Index Number:_____ SEC04/1.19m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2019 MAIN SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	I
DATE:	6th May 2019
TIME:	4:00 p.m. to 6:05 p.m.

Answer **ALL** questions in this paper in the spaces provided.

1. A student tested Greek yoghurt and cornmeal for the presence of different biological molecules. The student performed Benedict's test, Biuret test and Iodine test on both the Greek yoghurt and the cornmeal. The table below shows the results:

Food tested	**Benedict's test**	**Biuret test**	**Iodine test**
Greek yoghurt	Brick red precipitate formed	Purple colour formed	No change
Cornmeal	No change	Purple colour formed	Blue black colour formed

a. Use the table of results to identify the biological molecules (food components) present in Greek yoghurt and in cornmeal respectively.

Greek yoghurt: _____

Cornmeal: _____ (4)

b. Describe how the student performed the Benedict's test.

_____

_____

_____ (2)

c. Cornmeal has a yellowish colour. Explain how this may limit the interpretation of results at the end of the experiment.

_____

_____ (1)

d. Nutritionists recommend that Greek yoghurt is included in one's diet as it includes a mineral that is important for the maintenance of strong bones. Name the mineral.

_____ (1)

e. Greek yoghurt provides energy quicker than cornmeal. Use the information in the table and your own knowledge to explain this statement.

_____

_____

_____ (2)

(Total: 10 marks)

2. In a study of the Mediterranean Venice lagoon, the following ecological interactions were observed.

Clams, shrimps and zooplankton feed on phytoplankton, seagrass and algae. Sea bream (fish) feed on clams and shrimps while seabass and mullet (also fish) feed on zooplankton. Sea gulls are predators of seabass, sea bream and mullet.

a. In the space provided, from the above, draw a food chain with **FOUR** trophic levels.

(2)

b. Fishing is the main human factor that influences marine food webs. If seabass, sea bream and mullet are heavily caught, describe the impact on:

i) sea gulls;

_____ (1)

ii) phytoplankton.

_____

_____(2)

c. Explain why in a pyramid of numbers, the top consumers in a sea ecosystem have the least number.

_____

_____ (2)

d. A report by Oceana on overfishing in western Mediterranean Sea, stated the following:

Catches of juvenile (young) fish are too high.

Explain how this will affect the fish population.

_____

_____(2)

(Total: 9 marks)

3. The optimum growth temperature of organisms ranges between -5°C to above 45°C. Bacteria can grow across a large spectrum of environmental conditions. A group of students carried out an investigation to determine how bacteria are affected by temperature. Their results are shown in the following table.

Temperature (°C)	**Effect on bacteria**
-20	Bacteria live but do not multiply
0	Bacteria grow slowly but some multiply
40	Bacteria grow and multiply
95	Many bacteria killed
100	All bacteria killed

a. i) The students found that the optimal growth temperature for bacteria is 40°C. Why did the bacterial population grow best at this temperature?

_____

_____ (1)

ii) Name **TWO** other environmental conditions that affect the growth of bacteria.

1. _____

2._____ (2)

b. Explain why:

i) at -20°C bacteria live but do not multiply;

_____ (1)

ii) a temperature of 100°C kills all bacteria.

_____ (1)

This question continues on next page.

c. Fill in the following table. Use '**Y**' for yes and '**N**' for no.

Feature	**TB Bacterium**	**Human Immunodeficiency Virus (HIV)**	**Amoeba (Protist)**
Presence of cell wall			
Organism is a single cell			
Living			
DNA enclosed in a membrane			
Can only reproduce inside living cells			

(5)

(Total: 10 marks)

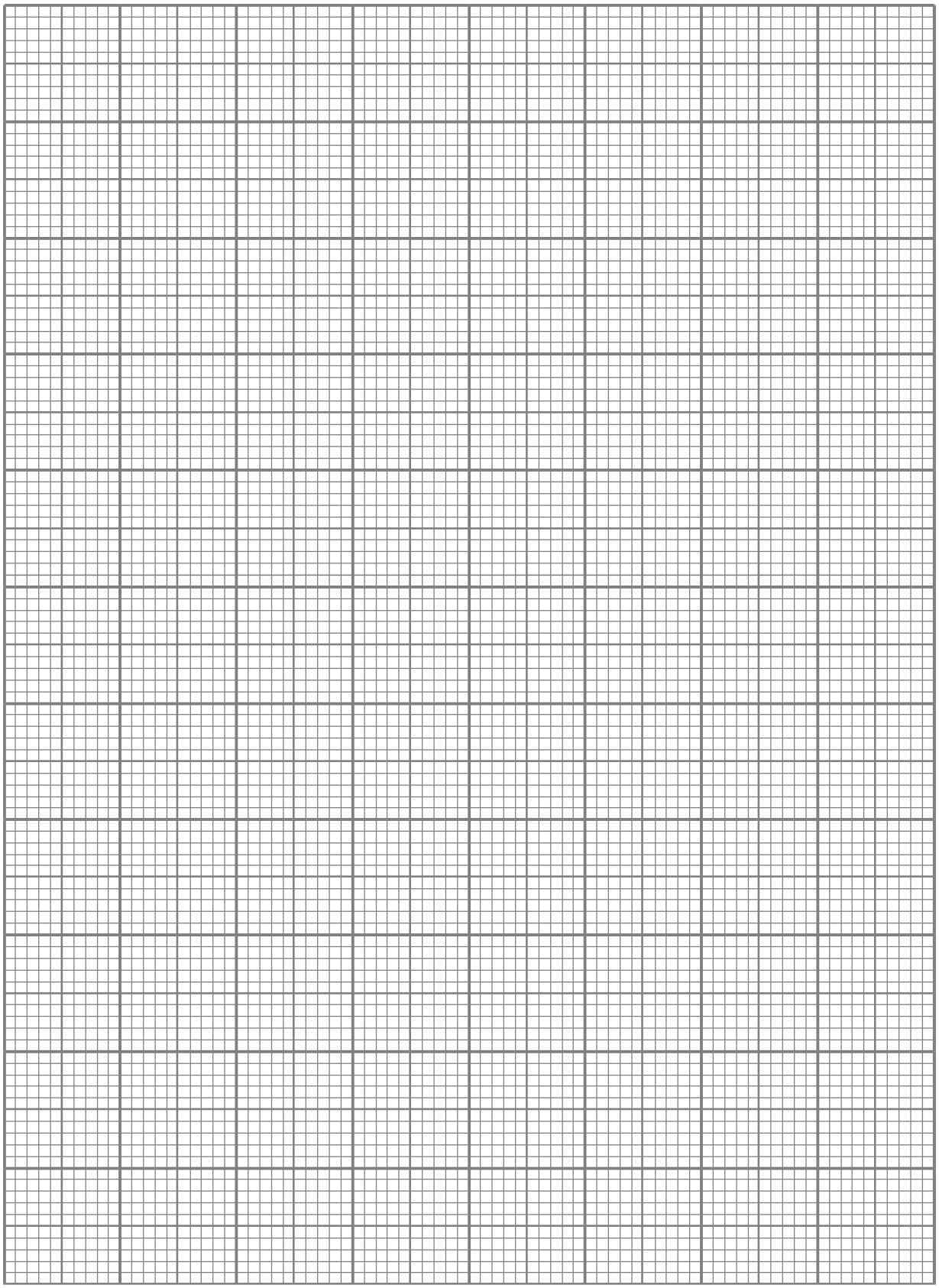
4. Scientists investigated the effect of the concentration of food given on the growth of the larvae of the mosquito *Aedes aegypti*.
In the experiment they hatched the mosquito larvae at the same time in four different beakers. They then added a different concentration of a mixture of food consisting of beef-liver powder, tuna meal and vitamins to each beaker. All beakers were kept at a temperature of 27°C.
They then measured the time taken for the larvae to form a pupa.

The table below summarises their findings:

% Concentration of food	Average time taken for larva to form a pupa/ hours
1	14.71
2	9.92
4	6.58
8	6.24

Adapted from Couret J., Dotson E. & Benedict M.Q. (2014) Temperature, Larval Diet, and Density Effects on Development Rate and Survival of Aedes aegypti (Diptera: Culicidae)

a. Use the graph paper provided to draw a line graph showing the average time taken for larva to form a pupa (on the y-axis) against the % concentration of food (on the x-axis). Use a ruler to join the points. (4)



This question continues on next page.

b. Explain why the mosquito larvae were all hatched at the same time.

_____

_____(2)

c. i) Describe the effect of the concentration of food on the time taken for the mosquito larvae to form a pupa.

_____

_____(1)

ii) Describe the effect of the concentration of food on the rate of growth of the mosquito larva.

_____

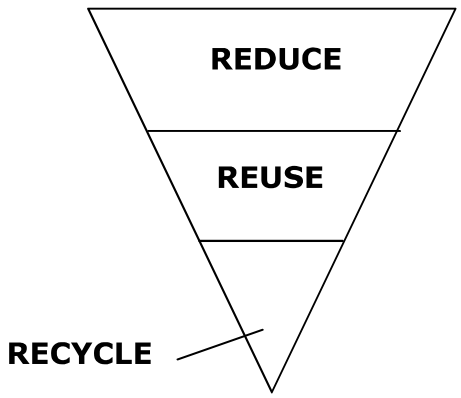
_____(2)

d. Beef liver and tuna meal are rich in protein. Explain why the food chosen in this experiment was rich in protein.

_____(1)

(Total: 10 marks)

5. a. Below is a waste management hierarchy model. The top of the inverted pyramid is the most preferred type of waste management while the bottom of the inverted pyramid is the least preferred.



i) List **ONE** way how a family would reduce waste.

_____ (1)

ii) Explain why recycling is considered as the least preferred of the 3 'R's of waste management.

_____

_____ (2)

b. On the 31st October 2018, all localities in Malta and Gozo started separating organic waste.

i) List **ONE** by-product of the treatment of organic waste.

_____(1)

ii) Give **ONE** reason why **not** separating organic waste is unsustainable.

_____

_____ (2)

c. A local newspaper article, published in August 2018, stated that at least 20 turtles had been found dead during that current year, after ingesting plastic. Propose **ONE** way to reduce the increase of plastic in our seas.

_____

_____ (2)

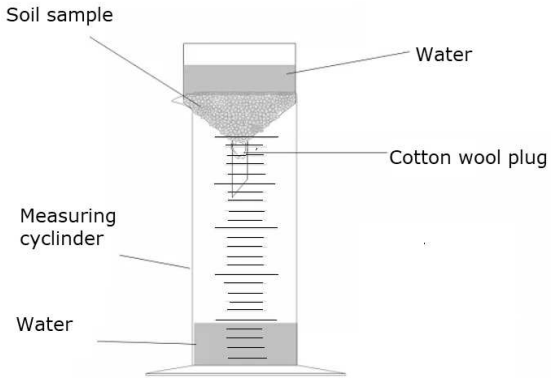
(Total: 8 marks)

6. The water holding capacity of a soil is a very important characteristic. Soils that hold generous amounts of water are less subject to leaching losses of nutrients. A sandy soil has a limited water holding capacity when compared to a clay soil. After a soil is saturated with water, all of the excess water and some of the nutrients and pesticides that are in the soil solution are leached downward in the soil profile.

a. What is the water holding capacity of a soil?

_____ (1)

b. Figure 6.1 shows the apparatus used to investigate the water holding capacity of soil.



Taken from https://www.revision.co.zw/experiment-comparing-the-water-holding-capacity-of-the-soil/

Figure 6.1

i) List **ONE** precaution in this investigation.

_____ (1)

This question continues on next page.

ii) Explain how a student would calculate the quantity of water held by the soil.

_____

_____ (2)

c. Although the amount of organic material of most soils is small in volume compared to the amount of soil minerals, it plays an important role in supporting plant growth. What is organic material composed of?

_____

_____ (2)

d. Explain the importance of organic material to the soil?

_____

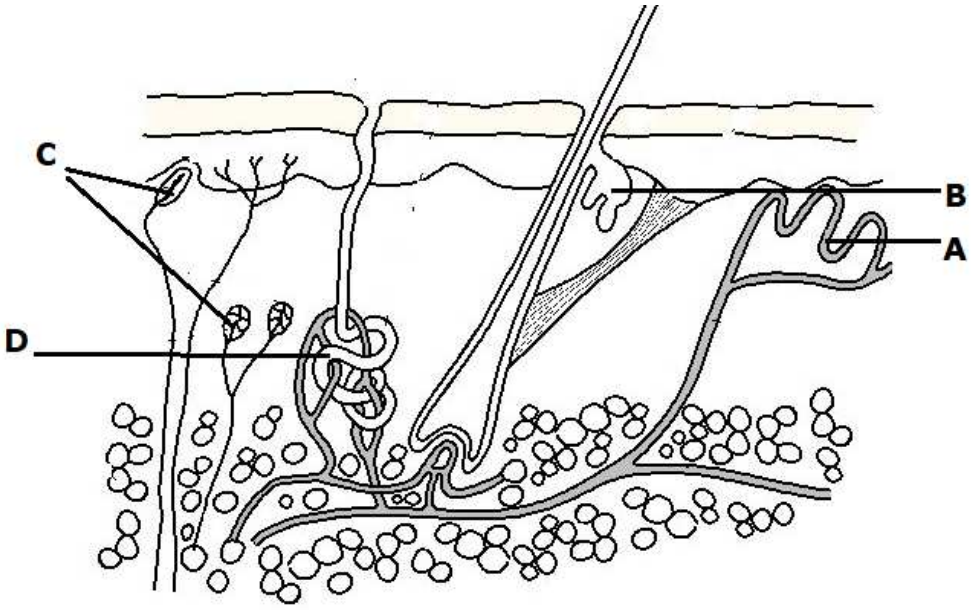
_____

_____

_____ (4)

(Total: 10 marks)

7. a. Figure 7.1 shows a cross-section of the human skin.



http://kidskunst.info/linked/anatomy-and-histology-of-the-skin-contents-616e61746f6d79.htm

Figure 7.1

i) Which structure, from A and B above, is **not** directly affected by a change in atmospheric temperature?

_____ (1)

ii) Name the structures C and D, shown in the diagram.

_____ (2)

iii) Describe what happens to structures C and D as the atmospheric temperature rises.

_____

_____ (2)

b. The German biologist Carl Bergmann observed that within the same species of endothermic animals, populations having smaller individuals are more often found in warm climates near the equator, while those with larger, or heavier individuals, are found further from the equator in colder regions. Body size and shape are significant factors in how efficiently an individual responds physiologically to cold and hot climates.

Members of the Masai tribe of East Africa have an optimal body shape. They are normally tall and have slender bodies with long limbs. On the other hand, Eskimos of the far northern regions have a stocky body with short appendages. Eskimos traditionally consume large quantities of high calorie fatty foods.

i) Explain how the body size and shape of the Masai tribe and Eskimos are efficient adaptations to hot and cold climates.

_____

_____

_____

_____

_____(4)

ii) Why do Eskimos traditionally consume fatty marine animals like seals or whales?

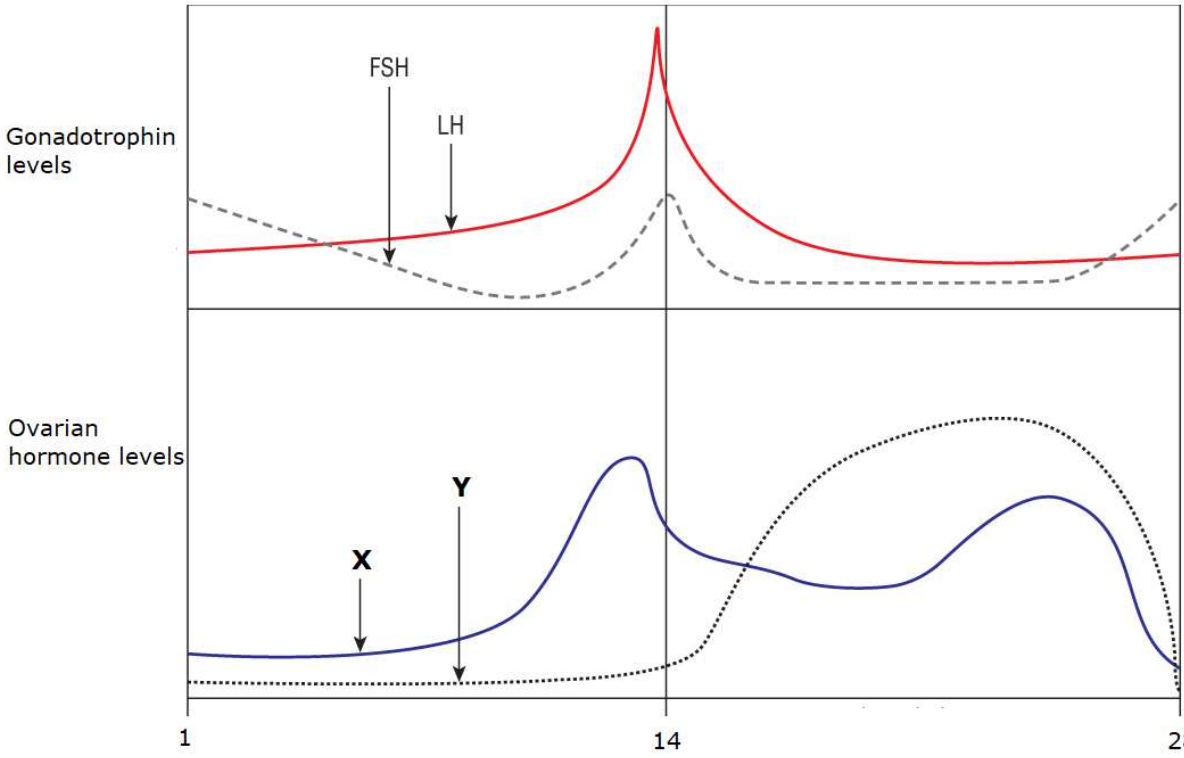
_____(1)

(Total: 10 marks)

Please turn the page.

8. The female menstrual cycle is controlled by hormones.

Figure 8.1 shows two sets of graphs. The upper set shows the concentration of Follicle Stimulating Hormone (FSH) and Luteinising Hormone (LH) while the lower set shows the concentration of two other reproductive hormones in the blood plasma during a woman's menstrual cycle.



Taken from https://accesspharmacy.mhmedical.com

Figure 8.1

a. Name the endocrine gland which produces FSH and LH.

_____(1)

b. The lower graph shows the concentration of two hormones X and Y produced by the ovary.

i) Name the hormones X and Y.

X_____ Y_____(2)

ii) On which day did ovulation occur? Using the graphs in Figure 8.1, give an explanation for your answer.

Day: _____ (1)

Explanation: _____

_____ (2)

iii) Describe an example of negative feedback involving **TWO** of the four hormones mentioned in the previous page.

_____

_____ (2)

c. Infertility is often the result of hormonal imbalance.

i) What is meant by the term infertility?

_____ (1)

ii) Give **ONE** cause of infertility in women (other than the one stated above).

_____ (1)

iii) In vitro fertilisation (IVF) is one way of dealing with infertility. In IVF, the ovum is fertilised by the sperm outside the female body. List the organ that releases the ovum and state where implantation occurs.

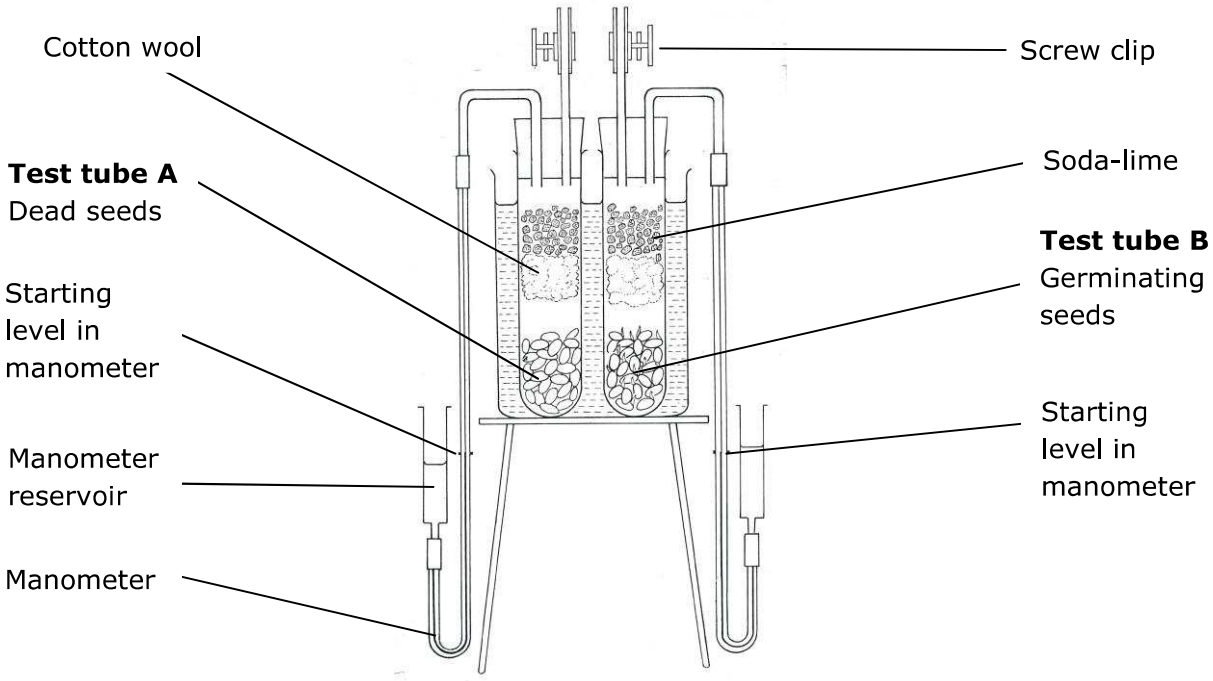
_____

_____ (2)

(Total: 12 marks)

Please turn the page.

9. Figure 9.1 shows an apparatus used to investigate aerobic respiration in plants. Soda-lime absorbs carbon dioxide in the test tubes. The screw clips were closed at the beginning of the investigation. The level of the manometer fluid was observed after one hour.



Taken from http://www.biology-resources.com/biology-experiments2.html

Figure 9.1

a. Describe the change in levels, if any, to the manometers attached to test tube A and B.

Test tube A_____ (1)

Test tube B_____ (1)

b. Propose a reason for the change in levels.

_____

_____(2)

c. Explain why the presence of soda-lime in the test tubes is important.

_____

_____(2)

d. Explain why both test tubes are put in a water bath. The water was left at room temperature.

_____

_____ (2)

e. i) State the reason why the living seeds were soaked for two days before the investigation.

_____

_____(2)

ii) Give **ONE** reason why dead seeds are also soaked for two days.

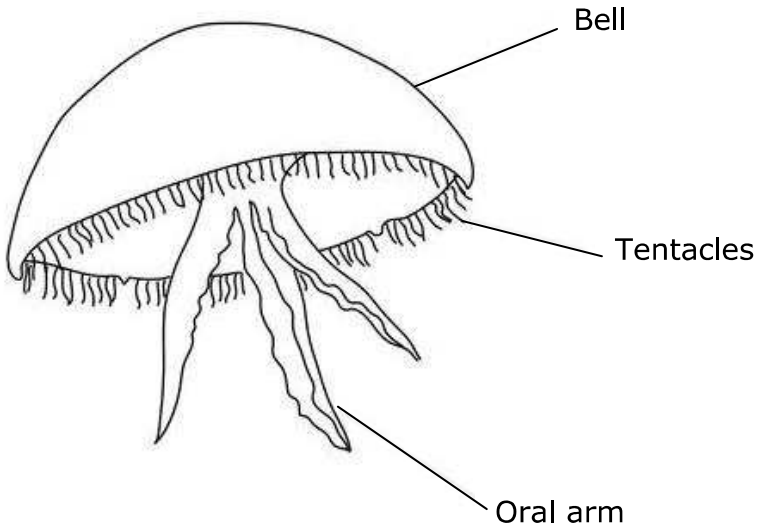
_____

_____ (1)

(Total: 11 marks)

Please turn the page.

10. a. Figure 10.1 shows the general anatomy of a jellyfish. The jellyfish belongs to the phylum Cnidaria (or Coelenterata).



Taken from: https://collections.museumvictoria.com.au/content/media/39/494489-small.jpg
Figure 10.1: General anatomy of a jellyfish

i) Describe the general body plan of a Cnidarian.

_____

_____ (2)

ii) What type of cells are typically present on the tentacles of a Cnidarian? State the function of these cells.

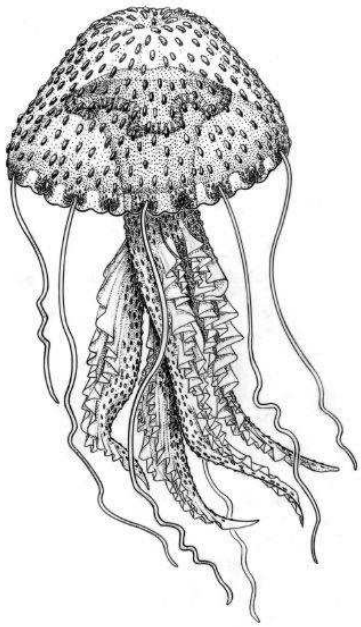
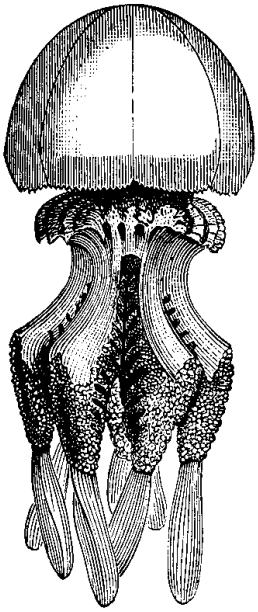
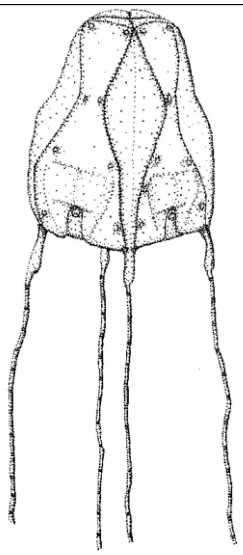
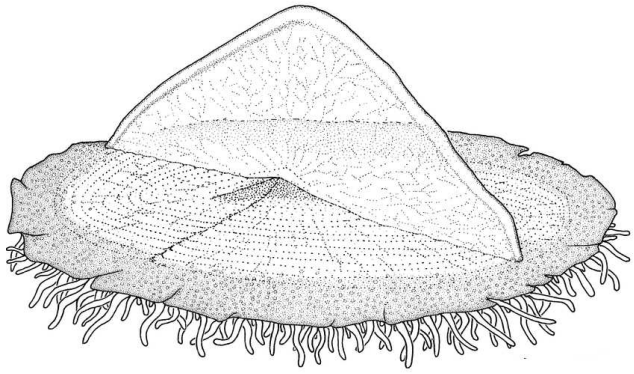
Type of cells: _____

Function: _____ (2)

b. The figures below show four jellyfish that have been observed in the Mediterranean Sea. Use the key provided to identify each jellyfish. Write the common name of each in the space provided.

Key:

1	a b	Flat bell with a perpendicular flap on its upper surface Bell is not flat and does not have a perpendicular flap on its upper surface	By the wind sailor Go to 2
2	a b	No oral arms visible Oral arms visible	Boxed jellyfish Go to 3
3	a b	Tentacles attached to bell No tentacles attached to bell	Mauve stinger Barrel jellyfish

Cnidarian A	**Cnidarian B**
 *https://i.pinimg.com/originals*	 *https://c1.staticflickr.com*
Name:	**Name:**
Cnidarian C	**Cnidarian D**
 *https://www.researchgate.net*	 *https://www.researchgate.net*
Name:	**Name:**

(Note: Figures are not to scale.) (4)

This question continues on next page.

c. Cnidaria do not have a circulatory system simply because it is not needed. Mammals developed a complex circulatory system. Explain this statement.

(2)

(Total: 10 marks)

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2019 MAIN SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	IIA
DATE:	7th May 2019
TIME:	4:00 p.m. to 6:05 p.m.

Write your answers on the booklet provided. Write down the number of the questions you answer on the front page of your answer booklet.
Please note that for question 2 of this paper you need the graph paper in the booklet.

SECTION A: Answer ALL questions in this section. This section carries 25 marks.

1. Read the following passage and then answer the questions that follow.

The EU Pollinators Initiative

On 1st July 2018, the European Commission published an EU rescue plan for wild pollinators in order to stop rapid decline across Europe. Pollinator decline is a global phenomenon with potentially severe impacts on natural ecosystems and food security. It has attracted worldwide attention, leading to persistent calls for action across Europe and elsewhere.

In Europe, around 84% of crop species and 78% of wild flowering species depend, at least in part, on animal pollination. Bees are amongst the most prolific pollinators. The best known is the domesticated western honeybee *Apis melifera*, but there are in fact almost 2,000 wild bee species in the EU, a significant proportion of which are in serious decline. More than 26,500 species are threatened with extinction. That is more than 27% of all assessed species.

Although the plight of the honeybees is already well known, there is a much greater problem, namely the dramatic decline in the occurrence and diversity of all kinds of European wild insect pollinators, including wild bees, hoverflies, butterflies and moths. Although insect pollinators are a driving force behind healthy ecosystems, their disappearance would not only be a disaster for Europe's biodiversity but would also have serious social and economic implications. In many parts of the world where most wild pollinators have been lost, farmers see themselves forced to pay beekeepers for pollination services, to laboriously pollinate fruit trees by hand, or altogether abandon crops and orchards dependent on insect pollination.

The current scientific knowledge suggests that there is no single factor of pollinator decline. The EU has introduced actions to support honeybee health and apiculture and, is tackling the spread of invasive alien species such as the Asian yellow-legged hornet *Vespa velutina,* which attack bee-hives, or the Himalayan Balsam *Impatiens glandulifera* which smothers out pollinator habitats.

The parasitic Varroa mite is spreading disease; a bite from these mites injects the deadly Deformed Wing Virus into the bees' blood and can destroy an entire honey bee colony. Varroa mites (*Varroa destructor* and *Varroa jacobsoni*) are tiny red-brown external parasites of honey bees. Although Varroa mites can feed and live on adult honey bees, they mainly feed and reproduce on larvae and pupae in the developing brood, causing malformation and weakening of honey bees as well as transmitting numerous viruses.

The EU has already restricted the use of three pesticides. Various measures are being promoted to maintain or create pollinator habitats for instance through ecological focus areas, agri-environment-climate measures, Natura 2000 payments, or investments in organic farming. Yet, these measures have not been sufficient to halt the decline of pollinators.

(Adapted from: The Natura 2000 Newsletter Number 44 / July 2018)

a. i) Apart from wild bees, name **TWO** other European wild insect pollinators mentioned in the text. (1)

ii) Bees and mites belong to the same phylum but different classes. List **TWO** structural characteristics shared by all organisms in this phylum. (2)

iii) Give the species name of **ONE** parasitic mite. (1)

b. Explain why organic farming helps maintain pollinator habitats. (2)

c. The decline of bees and insect pollinators decreases vitamin-rich crops like fruits and vegetables. State **ONE** effect such an impact may have on humans. (1)

d. Give **TWO** ecological effects of the decline of pollinators. (2)

e. Bees and other pollinators have positive effects on other factors besides production of food for humans. Describe **ONE** of these positive effects. (1)

f. Human impact has increased drastically the rate of extinction of bees and other pollinators. List **TWO** ways in which humans are responsible for such a high extinction rate. (2)

(Total: 12 marks)

2. 'Sun' plants grow exposed to direct sunlight whilst 'shade' plants grow in areas shaded by larger plants.

   The data in the table below shows how the rate of photosynthesis in a 'sun' plant and in a 'shade' plant varies with increasing light intensity.

Light intensity / arbitrary units	Rate of photosynthesis in 'sun' plant / arbitrary units	Rate of photosynthesis in 'shade' plant / arbitrary units
0	0	0
50	2	5
100	4	10
150	8	12
200	18	15
250	22	15
300	26	15
400	32	15
500	38	15
600	40	15

   a. On the graph paper provided (use the 2 mm grid scale), draw a graph to show the variation in the rate of photosynthesis in the 'sun' plant with increasing light intensity. Join the points of the graph with straight lines. Plot light intensity on the x-axis. Using the same pair of axes plot a graph to show how the rate of photosynthesis in the 'shade' plant varies with increasing light intensity. Join the points of this graph with straight lines. (6)

   b. Compare the rate of photosynthesis in the 'sun' plant and the 'shade' plant at light intensities between 0 and 150 arbitrary units. Explain how this indicates that 'shade' plants are adapted to survive in their particular habitat. (2)

   c. In a review of the data, a scientist wrote, "The 'shade' plant reached the maximum rate of photosynthesis at a light intensity 200 arbitrary units whilst the 'sun' plant still had not reached the maximum rate at a light intensity of 600 arbitrary units." Use the data in the graph to explain why this statement is correct. (2)

   d. The data was obtained from plants exposed to a 0.02% CO_2 concentration.
      i) Predict the value of the rate of photosynthesis in the 'shade' plant at a light intensity of 600 arbitrary units placed in a CO_2 concentration of 0.04%. (1)
      ii) Give a reason for your answer. (2)

(Total: 13 marks)

Please turn the page.

SECTION B: Answer any THREE questions from this section.

3. All living organisms need water to survive.

a. Give **ONE** reason for the following observations:
   i) 90% of blood plasma is made up of water; (2)
   ii) most of the cytoplasm inside cells is made up of water; (2)
   iii) during a meal it is important to drink water. (2)

b. All terrestrial organisms face the challenge of losing too much water from their body, particularly through their gas exchange surface. Explain why all terrestrial organisms lose water vapour from their gas exchange surface. (2)

c. Structures in leaves in plants and tracheal systems in insects can both be closed to prevent water loss from the gas exchange surface.
   i) Name the structures in leaves and the structures in insects that prevent water loss when they are closed. (2)
   ii) Mammals and birds do not have any structures to close the lungs and so prevent water loss. Describe **ONE** adaptation that mammals and birds have to reduce water loss from their lungs. (2)
   iii) Explain why fish do not have any adaptations to prevent water loss over their gills. (2)

d. All protists live in fresh water. *Chlorella* is a plant-like protist whilst the *Amoeba* is an animal-like protist. Explain why the *Amoeba* needs a contractile vacuole to be able to survive in a fresh water habitat but *Chlorella* does **not**. (4)

e. The table shows the amount of water and salt lost from the kidneys and skin on a cold and on a hot day respectively.

	Water lost from kidneys/dm^3	Water lost from skin/dm^3	Salt loss from kidney/g	Salt loss from skin/g
Cold day	1.8	0.0	20.2	0.0
Hot day	0.4	2.3	14.4	5.8

   i) Explain the difference in the amount of water lost from the kidneys on a cold day and on a hot day. (4)
   ii) Name the part of the nephron through which most water is filtered. (1)
   iii) Name the hormone involved in the reabsorption of water and state the main region of the nephron where water is absorbed. (1, 1)

(Total: 25 marks)

4. a. i) Explain **THREE** ways how humans impact the carbon cycle. (6)
   ii) Describe **TWO** ways by which organisms move carbon through the carbon cycle. (4)

   b. Farmers include urea in cattle food. Explain why urea is added to cattle food. (3)

   c. The nitrogen (N) cycle is one of the most important cycles on Earth, as nitrogen is an essential nutrient for all known life forms. Natural processes, driven mostly by microbes fix and deliver bioavailable nitrogen to Earth.
      i) Define nitrogen fixation. (2)
      ii) In recent years, human activity has doubled the amount of fixed nitrogen. Describe how human activity has doubled the amount of fixed nitrogen. (2)

   d. Name the process and the bacteria responsible for:
      i) the conversion of nitrate to gaseous nitrogen; (2)
      ii) the conversion of animal waste to ammonia. (2)

   e. How does the relationship between *Rhizobium* and a legume species benefit both organisms? (4)

(Total: 25 marks)

Please turn the page.

5. Huntington's disease is a progressive brain disorder that causes uncontrolled movements, emotional problems and loss of thinking ability. The most common form of this disease usually appears in a person's thirties or forties.
It is an autosomal genetic disorder caused by a dominant allele, H.

Figure 5.1 below shows the family tree for a family that has a history of Huntington's disease.

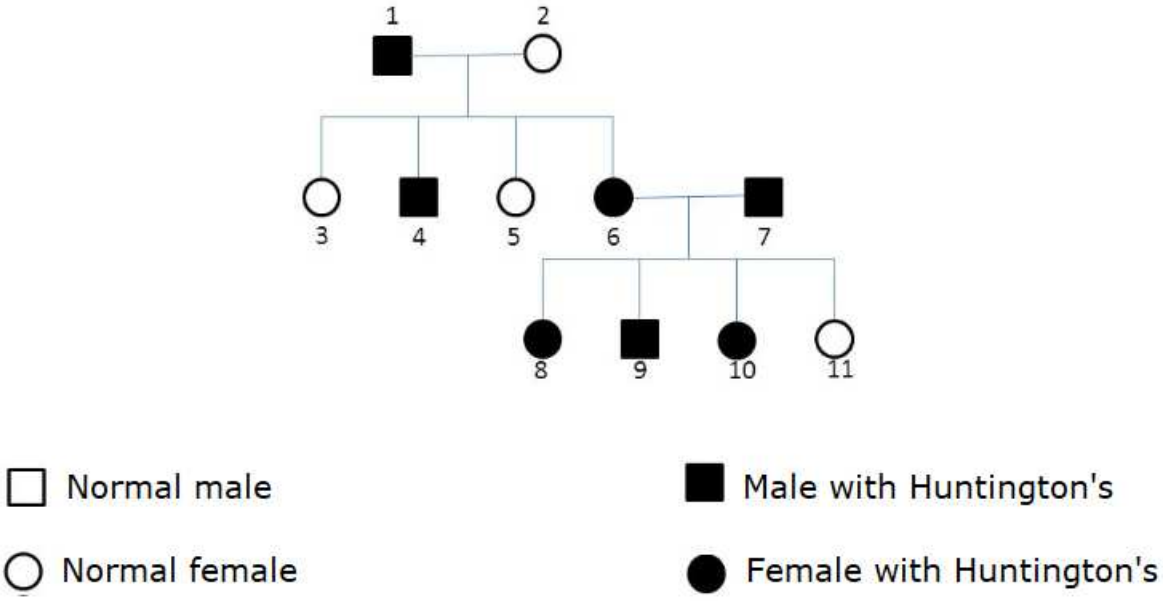


Figure 5.1

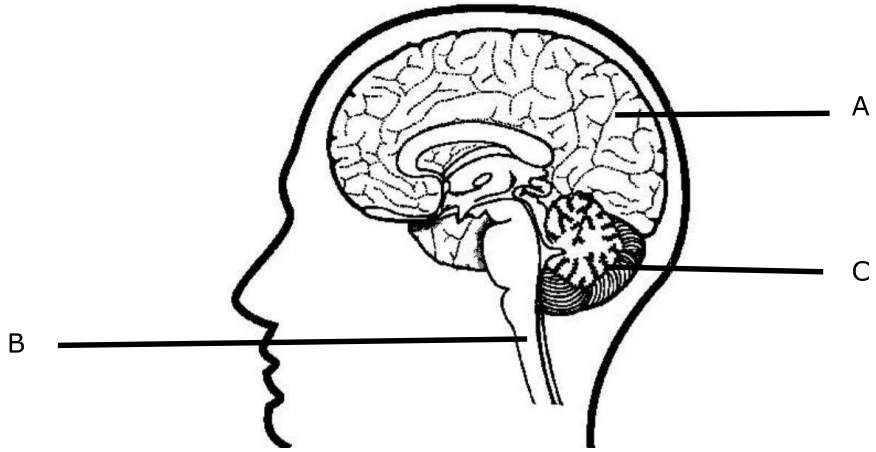
a. i) State the possible genotypes for persons 1 and 2. Give evidence for your answer. (3)

ii) A genetic counsellor suggested that persons 6 and 7 are both heterozygous individuals. Using the genetic counsellor's suggestion, explain why person 11 does not suffer from Huntington's disease. (2)

iii) Persons 6 and 7 want to have another child. Draw a genetic diagram to show the possible outcomes. List the probability of a child suffering from Huntington's disease. (4)

b. Give **TWO** ways in which an autosomal genetic condition such as Huntington's disease differs from a sex-linked genetic condition, such as haemophilia. (2)

c. Huntington's disease is a neurodegenerative disease. The term neurodegenerative disease refers to a range of conditions which result in progressive loss of structure or function of the neurons in the human brain. The following figure (Figure 5.2) shows the structure of the human brain.



https://faculty.washington.edu/chudler/pdf/color.pdf

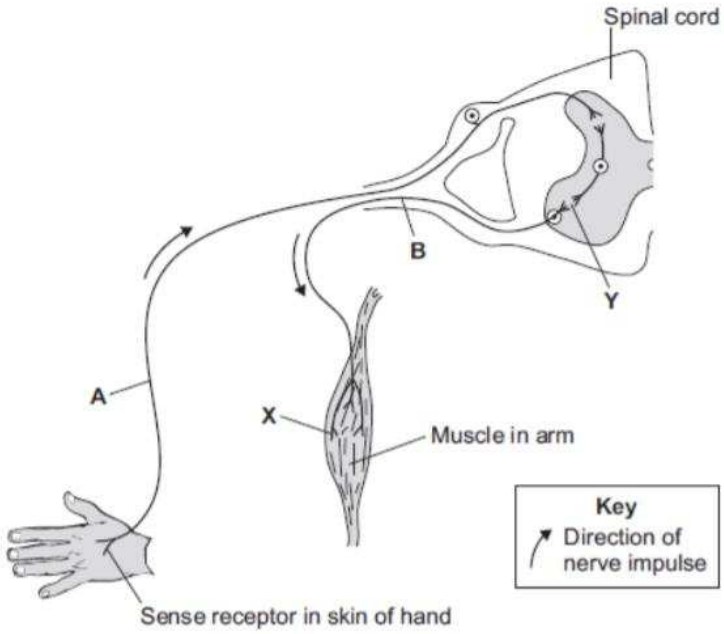
Figure 5.2

i) Name the parts labelled A, B and C. (3)

ii) Give **ONE** function of the part labelled B. (1)

iii) The hypothalamus in the brain plays a role in homeostasis. What is meant by homeostasis? (1)

d. Figure 5.3 shows the neurons and parts of the body involved in a response to touching a hot object.



http://www.expertguidance.co.uk/wp-content/uploads/2018/01/Biology-B1-Nerves-and-hormones-Part-1.pdf

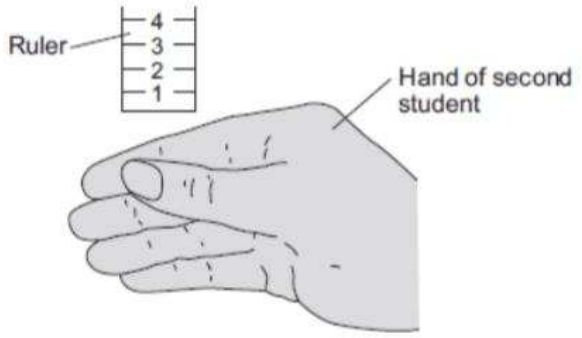
Figure 5.3

i) The hand touches a hot object. An impulse travels through the nervous system to a muscle (point X). The muscle moves the hand away from the hot object. This is a reflex action. Explain why the hand is pulled back from the hot object before pain is felt. (1)

ii) Reflex actions are important for animal survival. Explain why. (2)

This question continues on next page.

e. Some university students investigated the effect of caffeine on a person's reaction time. One student held a ruler just above a second student's hand. The first student let go the ruler and the second student caught it as soon as possible.



http://www.nuffieldfoundation.org/practical-biology/measuring-reaction-time-human-nerve-controlled-reaction

Figure 5.4

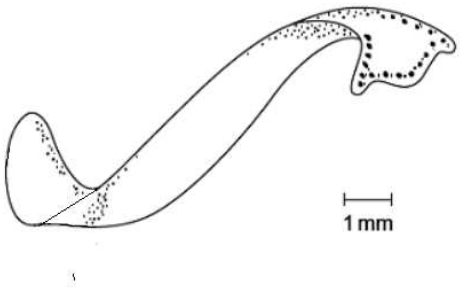
The students repeated the experiment for another 7 times.
The student catching the ruler then drank a cup of strong coffee. (Coffee contains caffeine). Fifteen minutes after drinking the coffee, the experiment was repeated.
The table below shows the results obtained.

	Distance fallen by ruler before it was caught/ cm							
Before drinking coffee	18	21	25	15	19	16	12	21
After drinking coffee	8	13	11	17	10	14	13	13

i) Calculate the average distance fallen by the ruler in both experiments. (2)
ii) What do the results show about the effect of caffeine on reaction time? (1)
iii) Give a reason why a scientist may not accept the conclusion for part e ii). (1)
iv) State **TWO** ways how the students could improve their investigation. (2)

(Total: 25 marks)

6. Flatworms are small animals that live in water. They have no specialised gas exchange or circulatory systems. The diagram below shows one type of flatworm.



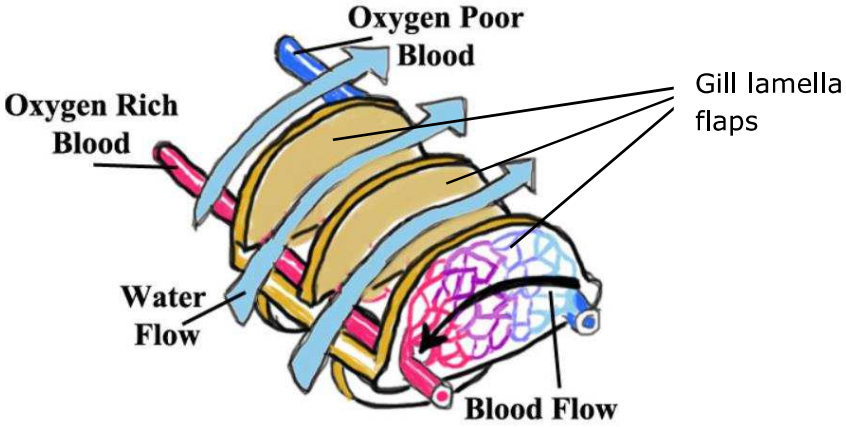
https://www.google.com/search

Figure 6.1

a. i) Name the process by which oxygen reaches the cells inside the body of this flatworm. (1)

ii) The body of the flatworm is adapted for efficient gas exchange between the water and the cells inside the body. Using the diagram, give **TWO** features of the flatworm's body which allow for efficient gas exchange. (2)

b. The diagram below shows how gaseous exchange occurs across the gills of a fish.



https://www.google.com/search

Figure 6.2

i) Explain the importance of the lamellar flaps in gaseous exchange. (2)

ii) Explain why the gills of a fish:

- have a rich blood supply; (1)
- are thin. (1)

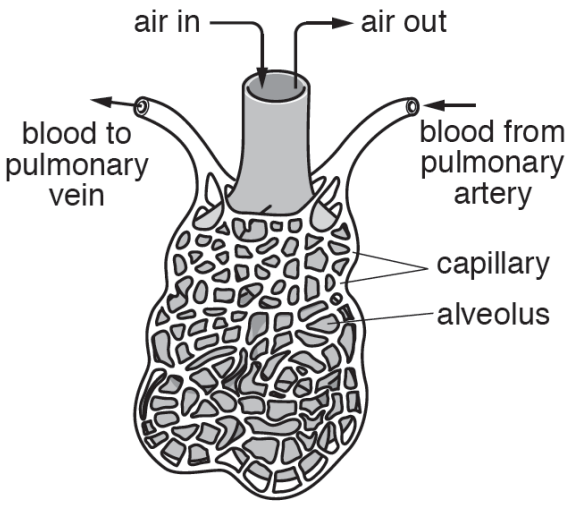
c. i) Explain how oxygen and carbon dioxide are exchanged between atmospheric air and the muscle tissues of an insect. (2)

ii) State **ONE** difference between gas exchange in fish and gas exchange in insects. (1)

iii) Most insects tend to be relatively small in size. Explain the effect of the main limiting factor on an insect's size. (2)

This question continues on next page.

d. In humans, the gas exchange surfaces are alveoli in the lungs.

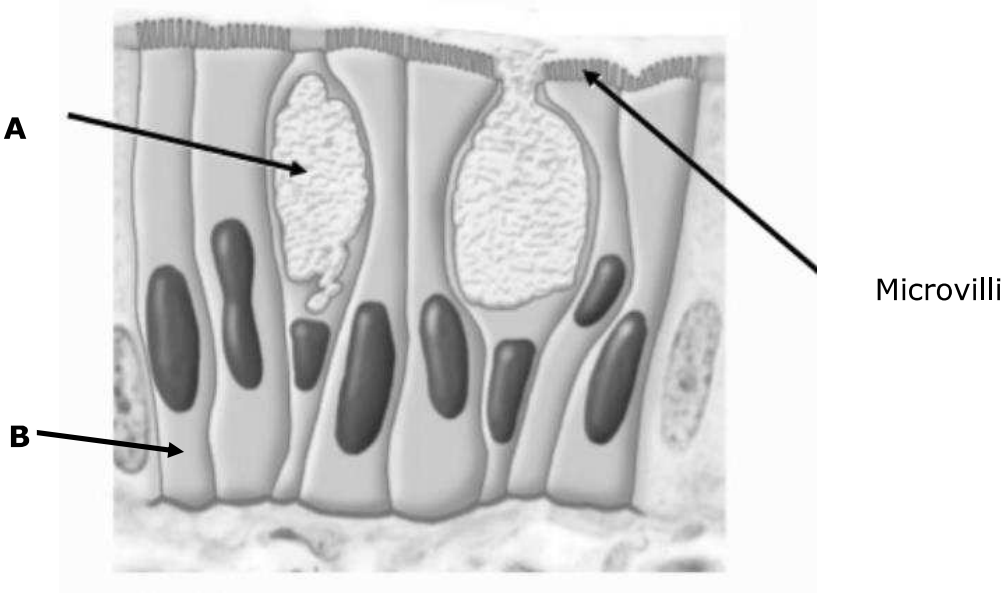


https://www.google.com/search

Figure 6.3

Draw a diagram of a cross section through an alveolus and label **THREE** features which make it an efficient gas exchange surface. Explain how each feature makes the alveoli an efficient gas exchange surface. (5)

e. The figure below shows part of the epithelium that lines the trachea in humans.



https://www.slideshare.net/RolaHanania/rola-andony-hanania

Figure 6.4

i) Name the cells labelled A and B. (2)

ii) Explain how these cells protect the gas exchange system in humans. (2)

f. In an investigation a student recorded the volume of air inspired in one minute. Two measurements were taken, one when the student was resting and the other after she had run a 400 m race.

	Volume of air inspired in one minute/ dm^3
Resting	5.80
At end of race	88.75

i) Calculate the increase in the volume of air inspired by the student at the end of the race. (1)

ii) State **TWO** changes that the body must make to increase the volume of inspired air. (2)

iii) Suggest **ONE** reason why the body needs more air during exercise. (1)

(Total: 25 marks)

7. Land plants evolved from very simple plants to complex flowering plants.

a. i) Name the phylum that contains the most primitive of land plants. (1)

ii) Explain why these plants do **not** grow into large shrubs. (2)

iii) List **TWO** plant structures that evolved in other groups to help them live on land. (2)

iv) Explain how the structures listed in part aiii) helped them be successful on land. (4)

b. Rats and birds eat the seeds of pine cones.

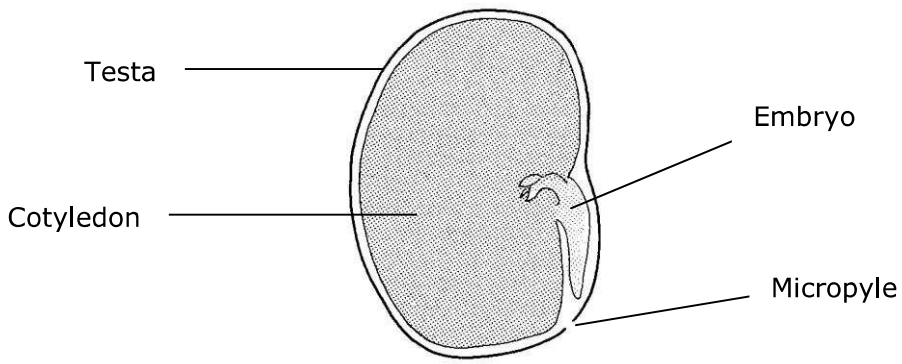
i) List **ONE** characteristic of conifers other than seed formation. (1)

ii) Rats are mammals. State the phylum to which the class mammals belong to. (1)

iii) Give **TWO** structural characteristics of mammals. (2)

c. Germination is the sprouting of a seedling from a seed. In a type of germination the cotyledons are brought out of the ground by the embryo stem. Name this type of germination. (1)

d. The figure below shows a cross-section of a seed.



http://www.biology-resources.com/drawing-plant-seed-05.html

Figure 7.1

i) Name a complex polysaccharide found in the cotyledons. (1)

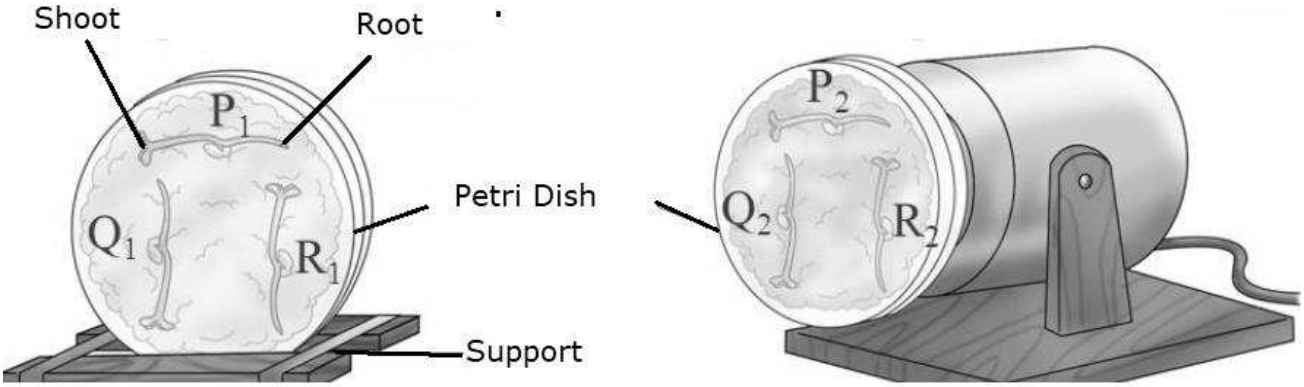
ii) Give the function of the micropyle. (1)

This question continues on next page.

e. Explain why the following statement is incorrect. (3)

Plants take in all substances they need to grow from the roots.

f. In an investigation on the growth of roots, seeds were planted in 2 petri dishes. One petri dish was left static and the other was set to rotate on a clinostat for several days. Below is the experimental set up at the start of the experiment.



Stationary Petri dish **Rotating Petri dish**

https://slideplayer.com/slide/10244066/

Figure 7.2

i) Describe the growth pattern shown by the roots for each petri dish after several days. (2)

ii) Explain why such results were obtained. (2)

iii) Explain why the two petri dishes were left in complete darkness during the investigation. (2)

(Total: 25 marks)

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2019 MAIN SESSION

SUBJECT:	**Biology**
PAPER NUMBER:	IIB
DATE:	7th May 2019
TIME:	4:00 p.m. to 6:05 p.m.

Write your answers on the booklet provided. Write down the number of the questions you answer on the front page of your answer booklet.
Please note that for question 6 of this paper you need the graph paper in the booklet.

Answer any FOUR questions.

1. The Carbon cycle is one of the most important cycles of the Earth. The total amount of carbon remains fixed since there is no creation or destruction of carbon in this process. It only involves the movement of this element around a complete cycle in compound form.

   a. Draw a simple flow chart to show the carbon cycle. (10)

   b. The nitrogen (N) cycle is one of the most important cycles on Earth, since nitrogen is an essential nutrient for all known life forms. In some plants, nitrogen in the air can be changed into plant protein. Define nitrogen fixation. (2)

   c. Nitrogen fixation by microorganisms with an additional small amount from lightning strikes, used to be the only way in which nitrogen made its way from the environment into living organisms. It is thought that human activity has doubled the amount of fixed nitrogen. Explain how this has happened. (4)

   d. Name the process and the bacteria responsible for the conversion of nitrate to gaseous nitrogen. (2)

   e. Farmers include urea in cattle food.
      i) Name the type of molecule that is deaminated by the liver to produce urea. (1)
      ii) Explain why the addition of urea increases rate of growth. (2)

   f. How does the relationship between *Rhizobium* and a legume species benefit the plant? (4)

(Total 25 marks)

Please turn the page.

2. Pollinator decline is a global phenomenon affecting natural ecosystems and food security. In Europe, around 84% of crop species and 78% of wild flowering species depend, at least in part, on animal pollination. Bees are in serious decline and many are threatened with extinction. But this is not all, there is a dramatic decline in the occurrence and diversity of all kinds of European wild insect pollinators, including wild bees, hoverflies, butterflies and moths.

a. i) From the text, apart from wild bees, name **TWO** other European wild insect pollinators. (2)

ii) Describe insect pollination. (2)

The EU is tackling the spread of invasive alien (not usually found in Europe) species such as the Asian yellow-legged hornet *Vespa velutina,* which attack bee-hives, or the Himalayan balsam *Impatiens glandulifera* which invades pollinator habitats. The Varroa mites (*Varroa destructor* and *Varroa jacobsoni*) are tiny red-brown external parasites of honey bees. The EU has not only already restricted the use of three pesticides but is also contributing to maintain, protect and create pollinator habitats that are important for pollinators.

(Adapted from: The Natura 2000 Newsletter Number 44 / July 2018)

b. Bees and mites belong to the same phylum but different classes.

i) Bees have three pairs of jointed appendages. Name the class to which bees belong. (1)

ii) List **TWO** structural characteristics shared by all organisms in this phylum. (2)

iii) Give the species name of **ONE** parasitic mite. (1)

iv) Mites have four pairs of jointed appendages. List the class to which mites belong. (1)

c. 'Pollinators are forced to pay beekeepers for pollination services'. Explain this statement. (3)

d. Explain why ecologically the decrease of pollinators is potentially serious. (3)

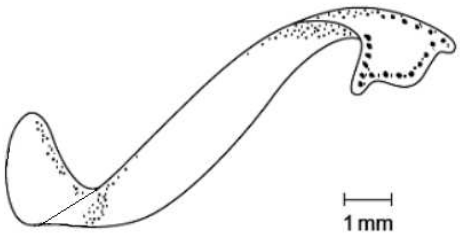
e. Bees and other pollinators make important contributions to agriculture. Their decline is likely to impact the production and costs of vitamin-rich food crops like fruits and vegetables. Name **ONE** effect such an impact may have on humans. (2)

f. Pollinators support the production of 87 of the leading food crops worldwide. Give **ONE** reason why the benefits that bees and other small pollinators bring us go beyond human food. (3)

g. Human impact has increased the extinction rates of pollinators. Explain this statement. (5)

(Total: 25 marks)

3. Flatworms are small animals that live in water. The diagram below shows one type of flatworm which is free living.



https://www.google.com/search

Figure 3.1

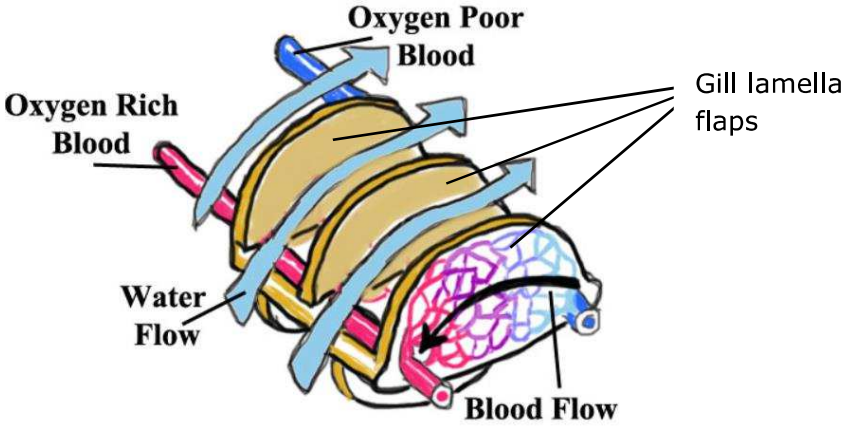
a. i) Many flatworms are parasites. Define the term parasite. (1)

ii) Name **TWO** characteristics of the body structure of flatworms. (2)

iii) Name the process by which oxygen reaches the cells inside the body of this flatworm. (1)

iv) Explain why flatworms do **not** possess specialised gas exchange surfaces. (2)

b. The diagram below shows how gaseous exchange occurs across the gills of a fish.



https://www.google.com/search

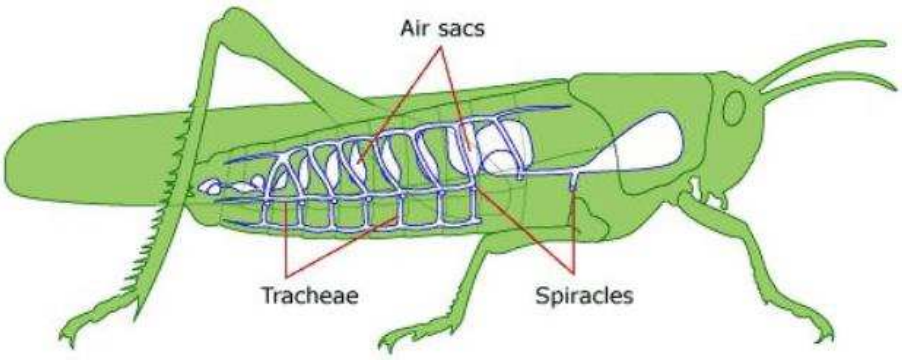
Figure 3.2

i) Give **THREE** characteristics of gills which make them efficient gas exchange surfaces. (3)

ii) Explain the importance of lamellae in gills. (2)

This question continues on next page.

c. The diagram shows the respiratory system of an insect.



https://www.google.com/search

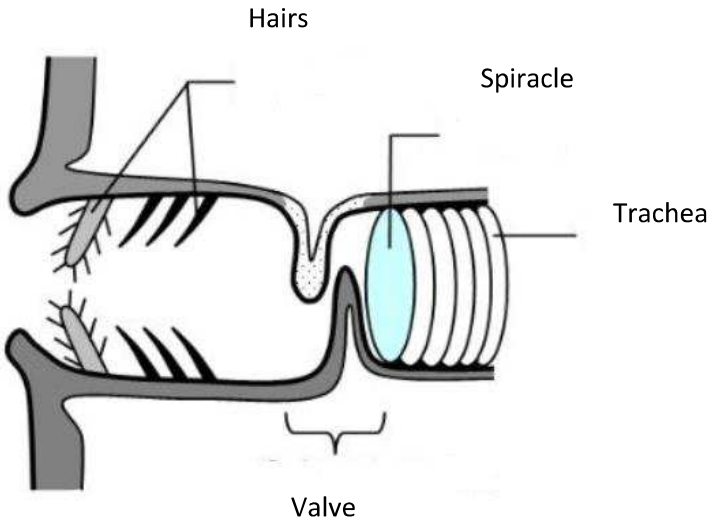
Figure 3.3

i) Name the phylum to which insects belong. (1)

ii) The body of insects is covered with a hard exoskeleton. Give **THREE** functions of the exoskeleton. (3)

iii) State **ONE** difference between gas exchange in fish and gas exchange in insects. (1)

iv) The diagram below shows details of one of the spiracles.



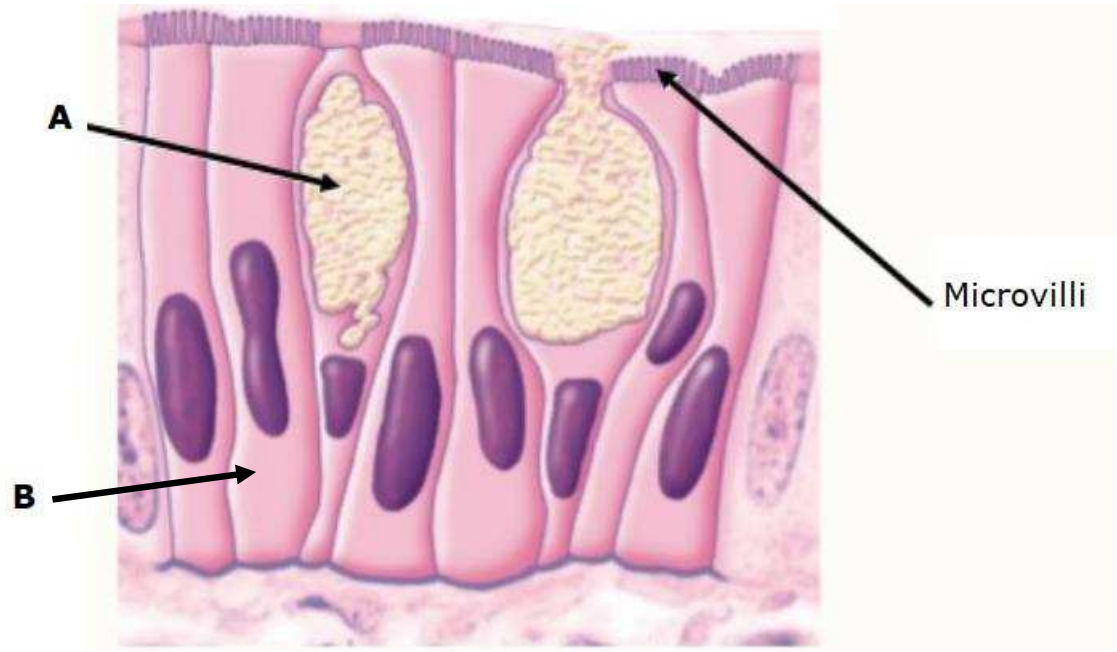
https://www.google.com/search

Figure 3.4

Insects have several adaptations which allow them to live successfully on land. Give **ONE** way how the hairs at the opening of the spiracles might serve as an adaptation to prevent water loss. (2)

v) Some plants living in dry environments have epidermal hairs to prevent water loss. Give **THREE** other adaptations shown by plants living in dry environments. (3)

d. The figure below shows part of the epithelium that lines the trachea in humans.



https://www.slideshare.net/RolaHanania/rola-andony-hanania

Figure 3.5

i) Name the cells labelled A and B. (2)

ii) Explain how these cells protect the gas exchange system in humans. (2)

(Total: 25 marks)

4. All living organisms need water to survive.

a. State the property of water responsible for the following observations:

i) 90% of blood plasma is made up of water; (2)

ii) most of the cytoplasm inside cells is made up of water; (2)

iii) water must be present for digestion to occur. (2)

b. All gas exchange surfaces are moist. Explain why terrestrial organisms lose a lot of water from their gas exchange surface. (2)

c. i) Stomata in plants close to prevent water loss. Draw a labelled diagram of two guard cells surrounding a stoma. (4)

ii) Terrestrial mammals developed efficient gaseous exchange surfaces to reduce water loss. Explain how the reduction of water was achieved. (2)

d. All protists live in fresh water. *Chlorella* is a plant-like protist whilst the *Amoeba* is an animal-like protist.

i) The *Amoeba* has a contractile vacuole. Describe the function of the contractile vacuole. (3)

ii) Explain why *Chlorella* does not have a contractile vacuole and still survives in fresh water. (2)

This question continues on next page.

e. The table shows the amount of water and salt lost from the kidneys and skin on a cold and on a hot day respectively.

	Water lost from kidneys/dm^3	Water lost from skin/dm^3	Salt loss from kidney/g	Salt loss from skin/g
Cold day	1.8	0.0	20.2	0.0
Hot day	0.4	2.3	14.4	5.8

i) Name the process responsible for the loss of water and salt from the skin on hot days. State the biological importance of this process. (2)

ii) Explain the difference in the amount of water lost from the kidneys on a cold day and on a hot day. (4)

(Total: 25 marks)

5. Huntington's disease is a progressive brain disorder that causes uncontrolled movements, emotional problems and loss of thinking ability. The most common form of this disease usually appears in a person's thirties or forties.
It is an autosomal genetic disorder caused by a dominant allele, H.

Figure 5.1 below shows the family tree for a family that has a history of Huntington's disease.

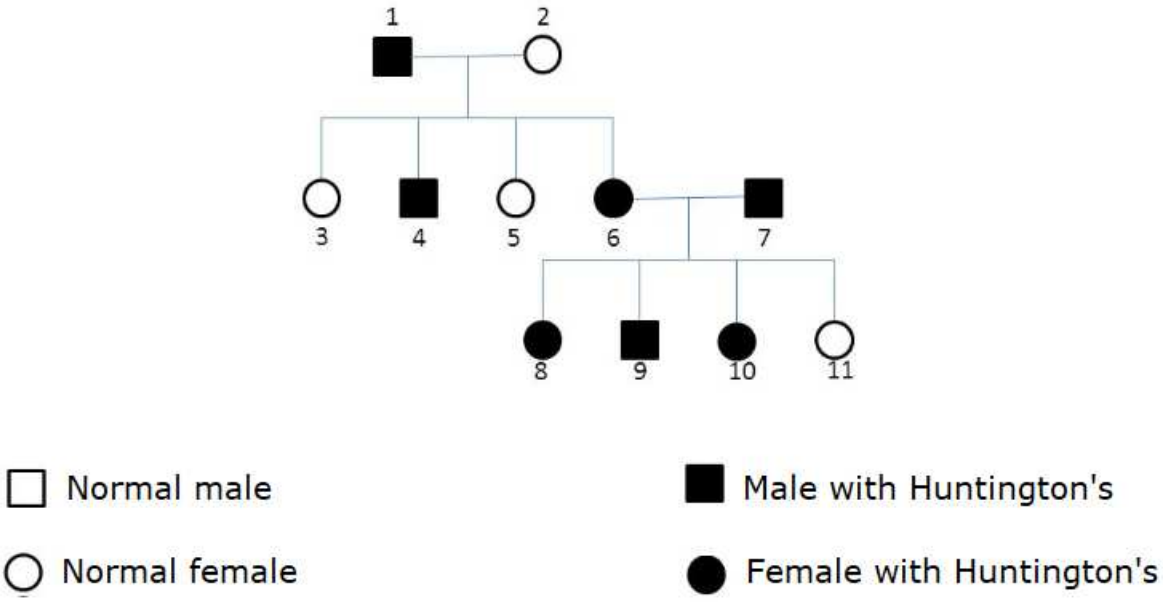


Figure 5.1

a. What is an allele? (1)

b. State the possible genotypes for persons 1 and 2. Give evidence for your answer. (3)

c. A genetic counsellor suggested that persons 6 and 7 are both heterozygous individuals.

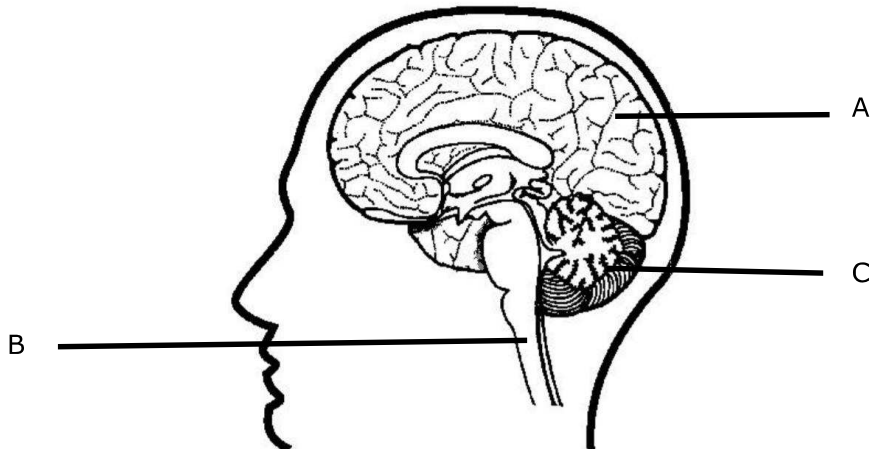
i) What is meant by heterozygous? (1)

ii) Using the genetic counsellor's suggestion, explain why person 11 does not suffer from Huntington's disease. (2)

d. Persons 6 and 7 want to have another child. Draw a genetic diagram to show the possible outcomes. List the probability of a child suffering from Huntington's disease. (4)

e. Define the term autosome. (1)

f. Huntington's disease is a neurodegenerative disease which results in progressive loss of structure or function of the neurons in the human brain. Figure 5.2 below shows the structure of the human brain.



https://faculty.washington.edu/chudler/pdf/color.pdf

Figure 5.2

i) Name the parts labelled A, B and C. (3)
ii) Give **ONE** function of the part labelled B. (1)

g. A man hurt his head in an accident. Doctors found that he could not remember anything that happened on the day of the accident.

i) Name the part of the brain concerned with memory. (1)
ii) Give **ONE** other function of the cerebrum. (1)
iii) Doctors suspected that the man might also have injured his spine. They touched different areas of his skin with a sharp point and asked the man to tell them each time if he could feel the sharp point. The doctors found that the man could feel the sharp point when the point touched his arms but not when the point touched his legs. State what this information could tell the doctors about the damage to the man's spinal cord. (2)

This question continues on next page.

h. The photograph below shows a new born baby.

https://www.google.com/search

New born babies have reflex actions.

i) Define a reflex action. (1)

ii) Reflex actions help new born babies to survive. Copy and complete the table below by adding numbers to the column to show how each reflex action helps new born babies to survive.

	Reflex action		**How the reflex action helps the baby**
1	If milk goes down the baby's wind-pipe, the baby coughs.		Helps to protect some of the baby's receptors.
2	If the mother strokes the baby's mouth, the baby begins to suck.		Helps the baby to hold on to the mother.
3	If the mother touches the palm of the baby's hand, the baby clenches its fist.		Prevents the baby from choking.
4	If a bright light shines on the baby, the baby's eyes shut.		Helps the baby to feed.

(4)

(Total: 25 marks)

6. 'Sun' plants grow exposed to direct sunlight whilst 'shade' plants grow in areas shaded by larger plants.
   The data in the table below shows how the rate of photosynthesis in a 'sun' plant and in a 'shade' plant varies with increasing light intensity.

Light intensity / arbitrary units	Rate of photosynthesis in 'sun' plant / arbitrary units	Rate of photosynthesis in 'shade' plant / arbitrary units
0	0	0
50	2	5
100	4	10
150	8	12
200	18	15
250	22	15
300	26	15
400	32	15
500	38	15
600	40	15

a. On the graph paper provided (use the 2 mm grid scale), draw a graph to show the variation in the rate of photosynthesis in the 'sun' plant with increasing light intensity. Join the points of the graph with straight lines. Plot light intensity on the x-axis. (6)

b. On the same graph paper provided sketch a curve to show how the rate of photosynthesis in 'shade' plants varies with increasing light intensity. (Note that the maximum rate reached is 15 a.u.) (2)

c. Use the data in the table to compare the rate of photosynthesis in the 'sun' plant and the 'shade' plant at light intensities between 0 and 150 arbitrary units. Explain how this indicates that 'shade' plants are adapted to survive in their particular habitat. (3)

d. Use the data in the table to explain why the 'shade' plant reached the maximum rate of photosynthesis at a light intensity 200 arbitrary units but the 'sun' plant had **not**. (2)

e. The data was obtained from plants exposed to a 0.02% CO_2 concentration. Predict the value of the rate of photosynthesis in the 'shade' plant at a light intensity of 600 arbitrary units placed in a CO_2 concentration of 0.04%. Give a reason for your answer. (3)

f. Explain why at a light intensity of 600 arbitrary units 'sun' plants grow faster than 'shade' plants. (2)

g. 'Shade' plants tend to have larger leaves than 'sun' plants. The 'shade' plants tend to keep their leaves in a horizontal position. Explain how larger leaves kept in a horizontal position allow 'shade' plants to survive in a habitat with low light intensity. (3)

h. The chloroplasts in palisade cells in 'shade' plants are larger than the chloroplasts of 'sun' plants.
   i) State the function of chloroplasts. (1)
   ii) Name **ONE** pigment found in chloroplasts. (1)
   iii) Give an advantage that 'shade' plants gain by having larger chloroplasts. (2)

(Total: 25 marks)

7. Land plants evolved from very simple plants to complex flowering plants.

   a. i) List **ONE** characteristic that shows that mosses are simple plants. (2)
   ii) Explain why these plants do **not** grow into large shrubs. (2)
   iii) List **ONE** plant structure that evolved in ferns that made them successful on land. (2)
   iv) Explain how the structure listed in part aiii) helped ferns be successful on land. (3)

   b. Rats and birds eat the seeds of pine cones.
   i) List **ONE** characteristic of conifers other than seed formation in pine cones. (2)
   ii) Rats are mammals. State the phylum to which the class mammals belong to. (1)
   iii) Give **TWO** structural characteristics of mammals. (4)

   c. A recent article on mould fungi and plants states that fungi protects plants from disease and boost their growth.
   i) Draw a diagram of a mould fungus and include labels of hyphae, mycelium and sporangium. (5)
   ii) Describe asexual reproduction in mould fungi. (2)
   iii) Explain how the production of many spores increases the chance of the species survival. (2)

(Total: 25 marks)

8. a. The following statements are incorrect. Write the correct statement and explain each correct statement.
   i) Chemical digestion starts in the stomach with the breakdown of starch. (1, 3)
   ii) Both the pancreas and the liver secrete digestive enzymes in the ileum. (2, 4)
   iii) The large intestine absorbs the digested products of food. (2, 3)

   b. List **TWO** differences between the human digestive system and the digestive system of a ruminant herbivore. Give your answer in the form of a table. (4)

   c. Both human and ruminants have mutualistic bacteria in the alimentary canal.
   i) Define the term mutualistic. (2)
   ii) In humans, these bacteria produce vitamins and help to process waste. Explain the role of mutualistic bacteria in ruminants. (4)

(Total: 25 marks)