

**Combined Science**  
**PAPER 4**  
**Higher Tier**

Total Marks
-------------

**Time: 1 hour 10 minutes**

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

<b>Surname</b>					
<b>Other names</b>					
<b>Centre Number</b>					
<b>Candidate Number</b>					

**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.**

**Calculators may be used.**

**Any diagrams may NOT be accurately drawn, unless otherwise indicated.**

**You must show all your working out with your answer clearly identified at the end of your solution.**

## **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 ☒.**

- 1 (a) Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows the stem of a plant which connects the roots to the leaves and flowers. Inside the stem are xylem and phloem.**
- (i) Living cells in phloem use energy to transport sucrose.**

**Which organelles release energy in living cells?  
(1 mark)**

- ☐ **A vacuoles**
- ☐ **B mitochondria**
- ☐ **C nuclei**
- ☐ **D ribosomes**

**(continued on the next page)**

**1 continued.**

- (ii) Describe TWO features of the structure of xylem vessels that can be seen in Figure 1. (2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**1 continued.**

- (b) A scientist investigated how the flow of air affected the rate of transpiration in a plant.**

**A fan was used to change the flow of air.**

**The volume of water taken up by the plant was measured.**

**Look at Figure 2 for Question 1(b) in the Diagram Booklet. It shows the results of this investigation.**

- (i) Explain why switching on the fan caused a change in the volume of water taken up by the plant.  
(3 marks)**

---

---

---

---

---

---

**(continued on the next page)**

**Turn over**

**1 continued.**

---

---

---

- (ii) Give ONE reason why the volume of water taken up by the plant was also measured when the fan was not switched on.  
(1 mark)**

---

---

---

**(continued on the next page)**

**1 continued.**

- (iii) Calculate the rate of water uptake from 8 minutes to 10 minutes when the fan was switched on.  
(2 marks)**

**Use the equation**

$$\text{rate of water uptake} = \frac{\text{volume of water taken up}}{\text{time taken}}$$

\_\_\_\_\_ mm<sup>3</sup> per minute

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

---



**2 (a) Look at Figure 3 for Question 2(a) in the Diagram Booklet. It shows a cross-section of an artery and a vein.**

**(i) Explain ONE difference between the artery wall and the vein wall shown in Figure 3.  
(2 marks)**

---

---

---

---

---

---

---

---

**(continued on the next page)**

**2 continued.**

- (ii) Name ONE structure that is found in veins but not found in arteries.  
(1 mark)**

---

---

**(continued on the next page)**

**2 continued.**

**(b) A human body has  $5\text{ dm}^3$  of blood.**

**At rest 20% of the blood travels to the muscles.**

**During exercise 60% of the blood travels to the muscles.**

- (i) Calculate the volume of blood travelling to the muscles during exercise.  
(2 marks)**

\_\_\_\_\_  $\text{dm}^3$

**(continued on the next page)**

**2 continued.**

- (ii) Explain ONE reason why there is an increase in blood flow to muscles during exercise.  
(2 marks)**

---

---

---

---

---

---

---

---

---

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

---

- 3 (a) Bacteria in the root nodules of a leguminous plant provide the plant with nitrogen compounds.

The leguminous plant provides the bacteria with sugars.

- (i) Which term describes the relationship between this leguminous plant and the bacteria?  
(1 mark)

- ☐ A parasitism
- ☐ B indigenous
- ☐ C biodiversity
- ☐ D mutualism

- (ii) The width of a root nodule is 7.5 mm.

Give the width in  $\mu\text{m}$ .  
(1 mark)

\_\_\_\_\_  $\mu\text{m}$

(continued on the next page)

3 continued.

(b) Figure 5 shows part of the nitrogen cycle.

**FIGURE 5**

dead animals and plants  $\xrightarrow{\text{X}}$  ammonia  $\xrightarrow{\text{Y}}$  nitrates

- (i) Identify the types of microorganism involved in process X and process Y.  
(2 marks)

X \_\_\_\_\_

\_\_\_\_\_

Y \_\_\_\_\_

\_\_\_\_\_

(continued on the next page)

**3 continued.**

- (ii) Explain how crop rotation increases nitrate levels in the soil.  
(3 marks)**

---

---

---

---

---

---

---

---

---

---

**(continued on the next page)**

**3 continued.**

- (iii) Explain why increased nitrate levels in the soil improve crop yield.  
(2 marks)**

---

---

---

---

---

---

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

---



**4 (a) The combined contraceptive pill contains artificial versions of oestrogen and progesterone.**

**(i) Explain how the combined contraceptive pill prevents pregnancy.  
(2 marks)**

---

---

---

---

---

---

**(continued on the next page)**

**4 continued.**

- (ii) When taken correctly, the combined pill can be over 99% effective.**

**Taking the combined pill can lead to weight gain.**

**Give ONE other disadvantage of using the combined pill as the only method of contraception.**

**(1 mark)**

---

---

**(continued on the next page)**

**4 continued.**

**(b) Excessive weight gain and obesity increase the likelihood of developing type 2 diabetes.**

**Explain the effect of type 2 diabetes on the body.  
(3 marks)**

---

---

---

---

---

---

---

---

---

---

**(continued on the next page)**

**4 continued.**

- (c) A woman had unexplained weight loss and fatigue. She had blood tests to investigate the cause of these symptoms.**

**Look at Figure 6 for Question 4(c) in the Diagram Booklet. It shows the results.**

**Comment on the results of these blood tests and the possible causes of the woman's weight loss and fatigue.**

**(4 marks)**

---

---

---

---

---

---

---

---

---

**(continued on the next page)**

**Turn over**

**4 continued.**

---

---

---

---

---

---

---

---

---

---

**(Total for Question 4 = 10 marks)**

---

- 5 The effect of different types of exercise on the heart rate of an athlete was investigated.**

**The athlete counted the number of beats in 10 seconds at the carotid artery pulse point by placing her index and middle finger on the side of her neck in the soft hollow beside the windpipe.**

**This measurement was used to calculate the heart rate.**

**The athlete exercised for 20 minutes.**

**The heart rate was recorded every 5 minutes during each type of exercise.**

- (a) (i) State how the heart rate was calculated using this method.  
(1 mark)**

---

---

---

**(continued on the next page)**

**5 continued.**

- (ii) Give TWO ways of improving the method used to obtain the data needed to calculate the heart rate.  
(2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**5 continued.**

**Look at Figure 8 for Question 5(a)(iii) in the Diagram Booklet. It shows the results of this investigation.**

**(iii) Comment on the difference in the heart rates during these types of exercise.  
(3 marks)**

---

---

---

---

---

---

---

---

---

---

**(continued on the next page)**

**Turn over**



**5 continued.**

---

---

**(b) Exercise increases adrenalin levels.**

**(i) State which endocrine gland  
secretes adrenalin.**

**(1 mark)**

---

---

**(continued on the next page)**

**5 continued.**

- (ii) Explain the effect of adrenalin on liver cells during exercise.  
(3 marks)**

---

---

---

---

---

---

---

---

---

---

---

**(continued on the next page)**

**5 continued.**

- (c) After high intensity exercise, the pH of muscles can decrease from pH 7·0 to pH 6·3.**

**Explain this change in pH.  
(2 marks)**

---

---

---

---

---

---

---

---

---

---

**(Total for Question 5 = 12 marks)**

---

- 6 (a) Scientists use a technique called mark and recapture to estimate animal populations in a habitat.**

**A sample of the population is captured and a harmless mark is added to each animal.**

**These animals are released and after a period of time the population is sampled again.**

**This second sample includes some recaptured animals that have marks on them.**

**The population can be estimated using this equation**

$$\text{population size} = \frac{\text{number marked in the first sample} \times \text{size of the second sample}}{\text{number recaptured in the second sample}}$$

**A scientist used this technique to determine the change in the population size of snails in a pond from March to July.**

**Look at Figure 9 for Question 6(a) in the Diagram Booklet. It shows the results.**

**(continued on the next page)**

**6 continued.**

- (i) Using data from Figure 9, calculate the difference in the population size from March to July.  
(3 marks)**

**Difference in the population size \_\_\_\_\_**

**(continued on the next page)**

**6 continued.**

- (ii) State TWO factors the scientist should control when sampling the habitat in March and July. (2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**6 continued.**

**(b) This pond is affected by eutrophication.**

**Explain ONE possible cause of eutrophication.  
(2 marks)**

---

---

---

---

---

---

---

---

---

---

**(continued on the next page)**

**6 continued.**

**\*(c) Reforestation has a beneficial effect on air composition and biodiversity.**

**Animal conservation projects can also have a beneficial effect on biodiversity.**

**Explain the beneficial effects of reforestation and animal conservation projects.  
(6 marks)**

---

---

---

---

---

---

---

---

---

---

**(continued on the next page)**

**Turn over**



**6 continued.**

[illegible]

**(continued on the next page)**

**Turn over**

**6 continued.**

---

---

---

---

---

---

---

**(Total for Question 6 = 13 marks)**

---

---

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