

Combined Science  
PAPER 1  
Higher Tier

Total Marks
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Tuesday 16 May 2023 – Morning

Time: 1 hour 10 minutes

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

**YOU MUST HAVE**

**Calculator, ruler**

**YOU WILL BE GIVEN**

**Diagram Booklet**

**INSTRUCTIONS**

**Answer ALL questions.**

**Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.**

**INFORMATION**

**The total mark for this paper is 60.**

**The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.**

**(continued on the next page)**

**Turn over**

**Information continued.**

**In the questions marked with an ASTERISK (\*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate. There may be spare copies of some diagrams.**

## **ADVICE**

**Read each question carefully before you start to answer it.**

**Try to answer every question.**

**Check your answers if you have time at the end.**

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**Answer ALL questions. Write your answers in the spaces provided.**

**Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

- 1 (a) Name the type of reproduction that produces genetically identical organisms.  
(1 mark)**
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- (b) Grafting is a technique used to grow some varieties of apple tree.**

**Look at FIGURE 1 for Question 1(b) in the Diagram Booklet. It shows apple tree shoots grafted on to a rootstock.**

**Turn over**

**Grafting can be used to produce apple trees that are genetically identical.**

**Give ONE advantage and ONE disadvantage of growing genetically identical apple trees.  
(2 marks)**

**Answer space continues on the next page.**

**advantage**

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**disadvantage**

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**Turn over**

**1 continued.**

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**(c) As apples ripen, enzymes convert starch into sugars.**

**Devise a method to find the optimum pH of an enzyme that breaks down starch.**

**You may use standard laboratory equipment and the solutions given in the list below.**

**(4 marks)**

**starch solution**

**enzyme solution**

**iodine solution**

**a range of pH solutions**

**(continued on the next page)**

**Turn over**

**1(c) continued.**

**Answer space continues on the next page.**

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**Turn over**

**1(c) continued.**

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**(continued on the next page)**



**1 continued.**

**(d) The optimum pH of an enzyme is pH 6.**

**Explain why this enzyme would not work at pH 10.  
(2 marks)**

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**(Total for Question 1 = 9 marks)**

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**Turn over**

- 2 Look at FIGURE 2 for Question 2(a) in the Diagram Booklet. It shows colonies of bacteria growing on an agar plate.**

**Each colony starts as one bacterium.**

**Every time bacteria reproduce, the number of bacteria in each colony doubles.**

- (a) Calculate the number of bacteria in a colony after five hours, if each bacterium reproduces every 30 minutes.  
(2 marks)**

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**bacteria**

**(continued on the next page)**

**Turn over**

**2 continued.**

**(b) Some bacteria are pathogens.**

**(i) State the meaning of the term  
pathogen.  
(1 mark)**

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**(ii) Explain why antibiotics can be  
used to treat bacterial infections.  
(2 marks)**

**Answer space continues on the next page.**

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**Turn over**

**2(b)(ii) continued.**

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**(continued on the next page)**

**2(b) continued.**

**(iii) A rod-shaped bacterium is  
0.005 mm long.**

**A student draws the  
rod-shaped bacterium.**

**The bacterium in the drawing is  
80 mm long.**

**Calculate the magnification of  
this drawing.  
(2 marks)**

**magnification =**

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**(Total for Question 2 = 7 marks)**

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**Turn over**

**3 (a) Look at FIGURE 3 for Question 3(a) in the Diagram Booklet. It shows a diagram of a mouse sperm cell.**

**(i) Which row of the table shows the functions of structure A and structure B?  
(1 mark)**

	<b>function of structure A</b>	<b>function of structure B</b>
<input type="checkbox"/> <b>A</b>	releases energy	contains the genetic material
<input type="checkbox"/> <b>B</b>	produces glucose	contains digestive enzymes
<input type="checkbox"/> <b>C</b>	releases energy	contains digestive enzymes
<input type="checkbox"/> <b>D</b>	produces glucose	contains the genetic material

**(continued on the next page)**

**3(a) continued.**

**(ii) The diploid chromosome number for a mouse is 40.**

**State the number of chromosomes in a mouse sperm cell.  
(1 mark)**

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**(continued on the next page)**

**3 continued.**

**(b) After a mouse egg cell is fertilised, cell division produces a ball of genetically identical stem cells.**

**(i) Look at the text for Question 3(b) (i) in the Diagram Booklet.**

**Which is the correct order for the stages of one cell division?  
(1 mark)**

☐ **A**

☐ **B**

☐ **C**

☐ **D**

**(continued on the next page)**

**Turn over**



**3(b) continued.**

- (ii) The genetically identical stem cells produce the cells that develop into an embryo.**

**Describe how stem cells produce the cells of an embryo.  
(2 marks)**

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**(continued on the next page)**

**3 continued.**

- (c) Scientific research has made many discoveries and developments allowing stem cells to be used in medical treatments.**

**Look at FIGURE 4 for Question 3(c) in the Diagram Booklet. It shows a timeline for some of these discoveries and developments.**

- (i) Give ONE scientific reason why the bone marrow transplant in 1968 was from a sister to her brother.  
(1 mark)**

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**(continued on the next page)**

**Turn over**

**3(c) continued.**

**(ii) Give ONE scientific reason why some people are opposed to the isolation of human embryonic stem cells.**

**(1 mark)**

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**(iii) Stem cells, with the properties of embryonic stem cells, can be produced from a patient's own skin cells.**

**Discuss the benefits of using these stem cells to treat the patient.**

**(3 marks)**

**Answer space continues on the next page.**

**Turn over**

**3(c)(iii) continued.**

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**(Total for Question 3 = 10 marks)**

**Turn over**

- 4 (a) In the 19th century the destruction of wetland habitats caused the extinction of the bittern in the UK.**

**Look at FIGURE 5 for Question 4(a) in the Diagram Booklet. It shows a bittern.**

**Restoration of the habitats has led to the birds returning to the UK.**

**Male bitterns make a loud booming sound.**

**This allows the numbers of male bitterns to be counted.**

**In 1997, 11 males were counted and this increased to 221 males in 2021.**

**(continued on the next page)**

**4(a) continued.**

- (i) Calculate the percentage increase in the number of males from 1997 to 2021.  
(3 marks)**

\_\_\_\_\_ %

**(continued on the next page)**

**4(a) continued.**

**The bitterns are difficult to see in the reeds of the habitat.**

**(ii) Give ONE benefit of this to the bittern.  
(1 mark)**

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**(continued on the next page)**

**4(a) continued.**

**(iii) There is some concern that the bitterns in the UK are all closely related. This could make them susceptible to extinction.**

**Explain, using your knowledge of natural selection, why being closely related could make the bitterns susceptible to extinction.  
(3 marks)**

**Answer space continues on the next page.**

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**4(a)(iii) continued.**

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**(b) Describe how selective breeding  
can be used to produce a large  
population of animals that are not  
closely related.  
(2 marks)**

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**4 continued.**

**(c) Sex determination in birds is different from humans.**

**Males are homozygous Z and females are heterozygous ZW.**

**Look at the Punnett square for Question 4(c) in the Diagram Booklet. Complete the Punnett square to show how sex is determined in birds. (2 marks)**

**(Total for Question 4 = 11 marks)**

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- 5 A student investigated the movement of water in potatoes.**

**The student used three identical cubes of potato.**

**Look at FIGURE 6 for Question 5 in the Diagram Booklet. The size of a cube is shown in Figure 6.**

- (a) (i) Calculate the volume of this cube.**

**Include the units in your answer.  
(2 marks)**

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**(continued on the next page)**

**Turn over**

**5(a) continued.**

**One cube was placed in water and each of the other two cubes were placed in solutions with different concentrations of salt.**

**The cubes were left for 20 minutes.**

**Look at FIGURE 7 for Question 5(a) in the Diagram Booklet. It shows the student's results.**

**(ii) Give ONE way the student could ensure the measurement of the mass of the cubes is accurate.  
(1 mark)**

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**5(a) continued.**

**(iii) Explain the mass change in the cube in the concentrated salt solution.  
(3 marks)**

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**(continued on the next page)**

**Turn over**

**5(a) continued.**

**(iv) The student wanted to find the concentration of salt solution where the potato cube did not change mass.**

**Describe how the student could modify this investigation to find this concentration.  
(3 marks)**

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**Turn over**

**5(a)(iv) continued.**

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**(b) Explain why potato cells do not burst  
when placed in water.  
(2 marks)**

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**(Total for Question 5 = 11 marks)**

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- 6 (a) A person's mass is partially influenced by the alleles they inherit from their parents.**

**Give TWO other factors that can influence a person's mass.  
(2 marks)**

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**(continued on the next page)**

**6 continued.**

**(b) Look at FIGURE 8 for Question 6(b) in the Diagram Booklet. It shows the data obtained from a patient by a doctor doing a health check.**

**The guidance used by the doctor is also listed in Figure 8.**

**Comment on the data and the health risks to this patient.  
(4 marks)**

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**Turn over**

**6(b) continued.**

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**6 continued.**

**\*(c) The doctor also tested the reaction time of the patient.**

**Describe the structure and function of a reflex arc.  
(6 marks)**

**Answer space continues on the next page.**

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**Turn over**

**6(c) continued.**

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**Turn over**

**6(c) continued.**

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**(Total for Question 6 = 12 marks)**

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**TOTAL FOR PAPER = 60 MARKS**  
**END OF PAPER**