

16.4.1 The reproductive systems, the gametes and the placenta

Name: _____ Class: _____ Date: _____

Total: 31 marks

KEY WORDS sperm 精子 • placenta 胎盘 • fetus 胎儿 • fertilisation 受精 • embryo 胚胎

Objective

Sheet 16.4 covered the **placenta** 胎盘 and one sperm question. This sheet is the rest of 16.4: naming every part of the male and female reproductive systems **with its function**, the **adaptive features** 适应特征 of the two **gametes** 配子 and how they compare, what happens between **fertilisation** 受精 and **implantation** 着床, and exactly what crosses the placenta. Nearly every mark here is a named part paired with what it does. This sheet covers syllabus 16.4.

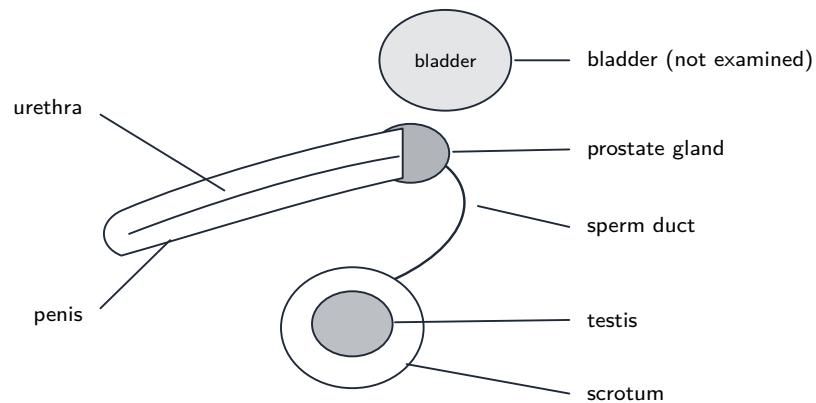
You must be able to:

- identify, and state the functions of, the testes, **scrotum** 阴囊, **sperm ducts** 输精管, **prostate gland** 前列腺, **urethra** 尿道 and penis
- identify, and state the functions of, the ovaries, **oviducts** 输卵管, **uterus** 子宫, **cervix** 子宫颈 and vagina
- describe fertilisation as the fusion of the **nuclei** 细胞核 of a sperm and an egg cell
- explain the adaptive features of sperm: the **flagellum** 鞭毛, the **mitochondria** 线粒体 and the enzymes in the **acrosome** 顶体
- explain the adaptive features of egg cells: the energy stores and the **jelly coat** 卵膜 that changes at fertilisation
- compare male and female gametes by size, structure, **motility** 运动能力 and numbers
- state that the **zygote** 受精卵 forms an **embryo** 胚胎, a ball of cells that implants into the lining of the uterus
- identify, and state the functions of, the **umbilical cord** 脐带, placenta, **amniotic sac** 羊膜囊 and **amniotic fluid** 羊水
- describe how the placenta and umbilical cord exchange dissolved nutrients, gases and excretory products, and state that some **pathogens** 病原体 and **toxins** 毒素 can cross the placenta

1 Worked examples

Study these first. Each one shows a **method** that a question later on this sheet needs.

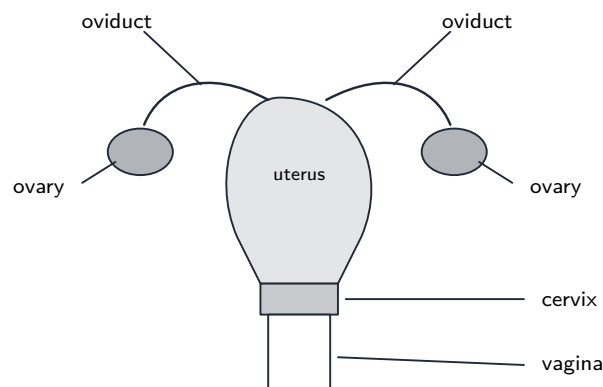
■ The male system: six parts, six functions



Each part has *one* function to learn: **testis** makes sperm and testosterone; **scrotum** holds the testes outside the body, slightly cooler; **sperm duct** carries sperm; **prostate gland** adds fluid; **urethra** carries sperm (and urine) out; **penis** places sperm inside the vagina.

part	function
testis	makes sperm, and the hormone testosterone 睾酮
scrotum	holds the testes outside the body, where it is slightly cooler than body temperature
sperm duct	carries sperm from the testis towards the urethra
prostate gland	adds fluid to the sperm, which the sperm swim in
urethra	carries sperm (and, at other times, urine) out of the body
penis	becomes firm and places the sperm inside the vagina

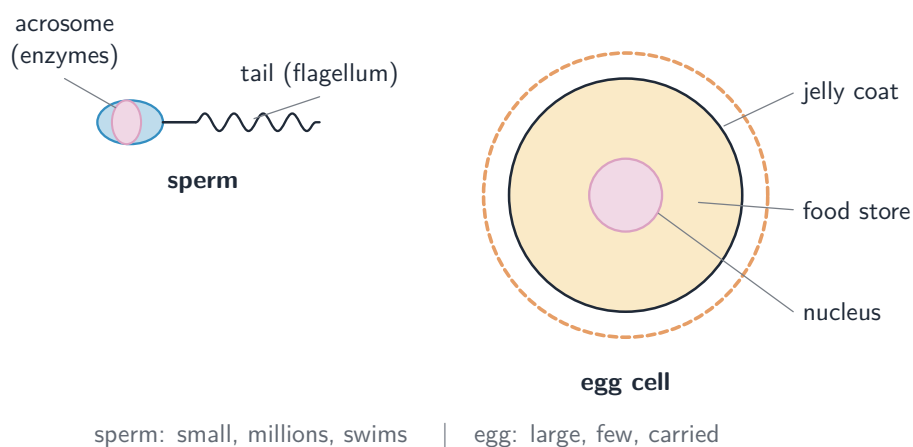
■ The female system: five parts, five functions



Ovary releases an egg cell each month; **oviduct** carries it, and is where **fertilisation** happens; **uterus** is where the embryo implants and the fetus develops; **cervix** is the ring of muscle at its neck; **vagina** receives the sperm and is the birth canal.

part	function
ovary	makes egg cells and releases one about once a month
oviduct	carries the egg cell towards the uterus; fertilisation happens here
uterus	where the embryo implants and the fetus develops; its muscular wall pushes the baby out at birth
cervix	a ring of muscle at the neck of the uterus, which holds the fetus in and widens at birth
vagina	receives the sperm, and is the birth canal

■ The gametes, and why each is shaped as it is



Fertilisation is the fusion of the nucleus of a sperm with the nucleus of an egg cell. Two haploid nuclei join, giving a diploid zygote. Say *nuclei*, not “the sperm joins the egg”.

feature of a sperm	what it does
flagellum (tail)	beats so the sperm can swim to the egg cell
many mitochondria in the middle piece	release the energy for swimming, by respiration
enzymes in the acrosome	digest a way through the jelly coat so the nucleus can enter
feature of an egg cell	what it does
energy stores in the cytoplasm	feed the embryo until it implants and the placenta takes over
the jelly coat	changes the instant one sperm enters, so no second sperm can get in

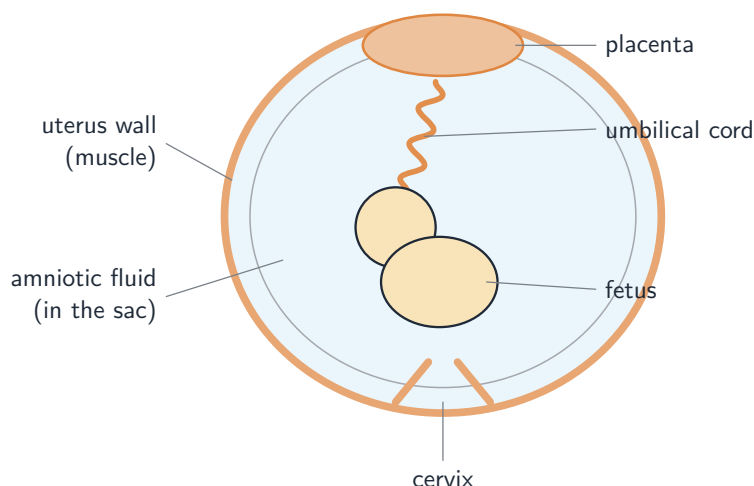
The **comparison question** asks for four things, so answer in four pairs:

	sperm	egg cell
size	much smaller	much larger
structure	a flagellum and many mitochondria	energy stores and a jelly coat, no flagellum
motility	moves itself	cannot move itself; it is carried along the oviduct
numbers	millions released at once	usually one a month

■ From zygote to implantation

1. The sperm nucleus fuses with the egg nucleus in the **oviduct**, giving a **zygote**.
2. The zygote divides by **mitosis** 有丝分裂 into a **ball of cells**, the **embryo**, as it travels down the oviduct.
3. The embryo **implants** into the **lining of the uterus**, and the placenta begins to develop.

■ The placenta: what crosses, and what does not



structure	function
placenta	the exchange surface between the mother's blood and the fetus's blood
umbilical cord	carries the fetus's blood to and from the placenta
amniotic sac	encloses the fetus and holds the amniotic fluid
amniotic fluid	protects the fetus from knocks and supports its weight

- **From mother to fetus:** dissolved **nutrients** (glucose, amino acids) and **oxygen**.
- **From fetus to mother:** **carbon dioxide** and **urea** 尿素 – the excretory products.

- Everything crosses by **diffusion** 扩散, so the placenta has a **large surface area** and a **thin barrier**, which gives a short diffusion distance.
- The two blood supplies stay **separate**. They come very close but never mix.
- $\triangle$ Some **pathogens** and **toxins** can cross the placenta as well – for example nicotine and carbon monoxide from smoking, and alcohol.

2 Practice

Now use the methods above.

2.1 Name the part of the male reproductive system that makes sperm, and the part that adds fluid to them. [2]

2.2 Name the part of the female reproductive system where fertilisation happens, and the part where the embryo implants. [2]

2.3 Describe what happens at fertilisation. [2]

2.4 State the function of the jelly coat of an egg cell, and explain why it changes at fertilisation. [3]

2.5 State **two** ways, other than size, in which an egg cell differs from a sperm cell. [2]

2.6 Describe what happens to the zygote between fertilisation and implantation. [3]

3 Exam-style questions

3.1 Which row correctly compares a human egg cell with a human sperm cell? [1]

	size of egg	which gamete moves itself	number released
A	larger	the egg	more eggs than sperm
B	larger	the sperm	fewer eggs than sperm
C	smaller	the sperm	more eggs than sperm
D	larger	the sperm	more eggs than sperm

3.2 A sperm cell and an egg cell are both adapted to their functions.

(a) Explain how the **acrosome**, the **mitochondria** and the **flagellum** each adapt a sperm cell to its function. [3]

(b) Explain how the **energy stores** and the **jelly coat** each adapt an egg cell to its function. [3]

3.3 A fetus develops in its mother's uterus, joined to the placenta.

(a) Name the structure that joins the fetus to the placenta, and state the function of the amniotic fluid. [2]

(b) Name **two** substances that pass from the mother's blood to the fetus's blood, and **one** that passes from the fetus's blood to the mother's. [3]

(c) The placenta has a large surface area and a very thin barrier between the two blood supplies. Explain why both of these features are needed. [2]

(d) A pregnant woman smokes. Explain how this can affect her fetus. [3]

Solutions

Each answer shows the steps, then the **result**.

2.1

- the **testis** makes sperm
- the **prostate gland** adds fluid to them

2.2

- fertilisation happens in the **oviduct**
- the embryo implants in the **uterus**, in its lining

2.3

- the **nucleus** of a sperm fuses with the **nucleus** of an egg cell
- the two haploid nuclei join, giving a **diploid zygote**

2.4

- the jelly coat surrounds and **protects** the egg cell
- as soon as one sperm has entered, the coat **changes**
- so that **no other sperm can get in**, which keeps the zygote diploid

2.5

- any **two** of: the sperm can **move itself** with its flagellum, while the egg cell cannot; **millions** of sperm are released at once, but usually only **one** egg a month; the egg cell has **energy stores** and a **jelly coat**, which the sperm does not

2.6

- the zygote divides by **mitosis**
- forming a **ball of cells**, the embryo, as it travels down the oviduct
- the embryo then **implants** into the lining of the uterus

3.1 B

- the egg cell is much larger, the sperm is the gamete that swims, and far more sperm are released than eggs
- **A** has the egg swimming; **C** has the sizes the wrong way round; **D** has the numbers the wrong way round

3.2

(a)

- the **acrosome** contains enzymes that **digest** a way through the jelly coat, so the sperm nucleus can enter
- the **mitochondria** release **energy** by respiration, for swimming
- the **flagellum** beats, so the sperm can **swim** to the egg cell

(b)

- the **energy stores** in the cytoplasm feed the embryo until it implants and the placenta can supply it
- the **jelly coat** protects the egg cell, and **changes** once a sperm has entered
- so that no second sperm can enter, which keeps the chromosome number correct

3.3

(a)

- the **umbilical cord**
- the amniotic fluid **protects the fetus from knocks** and supports its weight

(b)

- from mother to fetus, any two of: **glucose, amino acids, oxygen**
- from fetus to mother, either: **carbon dioxide** or **urea**

(c)

- substances cross by **diffusion**, and a large surface area means **more can diffuse at once**
- a thin barrier gives a **short diffusion distance**, so diffusion is faster

(d)

- some **toxins** in tobacco smoke can **cross the placenta** into the fetus's blood
- **carbon monoxide** binds to the fetus's haemoglobin, so its blood carries **less oxygen**
- so the fetus receives less oxygen for respiration and grows more slowly, giving a low birth mass