

16.4 Sexual reproduction in humans

Name: _____ Class: _____ Date: _____ Total: 30 marks

KEY WORDS placenta 胎盘 • sperm 精子 • fertilisation 受精 • fetus 胎儿 • egg 卵子

Objective

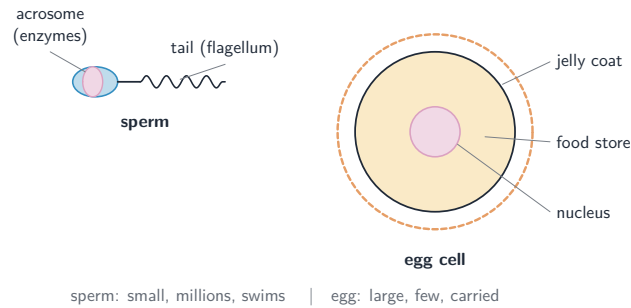
Build the skills to answer exam questions on **sexual reproduction in humans** 人类有性生殖 — the gametes, fertilisation, and the **placenta** 胎盘.

You must be able to:

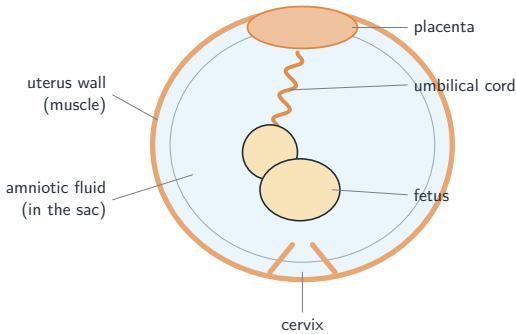
- compare the sperm and egg cell and their adaptations
- state where fertilisation happens
- describe the roles of the placenta, umbilical cord and amniotic sac

1 Worked examples

■ Gametes and pregnancy



Sperm: small, many, swims (flagellum). Egg: large, few, food store



Placenta: exchanges nutrients/gases/wastes (bloods never mix); cord joins fetus; amniotic fluid cushions

■ The gametes, the journey, and what the placenta is for

The two gametes are adapted in opposite directions. The **sperm** 精子 is small and mobile: a flagellum to swim, many mitochondria in the mid-piece to release the energy for swimming, and an acrosome carrying enzymes to digest a path through the egg's membrane. The **egg** 卵子 is much larger and not mobile: it carries a store of food (yolk) for the early embryo, and its membrane changes the moment one sperm enters so no second sperm can get in.

The sequence the exam asks for, in order: an egg is released from an ovary at **ovulation** 排卵; it travels along the **oviduct** 输卵管; **fertilisation** 受精 — the fusion of the nuclei of a sperm and an egg — happens in the oviduct; the resulting **zygote** 受精卵 divides by mitosis as it travels on; the ball of cells reaches the uterus and **implants** in the thick uterus lining.

The placenta 胎盘. The mother's blood and the fetus's blood come very close but **never mix** — that is a marking point, and the reason matters: the two blood pressures differ, and the blood groups may differ. Exchange happens by **diffusion** across the placenta's large surface area of villi, down concentration gradients:

To the fetus	To the mother
oxygen, glucose, amino acids, water, mineral ions, antibodies	carbon dioxide, urea

The **umbilical cord** carries the blood between fetus and placenta. **Amniotic fluid** 羊水 in the amniotic sac cushions the fetus against bumps, supports its weight and keeps its temperature steady.

△ Harmful substances cross too. Nicotine and carbon monoxide from smoking reduce the oxygen the fetus receives, so birth mass is lower; alcohol and some viruses and drugs also cross.

2 Practice

2.1 State where fertilisation occurs in a human. [1]

2.2 State the role of the amniotic fluid. [1]

2.3 Name two structures that adapt a sperm cell to its function, and give the use of each. [4]

2.4 State two substances that pass from the fetus's blood to the mother's. [2]

2.5 Explain why the mother's and the fetus's blood must not mix. [2]

3 Exam-style questions

3.1 The egg cell, compared with a sperm cell, is: [1]

- A smaller and able to swim
- B larger and stores food
- C present in millions
- D has a flagellum

3.2 The placenta supports the developing fetus.

(a) State two substances that pass from the mother's blood to the fetus. [2]

(b) State one feature of the sperm cell and how it helps. [2]

3.3 The diagram of a pregnant uterus shows the placenta, the umbilical cord and the amniotic sac.

(a) Complete the table by naming the structure that carries out each function. [3]

Function	Structure
exchanges substances between mother and fetus	
carries blood between the fetus and the placenta	
cushions the fetus and supports its weight	

(b) Describe how oxygen passes from the mother's blood to the fetus's blood. [3]

(c) Explain two ways in which the sperm cell is adapted for reaching and entering the egg. [4]

(d) State where fertilisation takes place, and describe what happens to the zygote in the days that follow. [3]

(e) A pregnant woman smokes. Explain one effect this has on the developing fetus. [2]

Solutions

2.1 in the oviduct.

2.2 it cushions/protects the fetus.

2.3 Any two structures, each with its use: a flagellum or tail, to swim to the egg; many mitochondria in the mid-piece, to release energy for swimming; an acrosome, containing enzymes to digest through the egg's membrane.

2.4 Carbon dioxide; urea.

2.5 The blood pressure in the mother's vessels is much higher and would damage the fetus's vessels; the blood groups may be different, so the bloods could react together.

3.1 B. The egg is larger and stores food.

3.2 (a) any two of: oxygen; glucose; (dissolved) nutrients.

(b) e.g. a flagellum/tail lets the sperm swim to the egg; or many mitochondria for energy.

3.3 (a) The placenta; the umbilical cord; the amniotic fluid, in the amniotic sac.

(b) The mother's blood in the placenta has a higher concentration of oxygen than the fetus's blood; oxygen therefore diffuses down the concentration gradient across the placenta; the placenta has a large surface area of villi, which makes the diffusion fast enough to supply the fetus.

(c) Any two, each for two marks: a flagellum lets it swim along the oviduct to the egg; many mitochondria release the energy needed for that swimming; the acrosome contains enzymes that digest a path through the egg's membrane so the nuclei can fuse.

(d) Fertilisation takes place in the oviduct; the zygote divides repeatedly by mitosis as it travels towards the uterus; the resulting ball of cells implants in the thick uterus lining.

(e) Carbon monoxide from the smoke binds to the fetus's haemoglobin (or nicotine narrows the blood vessels), so less oxygen reaches the fetus; the fetus grows more slowly and is likely to have a lower birth mass.