Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

BIOLOGY **0610/43**

Paper 4 Theory (Extended) **October/November 2021**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

© UCLES 2021

1 Enzymes are used in genetic engineering.

(a) Define the term enzyme.

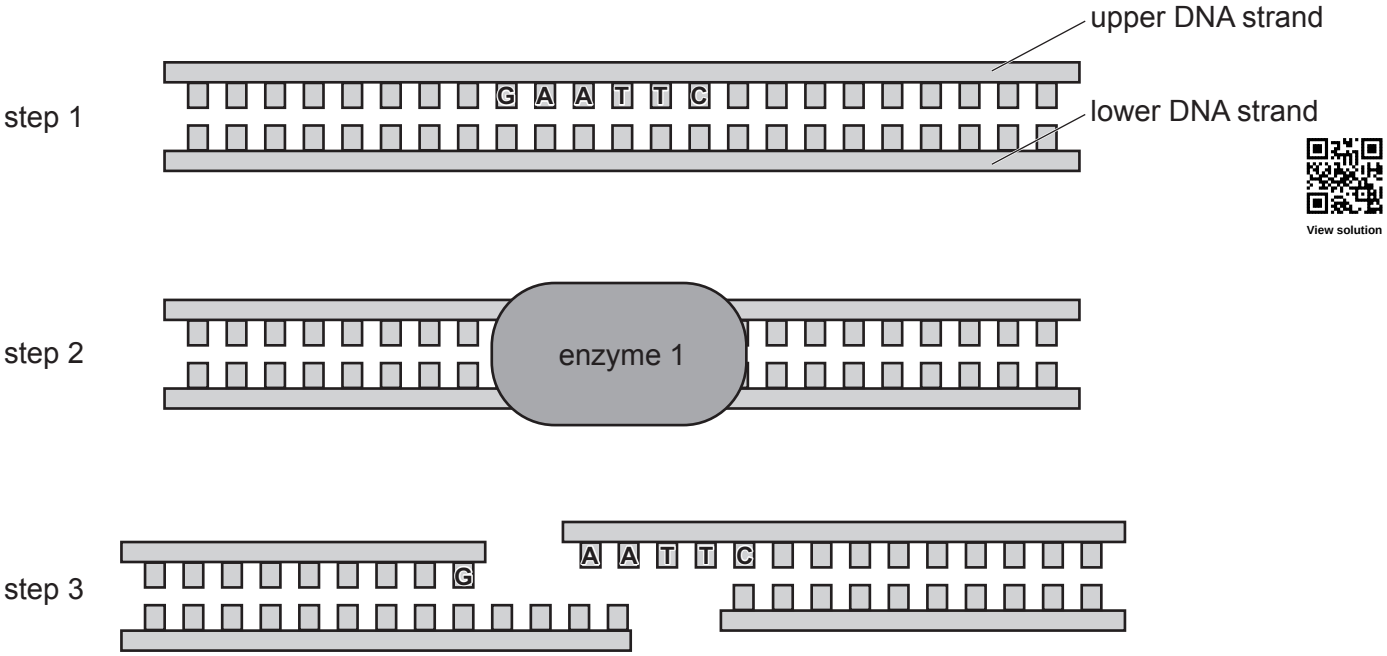
View solution

.....

.....

..... [2]

(b) The process of genetic engineering often starts with the steps shown in Fig. 1.1.



View solution

Fig. 1.1

(i) State the sequence of bases on the lower strand of the DNA molecule in step 1.

upper DNA strand	G	A	A	T	T	C
lower DNA strand						

[1]

(ii) State the name of enzyme 1 in step 2 of Fig. 1.1.

..... [1]

View solution

(iii) Describe the effect of enzyme 1 on the DNA molecule in step 3.

View solution

.....

.....

.....

.....

..... [2]

(iv) Explain how enzyme 1 in Fig. 1.1 is specific to the exact sequence of DNA bases.

View solution

.....

.....

.....

.....

..... [2]

(c) Another enzyme, enzyme 2, is used **later** in the process of genetic engineering.

View solution

Fig. 1.2 is a diagram showing the action of enzyme 2.

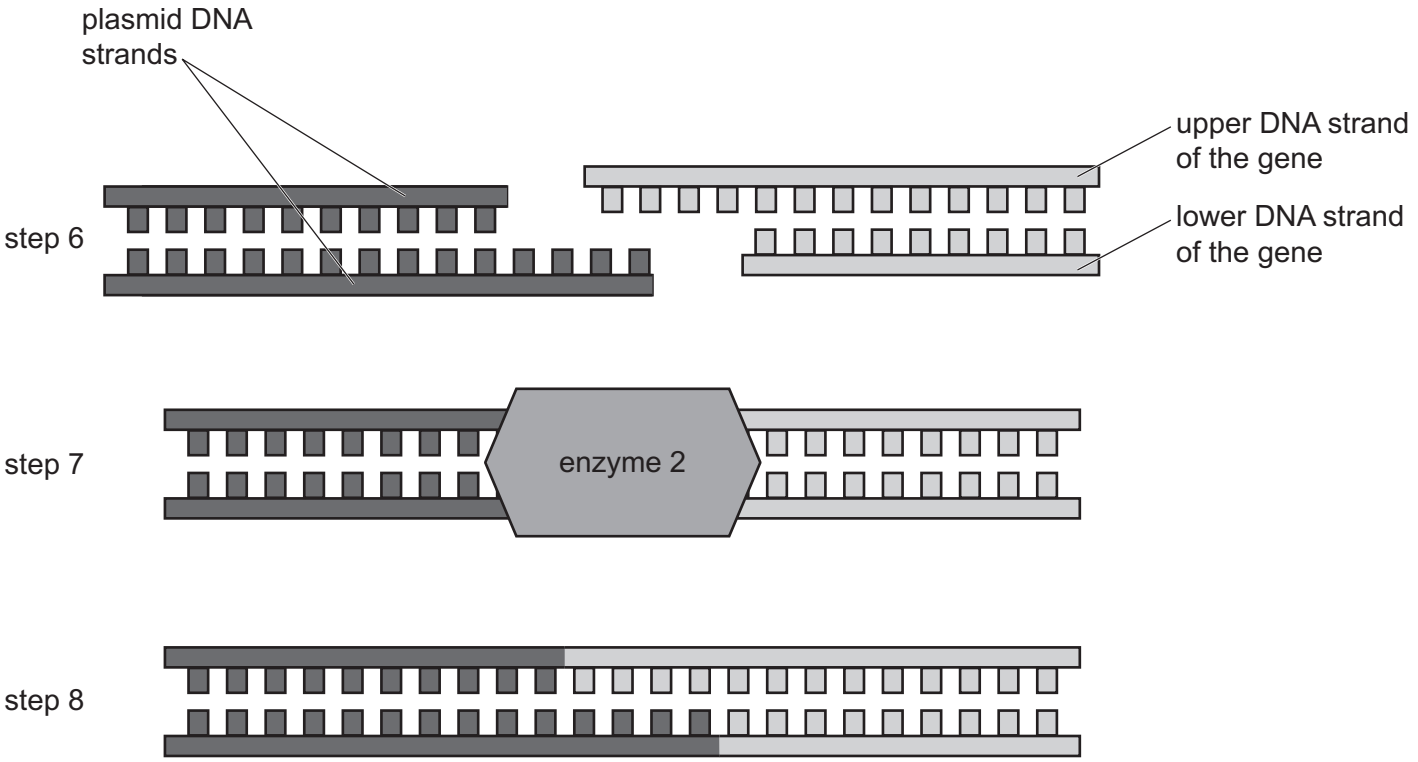


Fig. 1.2

(i) Some organisms naturally contain DNA in the form of a plasmid.

State the name of the type of organism that naturally contains plasmids.

..... [1]

(ii) State the name of enzyme 2 in step 7 of Fig. 1.2.

View solution

..... [1]

(iii) State the name of the molecule formed in step 8.

..... [1]

View solution

(d) Sketch a graph to describe how the activity of the enzymes used in genetic engineering would change if the reaction occurred at a range of temperatures from very cold to very hot.

View solution

Label the axes with appropriate titles.

Do **not** use units or a numbered scale.



[3]

[Total: 14]

2 Fig. 2.1 is a photomicrograph of the end of a plant root.

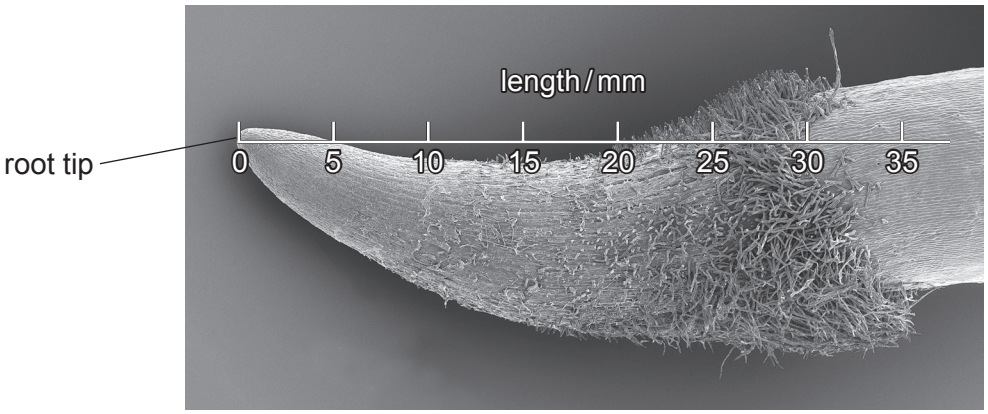


Fig. 2.1

Fig. 2.2 shows the results of a study on the rate of uptake of nitrate ions at different points along the root shown in Fig. 2.1.

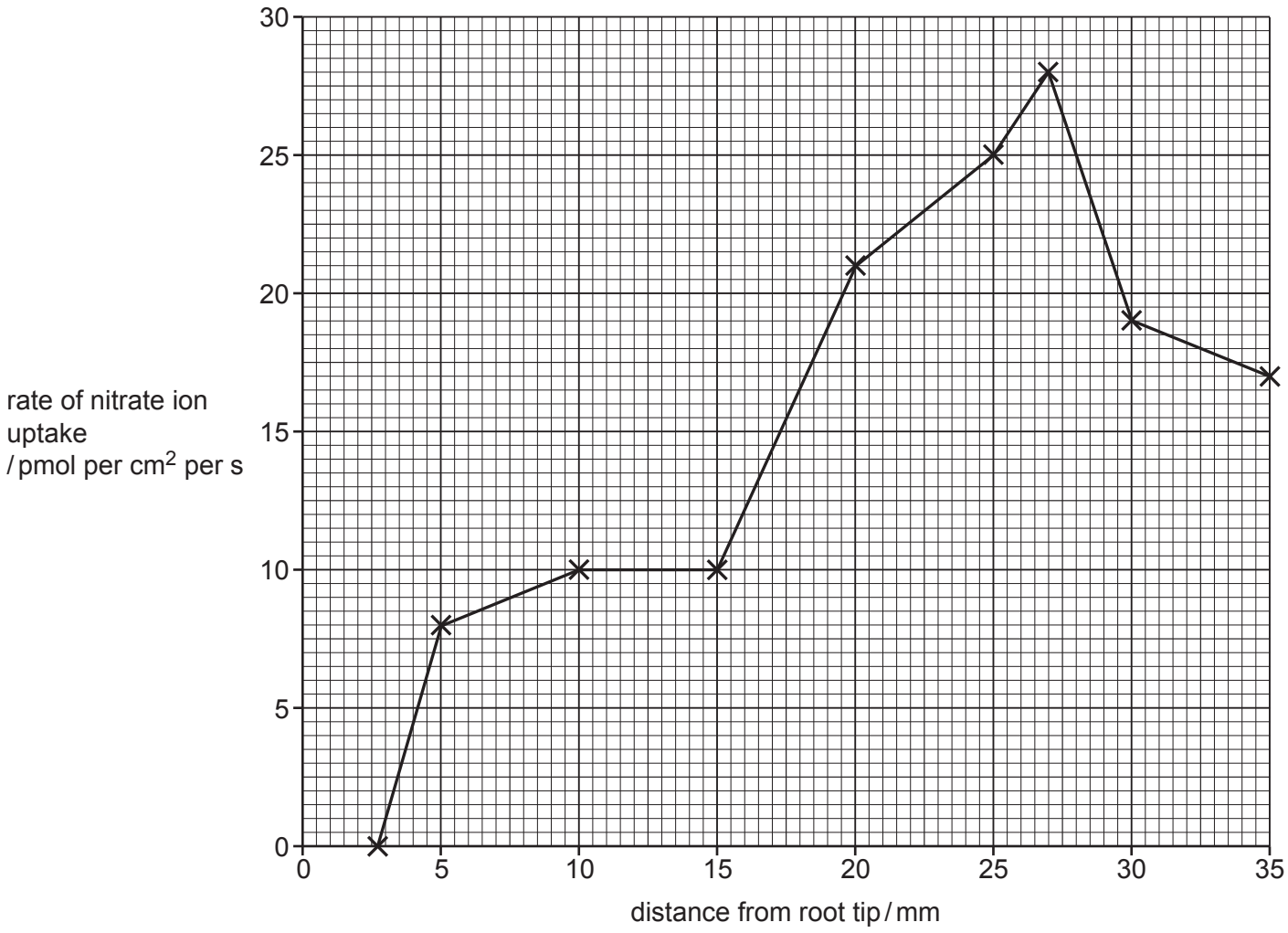


Fig. 2.2

(a) (i) Describe the rate of uptake of nitrate ions along the root.

View solution

Use the information in Fig. 2.1 and Fig. 2.2 in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(ii) Explain how nitrate ions move from the soil into roots.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(iii) Explain why the uptake of ions, such as nitrate, is important for the uptake of water in roots.

.....

.....

..... [1]

(iv) Explain why plants need nitrate ions, **other than** for the uptake of water.

.....

.....

.....

.....

.....

.....

..... [3]

(v) Describe how nitrate ions are formed in the soil.

.....

.....

.....

.....

.....

.....

..... [3]

(b) (i) Fig. 2.3 shows some of the events that occur when high concentrations of nitrate ions flow into lakes.

View solution

A	a decrease in the concentration of dissolved oxygen
B	a decrease in the population of consumers
C	a decrease in the population of producers
D	a decrease in light intensity at the bottom of the lake
E	an increase in the population of decomposers
F	an increase in the population of producers

Fig. 2.3

Put the events shown in Fig. 2.3 into the correct sequence.

[2]

(ii) State the name of the process summarised in Fig. 2.3.

..... [1]

[Total: 19]

View solution

3 A researcher investigated genetic variation in fruit flies, *Drosophila melanogaster*.

The bodies of fruit flies can be black or yellow. A yellow body colour is a recessive feature in fruit flies.

(a) Two heterozygous fruit flies with black bodies were bred together.

View solution

Predict the phenotypes of the offspring **and** the phenotypic ratio for this cross.

..... [1]

(b) In another fruit fly breeding experiment, researchers counted 124 offspring with black bodies and 121 offspring with yellow bodies.

Draw a genetic diagram to explain the results of this cross. Use the letter **B** to represent the allele for black body colour and the letter **b** to represent the allele for yellow body colour.

View solution

parental phenotypes ..... × .....

parental genotypes ..... × .....

gametes ..... , ... × ..... , ...

offspring genotypes .....

expected offspring phenotype ratio ..... black : ..... yellow

actual offspring phenotype ratio 124 black : 121 yellow

[5]

(c) The crab, *Cerberusa caeca*, lives in dark caves and has no coloured pigment.

View solution

Fig. 3.1 is a photograph of *C. caeca*.



Fig. 3.1

(i) *C. caeca* and *D. melanogaster* are both arthropods.

State **one** feature present in all arthropods but **not** present in vertebrates.

..... [1]

(ii) *C. caeca* is a crustacean and *D. melanogaster* is an insect.

State **one** morphological feature of *C. caeca* that distinguishes it as a crustacean and **not** as an insect.

..... [1]

View solution

(d) The ancestors of *C. caeca* had pigmented bodies.

The lack of a coloured pigment in *C. caeca* is called albinism and was caused by a mutation many thousands of years ago.

(i) Explain the mechanism that has resulted in the allele for albinism becoming common in recent generations in populations of *C. caeca*.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) State **two** factors that can cause mutations.

View solution

1 .....

2 .....

[2]

[Total: 13]

4 HIV is a pathogen that can cause AIDS.

(a) Describe how HIV is transmitted from one person to another.

View solution

.....

.....

.....

.....

.....

.....

..... [3]

(b) All viruses contain genetic material. HIV contains genetic material called RNA.

View solution

State **one** other feature common to all viruses.

..... [1]

(c) **(i)** Describe the function of lymphocytes.

View solution

.....

.....

.....

.....

.....

.....

..... [3]

(ii) State how infection with HIV affects the lymphocytes if untreated.

View solution

.....

..... [1]

(d) Doctors wanted to determine whether dietary supplements could help people infected with HIV.

They randomly put volunteers with HIV into two groups:
- a treatment group, who received HIV medication and additional vitamin and mineral supplements
- a control group, who received HIV medication but no additional supplements.

View solution

The details of the two groups are outlined in Table 4.1.

Table 4.1

	treatment group	control group
total number of volunteers	18	22
average age / years	45.6	46.6
average mass / kg	82.3	82.5

The dietary supplements were given to the treatment group twice a day for three months. The nutrients in the supplements included:
- vitamin C
- vitamin D
- calcium
- iron
- other minerals and vitamins.

(i) Explain why vitamin C and iron are important in the human diet.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

Table 4.2 shows some of the results from the study.

Table 4.2

	treatment group		control group	
	at the start	after three months	at the start	after three months
average number of lymphocytes / cells per µg of blood	357	422	461	461
average number of copies of HIV RNA per cm^3 of blood	4291	897	2648	5935

(ii) Use the data for the treatment group, shown in Table 4.2, to calculate the percentage decrease in the average number of copies of HIV RNA per cm^3 of blood.

View solution

Space for working.

.....%
[2]

(iii) Evaluate the effect of the dietary supplements on the lymphocytes.

View solution

Use the information in Table 4.2 in your answer.

.....

.....

.....

.....

..... [2]

[Total: 16]

5 Fig. 5.1 shows people fishing on a large scale and a small scale.



large-scale fishing



small-scale fishing

Fig. 5.1

All types of fishing can have a negative impact on fish stocks.

View solution

(a) Discuss how governments can regulate fishing to maintain fish stocks.

Use the word **sustainable** in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

(b) Fig. 5.2 shows the location of a chemical factory near a river.

View solution

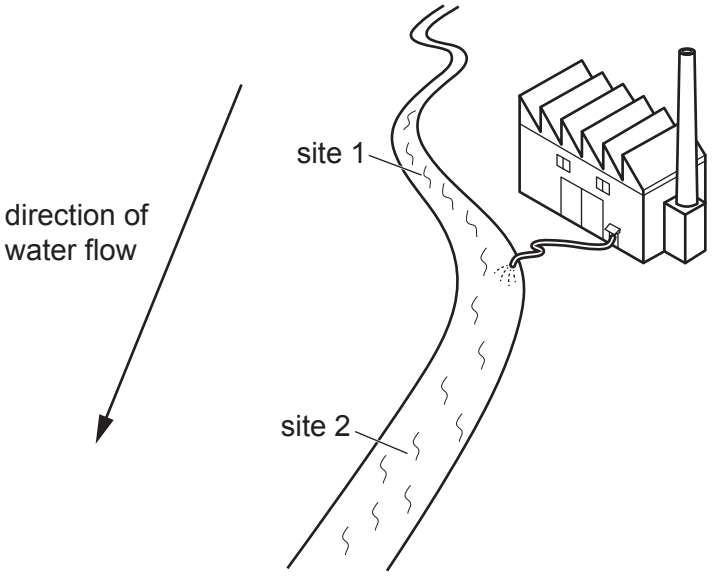


Fig. 5.2

Fig. 5.3 shows the sex ratio of the fish, *Catostomus commersonii*, in the river at site 1 and site 2. Intersex fish have both female and male reproductive organs.

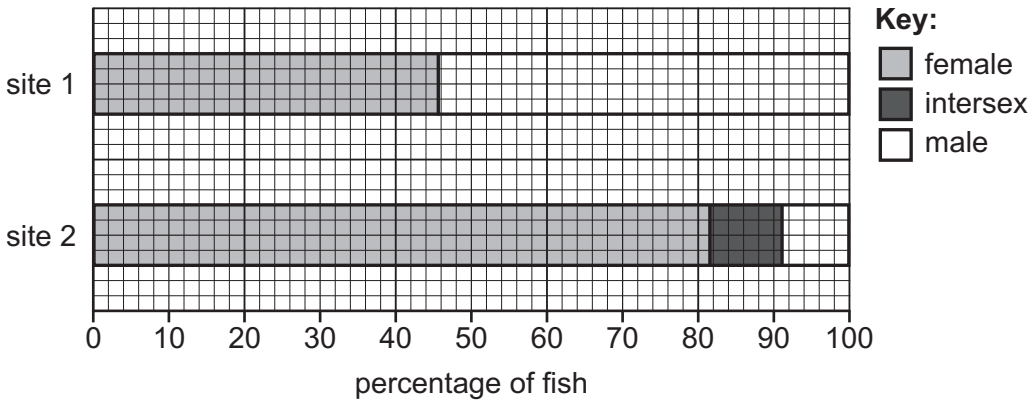


Fig. 5.3

State **and** explain what type of chemical the factory could be releasing into the river that would cause the effects shown in Fig. 5.3.

type of chemical .....

explanation .....

.....

.....

[2]

(c) State how sex is inherited in humans.

View solution

..... [1]

[Total: 9]

© UCLES 2021

6 The heart pumps blood around the body.

(a) Explain why the heart is an organ.

View solution

.....

.....

..... [1]

(b) Complete the sentences:

View solution

The ..... system includes the heart and blood vessels. Deoxygenated blood from the body is transported to the heart in the ..... .

During a heart beat the ventricles contract. The right ventricle pumps deoxygenated blood to the lungs. The right ventricle has a ..... muscular wall than the left ventricle.

Gas exchange in the lungs occurs by ..... . Oxygenated blood travels back to the heart where it enters the ..... of the heart.

The two sides of the heart are separated by the ..... . This structure prevents the mixing of oxygenated and deoxygenated blood. Oxygenated blood is then delivered to the rest of the body. Blood is supplied to the muscle of the heart in the ..... .

[7]

(c) Many people monitor their heart rate by counting their pulse.

View solution

State **one** other method of monitoring heart rate.

..... [1]

[Total: 9]

© UCLES 2021

BLANK PAGE

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.

© UCLES 2021