

Sexual reproduction in humans

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Read first: [Asexual reproduction and reproduction in plants](#), [Hormones and homeostasis](#)

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What you need to know

This topic covers the human reproductive systems, gametes and fertilisation, pregnancy, the sex hormones and sexually transmitted infections. It comes up on every paper: one-mark multiple-choice questions on Papers 1 and 2, and longer parts on Papers 3 and 4, usually built on a diagram of a reproductive system, a fetus in the uterus or a graph of the menstrual cycle. Outcomes marked **Extended only** are tested on Papers 2 and 4 only. By the end of this topic you should be able to:

1. **Find on a diagram, and give the function of**, each part of the male reproductive system: testes, scrotum, sperm ducts, prostate gland, urethra and penis.
2. **Find on a diagram, and give the function of**, each part of the female reproductive system: ovaries, oviducts, uterus, cervix and vagina.
3. **Describe fertilisation**: the nucleus of a male gamete (a sperm) fuses with the nucleus of a female gamete (an egg cell).
4. **Explain how a sperm is adapted** to its job, using three features: the flagellum, the mitochondria and the enzymes in the acrosome.
5. **Explain how an egg cell is adapted**, using two features: its energy stores and its jelly coat, which changes at fertilisation.
6. **Compare sperm and egg cells** for size, structure, ability to move (motility) and the numbers made.
7. **State what happens in early development**: the zygote becomes an embryo, a ball of cells, which implants in the lining of the uterus.
8. **Find on a diagram, and give the function of**, the umbilical cord, placenta, amniotic sac and amniotic fluid.
9. **Extended only**: describe how the placenta and umbilical cord exchange dissolved nutrients, gases and excretory products between the mother's blood and the fetus's blood.
10. **Extended only**: state that some pathogens and toxins can cross the placenta and harm the fetus.
11. **Describe what testosterone and oestrogen do** at puberty: they bring about and control the secondary sexual characteristics.
12. **Describe the menstrual cycle** as a series of changes in the ovaries and in the lining of the uterus.
13. **Extended only**: state where oestrogen and progesterone are made, during the menstrual cycle and during pregnancy.

14. **Extended only:** explain how four hormones, FSH, LH, oestrogen and progesterone, control the menstrual cycle and pregnancy.
15. **Describe a sexually transmitted infection (STI):** an infection passed on through sexual contact.
16. **State that HIV** (human immunodeficiency virus) is a pathogen that causes an STI, and that HIV infection may lead to AIDS.
17. **Describe how HIV is passed on,** and **explain how the spread of STIs is controlled.**

Birth control methods, artificial insemination and IVF for humans left the syllabus in 2023, and labour and birth are not listed in it. Older past papers ask about them; this note covers them only briefly, in "How to do it".

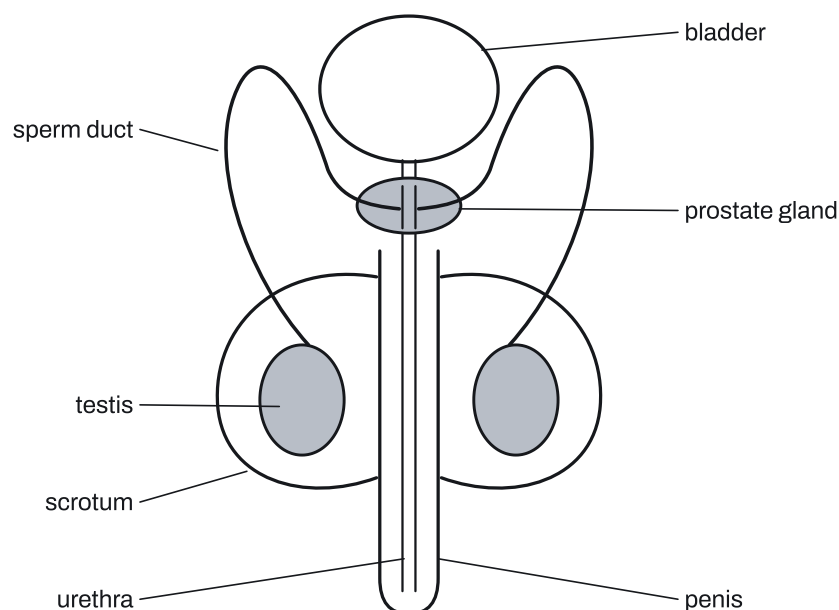
Understand it

Sexual reproduction in humans

Humans reproduce only sexually. Each parent makes **gametes** (sex cells): the male gametes are **sperm**, the female gametes are **egg cells**. At **fertilisation** the **nucleus** of a sperm fuses with the **nucleus** of an egg cell, making a single new cell, the **zygote**. It is the nuclei that fuse, because they carry the chromosomes. The zygote grows into a new person who is genetically different from both parents.

(A body cell has 46 chromosomes; each gamete has half as many, 23, so the zygote has $23 + 23 = 46$ again. Gametes are made by meiosis, which you meet in the Inheritance topics.)

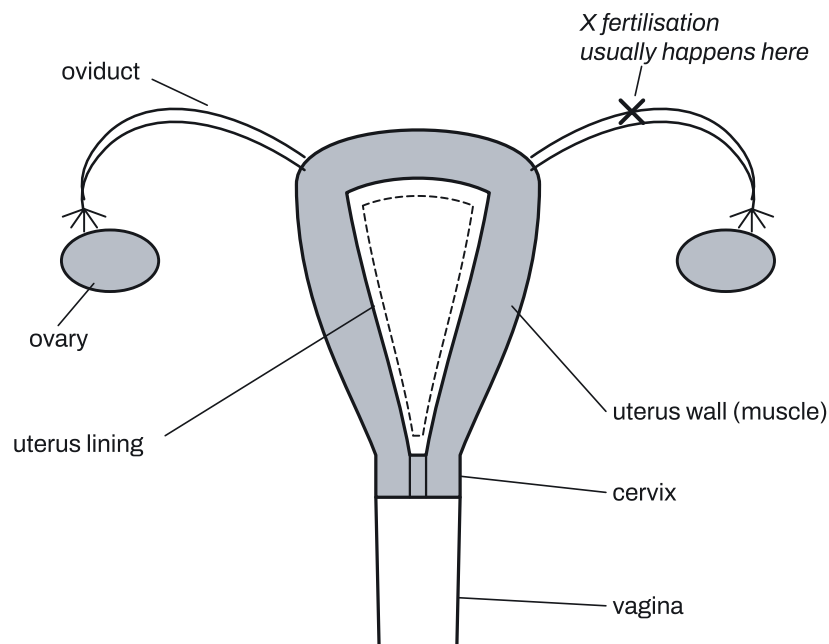
The male reproductive system



Part	What it does
Testis (plural testes)	Makes sperm; also makes the hormone testosterone
Scrotum	Sac of skin that holds and protects the testes outside the body, where it is a little cooler, which suits sperm production
Sperm duct	Carries sperm from the testis to the urethra
Prostate gland	Makes the fluid that sperm swim in (it contains nutrients); sperm + fluid = semen
Urethra	Carries semen, and at other times urine, out of the body through the penis
Penis	Places semen in the vagina during sexual intercourse; also carries urine out

The **bladder** stores urine; it is part of the excretory system, not the reproductive system, but it is drawn on these diagrams, so know where it is. Sperm pass along this route: **testis** → **sperm duct** → **urethra** → **out of the penis**, and then, in the woman, **vagina** → **cervix** → **uterus** → **oviduct**, where they may meet an egg.

The female reproductive system

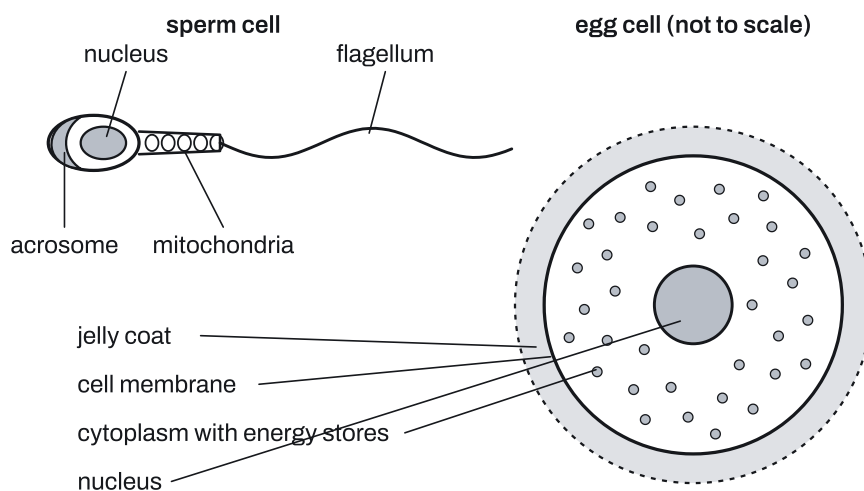


Part	What it does
Ovary	Contains and releases egg cells (one about every 28 days); makes the hormones oestrogen and progesterone
Oviduct (egg tube)	Carries the egg from the ovary to the uterus; fertilisation happens here
Uterus (womb)	Where the embryo implants and the fetus grows; its muscular wall pushes the baby out at birth

Part	What it does
Uterus lining	Soft, with many blood vessels; the embryo implants in it; it is shed each month if there is no pregnancy
Cervix	A ring of muscle at the neck of the uterus; keeps the fetus in the uterus during pregnancy and widens at birth
Vagina	Receives the penis and sperm during intercourse; the baby passes out through it at birth

Ovulation is the release of an egg cell from an ovary. The egg drifts along the oviduct. If sperm are there, one may fertilise it **in the oviduct**, not in the uterus or the ovary.

Sperm and egg cells



Each gamete's structure suits its job. Give the **feature** and **what it is for** together:

Sperm feature	Why it helps
Flagellum (tail)	Moves from side to side so the sperm can swim through the uterus and oviduct to the egg
Many mitochondria in the middle piece	Carry out aerobic respiration, which releases energy for the flagellum to swim
Acrosome containing enzymes	The enzymes digest (break down) the jelly coat of the egg, so the sperm nucleus can get in
Egg cell feature	Why it helps
Energy stores in the cytoplasm (such as fat and protein)	Supply energy and materials for the zygote's first cell divisions, before it implants
Jelly coat	Changes at fertilisation (it hardens), so only one sperm can enter

Both gametes carry a nucleus with half the normal number of chromosomes, so that the zygote has the full number.

	Egg cell	Sperm
Size	Large (about 0.1 mm across, just visible)	Much smaller (the head is about 0.005 mm long)
Structure	Round; jelly coat; lots of cytoplasm with energy stores; no flagellum	Head with acrosome, middle piece with mitochondria, flagellum; very little cytoplasm
Motility	Cannot swim (non-motile); moved along the oviduct	Swims (motile), using its flagellum
Numbers	Few: usually one released each month	Millions made every day; millions in each release of semen

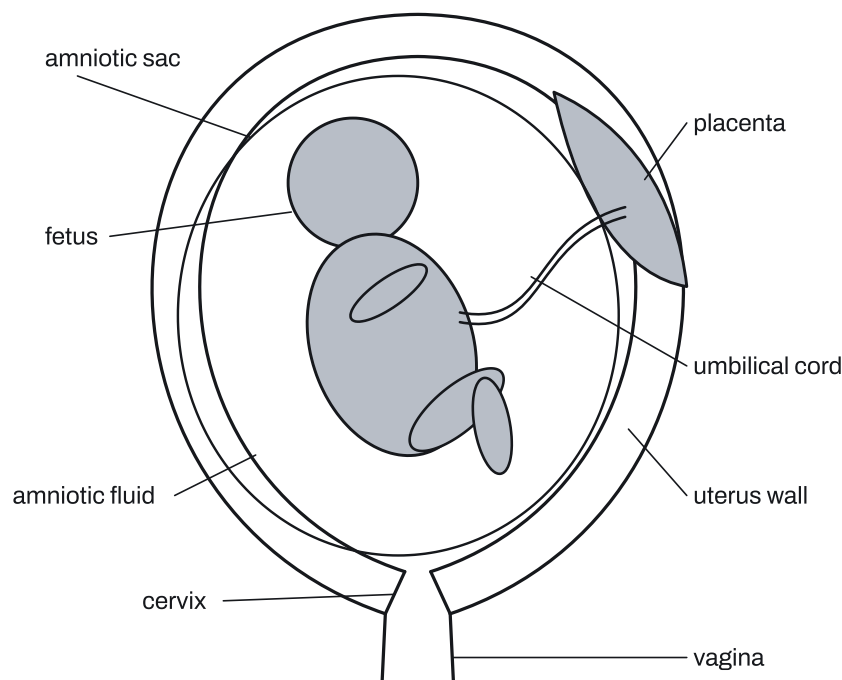
So many sperm are made because most die or get lost on the way: making millions raises the chance that one reaches the egg.

From zygote to fetus

1. **Fertilisation** in the oviduct makes a **zygote**.
2. The zygote divides by mitosis again and again as it moves down the oviduct, forming a **ball of cells**: the **embryo**.
3. After about a week the embryo **implants** (sinks into) the thick lining of the **uterus**.
4. The placenta forms, and the embryo grows. Once its organs have formed (after about 8 weeks) it is called a **fetus**.

So the order is **zygote** → **embryo (ball of cells)** → **implantation** → **fetus**.

The fetus in the uterus



Part	What it does
Placenta	Organ attached to the uterus wall where substances pass between the mother's blood and the fetus's blood
Umbilical cord	Joins the fetus to the placenta; its blood vessels carry the fetus's blood to and from the placenta
Amniotic sac	Membrane around the fetus; makes and holds the amniotic fluid
Amniotic fluid	Protects the fetus from bumps (mechanical shock) by cushioning it; lets it move; helps keep its temperature steady

The amniotic fluid does **not** feed the fetus: food and oxygen come through the placenta.

Extended only: how the placenta works. The fetus's blood flows along the umbilical arteries into capillaries in the placenta's many finger-like projections (villi). These dip into spaces filled with the mother's blood. The two bloods are **kept separate**; substances cross between them by **diffusion** across a thin barrier.

- **Mother → fetus:** oxygen, and dissolved nutrients such as glucose, amino acids, water, ions and vitamins; also antibodies.
- **Fetus → mother:** carbon dioxide and urea (excretory products).

The placenta is good at this because it has a **large surface area** (the villi), a **thin barrier** (a short diffusion distance, with capillaries close to the mother's blood) and a **good blood supply** on both sides, which keeps the concentration gradients steep.

The **umbilical artery** carries the fetus's blood **to** the placenta: it is **low in oxygen and nutrients, and high in carbon dioxide and urea**. The **umbilical vein** carries blood **back to** the fetus: **high in oxygen and nutrients, low in carbon dioxide and urea**. (This is the opposite of the adult pattern, where arteries carry oxygen-rich blood: here "artery" just means "away from the fetus's heart".)

Keeping the bloods apart protects the fetus from the mother's higher blood pressure, and the placenta stops many harmful substances. **Extended only:** but **some pathogens and toxins do cross the placenta** and can harm the fetus: for example the rubella virus and HIV (pathogens), and nicotine, alcohol and some other drugs (toxins). That is why pregnant women are advised not to smoke or drink alcohol.

Puberty and the sex hormones

At puberty the testes start to make **testosterone** and the ovaries start to make **oestrogen**. These hormones bring about the **secondary sexual characteristics** (the changes that make the body adult, apart from the sex organs you are born with) and keep them going afterwards.

Testosterone (made by the testes)	Oestrogen (made by the ovaries)
Voice deepens	Breasts develop
Hair grows on the face and body	Hips widen
Muscles develop, shoulders broaden	Menstrual cycles start
Testes start making sperm	Ovaries start releasing eggs

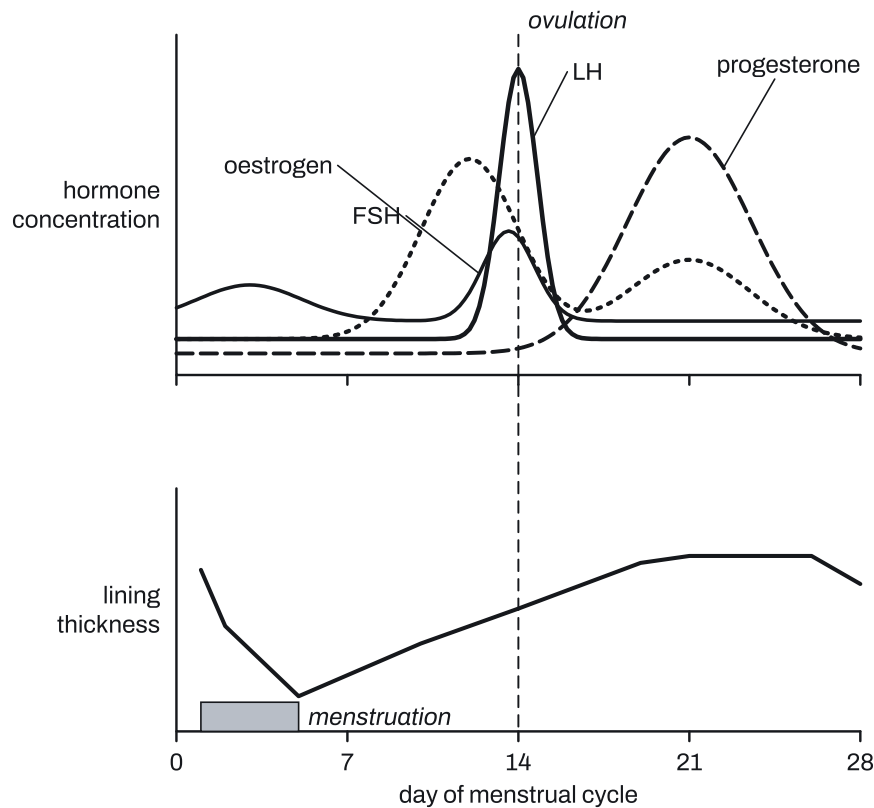
In **both** sexes (each caused by that person's own sex hormone): pubic and underarm hair grows, the sex organs grow, there is a growth spurt and the body shape changes.

The menstrual cycle

About every 28 days, from puberty until middle age, a woman's body gets ready for a possible pregnancy. The **menstrual cycle** is the set of changes in the **ovaries** and in the **lining of the uterus**. Day 1 is the first day of bleeding.

- **Days 1–5, menstruation:** the lining of the uterus breaks down and is lost through the vagina with a little blood (a period). Meanwhile, in an ovary, an egg starts to mature inside a **follicle** (a fluid-filled space).
- **Days 6–14:** the lining **repairs and thickens**, with more blood vessels. The follicle grows.
- **About day 14, ovulation:** the follicle bursts and releases the egg into the oviduct.
- **Days 15–28:** the lining stays **thick** and is thickest in this half of the cycle (around day 21), ready for an embryo to implant. The empty follicle makes progesterone.
- If no embryo implants, the lining breaks down again at day 28, and a new cycle starts. If one does implant, the lining is kept and there are no more periods during pregnancy.

Extended only: the hormones.



Hormone	Made by	What it does
FSH (follicle-stimulating hormone)	Pituitary gland	Makes an egg mature in a follicle in the ovary; makes the ovary release oestrogen
LH (luteinising hormone)	Pituitary gland	A sudden peak (surge) just before day 14 causes ovulation ; then makes the empty follicle release progesterone
Oestrogen	Ovary (the growing follicle)	Makes the uterus lining repair and thicken after menstruation
Progesterone	Ovary (the empty follicle)	Keeps the lining thick (maintains it) ready for implantation

Read the graph to tell them apart: **LH** has the tallest, sharpest peak, at ovulation; **FSH** peaks at the same time but lower; **oestrogen** rises in the first half and peaks before ovulation; **progesterone** is low in the first half and highest around day 21.

When the empty follicle stops making progesterone near the end of the cycle, the progesterone level falls and the lining breaks down: menstruation.

Pregnancy. If an embryo implants, progesterone and oestrogen stay **high** all through pregnancy. At first the ovary keeps making them; then the **placenta** takes over and becomes the main source. High progesterone keeps the lining in place, and high progesterone and oestrogen stop FSH and LH being released, so no more eggs mature, there is no ovulation and there are no periods.

Where oestrogen and progesterone are made

During the menstrual cycle	Ovaries
During pregnancy	Ovaries at first, then mainly the placenta

Sexually transmitted infections

A **sexually transmitted infection (STI)** is an infection passed from person to person through sexual contact. Some are caused by bacteria (chlamydia, gonorrhoea and syphilis, which can be treated with antibiotics); others by viruses.

HIV (human immunodeficiency virus) is a **virus**: a pathogen that causes an STI. HIV infection **may lead to AIDS** (acquired immune deficiency syndrome). HIV destroys some of the body's lymphocytes, so the person makes fewer antibodies; after some years they cannot fight off other infections, and that condition is AIDS. HIV is the pathogen; AIDS is the condition it can lead to. Antibiotics do not work on HIV, because it is a virus; antiviral drugs slow it down.

HIV lives in body fluids: blood, semen, vaginal fluid and breast milk. It is passed on by:

- **unprotected sexual intercourse** (without a condom) with an infected person;
- **blood**: sharing needles (for example by drug users), transfusions of unscreened blood, or blood-to-blood contact through cuts;
- **mother to baby**: across the placenta, during birth, or in breast milk.

It is **not** passed on by hugging, shaking hands, kissing, saliva, sharing plates, cups or food, coughs and sneezes, toilet seats, water or insect bites.

Controlling the spread of STIs:

- use **condoms** (or femidoms): a barrier that stops the exchange of body fluids;
- have fewer sexual partners, or no sexual contact (abstinence);
- **test** people, trace and test their sexual partners, and **treat** those infected (antibiotics for bacterial STIs, antiviral drugs for HIV, which also make it less likely to be passed on);
- **education** about how STIs spread and how to avoid them;
- **screen** donated blood before transfusions; heat-treat blood products;
- drug users should not share needles (needle-exchange schemes give out sterile ones);
- an HIV-positive mother can take antiviral drugs during pregnancy and avoid breastfeeding.

Key facts and formulas

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

Formula	Status
Testis: sperm and testosterone; scrotum: holds testes; sperm duct: testis → urethra; prostate gland: fluid for sperm; urethra: semen and urine out; penis: semen into vagina	Learn it
Ovary: releases eggs, makes oestrogen and progesterone; oviduct: carries egg, site of fertilisation; uterus: implantation and growth; cervix: neck of uterus; vagina: receives sperm, birth canal	Learn it
Fertilisation: fusion of the nuclei of a sperm and an egg cell → zygote	Learn it
Sperm: flagellum (swim), mitochondria (release energy), acrosome enzymes (digest jelly coat)	Learn it
Egg: energy stores (early divisions), jelly coat changes at fertilisation (only one sperm enters)	Learn it
Egg: large, non-motile, few; sperm: small, motile, millions	Learn it
Zygote → embryo (ball of cells) → implants in the uterus lining → fetus	Learn it
Placenta: exchange; umbilical cord: links fetus to placenta; amniotic sac: holds fluid; amniotic fluid: protects from shock	Learn it
Extended: mother → fetus: oxygen, glucose, amino acids, antibodies; fetus → mother: carbon dioxide, urea; by diffusion, bloods separate	Learn it
Extended: umbilical artery: to placenta, low O ₂ , high CO ₂ and urea; umbilical vein: to fetus, high O ₂ and nutrients	Learn it
Testosterone (testes): deep voice, facial hair, muscles; oestrogen (ovaries): breasts, wider hips, periods start	Learn it
Cycle: menstruation days 1–5, lining thickens to day 14, ovulation about day 14, lining kept thick days 14–28, thickest about day 21	Learn it
Extended: FSH: egg matures, oestrogen made; LH: ovulation; oestrogen: lining repairs and thickens; progesterone: lining maintained	Learn it
Extended: oestrogen and progesterone: ovaries in the cycle; placenta (mainly) in pregnancy	Learn it
HIV: a virus; causes an STI; may lead to AIDS; spread by unprotected sex, blood, mother to baby	Learn it
Percentage change = $\frac{\text{new} - \text{original}}{\text{original}} \times 100$; 1 mm = 1000 μm	Learn it

How to do it

We tagged 138 questions for this topic (2021–2025, Papers 1–4; 137 different, since one multiple-choice question appears on two papers). 38 of them mix types, so the counts add up to 195.

Question type	Questions
Name reproductive structures and their functions	31
Menstrual-cycle and pregnancy hormones	25
Sex hormones at puberty and secondary sexual characteristics	24
STIs and HIV	24
Gamete adaptive features and comparing sperm and eggs	23
The uterus lining and the timing of events in the cycle	18
Fertilisation and early development	17
Placenta, umbilical cord and amniotic sac	17
Read reproduction data and calculate	10
Birth control and fertility treatment (no longer in the syllabus)	6

Most are one-mark multiple choice. On Papers 3 and 4 they are parts of a longer question, usually built on a lettered diagram of a reproductive system, a fetus in the uterus or a graph of hormones or lining thickness.

1. Name reproductive structures and their functions (31 questions)

- Orient yourself.** Male: find the bladder first (top, round); the urethra runs from it through the penis; the testis hangs below in the scrotum; the sperm duct loops from the testis up over the bladder; the prostate gland sits just below the bladder around the urethra. Female: the uterus is the central hollow organ; the oviducts run out from its top; the ovaries are at their ends; the cervix is the narrow neck; the vagina leads out.
- Give the function** from the tables in "Understand it".

Variations you will meet:

- Complete a table of letter, name and function:** one mark per row, so the letter, the name and the function in that row must all be right.
- "Where does fertilisation happen?"** The oviduct. A cross or label line must end **on the oviduct**, not in the uterus or the ovary. **Implantation:** the uterus lining. **Egg release:** the ovary.
- "Which part makes sperm?"** The testes (not the scrotum, which only holds them). **"Which makes the fluid sperm swim in?"** The prostate gland (not the testes).
- Sperm duct and urethra.** The sperm duct carries only sperm, from the testis to the urethra; the urethra carries semen **and** urine out of the body. Don't call the sperm duct the "sperm tube" or say the testes store semen.

- **The route of sperm** (multiple choice): testis → sperm duct → urethra → (penis) → vagina → cervix → uterus → oviduct.
- **A correctly labelled diagram** (multiple choice): check where each label line ends, one by one.
- **Extended: the prostate gland** "makes fluid for the sperm to swim in"; mentioning that the fluid provides nutrients also scores.

2. Menstrual-cycle and pregnancy hormones (25 questions, Extended)

1. **Identify the curves** on a 28-day graph: LH has the tallest, sharpest peak at about day 14; FSH peaks at the same time but lower; oestrogen rises in the first half and peaks just before ovulation; progesterone is low until day 14 and highest around day 21.
2. **Give the role** (one fact per mark): FSH: an egg matures in its follicle, and oestrogen is made; LH: ovulation, then progesterone is made; oestrogen: the lining repairs and thickens; progesterone: the lining is maintained.
3. **Give the site**: FSH and LH from the pituitary gland; oestrogen and progesterone from the ovary during the cycle, and mainly the placenta in pregnancy.

Variations you will meet:

- **"Which hormone keeps the lining thick in pregnancy?"** Progesterone. **"Which hormones are high in pregnancy?"** Oestrogen and progesterone (not LH or FSH).
- **"Describe and explain how progesterone changes in pregnancy."** It increases and stays high (one mark), because it is made by the placenta and it keeps the lining in place, so there is no menstruation or ovulation (one mark).
- **Sketch the progesterone line** on a graph of FSH and LH: low until about day 14, rising to a peak around day 21, then falling by day 28.
- **"Suggest the target organ for FSH"**: the ovary. **"How does it get there?"** In the blood (plasma).
- **"Describe the relationship" between two curves**: compare pattern, the day of the peak and the heights, with values read off the graph ("both peak on day 14; LH rises to a higher peak than FSH").
- **"Name the hormone released by the placenta"**: progesterone (or oestrogen), never FSH or LH.

3. Sex hormones at puberty and secondary sexual characteristics (24 questions)

1. **Name the hormone and its gland**: testosterone from the testes; oestrogen from the ovaries.
2. **Match the characteristic**: voice deepening, facial hair and bigger muscles are testosterone; breasts, wider hips and the start of periods are oestrogen.

Variations you will meet:

- **"Which happens in both males and females?"** Pubic and underarm hair, growth of the sex organs, a growth spurt, changes in body shape.
- **Tick tables** (testosterone, oestrogen or both): one mark per row, and an extra tick loses the row.

- **"State the organ that makes a female sex hormone, and one function":** the ovary; oestrogen brings about the secondary sexual characteristics, such as breast growth (or: it makes the uterus lining thicken).
- **Wrong answers to avoid:** progesterone does not cause the secondary sexual characteristics; adrenaline and insulin are not sex hormones.
- **Describe changes in a boy at puberty:** give separate physical changes, one per mark (voice deepens, facial and body hair, muscles grow, testes make sperm, penis and testes grow).

4. STIs and HIV (24 questions)

1. **Definition:** an STI is an infection passed on through sexual contact.
2. **HIV** is a virus (a pathogen) that causes an STI; infection may lead to AIDS.
3. **Transmission:** unprotected sex; blood (shared needles, unscreened transfusions); mother to baby (placenta, birth, breast milk).
4. **Control:** condoms, fewer partners, testing and treating, contact tracing, education, screening blood, sterile needles.

Variations you will meet:

- **"Which methods can transmit HIV?"** Pick only the body-fluid routes: sex, blood and needles, mother to fetus or baby. Reject food, water, plates, hugging, saliva, coughing and insect bites.
- **"What could explain a fall in new HIV infections?"** More screening of blood, more condom use, more education, fewer shared needles. An increase in drug use, reused needles or unprotected sex would raise infections.
- **"What type of organism causes AIDS?"** A virus (HIV), not a bacterium. HIV is the pathogen, not AIDS.
- **"Which STIs can be treated with antibiotics?"** Only the bacterial ones (such as chlamydia, gonorrhoea and syphilis), never HIV or other viruses.
- **"Describe how the risk of a mother passing HIV to her baby can be reduced":** antiviral drugs in pregnancy, avoiding breastfeeding (bottle-feeding with formula), and care during birth.
- **Extended: effects of HIV:** it destroys lymphocytes, so fewer antibodies are made and the person catches other infections.
- **Be specific.** "Use contraception" is too vague: say "use a condom". "Be careful" scores nothing.

5. Gamete adaptive features and comparing sperm and eggs (23 questions)

1. **Sperm:** flagellum to swim; many mitochondria to release energy (by respiration) for swimming; acrosome containing enzymes to digest the jelly coat.
2. **Egg:** energy stores for the first divisions; a jelly coat that changes at fertilisation so only one sperm gets in.
3. **Compare:** egg larger, non-motile, few; sperm smaller, motile, millions.

Variations you will meet:

- **"Explain three adaptive features":** each needs the **feature and its purpose**: "a flagellum to swim to the egg" earns the mark; "a flagellum" alone may not.

- **"Which part contains digestive enzymes?"** The acrosome (the cap at the tip of the head). **"Which provides the energy to swim?"** The mitochondria.
- **Say "release" energy**, not "produce" or "make" energy.
- **The acrosome is not an enzyme**: it **contains** enzymes.
- **"Which feature is found only in the egg?"** The jelly coat. The flagellum and acrosome are only in sperm; both have a nucleus with chromosomes.
- **Motility** means the ability to move by itself: the sperm is motile, the egg is not.
- **Why so many sperm?** Most don't reach the egg, so many are needed for one to succeed.
- **Abnormal sperm** (Extended): a sperm with no acrosome cannot digest the jelly coat; one with no flagellum or a short one cannot swim to the egg; one with few mitochondria has too little energy. Use the data to say which abnormality is most common in a person with low fertility.
- **Haploid nucleus**: sometimes accepted as a fourth sperm feature (so the zygote gets the normal number of chromosomes).

6. The uterus lining and the timing of events in the cycle (18 questions)

1. **Learn the timeline**: menstruation days 1–5; lining thickens days 6–14; ovulation about day 14; lining thickest and kept thick days 14–28.
2. **On a graph**, menstruation is where the lining thickness **falls**; ovulation is at the middle of the cycle; the lining is thickest in the second half.

Variations you will meet:

- **"On which day is the lining thickest?"** A day in the second half, such as day 21 (not day 2, 4 or 9).
- **"What happens at the start of the cycle?"** The lining breaks down (menstruation).
- **"What happens in the days before ovulation?"** The lining thickens (repairs).
- **Define the terms**: menstruation is the loss of the uterus lining (with blood); ovulation is the release of an egg from an ovary.
- **Complete a graph line**: after the fall at menstruation, draw it rising to day 14 and staying high (level) to about day 28.
- **Put events in order** (Extended): follicle develops → egg released into the oviduct → lining stays thick → (if no fertilisation) lining breaks down.
- **Most fertile days**: around ovulation (days 12–16), when an egg may be in the oviduct. On a body-temperature graph, ovulation is just before the temperature rises.
- **Link to the hormones** (Extended): the lining thickens because of oestrogen, stays thick because of progesterone, and breaks down when progesterone falls.

7. Fertilisation and early development (17 questions)

1. **Fertilisation** = the **fusion of the nuclei** of two **gametes** (a sperm and an egg cell). Two marks usually need both ideas: nuclei fuse, and they are gametes' nuclei.

2. **The sequence:** fertilisation in the oviduct → zygote → cell division (mitosis) → embryo, a ball of cells → implants in the uterus lining → fetus.

Variations you will meet:

- **"What is the ball of cells that implants?"** The embryo (not the zygote, fetus or placenta).
- **"State the name of the male gamete":** sperm (cell). **"Where are male gametes made?"** The testes.
- **Flow diagrams:** name the organ (ovary or testis), the process that makes gametes (meiosis), the fusion (fertilisation), the division of the zygote (mitosis) and implantation.
- **"Which statement is correct?"** All gametes are haploid; fertilisation fuses two haploid nuclei; the sperm is the male gamete.
- **Describe events from ovulation to a fetus** (Extended): egg released from the ovary into the oviduct; sperm swims to it; acrosome enzymes digest the jelly coat; nuclei fuse (fertilisation) in the oviduct to make a zygote; it divides by mitosis to form an embryo; the embryo implants in the uterus lining; it develops into a fetus; the placenta forms. Use the words egg, zygote, embryo and fetus correctly.

8. Placenta, umbilical cord and amniotic sac (17 questions)

1. **Name** the placenta (disc on the uterus wall), umbilical cord (tube from the fetus to the placenta), amniotic sac (membrane around the fetus) and amniotic fluid (the liquid inside the sac).
2. **Give the function:** exchange; carries blood between the fetus and placenta; holds the fluid; protects against mechanical shock.
3. **Extended: exchange** by diffusion, with the bloods kept separate: oxygen, glucose, amino acids, antibodies to the fetus; carbon dioxide and urea to the mother.

Variations you will meet:

- **"Which direction does a substance move?"** Urea and carbon dioxide go from the fetus to the mother; oxygen and glucose from the mother to the fetus. Glycogen (insoluble) and blood cells do not cross.
- **Umbilical artery or vein?** The artery takes blood **to** the placenta: low oxygen, low nutrients, high carbon dioxide and urea. The vein brings blood **to** the fetus: high oxygen and nutrients, low carbon dioxide and urea.
- **"How does the mother's blood change as it passes through the placenta?"** Its oxygen falls and its urea rises.
- **"What is a function of the placenta?"** It exchanges substances, and acts as a barrier to some toxins and pathogens. It does **not** exchange blood.
- **"Describe the functions of the placenta and umbilical cord"** (4 marks): the bloods are kept separate; named substances move from mother to fetus; named substances move from fetus to mother; antibodies pass to the fetus (passive immunity); the placenta is a barrier to some toxins and pathogens; the placenta makes progesterone.
- **Placenta adaptations:** large surface area, short diffusion distance (thin), good blood supply keeping a steep concentration gradient.

- **Amniotic fluid** (up to 3 marks): protects from mechanical damage; lets the fetus move (so muscles and bones develop); helps keep its temperature steady. It does not provide food.
- **Harmful substances**: the rubella virus, HIV, nicotine and alcohol can cross.
- **Labour and birth** (older questions only; not in the current syllabus): the amniotic sac breaks, the muscles of the uterus wall contract, the cervix widens (dilates), the baby is pushed out through the vagina, the umbilical cord is tied and cut, and the placenta (afterbirth) is delivered.

9. Read reproduction data and calculate (10 questions)

1. **Read the table or graph** carefully, with its units ("thousands", "per 1000 people").
2. **Describe a trend**: the overall direction, where it changes, and quote numbers with units.
3. **Percentage change** = $\frac{\text{new} - \text{original}}{\text{original}} \times 100$. Round only at the end, to what the question asks.
4. **Convert units first** if the two values are in different units: $1 \text{ mm} = 1000 \mu\text{m}$.

For example, a follicle grows from $25 \mu\text{m}$ to 20 mm across. Convert: $25 \mu\text{m} = 0.025 \text{ mm}$. Percentage increase = $\frac{20 - 0.025}{0.025} \times 100 = 79\,900\%$ (3 s.f.).

Variations you will meet:

- **"Which STI has half as many cases as another?"** Divide by 2 and match.
- **Calculate a difference** or a total from two rows; state the unit.
- **Percentage decrease** (for example in egg numbers, or in new HIV cases): use the original (earlier) value as the denominator.

10. Birth control and fertility treatment (6 questions, 2021–2022 only)

Birth control methods and human fertility treatment **left the syllabus in 2023**, so they won't be asked now. Two ideas from those questions still matter for the current syllabus: a **condom** (or femidom) is a barrier that protects against STIs as well as pregnancy; and **high oestrogen and progesterone stop FSH and LH being released**, which is why pregnancy stops ovulation. (The contraceptive pill works the same way, by keeping those two hormones high.)

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. Look at the male reproductive system in the first diagram in "Understand it".

(a) State the name of the structure that: (i) makes sperm; (ii) makes the fluid that sperm swim in; (iii) carries sperm from the testis to the urethra. **[3]**

(b) State the function of the scrotum. **[1]**

(c) State the name of the hormone made by the testes, and two secondary sexual characteristics it causes. **[3]**

(d) Explain two ways a sperm cell is adapted to reach and fertilise an egg cell. **[4]**

(a) (i) Testis **B1**. (ii) Prostate gland **B1**. (iii) Sperm duct **B1**.

(b) It holds and protects the testes outside the body **B1**.

(c) Testosterone **B1**. Any two: the voice deepens **B1**; hair grows on the face and body **B1**; the muscles develop.

(d) It has a flagellum **B1**, which lets it swim to the egg **B1**. It has an acrosome containing enzymes **B1**, which digest the jelly coat so the sperm nucleus can get into the egg **B1**. (Or: many mitochondria, which release energy by respiration for swimming.)

Example 2

Core, with Extended parts. A doctor measured the thickness of the lining of a woman's uterus on six days of one 28-day menstrual cycle.

Day	2	5	10	14	21	26
Thickness / mm	3.0	1.0	2.5	3.5	5.0	5.0

(a) Using the table, state the days on which menstruation was happening, and explain your answer. **[2]**

(b) Calculate the percentage increase in the thickness of the lining from day 5 to day 21. **[2]**

(c) State the day on which ovulation most likely happened. **[1]**

(d) **Extended:** state the names of the hormones that (i) make the lining thicken after menstruation and (ii) keep it thick after ovulation. **[2]**

(e) **Extended:** state where progesterone is made during this cycle, and where it is mainly made later in a pregnancy. **[2]**

(a) Days 2 to 5 (days 1–5) **B1**: the lining was getting thinner because it was breaking down and being lost **B1**.

(b) $\frac{5.0 - 1.0}{1.0} \times 100$ **M1** = 400% **A1**.

(c) Day 14 **B1**.

(d) (i) Oestrogen **B1**. (ii) Progesterone **B1**.

(e) The ovary **B1**; the placenta **B1**.

Example 3

Core, with an Extended part. The table shows the number of new HIV infections recorded in one region.

Year	2010	2020
New HIV infections	4800	1200

(a) Calculate the percentage decrease in new HIV infections from 2010 to 2020. **[2]**

(b) Suggest two changes that could explain this decrease. **[2]**

(c) State three ways in which HIV can be passed from one person to another. **[3]**

(d) **Extended:** gonorrhoea is an STI caused by a bacterium. Explain why antibiotics can treat gonorrhoea but not HIV infection. **[2]**

(a) $\frac{4800 - 1200}{4800} \times 100$ **M1 = 75% A1.**

(b) Any two: more use of condoms **B1**; more screening of donated blood **B1**; education about how HIV spreads; needle-exchange schemes so drug users don't share needles; more testing and treatment with antiviral drugs.

(c) Unprotected sexual intercourse **B1**; sharing needles (or transfusion of unscreened blood) **B1**; from mother to baby across the placenta or in breast milk **B1**.

(d) Antibiotics kill bacteria (or stop them growing) **B1**; HIV is a virus, and antibiotics have no effect on viruses **B1**.

Example 4

Extended. A woman is 20 weeks pregnant.

(a) Describe the events from ovulation to implantation. **[4]**

(b) Name two dissolved substances that pass from the mother's blood to the fetus's blood in the placenta, and two that pass the other way. **[2]**

(c) Compare the blood in the umbilical vein with the blood in the umbilical artery. **[2]**

(d) Explain why the woman is advised not to smoke. **[2]**

(e) State one function of the amniotic fluid. **[1]**

- (a) An egg is released from the ovary into the oviduct **B1**. A sperm's acrosome enzymes digest the jelly coat and the nucleus of the sperm fuses with the nucleus of the egg (fertilisation) in the oviduct, forming a zygote **B1**. The zygote divides by mitosis to form an embryo, a ball of cells **B1**, which implants in the lining of the uterus **B1**.
- (b) Mother to fetus: oxygen and glucose (or amino acids) **B1**. Fetus to mother: carbon dioxide and urea **B1**.
- (c) The umbilical vein carries more oxygen and more nutrients (such as glucose) **B1**, and less carbon dioxide and urea **B1**, than the umbilical artery.
- (d) Nicotine (a toxin in smoke) can cross the placenta **B1** and harm the fetus **B1**.
- (e) It protects the fetus from mechanical shock (or: lets the fetus move; keeps its temperature steady) **B1**.

Common mistakes

- **Putting fertilisation in the uterus** (or the ovary). It happens in the **oviduct**; the embryo then implants in the uterus lining. Examiners report the uterus as the commonest wrong answer.
- **Muddling the male tubes**. The **sperm duct** carries sperm from the testis to the urethra; the **urethra** carries semen and urine out. The **prostate gland**, not the testes, makes the fluid; the testes make sperm and do not store semen.
- **Saying "the fetus is in the stomach"** or that the baby comes out of the stomach. It grows in the **uterus**.
- **Writing a feature without its purpose**. "Mitochondria" alone is not an explanation: add "to **release** energy for swimming". Don't say mitochondria "produce" energy, or that the acrosome **is** an enzyme.
- **Saying sperm have large energy stores**. It is the **egg** that has energy stores; sperm have almost no cytoplasm.
- **Saying the jelly coat is an energy store**, or just that it "protects the egg". It **changes at fertilisation** so that only one sperm enters.
- **Misreading "motility"**. It means the ability to move: sperm are motile, eggs are not.
- **Using the words zygote, embryo and fetus loosely**. Zygote: the single cell made at fertilisation; embryo: the ball of cells that implants; fetus: the later stage with organs.
- **Saying food travels in the umbilical cord**, or that the mother's and fetus's blood mix. Dissolved **nutrients** travel in the fetus's blood; the two bloods never mix.
- **Saying the amniotic fluid feeds the fetus**. It protects it; nutrients come from the placenta.
- **Getting the umbilical vessels the wrong way round**. The umbilical **artery** takes blood **to** the placenta, low in oxygen and high in urea.
- **Naming progesterone for secondary sexual characteristics**, or misspelling testosterone so it looks like another word.
- **Giving a one-sex change when asked for a change in both sexes** at puberty (for example "breasts develop").
- **Choosing day 14 for the highest progesterone**. Progesterone peaks around day 21; day 14 is ovulation.

- **Calling AIDS the pathogen** or saying HIV is a bacterium. HIV is a virus; AIDS is the condition it may lead to.
- **Listing airborne or food routes for HIV**, or writing only "sex" without "unprotected". Name the body-fluid route precisely.
- **Writing "contraception"** to control STIs. Name the barrier method: condoms (or femidoms). The pill does not stop STIs.

How to get the marks

- **"Identify" or "state the letter"**: one letter per box; if a letter could be two structures, the question will tell you which one.
- **"State" or "name"**: a word or short phrase: "oviduct", "testosterone", "embryo".
- **"Describe"** a process (fertilisation, implantation, the cycle): steps in order, one fact per mark, with the right words (ovulation, oviduct, nuclei fuse, zygote, embryo, implants, lining).
- **"Explain"** an adaptation: the **feature plus what it does** in one sentence, one pair per mark pair.
- **"Compare"**: direct contrasts in one sentence each: "the egg is larger than the sperm"; "the sperm is motile but the egg is not".
- **"Suggest"** (for example, why HIV cases fell): apply ideas to the data given; several answers can be right.
- **Graph questions**: read values off accurately, quote days with the right unit, and use the curve's shape to name the hormone.
- **Label lines and crosses** must touch the exact structure (the oviduct, not the uterus next to it).
- **Tick tables**: tick only what is asked; an extra tick in a row loses that row.
- **Calculations**: show the working, use the original value as the denominator, give the answer to the stated significant figures or decimal places, and include "%" or the unit. Convert μm to mm ($\div 1000$) first when the units differ.
- **Three marks usually means three separate points**. Be specific: "condom", not "contraception"; "releases energy", not "gives energy".

Quick check

1. Name the part of the female reproductive system where: (a) fertilisation normally happens; (b) the embryo implants; (c) egg cells are released; (d) there is a ring of muscle at the neck of the uterus.
2. Which of these can transmit HIV? Kissing on the cheek; sharing needles; a transfusion of unscreened blood; a mosquito bite; breastfeeding; sharing a cup.
3. Give one difference between a sperm and an egg cell for each of: size, motility, numbers made.
4. **Extended**: in a 28-day menstrual cycle, which hormone (a) has a sharp peak that causes ovulation, (b) is at its highest around day 21? (c) Which organ mainly makes this second hormone late in pregnancy?
5. (a) A man's sperm count fell from 60 million to 45 million per cm^3 of semen. Calculate the percentage decrease. (b) An egg cell is 0.12 mm across and a sperm head is 4 μm across. How many times wider is the egg?

Answers

1. (a) Oviduct; (b) uterus lining; (c) ovary; (d) cervix.
2. Sharing needles, a transfusion of unscreened blood and breastfeeding. Kissing on the cheek, a mosquito bite and sharing a cup do not pass on HIV.
3. Size: the egg is much larger. Motility: the sperm swims (motile); the egg cannot (non-motile). Numbers: millions of sperm, but usually one egg a month.
4. (a) LH; (b) progesterone; (c) the placenta.
5. (a) $\frac{60 - 45}{60} \times 100 = 25\%$. (b) $0.12 \text{ mm} = 120 \mu\text{m}$, and $120 \div 4 = 30$ times.

Past questions to try

- **0610/43/O/N/25 Q6**: a table of male structures and functions, the hormone that deepens the voice and three adaptive features of sperm (Extended).
- **0610/32/O/N/25 Q4**: letters on the female reproductive system, where fertilisation happens and an ovarian hormone (Core).
- **0610/42/F/M/24 Q4**: naming the hormones on a menstrual-cycle graph, timing ovulation and menstruation, and progesterone in pregnancy (Extended).
- **0610/42/F/M/25 Q4**: the functions of the placenta, umbilical cord, amniotic sac and fluid, and controlling STIs (Extended).