

Combined Science  
PAPER 1  
Higher tier

Total Marks
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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**

**Ruler, calculator**

**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.**

**Turn over**

## **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.**

**In 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.**

**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 ☐.**

**(continued on the next page)**

1 (a) DNA molecules contain base pairs.

Describe how the base pairs are bonded together in a DNA molecule.  
(2 marks)

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**1 continued.**

**(b) Look at Figure 1 for Question 1(b) in the Diagram Booklet. It shows part of a DNA molecule.**

**(i) Write the code for the complementary DNA strand in Figure 1.  
(2 marks)**

**(continued on the next page)**

**1 continued.**

**(ii) Three bases code for each amino acid.**

**Which is the maximum number of amino acids coded for by this strand of DNA?  
(1 mark)**

☐ **A 3**

☐ **B 4**

☐ **C 6**

☐ **D 12**

**(continued on the next page)**

**Turn over**

**1 continued.**

**(iii) What is the shape of a DNA molecule?  
(1 mark)**

- ☐ **A triple stranded**
- ☐ **B single stranded**
- ☐ **C single helix**
- ☐ **D double helix**

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**1 continued.**

**(c) A student wanted to extract the DNA from fresh peas.**

**The student crushed the peas and added washing up liquid and water.**

**The enzyme protease was then added to this mixture.**

**(i) Explain why the enzyme protease was added to the mixture.  
(2 marks)**

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**1 continued.**

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**1 continued.**

**(ii) The mixture was then heated and filtered.**

**Finally, the student poured the filtrate into a test tube and ice cold ethanol was poured down the side of the test tube into the filtrate.**

**State why ice cold ethanol was poured into the filtrate.  
(1 mark)**

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

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**Turn over**

- 2 (a) Look at Figure 2 for Question 2(a) in the Diagram Booklet. It shows the number of people diagnosed with sexually transmitted infections (STIs) in the UK during 2017.**
- (i) State the sexually transmitted infection that has the median number of people diagnosed. (1 mark)**

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**2 continued.**

**(ii) The population of the UK in 2017 was 66 million people.**

**Calculate the total number of people diagnosed with chlamydia in the UK in 2017.  
(2 marks)**

**\_\_\_\_\_ people**

**(continued on the next page)**

**2 continued.**

**(iii) State why chlamydia  
can be described as a  
communicable disease.  
(1 mark)**

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**(iv) Give ONE way the transmission  
of chlamydia can be prevented.  
(1 mark)**

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**Turn over**

**2 continued.**

**(v) Explain why chlamydia can be treated with antibiotics.  
(2 marks)**

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**Turn over**

**2 continued.**

**(b) HIV is another sexually transmitted infection.**

**Explain how HIV can lead to the onset of AIDS.  
(2 marks)**

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**(Total for Question 2 = 9 marks)**

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3 (a) In 2017, a new strain of **Klebsiella pneumoniae** bacteria was discovered that was resistant to 26 different antibiotics.

(i) Explain how **Klebsiella pneumoniae** bacteria developed resistance to antibiotics.  
(4 marks)

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**3 continued.**

- (ii) State how the use of antibiotics could contribute to *Klebsiella pneumoniae* bacteria developing resistance to antibiotics.  
(1 mark)**

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**3 continued.**

**(iii) *Klebsiella pneumoniae* is a prokaryotic cell.**

**Which is a characteristic feature of a prokaryotic cell?  
(1 mark)**

- ☐ **A it has chloroplasts**
- ☐ **B it does not have a nucleus**
- ☐ **C it does not have ribosomes**
- ☐ **D it cannot reproduce without a host**

**(continued on the next page)**

**Turn over**

**3 continued.**

**(b) New antibiotics are being developed to treat the disease caused by *Klebsiella pneumoniae*.**

**Describe the stages of antibiotic development that would occur after the discovery of a new antibiotic.  
(3 marks)**

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**3 continued.**

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**(Total for Question 3 = 9 marks)**

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- 4 A student investigated the fat content of two types of milk: milk A and milk B.**

**Look at Figure 3 for Question 4 in the Diagram Booklet. Before starting the investigation, the student added a drop of oil from a pipette into a test tube of water as shown.**

**The drop of oil rose to the surface of the water.**

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**4 continued.**

- (a) The student then placed a drop of milk A into one test tube of water and a drop of milk B into a different test tube of water.**

**The drop of milk A sank to the bottom and the drop of milk B rose to the surface.**

**Give ONE reason for the drop of milk B rising to the surface.  
(1 mark)**

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**Turn over**



**4 continued.**

**(b)  $5\text{ cm}^3$  of milk B and  $1\text{ cm}^3$  of lipase were added to a different test tube.**

**The pH of this mixture was pH 7.**

**This test tube was placed in a water bath for 10 minutes.**

**The pH of the mixture changed from pH 7 to pH 5.**

**(i) Explain what caused this change in pH.  
(3 marks)**

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**4 continued.**

**(ii) This procedure was repeated with milk A.**

**There was no change in the pH of this mixture after 10 minutes.**

**Explain why there was no change in the pH of the mixture containing milk A.  
(2 marks)**

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**4 continued.**

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**(iii) The student repeated this procedure with lipase that had been boiled and left to cool.**

**This was added to another sample of milk B.**

**Describe why the pH did not change in this mixture.  
(3 marks)**

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**(Total for Question 4 = 9 marks)**

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- 5 (a) A student was investigating mitosis in the roots of a garlic plant.**

**Describe how the student could prepare a microscope slide to show mitosis in the growing roots of a garlic plant.  
(4 marks)**

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**5 continued.**

**(b) Describe what is produced when a single cell divides by mitosis.  
(3 marks)**

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**5 continued.**

**(c) The student observed 89 cells on the microscope slide.**

**Look at Figure 4 for Question 5(c) in the Diagram Booklet. It shows the number of cells at each stage of the cell cycle.**

**Use this equation to calculate the mitotic index for this slide.**

$$\text{mitotic index} = \frac{\text{number of cells in mitosis}}{\text{total number of cells}} \times 100$$

**Give your answer to three significant figures.  
(3 marks)**

**(continued on the next page)**

**Turn over**

**5 continued.**

**Mitotic index \_\_\_\_\_**

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**Turn over**

**5 continued.**

**(d) The mitotic index is often used in the diagnosis of cancer.**

**State the effect of cancer on cell division.  
(1 mark)**

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

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**6 There is a shortage of kidneys for organ transplants.**

**Scientists are investigating how to grow kidneys using genetically modified pig embryos.**

**Look at Figure 5 for Question 6 in the Diagram Booklet. It shows this process.**

**Step 1. Human stem cells taken from the patient needing a transplant**

**Step 2. Human cells injected into the early stages of the developing pig embryo. This pig embryo is genetically engineered so it does not grow pig kidneys.**

**Step 3. Pig grows the human kidneys rather than pig kidneys**

**Step 4. Kidneys taken from the pig are implanted into the human**

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**Turn over**

**6 continued.**

- (a) (i) State why the embryo of the pig must be engineered so it does not grow pig kidneys.  
(1 mark)**

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**6 continued.**

**(ii) Explain why human stem cells  
are used for this process.  
(2 marks)**

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**Turn over**

**6 continued.**

**(b) Look at Figure 6 for Question 6(b) in the Diagram Booklet. It shows the number of organ transplants needed and the number of donors available in the USA from 1991 to 2018.**

**(i) Compare the number of donors available with the number of organ transplants needed from 1991 to 2018.**

**Use information from the graph to support your answer.  
(3 marks)**

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**6 continued.**

**(ii) State why scientists are  
genetically engineering animals  
for organ transplants.  
(1 mark)**

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**6 continued.**

**\*(c) Bacteria have been genetically engineered to produce human insulin since 1978.**

**Explain how bacteria can be genetically engineered to produce human insulin.  
(6 marks)**

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(Total for Question 6 = 13 marks)

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