P530/2
BIOLOGY
(Theory)
Paper 2
Nov./Dec. 2023
2½ hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

BIOLOGY
(THEORY)

Paper 2

A PROPOSED MARKING GUIDE

TO UACE BIOLOGY PAPER 2 (P530/2) ⇒ 2023

BY WASSWA ENOCK ⇒ 0701300439
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NB
Question paper is attached below

SECTION A [40 marks]

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NB
Question paper is attached below

SECTION A [40 marks]

NO1 (a) Figure 1

(i) (a) Describe how the rate of photosynthesis varies with temperature of the Leaf (04 marks)

Key word ⇒ Varies [Meaning Dynamic observation's only]

Solution.

From 8°C to 30°C, rate of photosynthesis increases rapidly. ✓

From 30°C to 40°C, rate of photosynthesis increases gradually to maximum/peak ✓

From 40°C to 48°C, rate of photosynthesis decreases rapidly. ✓

From 48°C to 58°C, rate of photosynthesis decreases gradually to zero. ✓

max 04

(ii) Explain how the rate of respiration Varies with temperature of the Leaf (05 marks)

solution

- From 8°C to 45°C, rate of respiration increases gradually to maximum; because respiratory enzymes are activated, and gain kinetic energy, collide faster with the substrate forming many products.
- From 45°C to 69°C, rate of respiration decreases rapidly to zero, because of the increase of the leaf temperature beyond the optimum; caused denaturation of the respiratory enzymes;

max 05

(iii) Explain the difference in the rates of photosynthesis and respiration between leaf temperature of 40°C and 70°C (08 marks)

Solutions

From 40°C to 45°C, rate of photosynthesis decreases because photosynthetic enzymes have a lower optimum temperature while rate of respiration increases to the maximum because respiratory enzymes have a higher optimum temperature.

From 47°C to 58°C, rate of photosynthesis is lower because many photosynthetic enzymes are denatured by high temperatures beyond the optimum while rate of respiration is higher because few respiratory enzymes have been denatured by higher temperatures beyond optimum.

From 58°C to 69°C, rate of photosynthesis remain constant at zero because all the photosynthetic enzymes are completely denatured by higher temperatures beyond the optimum while rate of respiration decreases because there is ~~denaturatu~~ denaturation of the few remaining ~~photo~~ respiratory enzymes by higher temperatures

max 08

(iv) Explain the relationship between respiration and photosynthesis (04 marks)

Solution

As respiration increases, photosynthesis also increases, because the carbon dioxide produced from respiration is directly used/utilised in ~~phosth~~ photosynthesis as a raw material

As respiration decreases, photosynthesis also decreases, ~~because~~ because a decrease in respiration results into reduction in the amount of carbon dioxide which is a raw material for phosynthesis, hence decrease in photosynthesis

max 04

No1(b) Compare the amounts of Carbon dioxide absorbed by each of the two plant species A and B in Figure 2

(07 marks)

Similarities For amount of Carbon dioxide absorbed by plant species A and B

- In both, from 10°C to 25°C, amount of Carbon dioxide absorbed increases
- In both the amount of Carbon dioxide absorbed is the same at 30°C
- Both attained maximum amount of Carbon dioxide absorbed Accept equal
- In both, from 40°C to 60°C, amount of Carbon dioxide absorbed decreases Accept peak

Award any Correct 03 max 03

Differences

Amount of Carbon dioxide absorbed by plant A	Amount of Carbon dioxide absorbed by plant B
At 10°C, is higher	At 10°C, is Lower
From 10°C to 29°C is higher	From 10°C to 29°C is lower
From 25°C to 30°C, decreases	From 25°C to 30°C, increases
From 35°C to 45°C is Lower	From 35°C to 45°C is higher
Attained a lower maximum /peak	Attained a higher maximum /peak
Attained a peak earlier	Attained a peak later
From 30°C to 40°C decreases	From 30°C to 40°C increases
Maximum is 32 arbitrary units	Maximum is 39 arbitrary units

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No(c) From Figure 1 and 2, suggest the plant species whose rate of photosynthesis was studied in Figure 1. Give reason(s) for your answer (04 mark)

Solution

Plant B ✓ 02

Reasons

In Figure 1; maximum rate of photosynthesis is attained at leaf temperature of 40°C, which is equivalent to the leaf temperature at which the maximum amount of Carbon dioxide absorbed by plant B in Figure 2 is reached / attained

max 04

Reject C_4 / C_3 plants

1(d) Explain any two other factors that can affect the rate of photosynthesis. (04 marks)

solution

(i) Light intensity; The higher the light intensity, the higher the rate of photosynthesis, since light intensity promotes stomatal opening and also increases the internal leaf temperature

(ii) Carbon dioxide Concentration, ~~Cab~~ the higher the Carbon dioxide Concentration, the higher the rate of photosynthesis, because Carbon dioxide is a raw material for the process of photosynthesis, ~~which is~~ during the dark reactions like C_4 pathway and C_3 pathway

max 04

CamScanner

(e) Describe how Carbon dioxide from the atmosphere is fixed in the bundle sheath Cells (04 marks)

- ~~Within the~~ In the bundle sheath Cells, malate is decarboxylated to form pyruvate and Carbon dioxide.

Carbon dioxide combines with RUBP (Ribulose bisphosphate) under catalysis of RUBP Carboxylase enzyme to form Glycerate-3-phosphate which is reduced by NADPH2 and phosphorylated by ATP to form Triose phosphate (Tp).

Triose phosphate is phosphorylated by ATP to form RUBP

Max 04

SECTION B [60 marks]

NO2(a) Describe the ecological significance of each of the following forms of behaviour.

(i) Territorial behaviour (06 marks)

Solution

- Territoriality reduces both intraspecific and interspecific competition for resources as an organism defends it's territory against invasion by other organisms ✓

- Ensures adequate spacing of the mating pair of organisms and their offsprings to receive the available resources like food, breeding space ✓

- Minimizes the spread of diseases and parasites since in a territory, over population is avoided. ✓

- Territories are defended by using signals reduces changes of fighting ✓

- Controls population growth and promotes scattered population distribution ✓

- Ensures freedom from ~~interence~~ interference during mating ✓

- Genes from the strong organisms are passed to the next generation promote passage of superior genes to the next generation and elimination of inferior genes from the population ✓

Award only correct 06 points max 06

Reference Advanced Biology - Michael Kent Page 236-237

(ii) Courtship behaviour (07 marks)

- It induces mating of individuals who accept each other. ✓
- Courtship is also used as isolating mechanism, preventing off springs from interbreeding ✓
- Courtship enables organisms recognise each other as individuals and avoid aggression. ✓
- Brings both mating partners to recognise each other as individuals and avoid aggression ✓
- It synchronizes the time of producing offsprings with the availability of food. ✓
- Animals advertise their willingness to mate. ✓
- It ensures that members of the same species find each other and mate. ✓

Award only Correct 07

Mark 07

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(b) Giving an example in each case, suggest ways by which animals avoid predation (07 marks)

Solution

- Camouflage; Organism adopt Colour features of the environment and ability ~~sev~~ survive predation Forexample owl, toads ✓

- Mimicry, organisms resembles surrounding that seems ~~of~~ unpalatable forexample Coral, Milk, alligator, chameleon, leafy sea dragon ✓

- Fast escape, adopted powerful, highly flexible muscles in the locomotory devices like wings, legs that promote rapid escape of the prey from the predator forexample rabbits ✓

- Excellent senses, forexample smell, sight, hearing enables timely and accurate detection of the predators presence, and therefore prey's escape forexample rabbits, zebra ✓

- Using defensive structures, like sharp teeth, spines, horns, shell to guard against predation forexample hard plates on body of turtles ✓

- Use of Alarms, Inform of warning sounds enables one organism to successfully alert others ~~of~~ about the presence of predators forexample Monkeys make alarms and Birds ✓

- Nocturnal behaviour, Some preys are active at night without being noticed by predators forexample foxes, owl, bats ✓

Award any correct 07 max 07

CamScanner

Qn 3(a) Describe the structure of the mature vascular tissues in flowering plants. (10 marks)

Vascular tissues are Xylem tissues and Phloem tissues

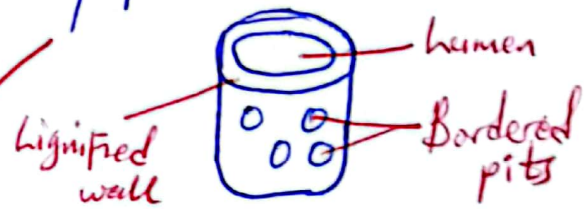
(i) Xylem tissue Contains two types of Conducting elements; Vessels and tracheids.

Structure of a Vessel.

A vessel is made up of a chain of elongated cylindrical cells placed end to end.

Has horizontal end walls that are broken down partially or Completely so that the cells are in open Communication with each other.

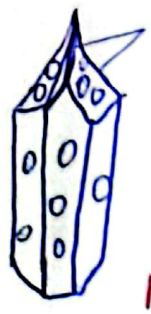
- The Cellulose side walls are impregnated with lignin;
- Has lignified walls that are perforated with numerous bordered pits Containing a torus



Structure of a tracheid

Tracheids are similar to Vessels, except that they are five or Six-sided in Cross-section

Tracheids have tapering end walls which are perfrated by pits



max 05

Structure of Phloem tissue

Phloem tissue Consists mainly of elongated sieve elements placed end to end so as to form long sieve tubes running parallel with the long axis of the plant.

Each sieve element is derived from a cell whose nucleus disintegrates during development; Has the endwalls, known as the sieve plates

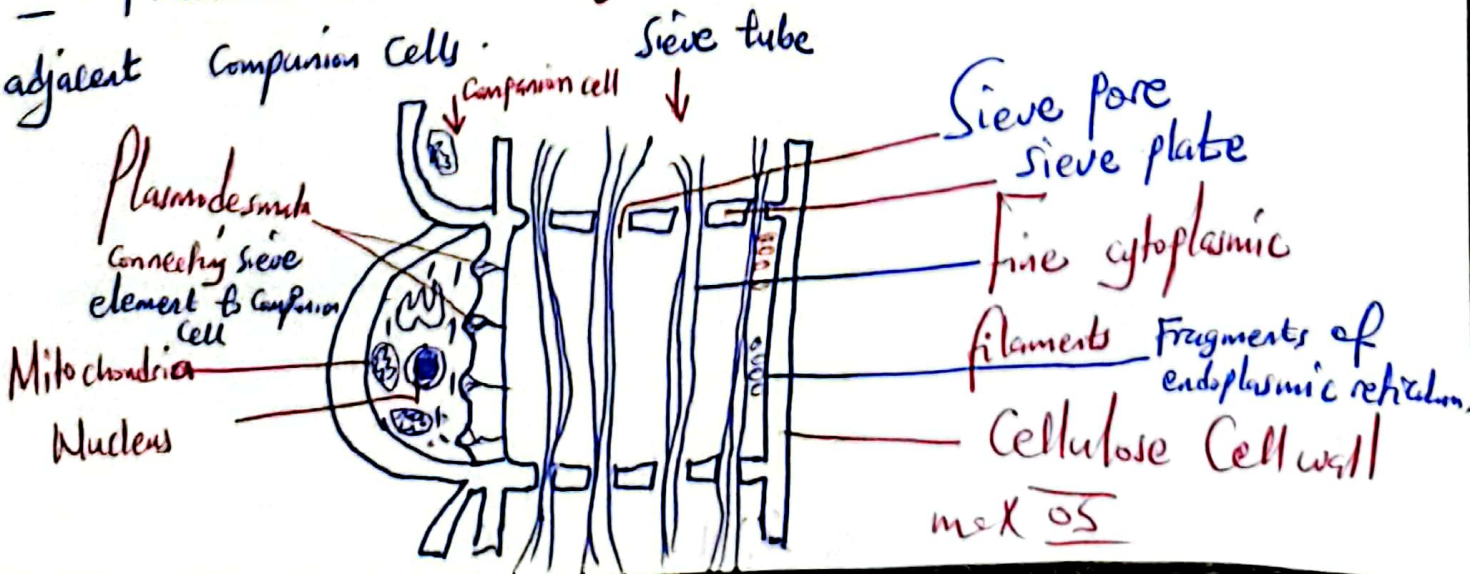
The sieve plates are perforated by numerous pores which allows the passage of materials from one sieve element to next.

Inside the sieve plates are ~~numerous~~ fine Cytoplasmic filaments which are Continuous; via the pores in the sieve plates, with similar Filament in the next sieve element.

- The cytoplasm of filaments is very Simple, with no endoplasmic reticulum, mitochondria, plastids and other organelles

- Closely applied to the side of each sieve element are one or more Companion Cells, which possess a nucleus, dense endoplasmic reticulum, ribosomes and numerous mitochondria

- Plasmodesmata Connect each sieve element with its adjacent Companion Cells.



max 05

3(b) Explain how the movement of water from the soil provides support in a herbaceous plant [10 marks]

Solution

- Support in a herbaceous plant is provided by the turgidity of the parenchyma tissues.

- Osmotic intake of water makes the cells turgid. The turgor pressure of the fluids in the vacuoles pushes the plasma membrane against the cell wall; creating support for it's stem and leaves, roots.

The cell walls are thickened by cellulose, which gives additional support to herbaceous plant

- The active pumping of salts into the stem, by the Casparian strip cells, results into rapid osmotic influx of water which generates root pressure hence turgidity of parenchyma cells

- As water passes through the cells of cortex and epidermal cells by vacuolar pathway ~~through~~ via cell vacuoles, symplast pathway via cytoplasm and apoplast via cellwall makes them to be turgid therefore supporting the root.

Max 10

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NO 4(a) How is the human placenta adapted for exchange of materials between the mother and the foetus.
(05 marks)

Solution

- Closeness of maternal and foetal blood vessels facilitates faster diffusion of substances ✓

- Chorionic villi contain numerous mitochondria to provide energy required for active transport ✓

- Numerous chorionic villi, increase surface area for absorption and transportation of materials ✓

- Two umbilical arteries, transport blood containing wastes from foetus to mother's blood for excretion ✓

- Umbilical vein, transport nutrient and oxygen rich blood from the mother to the foetus ✓

- Numerous maternal arterioles, supply oxygen and nutrients to the foetus ✓

- Numerous maternal venule, drain foetal blood containing wastes to be transported back to the maternal blood for excretion. ✓

Award any Correct 5 Max 05

4(b) The Mammalian embryo develops inside the mother's womb before being born. Explain the importance of this type of embryo development. (06 marks)

Solution

1- Enhanced protection; the embryo is shielded from external threats, predators and external dangers during the critical early stages of development.

- Optimized environmental conditions; ovoviviparity allows the parents to provide a stable and controlled environment for the developing embryo. This can be especially crucial in aquatic environments where temperature and other factors might vary.

- Increased survival rates; the protection and support offered by ovoviviparity contribute to higher survival rates for embryo.

- ~~4~~

Max 06

4(c) Describe the different exchange mechanisms by which materials move between the foetus and the mother. (09 marks)

- Osmosis; water passes across the placenta into the foetal circulation by osmosis.

- Simple diffusion; respiratory gases like oxygen needed for aerobic respiration diffuses from the mother's circulation to that of foetus down concentration gradient; also carbon dioxide a waste product of aerobic respiration diffuses in the opposite direction.

Nitrogeneous wastes (urea) also diffuses from the foetus to mother ~~ate~~ across the placenta.

Some ions such as sodium, potassium and calcium cross the placenta to foetal circulation by diffusion.

- Active transport; ions such as sodium, potassium, calcium cross mainly by active transport.

Amino acids, iron and vitamins cross by active transport.

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Facilitated diffusion; Glucose cross/ moves by facilitated diffusion through a specialised Carrier protein.

Award any Correct 09 MAX 09

NO5(a) Giving examples, describe the different functions performed by proteins in mammals (14 marks)

Solution

- Respiration and transport;

Haemoglobin transports oxygen; myoglobin stores oxygen in muscles

Mucin keeps respiratory surface moist thus maintains an efficient diffusion pattern of gases.

- Immunity; Antibodies defends the body against foreign antigens

- Nutrition;

Digestive enzymes like trypsin, amylase, lipase Catalyse the breakdown Proteins to polypeptides, starch to maltose and fats to fatty acids and glycerols respectively.

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- Reproduction;

Hormones such as prolactin induces milk production in mammals

Chromatin gives structural support to chromosomes;

- Growth

Hormones like thyroxine, growth hormone Control Basal metabolic rate and growth respectively

- Excretion

Enzymes like ureases, arginases Catalyse reactions of the ornithine cycle thus important in protein breakdown and urea formation.

- Support and movement

Actin and myosin for muscle Contraction

Ossein and Chondrin for Support in bone and Cartilage respectively.

- Sensitivity and Co-ordination;

Hormones like Insulin and glucagon Controls blood sugar levels, vasopressin Controls blood pressure, Rhodopsin and opsin which are photosensitive pigments in the retina phytochromes Controls flowering and germination.

No5 (b) Explain the factors that can cause protein denaturation (06 marks)

Solution.

Heat; Causes the atoms of the protein to vibrate more thus breaking hydrogen and ionic bonds.

Strong Acids; additional H^+ ions combine with COO^- groups on amino acid and form COOH, ionic bonds are hence broken

Strong alkalis; Reduced number of H^+ ions causes NH_3^+ groups to lose H^+ ions and form NH_2, hence breaking ionic bonds

Inorganic chemicals; the ions of heavy metals such as mercury and silver are highly electropositive. They combine with COO^- groups and disrupt ionic bonds. Similarly, highly electronegative ions like Cyanide (CN^-) combine with NH_3^+ groups and disrupt ionic bonds.

~~Organic~~ Organic Chemicals; organic solvents alter hydrogen bonding within a protein.

Mechanical force; physical movement may break hydrogen bonds

MAX 20 marks

No6

(a) State three major distinguishing features of gaseous exchange in fish and terrestrial insects (03 mks)

In fish the respiratory surface is gills/gill filaments while for insects is tracheoles.

For fish; the respiratory medium is wtr water while for insects is air

For fish, Respiratory gases moves within blood in blood vessels while for insects moves in haemolymph.

In Fish, oxygen is carried by a respiratory pigment while in insects, there is no specialised respiratory pigments that transport gases

Mark 03

6(b) How is gaseous exchange in a bony fish different from that of a Cartilagmous fish? (04 marks)

Solution

Gaseous exchange in bony fish	Gaseous exchange in Cartilaginous fish
Is by Counter current flow	Is by parallel flow
Water enters through mouth only	Water enters through mouth and spiracles
~~have~~ More oxygen is absorbed from water	less oxygen is absorbed from water
All gills are Ventilated	Not all gills are ventilated.
slower speed of water flow over gill lamellae	Faster speed of water flows over gill lamellae
Four pairs of gills are involved	Five pairs of gills are involved

Award only Correct 04

Max 04

(c) How is Ventilation in man Controlled? (13 marks)

Ventilation is Controlled by the respiratory Centre in the medulla oblongata of the brain.

Has two regions that is to say the expiratory centre and inspiratory Centre.

The main stimulus that Controls ventilation is the concentration of Carbon dioxide in the blood.

When Carbon dioxide levels increases, chemoreceptors in the Carotid and aortic bodies of the blood systems are stimulated and they send impulses through afferent nerve to the inspiratory Centre.

The inspiratory Centre then sends out impulses via the external intercostal and phrenic nerves to the intercostal muscles and diaphragm Causing them to increase the rate at which they Contract. This increases the rate of inspiration; During inspiration, the lungs are inflated and expand; Causing stimulation of the stretch receptors in the bronchial tubes, Impulses are then sent to the expiratory Centre via vagus nerve, alerting the brain of the degree of expansion of lungs. This switches off the Inspiratory activity so that respiratory muscles relax, hence expiration follows passively.

max 13 marks

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BIOLOGY
(THEORY)

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

This paper consists of sections; **A** *and* **B**.

Answer question **one** *in section* **A** *plus* **three** *others from section* **B**.

Candidates are advised to read the questions carefully, organise their answers and present them precisely and logically, illustrating with well labelled diagrams where necessary.

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SECTION A (40 MARKS)

Question **1** *is* **compulsory**.

1. Figure 1 shows the effect of temperature variation on the rate of photosynthesis and respiration in leaves of the same plant. The plant was given adequate amounts of light with other factors kept constant.

Figure 2 shows the effect of temperature variation on the amount of carbon dioxide absorbed by two plant species; **A** and **B**. Plants **A** and **B** each uses a different carbon dioxide fixation pathway.
Study the **two** figures and answer the questions that follow.

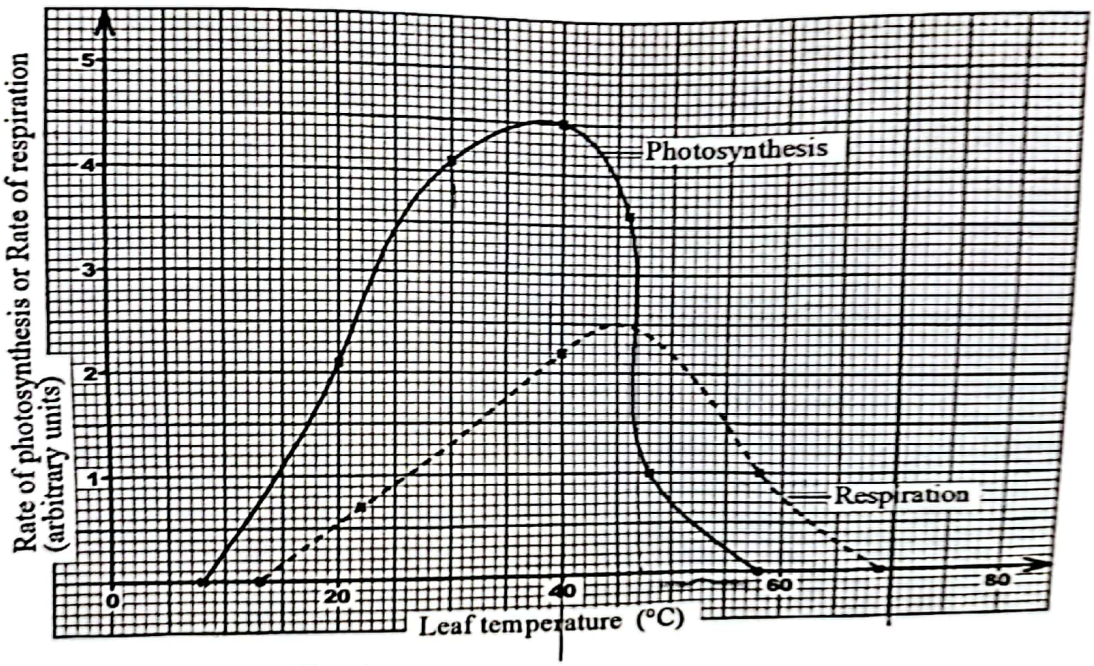

Fig. 1

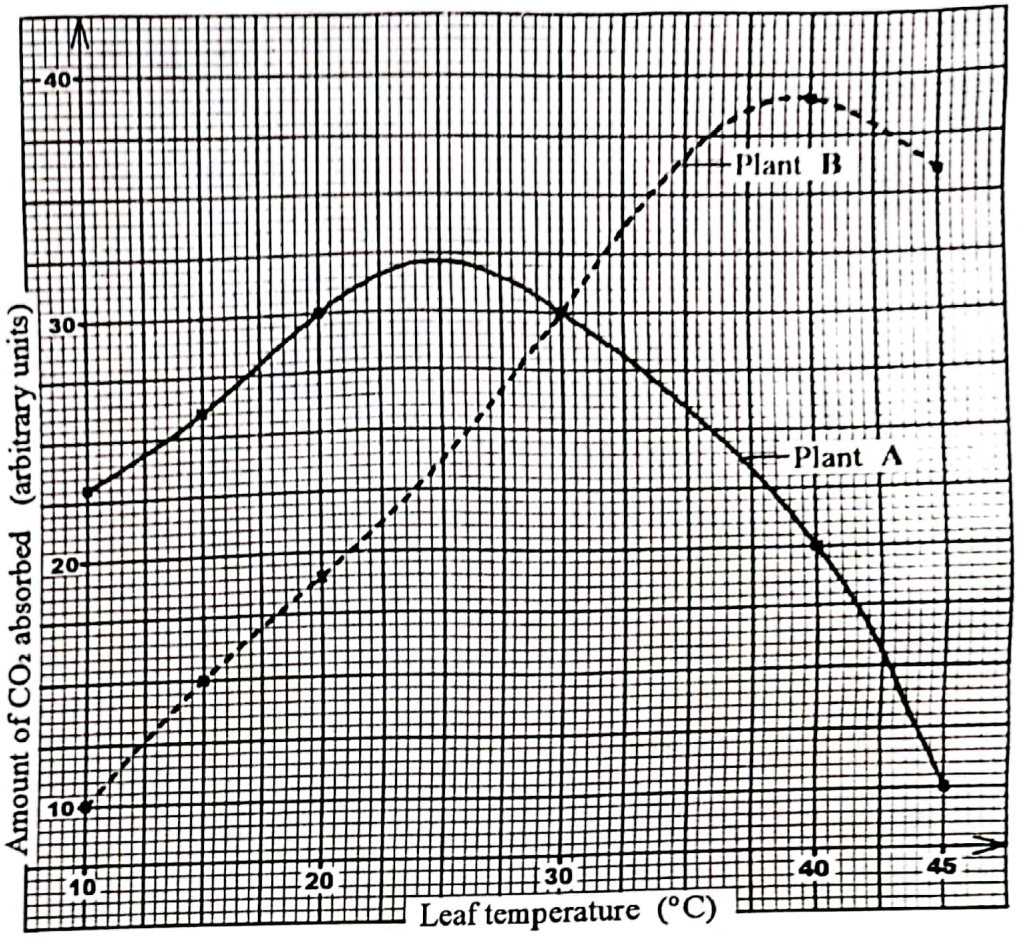

Fig. 2

(a) From figure 1:

(i) Describe how the rate of photosynthesis varies with temperature of the leaf. *(04 marks)*

(ii) Explain how the rate of respiration varies with temperature of the leaf. *(05 marks)*

(iii) Explain the difference in the rates of photosynthesis and respiration between leaf temperatures of 40 °C and 70 °C. *(08 marks)*

(iv) Explain the relationship between respiration and photosynthesis. *(04 marks)*

(b) Compare the amounts of carbon dioxide absorbed by each of the two plant species **A** and **B** in figure **2**. *(07 marks)*

(c) From figures **1** and **2**, suggest the plant species whose rate of photosynthesis was studied in figure **1**. *Give reason(s) for your answer.* *(04 marks)*

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(d) Explain any **two** other factors that can affect the rate of photosynthesis. *(04 marks)*

(e) Describe how carbon dioxide from the atmosphere is fixed in the bundle sheath cells. *(04 marks)*

SECTION B (60 MARKS)

Answer any **three** *questions from this section.*
Any additional question(s) answered will **not** *be marked.*

2. (a) Describe the ecological significance of each of the following forms of behaviour:
   (i) Territorial behaviour. *(06 marks)*
   (ii) Courtship behaviour. *(07 marks)*

   (b) Giving an example in each case, suggest ways by which animals avoid predation. *(07 marks)*

3. (a) Describe the structure of the mature vascular tissues in flowering plants. *(10 marks)*

   (b) Explain how the movement of water from the soil provides support in a herbaceous plant. *(10 marks)*

4. (a) How is the human placenta adapted for exchange of materials between the mother and the foetus? *(05 marks)*

   (b) The mammalian embryo develops inside the mother's womb before being born. Explain the importance of this type of embryo development. *(06 marks)*

   (c) Describe the different exchange mechanisms by which materials move between the foetus and the mother. *(09 marks)*

5. (a) Giving examples, describe the different functions performed by proteins in mammals. *(14 marks)*

   (b) Explain the factors that can cause protein denaturation. *(06 marks)*

6. (a) State **three** major distinguishing features of gaseous exchange in fish and terrestrial insects. *(03 marks)*

   (b) How is gaseous exchange in a bony fish different from that of a cartilaginous fish? *(04 marks)*

   (c) How is ventilation in man controlled? *(13 marks)*

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