

Cambridge IGCSE · Biology 0610 · Notes

Hormones and homeostasis

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Read first: [Biological molecules](#), [Blood vessels and blood](#), [The nervous system and sense organs](#)

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What you need to know

Hormones come up on almost every paper. Papers 1 and 2 ask one-mark multiple choice (which gland makes which hormone, what adrenaline does, what insulin and glucagon do, how the skin responds to heat and cold); Papers 3 and 4 build longer questions round a diagram of the body's glands, a section of skin or a graph of blood glucose or body temperature. Outcomes marked **Extended only** are tested on Papers 2 and 4 only. By the end of this topic you should be able to:

Core: hormones

1. **Describe a hormone:** a chemical substance, made by a gland and carried by the blood, that changes the activity of one or more specific target organs.
2. **Identify four endocrine glands** in diagrams and pictures and **name the hormone each one secretes:** adrenal glands → adrenaline; pancreas → insulin; testes → testosterone; ovaries → oestrogen.
3. **Describe adrenaline** as the hormone released in "fight or flight" situations, and its effects: faster breathing, faster heart rate and wider pupils.
4. **Compare nervous and hormonal control** by how fast they act and how long their effects last.

Core: homeostasis

5. **Describe homeostasis:** keeping the internal environment of the body constant.
6. **State that insulin lowers the blood glucose concentration.**

Extended only

7. **State that glucagon is also secreted by the pancreas.**
8. **Describe how adrenaline changes metabolic activity:** it raises the blood glucose concentration and raises the heart rate.
9. **Explain negative feedback:** how a value is kept close to its **set point**.
10. **Describe how blood glucose is controlled** by the liver, insulin and glucagon.
11. **Outline how type 1 diabetes is treated.**
12. **Identify in diagrams and pictures of the skin:** hairs, hair erector muscles, sweat glands, receptors, sensory neurones, blood vessels and fatty tissue.

13. **Describe how mammals keep their internal body temperature constant:** insulation, sweating, shivering and the role of the brain.
14. **Describe vasodilation and vasoconstriction** of the arterioles that supply the capillaries near the skin surface, and how they keep body temperature constant.

Neurones, receptors and the pupil reflex are from The nervous system and sense organs; glycogen and glucose are from Biological molecules; arterioles, capillaries and plasma are from Blood vessels and blood. This note uses them where questions on this topic do.

Understand it

Two ways to send messages

Your body coordinates its organs in two ways.

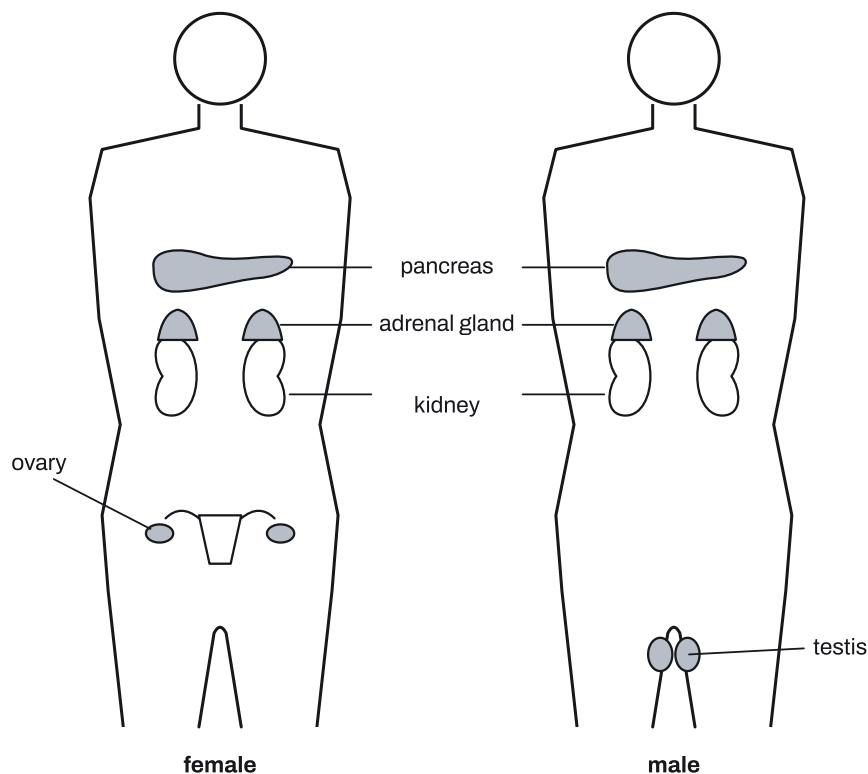
- The **nervous system** sends **electrical impulses** along **neurones**. Each neurone goes to one particular place, so the message is precise, and it arrives in a fraction of a second.
- The **endocrine system** is a set of **glands** that release **hormones** into the **blood**. A **hormone** is a **chemical substance**, produced by a **gland** and **carried by the blood** (dissolved in the **plasma**), which **alters the activity of one or more specific target organs**. The blood reaches every organ, but only the target organs respond to that hormone.

Because hormones must travel round the body in the blood, and then stay in the blood until they are broken down, hormonal control is different from nervous control:

	Nervous control	Hormonal control
Speed of action	faster (impulses)	slower (carried in the blood)
Duration of effect	shorter (stops when the impulses stop)	longer (lasts while the hormone is in the blood)
The message is	electrical impulses	a chemical
It travels	along neurones	in the blood plasma

So a reflex, like pulling your hand from a hot plate, is nervous: it has to be fast and it is over at once. Controlling blood glucose or growing up at puberty is hormonal: slower, but it lasts.

The endocrine glands you need



Gland	Where it is	Hormone	What the hormone does
Adrenal glands (two)	one on top of each kidney	adrenaline	prepares the body for action ("fight or flight")
Pancreas	upper abdomen, below the stomach	insulin (and glucagon , Extended)	insulin lowers blood glucose; glucagon raises it
Ovaries (two, female)	low in the abdomen, either side of the uterus	oestrogen	development of female secondary sexual characteristics
Testes (two, male)	outside the abdomen, in the scrotum	testosterone	development of male secondary sexual characteristics, such as facial hair

- The gland is the **adrenal gland**, not the "adrenaline gland" and not the kidney.
- The pancreas makes **hormones** (insulin and glucagon, which go into the blood) **and** digestive **enzymes** (amylase, protease and lipase, which go along the pancreatic duct into the small intestine). Don't mix the two lists.
- The **liver** does **not** make insulin or glucagon; it is their **target**.

Adrenaline: fight or flight

When you are frightened, excited or in danger, the adrenal glands release **adrenaline** into the blood. It gets the body ready to fight or run:

Effect	Why it helps
Breathing rate increases	more oxygen taken in and more carbon dioxide removed
Heart rate (pulse rate) increases	more blood, carrying oxygen and glucose, pumped to the muscles
Pupil diameter increases (pupils widen)	more light enters the eye, so you see better

The target for the pupil effect is the **eye** (the muscles of the **iris** change its shape). Adrenaline never **decreases** any of these.

Extended only: adrenaline also **increases the blood glucose concentration**. It makes the **liver** break down stored **glycogen** into **glucose**, which passes into the blood. With more glucose and oxygen reaching the muscles, their cells can **respire** faster and **release more energy** for **muscle contraction**. Adrenaline therefore changes the body's metabolic activity: faster heart rate and more glucose.

Homeostasis

Your cells work best in steady conditions: the right temperature for their enzymes, and enough glucose and water. **Homeostasis** is the **maintenance of a constant internal environment**. "Internal" means inside the body (the blood and tissue fluid), not the weather outside. Two examples in this topic are **blood glucose concentration** and **internal body temperature**.

Extended: negative feedback and the set point

Each controlled value has a **set point**, a normal value the body keeps it close to: about **37 °C** for internal body temperature. The value is never perfectly still; it drifts a little above and below the set point. Control works by **negative feedback**:

1. The value **moves away** from the set point (up or down).
2. The change is **detected** (by receptors, or by the gland itself).
3. A **response** starts that **reverses** the change.
4. The value **returns to the set point**, and the response **stops**.

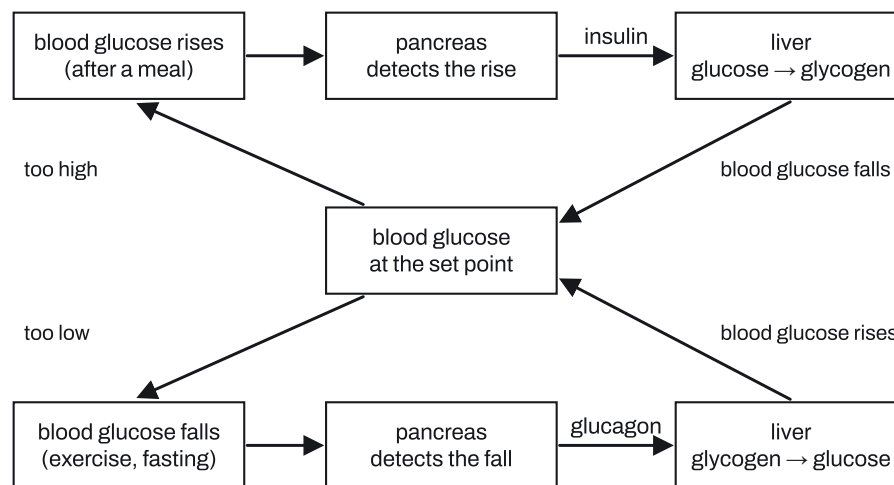
It is called **negative** because the response always acts **against** the change: a rise causes a fall, and a fall causes a rise. A response that pushed the value further the same way would not be negative feedback, so "releasing insulin when glucose is **low**" or "sweating when you are **cold**" can't be right.

Blood glucose

Glucose in the blood is the fuel your cells use for respiration. It rises after a meal with carbohydrates (starch is digested to glucose) and falls during exercise or when you haven't eaten.

Core: **insulin**, from the **pancreas**, **decreases** the blood glucose concentration.

Extended only: the pancreas uses two hormones, and the liver does the work:



- **Too high** (after a meal): the pancreas detects the rise and secretes more **insulin** into the blood. Insulin makes the **liver** (and muscles) take in glucose and convert it to **glycogen**, which is stored. Blood glucose **falls** back to the set point.
- **Too low** (exercise, fasting): the pancreas detects the fall and secretes **glucagon**. Glucagon makes the **liver** break down **glycogen** into **glucose**, which is released into the blood. Blood glucose **rises** back to the set point.

This is negative feedback. After a starchy meal, insulin **increases** and glucagon **decreases**.

Three words look alike, so learn them apart:

Word	What it is
Glucose	the sugar in the blood
Glycogen	the storage carbohydrate made from glucose, in the liver and muscles
Glucagon	the hormone that turns glycogen back into glucose ("glucose is gone ": glucagon)

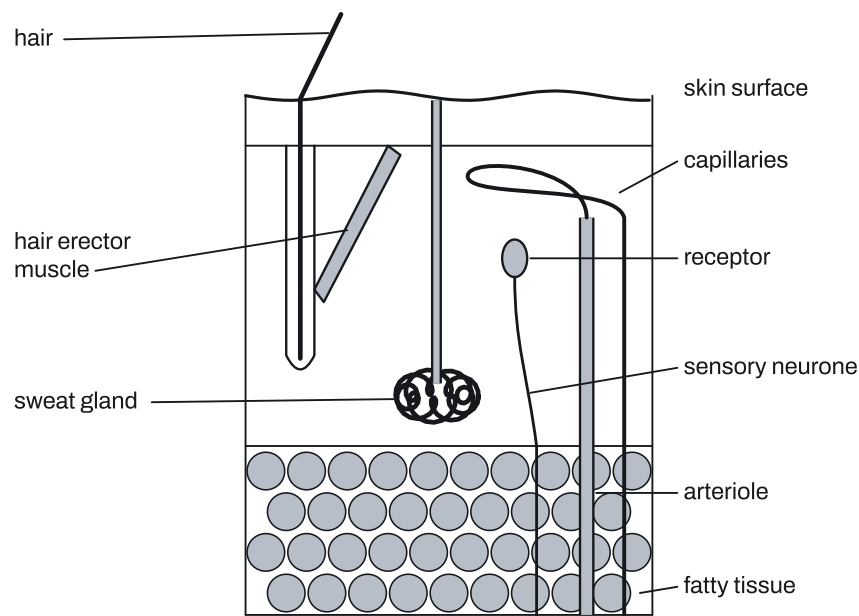
Insulin never turns glycogen into glucose; that is glucagon's job (and adrenaline's).

Extended: type 1 diabetes

In **type 1 diabetes** the cells in the pancreas that make insulin no longer work, so the body makes little or no insulin. Blood glucose can rise far too high after meals. It can't be cured, so it is controlled day by day:

- **monitor** the blood glucose concentration regularly (with a meter or a sensor);
- give **insulin** by **injection** or with an **insulin pump**;
- **count the carbohydrate** in food, and match food and insulin to the amount of **exercise**;
- if glucose drops too low, eat or drink some **sugar** (glucose) quickly;
- keep to a healthy body mass.

Extended: the skin and body temperature



Part of the skin	Role in keeping body temperature constant
Receptors	detect changes in the temperature of the skin (the outside temperature)
Sensory neurones	carry impulses from the receptors to the brain
Sweat glands	produce sweat when the body is too hot
Hairs and hair erector muscles	the muscles contract to raise the hairs, which trap a layer of air
Blood vessels (arterioles and capillaries)	change how much blood flows near the surface
Fatty tissue	insulation: reduces heat loss

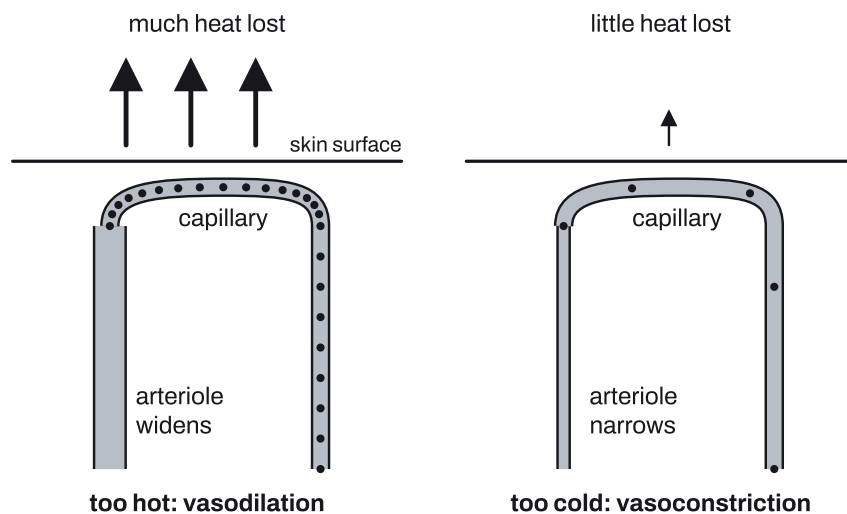
The **brain** is the control centre. It has its own **receptors** that detect the temperature of the **blood**, and it receives impulses from the skin receptors. If the temperature moves from the 37 °C set point, it sends impulses along motor neurones to the **effectors** (sweat glands, muscles, arterioles), which bring the temperature back by negative feedback.

When the body is too hot:

- **Vasodilation:** the **arterioles** supplying the skin surface capillaries **widen**, so **more blood** flows through the capillaries near the surface and **more heat is lost** to the air. This is why a hot person's skin looks red.
- **Sweating:** sweat glands make more sweat. The water in sweat **evaporates** from the skin, and evaporation takes **heat energy** from the skin, cooling it.
- The hair erector muscles relax, so the hairs lie flat and trap little air.

When the body is too cold:

- **Vasoconstriction:** the **arterioles** supplying the skin surface capillaries **narrow**, so **less blood** flows near the surface and **less heat is lost**.
- **Shivering:** skeletal muscles contract and relax rapidly. The extra **respiration** in the muscles **releases heat**.
- The **hair erector muscles contract**, the **hairs stand up** and trap a layer of **air**, which **insulates** the skin.
- Sweating stops or is reduced.
- The layer of **fatty tissue** insulates the body all the time.



It is the **arterioles** that widen and narrow: they have **muscle** in their walls. **Capillaries** have walls one cell thick and no muscle, so they **cannot** dilate or constrict, and blood vessels **do not move** up or down in the skin.

Key facts and formulas

There is no formula list in the IGCSE Biology exam. Everything below must be learnt.

Formula	Status
Hormone = a chemical substance, produced by a gland, carried by the blood, that alters the activity of one or more specific target organs	Learn it
Adrenal glands → adrenaline; pancreas → insulin; testes → testosterone; ovaries → oestrogen	Learn it
Adrenaline increases breathing rate, heart rate and pupil diameter	Learn it
Nervous control: faster, shorter-lasting; hormonal control: slower, longer-lasting	Learn it
Homeostasis = the maintenance of a constant internal environment	Learn it

Formula	Status
Insulin decreases blood glucose concentration	Learn it
Extended: the pancreas also secretes glucagon, which increases blood glucose concentration	Learn it
Extended: adrenaline increases blood glucose concentration and heart rate	Learn it
Extended: negative feedback: a change from the set point causes a response that returns the value to the set point	Learn it
Extended: insulin: liver converts glucose → glycogen; glucagon: liver converts glycogen → glucose	Learn it
Extended: internal body temperature set point: about 37 °C	Learn it
Extended: too hot: vasodilation of arterioles, sweating; too cold: vasoconstriction of arterioles, shivering, hairs raised	Learn it
Percentage change = $(\text{new value} - \text{original value}) \div \text{original value} \times 100$	Learn it
Range = highest value – lowest value, with units	Learn it

How to do it

We tagged 92 questions for this topic (2021–2025, Papers 1–4; some multiple-choice questions appear on more than one paper). 17 of them mix types, so the counts add up to 129.

Question type	Questions
Explain blood glucose control (insulin, glucagon, glycogen)	29
Match an endocrine gland to its hormone	28
State the effects of adrenaline	24
Explain temperature control	16
Define hormone, homeostasis or negative feedback; how hormones travel	11
Identify parts of the skin and their roles	8
Compare nervous and hormonal control	7
Outline the treatment of type 1 diabetes	3
Read or calculate from a graph	3

1. Explain blood glucose control (29 questions)

1. **Core:** the **pancreas** secretes **insulin**, which **lowers** blood glucose.
2. **Extended, glucose too high:** pancreas detects the rise → secretes **insulin** → **liver** converts **glucose to glycogen** and stores it → glucose falls to the set point.
3. **Extended, glucose too low:** pancreas detects the fall → secretes **glucagon** → **liver** converts **glycogen to glucose** → glucose rises to the set point.
4. Name the mechanism: **negative feedback** (an example of **homeostasis**).

Variations you will meet:

- **"Outline how blood glucose concentration is controlled"** (up to 6 marks): write both halves, one fact per sentence: negative feedback; the pancreas detects the change; it secretes insulin or glucagon; insulin lowers glucose; insulin makes the liver convert glucose to glycogen; glucagon raises glucose; glucagon makes the liver convert glycogen to glucose.
- **Gap-fills:** "...causes the **pancreas** to release insulin. Insulin causes the **liver** to remove glucose from the blood and convert it into **glycogen**. This is an example of **negative feedback**."
- **Multiple-choice traps:** the liver releasing insulin (no: the pancreas); insulin released when glucose is **low** (no: high); insulin turning glycogen into glucose (no: glucagon); glucose turned into "glucagon" (no: glycogen); the pancreas not responding to a rise (no).
- **"Which hormones increase blood glucose?"** **Glucagon and adrenaline**. Only insulin decreases it.
- **"Which response is part of negative feedback?"** One that **reverses** the change, such as making glycogen when glucose rises. Insulin for low glucose, or sweating when cold, are the wrong way round.
- **After a starchy meal:** insulin **increases**, glucagon **decreases**.
- **"Two hormones that change the amount of glycogen in the liver":** any two of insulin, glucagon, adrenaline.
- **"What does glucagon do?"** Stimulates the breakdown of glycogen to glucose, so blood glucose increases. The organ that secretes it is the **pancreas**.

2. Match an endocrine gland to its hormone (28 questions)

1. Learn the four pairs: **adrenal glands – adrenaline**, **pancreas – insulin** (and glucagon), **ovaries – oestrogen**, **testes – testosterone**.
2. On a body diagram, find each gland by position: small caps **on top of the kidneys** (adrenal); a long gland **across the upper abdomen**, near the stomach and small intestine (pancreas); **low in a female abdomen**, either side of the uterus (ovaries); **outside the male abdomen**, below it (testes).
3. If asked for a function: oestrogen and testosterone cause the **development of secondary sexual characteristics**; insulin **lowers blood glucose**; adrenaline prepares the body for **fight or flight**.

Variations you will meet:

- **Tables** with gland, letter and hormone: give **both letters** for the paired glands (ovaries or testes) when the diagram shows two.

- **"Which organ produces insulin?" or "Which is secreted by an endocrine gland?"** Pancreas; insulin. Glucose, starch, lactic acid and enzymes like amylase or lipase are not hormones.
- **Word lists:** "the glands directly above each kidney" are the **adrenal** glands; "the two organs whose hormones control secondary sexual characteristics" are the **ovary** and **testis**.
- **Matching hormones to functions:** growth of facial hair – testosterone; lowers blood glucose – insulin; widens the pupils – adrenaline; oestrogen – female characteristics (and, from Human reproduction, repairing the uterus lining).
- **"A person needs insulin injections. Which gland is not working?"** The pancreas.
- **Hormones and enzymes from the pancreas:** hormones insulin and glucagon; enzymes amylase, protease (trypsin) and lipase.
- **Hormones travel in the blood**, so each row in "gland and how it is transported" questions ends in **blood**, never nerves.

3. State the effects of adrenaline (24 questions)

1. **Released:** in "fight or flight" situations (fear, danger, excitement), by the **adrenal glands**.
2. **Core effects:** **breathing rate increases, heart (pulse) rate increases, pupil diameter increases.**
3. **Extended:** **blood glucose concentration increases** (liver breaks down glycogen to glucose).

Variations you will meet:

- **Rows of increase/decrease:** for adrenaline every one is **increase**. Check each column.
- **Graphs:** pick the lines that **rise** after adrenaline is released, for pupil diameter, heart rate, pulse rate and blood glucose.
- **"Which structure changes shape?" or "suggest the target organ"** for the pupil effect: the **iris**, in the **eye**.
- **"Explain why"** the effects help (Extended, 3 marks): glycogen is converted to glucose → **more glucose** in the blood → used in **respiration** by muscle cells → **releasing energy** → for **muscle contraction** (running or fighting). Faster breathing and heart rate bring more **oxygen** to the muscles and remove more **carbon dioxide**; wider pupils let in **more light**.
- **Circle-the-word:** adrenaline prepares the body for **action**; the heart pumps more blood containing **oxygen** to the muscles; faster breathing excretes more **carbon dioxide**; the pupils let in **more light**.
- **"State the part of the blood that transports adrenaline":** **plasma** (not red blood cells).
- **"An injection of adrenaline raises blood glucose. Why?"** More **glycogen is converted to glucose**.

4. Explain temperature control (16 questions, Extended)

Too cold (write one point per sentence, up to the number of marks):

1. Receptors (in the skin) detect the fall; the **brain** detects the lower **blood** temperature.
2. Impulses travel to the effectors.
3. **Vasoconstriction:** the **arterioles** supplying the skin surface capillaries **narrow**.

4. **Less blood flows** through the skin surface capillaries, so **less heat is lost**.
5. **Shivering**: rapid muscle contraction; more **respiration releases heat**.
6. **Hair erector muscles contract**, hairs stand up and **trap a layer of air** for insulation.
7. Less sweat is produced; **fatty tissue** insulates.
8. Temperature **returns to the set point**: **negative feedback**.

Too hot: receptors and brain detect the rise → **vasodilation** (arterioles **widen**) → **more blood** flows near the surface → **more heat lost**; **sweat** is produced and **evaporates**, taking **heat** from the skin; hairs lie flat; temperature returns to the set point.

Variations you will meet:

- **Multiple choice on vessels**: the right answer always names **arterioles**. "Vasoconstriction of veins" or "of capillaries" is wrong; so is "vasoconstriction **increases** blood flow".
- **0 °C and 40 °C**: shivering in the cold, sweating in the heat.
- **"Where are the receptors for blood temperature?"** In the **brain**. **"Which organ coordinates the response?"** The **brain**.
- **A graph of skin temperature falling** (after cold water, or on a cold day): vasoconstriction **reduced** blood flow to the skin, so the skin cooled while the inside of the body stayed near 37 °C.
- **Red skin in a warm room**: arterioles supplying the skin capillaries **dilate**, so more blood flows near the surface.
- **"Explain how sweating helps"**: sweat glands produce sweat → water **evaporates** from the skin surface → using **heat energy** from the body → temperature falls back to the set point (negative feedback). "Sweat cools you" alone is not enough.
- **Explain a graph** of body temperature against outside temperature: body temperature stays nearly constant; describe the cold responses for the times the surroundings are colder and the hot responses for the times they are hotter.

5. Define hormone, homeostasis or negative feedback; how hormones travel (11 questions)

1. **Hormone** (3 marks): a **chemical substance**, produced by a **gland**, **carried by the blood**, which **alters the activity of one or more specific target organs**.
2. **Homeostasis** (2 marks): the **maintenance of a constant / internal environment**.
3. **Negative feedback** (Extended): a change from the **set point** is detected and causes a response that **returns the value to the set point**.
4. **How hormones reach their target**: in the **blood** (plasma).

Variations you will meet:

- **Gap-fills from a word list**: hormones are **chemical** substances carried by the **blood**; glands that make hormones are **endocrine glands**; keeping a constant **internal** environment is **homeostasis**; the pancreas makes **insulin**, which controls blood **glucose**.

- **"State the name of the mechanism"** for keeping temperature or glucose constant: **negative feedback**.
Not "diabetes", not "homeostasis" if the question asks for the mechanism.
- **Sentence-matching**: "Hormones act more slowly than the nervous system" and "are involved in homeostasis" are true; "are impulses" and "have effects that last a shorter time" are false.

6. Identify parts of the skin and their roles (8 questions, Extended)

1. Work from the top: **hairs** stick out of the surface; the **hair erector muscle** is the small band joining the hair's root to the upper layer.
2. The **sweat gland** is the **coiled tube** deep in the skin with a duct up to the surface.
3. **Blood vessels**: an **arteriole** comes up from below and supplies **capillaries** just under the surface.
4. A **receptor** is a small ending in the skin with a **sensory neurone** leading away from it.
5. **Fatty tissue** is the layer of rounded cells at the bottom.

Variations you will meet:

- **Tables of name, letter and role**: fatty tissue – **insulation**; receptor – **detects temperature changes**; hair erector muscle – **contracts to raise the hair** (to trap air); sweat gland – **produces sweat**; arteriole – **constricts or dilates**.
- **"Which structure constricts to reduce heat loss?"** The **arteriole**.
- **"State the letter of the structure that produces sweat"**: the coiled gland.

7. Compare nervous and hormonal control (7 questions)

1. **Speed of action**: nervous **fast**, hormonal **slow**.
2. **Duration of effect**: nervous **short**, hormonal **long**.
3. Write **both halves** of each comparison in a written answer.

Variations you will meet:

- **Multiple-choice rows** (speed, duration): hormonal = **slow, long**; nervous = **fast, short**. "Nervous fast, long" and "hormonal fast, short" are distractors.
- **Tick boxes about nervous control**: information travels along **neurones**; **reflex actions** are an example. "Only chemical substances", "long-lasting" and "slow" describe hormones.
- **Tables to complete**: nervous – fast, short; hormonal – slow, long.

8. Outline the treatment of type 1 diabetes (3 questions, Extended)

Give as many **separate** points as there are marks:

1. **Monitor** the blood glucose concentration regularly.
2. **Insulin injections** (or an insulin pump).
3. **Count carbohydrates** in the diet; eat regular meals.

4. **Match food intake to activity**, and exercise.
5. Eat **sugar** if the blood glucose falls too low.
6. Keep a healthy weight.

Variations you will meet:

- **"State the name of the disease"** where the body can't make insulin (or the immune system destroys the insulin-making cells): **type 1 diabetes**.

9. Read or calculate from a graph (3 questions)

1. **Read values** carefully from the grid; check what each small square is worth.
2. **Percentage change** = $(\text{new} - \text{original}) \div \text{original} \times 100$. A fall gives a **negative** change. Round as asked (for example 2 significant figures).
3. **Range**: follow the question. "Calculate the range" wants the difference, highest – lowest, **with units** (such as 2 °C). If the question shows a range written as "from ... to ...", give yours the same way.
4. **Set point line**: draw a horizontal line at the normal value, **37 °C** for internal body temperature.

Worked examples

The bold codes show where marks are earned, as in Cambridge mark schemes. The number is how many marks.

- **M1** method mark: for a correct method, even if the numbers slip.
- **A1** accuracy mark: for a correct answer; it needs the M mark before it.
- **B1** mark for a correct result on its own, with no method needed.

Example 1

Core. (a) State the name of the gland that secretes: (i) adrenaline; (ii) testosterone; (iii) insulin. **[3]**

(b) A student is about to run a race and feels nervous. Their adrenal glands release adrenaline.

(i) State **two** effects of adrenaline on the student's body, other than a change in heart rate. **[2]**

(ii) The student's heart rate rose from 70 to 112 beats per minute. Calculate the percentage increase. **[2]**

(c) State **two** differences between the control of the body by hormones and by the nervous system. **[2]**

(a) (i) Adrenal gland **B1**. (ii) Testis **B1**. (iii) Pancreas **B1**.

(b)(i) Breathing rate increases **B1**; pupil diameter increases (pupils widen) **B1**.

(b)(ii) $\frac{112 - 70}{70} \times 100$ **M1** = 60% **A1**.

(c) Hormonal control is slower to act than nervous control **B1**; the effects of hormones last longer than the effects of nervous control **B1**.

Example 2

Extended. A person ate a meal rich in starch at time 0. The table shows their blood glucose concentration, in mg per 100 cm³.

Time / minutes	0	30	60	90	120
Blood glucose / mg per 100 cm ³	90	150	120	95	90

(a) Explain why the blood glucose concentration rose between 0 and 30 minutes. **[2]**

(b) Calculate the percentage change in blood glucose concentration from 30 minutes to 90 minutes. Give your answer to two significant figures. **[2]**

(c) Explain how the blood glucose concentration was returned to 90 mg per 100 cm³. **[4]**

(d) A person with type 1 diabetes ate the same meal. Outline **two** ways they could treat their condition. **[2]**

(a) Starch was digested to glucose **B1**, which was absorbed into the blood in the small intestine **B1**.

(b) $\frac{95 - 150}{150} \times 100 = -36.67$ **M1**, so the change is -37% (2 s.f.) **A1**.

(c) The pancreas detected the rise **B1** and secreted insulin **B1**. Insulin caused the liver to convert glucose into glycogen, which was stored **B1**. This is negative feedback, returning the concentration to its set point **B1**.

(d) Inject insulin (or use an insulin pump) **B1**; monitor blood glucose concentration and count the carbohydrate in meals **B1**.

Example 3

Extended. A person walked outside on a cold day. The table shows their internal body temperature.

Time / minutes	0	10	20	30	40
Internal body temperature / °C	37.0	36.7	36.5	36.9	37.1

(a) Calculate the range of the internal body temperature. State the units. **[1]**

(b) State the name of the mechanism that returned the temperature towards 37 °C. **[1]**

(c) Explain how the body raised its temperature between 20 and 40 minutes. **[5]**

(d) Later, the person ran and became too hot. Explain how sweating helped to cool them. **[2]**

(a) $37.1 - 36.5 = 0.6$ °C **B1**.

(b) Negative feedback **B1**.

(c) Any five of:

- receptors in the brain detected the fall in blood temperature **B1**;
- vasoconstriction: arterioles supplying the skin surface capillaries narrowed **B1**;
- less blood flowed near the skin surface, so less heat was lost **B1**;
- shivering: muscles contracted rapidly **B1**, and the extra respiration released heat **B1**;
- hair erector muscles contracted, raising the hairs to trap an insulating layer of air **B1**.

(d) Water in the sweat evaporated from the skin **B1**, using heat energy from the body **B1**.

Common mistakes

- **Naming the "adrenaline gland"**, or giving the kidney, brain or pancreas. The gland that makes adrenaline is the **adrenal gland**, on top of the kidney.
- **Mixing up glucagon and glycogen**. Glucagon is the hormone; glycogen is the store in the liver. Examiners report this confusion, and bad spelling of both, nearly every year: a word that could be either loses the mark.
- **Saying insulin turns glycogen into glucose**. Insulin does the opposite (glucose → glycogen). Glucagon turns glycogen into glucose.
- **Saying the liver makes insulin**. The **pancreas** makes insulin and glucagon; the liver responds to them.
- **Saying capillaries (or veins) constrict or dilate, or "move" towards the surface**. Only **arterioles** constrict and dilate; blood vessels don't move. Examiners see capillaries and veins in many answers.
- **"Sweat cools you down"** with no mechanism. Say the sweat **evaporates**, taking **heat** from the skin.
- **Incomplete hormone definitions**. Few candidates give all three parts: a **chemical**, made by a **gland**, **carried by the blood** to a **target organ**. Saying hormones travel along nerves is wrong.
- **Naming red blood cells** as what carries hormones. It is the **plasma**.
- **Calling glucose control "an example of diabetes"**. It is an example of **homeostasis** or **negative feedback**; diabetes is when it fails.
- **Vague fight-or-flight answers**. Link each step: adrenaline → glycogen broken down to **glucose** → more glucose for **respiration** → more **energy** for **muscle contraction**.
- **Weak type 1 diabetes answers**. "Take medicine" earns nothing: say **insulin injections, monitoring blood glucose, counting carbohydrates**.
- **Spelling testosterone, oestrogen and arterioles** so they can't be recognised.

How to get the marks

- **"State" or "name"**: one word or phrase (pancreas, insulin, negative feedback, vasoconstriction). Give one answer only; a wrong extra answer can cancel a right one.

- **"Describe" a hormone or homeostasis:** use the key words: **chemical, gland, blood, target organ; maintenance, constant, internal environment.**
- **"Explain" temperature or glucose control:** a chain of separate points, each a mark: **detected** by → **message** (impulse or hormone) → **effector** does what → **result** (more or less heat lost, glucose to glycogen) → **back to the set point.** Five marks need five different points.
- **Name the vessel:** "**arterioles** supplying the skin surface capillaries **constrict**" earns the mark; "blood vessels get smaller" does not.
- **Say what changes:** "**less** blood flows to the skin surface, so **less** heat is lost", not just "blood flow changes".
- **Compare:** for nervous vs hormonal, use comparative words for **both:** "hormonal control is **slower** and its effects last **longer**".
- **"Suggest":** apply what you know to a new situation (why wider pupils help in danger: more light, see better).
- **Calculations:** show the working, round as asked, give units, and keep the minus sign for a fall.
- **Diagrams:** when asked for a letter, give the letter; when asked for a label line, make it touch the structure.

Quick check

1. State the hormone secreted by: (a) the ovaries; (b) the adrenal glands; (c) the testes.
2. State two effects of adrenaline that a person would notice when frightened.
3. **Extended:** During a long run, a person's blood glucose concentration fell from 110 to 77 mg per 100 cm³.
(a) Calculate the percentage decrease. (b) State the hormone secreted by the pancreas in response, and its effect on the liver.
4. **Extended:** Explain why a person's skin looks pale on a very cold day.
5. **Extended:** A person's pulse rate rose from 64 to 96 beats per minute after an injection of adrenaline. Calculate the percentage increase, and state one other effect the injection would have on the blood.

Answers

1. (a) Oestrogen. (b) Adrenaline. (c) Testosterone.
2. Any two of: faster breathing; faster heart rate (pulse); wider pupils.
3. (a) $\frac{110 - 77}{110} \times 100 = 30\%$ decrease. (b) Glucagon; it makes the liver break down glycogen into glucose, which is released into the blood, so the concentration rises back to the set point.
4. Vasoconstriction: the arterioles supplying the skin surface capillaries narrow, so less blood flows near the surface. This reduces heat loss, and the skin looks pale because less blood is showing through it.
5. $\frac{96 - 64}{64} \times 100 = 50\%$. The blood glucose concentration increases (the liver converts glycogen to glucose).

Past questions to try

- **0610/42/O/N/24 Q3**: outline how blood glucose concentration is controlled, and the treatment of type 1 diabetes (Extended).
- **0610/43/O/N/23 Q4**: naming skin structures, keeping warm when it is cold, and what glucagon does (Extended).
- **0610/32/M/J/24 Q7**: homeostasis, a table of endocrine glands and hormones, and comparing nervous and hormonal control (Core).
- **0610/32/F/M/23 Q7**: the adrenal glands, the effects of adrenaline and how it is transported (Core).