THIS IS A LEGACY SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

BIOLOGY

Microbiology and Biotechnology

2805/04

Candidates answer on the Question Paper

OCR Supplied Materials:
None

Other Materials Required:
- Electronic calculator
- Ruler (cm/mm)

Friday 25 June 2010
Afternoon

Duration: 1 hour 30 minutes

OCE/19070

2805041

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

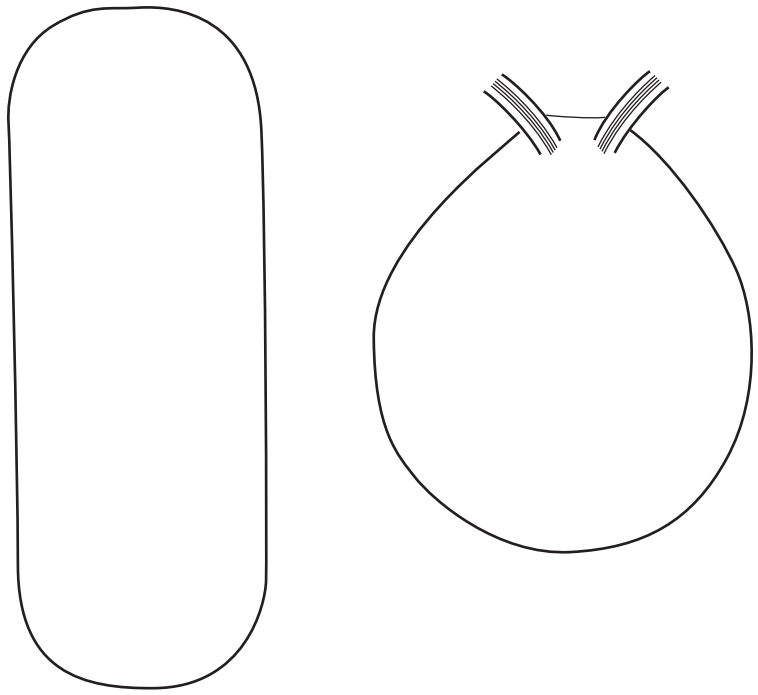
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **90**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You are advised to show all the steps in any calculations.
- This document consists of **20** pages. Any blank pages are indicated.

Examiner's Use Only:			
1			
2			
3			
4			
5			
6			
Total			

DC (GB/SW) 19070/3

Answer **all** the questions.

1 **(a)** Fig. 1.1 shows outline drawings of electron micrographs of the bacterium *Escherichia coli* and the protoctist, *Chlamydomonas*.



Escherichia coli magnification x 30 000

Chlamydomonas not drawn to scale

Fig. 1.1

(i) On Fig. 1.1, draw **and** label **one** cell structure common to both microorganisms. **[1]**

(ii) *Chlamydomonas* is a eukaryote.

On Fig. 1.1, draw **and** label **three** other cell structures found only in eukaryotes. **[3]**

(iii) Using Fig. 1.1, calculate the actual length of the *E. coli* bacterium.

Show your working and express your answer **to the nearest micrometre**.

Answer = ... μm **[2]**

(b) Describe **and** explain the advantages of using an electron microscope, rather than using a light microscope, to investigate the structure of *E. coli* and *Chlamydomonas*.

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..... **[5]**

(c) Bacteria can have within their cytoplasm a variety of inclusion bodies, such as granules. Granules are not membrane-bound and each consists of a specific densely-compacted substance, such as glycogen or polyphosphate (volutin).

(i) Suggest **one** advantage of the substances in granules being densely compacted.

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..... **[1]**

(ii) State **one** possible use to the bacterium of each of the following granular substances:

glycogen .....

.....

polyphosphate (volutin) .....

..... **[2]**

(d) *E. coli* can be genetically manipulated to synthesise useful products.

State **two** uses of genetically manipulated *E. coli* **in medicine**.

1 .....

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2 .....

..... **[2]**

[Total : 16]

2 In this question, one mark is available for the quality of use and organisation of scientific terms.

(a) Fig. 2.1 shows a biosensor that could be used to measure the concentration of glucose in a blood sample.

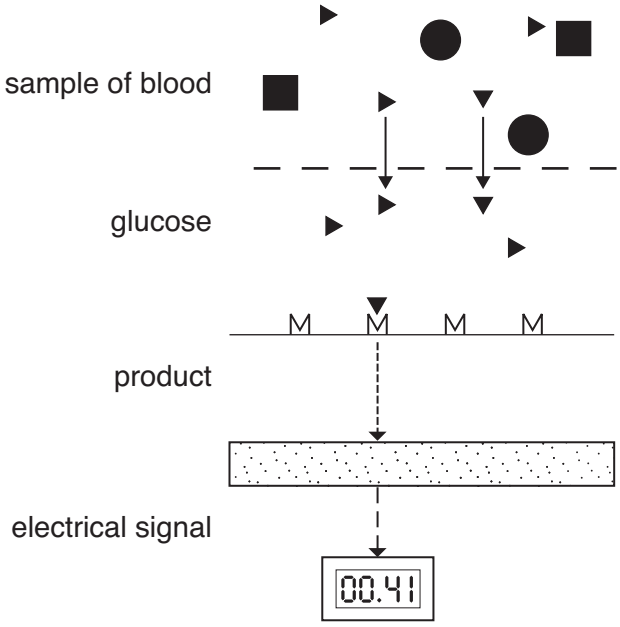

Fig. 2.1

Explain how this glucose biosensor works.

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..... **[7]**

Quality of Written Communication **[1]**

(b) Suggest **two** advantages that a biosensor may have to someone suffering from diabetes.

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..... **[2]**

(c) Some biosensors use monoclonal antibodies.

One stage in the production of a monoclonal antibody is the fusion of a lymphocyte and a myeloma cell.

(i) Name the type of cell that results from this fusion.

..... **[1]**

(ii) Explain why this fusion is necessary.

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..... **[3]**

(d) One medical use of monoclonal antibodies is to detect the presence of viruses, such as HIV.

Explain how the structure of viruses, such as HIV, allows this identification to be achieved.

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..... **[3]**

[Total : 17]

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QUESTION 3 STARTS ON PAGE 8

3 Fig. 3.1 shows a batch fermenter used to produce penicillin.

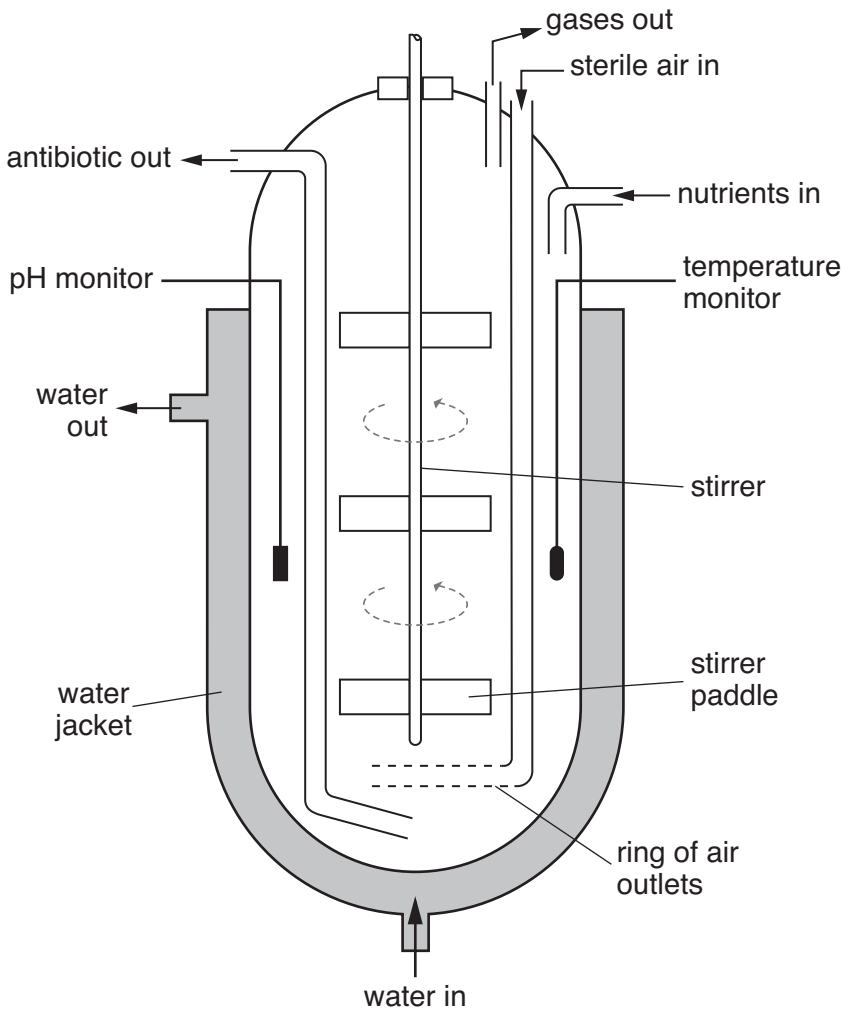

Fig. 3.1

(a) Explain why sterile air is pumped into the fermenter.

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..... **[2]**

(b) (i) The fungus that produces penicillin needs a supply of the elements carbon and nitrogen. State the form in which these elements are added to the culture.

carbon .....

nitrogen ..... **[2]**

(ii) Explain why it is necessary to pump water into the jacket surrounding the culture.

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..... **[3]**

(iii) State **why** pH is monitored **and** how it is controlled.

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..... **[2]**

QUESTION 3 CONTINUES ON THE NEXT PAGE

(c) Fig. 3.2 is a graph showing the production of penicillin and the growth of the fungus, *Penicillium*, in the fermenter shown in Fig. 3.1.

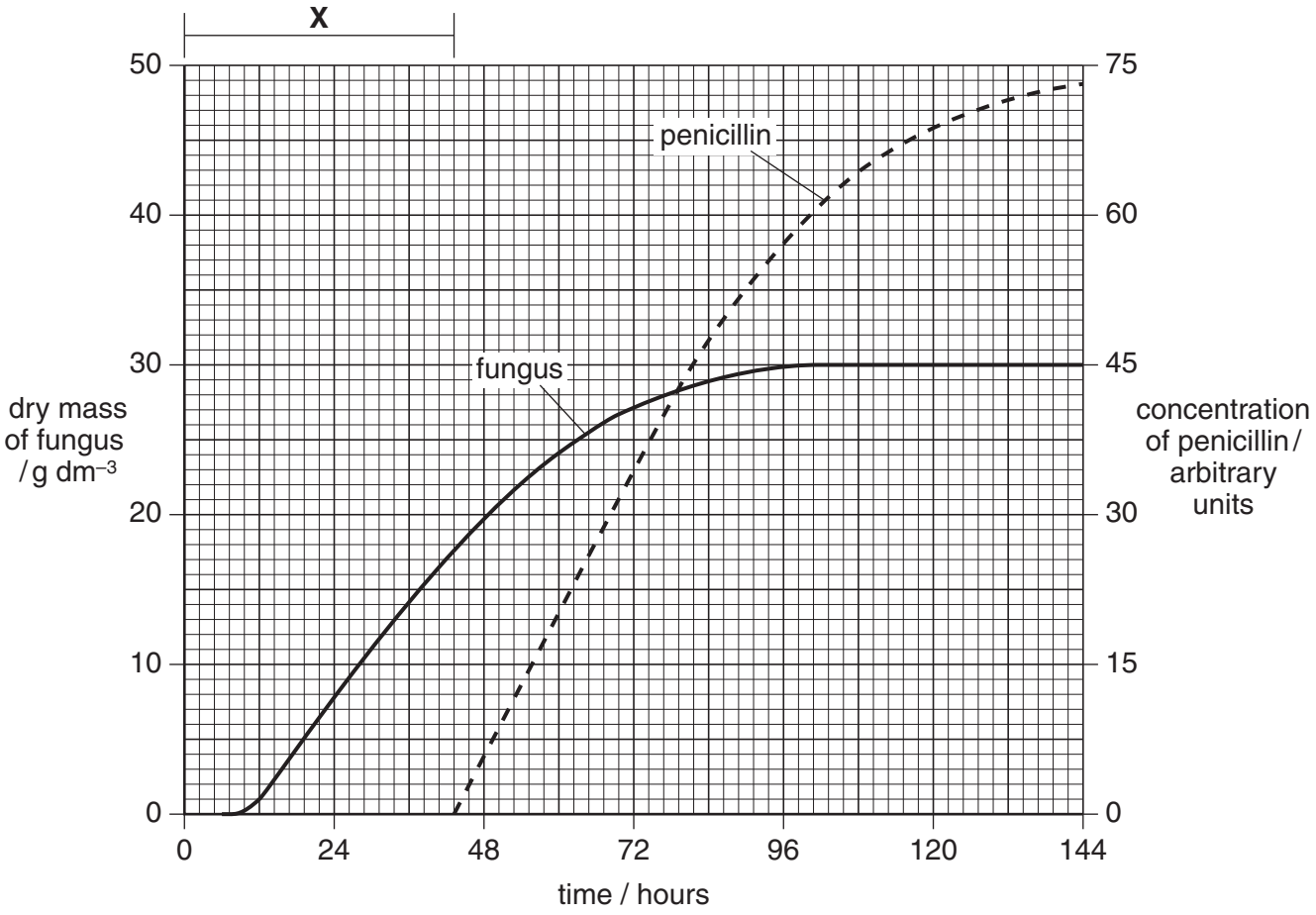

Fig. 3.2

(i) Using the data in Fig. 3.2, state the time when *Penicillium* enters its stationary phase.

..... **[1]**

(ii) Explain why there is no antibiotic produced during phase **X**.

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..... **[3]**

[Total : 13]

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QUESTION 4 STARTS ON PAGE 12

4 In an investigation into oxygen requirements for growth, a student obtained three different species of microorganism, **D**, **E** and **F**, each isolated from a different location.

The student prepared three sterile tubes half-filled with sterile nutrient broth. To each tube of broth, the student added small, equal amounts of:

- thioglycolate
- resazurin.

Thioglycolate chemically reduces the oxygen dissolved in the broth to water.

Resazurin is a dye that changes from colourless to pink in the presence of oxygen.

An equal volume of microorganism **D**, **E** and **F** was added, one to each tube, and incubated separately under the same controlled conditions. The results of the investigation are shown in Fig. 4.1.

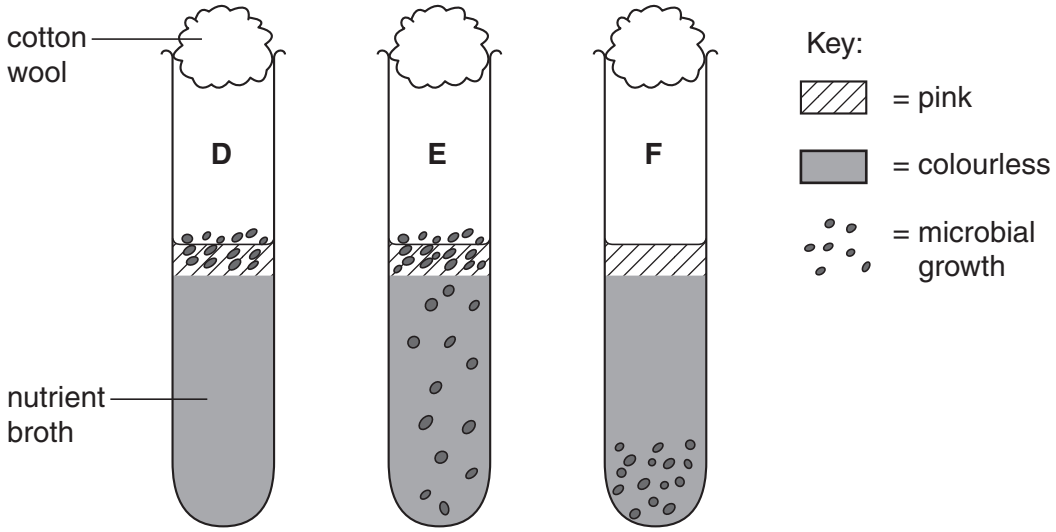

Fig. 4.1

(a) Explain why the student decided to add each of the substances, thioglycolate and resazurin, to the tubes of broth.

thioglycolate.....

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resazurin.....

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..... **[2]**

(b) Describe how you would inoculate a tube of nutrient broth if you were given a broth culture of microorganism **D**.

Include in your answer details of aseptic technique.

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..... **[5]**

(c) In this question, one mark is available for the quality of spelling, punctuation and grammar.

Describe **and** explain the results of the investigation shown in Fig. 4.1.

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.... [8]

Quality of Written Communication [1]

(d) The microorganisms **D**, **E** and **F** were isolated from three different locations.

Complete the table by:

- matching each microorganism to a location
- giving a reason for each choice.

location	microorganism	reason
beer fermentation vessel		....
mammalian skin surface		....
sewage sludge digester		....

[3]

[Total : 19]

5 Beer is produced from the fermentation of a liquid extract prepared mainly from malted (germinated) barley. Fig. 5.1 represents the main stages involved in the commercial manufacture of beer.

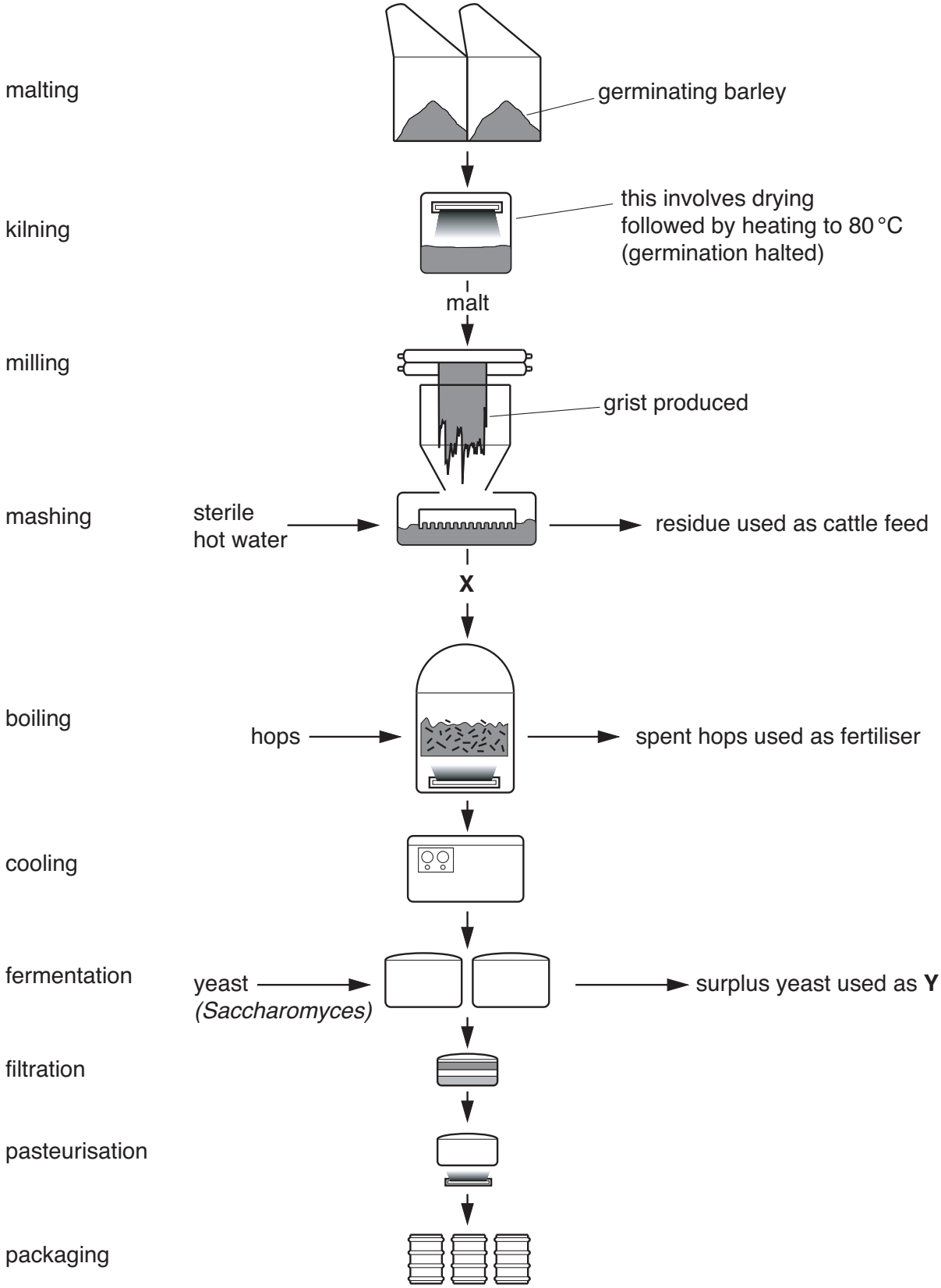

Fig. 5.1

(a) Name the liquid extract, **X**.

..... **[1]**

(b) Give **one** use **(Y)** for the surplus yeast.

..... **[1]**

(c) State the environmental conditions necessary for the germination of the barley seeds during malting.

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..... **[2]**

(d) Outline the sequence of events that occurs in the germination of a barley seed during malting.

You should include in your answer reference to changes in the seed as well as to any plant growth regulators and enzymes that are involved.

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..... **[4]**

(e) Suggest why germination needs to be stopped during the kilning stage.

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..... **[2]**

(f) The kilning stage involves drying followed by heating. Although most enzymes are denatured during this process, some enzymes are 'inactivated'. During mashing, these malt enzymes are reactivated to bring about an increase in the quantity of monosaccharides and amino acids available for yeast metabolism during the fermentation stage.

(i) Suggest why denaturation of these malt enzymes does not occur during the kilning process.

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..... **[1]**

(ii) Suggest why hot, rather than cold, water is used during mashing.

..... **[1]**

(iii) State **and** explain the likely outcome to the brewing process of having an increased 'quantity of monosaccharides and amino acids'.

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..... **[4]**

[Total : 16]

6 **(a)** Sewage contains both human and industrial waste.

State **two** reasons for treating sewage rather than allowing it to pass directly into waterways.

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..... **[2]**

(b) Explain how a modern sewage works reduces the amount of organic material in sewage by using the **activated sludge** process.

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..... **[4]**

(c) Sludge is the heavy material that falls to the bottom when sewage is allowed to rest in large tanks. The sludge may be passed into a digester, which contains bacteria. These bacteria produce methane if conditions are correct.

(i) Describe the conditions necessary for methane to be produced.

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..... **[2]**

(ii) Suggest **one** use for the methane produced.

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..... **[1]**

[Total : 9]

END OF QUESTION PAPER

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