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SUBJECT: **Biology**  
 PAPER NUMBER: I  
 DATE: 2<sup>nd</sup> September 2019  
 TIME: 9:00 a.m. to 12:05 p.m.

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### Directions to Candidates

- Write your index number in the space at the top left-hand corner of this page.
- Answer **ALL** questions. Write all your answers in the spaces provided in this booklet.
- The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.
- You are reminded of the necessity for good English and orderly presentation in your answers.
- In calculations you are advised to show all the steps in your working, giving your answer at each stage.
- The use of electronic calculators is permitted.

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#### For examiners' use only:

Question	1	2	3	4	5	6	7	8	9	10	Total
Score											
Maximum	12	11	12	10	10	6	6	11	10	12	<b>100</b>

1. This question is about biochemistry.

In the following graph, "C" represents Methionine whereas "D" represents Cysteine.

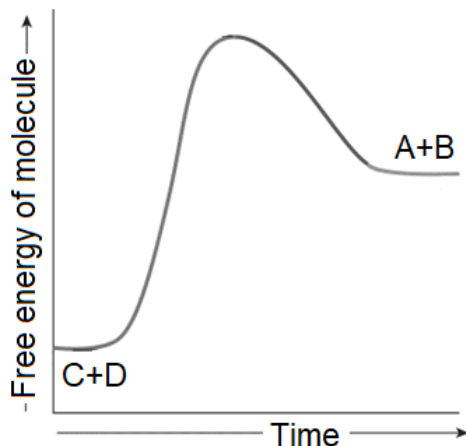


Figure 1: Graph showing energy changes in a chemical reaction.  
 (Adapted from: <https://content.openclass.com>)

a. What type of molecules, as represented by A and B, are formed when C and D react together?

A: \_\_\_\_\_ (½)

B: \_\_\_\_\_ (½)

b. Is the reaction depicted above endergonic (endothermic) or exergonic (exothermic)? Give a reason for your answer.

\_\_\_\_\_  
 \_\_\_\_\_ (2)

c. On Figure 1 above:  
 i. Mark and label the activation energy of the reaction. (1)  
 ii. Sketch a graph to show how the introduction of an enzyme would affect the reaction. (1)

d. Explain your answer to part c(ii).  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2)

e. Both Methionine and Cysteine contain sulfur in their R group. What effect might this have on the tertiary structure of the protein?

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(1)

f. Some proteins assume a fibrous shape whilst others are globular. Complete the table below by giving **ONE** function and an example of a protein that carries out the named function:

Type of protein	ONE function	Example
Fibrous		
Globular		

(4)

**(Total: 12 marks)**

2. This question is about classification of organisms.

Figure 2 below depicts *Peripatus novaezealandiae*, a Velvet Worm belonging to Phylum Onychophora. Onychophorans are fascinating because their features are intermediate between those of Annelida and Arthropoda. They are terrestrial but they are unable to control water loss and so are restricted to microclimates with high humidity.

Although they are coelomate, their coelom is reduced to small cavities whereas their main body cavity is filled with haemocoel. The respiratory system consists of numerous, irregularly distributed pits, from which many thin tracheae originate. The tracheae penetrate deep into the body, making oxygen available to the organs and tissues within.

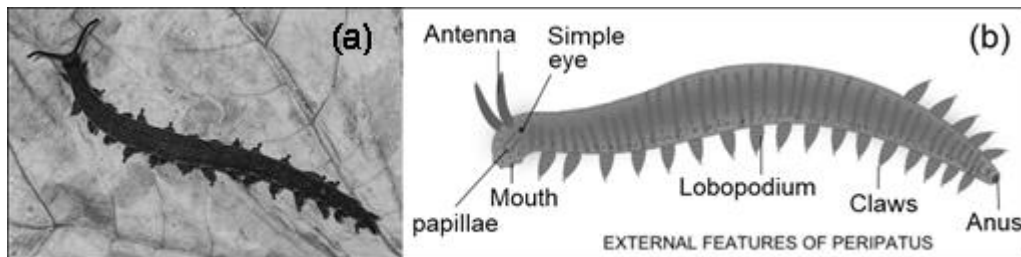


Figure 2: *Peripatus novaezealandiae*

(a) Photo taken in captive, controlled conditions (<https://www.mindenpictures.com/>);

(b) Diagrammatic representation (<https://www.studyandscore.com/studymaterial-detail/status-of-onychophora>)

**Question continues on next page**

- a. From your knowledge of taxonomy, deduce whether *Peripatus novaezealandiae* is more closely related to *Peripatus ruber* or to *Orthodera novaezealandiae*? Explain.

\_\_\_\_\_ (2)

- b. The fluid-filled body cavity of Onychophora acts as a hydrostatic skeleton. Give **TWO** other functions of the coelom.

\_\_\_\_\_ (2)

- c. Onychophora have pairs of stumpy legs (lobopodia) along the length of their body. These appendages are lobe-like extensions of the body similar to parapodia in Annelids. Name the annelid group that has parapodia.

\_\_\_\_\_ (1)

- d. Give **TWO** features that are present in all Arthropods but are missing in Onychophora.

\_\_\_\_\_ (2)

- e. Tick (✓) the correct box to show whether the following statements about Onychophora are True or False.

Statement	True	False
Onychophora are most probably diploblastic.		
They have an open circulatory system.		
Their respiratory system is more similar to Annelids than Arthropods.		
They possess antennae like all Arthropods.		
They exhibit radial symmetry.		
They show a degree of cephalisation.		

(3)

- f. The slug-like appearance of Onychophora has previously caused them to be incorrectly grouped with Gastropoda. To which phylum do gastropods belong?

\_\_\_\_\_ (1)

**(Total: 11 marks)**

3. This question is about inheritance.

Table 1 below shows some information about different types of haemophilia.

Table 1: Different types of haemophilia

<b>Disease</b>	<b>Factor Deficiency</b>	<b>Inheritance</b>
Haemophilia A	VIII (8)	X linked recessive
Haemophilia B	IX (9)	X linked recessive
Haemophilia C	XI (11)	Autosomal recessive

a. All types of haemophilia have a recessive pattern of inheritance. What does this mean?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (1)

b. The most common mutation in people with Haemophilia A is an inversion involving a large segment of the F8 gene.

i. Define the term gene.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (1)

ii. What is an inversion mutation?

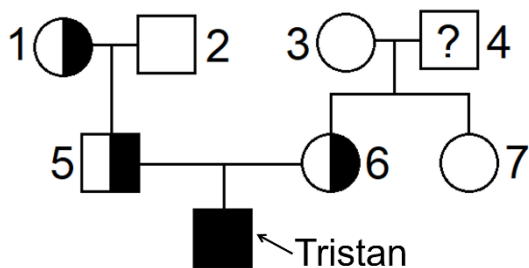
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

iii. Why does an inversion mutation lead to a deficiency in factor VIII?

\_\_\_\_\_  
\_\_\_\_\_ (1)

**Question continues on next page**

c. The following pedigree chart shows the presence or absence of Haemophilia C within Tristan’s family across generations.



**Key:**  
 Square: male  
 Circle: female  
 Shaded: allele for Haemophilia C

Figure 3: Pedigree chart showing presence or absence of Haemophilia C within a family.

i. Give **ONE** piece of evidence from the diagram that demonstrates that this chart is **not** showing the incidence of Haemophilia A but of Haemophilia C.

\_\_\_\_\_ (1)

ii. Determine the genotype of Tristan’s maternal grandfather (person 4).

\_\_\_\_\_ (1)

iii. Give the percentage probability of Tristan having a haemophilic sibling from the same parents.

\_\_\_\_\_ (1)

The pattern of inheritance shown above was first described by Gregor Mendel in 1865. In the early 1900s, his work was rediscovered and a flood of research began to determine the mechanisms behind it. A number of scientists agreed that the secret to inheritance lies within chromosomes after they observed them undergoing meiosis. However, many believed it was the proteins within chromosomes that held genetic information not DNA.

d. Name a group of proteins found within chromosomes and explain its function.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2)

e. List **TWO** things that happen to chromosomes during meiosis but not during mitosis.

\_\_\_\_\_  
 \_\_\_\_\_ (2)

**(Total: 12 marks)**

4. This question concerns the genetic code.

In 1952, Alfred Hershey and Martha Chase conducted a series of experiments to determine whether DNA or protein was the genetic material. They grew viruses in one of two media – radioactive sulfur and radioactive phosphorus – in order to label a specific viral component each time. The viruses were then allowed to infect bacteria. Then, the viruses and infected bacteria were separated by centrifugation.

a. Which of the two media would have contained labelled DNA? Explain.

\_\_\_\_\_  
\_\_\_\_\_ (2)

b. Explain why radioactively labelled DNA was found at the bottom of the test tube after centrifugation.

\_\_\_\_\_  
\_\_\_\_\_ (2)

c. A student suggested that this experiment should have been done using radioactive nitrogen instead of sulfur. Explain why he is wrong.

\_\_\_\_\_  
\_\_\_\_\_ (2)

d. List **FOUR** characteristics of the genetic code.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (4)

**(Total: 10 marks)**

***Questions continue on next page***

5. This question is on plant tissues.

Plant tissues may be divided in two groups: simple tissue made up of one type of cell such as parenchyma and complex tissue such as xylem and phloem.

a. Fill in the table below by giving a structural characteristic of each cell type and the related function.

Cell type	Structural characteristic	Function related to the structural characteristic chosen
Tracheid		
Xylem fibres		
Sieve tube element		

(6)

b. Give **TWO** ways in which collenchyma differs from sclerenchyma.

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(2)

c. Give **TWO** reasons why collenchyma is more suitable than sclerenchyma to function as a supporting tissue in the midrib of leaves and in the leaf stalk (which is where collenchyma is found).

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(2)

**(Total: 10 marks)**



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6. This question is about biogeochemical cycles.

The nitrogen biogeochemical cycle illustrates the flow of this major nutrient from one reservoir to another.

a. List **TWO** purposes of nitrogen in organisms.

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(2)

b. There are several types of bacteria that play a role in the nitrogen cycle. Mention the role of each of the following bacteria:

i. *Azotobacter*

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(1)

ii. *Pseudomonas*

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(1)

c. Define the term ammonification and mention the major natural reservoir of ammonia.

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(2)

**(Total: 6 marks)**

7. This question is on plant responses.

Plant responses are generally slower when compared to animals and often involve growth.

a. A potted plant was unilaterally illuminated, and the plant was observed to be growing towards the source of light. Give the term that matches this description.

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(1)

**Question continues on next page**

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b. There are five major types of plant growth substances. The most important out of all of these are the auxins.

i. Name **ONE** auxin.

\_\_\_\_\_ (1)

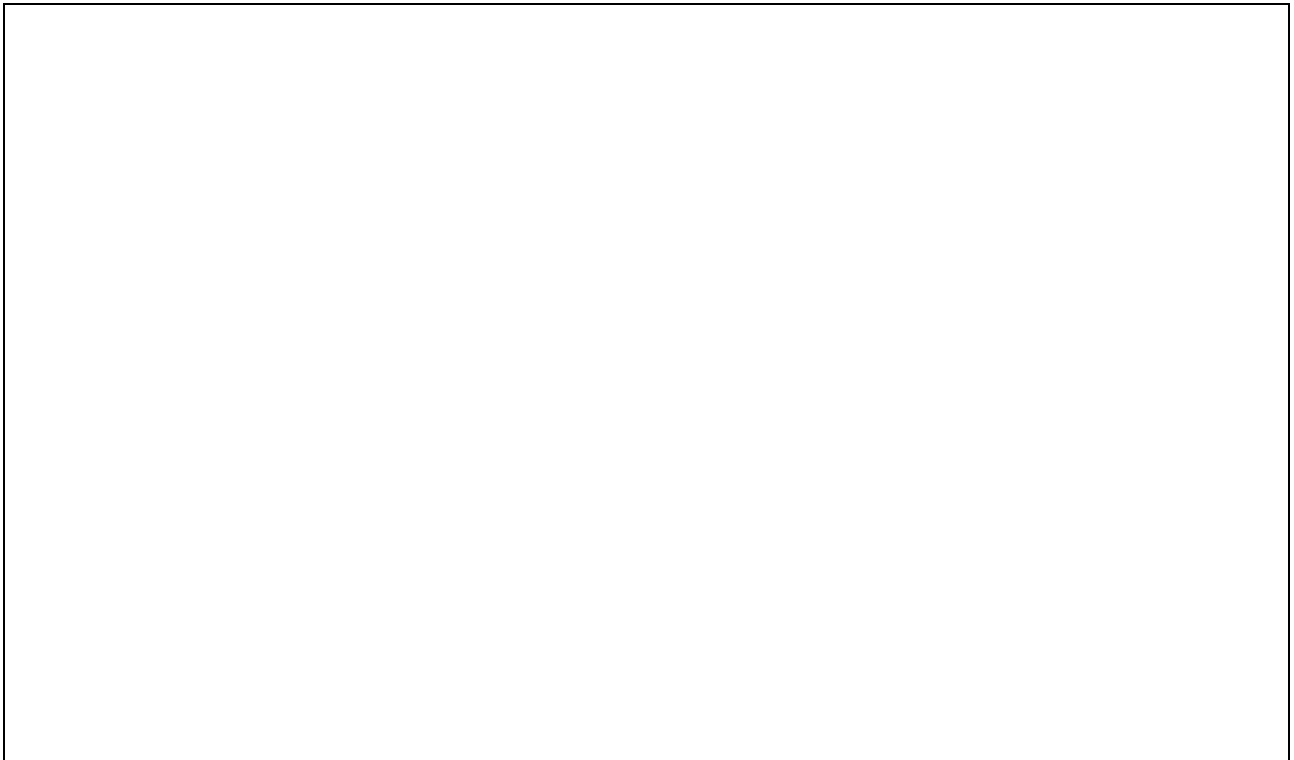
ii. Explain how auxin distribution enables plants to respond positively to light and grow towards it.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (4)

**(Total: 6 marks)**

8. This question is about reproduction in plants.

a. In the space below, draw the life cycle of *Dryopteris* sp.



(5)

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b. Explain in detail how the life cycle of *Dryopteris* sp. is different from that of *Funaria* sp.

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(3)

c. Discuss the mechanism by which *Dryopteris* sp. releases its spores.

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(3)

**(Total: 11 marks)**

**Questions continue on next page**

9. This question is about transport in plants.

a. Figure 4 shows a graph of a transpiration experiment between two plant species.

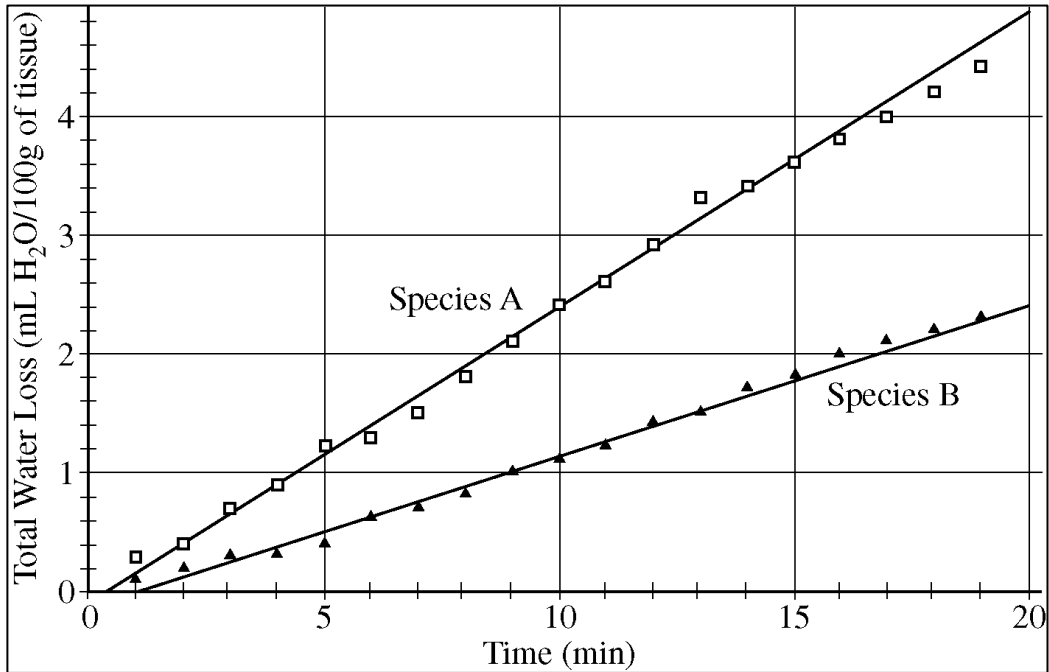


Figure 4: The rates of transpiration between two plant species.  
 (Source: <https://www.chegg.com>)

i. Calculate the rate of transpiration for each species. *You need to show your working.*

(4)

DO NOT WRITE ABOVE THIS LINE

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ii. Compare the rate of transpiration of the two plant species.

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(1)

iii. Identify and explain **THREE** structural adaptations that could explain the difference in the transpiration rates between species A and B.

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(3)

b. Many succulents and arid-climate plants have a specialised form of photosynthesis called Crassulacean Acid Metabolism (CAM). In the space provided, sketch a graph to show how stomatal opening changes between day and night when compared with most plants (either C3 or C4).



(2)

**(Total: 10 marks)**

**Questions continue on next page**

10. This question is about evolution.

a. A researcher collected two sets of data as indicated in Table 2 and Table 3.

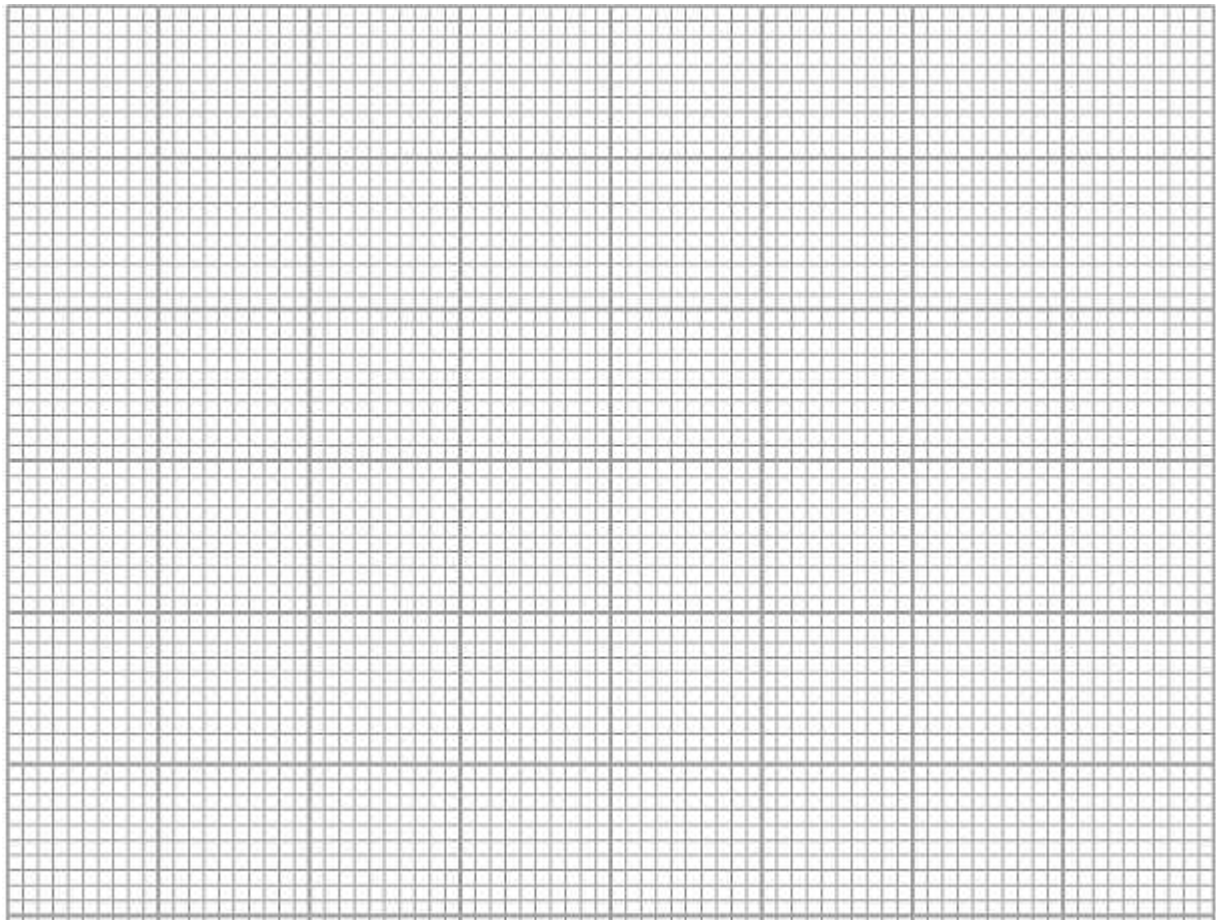
Table 2: Blood type in a population.

Blood type	Percentage of population
A	39
B	13
AB	8
O	40

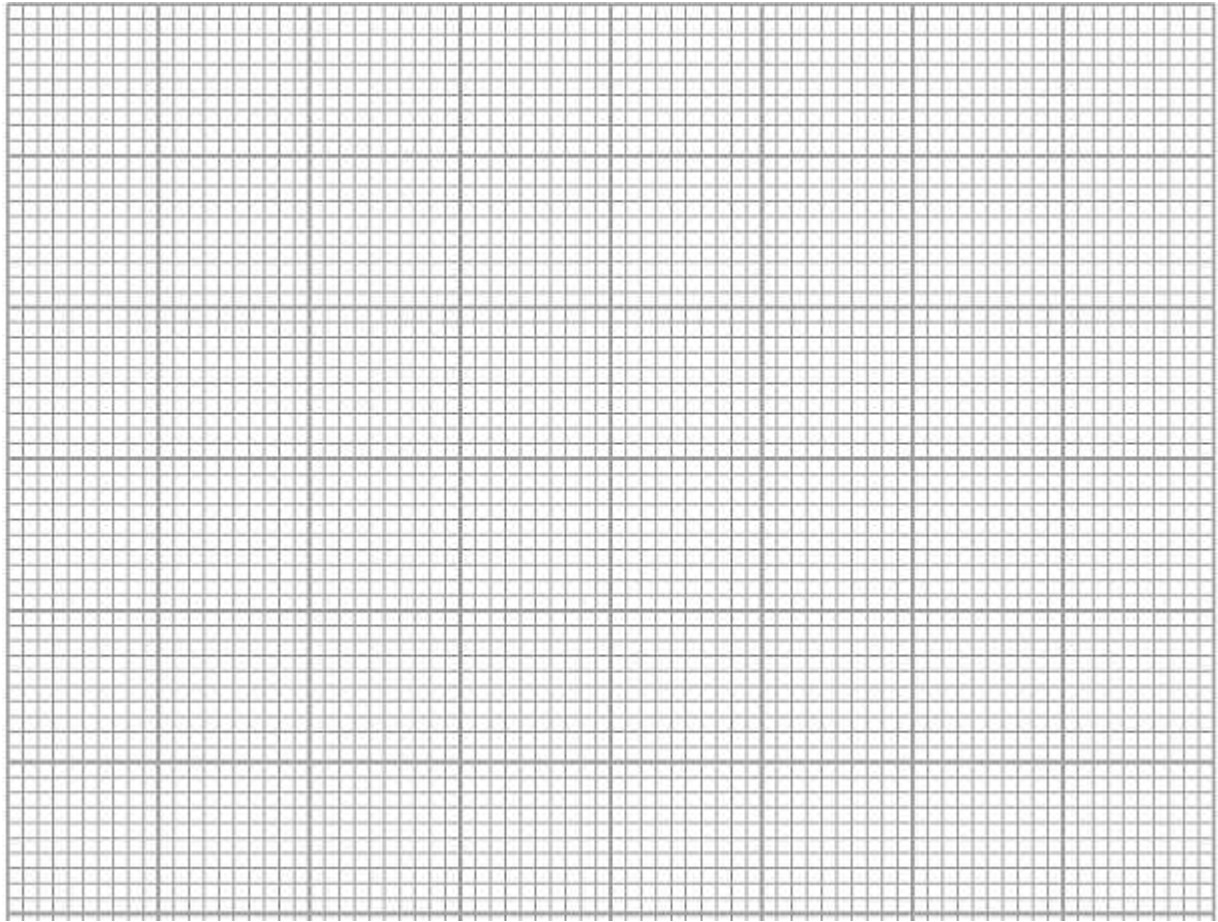
Table 3: Height in a population.

Height classes/cm	Number of people
<130	6
130 - 139	23
140 - 149	40
150 - 169	27
>170	5

i. Plot the data presented in Tables 2 and 3 in **TWO** separate bar graphs. (Use the graph papers below and on next page).



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(4)

ii. What type of variation are the two bar graphs showing? Explain your answer.

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(4)

**Question continues on next page**

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iii. Discuss what can control the characteristics showing such variations.

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(2)

b. List **TWO** factors that affect the Hardy-Weinberg equilibrium.

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(2)

**(Total: 12 marks)**





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SUBJECT:	<b>Biology</b>
PAPER NUMBER:	II
DATE:	3 <sup>rd</sup> September 2019
TIME:	9:00 a.m. to 12:05 p.m.

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### **Directions to Candidates**

- Answer the question in Section A, any **TWO** questions from Section B and **ONE** question from Section C. Write all your answers in the separate booklet provided.
  - If more than two questions from Section B are attempted, only the first two answers shall be taken into consideration.
  - If more than one question from Section C is attempted, only the first answer shall be taken into consideration.
  - The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.
  - You are reminded of the necessity for good English and orderly presentation in your answers.
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  - The use of electronic calculators is permitted.
-

**SECTION A****This section is obligatory.**

1. Read carefully the following extract. Then using the information provided and your knowledge of Biology, answer the questions that follow. The numerals in the left-hand margin are the line numbers.

**What ails a woman's heart?**

Consider almost everything you know about heart disease, particularly the type involving high cholesterol levels, clogged coronary arteries, stents and bypass surgeries. Now rebrand all that as "male-pattern" cardiovascular disease. That's how some researchers are reframing it after taking a closer look at heart disease in women. For years cardiologists were baffled as to why up to half of women with classic symptoms of blocked vessels – chest pain, shortness of breath and an abnormal cardiac stress test – turn out to have open arteries. Many women were subjected to repeated angiograms in search of blockages that weren't there.

More doctors now recognise that despite having open arteries, about half of women with this pattern nonetheless have ischemia – poor blood flow through the heart. The condition has gained a mouthful of a name: ischemia and no obstructive coronary artery disease, or INOCA.

The initial mystery of INOCA was how the heart could be starving for blood if its main arteries are not blocked. The answer often lies in the smaller branches and twigs of the vascular system. The walls of these vessels are too thin to accumulate plaque, but they can become dysfunctional, failing to contract or dilate as needed – when, for example, someone is walking up a flight of stairs. This, in turn, has a direct effect on cardiac output.

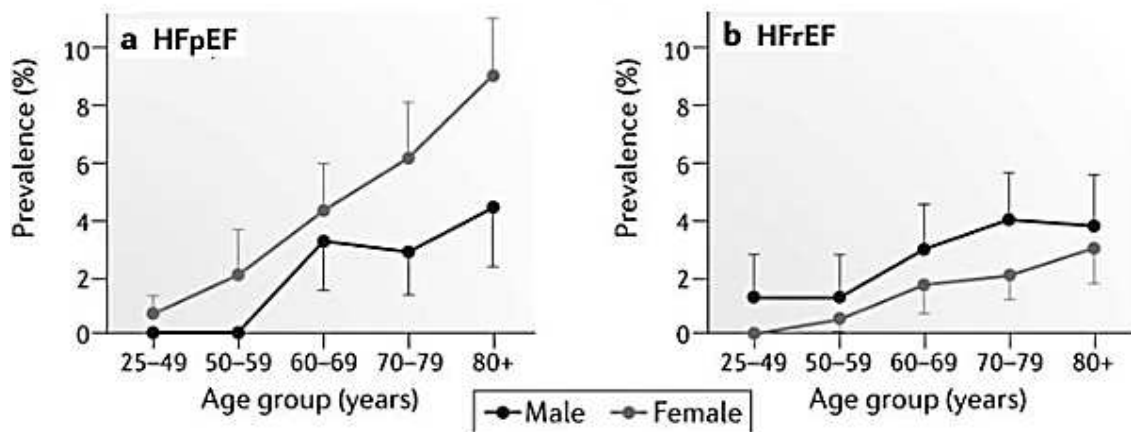
Half to two thirds of INOCA cases can be traced to such dysfunction, which is detected with specialised scanning or testing via catheter. It is not fully known why women are so susceptible, says cardiologist Pujja K. Mehta of Emory University's Women's Heart Center. Many of the usual suspects are implicated but a history of problems during pregnancy, such as elevated blood pressure and diabetes, and a history of depression and autoimmune diseases, both of which are more common in women, may also contribute.

Effective therapy is badly needed. Women with microvascular dysfunction often go on to develop heart failure. And not just any heart failure but a particularly female version. In men, the typical problem is a deteriorating ventricular systolic function; this is called heart failure with reduced ejection fraction, or HFrEF. In women, the more frequent issue is an impaired ventricular diastolic function; this is heart failure with preserved ejection fraction, or HFpEF.

Both types are rising in the U.S. because the population is getting older, fatter and more diabetic. As cardiologist Linda Peterson of Washington University School of Medicine notes: "More people survive their heart attacks, so they are dying of heart failure down the road." HFrEF is well understood. "We have buckets of knowledge and treatment for [it]," Bairey Merz, director of the Barbra Streisand Women's Heart Center, says, "but essentially no effective therapy for HFpEF. Had we studied women 50 years ago, we wouldn't be in this situation."

*(Adapted from <https://www.scientificamerican.com/article/what-ails-a-womans-heart/>)*

- a. Why is the heart so important to humans? (2)
- b. Describe the route taken by blood from the right ventricle to the left ventricle. (4)
- c. Why is shortness of breath a “classic symptom of blocked vessels” (line 5)? (2)
- d. In a cardiac stress test (line 6), the patient walks on a treadmill while an electrocardiogram (ECG) monitors the electrical activity generated by his/her heart muscle depolarisations.
  - i. Which heart structure generates spontaneous depolarisations without stimulation? (1)
  - ii. Briefly describe how the structure named in part (i) causes rhythmic contractions to be conducted through the heart. (4)
- e. Would you expect blood vessels supplying the heart of a healthy person to constrict or dilate when “someone is walking up a flight of stairs” (lines 14-15)? Explain. (2)
- f. Define “cardiac output” (line 15) and explain how it is calculated. (2)
- g. Name **ONE** “suspect” (line 19) implicated in heart diseases **not** mentioned in the text. (1)
- h. The following graphs show the prevalence of HFpEF and HFrEF by age and sex in a southwest European community-based cohort. Apart from HFpEF being more common in females and HFrEF in males (as described in lines 23-26), draw another **TWO** conclusions from these graphs. (2)



(Adapted from: <https://www.nature.com/articles/nrcardio.2017.65>)

- i. What is meant by “impaired ventricular diastolic function” (lines 25-26) and what effect would you expect this to have on the movement of blood through the heart? (2)
- j. Researchers measured the ventricular wall thickness of a group of people having different forms of heart failure and found that patients with HFrEF have thinner ventricular walls. Account for this observation. (2)
- k. How would the situation be different “had we studied women 50 years ago” (line 32)?(1)

**(Total: 25 marks)**

## SECTION B

**Answer any TWO questions from this section; your answers should take the form of essays. Each question carries twenty five marks.**

1. Membranes enable eukaryotic cells to perform distinct jobs so as to help the body function as a whole. Discuss this statement.
2. Hormones are responsible for most changes happening in the body. Discuss the roles of hormones in the context of:
  - a. childbirth and lactation;
  - b. control of blood glucose level;
  - c. fight or flight responses.
3. Discuss the intraspecific and interspecific interactions that may be exhibited within a community.
4. Inorganic ions have important and varied roles in cells. Discuss this statement with reference to **FIVE** inorganic ions.

**(Total: 50 marks)**

## SECTION C

**Answer ONE question from this section.**

1. Write brief notes on the following:
  - a. the cleidoic egg; (5)
  - b. mass flow within animals and plants; (5)
  - c. capacitation; (5)
  - d. the lac Operon; (5)
  - e. body symmetry in animals. (5)

**OR**

2. Use your knowledge of Biology to explain the following statements.
  - a. Fungi are more similar to animals than most other pathogens. (5)
  - b. About 375 million years ago, during the Devonian Period, a group of vertebrates pushed their way out of the water and onto land. (5)
  - c. Nature exhibits some fine examples of cloning. (5)
  - d. Tortoise-shell fur colour can only be found in female cats and never in male cats. (5)
  - e. In artificial selection, humans are exerting a directional selection pressure which leads to changes in alleles and genotype frequencies within the population. (5)

**(Total: 25 marks)**




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SUBJECT:	<b>Biology</b>
PAPER NUMBER:	III
DATE:	4 <sup>th</sup> September 2019
TIME:	9:00 a.m. to 10:35 a.m.

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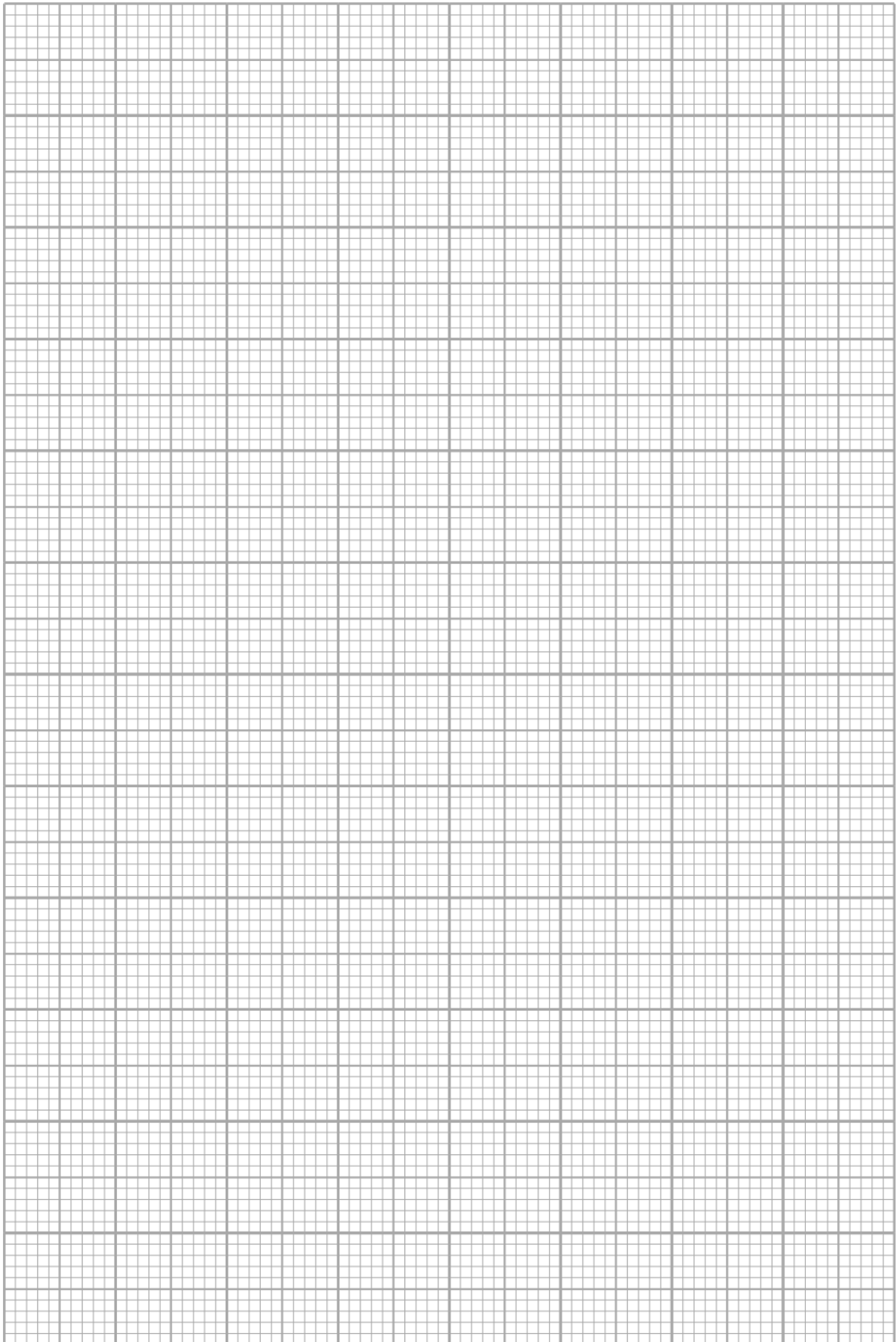
### Directions to Candidates

- Write your index number in the space at the top left-hand corner of this page.
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- 

### For examiners' use only:

Question	1	2	3	Total
Score				
Maximum	15	17	18	<b>50</b>





c. Which statistical test could the biologist use to study whether there is a statistically significant difference between the number of observations of females and of males?

\_\_\_\_\_ (1)

d. List **THREE** assumptions that should be satisfied for this test to be effective.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (3)

**(Total: 15 marks)**

2. This question is on biotechnology.

The Southern Blotting Technique is a laboratory procedure used to detect a specific sequence of DNA in a given DNA sample. It is highly specific since the probes used are complementary to the target DNA sequence. Due to its specificity, this technique has a wide range of applications, including forensic studies and paternity testing.

A paternity test was carried out to determine the biological father. DNA samples were collected from the mother, the child and two potential fathers. The samples were analysed using the Southern Blotting procedure shown in Figure 1 below.

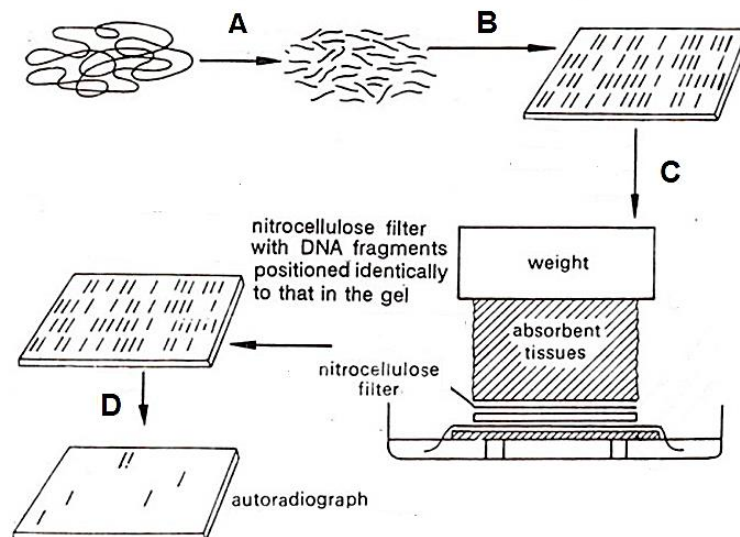


Figure 1: Southern Blotting Technique  
 (Source: <https://www.biologyexams4u.com>)



a. Identify process steps A to D depicted in Figure 1.

A \_\_\_\_\_ (1)

B \_\_\_\_\_ (1)

C \_\_\_\_\_ (1)

D \_\_\_\_\_ (1)

b. What is the role of restriction enzymes in this procedure?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

c. What is a gene probe?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

d. What would the sequence of the probe be if it had to complement the specific DNA sequence depicted below?

<b>Target DNA sequence:</b>	<b>ATAGGA</b>
Probe sequence:	_____

(1)

e. Explain why a radioactively labelled probe was used in this procedure.

\_\_\_\_\_  
\_\_\_\_\_ (1)

**Question continues on next page**

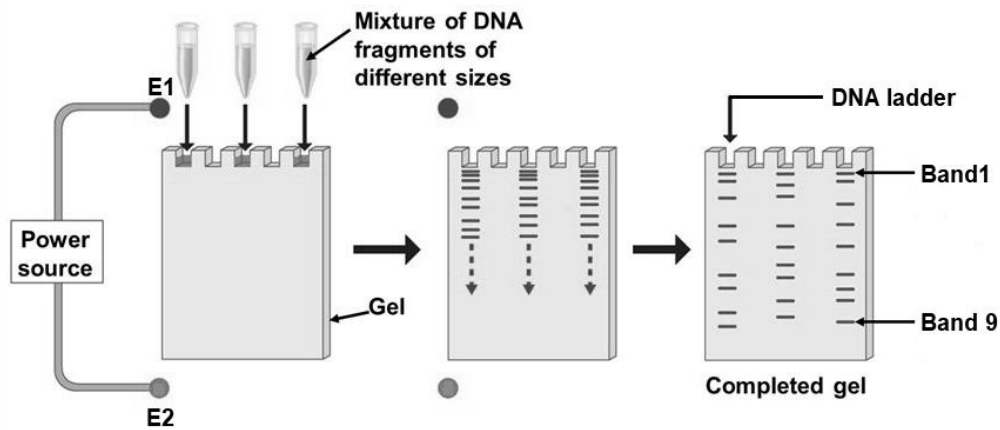


Figure 2: Agarose Gel Electrophoresis  
 (Source: <https://slideplayer.com>)

f. i. Figure 2 shows the set-up for agarose gel electrophoresis. What are the charges of electrodes E1 and E2 respectively?

E1 \_\_\_\_\_ (½)

E2 \_\_\_\_\_ (½)

ii. Explain how this set-up allows for the movement of DNA fragments away from the wells.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2)

iii. Are the fragments at Band 1 longer or shorter than those at Band 9? Give a reason for your answer.

\_\_\_\_\_  
 \_\_\_\_\_ (1)

iv. What is the role of the DNA ladder in gel electrophoresis?

\_\_\_\_\_  
 \_\_\_\_\_ (1)

g. Figure 3 shows the results obtained on the autoradiograph.

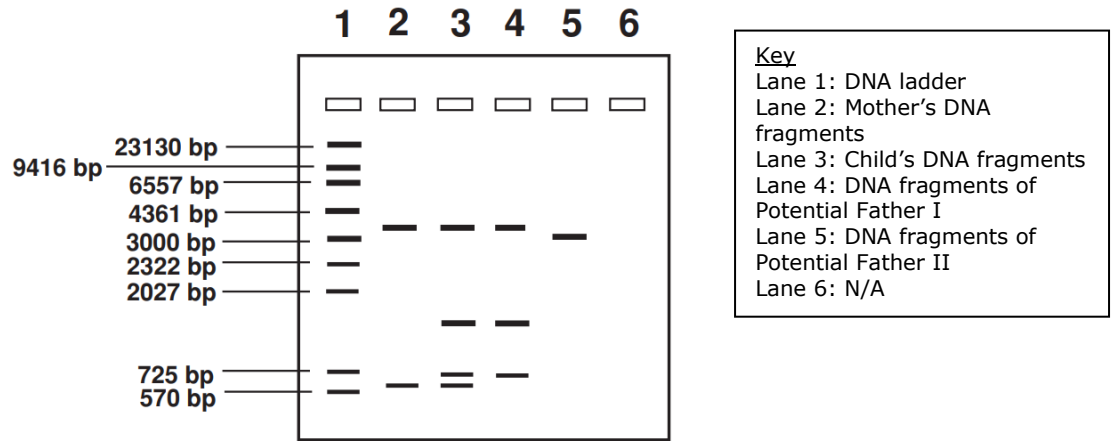


Figure 3: Autoradiograph  
 (Source: <https://www.edvotek.com>)

Using the results obtained from the autoradiograph in Figure 3, which of the two potential fathers is the biological father? Give **ONE** reason for your answer.

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(2)

**(Total: 17 marks)**

**Questions continue on next page**

- 3. This question is about histology.
  - a. Figure 4 is a transverse section through the ileum.



Figure 4: Transverse section through the ileum  
(Source: <http://wwwp3.cord.edu>)

In the space below, draw and label a low power plan of the ileum section shown in Figure 4.

(6)

- b. The photomicrograph in Figure 5 shows a longitudinal section of striated skeletal muscle.

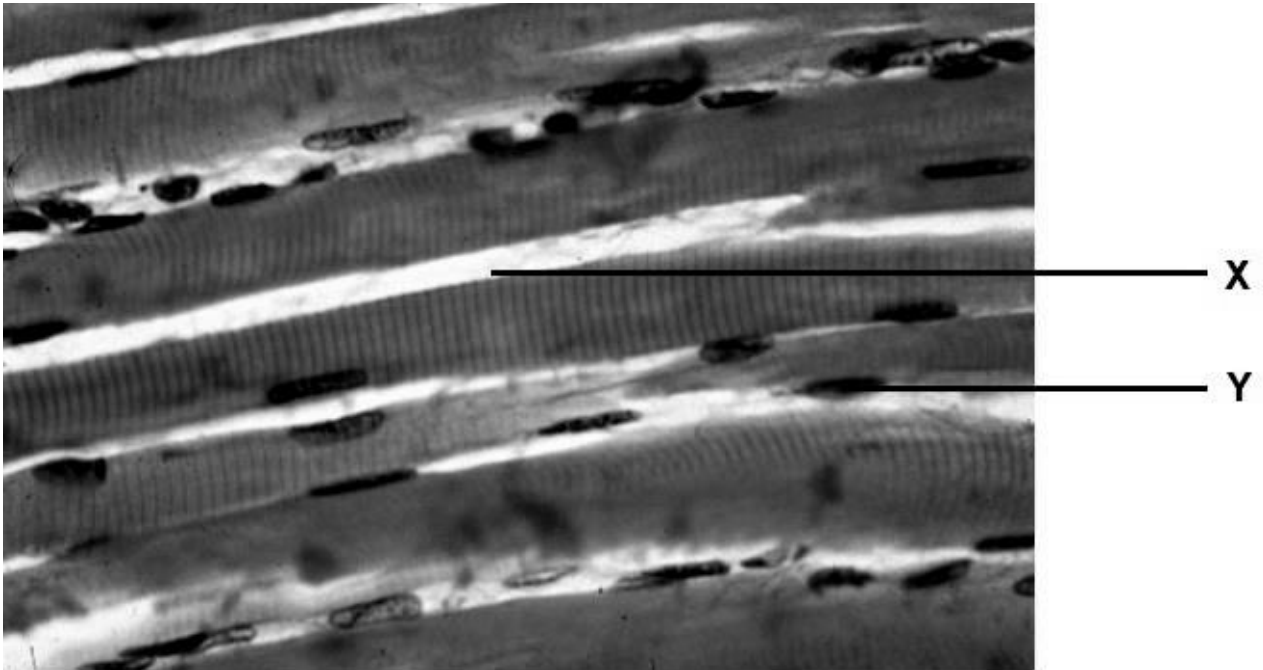


Figure 5: Longitudinal section of a type of muscle tissue  
(Source: <http://www.smartbank.it>)

- i. On Figure 5, mark the length of one sarcomere. (1)
- ii. On Figure 5, label **ONE** myofiber. (1)
- iii. Describe the shape of the fiber labelled as an answer to part (ii).

\_\_\_\_\_  
\_\_\_\_\_(1)

- iv. Identify structures X and Y.

X: \_\_\_\_\_(1)

Y: \_\_\_\_\_(1)

**Question continues on next page**

b. A diagrammatic representation of a sperm cell is shown in Figure 6.

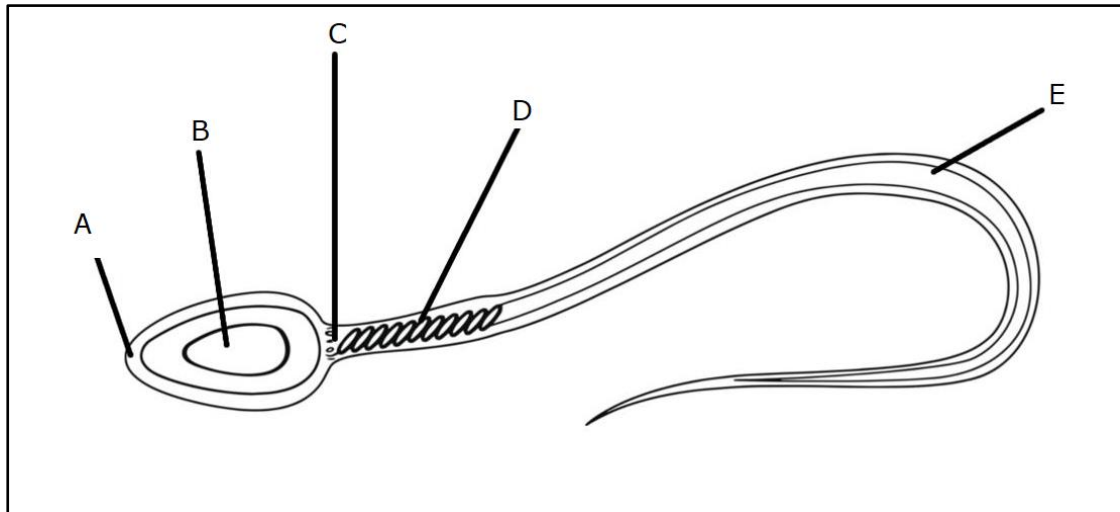


Figure 6: Diagrammatic representation of a sperm cell  
 (Adapted from: <https://pixfeeds.com/>)

i. Identify structures A to E.

Structure	Label
A	
B	
C	
D	
E	

(5)

ii. What is the importance of structures A and C?

A: \_\_\_\_\_ (1)

C: \_\_\_\_\_ (1)

**(Total: 18 marks)**

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L-Università  
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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE  
EXAMINATIONS BOARD

**ADVANCED MATRICULATION LEVEL  
2019 SECOND SESSION**

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SUBJECT: **Biology**  
PAPER NUMBER: IV – *Practical*  
DATE: 29<sup>th</sup> August 2019  
TIME: 1 hour 35 minutes

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### Directions to Candidates

- Write your index number in the space at the top left-hand corner of this page.
  - Answer **ALL** parts of the question. Write all your answers in this booklet. Drawings of biological material and graphical representations of data are to be made on the appropriate pages within this booklet.
  - The marks allotted to parts of question are indicated.
  - You are reminded of the necessity for good English and orderly presentation in your answers.
  - In calculations you are advised to show all the steps in your working, giving your answer at each stage.
  - The use of electronic calculators is permitted.
- 

**For examiners' use only:**

Question	Total
Score	
Maximum	<b>40</b>







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Carry out the investigation that you devised and insert the results in the table you prepared as your answer to part (g).

h. From your results, determine the lowest level of starch that can be detected using the iodine test.

\_\_\_\_\_ (1)

i. Estimate the starch concentration of each unknown solution. Concentration ranges are accepted.

A \_\_\_\_\_ (1)

B \_\_\_\_\_ (1)

C \_\_\_\_\_ (1)

j. The milk solutions provided were rice milk; almond milk and dairy milk. Deduce which of the solutions provided was rice milk.

\_\_\_\_\_  
\_\_\_\_\_ (2)

k. List **TWO** limitations in your investigation.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

l. Discuss the accuracy of this method and suggest how it could be improved to give more precise values of starch concentrations.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

**(Total: 40 marks)**

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