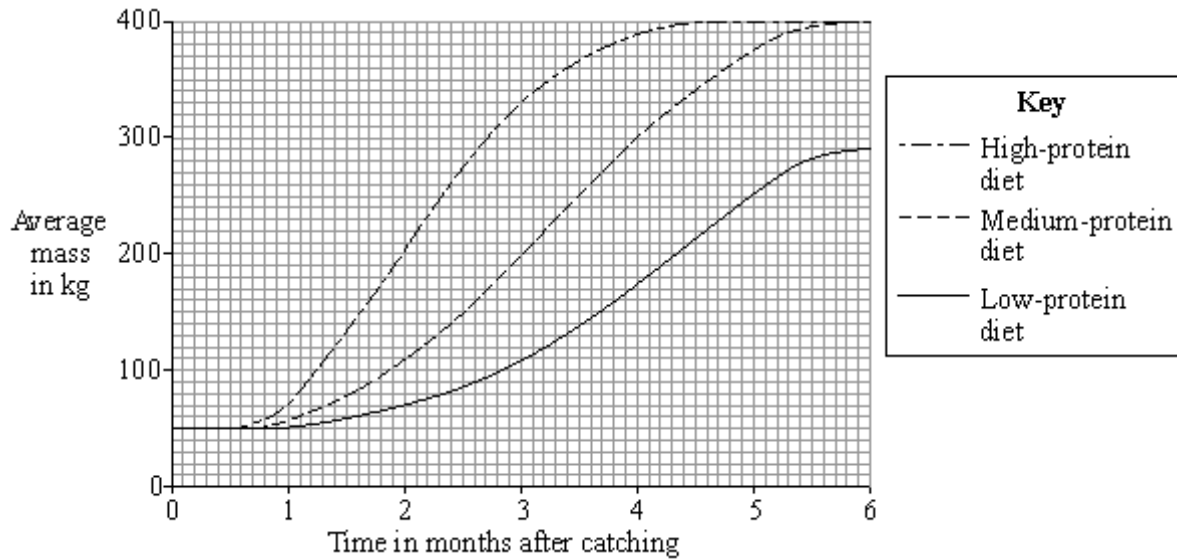
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(2)

(b) Young tuna are caught by fish farmers and reared in large pens in the sea.

The fish are fed more food than they would normally catch themselves so they grow quickly. When they reach 400 kg they are sold.

The graph below shows the effect of feeding tuna different amounts of protein in their food.



(i) Calculate the average increase in mass per month of the fish fed on the low-protein diet over the six months.

Show clearly how you work out your answer.

.....  
 .....

Average increase in mass per month ..... kg

(2)

(ii) There is not enough information in the graph to allow the fish farmer to decide whether to use the high-protein diet or the medium-protein diet.

Suggest **one** other piece of information that he needs in order to make this decision.

.....  
 .....

(1)

(c) Some consumers will not buy tuna grown in this way.

Suggest **one** reason for their decision.

.....  
.....

(1)  
(Total 8 marks)

**20**

A large supermarket chain is advertising 'our goal is to make our business carbon neutral in the next five years'.

(i) Why does the supermarket management think that this will attract more customers?

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(1)

(ii) One step that the supermarket chain intends to take is to obtain as much food as possible from British sources.

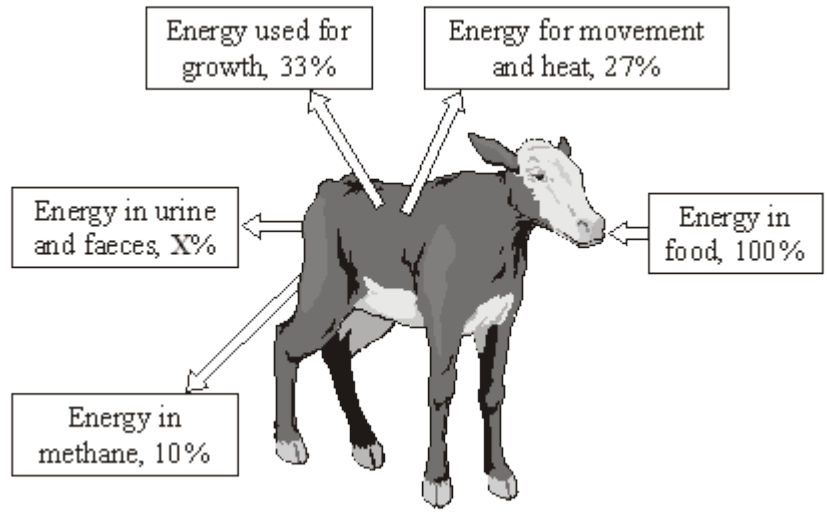
Explain how this will help the environment.

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(2)  
(Total 3 marks)

21

The diagram shows what happens to the energy in the food that a calf eats.



(a) Calculate the % energy lost as urine and faeces (X).  
Show clearly how you work out your answer.

.....  
.....

Energy lost as urine and faeces ..... %

(2)

(b) The energy in the food eaten by the calf in one day is 6 megajoules.  
Calculate the amount of this energy that would be used for growth.  
Show clearly how you work out your answer.

.....  
.....

Energy used for growth ..... megajoules.

(2)

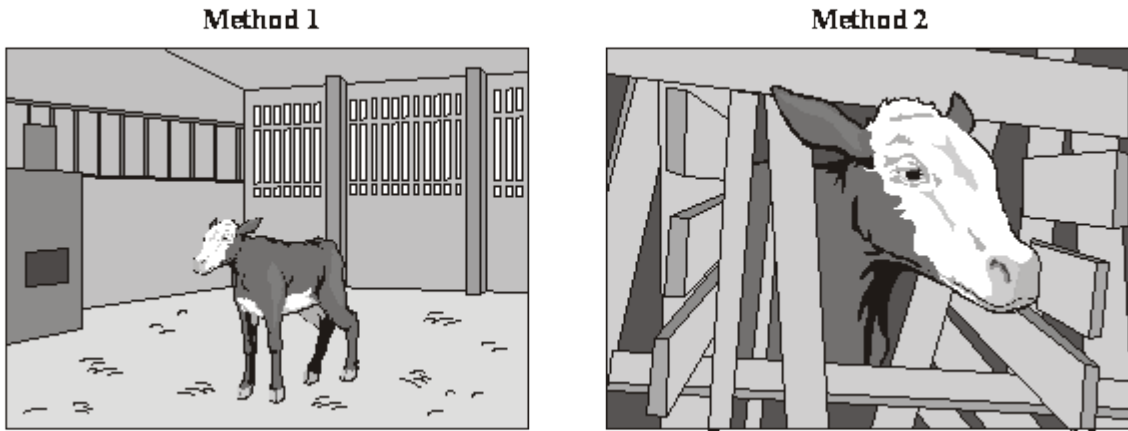
(c) Which process in the body transforms energy in food into heat?

.....

(1)

(d) The pictures show two methods of raising calves indoors.

**Method 2** is now banned.



(i) Calves raised indoors grow faster than calves raised outdoors.

Suggest **one** reason why.

.....  
.....

(1)

(ii) **Method 2** was banned after public campaigns.

Suggest **one** reason why people campaigned against this method of rearing calves.

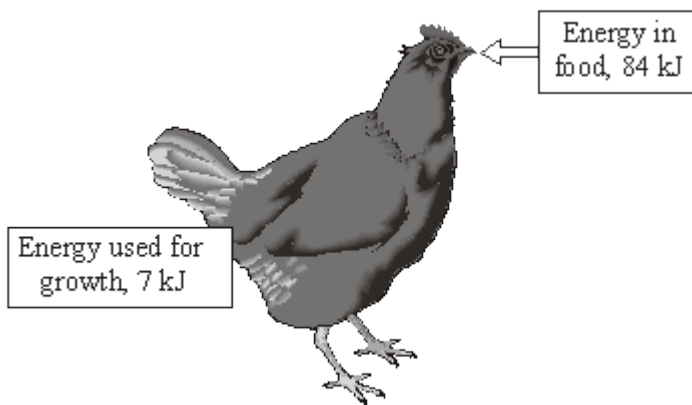
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(1)

(Total 7 marks)

22

The diagram shows what happens to some of the energy in the food that a chicken eats.



(a) Calculate the percentage of energy used for growth.

Show clearly how you work out your answer.

.....  
.....

Energy used for growth = ..... %

(2)

(b) The energy that is not transferred into growth is lost.

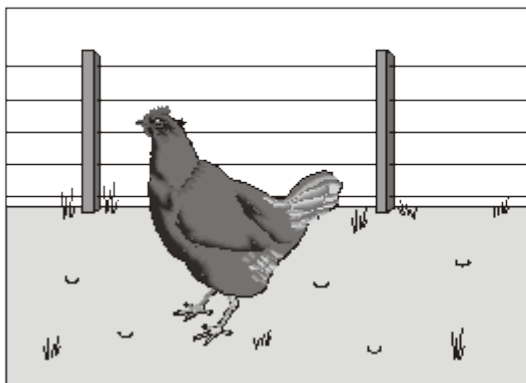
Give **three** ways in which this energy is lost.

- 1 .....
- 2 .....
- 3 .....

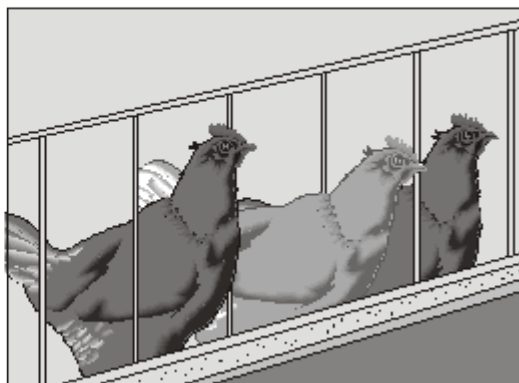
(3)

(c) The pictures show two ways of keeping chickens to produce eggs.

Chickens kept outdoors (free-range)



Chickens kept in cages (battery chickens)



Battery chickens produce more eggs per year than free-range chickens.

Suggest **one** reason why.

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(1)

- (d) The animals that we raise for food are usually herbivores (plant eaters) rather than carnivores (flesh eaters).

Explain why.

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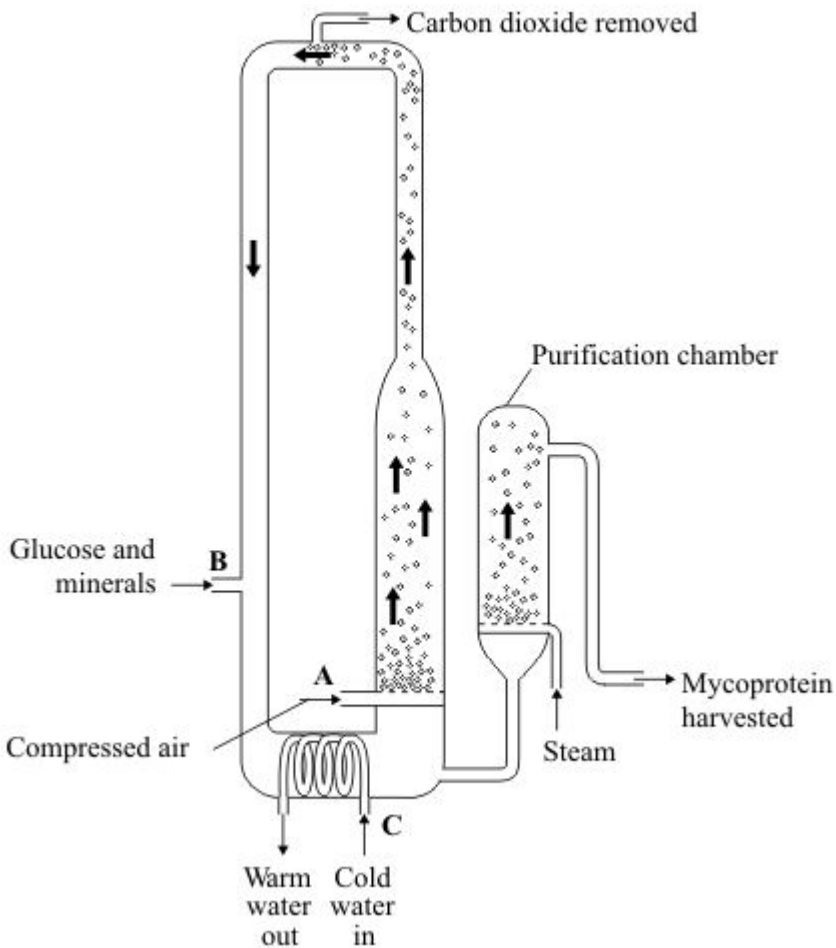
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(2)  
(Total 8 marks)

23

The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium* which is used to make mycoprotein.



(a) Bubbles of air enter the fermenter at **A**.

Give **two** functions of the air bubbles.

1 .....

2 .....

(2)

(b) Glucose is added to the fermenter at **B**.

Explain why glucose is added.

.....

(1)

(c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C**.

Explain what causes the fermenter to heat up.

.....

(1)

(d) It is important to prevent microorganisms other than *Fusarium* from growing in the fermenter.

(i) Why is this important?

.....

(1)

(ii) Suggest **two** ways in which contamination of the fermenter by microorganisms could be prevented.

1 .....

2 .....

(2)



- (e) Human cells cannot make some of the amino acids which we need. We must obtain these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

Name of amino acid	Amount of amino acid per 100 g in mg			Daily amount needed by a 70 kg human in mg
	Mycoprotein	Beef	Wheat	
Lysine	910	1600	300	840
Methionine	230	500	220	910
Phenylalanine	540	760	680	980
Threonine	610	840	370	490

A diet book states that mycoprotein is the best source of amino acids for the human diet.

Evaluate this statement.

Remember to include a conclusion in your evaluation.

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(4)  
(Total 11 marks)

24

Read the article about sustainable cod fishing.

Every December the European Commission makes proposals for cod fishing quotas in European Union (EU) waters. These quotas take into account data obtained by scientists.

Scientists calculate what proportion of the cod stock is being caught each year. They do this by working out the numbers in each age-group of cod.

Every year the fishermen say the scientists are exaggerating the danger to the stocks in the North Sea. The scientists say the fishermen are threatening their own long-term livelihoods by ignoring their warnings of a collapse of cod populations.

The scientists say that fishermen go only to parts of the sea where there are a lot of cod, so they get the wrong idea of the number of cod in the whole area.

- (a) The scientists and the fishermen have different opinions about the size of the cod population.

Explain why.

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(2)

- (b) The final decision on how many cod the fishermen are allowed to catch may not depend entirely on the data produced by the scientists.

Suggest **two** reasons for this.

1. ....

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2. ....

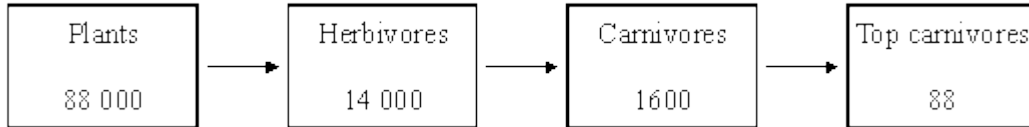
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(2)

(Total 4 marks)

25

The diagram shows a food chain in a pond. The figures show the amounts of energy in each type of organism, in kilojoules per m<sup>2</sup> of pond per year.



(a) Calculate the percentage of the energy in the plants that is passed to the top carnivores. Show clearly how you work out your final answer.

.....

.....

.....

Answer ..... %

(2)

(b) In the space below, draw a pyramid of biomass for this food chain. Label your drawing with the names of the organisms.

(2)

(c) If humans ate organisms from this food chain, it would be more efficient to eat plants than to eat herbivores. Why is this?

.....

.....

.....

(1)

(Total 5 marks)

The drawings and text for this question are based on an article from The Independent newspaper.

Some of Britain’s rarest wild flowers are likely to make a come-back thanks to an EC set-aside regime in which 15 per cent of arable land has been taken out of production.

As a result of this set-aside, shepherd’s needle, pheasant’s eye, corn gromwell, corn cockle, spreading hedge parsley and corn mouse tail are now thriving once again. They were once common in and around cereal fields and were even regarded as weeds, but were swept to near extinction by the intensification of agriculture after the Second World War. Their small, pale flowers are hardly seen. These plants cannot compete in fields where modern cereal crops are cultivated. Nor, however, do they flourish in semi-natural or wild habitats where nature is left to its own devices. They need farmland which is lightly tilled and cut once a year.

Dr Nick Sotherton, lowland research manager with the Game Conservancy Council, says that these species will flourish under the new rotational set-aside regime, in which farmers are compensated for taking land out of production in an attempt to end crop surpluses.

EC agriculture ministers are meeting to decide how much land should be used for rotational set-aside – in which a field is taken out of production for just one year before being replanted – and how much should be set-aside permanently. The ultimate set-aside is a wood, and Britain is seeking a forestry option.

The Game Conservancy Council says that the rotational scheme can benefit ground nesting birds as well as rare flowers that will not be helped by longer-term set-aside. But Richard Knight of the Wildlife Advisory Group, says “Non-rotational is better because it gives flora and fauna a chance to get well established”.

“Intensification of agriculture” has led to the creation of artificial ecosystems.

- (a) Explain how the creation of artificial ecosystems may have led to the near-extinction of the plants seen in the picture above.

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(4)

(b) What would you recommend to ministers meeting to decide a policy involving rotational set-aside and permanent set-aside? Explain the reasons for your answer.

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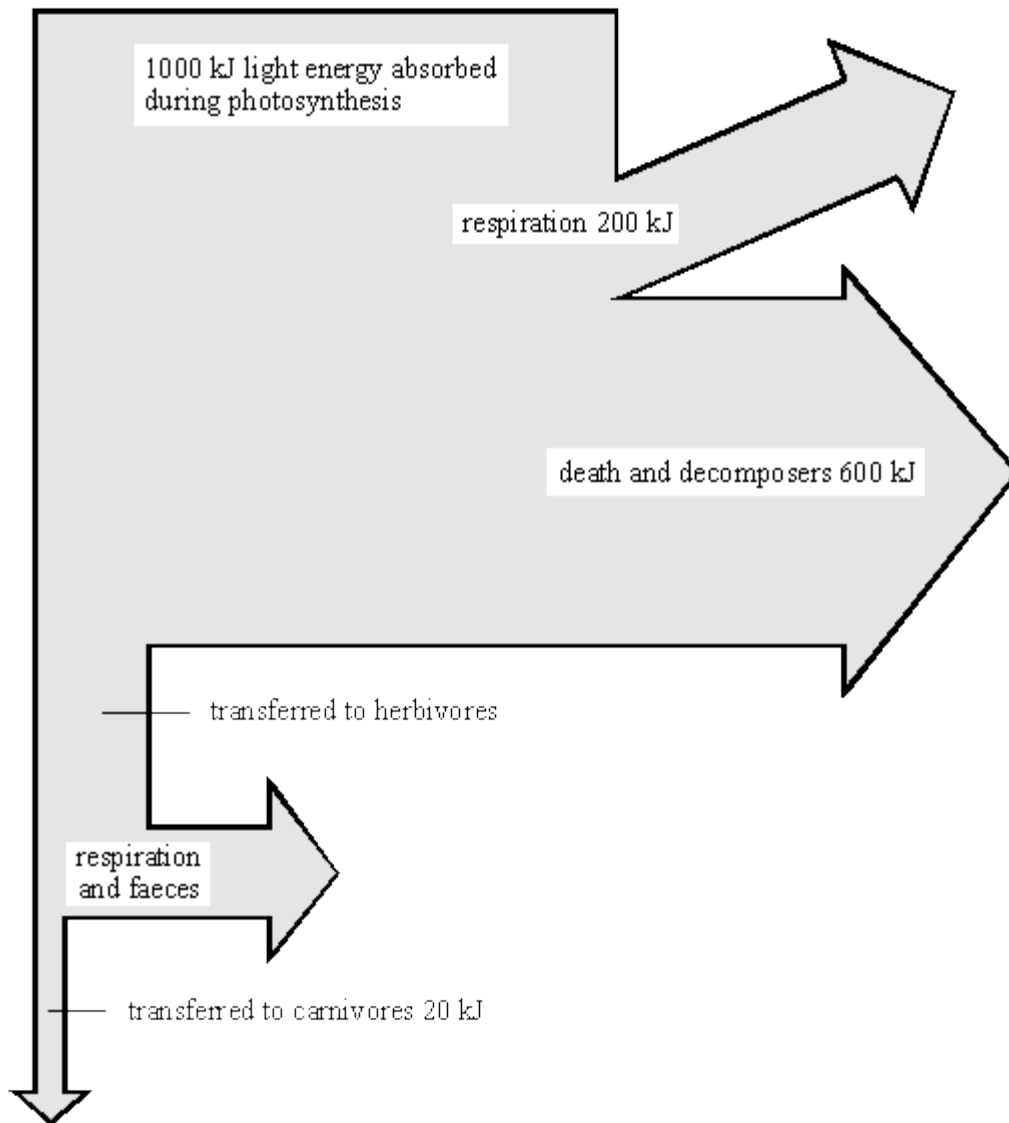
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(4)  
(Total 8 marks)

27

(a) The diagram shows what happens to each 1000 kJ of light energy absorbed by plants growing in a meadow.



Use the information from the diagram to calculate:

- (i) how much energy was transferred to herbivores;

..... kJ

(1)

- (ii) the percentage of the energy absorbed during photosynthesis that was eventually transferred to carnivores. Show your working.

..... %

(2)

- (b) The table gives the energy output from some agricultural food chains.

FOOD CHAIN	ENERGY AVAILABLE TO HUMANS FROM FOOD CHAIN (kJ PER HECTARE OF CROP)
cereal crop ⇒ humans	800 000
cereal crop ⇒ pigs ⇒ humans	90 000
cereal crop ⇒ cattle ⇒ humans	30 000

Explain why the food chain *cereal crop ⇒ humans* gives far more energy than the other two food chains.

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(3)

- (c) The amounts of energy available to humans from the food chain  
*cereal crop* ⇒ *pigs* ⇒ *humans*  
can be increased by changing the conditions in which the pigs are kept.

Give **two** changes in conditions which would increase the amount of energy available. In each case explain why changing the condition would increase the available energy.

Change of condition 1 .....

Explanation .....

.....

.....

Change of condition 2 .....

Explanation .....

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(4)  
(Total 10 marks)

**28** **Battery Pigs!**

Some countries have battery pigs! Large numbers of pigs are kept indoors and have limited living space which restricts their movement. The temperature of their environment is carefully controlled.



This is a way of producing food efficiently.

These pigs have their movement restricted. Explain why.

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**(Total 2 marks)**

**29** Many of the plants that we eat as fruits and vegetables in the UK are imported. The transport used to import foods accounts for about 2.5% of the UK's carbon dioxide emissions. During winter, it is necessary to import foods because most of the UK's fresh vegetables have to be grown in greenhouses. Energy is needed to heat and light these greenhouses.



Give **one** argument for and **one** against growing all of our vegetables in the UK. These arguments should consider the environmental effect of carbon dioxide emissions.

Argument for:

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Argument against:

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**(Total 3 marks)**

**30**

Nitrate fertilisers are important in agriculture. They help to increase crop yields and so make food cheaper to buy. Some of the nitrate fertilisers run off into rivers and get into drinking water. The problem is that the nitrates can react with iron in our blood. This reduces the blood's ability to carry oxygen. If the amount of nitrate in drinking water is too high, it can cause 'blue baby syndrome', in which babies look blue due to lack of oxygen.

The table shows the amount of nitrate fertilisers used and the crop yield.

Nitrate fertilisers in kilograms per hectare of land	0	150	250
Crop yield in tonnes per hectare of land	5	8	7

Use the information above to suggest what should be done, by farmers and government, to prevent 'blue baby syndrome'. Explain the reasons for your suggestions.

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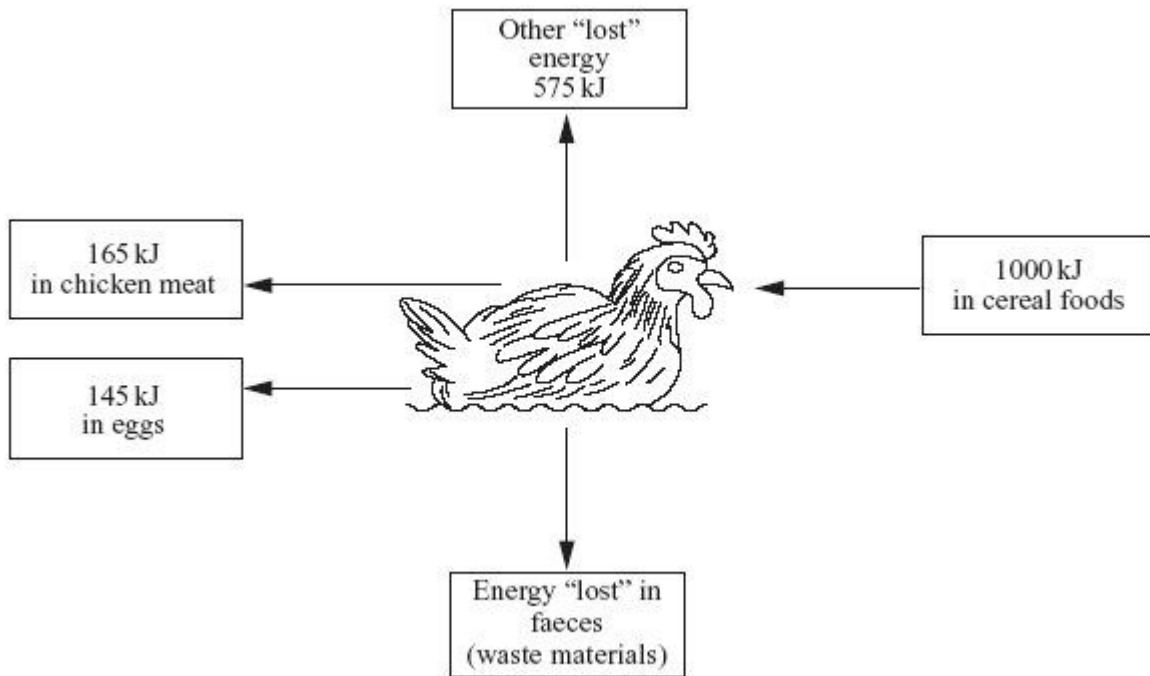
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(Total 3 marks)

31

Chickens are kept as farm animals to produce food. Free-range chickens are allowed to feed in a large space outside. The diagram shows how energy supplied in food to a free-range chicken is transferred.



(a) Calculate the amount of energy “lost” in faeces.

.....  
 .....

Energy “lost” = ..... kJ

(1)

(b) Some farmers use the battery method. They keep large numbers of chickens in a small indoor space. The food yield from these chickens is higher than that from free-range chickens. Explain why, as fully as you can.

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 .....  
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(4)

(Total 5 marks)

**32**

The information in the table compares two farms. Both are the same size, on similar land, close to one another and both are equally well managed.

Name of farm	Activity	Energy value of food for humans produced in one year	Number of people whose energy requirements can be met by this food
Greenbank Farm	Grows food for humans	3285 million kJ	720
Oaktree Farm	Grows food for animals on the farm which become food for humans	365 million kJ	80

- (a) Use this information to work out the average daily human energy requirement in kilojoules (kJ) per day.

.....  
.....

Energy requirement = ..... kJ/day

(2)

- (b) The figures show that farms like Greenbank Farm can be nine times more efficient at meeting human food energy requirements than farms such as Oaktree Farm.

- (i) The food chain for Greenbank Farm is:

vegetation → humans

What is the food chain for Oaktree Farm?

.....

(1)

- (ii) Explain why Greenbank Farm is much more efficient at meeting human food energy requirements.

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.....

(3)

- (c) The human population has been increasing rapidly throughout this century. It is now about 6 billion and is still growing. What does the information in this question suggest about likely changes in the human diet which may need to occur during the coming century? Explain your answer.

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(4)

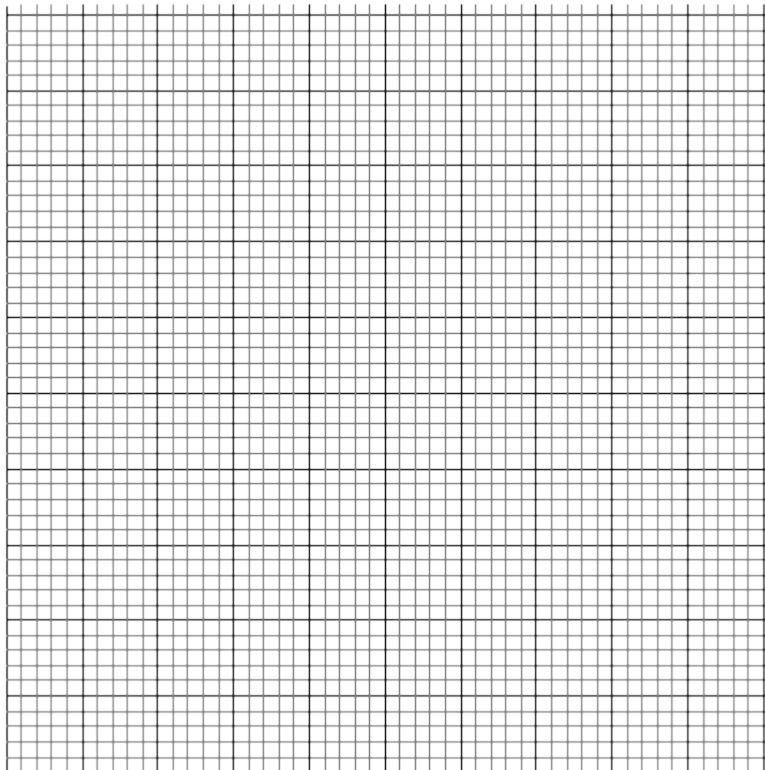
(Total 10 marks)

**33**

The figures below show how the yield of a wheat crop is affected by adding nitrogen fertiliser.

<b>Nitrogen fertiliser added (kg/hectare)</b>	<b>Yield (tonnes/hectare)</b>
0	26
50	28
75	31
100	34
125	40
150	43
175	44
200	44

(a) Display these results on the graph paper in the most suitable way.

**(4)**

(b) What conclusions can you draw from the graph?

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(3)  
(Total 7 marks)

34

(a) 1m<sup>2</sup> of a field gets about 1050MJ of light energy per year.

Only 21 500kJ of energy is stored in the new grass.

(i) How is the energy stored in the new grass?

.....

(1)

(ii) What is the % of light energy stored in the grass?

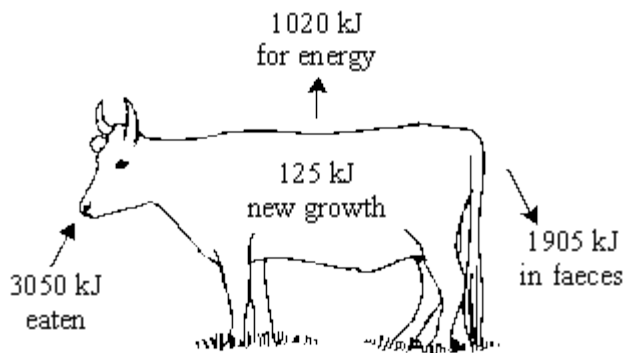
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(1)

(b)



The diagram shows what happens to the energy from grass in part of a field which is grazed by a bullock.

Using information in the diagram suggest why food chains are usually short.

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(3)

(c) Many of the animals which from part of our diet are herbivores rather than carnivores. Explain why as fully as you can.

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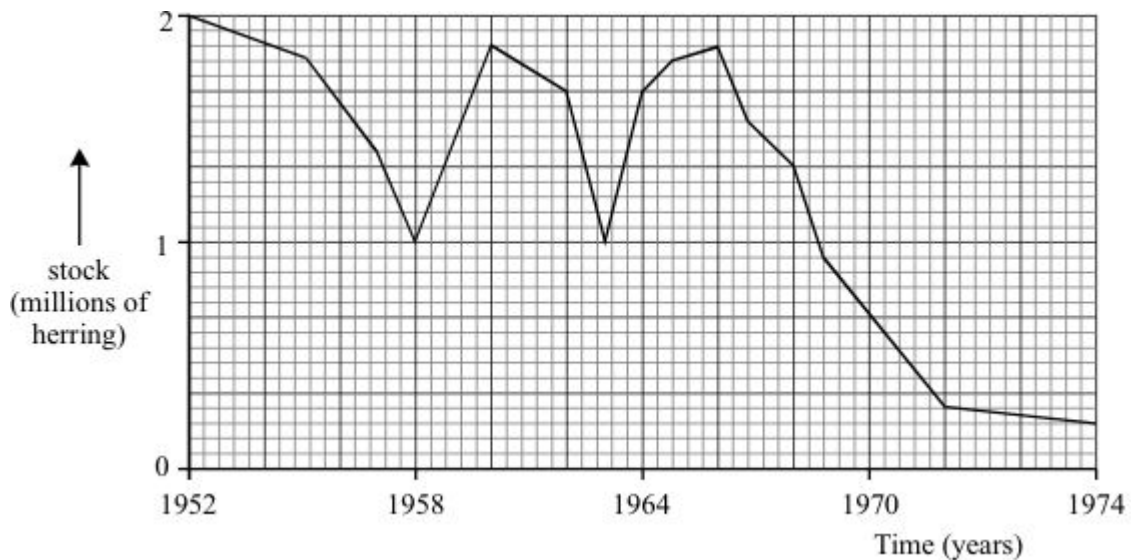
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(3)

(Total 8 marks)

35



The graph shows the variations in the North Sea herring population between 1952 and 1974. These fish were formerly caught in large numbers by fleets of trawlers but fishing has been restricted since 1974 as a conservation measure. Herrings lay about 20 000 eggs per year but do not reproduce until they are about 3–5 years old, when they are about 25cm long. It takes 11 years for a herring to reach its mature adult length.

The following measures have been suggested to prevent overfishing:

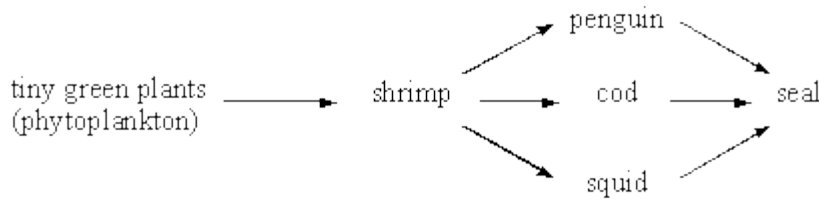
- limiting mesh size of nets,
- specifying maximum catch by each boat per year.
- prohibiting fishing in herring breeding grounds.
- prohibiting fishing at certain times of the year.

Evaluate their probable effects on both fish stocks and the fishermen, using the information given above.

(Total 9 marks)

36

Scientists have found the following food web in the cold Antarctic Ocean.



(a) Humans are removing large numbers of the cod.

Some scientists argue that this could lead to a decrease in the numbers of squid and penguins.

Others argue that the numbers of squid and penguins will stay the same.

Carefully explain each argument.

Why they might decrease.

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.....

(1)

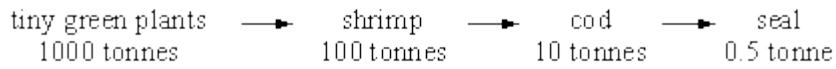


Why they might stay the same.

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

(2)

- (b) The following information is about the biomass of the organisms in one of the food chains in the web.



Draw and label a pyramid of biomass for this chain.

(2)

- (c) Explain, as fully as you can, why the conversion of shrimp biomass into cod biomass is more efficient than that of cod biomass into seal biomass in the cold Antarctic Ocean.

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

(3)

(d) Boats from many countries fish the Antarctic Ocean. The cod are being overfished. If the numbers of cod are to increase, the population must be carefully managed.

(i) Suggest **two** control measures which would prevent a further drop in numbers,

.....  
.....

(2)

(ii) Suggest why **one** of your control measures would be difficult to put into practice.

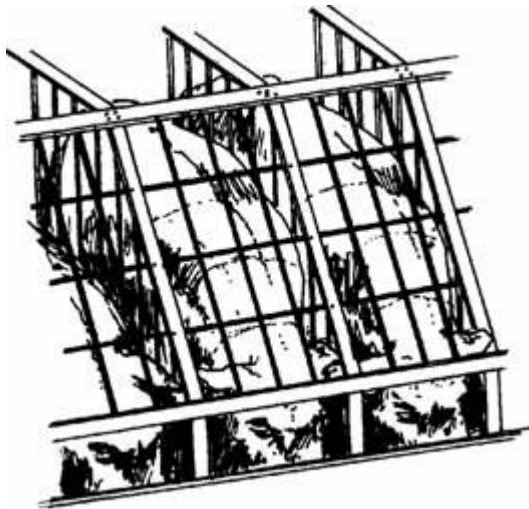
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(1)

(Total 11 marks)

37

To produce cheap meat, animals must be grown (reared) efficiently. When pigs are reared intensively they are kept indoors. Their surroundings are closely monitored to make sure they have even ventilation and the correct temperature. The risk of infection is high but is reduced by feeding them antibiotics and removing their faeces. The pigs live in cages and cannot move around much.



(a) Explain why farmers control the temperature.

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

(2)

(b) Explain why farmers want to stop the pigs moving about.

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

(2)

(c) Give two arguments **against** rearing pigs indoors instead of rearing them outdoors.

1 .....

2 .....

(2)

**(Total 6 marks)**