OCR
Oxford Cambridge and RSA

Friday 16 October 2020 – Morning

A Level Biology A

H420/02 Biological diversity

Time allowed: 2 hours 15 minutes

You can use:
- a ruler (cm/mm)
- a scientific or graphical calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **28** pages.

ADVICE
- Read each question carefully before you start your answer.

SECTION A

You should spend a maximum of 20 minutes on this section.

Write your answer to each question in the box provided.

Answer **all** the questions.

1 Which of the following human diseases, **A** to **D**, is caused by a fungus?

A athlete's foot

B influenza

C malaria

D tuberculosis

Your answer ☐ **[1]**

2 Which of the following plant diseases, **A** to **D**, is caused by a pathogen from the kingdom Protoctista?

A black sigatoka in bananas

B ring rot in tomatoes

C tobacco mosaic disease

D tomato late blight

Your answer ☐ **[1]**

3 Which of the following statements, **A** to **D**, is **not** true of human erythrocytes?

A They are produced from stem cells.

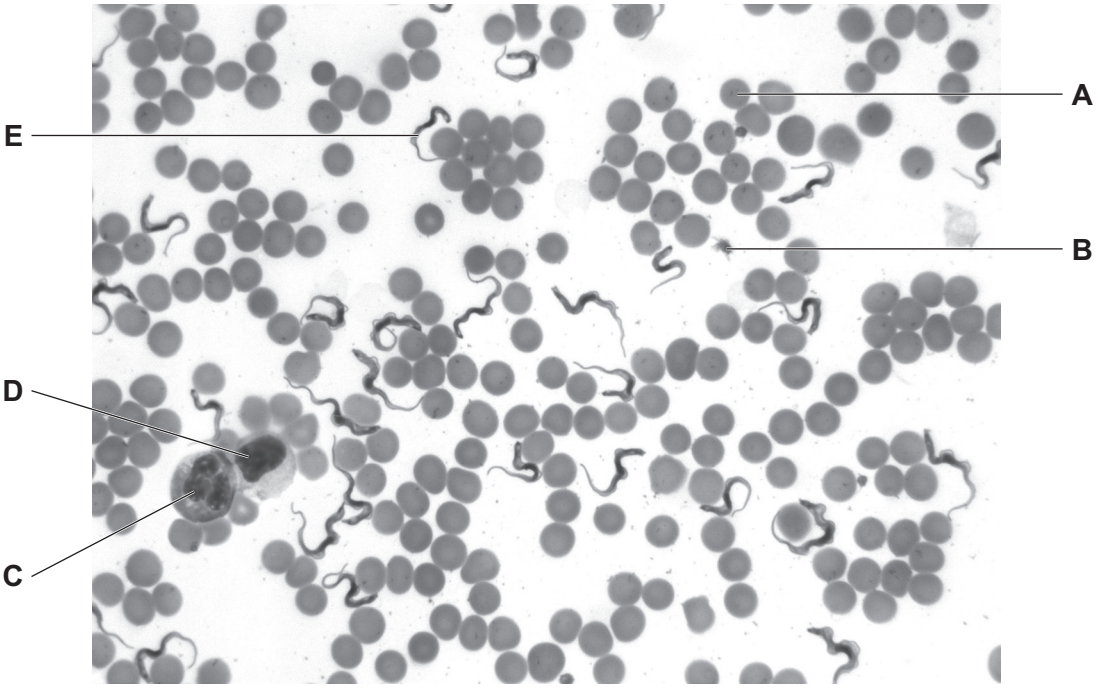
B They are produced in bone marrow.

C They are specialised cells.

D They undergo mitosis.

Your answer ☐ **[1]**

Questions 4 and 5 refer to the following image of a human blood smear.



4 Which of the blood components, labelled **A** to **D**, shows a lymphocyte?

Your answer ☐ **[1]**

5 The cell labelled **E** shows a parasite called *Trypanosoma*.

Which of the following statements is/are evidence that *Trypanosoma* is a eukaryote?

1 a nucleus is present
2 it is a similar size to blood cells
3 the presence of flagella

A 1, 2 and 3

B only 1 and 2

C only 2 and 3

D only 1

Your answer ☐ **[1]**

6 Plants can produce a variety of chemicals in response to pathogens.

Which of the following, **A** to **D**, is produced by plants in response to pathogens?

A antibacterial compounds

B antibodies

C ethylene

D penicillin

Your answer ☐ **[1]**

7 Scientists self-pollinated some pea plants that were heterozygous for the gene controlling height.

They expected a 3:1 ratio of tall plants to short plants in the offspring.

1046 plants grew in the next generation. 798 were tall and 248 were short.

Which of the following, **A** to **D**, is a statistical test that could be used to determine if these numbers are significantly different from a 3:1 ratio?

A chi-squared

B Spearman's rank

C standard deviation

D Student's t-test

Your answer ☐ **[1]**

8 Polar bears, *Ursus maritimus*, and giant pandas, *Ailuropoda melanoleuca*, both belong to the family Ursidae.

Which of the following, **A** to **D**, is **not** true about the classification of polar bears and giant pandas?

A They each belong to a different class.

B They each belong to a different species.

C They each belong to the same order, carnivora.

D They each belong to the same phylum, chordata.

Your answer ☐ **[1]**

9 Which of the following statements is/are evidence that DNA replication is semiconservative?

1 After one replication, the number of adenine nucleotides is equal to the number of guanine nucleotides.
2 After two replications, two DNA molecules have one original and one new strand, and two DNA molecules have two new strands.
3 After three replications, there are eight DNA molecules, only two of which have strands from the original DNA.

A 1, 2 and 3

B only 1 and 2

C only 2 and 3

D only 1

Your answer ☐ **[1]**

10 Which of the following reactions, **A** to **D**, describes the conversion of a polymer to a monomer?

A fatty acids and glycerol —esterification→ triglyceride

B insulin —condensation→ amino acids

C maltose —hydrolysis→ glucose

D starch —hydrolysis→ glucose

Your answer ☐ **[1]**

11 Which of the following, **A** to **D**, is true of a competitive enzyme inhibitor?

A binds to a site other than the active site

B can bind irreversibly to the active site

C changes the shape of the active site

D effects can be overcome by adding more substrate

Your answer ☐ **[1]**

12 Which of the following, **A** to **D**, is **not** true about adult stem cells?

A They are found in bone marrow.

B They are not specialised.

C They are totipotent.

D They can be used as a renewing source of undifferentiated cells.

Your answer ☐ **[1]**

13 The nitrogen cycle involves a range of reactions and microorganisms.

Which of the following processes, **A** to **D**, usually occurs under anaerobic conditions?

A conversion of amino acids to ammonium compounds

B conversion of urea to ammonium compounds

C nitrification

D nitrogen fixation

Your answer ☐ **[1]**

14 Which of the following bacteria, **A** to **D**, convert ammonium compounds to nitrites?

A *Azotobacter*

B *Nitrobacter*

C *Nitrosomonas*

D *Rhizobium*

Your answer ☐ **[1]**

15 Ash trees are common throughout the UK. They often grow in dense woodland.

Which of the following, **A** to **D**, is an abiotic factor that is likely to affect the growth of young ash trees?

A the availability of light underneath larger trees in the wood

B the availability of oxygen in the air

C the presence of a pathogen that causes ash dieback disease

D the species of bacteria present in the soil

Your answer ☐ **[1]**

SECTION B

Answer **all** the questions.

16 The body plan of multicellular organisms is under genetic control.

(a) Complete the passage below using the most appropriate words from the list.

analogous	**archaea**	**development**	**DNA**	**domains**
homeobox	**homologous**	**homozygous**	**kingdoms**	**operon**
phyla	**plant**	**preserved**	**prokaryotes**	**regulator**
ribosomes	**transcription**	**translation**		

The development of body plan in eukaryotic organisms is controlled by ..... genes. These genes code for proteins that are able to bind to ..... and turn specific genes on and off and are known as ..... factors. These proteins contain a sequence of base pairs that varies little between species within the animal, ... or fungus ..... .

[5]

(b) Investigations into the activity of genes that control body plan frequently use fruit flies and mice.

One reason fruit flies are used is that there are fewer public concerns about the ethics of using flies.

(i) Suggest **two other** reasons why fruit flies are chosen for research into genes controlling the development of body plan.

1 .....

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2 .....

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[2]

(ii) There are some public concerns about the ethics of using mice in these investigations.

Suggest **two** reasons why mice are chosen as a suitable species for investigation.

1 .....

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2 .....

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[2]

Turn over for the next question

17 Tannase is an enzyme produced by some microorganisms. Tannase is useful in many industrial applications including food production.

The tannase used in food production can be free in solution or immobilised.

(a) State one method by which tannase could be immobilised.

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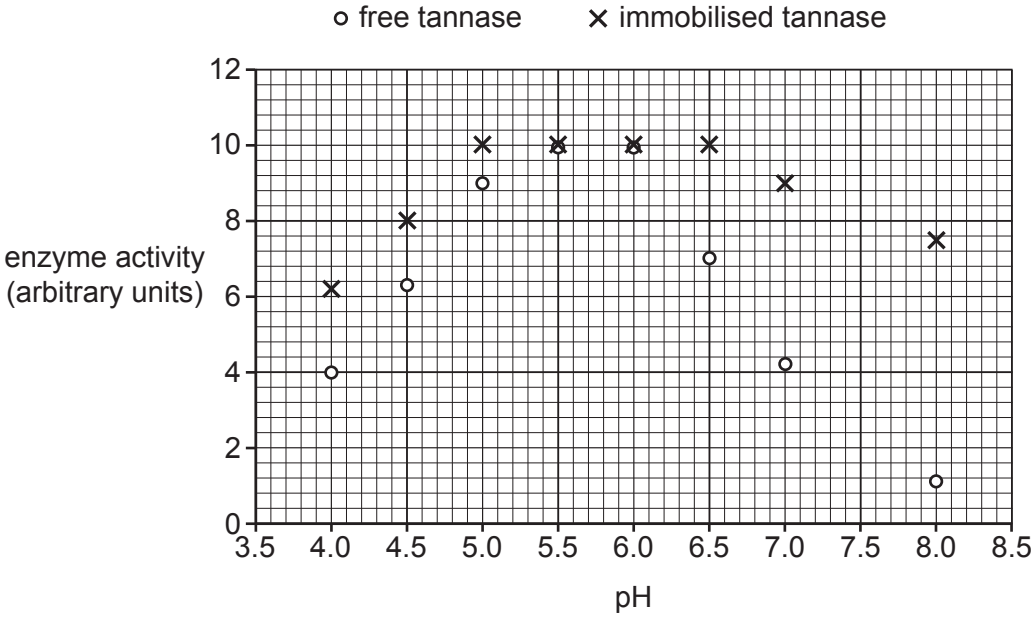
..... **[1]**

(b) Scientists compared the activity of free tannase and immobilised tannase. They investigated the activity of tannase over a range of pH.

The results are shown in the graph.



(i) Calculate how many times more active immobilised tannase is compared to free tannase at pH8.0.

Give your answer to an appropriate number of significant figures.

number of times = ... **[2]**

(ii) Draw a line of best fit for the free tannase on the graph.

..... Answer on **the graph** ..... **[1]**

(iii) A student concluded that the optimum pH for this tannase enzyme is pH5.8.

Explain why the data in the graph might not support the student's conclusion.

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

(iv) The results suggested that immobilised tannase was more stable over a range of pH values than free tannase.

Explain why immobilised tannase is more active at pH8 than free tannase.

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

(c) Immobilised enzymes are often active over a greater pH and temperature range than free enzymes.

Using immobilised enzymes can be cheaper than using free enzymes.

(i) Suggest **two** reasons why using immobilised enzymes in industrial processes could be cheaper than using free enzymes.

1 .....

2 .....
[2]

(ii) State **one** disadvantage of using immobilised enzymes in industrial processes.

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

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18 Individuals within populations vary. Much of this variation is under genetic control.

(a) Two groups of scientists were studying genetic polymorphism in fruit flies.

They extracted DNA from two different species of fruit fly, A and B.

The first group of scientists studied 26 gene loci from species A. They calculated the genetic polymorphism of species A to be 0.35.

The second group of scientists studied 32 gene loci from species B. They found that 13 of the gene loci were polymorphic.

(i) Calculate the proportion of genetic polymorphic gene loci of species B.

proportion = ... **[2]**

(ii) Evaluate the conclusion that species B shows greater genetic polymorphism than species A.

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

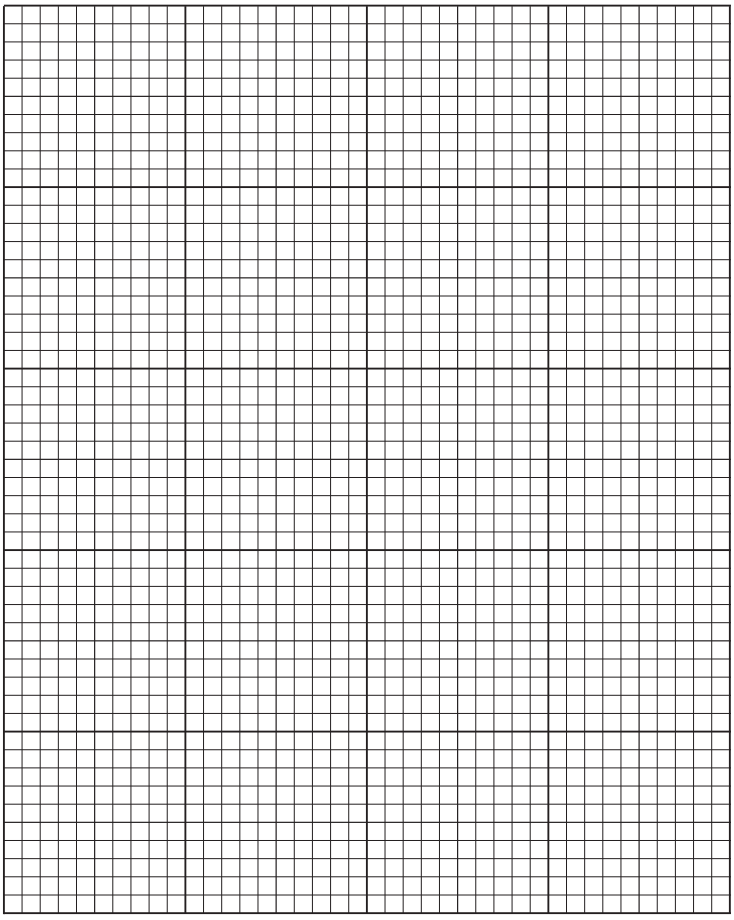
(b) When studying variation, it is sometimes impractical to analyse DNA.

A student was investigating variation between a number of students in their school. They recorded the frequency of students that could and could not roll their tongue.

The results are shown in the table.

Phenotype	Frequency	
	Females	**Males**
Tongue-rolling	83	88
Non tongue-rolling	43	34

(i) Represent the data in the table as a bar chart on the grid provided below.



[4]

(ii) Since 1940, people have believed that the ability to roll the tongue is caused by a single gene with two alleles.

R is dominant and allows tongue-rolling.

r is recessive and does not allow tongue-rolling.

The genotype of students who can roll their tongue could be either RR or Rr.

In the results shown in the table opposite
- the total number of students who could roll their tongue = **171**
- the total number of students who could not roll their tongue = **77**.

The Hardy–Weinberg principle allows us to estimate the proportion of each genotype.

Use the Hardy–Weinberg principle to estimate the proportion of heterozygous individuals in the school survey in the table.

Use the equations:

$p^2 + 2pq + q^2 = 1$

$p + q = 1$

proportion = ... **[3]**

(iii) The Hardy–Weinberg principle might not give an accurate estimate of the proportion of genotypes for the results of the student's investigation.

The population of students varies from year to year and so cannot be said to be stable.

State **two other** reasons why it might be inappropriate to use the Hardy–Weinberg principle to estimate allele frequencies for the results in the table.

1 .....

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2 .....

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[2]

19 Mitosis and meiosis are important in the life cycles of organisms.

(a) *Hydra* is a small animal that lives in fresh water. When environmental conditions are favourable, *Hydra* reproduces asexually. Large numbers of offspring can be produced in this way.

Asexual reproduction in *Hydra* is shown in Fig. 19.1.

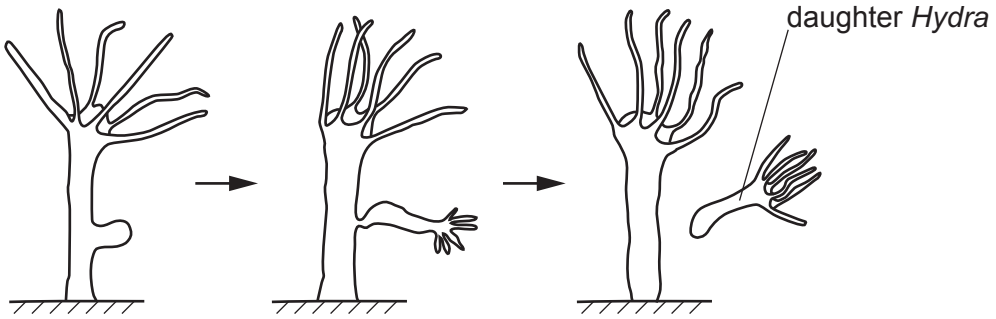

Fig. 19.1

(i) Asexual reproduction involves mitosis.

Name the stages of mitosis in the correct order.

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

(ii) Suggest why *Hydra* reproduces asexually when conditions are favourable.

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

(b) When conditions are not favourable, *Hydra* reproduces sexually. This often happens in the winter.

Cells in the body wall produce sperms and eggs by meiosis.

Large numbers of sperms are released into the water. These sperms can fertilise eggs from different individuals. Each egg forms a tough outer coat, and can lie dormant at the bottom of the water until conditions improve.

(i)* Explain how sexual reproduction in *Hydra* leads to genetic variation in the offspring.

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Additional answer space if required.

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(ii) Suggest why sexual reproduction in *Hydra* usually occurs in the winter.

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(c) Mosses are small plants that live in damp conditions.

The life cycle of many mosses involves two stages: a gametophyte and a sporophyte.

The gametophyte contains haploid cells and produces sperms and eggs.

The sporophyte contains diploid cells and produces spores which can be spread easily through the air.

The spores germinate and grow into a gametophyte.

Fig. 19.2 shows the life cycle of the moss *Funaria*.

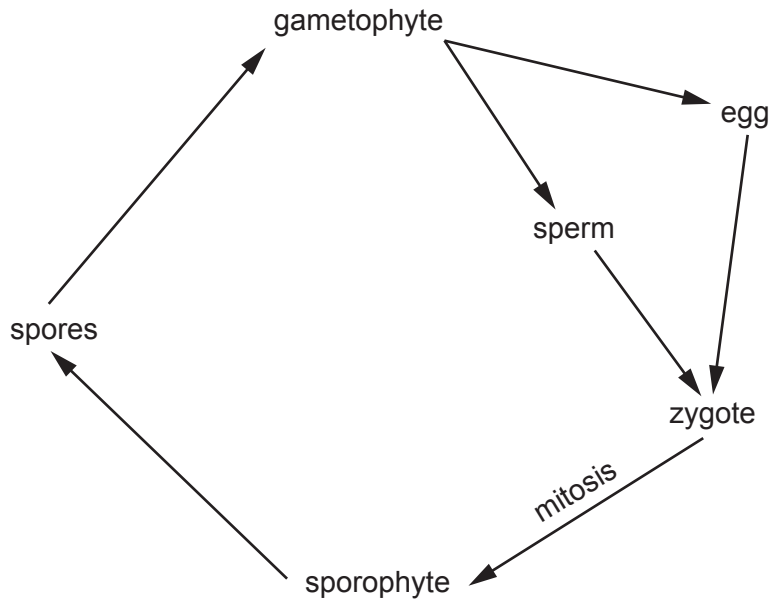

Fig. 19.2

(i) The zygote grows into the sporophyte by mitosis.

The haploid gametophyte of one species of *Funaria* contains 28 chromosomes.

A single DNA molecule contains two strands.

Calculate the number of strands of DNA present in the nucleus of the zygote immediately before mitosis.

number of strands = ... **[1]**

(ii) Mark an **X** on **Fig. 19.2** at the point at which meiosis occurs.

..... Answer on **Fig. 19.2** .....**[1]**

(iii) A diagram of a moss sperm is shown in Fig. 19.3.

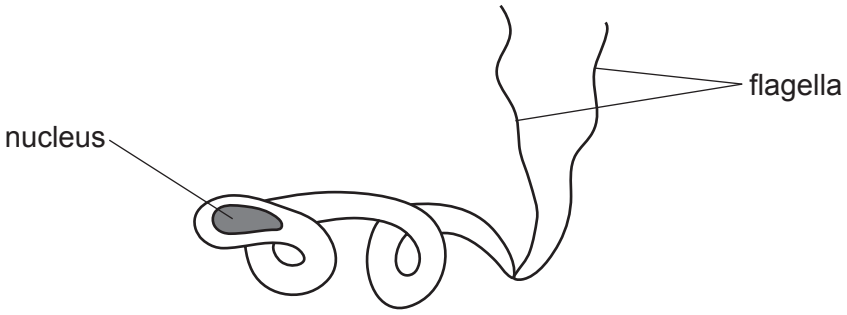

Fig. 19.3

The flagella allow the sperm to move towards an egg.

Suggest and explain another adaptation that is likely to be present in these sperm cells.

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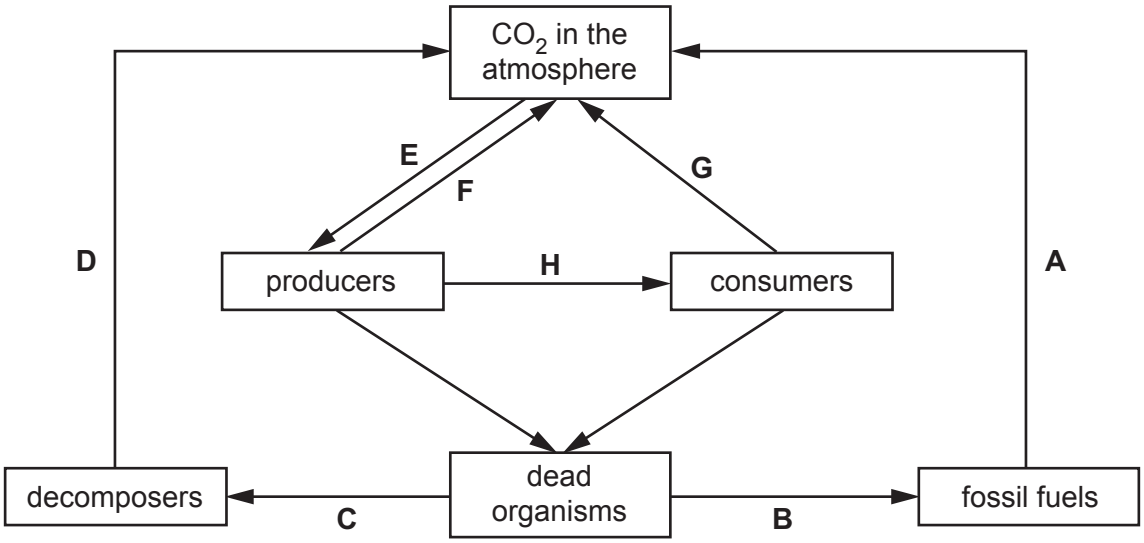
..... **[2]**

20 Carbon and nitrogen are elements that are recycled.

The flow chart shows the carbon cycle.



(a) (i) Identify the processes occurring at **A** and **F**.

A ..... **F** ..... **[2]**

(ii) The concentration of carbon dioxide (CO_2) in the atmosphere varies depending on the time of year.

Suggest why the concentration of CO_2 in the atmosphere increases during the winter months and decreases during the summer months.

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

(b) In plants the glucose produced by photosynthesis is changed into starch for storage. Glucose and starch are both carbohydrates.

(i) Complete the table below to show the main differences in structure between glucose and starch.

Glucose	Starch

[3]

(ii) Carbohydrates contain only the elements carbon, hydrogen and oxygen.

Polypeptides contain carbon, hydrogen, oxygen and nitrogen.

Name one **other** element present in polypeptides.

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

(c)* The nitrogen cycle shares many similarities with the carbon cycle.

Describe the similarities between the nitrogen cycle and the carbon cycle.

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Additional answer space if required.

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21 Algae are photosynthetic organisms that live in water.

(a) A rapid increase in the population of algae is known as an algal bloom.

Scientists studied the population of algae in a river in the UK at different times of year. Their results are shown in Fig. 21.1.

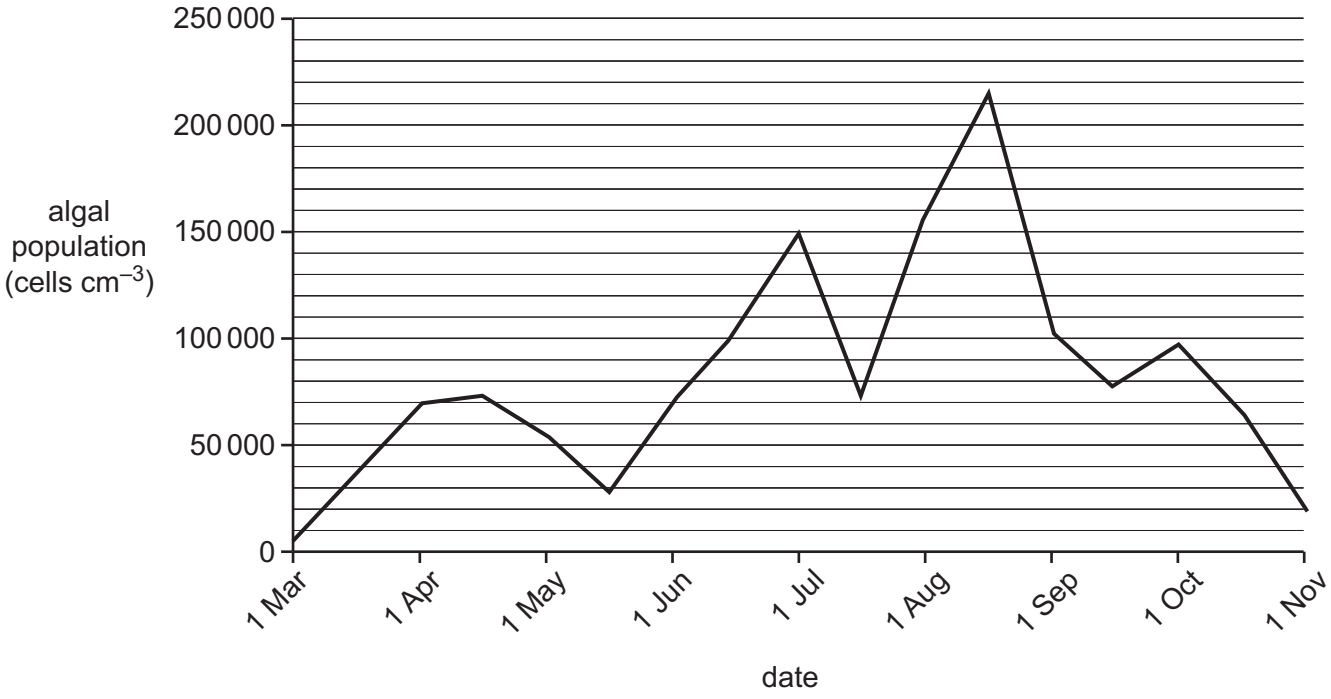

Fig. 21.1

(i) Calculate the percentage decrease in the population of algae between the peak population and 1 November.

percentage decrease = ... **[2]**

(ii) The river in which the study was conducted is described as a dynamic ecosystem.

Use Fig. 21.1 to explain why this ecosystem could be described as dynamic.

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

(iii) A student concluded that the increase in population of algae was due to higher temperatures and higher light intensity in the summer months.

Considering Fig. 21.1 as the student's data source, discuss the weaknesses in this conclusion.

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

(b) Many algal species are unicellular organisms. Some occur in colonies of more than one cell.

Fig. 21.2 shows a typical algal cell.

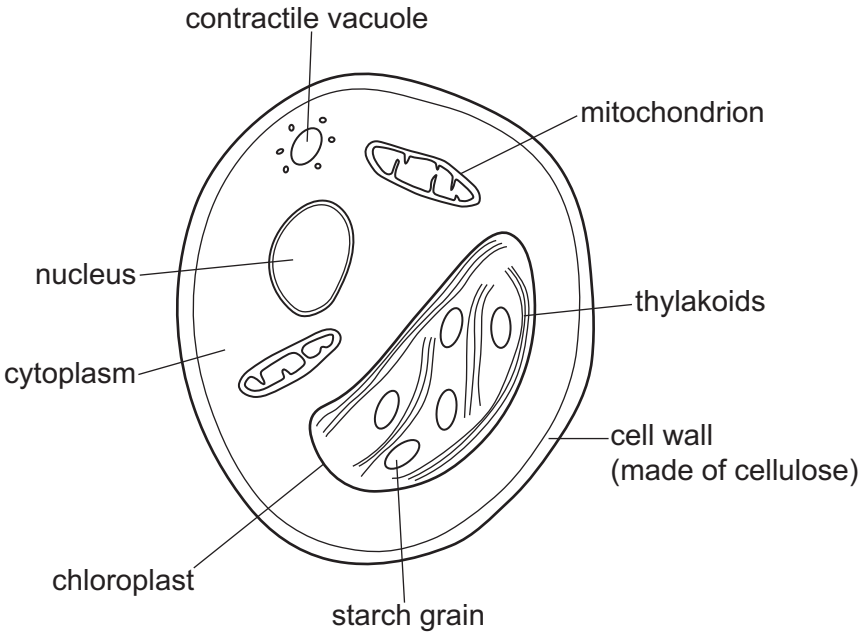

Fig. 21.2

(i) At various times, algae have been classified in different kingdoms.

Using the information given above, draw a conclusion about which kingdom is the most appropriate in which to classify algae.

In your answer explain why other kingdoms are not appropriate choices.

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

(ii) Suggest one piece of evidence **not** given above that could be used to provide strong support for the classification of algae in a particular kingdom.

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

22 The human body is able to protect itself from disease in a variety of ways.

(a) The table shows a list of cells and structures.

Letter	Cell or structure
A	antigen-presenting cells
B	erythrocytes
C	goblet cells
D	lymphocytes
E	lysosomes
F	mucous membranes
G	neutrophils
H	phagosomes
I	platelets
J	skin

(i) Which letter or letters indicate cells or structures involved in preventing the entry of pathogens into the body?

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

(ii) Which letter or letters indicate cells or structures that act as a **physical barrier** to the entry of pathogens?

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

(iii) Which letter or letters indicate cells or structures that are involved in phagocytosis?

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

(iv) Which letter or letters indicate a tissue?

Explain your answer.

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

(b) Phagocytosis involves cytokines and opsonins.

State the role of cytokines and opsonins in phagocytosis.

cytokines .....

.....

opsonins .....

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[2]

(c) Chickenpox is a common disease.

People who have recently recovered from chickenpox can donate plasma so that their antibodies can be given to leukaemia patients with weakened immune systems.

(i) Use a tick (✓) to indicate in the table below which type of immunity is functioning in a leukaemia patient when given chickenpox antibodies.

Type of immunity	
natural and active	
natural and passive	
artificial and active	
artificial and passive	

[1]

(ii) Explain your answer to part **(i)**.

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

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).