

CHAPTER


2

Cellular Organization




2.1 Knowledge

Understanding Tissues, Organs, and Systems in Animals and Plants

[SLO: B-09-E-1]	Distinguish between tissues, organs and system with examples from animals and plants	29	
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2.2 Knowledge

The Leaf Structure: Tissues and Function

[SLO: B-09-E-4]	Discuss the different types of tissue come together to form the leaf	32	
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2.3 Knowledge

Plant Physiology: Structures and Roles of Various Plant Organs

[SLO: B-09-E-8]	Explain plant physiology in terms of structures and roles of various plant organs	35	
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2.4 Knowledge

Emergent Properties in Biology

[SLO: B-09-E-2]	Describe the concept of emergent properties as gain in functionalities and how it applies to the following going from sub-cellular organelles to cells - going from cells to tissues - going from tissues to organs - going from organs to systems - going from systems to living organisms	38	
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2.5 Knowledge

The Human Stomach: Tissues and Function

[SLO: B-09-E-3]	Enlist the different types of tissue come together to form the stomach organ in the human body	42	
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2.6 Knowledge

Major Organ Systems in the Human Body

[SLO: B-09-E-5]	Discuss the organ system come together to form the human body	45	
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2.7 Knowledge

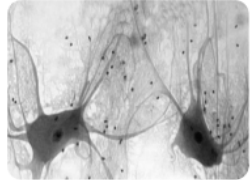
Homeostasis

[SLO: B-09-E-07]	Discuss the various organs and systems of the human body work to maintain homeostasis	50	
[SLO: B-09-E-06]	Describe the advantages of homeostasis	55	

Unit 2 Cellular Organization

Content Domain / Area	SLO No./ Description	Form Assessment	of Cognitive Level (Knowledge, Understanding, Application)
E	[SLO: B-09-E-1] Distinguish between tissues, organs and system with examples from animals and plants	Summative	Understanding

Multiple Choice Questions (MCQs)

- Which of the following tissues is responsible for photosynthesis in plants?
 - Vascular tissue
 - Ground tissue
 - Meristematic tissue
 - Epidermal tissue
- Which type of animal tissue transmits signals throughout the body?
 - Connective tissue
 - Epithelial tissue
 - Muscle tissue
 - Nervous tissue
- Which tissue in plants is responsible for growth and cell division?
 - Epidermal tissue
 - Meristematic tissue
 - Vascular tissue
 - Ground tissue
- Which organ system in humans is responsible for the transportation of oxygen and nutrients?
 - Digestive system
 - Circulatory system
 - Nervous system
 - Respiratory system
- What type of plant tissue provides protection from the external environment?
 - Epidermal tissue
 - Vascular tissue
 - Ground tissue
 - Meristematic tissue
- Which of the following is an example of an organ in plants?
 - Heart
 - Leaf
 - Kidney
 - Muscle
- Which animal tissue is involved in movement?
 - Nervous tissue
 - Connective tissue
 - Muscle tissue
 - Epithelial tissue
- Identify the type of tissue shown in the diagram.
 
 - Nervous tissue
 - Connective tissue
 - Muscle tissue
 - Epithelial tissue
- What is the primary function of connective tissue in animals?
 - Protection
 - Movement
 - Signal transmission
 - Support and binding
- Which type of tissue in plants ensures the transport of water and nutrients?
 - Ground tissue
 - Meristematic tissue
 - Epidermal tissue
 - Vascular tissue
- Which system in animals is responsible for the breakdown and absorption of nutrients?
 - Nervous system
 - Digestive system
 - Respiratory system

- D) Circulatory system
12. What is the role of epithelial tissue in animals?
 A) To form protective barriers

- B) To transport nutrients
 C) To transmit signals
 D) To enable movement

Short Response Questions (SRQs)

1. Explain the difference between epithelial tissue and connective tissue in animals.

(1.5 marks for each point)

Answer: Epithelial tissue forms protective barriers covering surfaces and lining cavities, while connective tissue supports, connects, and binds other tissues.

2. Describe the role of vascular tissue in plants and provide two examples of its function.

(2 marks for role)

(0.5 mark for each example)

Answer: Vascular tissue is responsible for transporting water, nutrients, and minerals throughout the plant. Example 1: Xylem transports water from roots to leaves. Example 2: Phloem transports food produced in leaves to other parts of the plant.

3. What are the main differences between an organ and an organ system? Provide examples for both.

(2 marks for definitions)

(1 mark for examples)

Answer: An organ is a group of tissues that perform a specific function, such as the heart in animals or the leaf in plants. An organ system is a group of organs that work together to perform related functions. For example, the digestive system in humans.

4. Complete the following table by filling in the missing blanks for each tissue type.

(1 mark each for three points; total 3 marks)

Type of Tissue	Function
Epithelial Tissue	
	Supports and binds tissues
Nervous Tissue	

5. Compare and contrast meristematic tissue and ground tissue in plants.

(1.5 marks each for comparison and contrast; Total 3 marks)

Answer: Meristematic tissue is responsible for plant growth and cell division, while ground tissue is involved in photosynthesis and storage. Both are essential for plant function, but they have distinct roles.

6. Explain how tissues form organs in animals, using the example of the lung.

(2 marks for explanation)

(1 mark for example)

Answer: Different tissues, such as epithelial, connective, muscle, and nervous tissues, come together to form an organ like the lung. The lung functions in gas exchange, facilitated by the different tissues working together.

7. How does the plant vascular tissue contribute to the survival of the plant? Provide an example.

(2 marks for function)

(1 mark for example)

Answer: Vascular tissue transports water and nutrients essential for growth and survival. For example, xylem moves water from roots to leaves, which is necessary for photosynthesis.

8. Differentiate between the tissues found in plants and animals with examples.

(1 mark each for three points; total 3 marks)

Answer: Plant tissues include meristematic, ground, epidermal, and vascular tissues, whereas animal tissues consist of epithelial, connective, muscle, and nervous tissues. Example: Ground tissue in plants aids photosynthesis; epithelial tissue in animals provides protection.

9. Why are meristematic tissues important for plant growth? Describe their characteristics.

(2 marks for importance)	(1 mark for characteristics)
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Answer: Meristematic tissues are essential for plant growth as they have a high capacity for cell division, enabling the plant to grow and form new tissues. They are small, cuboidal in shape, and have large nuclei.

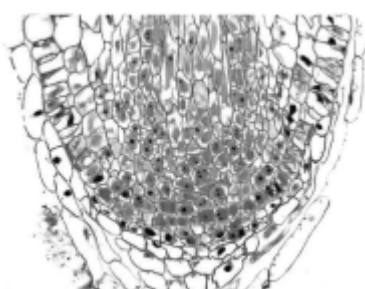
10. Explain the role of the digestive system in humans. How does it differ from the plant organ systems?

(2 marks for the human digestive system role)	(1 mark for the difference from plant systems)
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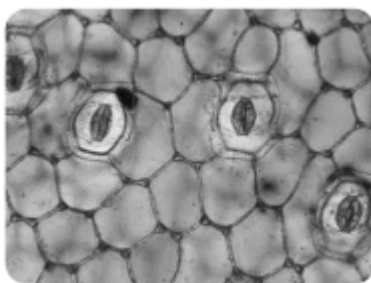
Answer: The digestive system breaks down food and absorbs nutrients essential for survival. Unlike plants, which lack organ systems, human organ systems perform specialized functions that plants achieve through individual organs.

11. Observe the diagrams and answer the following questions

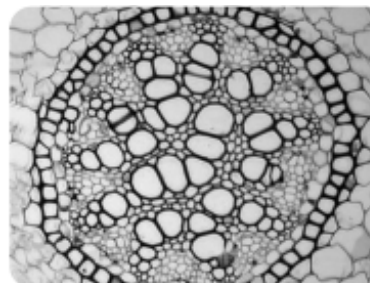
- i) Identify the types of tissue labelled as a, b, and c.
- ii) List the role of each tissue in plants.



a



b



c

1.5 marks for part i)	1.5 marks for part ii)
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Answer

- a) Meristematic tissue b) Epidermal tissue c) Vascular tissue

ii)

Meristematic tissue: Responsible for growth

Epidermal tissue: Offers protection from the external environment

Vascular tissue: Ensure the transport of water and nutrients

Multiple Choice Questions (MCQs)

1.	B	7.	C
2.	D	8.	A
3.	B	9.	D
4.	B	10.	D
5.	A	11.	B
6.	B	12.	A

SRQs

Type of Tissue	Function
Epithelial Tissue	Forms protective barriers
Connective Tissue	Supports and binds tissues
Nervous Tissue	Transmits signals throughout the body

Content Domain / Area	SLO No./ Description	Form of Assessment	Cognitive Level (Knowledge, Understanding, Application)
E	[SLO: B-09-E-4] Discuss the different types of tissue come together to form the leaf	Summative	Understanding

Multiple Choice Questions (MCQs):

1. Which tissue in the leaf acts as a protective barrier between the plant and its environment?

- A) Mesophyll Tissue
- B) Vascular Tissue
- C) Epidermal Tissue
- D) Ground Tissue

2. What is the primary role of guard cells in the leaf?

- A) To transport water and minerals
- B) To facilitate photosynthesis
- C) To regulate the opening and closing of stomata
- D) To provide structural support

3. Which part of the leaf contains the xylem and phloem?

- A) Palisade Mesophyll
- B) Epidermis
- C) Spongy Mesophyll
- D) Vascular Tissue

4. Which tissue is responsible for most of the leaf's photosynthesis?

- A) Epidermal Tissue
- B) Palisade Mesophyll
- C) Spongy Mesophyll
- D) Vascular Tissue

5. What is the main function of spongy mesophyll cells in the leaf?

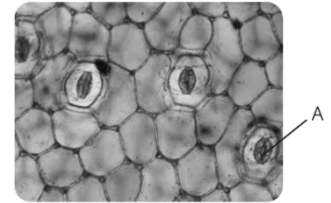
- A) Storing nutrients
- B) Facilitating gaseous exchange
- C) Providing mechanical support
- D) Absorbing water

6. Which structure in the leaf helps prevent water loss?

- A) Cuticle
- B) Chloroplast
- C) Stomata
- D) Guard Cells

7. Identify the structure labelled as 'A' in the epidermal tissues of the leaf.

- A) Hydathodes
- B) Chloroplast
- C) Stomata
- D) Chlorophylls



8. How do vascular tissues contribute to leaf function?

- A) By supporting the leaf structure
- B) By facilitating photosynthesis
- C) By transporting water, minerals, and food
- D) By protecting the leaf from UV light

9. What role do bundle sheath cells play in a leaf?

- A) Photosynthesis
- B) Structural support and protection of vascular bundles
- C) Storing water
- D) Absorbing sunlight

10. What are leaf hairs (trichomes) primarily responsible for?

- A) Preventing water loss
- B) Facilitating photosynthesis
- C) Absorbing sunlight
- D) Protecting against UV light and herbivore attacks

11. Which tissue layer is transparent and allows light to pass through to the photosynthetic cells below it?

- A) Palisade Mesophyll
- B) Spongy Mesophyll
- C) Epidermis
- D) Vascular Tissue

12. Which part of the leaf is primarily involved in transporting the sugars produced during photosynthesis?

- A) Xylem
- B) Phloem
- C) Guard Cells
- D) Cuticle

Short Response Questions (SRQs):

1. Explain the function of the epidermal tissue in leaves.

(3 marks: 1 mark for protection, 1 mark for transparency, 1 mark for water loss prevention)

Answer: The epidermal tissue forms the outer layer of the leaf, acting as a protective barrier between the plant and its environment. It is transparent, allowing light to pass through for photosynthesis. It is covered by a cuticle that helps prevent water loss.

2. Describe the role of palisade mesophyll and spongy mesophyll in a leaf.

(1.5 marks for palisade mesophyll)

(1.5 marks for spongy mesophyll)

Answer: The palisade mesophyll contains tightly packed cells rich in chloroplasts. It is responsible for most of the leaf's photosynthesis. The spongy mesophyll has loosely arranged cells with air spaces to facilitate gaseous exchange and also contributes to photosynthesis.

3. What is the significance of vascular tissues in leaves?

(1.5 marks for xylem)

(1.5 marks for phloem)

Answer: Vascular tissues, such as xylem and phloem, transport water, minerals, and nutrients throughout the leaf. The xylem carries water and minerals from the roots, while the phloem distributes sugars produced during photosynthesis to different parts of the plant.

4. How do guard cells and stomata contribute to the function of the leaf?

(1.5 marks for guard cells)

(1.5 marks for stomata)

Answer: Guard cells control the opening and closing of stomata, regulating gas exchange and water loss. Stomata allow the entry of carbon dioxide necessary for photosynthesis and release oxygen and water vapour.

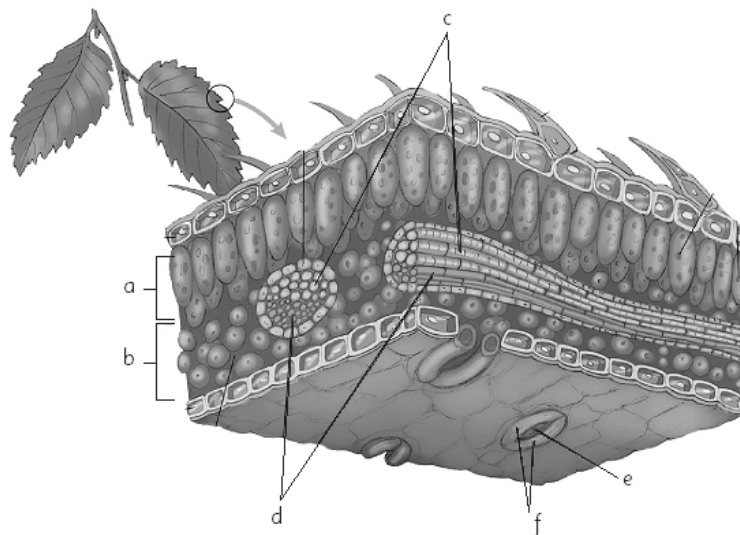
5. Discuss the role of the cuticle and leaf hairs in protecting the leaf.

(1.5 marks for cuticle)

(1.5 marks for leaf hairs)

Answer: The cuticle is a waxy layer that covers the epidermis and prevents water loss through evaporation. Leaf hairs (trichomes) protect the leaf from excessive transpiration, UV light, and herbivore attacks.

6. Identify the structures labelled as a,b,c,d, e and f in the cross-sectional view of the leaf.



0.5 marks for each identification

Answer

- a) Palisade mesophyll
- b) Spongy mesophyll
- c) Xylem

- d) Phloem
- e) Stoma
- f) Guard cells

Extended Response Question (ERQ):

1. Explain how different types of tissues in a leaf work together to enable its functions. Provide specific examples of how these tissues contribute to processes such as photosynthesis, gas exchange, and protection.

(3 marks for explaining tissue roles)	(2 marks for examples)
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Answer:

A leaf is commonly known as a green, flat part of a plant, but it is actually a complex structure composed of various tissues. It serves several essential functions, such as photosynthesis, gaseous exchange, and transpiration. The main types of tissues that make up a leaf are:

1. Epidermal Tissue: The epidermal tissue forms the outer layer of the leaf and acts as a protective barrier between the plant and its environment. This layer is covered by a waxy substance called the cuticle, which helps prevent water loss through evaporation. Within the epidermis are bean-shaped cells known as guard cells, which surround and regulate tiny openings called stomata. These stomata control gas exchange (intake of carbon dioxide, the release of oxygen, and water vapour), which is crucial for photosynthesis and transpiration.

2. Mesophyll Tissue: Located beneath the epidermis, mesophyll tissue is divided into palisade and spongy mesophyll. Palisade mesophyll has tightly packed cells rich in chloroplasts. It is responsible for most of the leaf's photosynthesis. Spongy mesophyll, contains loosely arranged cells and air spaces. These air spaces facilitates efficient gas exchange for photosynthesis and respiration.

3. Vascular Tissue: Vascular tissue, comprising xylem and phloem, ensures efficient transport within the leaf. The xylem delivers water and minerals from the roots to leaf cells, which is essential for photosynthesis. The Phloem distributes sugars produced during photosynthesis to other parts of the plant.

Coordination and Integration of Tissues: Together, these tissues enable the leaf to perform multiple functions simultaneously, ensuring the plant's overall health and growth.

Examples:

The epidermis is thin and transparent. This allows light to pass through to the photosynthetic cells (palisade mesophyll cells) present beneath, where most of the photosynthesis occurs.

Guard cells control the opening of stomata. These stomata enable carbon dioxide uptake while preventing excessive water loss, especially in arid conditions.

Vascular tissues, including the xylem and phloem, work together to transport essential resources. The xylem brings water from the roots to the mesophyll cells. The phloem distributes the sugars produced during photosynthesis to other parts of the plant for storage or growth.

ANSWERS

Multiple Choice Questions (MCQs)

1.	C	7.	C
2.	C	8.	C
3.	D	9.	B
4.	B	10.	D
5.	B	11.	C
6.	A	12.	B

SLO No./ Description	Form of Assessment	Cognitive (Knowledge, Understanding, Application)	Level
E	[SLO: B-09-E-08] Explain plant physiology in terms of structures and roles of various plant organs	Summative	Understanding

Multiple Choice Questions (MCQs)

1. Which type of root has a single dominant root with smaller lateral roots?

- A) Fibrous root
- B) Taproot
- C) Adventitious root
- D) Aerial root

2. What is the primary role of leaves in plants?

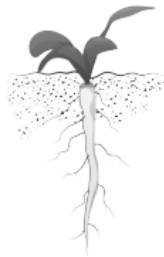
- A) Reproduction
- B) Photosynthesis
- C) Nutrient storage
- D) Water absorption

3. Which plant organ primarily supports the plant by transporting water, nutrients, and food throughout the plant?

- A) Roots
- B) Flowers
- C) Stems
- D) Leaves

4. Identify the type of roots shown in the diagram.

- A) Fibrous root
- B) Taproot
- C) Adventitious root
- D) Aerial root



5. Which part of a flower produces pollen grains?

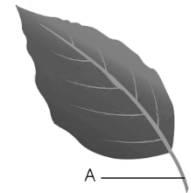
- A) Sepals
- B) Petals
- C) Stamens
- D) Carpels

6. How do vascular tissues in the stem contribute to the plant?

- A) By absorbing water and minerals
- B) By providing rigidity and strength
- C) By storing food
- D) By attracting pollinators

7. Identify the part labelled as 'A' in the diagram.

- A) Midrib
- B) Margin
- C) Vein
- D) Petiole



8. What is the function of guard cells in leaves?

- A) To transport water
- B) To regulate gas exchange
- C) To store nutrients
- D) To produce pollen

9. Which part of the flower is responsible for producing female gametes?

- A) Sepals
- B) Petals
- C) Stamens
- D) Carpels

10. What is the function of xylem in vascular tissues?

- A) Transporting food
- B) Conducting water and minerals
- C) Supporting flowers
- D) Providing protection

11. Which type of root system enhances nutrient absorption due to its wide network?

- A) Fibrous root
- B) Taproot
- C) Prop root
- D) Buttress root

12. Which structure of the plant provides protection and helps disperse seeds?

- A) Stems
- B) Leaves
- C) Roots
- D) Fruits

13. What is the role of the petiole in leaves?

- A) Connecting the leaf to the stem
- B) Producing pollen grains

- C) Absorbing water
- D) Storing food

- A) Absorb nutrients
- B) Prevent water loss
- C) Store food
- D) Transport minerals

14. Which of the following is a function of the cuticle on the epidermal tissue of leaves?

Short Response Questions (SRQs)

1. Describe the two main types of root in plants and their respective functions.

(1.5 marks for each type; total 3 marks)

Answer:

Taproots have a single dominant root with smaller lateral roots. It provides deep anchorage to the plant and stores food.

Fibrous roots consist of a network of roots all about the same size. It enhances surface area for better absorption of water and nutrients.

2. Explain the importance of leaves in a plant's survival and their main functions.

(3 marks for the importance of leaves)

Answer:

Leaves are vital for photosynthesis, converting sunlight into food.

They facilitate gas exchange by taking in carbon dioxide and releasing oxygen through stomata.

Leaves manage water loss through transpiration.

3. Discuss the role of the stem in plant physiology. How does its structure support the plant?

(2 marks for the role of the stem)

(1 mark for its support to plant)

The stem plays an important role in plant physiology by acting as the plant's backbone. It supports the leaves, flowers, and fruits. The stem also helps in transporting water, nutrients, and food throughout the plant.

Inside the stem, there are two main vascular tissues: the xylem, which transports water, and the phloem, which transports food. Some stems, like tubers (potatoes) and bulbs (onions), store nutrients and water. This helps the plant survive during adverse conditions.

4. What is the function of the flower in plant reproduction, and what are its key parts?

(1 mark for the function of flower)

(2 marks for its key parts)

Flowers facilitate reproduction by producing male and female gametes. The male reproductive part of the flower is the stamen, which produces pollen. The female reproductive part is the carpel, which contains the ovary for embryo development. Petals attract pollinators, while sepals protect the developing bud.

5. How do guard cells function in leaves to help manage plant health?

(3 marks for the functions)

Guard cells control the opening and closing of stomata, regulating gas exchange and minimizing water loss. This process ensures that the plant retains the necessary moisture while obtaining carbon dioxide for photosynthesis.

6. Explain the role of xylem and phloem in the transport system of plants.

(1.5 marks for the role of xylem)

(1.5 marks for role of phloem)

The xylem conducts water and minerals from roots to leaves. Phloem distributes sugars produced during photosynthesis throughout the plant. Together, they maintain the plant's water and nutrient balance, ensuring growth and health.

7. Describe how the structure of vascular tissues contributes to the mechanical support of the plant.

(2 marks for the role of xylem)

(1 mark for the role of phloem)

Xylem, with its thick walls, provides rigidity and strength to withstand environmental stresses.

Phloem assists in nutrient transport, supporting the plant's overall stability.

8. How do roots assist in the overall growth and stability of a plant?

(1 mark for each point)

Roots anchor the plant in the soil and absorb water and nutrients. They also store food, ensuring stability and continuous growth. This enables the plant to survive in various environments.

9. Describe the main parts of a flower and their roles in plant reproduction.

Answer:

(1 mark for naming parts of flower)	(0.5 mark for the role of each part)
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1. **Parts:** Sepals, petals, stamens, and carpels.

2. **Roles:**

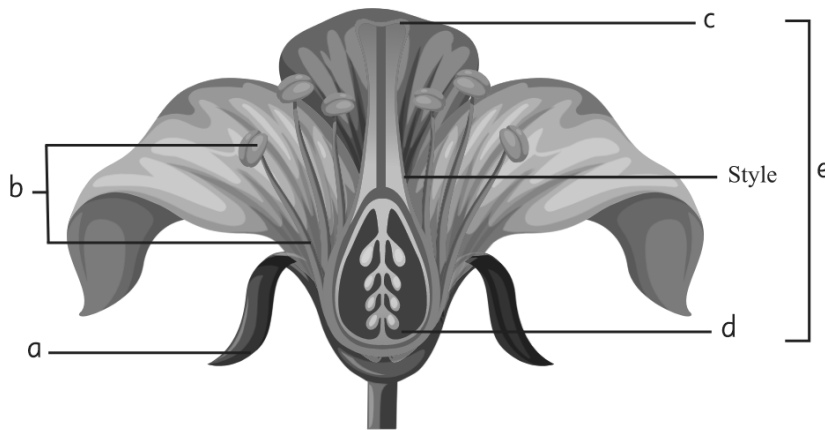
Sepals: Protect the flower bud before it opens.

Petals: Attract pollinators with their bright colours and scent.

Stamens: Male reproductive part that produces pollen (male gametophyte).

Carpels: Female reproductive part that contains the ovary, style, and stigma and is responsible for the production of embryo sacs (female gametophyte).

10. Below are parts of a flower labelled as a, b, c, d, e, and f in the diagram. For each part, the function is provided; identify the labelled part responsible for that function and write its name.



Function	Part Responsible for Function (a, b, c, d, e, f)	Identification (Name of Part)
Produces pollen grains (male reproductive structure)		
Protects the flower bud before it opens		
Produces embryo sacs (female reproductive structure)		

0.5 marks for identifying each part = Total 1.5 marks	0.5 marks for naming each part = Total 1.5 marks
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Answer

Function	Part Responsible for Function (a, b, c, d, e, f)	Identification (Name of Part)
Produces pollen grains (male reproductive structure)	b	Stamen
Protects the flower bud before it opens	a	Sepals
Produces embryo sacs (female reproductive structure)	e	Carpels

Extended Response Question (ERQ)

1. Discuss how different plant organs—roots, stems, leaves, and flowers—contribute to the plant's growth, survival, and reproduction. (5)

(5 marks for explaining roles)

Content Domain / Area	SLO No./ Description	Form of Assessment	Cognitive Level (Knowledge, Understanding, Application)
E	[SLO: B-09-E-2] Describe the concept of emergent properties as gain in functionalities and how it applies to the following going from sub-cellular organelles to cells - going from cells to tissues - going from tissues to organs - going from organs to systems - going from systems to living organisms	Summative	Application

Answer:

Roots play a vital role in a plant's stability and nourishment. They anchor the plant firmly in the soil. Roots also absorb water and dissolved minerals from the soil, which are essential for the plant's growth. In certain plants, such as carrots and radishes, roots also serve as storage organs for carbohydrates, which help plant survive during unfavourable conditions.

Stems act as the plant's backbone, providing support to leaves, flowers, and fruits. Stems contain vascular tissues, xylem and phloem, that transport water, nutrients, and food throughout the plant. For example, the xylem moves water and minerals absorbed by the roots up to the leaves. Similarly, the phloem distributes the sugars produced by photosynthesis to other parts of the plant. Additionally, some stems, like those in potatoes and onions, serve as storage organs, ensuring the plant's survival during adverse conditions.

Leaves are the primary sites for photosynthesis, a process that converts sunlight into chemical energy in the form of glucose. The broad, flat surface of the leaves maximizes sunlight absorption. The stomata (tiny openings on the leaf surface) regulate gas exchange, allowing carbon dioxide to enter for photosynthesis and oxygen to exit as a by-product. Furthermore, the leaves facilitate transpiration, the process of water vapor loss, which helps in cooling the plant. Transpiration also helps in maintaining the flow of water and minerals from the roots to the leaves.

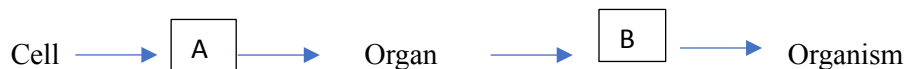
Flowers are the reproductive organs of plants. The typical structure of a flower consists of four main parts: sepals, petals, stamens, and carpel. **Sepals** form the outermost layer, usually green in colour, and protect the flower buds. While **petals** are usually brightly coloured and fragrant, attracting pollinators to the flower. **Stamens** are the male reproductive structures of the flower. Each stamen consists of a filament and an anther and is responsible for producing pollen grains (male gametophyte). The **carpel** is the female reproductive structure consisting of the stigma, style and ovary and is responsible for the production of embryo sacs (female gametophyte). Flowers are significant as they attract pollinators to assist pollen transfer and are essential in producing seeds and fruits. Fruits develop from flowers and contain seeds. They protect and help disperse seeds, which carry the potential to grow into new plants. .

Answer

Multiple Choice Questions (MCQs)			
1.	B	8.	B
2.	B	9.	D
3.	C	10.	B
4.	B	11.	A
5.	C	12.	D
6.	B	13.	A
7.	D	14.	B

Multiple Choice Questions (MCQs)

- Which of the following best illustrates the concept of emergent properties at the cellular level?**
 - A single ribosome synthesizing proteins
 - Mitochondria producing ATP within a single cell
 - Muscle cells contracting together to perform peristalsis in the esophagus
 - A nerve impulse travelling through a single neuron
- How do emergent properties manifest when tissues form organs, such as in the stomach?**
 - Tissues work independently to perform isolated functions.
 - Tissues combine their functions, like epithelial and muscular tissues working together for digestion.
 - Organs function the same regardless of tissue composition.
 - Different tissues are only structural and do not interact functionally.
- Why is the digestive system considered an example of emergent properties at the system level?**
 - It breaks down food independently without any other organ's help.
 - It relies on the coordinated actions of multiple organs like the stomach and intestines to perform complete digestion.
 - It functions in isolation from other systems in the body.
 - It has a single purpose and does not interact with other bodily systems.
- The following sequence shows different levels of biological organization:**



- Which of the following correctly fills in the missing levels?**
 - A: Tissue, B: Organ System
 - A: Organ System, B: Tissue
 - A: Organ System, B: Molecule
 - A: Molecule, B: Tissue
- Which example best shows how organ systems exhibit emergent properties at the organism level?**
 - The digestive and immune systems working together to protect against pathogens in food
 - The circulatory system pumping blood only to the brain
 - The respiratory system functioning without any support from other systems
 - The nervous system sending signals only to the limbs
- How does the concept of emergent properties help in understanding the coordinated functioning of the digestive system?**
 - It shows that all digestive organs can function independently without coordination.
 - It reveals that only the stomach plays a significant role in digestion.
 - It illustrates that digestive organs collectively achieve efficient digestion and nutrient absorption.
 - It confirms that emergent properties are irrelevant to the digestive system.
- Why is the collaboration between different organ systems essential at the organism level?**
 - It allows for isolated functioning of each system without external influence.
 - It enhances the overall functionality and survival of the organism.
 - It ensures that no system is dependent on another for its functions.
 - It reduces the complexity of biological processes.
- What happens when cells form tissues regarding emergent properties?**
 - Each cell loses its individual function.
 - Tissues acquire new functionalities that individual cells cannot achieve alone.
 - The cells stop working together.
 - Tissues become less complex than individual cells.
- How does the coordination among different organelles within a cell demonstrate emergent properties?**

- A) It shows that organelles can function without interaction.
- B) It leads to the failure of the cell to maintain homeostasis.
- C) It prevents the cell from performing any metabolic activities.
- D) It enables the cell to perform complex tasks like muscle contraction.

Short Response Questions (SRQs)

1. How do sub-cellular organelles demonstrate emergent properties in muscle cells? Provide an example.

(2 marks for explaining functions of organelles)	(1 mark for linking to emergent properties)
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Answer: Sub-cellular organelles like mitochondria provide ATP, ribosomes synthesize proteins, and the endoplasmic reticulum regulates calcium. Together, they enable muscle cells to contract efficiently, an emergent property not achievable by any organelle alone.

2. Explain the significance of emergent properties in biological systems by comparing the roles of a single organelle and a whole cell.

(2 marks for explaining roles)	(1 mark for linking to emergent properties)
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Answer: A single organelle, like a mitochondrion, produces energy, but it cannot sustain life on its own. A whole cell, with multiple organelles, can perform all necessary functions for survival, such as metabolism, protein synthesis, and replication, demonstrating emergent properties. For instance, in muscle cells, mitochondria, ribosomes, and other organelles work together to enable contraction, an ability beyond an individual organelle.

Analyze the role of different tissues in enabling the stomach to function as an organ in digestion.

(2 marks for analyzing tissue roles)	(1 mark for linking to emergent properties)
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The epithelial tissue secretes digestive enzymes, while the muscular tissue enables the mixing and movement of food. Together, they create the emergent property of digestion. The combined actions allow the stomach to break down food into absorbable forms, a function that neither tissue could achieve alone.

3. Evaluate the importance of emergent properties in biological systems by comparing the functions of a single cell to that of a tissue.

(1.5 marks for explaining single-cell functions)	(1.5 marks for evaluating emergent properties in tissues)
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A single cell can perform basic functions like metabolism and replication. However, tissues, made up of multiple cells working together, can perform more complex tasks. Examples include coordinated muscle contraction or nutrient absorption. This illustrates that emergent properties at the tissue level provide greater functional advantages, demonstrating the importance of biological organization.

4. Evaluate the role of the digestive system in showcasing emergent properties at the system level.

(1.5 marks for evaluation)	(1.5 marks for example)
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Answer: The digestive system demonstrates emergent properties by combining organs like the stomach and intestines to perform complex digestion, which is beyond the capability of a single organ. For example, the stomach breaks down proteins while the intestines absorb nutrients. This coordinated function ensures that food is efficiently digested and nutrients are absorbed, showcasing how emergent properties enhance survival.

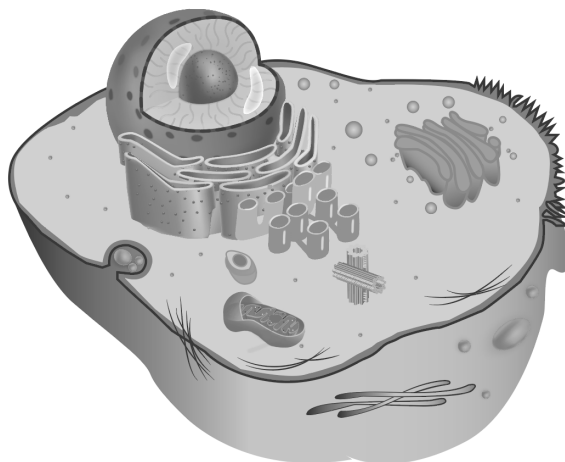
5. How does the interaction between different organ systems in the human body illustrate the concept of emergent properties? Provide a specific example.

(2 marks for explaining the interaction)	(1 mark for the specific example)
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Answer: Different organ systems, such as the digestive, circulatory, and immune systems, work together to maintain health and functionality. For example, the immune system protects against pathogens ingested

with food, while the digestive system processes and absorbs nutrients, showing how their collaboration supports overall well-being, an emergent property not achievable by any single system.

6. Observe the diagram of the animal cell.



- i. Identify the organelles whose collaborative actions enable a muscle cell to contract.
- ii. How does each organelle contribute to this process?

1.5 marks for identification of organelles	1.5 marks for highlighting their contributions
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Answer

- The organelles mitochondria, endoplasmic reticulum and ribosomes labelled as 3, 5, and 7 are responsible for muscle cells to contract.
- Mitochondria, essential for energy production, provide the necessary power for this process. Ribosomes are tasked with creating specific proteins that are crucial for contraction. Moreover, the endoplasmic reticulum plays a primary role in managing calcium storage and release, a critical element required to contract muscle fibers.

Extended Response Question (ERQ)

7. Discuss the concept of emergent properties in biological systems and how they are exemplified at different levels of organization, from sub-cellular organelles to whole organisms. Provide examples to illustrate how these properties contribute to the overall functionality and survival of living organisms.

(5 marks total; 3 marks for explaining emergent properties at different levels)	(2 marks for examples)
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Emergent properties in biology refer to new functions and capabilities that arise when simpler units combine to form more complex structures.

At the **sub-cellular level**, organelles like mitochondria, ribosomes, and the endoplasmic reticulum work together to enable muscle cells to contract. This is a function that is not possible for any single organelle alone. At the **cellular level**, groups of cells form **tissues** that perform specialized tasks. For example, epithelial and muscular tissues collaborate in the stomach to digest food, demonstrating emergent properties at the tissue level.

When tissues combine to form **organs** like the stomach or heart, they enable the organ to perform complex functions, such as digestion or pumping blood. At the **organ system level**, multiple organs work in coordination. For instance, the digestive and circulatory systems work together to digest, absorb, and distribute nutrients, showing emergent properties that support the organism's survival.

At the **whole organism level**, these emergent properties become even more evident. Different systems work together to maintain homeostasis, adapt to environmental changes, and ensure reproduction. For example, the nervous system controls and integrates the activities of all other systems, illustrating how emergent properties enable an organism to function as a unified whole, more capable than the sum of its parts.

ANSWERS

Multiple Choice Questions (MCQs)			
1.	C	6.	C
2.	B	7.	B
3.	B	8.	B
4.	A	9.	D
5.	A		

Content Domain / Area	SLO No./ Description	Form of Assessment	Cognitive Level (Knowledge, Understanding, Application)
E	[SLO: B-09-E-3] Enlist the different types of tissue come together to form the stomach organ in the human body	Summative	Understanding

Multiple Choice Questions (MCQs)

- | | |
|---|--|
| <p>1. Which type of tissue in the stomach secretes gastric juice essential for protein breakdown?</p> <p>A) Muscular tissue
B) Nervous tissue
C) Epithelial tissue
D) Connective tissue</p> <p>2. What is the primary function of connective tissue in the stomach?</p> <p>A) Secreting digestive enzymes
B) Sending signals for muscle contraction
C) Providing structural support and connecting layers
D) Facilitating the movement of food</p> <p>3. Which type of tissue in the stomach is involved in controlling the digestive processes by sending signals for muscle contraction?</p> <p>A) Epithelial tissue
B) Nervous tissue
C) Muscular tissue
D) Connective tissue</p> <p>4. Which tissue in the stomach allows it to mix food with gastric juice and break it down into a semi-liquid form?</p> <p>A) Epithelial tissue
B) Connective tissue
C) Nervous tissue
D) Muscular tissue</p> <p>5. What role does the mucous in the epithelial tissue play in the stomach?</p> | <p>A) Absorbs nutrients
B) Protects the stomach lining from acid
C) Facilitates muscle contractions
D) Regulates secretion of digestive enzymes</p> <p>6. How does the nervous tissue in the stomach contribute to digestion?</p> <p>A) By secreting gastric juice
B) By contracting and relaxing muscles
C) By sending signals to regulate digestion
D) By providing structural support</p> <p>7. Which tissue is primarily responsible for creating the acidic environment in the stomach necessary for digestion?</p> <p>A) Connective tissue
B) Muscular tissue
C) Epithelial tissue
D) Nervous tissue</p> <p>8. What is the function of the circular muscles found in the muscular tissue of the stomach?</p> <p>A) To connect stomach layers
B) To facilitate food mixing
C) To regulate enzyme secretion
D) To protect the stomach lining</p> <p>9. In which layer of the stomach is nervous tissue primarily concentrated?</p> <p>A) Outer layer
B) Submucosa and muscular layer
C) Epithelial layer
D) Connective layer</p> |
|---|--|

Short Response Questions (SRQs)

1. Describe how the epithelial tissue in the stomach assists in both protection and chemical digestion.

(3 marks: 1.5 marks for explaining protection)

(1.5 marks for chemical digestion support)

Answer: The epithelial tissue lines the innermost layer (mucosa) of the stomach wall. It is responsible for secreting gastric juice, which includes hydrochloric acid (HCl) and digestive enzymes like pepsin. HCl creates an acidic environment necessary for activating pepsin, which breaks down proteins. The epithelial tissue also secretes mucus, which protects the stomach lining from acid and digestive enzymes. This helps in both protection and chemical digestion.

2. Describe how muscular tissue in the stomach contributes to the digestive process. Include the roles of different muscle orientations.

(3 marks: 2 marks for explaining muscle function)

(1 mark for describing the roles of different muscle orientations)

The muscular tissue in the stomach, composed of longitudinal and circular muscles, continuously contracts and relaxes. This action helps mix food with gastric juices, breaking it down into a semi-liquid form. **Longitudinal muscles** shorten the length of the stomach, while **circular muscles** constrict or narrow the stomach. Together, these muscles ensure thorough mixing and the mechanical breakdown of food.

3. What is the function of nervous tissue in the stomach? Provide an example of its role in digestion.

(3 marks: 2 marks for describing the control function)

(1 mark for providing an example)

Nervous tissue in the stomach controls the digestive processes of the stomach. It sends signals to the stomach muscles, prompting them to contract for digestion, and regulates the secretion of gastric juices. For example, it sends signals to produce more gastric juice when food enters the stomach.

4. List any three types of tissue found in the stomach and briefly describe their functions.

(3 marks: 0.5 marks for each tissue function.)

Answer:

Epithelial Tissue: Secretes gastric juice and protects the lining of the stomach.

Connective Tissue: Provides structural support and connects layers of the stomach wall.

Muscular Tissue: Enables the mixing of food with digestive juice through contractions.

Nervous Tissue: Sends signals for muscle contractions and regulates gastric juice secretion.

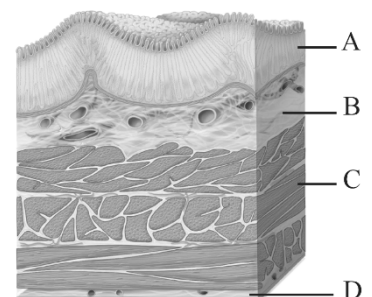
5. How does the connective tissue contribute to the overall function of the stomach, and what protective role does it play?

(3 marks: 2 marks for describing the function)

(1 mark for explaining the protective role)

Answer: Connective tissue is found in the submucosa and the outermost protective layer of the stomach wall. In the submucosa, it provides structural support and connects the layers of the stomach wall. It houses blood vessels and nerves essential for nutrient supply and signal transmission. In the outer layer, it forms a protective barrier against mechanical stress, friction, and damage.

6. Observe the diagram of the stomach showing different layers and answer the following questions.



- a) Identify the muscular layer in the diagram. What is its function in the digestive process?
 b) Identify the submucosa in the diagram. What important structures are found in this layer?

1.5 marks for part a)	1.5 marks for part b)
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a) The **muscular layer** is labelled as 'C' in the diagram below the submucosa.

Function: The muscles in this layer are arranged in different directions, including the outer **longitudinal muscles** and inner **circular muscles**. These muscles continuously contract and relax, allowing the stomach to mix food with gastric juices and break it down into a semi-liquid form.

b) **The submucosa** is labelled as 'B' in the diagram.

Important structures: The submucosa contains blood vessels, nerves, and connective tissue.

Extended Response Question (ERQ)

7. Explain how the different types of tissues in the stomach work together to enable it to perform its digestive functions. Provide examples of how these tissues contribute to both mechanical and chemical digestion.

(5 marks: 3 marks for explaining the roles of each tissue)	(2 marks for providing examples of their functions)
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Answer:

The stomach's function in digestion relies on the coordinated work of four primary tissues: epithelial, connective, muscular, and nervous tissues.

Epithelial tissue forms the innermost lining (mucosa) of the stomach. It secretes gastric juices, including hydrochloric acid (HCl) and digestive enzymes like pepsin, which are crucial for breaking down proteins into smaller peptides. It also secretes mucus to protect the stomach lining from the corrosive effects of the acid.

Connective tissue provides structural support to the stomach and maintains its shape. It houses blood vessels and nerves that supply the stomach with nutrients and signal transmission. It also connects different layers of the stomach wall and forms a protective barrier to prevent damage from mechanical stress or friction.

Muscular tissue enables the mechanical (physical) digestion of food by contracting and relaxing in different directions with the help of longitudinal and circular muscles. It also helps in chemical digestion by effectively mixing the food with gastric juice and breaking it down into a semi-liquid form called **chyme**. This action facilitates further digestion and nutrient absorption in the intestines.

Nervous tissue in the stomach controls the digestive processes of the stomach. It sends signals to the stomach muscles, prompting them to contract for digestion, and regulates the secretion of gastric juices. For example, it sends signals to produce more gastric juice when food enters the stomach. Together, these tissues ensure both mechanical and chemical digestion in the stomach. For instance, while the muscular tissue churns food, the epithelial tissue secretes enzymes that chemically break down nutrients. The connective tissue supports and protects the stomach's structure, and the nervous tissue coordinates these actions, ensuring efficient digestion.

ANSWERS

Multiple Choice Questions (MCQs)

1.	C	6.	C
2.	C	7.	C
3.	B	8.	B
4.	D	9.	B
5.	B		

Content Domain / Area	SLO No./ Description	Form of Assessment	Cognitive Level (Knowledge, Understanding, Application)
E	[SLO: B-09-E-5] Discuss the organ system come together to form the human body	Summative	Understanding

Multiple Choice Questions (MCQs)

- Which layer of the skin contains sweat glands and hair follicles?**
 - Epidermis
 - Dermis
 - Subcutaneous tissue
 - Keratin
- What is the primary function of the circulatory system?**
 - Digestion of food
 - Elimination of waste products
 - Transport of oxygen, nutrients, and waste products
 - Regulation of body temperature
- What is the role of the skeletal system in the human body?**
 - To transport nutrients
 - To produce hormones
 - To provide structure and support
 - To regulate body temperature
- Which system controls the body's movements and regulates body temperature?**
 - Nervous system
 - Muscular system
 - Circulatory system
 - Endocrine system
- Which gland in the endocrine system is associated with the release of growth hormone?**
 - Adrenal gland
 - Thyroid gland
 - Pituitary gland
 - Pancreas
- What does the urinary system consist of?**
 - Heart, veins, and arteries
 - Kidneys, ureters, urinary bladder, and urethra
 - Brain, spinal cord, and nerves
 - Skin, hair, and nails
- Which of the following systems is primarily responsible for regulating body temperature?**
 - Circulatory system
 - Integumentary system
 - Muscular system
 - All of these
- What type of muscle is responsible for involuntary movements, such as moving food through the digestive tract?**
 - Skeletal muscle
 - Cardiac muscle
 - Smooth muscle
 - Tendons
- Which system includes the brain and spinal cord and is responsible for controlling all body activities?**
 - Endocrine system
 - Skeletal system
 - Nervous system
 - Muscular system
- What is the function of sebaceous glands in the integumentary system?**
 - Regulating body temperature through sweat
 - Producing oil to keep the skin and hair moisturized
 - Protecting the body from bacteria and viruses
 - Excreting waste products
- Which part of the skeletal system helps to reduce friction during joint movement?**
 - Bones
 - Ligaments
 - Cartilage
 - Tendons
- Which organ in the urinary system is primarily responsible for filtering the blood to form urine?**
 - Urethra
 - Bladder
 - Ureters
 - Kidneys
- What is the role of the neuroglia in the nervous system?**
 - To transmit signals between neurons
 - To regulate hormone levels
 - To support and protect neurons
 - To control muscle contraction
- How do ligaments function within the skeletal system?**
 - They attach muscles to bones
 - They store minerals
 - They hold bones together at joints
 - They provide a protective covering
- Which of the following systems helps the endocrine system regulate body functions by releasing hormones?**
 - Nervous system
 - Digestive system
 - Circulatory system
 - Skeletal system

Short Response Questions (SRQs)

1. Give the role of the integumentary system in maintaining homeostasis in the human body.

(1 mark each for three roles: protection, temperature regulation, and moisture retention; totaling 3 marks)

Answer: The integumentary system includes the skin, hair, nails, sweat glands, and sebaceous glands. It helps maintain homeostasis by protecting against environmental hazards and regulating body temperature through sweating. It also prevents dehydration by producing oils.

2. What are the three types of muscles present in the muscular system? Give an example of each.

(Total 3 marks: 1 mark each for describing and giving examples of each muscle type)

The **muscular system** consists of three types of muscles:

➤ **Skeletal muscles:** These are attached to bones and are responsible for voluntary movements of the body.

Example: Muscles in the arm.

➤ **Smooth muscles:** These are found in organs and help with automatic movements, such as moving food through the digestive tract.

Example: Stomach muscles.

➤ **Cardiac muscle:** This muscle is only found in the heart and helps pump blood.

Example: Heart muscle.

3. What is the role of the nervous system in coordinating body functions?

(total 3 marks for elaborating role of nervous system)

The nervous system includes the brain, spinal cord, and nerves, which work together to manage thoughts, decisions, movements, and sensations. The brain acts as the control center for thoughts and decisions. The spinal cord serves as the communication pathway between the brain and the body. Nerves carry signals to and from the brain, allowing different body parts to function. Together, they help regulate everything from movement to breathing and thinking.

4. How do the skeletal and muscular systems work together to facilitate movement?

(1.5 marks for skeletal system's role)

(1.5 marks for muscular system's role)

Answer: The skeletal system provides the structural framework, while the muscular system attaches to bones through tendons. Muscles contract and pull on bones, creating movement at the joints. This coordinated action allows for body movements such as walking, running, or lifting objects.

5. How do the endocrine system and nervous system work together to maintain homeostasis?

(1 mark for the role of endocrine system)

(1 mark for the role of nervous system)

(1 mark for the example)

Answer: The endocrine system releases hormones into the bloodstream, which are transported by the circulatory system to target organs. The nervous system provides immediate responses to changes in the body by transmitting electrical signals, while the endocrine system provides long-term regulation through hormones. For example, the nervous system may signal the release of adrenaline from the adrenal glands during stress, which is an interaction between both systems.

6. Explain the role of the urinary system in maintaining fluid balance in the human body.

(3 marks for explaining the role of the urinary system)

Answer: The urinary system maintains fluid balance by filtering blood in the kidneys. It removes excess water, electrolytes, and waste products and produces urine. The ureters transport urine from the kidneys to the bladder, where it is stored until excretion through the urethra. This process helps regulate the volume and composition of body fluids, ensuring that cells function properly.

7. What are the main components of the circulatory system, and how do they contribute to its function?

(1 mark each for describing components and their function, totaling 3 marks)

Answer: The main components of the circulatory system are the heart, blood vessels (arteries, veins, capillaries), and blood. The heart pumps blood throughout the body. The arteries carry oxygen-rich blood from the heart to tissues and veins return oxygen-poor blood to the heart. Capillaries facilitate the exchange of oxygen, nutrients, and waste between blood and tissues.

8. How does the skeletal system provide both structure and support to the human body?

(3 marks for elaborating the different functions of skeletal system)

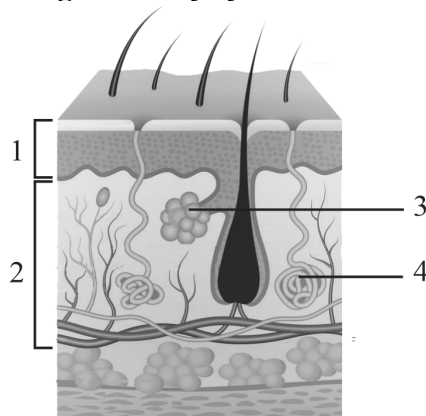
Answer: The skeletal system provides a rigid framework for the body, giving it shape and support. Bones protect vital organs, such as the brain, heart, and lungs. The skeletal system also facilitates movement by serving as points of attachment for muscles. It also stores essential minerals like calcium and produces blood cells within the bone marrow.

9. Illustrate the relationship between the circulatory and respiratory systems in maintaining oxygen supply in the body.

(1 mark for respiratory system function)	(1 mark for circulatory system function)	(1 mark for their interaction)
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Answer: The respiratory system brings oxygen into the body and removes carbon dioxide through breathing. The circulatory system transports oxygen from the lungs to cells throughout the body and carries carbon dioxide back to the lungs for exhalation. This collaboration ensures that body cells receive a constant supply of oxygen for energy production and that carbon dioxide, a waste product, is removed efficiently.

10. The diagram below shows the integumentary system of the human body.



- i) Identify the structures labelled as 1, 2, 3, and 4.
- ii) Write the function of the structure labelled as 3.

0.5 marks for each identification = Total 2 marks	1 mark for function
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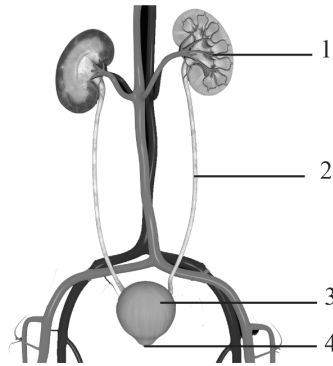
Answer

- i)
 - 1. Epidermis
 - 2. Dermis
 - 3. Sebaceous gland
 - 4. Sweat gland

ii) Sebaceous glands produce oil to keep the skin and hair moisturized.

11. Observe the diagram and answer the following questions:

- i) What system is shown in the diagram?
- ii) Identify the parts labelled as 1, 2, 3 and 4.
- iii) Identify the structure in the diagram that is responsible for blood filtration.



(0.5 mark for identification of diagram)	(2 marks for labelling)	(0.5 mark for the structure identification involved in blood filtration)
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Answer

- i) The diagram shows the urinary system.
- ii) 1: Kidney
2: Ureter
3: Urinary bladder
4: Urethra
- iii) The kidneys are responsible for blood filtration.

Extended Response Questions (ERQs)

1. Discuss how the different organ systems in the human body interact to maintain overall health. Provide examples to illustrate their interdependence.

(5 marks total; 3 marks for explaining interactions)	(2 marks for examples)
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Answer:

The organ systems in the human body are highly interdependent and work collectively to maintain overall health and homeostasis. Each system has specific roles, but they constantly interact to support the body's functions.

For instance, the **circulatory system** is crucial for transporting oxygen, nutrients, hormones, and waste products to and from cells. It supports the **respiratory system** by carrying oxygen from the lungs to all body tissues and returning carbon dioxide to the lungs for expulsion. The **digestive system** works alongside the circulatory system by breaking down food into essential nutrients, which are then absorbed into the bloodstream and transported to cells throughout the body for energy and growth.

The **endocrine system** plays a regulatory role by releasing hormones directly into the bloodstream. These hormones influence various processes, such as growth, metabolism and stress responses. For example, the thyroid gland releases hormones that regulate metabolic rate, which affects the energy available for the functioning of all other organ systems.

The **nervous system** coordinates actions and responses to stimuli from both internal and external environments. It quickly sends signals to muscles to contract, to glands to release hormones, and to other systems to adjust their activities. It works closely with the **immune system** to protect the body from pathogens. For example, it can trigger reflexes that remove harmful substances from the body, such as sneezing or coughing.

Examples: During physical exercise, the **muscular system** increases its demand for oxygen and nutrients. The **respiratory system** responds by increasing the breathing rate, bringing more oxygen into the body. The **circulatory system** then pumps blood more rapidly to distribute this oxygen to the muscles while removing carbon dioxide. Simultaneously, the **urinary system** helps to maintain fluid balance and remove waste products produced by muscle activity.

Another example is during a fight-or-flight response, where the **nervous system** detects danger and signals the **endocrine system** to release adrenaline, a hormone that prepares the body for rapid action. The heart

rate increases, the airways widen, and energy is released from stored glycogen to support immediate physical activity. The **circulatory** and **respiratory systems** work together to ensure that muscles receive the necessary oxygen and nutrients to perform effectively.

These interactions highlight the complex interdependence of organ systems in maintaining overall health, ensuring that the body can respond to both immediate and long-term challenges.

2. Explain the roles of the circulatory, urinary, and endocrine systems in maintaining homeostasis.

How do they work together to regulate the body's internal environment?

(5 marks total; 3 marks for explaining roles)	(2 marks for explaining their collaboration)
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Answer:

The **circulatory system** plays a vital role in maintaining homeostasis by transporting essential substances such as oxygen, nutrients, and hormones to cells while removing waste products like carbon dioxide and urea. It maintains body temperature by distributing heat and helps regulate pH levels in the blood. The heart, arteries, veins, and capillaries ensure that these functions are carried out efficiently throughout the body.

The **urinary system** maintains homeostasis by filtering blood to remove waste products, excess salts, and water, forming urine. The kidneys regulate water balance, electrolyte levels, and blood pressure by adjusting the amount of water and salts excreted. They release **renin**, an enzyme that plays a key role in the regulation of blood pressure.

The **endocrine system** maintains homeostasis by producing hormones that regulate many bodily functions, such as metabolism, growth, reproduction, and stress response. For example, the pancreas releases insulin and glucagon to regulate blood sugar levels. The thyroid gland secretes hormones that control the metabolic rate. The adrenal glands release cortisol, which helps the body respond to stress and maintain blood glucose levels.

Collaboration: These three systems work together closely to ensure that the body's internal environment remains stable. For instance, if blood pressure drops, the kidneys release **renin** to increase blood pressure. Meanwhile, the endocrine system releases hormones like **aldosterone**, which also increases blood pressure.

During dehydration, the pituitary gland releases **antidiuretic hormone (ADH)**. This hormone signals the kidneys to retain water, helping to conserve body fluids and maintain blood pressure. The circulatory system transports these hormones to their target organs, ensuring communication and response to any changes in the body's internal environment.

The pancreas releases insulin and glucagon in response to blood glucose levels. When blood sugar levels are high, insulin helps cells take up glucose. When blood sugar levels are low, glucagon stimulates the release of glucose. The circulatory system carries these hormones, allowing the body to maintain a stable glucose concentration.

These examples show the close interaction between the **circulatory, urinary, and endocrine systems** in regulating the body's internal environment. This highlights how these systems play essential roles in maintaining **homeostasis**.

ANSWERS

Multiple Choice Questions (MCQs)			
1.	B	9.	C
2.	C	10.	B
3.	C	11.	C
4.	B	12.	D
5.	C	13.	C
6.	B	14.	C
7.	D	15.	A
8.	C		

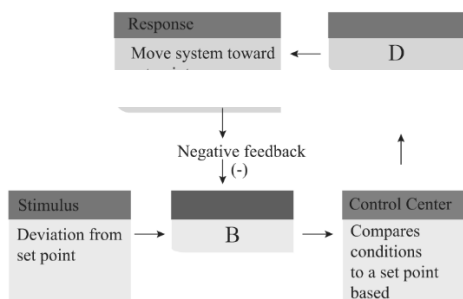
Content Domain / Area	SLO No./ Description	Form of Assessment	Cognitive Level (Knowledge, Understanding, Application)
E	[SLO: B-09-E-07] Discuss the various organs and systems of the human body work to maintain homeostasis	Summative	Understanding

Multiple Choice Questions (MCQs)

- What is homeostasis?**
 - The body's ability to maintain a stable internal environment
 - The process of digesting food
 - The growth of cells and tissues
 - The breakdown of nutrients in the body
- Which organ releases hormones to regulate water balance in the body?**
 - Heart
 - Lungs
 - Pituitary gland
 - Liver
- Which of the following mechanisms is used by the body to prevent overheating?**
 - Increasing blood sugar levels
 - Shivering to generate heat
 - Sweating to cool down
 - Releasing glucagon
- How does the body respond when blood glucose levels rise?**
 - Pancreas releases glucagon
 - Liver stores glucose as glycogen
 - Muscles decrease their activity
 - Kidneys excrete excess glucose
- What is the primary role of negative feedback mechanisms in the body?**
 - To amplify changes
 - To maintain homeostasis
 - To stimulate the growth of new tissues
 - To release hormones into the bloodstream
- Which organ system is primarily responsible for regulating blood glucose levels?**
 - Nervous system
 - Integumentary system
 - Respiratory system
 - Endocrine system
- What role does the hypothalamus play in maintaining homeostasis?**
 - Produces red blood cells
 - Filters waste from the blood
 - Acts as a control center for regulating body temperature
 - Secretes digestive enzymes
- Which hormone is responsible for lowering blood glucose levels in the body?**
 - Insulin
 - Glucagon
 - Adrenaline
 - Cortisol
- How does the body react when dehydrated to maintain homeostasis?**
 - Increases sweating
 - Releases antidiuretic hormone (ADH)
 - Lowers blood pressure
 - Increases breathing rate
- What mechanism does the body use to control bleeding from a wound?**
 - Negative feedback
 - Positive feedback
 - Hormonal regulation
 - Thermoregulation
- Which gland releases hormones that help maintain homeostasis by regulating metabolic rate?**
 - Thyroid gland
 - Pituitary gland
 - Adrenal gland
 - Pineal gland
- What happens when blood glucose levels fall below the set point?**
 - The pancreas releases insulin
 - The liver converts glucose into glycogen
 - The pancreas releases glucagon
 - The kidneys filter out excess glucose
- What is the primary purpose of vasoconstriction during cold exposure?**
 - To cool the body down
 - To increase heart rate
 - To conserve body heat

D) To enhance glucose uptake

14. In the diagram of the negative feedback loop, identify the parts labelled "B" and "D".



Option	B	D
A	Receptor	Effector
B	Control Center	Receptor
C	Effector	Control Center
D	Response	Stimulus

Short Response Questions (SRQs)

1. Describe the concept of homeostasis and its significance to the human body.

(1 mark for the concept of homeostasis)	(2 marks for its significance)
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Answer:

Homeostasis is the process by which the body maintains a stable internal environment despite external changes.

It is essential for the optimal functioning of cells and tissues.

Regulates factors like temperature, glucose levels, and water content to ensure health and survival.

2. How does the body use negative feedback mechanisms to regulate body temperature?

(1.5 marks for cooling mechanisms)	(1.5 marks for warming mechanisms)
------------------------------------	------------------------------------

Answer:

When the body temperature rises above the set point, the hypothalamus activates cooling mechanisms such as sweating and vasodilation to release heat.

When the temperature falls below the set point, the hypothalamus activates warming mechanisms like shivering and vasoconstriction to conserve heat.

3. Describe the role of insulin and glucagon in maintaining blood glucose levels.

(1.5 marks for the role of insulin)	(1.5 marks for the role of glucagon)
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Answer:

Insulin, released by the pancreas, lowers blood glucose levels by promoting the uptake of glucose by cells. It also helps convert glucose into glycogen in the liver.

Glucagon raises blood glucose levels by signalling the liver to convert glycogen back into glucose and release it into the bloodstream.

4. How do negative feedback mechanisms help maintain homeostasis? Provide an example.

(1.5 marks for defining Negative feedback mechanisms)	(1.5 marks for the example)
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Answer:

Negative feedback mechanisms maintain homeostasis by reversing changes to keep internal conditions stable. For example, if blood glucose level rises, the pancreas releases insulin to lower it. It brings the level back to normal.

5. Describe how the endocrine and nervous systems interact to regulate homeostasis.

(1 mark for coordination)	(1 mark for the role of the nervous system)	(1 mark for the role of endocrine system)
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Answer:

The endocrine and nervous systems work together to regulate homeostasis by using hormones and nerve signals. The nervous system quickly responds to changes (like temperature) and sends signals to the endocrine system. The endocrine system releases hormones to adjust body functions, such as metabolism or water retention.

6. What role do sweat glands play in thermoregulation?

(3 marks for the role of sweat glands)

Answer:

Sweat glands help in thermoregulation by producing sweat. The sweat evaporates from the skin's surface, cooling the body down. This process helps to lower body temperature when it rises above the normal set point.

7. Explain how the regulation of water concentration in the body demonstrates homeostasis.

(1 mark for the role of osmoreceptors)

(1 mark for the role of hypothalamus)

(1 mark for the role of kidneys)

Answer:

The body regulates water concentration through the action of osmoreceptors that detect changes in blood water levels. When dehydration occurs, the hypothalamus releases antidiuretic hormone (ADH). ADH prompts the kidneys to reabsorb more water, thereby maintaining fluid balance and homeostasis.

8. How does the body use positive feedback during injury, such as blood clotting?

(1 mark for defining Positive feedback)

(2 marks for describing Positive feedback through blood clotting process)

Answer:

Positive feedback amplifies the response to an injury. When a blood vessel is damaged, platelets stick to the site and release chemicals that attract more platelets. This rapidly forms a clot to prevent further blood loss.

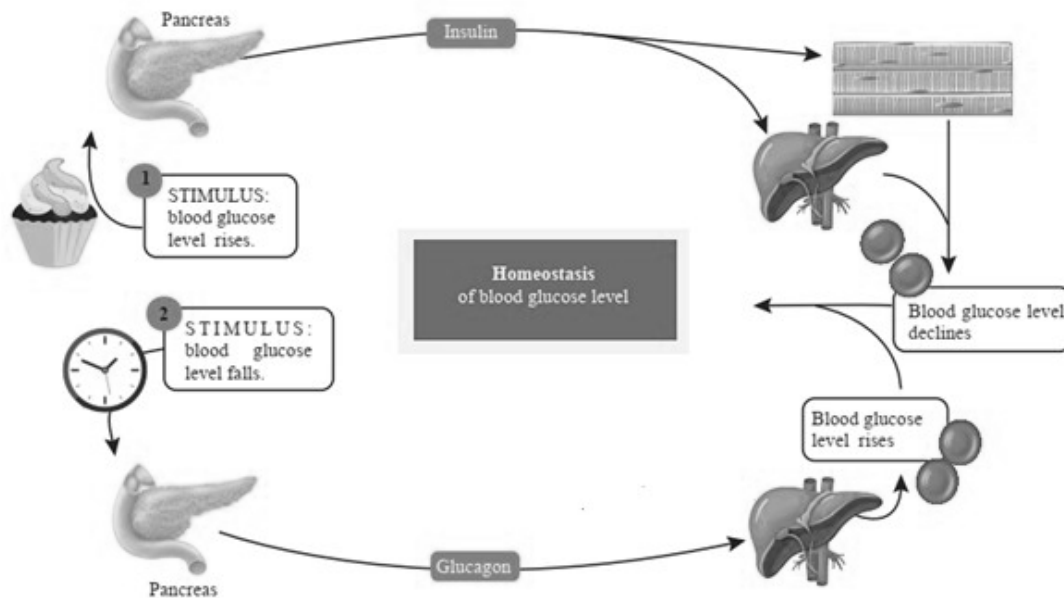
9. What is the role of the liver in maintaining glucose homeostasis?

(3 marks for the role of liver)

Answer:

The liver helps maintain glucose homeostasis by storing excess glucose as glycogen. It releases glucose into the blood when levels are low. It acts in response to hormones like insulin and glucagon to balance blood glucose levels.

10. Observe the diagram showing blood glucose regulation and answer the following:



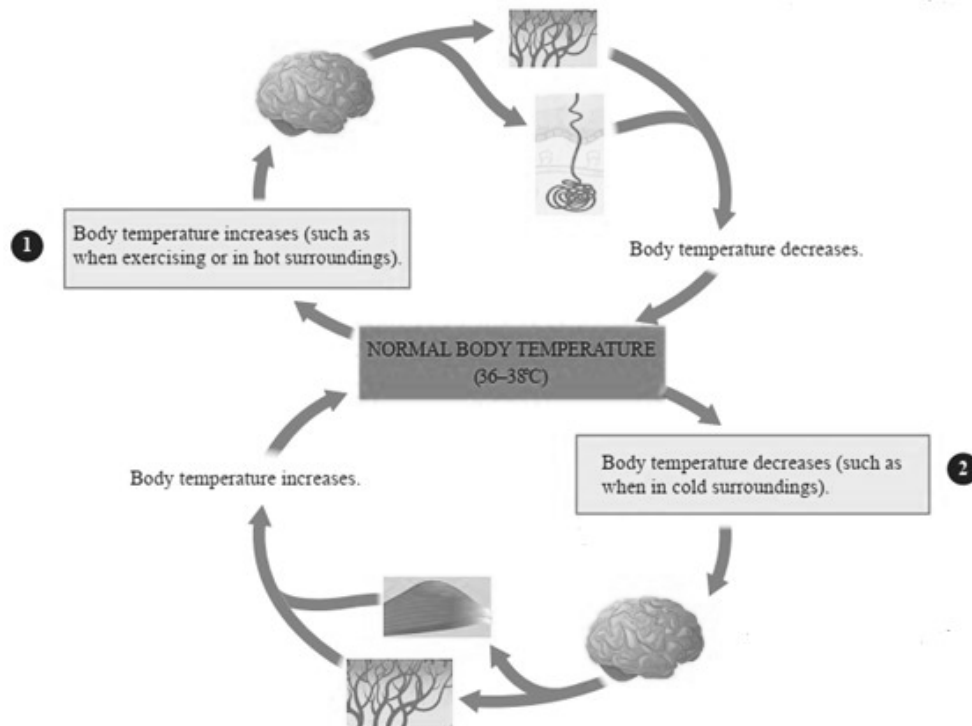
- a) What action does the pancreas take when blood glucose levels are high?
- b) How does the pancreas restore blood glucose levels when they drop too low?
- c) Which organ stores glucose as glycogen, and why is this storage important for maintaining balance in the body?

1 mark for each part = Total 3 marks

Answer

- When food is consumed, blood glucose levels rise, triggering the pancreas to release insulin. This signals liver and muscle cells (effectors) to absorb and store glucose as glycogen, lowering blood glucose levels.
- During fasting, blood glucose levels decrease, prompting the pancreas to release glucagon. This directs the liver to convert stored glycogen into glucose and release it into the bloodstream. This raises blood glucose levels.
- The liver stores glucose as glycogen. This process is important because it helps maintain blood glucose levels within a normal range. It ensures a steady supply of energy to the body and prevents extreme highs and lows in blood sugar, which are crucial for maintaining homeostasis.

11. Observe the diagram showing body temperature regulation and answer the following:



- What action does the body take when the temperature increases above the normal range during exercise or in hot surroundings?
- How does the body respond when the temperature drops below normal, such as in cold surroundings?
- Why is maintaining a stable body temperature important for overall homeostasis?

1 mark for each part = Total 3 marks

Answer

- The hypothalamus activates cooling mechanisms by causing sweat glands to secrete sweat. As the sweat evaporates, it helps cool the body. Additionally, blood vessels in the skin dilate and fill with warm blood, allowing heat to radiate from the skin's surface.
- The hypothalamus activates warming mechanisms, leading to shivering, where skeletal muscles rapidly contract to generate heat. Additionally blood vessels in the skin constrict to reduce heat loss by diverting blood to deeper tissues.
- Maintaining a stable body temperature is essential to ensure that enzymes function optimally, preventing damage from excessive heat or cold.

Extended Response Questions (ERQs)

1. Discuss how different organ systems collaborate to maintain homeostasis in the body, particularly focusing on temperature regulation. Provide specific examples of their interactions.

(1 mark for the role of each organ system: integumentary, nervous, muscular, and circulatory systems; total 4 marks)

(1 mark for their collaboration)

Answer: The human body maintains a stable internal temperature through the collaborative actions of multiple organ systems, primarily the integumentary, nervous, muscular, and circulatory systems. When the body's temperature begins to rise due to external heat or physical exertion, the nervous system detects the change through temperature receptors in the skin and the hypothalamus, a region in the brain. In response, the hypothalamus sends signals to the integumentary system, specifically the sweat glands, to produce sweat. The evaporation of sweat from the skin's surface cools the body down. Additionally, blood vessels in the skin undergo vasodilation, widening to increase blood flow to the skin's surface, allowing heat to dissipate more efficiently.

Conversely, when the body's temperature drops, the hypothalamus triggers vasoconstriction, where blood vessels narrow to reduce blood flow to the skin, conserving body heat. Simultaneously, the hypothalamus signals the muscular system to initiate shivering, which is a rapid, involuntary muscle contractions that generate heat. The circulatory system also plays a crucial role by distributing warm blood from the core of the body to the peripheries or conserving warmth by directing blood away from the peripheries toward vital organs. These processes work in tandem to maintain a stable internal environment, preventing **hypothermia** or **hyperthermia** and ensuring optimal conditions for cellular function. This complex integration of different systems demonstrates how homeostasis is maintained through multiple feedback mechanisms working in harmony.

2. Explain the role of the circulatory, urinary, and endocrine systems in maintaining water balance and how they interact to regulate water concentration in the body.

(1 mark for the role of each organ system: circulatory, urinary, and endocrine systems; total 3 marks)

(2 marks for their collaboration)

Answer: Water balance is critical for the body's overall function, and it is maintained through the coordinated efforts of the circulatory, urinary, and endocrine systems. The circulatory system transports blood, which contains water, nutrients, and waste products, to the kidneys. The urinary system, specifically the kidneys, filters the blood to remove excess water, salts, and waste to form urine. This filtration process is crucial for maintaining the balance of water and electrolytes, which is essential for normal cellular activity and blood pressure regulation.

The endocrine system regulates this process by releasing hormones such as **antidiuretic hormone** (ADH). When the body is dehydrated, osmoreceptors in the hypothalamus detect the change and signal the pituitary gland to release ADH. ADH then acts on the kidneys, prompting them to reabsorb more water back into the bloodstream, thereby conserving water and reducing urine output. Conversely, when there is excess water in the body, ADH secretion is reduced, allowing the kidneys to excrete more water in the urine.

These interactions between the circulatory, urinary, and endocrine systems ensure that the body maintains homeostasis by regulating water content, preventing dehydration, and maintaining blood volume and pressure. This balance is crucial for overall physiological stability.

3. Analyze the significance of homeostasis in the context of blood glucose regulation and describe how different systems interact to achieve this balance. Provide examples of feedback mechanisms involved.

(1 mark for the role of each organ system: endocrine, digestive, and circulatory systems; total 3 marks)	3. marks for their collaboration)
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Answer: Homeostasis in blood glucose regulation is vital for maintaining energy balance and overall metabolic health. The endocrine, digestive, and circulatory systems work together to keep blood glucose levels within a narrow range. When blood glucose levels rise after eating, the pancreas, part of the endocrine system, detects the increase and releases insulin. **Insulin** facilitates the uptake of glucose by cells, particularly muscle and fat cells, and promotes the conversion of excess glucose into glycogen for storage in the liver. This process lowers blood glucose levels back to the normal range, demonstrating a **negative feedback mechanism** where the rise in glucose triggers a response that brings it down.

Conversely, when blood glucose levels drop, such as during fasting or intense exercise, the pancreas releases glucagon, another hormone. **Glucagon** signals the liver to break down stored glycogen into glucose and release it into the bloodstream. It raises blood glucose levels to meet the body's energy demands. This balance ensures a continuous supply of glucose to cells, particularly to critical organs like the brain, which relies heavily on glucose for energy.

The digestive system contributes by breaking down carbohydrates into glucose, which is then absorbed into the bloodstream. The circulatory system distributes this glucose throughout the body, ensuring that all cells receive the necessary fuel to perform their functions. This regulation involves a series of feedback loops: the pancreas monitors blood glucose levels and adjusts hormone secretion accordingly, while the liver stores and releases glucose as needed. These mechanisms exemplify the importance of homeostasis, as they prevent both **hyperglycemia** (high blood sugar) and **hypoglycemia** (low blood sugar), conditions that can have severe health implications. This coordination among multiple systems highlights the body's complex regulation strategies to maintain internal stability.

ANSWERS

Multiple Choice Questions (MCQs)			
1.	A	8.	A
2.	C	9.	B
3.	C	10.	B
4.	B	11.	A
5.	B	12.	C
6.	D	13.	C
7.	C	14.	A

Content Domain / Area	SLO No./ Description	Form of Assessment	Cognitive Level (Knowledge, Understanding, Application)
E	[SLO: B-09-E-06] Describe the advantages of homeostasis	Summative	Understanding

Multiple Choice Questions (MCQs)

- Which of the following bodily functions is NOT directly regulated by homeostasis?
 - Blood glucose levels
 - Fluid and electrolyte balance
 - Waste elimination
 - Digestion of food
- How does homeostasis protect the body from harmful conditions such as extreme cold?
 - By generating more body fat
 - By triggering shivering to generate heat
 - By reducing the amount of oxygen, the body uses
 - By increasing the blood flow towards the skin
- How does homeostasis support nerve transmission?
 - By regulating enzyme production
 - By maintaining the balance of fluids and electrolytes
 - By increasing external temperature
 - By triggering muscle contractions

Short Response Questions (SRQs)

1. Why is homeostasis crucial for maintaining a stable internal environment in the body?

3 marks for the significance of homeostasis

Homeostasis is crucial because it maintains a stable internal environment essential for the optimal functioning of cells and tissues. It ensures conditions like temperature and pH are kept within a narrow range. This stability allows **enzymes** and other cellular processes to work efficiently.

2. List any three advantages of homeostasis.

1 mark for each advantage = Total 3 marks

1. Homeostasis also plays a key role in eliminating metabolic wastes and toxins, preventing their accumulation and potential harmful effects.
2. It supports stable conditions for growth and development, ensuring that the body's systems develop correctly and function harmoniously.
3. It ensures that conditions like temperature and pH are kept within a narrow range, allowing enzymes and other cellular processes to work efficiently.

ANSWERS

Multiple Choice Questions (MCQs)

1.	D	3.	B
2.	B		