| Candidate Forename | | Candidate Surname | |
|---|---|---|---|

| Centre Number | | | | | | Candidate Number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

# OXFORD CAMBRIDGE AND RSA EXAMINATIONS

## ADVANCED SUBSIDIARY GCE

# F212

# BIOLOGY

## Molecules, Biodiversity, Food and Health

**TUESDAY 12 JANUARY 2010: Morning**
**DURATION: 1 hour 45 minutes**

**SUITABLE FOR VISUALLY IMPAIRED CANDIDATES**

**Candidates answer on the Question Paper**

**OCR SUPPLIED MATERIALS:**

**Insert (inserted)**

**OTHER MATERIALS REQUIRED:**

**Electronic calculator**
**Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**

DC (KN/SW) MEP10071 23036

## INSTRUCTIONS TO CANDIDATES

- **Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.**
- **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.**
- **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 100.**
- **You may use an electronic calculator.**
- **You are advised to show all the steps in any calculations.**

**Where you see this icon you will be awarded marks for the quality of written communication in your answer.**

**BLANK PAGE**

**Answer ALL the questions.**

**1 (a) A balanced diet is essential for good health.**

**Complete the following passage by using the most appropriate terms from the list to fill the gaps.**

**Each term SHOULD NOT be used more than once.**

**HAEMOGLOBIN IRON COLLAGEN OBESE**

**CALCIUM ANOREXIC SODIUM**

**A balanced diet is one which provides an adequate intake of energy and nutrients for the maintenance of our body. If energy intake exceeds energy usage over a period of time, an individual can become _____ .**

**The deficiency disease anaemia can be caused by a lack of the mineral _____ in the diet. As a result of this deficiency, the body is unable to produce sufficient amounts of the protein _____ in red blood cells. [3]**

**(b) The Body Mass Index (BMI) is one way of determining whether a person is underweight or overweight.**

**BMI can be calculated using the formula:**

$$\text{BMI} = \frac{\text{mass in kg}}{(\text{height in m})^2}$$

**Calculate the BMI of a female of mass 69 kg and a height of 1.67 m.**

**Show your working. Give your answer to ONE DECIMAL PLACE.**

**Answer = _____ [2]**

**(c) Another way of determining whether a person is underweight or overweight is to use a graph showing the relationship between height and body mass.**

**Fig. 1.1 is an example of this type of graph.**

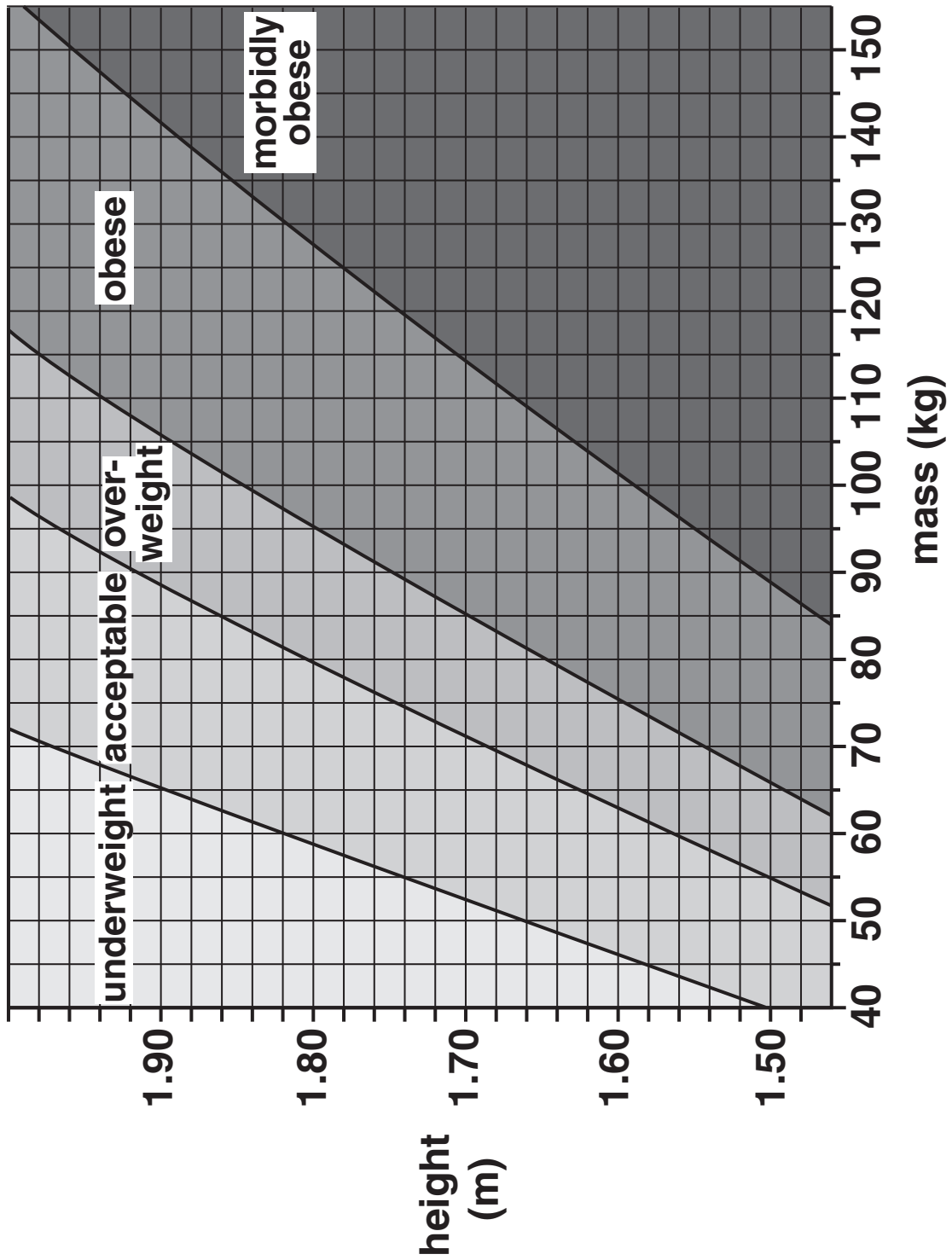



**Fig. 1.1**

**(i) Using Fig. 1.1, state the category into which a female who has a body mass of 69 kg and a height of 1.67 m is placed.**

_____ **[1]**

**(ii) There are many factors that determine the category into which a person is placed. Fig. 1.1 does not take into account all of these factors.**

**Suggest why the female in (c)(i) might be placed in the wrong category.**

_____

_____

_____

_____ **[2]**

**(d) Name <u>TWO</u> diseases associated with obesity.**

**1** _____

**2** _____ **[2]**

**[Total: 10]**

**2 Fig. 2.1 represents a water molecule.**

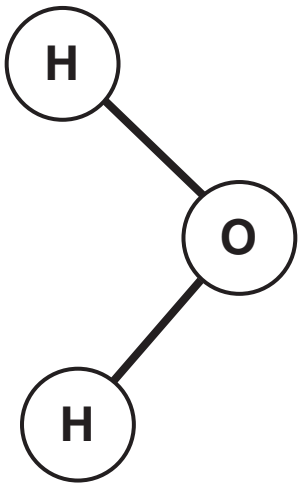



**Fig. 2.1**

**(a) Water molecules are polar. As a result, they attract each other.**

**<u>DRAW A SECOND WATER MOLECULE ON FIG. 2.1.</u>**

**Your drawing should show:**

- **the bond(s) between the two molecules**
- **the name of the bond**
- **the charges on each atom.** **[3]**

**(b) Ponds provide a very stable environment for aquatic organisms.**

**Three properties of water that contribute to this stability are as follows:**

- **the density of water decreases as the temperature falls below 4 °C so ice floats on the top of the pond**
- **it acts as a solvent for ions such as nitrates ($NO_3^-$)**
- **a large quantity of energy is required to raise the temperature of water by 1 °C.**

**Explain how these three properties help organisms survive in the pond.**

**In your answer you should make clear the links between the behaviour of the water molecules and the survival of the organisms.**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[8]**

**(c) Water is important in many biological reactions.**

**Complete Table 2.1 by writing an appropriate term next to each description.**

**Table 2.1**

| description | term |
|---|---|
| the type of reaction that occurs when water is added to break a bond in a molecule | |
| the phosphate group of a phospholipid that readily attracts water molecules | |

**[2]**

**[Total: 13]**

3 (a) **The enzyme DHPS is involved in the production of folic acid in bacteria.**

- **The substrate for DHPS is a molecule known as PABA.**

- **The enzyme DHPS is inhibited by the drug sulfonamide.**

**Fig. 3.1 shows the structure of PABA and that of sulfonamide.**

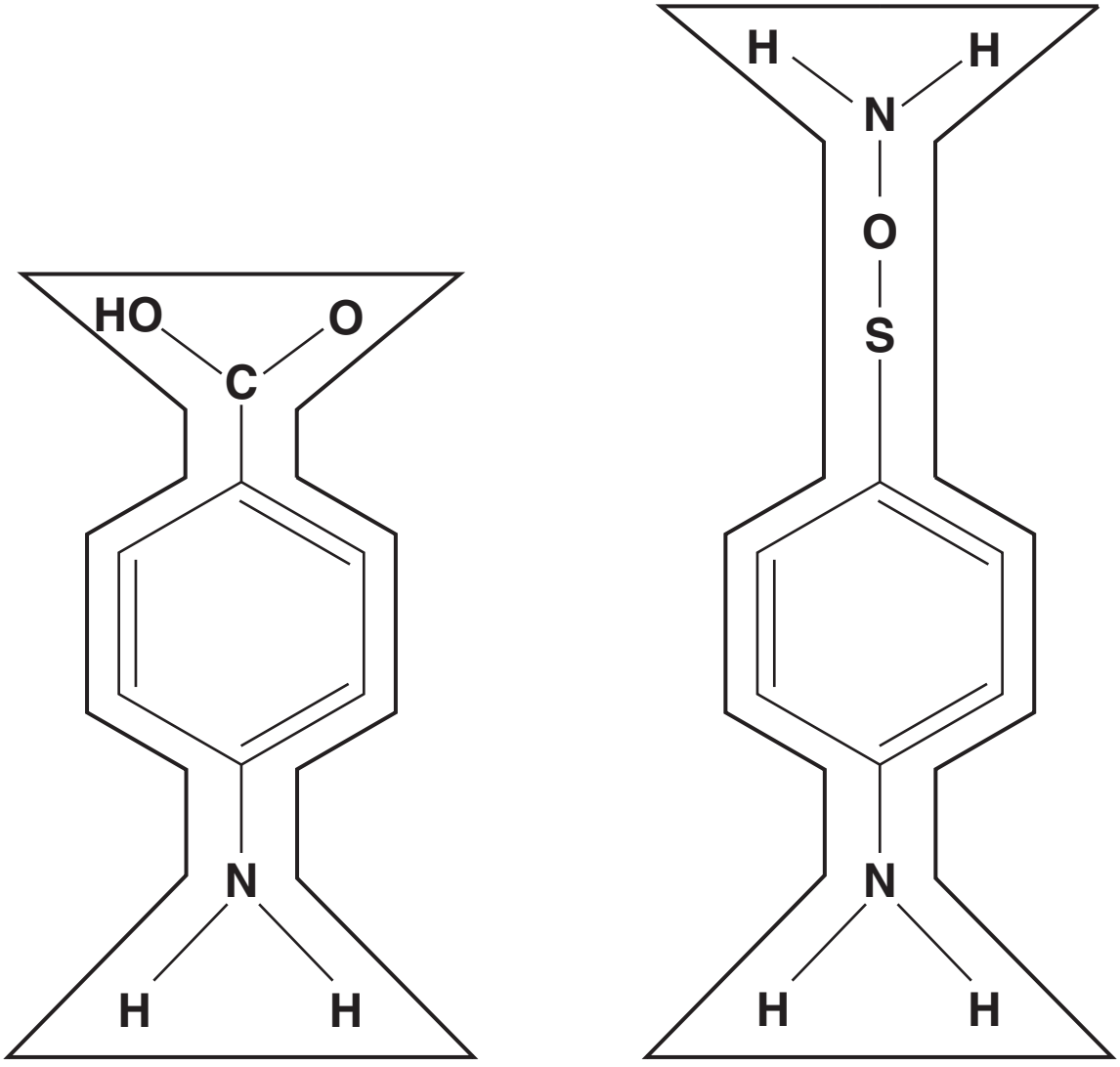
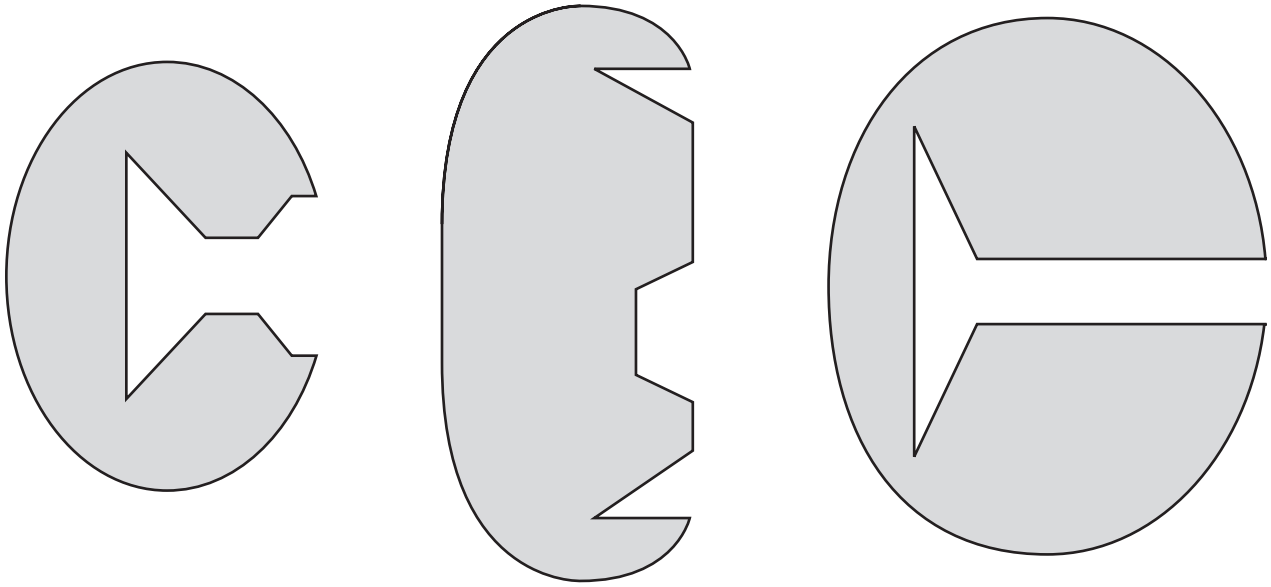



**Fig. 3.1**

(i) **Diagrams X, Y and Z represent these enzyme molecules and their active sites.**



**X** **Y** **Z**

**State the letter, X, Y or Z, that most accurately represents the enzyme DHPS.**

_____ **[1]**

(ii) **Using the information in Fig. 3.1, explain why sulfonamide acts as a competitive inhibitor of DHPS.**

_____

_____

_____

_____

_____

_____ **[3]**

**(b) Fig. 3.2 shows the effect of increasing the concentration of the substrate (PABA) on the rate of reaction.**

- **Curve A shows the rate of reaction without the presence of the competitive inhibitor sulfonamide.**

- **Curve B shows the rate of reaction in the presence of the competitive inhibitor sulfonamide.**

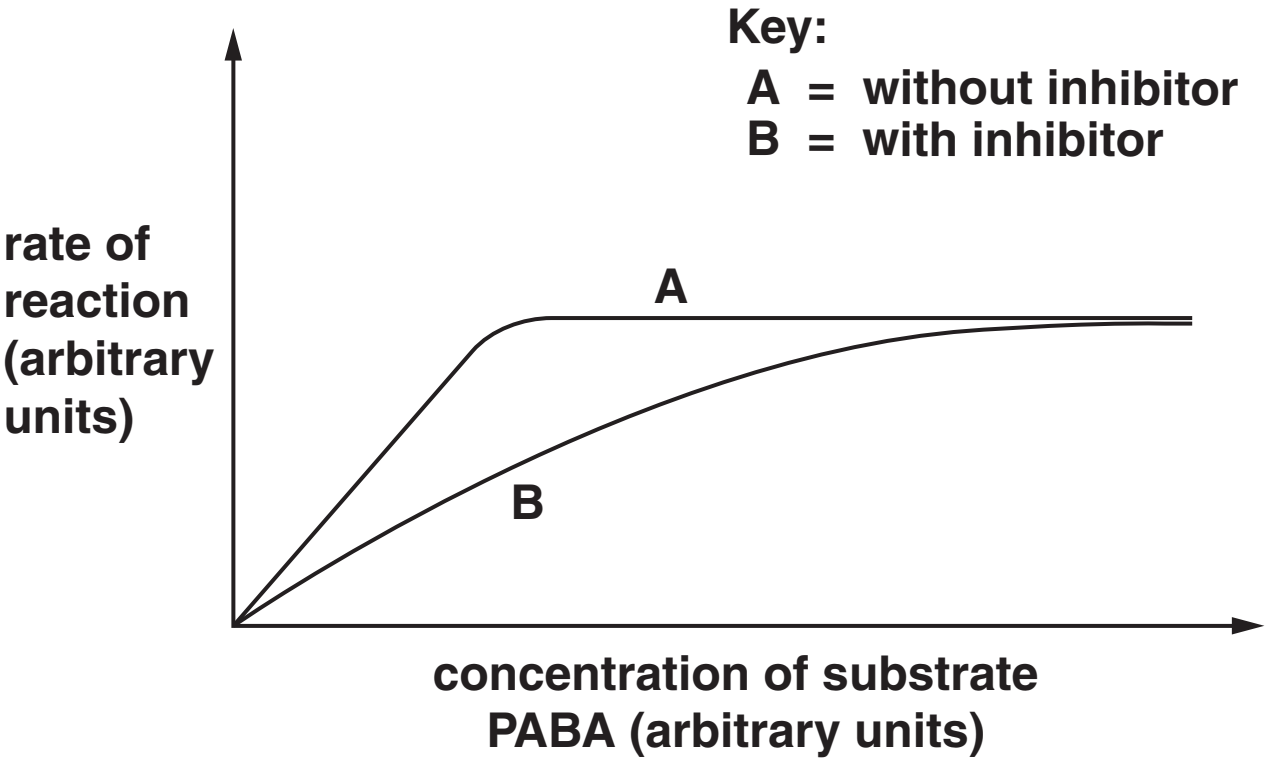



**Fig. 3.2**

**Explain the effect of increasing the concentration of substrate on the rate of reaction;**

**(i) without inhibitor,**

_____

_____

_____

_____

_____

_____ **[3]**

**(ii) with inhibitor.**

_____

_____

_____

_____

_____ **[2]**

**(c) Antibiotic resistance in bacteria is becoming an increasing problem.**

**Describe how a sulfonamide-resistant population of bacteria could develop.**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[4]**

**BLANK PAGE**

(d) **Hospitals can check to see if a strain of bacteria causing an infection is resistant to a range of antibiotics by using a MULTODISC. A multodisc contains different antibiotics.**

- **The bacteria are isolated from a patient.**
- **The bacteria are spread on nutrient agar in a Petri dish.**
- **The multodisc is placed on the agar.**

**Fig. 3.3 shows a Petri dish with the bacteria, in which is placed a multodisc containing six different antibiotics.**

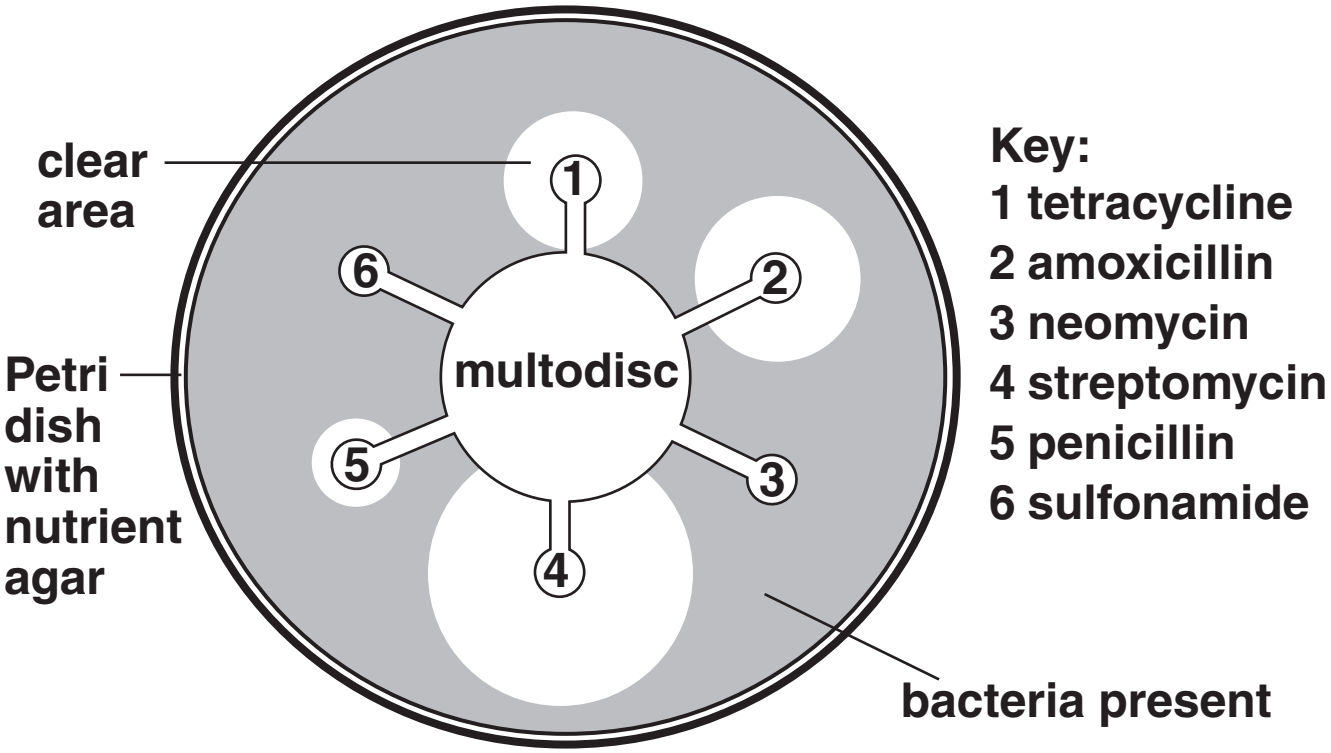



**Fig. 3.3**

**(i) Explain why there are clear areas of agar in the Petri dish.**

_____

_____

_____ **[1]**

**(ii) Using Fig. 3.3, name the antibiotic that is most effective against the bacteria causing the infection.**

_____ **[1]**

**(iii) Suggest <u>THREE</u> reasons why a hospital might use a multodisc to select the most suitable antibiotic for treating a patient.**

_____

_____

_____

_____

_____

_____ **[3]**

**(e) Drugs, such as antibiotics, are often first discovered in the natural environment.**

**Explain why it may become increasingly difficult to discover new drugs in the future.**

_____

_____

_____

_____

_____

_____ **[2]**

**[Total: 20]**

4 (a) Amino acids are the basic building blocks for proteins. Fig. 4.1 shows the amino acid cysteine.

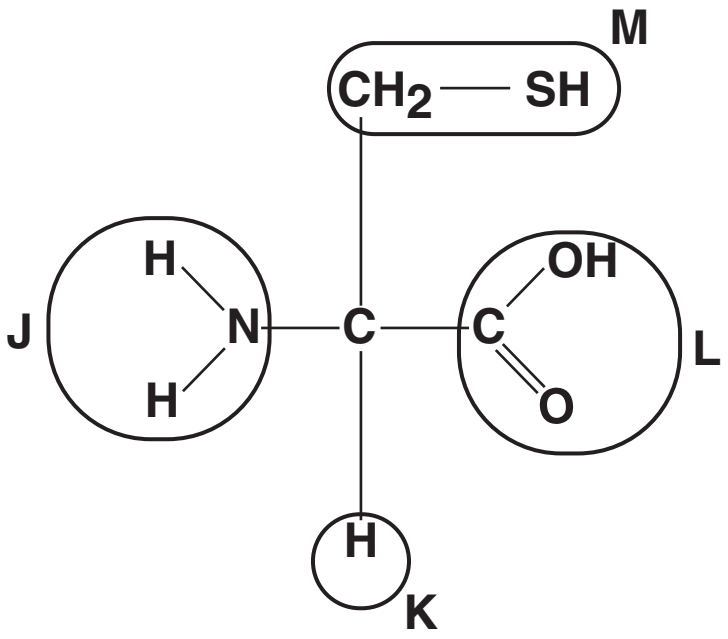



Fig. 4.1

(i) Complete the table by selecting the letter, J, K, L or M, that represents the following groups in cysteine.

| group | letter |
|---|---|
| carboxyl | |
| R group | |
| amine group | |

[3]

**(ii) The primary structure of a protein consists of a chain of amino acids.**

**Describe how a second amino acid would bond to cysteine in forming the primary structure of a protein.**

_____

_____

_____

_____

_____

_____

_____ **[3]**

**(b) Each amino acid has a different R group.**

**Describe how these R groups can interact to determine the <u>TERTIARY</u> structure of a protein.**

_____

_____

_____

_____

_____

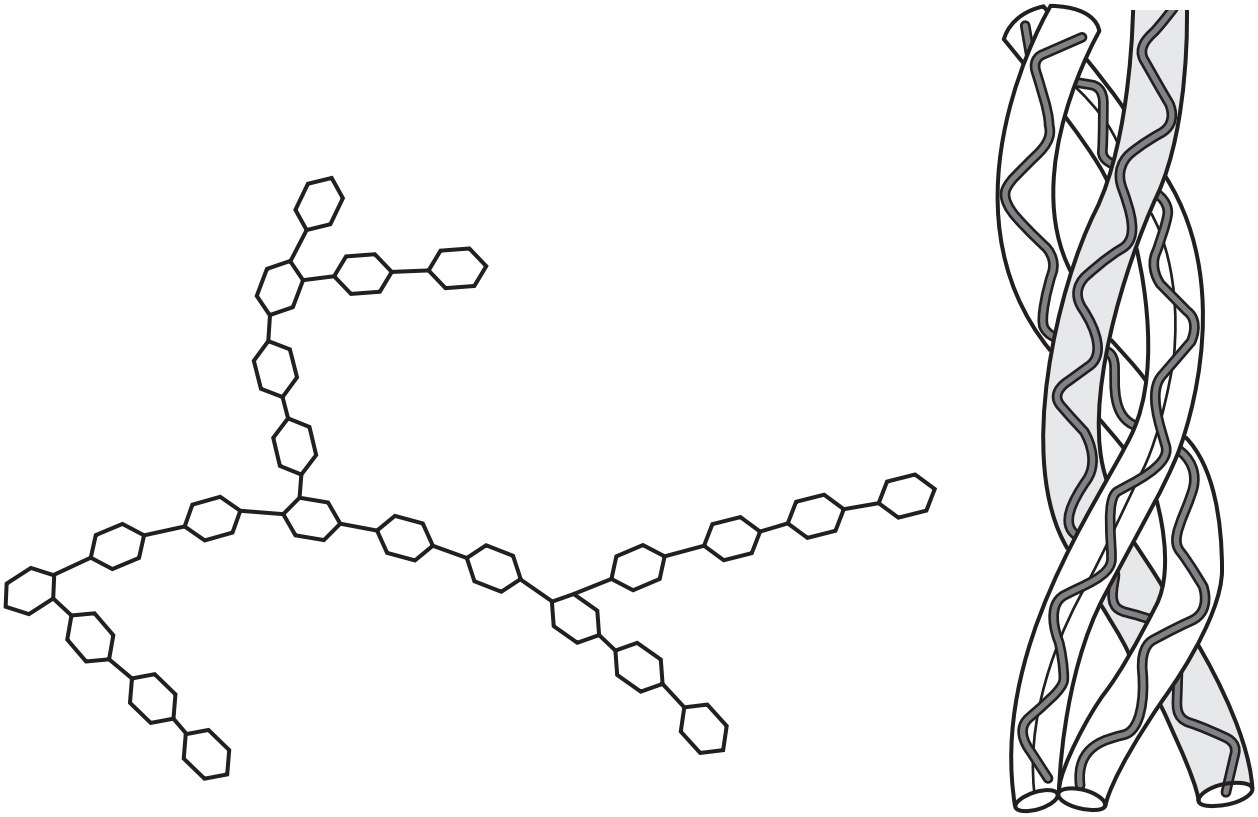
_____

_____

_____

_____ **[4]**

**(c) Fig. 4.2 shows the structure of two polymers, glycogen and collagen, that are found in mammals.**



**glycogen** **collagen**

**Fig. 4.2**

(i) **Complete the table below to give three <u>DIFFERENCES</u> between the <u>STRUCTURE</u> of glycogen and collagen.**

| glycogen | collagen |
|---|---|
| | |
| | |
| | |

**[3]**

(ii) **Collagen is found in the ligaments which hold bones together at joints.**

**State <u>TWO</u> properties of collagen that make it suitable for this purpose.**

**1** _____

**2** _____ **[2]**

**[Total: 15]**

5 (a) Coronary heart disease (CHD) can be described as a multifactorial disease. This means that a number of different risk factors contribute to the development of the disease.

Fig. 5.1 shows the percentage of cases of CHD in a population to which each risk factor contributed.

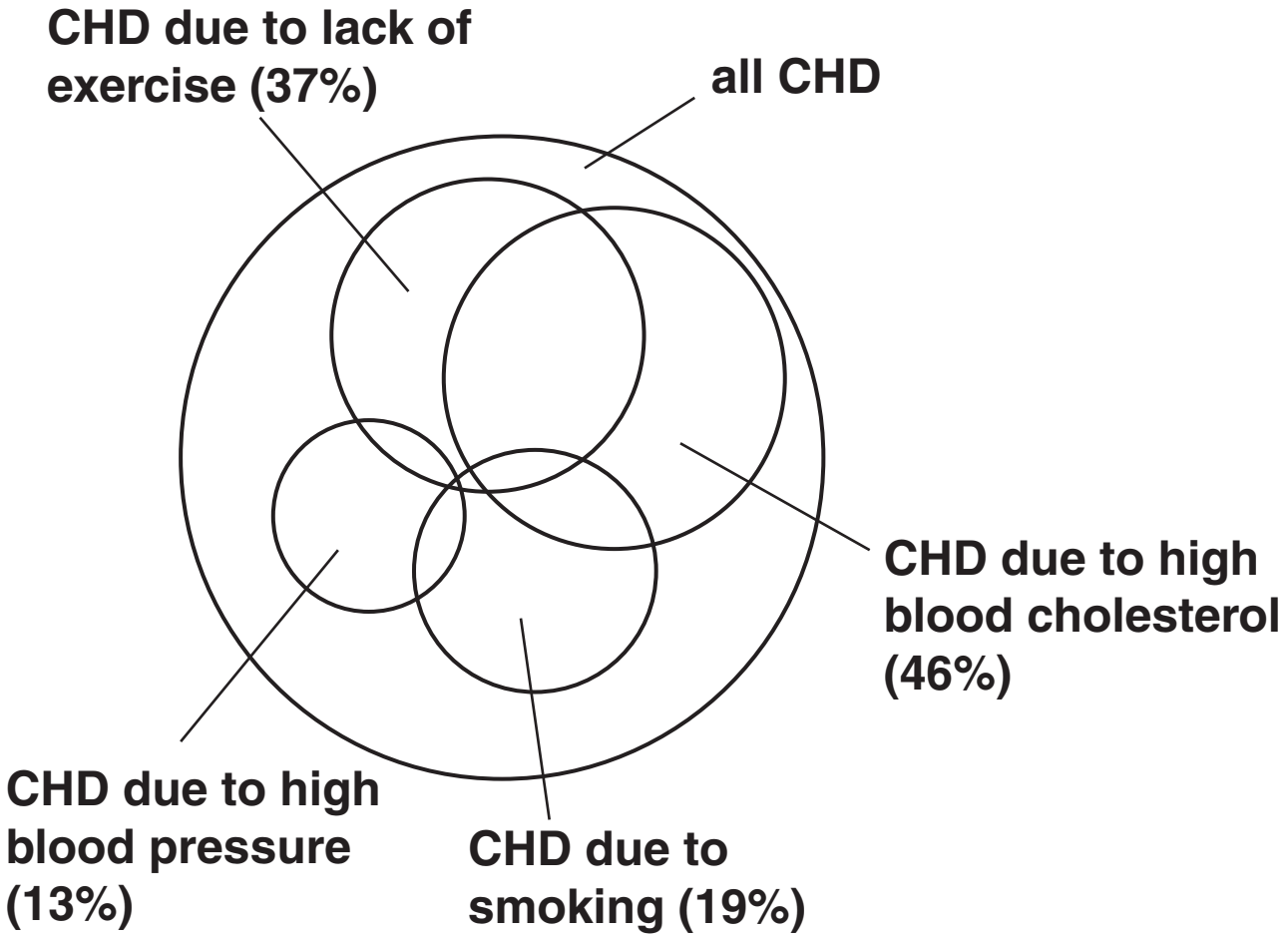



Fig. 5.1

(i) When you add up the different risk factor percentages for the population you find that it is greater than 100%.

Suggest why.

_____

_____ [1]

(ii) State TWO further risk factors that are NOT shown in Fig. 5.1.

1 _____

2 _____ [2]

(iii) Smoking is a contributing factor in 19% of all cases of CHD.
Table 5.1 lists a number of effects of cigarette smoke.
Use a tick (✓) to indicate which component of cigarette smoke causes each effect.
The first row has been done for you.

Table 5.1

| effect | nicotine | carbon monoxide |
|---|---|---|
| increases heart rate | ✓ | |
| constricts arterioles | | |
| damages the lining of arteries | | |
| reduces the ability of haemoglobin to carry oxygen | | |
| makes platelets sticky | | |

[4]

**(b) Cholesterol is transported in the form of lipoproteins. High levels of low density lipoproteins (LDLs) in the blood are a risk factor in heart disease.**

**Outline the role of LDLs in the formation of an atheroma.**

_____

_____

_____

_____

_____

_____ **[2]**

**(c) An atheroma can grow to a point where it restricts blood flow in a coronary artery, causing coronary heart disease (CHD).**

**Fig 5.2 shows a method of reducing the symptoms of CHD.**

**A stent is a tubular device, containing a 'balloon', which can be inserted into the damaged artery. The stent can be opened up by inflating the balloon.**

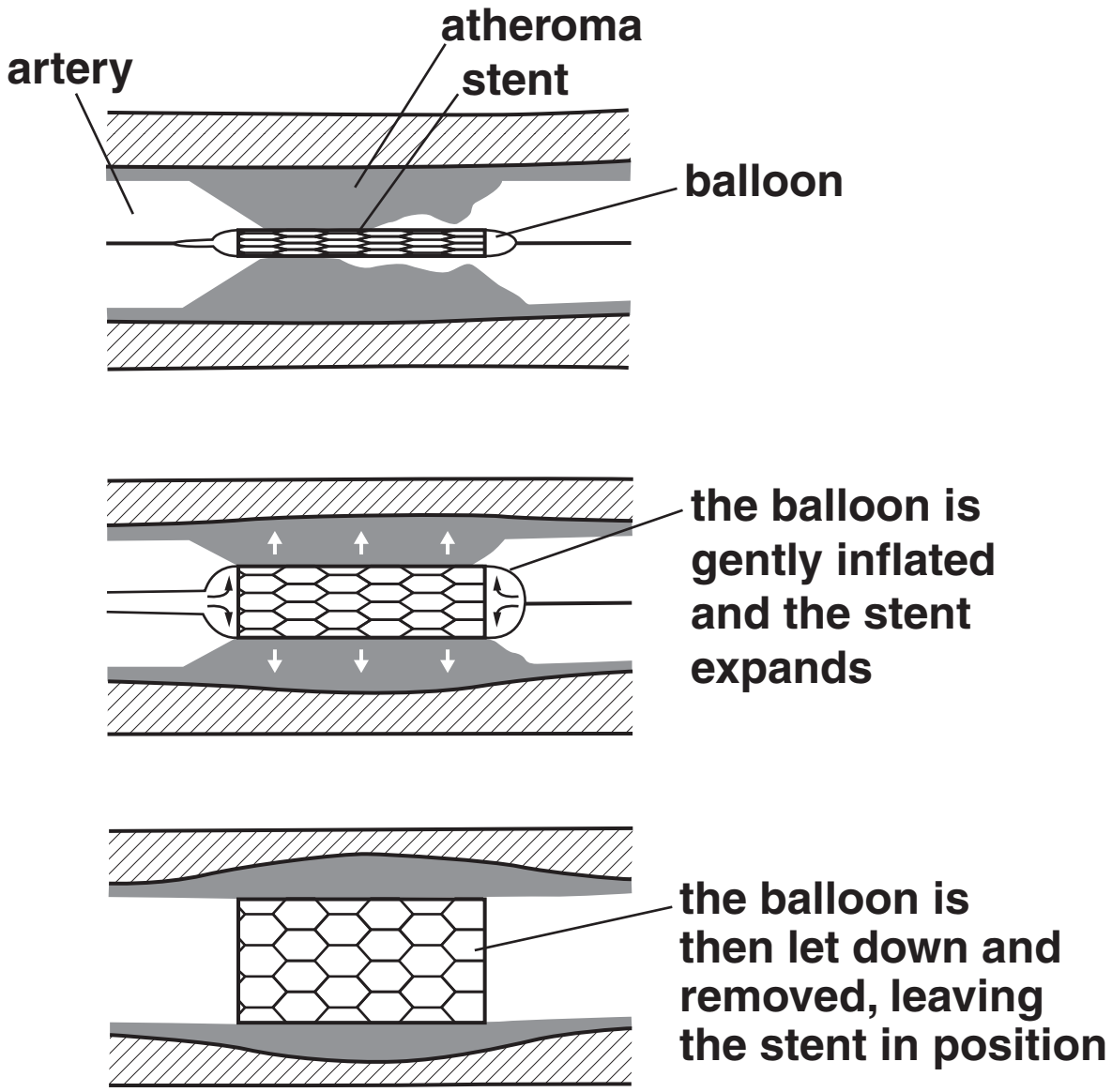



**Fig. 5.2**

**Explain how the inserted stent would reduce the symptoms of CHD.**

_____

_____

_____

_____

_____

_____

_____

_____ **[4]**

**[Total: 13]**

**6 DNA and RNA are nucleic acids.**

**(a) (i) State the components of a DNA nucleotide.**

_____

_____

_____

_____ **[3]**

**(ii) Describe how the structure of RNA differs from that of DNA.**

_____

_____

_____

_____ **[2]**

**(b) Before a cell divides, the DNA needs to be accurately replicated.**

**Describe how a DNA molecule is replicated.**

**In your answer you should make clear how the steps in the process are sequenced.**

_____

_____

_____

_____

_____

_____

_____

_____ **[7]**

**(c) (i) State what a gene codes for.**

_____

_____

_____ **[1]**

**(ii) Suggest how changing the sequence of DNA nucleotides could affect the final product the DNA codes for.**

_____

_____

_____

_____

_____ **[2]**

**[Total: 15]**

**7 Fig. 7.1, ON THE INSERT, shows a diagram of part of a heathland habitat. A study was carried out on the biodiversity of this habitat.**

**(a) Define the terms:**

**habitat** _____

_____

_____

**biodiversity** _____

_____

_____ **[3]**

**(b) In this study, a student placed his quadrat on areas he considered to have the most biodiversity.**

**Explain what is wrong with this technique.**

_____

_____

_____

_____

_____ **[2]**

(c) The student looked at the abundance of three plants at different distances from the bottom of the slope.

The results table drawn by the student is shown below.

Table 7.1

| distance from bottom of slope | percentage cover of each plant species | | |
|---|---|---|---|
| | cotton grass | ling | bracken |
| 0 m | 76 | 0 | 0 |
| 10 m | 68 | 0 | 0 |
| 20 m | 0 | 2 | 0 |
| 30 m | 0 | 35 | 0 |
| 40 m | 0 | 50 | 0 |
| 50 m | 0 | 60 | 7 |
| 60 m | 0 | 40 | 17 |
| 70 m | 0 | 10 | 42 |
| 80 m | 0 | 0 | 68 |
| 90 m | 0 | 0 | 71 |
| 100 m | 0 | 0 | 74 |

(i) The format of the student's table is incorrect.

Suggest <u>ONE</u> way in which the student could correct the table.

_____

_____ [1]

**Fig. 7.2 is a graph showing the distribution of cotton grass and bracken at different distances from the bottom of the slope.**

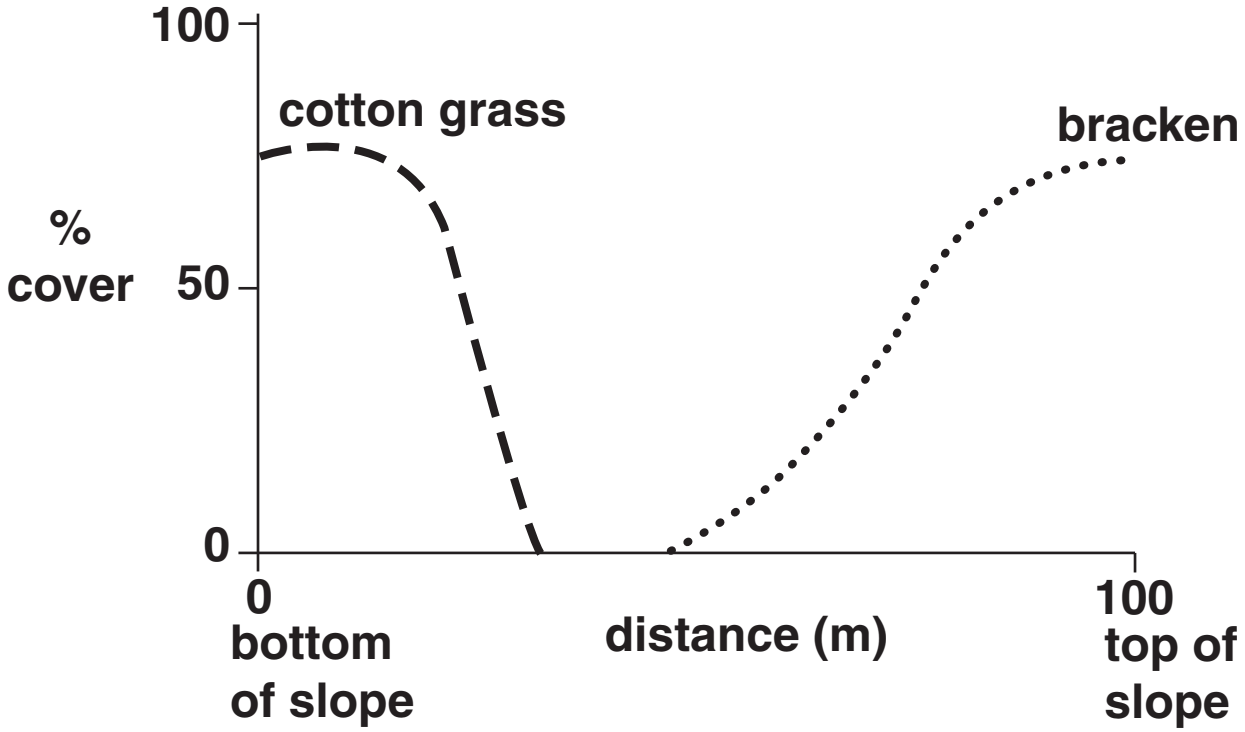



**Fig. 7.2**

**(ii) Using the information in Table 7.1, <u>SKETCH ON FIG. 7.2</u> a curve to show the distribution of <u>LING</u>. [3]**

**(iii) Describe the distribution of <u>BRACKEN</u>.**

_____

_____

_____

_____

_____ **[2]**

**(d) (i) The student was asked to calculate the biodiversity using Simpson's Index of Diversity.**

**Suggest what additional data he would need to <u>COLLECT</u> in order to calculate Simpson's Index of Diversity in this habitat.**

_____

_____

_____

_____

_____ **[2]**

**(ii) The student calculated Simpson's Index as 0.2. This is a low value.**

**State the <u>SIGNIFICANCE</u> of this low value for this habitat.**

_____

_____

_____ **[1]**

**[Total: 14]**

**END OF QUESTION PAPER**

BLANK PAGE