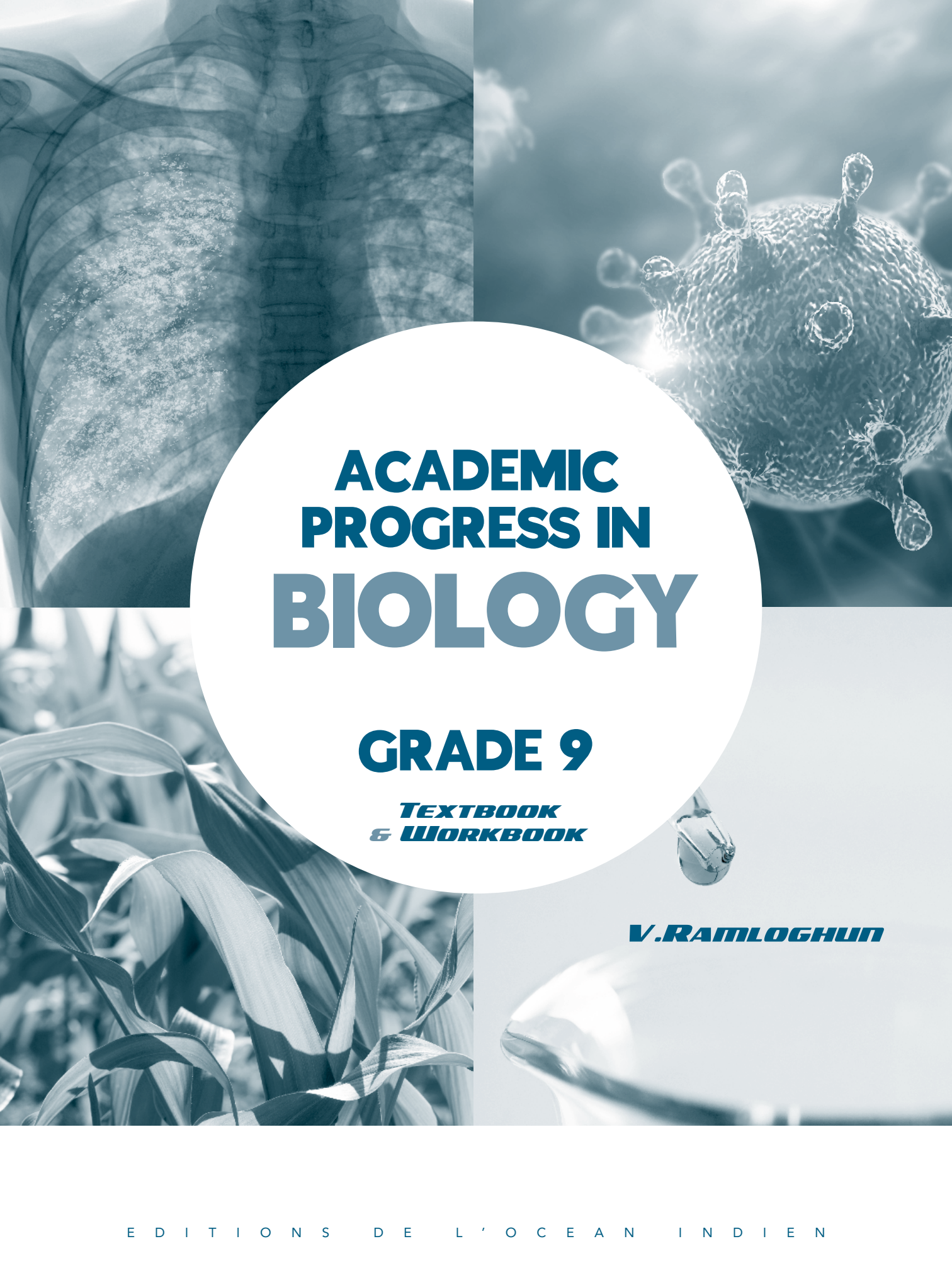




ACADEMIC PROGRESS IN BIOLOGY

GRADE 9

***TEXTBOOK
& WORKBOOK***

V. RAMLOGHUN

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The specimen and exam papers from the Mauritius Examination Syndicate (MES) for National Certificate of Education has been inserted with the purpose to guide students in their preparations for the exams.

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Preface

Academic progress in Grade 9 Biology has been specially written for the Grade 9 level in accordance with the latest syllabus changes. It is both a textbook and a workbook.

The book covers the whole syllabus in detail with diagrams to illustrate ideas more clearly. This book is also a workbook covering a wide range of questions in each topic be it multiple choice or structured questions.

The book has a chapter written to cover special skills such as plotting of line graph, histogram & barchart, drawing skills, calculation of magnification and calculation of area of an irregular object. These skills will build up confidence in students so that they are better prepared for their exams.

It is hoped that both teachers and students will fully benefit from this book.

V. RAMLOGHUN

BSC, Mphil

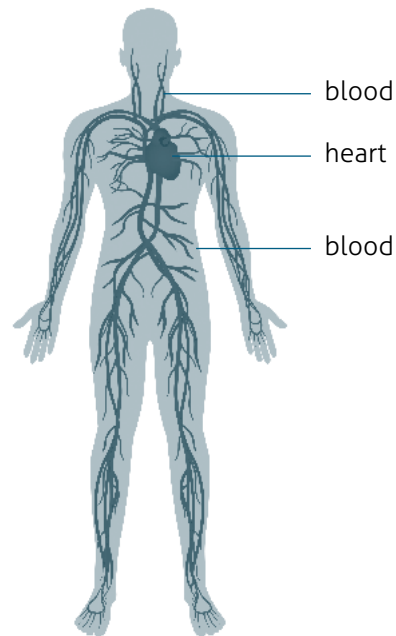
UNIT B1

Blood circulatory system

Learning Objectives

- Recognise that the human circulatory system consists of blood, heart and blood vessels.
- List the components of blood and state the function of red blood cell, white blood cell, platelets and blood plasma.
- Outline the structure and function of blood vessels (arteries, veins and capillaries) in terms of wall elasticity, thickness and size of lumen.
- Recognise that heart pumps blood throughout the body.
- Investigate and state the effect of physical activity on pulse rate.
- Locate a pulse point.
- Show an awareness of the different examples of cardiovascular diseases such as stroke, heart attack and hypertension.
- Interpret data from graphs related to cardiovascular diseases.

- The blood circulatory system carries oxygen, nutrients, and other substances throughout the body. It also removes wastes.
- It consists of three components: **blood**, **blood vessels** and **heart**.
- Blood is a **living fluid tissue** mostly made of a pale-yellow liquid called plasma which carries various substances dissolved in it.
- Blood also contains three types of blood cells: **red blood cells**, **white blood cells** and **blood platelets**.



The blood circulatory system

- Red blood cells carry oxygen around the body in the form of oxyhaemoglobin.
- There are two types of white blood cells: phagocyte and lymphocyte.
- Phagocytes engulf and digest bacteria and germs to destroy them.
- Lymphocytes produce substances called antibodies which destroy specific disease-causing organisms such as bacteria, viruses and other germs.
- Blood platelets are formed of pieces of blood cells. They clot blood to stop loss of blood during bleeding.

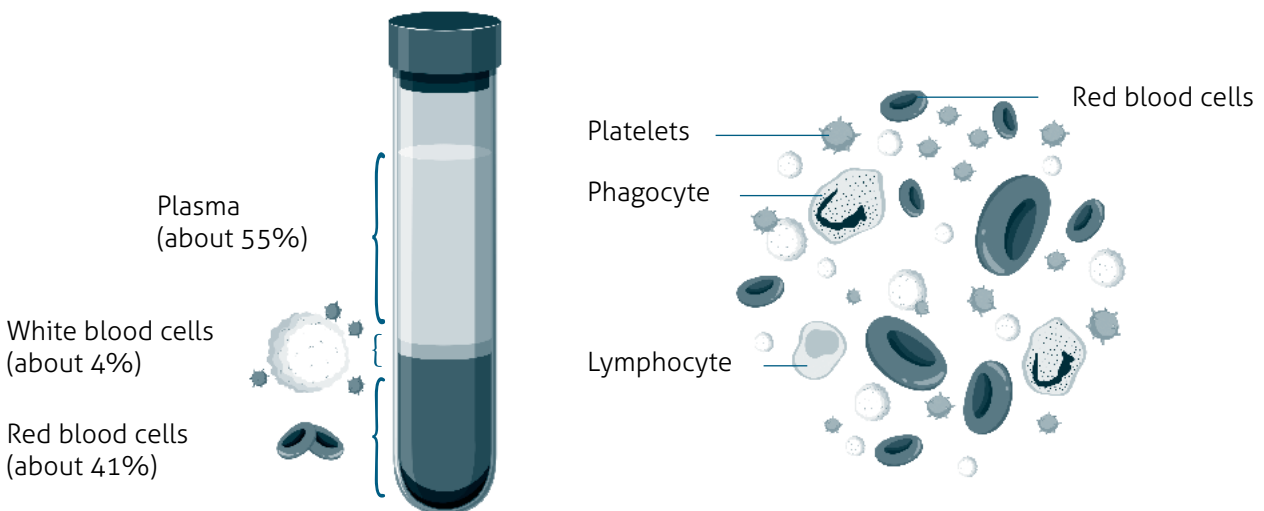
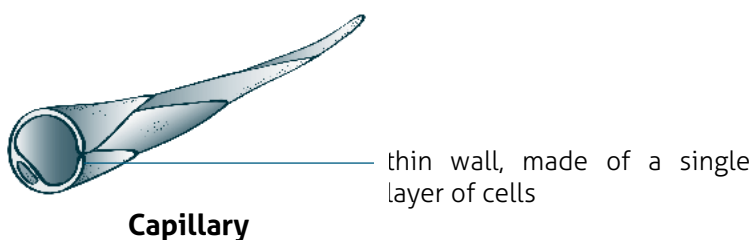
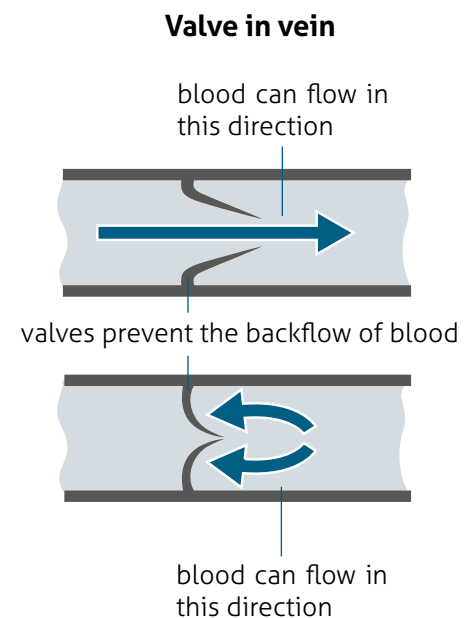
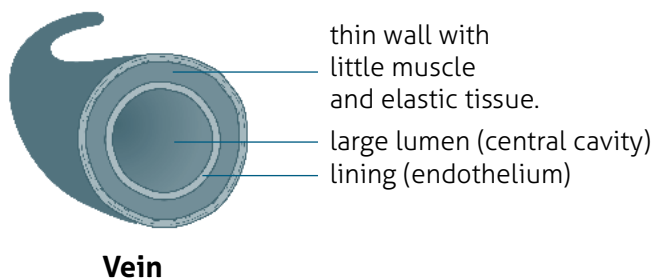
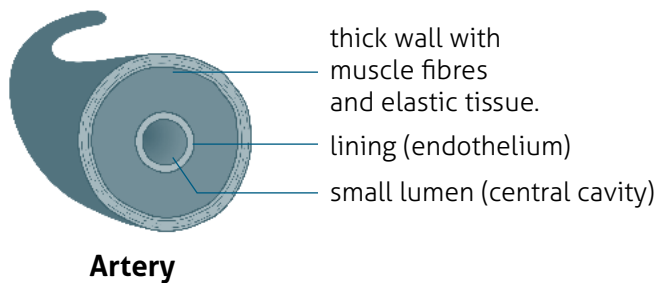


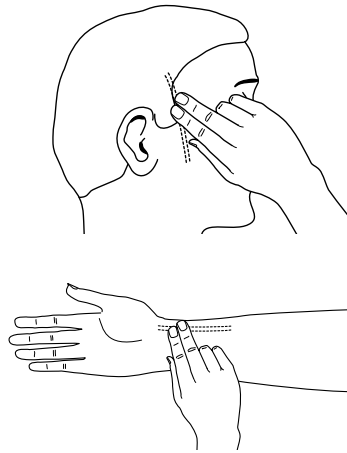
Diagram of a blood smear

- Blood vessels are tube like organs which transport blood.
- There are three main types of blood vessels: arteries, veins and capillaries.
- Arteries transport blood away from the heart.
- Veins transport blood towards the heart.
- Capillaries connect arteries and veins and carry blood as close as possible to body tissues. The table below gives some comparison among the three blood vessels.

Features	Artery	Capillary	Vein
Wall elasticity	More elastic	Not elastic	Less elastic
Wall thickness	Thick wall to resist high blood pressure	Negligible, wall made of only one cell thick	Thin wall
Size of lumen	Small	Very small	Large

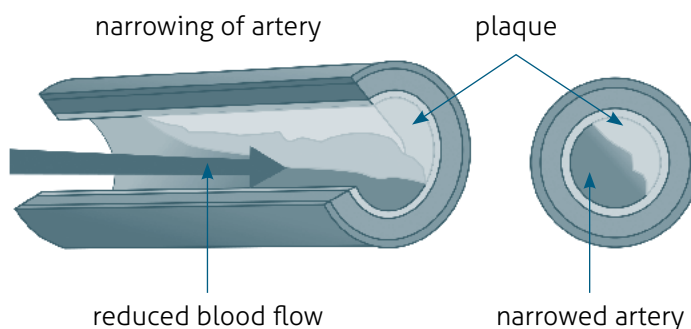


- The heart is a muscular pump which pumps blood throughout the body. It ensures continuous flow of blood to the whole body.
- The beating of the heart causes blood to flow under high pressure in the arteries. This pressure slightly stretches the wall of the artery. This stretching is known as pulse.
- Pulses can be felt at pulse points. There are several pulse points in our body e.g., the wrist, the neck and the temple.
- Pulse rate is the number of pulses in one minute. It is a direct indicator of heartbeat.



Pulse points (temple and wrist)

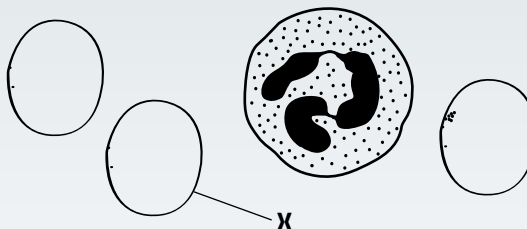
- During physical activity the heart beats faster to pump blood to the muscles for contraction and as a result the pulse rate increases.
- The greater the intensity of physical exercise, the greater is the pulse rate.
- Cardiovascular diseases occur when the blood circulatory system does not function properly. This happens when the arteries are blocked by fats and cholesterol deposits causing obstruction to the flow of blood.



- Stroke, heart attack and hypertension are examples of cardiovascular diseases.
- The risk of cardiovascular diseases increases with smoking, stress, lack of exercise, obesity, large intake of salt and taking unhealthy food.
- Cardiovascular diseases can be prevented by relaxation, regular exercise, taking a balanced diet and avoiding unhealthy food.

Multiple choice questions

1. The diagram shows human blood cells, as seen under a microscope.

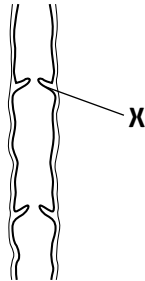


What is the function of cell **X**?

- A. to carry glucose
 - ☒ B. to carry oxygen
 - C. to defend against disease
 - D. to make the blood clot
2. Which factor increases the risk of developing stroke?
- A. low fat diet
 - B. regular exercise
 - C. relaxation
 - ☒ D. smoking
3. The table shows the concentration of red blood cells, white blood cells and platelets in the blood of four patients.
- Which patient is most likely to suffer from low red blood cell count and will find it difficult to form a blood clot?

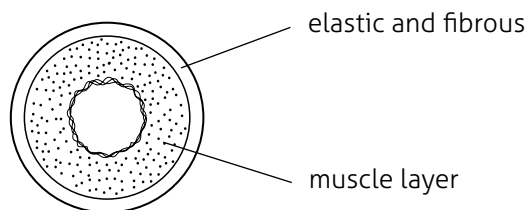
	red blood cells /cells per mm ³	white blood cells /cells per mm ³	platelets /cells per mm ³
A.	2 525 000	643	296 000
B.	2 275 000	756	27 500
C.	7 250 000	650	275 000
☒ D.	2 525 000	405	25 000

4. The diagram shows a section of a human vein.



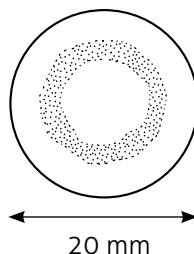
What is the function of the part labelled X?

- ☒ A. to make sure the blood does not flow back
 - B. to make sure the blood stops while flowing
 - C. to make sure the blood flows at high speed
 - D. to make sure the blood flows back
5. The diagram shows a cross-section through a human blood vessel.



Which type of blood vessel does the diagram show?

- ☒ A. an artery
 - B. a capillary
 - C. a vein
 - D. a ventricle
6. A student draws a red blood cell. The drawing is 20 mm in diameter.



This red blood cell is actually 0.008 mm in diameter

What is the magnification of the cell shown in the drawing?

- A. $\times 40$
- B. $\times 250$
- ☒ C. $\times 2500$
- D. $\times 40\,000$

7. Which blood vessel has the thinnest wall?
- A. Artery
 - B. Vein
 - ☒ C. Capillary
 - D. Arteriole
8. The liquid part of blood is known as
- A. Water
 - B. Sap
 - ☒ C. Plasma
 - D. Platelet
9. Which factor contributes to heart attack?
- A. Doing physical exercise regularly
 - ☒ B. Taking stress
 - C. Eating a balanced diet
 - D. Avoiding saturated fats
10. Which is a pulse point in the human body?
- A. The toe
 - ☒ B. Wrist
 - C. Ear
 - D. Nose
11. Which organ ensures continuous flow of blood in the body?
- A. Stomach
 - ☒ B. Heart
 - C. Intestine
 - D. Liver
12. Which part of the blood contains haemoglobin?
- A. Plasma
 - B. Platelets
 - ☒ C. Red blood cells
 - D. White blood cells
13. Which blood cell contain a large round nucleus?
- A. Phagocyte
 - ☒ B. Lymphocyte
 - C. Platelet
 - D. Red blood cell

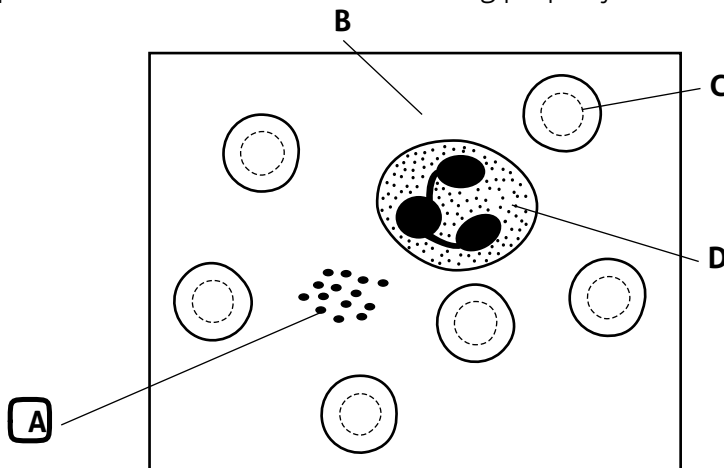
14. What happens to the pulse rate during exercise?

- A. Decreases
- B. Stays the same
- ☒ C. Increases
- D. Becomes zero

15. The diagram shows human blood as seen through a light microscope.

A person's blood is unable to clot.

Which component of the blood is not functioning properly?



16. Which structure contains valves?

- ☒ A. Vein
- B. Artery
- C. Capillary
- D. Phagocyte

17. The diagram shows a human blood cell.



What is its function?

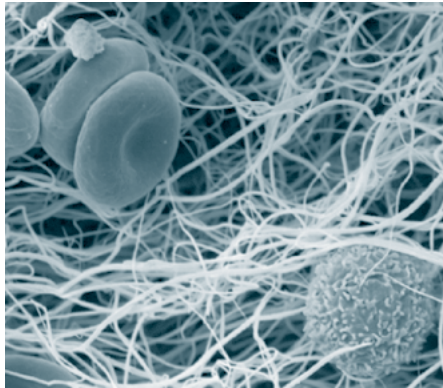
- ☒ A. defence against disease
- B. blood clotting
- C. oxygen transport
- D. carry food

18. Group the cells in order of increasing size.

Red blood cell, platelet, phagocyte

- A. red blood → cell → phagocyte → platelet
- B. phagocyte → red blood cell → platelet
- C. phagocyte → platelet → red blood cell
- ☒ D. platelet → red blood cell → phagocyte

19. What does the diagram below shows?



- A. red blood cell carrying oxygen
 - ☒ B. blood clotting
 - C. white blood cell destroying bacteria
 - D. plasma flowing
20. Which blood vessel has the largest lumen?
- A. Artery
 - B. Capillary
 - ☒ C. Vein
 - D. Arteriole

Structured
questions

1. Fill in the table below by inserting the function of each component of blood.

Component	Function
Red blood cell	transports oxygen around the body
Phagocyte	engulfs bacteria and germs
Lymphocyte	produces antibodies to protect the body against diseases
Platelet	initiates blood clotting
Plasma	transports nutrients around the body

2. State whether the following statements are true or false.

Statements	T/F
1. Arteries carry blood away from the heart.	T
2. Heart is a muscular pump which ensures continuous blood flow in the body.	T
3. Capillary has the thickest wall to resist blood pressure.	F
4. A pulse can be felt at the temple of the head.	T
5. Hypertension is caused by relaxation.	F
6. Lymphocyte engulfs bacteria.	F
7. Platelets carry oxygen.	F
8. Valve prevent backflow of blood.	T
9. Obesity increases the risk of developing cardiovascular diseases.	T
10. Plasma is the liquid part of blood.	T

3. Match each word with its correct function.

Statements	Function
Heart	Carries blood away from the heart.
Lymphocyte	Prevents backflow of blood.
Vein	Pumps blood to the whole body.
Valve	Produces antibodies.
Artery	Carries blood towards the heart.

4. Fill the spaces with the words given below

capillary plasma pressure white blood cell pulse
 smoking circulatory chambers deposit red blood cell
 stroke

- The **circulatory** system consists of blood, blood vessels and the heart.
- Stroke** is a type of cardiovascular disease.
- An artery carries blood at high **pressure**.
- A **red blood cell** is smaller than a **white blood cell**.
- The lumen of a **capillary** has same size as that of a red blood cell.
- Plasma** is a pale yellow liquid.
- The **pulse** rate increases during exercise.
- The human heart has four **chambers**.
- Smoking** increases the risk of heart attack.
- Fats **deposit** can block the lumen of arteries.

5. a. Fig. 5.1 shows simplified cross-sections of three different types of blood vessel. The artery has been identified.



Fig. 5.1

- i. Complete Fig. 5.1 to identify the other two types of blood vessel.
- ii. List two ways how the structure of a capillary differs from a vein.
 1. A capillary has a thin wall made of only one cell while an artery has a thicker wall.
 2. A capillary has a very small lumen while an artery has a larger lumen.

- b. Fig. 5.2 shows red blood cells.



Fig. 5.2

- i. State the function of red blood cells.
they carry oxygen around the body.
- ii. A component of the blood is needed to clot the blood.
State the name of this component.
blood platelets

Fig. 5.3 shows a diagram of a different type of human blood cell. The diameter **XY** in the diagram of the cell is 30 mm.

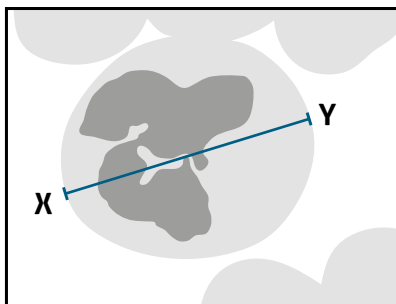


Fig. 5.3

The actual diameter **XY** of the cell is 0.015 mm.
Calculate the magnification of the cell shown in Fig. 5.3.

$$30 \text{ mm} / 0.015 \text{ mm} = 2000$$

Magnification = **X** **2000**

6. a. Fig. 6.1 shows a cross-section of a vein and Fig. 6.2 shows a longitudinal section of the vein.

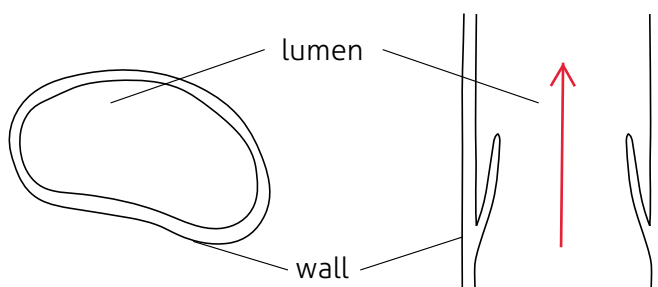


Fig. 6.1

Fig. 6.2

- i. Describe **two** features, visible in Fig. 6.1 and Fig. 6.2, which show that this blood vessel is a vein.

1. **The wall is thin.**
.....
.....
2. **The blood vessel contains valve.**
.....
It has a large lumen. (additional answer)
.....

ii. Draw an arrow on Fig. 6.2 to show the direction of blood flow in this vein.

- b. Two groups of students, **A** and **B**, investigated how running affected their pulse rates. There were three students, **1**, **2** and **3**, in each group.

They measured their pulse rates when at rest, then all ran the same distance and immediately measured their pulse rates again. The results are shown in Fig. 6.3.

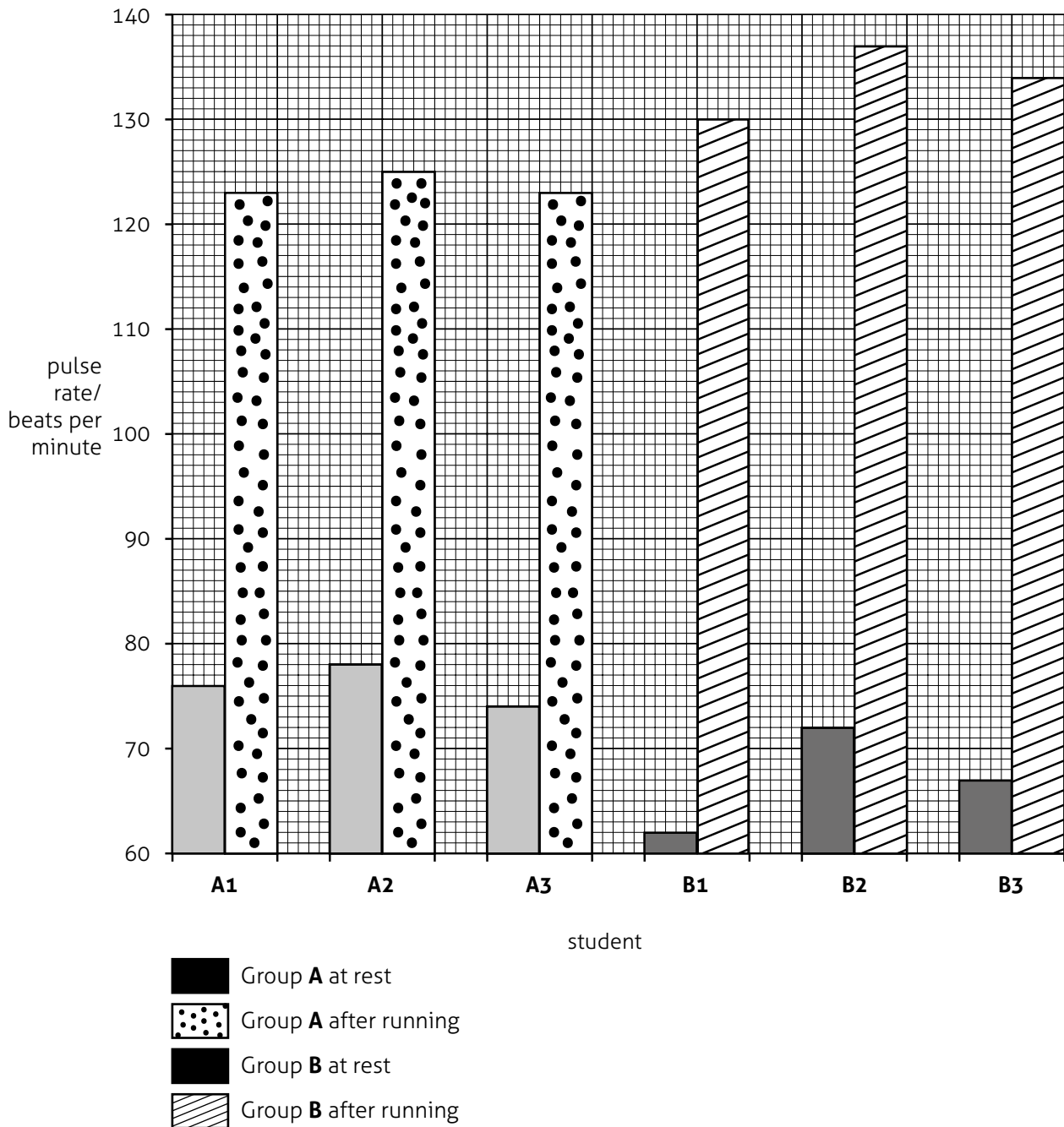


Fig. 6.3

- i. Suggest a method the students could use to measure their pulse rates.

Place two fingers on the wrist and count the number of pulse in 60 seconds.

- ii. Calculate the average pulse rate for the three students in group **A** when at rest.

$$\frac{(76 + 78 + 74)}{3} = 76$$

76 beats per minute

- iii. State the effect of running on the pulse rate using the information in Fig. 6.3.

Running increases the pulse rates.

- iv. State which student had the greatest change in pulse rate after running.

Student B2

- v. Describe **two** differences in the data between group **A** and group **B** in Fig. 6.3.

1. The pulse rates at rest in group A students are higher than that of group B

2. The pulse rates of group B students after running are higher than that of group A students.

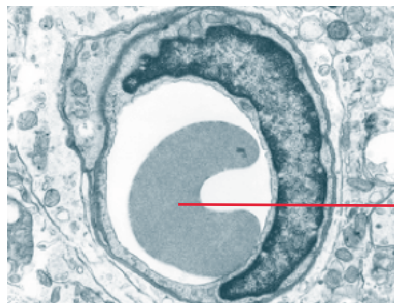
7. Blood circulates round the body in arteries, veins and capillaries.

- a. Place ticks (✓) in the correct boxes in Table 7.1 to show the features of vein.

structure and function	vein
	capillaries
has large lumen	✓
carries blood to the heart	✓
wall is thin	✓
carries blood at low pressure	✓
has gaps through which plasma comes out	

Table 7.1

- b. Fig. 7.1 shows a photomicrograph of a capillary with one red blood cell passing through it.



→ red blood cell

Fig. 7.1

- i. Identify and label the red blood cell in the Fig. 7.1.
- ii. State the function of the red blood cells shown in Fig. 7.1.

It carries oxygen around the body.

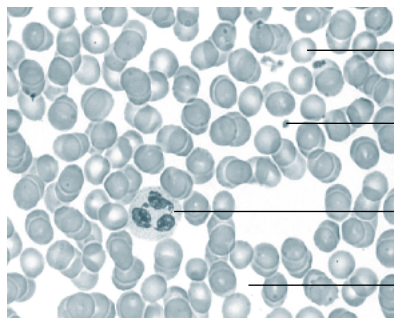
- iii. White blood cells are one component of blood.
State the name of the **two** types of white blood cells.

1. Phagocytes

2. Lymphocytes

8. Figure 8.1 shows the photograph of a normal blood sample.

Magnification
x 100



A

B

C

D

Fig. 8.1

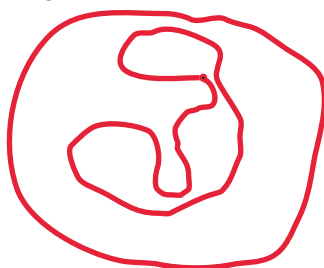
- b. Identify the parts of the blood labelled A, B and C.

A Red blood cell

- B Blood platelet
- C White blood cell (phagocyte)

c. Give **two** differences, shown in the photograph, between A and C.

1. A is smaller than C.
 2. Nucleus is absent in A while it is present in C.
- ii. Make a large drawing of the cell labelled **C** in Fig. 8.1.



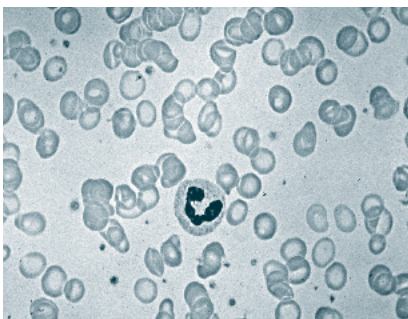
Part **D** is a liquid that transports different food substances around the body.

d. Name **two other** substances which are transported in this part of the blood.

1. vitamins
2. oxygen

e. The photograph shows a blood sample from a person suffering from a blood disorder.

Magnification
x 100



i. Describe **one** difference between this sample and the normal blood sample.

This sample contains fewer red blood cells.

9. a. The picture in figure 9.1 shows three different blood vessels X, Y and Z, seen using a light microscope.

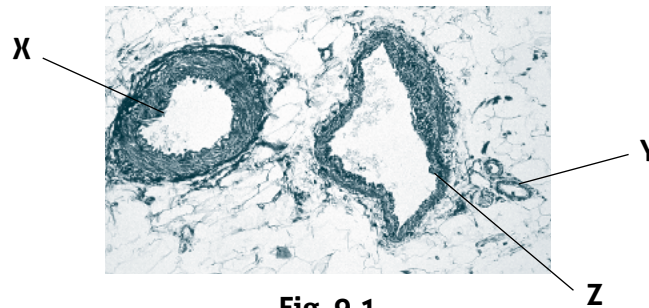


Fig. 9.1

- i. Compare blood vessels X and Z and describe the differences that can be seen in the picture.

X has a thicker wall than Z

X has a smaller lumen than Z

X has a circular shape while Z has an irregular shape

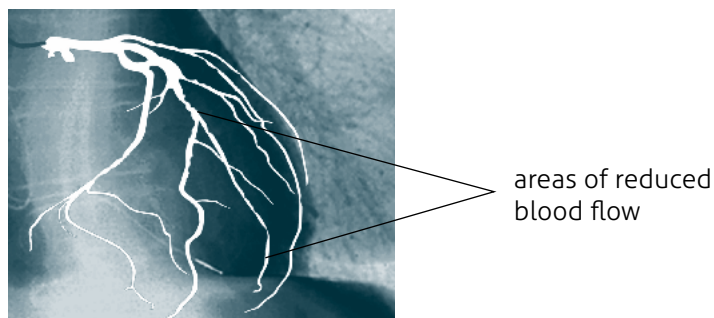
- ii. Blood vessel Y is a capillary. Explain how the structure of a capillary is adapted to its function.

A capillary has very thin wall with only one cell thick through which exchange can take place. It is very small so that it exposes a large surface area for rapid

diffusion of nutrients and gases.

- b. An X-ray was taken of the arteries on the surface of the heart of a patient suffering from heart disease.

The white areas show the blood flow through the arteries on the surface of the heart.



- ii. What builds up in the wall of the arteries to cause reduced blood flow?

Deposit of cholesterol and fats.

iii. Give **two** factors that increase the risk of this type of damage to the arteries.

1. **Stress, lack of exercise**

2. **Smoking, food containing saturated fats**

10. A group of students investigated how their pulse rate changed during exercise. They measured their resting pulse rate before they started exercising.

a. i. Describe how to measure pulse rate.

Place two fingers on the wrist and count the number of pulse in 60 seconds.

ii. Explain why it is important to measure the **resting** pulse rate.

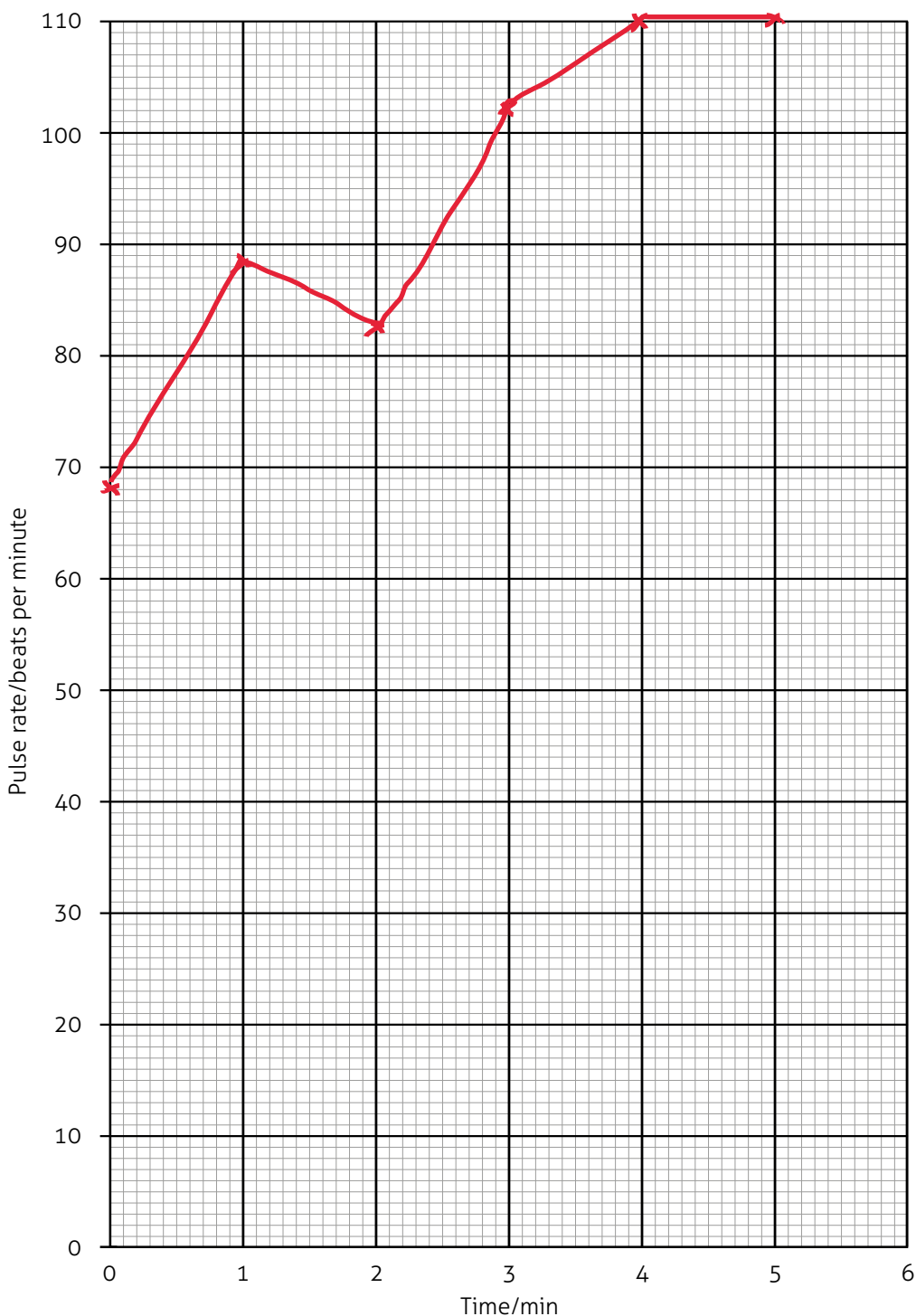
To be able to compare the pulse rate after exercise. The resting pulse rate acts as a reference point.

b. The students exercised for 1 minute and then measured their pulse rate. They immediately exercised for another minute and measured their pulse rate again. They continued exercising and measured their pulse rate every minute up to a total of 5 minutes.

Table 10.1 shows the results for one of the students.

Time/min	Pulse rate/beats per minute
0 (resting)	68
1	88
2	82
3	102
4	110
5	110

- i. Plot a line graph of the results shown.



- ii. Describe the trend shown by the pulse rate as time increases.

As time increases the pulse rate increases for the first minute then decreases and finally increases for the next two minutes. From 4 to 5 minutes, the pulse rate remains constant.

- d. Fig. 10.1 shows a cross-section of a human coronary artery as seen with a microscope.

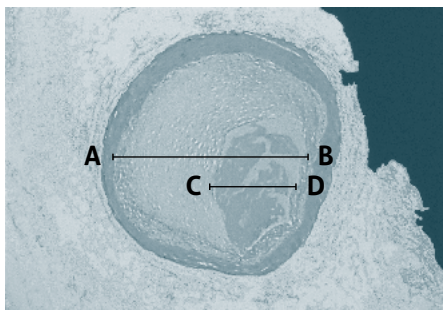


Fig. 10.1

The actual internal diameter of this coronary artery at AB is 4.3 mm.

- i. Measure the length of AB in Fig. 10.1.

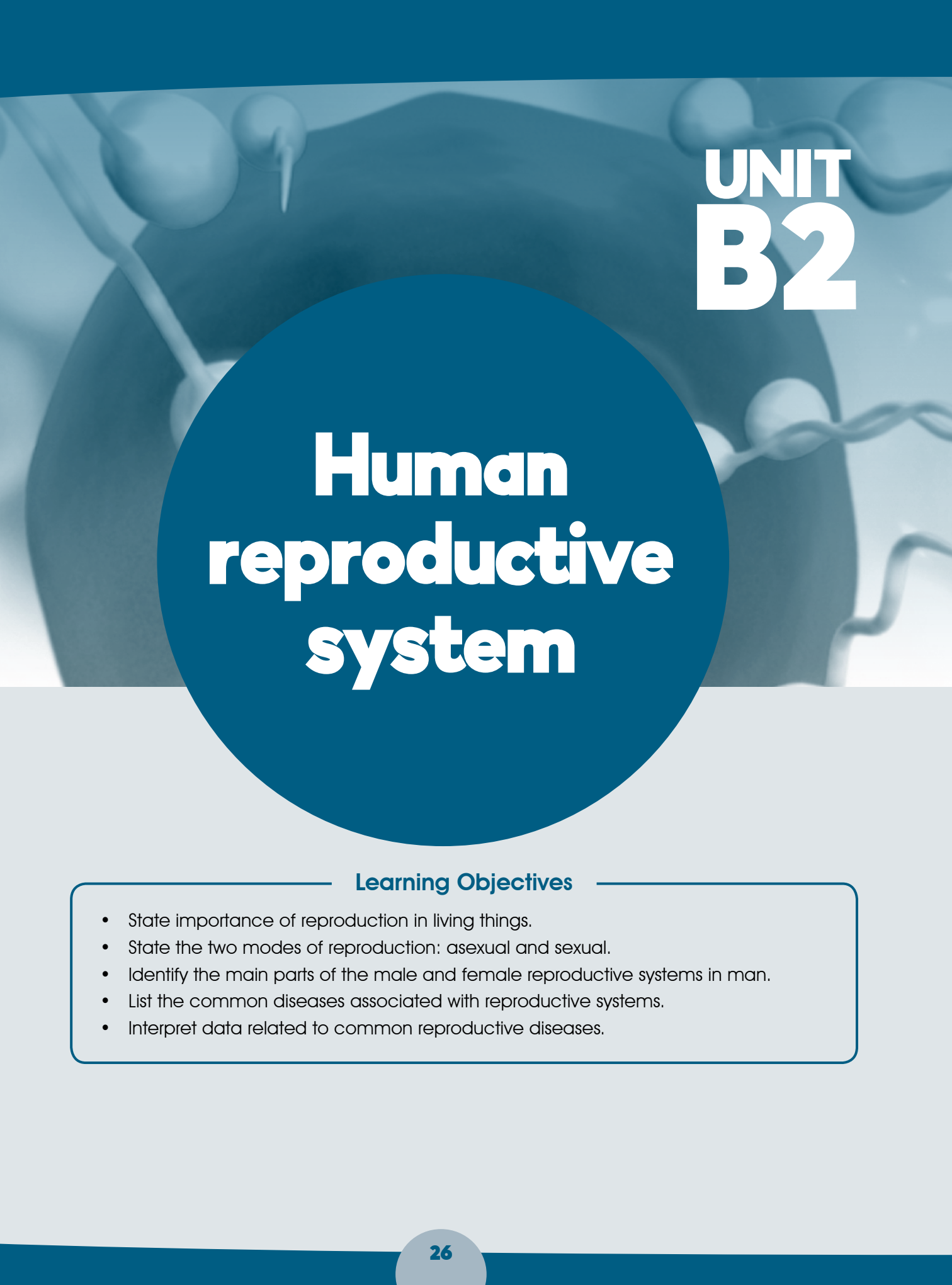
length of AB in Fig. 10.130..... mm

Calculate the magnification of Fig. 10.1.

Show your working.

$$\frac{30 \text{ mm}}{4.3 \text{ mm}}$$

magnification X6.9.....



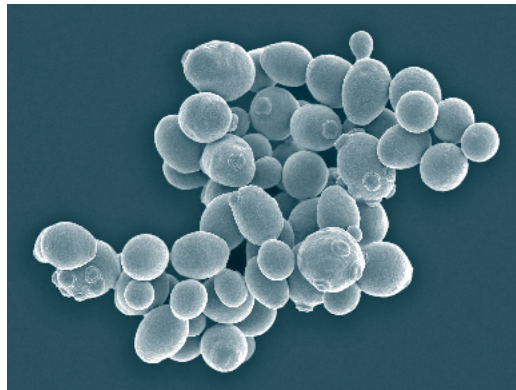
UNIT B2

Human reproductive system

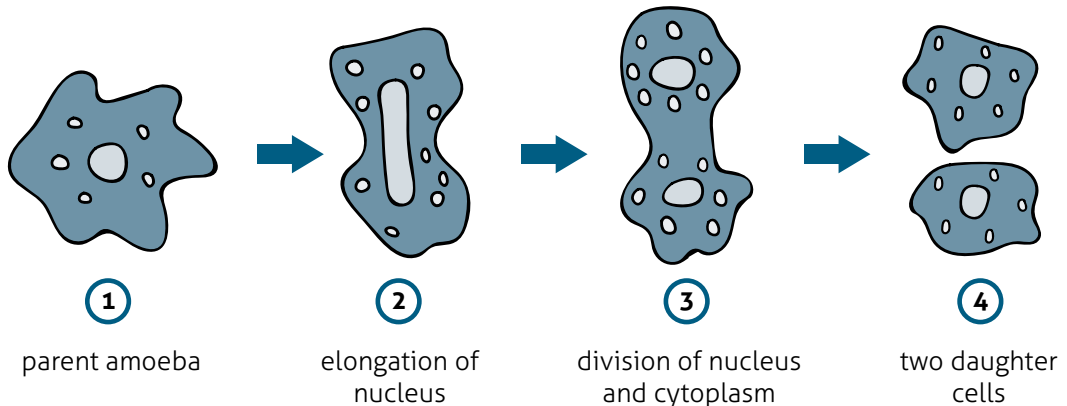
Learning Objectives

- State importance of reproduction in living things.
- State the two modes of reproduction: asexual and sexual.
- Identify the main parts of the male and female reproductive systems in man.
- List the common diseases associated with reproductive systems.
- Interpret data related to common reproductive diseases.

- Reproduction is the production of new individuals from existing parents.
- It is important to ensure the continuation of species.
- There are two types of reproduction: asexual and sexual.
- Asexual reproduction is the production of new individuals from only one parent.
- All the offspring (new individuals) produced are identical. They have the same genes and same characteristics.

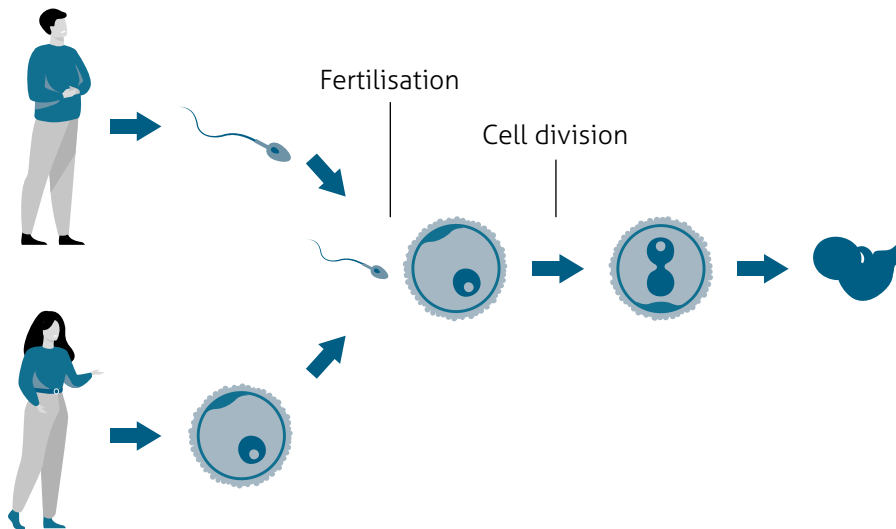


Yeast reproducing by asexual reproduction



Binary fission in amoeba (sexual reproduction)

- Sexual reproduction is the production of new individuals by the fusion of male and female gametes.
- Male gametes are produced in the male reproductive system while female gamete is produced in the female reproductive system.



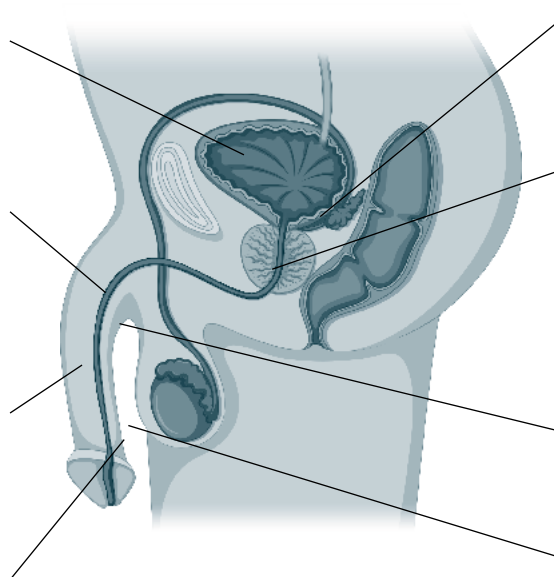
Fusion of male and female gametes

Urinary bladder – a sac which stores urine temporarily.

Urethra – a tube which carries urine and semen.

Penis – the organ which releases sperms in the vagina during sexual intercourse.

Scrotum – a sac which encloses the testis.



Seminal vesicle

Prostate gland

Sperm duct – muscular tube that carries sperm from testis to urethra.

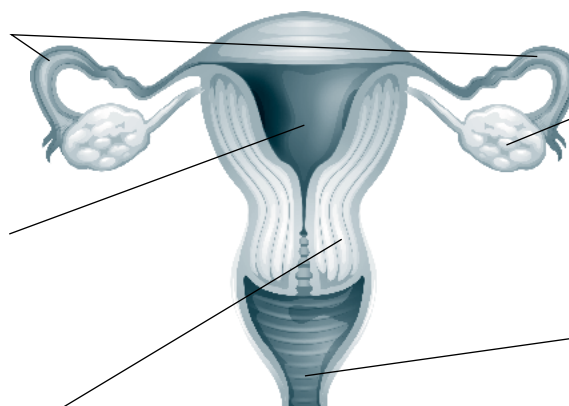
Testis – organ which produces sperm.

Male reproductive system

Fallopian tube or oviduct – a sac which stores urine temporarily.

Uterus – it is the organ where the embryo implants, nourishes itself, grows and develops into a foetus.

Cervix – it is the neck of the uterus, it separates the vagina and the uterus.

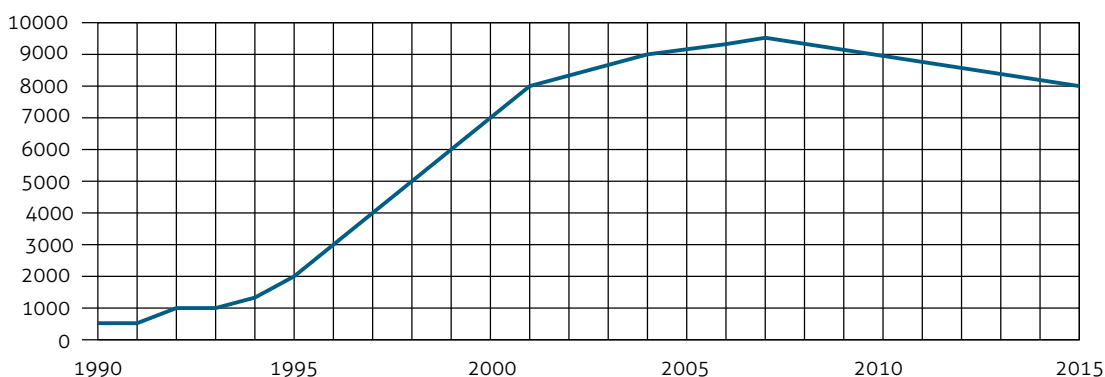


Ovary – it is the organ which produces ova (sing. ovum) and releases in the oviduct. It is found in pair on both side of the uterus.

Vagina – also known as the birth canal, where sperms are deposited by the penis during sexual intercourse.

Female reproductive system

- There are many diseases which are associated with the reproductive systems. These diseases are known as sexually transmitted diseases or STDs.
- Examples of STDs include syphilis, AIDS (Acquired Immunodeficiency Syndrome), gonorrhoea, herpes among others.
- STDs are communicable diseases as they can be transmitted from an infected to an uninfected person.
- They can be caused by germs called viruses, bacteria or fungi.
- The number of people infected with STDs are compiled every year and displayed in the form of graphs.
- Graphs provided many information about the trend of the disease in a country at specific periods of the year.
- Graphs from several consecutive years in a country can be compared and interpreted.
- Graphs can also be compared from different countries.
- One such graph is given below.



People living with HIV in Mauritius

- From this graph it can be seen that from 1990 to 2007 the number of people infected with HIV keeps on increasing from 500 to 8500. From 2007 to 2015 the number slightly decreases from 8500 to 7000.

- This is how a graph is described. Always start with the x-axis first and then observe what happens on the y-axis, then describe.
- If asked to explain then you can say that due to mass sensitisation and education people are more aware about STDs and taking precautions hence the number of people is declining from 2007 onwards.
- You can also add that nowadays there are better health facilities and people are getting better treatment.
- This is how a graph about STD can be interpreted.
- Remember the data can be displayed in the form of a bar chart but don't worry the trend remains the same and the explanation as well.

Multiple choice questions

Encircle the best answer.

1. What is asexual reproduction?
A. The fusion of male and female gametes
B. Production of individuals from two parents
C. Production of twins from one two parents
D. Production of identical individuals from a single parent
2. Which of these organisms reproduce asexually?
A. Horse
B. Mango tree
C. Human
D. Bacteria
3. How many parents are involved in asexual reproduction?
A. 1
B. 2
C. 3
D. 4
4. Sexual reproduction involves
A. The fusion of two male gametes
B. The division of one cell into two daughter cells
C. The fusion of male and female gametes
D. The fusion of two female gametes

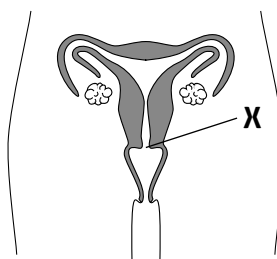
5. Which part of the female reproductive system produces egg cells?

- A. Oviduct
- B. Testis
- C. Sperm duct
- D. Ovary**

6. What are the characteristics of asexual reproduction?

	fusion of gametes	individual identical
A.	✓	✓
B.	✓	✗
C.	✗	✓
D.	✗	✗

7. The diagram shows a human female's reproductive organs.



What is the name of structure **X**?

- A. cervix**
- B. ovary
- C. oviduct
- D. uterus

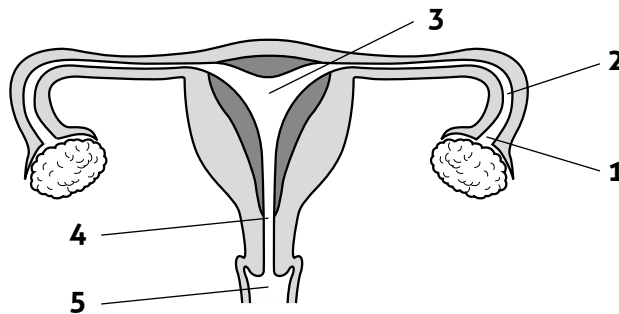
8. The diagram shows a plant that is producing small plantlets.



Which statement about the plantlets is correct?

- A. They are different from the parent plant.
- B. They are identical to the parent plant.**
- C. They are produced as a result of the fusion of gametes.
- D. They are produced by fertilisation of flowers.

9. Which one is a sexually transmitted disease?
- A. Influenza
 - B. Malaria
 - C. AIDS**
 - D. Diabetes
10. What is the name of the membranous sac which protects the testis?
- A. Ovary
 - B. Fallopian tube
 - C. Scrotum**
 - D. Sperm duct
11. The diagram shows the female reproductive system.



At which labelled points are sperms and ova released?

	sperms	ova
A.	3	2
B.	4	2
C.	5	1
D.	5	3

Questions 12-14 refer to the table which shows the number of cases of syphilis and AIDS in four consecutive years.

	syphilis	AIDS
2010	68	568
2011	74	401
2013	88	520
2014	55	260

12. What happens to the number of cases in each disease in 2011 compared to 2010?

	increase	decrease
A.	✓	✓
B.	✓	✗
C.	✗	✓
D.	✗	✗

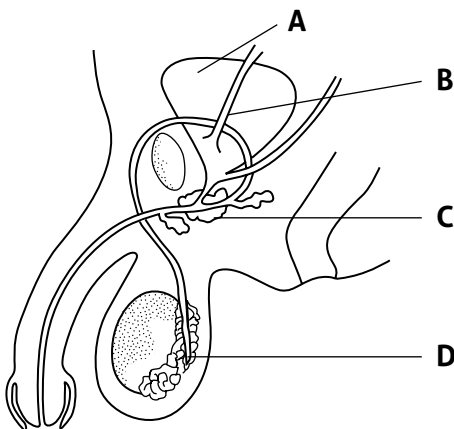
13. What was the decrease in the number of AIDS cases from 2013 to 2014?

- A. 308
B. 167
C. 260
D. 119

14. In which year was the decrease in both syphilis and AIDS greatest?

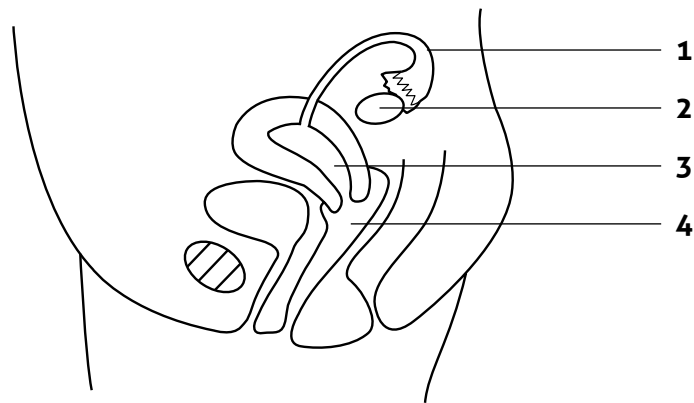
- A. 2014**
B. 2011
C. 2010
D. 2012

Questions 15-17 refer to the male reproductive system shown below



15. Which part shows the prostate gland? **C**
16. Where is urine stored? **A**
17. Which tube carries sperms from the testis? **D**

Questions 18 and 19 refer to the diagram which shows a side view of the female reproductive system.



18. In which region are sperms released during sexual intercourse and where does fertilization usually take place?

	sperm released	fertilisation
A.	3	1
B.	3	2
C.	4	1
D.	4	2

19. Where are ova produced in the female reproductive tract?

- A. 1
B. 2
 C. 3
 D. 4

20. What is the path taken by sperm cells before release from the body?

- A. testis → urethra → prostate glans
 B. urethra → prostate gland → testis
C. testis → sperm duct → urethra
 D. sperm duct → testis → urethra

Structured questions

1. Copy and complete each sentence, using words from the list. You may use each word once, more than once or not at all.

egg embryo fertilisation gametes ovary oviduct uterus

- a. Sperm cells and egg cells are**gametes**..... .
- b. The fusion of the nucleus of a sperm cell and the nucleus of an egg cell is called **fertilisation**..... .
- c. A zygote is formed in the**oviduct**..... .
- d. A zygote divides repeatedly to form an**embryo**..... .

2. State whether the statements are **True** or **False**.

Statements	T/F
i. The male gamete is known as sperm.	T
ii. Fertilisation takes place in the uterus.	F
iii. Diabetes is a sexually transmitted disease.	F
iv. Scrotum is part of the male reproductive system.	T
v. Sperms are deposited in the vagina.	T
vi. Strawberry reproduces asexually.	T
vii. Individuals produced from sexual reproduction are identical.	F
viii. The fusion of male and female gametes occurs in sexual reproduction.	T
ix. The foetus develops in the oviduct.	F
x. Urethra carries both urine and semen.	T

3. a. Match the words with their corresponding function.

Sperm duct	A sexually transmitted disease.
Fallopian tube	An organ where sperms are produced.
Ovaries	A tube which carries semen.
Testis	A tube where fertilisation occurs.
Syphilis	An organ which produces female gametes.

- b. There are several different stages during the process of human reproduction. Some of these stages are shown in the box.

baby

embryo

fetus

gametes

zygote

Complete the table by writing the name of the stages in each empty box to show the correct order in which they occur.

Order	Name of stage
1	gamete
2	zygote
3	embryo
4	fetus
5	baby

4. Fig. 4.1 shows the structure of the female reproductive organ.

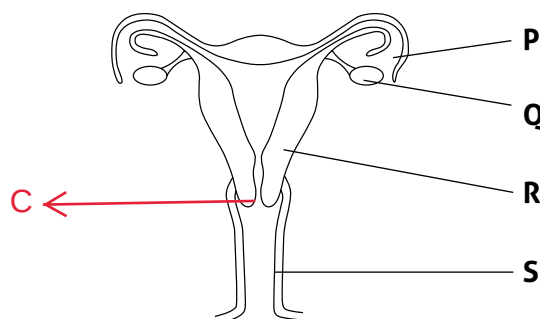


Fig. 4.1

- a. i. Name the structures labelled in the diagram.

P Oviduct or fallopian tube

Q Ovary

R **Uterus**

S **Vagina**

- ii. Use the letter **C** to label the cervix.
 iii. Describe the function of the oviduct and of the uterus.

the oviduct

Fertilisation takes place in the oviduct.

the uterus

The fetus develops in the uterus.

5. Fig. 5.1 shows the male reproductive system.

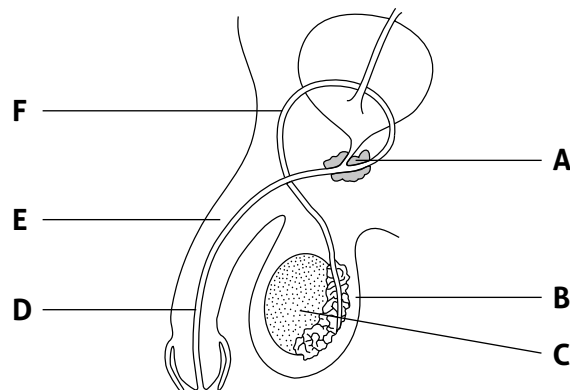


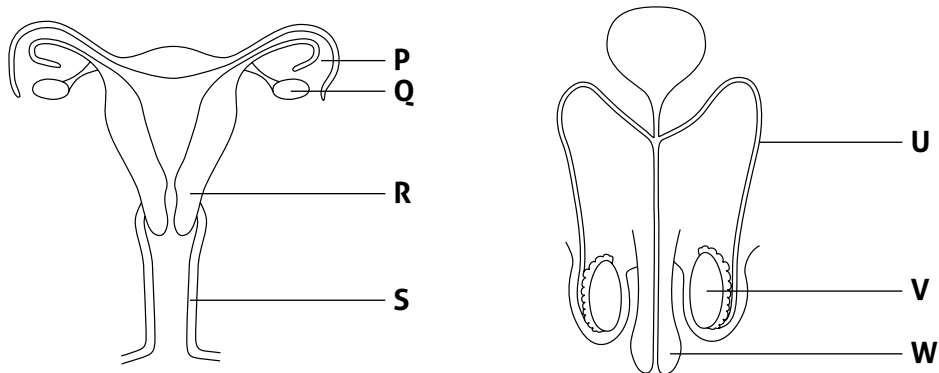
Fig. 5.1

- a. Complete Table 5.1 by stating the letter to show which part is responsible for the function.

Function	Letter
Produces secretions which activate the sperm.	A
Produces sperm.	C
Tube which carries sperm only.	F

Table 5.1

6. The diagrams show the female and male reproductive systems.



The table lists some events that take place in the female reproductive system, some that take place in the male reproductive system, and some that take place in both.

Complete the table by giving the letter, or letters, to indicate where each event takes place. The first one has been done for you.

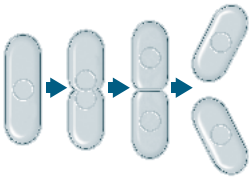
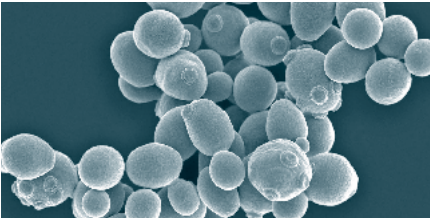
Event	Letter
Fertilisation	P
Product of gametes	Q and V
Development of foetus	R
Passage of urine	W

7. a. Plants and animals can reproduce asexually and sexually.
i. Define asexual reproduction.

It is the process by which genetically identical offspring are produced from only one parent

- ii. The table below shows photographs of organism producing new individuals. Insert a tick (✓) or (✗) cross to state whether they reproduce by sexual or asexual methods.

	Sexual	Asexual
 Fertilisation	✓	

 Bacteria dividing		✓
 Yeast budding		✓
 Hen with chicks	✓	

8. Fig. 8.1 shows the female gamete (ovum). It is surrounded by a 'jelly coat' and many cells.

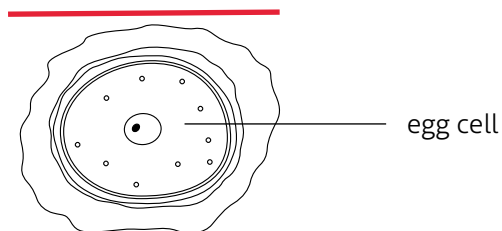
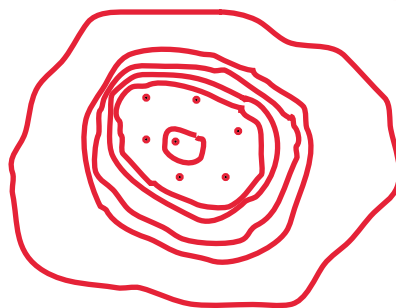


Fig 8.1

- i. Make a large drawing of the ovum shown above.



- ii. Measure the width at its widest point in Fig. 8.1.

..... 30 mm

- iii. Measure the width of your drawing at the same point.

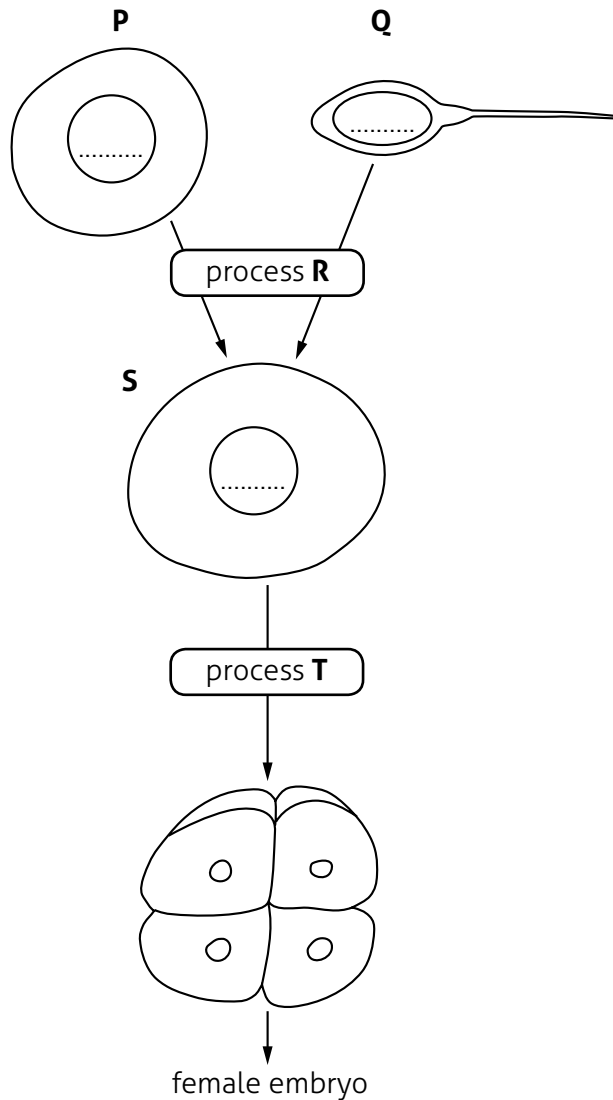
..... 50 mm

- iv. Calculate the magnification of the ovum as shown in Fig. 8.1.
Show your working and express your answer to the nearest whole number.

$$\frac{50 \text{ mm}}{30 \text{ mm}}$$

answer = X 1.7

9. a. Fig. 9.1 represents the early stages in the development of a female embryo.



not to scale

Fig. 9.1

- i. State the names of the cells labelled **P**, **Q** and **S** in Fig. 9.1.

P Egg or ovum

Q Sperm

S Zygote

- ii. State the names of processes **R** and **T** in Fig. 9.1.

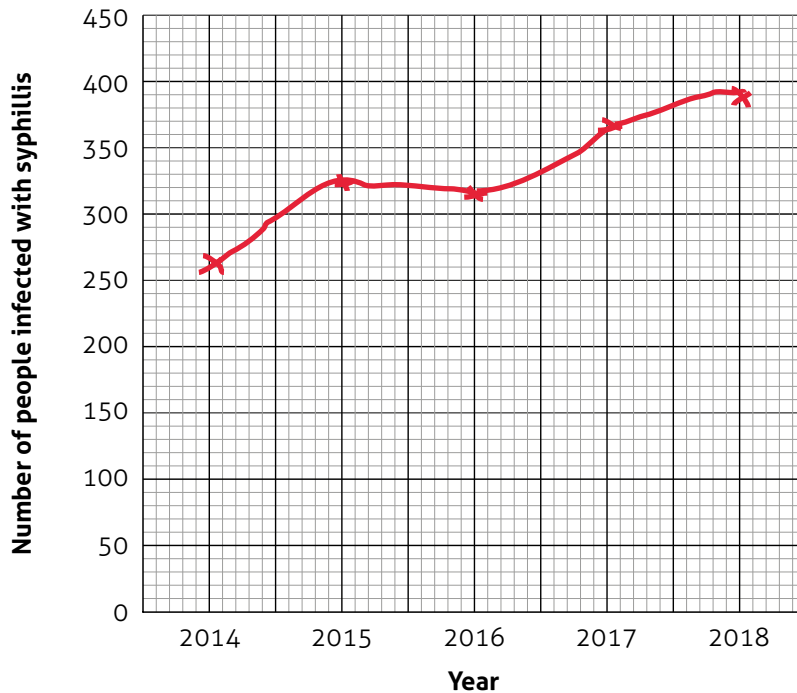
R Fertilisation

T Mitosis or cell division

- b. The table below shows the number of people infected with syphilis from 2014 to 2018 in Mauritius.

Year	2014	2015	2016	2017	2018
No. of people infected with syphilis	260	322	319	368	382

- i. Plot a line graph from the data shown in the table in the graph given below.



- ii. Describe the trend in the number of people infected with syphilis from 2014-2018.

As the years increases, teh number of people infected with syphilis also increases

- iii. How many more people are infected with syphilis in 2018 compared to 2014?

382 people are infected in 2018 compared to 260 in 2014. An increase of 122.

- iv. Which type of disease is syphilis?

Sexually transmitted disease (STD)

10. a. Fig. 10.1 is a diagram of the human female reproductive system.

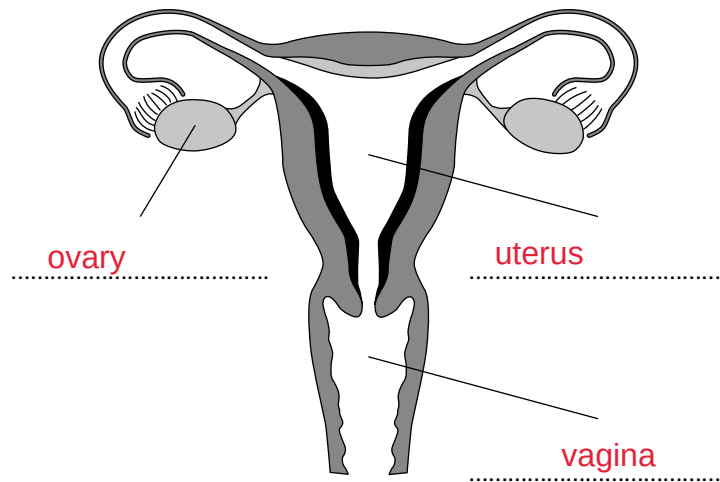


Fig. 10.1

- i. Label Fig. 10.1 using words from the list.
Each word may be used once, more than once or not at all.

cervix

ovary

oviduct

uterus

vagina

- ii. The boxes on the left are parts of the human female reproductive system. The boxes on the right are the functions of the different parts.
Draw one line from each part to its function.

Part	Function
ovary	site of fertilisation
oviduct	receives penis during sexual intercourse
uterus	releases female gametes
vagina	where fetus develops

- b. HIV is a sexually transmitted disease often spread through unprotected sexual intercourse.

Fig. 10.2 is a graph showing the number of new infections of HIV in a country between 1999 and 2009.

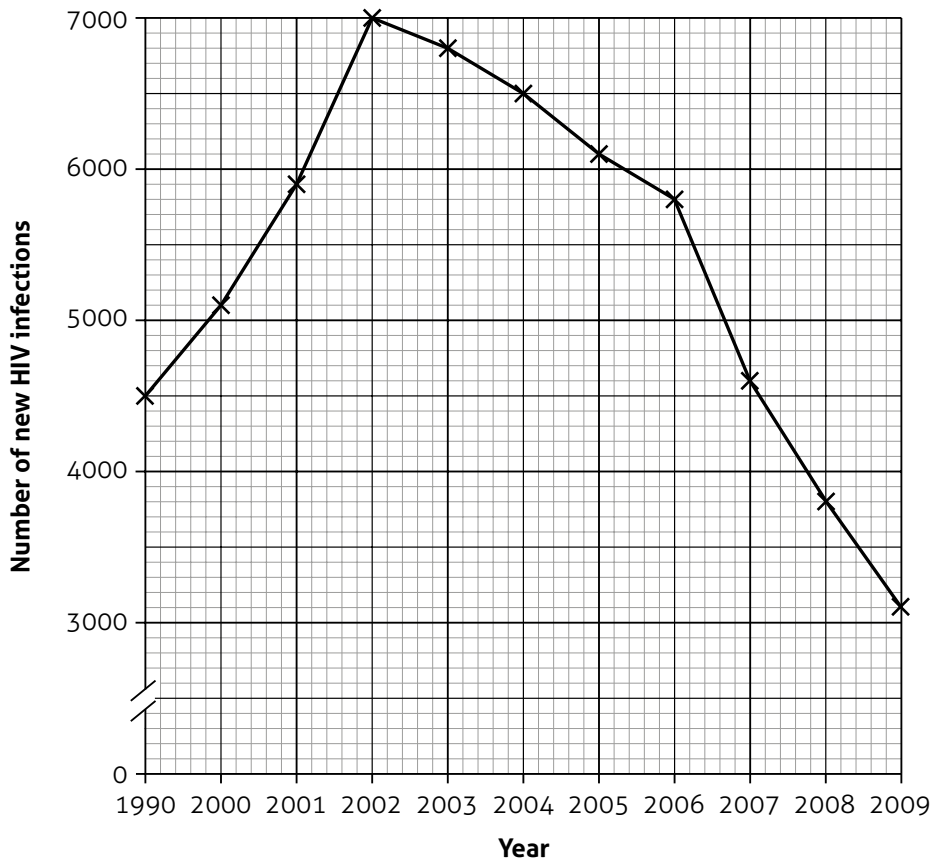


Fig. 10.2

- i. Calculate the overall change in the number of new HIV infections between 1999 and 2009.

$$4500 - 3100 = 1400$$

- ii. Describe the trends in new HIV infections between 1999 and 2009. Use data to support your answer.

The number of new HIV infections increases steadily from 1999 to 2002 from 4500 to 7000. From 2002 to 2009 the number decreases steadily from 7000

to 3100.



UNIT B3

Biodiversity

Learning Objectives

- Give a simple definition of biodiversity.
- Explain the importance of biodiversity to mankind.
- Use quadrats to estimate and record the number of species in a given ecosystem.
- Show an understanding that biodiversity can be affected by natural calamities such as cyclones and droughts.
- Discuss ways by which human activities such as deforestation, pollution, degradation of habitat, invasive alien species, global warming can have a negative impact on biodiversity.
- Suggest solutions to the above threats.

- Biodiversity is a short form for biological diversity which means the variety of living organisms in the world or in any defined area.
- Biodiversity provides many benefits to man, which can be grouped into three categories:
 - i. resources
 - ii. ecological
 - iii. socio-economic
 - iv. inspiration of cultural traditions

1. Resources



1. Food
2. Medicine
3. Clothes
4. Rubber
5. Oil
6. Fibre
7. Timbre
8. Paper

2. Ecological



1. Refresh the air we breathe.
2. Provides clean water.
3. Maintains balance in nature.
4. Prevents soil erosion.
5. Microorganisms recycle waste and dead materials too make soil fertile.

3. Inspiration for cultural traditions



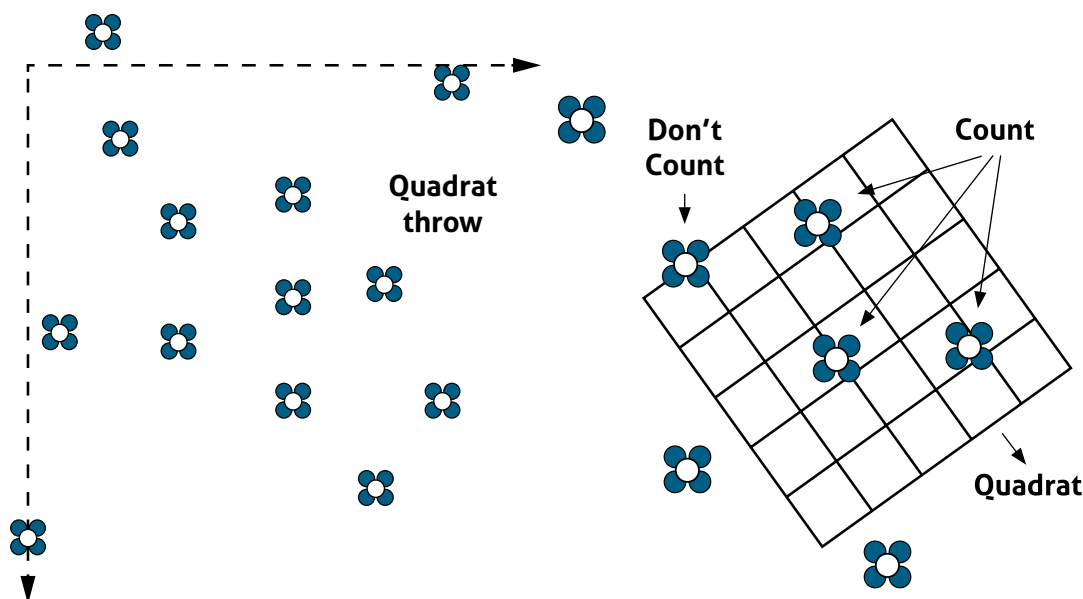
1. Ceremonies
2. Decorations
3. Music
4. Mythology

4. Socio-economic



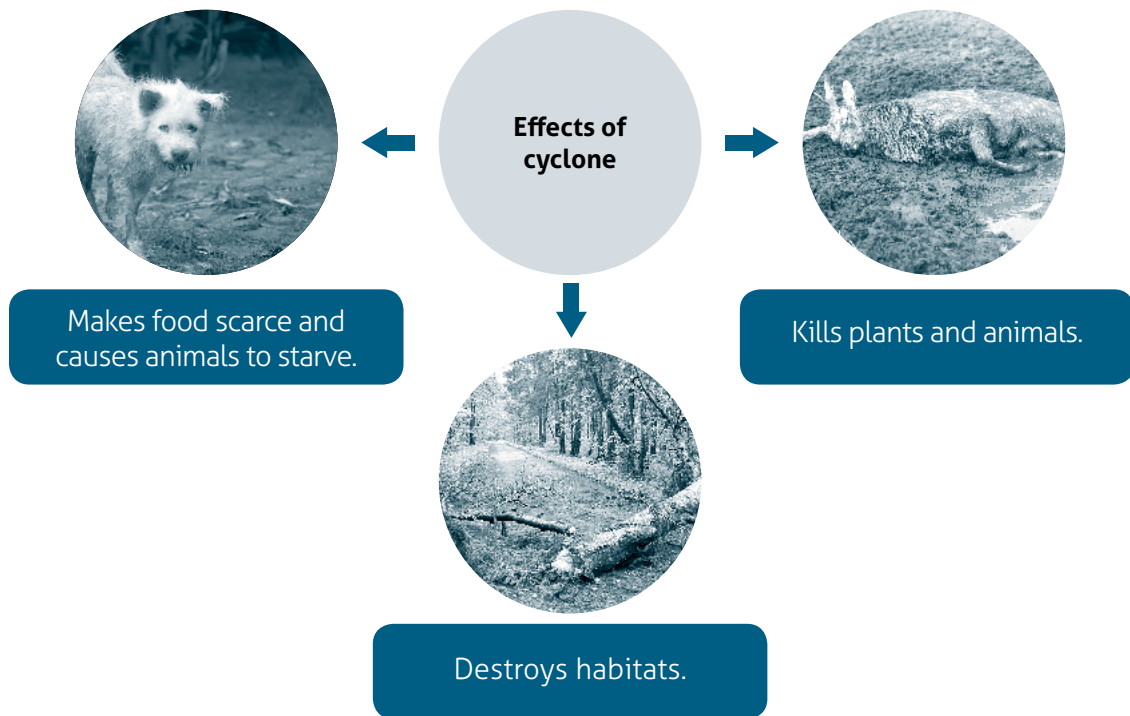
1. Opportunities for research & educat.
2. Provides natural beauty for recreation like sports, trekking.
3. Provides monetary value through ecotourism.

- The number of living organisms is very large. In order to study biodiversity, it is important to measure, count and record.
- One way to measure the number of living organisms in a given area is by using a **quadrat**.
- A quadrat is a square-shaped wooden frame which is placed at random places in a given area of an ecosystem. (**Ecosystem** is the area where living and non-living things live and interact with each other.)
- It is used to count the number of species of each organism inside the quadrat and use the value to estimate the approximate number of species in a large area.



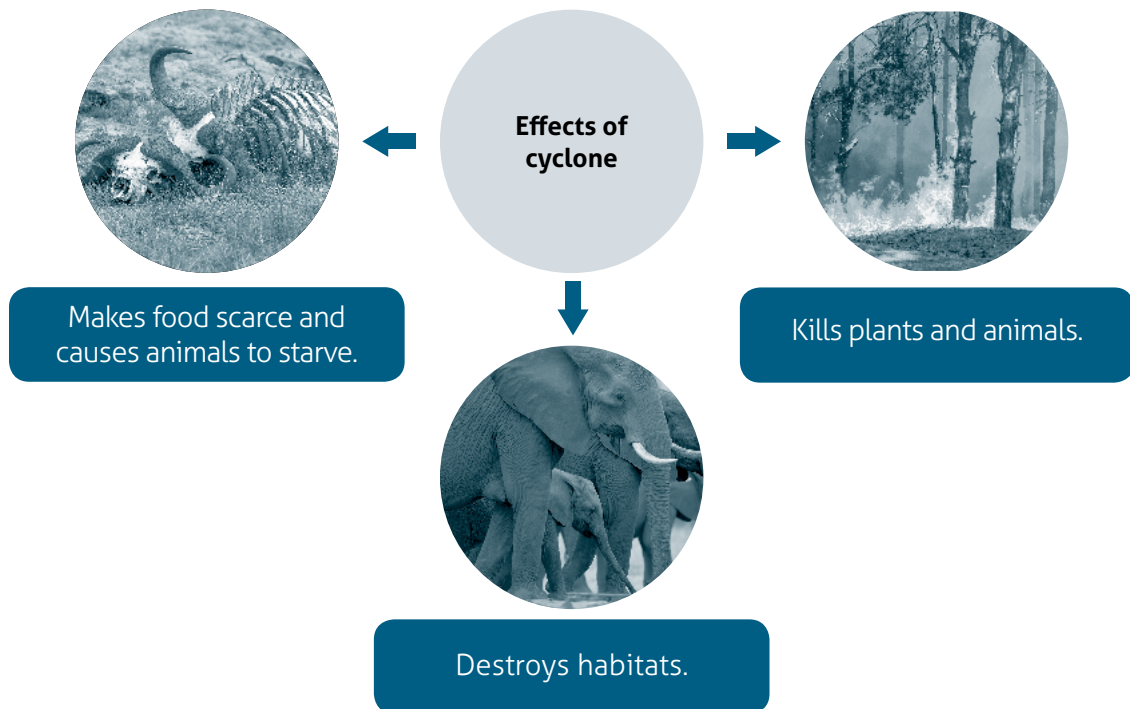
A quadrat used to sample flowers in an area

- The quadrat has to be thrown randomly so that there is no bias.
- The quadrat is thrown at several point and an average is calculated before estimation for the whole area.
- The greater the number of species in a given ecosystem, the richer is the biodiversity and it is more stable.
- Such rich biodiversity quickly stabilises after any natural calamity.
- However, if the number of species is not high then natural calamities have significant effect on biodiversity leading to a decrease in biodiversity.
- Example of natural calamities include cyclones, droughts, earthquakes, volcanoes etc.
- A cyclone can greatly damage biodiversity in the following ways:



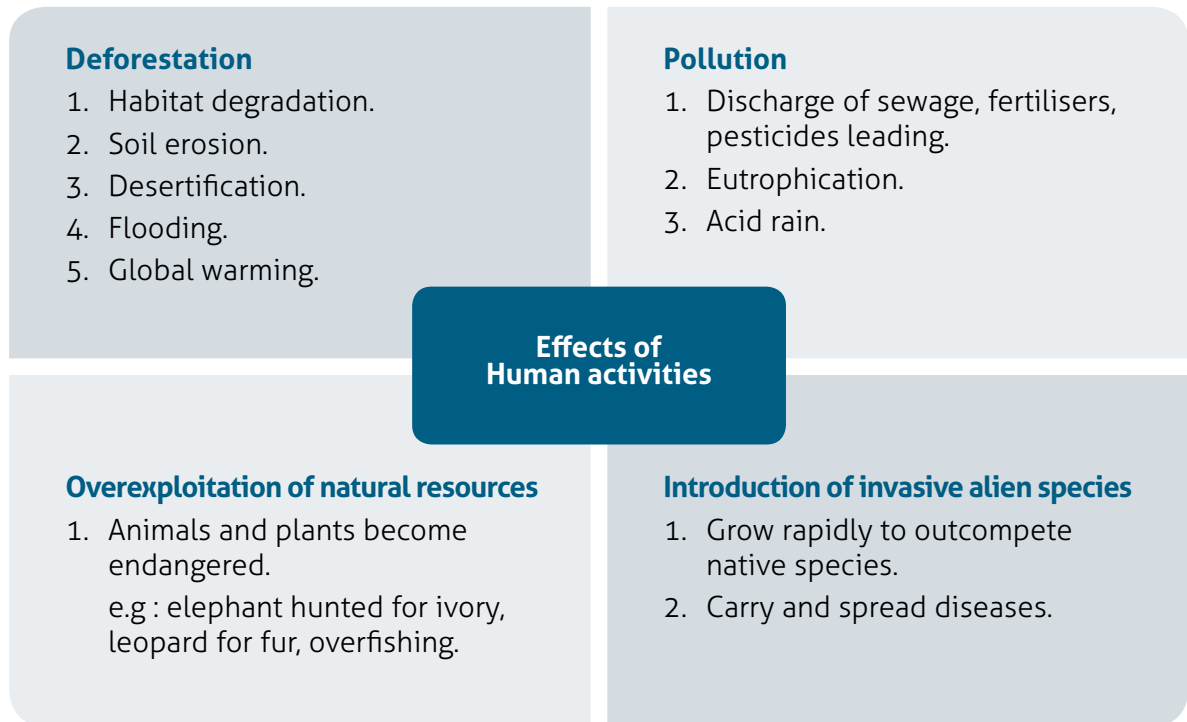
Effects of cyclone on biodiversity

- Drought is another natural calamity which causes changes in the distribution of biodiversity.



Effects of drought on biodiversity

- Human activities can greatly affect biodiversity in various ways such as:
 1. Deforestation
 2. Pollution
 3. Introduction of invasive alien species and
 4. Overexploitation of natural resources



Effects of human activities on biodiversity

- Deforestation is the clearing of forest by cutting down trees for various purposes. Unfortunately, deforestation causes more harm than benefit. It leads to
 1. Soil erosion because roots cannot hold the soil
 2. Habitats are destroyed and degraded leading to death of animals and plants
 3. Flooding in rivers
 4. Formation of deserts due to reduced rainfall
 5. Increase in temperature leading to global warming

Coral bleaching



Melting of polar ice caps



Effects of
Global warming



Decreased rainfall



Increase in forest fires

Effects of global warming on biodiversity



Habitat degradation causes separation of species into small groups which can disappear

- Pollution is the release of unwanted substances in the environment, which can cause harm to the living organisms.
- These unwanted substances are known as **pollutants**.
- There are different types of pollution all of which harm the living organisms. These are:
 1. Water pollution
 2. Land pollution
 3. Air pollution
 4. Noise pollution

Water pollution**Land pollution****Types of pollution****Noise pollution****Air pollution**

Types of pollution which affect biodiversity

- Water is polluted by the release of fertilisers, sewage, plastic bottles and various other waste substances in water. It greatly affects aquatic organisms and kill them.
- When fertiliser reach water, it causes rapid growth of algae and water plants which die and decompose depleting the water of oxygen. Aquatic organisms like fishes suffocate and die. This is called **eutrophication**.
- Land is polluted by the release of garbage on land. These garbage produce toxic gases with bad smell affecting surrounding biodiversity.
- Air is polluted by the release of toxic gases from burning of oil, coal, plastics and garbage. Gases such as sulphur dioxide, oxides of nitrogen combine with water to fall as acid rain destroying crops, forests and aquatic life.
- Loud noise produced from ships, boats, cars, lorries and various engines greatly affect animals and plants both on land and in water and reduce biodiversity.

- Alien species are organisms which have been brought and introduced from outside and area or country. They are called **exotic** or **alien** while those animals or plants which always exist in a place are called native or endemic. Alien species when introduced cause great reduction in native biodiversity in the following ways:
 1. They grow fast and outcompete the native organisms which decrease in number and may ultimately become extinct.
 2. They may carry and spread diseases which can infect and affect native organisms.
- Examples of invasive alien species include Chinese guava (goyave de chine), liane cerf, rats, mongoose, macaque, Ravenal (traveller's plant).

Chinese guava



Crab eating macaque



Traveller's plant (Ravenal)



Invasive alien species



Indian mongoose



Liane cerf



Ship rat

Invasive alien species affecting Mauritian biodiversity

- Humans have always exploited natural resources from nature to survive and lead a prosperous life. However, the growing demand for natural resources by the ever-growing human population has forced man to overexploit the resources to such an extent that they are in the verge of extinction or highly endangered.
- Examples include African elephants hunted for their ivory and meat, leopard hunted for fur, parakeet bird illegally traded as a pet, Bengal tiger hunted for trophy, overfishing of fishes to satisfy market demand etc.
- To prevent the destruction to biodiversity it is important to protect them from all these harmful activities.
- The restoration, protection and preservation of biodiversity is known as **conservation**.

- Conservation can be achieved in many ways:
 1. Monitoring areas having high significance of biodiversity.
 2. Sustainable management of forests to continue obtaining benefits from them and at the same time protect them for present and future generations.
 3. Restoration of forests by planting trees.
 4. Reduction in the use of non-biodegradable materials e.g. plastic
 5. Recycling of materials such as paper, plastic, glass and metals to remove pressure from biodiversity
 6. Reduction in all types of pollution e.g. by not dumping wastes in the environment.
 7. Banning of hunting of endangered animals.
 8. Maintaining botanical gardens and zoos to protect organisms.
 9. Captive breeding to protect and produce endangered plants and animals in zoos and protected areas. Captive breeding helps to monitor the health, food and shelter of an endangered organism. They are bred in captivity and released in the wild when ready.
 10. Controlling invasive alien species by removing them from wherever they pose threat to native species.
 11. Enforcement of legislation and law to protect native species and to punish those who do not abide to law.
 12. Sensitising people through education, posters, media and talks on the importance of conserving biodiversity

Multiple choice questions

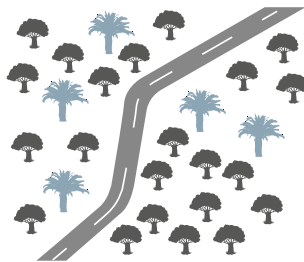
1. Biodiversity is the of organisms on earth.
 - A. number
 - ☒ B. variety
 - C. amount
 - D. study
2. Which one is a socio-economic importance of biodiversity?
 - A. provides food
 - B. provides medicine
 - ☒ C. ecotourism
 - D. maintains balance in nature

3. The number of roses in a garden can be estimated by using a
- ☒ quadrat
 - ☐ meter rule
 - ☐ ruler
 - ☐ measuring tape
4. Natural calamities such as can destroy large number of organisms.
- ☐ pollution
 - ☒ cyclone
 - ☐ alien species
 - ☐ deforestation
5. Which one is the effect of drought?
- ☒ migration of animals
 - ☐ soil erosion
 - ☐ flooding
 - ☐ degradation of habitat

6. Which row shows the effects of deforestation?

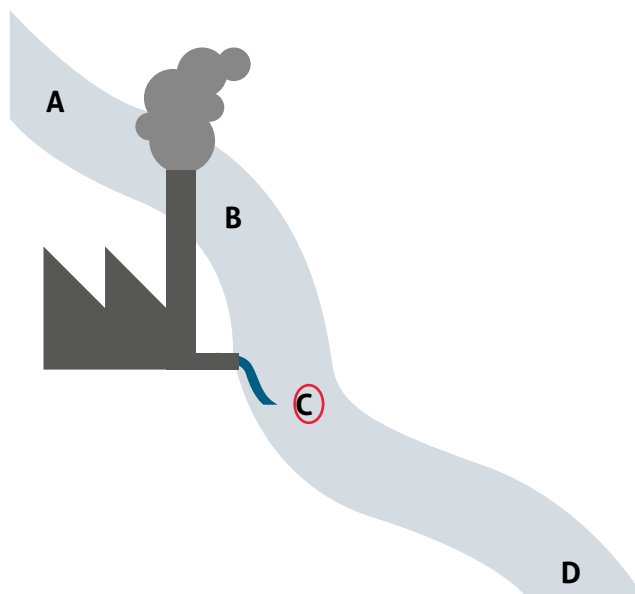
A.	global warming	pollution
☒ B.	soil erosion	global warming
C.	global warming	wildfire
D.	wildfire	soil erosion

7. What does the diagram below shows?



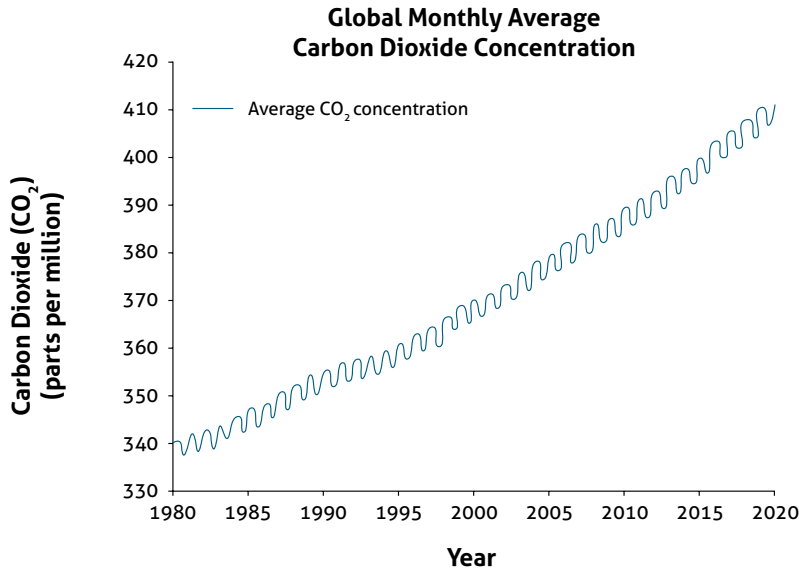
- ☐ deforestation
 - ☒ habitat degradation
 - ☐ soil erosion
 - ☐ global warming
8. Which type of pollution gives rise to acid rain?
- ☐ Land pollution
 - ☐ Water pollution
 - ☐ Noise pollution
 - ☒ Air pollution

9. Which one of these can lead to eutrophication?
- A. dumping of garbage on landfills
 - B. release of exhaust gases by industries
 - C. release of sewage in the sea**
 - D. engines rumbling on the road
10. Which of these is an alien species?
- A. Pink pigeon
 - B. Kestrel
 - C. Echo parakeet
 - D. Mongoose**
11. Why is an alien species considered invasive?
- A. It helps native species to survive
 - B. It grows slower than native species
 - C. It grows faster than native species**
 - D. It does not compete with native species
12. The diagram below shows industrial waste discharged into a nearby river.



At which point the harm caused to the aquatic organisms in the river is greatest?

13. The graph below shows the increasing level of carbon dioxide in the atmosphere over the years?



What is the trend shown in the graph?

- A. The CO₂ concentration increases then decreases over the years
 - B. The CO₂ concentration decreases over the years
 - ☒ C. The CO₂ concentration shows a gradual increase from 1980 to 2020
 - D. The CO₂ concentration fluctuates over the years
14. Which one is an effect of global warming?
- ☒ A. Rising sea levels
 - B. Starvation
 - C. Malnutrition
 - D. Competition among organisms

15. The diagram below shows a poster on biodiversity drawn by a student.



What is the poster showing?

- A. Effect of deforestation on biodiversity
- ☒ B. Effect of pollution of biodiversity
- C. Effect of alien species on biodiversity
- D. Effect of habitat fragmentation on biodiversity

16. Which one is a conservation method to protect forest?
- ☒ A. planting new trees
 - ☐ B. stop releasing sewage in rivers
 - ☐ C. reduce emission of gas from factories
 - ☐ D. stop burning fossil fuels
17. What is captive breeding?
- ☐ A. Trap animals and plants in the forest
 - ☐ B. Make animals captive to sell their meat
 - ☒ C. Take care of plants and animals in protected areas and increase their population
 - ☐ D. Breed animals and plants for commercial purpose
18. The symbol below was found in a poster showing conservation of biodiversity.



What is the meaning of this symbol?

- ☐ A. Stop pollution
 - ☐ B. Green environment
 - ☒ C. Reduce, reuse and recycle
 - ☐ D. Clean air
19. Which row shows two methods of conserving biodiversity?

☒ A.	Enforce laws	Ban hunting of endangered organisms
☐ B.	Captive breed endangered organisms	Release sewage into rivers
☐ C.	Clear forest	Sensitise the public
☐ D.	Use more plastic products	Recycle

20. What is sustainable management of forest?
- ☐ A. Stop cutting down trees in forests
 - ☐ B. To monitor and protect forests
 - ☒ C. To obtain benefits from forests and at the same time conserve them for now and future generations
 - ☐ D. Removing all alien plants and animals from a forest

Structured
questions

1. Choose the words in the list below to complete the sentences.

habitat exotic greater medicine marine quadrat
captive breeding pesticides global warming conservation

- i. The wooden frame used to sample the number of snails in a garden plot is known as a quadrat.
- ii. Conservation is the protection and preservation of biodiversity.
- iii. The greater the number of different species, the richer is the biodiversity.
- iv. Biodiversity provides many benefits to man such as medicine.
- v. Pesticides released from agricultural land can affect aquatic life.
- vi. The increasing temperature cause rise in sea level is known as global warming.
- vii. Rats are exotic species which were brought from outside the country.
- viii. Building road in between a forest causes habitat degradation.
- ix. Oil spill from wrecked ships is a severe type of marine pollution.
- x. The number of endangered animals can be increased in zoos in a process called captive breeding.

2. State whether the statements are **true (T)** or **false (F)**.

Statements	T/F
i. Traveller's plant is an alien species which affect native plants.	T
ii. Rubber is a cultural benefit derived from biodiversity.	F
iii. Forest fires occur due to drought..	T
iv. Cyclone is a human induced calamity.	F
v. Pesticides are released by factories directly into sea.	F

vi. Habitat destruction by deforestation is the main cause of species extinction.	T
vii. Release of carbon dioxide causes acid rain.	F
viii. The <i>Trochetia boutoniana</i> plant is endemic to Mauritius.	T

3. Match the following terms with their correct meaning.

Statements	Function
Liane cerf	Any substance harmful to the environment.
Recycling	Death of aquatic organisms due to lack of oxygen.
Pollutant	An alien plant affecting Mauritian biodiversity.
Eutrophication	Harvesting more than can be replaced by nature.
Overexploitation	A conservation method to protect biodiversity.

4. Name the human activity in the photographs and explain their effect on biodiversity.

Human activity	Effects
 release of plastic into river	causes suffocation and death of aquatic animals.
 overfishing	leads to overexploitation of fishes and their extinction.

	causes eutrophication and death of aquatic plants and animals.
release of sewage	

5. Fig. 5.1 shows some human activities that have an effect on the environment.

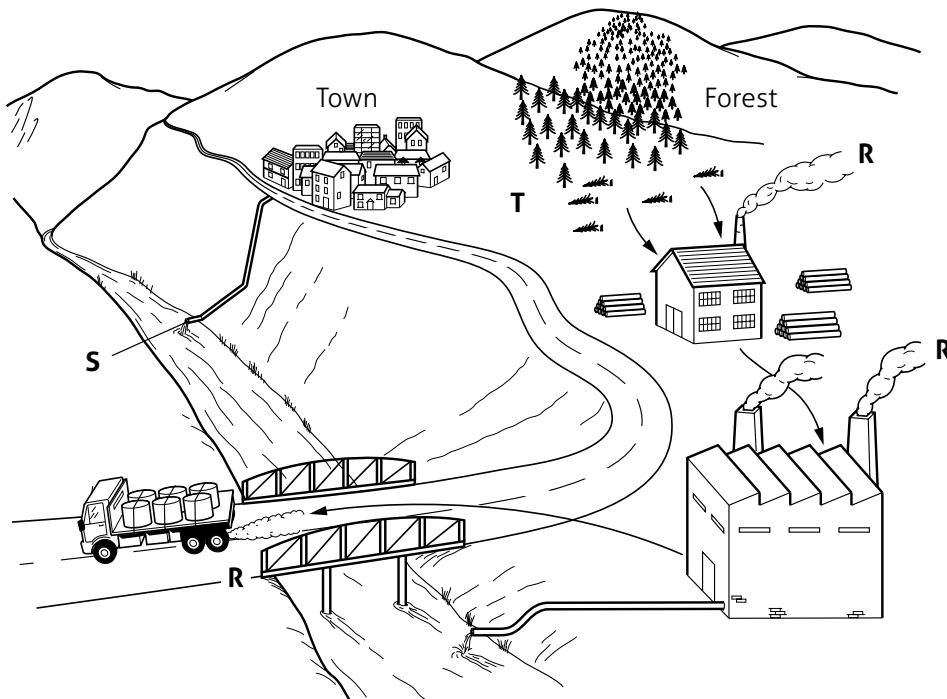


Fig. 5.1

- a. Name two gases, other than carbon dioxide, released at R that are harmful to the environment.

For each gas, state the harm that it causes.

gas 1

sulphur dioxide or oxides of nitrogen

harm caused

causes acid rain and damages forests and affects aquatic life in rivers.

gas 2

carbon monoxide

harm caused

combines with haemoglobin and prevents red blood cells to carry oxygen

- b. Explain how recycling could prevent the damage caused to the environment at **S** and **T** at **S**

If sewage is recycled, the water released will not cause death of aquatic plants and animals.

at **T**

Recycling of paper will prevent further deforestation.

6. a. The government of a country introduced a law called the Endangered Species Act. It was hoped that the Act would help to conserve species that were at risk from extinction. Table 6.1 shows the numbers of birds from different species before and after the Act was introduced.

Species	Number of birds	
	Before the act	After the act
Bald eagle	416	9789
Kirtland's warbler	210	1415
Nene goose	400	1275
Pepegrine falcon	324	1700
Whooping crane	54	513

Table 6.1

- i. State which species was the most at risk from extinction in Table 6.1.

Whooping crane

- ii. Calculate the percentage increase in the number of Kirtland's warblers. Give your answer to the nearest whole number.

$$\frac{1415-210}{210} \times 100 = 574\%$$

574 %

List three reasons why species become endangered or extinct.

1. due to habitat destruction
2. due to overexploitation
3. due to introduction of invasive alien species

- iii. Describe **one** method of conserving endangered plant species.

1. Create botanic gardens and cultivate these plants.
2. Create national parks and protect these plants from invasive animals and diseases.

7. Below is an extract from an article entitled 'Invasive plants hurt locals in Mauritius'. Read the extract and answer the questions which follow.

"Mauritius is home to an astounding 691 **native plant species**, nearly 40 percent of which are found no-where else in the world. Worryingly, of these, over 80 percent are considered **threatened with extinction**. In Mauritius, several forest species regenerate better and achieve greater seedling densities following **invasive alien plant** control, which also results in a natural increase in species richness. Our findings thus suggest a possible mechanism for the greater density and species richness of native seedlings, saplings and adults trees found in weeded Mauritian lowland wet forest."

- a. Define the following terms as used in the extract

- ii. native plant species

plants found only in a particular area and not brought from outside.

- ii. invasive alien plant.

Plants which are introduced from outside and they grow very rapidly

- iii. Explain how invasive alien plants cause native plants to be '*threatened with extinction*'.

These invasive alien species grow rapidly and outcompete native species.

- iv. Which control measure has been mentioned in the extract to encourage growth of native species?

Control of alien species by removing them.

- v. Which term (not found in the extract) is used to describe organisms which are "*found no-where else in the world*".

endemic

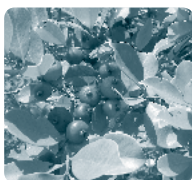
- vi. Name **two animals** which are found only in Mauritius.

1. Echo-parakeet

2. Pink Pigeon , Kestrel

- b. The diagrams below show some alien species which have invaded the Mauritian biodiversity.

- i. Identify each organism and match with its correct name.



Mongoose

Chinese guava

Macaque

Traveller's plant

8. Fig. 8.1 shows the outline of the garden of a florist. He grows three types of flowers. He wanted to estimate the number of flowers in his garden. He used a quadrat of area 1 m² and placed it randomly in five places as shown below.

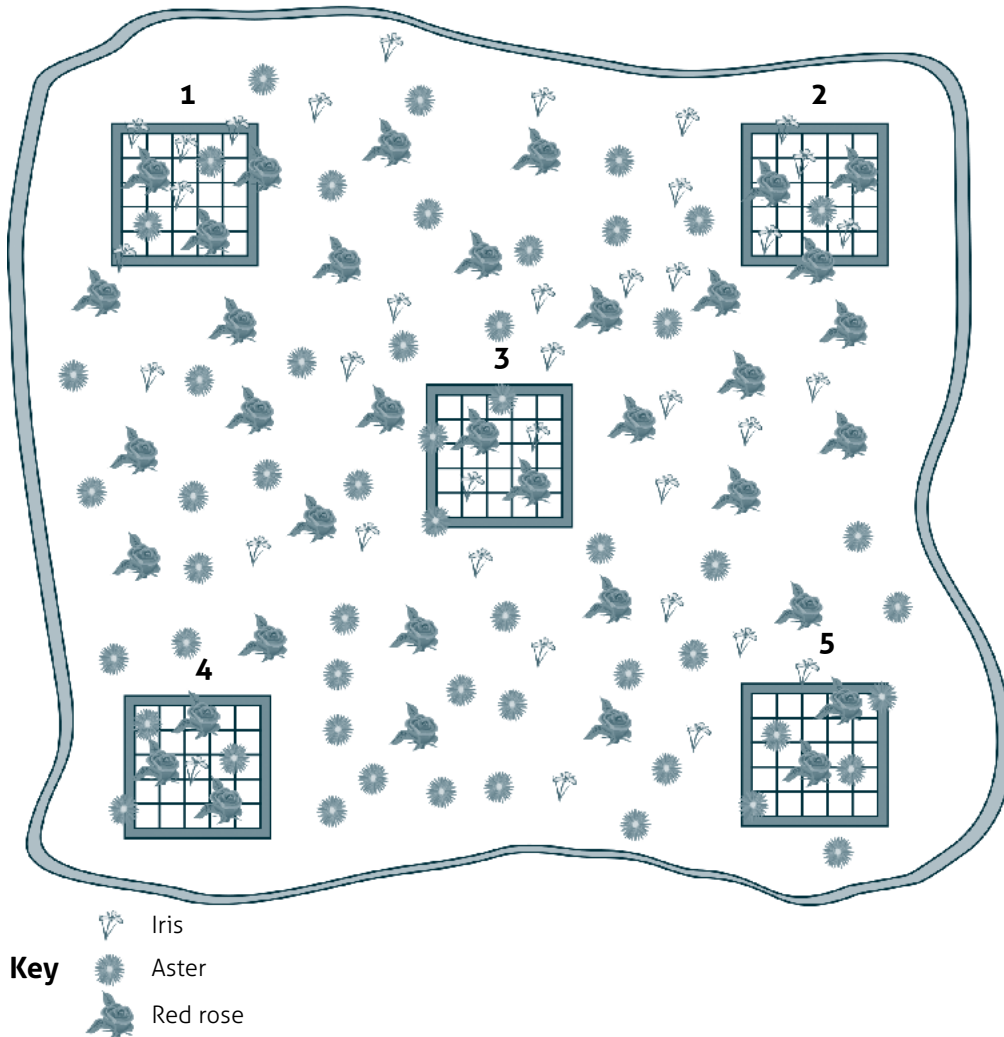


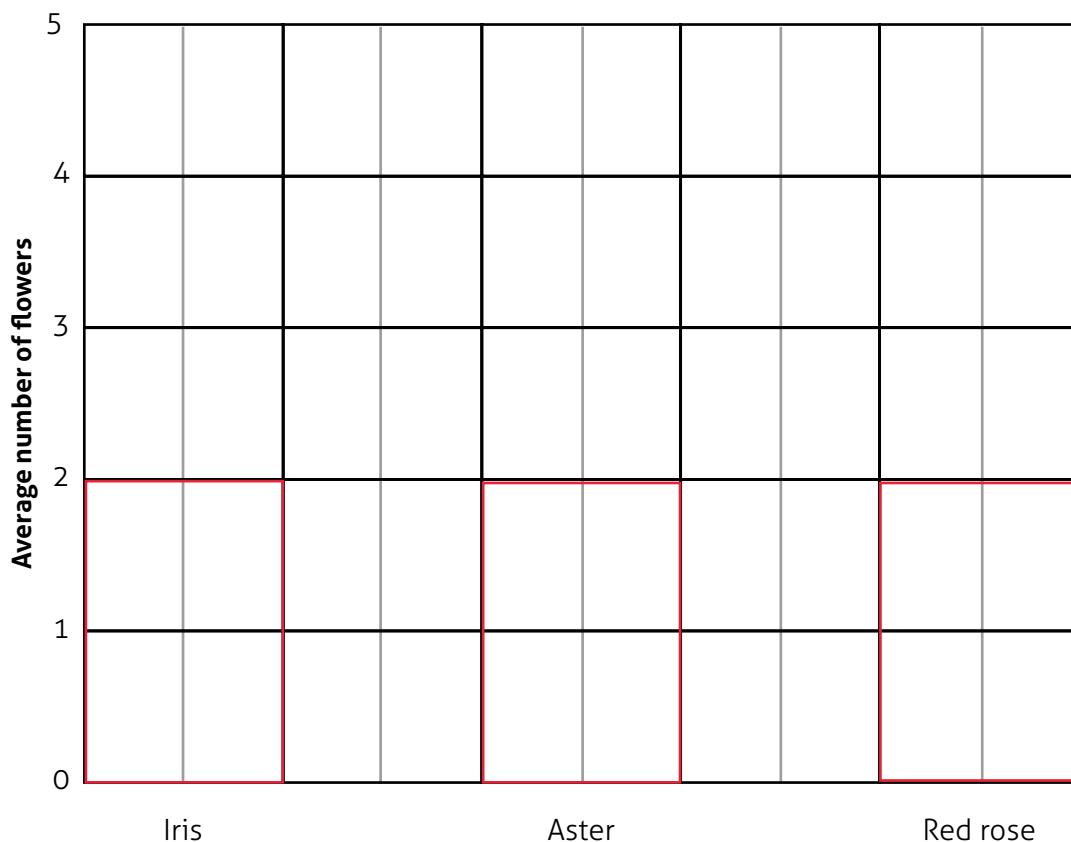
Fig. 8.1

- i. Count the number of flowers in each quadrat and fill in the table below.

Note: count only flowers inside the grid of the quadrat. Do not count those on the frame of the quadrat.

Flowers	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Iris	4	4	2	1	0	2
Aster	2	1	2	2	3	2
Red rose	2	2	2	3	2	2

- ii. Plot a bar chart of the average number of each flower in the grid below.



- iii. The area of the plot of land is 36 m². Calculate the total number of each flower growing in the garden.

Iris : $36 \times 2 = 72$

Aster : 72

Red Rose : 72

- iv There are many butterflies which visit the garden. The florist wanted to count the butterflies using the same method.
Suggest why this is not possible.

Butterflies have wings and can easily fly when a quadrat is used making it difficult to count.

9. a. Fig. 9.1 shows a tropical forest where the trees have been cut down.



Fig. 9.1

- i. State the name of the type of habitat destruction shown in Fig. 9.1.
- Deforestation
- ii. Describe two reasons why humans destroy habitats such as tropical forests.

1. To obtain timber for construction

2. To clear forest for agriculture

- b. Fig. 9.2 is a graph showing the estimated area of trees that have been removed from tropical forests between 2001 and 2017.

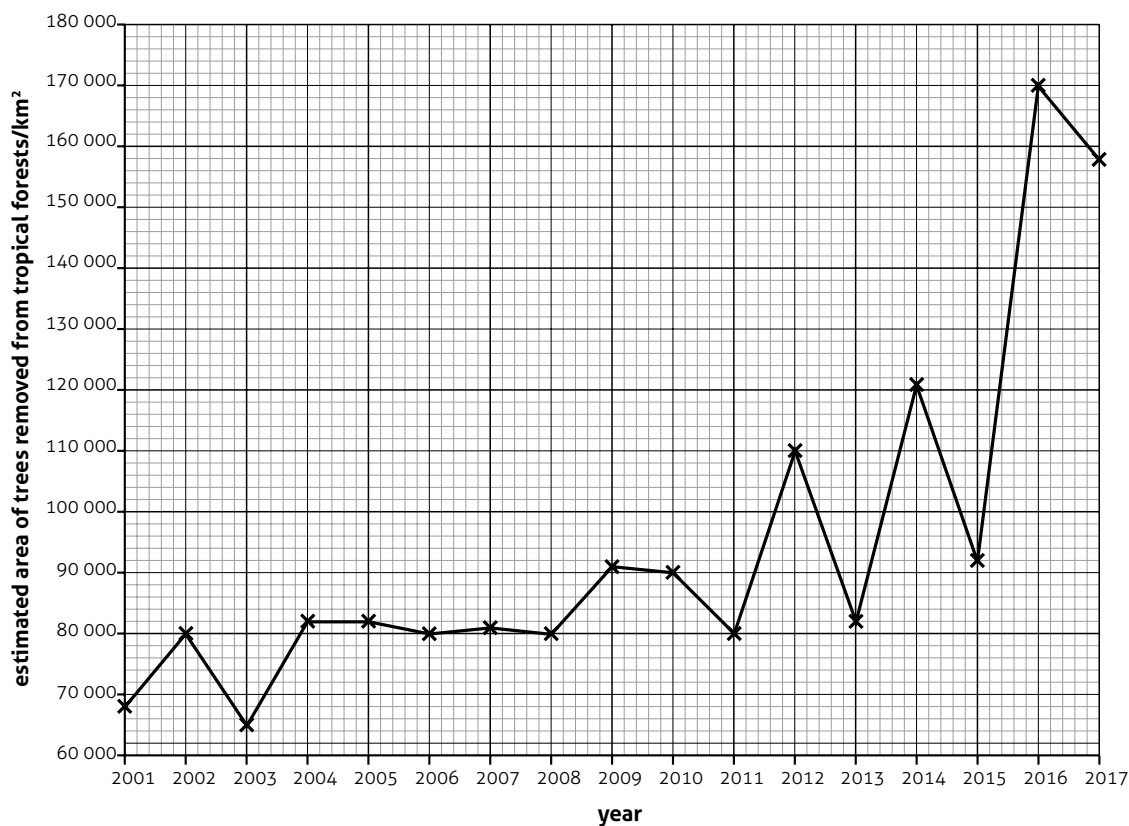


Fig. 9.2

- i. State the year which had the lowest estimated area of trees removed from tropical forests on Fig. 9.2.

2003

- ii. State the area of trees removed in 2012 on Fig. 9.2.

110 000

km²

- iii. A student made three statements about the data in Fig. 9.2:
1. The number of trees cut down increases every year.
 2. The number of trees cut down in 2014 was three times more than the number of trees cut down in 2003.
 3. Fewer trees were cut down in 2017 than in 2016.

Complete Table 9.1 by using the data in Fig. 9.2 to decide if each statement is true or false and state the evidence that supports your decision.

Statement number	True or false	Evidence
1	F	it increases and decreases
2	F	it was only 1.8 times
3	T	the graph shows a decrease

Table 9.1

10. Below is a summary of the conservation effort to save the Mauritian Echo Parakeet.



“In 1973 there were only 20 birds left due to hunting, deforestation and invasive alien species. Initially, all conservation attempts failed and the status of Echo Parakeet was critically endangered. The Mauritian Wildlife Foundation in collaboration with the government prioritised the conservation of this bird. Consequently, in 1994 the Black River Gorges was declared a national park where the bird was bred in captivity. After much effort, by 2019 the number of Echo parakeet increased to 750. Its status was shifted from critically endangered to vulnerable.”

- a. Define the term conservation.

Conservation is the restoration, preservation and protection of biodiversity.

- b. Explain how each of the following caused decline in the number of the Mauritian Echo Parakeet:

i. hunting

Killed teh birds and reduced their numbers

ii. deforestation

Destroyed their habitat and food

iii. invasive alien species

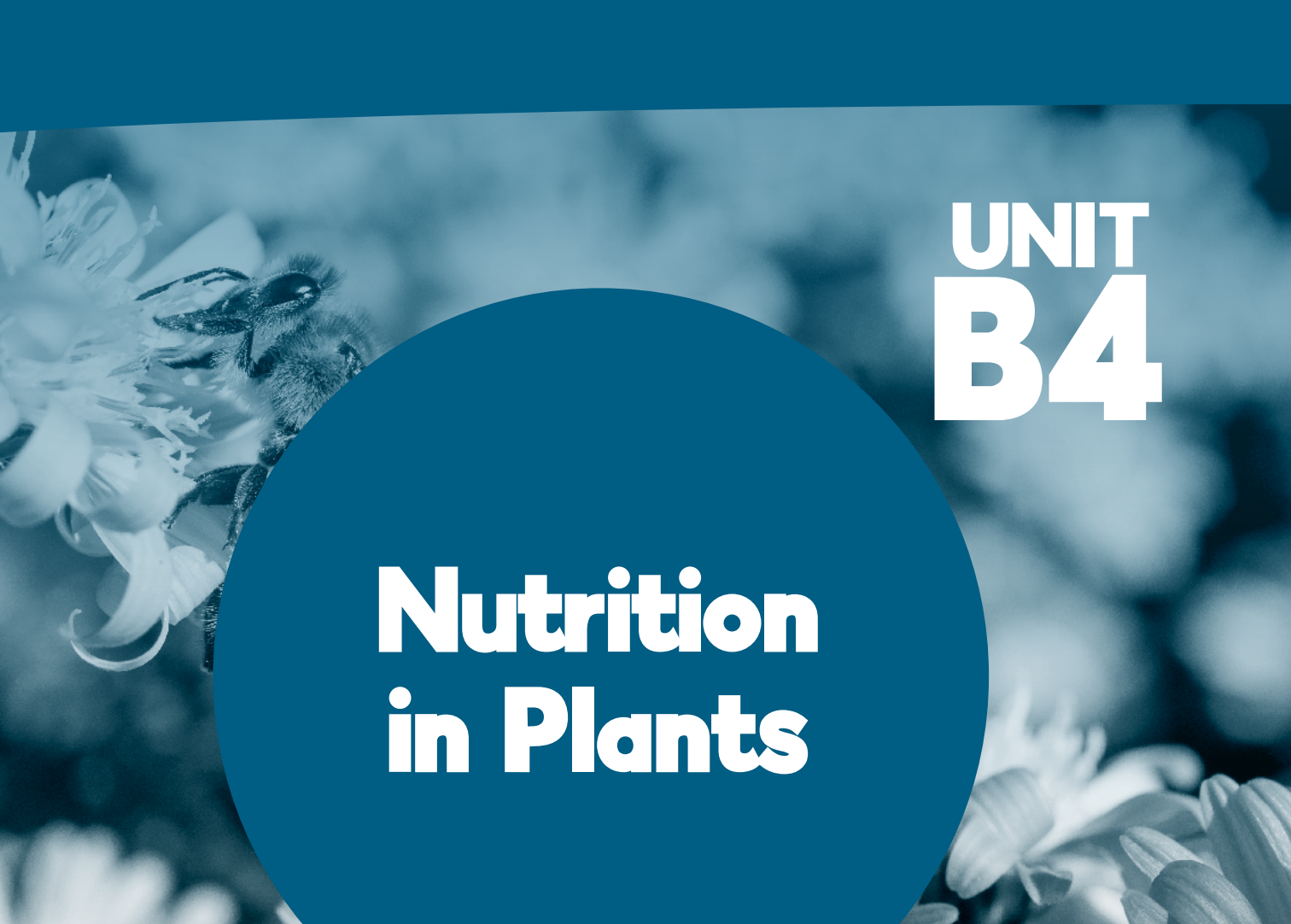
Outcompete the echo parakeet and prevented them from feeding properly

- c. What is captive breeding?

It is the caring and protection of animals in protected areas such as zoos and national parks.

- d. What is the role of a national park in conservation?

National park provides natural habitat to endangered animals and plants and close monitoring of the health of animals and plants. It also helps to sensitise the public about conservation.

A close-up photograph of a bee on a white flower, with a blue circular graphic overlaying the center of the image.

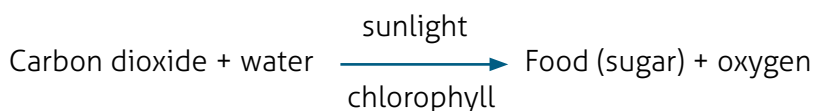
UNIT B4

Nutrition in Plants

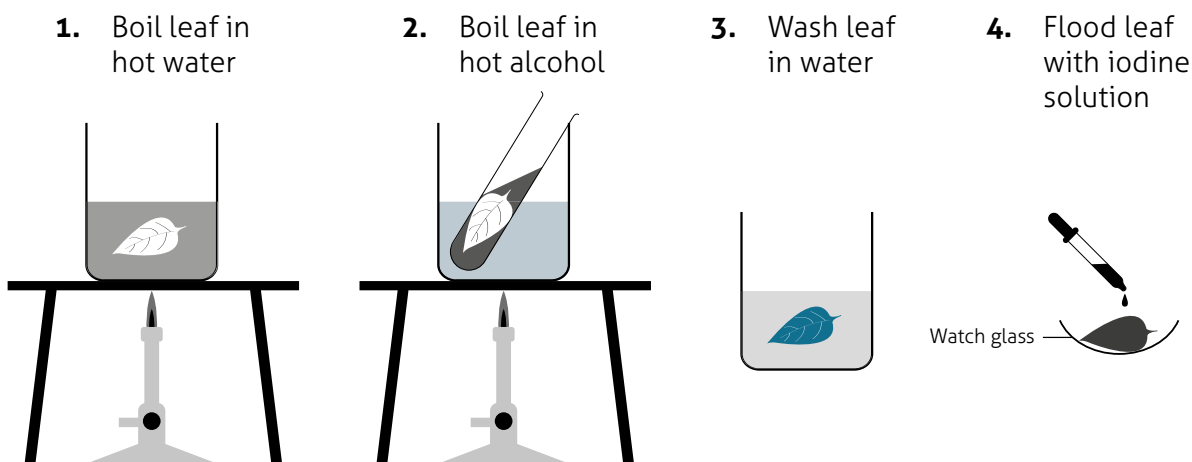
Learning Objectives

- Explain photosynthesis as a process of producing food in plants.
- State the word equation for photosynthesis.
- Explain how a leaf is adapted for photosynthesis (large surface area, veins, stomata, chlorophyll).
- Identify the different tissues making a dicot leaf with the help of a diagram.
- Investigate that some substances (e.g. particles/ water) can move from a region of higher concentration to a region of lower concentration.
- Observe vascular bundles in a cross section of a root and a stem using microscope/ poster.
- Recognise vascular bundles using cross section diagram of a root and stem.
- Identify xylem and phloem in a vascular bundle of a root and a stem.
- Investigate and state the factors that are important for photosynthesis.
- (propose/ conduct simple experiment to determine factors which are important for photosynthesis).
- Communicate the proposed experiments/ results of experiments on factors which are important for photosynthesis.

- Photosynthesis is a fundamental process during which green plants manufacture their own food in the form of sugar using carbon dioxide and water in the presence of sunlight and chlorophyll.
- Oxygen is released during photosynthesis.
- The word equation for photosynthesis is written as follows:



- The food is produced in the form of **glucose** which is rapidly converted into **starch** because in that form it be stored inside a plant for longer period of time.
- In order to investigate whether a plant has carried out photosynthesis, a test for the presence of starch is carried out.
- A starch test consists of four simple steps:
 1. Boil the leaf in a water bath to kill the leaf.
 2. Boil the leaf in hot alcohol over a water bath to remove chlorophyll so that later colour change can be seen. (**safety:** flame should be turned off while boiling in alcohol in a water bath since alcohol is highly flammable).
 3. Wash the decolorized leaf with warm or cold water to soften it and to remove all alcohol and make it permeable to iodine solution.
 4. The leaf is flooded with iodine solution to test for the presence of starch.
 5. If the leaf turns blue-black, starch is present but if it remains pale yellow or brown then starch is absent.



Steps in starch test

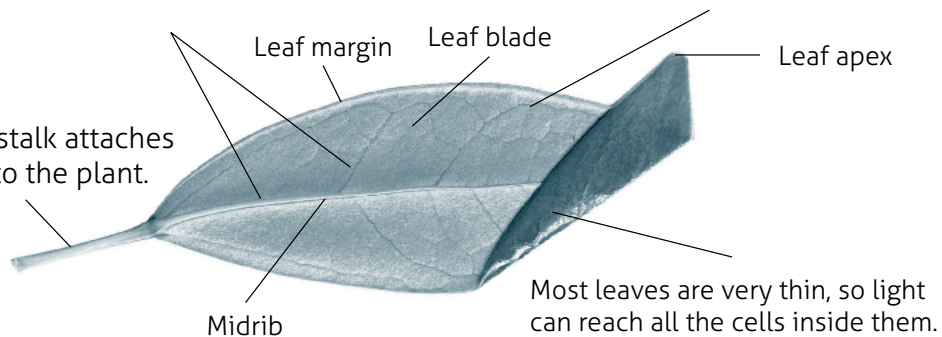
- If the leaf turns blue-black then starch is present and photosynthesis has taken place.
- If the leaf remains pale yellow or brown then starch is absent and photosynthesis has not taken place.
- In biology experiments, heating is not done directly. Substances are always heated over a water bath to prevent any danger of burning.
- In the starch test alcohol is inflammable so the flame must be off during boiling.

- The leaf is the main organ where photosynthesis occurs. It has several adaptations which ensures that photosynthesis takes place at the optimum level.

The veins carry water to the cells in the leaf. They also help to support the leaf and hold it out flat.

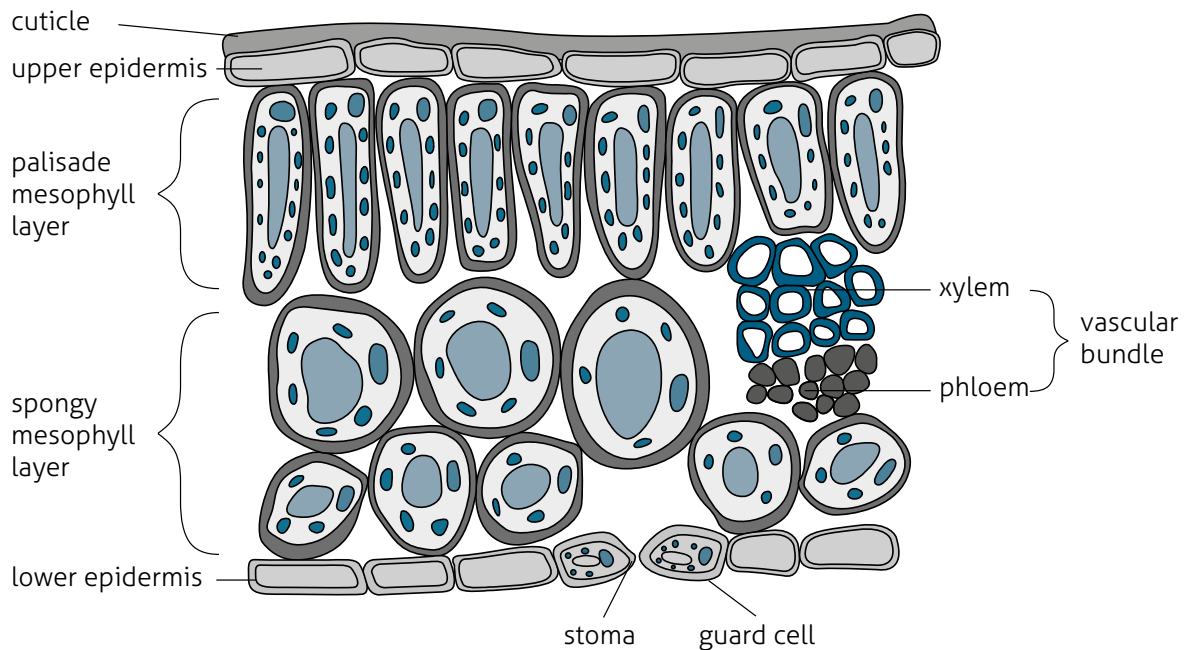
The leaf looks green because its cells contain chlorophyll.

The leaf stalk attaches the leaf to the plant.



Features	Adaptations
Large surface area	- Leaves are broad and flat to provide a large surface area to absorb maximum sunlight. - The surface area of a leaf can be calculated by drawing an outline of the leaf on a grid (squared paper) of known dimensions and counting the number of squares and adding them up. - The total surface area of all leaves in a plant is calculated by finding the average surface area of one leaf and multiplying by the total number of leaves.
Chlorophyll	- Chlorophyll is a green pigment which is important to capture sunlight for photosynthesis. - This is why most leaves are green as they contain chlorophyll. Some leaves are not green because the green chlorophyll is masked (hidden) by other darker pigments such a purple, red etc.
Stomata	A leaf contains many small pores both on top and on its lower surface. These pores are called stomata. They help the leaf to absorb carbon dioxide for photosynthesis and give out oxygen and water vapour.
Veins	- Veins are present throughout a leaf in a network. These veins two vessels: - Xylem vessels which bring water from root to the leaf for photosynthesis - Phloem vessels which transport foods manufactured in the leaf during photosynthesis to all parts of the plant.

- Apart from the four adaptations, a leaf has many structures which further help it to carry out photosynthesis.
- When a leaf is cut into thin section and viewed under a microscope, the cross section reveals many tissues inside.

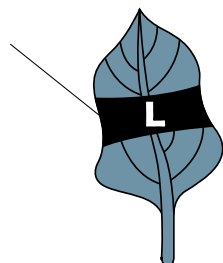


Transverse section of a leaf

- **Internal adaptations of the leaf**
- **Upper epidermis**
 - It is made up of a single layer of closely-packed cells with a thick cuticle.
 - Covered by a thin waxy layer called cuticle which protects the leaf and prevents excessive evaporation of water.
 - It is transparent to allow sunlight to pass through.
- **Mesophyll**
 - consists of two types: palisade and spongy
 - lies between the upper and lower epidermis.
- **palisade mesophyll**
 - consists of one or two layers of closely-packed, long and cylindrical cells containing numerous chloroplasts to allow maximum absorption of light.
 - its cells contain more chloroplasts than spongy cells as they receive more sunlight.
- **spongy mesophyll**
 - cells are irregular in shape—causing large intercellular air spaces among them to allow for rapid diffusion of gases.
 - contain fewer chloroplasts.
 - cells are covered with a thin film of moisture so that carbon dioxide can dissolve in it.
 - xylem and phloem are present here.

- **Lower epidermis**
 - consists of a single layer of closely-packed cells covered by an outer layer of cuticle which reduces water loss.
- **Guard cells and stomata**
 - These are sausage-shaped cells which contain chloroplasts and can photosynthesise.
 - They open up into small spores called stomata which allows the exchange of carbon dioxide, oxygen and water vapour.
- Gases diffuse into and out of the leaf through stomata by **diffusion**.
- Diffusion is the random movement of molecules from a region of high concentration to a region of low concentration down a concentration gradient.
- When an uprooted Balsam plant is placed in red coloured water, red pencil lines are observed along the stem from outside.
- When the root and stem are cut using a blade and viewed a microscope, the following observations are made.
- The region which is stained with dye is known as **xylem** vessel. It transports water and mineral salts from the root to other parts of the plant. It also provides mechanical support to a plant.
- The sugar (food) which is manufactured in the leaves during photosynthesis is transported to other parts of the plant through another special vessel called **phloem**.
- Xylem and phloem are always found together in a tissue called the **vascular bundle**.
- We have seen that a plant requires carbon dioxide, water, sunlight and chlorophyll to carry out photosynthesis. This information is obtained by carrying out practical investigations in the laboratory.
- To show whether a plant has carried out photosynthesis, a test for starch is carried out.
- Before carrying out the tests, a potted plant is first placed in darkness for 24 hours. In the dark all the starch will be transported to other storage organs such as roots and fruits. This process of removing starch from a plant is known as **destarching**.
- Destarching is important so that the presence of starch after the experiment will be solely due to the factor under investigation.
- All these experiments are carried out under controlled conditions.
- There are three important experiments which are carried out to determine the factors important for photosynthesis. These are:
 - **Experiment to show that sunlight is important for photosynthesis**
 - A potted plant is first destarched by placing in darkness then one leaf is partly covered with a black paper to prevent it from getting sunlight.
 - After destarching the plant is placed in sunlight for 2 hours.
 - Starch test is then carried out in the leaf.

Black paper to prevent light from reaching the leaf

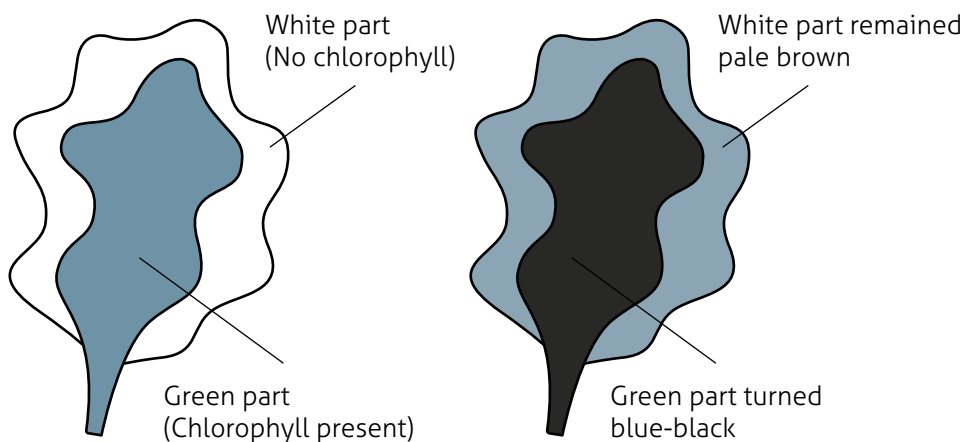


Part not exposed to light remain pale brown

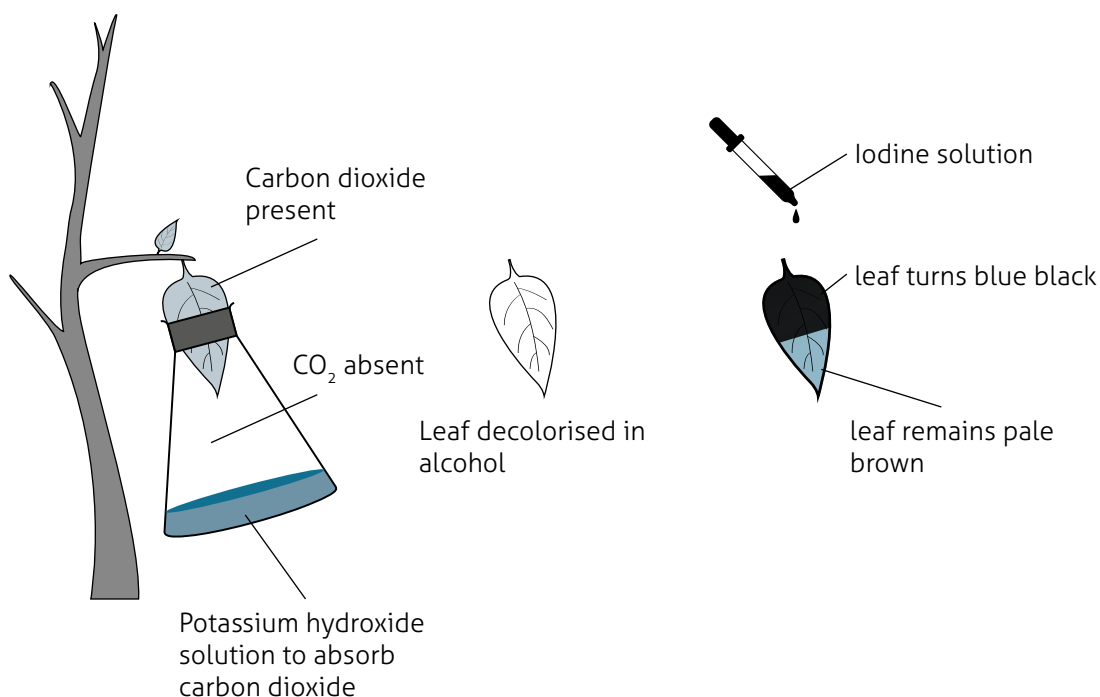


Part exposed to light turns blue black

- **Experiment to show that chlorophyll is important for photosynthesis**
 - Here also a potted plant containing variegated leaves is destarched.
 - It is then placed in sunlight and one leaf tested for starch.



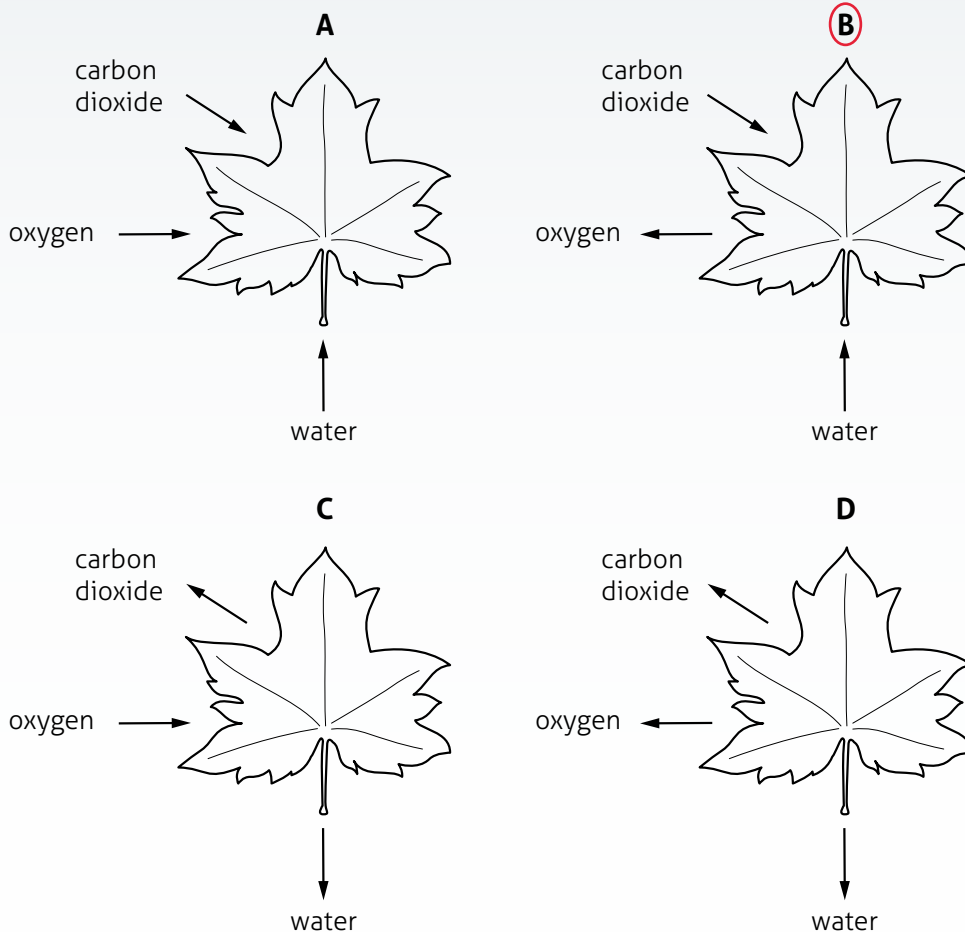
- **Experiment to show that carbon dioxide is important for photosynthesis**
 - As above, a potted plant is destarched by placing in darkness for 24 hours.
 - One leaf is partly enclosed in a conical flask containing sodium hydroxide which absorbs carbon dioxide.
 - The plant is then placed in sunlight and the leaf is tested for starch.



Multiple
choice
questions

Encircle the letter which shows the correct answer.

- Through which structure is carbon dioxide absorbed by a leaf?
 - Chlorophyll
 - B. Stomata**
 - Mesophyll layer
 - Upper epidermis
- Which diagram shows substances going into and out of a leaf when glucose is being formed?



- What is produced during photosynthesis?
 - Carbon dioxide
 - Water
 - C. Oxygen**
 - Sunlight

4. Which adaptation helps water to be brought to the leaves?

- A. Large surface area
- B. Having stomata
- C. Presence of veins**
- D. Presence of chlorophyll

5. Which two cells contain chloroplast?

A.	Palisade cell	Spongy cell
B.	Palisade cell	Guard cell
C.	Epidermal cell	Spongy cell
D.	Epidermal cell	Guard cell

6. Which step in starch test removes chlorophyll?

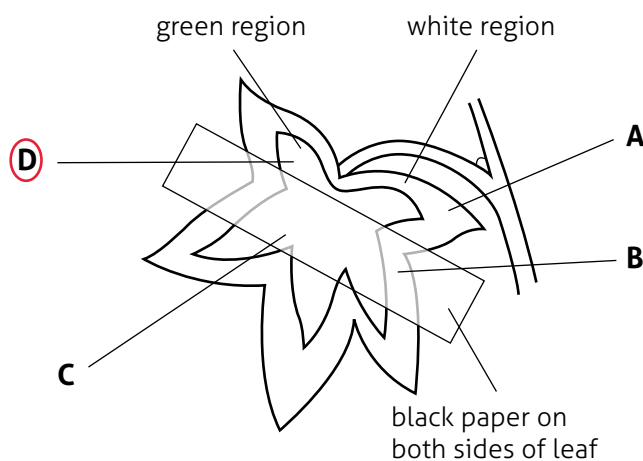
- A. Boiling the leaf in water
- B. Washing the leaf with warm water
- C. Boiling the leaf with alcohol**
- D. Flooding the leaf with iodine solution

7. Carbon dioxide is absorbed from the air into the leaf by

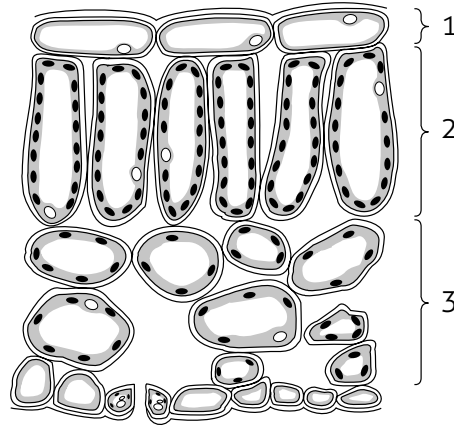
- A. Photosynthesis
- B. Diffusion**
- C. Evaporation
- D. Osmosis

8. A plant with variegated leaves has the starch removed from its leaves by placing it in a dark cupboard for 48 hours.

Black paper is then fixed on one leaf as shown and the plant is exposed to light. After 24 hours, which part of the leaf contains starch?



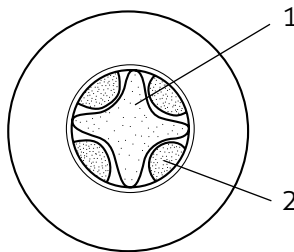
9. The diagram shows a leaf as seen in cross-section under the microscope.



What are tissues 1, 2 and 3?

	1	2	3
A.	epidermis	palisade mesophyll	spongy mesophyll
B.	epidermis	Guard cell	palisade mesophyll
C.	palisade mesophyll	epidermis	spongy mesophyll
D.	Epidermal cell	palisade mesophyll	epidermis

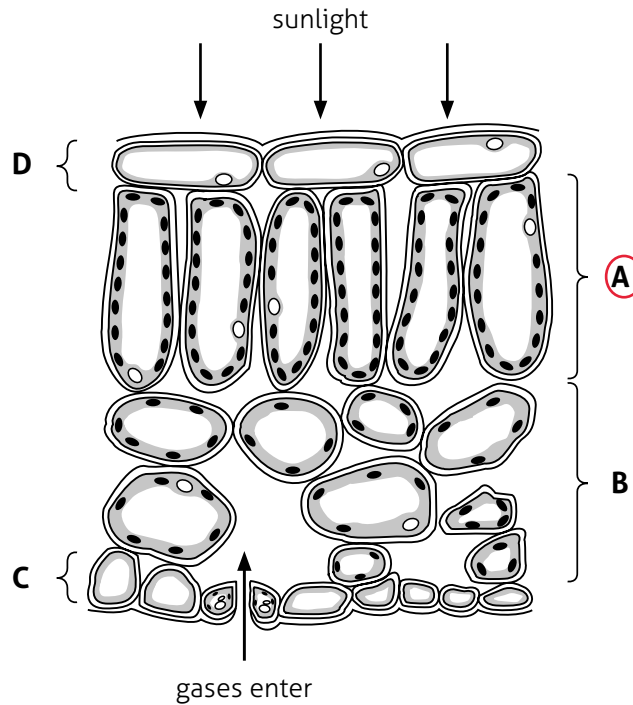
10. The diagram shows a transverse section through a plant root.



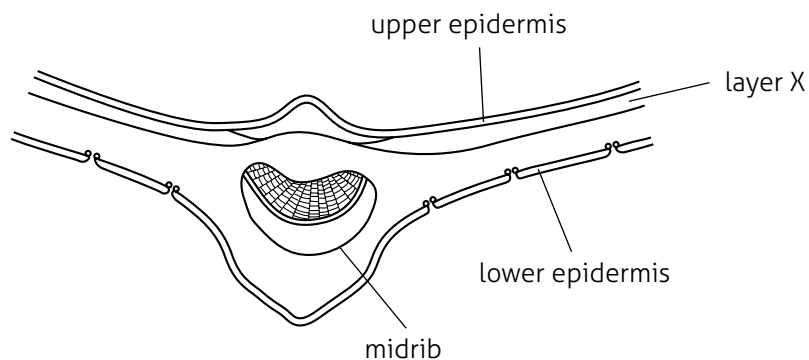
In which labelled structure is sugar transported from the leaves to all parts of a plant?

- A.** 1 and 2
B. 1 only
C. 2 only
D. Neither 1 or 2
11. Which substance is used up in photosynthesis?
- A.** Chlorophyll
B. Light
C. Oxygen
D. Water

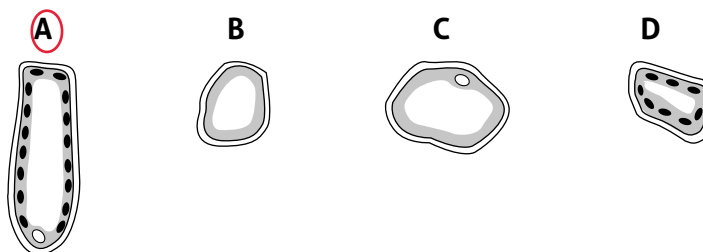
12. The diagram shows some cells in a leaf of a green plant. In which layer of cells does most photosynthesis occur?



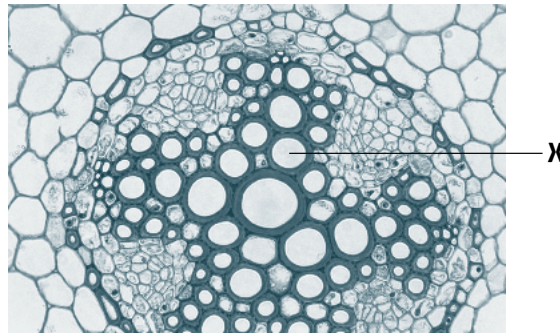
13. The diagram shows a cross-section of part of a leaf.



Which type of cell is found in layer X?



14. The picture shows cells from the centre of a root, seen using a light microscope.



Which type of transport cell is labelled **X**?

- A. Phloem
 - B. Root hair
 - C. Stomata
 - D. Xylem**
15. Which words correctly complete the paragraph?

Diffusion may be defined as the net movement of particles from a region of their1..... concentration, to a region of their2..... concentration, where movement is3..... a concentration gradient.

	1	2	3
A.	higher	lower	down
B.	higher	lower	up
C.	lower	higher	down
D.	lower	higher	up

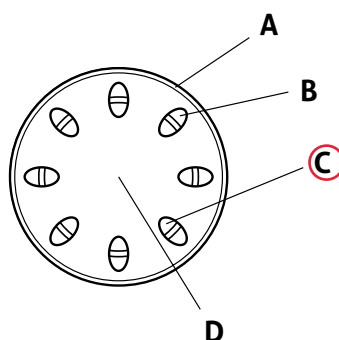
16. The equation for photosynthesis is shown.

.....1..... +2..... → glucose +3.....

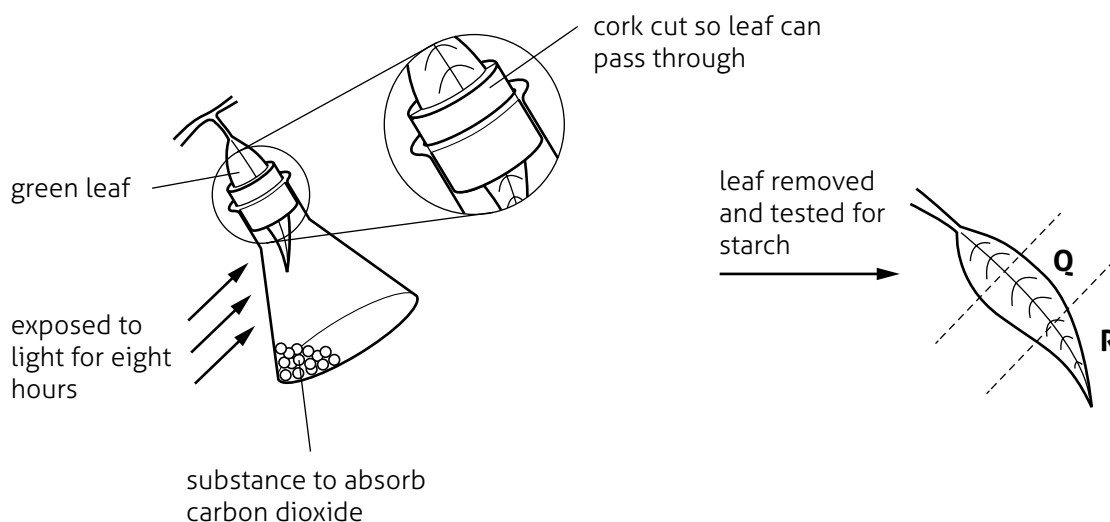
Which words correctly complete gaps 1, 2 and 3?

	1	2	3
A.	carbon dioxide	light	oxygen
B.	carbon dioxide	water	oxygen
C.	oxygen	light	carbon dioxide
D.	oxygen	water	carbon dioxide

17. The diagram shows part of a section through a plant stem. Which tissue transports water from the roots to the leaves?



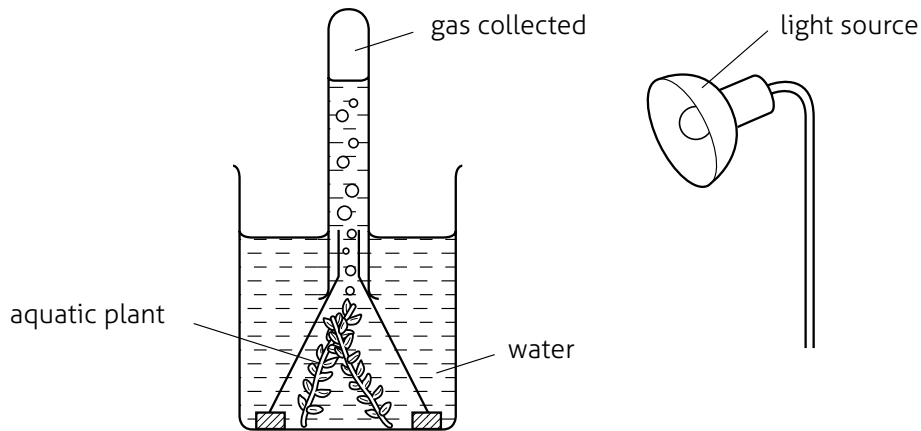
18. A plant is kept in the dark for two days. One of its leaves is used in an experiment to investigate photosynthesis as shown in the diagram.



What are the colours of **Q** and **R**, when the leaf is tested for starch using iodine solution?

	Q	R
A.	blue/black	brown
B.	brown	brown
C.	blue/black	blue/black
D.	brown	blue/black

19. An experiment is set up as shown. The volume of gas collected is measured after 30 minutes.



What is the identity of the gas collected?

- A. Carbon dioxide
 - ☒ B. Oxygen
 - C. Water vapour
 - D. Nitrogen
20. Which two substances are the products of photosynthesis?
- A. carbon dioxide and glucose
 - B. carbon dioxide and water
 - C. oxygen and carbon dioxide
 - ☒ D. oxygen and glucose

Structured questions

1. Match the words with the corresponding meaning

Stomata	Placing a plant in darkness to remove starch
Xylem	A vessel which transports food in plants.
Diffusion	Small pores through which oxygen leaves a leaf.
Phloem	Process by which carbon dioxide enters a leaf.
Destarching	Vessel which transports water to all parts of a plant.

2. Fill the empty spaces with the words given in the list below.

surface area palisade blue-black water vascular spongy
 chlorophyll aluminium variegated carbon dioxide guard cells

- i. Carbon dioxide and**water**..... combine in presence of sunlight and**chlorophyll**..... to produce sugar during photosynthesis.
- ii. A leaf has a large**surface** **area** to absorb maximum sunlight.
- iii. The**vascular**..... bundle contains both xylem and phloem.
- iv. Cylindrical cells are found in the**palisade**..... layer of a leaf.
- v. A**variegated**..... leaf contains white and green parts.
- vi. When iodine solution is added to a decolourised leaf, it turns**blue-black**.....
- vii. A leaf is covered with**aluminium**..... foil to test for the importance of sunlight in photosynthesis.
- viii. Sodium hydroxide is used to absorb**carbon dioxide**.....
- ix. The**spongy**..... layer contains many air spaces.
- x. The**guard** **cell** control the opening and closing of stomata in a leaf.

3. Photosynthesis is the process by which plants obtain nutrition.
- a. Write a balanced chemical symbol equation for photosynthesis.



- b. Leaves can be tested for starch to show that photosynthesis has taken place. This is the method given in a biology textbook.
1. Remove the leaf you want to test from the plant.
 2. Half fill a 250 cm³ beaker with water and boil the water using a Bunsen burner.
 3. Using a pair of forceps, hold the leaf in the boiling water for 20 seconds.
 4. Turn the Bunsen burner off.
 5. Using the forceps, push the leaf to the bottom of a boiling tube and cover it with ethanol.
 6. Place the boiling tube in the beaker of very hot water. The ethanol will boil.
 7. When the leaf is colourless, remove it from the boiling tube and wash it in cold water for a few seconds.
 8. Place the leaf flat on a white tile.
 9. Add dilute iodine solution with a pipette, making sure the whole leaf is covered.
 10. Any starch present will react with the iodine solution.

- i. Explain a safety precaution that should be taken when carrying out this test.

The Bunsen Burner should be switched off while boiling the leaf in alcohol.

- ii. State the purpose of step 3.

To kill the leaf to stop all chemical reactions.

- iii. State the purpose of step 6.

to decolorise the leaf so that later colour change can be visible.

- c. Experiments can be done to demonstrate that light, chlorophyll and carbon dioxide are needed for photosynthesis.

Testing leaves for starch is the final step in these experiments.

Explain what other steps need to be taken to demonstrate that each of these factors is needed for photosynthesis.

- i. light

The leaf is covered with aluminium foil and placed in darkness for destarching.
After that the leaf is placed in sunlight and tested for starch.

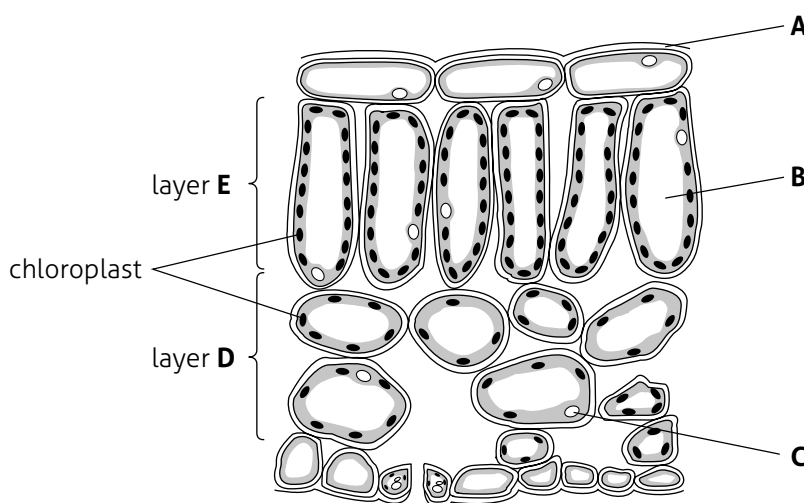
ii. chlorophyll

A variegated leaf is taken and destarched. then it is placed in sunlight and the leaf tested for starch

iii. carbon dioxide

the leaf is enclosed in a flask containing sodium hydroxide to absorb all carbon dioxide. The leaf is destarched and placed in sunlight. After that the leaf is tested for starch

4. The diagram shows a cross section through a leaf.



i. Name the structures **A**, **B** and **C**.

A cuticle

B palisade cell

C spongy cell

ii. Chloroplasts contain chlorophyll. Describe the function of chlorophyll.

Chlorophyll absorbs sunlight for photosynthesis.

iii. Explain why each cell in layer **E** contains more chloroplasts than each cell in layer **D**.

because it is the first layer which is exposed to sunlight. In order to absorb the maximum amount of sunlight, there are many chloroplasts in these cells.

5. Photosynthesis occurs in leaves.
a. Complete the word equation for photosynthesis.

carbon dioxide + water → glucose + oxygen

Fig. 5.1 shows a photomicrograph of a cross-section of part of a leaf.

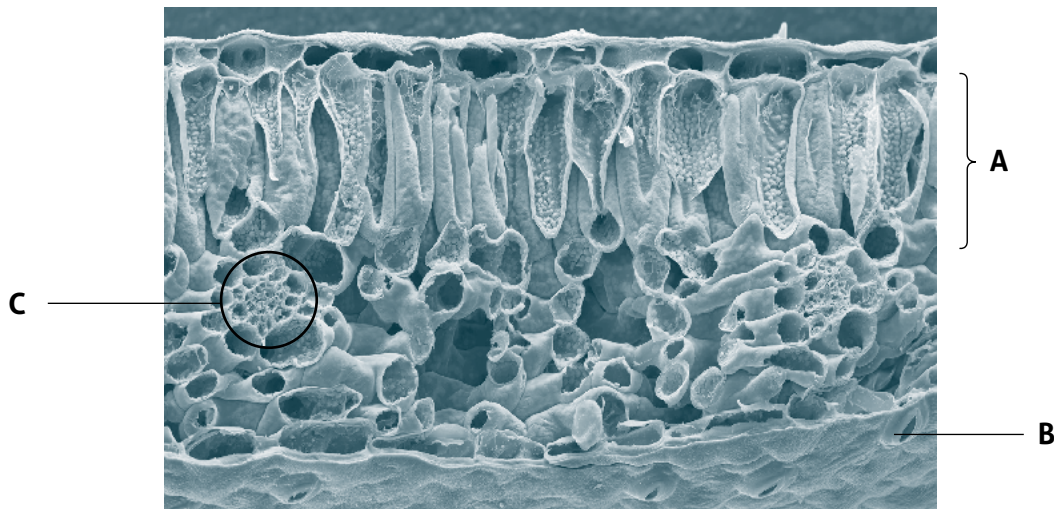


Fig. 5.1

- a. i. Identify tissue **A** on Fig. 5.1 and state the name and function of this tissue.

name

palisade tissue

function

absorb maximum sunlight for photosynthesis

- ii. Structure **C** in Fig. 5.1 is part of the transport system in the leaf.
State the names of **two** tissues that structure **C** contains.

1. Xylem

2. Phloem

- iii. Identify and state the name of cell **B** in Fig. 5.1.

guard cell

- b. A plant is in bright sunlight and has plenty of water.
Gases move into and out of its leaves.

Complete Table 5.1 to show the net direction of movement for the named gases. Place a tick (✓) in each correct box.

Name of gas	Moves into leaves	Moves out of leaves
Carbon dioxide	✓	
Oxygen		✓
Water vapour		✓

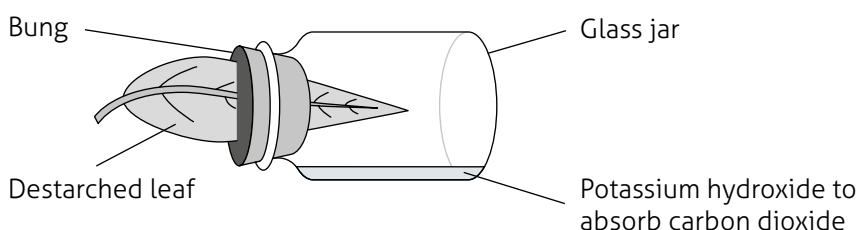
Table 5.1

6. A student investigates the effect of carbon dioxide on photosynthesis. The student places a plant in the dark to remove starch from its leaves.

- a. Explain why a leaf becomes destarched if it is placed in the dark.

Because in darkness there is no photosynthesis, the plant uses the food store and transports them to other parts away from the leaves.

- b. The student puts one of the destarched leaves through the bung of a glass jar containing potassium hydroxide, as shown in the diagram.



She places the apparatus in the light for 24 hours, and then tests the leaf for starch.

- i. Describe a safe method of testing this leaf for starch.

Step 1

the leaf is boiled in water to kill the leaf and stop all chemical reactions.

Step 2

The leaf is again boiled in alcohol to remove chlorophyll so that later colour change can be seen easily.

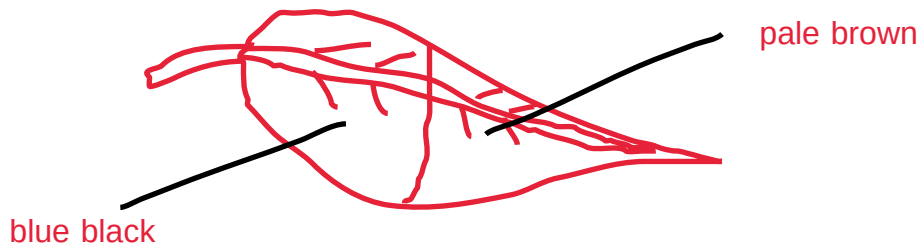
Step 3

The leaf is then washed with water to remove alcohol and make it permeable to iodine solution.

Step 4

The leaf is flooded with iodine solution to test for the presence of starch.

ii. Draw a labelled diagram of the leaf to show the results of the starch test.



7. a. Fig. 7.1 shows cross-sections through a root and a stem of a flowering plant.

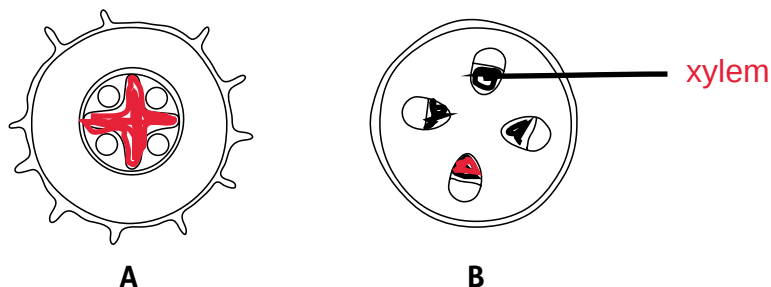


Fig. 7.1

i. State which diagram, **A** or **B**, represents the root.
Give **two** reasons for your answer.

The root is diagram **A**

Reason 1

The vascular bundle is found in the middle.

Reason 2

The root hairs are present on the outside.

ii. On diagram **B**, in Fig. 7.1, shade in one area where the xylem is found.

b. Some red dye in water is used to identify the xylem in a plant. A plant is placed in the red dye for a few hours.

i. Shade in one area in both of the drawings in Fig. 7.1 where the red dye can be seen.

ii. Name the cells which absorb water from the soil.

Root hairs

iii. Describe **one** function of water in the plant.

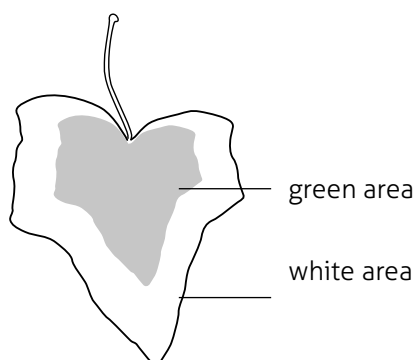
It transports mineral ions across the plant.

iv. Describe the function of phloem in a plant.

It transports food from the leaves to other parts of the plant.

8. Variegated leaves have green areas that contain chlorophyll and white areas where chlorophyll is absent.

A student investigated the factors needed for photosynthesis to take place. He used a plant with leaves that were all variegated as shown below.



- a. He began by placing the plant in a dark room for 24 hours.

Explain why this was necessary.

to destarch the leaf.

- b. He then picked a leaf, immediately prepared it and tested it for the presence of starch.

i. Name the testing reagent he used. iodine solution.

ii. Name a suitable piece of apparatus for adding the reagent in this test.

A dropper

iii. Describe and explain the appearance of the two areas of the leaf after he had carried out this test for starch.

Description

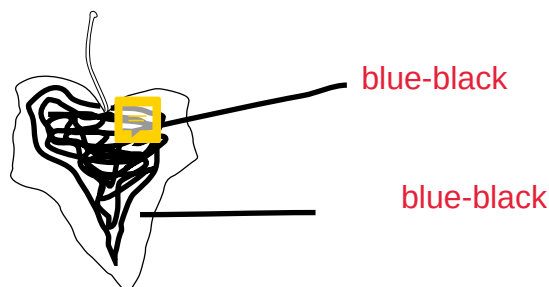
The green area turn blue-black while the white area turns pale brown.

Explanation

Since the green part contains chlorophyll it produces starch by photosynthesis while the white part has no chlorophyll so there was no photosynthesis and no starch.

- c. He moved the plant into bright sunlight for a day and then tested another leaf for the presence of starch.

i. Complete and label the diagram of the leaf to show any colours the student observed at the end of this test.



ii. State your conclusion from this investigation about the factors needed for photosynthesis.

This investigation shows that chlorophyll is essential for photosynthesis.

9. Fig. 9.1 shows the lower surface of a leaf from a dicotyledonous plant, on a 1 cm² grid.

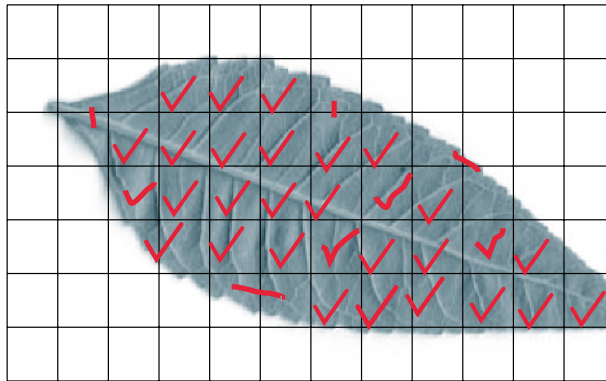


Fig. 9.1

- a. i. Make a large, labelled drawing of the leaf in Fig. 9.1.



- ii. Calculate the surface area of the leaf in Fig. 9.1.

Surface area 34 cm²

- iii. Describe the method you used to determine the surface area of the leaf.

the number of squares covered by the leaf is counted. Two half squares are counted as one.

.....

.....

Fig. 9.2 shows two leaves from the same plant.

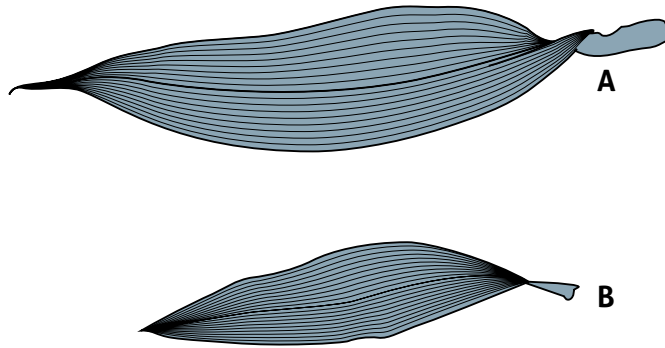
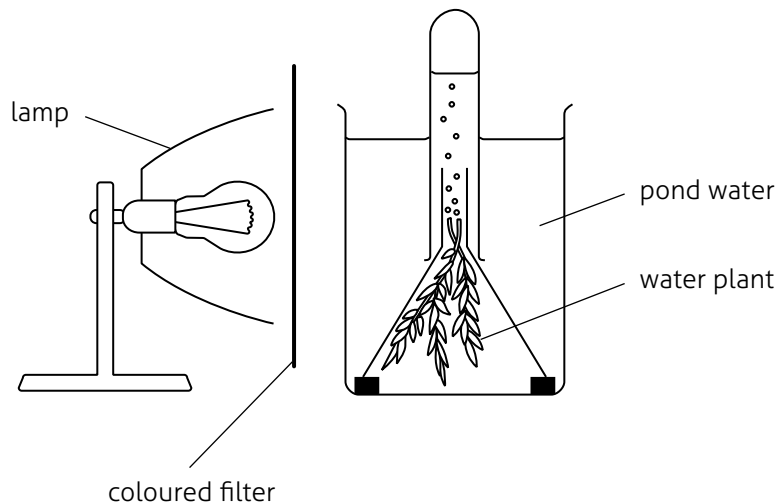


Fig. 9.2

- iv. Suggest which leaf carries out more photosynthesis and explain why.

leaf A as it has the largest surface area and absorbs more sunlight than leaf B.

10. A student carries out an experiment to investigate the effect of changing the colour of light on the rate of photosynthesis in a water plant. She sets up the apparatus shown.



- a. Name the gas given off during photosynthesis.

oxygen

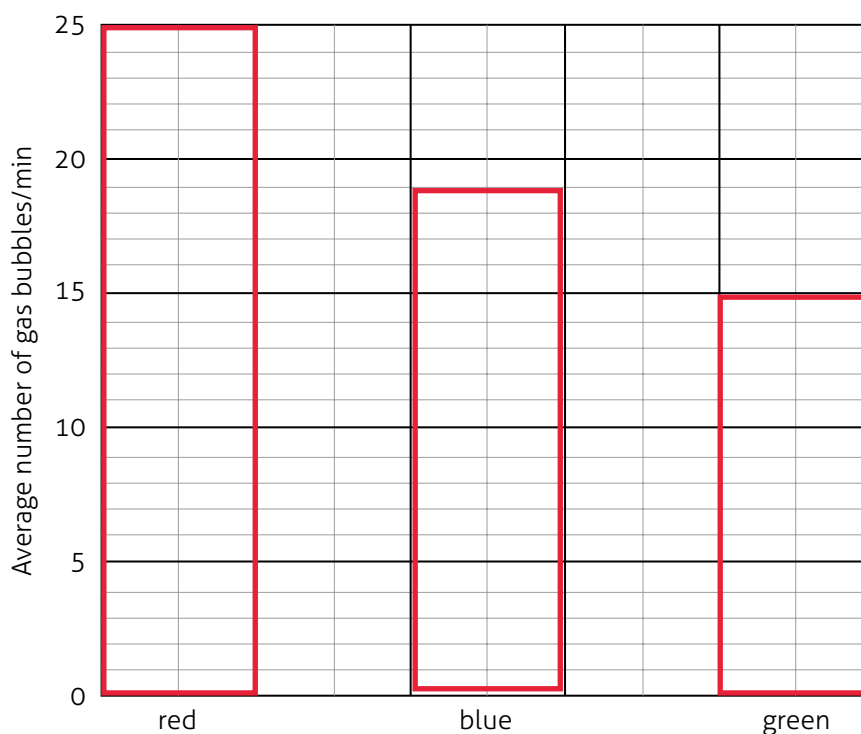
- b. The table shows the results the student obtained from her investigation.

Colour of light	Number of glass bubbles released in one minute			
	Trial 1	Trial 2	Trial 3	Average
Red	23	26	25	25
Blue	19	18	21	19
Green	12	16	16	15

- i. Complete the table by calculating the average rate of photosynthesis for red light.

$$\frac{23+26+25}{3} = 25$$

- c. Plot a bar graph to show the effect of the different colours of light on the average rate of photosynthesis.



- i. Describe what happens to the average number of bubbles released in one minute as light changes from red to blue.

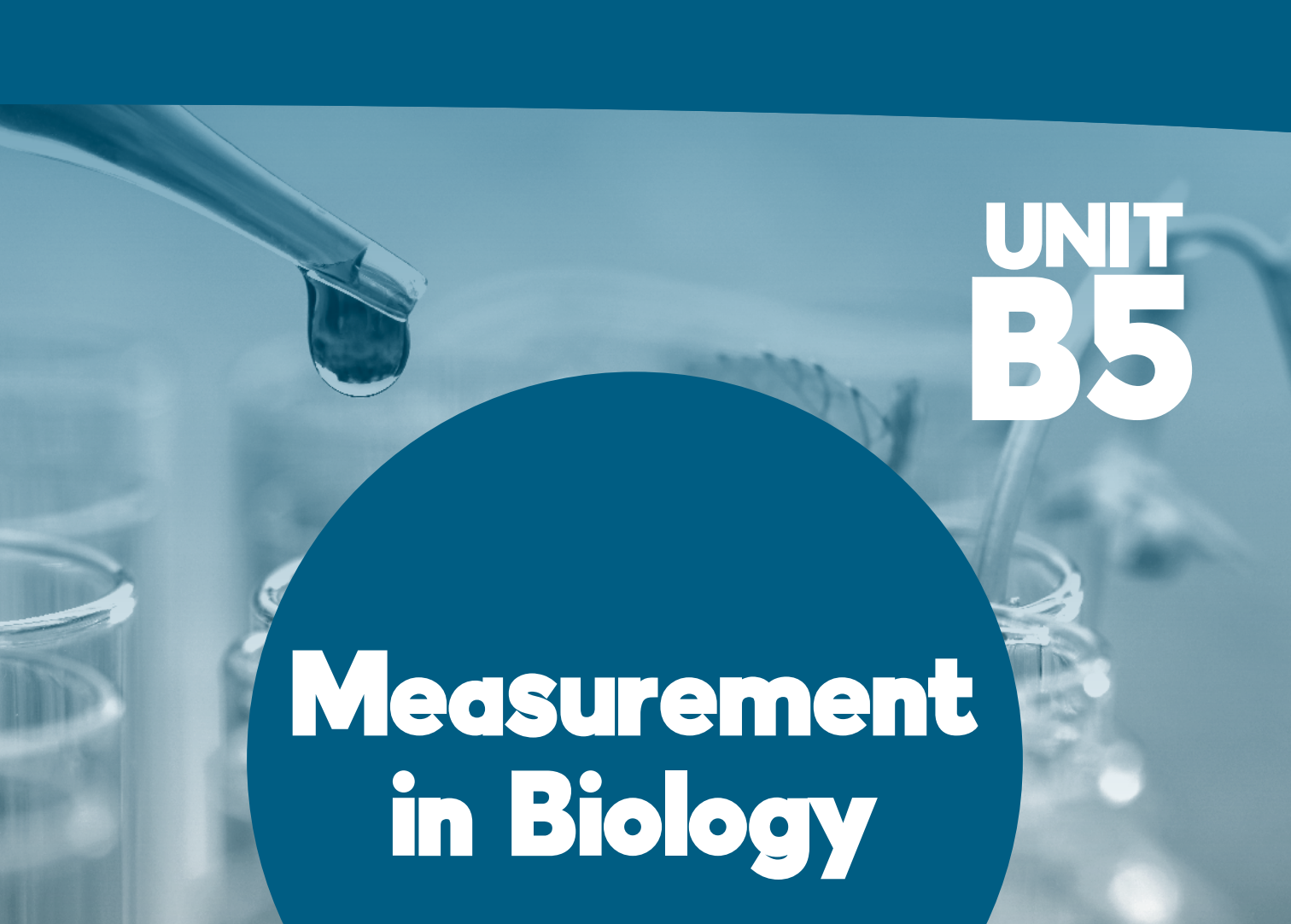
the average number of bubbles decreases from 25 to 19.

- ii. By how much did the average number of bubbles released per minute changed when the light is changed from red to green.

the average number changes from 25 to 15. It decrease by 10 bubbles.

- iii. Can you suggest why the average number of bubbles released per minute changed when light is changed?

A plant uses different colours of light during photosynthesis. It uses red light better than blue and blue better than green hence the number oxygen bubbles is higher in red then blue and green.



UNIT B5

Measurement in Biology

Learning Objectives

- Count and record the status of biodiversity (e.g., number of organisms/ species) in a given/selected ecosystem.
- Record amount of oxygen (e.g. number of bubbles) released during photosynthesis.
- Represent the recorded data using appropriate diagrams.
- Count pulse rate under different conditions (e.g. at rest, after exercise)
- Find out/calculate magnification of simple specimens under the microscope.

Since there are many practical investigations in Biology, it follows that the results of any investigation be recorded and displayed in such a way that anyone reading will clearly understand the procedure, result, interpretation and conclusion of the investigation.

In any practical investigation, there are variables. Variables are factors which are involved in an investigation. There are three main types of variables:

1. Dependent variable
2. Independent variable
3. Controlled variables – not important in graph plotting so we will not consider.

Dependent variable (DV)

This is the variable which is measured and recorded in an experiment. In simple experiments there is usually one dependent variable. E.g., no. of oxygen bubbles which are counted, pulse rate before and after exercise etc.

Independent variable (IV)

This is the variable which is changed in an experiment.

E.g.

- i. while counting pulse rate, we change the condition: before the exercise (at rest) and then after exercise. Thus, before and after are independent variables.
- ii. while counting no. of oxygen bubbles, the distance of the lamp is changed to vary light intensity. This, this change in light intensity is the independent variable.

Recording the results in a table

A table consist of columns and rows

↓ ↓
columns

LHC (IV)	RHC (DV)

While recording data in a table, the dependent variable should be recorded on the left-hand column (LHC) while the independent variable is recorded on the right-hand column (RHC).

E.g., let's consider the data recorded for the release of oxygen bubbles at different temperatures.

10°C 1 bubble ; 20°C 10 bubbles ; 30°C 25 bubbles ; 40°C 15 bubbles ; 50°C 5 bubbles

Here the dependent variable is **no. of bubbles** so it goes in the LHC while **temperature** is the independent variable so it goes on the RHC.

In a vertical table, the variables are recorded as follows:

Temperature/ $^{\circ}\text{C}$	RHC (DV)
10	1
20	10
30	25
40	15
50	5

In a horizontal table, the independent variable is shown on the top row while the dependent variable is on the bottom row.

Temperature/ $^{\circ}\text{C}$	10	20	30	40	50
No. of bubbles/arbitrary units	1	10	25	15	5

Graphical representation

There are different types of graphical representation depending on what is asked in the exam. Usually, line graphs and bar charts are asked.

(I) Line graph

Line graph is drawn when the data is continuous.

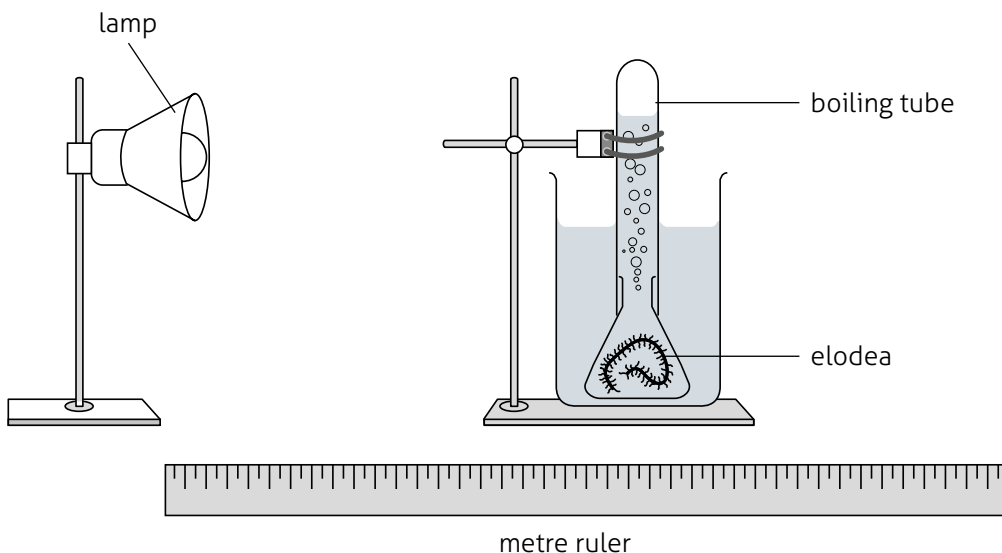
What maths skills do you need to draw a line graph?

1. Drawing the axes.	- Deciding which variable goes on which axis. - Choosing the range of each axis. - Choosing an appropriate scale.
2. Plotting the data points.	How to accurately plot each data point.
3. Drawing the line or curve of best fit.	Knowing how to draw a line or curve of best fit.

1. Drawing the axes

Worked example

A student investigated the relationship between light intensity and volume of oxygen produced by the pondweed *Elodea* during photosynthesis.



The equipment used to investigate how light intensity affects the rate of photosynthesis.

Distance between lamp and plant/cm	Number of oxygen bubbles produced in one minute
10	56
20	28
30	24
60	18
80	10
100	6

Table 1.1

Results from an investigation into how light intensity affects the rate of photosynthesis Draw the axes for a graph of this data.

Step 1: First, you need to decide which is the dependent variable and which is the independent variable.

In this example, the distance the lamp was from the plant was the variable being changed by the students so this is the independent variable. It goes on the **x-axis**.

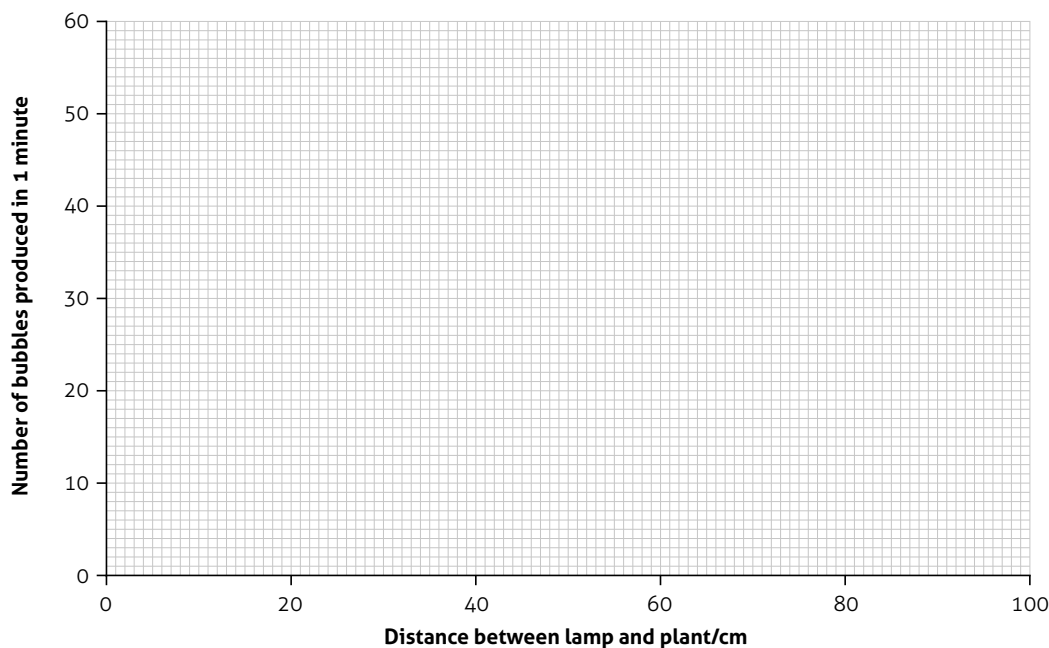
The number of bubbles produced in 1 minute changed as a result of moving the lamp, so this was the dependent variable. This goes on the y-axis.

Step 2: Next, you will need to work out a suitable scale for each axis. This is the same skill you learnt about previously when drawing bar charts. The only difference is, with a line graph, you will also need to choose a scale for the x-axis.

Note:

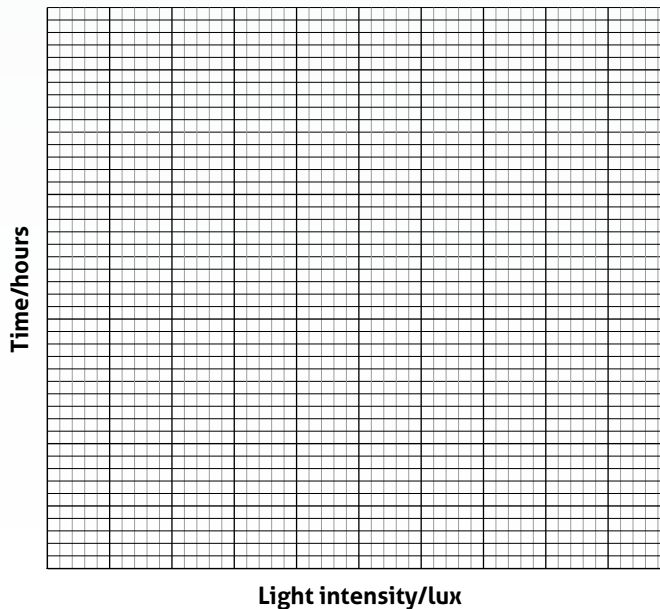
In the table, the values for the dependent variable do not increase by equal amounts: 10, 20, 30, 60, 80, 100. You must not plot these values on the x-axis, but instead make sure each large square has the same value, such as 0, 20, 40, 60, 80, 100.

Sometimes the independent variable in a table might not be in numerical order. For example, the student may have chosen to use a distance of 100 cm, not 10 cm first. Even if this is the case, you must always draw the axes so they start at 0 and then increase as you go along.



Practice
questions

1. A student investigated how the amount of carbon dioxide affected the rate of photosynthesis. He changed the concentration in the water surrounding a piece of Elodea and kept the light intensity the same. He measured the volume of oxygen produced in one minute.
 - a. What independent variable did he use? Circle the letter of your choice.
 - A. Light intensity
 - B. Length of the Elodea
 - C. Volume of oxygen produced in 1 minute
 -  Concentration of carbon dioxide
 - b. After collecting his results, he decided to draw a line graph. State what variable he should plot on the:
 - i. y-axis volume of oxygen produced in one minute
 - ii. x-axis concentration of carbon dioxide
2. The light intensity (in lux) of a point in a forest was measured over a period of 24 hours. The following sketch shows the axes labels for a line graph of the results.



Describe the mistake made in the labels.

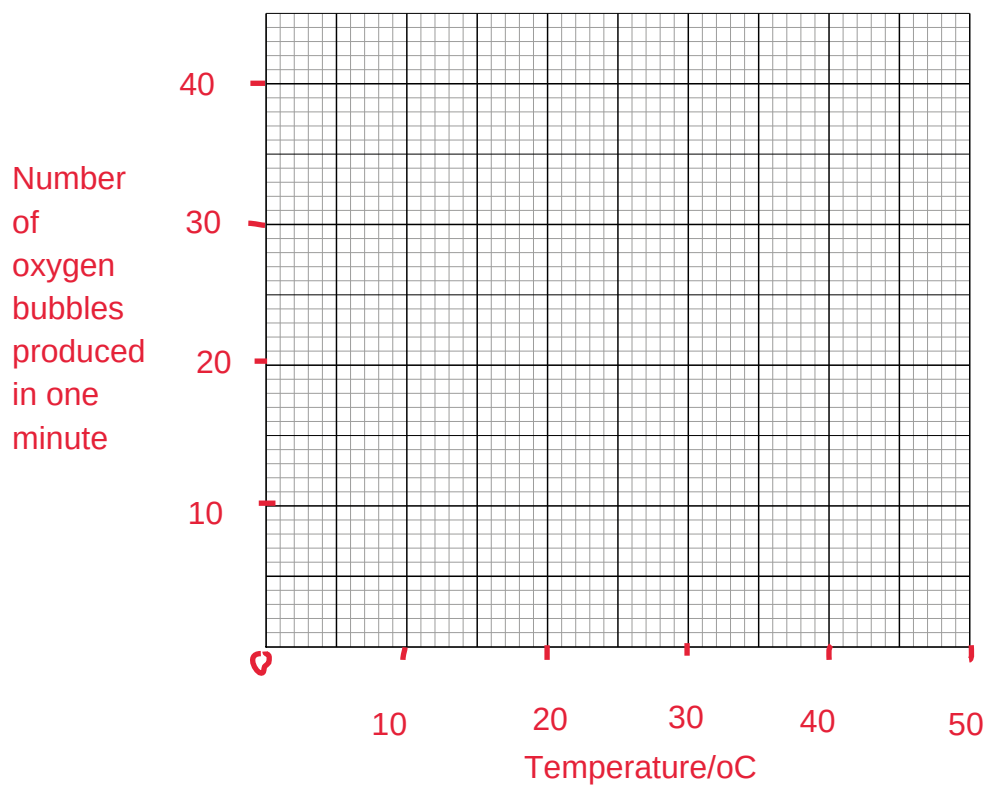
Time should have been in x-axis and light intensity in y-axis.

3. A student investigates the effect of temperature on the rate of photosynthesis. The table shows his results.

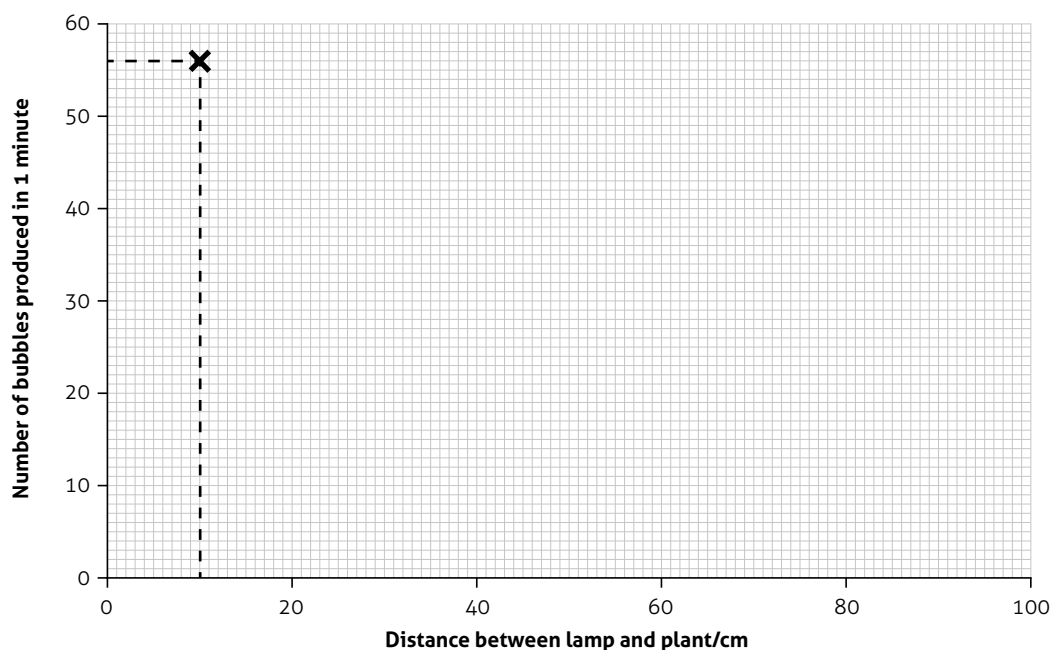
Temperature/ $^{\circ}\text{C}$	Number of oxygen bubbles produced in one minute
10	16
20	25
30	33
40	43
50	0

Complete the axes below. You should:

- Decide which variable to plot on which axis.
- Choose a suitable scale for both axes and write numbers and tick marks on them.
- Write labels for each axis.



2. Plotting the data points



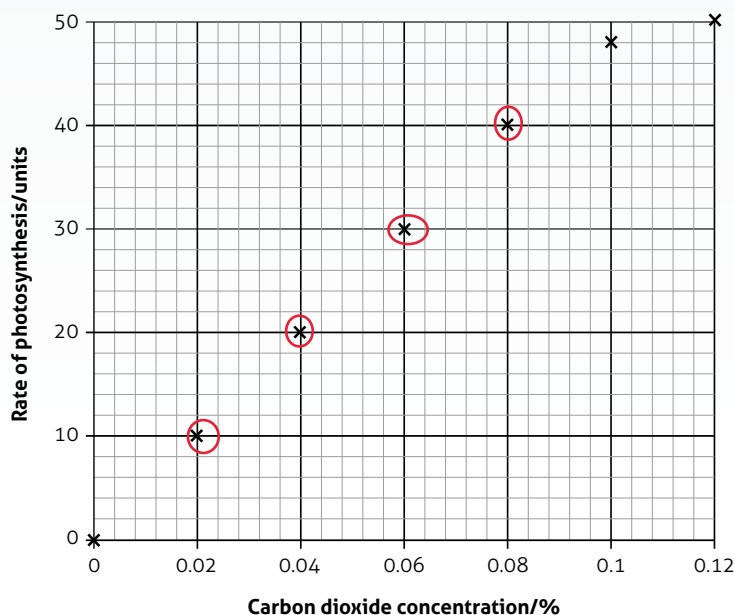
1. To plot this data point, find where 10 is on the x-axis and then travel up this line until you reach 56 on the y-axis. Draw a cross (x) or a small dot with a circle drawn around it (⊙) so the middle of the cross or dot is where these lines meet. Students should not use a dot alone (•) or filled circle (●) in order to ensure that examiners can give credit where it is due for correct plotting.
2. Carry on until you have plotted all the data points.
3. Use a ruler to guide you along the lines if you find it difficult.

Practice questions

1. A student found the following results table on the internet.

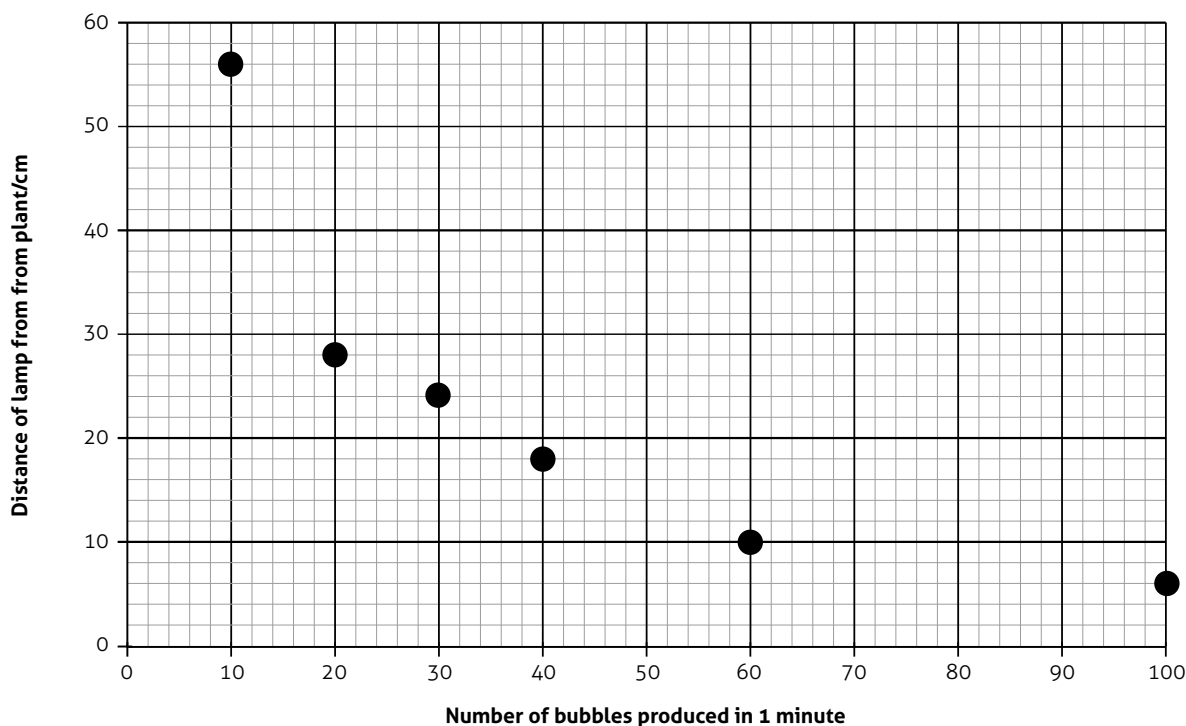
Carbon dioxide concentration/%	Rate of photosynthesis/units
0	0
0.02	20
0.04	34
0.06	40
0.08	45
0.1	48
0.12	50

- a. She plotted the data on a line graph.



- b. Circle any data points she has plotted **incorrectly**.

2. A student plotted his results from an investigation on photosynthesis. His graph is shown below.



- a. Describe what he has done wrong.

The plots are too large. The dots are too large.

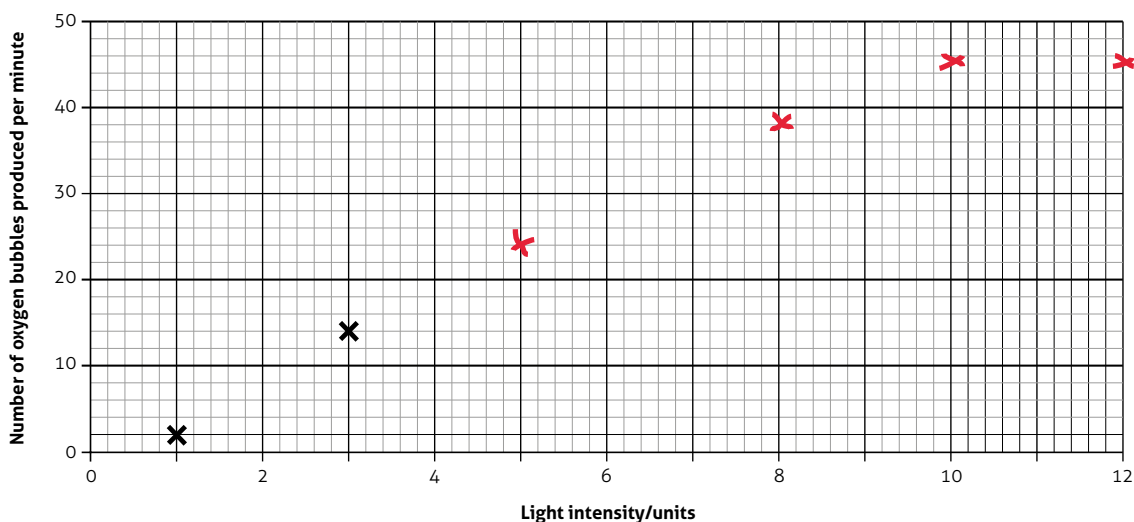
- b. Explain what he should do to rectify his mistake and why it is important he does.

He should put a dot in a circle or replace the dot by a cross.

3. The table shows some results for an investigation on photosynthesis.

Light intensity/units	Number of oxygen bubbles produced per minute
1	2
3	12
5	24
8	38
10	45
12	45

- a. Complete the following graph by drawing the remaining data points.

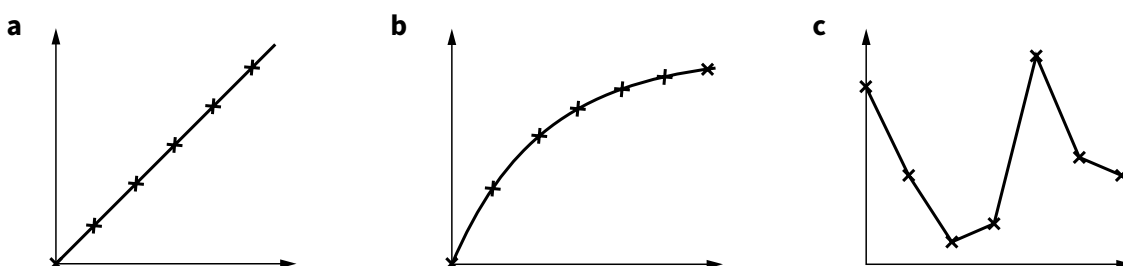


3. Drawing a line or curve of best fit

1. Joining the points

In biology the data you collect might be taken at intervals over time. For example, pollution levels once a month, or population size once every 5 years.

The data points should be joined with straight lines. The line could be straight (see Figure 3.12a), curved (see Figure 3.12b) or go up and down in a zig-zag fashion (see Figure 3.12c).



2. Drawing a best-fit line

Most of the line graphs you draw in biology are using results from an investigation where one variable affects another. In this case the data points will not be accurate because of errors, so you will draw a best-fit line to show the trend of the data.

Worked example

Follow these steps:

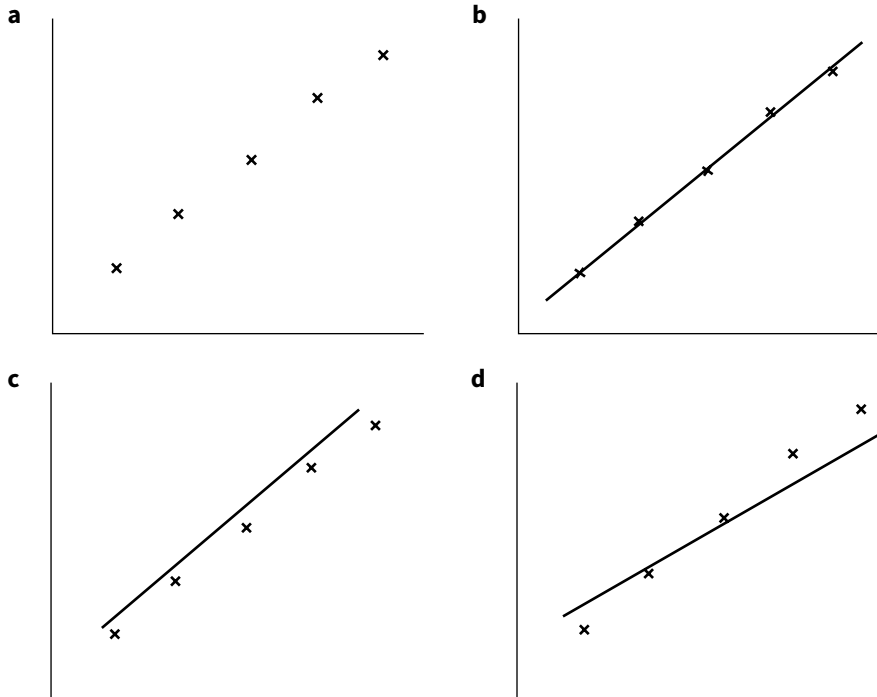
Step 1: Place a transparent ruler along the data points. This will allow you to see all the points so you can judge where to draw the line.

Step 2: Decide if the line should go through the origin (0,0).

Step 3: Move the ruler so there are roughly the same number of points, evenly spread, above and below the line.

Step 4: Use a sharp pencil to draw the line.

The line of best could be a curve. The same rules apply – try to draw a line that passes by most of the points.



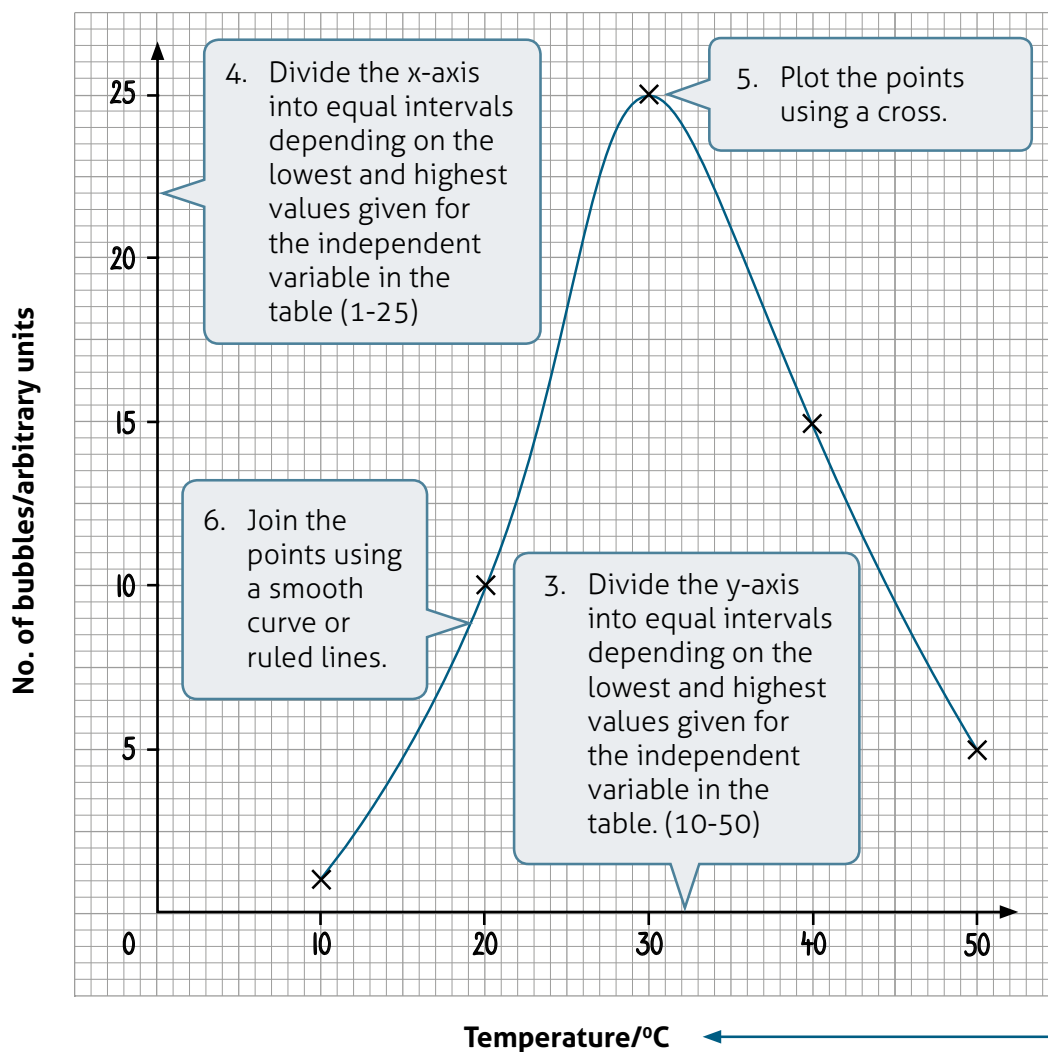
The line drawn in **b** is an example of a good line of best fit. **c** and **d** are not good lines of best fit; in **c** the line is too high and in **d** the line has the wrong gradient (steepness).

Summary of plotting a line graph

Temperature/ $^{\circ}\text{C}$	10	20	30	40	50

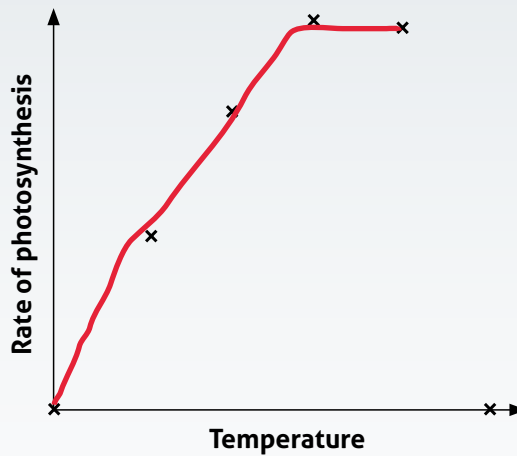
2. No. of bubbles is the dependent variable so, it goes on the y-axis.

1. Temperature is the independent variable so, it goes on the x-axis.

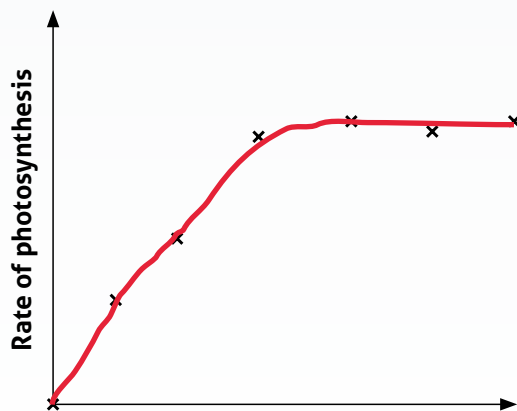


Practice questions

1. The graph below shows the results from an investigation into how temperature affects the rate of photosynthesis.
- a. Draw a curve of best fit on the graph.

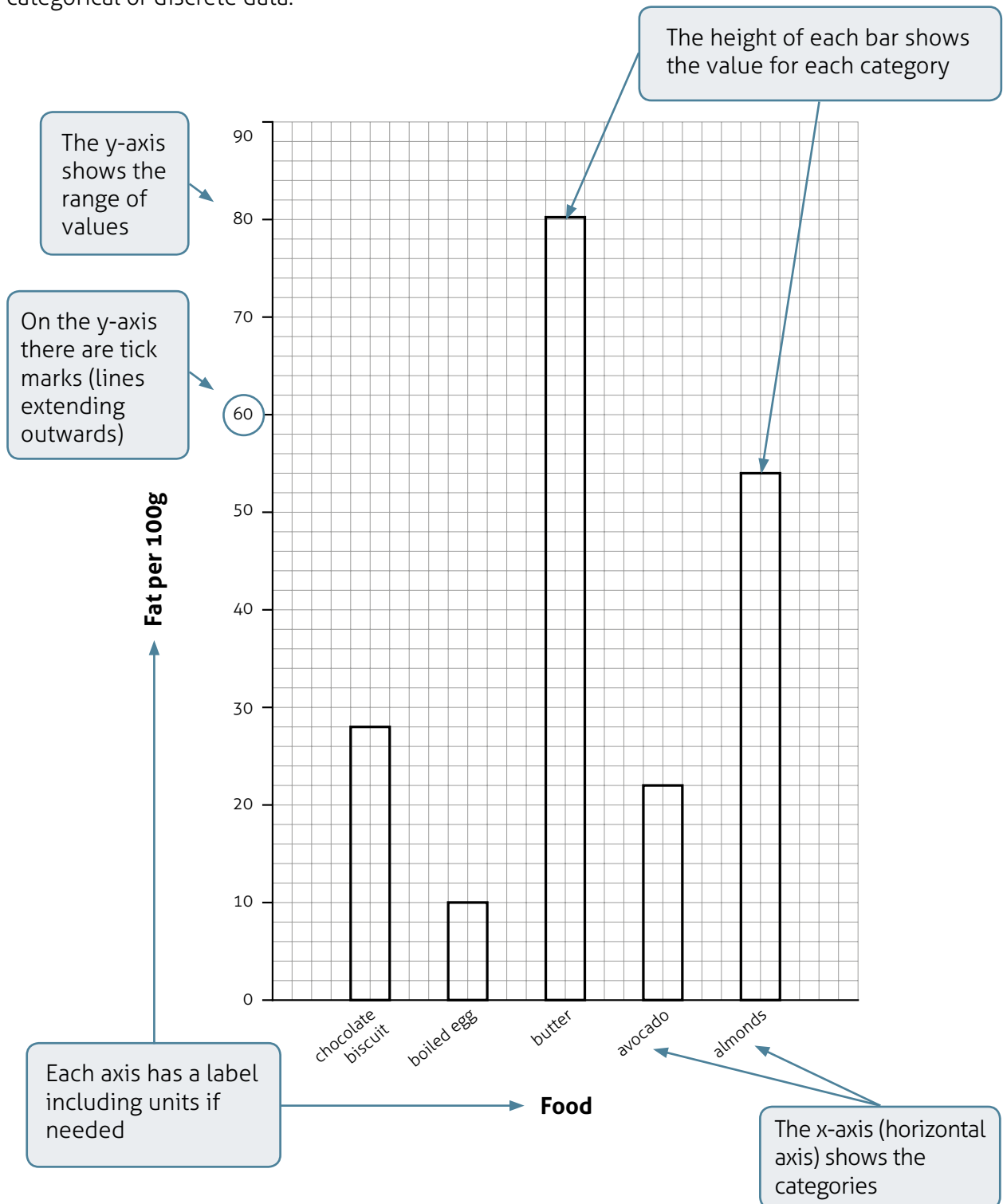


- b. Draw a curve of best fit on the graph below.



Drawing bar charts

Bar charts are used to show data that can be sorted into different categories. This might be categorical or discrete data.



A bar chart can be used to compare the amount of fat in different foods.

What maths skills do you need to draw a bar chart?

1. Choosing a suitable Scale for the y-axis	- Choose the scale so all the data can be included. - Aim to use as much of the graph paper as you can. - Avoid scales that make the values hard to read.
2. Drawing the bars	- Show each category by one bar. - Make all the bars the same width and separate them with a gap. - Draw the bars as accurately as you can to the correct height.

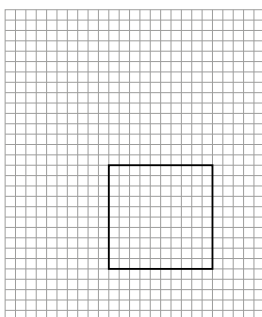
1. Choosing a suitable scale for the y-axis

In the bar chart showing blood groups, the y-axis is going to display the number of people. The lowest number of people is 2 and the highest is 28.

It is always best to start the y-axis at 0 (unless all the numbers are very large). So, for this bar chart the y-axis will start at 0 and go up to at least 28.

Graph paper is normally divided up into large squares, see Figure 3.2. Each square contains many smaller squares, normally: $10 \times 10 = 100$

The side of each large square on the graph paper should have a value of 1, 2 or 5 multiplied by a power of 10.



For example, you could choose :

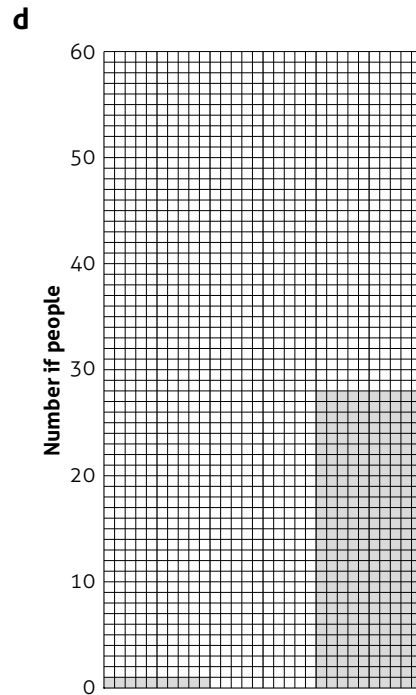
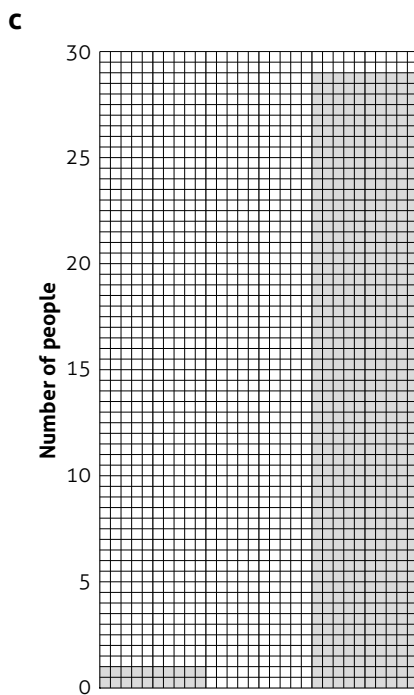
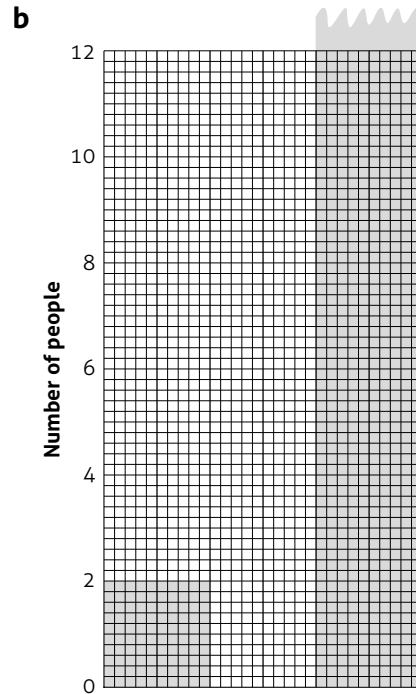
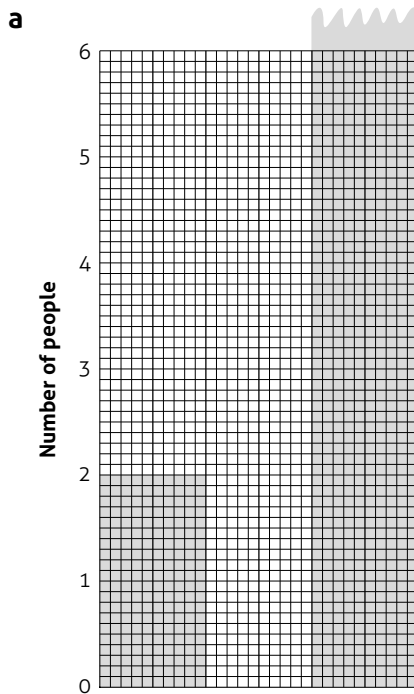
One large square on this graph paper

Worked example

The table shows the number of people with different blood groups

Blood group	Number of people
A	24
B	6
AB	2
O	28

- a. Which of these scales would you choose? Explain.



The scale in **C** would be the best choice.

This is because in A and B the scales mean that the bar for 28 people will not fit on the paper.

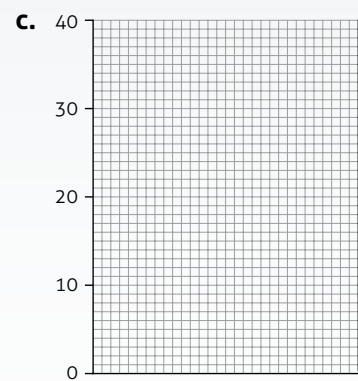
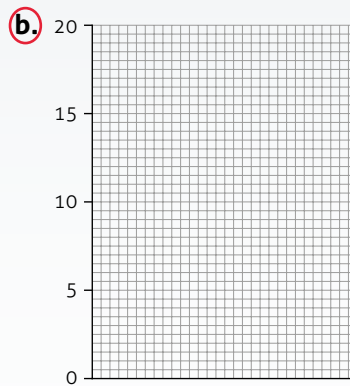
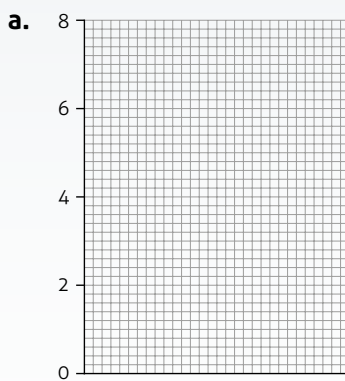
The scale in D results in the bar for two people being too small to read easily.

Practice
questions

1. Some people can roll their tongue and others cannot. The number of students who can or can't roll their tongue in a class was counted. The data are shown in the table below.

Tongue roller	Number of students
yes	18
no	12

- a. Which y-axis scale (A – C) is the best choice to display this data? Draw a circle around the correct letter.



2. A student collected data on the colour of flowers on different pea plants. His data are shown in the table below.

Colour of flowers	Number of plants
white	82
yellow	26
red	14

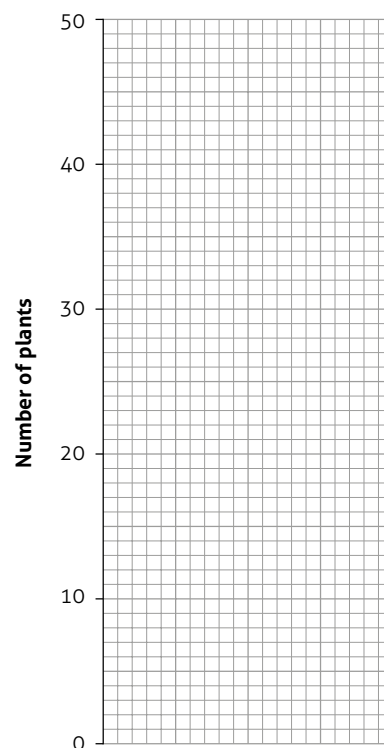
He starts to write the scale on the y-axis on the graph paper as shown below.

- a. Explain what he is doing is wrong and why.

Th emaximum scale is above 80 while
in his graph it stops at 50.

- b. Suggest how he should draw the scale.

He should use 5 squares for 10 units.



2. Drawing the bars

- Draw bars to extend from the x-axis.
- Each bar represents one category.
- The height of the bar shows the value for each category.

If we consider the table for the blood group data seen above, the steps needed to draw the bars are as follows

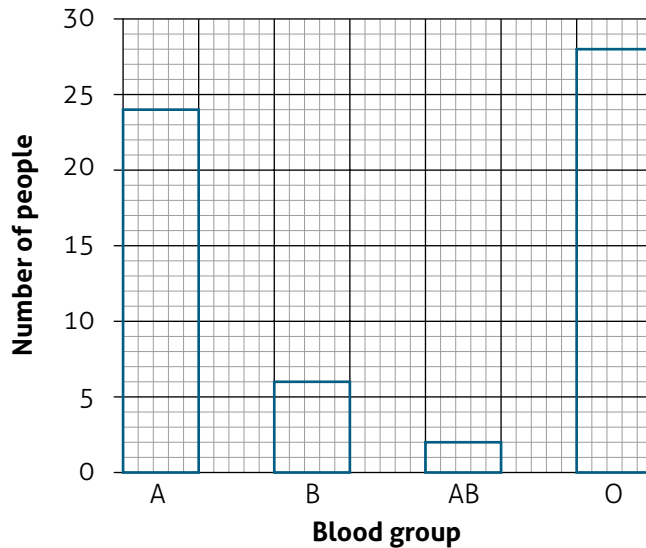
Blood group	Number of people
A	24
B	6
AB	2
O	28

1. Draw a line for the x-axis.
2. Draw the bars in order of the rows in the table. So, for this chart the first bar will show the number of people with blood group A. Use a ruler to draw the first bar next to the y-axis.
Use the scale to work out where the top of the bar should be. Using this scale, two small squares represent 1 person. There is no need to colour the bars in.
3. Underneath the bar, write the name of the category.
4. Leave a gap and draw the next bar. The size of the gap is not important, as long as the bars are not touching.

Key questions to ask:

- a. How many bars will you need to draw?
There are four blood groups, so there will be four bars.
- b. How wide will each bar be?
Work out how you will fit the four bars on your grid.
- c. How much space will you leave between each bar? Allow the same amount of space between each.

5. Underneath the x-axis, write the label (copy this from the table). For this chart, it is 'Blood group'.



Practice questions

1. A student collected data on the number of boys in each year in his school. His data are shown in the table.

Year	Number of boys
7	120
8	89
7	101
8	117
9	95

He draws a bar chart.

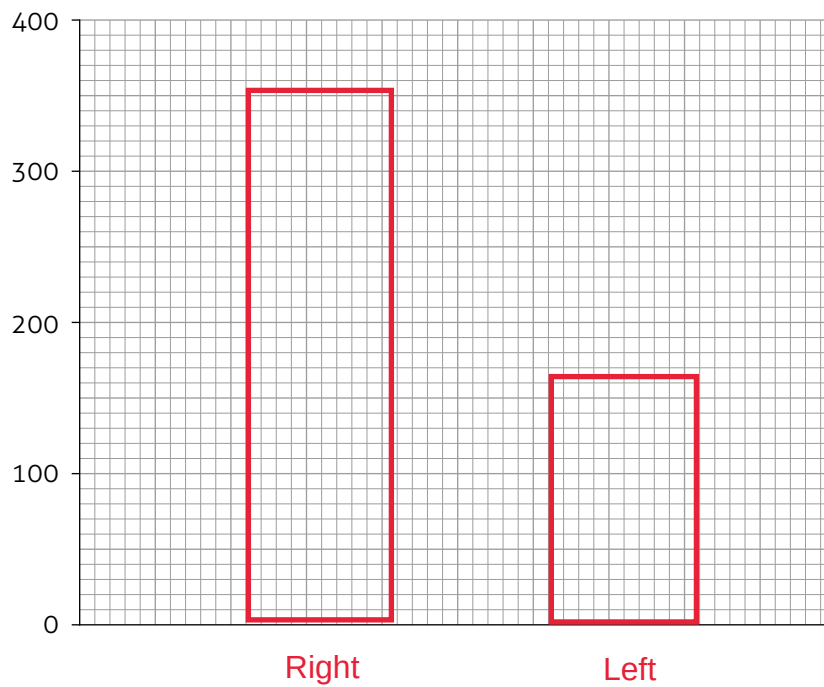
a. State the title of the x-axis. **year**

b. State the name of the first bar he will draw. **year 7**

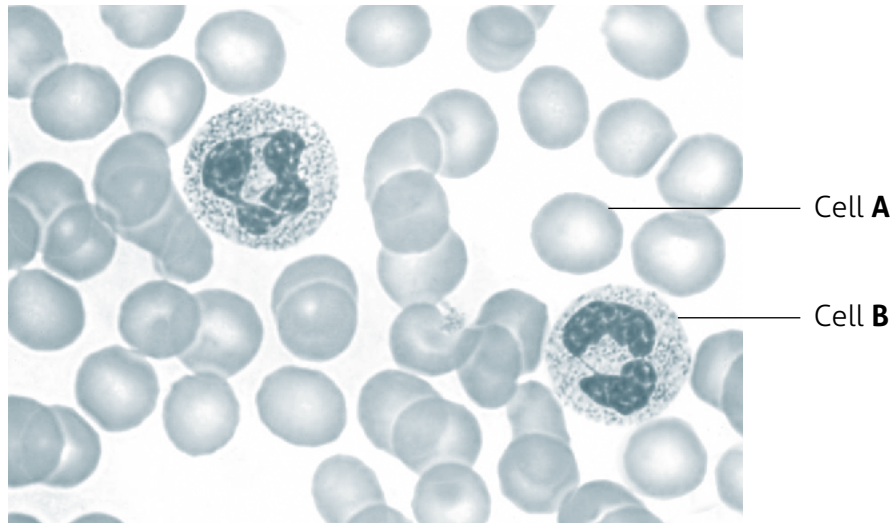
2. The student then collected data on how many boys in the school were left or right-handed. His data are shown in the table.

Handedness	Number of boys
Right	354
Left	168

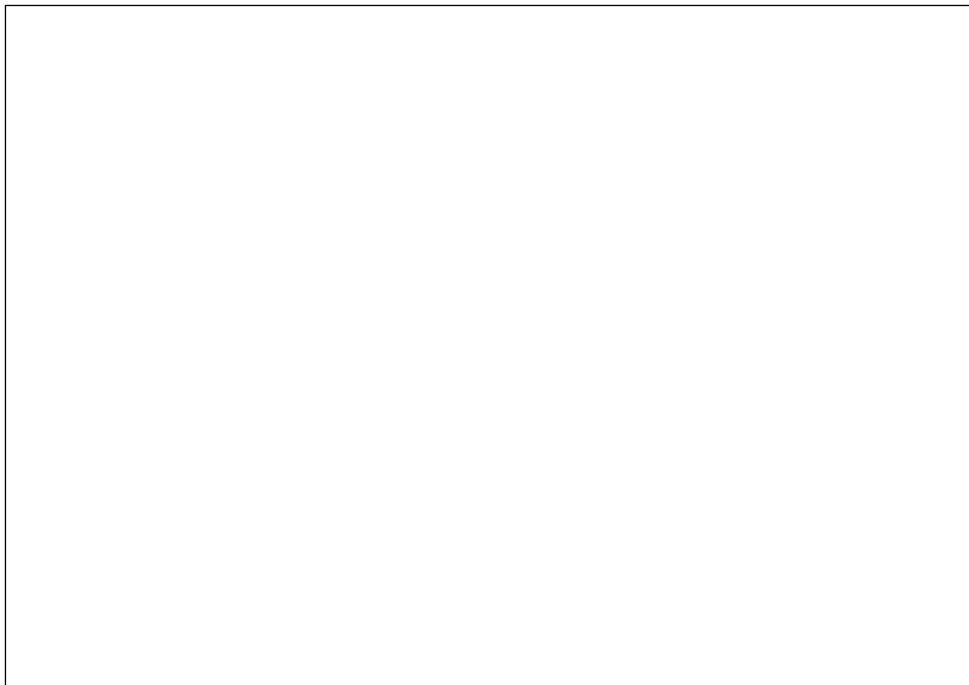
- a. Complete the bar chart to show the data.



Drawing skills

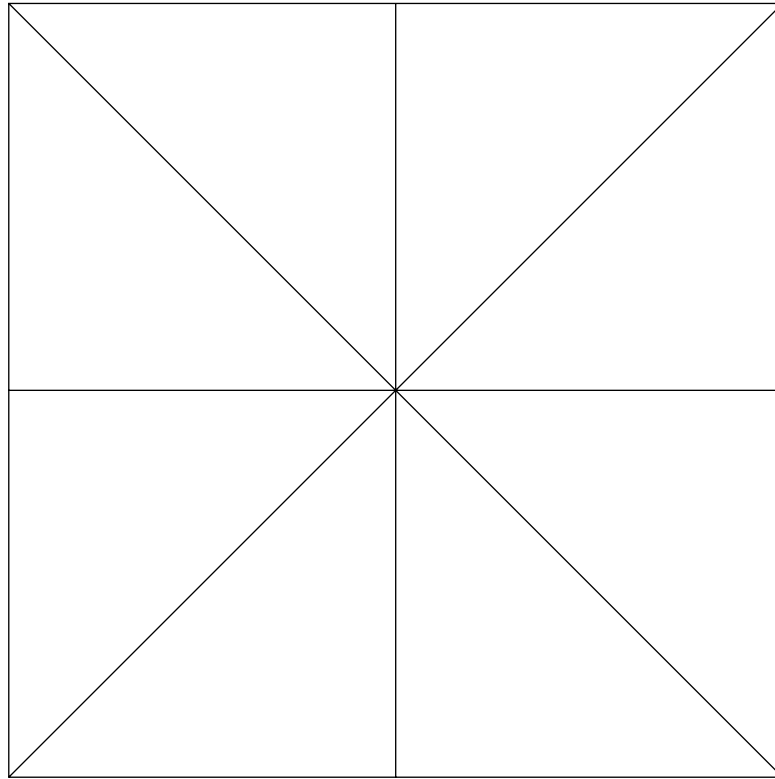
**Fig. 1.1**

1. Make a large drawing of cell B in the space below



Steps in drawing a cell in Biology

1. Divide the drawing space into halves and diagonals as shown below.



2. Repeat the same thing in Fig. 1.1 to enclose cell B as shown below.

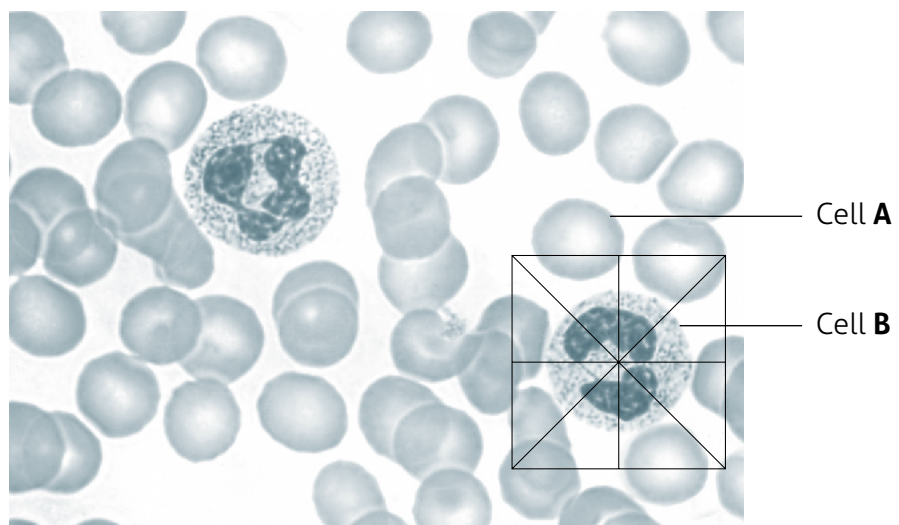


Fig. 1.1

3. Mark the boundaries of cell B wherever it touches the lines drawn in the grid.

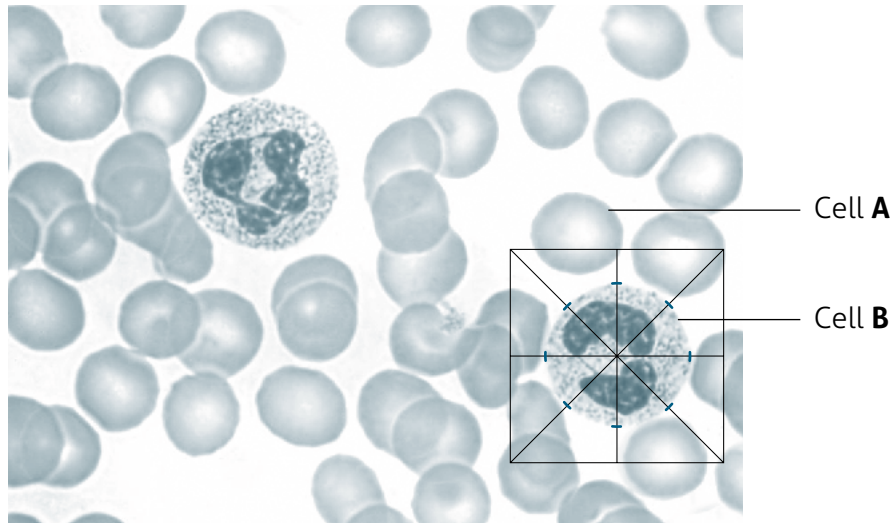
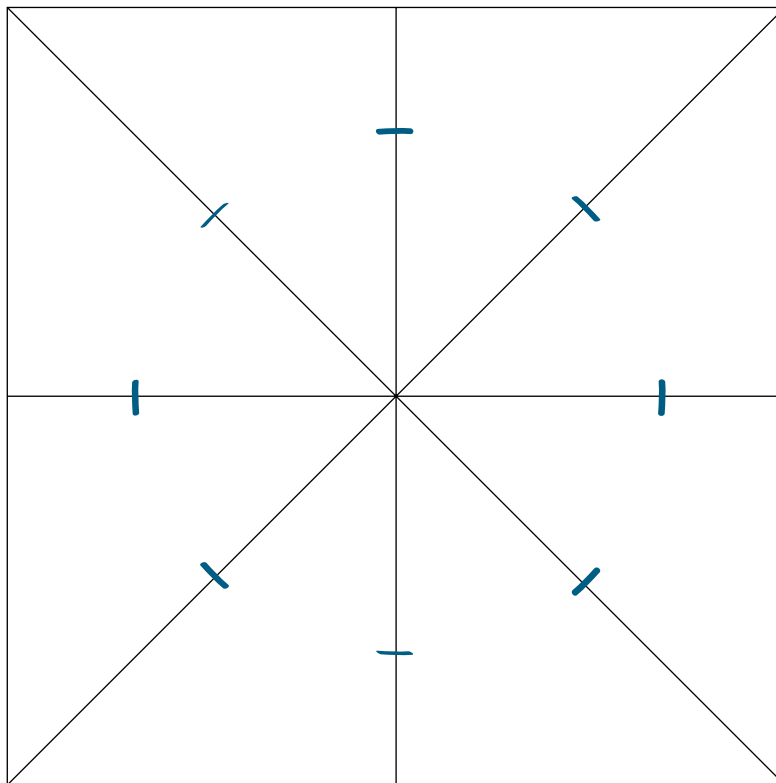
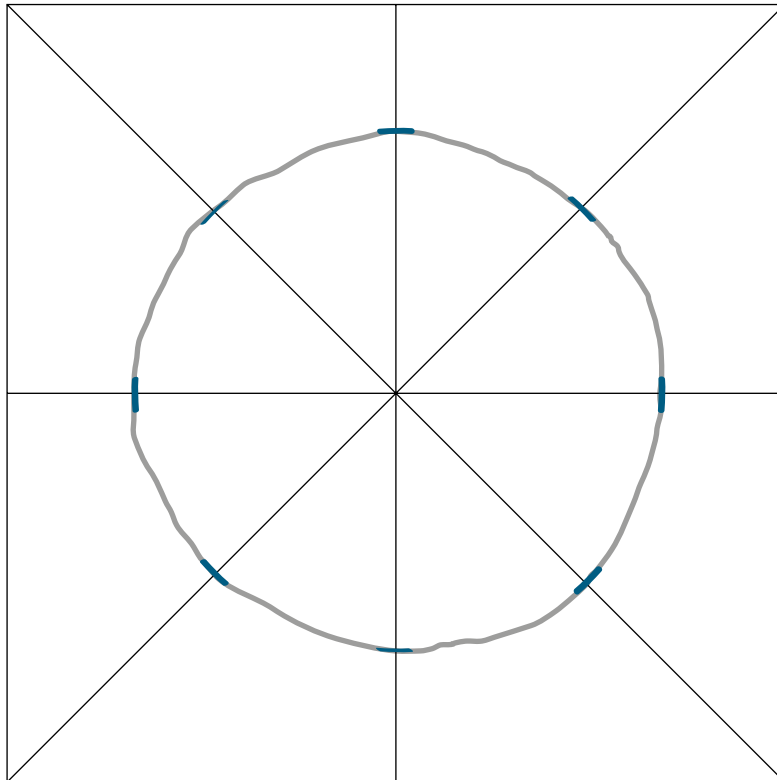


Fig. 1.1

4. Multiple each measurement by 2 since the drawing space is large and mark in the same way in the drawing space.



5. Start joining the demarcations draw approximately into a similar shape as cell B.



6. Repeat the demarcations for the nucleus inside both in the image and in the drawing space.

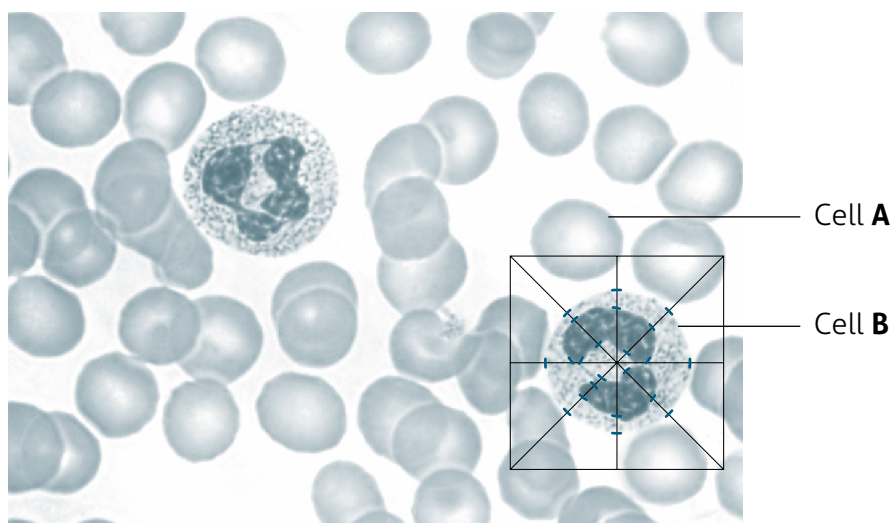
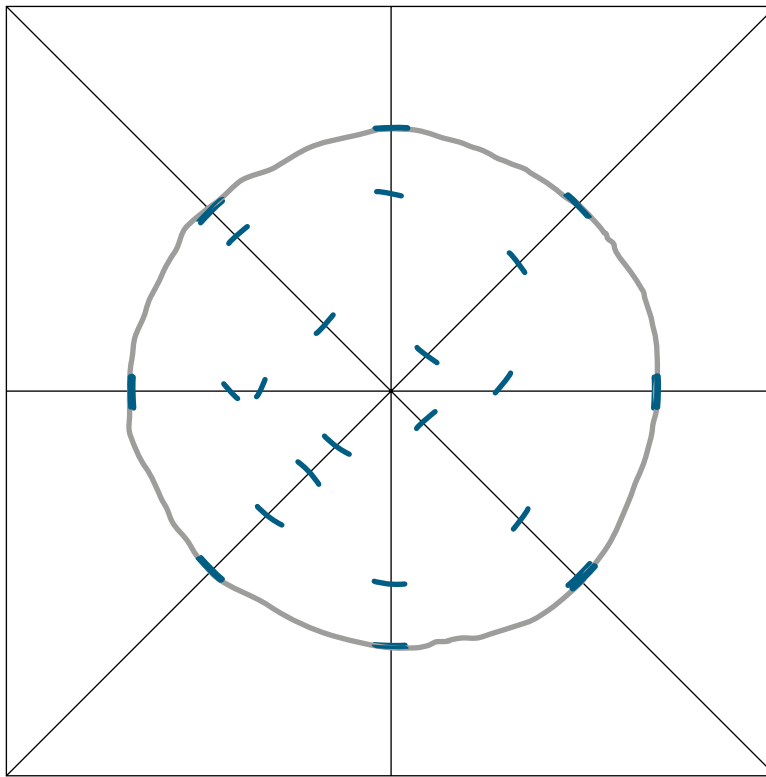
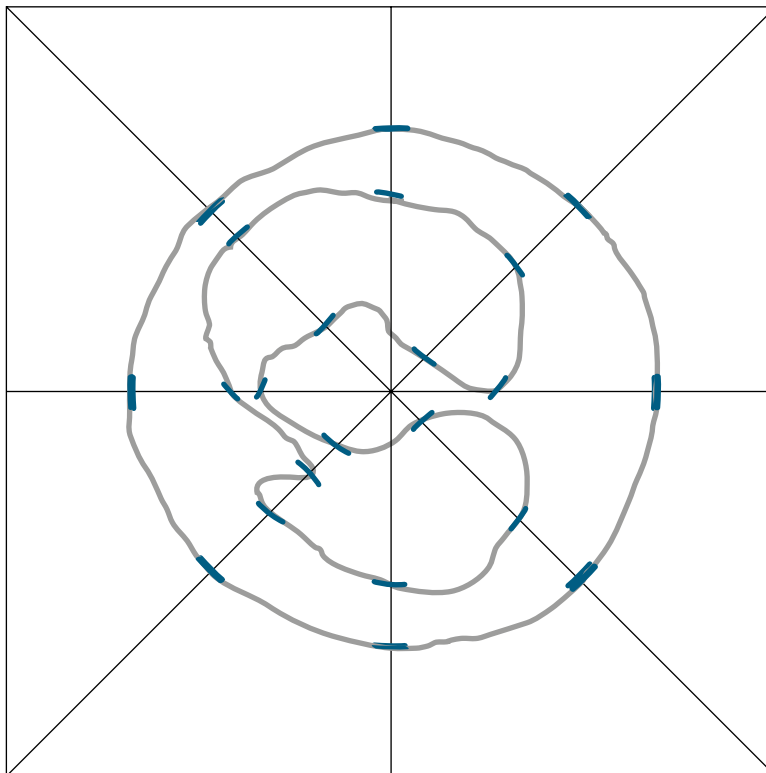


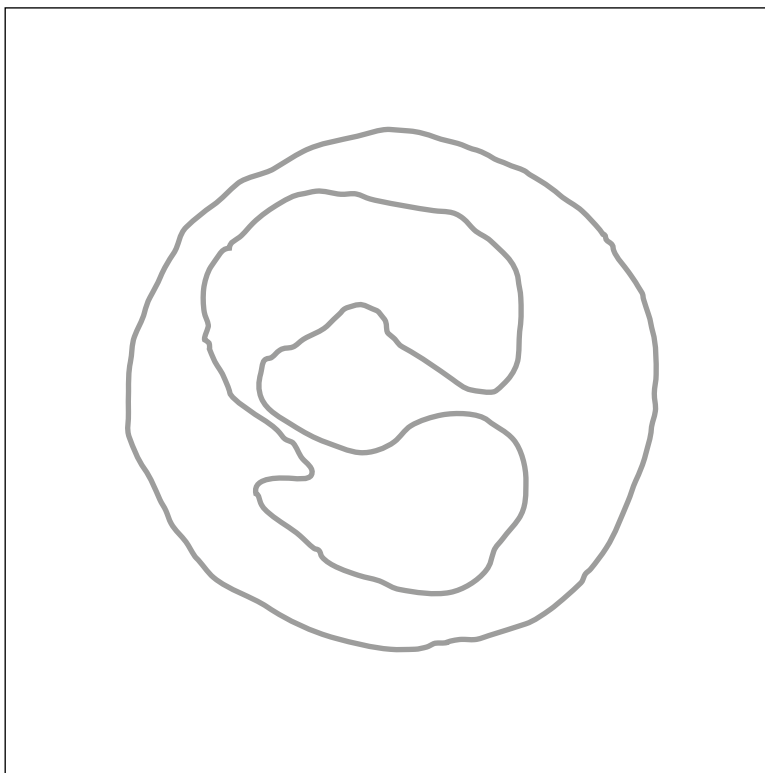
Fig. 1.1



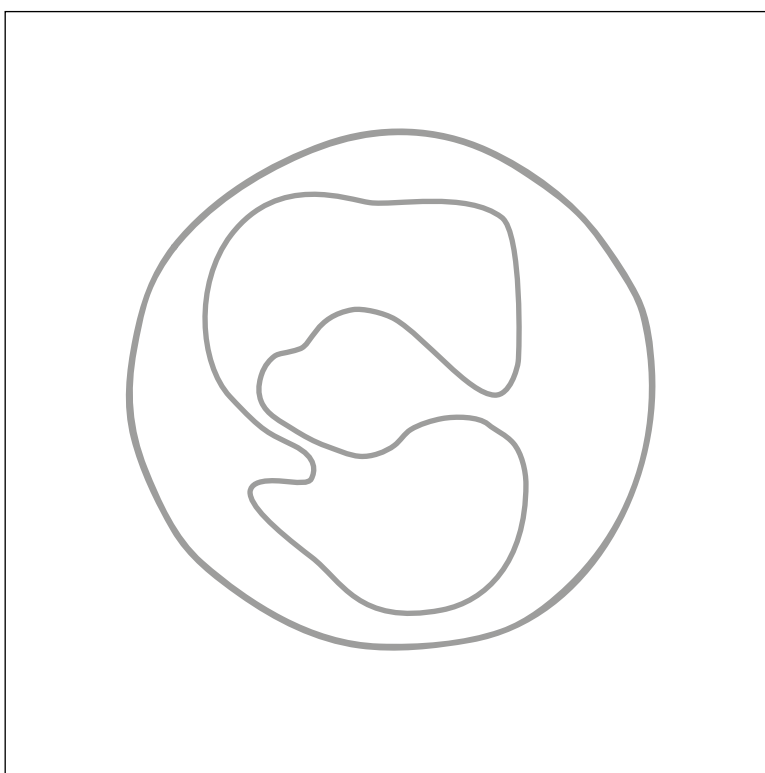
7. Join the markings to draw the lobed nucleus.



8. Erase all the markings and guidelines from the drawing space.



9. Now refine the drawing by making the lines smooth.



Calculating magnification

The drawing of an image is usually larger than the image.

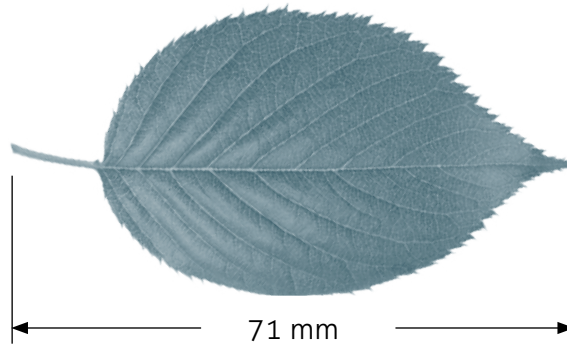
Magnification is the number of times a drawing is greater than an image.

It is calculated using the formula given below.

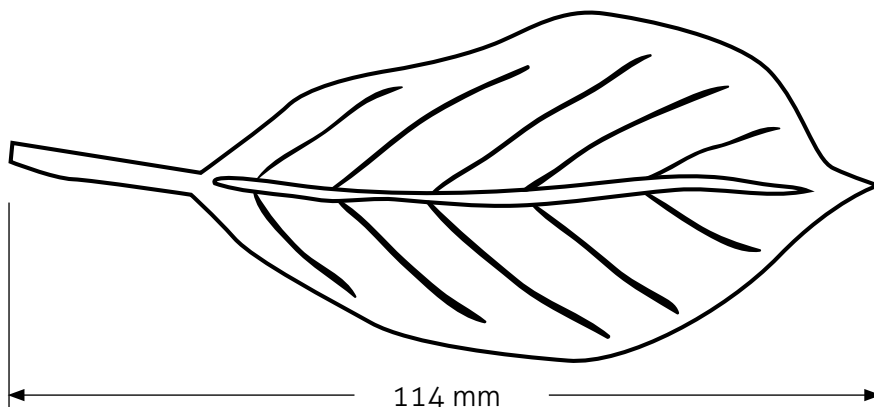
$$\text{Magnification} = \frac{(\text{size of drawing})}{(\text{size of image (actual size)})}$$

Worked example

1. The image below shows a leaf. Make a large drawing of the leaf and calculate the magnification of the drawing.



size of image = 71mm



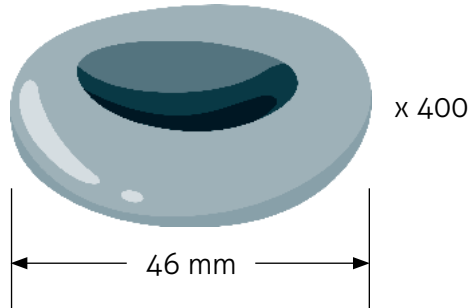
size of image = 114mm

$$\begin{aligned}\text{Magnification} &= \text{size of drawing/size of image} \\ &= 114 \text{ mm}/71 \text{ mm} \\ &= \times 1.6\end{aligned}$$

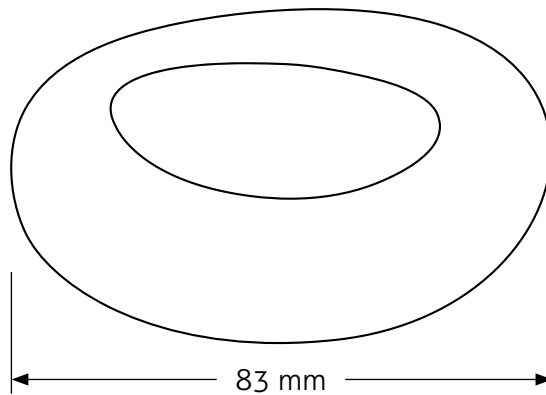
Remember magnification has no unit.

Calculating magnification using magnification factor.

2. Make a large drawing of the red blood cell and calculate its magnification using the magnification factor $\times 400$.



size of image = 46mm



size of image = 83mm

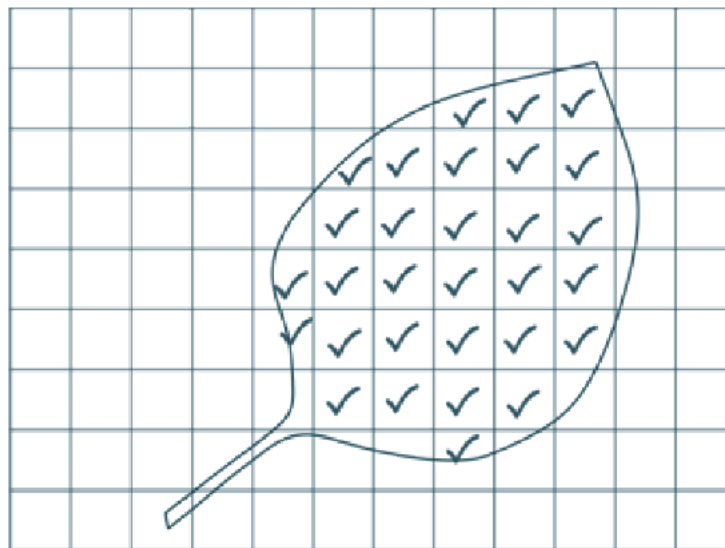
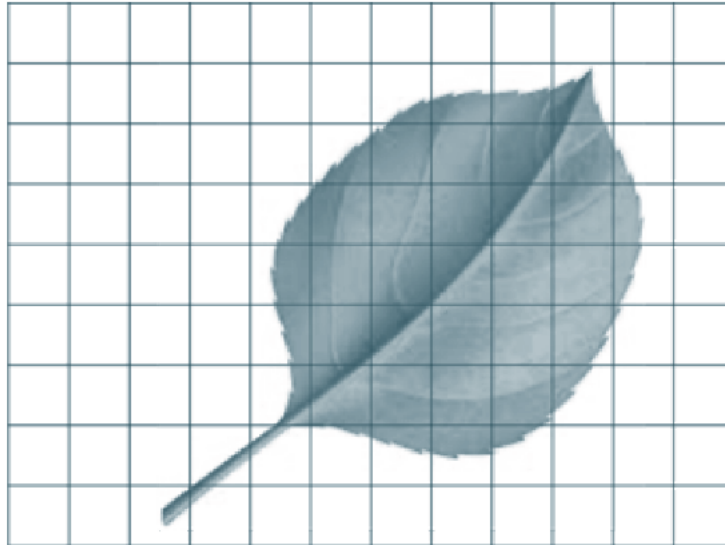
$$\text{Magnification} = \frac{\text{size of drawing}}{\text{size of image (actual size)}} \times \text{magnification factor}$$

$$\text{Magnification} = \frac{83 \text{ mm}}{46 \text{ mm}} \times \text{magnification factor}$$

$$= \times 722 \text{ (to the nearest whole number)}$$

Estimating the surface area of a leaf

1. Area of a leaf can be estimated by tracing the shape of the leaf on a grid of dimension 1 cm and then count the number of squares covered by the shapes.



2. Squares that are more than 50% covered by the shape are counted as 1cm^2 each.
3. Using the method given above, the area of the leaf is found to be approximately 27 cm^2 .

SCIENCE (N 530)
BIOLOGY SECTION

TIME: 45 MINUTES

Additional Materials: Ruler

Specimen paper

October 2020

Read these instructions first

1. Write your Index Number in the space provided above.
2. Write in dark blue or black ink.
3. Answer **all** questions.
4. All answers must be written in the spaces provided.
5. You may use a soft pencil for any diagrams, graphs or rough working.
6. Any rough working should be done in this booklet.
7. Do not use correction fluid.
8. Calculators are not allowed.
9. The total of the marks for this paper is **50**.
The number of marks is given in brackets for each question or part question.
10. Check that this assessment booklet consists of **5** questions printed on **11** pages from pages 2 to
11. Any discrepancy in the document must be immediately notified to the invigilator.

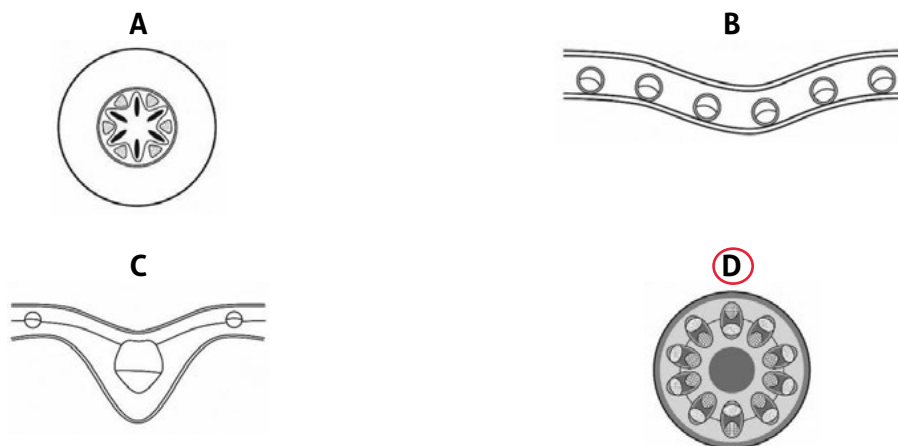
NCE – SCIENCE (BIOLOGY SECTION) SPECIFICATIONS

Topic/ Content Strand	Question Number	Learning Outcomes (Syllabus)	Page No in Textbook Grade 9	Assessment Objectives									Total
				AO1: Knowledge with Understanding			AO2: Application			AO3: Scientific Inquiry and Problem Solving Skills			
				Basic	Intermediate	Proficient	Basic	Intermediate	Proficient	Basic	Intermediate	Proficient	
Transport in Animals	1(1)	B1.4		1									
	1(2)	B1.2		1									
	1(3)	B1.7		1									
	4(a) (i)	B1.3					2						
	4(a) (ii)	B1.3						2					
	4(b) (i)	B1.6		1									
	4(b) (ii)	B1.5						1					
	4(b) (iii)	B5.4									1		
	4(b) (iv)	B5.4									1		
	4(c) (i)	B1.2						1					
	4(c) (ii)	B5.5										2	
	4(c) (iii)	B5.5									1		
	4(c) (iv)	B5.5										2	
Nutrition in Plants	1(4)	B4.6		1									
	1(5)	B4.8		1									
	5(a) (i)	B5.2						1					
	5(a) (ii)	B4.9				1							
	5(a) (iii)	B4.2				1							
	5(a) (iv) 1.	B5.2										2	
	5(a) (iv) 2.	B5.3											2
	5(a) (v)	B5.3										1	
	5(a) (vi)	B4.10											1
	5(b)	B4.3				2							
Reproduction	1(6)	B2.2		1									
	1(7)	B2.5						1					
	1(8)	B2.4		1									
	1(9)	B2.3		1									
	2(a)	B2.3		4									
	2(b)	B2.2		3									
Biodiversity	1(10)	B3.4						1					
	3(a) (i)	B3.1		1									
	3(a) (ii)	B5.1		1									
	3(a) (iii)	B3.5		1									
	3(a) (iv)	B3.4		1									
	3(b) (i)	B3.4		1									
	3(b) (ii)	B3.4		1									
	3(c) (i)	B3.4		1									
	3(c) (ii)	B3.4						1					
Total marks				23	4	0	7	3	0	1	9	3	50
Total of the AOs				27			10			13			50
% of each AO				54			20			26			100

Basic: 62%
Intermediate: 30%
Proficient: 6%

Question 1 (10 marks)**Circle the correct answer.**

1. Which organ **pumps** blood to all parts of the body?
☒ A Heart
B Liver
C Lungs
D Stomach
2. Which one of the following is a function of blood **platelets**?
A They transport oxygen
B They produce antibodies
☒ C They help in blood clotting
D They transport digested food
3. Which one of the following can result in the development of cardiovascular diseases?
A Mosquito bites
☒ B A diet high in fat
C A diet high in vitamins
D Physical exercises
4. Which one of the following diagrams shows vascular bundles in the cross-section of a stem?



5. Which one of the following is a function of the **xylem** vessel in plants?
- A It transports food
 - ☒ B It transports water
 - C It transports oxygen
 - D It transports carbon dioxide
6. Which one of the following is the mode of reproduction of **yeasts**?
- A Laying eggs
 - B Giving birth to their young
 - ☒ C Forming small buds
 - D Splitting into 2 new cells
7. The table below shows the number of females with HIV/AIDS from 2014 to 2017 in Mauritius.

Year	Number of females with HIV/AIDS
2014	322
2015	262
2016	320
2017	369

In which year was there the **smallest** number of females with HIV/AIDS?

- A 2014
 - ☒ B 2015
 - C 2016
 - D 2017
8. Which one of the following is an example of a **sexually transmitted disease**?
- A Cancer
 - B Diabetes
 - C Malaria
 - ☒ D Syphilis

9. Fig. 1.1 shows the male reproductive system in humans.

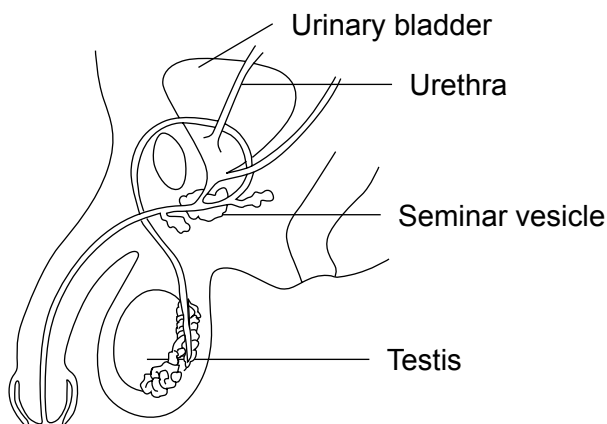


Fig. 1.1: Male reproductive system

In which part are the male **gametes** produced?

- A Seminal vesicle
 - ☒ B Testis
 - C Urethra
 - D Urinary bladder
10. Fig. 1.2 shows some of the effects of human activity on a river.

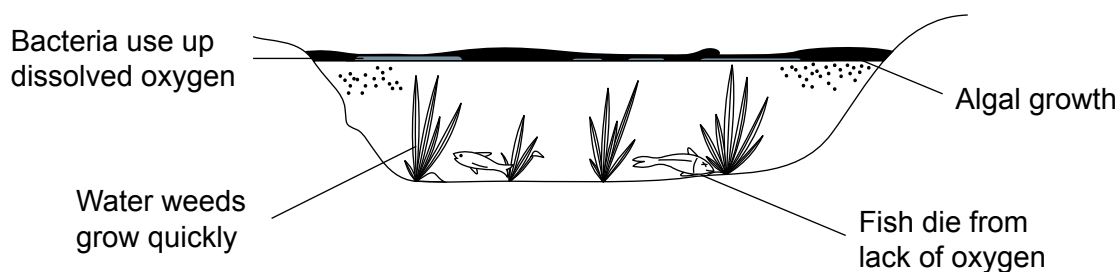


Fig. 1.2: Part of a river ecosystem

Which one of the following is the direct cause of these effects?

- ☒ A Run-off of fertilisers
- B Global warming
- C Air pollution
- D Oil spill

Question 2 (7 marks)

(a) Fig. 2.1 shows part of the female reproductive system in humans.

On the diagram, label parts **A** to **D** using the appropriate word from the list below:

Fallopian tube, Ovary, Vagina, Uterus, Cervix

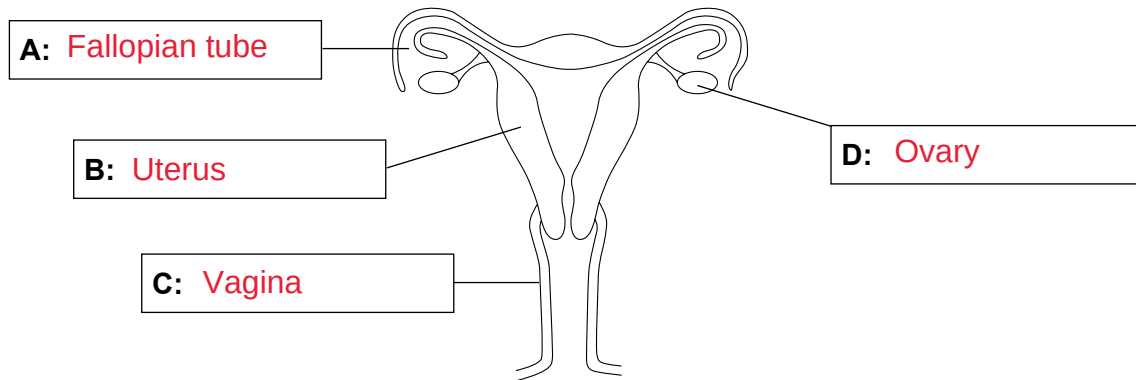


Fig. 2.1: Female reproductive system

[4]

(b) Put a tick [✓] or a cross [X] in each box to show the mode of reproduction of the different organisms given in the table below.

An example is done for you.

Organisms	Mode of reproduction	
	Asexual reproduction	Sexual reproduction
Humans	x	✓
Amoeba	✓	X
Spider plant	✓	X
Kestrel	X	✓

[3]

Question 3 (8 marks)

(a) Fill in the blanks with the words provided from the list below:

conservation extinction biodiversity ecosystem erosion quadrat

- (i) The variety of plants and animals in a defined area is known as the area's ecosystem.
- (ii) A quadrat is used to estimate the number of organisms such as plants, algae or slow-moving animals in a defined area.
- (iii) The protection, restoration and management of natural resources is known as conservation.
- (iv) Overfishing of fish such as the blue tuna can lead to the extinction of the species.

[4]

(b) Fig. 3.1 shows the changes in native forest cover in Mauritius from 1638 to 1997.

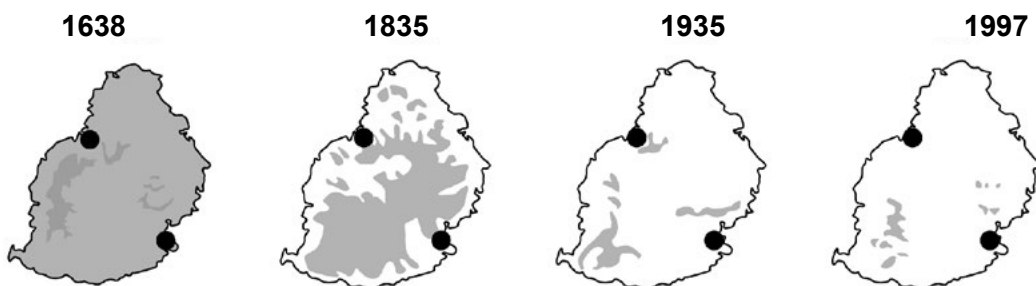


Fig. 3.1: Native forest cover

- (i) Name the process responsible for the changes in the forest cover over the years.
Deforestation
- (ii) Give one consequence of the decrease in the native forest cover.
Increase in soil erosion and flooding.

[1]

[1]

(c) Fig. 3.2 shows the growth of Chinese guava in the native forests of Mauritius.



Fig. 3.2: Chinese guava plants in Mauritius

Chinese guava plants compete directly with native plants for water, sunlight and space.

- (i) What is the name given to such exotic species of organisms which affect native organisms?

allien species

[1]

- (ii) Apart from competing for resources, give one other threat from such exotic plants.

They spread diseases

[1]

Question 4 (14 marks)

(a) Fig. 4.1 shows two types of blood vessels, P and Q, found in the human body.

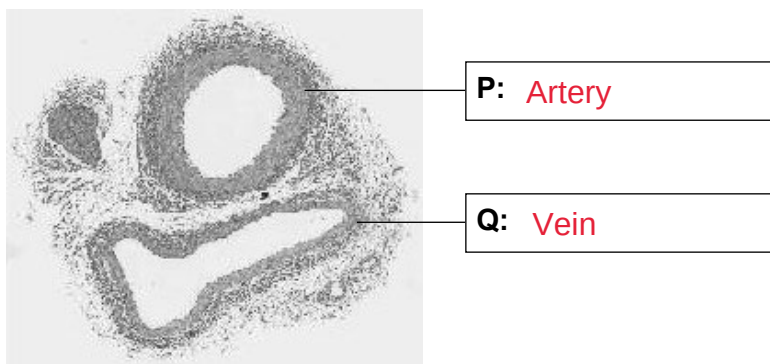


Fig. 4.1: Two types of blood vessels

(i) On **Fig. 4.1**, name blood vessels **P** and **Q**. [2]

(ii) Give two **visible** features on **Fig. 4.1** which help you to identify the two blood vessels.

1. The lumen is small in P thus it is an artery.
2. The lumen of Q is large therefore it is a vein.

[2]

(b) The table below shows the results of an experiment carried out on a student to find out how physical exercise affects his pulse rate.

Activity	Pulse rate/min
Rest	75
30 steps-up	120

(i) Give one site on the body where a pulse can be felt.

Wrist, temple or neck

[1]

(ii) Give the importance of an increased pulse rate during exercising.

An increased pulse rate supplies more nutrients and oxygen to the muscles for contraction which is important during exercise.

[1]

- (iii) Explain why it is important to take the pulse of the student at rest first.

To be able to compare the pulse rate after exercise

[1]

- (iv) What can be done to make sure that the results of this experiment are correct?

Repeat the experiment and calculate an average.

[1]

- (c) Fig. 4.2 shows a blood smear as seen under the microscope.

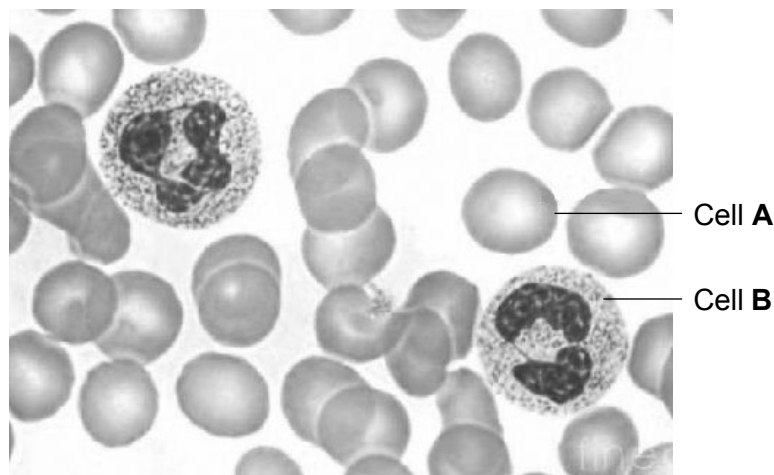


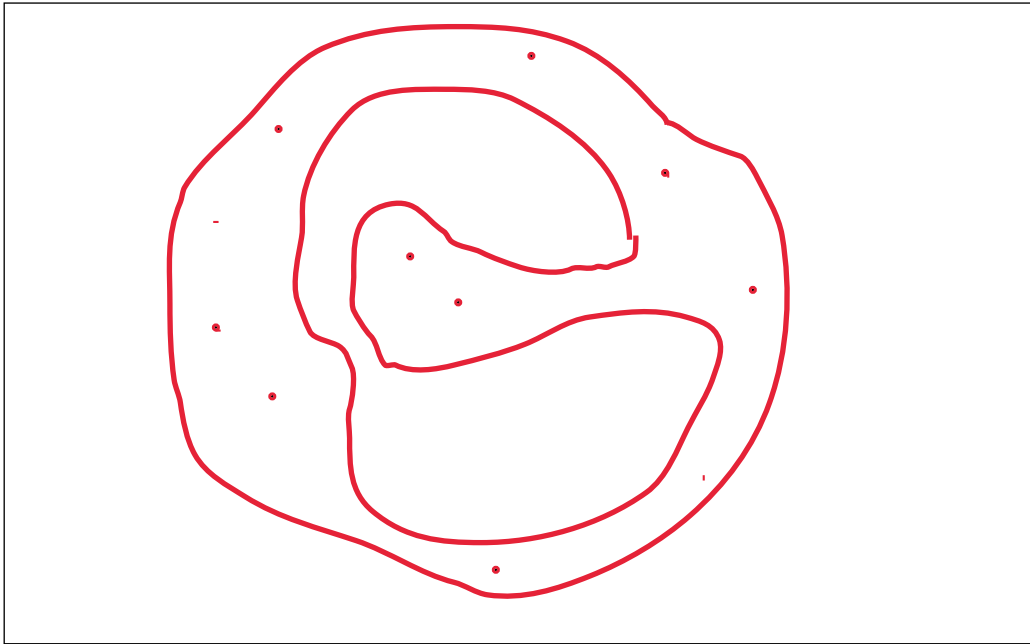
Fig. 4.2: Blood smear

- (i) Name cell A.

Red blood cell

[1]

- (ii) Make a large drawing of cell **B** in the space below



[2]

- (iii) Measure the diameter of your drawing

Diameter of drawing = 70 mm

[1]

- (iv) Calculate the magnification of your drawing compared to cell **B** in Fig. 4.2.
(Do not simplify your answer.)

$$\begin{aligned} &\text{Size of drawing/ Actual size} \\ &70 \text{ mm/ } 20 \text{ mm} \\ &= 3.5 \end{aligned}$$

Magnification of drawing = X3.5

[2]

Question 5 (11 marks)

- (a) Sabrina conducts an experiment to investigate a particular factor affecting the rate of photosynthesis in Elodea plants.

She places 3 lamps at different distances from 3 different plants:

Setup 1 - 15 cm away from the plant (as shown in Fig. 5.1);

Setup 2 - 30 cm away from the plant;

Setup 3 - 45 cm away from the plant.

She records the number of bubbles coming out from each of the 3 plants every 5 minutes.

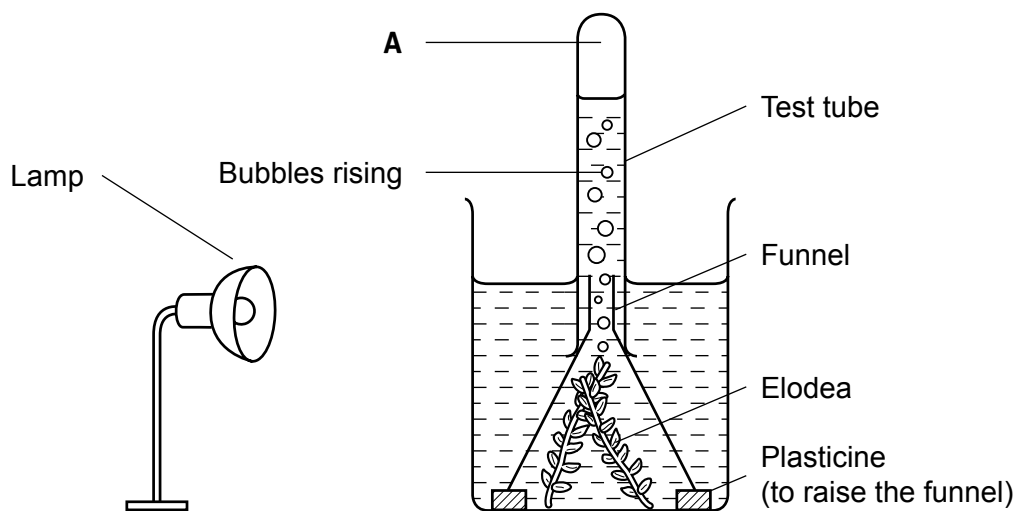


Fig. 5.1: Experiment on photosynthesis

- (i) Which gas is collected at **A** in **Fig. 5.1**?

Oxygen

[1]

- (ii) Which factor affecting photosynthesis is Sabrina investigating?

Light intensity

[1]

- (iii) Write down the word equation for photosynthesis.

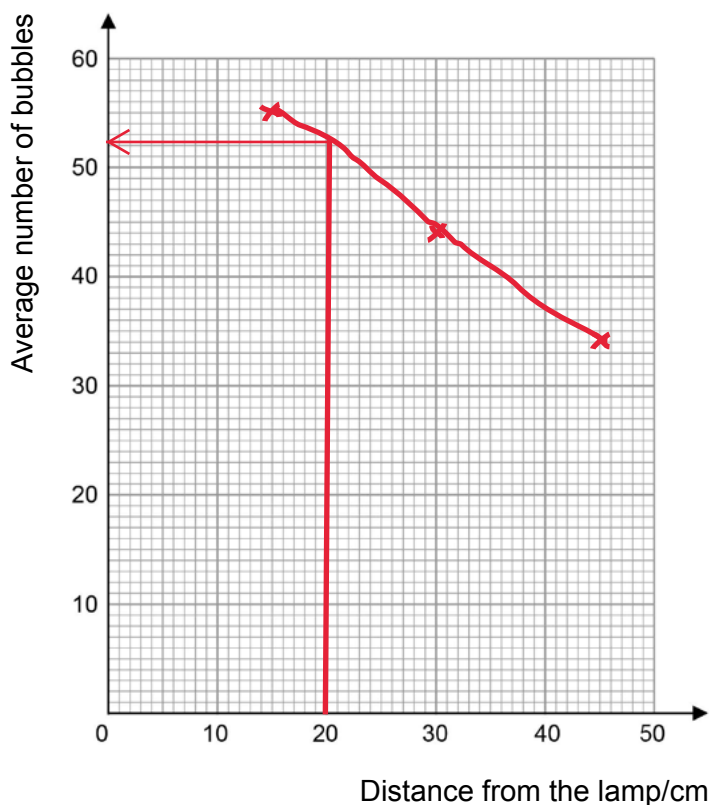
carbon dioxide + water $\xrightarrow[\text{chlorophyll}]{\text{sunlight}}$ glucose + oxygen

[1]

(iv) The table below shows the data collected by Sabrina.

	Distance of lamp from the plant	No. of bubbles between 5 and 10 minutes	No. of bubbles between 10 and 15 minutes	Average No. of bubbles recorded for every 5 minutes
Setup 1	15 cm	54	56	55
Setup 2	30 cm	43	45	<u>44</u>
Setup 3	45 cm	35	33	<u>34</u>

- In the table above, write down the **average** number of bubbles recorded every 5 minutes for each plant in setups 2 and 3. [2]
- On the graph below, plot the average number of bubbles recorded over 5 minutes for each plant against the distance of the lamp from the plant. Draw a line to connect the plotted points. [2]



- (v) Using the graph to help you, predict the results that the student would get if the lamp was positioned **20 cm** from the plant.

52 bubbles

[1]

- (vi) Sabrina counted the number of bubbles to measure the amount of gas given off during photosynthesis.

Suggest one reason why counting bubbles is **not** an accurate way of measuring the amount of gas given off.

All the bubbles are not of the same size

[1]

- (b) Photosynthesis occurs mainly in the leaves of plants.

Give **two** ways in which leaves are adapted for photosynthesis.

1. they expose a large surface area for maximum light absorption

2. they have many pores called stomata for absorption of carbon dioxide by diffusion.

[2]

SCIENCE (N 530)
BIOLOGY SECTION

TIME: 45 MINUTES

Additional Materials: Ruler

Exam paper

March/April 2021

Read these instructions first

1. Write your Index Number in the space provided above.
2. Write in dark blue or black ink. Do not use correction fluid.
3. You may use a soft pencil for any diagram, graph or rough working.
4. Diagrams are not drawn to scale unless otherwise specified.
5. Any rough working should be done in this booklet.
6. Answer **ALL** questions.
7. This document consists of 5 questions printed on 9 pages.
8. The number of marks is given at the end of each question or part question.
9. The total number of marks for this paper is **50**.

Question 1 (10 marks)**Circle the correct answer.**

1. Which one of the following is a **non-communicable** disease?
 - A Stroke
 - ☒ B Syphilis
 - C Gonorrhea
 - D Influenza

2. Which part of human blood fights against foreign bodies?
 - A Plasma
 - B Red blood cells
 - ☒ C White blood cells
 - D Platelets

3. Which of the following gases causes acid rain?
 - A Carbon monoxide
 - ☒ B Sulfur dioxide
 - C Oxygen
 - D Hydrogen

4. What is meant by the term biodiversity?
 - A The place where different species live.
 - ☒ B The variety of species in a defined area.
 - C The conditions in which different species live.
 - D The number of organisms of the same species.

5. Which process, harmful to the environment is shown in **Figure 1.1**?

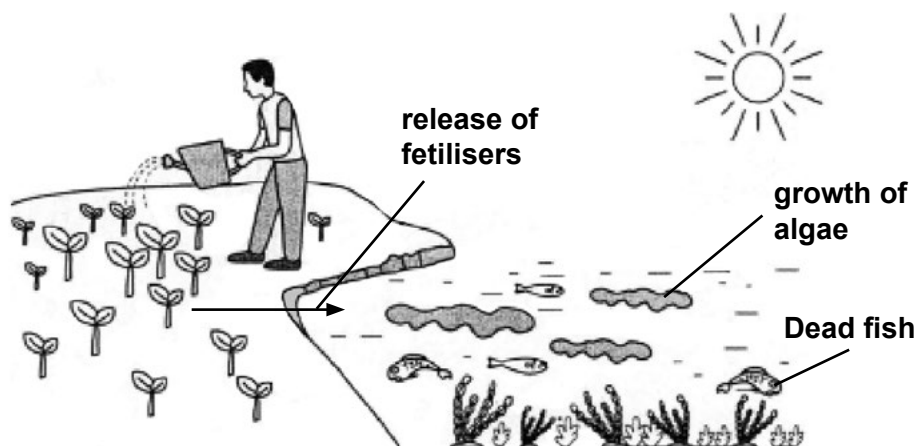


Figure 1.1

- A** Global warming
 - B** Ozone depletion
 - C** Deforestation
 - D** Eutrophication
6. What are invasive alien species?
- A** Exotic species which affect native species.
 - B** Endemic species found naturally in a specific region.
 - C** Species that have become extinct.
 - D** Species that are endangered.
7. Carbon dioxide enters a leaf by the process of diffusion.
What happens to particles during diffusion?
- A** They move from a region of high concentration to a region of low concentration.
 - B** They move from a region of low concentration to a region of high concentration.
 - C** They move from a hot region of the leaf to a cold one.
 - D** They move from a cold region of the leaf to a hot one.

8. What is a male sex cell called?
- A Penis
 - B Scrotum
 - ☒ C Sperm
 - D Testis
9. Which of the following actions would help control the spread of HIV?
- A Carrying out regular physical exercise.
 - ☒ B Using protection during sexual contact.
 - C Washing hands regularly.
 - D Eating healthy food.
10. Figure 1.2 shows steps in the fertilisation process.

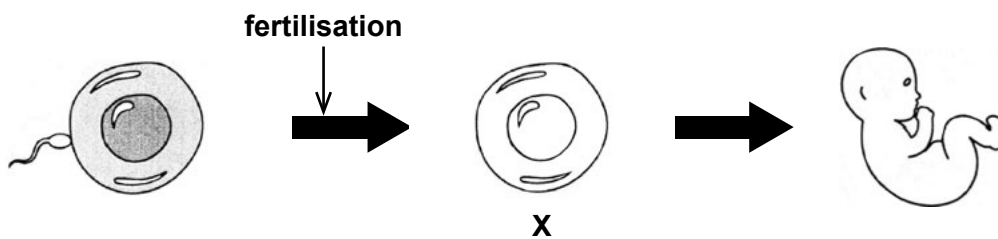


Figure 1.2: Steps in the fertilisation process.

In **Figure 1.2**, Diagram **X** shows the

- A embryo
- B foetus
- C ovum
- ☒ D zygote

Question 2 (8 marks)

Figure 2.1 shows the skeleton of a leaf.

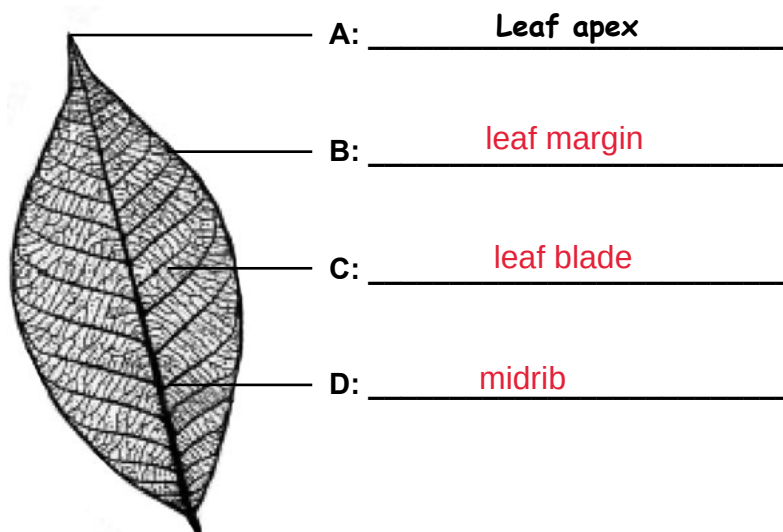


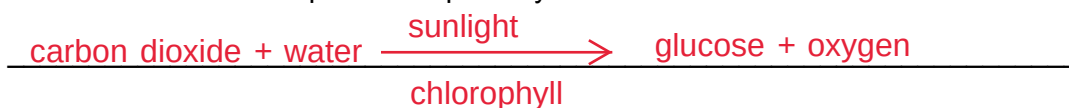
Figure 2.1: Diagram of a leaf skeleton

(a) Label parts B, C and D.

(b) Leaves are the main site for photosynthesis in plants.

Write down the word equation for photosynthesis.

[1]



(c) Give **two** ways in which leaves are adapted for photosynthesis.

1. large surface area
2. presence of stomata

[2]

(d) Explain how each adaptation you mentioned in part (c) helps the plant carry out photosynthesis.

1. A large surface area allows maximum absorption of sunlight for photosynthesis
2. Large number of stomata allows absorption of carbon dioxide for photosynthesis

[2]

Question 3 (9 marks)

Sexual and asexual reproduction are the two main ways organisms reproduce.

(a) State the importance of reproduction for living organisms .

It helps to replace organisms which die.

[1]

(b) Give **two** differences between sexual and asexual reproduction.

1. In asexual reproduction there is only one parent involved while in sexual reproduction there are two parents

2. The offspring produced during asexual reproduction are genetically identical while in sexual reproduction, the offspring produced are not genetically identical.

[2]

(c) Give one example of an organism that reproduces asexually .

Bacteria, amoeba, strawberry

[1]

(d) Match each organ of the reproductive system in **Column A** to its correct function in **Column B**.

Column A		Column B
Organ		Function
Ovary		Where sperms are produced
Uterus		Where a foetus grows
Oviduct		Carries sperms to the urethra
Scrotum		Holds the testis
Testis		Where fertilisation occurs
		Produces eggs

[5]

Question 4 (14 marks)

Figure 4.1 shows sections of different blood vessels: an artery, a vein and a capillary.

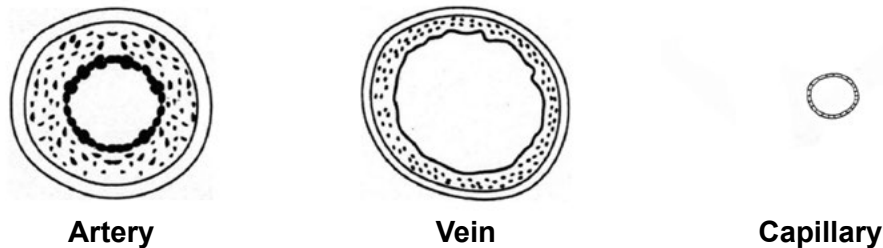


Figure 4.1: Sections of an artery, a vein and a capillary

(a) Observe **Figure 4.1** carefully. Give **two** visible differences between the artery and the vein.

1. The lumen of artery is smaller than vein
2. The artery has a thicker wall than vein

[2]

(b) Give the function of each blood vessel.

1. Artery: carries blood away from heart at high pressure
2. Vein: carries blood towards the heart at low pressure
3. Capillary: connects the artery and vein and involved in exchange

[3]

(c) For each blood vessel, give one way in which its structure is adapted to its function.

1. Artery: Its wall is thick to resist the high pressure of blood bursting the vessel.
2. Vein: It has valves to prevent backflow of blood.
3. Capillary: Its wall is only one cell thick to allow nutrients and oxygen to diffuse out to tissue cells.

[3]

- (d) Table 1 shows the rate of blood supply to different parts of the body (cm^3/min) of an athlete when at rest and during exercise.

Body part	Rate of blood supply when at rest (cm^3/min)	Rate of blood supply during exercise (cm^3/min)
Digestive system	1350	600
Kidney	1000	550
Skin	450	1700
Brain	650	650
Arteries of the heart	150	550
Muscles of the skeleton	750	8000
Bone	650	450

Table 1 : Rate of supply of blood

- (i) Use the information from **Table 1** to complete **Table 2** below. An example is given.

Organ	Rate of blood supply during exercise		
	Reduced	Unchanged	Increased
Digestive system	✓		
Kidney	✓		
Skin			✓
Brain		✓	
Arteries of the heart			✓
Muscles of the skeleton			✓
Bone	✓		

[3]

Table 2

- (ii) Which part of the athlete's body was supplied with most blood during exercise?

Muscles of the skeleton

[1]

- (iii) Give **two** reasons why this part of the athlete's body received the most blood supply during exercise.

1. The muscles need oxygen for respiration

2. the muscles need nutrients to be used in respiration

[2]

Question 5 (9 marks)

A student is exploring the biodiversity of an ecosystem using quadrats to collect information. She lays out five quadrats in an area as shown in **Figure 5.1** below.

The following organisms are found in the ecosystem: slugs, snails and marigold (genda) flowers.

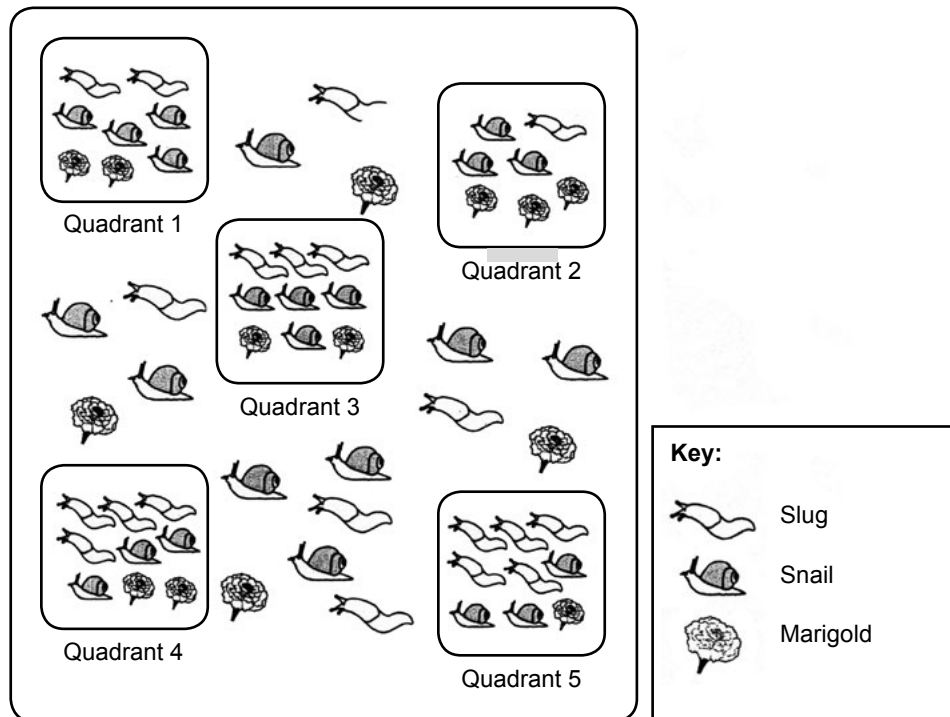


Figure 5.1

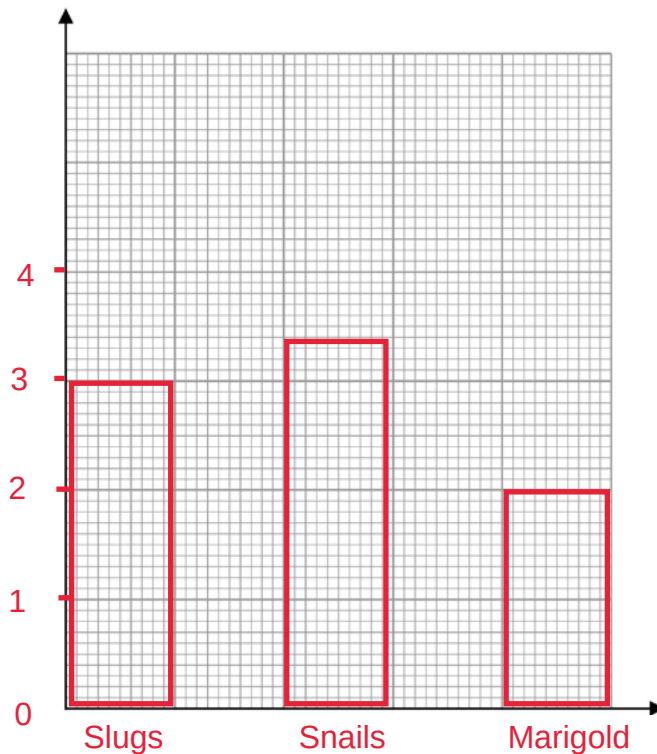
(a) Based on the information provided in **Figure 5.1**, complete **Table 3** below by:

- (i) giving the missing number of organisms in the quadrats [2]
- (ii) calculating the mean number of organisms in the quadrats [2]

Type of organism	Number of organisms in each quadrant					Mean number of organisms
	Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	Quadrant 5	
Slugs	2	1	3	4	<u>5</u>	<u>3</u>
Snails	4	3	4	3	3	3.4
Marigold	2	<u>3</u>	2	2	1	<u>2</u>

Table 3

- (b) Using the information from **Table.3**, construct a bar chart of the mean number of each type of organism per quadrat. [3]



- (c) What can you observe from the bar chart you have drawn in part (b)?

There are more snails than slugs and marigold.

[1]

- (d) The student wants to get a better estimate of the number of organisms in the defined area of the ecosystem. What must she do?

She must use more than 5 quadrats and find an average.

[1]