UNIT 13 Co-ordination and Response

MCQ Section

1. The diagram shows a section of the spinal cord.

Which identifies the neurones of the reflex arc shown?

<table>
<thead>
<tr>
<th></th>
<th>Motor Neurone</th>
<th>Relay Neurone</th>
<th>Sensory Neurone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

[D01/P1/Q24]

2. The diagram shows a section through a human eye.

Which structure contains muscle fibres that contract in response to sudden changes in light intensity?

[D01/P1/Q25]

3. The graphs show the concentrations of glucose and insulin in the blood of a healthy person.

Which graph shows the changes expected after a meal containing starch?

[D01/P1/Q22]

1. D The sensory neurone transmits impulses produced by a stimulus detected by the sensory organ to the spinal cord. The relay neurone helps to transfer these impulses to the motor neurone. The motor neurone transmits the impulses it receives to an appropriate effector to produce a response.

2. B Structure B is the iris which contains radial and circular muscles. In bright light circular muscles contract to decrease the size of the pupil.

3. A Digestion of starch produces glucose causing an increase in glucose concentration in blood. This increases the production of insulin which converts the excess glucose into glycogen for storage in the liver and muscles.
11. When a person is frightened, which substance increases the blood sugar levels?
   A. adrenaline
   B. amylase
   C. glycogen
   D. insulin

   [J00/P1/Q22]

12. Which part of the brain detects temperature changes in the blood?
   A. cerebellum
   B. cerebral hemispheres
   C. hypothalamus
   D. medulla

   [J00/P1/Q23]

13. Which of the following, when present in urine, shows that a person is diabetic?
   A. glucose
   B. sodium chloride
   C. urea
   D. water

   [D99/P1/Q22]

14. Diagram 1 shows the iris and pupil of a person's eye. Diagram 2 shows the same eye after a change in external conditions.

   Which change caused this response?
   A. a decrease in light intensity
   B. an increase in light intensity
   C. focusing on a distant object
   D. focusing on a nearby object

   [J00/P1/Q24]

15. Where is the hormone insulin produced and where does it act?
   site of production | site of action
   A. adrenal glands | ileum
   B. adrenal glands | liver
   C. pancreas | ileum
   D. pancreas | liver

   [D99/P1/Q23]

16. What is the shape and size of the iris and pupil of the eye, and the condition of the circular muscles of the iris, when viewing an object in bright light?

   A
   B
   C
   D

   [D99/P1/Q24]

10. D. When sensory neurones are activated by a decrease in surrounding temperature, nerve impulses are sent to the sweat glands to reduce sweat production.

11. A. Adrenaline is a hormone that is secreted to prepare the body for fight or flight response. More glucose is released into blood as adrenaline sent to the liver converts more glycogen into glucose.

12. C. The hypothalamus contains the temperature control centre which detects and responds to changes in the blood temperature flowing through it.

13. A. Diabetes Mellitus is a disorder caused by a lack of or absence of insulin produced by the pancreas. This prevents the body from utilising glucose for metabolism and storing excess glucose as glycogen in the liver. As a result, the blood glucose rises above normal level causing excess glucose to be excreted in the urine.

14. B. A sudden increase in light intensity causes the circular muscles of the iris to contract and the radial muscles relax. This causes the pupils to decrease in size thus reducing the amount of light entering the eye.

15. D. The pancreas is an endocrine gland which has specialised cells called islets of Langerhans that secrete the hormone insulin directly into the bloodstream. Insulin acts on excess glucose in the liver and converts it into glycogen for storage in the liver.
The blood temperature is maintained through various mechanisms.

- Increases increase temperature.
- Decreases decrease temperature.
- Muscle activity plays a role in adjusting blood temperature.

1. Which of these muscles does not control blood temperature?
   - Muscle A
   - Muscle B
   - Muscle C

2. What happens to muscle X and muscle Y?
   - Muscle X relaxes, Muscle Y contracts.
   - Muscle X contracts, Muscle Y relaxes.
   - Muscle X contracts, Muscle Y contracts.
   - Muscle X relaxes, Muscle Y relaxes.

3. During vigorous exercise, the body temperature increases. This increase is
   - A) Due to increased metabolism.
   - B) Due to decreased sweating.
   - C) Due to increased sweating.
   - D) Due to decreased metabolism.

4. The diagram shows the section of the
   - A) Heart
   - B) Lungs
   - C) Kidneys
   - D) Digestive system

5. In which blood cell does white blood cells reside?
   - A) In the blood plasma
   - B) In the bone marrow
   - C) In the liver
   - D) In the spleen

6. A) White blood cell
   - B) Red blood cell
   - C) Platelet
   - D) Plasma protein

7. The diagram shows a vertical section of the
   - A) Spine
   - B) Brain
   - C) Heart
   - D) Liver

8. The diagram shows the
   - A) Liver
   - B) Kidney
   - C) Lung
   - D) Heart

9. In which of the following does the body maintain constant temperature?
   - A) While resting
   - B) While exercising
   - C) While sleeping
   - D) While fasting

10. What are the functions of the circulatory system?
    - A) Transport of nutrients and oxygen to cells.
    - B) Regulation of body temperature.
    - C) Regulation of blood pressure.
    - D) All of the above.
22. Where are hormones destroyed?
   A adrenal glands
   B kidneys
   C liver
   D pancreas
   [D98/P1/Q22]

23. Which of the following shows the shapes and sizes of the iris and pupil of the eye when viewing an object in bright light?
   A front view of iris and pupil contracted
   B circular iris muscles relaxed
   C relaxed
   D contracted
   [J98/P1/Q23]

24. Which change occurs when the ciliary muscles in the eye of a mammal are contracted?
   A Images of distant objects are focused on the retina.
   B The diameter of the pupil is reduced.
   C The lens becomes flattened.
   D Tension on the suspensory ligaments is reduced.
   [J98/P1/Q22]

25.

26. The diagram shows a cross-section of the spinal cord of a mammal.
   Which region contains the axons (fibres) of motor neurones, but not those of sensory neurones?

27. The events listed occur during contraction of the pupil of the eye in response to increased light intensity.
   1. impulses pass along motor neurone
   2. contraction of circular iris muscles
   3. stimulation of the retina
   4. impulses pass along sensory neurone
   What is the correct order of these events?
   [J98/P1/Q24]

28.

29. D When the ciliary muscles of the eye contract, the suspensory ligaments slacken and the lens becomes shorter and thicker. This allows a near object to be focused on the retina. The diameter of the pupil is reduced when the circular muscles of the iris contract.

25. C Y is the cerebrum which controls all voluntary actions and responsible for reasoning, speech, processing and storage of information. Z is the cerebellum which co-ordinates muscles to maintain balance and make precise movements.

26. D The ventral root of the spinal cord (D) contains axons of motor neurones. The dorsal root (B) contains sensory nerve fibres with the cell bodies of all the sensory fibres situated in the dorsal root ganglion (A). The region C is composed of white matter.

27. D The order of events is typical of a reflex action.
25. Which region secretes hormones?
A. balance B. breathing C. memory D. vision

34. Which of the following results from increased secretion of adrenaline?
A. increased blood supply to the intestine B. increased supply of glucose in the blood C. decreased sweating D. decreased breathing rate

29. After vigorous muscular exercise, which blood vessel carries the most carbon dioxide?
A. aorta B. hepatic artery C. pulmonary vein D. vena cava

35. The diagram shows a section through the brain. Which structure is the medulla oblongata?
A. medulla B. cerebellum C. cerebral hemispheres D. thalamus

30. Which part of the brain detects temperature changes in the blood?
A. aorta B. hepatic artery C. pulmonary vein D. vena cava

31. Which diagram shows how light from a distant object falls on the back of the eye to form a clear image?
A. A B. B C. C D. D

32. What is the function of the iris in the mammalian eye?
A. to alter the shape of the lens B. to control the amount of light entering the eye C. to focus light rays on the retina D. to protect the cornea from damage
36. A child is frightened by a loud noise and shouts for help. In which order are the different types of neurone involved in this response?

   \[ \text{involved first} \rightarrow \text{involved last} \]

   A motor neurone relay neurone sensory neurone
   B motor neurone sensory neurone relay neurone
   C sensory neurone motor neurone relay neurone
   D sensory neurone relay neurone motor neurone

   [J96/P1/Q21]

37. Where is the hormone insulin produced and where does it act?

   \[ \text{site of production} \rightarrow \text{site of action} \]

   A adrenal glands ileum
   B adrenal glands liver
   C pancreas ileum
   D pancreas liver

   [J96/P1/Q22]

38. The diagram shows a section through the eye. Which structure contains the muscles which contract in order to produce a focused image on the retina?

   A
   B
   C
   D

   [D95/P1/Q20]

39. A child is frightened by a loud noise and shouts for help. In which order do the different types of neurone become active in this response?

   \[ \text{active first} \rightarrow \text{involved last} \]

   A motor neurone relay neurone sensory neurone
   B motor neurone sensory neurone relay neurone

   [J95/P1/Q22]

40. The diagram shows a section through the human eye. Which structure contains muscle fibres which contract in response to sudden changes in light intensity?

   A
   B
   C
   D

   [D95/P1/Q20]

41. Which region of the human brain controls balance and muscular coordination?

   A cerebellum
   B cerebrum
   C hypothalamus
   D medulla

   [J95/P1/Q22]
42. Which changes take place in the iris of the eye when a person moves quickly from darkness into bright light?
A. contract
B. relax
C. decrease
D. increase

43. The diagram shows a section through the human skull and brain.
Which part helps to regulate body temperature?
A. hypothalamus
B. cerebellum
C. pituitary gland
D. cerebral cortex

44. In which of these directions do impulses in sensory, relay (intermediate) and motor neurones travel?
A. away from the central nervous system
B. towards the central nervous system
C. within the central nervous system
D. all of the above

45. Which of the following normally enters the blood as it passes through the pancreatic duct?
A. amino acids
B. glycogen
C. insulin
D. lipase

46. The pupil of the eye is dilated in the pancreas.
Which gland secretes insulin?
A. pancreas
B. liver
C. thyroid gland
D. parathyroid gland

47. The diagram shows the front view of an eye of a person in a dark room.
What happens when the person walks into sunlight?
A. radial muscles contract; size decreases
B. circular muscles contract; size decreases
C. radial muscles relax; size increases
D. circular muscles relax; size increases
E. no change
48. Where is the hormone insulin produced and where does it act?

<table>
<thead>
<tr>
<th>Site of production</th>
<th>Site of action</th>
</tr>
</thead>
<tbody>
<tr>
<td>A adrenal glands</td>
<td>body muscles</td>
</tr>
<tr>
<td>B adrenal glands</td>
<td>liver</td>
</tr>
<tr>
<td>C liver</td>
<td>body muscles</td>
</tr>
<tr>
<td>D pancreas</td>
<td>ileum</td>
</tr>
<tr>
<td>E pancreas</td>
<td>liver</td>
</tr>
</tbody>
</table>

[D93/P1/Q21]

52. Which diagram shows how light from a distant object falls on the back of the eye to form a clear image?

[A, B, C, D, E]

[J93/P1/Q22]

53. The diagram shows a section through the brain.

Which part contains the rods and cones?

[J93/P1/Q21]

54. The table shows the time taken for a driver to stop the car in an emergency before and after drinking alcohol.

<table>
<thead>
<tr>
<th>Time taken to decide to stop / sec</th>
<th>Time taken to stop / sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>before drinking alcohol</td>
<td>1.5</td>
</tr>
<tr>
<td>after drinking alcohol</td>
<td>2.1</td>
</tr>
</tbody>
</table>

[J02/P1/Q17]

51. What causes an oxygen debt to develop?

A Breathing becomes very rapid.
B Carbon dioxide levels in the blood rise.
C Oxygen demand exceeds oxygen supply.
D The heartbeat increases.

[J02/P1/Q17]

50. The diagram shows a section through the eye.

Which part controls conscious thought, learning, memory and speech?

[J93/P1/Q23]

49. The diagram shows a nerve pathway involved in a reflex action.

Which structure is a motor neurone?

[D93/P1/Q22]
59. The diagram shows part of the nervous system, including a reflex arc. It has been cut at X.

A bee stings a finger, as shown. What are the effects of this sting?

<table>
<thead>
<tr>
<th>pain felt</th>
<th>arm moved</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>no</td>
</tr>
<tr>
<td>B</td>
<td>no</td>
</tr>
<tr>
<td>C</td>
<td>yes</td>
</tr>
<tr>
<td>D</td>
<td>yes</td>
</tr>
</tbody>
</table>

60. The diagram shows some of the features of human skin. Which part of the brain co-ordinates the information labelled in the diagram?

A cerebrum
B cerebellum
C hypothalamus
D medulla

61. In a nerve pathway, the following events take place.

1. activation of muscle
2. activation of receptor
3. passage of impulses along a motor neurone
4. passage of impulses along a sensory neurone

What is the correct order of these events?

<table>
<thead>
<tr>
<th>first → last</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 2 3 4 1</td>
</tr>
<tr>
<td>B 2 4 3 1</td>
</tr>
<tr>
<td>C 4 1 3 2</td>
</tr>
<tr>
<td>D 4 2 1 3</td>
</tr>
</tbody>
</table>

62. What effects would an increase in adrenaline have on the body?

<table>
<thead>
<tr>
<th>concentration of glycoprotein in the liver</th>
<th>concentration of glucose in the blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>A decrease</td>
<td>increase</td>
</tr>
<tr>
<td>B increase</td>
<td>increase</td>
</tr>
<tr>
<td>C no effect</td>
<td>decrease</td>
</tr>
<tr>
<td>D increase</td>
<td>no effect</td>
</tr>
</tbody>
</table>

63. Contraction of the hair erector muscle causes hair to stand and an insulating layer of air is trapped between hairs. An increase in blood flow to the skin is a result of vasodilation of the arterioles. This results in less heat loss from blood into the surroundings by radiation.
64. A. Insulin  B. Glucagon  C. Adrenaline  D. Protase

65. A. Increases in light intensity  B. Decreases in light intensity  C. Increase in pupil size  D. Decrease in pupil size

66. A. To pass nerve impulses to other neurons  B. To receive sensory impulses from the receptors  C. To control the size of the pupil  D. To coordinate the movements of the skeletal muscles

67. A. Hair receptors  B. Muscle receptors  C. Surface capillaries  D. Nerve receptors

68. A. Relax  B. Contract  C. Dilate  D. Narrow

**Question 1**

The levels of sugar and of adrenaline in a person's blood were measured at the same time over a period of six minutes. Fig. 4.1 shows these measurements.

![Graph showing concentration of blood sugar and adrenaline over time](image)

**Fig. 4.1**

(a) Name the sugar known as blood sugar. [1]
(b) Suggest what may have happened to the person at time T. [1]
(c) Explain why the concentration of blood sugar changed after time T. [2]
(d) Explain how the concentrations of blood sugar and adrenaline are returned to their original levels. [4]

**Solution**

(a) Glucose

(b) The person must be under conditions of fear, anger or anxiety at time T.
Comment 1

(d) Adrenaline is secreted under conditions of fear, anger or anxiety. It causes an increase in the concentration of blood sugar after time T.

(d) Blood sugar: Glucose is oxidised during tissue respiration to produce energy required for faster metabolic reactions and muscle contractions. During this period, both oxygen and glucose are carried faster to the muscles for tissue respiration to release more energy to prepare the person for fight or flight.

Adrenaline: The effect of hormone adrenaline is immediate and last for a very short period. When the person calms down, the secretion of adrenaline stops and the used adrenaline is carried to the liver where they are destroyed.

Comment 2

(a) Name the structures labelled U to X.

(a) On Fig. 5.1, continue the light rays into the eye to show how a focused image is produced on the retina.

(b) Choose the lens, A to D in Fig. 5.2, which most closely resembles the appearance of the lens in the eye when focused on the book.

(c) Describe the changes in the eye from looking at distant objects to near objects.

Solution

(a) U: choroid muscle
V: Cornea
W: Iris
X: Sclera

(b) (i) Describe what has happened in the eye to bring about this change in the shape of the lens.
(c) (i) Lens B

(ii) When the eye focuses on a near object, the circular muscles of the ciliary body contract. This slackens or releases the pull on the suspensory ligaments and the lens. The elastic nature of the lens causes it to become thicker and more convex. The diverging rays from the near object can be brought to focus as a clear image on the retina.

**Question 3**

Explain how a named stimulus leads to a reflex response in a mammal. [7]

**Solution**

Stimulus – Heat from a very hot object

A simple reflex action takes place from the moment a person accidentally touches a very hot object to the moment the hand is removed from the object.

The sequence of events is as follows:

1. The heat on the object stimulates the nerve endings of the heat and pain receptors in the skin.
2. Impulses are produced. The impulses travel along the sensory neurone to the spinal cord.
3. In the spinal cord, the impulses are transmitted across a synapse to the intermediate neurone, then across another synapse to the motor neurone.
4. Motor impulses leave the spinal cord along the motor neurone to the effector.
5. The effector is the biceps muscle, which contracts. This brings about a sudden withdrawal of the hand from the hot object.
The sequence of events is as follows:

1. When a person accidentally touches a very hot object, a simple reflex action occurs. The heat is transferred to the skin, which in turn triggers a reflex action. The nerve impulse travels along the sensory neuron to the spinal cord, then to the motor neuron, which stimulates the muscle to contract, pulling the hand away from the object.

2. Explain why hormonal responses are slower than reflex actions.

3. Describe the pathway of a simple reflex action, starting with the event that begins the action.

4. Name the structure that is a component of a spinal nerve.

5. The effect of a hormone is the basis of the action of the arm, which is a skeletal muscle. When it is stimulated by nerve impulses, it contracts and causes the arm to bend upwards to start a called action.

6. A spinal nerve has a component of a motor neuron that transmits the nerve impulses to the spinal cord. When a nerve impulse reaches the spinal cord, it travels along the spinal cord to the motor neuron, which stimulates the muscle to contract. The muscle contracts, causing the arm to bend upwards.
1. The heat on the object stimulates the nerve endings of the heat and pain receptors in the skin.
2. Impulses are produced. The impulses travel along the sensory neurone to the spinal cord.
3. In the spinal cord, the impulses are transmitted across a synapse to the intermediate neurone, then across another synapse to the motor neurone.
4. Motor impulses leave the spinal cord along the motor neurone to the effector.
5. The effector is the biceps muscle, which contracts. This brings about a sudden withdrawal of the hand.

(b) Hormonal responses are slower because hormones, which initiate and control the responses, are chemicals transported by blood. In reflex actions, the impulses are electrical in nature and are transmitted by specialised cells, neurones that make up nerve tissues.

**Question 6**

(a) (i) Describe how a named hormone leaves the organ that produces it and arrives at the cells of its target organ. (You should refer to all structures involved during its journey.)

(ii) Explain the effect of the hormone you have named on its target organ. [9]

(b) Describe what happens to hormones after they have brought about their effects on their target organs. [3]

**Solution**

(a) The hormone insulin is secreted by a small group of cells called the Islets of Langerhans in the pancreas. The pancreas is an endocrine gland, which is a ductless gland. Insulin is secreted directly into the blood plasma of the bloodstream. The deoxygenated blood containing the hormone leaves the pancreas through the veins, which join with the vena cava leading to the heart. The blood enters the right atrium of the heart and gets pumped to the lungs via the pulmonary artery when the right ventricle contracts. The blood replenishes its oxygen in the lungs and returns to the left side of the heart via the pulmonary vein. The oxygenated blood is finally pumped to the rest of the body via the aorta when the left ventricle contracts. The blood is sent to the liver, which is its target organ, via the hepatic artery. Insulin in the blood stream diffuses out into the liver cells and stimulates the cells to convert excess glucose to glycogen for storage in the liver cells.

(b) After they have performed their function, hormones are eventually carried to the liver by blood and eventually destroyed by the liver. They are converted to inactive substances by the liver cells and are excreted by the kidneys.

**Question 7**

State how a named addictive drug can affect reflex actions. [2]

[I99/P2/Q10c]
Alcohol is a depressant. Excessive consumption of alcohol results in a high level of alcohol in the blood. The alcohol depresses the central nervous system by slowing down the rate of transmission of nerve impulses initiated by external stimuli to the central nervous system. This results in slower reactions, poor muscle coordination and poor judgment.

**Question 8**

(i) Explain the antagonistic action of the iris muscles.

(ii) In the presence of bright light, the circular muscles of the iris contract and the radial muscles relax causing the pupils to become smaller in size. In dim light, the radial muscles of the iris contract while the circular muscles relax, causing the pupils to become larger in size.
Question 9

Figure 3.1 shows some of the structures involved in a reflex action.

Muscles work as a pair to bend the arm at the elbow.

(a) (i) State the term used to describe such a pair of muscles.

(ii) Explain why muscles are arranged in this way. [2]

(b) (i) As a result of a stimulus, the hand moves in the direction shown. On Fig. 3.1, indicate with an arrow, and label, the place where a named suitable stimulus might be applied to produce this movement.

(ii) Complete Fig. 3.1 by drawing, in their correct positions, and labelling, the following structures involved in this reflex action:

- sensory neurone,
- relay neurone,
- motor neurone,
- muscle.

(iii) State three ways in which this action differs from a deliberate decision to lower the arm.

[7]

Solution

(a) (i) Antagonistic muscles

(ii) The muscles are arranged in such a way that when they contract they pull in opposite directions. When the biceps contract, the forearm bends. When the triceps contract, the arm straightens.
(a) How does an external stimulus reach the brain?

(b) Describe briefly how the brain receives information about the external environment.

(c) Describe briefly how the brain receives information about the external environment.

(d) Describe briefly how the brain receives information about the external environment.

(e) Describe briefly how the brain receives information about the external environment.

(f) Describe briefly how the brain receives information about the external environment.

(g) Describe briefly how the brain receives information about the external environment.

(h) Describe briefly how the brain receives information about the external environment.

(i) Describe briefly how the brain receives information about the external environment.

(j) Describe briefly how the brain receives information about the external environment.

(k) Describe briefly how the brain receives information about the external environment.

(l) Describe briefly how the brain receives information about the external environment.

(m) Describe briefly how the brain receives information about the external environment.

(n) Describe briefly how the brain receives information about the external environment.

(o) Describe briefly how the brain receives information about the external environment.

(p) Describe briefly how the brain receives information about the external environment.

(q) Describe briefly how the brain receives information about the external environment.

(r) Describe briefly how the brain receives information about the external environment.

(s) Describe briefly how the brain receives information about the external environment.

(t) Describe briefly how the brain receives information about the external environment.

(u) Describe briefly how the brain receives information about the external environment.

(v) Describe briefly how the brain receives information about the external environment.

(w) Describe briefly how the brain receives information about the external environment.

(x) Describe briefly how the brain receives information about the external environment.

(y) Describe briefly how the brain receives information about the external environment.

(z) Describe briefly how the brain receives information about the external environment.
Solution

(a) A: Pituitary gland
B: Hypothalamus
C: Cerebral Hemisphere
D: Cerebellum
E: Medulla Oblongata

The main functions of each of the labelled parts are summarised below:

<table>
<thead>
<tr>
<th>Parts of the Brain</th>
<th>Function</th>
</tr>
</thead>
</table>
| Pituitary gland (The Master gland) | An endocrine gland which secretes a number of hormones directly into the bloodstream to control and regulate various body’s activities:  
1. Growth hormone which controls the rate of bone growth.  
2. Thyroid-stimulating hormone which stimulates the thyroid gland to secrete hormone Thyroxine. Thyroxine influence growth (especially in childhood) by controlling respiration and rate of metabolic processes.  
3. Gonad-stimulating hormone which stimulates the gonads (ovaries and testes) to secrete sex hormones.  
4. Anti-diuretic hormone which promotes reabsorption of water in kidney nephrons and reduces urine volume. |
| Hypothalamus                  | Controls blood pressure, heart rate, and peristaltic movements in alimentary canal.  
Contains osmoreceptors and thermal receptors to detect changes in concentration and temperature of blood to help regulate water balance and temperature to maintain a constant environment in body. |
| Cerebral Hemisphere           | Controls all voluntary actions. Cerebral cortex divided into regions containing specialised groups of neurones responsible for generating sensations such as touch, vision, hearing, taste and smell. Responsible for intelligence, reasoning, processing and storage of information. |
| Cerebellum                    | Control and coordinates muscles to maintain balance.                     |
| Medulla Oblongata             | Controls involuntary (automatic) functions such as heart and breathing rates, blood circulation etc. |

(b) An external stimulus such as the sight of a sharp object approaching the eye is detected by the photoreceptors in the retina of the eye and initiates nerve impulses in the sensory neurones. The nerve impulses travels along sensory neurones, which joins to form the optic nerve, to the sensory area concerned with vision in the cerebral cortex of the brain.
COMMENT ON ANSWER

Pupil reflex:

1. The Pupil reflex controls the amount of light entering the eye, ensuring that there is sufficient light for clear vision and reducing the impact of over-exposure.

2. Pupil size is affected by the action of the iris muscles, which adjust to control the amount of light entering the eye. The iris muscles contract and dilate to regulate the amount of light entering the eye, which is then focused onto the retina.

3. As the lamp is moved from position 1 to 2, the diameter of the pupil is increased from 3.1 mm to 4.0 mm.

4. The table shows the diameter of the lamp's position and the diameter of the pupil at that position:

<table>
<thead>
<tr>
<th>Position of Lamp (mm)</th>
<th>Diameter of Pupil (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>2</td>
</tr>
<tr>
<td>3.9</td>
<td>3</td>
</tr>
<tr>
<td>4.4</td>
<td>4</td>
</tr>
<tr>
<td>3.8</td>
<td>6</td>
</tr>
<tr>
<td>4.2</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 2

5. At seven different positions, Table 2 shows the diameter of the lamp's position and the diameter of the pupil when the lamp was placed.

Figure 4

6. Figure 4 shows a person taking part in an experiment on the eye's response to

Question II

Pupil reflex experiment
Question 12

Fig. 6 shows a section through an eye.

![Diagram of an eye with labels A, B, C, D, E, and F]

Fig. 6

(a) Explain what happens in the eye when a person reads the words on the page of a book. Your answer should refer to, and identify, structures A to F on the diagram. [10]
(b) Suggest why it is an advantage to have two eyes instead of one. [2]

[J96/P2/Q9]

Solution

(a) When a person reads the words on the page of a book, his eyes accommodate for near vision. The circular muscles of the ciliary body (D) contract. This slackens the pull on the suspensory ligaments (A) and the lens (B). The elastic nature of the lens causes it to become thicker and more convex.

Light rays from the words are reflected into the eye and through the cornea (C), which is transparent. Since the cornea is a denser medium than air, light rays falling onto it are refracted inwards towards the lens. The thickened lens has a shorter focal length and is able to bring the diverging rays from the words into focus on the fovea centralis (E).

The image of the words on the fovea stimulates the photoreceptors there. These are connected to the nerve-ends from the optic nerve (F). This nerve conveys the impulses to the brain where the image is processed and its meaning recognized.

(b) The two eyes give us stereoscopic vision. This enables us to see three-dimensional objects, and to get a better perception of size, depth, and distance of the object from us.

[J94/P2/Q9]

Question 13

(a) Describe the events which occur from the moment a person accidentally touches a very hot object to the moment the hand is lifted clear. [9]
(b) Explain how the action of deliberately raising the arm differs from the sequence of events described in (a). [3]

[J94/P2/Q9]
Then a person accidentally touches a very hot object, a simple reflex action occurs. The sequence of events is as follows:

- The heat on the object stimulates the nerve endings (receptor) in the skin.
- Impulses are produced. These travel along the sensory neurone to the spinal cord.
- In the spinal cord, the impulses are transmitted across a synapse to the intermediate neurone, then across another synapse to the motor neurone.
- Motor impulses leave the spinal cord along the motor neurone to the effector.

The effector is the biceps muscle, which contracts. This brings about a sudden withdrawal of the band.

**Question 14**

(a) What is a reflex action?  
(b) Nerves and hormones are both used to control processes within the body. Using examples, show how nervous control and hormonal control (i) resemble, and (ii) differ from one another.

**Solution**

(a) A reflex action is an immediate response to a specific stimulus without conscious control. It is the simplest form of response in higher animals.

(b) (i) Hormonal control and nervous control are similar in that both serve as a means of co-ordination within the body. In both cases, a stimulus causes the transmission of a message to a target organ (effector) which carries out a response. For example, when the hand touches a hot object, the heat on the object stimulates the nerve endings in the skin. Impulses are produced, and transmitted via the spinal cord to the biceps muscle.
**Solution**

1. When a person accidentally touches a very hot object, a simple reflex action occurs. The sequence of events is as follows:

   1. The heat on the object stimulates the nerve endings (receptor) in the skin.
   2. Impulses are produced. These travel along the sensory neurone to the spinal cord.
   3. In the spinal cord, the impulses are transmitted across a synapse to the interneurone, then across another synapse to the motor neurone.
   4. Motor impulses leave the spinal cord along the motor neurone to the effector.
   5. The effector is the biceps muscle, which contracts. This brings about a sudden withdrawal of the hand.

**Question 14**

(a) What is a reflex action?

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(a) A reflex action is an immediate response to a specific stimulus without conscious control. It is the simplest form of response in higher animals.

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which when contract, bringing about a sudden withdrawal of the hand.
In the hormonal system, a decrease in osmotic pressure in the blood
causes anti-diuretic hormone to be produced and transported to the
kidneys. The kidneys respond by absorbing more water.

(ii) Differences between nervous and hormonal control:

<table>
<thead>
<tr>
<th>Nervous control</th>
<th>Hormonal control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Involves nervous impulses.</td>
<td>Involves hormones.</td>
</tr>
<tr>
<td>2. Impulses are transmitted by neurones.</td>
<td>Hormones are transported by blood.</td>
</tr>
<tr>
<td>3. Quick response. E.g. when hand touches a hot</td>
<td>Slow response. E.g. testosterone controls the</td>
</tr>
<tr>
<td>object, there is a sudden withdrawal of the hand, a</td>
<td>development of male sex organs and secondary sexual</td>
</tr>
<tr>
<td>perception of pain and even a cry of pain immediately.</td>
<td>characteristics. This develops over a period of time.</td>
</tr>
<tr>
<td>4. Response short-lived. E.g. The responses to a hot</td>
<td>Response may be short-lived or long-lived. E.g. The</td>
</tr>
<tr>
<td>object cease once the object is removed.</td>
<td>effects of testosterone last forever.</td>
</tr>
<tr>
<td>5. May be voluntary or involuntary. E.g. The reflex</td>
<td>Always involuntary. The activities of some endocrine</td>
</tr>
<tr>
<td>actions are involuntary. Desired actions such as</td>
<td>glands are controlled by the nervous system e.g. the</td>
</tr>
<tr>
<td>wishing to pull your hand away when someone touches</td>
<td>adrenal medulla. Others are regulated by chemical</td>
</tr>
<tr>
<td>you are voluntary.</td>
<td>substances or by other endocrine glands.</td>
</tr>
<tr>
<td>6. Usually localised. The effect usually takes place</td>
<td>May affect more than one target organ. E.g. Progesterone causes</td>
</tr>
<tr>
<td>at only one set of muscles.</td>
<td>enlargement of wall of uterus, mammary glands and</td>
</tr>
<tr>
<td></td>
<td>prevents ovulation.</td>
</tr>
</tbody>
</table>

**Question 15**

Fig. 2.1 shows a section through the spinal cord and also some of the muscles and bones of the arm (not drawn to the same scale).

(a) On the diagram,
(i) label bones E and F;
(ii) draw in the neurone carrying impulses from the spinal cord to the triceps muscle. [5]
Solution

(1) When an athlete is starting a race, the anterior and posterior tibialis contract the muscles of the lower leg. The knee moves from position 1 to 2, the knee extensor muscles will move the leg forward.

(2) The movement in the figure is shown about the ankle joint. The figure shows the leg moving from position 1 to 2.

(3) The knee extensor muscles will connect to the anterior tibialis at the ankle. It is identified by letter A. The tibialis anterior muscle is shown in the figure.

(4) The diagram shows the leg of an athlete as he starts a race. The arrow in the direction of the arrow shows the movement of the leg.

(5) Define a hormone.

(6) Explain how the body increases the glucose level before the start of a race.

(7) There is a reason why the anterior tibialis muscle does movement. Explain why.

(8) Which tibialis anterior muscles will connect to the anterior tibialis muscle of the lower leg moves from position 1 to 2.

(9) Identify, by letter, two extensor muscles in Figure 2.2.
Question 17

Fig. 5.1 shows an outline of the upper part of a human body and the positions of some of the internal organs.

![Diagram of human body with labeled organs: stomach, kidney]

**Fig. 5.1**

(a) Some glands (endocrine glands) produce chemical substances that alter the activity of target organs. Name the group of chemical substances produced by endocrine glands. [1]

(b) (i) On Fig. 5.1, use the letters G and H and label lines to indicate the positions of two different endocrine glands. [2]

(ii) Complete Table 5.1 for glands G and H. [4]

<table>
<thead>
<tr>
<th>name of gland</th>
<th>chemical produced</th>
<th>effect on the body</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(c) Suggest an explanation for the fact that the chemicals produced by endocrine glands are usually in the form of small molecules. [2]
Hormones are secreted into the bloodstream and transported by the blood stream and reach cells in target organs.

- Liver produces cell membranes and walls of blood vessels into the blood.
- Blood plasma. They need to be small in order to diffuse faster across force.

---

<table>
<thead>
<tr>
<th>Concentration of Hormone in Blood</th>
<th>Insulin</th>
<th>Pancreas</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Glucose in the Liver. It helps to maintain the concentration of excess Glucose in the blood.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition of the Pancreatic Cells</th>
<th>Adrenalin</th>
<th>Adrenal Gland</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>High or Low. For example: Light or Sleep, The overall effect is to prepare the body for the body.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Effect on the Body | Produced | Chemo 
|--------------------|----------|---|
| Name of hormone

---

**Comment on Answer**

- Insulin is secreted by the pancreas.
- The beta cells of the islet of Langerhans are located in the pancreas. They produce insulin.
- Insulin helps to lower blood glucose levels.

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**Solution**

- H: Hormone (Insulin)
- G: Glands (Pancreas)
Question 18

In an experiment, a person looked at the same light source from various different distances. The diameter of their pupil was measured at each distance. Fig. 2.1 shows how the diameter varied.

(a) Describe the relationship between the distance from the light source and pupil diameter shown in Fig. 2.1. [2]

(b) What type of response accounts for this change in pupil diameter? [1]

(c) Explain how the response is brought about as the distance from the light source is increased from 2 to 4 m. [5]

(d) Albino people lack colouring material (pigment) in their bodies. Suggest why albino people should avoid looking at bright lights. [3]

Solution

(a) The pupil diameter increases as the distance from the light source increases. As the light intensity decreases, the size of the pupil increases.

(b) A reflex action or pupil reflex has occurred.

(c) The diameter of the pupil increases from 1.2 to 2.2 mm when the light source is moved from 2 m to 4 m. As the light intensity entering the eye is decreased, the photoreceptors in the retina are stimulated and nerve impulses are initiated. The information about the change in the light intensity of the external environment is transmitted as electrical nerve impulses via the sensory neurones in the optic nerve to the brain, which then transmits them to the motor neurones. The nerve impulses are finally sent to the circular and radial muscles of the iris to produce a response. The circular muscles of the iris relax and the radial muscles in the iris contract causing the size of the pupil to increase.

(d) The lack of pigment in the eye of an albino leads to hyper-photosensitivity. The absence of melanin pigment in the choroid layer of the eye causes internal reflection of light within the eyeball resulting in blurred vision. The iris of an albino is therefore, not an opaque disc and allows stray light to enter the eye.

COMMENT on ANSWER

(b) The pupil reflex controls the amount of light entering the eye. The size of the pupil changes with changing light conditions, dilating in dim conditions to allow sufficient light for the formation of sharper images and constricting in bright light to protect the retina from damage by high light intensity.

(d) Albinism results from a mutation in the genes that control pigment formation in the body. Melanin pigment is absent in the skin, hair and eyes. Their skin is particularly susceptible to sunburn.