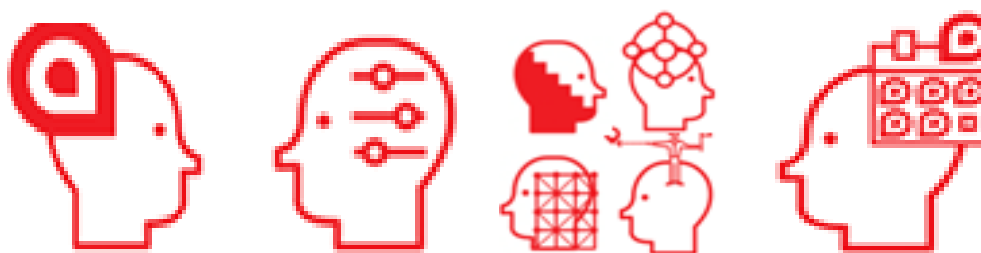




ARCHBISHOP ILSLEY CATHOLIC SCHOOL

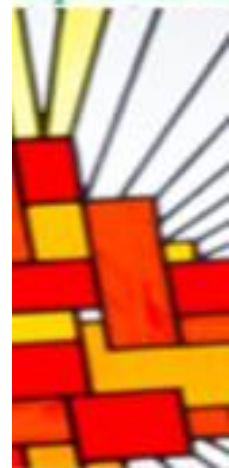
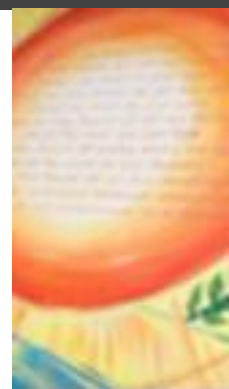
Justus et Tenax Propositi - Just and Firm of Purpose

AQA CS/Triple GCSE
Biology
B5 Homeostasis and Response
Part 1
Lessons 1-10
Knowledge and Mastery Book



Do not write in this booklet

**ALL answers to be written in your
exercise book**

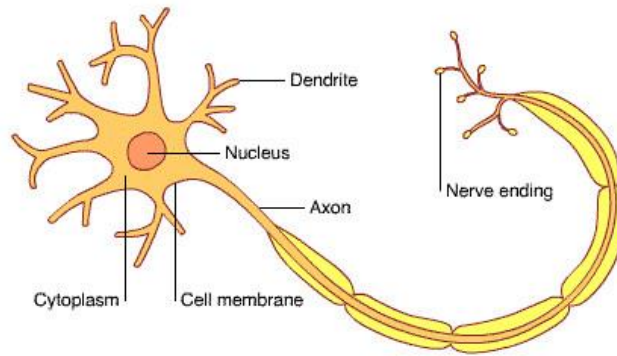


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Lesson 1 The Nervous System

The nervous system is specifically to react to our surroundings and coordinate our behaviour. The system uses **electrical** and **chemical** send information rapidly.

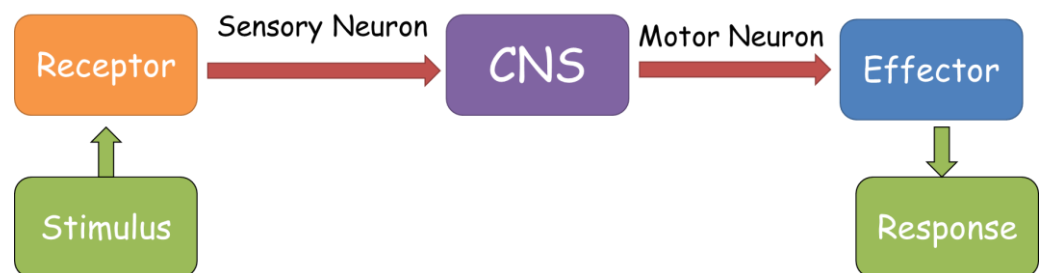
The nervous system is made of cells (neurones). **Neurones** are specialised cells which can carry **electrical** impulses along their long thin **axon**. The specialised branches at each end form connections with other neurons. Neurones come in 3 main forms **sensory** neurone, **relay** neurone and **motor** neurone.



adapted
nervous
signals so
nerve

Neurone	Function	Location
Sensory neurone	These connect receptors to the coordinator	Peripheral nervous system
Relay neurones	These coordinate the correct response to the stimulus	Central nervous system
Motor neurone	These send the signal from the coordinator to the effector	Peripheral nervous system

A stimulus is a change in the environment. This can be the environment around you or the environment around your cells. Receptor cells detect the stimulus. The CNS is responsible for coordinating all the sensory information around you, all your thoughts and maintaining all your internal systems (e.g. heart and breathing rate). Effectors are either muscles or glands. Muscles can cause the body to move or cause a change in the cardiovascular or digestive systems. Glands release hormones which can have many different effects on cells and tissues around the body.



Lesson 1 Mastery Questions

1. List 3 things humans, and all mammals, must keep constant to survive.
2. What is a receptor? Give an example
3. What is the job of the CNS and what does it stand for?
4. What is an effector? Give an example
5. What is a stimulus? Give an example
6. What are two differences between nervous and hormonal responses?
7. What does 'optimum' mean?
8. Draw a 'lock and key' diagram to show the specific action of enzymes. Include the following labels: *Enzyme, substrate, active site, enzyme-substrate complex, product*
9. Define 'denatured' a diagram might help
10. What is the scientific word for a nerve cell?
11. What kind of signal passes along neurones?
12. What is the name for the cells which detect changes in the environment?
13. Name the 3 types of neurones in a reflex arc
14. What are the two coordinators of the nervous system?
15. Why is a reflex arc automatic?
16. Define 'effector'
17. What type of signal passes through a synapse
18. Define 'diffusion'
19. What is the name of the organelle which contains the genetic material in the neurone?
20. List 2 ways a neurone is specialised to carry out its function.

Lesson 1 Exam Questions

Q1.

Caffeine is a drug that affects reaction time.

Coffee is a drink that contains caffeine.

Five students investigated the effect of drinking coffee on their reaction time.

Each student sat in front of a computer screen showing a reaction timer.

This is the method used.

1. Press any key on the keyboard when the colour of the screen changes to green.
2. Record the reaction time shown on the computer screen.
3. Drink coffee containing caffeine.
4. Wait 15 minutes then repeat steps 1 and 2.

(a) What is the dependent variable in the investigation?

Pick one:

The coffee containing caffeine Number of students Reaction Time

(1)

(b) Give **two** control variables the students should have used.

(2)

(c) Why did the students wait 15 minutes after drinking the coffee before repeating the test?

(1)

(d) Responding to the colour change of the screen involves a receptor in the student.

Where is the receptor in the student?

Pick one:

Ear Eye Skin

(1)

(e) Responding to the colour change of the screen involves an effector in the student.

What is the effector in the student?

Pick one:

Brain Gland Muscle Spinal Cord

The table below shows the results.

Student	Reaction time in milliseconds	
	Before drinking coffee	After drinking coffee
1	385	255
2	420	291
3	285	265
4	871	259
5	463	247

- (f) What is the effect of drinking coffee on reaction time?

Use the table above.

(1)

- (g) Which student had the smallest change in reaction time after drinking coffee?

Pick one:

Student 1 Student 2 Student 3 Student 4 Student 5

(1)

- (h) The students decided that one of the results was anomalous.

What should the students do with the anomalous result when calculating the mean change in reaction time?

(1)

(Total 9 marks)

Q2.

Humans use the nervous system to react to changes in the environment.

- (a) (i) Which word means a change in the environment?

Draw a ring around the correct answer.

neurone

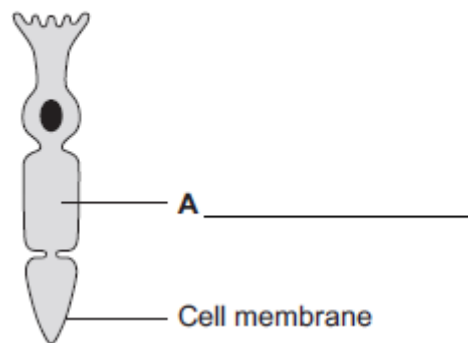
reflex

stimulus

(1)

- (ii) **Figure 1** shows a light receptor cell.

Figure 1



Use the correct answer from the box to label part **A** on **Figure 1**.

chloroplast

cytoplasm

vacuole

(1)

- (b) **Figure 2** shows a boy riding a bicycle on a sunny day.

Figure 2



- (i) Receptors in the boy's body detect changes in the environment.

Which organ contains receptors for the following:

Sound of traffic from behind him

Flashing blue lights of a police car

Cooler air temperature in the shadows

(3)

- (ii) The boy's response to danger is to pull on the bicycle brakes.

Which type of effector causes this response?

Pick one:

Gland

Muscle

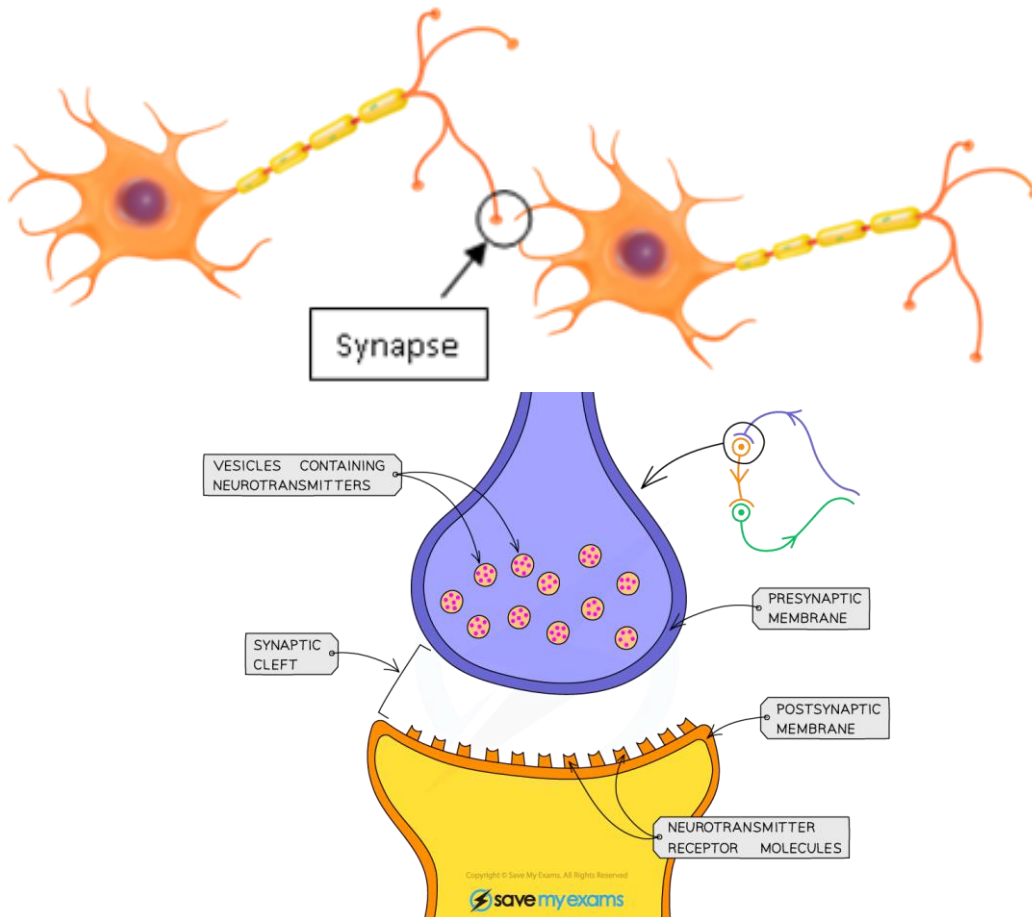
Synapse

(Total 6 marks)

(1)

Lesson 2 Synapses and the Reflex Arc

Where a nerve ends and joins to another there is a gap. This gap is known as a **synapse**. At the synapse, the electrical signal is transferred into a chemical signal that **diffuses** across the gap. This is done because the electrical signal used in neurones cannot cross the gap. Synapses slow down the message slightly as chemical signals travel more slowly than electrical signals.



How a synapse works (HT only)

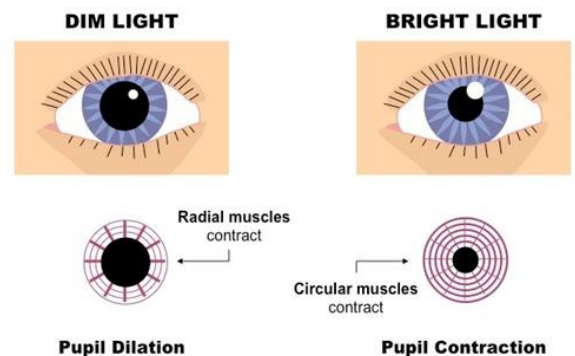
1. An electrical impulse in the first neuron causes a neurotransmitter chemical to be released
2. The chemicals **diffuse** across the gap between neurons
3. The chemicals then attach, bind, to receptors on the cell membrane of the second neuron
4. This triggers a chain reaction which causes an electrical impulse to be generated in the second neuron

In summary: A chemical message is converted into an electrical message to cross the synaptic cleft and is then reconverted into an electrical message.

The Reflex Arc

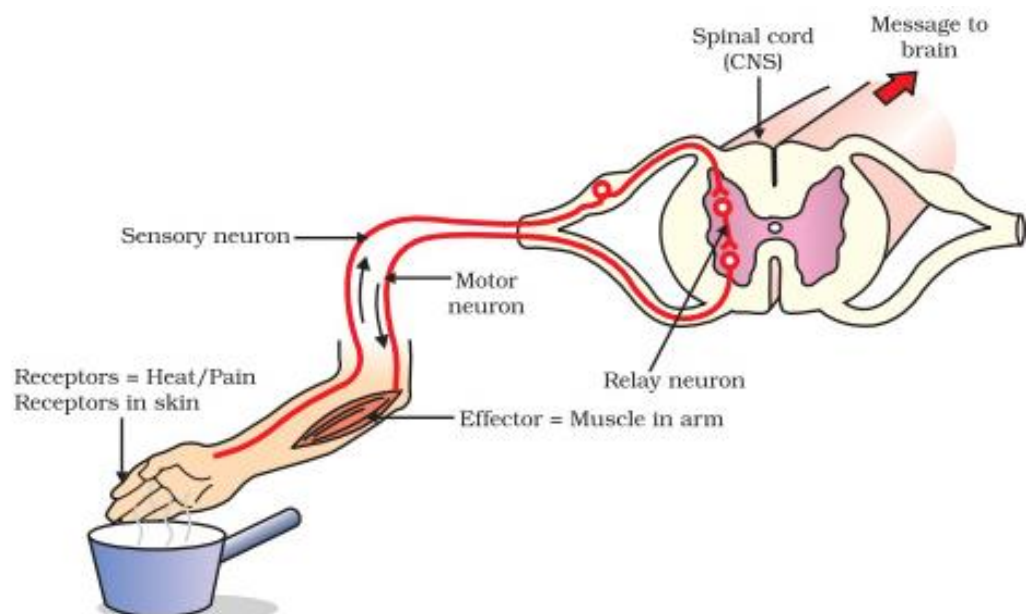
Reflexes are automatic responses that don't require conscious thought. This means the signal never goes to your brain. They still have to send a signal to the CNS but they only go to the spinal cord. The same neurons are also involved, sensory, relay and motor. However, they only pass through 1 relay neuron in the spinal cord. This reduces the number of synapses the message passes across making the time between stimulus and response much shorter.

A good example is in the eye. When the light levels are low, and it is dark your pupils get bigger, dilate. If you move into the light, your eyes detect the increase in light and automatically your pupils will shrink, constrict. This happens without conscious thought. Eyes are a very delicate and important sense for many animals. By quickly adjusting to light



conditions, we can protect the light receptor cells in our eyes from being damaged by too much light. You experience a temporary form of this damage when you stare at a bright light and still have a bright spot in your vision when you look away or close your eyes. If our eyes did not adjust so quickly and without our knowledge to changing light levels this would happen much more often and could result in lasting damage.

Another example of a reflex arc is in response to pain. Imagine accidentally touching something hot or a pin with your hand. Your body will respond by instantly withdrawing your hand. Below is a diagram showing the basic structure of a reflex arc.



Lesson 2 Mastery Questions

1. What is the name of the gap and the surrounding structures in a neurone?
2. In as few words as possible describe what happens at a synapse.
3. What do synapses do to the speed of transmission?
4. Why does the above answer have to happen?
5. What is a reflex action?
6. How is a reflex action different from an action you choose to do?
7. Is blinking a reflex?
8. Is walking a reflex?
9. Where do reflexes go to?
10. What makes a reflex faster than a normal response?
11. Describe the pupil reflex.
12. Why is it important the pupil reflex is automatic?
13. Describe the pain reflex.
14. Why is it important that the pain reflex is automatic?

Higher Tier Only Mastery Questions (to be done in addition to the above)

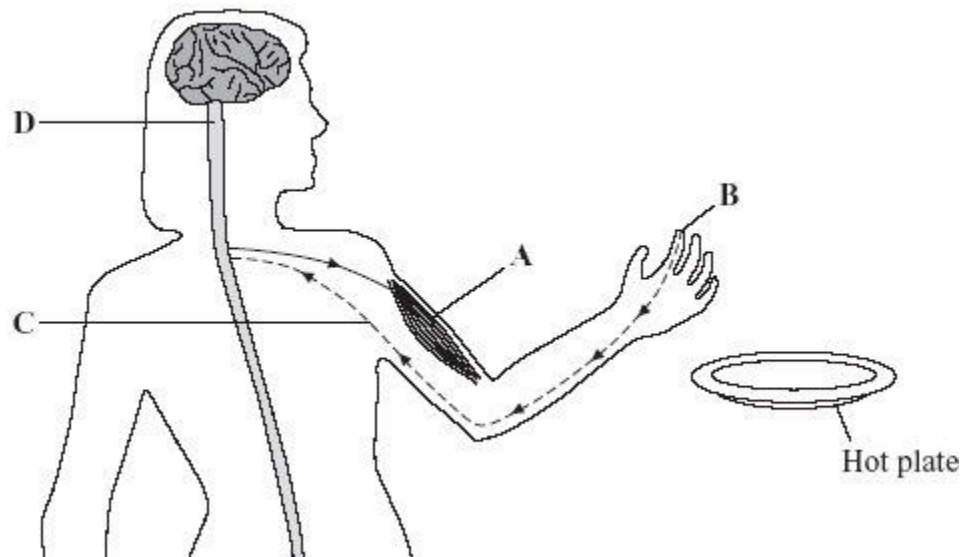
1. What is the name of the chemical released when the electrical impulse reaches the synapse?
2. What process allows the chemical to move across the gap?
3. What do these chemicals do at the second neurone?
4. In as few words as possible describe what happens at a synapse.
5. What do synapses do to the speed of transmission?

Lesson 2 Exam Questions

Q1.

A girl picks up a hot plate. A reflex action causes her to drop it.

The diagram shows some of the structures involved in this reflex action.



Use words from the box to name the structures labelled **A**, **B**, **C** and **D**.

brain	gland	muscle	neurone	receptor	spinal cord
-------	-------	--------	---------	----------	-------------

(Total 4 marks)

Q2.

Reflex actions are rapid and automatic.

(a) Name the following structures in a reflex action.

- (i) The structure that detects the stimulus.
- (ii) The neurone that carries impulses to the central nervous system.
- (iii) The neurone that carries impulses away from the central nervous system.
- (iv) The structure that brings about the response.

(4)

(b) Describe what happens at a synapse when an impulse arrives.

(2)

(c) Some people have a condition in which information from the skin does not reach the brain.

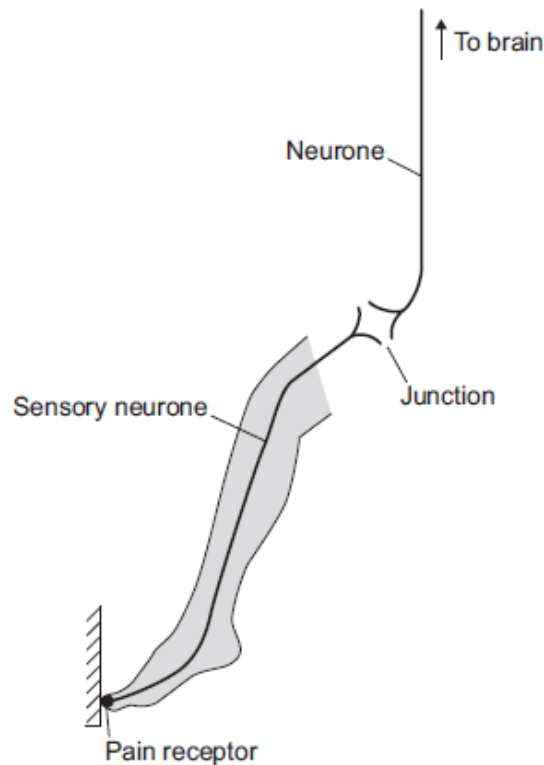
Explain why this is dangerous for the person.

(2)

(Total 8 marks)

Q3. HIGHER TIER ONLY

The diagram shows the pathway of an impulse from a pain receptor when someone bangs their toe on a hard surface.



- (a) (i) What is the junction between neurones called?

(1)

- (ii) How does information cross the junction between neurones?

(1)

- (b) If you bang your toe you feel the pressure of the impact before you feel the pain. This is because the impulse from a touch receptor travels faster than the impulse from a pain receptor.

The speed of transmission of the impulse from a touch receptor is 76.2 m / s.

The speed of transmission of the impulse from a pain receptor is 0.60 m / s.

The following equation can be used to calculate how long it takes for each impulse to reach the brain:

$$\text{Speed of transmission} = \frac{\text{distance}}{\text{time}}$$

If the distance each impulse has to travel from the toe to the brain is 1.920 metres, it will take 0.025 seconds for the impulse from the touch receptor to reach the brain.

Calculate how much **longer** it will take the impulse from the pain receptor to reach the brain.

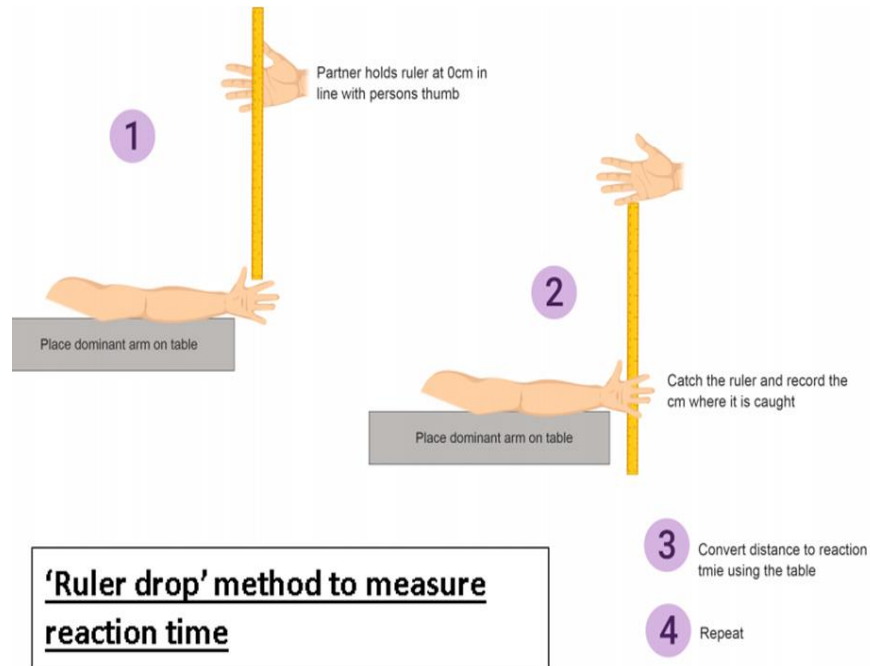
You must show your working.

(3)

(Total 5 marks)

Lesson 3 Human Reaction Time

The time taken to complete the nervous pathway from stimulus to response is called reaction time. The reaction times of humans are all slightly different and can be affected by external factors. Factors that affect reaction time include age, gender, physical fitness, fatigue, distraction. Drugs also effect reaction time. Depressants such as alcohol and cannabis slow reaction time whereas stimulants such as caffeine may increase reaction time.



Reliability and Accuracy

Key Word	What does it mean?	How can we check and improve?
Accuracy	How close to the true value your results are	<ul style="list-style-type: none"> Remove chances for error in experiment Use higher resolution measurements and equipment Ensure all control variables have been identified
Reliability	How much can you trust your results are accurate	<ul style="list-style-type: none"> Are your repeats similar to each? Improve reliability by removing anomalies and doing more repeats

Factors effecting reaction time
Caffeine intake
Amount of sleep
Distractions

Sources of error in the method
<ul style="list-style-type: none"> Not holding the ruler exactly at 0cm by the catcher's hand Not recording the correct measurement because the ruler was caught at an angle Catcher able to anticipate when ruler will be dropped

How can we improve the ruler drop test?

Using a computer to measure reaction time reduced human error in measurement and ensures each participant has exactly the same conditions. All control variables also need to be kept the same prior to the experiment.

Lesson 3 Mastery Questions

1. What is accuracy?
2. How can we improve the accuracy of the ruler drop experiment?
3. What is reliability?
4. How can we improve the reliability of the ruler drop experiment?
5. What is the independent variable in this investigation?
6. What is the dependent variable in this investigation?
7. What are the control variables in this investigation?

Lesson 3 Exam Questions

Q1. Level 1

Caffeine is a drug that affects reaction time.

Coffee is a drink that contains caffeine.

Five students investigated the effect of drinking coffee on their reaction time.

Each student sat in front of a computer screen showing a reaction timer.

This is the method used.

1. Press any key on the keyboard when the colour of the screen changes to green.
2. Record the reaction time shown on the computer screen.
3. Drink coffee containing caffeine.
4. Wait 15 minutes then repeat steps 1 and 2.

- (a) What is the dependent variable in the investigation?

Pick one:

The coffee containing caffeine The number of students Reaction time

(1)

- (b) Give **two** control variables the students should have used.

(2)

- (c) Why did the students wait 15 minutes after drinking the coffee before repeating the test?

(1)

- (d) Responding to the colour change of the screen involves a receptor in the student.

Where is the receptor in the student?

Pick one:

Ear Eye Skin

(1)

- (e) Responding to the colour change of the screen involves an effector in the student.

What is the effector in the student?

Pick one:

Brain Gland Muscle Spinal Cord

(1)

The table below shows the results.

Student	Reaction time in milliseconds	
	Before drinking coffee	After drinking coffee
1	385	255
2	420	291
3	285	265
4	871	259
5	463	247

- (f) What is the effect of drinking coffee on reaction time?

Use the table above.

(1)

- (g) Which student had the smallest change in reaction time after drinking coffee?

Pick one:

Student 1 Student 2 Student 3 Student 4 Student 5

(1)

- (h) The students decided that one of the results was anomalous.

What should the students do with the anomalous result when calculating the mean change in reaction time?

(1)

(Total 9 marks)

Q2. Level 2

Some students investigated the effect of drinking caffeine on reaction time.

They used a drink containing 32.25 mg of caffeine per 100 cm³. The method is shown below:

1. Divide the students into four groups, **A**, **B**, **C** and **D**.
2. Measure and record the reaction time of each student using the ruler-drop test.
3. Students in:
 - group **A** drink 200 cm³ of water
 - group **B** drink 200 cm³ of the caffeine drink
 - group **C** drink 400 cm³ of the caffeine drink
 - group **D** drink 600 cm³ of the caffeine drink.
4. Repeat step 2 after 15 minutes.

- (a) Describe how to do the ruler-drop test.

(3)

- (b) **Table 1** shows the mass of caffeine taken in by each student.

Table 1

Group	Mass of caffeine in mg
A	0
B	64.5
C	129.0
D	X

Calculate value **X**.

(1)

- (c) Why did group **A** drink water instead of the caffeine drink?

(1)

Table 2 was used to convert the results of the ruler-drop test into reaction times.

Table 2

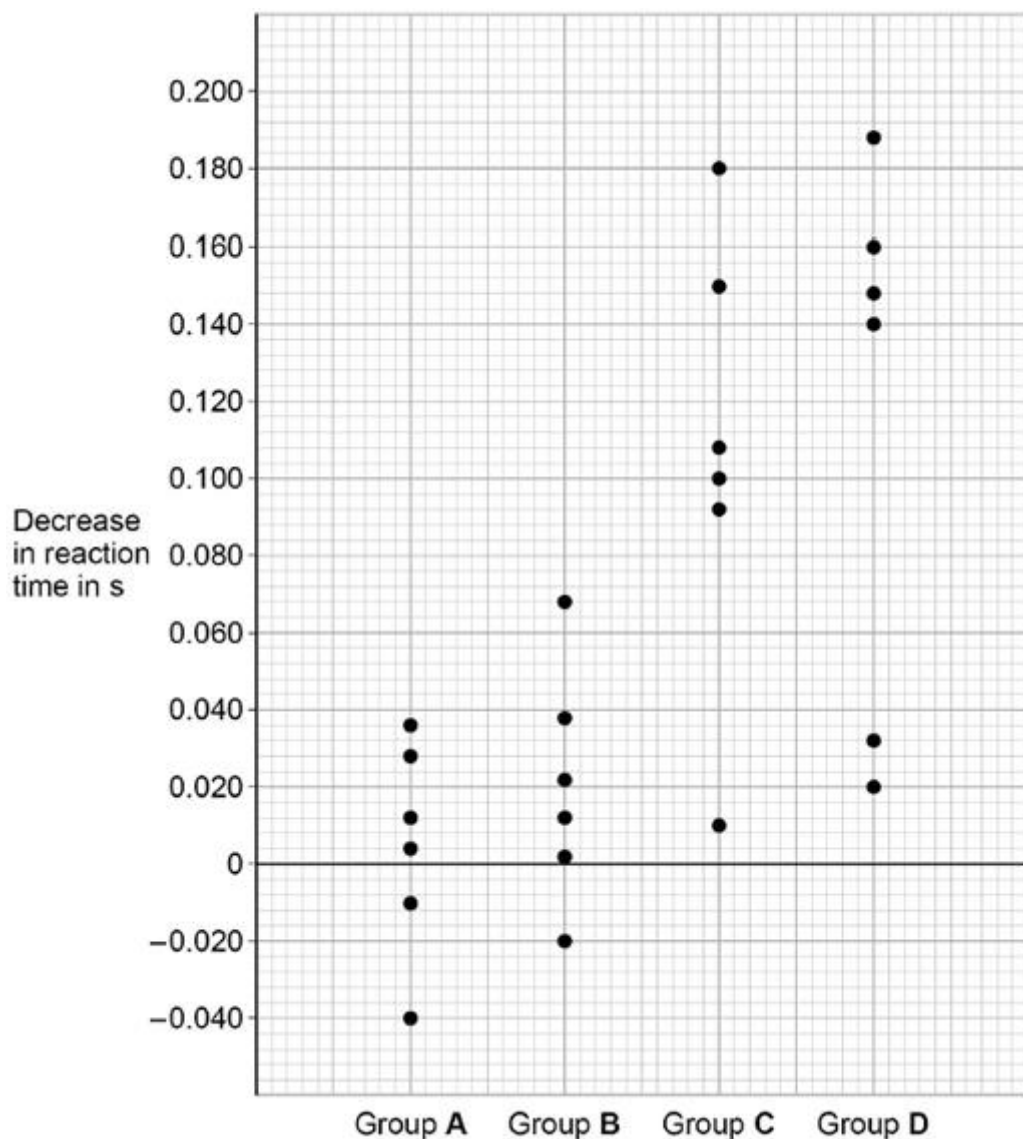
Distance in cm	Reaction time in s	Distance in cm	Reaction time in s
2	0.064	28	0.239
4	0.090	30	0.247
6	0.111	32	0.256
8	0.128	34	0.263
10	0.143	36	0.271
12	0.156	38	0.278
14	0.169	40	0.286
16	0.181	42	0.293
18	0.192	44	0.300
20	0.202	46	0.306
22	0.212	48	0.313
24	0.221	50	0.319
26	0.230	52	0.326

- (d) Estimate the reaction time for a student who recorded a distance of 23 cm

(1)

Students calculated the decrease in their reaction time after the drink compared with before the drink.

The graph shows the results for each student.



- (e) Describe the effect of the mass of caffeine taken in on the decrease in reaction time. (1)
- (f) For three students the decrease in reaction time was negative.
Give the reason why the value was negative. (1)
- (g) What is the range of results for group **C**? (1)
- (h) Suggest **two** variables that should have been controlled in this investigation. (2)
- (i) Explain why the ruler-drop test does **not** involve a reflex action. (2)

(Total 13 marks)

Q3. Level 3 (Higher Tier Only)

Caffeine is a drug that decreases reaction time.

A group of sixteen students investigated the effect of caffeine on reaction time.

The students were all 15-year-old girls.

The group was divided into 8 pairs of students.

This is the method used.

1. Student **A** starts two stopwatches at the same time.
2. Student **A** then gives one of the stopwatches to Student **B**.
3. Student **A** says “stop” at the same time as stopping her stopwatch. Student **B** stops her stopwatch as quickly as possible after Student **A** says “stop”.
4. The difference in time shown on the two stopwatches is recorded. This is the reaction time of Student **B**.
5. Student **B** drinks a caffeinated drink.
6. The students wait 15 minutes and then repeat steps 1 to 4.

- (a) Suggest **one** control variable the students should have used in the investigation.

Do **not** refer to age or sex in your answer.

(1)

- (b) Suggest **two** sources of random error when using this method to measure a person’s reaction time.

(2)

The table below shows the results.

Student pair	Decrease in reaction time after drinking the caffeinated drink in seconds
1	0.039
2	0.021
3	0.027
4	0.041
5	0.022
6	0.036
7	0.024
8	0.097

- (c) Why can a mode **not** be determined for the data in the table above?

(1)

- (d) The students decided the result from pair **8** was anomalous.

The students calculated that the mean decrease in reaction time was 0.030 seconds.

Describe how the students calculated the mean decrease in reaction time.

(1)

- (e) Caffeine causes the release of adrenaline.

Adrenaline affects heart rate.

Explain how the effect of adrenaline on heart rate might cause reaction time to decrease.

(4)

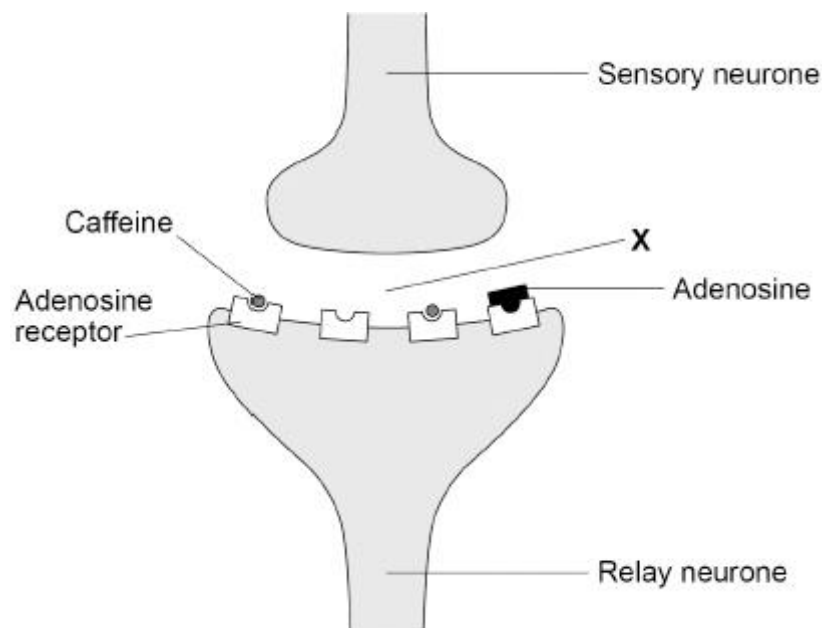
Adenosine is a different chemical made by the body.

Adenosine binds to receptors on relay neurones.

Adenosine decreases the number of impulses in relay neurones.

The figure below shows how caffeine binds to adenosine receptors on a relay neurone.

When caffeine binds to adenosine receptors it blocks the receptor so adenosine cannot bind.



- (f) Label **X** shows the gap between the sensory neurone and the relay neurone.

What is the name of the gap labelled **X**?

(1)

- (g) Suggest why reaction time decreases when caffeine binds to adenosine receptors.

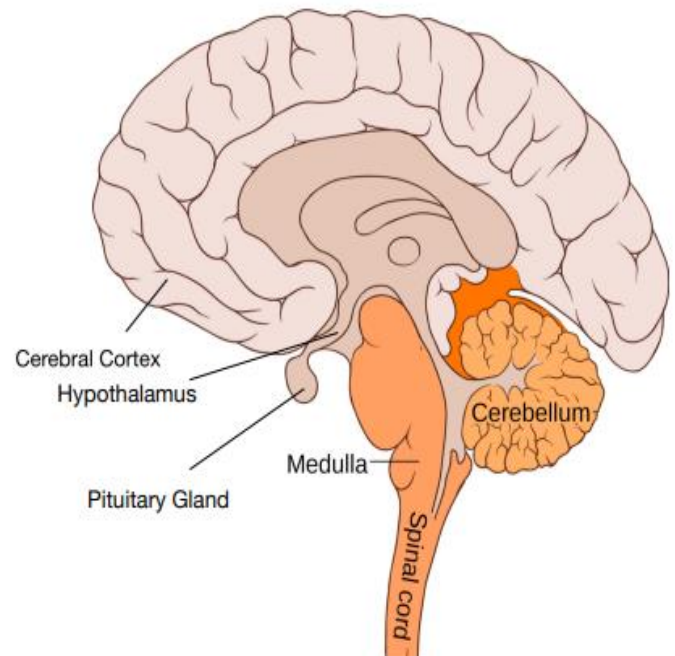
(2)

(Total 12 marks)

Lesson 4 The Brain (Triple Only)

The brain is a part of the central nervous system, along with the spinal cord, and is made of billions of connected neurones that is in charge of all complex behaviour. It controls movement (motor functions), various aspects of homeostasis including water concentration regulation and temperature regulation, and allows for emotions.

It is composed of many different sections, each with their own role. The **Cerebral cortex** is located along the outside of the brain, and is the bit that looks heavily folded. This is responsible for your consciousness, intelligence, memory and language. The **Medulla** is located towards the middle of the bottom of the brain, in an area called the brain stem. It controls your unconscious activities, including breathing and heart beat. The **Hypothalamus** is the part of your brain that is predominantly involved with homeostasis, and the **Cerebellum** is responsible for muscle coordination. All of these parts of the brain, and many more, coordinate to allow you to function as a human being.



Methods of Study

The brain is very difficult to study- any attempt to physically look at it will mean that an organism cannot undergo its normal behaviour, as having this organ exposed is incredibly risky. And physically looking at this organ does not give much information regarding its function. There are three main ways of studying the brain:

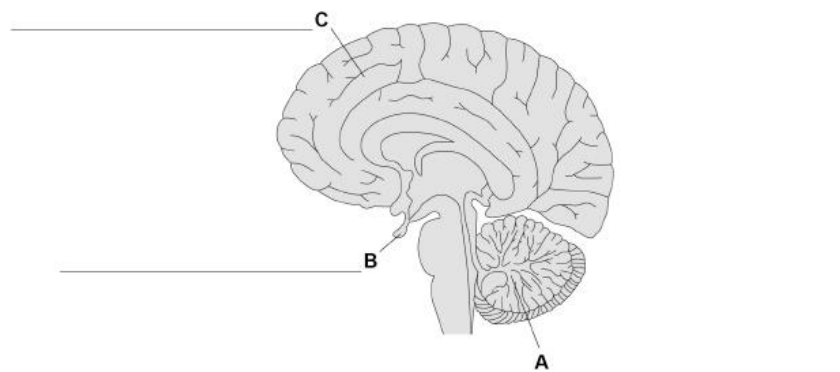
- Studying patients with brain damage, for example Phineas Gage, can allow us to see what changes about a person if certain regions of their brain are damaged- e.g., damage to the frontal cortex causing someone to lose their inhibitions (control of themselves)
- Electrically stimulating the brain can allow us to see what each part does- for example, stimulating the motor cortex causes muscular contraction, implying it is used in movement.
- MRI Scans give very detailed pictures of the brains structure, including which areas are active at a given time. For example, if a person is trying to access a memory, the region of the brain responsible for this will appear lit up on the screen.

Lesson 4 Mastery Questions

1. What does the cerebral cortex do?
2. Which part of the brain is responsible for muscle coordination?
3. Which part of the brain controls unconscious activities?
4. Which part of the brain is responsible for temperature regulation?
5. Why is it difficult to study the brain?
6. Describe 3 ways we can study the brain
7. For each of the three ways, describe what they show about brain function

Lesson 4 Exam Questions

Q1.



- (a) Label **A**, **B** and **C** on the diagram above.

Choose answers from the box.

cerebellum	cerebral cortex	medulla	pituitary gland
-------------------	------------------------	----------------	------------------------

(3)

- (b) Which part of the brain controls balance when riding a bicycle?

Pick one: Cerebellum Medulla Pituitary Gland

(1)

- (c) The ears send information about sound to the brain.

Which word describes the brain?

Pick one: Coordinator Effector Receptor Stimulus

(1)

- (d) What type of cell carries impulses from the ears to the brain?

(1)

(Total 6 marks)

Q2.

This question is about the nervous system.

- (a) Describe the difference between the function of a receptor and the function of an effector.

In your answer you should give **one** example of a receptor and **one** example of an effector.

(4)

- (b) Synapses are important in the nervous system.

(i) What is a synapse?

(2)

(ii) Describe how information passes across a synapse.

(2)

- (c) Reflexes may be co-ordinated by the brain or by the spinal cord.

(i) The reflexes from sense organs in the head are co-ordinated by the brain.

Name a sense organ involved in a reflex co-ordinated by the spinal cord.

(1)

(ii) The table shows information about reflexes co-ordinated by the brain and reflexes co-ordinated by the spinal cord.

Organ co-ordinating the reflex	Mean length of neurones involved in cm	Mean time taken for reflex in milliseconds	Mean speed of impulse in cm per millisecond
Brain	12	4	3
Spinal cord	80	50	

Calculate the mean speed of the impulse for the reflex co-ordinated by the spinal cord.

(1)

(iii) In reflexes co-ordinated by the brain there are **no** relay neurones.

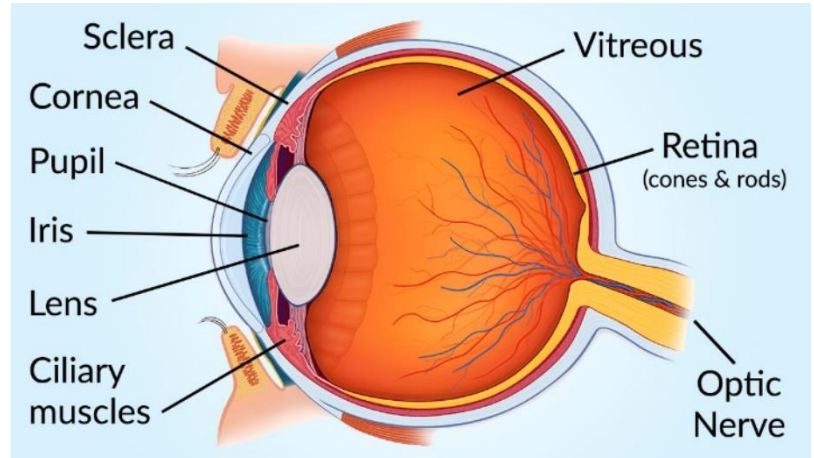
Suggest why there is a difference in the mean speed of the impulse for the two reflexes.

(2)

(Total 12 marks)

Lesson 5 The Eye

The eye is the organ associated with sight. It detects light through photoreceptor cells, and is a complex organ that allows us to see both in 3D and in colour. As it is an organ, it is composed of many different tissues that work together to allow us to see.

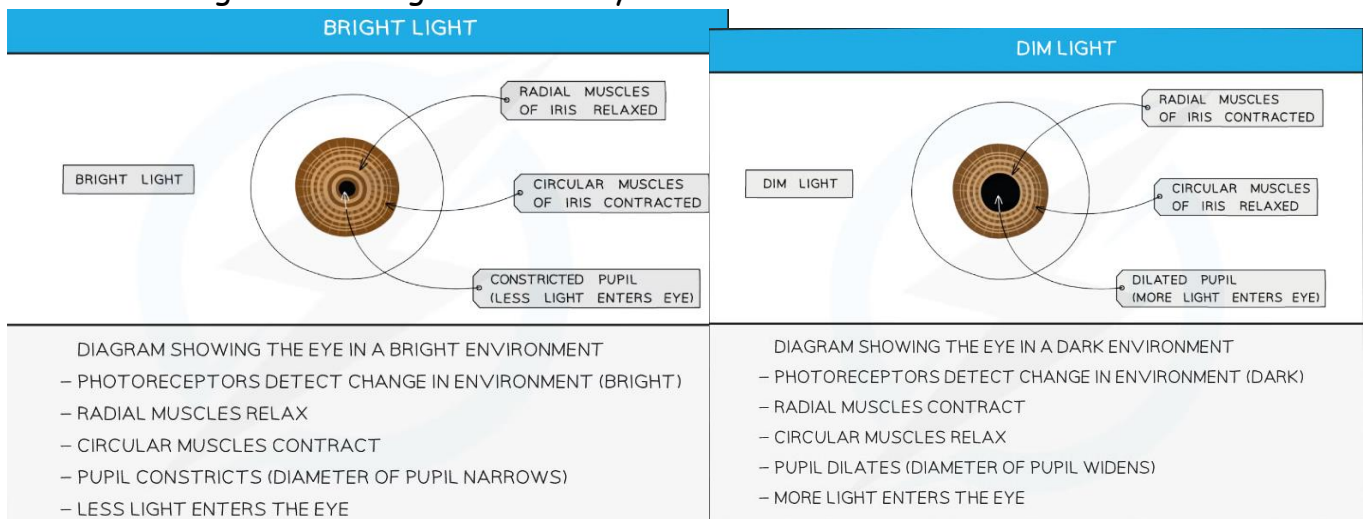


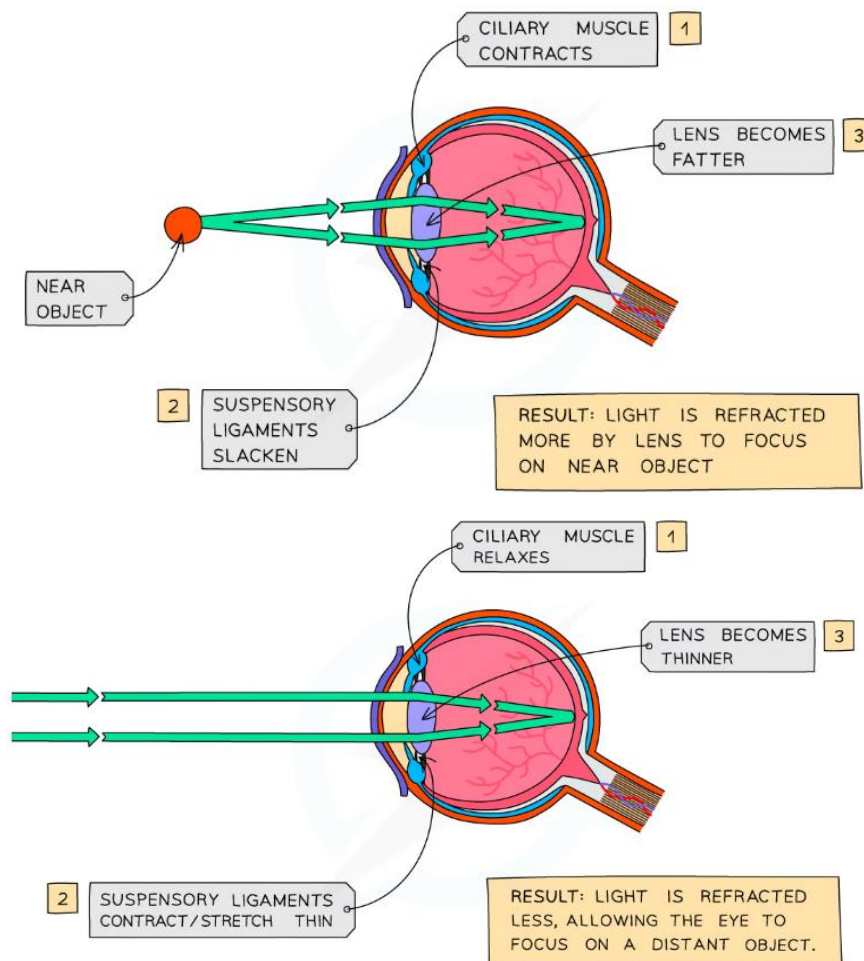
The **Sclera** is a tough, supporting wall of the eye. It provides protection to the fragile tissues housed within. The **Cornea** sits just below the sclera, and is transparent. It's job is to refract light into the eye. The **Iris** is the coloured part of your eye, and contains muscles that can change the size of your **Pupil**- a small opening that becomes larger or smaller in low or high light conditions, respectively.

The **Lens** is connected to **ciliary muscles** and **suspensory ligaments**, and can change shape to focus light onto the **Retina**, which is the part of the eye containing rods and cones to detect both light intensity and colour (stimuli). As it detects changes in the environment, the cells within are considered receptors. This is connected to the **Optic Nerve** which sends information about the intensity and colour of light to the brain to be interpreted.

The Iris Reflex

The eye is very sensitive, including to light. Bright light can damage your retina. To avoid this, the eye is able to change the shape of the pupil. In bright light, **Circular muscles** in the iris **contract** and **Radial muscles relax**, causing the pupil to get smaller and reduce the amount of light that can get into the eye. In low light, **circular muscles** in the iris **relax** and **Radial muscles contract**, causing the pupil to get larger and increase the amount of light that can get into the eye.





Accommodation

Depending on the distance of an object from the eye, the light received into the eye must be refracted differently to make sure it hits the retina, which does not move. To do this, the ciliary muscles can contract or relax- contracting pulls on the suspensory ligaments, which pull the lens thin and long; relaxing the muscles puts less strain on the suspensory ligaments, meaning the lens can get thicker and shorter. A thicker lens refracts light more, which is needed when looking at things close up. A

thinner lens refracts light less, needed for things that are further away.

	OBJECT FAR AWAY – THE LIGHT IS REFRACTED LESS	OBJECT CLOSE BY – THE LIGHT IS REFRACTED MORE
CILIARY MUSCLES	RELAXED	CONTRACTED
SUSPENSORY LIGAMENTS	PULLED TIGHT	SLACK
LENS	THINNER	FATTER

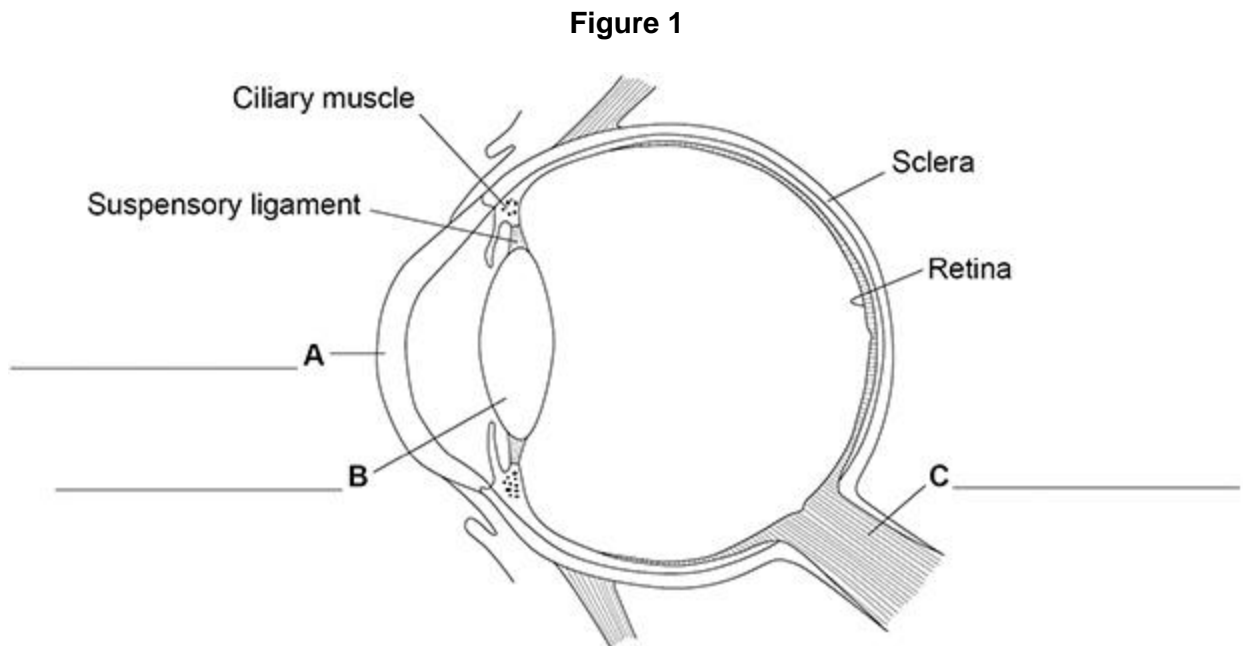
Lesson 5 Mastery Questions

1. What is the role of the sclera?
2. What is the role of the cornea?
3. What is the role of the iris?
4. What is the role of the pupil?
5. What is the role of the lens?
6. What is the role of the retina?
7. What are the roles of the ciliary muscles and suspensory ligaments? (hint; they are linked!)
8. What is the role of the optic nerve?
9. Outline the Iris Reflex
10. What do the following things do when looking at an object that is close up:
 - a. Suspensory ligament
 - b. Lens
 - c. Ciliary muscles
 - d. Amount of light let in
11. What do the following things do when looking at an object that is far away:
 - a. Suspensory ligament
 - b. Lens
 - c. Ciliary muscles
 - d. Amount of light let in
12. What do each of the following do to the amount that light is refracted by the lens?
 - a. A thin, long lens
 - b. A short, thick lens
13. What is the name of how the eye changes when looking at things far away and close up?

Q1.

The human eye can form images of objects that are at different distances away from the eye.

Figure 1 is a diagram of the eye.



- (a) Label structures **A**, **B** and **C** on **Figure 1**.

Choose answers from the box.

cornea	eyelid	iris	lens	optic nerve
--------	--------	------	------	-------------

(3)

The eye in **Figure 1** is focused on a distant object.

If the eye then focuses on the words in a book, changes would occur in the eye.

The light rays would be refracted more by the lens.

- (b) How does the lens refract the light more?

Pick one:

- (1) By Becoming Longer By Becoming Thicker By becoming transparent

- (c) Which **two** structures control the shape of the lens?

Pick 2:

Ciliary Muscles Cornea Iris Sclera Suspensory Ligament

(2)

- (d) To form a clear image, the light rays entering the eye must focus on one structure in the eye.

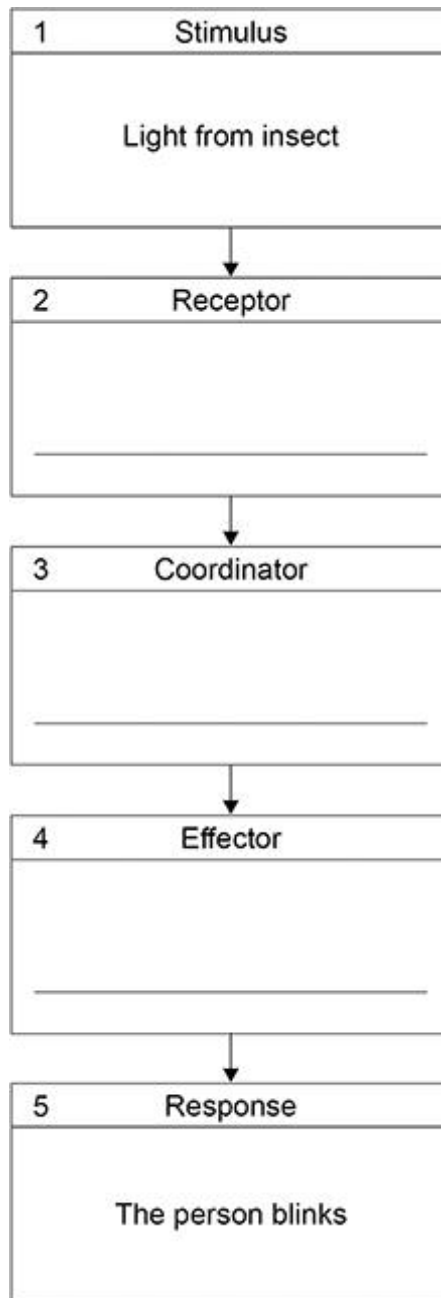
Name the structure.

(1)

- (e) An insect flies near a person's eye. The person blinks. This is a reflex action.

Figure 2 shows the coordination system for this reflex action.

Figure 2



Copy and complete **Figure 2**.

Choose answers from the box below.

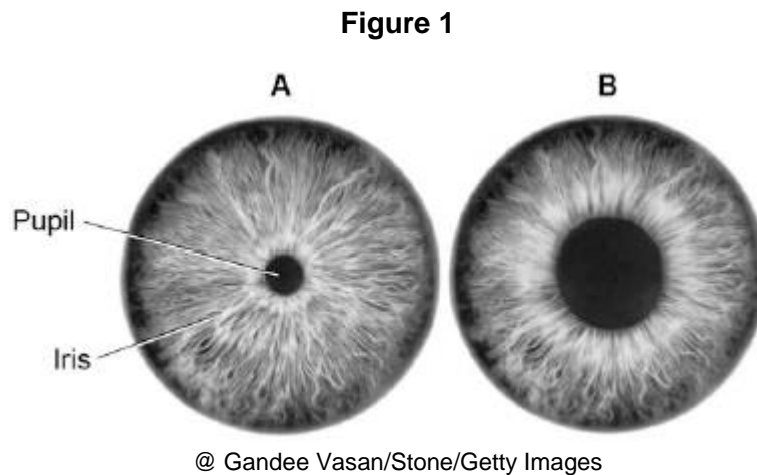
Write **one** word in each of boxes **2**, **3** and **4** of **Figure 2**.

brain	cornea	iris	muscles	retina
-------	--------	------	---------	--------

(2)
(Total 9 marks)

Q2.

Figure 1 shows a reflex in the iris of the human eye in response to changes in light levels.



- (a) Describe the changes in the pupil and iris going from **A** to **B** in **Figure 1**.

Explain how these changes occur.

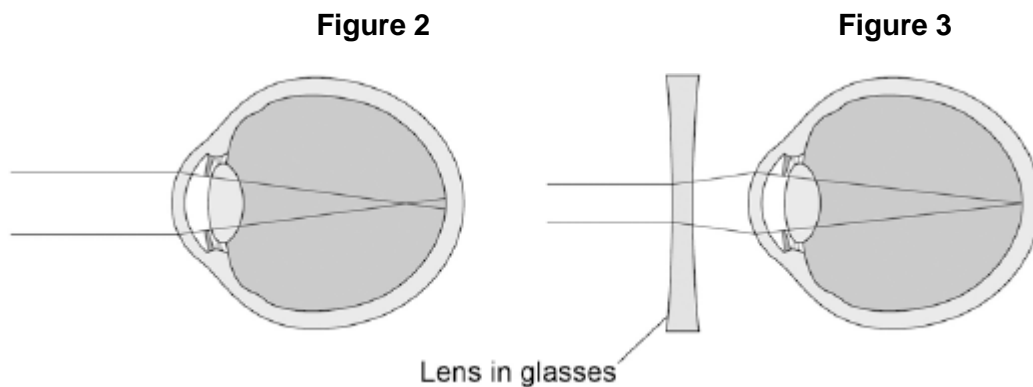
Refer to the changes in light level in your answer.

(4)

- (b) Some people wear glasses to improve their vision.

Figure 2 shows light entering the eye in a person with blurred vision.

Figure 3 shows how this condition is corrected with glasses.



Compare **Figure 2** and **Figure 3**.

Explain how the blurred vision is corrected.

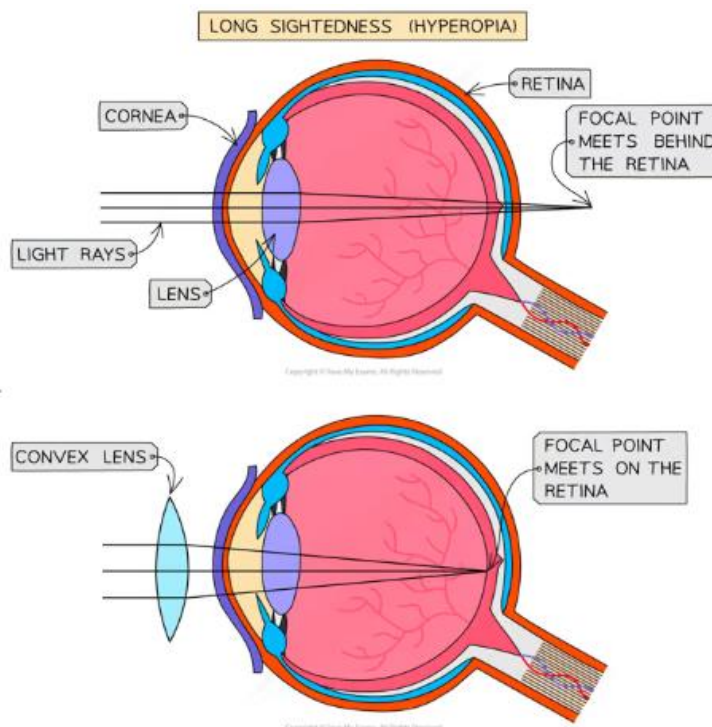
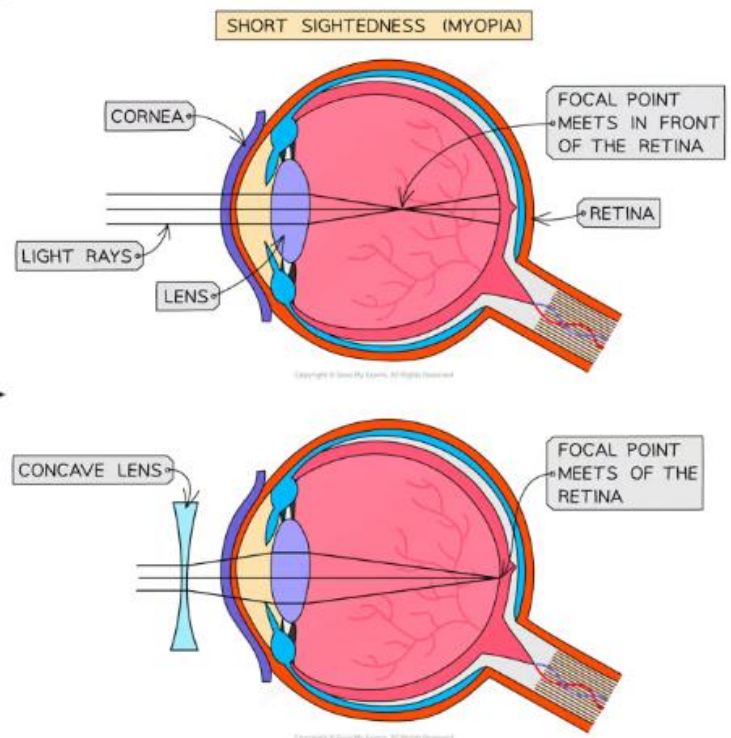
(2)

(Total 6 marks)

Lesson 6 Correcting Vision

Some people need glasses. This is because their eyes are unable to properly correct their vision when they are looking at something either too far away, too close, or both. Those who are short sighted are called **Myopic**, or having **Myopia**, and will struggle to see things far away, and those who are long sighted have **Hyperopia**, struggling to see things close up.

Myopia is caused when the lens is more curved than normal, and the light is refracted too much. This causes the rays of light to converge before the retina, causing a blurry image. **Concave lenses**, which bend inward, are used to correct this so that the light focuses in the right place. →



Hyperopia is caused when the lens is less curved than normal, and the light is refracted too little. This causes the rays of light to converge after the retina, causing a blurry image. **Convex lenses**, which bend outward, are used to correct this so that light focuses in the right place. ←

Other treatments include:

Contact lenses- lenses that sit on the surface of the eye and bend the light like glasses would.

Laser eye surgery changes the shape of the cornea, and can correct the faulty vision- in short sighted people you make it slimmer, and in long sighted people you make it more powerful to bend the light more.

Replacement lens surgery removes the lens and replaces it with a new one that refracts the light more, and is more commonly used in people with hyperopia.

Lesson 6 Mastery Questions

1. Why are some people long sighted?
2. Why are some people short sighted?
3. What is myopia?
4. What is hyperopia?
5. What lenses fix myopia, and what shape are these lenses?
 - a. How do these lenses fix myopia?
6. What lenses fix hyperopia, and what shape are these lenses?
 - a. How do these lenses fix hyperopia?
7. How do contact lenses work?
8. How does laser eye surgery work?
9. How does replacement lens surgery work?

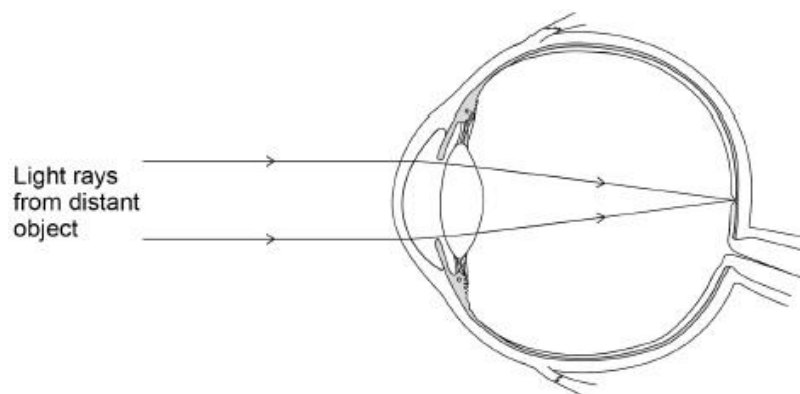
Lesson 6 Exam Questions

Q1.

The human eye can focus on objects at different distances.

Figure 1 shows how a clear image of a **distant** object is formed in a person's eye.

Figure 1



- (a) Explain how the person's eye could adjust to form a clear image of a **nearer** object.

(6)

- (b) Explain why a long-sighted person has difficulty seeing near objects clearly.

(2)

- (c) Long-sightedness can be corrected by wearing spectacles.

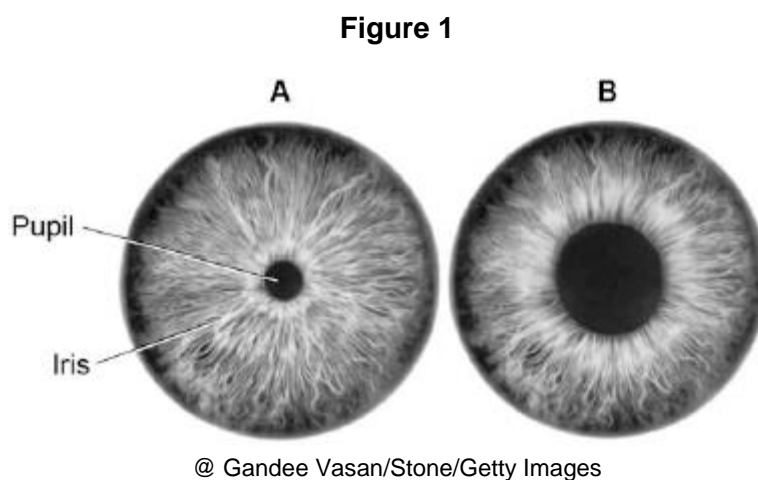
Describe how spectacle lenses can correct long-sightedness.

(3)

(Total 11 marks)

Q2.

Figure 1 shows a reflex in the iris of the human eye in response to changes in light levels.



- (a) Describe the changes in the pupil and iris going from **A** to **B** in **Figure 1**.

Explain how these changes occur.

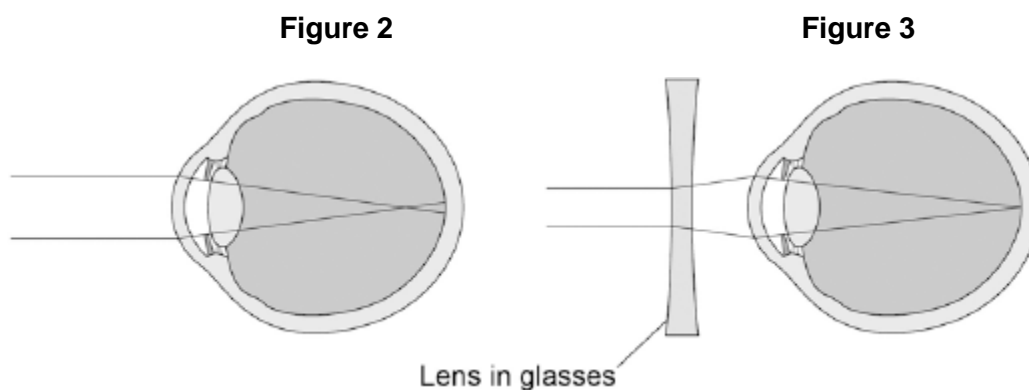
Refer to the changes in light level in your answer.

(4)

- (b) Some people wear glasses to improve their vision.

Figure 2 shows light entering the eye in a person with blurred vision.

Figure 3 shows how this condition is corrected with glasses.



Compare **Figure 2** and **Figure 3**.

Explain how the blurred vision is corrected.

(2)

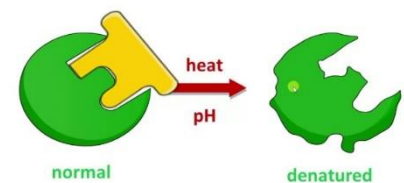
(Total 6 marks)

Lesson 7: Homeostasis

Humans have been able to colonise most of the earth. Even in extreme environments, like the Arctic Circle and the Sahara Desert, humans can live and thrive. Surprisingly, we are actually not very good at surviving in these places without our technology. Humans, like all mammals need to maintain a constant internal environment. If our core body temperature, blood glucose levels, or water levels change too much we can get very ill or even die. Enzymes are very specific. Changes in conditions affect their shape causing them to **denature**. This stops the enzymes from working, meaning many vital processes cannot happen. Enzymes are the main reason for homeostasis.

Homeostasis is the regulation of the internal conditions of a cell or organism to maintain **optimum conditions** for function in response to internal and external changes. This means the conditions inside the body are kept the same,

Raising the temperature too high can **DENATURE** the enzyme so the substrate doesn't fit anymore.

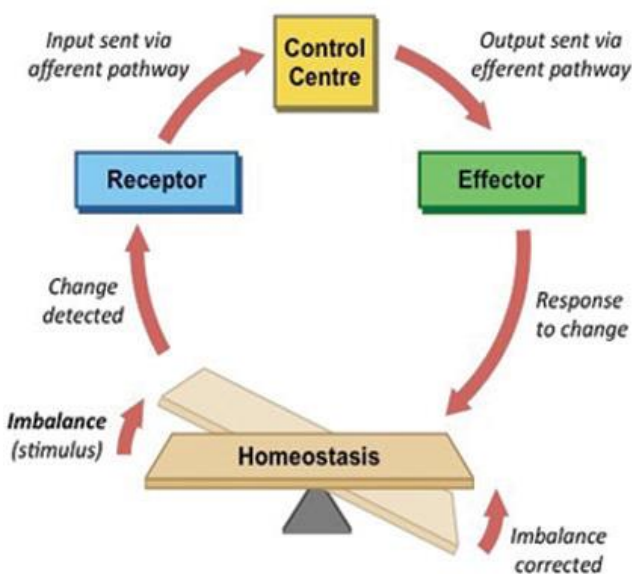


even when

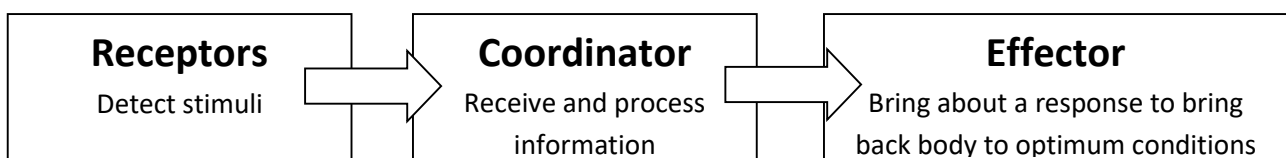
environmental conditions change. It keeps the conditions within optimum levels. They all follow the same basic structure; the receptor detects, the CNS coordinates and then the effector responds. This process of a change happening, and something happening to reverse that change is known as a **Neg**

Homeostatic control mechanisms come in two forms:

- **Nervous** responses: electrical signals travel quickly down nerve cells
- Hormonal** responses: chemical signals travel more slowly via the bloodstream.



Component	Function	Examples
Receptor	Detect	Photo(light)receptor, chemoreceptor, temperature receptor
Coordinator	Coordinate	Brain and spinal cord
Effector	Respond	Muscle (contract or relax) or Gland (secrete hormones)



Control of Temperature (Triple Biology Only)

Receptor

Temperature receptors in the hypothalamus detect internal body temperature.

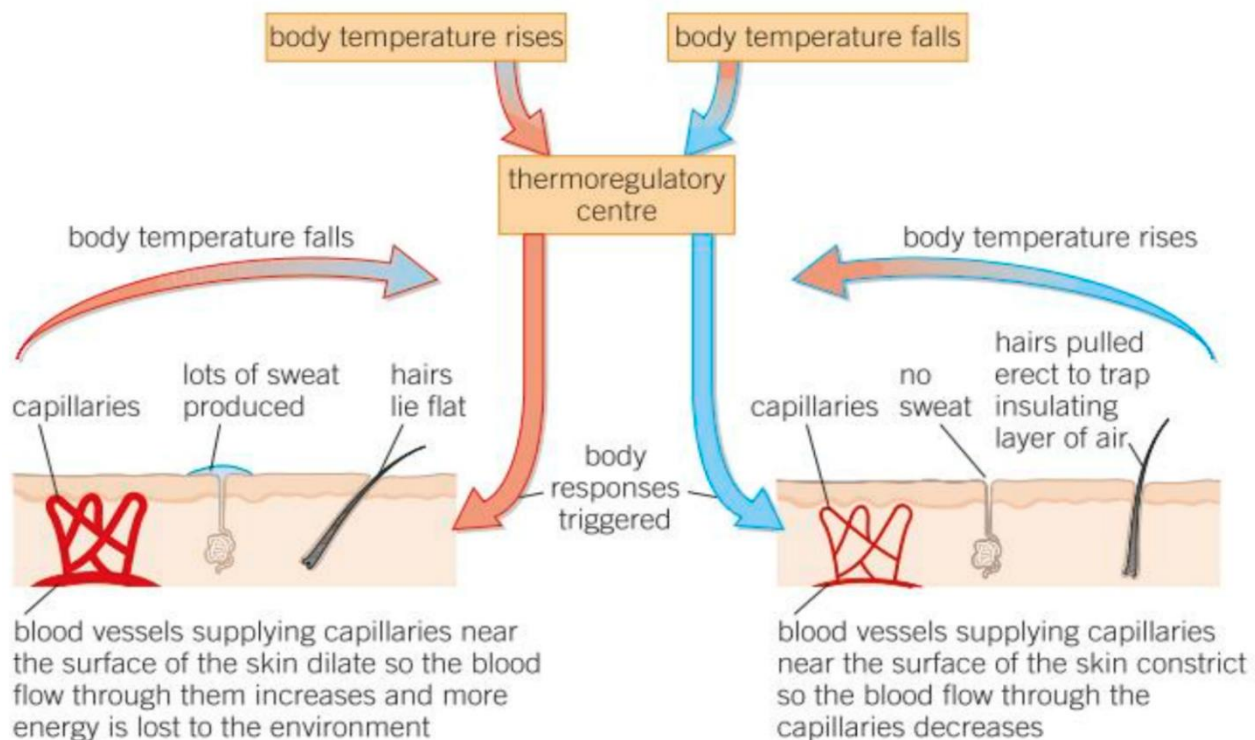
Coordinator

Located in the CNS, or more specifically the brain, the hypothalamus also acts as the coordinator. A bit like a thermostat in a home, it sets body temperature at around 37°C. If the temperature goes above or below this it will send messages to effectors.

Effectors

- Skeletal muscles contract and relax quickly to generate heat through respiration. This is known as shivering.
- Sweat glands release sweat which then absorbs heat and evaporates from the skin's surface.
- Muscles surrounding blood vessels may cause vessels to dilate or constrict.
 - Dilated vessels allow more blood to flow near to the skin's surface so more heat is lost by conduction.

Constricted vessels reduce the amount of blood flowing near the skin's surface which reduces the amount of heat lost by conduction



Lesson 7 Mastery Questions

1. What are 3 things humans maintain as part of their internal environment?
2. What is the state of an enzyme that has lost its shape?
3. What is homeostasis?
4. What is the basic structure for homeostasis?
5. What is this basic structure, of a change bring reversed with an effect, known as?
6. What two mechanisms allow homeostasis to happen?
7. What is the role of receptors?
8. What is the role of coordinators?
9. What is the role of effectors?
10. What are the two types of effectors?

Lesson 7 Exam Questions

Q1.

Conditions inside the human body are controlled.

- (a) What is the control of conditions inside the body called?

Pick one:

Excretion Fertilisation Homeostasis Osmosis

(1)

- (b) What are the **two** ways information is sent to control body conditions?

Pick one:

Antigens Hormones Muscles Nerve impulses Red blood cells

(2)

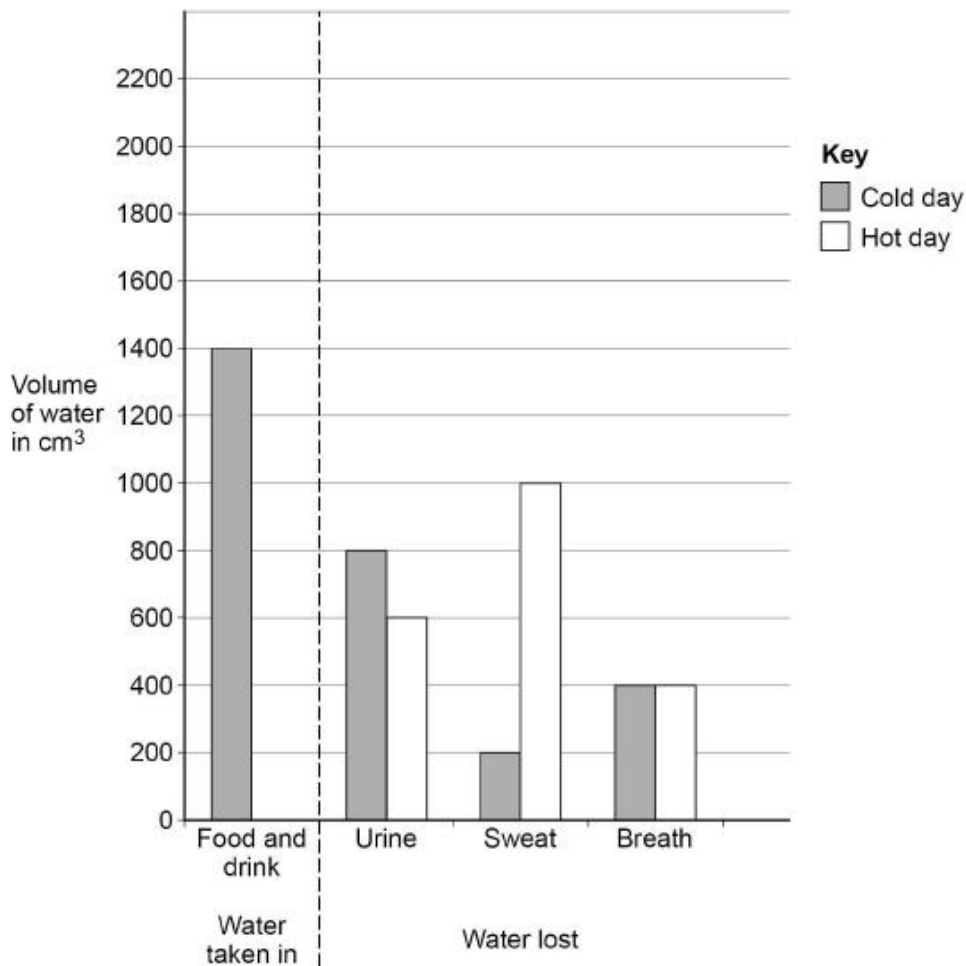
- (c) One condition in the body that needs to be controlled is the level of water.

Give **one** other condition in the human body that needs to be controlled.

(1)

The graph shows the volumes of water taken in and lost by one person.

The volume for water taken in on a hot day has **not** been plotted on the bar graph.



(d) The person lost 1400 cm³ of water on the cold day.

How much extra water did they lose on the hot day in cm³?

(2)

(e) Explain why the volume of water lost on a hot day is higher than on a cold day.

(2)

(f) A boy drank 750 cm³ of water.

His total intake of water for that day was 3000 cm³

Calculate the percentage of the boy's total intake that the 750 cm³ represents.

(2)

(Total 10 marks)

Q2.

This question is about the nervous system.

- (a) Describe the function of receptors in the skin.
- (b) A response is caused when information in the nervous system reaches an effector.
- (i) There are two different types of effector.

(2)

Complete the table to show:

- the two different types of effector
- the response each type of effector makes.

Type of effector	Response the effector makes
1 _____	_____ _____
2 _____	_____ _____

(4)

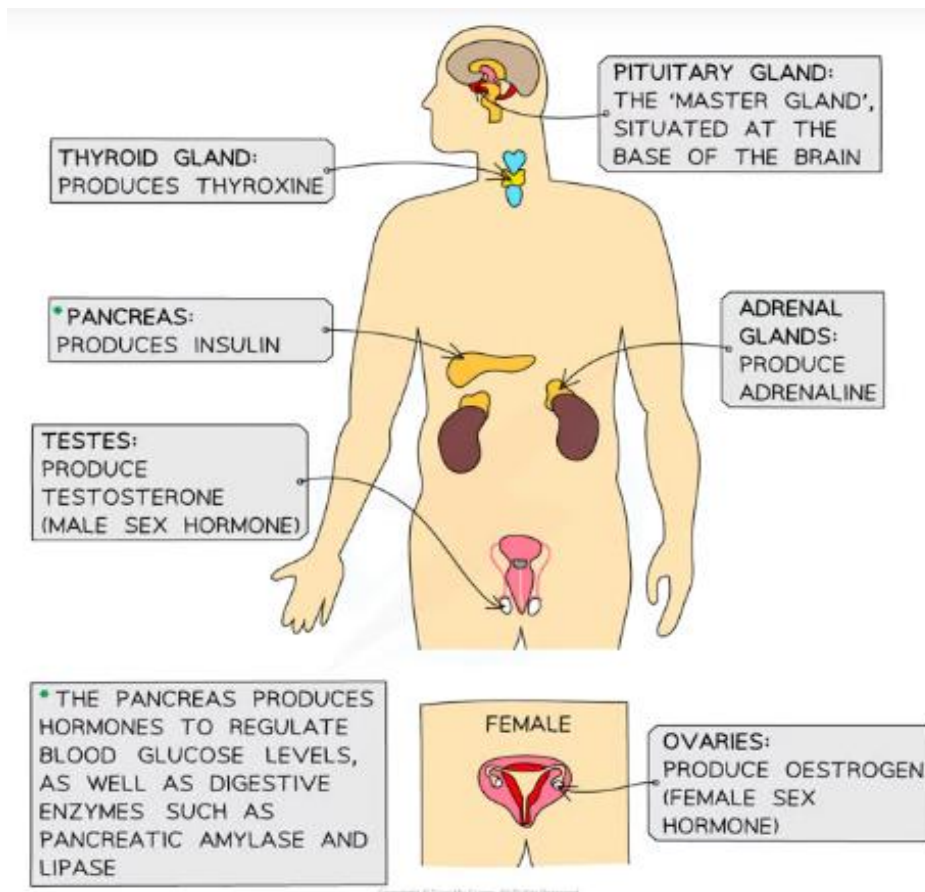
- (ii) Some effectors help to control body temperature.
- Give **one** reason why it is important to control body temperature.

(1)

Lesson 8 Endocrine System

The endocrine system is made up of glands and the hormones they release. Hormones are chemical messengers, and travel along blood vessels, carried in the plasma of the bloodstream. When they reach their target cells they attach, bind, to receptors on the cell membrane. This triggers changes inside cells. Hormones will only effect cells that have the correct receptor. The advantage of hormonal coordination is it can have a more long-lasting effect. The

disadvantage is that it takes longer to work. A good example of this is puberty. Sex hormones, oestrogen, and testosterone, are released from the sex glands, ovaries and testes, and cause the changes to the body over several years. These changes then last several decades to a lifetime.



Gland	Hormone (H)	Function
Pituitary	Thyroid stimulating, SH, Follicle Stimulating, Luteinizing, Anti Diuretic, Growth	Controls the other glands
Thyroid	Thyroxine	Rest and digest
Adrenal	Adrenaline	Fight or flight
Pancreas	Insulin and glucagon	Controls glucose levels in blood
Ovaries	Oestrogen	Puberty and menstrual cycle
Testes	Testosterone	Puberty

Adrenaline

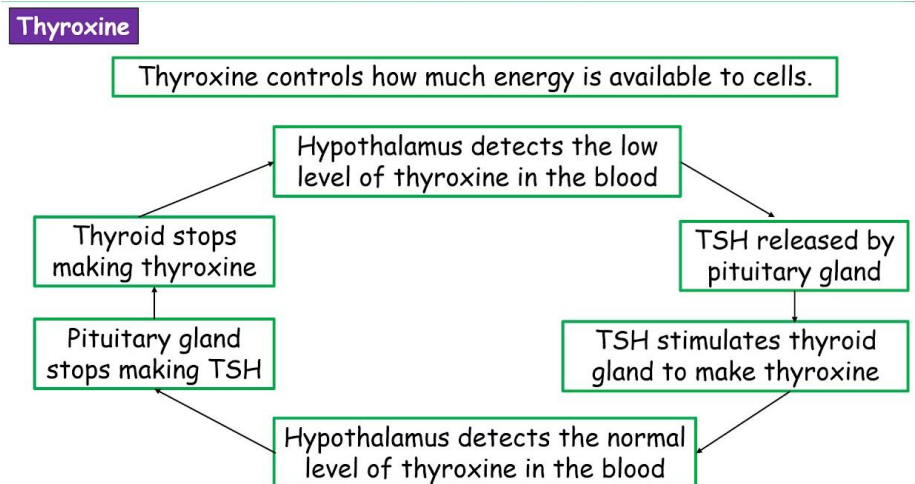
Adrenaline is secreted by the adrenal glands, located just above the kidneys. It is released in response to stressful or scary situations, getting the body ready for 'fight or flight' by increasing the supply of oxygen and glucose to cells in the muscles and brain, by increasing heart rate for instance.

Thyroxine

Thyroxine regulates metabolism.

It is released in the thyroid gland, in the neck, and regulates **basal metabolic rate**- the speed at which chemical reactions in the body occur while the body is at rest.

It is released when the **Pituitary gland** releases thyroid stimulating hormone. A negative feedback system controls its release.

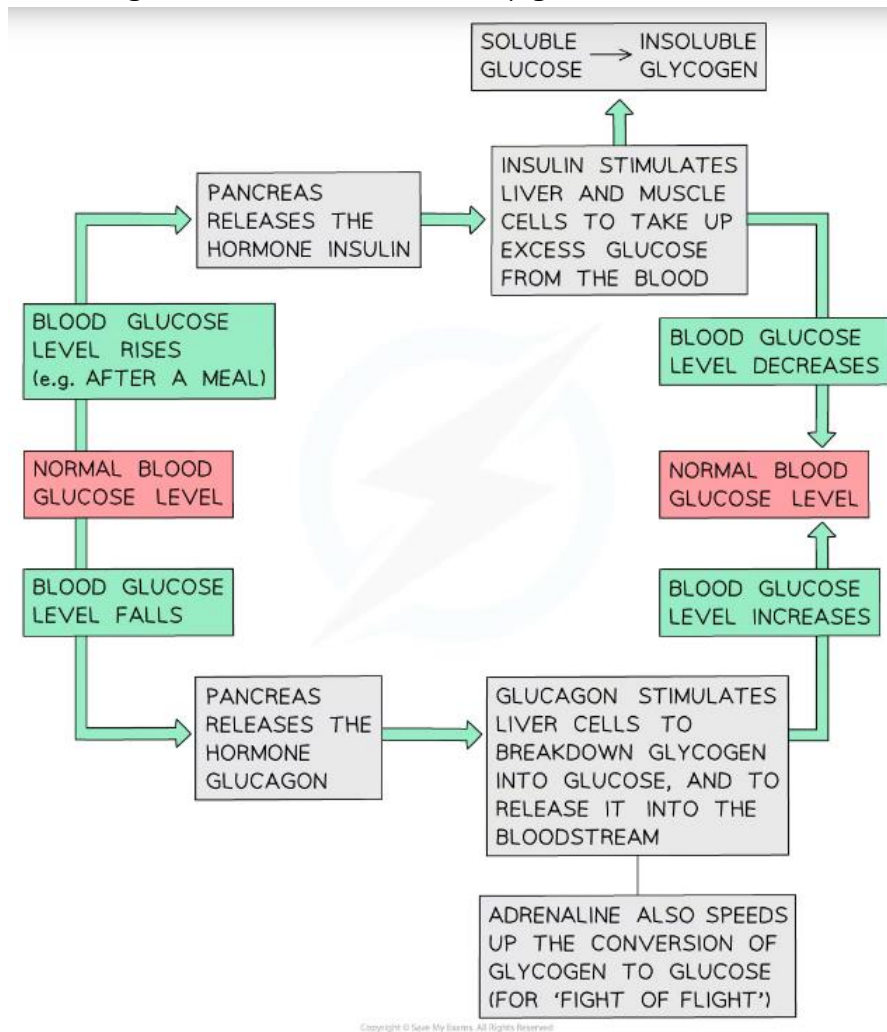


Lesson 8 Mastery Questions

1. What hormones does the pituitary release?
2. What are the overall roles of these hormones? (not each individual one)
3. What hormone does the thyroid release?
4. What are the overall roles of this?
5. What hormone does the adrenal gland release?
6. What are the overall roles of this?
7. What hormones does the pancreas release?
8. What are the overall roles of this?
9. What hormones do the Ovaries release?
10. What are the overall roles of this?
11. What hormones do the testes release?
12. What are the overall roles of this?
13. What are the differences between neuronal and hormonal communication?
14. Where are hormones released from?
15. How do they move around the body?
16. How do hormones affect cells in the body?
17. Are hormones specific? Think what this might mean and explain why, or why not.
18. What is one effect of adrenaline on the body?
19. What is the response adrenaline causes called?
20. What hormone stimulates the release of thyroxine?

Lesson 9-10 Controlling Blood Glucose and Diabetes

It is important for the body to have a suitable supply of glucose circulating in the blood so that cells around the body can undergo respiration. However, the level fluctuates throughout the day- too low, and a person may not be able to release enough energy to meet their requirements, too high and it can result in permanent damage to parts of the body. Blood glucose concentration is monitored and controlled by the pancreas as part of homeostasis. This is an endocrine gland, and is able to release both insulin and glucagon depending on the level of glucose in the blood at any given time:



- If levels are too high, insulin is released. This reduces blood sugar levels by converting glucose in the blood into glycogen, which can be stored in cells.

- If levels are too low, glucagon is released. This increases blood sugar levels by converting glycogen in the cells into glucose that can be released and circulate in the blood.

This forms a **Negative Feedback Loop**, as discussed previously:

Diabetes

Diabetes is a condition in which the body becomes unable to regulate blood glucose properly. There are two types, type 1 you are born with and type 2 you can get as a result of a diet high in sugar.

	Type 1	Type 2
Cause	Inability of pancreas to produce insulin	Cells of the body become resistant to insulin or insufficient insulin produced by the pancreas
Treatment	Monitoring blood glucose levels and injecting human insulin throughout the day (particularly after meals consumed)	Maintain a low-carbohydrate diet and regular exercise to reduce need for insulin

Lesson 9-10 Mastery Questions

1. Why does the body need glucose?
2. What can happen if concentrations get too high?
 - a. What hormone is released if concentrations get too high?
 - b. What does this hormone do?
3. What can happen if concentrations get too low?
 - a. What hormone is released if concentrations get too low?
 - b. What does this hormone do?
4. What is negative feedback? (Previous lesson)
5. Why is control of blood glucose concentration an example of homeostasis?
6. What is diabetes?
7. What causes type 1 diabetes?
 - a. How do you treat type 1 diabetes?
8. What causes type 2 diabetes?
 - a. How do you treat type 2 diabetes?

Lesson 9-10 Exam Questions

Q1.

Diabetes is a condition where the concentration of sugar in the blood can become too high.

- (a) Which chemical decreases the concentration of sugar in the blood?

Pick one of the following:

Glucose Glycogen Insulin

(1)

- (b) Which organ monitors and controls the concentration of sugar in the blood?

Pick one of the following:

Kidney Pancreas Stomach

(1)

A company produces two breakfast cereals.

In a 30 g serving:

- cereal **A** contains 11 g of sugar
- cereal **B** contains 25% less sugar than cereal **A**.

- (c) Calculate 25% of 11 g

(2)

- (d) Calculate the mass of sugar in a 30 g serving of cereal **B**.

Use your answer from part (c).

(1)

- (e) Decreasing sugar in the diet can help prevent Type 2 diabetes.

Give **one** other health benefit of eating less sugar.

(1)

- (f) Taking regular exercise can improve health.

The table below shows how walking quickly or running may reduce the risk of developing different medical conditions.

The greater the percentage reduction in risk, the less chance there is of developing the medical condition.

Medical condition	Percentage (%) reduction in risk of developing the medical condition	
	Walking quickly	Running
Coronary heart disease	9.3	4.5
Diabetes	12.3	12.1
High cholesterol	7.0	4.3

Compare the effects of walking quickly with the effects of running on the medical conditions given in table above.

(4)

(Total 10 marks)

Q2.

- (a) Control systems help to keep conditions in the human body relatively constant.

What is the general name for the processes that keep body conditions relatively constant?

Pick one of the following:

Eutrophication Homeostasis Hydrodropism

(1)

- (c) A person with Type 1 diabetes does not make enough insulin.

The person needs to test their blood at intervals throughout the day.

If the concentration of glucose in their blood is too high, the diabetic person needs to inject insulin.

- (i) Insulin is a protein.

It must be injected and cannot be taken by mouth.

Explain why.

(2)

- (ii) Apart from injecting insulin, give **one other** way that a diabetic person could help to control the concentration of glucose in their blood.

(1)

- (d) Pet dogs have been trained to detect if the concentration of glucose in the blood of their diabetic owners is outside the normal healthy range. These dogs are called 'medical response dogs'.
The dogs respond in different ways. They may bark, jump up, or stare at their owners. They may even fetch a blood-testing kit.

- (i) Suggest what stimulus the dogs might be responding to when they behave like this.

(1)

- (ii) **Table 1** shows how the concentration of glucose varied in blood samples from five diabetic people. Measurements were made both before and after getting a medical response dog.

Table 1

		Mean percentage of blood samples with different concentrations of glucose from the five diabetic people		
	Number of blood samples measured	Low glucose	Within normal range of glucose	High glucose
Before getting a dog	1704	32.6	54.8	12.6
After getting a dog	1724	18.6	61.6	19.8

A survey was made of the effect of a medical response dog on the lives of 16 diabetic people. **Table 2** shows how well these diabetic people agreed with each statement in the survey.

Table 2

Statement in survey	Totally agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Totally disagree
I am more independent since getting my dog.	12	2	2	0	0
There are disadvantages to having a medical response dog.	0	0	4	4	8
I trust my dog to alert me when my sugar levels are low.	11	3	1	0	1
I trust my dog to alert me when my sugar levels are high.	6	7	0	1	2

Evaluate how useful medical response dogs are for warning diabetic people that the concentration of glucose in their blood is outside the normal range.

Use information from **Tables 1 and 2**.

(5)

- (e) **Table 3** shows the concentrations of some substances in the urine of a non-diabetic person and in the urine of a diabetic person.

Table 3

Substance	Concentration of substance in urine in g per dm ³	
	Non-diabetic person	Diabetic person
Protein	0	0
Glucose	0	2.0
Urea	20.0	19.5
Sodium ions	6.0	5.8

Compare the results for the non-diabetic person and the diabetic person.
Give reasons for any differences.

Use your knowledge of how the kidney works.

(5)

(Total 19 marks)

Q3.

The number of cases of Type 2 diabetes in the UK is increasing rapidly.

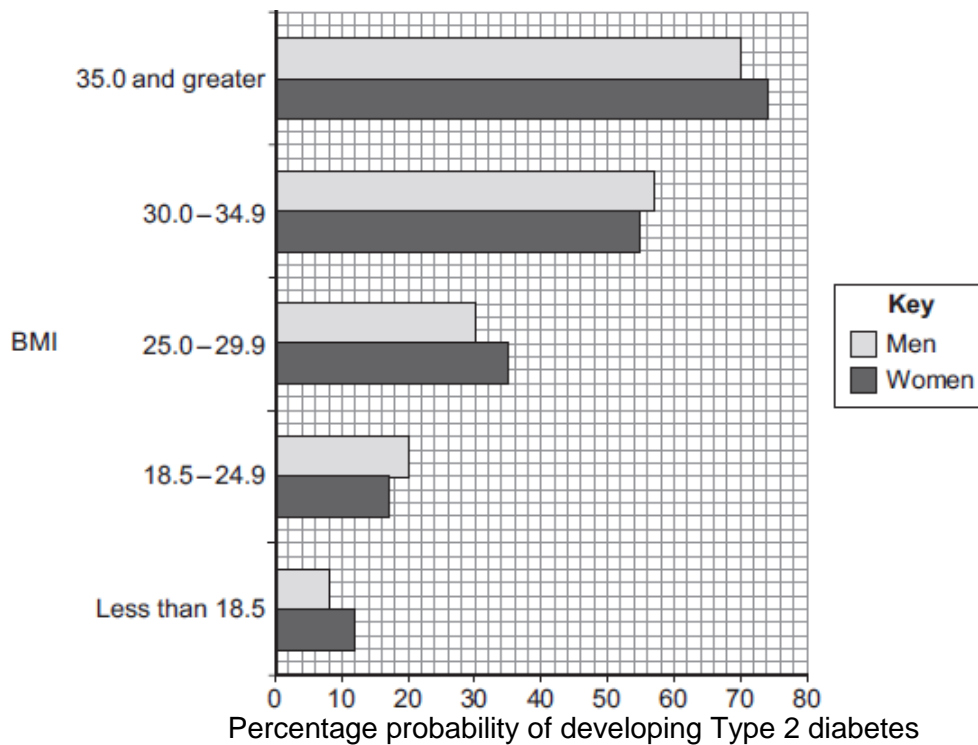
- (a) Describe how insulin and glucagon help control the blood sugar concentration in a healthy person.
- (b) What is Type 2 diabetes?
- (c) Body mass index (BMI) is a person's body weight divided by the square of his or her height.

(6)

(1)

- (i) **Graph 1** shows the relationship between BMI and the percentage probability of developing Type 2 diabetes.

Graph 1

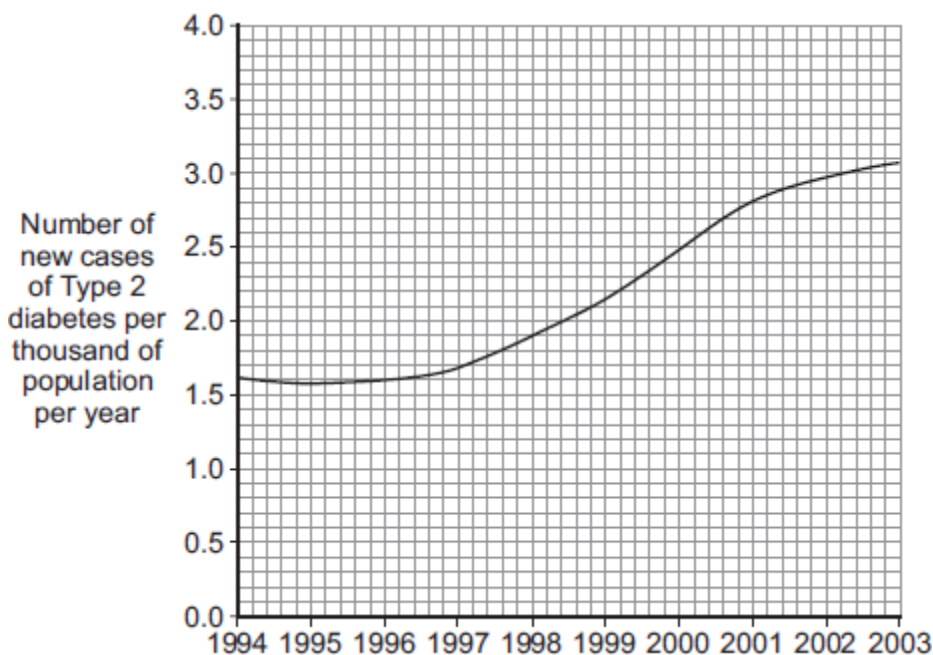


Suggest an explanation for the relationship between BMI and the risk of developing Type 2 diabetes.

(2)

- (ii) **Graph 2** shows changes in the number of new cases of Type 2 diabetes in the UK.

Graph 2



Suggest explanations for the trend shown by the data in **Graph 2**.

(3)

(Total 12 marks)