GCE AS/A LEVEL

2400U10–1

MONDAY, 12 MAY 2025–MORNING

BIOLOGY– AS UNIT 1

BASIC BIOCHEMISTRY AND CELL ORGANISATION

1 hour 30 minutes plus your additional time allowance

Surname: _____

First name(s): _____

Centre Number: _____

Candidate Number: 2 _____

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	11	
2.	13	
3.	15	
4.	12	
5.	10	
6.	10	
7.	9	
Total	80	

ADDITIONAL MATERIALS

A calculator and a ruler.

ITEMS INCLUDED WITH QUESTION PAPER

A separate Diagram Booklet.

The Diagram Booklet MUST be handed in to the invigilators and sent for marking.

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball – point pen, black felt tip or your usual method.

Write your name, centre number and candidate number in the spaces on the front cover.

Answer ALL questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part – question.

The assessment of the quality of extended response (QER) will take place in question 7

The quality of written communication will affect the awarding of marks.

Answer ALL questions.

1. (a) Refer to IMAGE 1.1 in the separate Diagram Booklet. IMAGE 1.1 shows some cells undergoing mitosis.

(i) The cell labelled D is at interphase of the cell cycle.
State TWO events that occur during this stage.

I. _____

II. _____

[2 marks]

(ii) Use letters (A – F) from IMAGE 1.1 to identify ONE cell in each of the following stages of mitosis.

Telophase: _____

Prophase: _____

Anaphase: _____

[2 marks]

continued on the next page . . .

Question 1 (a) continued

1. (a) (iii) Starting with the letter D, place the letters from IMAGE 1.1 in the correct order during the cell cycle.

D _____ _____ _____ _____ _____

[1 mark]

(b) Look at the table for Question 1 (b) in the separate Diagram Booklet.
Describe THREE differences between the processes of mitosis and meiosis.

[3 marks]

(c) Refer to IMAGE 1.2 in the separate Diagram Booklet. Some organisms are capable of reproducing both sexually and asexually, for example bracken, a type of fern. IMAGE 1.2 shows the life cycle of bracken.

During the life cycle, a mature plant (called a sporophyte) produces spores by meiosis. These spores germinate and grow into an offspring called a gametophyte.

continued on the next page . . .

Question 1 (c) continued

The gametophyte reproduces sexually.
It produces gametes that undergo fertilisation.
The zygote formed develops into a new sporophyte.

A species of bracken found in Wales has a diploid chromosome number of 104

Use all the information given to answer the following questions.

1. (c) (i) State the type of cell division involved in producing the gametes in bracken.

_____

[1 mark]

continued on the next page . . .

Question 1 (c) continued

1. (c) (ii) State the number of chromosomes that would be found inside each cell of the sporophyte and the gametophyte in this species of bracken.

Sporophyte: _____

Gametophyte: _____

[2 marks]

(Total for Question 1 = 11 marks)

2. Refer to IMAGE 2.1 in the separate Diagram Booklet.
IMAGE 2.1 shows a transmission electron micrograph of a specialised cell from the pancreas.
These cells are responsible for producing and secreting the hormone insulin.

(a) (i) Identify the structures labelled A to C in IMAGE 2.1

A _____

B _____

C _____

[2 marks]

(ii) The two structures labelled D are both the same type of organelle.
Explain why the two structures differ in appearance.

_____

_____

_____

[1 mark]

continued on the next page . . .

Question 2 continued

2. (b) Refer to IMAGE 2.2 in the separate Diagram Booklet. Insulin is a globular protein. It is produced from a single polypeptide called proinsulin. This is shown in IMAGE 2.2

(i) State the highest level of protein structure shown by proinsulin in IMAGE 2.2

[1 mark]

(ii) The polypeptide chain of proinsulin is composed of 86 amino acids.
State the minimum number of nucleotide bases contained in the gene coding for proinsulin.

[1 mark]

continued on the next page . . .

Question 2 continued

2. (c) Refer to IMAGE 2.3 in the separate Diagram Booklet. Following synthesis of proinsulin by ribosomes, proinsulin must undergo post translational modification to form functional insulin. This is shown in IMAGE 2.3

(i) Use IMAGE 2.3 and YOUR KNOWLEDGE OF CELL ORGANELLES to describe the production of functional insulin.
Your answer should describe the process from the point at which proinsulin has been synthesised by ribosomes to the point at which it is secreted from the cell.
Details of translation are not required.

[5 marks]

continued on the next page . . .

Question 2 (c) continued

2. (c) (ii) Explain the role of organelle D on IMAGE 2.1 in the PRODUCTION and SECRETION of insulin.

[3 marks]

(Total for Question 2 = 13 marks)

3. (a) Refer to IMAGE 3.1a and IMAGE 3.1b in the separate Diagram Booklet. IMAGE 3.1a shows a molecule of alpha glucose and IMAGE 3.1b shows a molecule of glucose − 1 − phosphate.

Alpha glucose and glucose − 1 − phosphate are not structural isomers of each other.
Use IMAGES 3.1a and 3.1b to explain why.

_____

_____

_____

[1 mark]

continued on the next page . . .

Question 3 continued

3. (b) Starch phosphorylase is an enzyme that catalyses the FORMATION OF STARCH from glucose − 1 − phosphate.

A student investigated the effect of the concentration of glucose − 1 − phosphate on the activity of starch phosphorylase. They used the following method:

1. **Add a drop of iodine into each of the wells on a spotting tile.**
2. **Add 5 cm^3 of 1% glucose − 1 − phosphate solution to a test tube.**
3. **Add 5 cm^3 of 1% starch phosphorylase into a separate test tube.**
4. **Place both test tubes in a thermostatically controlled water bath at 20°C for 5 minutes.**
5. **Pour the starch phosphorylase into the test tube of glucose − 1 − phosphate solution and mix.**

continued on the next page . . .

Question 3 (b) continued

6. At one−minute intervals remove a drop of the extract from the mixture and add it to the iodine in the spotting tile and record the time taken for a blue−black colour to appear.
7. Repeat steps 1 to 6 for glucose−1−phosphate concentrations of 2%, 3%, 4% and 5%

(i) The starch phosphorylase solution and the glucose−1−phosphate solution were both placed in the water bath for 5 minutes to equilibrate.
Explain why this is important in this experiment.

_____

_____

_____

[1 mark]

continued on the next page . . .

Question 3 (b) continued

3. (b) (ii) The student used a graduated pipette to transfer the $5\ cm^3$ of glucose − 1 − phosphate to the test tube. The graduated pipette was accurate to $\pm 0 \cdot 2\ cm^3$

Calculate the percentage error of the volume measured.

percentage error = _____ %

[2 marks]

continued on the next page . . .

Question 3 (b) continued

3. (b) (iii) The results of the investigation are shown in TABLE 3.2 provided in the separate Diagram Booklet.

Use the data in TABLE 3.2 to calculate the mean rate of starch synthesis at a glucose − 1 − phosphate concentration of 3%
WRITE YOUR ANSWER IN TABLE 3.2

Space for working

[2 marks]

continued on the next page . . .

Question 3 (b) continued

3. (b) (iv) Describe and explain the effect of glucose − 1 − phosphate concentration on the mean RATE of starch synthesis during this investigation.

[3 marks]

3. (b) (v) One of the limitations of this practical is that the results depend on a subjective judgement of the colour change.
Look at the table for Question 3 (b) (v) in the separate Diagram Booklet.
State TWO OTHER limitations AND suggest how the method could be improved to reduce the effect of each.

[4 marks]

continued on the next page . . .

Question 3 continued

3. (c) Describe a biochemical test the student could use to show that glucose − 1 − phosphate is a REDUCING SUGAR.

[2 marks]

(Total for Question 3 = 15 marks)

4. (a) Plasma membranes are described as being selectively permeable.

Explain what is meant by the term SELECTIVELY PERMEABLE.

_____

_____

_____

[1 mark]

(b) Describe ONE similarity and TWO differences between facilitated diffusion and active transport.

Similarity: _____

_____

_____

_____

_____

Difference 1: _____

_____

_____

Difference 2: _____

[3 marks]

continued on the next page . . .

Question 4 continued

4. (c) Refer to GRAPH 4 in the separate Diagram Booklet. An investigation was carried out to determine how different molecules are transported into cells across the plasma membrane. During the investigation epithelial cells were placed into solutions with increasing concentrations of molecules A, B and C.
The solutions were maintained at 35°C
The results are shown in GRAPH 4

(i) Molecule A is non−polar and molecule B is polar.
Explain how GRAPH 4 provides evidence to support this statement.

[4 marks]

4. (c) (ii) Suggest an explanation for the result shown by molecule **C**.

[1 mark]

continued on the next page . . .

Question 4 (c) continued

4. (c) (iii) When the investigation was repeated at temperatures higher than 35°C the rate of uptake of molecule C increased.
Explain the reason for the change in the rate of uptake.

[3 marks]

(Total for Question 4 = 12 marks)

5. (a) Refer to IMAGE 5.1 in the separate Diagram Booklet. IMAGE 5.1 shows the structure of two amino acids, tyrosine and valine.

(i) On IMAGE 5.1 DRAW A CIRCLE around the R−group of EACH amino acid.

[1 mark]

(ii) These two amino acids can be joined together during a chemical reaction. State the type of reaction and name the bond formed when these two amino acids are joined together.

Type of reaction _____

_____

Bond formed _____

_____

[2 marks]

continued on the next page . . .

Question 5 continued

5. (b) The enzyme tyrosinase converts tyrosine into melanin.

Explain why only tyrosinase can catalyse this reaction.

[3 marks]

continued on the next page . . .

Question 5 continued

5. (c) Melanin is a pigment that is responsible for dark fur colouration. The more melanin produced the darker the fur. In Siamese cats, the conversion of tyrosine to melanin by tyrosinase is affected by temperature. Above $35^{\circ}C$ tyrosinase is denatured.

Refer to IMAGE 5.2 in the separate Diagram Booklet. IMAGE 5.2 shows the distribution of dark and light fur in a Siamese cat.

Use the information given to explain why Siamese cats have dark faces, ears, paws and tails, but the main part of the body is light.

[4 marks]

(Total for Question 5 = 10 marks)

6. There are several types of lipids found in cells. These include triglycerides and phospholipids.

(a) State ONE similarity and ONE difference between the structure of a triglyceride and the structure of a phospholipid.

SIMILARITY: _____

_____

_____

DIFFERENCE: _____

_____

_____

[2 marks]

continued on the next page . . .

Question 6 continued

6. (b) Refer to IMAGE 6.1 in the separate Diagram Booklet. In 1925, two scientists, Gorter and Grendel, investigated the arrangement of phospholipids in the plasma membrane. This involved the removal of the phospholipids from the surface membrane of all the red blood cells in a sample of blood. The phospholipids were then placed on the surface of water and allowed to spread out to form a single layer. This is shown in IMAGE 6.1

(i) Explain the arrangement of the phospholipids when placed on the surface of the water in IMAGE 6.1

[2 marks]

continued on the next page . . .

Question 6 (b) continued

Refer to TABLE 6.2 in th separate Diagram Booklet. The scientists recorded a number of different measurements for samples of blood from different animals as shown in TABLE 6.2

6. (b) (ii) Use the following equation to calculate the surface area of ONE red blood cell in the dog.
WRITE YOUR ANSWER IN TABLE 6.2

$$A = \frac{T \times 10^{12}}{V \times N}$$

Where:

A = surface area of one red blood cell

T = total surface area of red blood cells

V = volume of blood sampled

N = the number of red blood cells in $1\ cm^3$

Use the space provided on the next page.

continued on the next page . . .

Question 6 (b) (ii) continued

Space for working:

[3 marks]

continued on the next page . . .

Question 6 (b) continued

6. (b) (iii) I. Calculate the ratio of total surface area of phospholipids to total surface area of red blood cells for HUMANS.
WRITE YOUR ANSWER IN TABLE 6.2

Space for working:

[1 mark]

continued on the next page . . .

Question 6 (b) (iii) continued

6. (b) (iii) II. Suggest the conclusion reached by Gorter and Grendel regarding the arrangement of phospholipids in plasma membranes.
Describe how your answer to 6 (b) (iii) I. and the data in TABLE 6.2 provides evidence to support their conclusion.

[2 marks]

(Total for Question 6 = 10 marks)

7. A key principle of molecular biology is that genetic information flows only in one direction, from DNA, to RNA, to protein.

Refer to IMAGE 7.1 in the separate Diagram Booklet. The distribution of DNA and RNA within cells can be determined by using a specific type of microscopy. IMAGE 7.1 shows an isolated animal cell (the nucleus has been stained blue) with the two positions within a cell where analysis was carried out. The analysis in TABLE 7.2 provided in the separate Diagram Booklet, shows the percentage of total DNA and RNA at these two positions.

Use the information provided and your knowledge of the functions of DNA and RNA to describe and explain the distribution of DNA and RNA within the cell.

Describe the process by which "genetic information flows from DNA to RNA".

[9 QER marks]

(Total for Question 7 = 9 marks)

END OF PAPER

TOTAL 80 MARKS

Question number	Additional pages, if required. Write the question number(s) in the left – hand margin.

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MONDAY, 12 MAY 2025 – MORNING

BIOLOGY – AS UNIT 1
BASIC BIOCHEMISTRY AND CELL ORGANISATION

Diagram Booklet

The Diagram Booklet MUST be handed in to the invigilators and sent for marking.

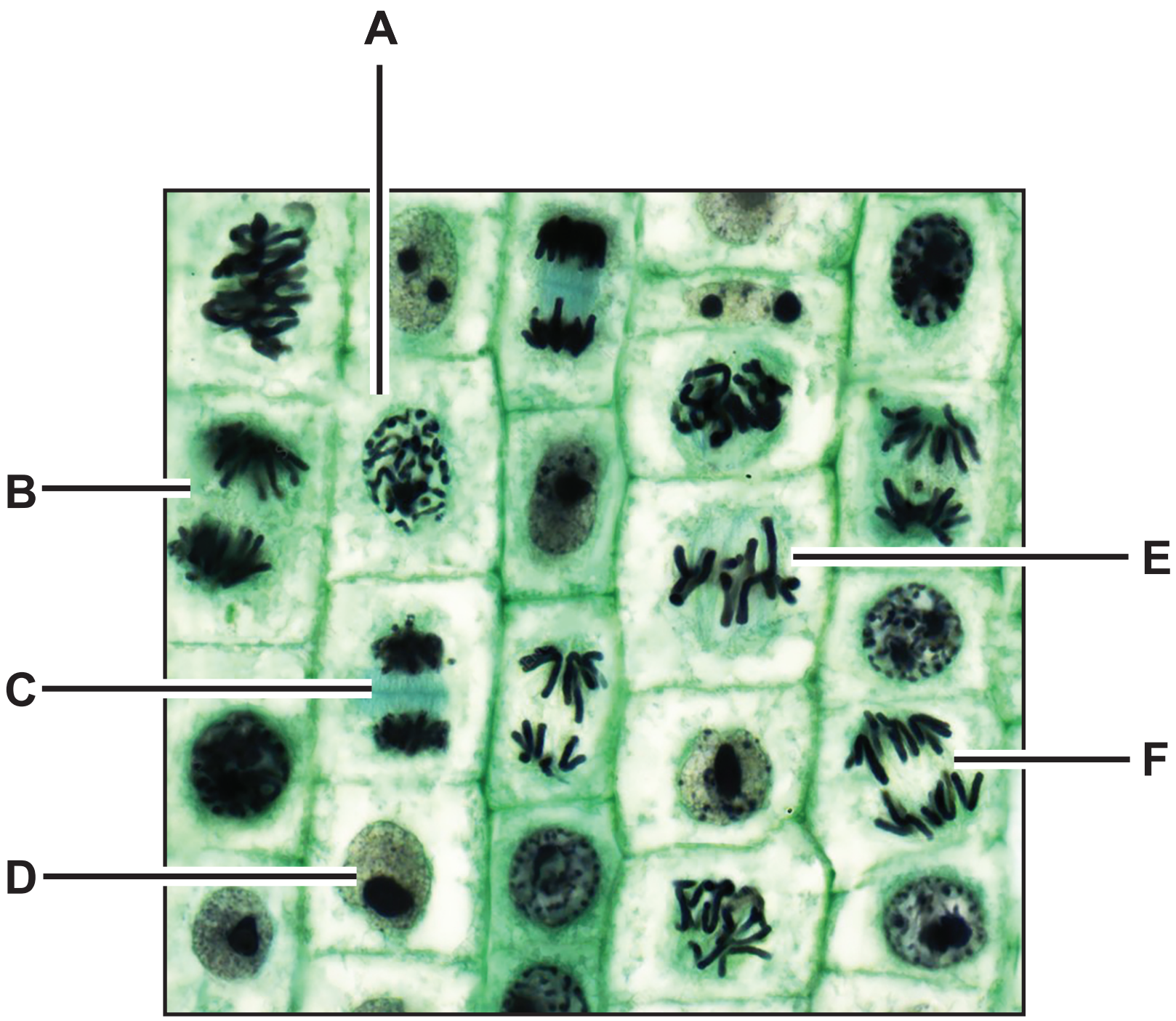
Surname: _____

First name(s): _____

Centre Number: _____

Candidate Number: 2 _____

IMAGE 1.1



Question 1 (b)

TABLE

MITOSIS	MEIOSIS
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____

IMAGE 1.2

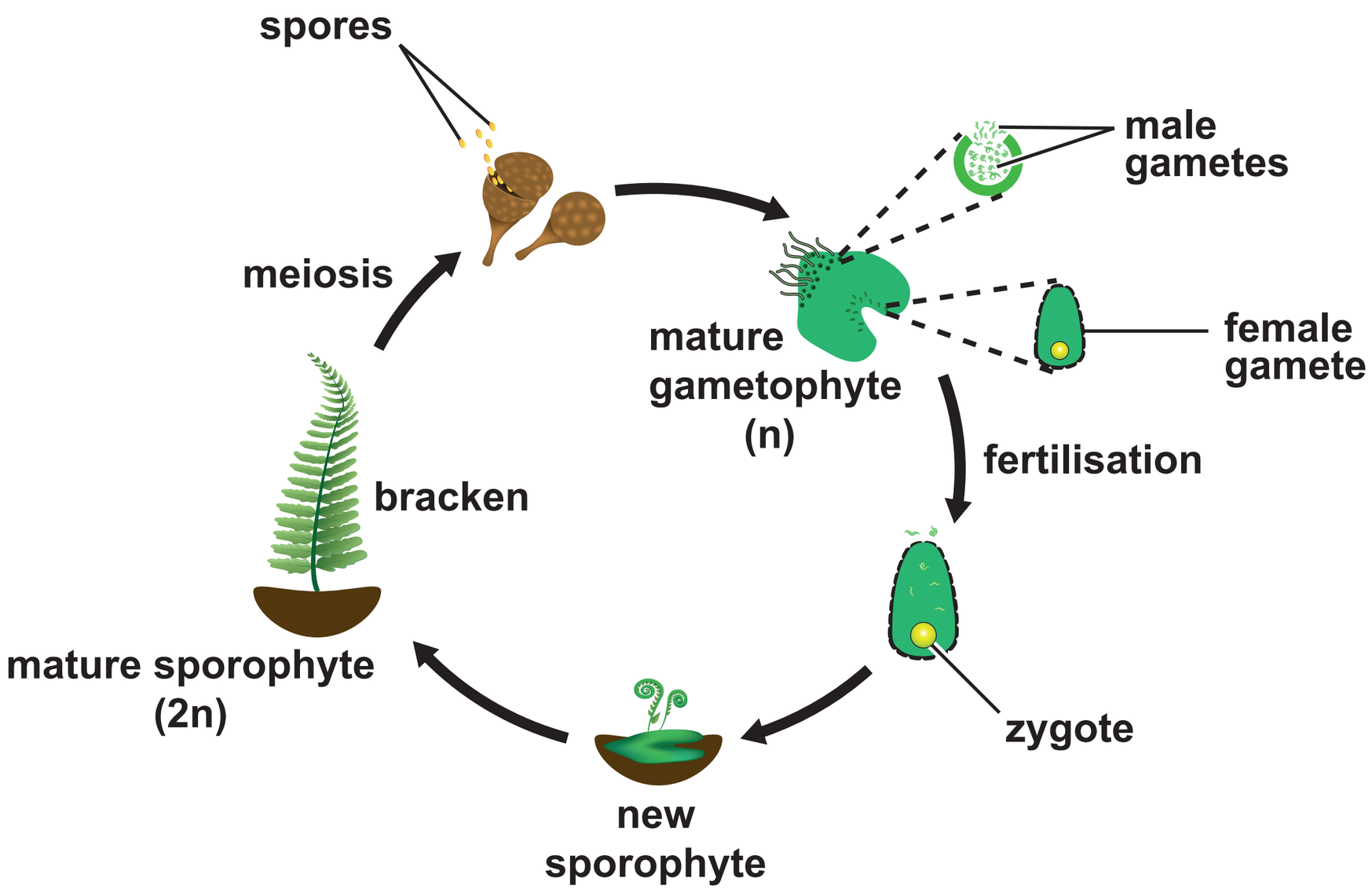

spores
meiosis
male gametes
mature gametophyte (n)
female gamete
fertilisation
bracken
mature sporophyte (2n)
zygote
new sporophyte

IMAGE 2.1

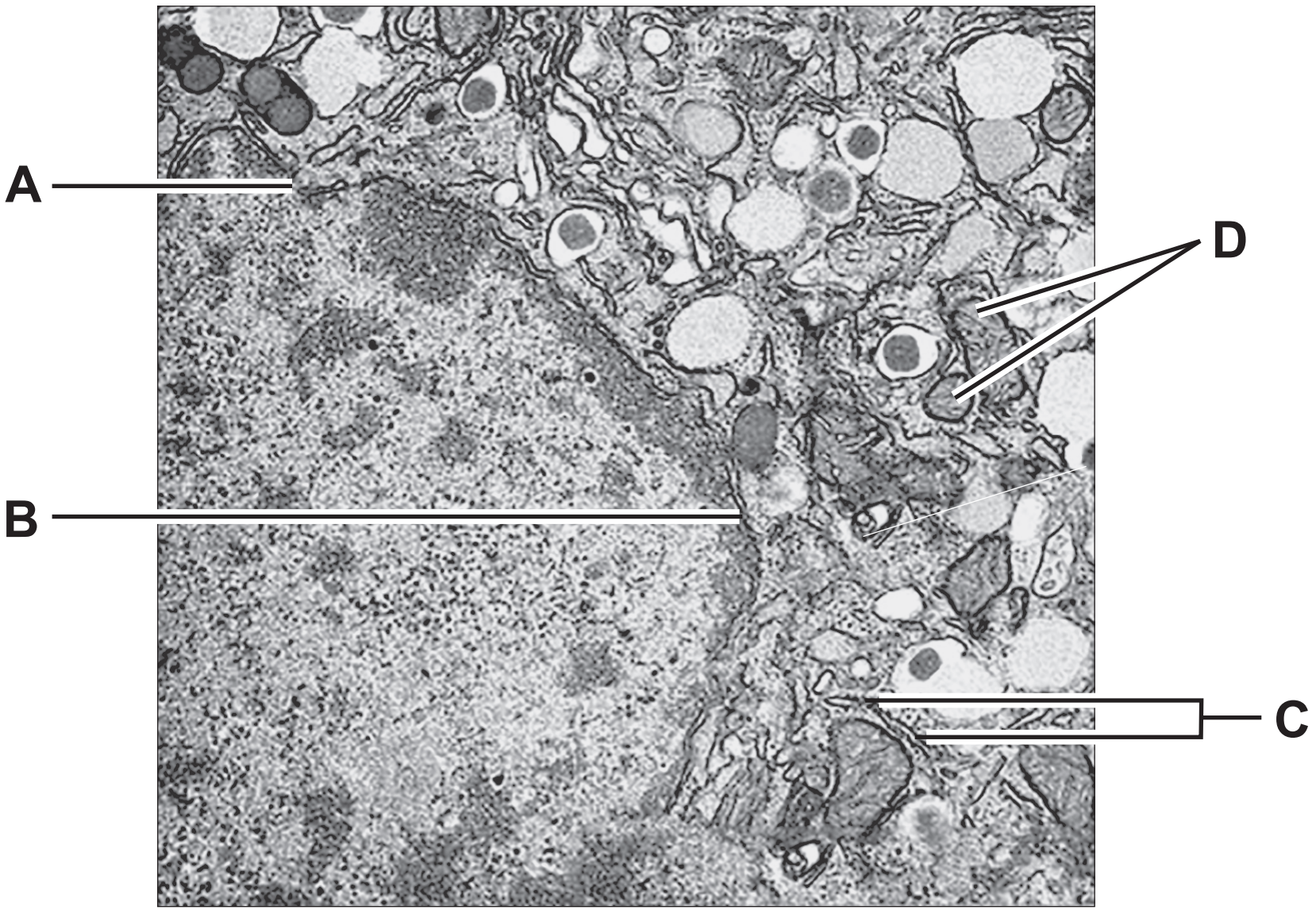


IMAGE 2.2

Proinsulin

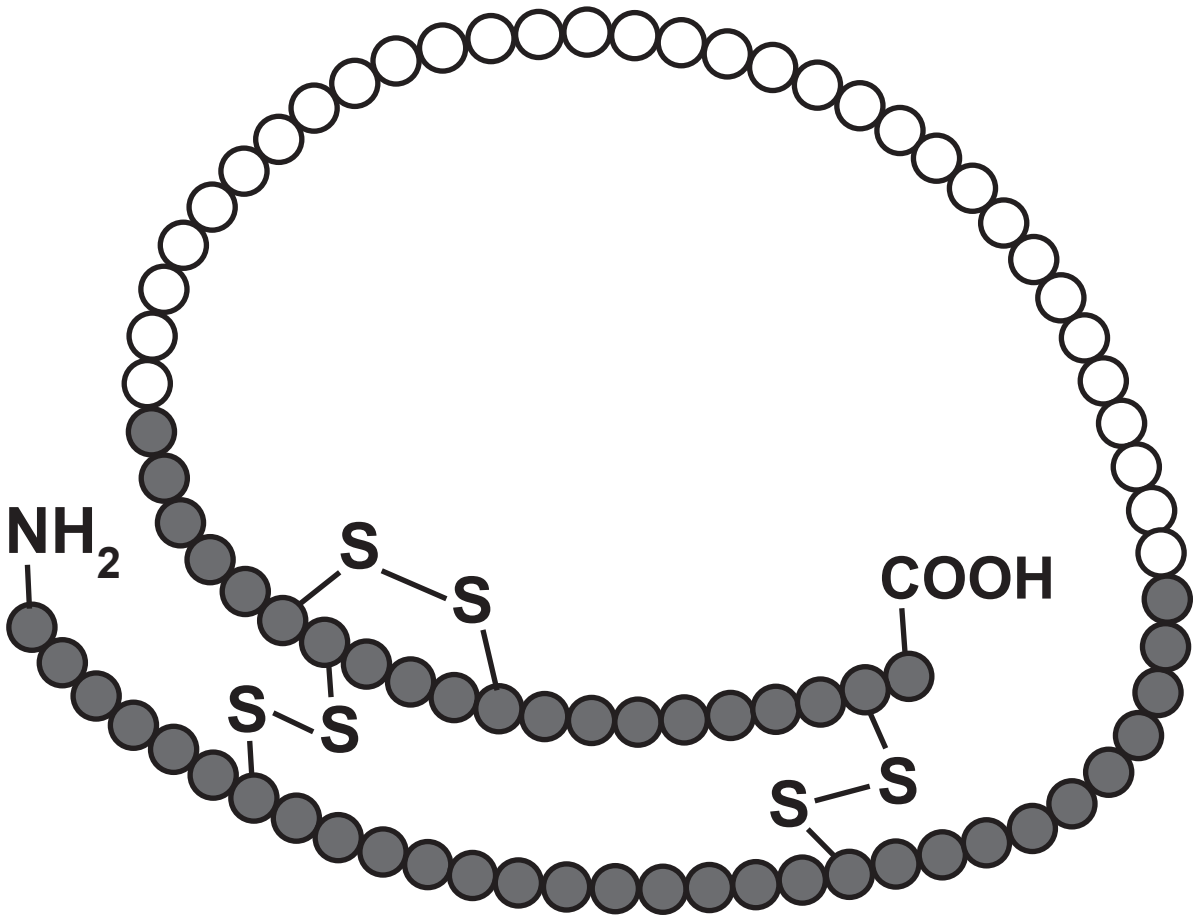


IMAGE 2.3

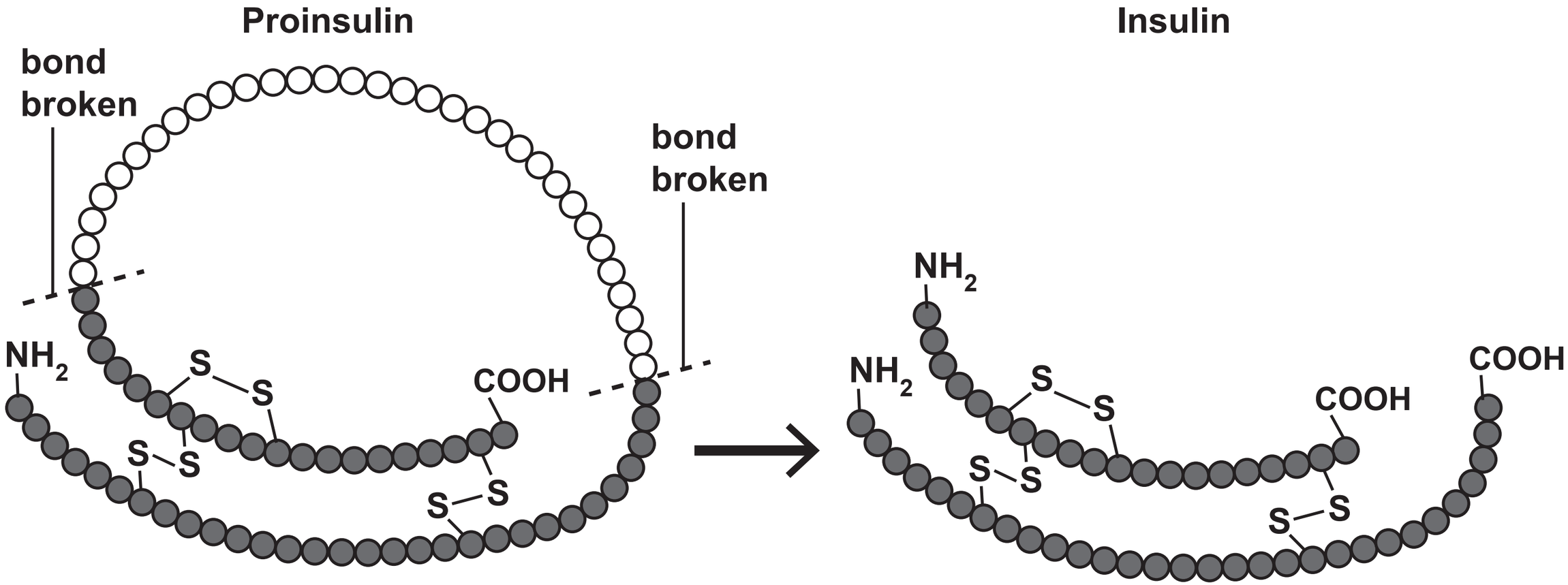

Proinsulin
bond broken
bond broken
NH2
S
S
COOH
S
S
S
S
Insulin
NH2
S
S
COOH
COOH
S
S
S
S

IMAGE 3.1a and IMAGE 3.1b

IMAGE 3.1a

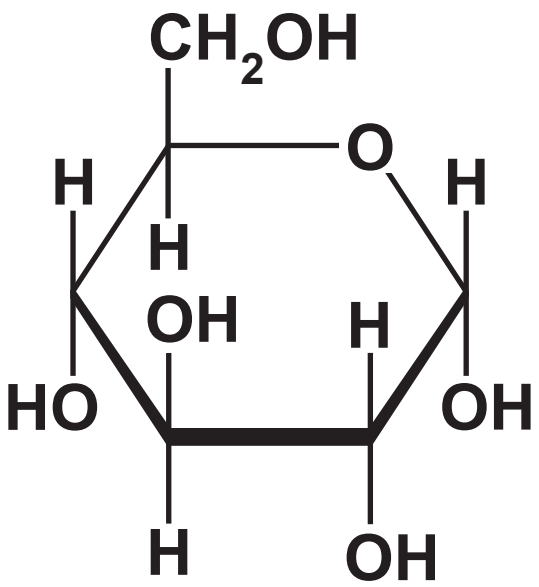


IMAGE 3.1b

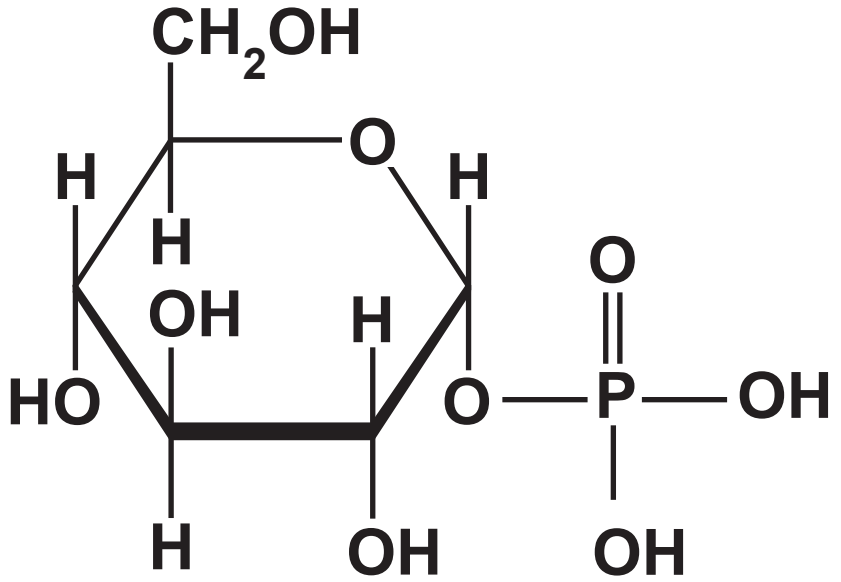


TABLE 3.2

Concentration of glucose-1-phosphate / %	Time taken for iodine solution to turn blue-black / minutes				Mean rate of starch synthesis / $min^{-1} \times 10^{-2}$
	Trial 1	Trial 2	Trial 3	Mean	
1	17	18	20	18•3	5•5
2	14	16	15	15•0	6•7
3	11	13	14	12•7	_____
4	8	7	9	8•0	12•5
5	9	7	8	8•0	12•5

Question 3 (b) (v)

TABLE

LIMITATION	IMPROVEMENT
1. _____	1. _____
2. _____	2. _____

GRAPH 4

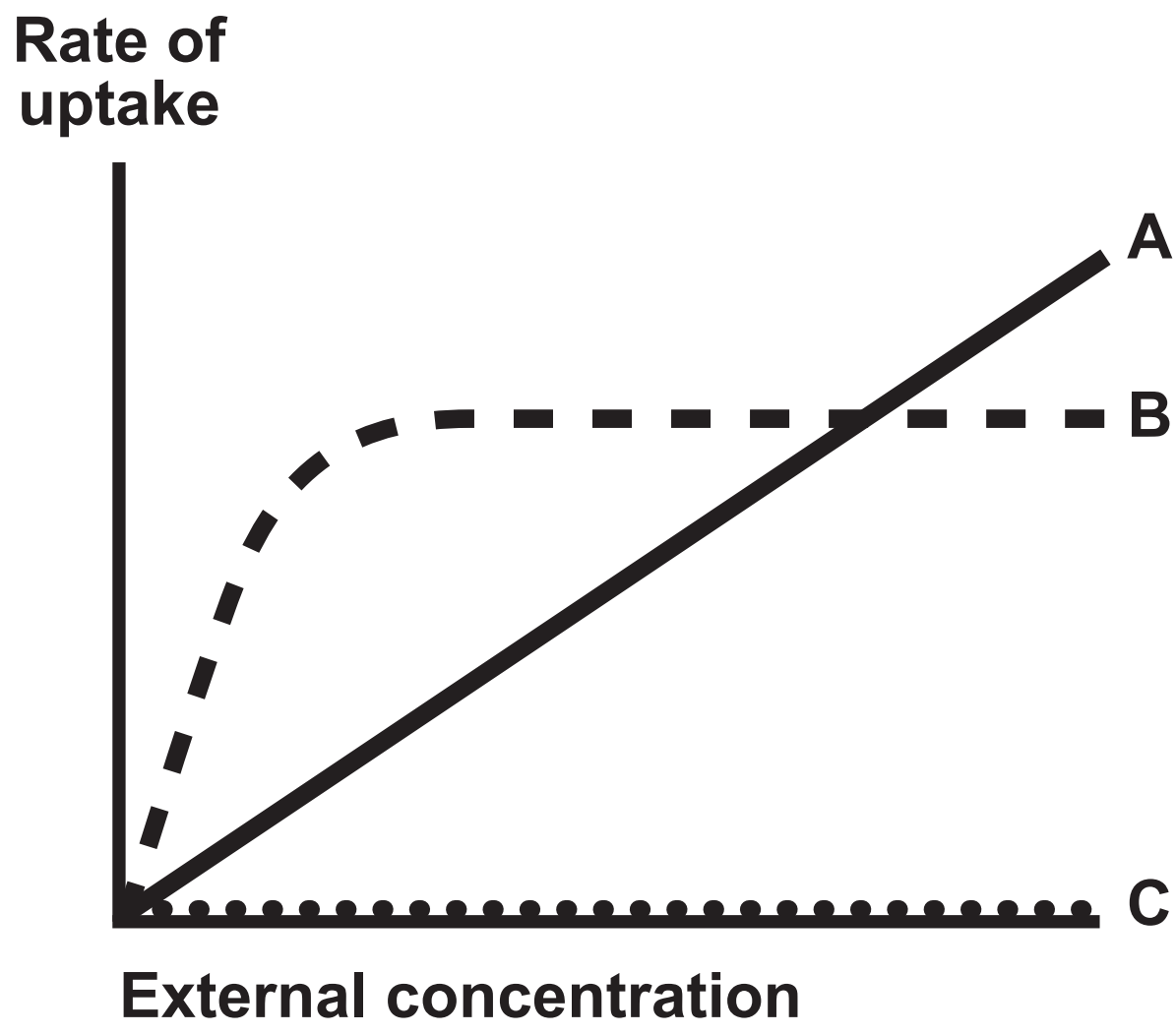
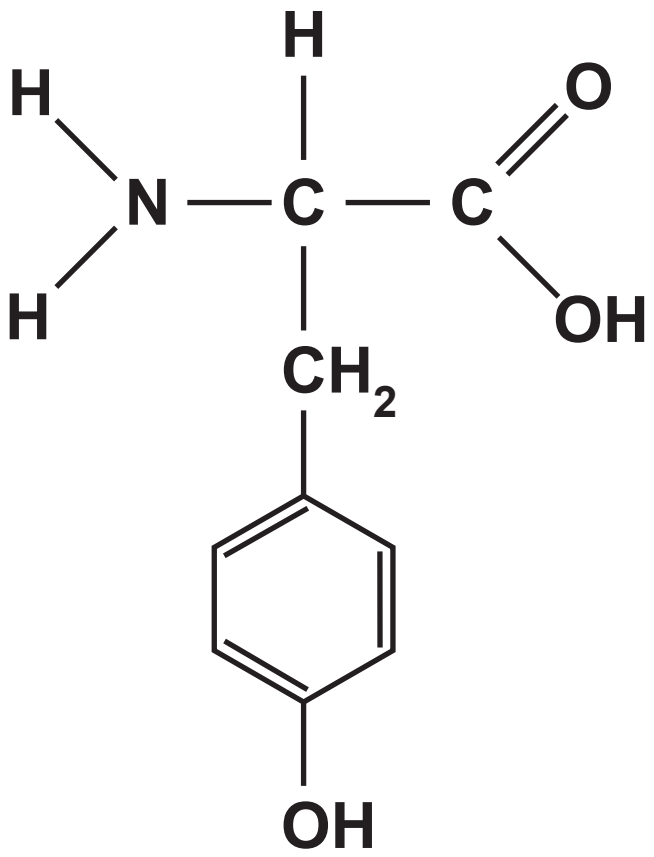


IMAGE 5.1

Tyrosine



Valine

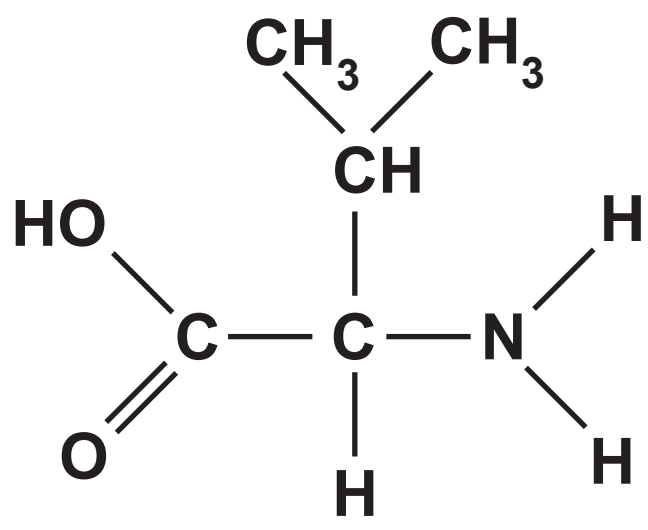


IMAGE 5.2

Siamese cat



IMAGE 6.1

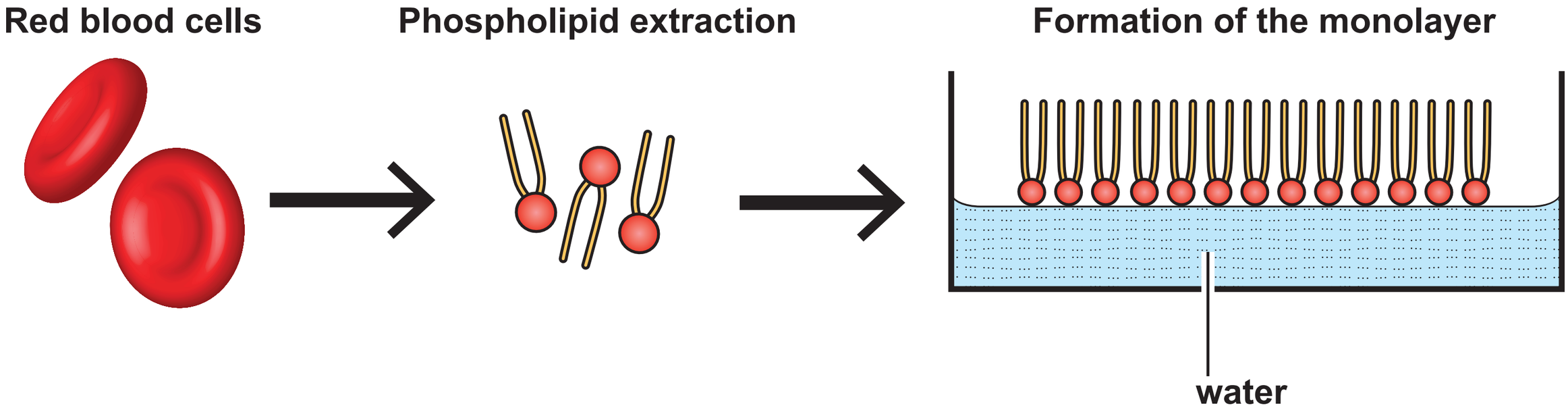

Red blood cells
Phospholipid extraction
Formation of the monolayer
water

TABLE 6.2

Animal	Volume of blood sampled/ cm^3	Number of red blood cells $\times 10^9$ in 1 cm^3	Surface area of one red blood cell / μm^2	Total surface area of red blood cells / m^2	Total surface area of phospholipids extracted from red blood cells / m^2	Ratio of total surface area of phospholipids to total surface area of red blood cells
Dog	40	8•00	_____	31•30	62•0	2•0 : 1
Sheep	10	9•90	29•8	2•95	6•2	2•1 : 1
Rabbit	10	5•90	92•5	5•46	9•9	1•8 : 1
Guinea pig	1	5•85	89•8	0•52	1•0	1•9 : 1
Goat	10	19•30	17•8	3•34	6•1	1•8 : 1
Human	1	4•74	99•4	0•47	0•9	_____ : 1

IMAGE 7.1

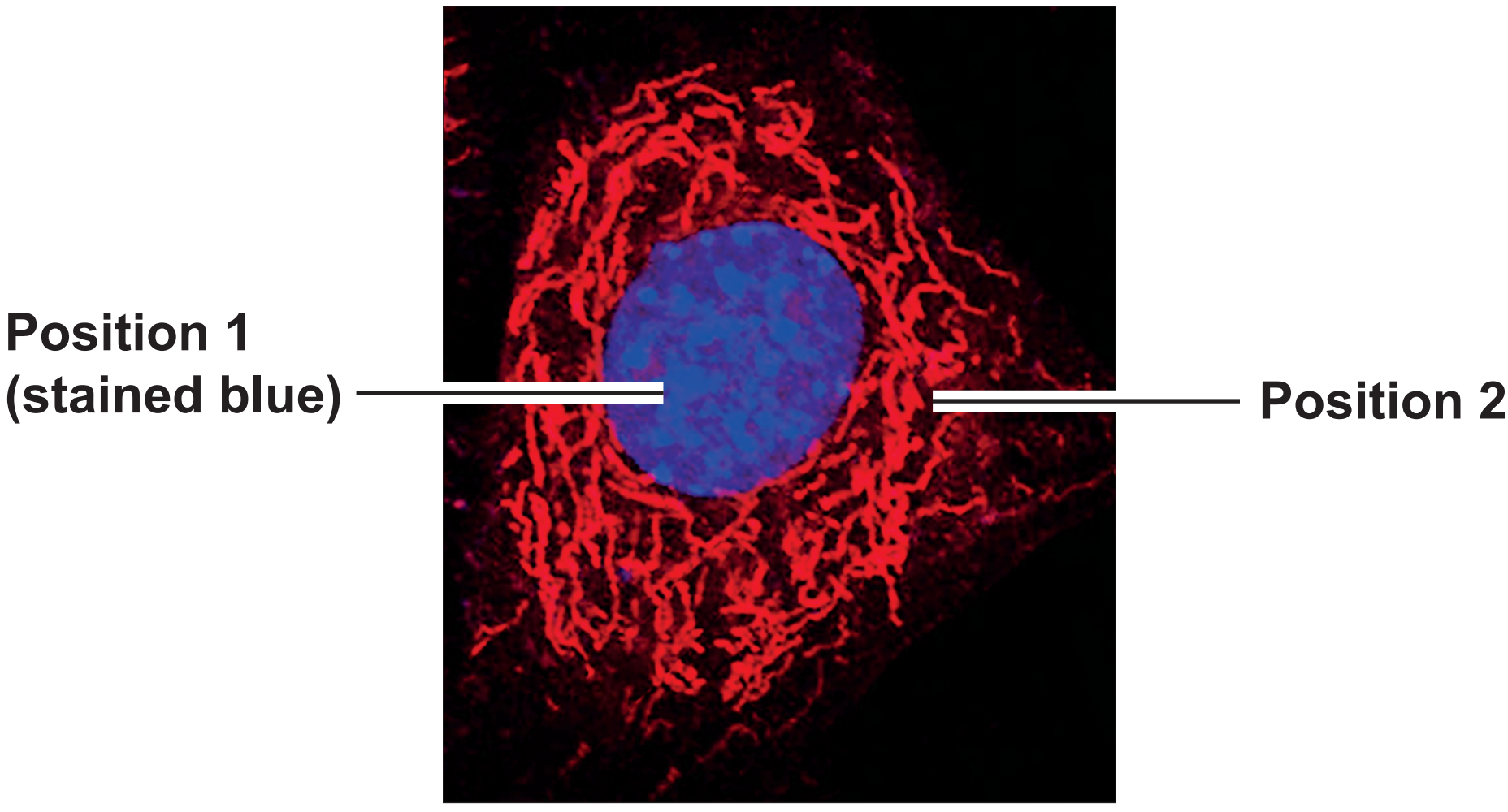


TABLE 7.2

Nucleic acid	Percentage of nucleic acid		
	Position 1	Position 2	Total
DNA	99•9	0•1	100•0
RNA	34•2	65•8	100•0