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Human reproduction class 12 NCERT solutions: step-by-step coloured PDF answers for Class 12 / 12th Biology, 2026-27 Latest Edition

Chapter 2: Human Reproduction

About this Chapter

This chapter explains how humans reproduce sexually. We study the **male reproductive system** and the **female reproductive system**, the making of gametes by **gametogenesis** (spermatogenesis and oogenesis), the **menstrual cycle**, fertilisation, implantation, pregnancy, and parturition. By the end you can draw and label every reproductive structure, name the hormones that control each event, and explain the path from ovulation to childbirth.

Topics covered: Male reproductive system • Female reproductive system • Spermatogenesis & spermiogenesis • Oogenesis • Menstrual cycle • Fertilisation & implantation • Pregnancy & parturition

Quick Formula Sheet

Gamete chromosome number (human):
Sperm = 23 (haploid), Ovum = 23 (haploid), Zygote = 46 (diploid)

Hormones at a glance:
FSH → Sertoli cells / follicle growth; LH → ovulation & Leydig cells;
Oxytocin & relaxin → parturition; hCG, hPL, progesterone → pregnancy

Eggs released per ovarian cycle (human):
1 ovum / month (humans are uniparous, normally one egg)

Also see for this chapter: Revision Notes | Formula Sheet | Exemplar Solutions

NCERT Exercises

Q 2.1 **Fill in the blanks:**

(a) Humans reproduce _____ (asexually/sexually).

(b) Humans are _____ (oviparous, viviparous, ovoviviparous).

(c) Fertilisation is _____ in humans (external/internal).

(d) Male and female gametes are _____ (diploid/haploid).
(e) Zygote is _____ (diploid/haploid).
(f) The process of release of ovum from a mature follicle is called _____.
(g) Ovulation is induced by a hormone called _____.
(h) The fusion of male and female gametes is called _____.
(i) Fertilisation takes place in _____.
(j) Zygote divides to form _____ which is implanted in uterus.
(k) The structure which provides vascular connection between foetus and uterus is called _____.

SOLUTION

Concept used. Each blank tests one core fact about human sexual reproduction. **Sexual reproduction** means two parents make haploid gametes that fuse. A **viviparous** animal gives birth to live young that developed inside the mother's body. **Internal fertilisation** means the sperm meets the egg inside the female body. **Haploid** (n) means one set of chromosomes; **diploid** ($2n$) means two sets. We answer each blank from these definitions.

Step 1. **(a) sexually.** Humans have two sexes. A male and a female each contribute a gamete, so reproduction is sexual, not asexual.

Step 2. **(b) viviparous.** The young one develops inside the mother's uterus and is born alive, so humans are viviparous (not egg-laying like birds).

Step 3. **(c) internal.** Sperm are deposited inside the female tract and the egg is fertilised inside the body, so fertilisation is internal.

Step 4. **(d) haploid.** Gametes are formed by meiosis. A human sperm and a human ovum each carry 23 chromosomes, so both gametes are haploid (n).

Step 5. **(e) diploid.** A haploid sperm ($n = 23$) fuses with a haploid ovum ($n = 23$). The zygote therefore has $23 + 23 = 46$ chromosomes, so it is diploid ($2n$).

Step 6. **(f) ovulation.** The release of the secondary oocyte (ovum) from a mature Graafian follicle is called ovulation.

Step 7. **(g) Luteinising Hormone (LH).** A sharp rise in LH (the LH surge) from the anterior pituitary triggers ovulation.

Step 8. **(h) fertilisation (syngamy).** The fusion of the male gamete (sperm) and the female gamete (ovum) is fertilisation, also called syngamy.

Step 9. **(i) the ampulla of the fallopian tube.** Fertilisation occurs at the ampullary–isthmic junction of the oviduct, that is, in the ampulla region of the fallopian tube.

Step 10. **(j) blastocyst.** The zygote divides (cleavage) into a morula and then forms a

hollow blastocyst, which implants in the uterine wall.

Step 11. **(k) placenta.** The placenta is the structure that links the foetal blood supply with the maternal blood supply (a vascular connection between foetus and uterus).

Final Answer: (a) sexually (b) viviparous (c) internal (d) haploid (e) diploid (f) ovulation (g) Luteinising Hormone (LH) (h) fertilisation (syngamy) (i) ampulla of the fallopian tube (j) blastocyst (k) placenta

☞ **Quick recall**

Gamete arithmetic: $n + n = 2n$. Two haploid gametes (23 each) fuse to give a diploid zygote (46). This single line explains blanks (d) and (e) together.

EXPERT'S SOLUTION *: Sneha Iyer, M.Sc Zoology, Banaras Hindu University*

Quick reading. Read each blank as a yes/no fact, then anchor it to one definition so you never guess. I group the eleven blanks into three families: *type of reproduction* (a, b, c), *ploidy* (d, e), and *events and structures* (f to k).

- Type family: humans need two parents (sexual), keep the young inside and deliver live offspring (viviparous), and join gametes inside the body (internal).
- Ploidy family: meiosis halves the chromosome number, so gametes are haploid; fusion restores it, so the zygote is diploid.
- Events family: ovum release is ovulation; the trigger is the LH surge; gamete fusion is fertilisation; it happens in the ampulla; the zygote becomes a blastocyst; the foeto-maternal bridge is the placenta.

Step 1. Fix the ploidy logic once. Human body cells are $2n = 46$. Meiosis in testis and ovary gives gametes with $n = 46/2 = 23$. So (d) is haploid.

Step 2. Fertilisation reverses this. Sperm (23) + ovum $(23) \Rightarrow$ zygote $(46) = 2n$. So (e) is diploid. Check: $23 + 23 = 46$ (correct), the normal human number.

Step 3. Walk the timeline for (f) to (k): mature follicle bursts (ovulation, f) under the LH surge (g); sperm fuses with ovum (fertilisation, h) in the ampulla (i); the zygote cleaves to a blastocyst (j) that implants; the placenta (k) then forms.

Why this matters. The whole chapter is one storyline: make haploid gametes, fuse them inside the body, grow a diploid embryo, support it through the placenta. Every blank here is a checkpoint on that single path.

Final Answer: (a) sexually, (b) viviparous, (c) internal, (d) haploid, (e) diploid, (f) ovulation, (g) LH, (h) fertilisation, (i) ampulla of fallopian tube, (j) blastocyst, (k) placenta.

Q 2.2 Draw a labelled diagram of male reproductive system.

SOLUTION

Concept used. The **male reproductive system** is made of a pair of **testes** (where sperms and the male hormone are made), a set of **accessory ducts** (rete testis, vasa efferentia, epididymis, vas deferens, ejaculatory duct, urethra) that carry sperm out, **accessory glands** (seminal vesicles, prostate, bulbourethral glands) that add fluid, and the external genitalia (penis). We reproduce the two standard NCERT views: a sectional view of the male pelvis and a front view that opens up the testis to show inner ducts.

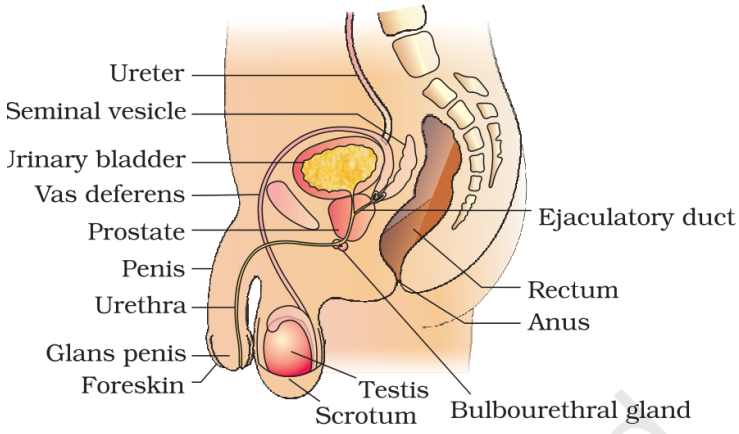

Figure 2.1(a) Diagrammatic sectional view of male pelvis showing reproductive system

Fig. 2.1(a) Diagrammatic sectional view of male pelvis showing the reproductive system. NCERT Class 12 Biology, Chapter 2.

Step 1. The **testes** sit outside the body in a pouch called the **scrotum**. The scrotum keeps the testes about 2–2.5°C below body temperature, which sperm formation needs.

Step 2. Sperms made in the testis pass through the rete testis and vasa efferentia into the **epididymis**, where they mature and are stored.

Step 3. From the epididymis the **vas deferens** carries sperm upward, loops over the urinary bladder, and joins the duct of the seminal vesicle to form the **ejaculatory duct**.

Step 4. The ejaculatory duct opens into the **urethra**, the common passage for urine and

semen, which runs through the **penis** and opens at the urethral meatus.

Step 5. Accessory glands add secretions: the paired seminal vesicles, the single prostate, and the paired bulbourethral glands. Their fluids plus the sperms make up **semen**.

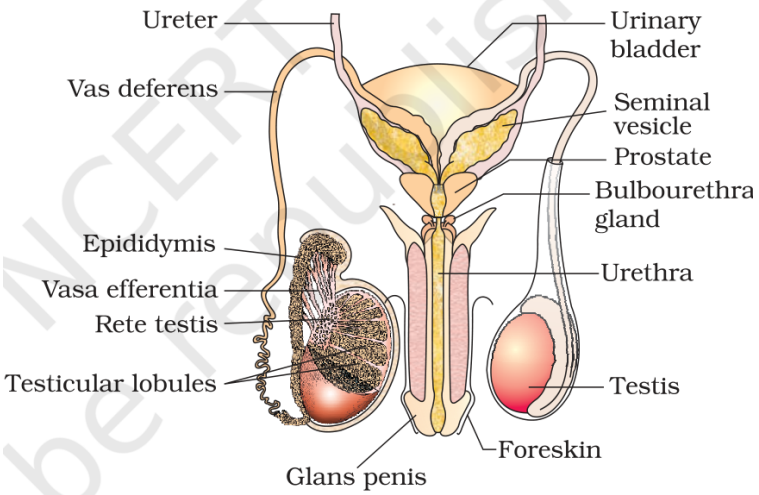

Figure 2.1(b) Diagrammatic view of male reproductive system (part of testis is open to show inner details)

Fig. 2.1(b) Diagrammatic view of the male reproductive system (part of testis is open to show inner details). NCERT Class 12 Biology, Chapter 2.

Final Answer: The labelled male reproductive system is shown above in Fig. 2.1(a) and Fig. 2.1(b): testis, scrotum, epididymis, vas deferens, seminal vesicle, prostate, bulbourethral gland, ejaculatory duct, urethra and penis.

♥ Why this matters

Every later topic, sperm transport, the role of accessory glands in semen, and where each hormone acts, refers back to these two figures. Memorising the path testis → epididymis → vas deferens → ejaculatory duct → urethra makes the rest of the chapter easy.

EXPERT'S SOLUTION *: Arjun Nair, M.Sc Biotechnology, AIIMS Delhi*

Picture-first. For a "draw and label" question, examiners give marks for (i) a clean outline, (ii) correct positions, and (iii) correctly spelled labels. I memorise the system as four blocks and place labels block by block so nothing is missed.

- Block 1: gonad and its cover, testis inside the scrotum.
- Block 2: duct system in order, rete testis, vasa efferentia, epididymis, vas deferens, ejaculatory duct, urethra.

- Block 3: three accessory glands, seminal vesicle, prostate, bulbourethral gland.
- Block 4: external genitalia, the penis with glans and foreskin.

Step 1. Start with the body outline and mark the scrotum low and outside, then draw the oval testis inside it.

Step 2. Trace the duct from the testis upward: epididymis hugging the testis, vas deferens looping over the bladder, joining the seminal vesicle duct to form the ejaculatory duct, then the urethra down the penis.

Step 3. Add the three glands at their points of entry and label the penis parts. Cross-check every label against Fig. 2.1(a) and 2.1(b) so spelling and position both score.

Why this matters. A correctly ordered duct system is the backbone answer that examiners look for first; getting the sequence right earns most of the marks even before fine detail.

> **Final Answer:** A correctly labelled diagram (as in Fig. 2.1a, b) with testis, scrotum, epididymis, vas deferens, seminal vesicle, prostate, bulbourethral gland, ejaculatory duct, urethra and penis is the complete answer.

Q 2.3 Draw a labelled diagram of female reproductive system.

SOLUTION

Concept used. The **female reproductive system** has a pair of **ovaries** (make ova and female hormones), a pair of **oviducts** (fallopian tubes), the **uterus** (womb), the **cervix**, the **vagina**, and the external genitalia. The mammary glands are functionally part of the female reproductive system. We give the two standard NCERT views: a sectional view of the female pelvis and a front view of the system.

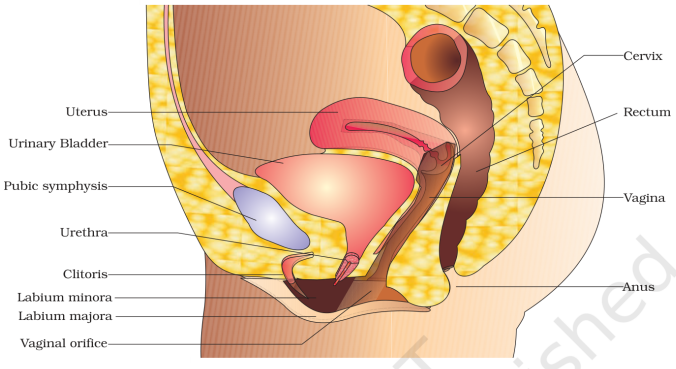

Figure 2.3 (a) Diagrammatic sectional view of female pelvis showing reproductive system

Fig. 2.3(a) Diagrammatic sectional view of female pelvis showing the reproductive system. NCERT Class 12

Biology, Chapter 2.

Step 1. Each **ovary** lies in the lower abdomen, is about 2–4 cm long, and produces ova and the hormones oestrogen and progesterone.

Step 2. The funnel-shaped **infundibulum** of the oviduct has finger-like **fimbriae** that collect the released ovum. The infundibulum leads to the wider **ampulla**, then the narrow **isthmus**, which opens into the uterus.

Step 3. The **uterus** is a muscular, pear-shaped organ. Its wall has three layers: outer **perimetrium**, thick muscular **myometrium**, and inner glandular **endometrium** (it is the endometrium that changes during the menstrual cycle).

Step 4. The uterus opens into the **vagina** through a narrow **cervix**; the cervical cavity is the cervical canal.

Step 5. The external genitalia include the mons pubis, labia majora, labia minora, hymen and clitoris.

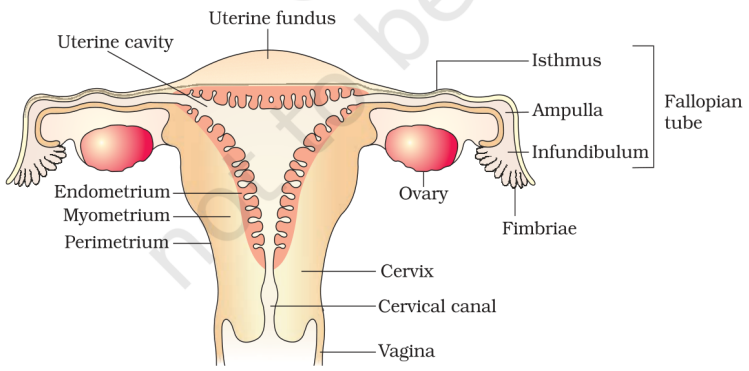

Figure 2.3 (b) Diagrammatic sectional view of the female reproductive system

Fig. 2.3(b) Diagrammatic sectional view of the female reproductive system. NCERT Class 12 Biology, Chapter 2.

Final Answer: The labelled female reproductive system is shown above in Fig. 2.3(a) and Fig. 2.3(b): ovary, fallopian tube (infundibulum, ampulla, isthmus, fimbriae), uterus (endometrium, myometrium, perimetrium), cervix, cervical canal and vagina.

EXPERT'S SOLUTION *: Aanya Banerjee, Ph.D Molecular Biology, NCBS Bangalore*

Picture-first. I draw the female system as a central "Y": the uterus in the middle, an oviduct and ovary on each arm, and the vagina below. Labelling along this Y guarantees nothing is left out.

- Top of each arm: ovary, then the tube parts in order, fimbriae, infundibulum, ampulla,

isthmus.

- Centre: uterus with its three wall layers named from inside out, endometrium, myometrium, perimetrium.
- Base: cervix, then cervical canal, then vagina.

Step 1. Sketch the uterus first as a hollow pear, then add the two oviducts curving up to the two ovaries.

Step 2. Label the tube parts from the ovary inward so the order fimbriae → infundibulum → ampulla → isthmus is clearly shown (this order matters for the fertilisation question later).

Step 3. Name the three uterine layers and finish with cervix, cervical canal and vagina. Verify each label against Fig. 2.3(a) and 2.3(b).

Why this matters. Knowing the tube order tells you exactly where fertilisation happens (ampulla) and where the embryo travels to implant (uterus), which links straight to Questions 17 and the fertilisation pathway.

> **Final Answer:** A correctly labelled diagram (as in Fig. 2.3a, b) with ovary, oviduct (fimbriae, infundibulum, ampulla, isthmus), uterus (endometrium, myometrium, perimetrium), cervix and vagina is the complete answer.

Q 2.4 Write two major functions each of testis and ovary.

SOLUTION

Concept used. A **gonad** has two jobs: a **gametogenic** job (making gametes) and an **endocrine** job (making sex hormones). The testis is the male gonad and the ovary is the female gonad. We state the two jobs for each.

Step 1. **Testis, function 1 (gametogenic).** The seminiferous tubules of the testis produce male gametes, **spermatozoa**, by the process of spermatogenesis.

Step 2. **Testis, function 2 (endocrine).** The Leydig (interstitial) cells of the testis secrete male sex hormones called **androgens**, mainly testosterone.

Step 3. **Ovary, function 1 (gametogenic).** The ovary produces the female gamete, the **ovum**, by the process of oogenesis.

Step 4. **Ovary, function 2 (endocrine).** The ovary secretes the female sex hormones **oestrogen** and **progesterone**, which control the menstrual cycle and support pregnancy.

> **Final Answer:** Testis: (1) produces sperms (spermatogenesis); (2) secretes androgens (testosterone). Ovary: (1) produces ova (oogenesis); (2) secretes oestrogen and progesterone.

☞ Exam Tip

"Two major functions" of any gonad is almost always one gametogenic plus one endocrine point. Write them as a labelled pair, this framing earns full marks and is hard to forget.

EXPERT'S SOLUTION *: Krishna Desai, M.Sc Microbiology, JNU*

Structural observation. Every gonad is a "factory plus a gland". Spotting this pattern lets you answer the same way for testis and ovary without rote learning.

Step 1. Identify the factory part. In the testis these are the seminiferous tubules (make sperm); in the ovary these are the follicles (make ova).

Step 2. Identify the gland part. In the testis these are the Leydig cells (make androgens); in the ovary the follicle and corpus luteum (make oestrogen and progesterone).

Step 3. State one point from each part for each organ, giving exactly the two major functions asked for.

Why this matters. The same "gamete + hormone" template answers many short questions in this chapter and in Reproductive Health, so it is worth fixing firmly.

> **Final Answer:** Testis: makes sperms and secretes androgens. Ovary: makes ova and secretes oestrogen and progesterone.

Q 2.5 Describe the structure of a seminiferous tubule.

SOLUTION

Concept used. A **seminiferous tubule** is the coiled tube inside each testicular lobule where sperms are made. To describe it we name its lining cells (germ cells and Sertoli cells) and the tissue around it (interstitial Leydig cells), and say what each does.

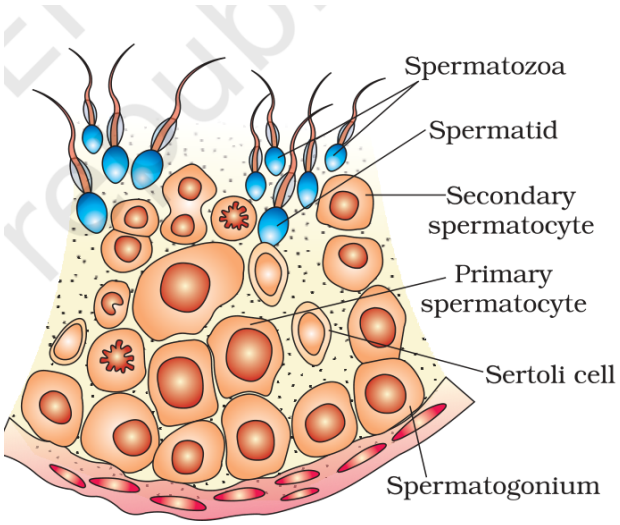

Figure 2.5 Diagrammatic sectional view of a seminiferous tubule (enlarged)

Fig. 2.5 Diagrammatic sectional view of a seminiferous tubule (enlarged). NCERT Class 12 Biology, Chapter 2.

Step 1. Each testicular lobule has 1–3 highly coiled seminiferous tubules. The inner lining of each tubule is made of two kinds of cells: male germ cells (spermatogonia) and **Sertoli cells**.

Step 2. The **spermatogonia** lie near the wall of the tubule. They divide and mature into primary spermatocytes, secondary spermatocytes, spermatids and finally spermatozoa, moving toward the centre (lumen) of the tubule.

Step 3. The **Sertoli cells** are tall cells that extend from the wall to the lumen. They provide nourishment and support to the developing germ cells (so they are also called nurse cells).

Step 4. The regions outside the seminiferous tubules, between them, contain small blood vessels and **Leydig cells** (interstitial cells). The Leydig cells synthesise and secrete the testicular androgens.

Step 5. A few other immunologically competent cells are also present in the interstitial spaces.

Final Answer: A seminiferous tubule is lined by spermatogonia (which form sperms) and supporting Sertoli (nurse) cells; the spaces around the tubules contain Leydig cells that secrete androgens.

EXPERT'S SOLUTION *: Aditi Sharma, M.Sc Zoology, Banaras Hindu University*

Structural observation. Describe the tubule from the wall inward, then step just outside it. This "inside-out" order keeps the answer complete and ordered.

- At the wall: spermatogonia (germ cells) and the base of Sertoli cells.
- Toward the lumen: maturing stages, primary and secondary spermatocytes, spermatids, then spermatozoa.
- Just outside the tubule: Leydig (interstitial) cells and blood vessels.

Step 1. Name the two cell types lining the tubule: germ cells and Sertoli cells, and state where each sits.

Step 2. Trace the germ-cell maturation gradient from wall to lumen so the description shows movement, not just a list.

Step 3. Step outside the tubule and add the Leydig cells, noting their hormone role, which completes the picture for full marks.

Why this matters. The wall-to-lumen gradient you describe here is exactly the spermatogenesis sequence asked in Question 6, so one clear picture answers two questions.

> **Final Answer:** Tubule lined by spermatogonia and Sertoli (nurse) cells, with germ cells maturing from wall to lumen; Leydig cells lie outside and make androgens.

Q 2.6 What is spermatogenesis? Briefly describe the process of spermatogenesis.

SOLUTION

Concept used. **Spermatogenesis** is the process by which immature male germ cells (spermatogonia) become mature spermatozoa in the testis. It involves **mitosis** (to multiply cells), **meiosis** (to halve the chromosome number from $2n$ to n) and a final change of shape called spermiogenesis.

Step 1. **Multiplication.** At puberty, spermatogonia on the inside wall of the seminiferous tubules increase in number by mitosis. Each spermatogonium is diploid and has 46 chromosomes.

Step 2. **Growth into primary spermatocyte.** Some spermatogonia, called primary spermatocytes, periodically undergo growth. A primary spermatocyte is still diploid ($2n = 46$).

Step 3. **First meiotic division.** A primary spermatocyte completes the first meiotic (reduction) division to form two equal haploid **secondary spermatocytes**, each with 23 chromosomes (n).

Step 4. **Second meiotic division.** Each secondary spermatocyte undergoes the second meiotic division to give four equal haploid **spermatids** (each $n = 23$).

Step 5. **Spermiogenesis.** The spermatids are transformed into **spermatozoa** (sperms) by spermiogenesis. After this, sperm heads become embedded in Sertoli cells and are finally released into the lumen by **spermiation**.

> **Final Answer:** Spermatogenesis is the formation of haploid spermatozoa from diploid spermatogonia: spermatogonium $\rightarrow$ primary spermatocyte $\rightarrow$ (meiosis I) $\rightarrow$ secondary spermatocytes $\rightarrow$ (meiosis II) $\rightarrow$ spermatids $\rightarrow$ (spermiogenesis) $\rightarrow$ spermatozoa.

EXPERT'S SOLUTION *: Rohit Verma, M.Sc Biotechnology, AIIMS Delhi*

Quick reading. Track one number, the chromosome count, through the pathway. When the number halves you know meiosis happened; this makes the whole process easy to recall.

Step 1. Spermatogonium: $2n = 46$. Mitosis only multiplies cells, the number stays 46.

Step 2. Primary spermatocyte: still $2n = 46$. It then enters meiosis I.

Step 3. After meiosis I: two secondary spermatocytes, each $n = 46/2 = 23$. The halving marks the reduction division.

Step 4. After meiosis II: four spermatids, each still $n = 23$ (meiosis II does not change the number). Spermiogenesis then reshapes each spermatid into a motile sperm; spermiation releases it.

Why this matters. The same chromosome-tracking trick works for oogenesis in Question 12; mastering it here makes that question almost free.

> **Final Answer:** $46 \rightarrow 46 \rightarrow$ (meiosis I) $\rightarrow 23, 23 \rightarrow$ (meiosis II) $\rightarrow 23{\times}4$ spermatids $\rightarrow$ sperms; this chain is spermatogenesis.

Q 2.7 Name the hormones involved in regulation of spermatogenesis.

SOLUTION

Concept used. Spermatogenesis starts at puberty and is under the control of the **hypothalamus–pituitary–testis axis**. We name the hormones in the order they act along this axis.

Step 1. **GnRH.** At puberty the hypothalamus releases increased amounts of **Gonadotropin Releasing Hormone (GnRH)**.

Step 2. **LH and FSH.** GnRH acts on the anterior pituitary and stimulates secretion of two gonadotropins: **Luteinising Hormone (LH)** and **Follicle Stimulating Hormone (FSH)**.

Step 3. **Action of LH.** LH acts on the Leydig cells and stimulates them to secrete **androgens** (mainly testosterone). Androgens in turn stimulate the process of spermatogenesis.

Step 4. **Action of FSH.** FSH acts on the Sertoli cells and stimulates secretion of factors that help the process of spermiogenesis.

> **Final Answer:** The hormones are GnRH (from the hypothalamus), LH and FSH (from the anterior pituitary), and androgens / testosterone (from the Leydig cells).

☞ **Memory hook**

GnRH → (LH, FSH) → (androgens via LH on Leydig; spermiogenesis support via FSH on Sertoli). Reading top-down along the axis gives the full list in the right order.

EXPERT'S SOLUTION *: Vivaan Rao, Ph.D Molecular Biology, NCBS Bangalore*

Strategic angle. Answer along the control axis, not as a loose list. Each hormone has a clear "from where" and "acts on what", and naming both makes the answer precise.

- Hypothalamus: GnRH.
- Anterior pituitary (released because of GnRH): LH and FSH.
- Testis (responding to LH): androgens / testosterone.

Step 1. State the source hormone GnRH and its origin (hypothalamus).

Step 2. Name the two gonadotropins LH and FSH and their origin (anterior pituitary).

Step 3. Add the target effects: LH → Leydig cells → androgens; FSH → Sertoli cells → spermiogenesis support. This gives every hormone the question wants.

Why this matters. The same hypothalamus-pituitary-gonad axis controls the menstrual cycle in Question 17, so this layout transfers directly.

> **Final Answer:** GnRH, LH, FSH and androgens (testosterone) regulate spermatogenesis.

Q 2.8 Define spermiogenesis and spermiation.

SOLUTION

Concept used. These are two successive late events of spermatogenesis. **Spermiogenesis** is a change of *shape*; **spermiation** is a *release*. We define each separately.

Step 1. **Spermiogenesis.** It is the process by which spermatids (round, non-motile cells) are transformed into spermatozoa (sperms) that have a head, neck, middle piece and tail. No cell division occurs here; only the shape and parts change.

Step 2. **Spermiation.** After spermiogenesis the sperm heads remain embedded in the Sertoli cells for a while. Spermiation is the process by which these mature sperms are finally released from the Sertoli cells into the lumen of the seminiferous tubule.

> **Final Answer:** Spermiogenesis: transformation of spermatids into spermatozoa (shape change). Spermiation: release of the mature spermatozoa from the Sertoli cells into the seminiferous tubule lumen.

EXPERT'S SOLUTION *: Tara Pillai, M.Sc Zoology, Banaras Hindu University*

Quick reading. Two words that sound alike but mean different things. I anchor each to one key verb: spermio*genesis* = *make the shape*; sperm*iation* = *set it free*.

Step 1. Spermiogenesis: input is a spermatid, output is a fully formed sperm. The change is structural (grows a tail, condenses the head), not numerical.

Step 2. Spermiation: input is a sperm stuck to a Sertoli cell, output is a free sperm in the tubule lumen. The change is positional (release), not structural.

Why this matters. Exam questions often pair these terms to test whether you know the order, shape change first, then release.

> **Final Answer:** Spermiogenesis = spermatid $\rightarrow$ sperm (shape). Spermiation = sperm released from Sertoli cell into tubule lumen.

Q 2.9 Draw a labelled diagram of sperm.

SOLUTION

Concept used. A **sperm** is a microscopic single cell made of a **head**, a **neck**, a **middle piece** and a **tail**, all wrapped by a plasma membrane. We draw the NCERT figure and

label every part with its job.

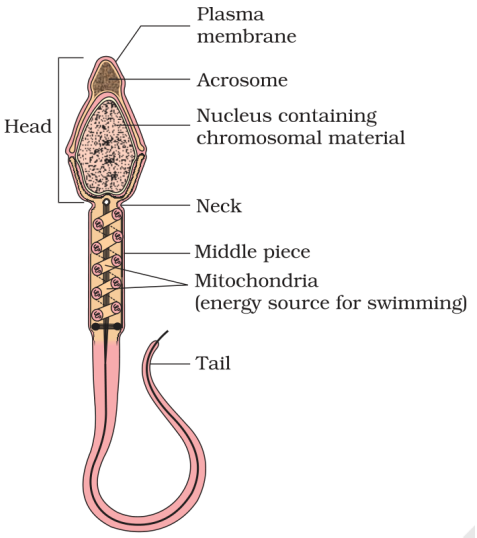

Figure 2.6 Structure of a sperm

Fig. 2.6 Structure of a sperm. NCERT Class 12 Biology, Chapter 2.

Step 1. The **head** contains an elongated haploid nucleus. Its front part is covered by a cap-like **acrosome** filled with enzymes that help the sperm penetrate the ovum at fertilisation.

Step 2. A **plasma membrane** envelops the whole body of the sperm.

Step 3. The **middle piece** has many **mitochondria** that produce the energy needed for the movement of the tail.

Step 4. The **tail** is the longest part; its lashing movement gives the sperm its motility, which is essential for fertilisation.

Final Answer: The labelled sperm (Fig. 2.6) shows plasma membrane, acrosome, nucleus, head, neck, middle piece (with mitochondria) and tail.

EXPERT'S SOLUTION *: Ishaan Kapoor, M.Sc Biotechnology, AIIMS Delhi*

Picture-first. Draw the sperm as four blocks in a line and attach one function word to each block. Examiners want the four named parts plus the acrosome.

- Head: nucleus + acrosome (genetic material + entry enzymes).
- Neck: short connecting region.
- Middle piece: mitochondria (power house).
- Tail: motility.

Step 1. Draw an oval head, a short neck, a thicker middle piece, then a long whip-like tail.

Step 2. Mark the acrosome as a cap on the front of the head and label the nucleus inside it.

Step 3. Show mitochondria coiled around the middle piece and label the plasma membrane around the whole cell, then check every label against Fig. 2.6.

Why this matters. The acrosome and the mitochondria-rich middle piece directly explain how the sperm reaches and enters the ovum, which connects to the fertilisation pathway.

> **Final Answer:** A four-part labelled sperm (head with acrosome and nucleus, neck, middle piece with mitochondria, tail) is the complete answer.

Q 2.10 What are the major components of seminal plasma?

SOLUTION

Concept used. **Semen** = sperms + seminal plasma. The **seminal plasma** is the fluid part of semen, contributed by the male accessory glands (seminal vesicles, prostate, bulbourethral glands). We list what it is rich in and why.

Step 1. Seminal plasma is rich in **fructose**, a sugar that provides energy to the sperms for their motility.

Step 2. It contains **calcium** and certain **enzymes** (secreted mainly by the prostate and seminal vesicles).

Step 3. It also contains other ions and secretions that nourish the sperms and keep the medium suitable for their movement and survival.

> **Final Answer:** Seminal plasma is rich in fructose, calcium and certain enzymes (it is the secretion of the seminal vesicles, prostate and bulbourethral glands that nourishes and activates the sperms).

EXPERT'S SOLUTION *: Meera Joshi, M.Sc Microbiology, JNU*

Quick reading. Remember the seminal plasma by its job: feed and activate sperms. The components follow from that job.

Step 1. Energy supply: fructose (sugar) gives sperms fuel for swimming.

Step 2. Activation and medium: calcium ions and enzymes help activate the sperms and maintain a favourable medium.

Step 3. Source check: these come from the accessory glands, not the testis, which is why a vasectomy still allows fluid but no sperms.

Why this matters. Knowing what seminal plasma does explains the role of the accessory glands asked in Question 11.

> **Final Answer:** Fructose, calcium and certain enzymes are the major components of seminal plasma.

Q 2.11 What are the major functions of male accessory ducts and glands?

SOLUTION

Concept used. The male system has **accessory ducts** (rete testis, vasa efferentia, epididymis, vas deferens) and **accessory glands** (paired seminal vesicles, a prostate, paired bulbourethral glands). We state the function of each group.

Step 1. **Function of accessory ducts.** The accessory ducts **store** the sperms and **transport** them from the testis to the outside through the urethra. In the epididymis the sperms also **mature** and gain motility.

Step 2. **Function of accessory glands (energy).** The seminal vesicles and prostate secrete a fluid rich in **fructose**, which nourishes the sperms.

Step 3. **Function of accessory glands (medium and motility).** Their secretions also provide **calcium** and **enzymes**, activate the sperms and make a fluid medium that is essential for the easy transport and motility of sperms.

> **Final Answer:** Accessory ducts store, mature and transport sperms; accessory glands secrete a fructose-, calcium- and enzyme-rich fluid that nourishes, activates and provides a transport medium for the sperms.

EXPERT'S SOLUTION *: Dev Chatterjee, M.Sc Biotechnology, AIIMS Delhi*

Structural observation. Split the answer into "ducts = plumbing" and "glands = support fluid". Each half then has a clean, markable point.

- Ducts: a one-way path, store → mature (epididymis) → transport.
- Glands: make the carrier fluid, energy (fructose), activation (calcium, enzymes), lubrication.

Step 1. State the duct functions together: storage, maturation in the epididymis, and transport to the urethra.

Step 2. State the gland functions together: nourishment (fructose), activation (calcium, enzymes), and a fluid medium for motility.

Step 3. Conclude that ducts move the sperm while glands keep it alive and motile, the complete two-part answer.

Why this matters. This division (move vs. support) explains why semen has both cells and a rich fluid, linking back to Question 10.

> **Final Answer:** Ducts: store, mature and transport sperms. Glands: provide a fructose-, calcium- and enzyme-rich nourishing, activating fluid medium.

Q 2.12 What is oogenesis? Give a brief account of oogenesis.

SOLUTION

Concept used. **Oogenesis** is the process of formation of a mature female gamete (ovum) from the female germ cells in the ovary. Like spermatogenesis it uses mitosis and meiosis, but it begins in the embryo, pauses for years, and produces only one ovum per cycle.

Step 1. **Starts in foetal life.** Oogenesis is initiated during the embryonic (foetal) stage. Gamete mother cells, the **oogonia**, are formed in the foetal ovary; no more oogonia are formed after birth.

Step 2. **Primary oocyte, arrested.** Oogonia enter prophase I of the first meiotic division and get arrested at that stage as **primary oocytes**. Each primary oocyte gets surrounded by a layer of granulosa cells, forming the primary follicle.

Step 3. **Follicle development.** The primary follicle becomes a secondary follicle and then a tertiary follicle, which has a fluid-filled cavity called the **antrum**. The primary oocyte in the tertiary follicle completes meiosis I.

Step 4. **Unequal division.** Meiosis I gives a large haploid **secondary oocyte** and a tiny **first polar body**; the secondary oocyte keeps the bulk of the nutrient-rich cytoplasm.

Step 5. **Graafian follicle and ovulation.** The tertiary follicle becomes the mature **Graafian follicle**, which ruptures to release the secondary oocyte (ovulation). Meiosis II of the secondary oocyte completes only if a sperm enters.

Final Answer: Oogenesis is the formation of a haploid ovum from oogonia in the ovary: oogonia → primary oocyte (arrested in meiosis I) → secondary oocyte + first polar body → ovum (meiosis II completed at fertilisation).

✗ Common Pitfall

Do not say oogenesis "produces four ova". Unlike spermatogenesis (four sperms), oogenesis gives only *one* functional ovum; the other products are non-functional polar bodies.

EXPERT'S SOLUTION *: Ananya Reddy, Ph.D Molecular Biology, NCBS Bangalore*

Quick reading. Compare against spermatogenesis to remember the three differences: starts before birth, pauses, and gives one ovum (not four).

Step 1. Timing: oogonia form in foetal life only; this is unlike spermatogonia, which keep dividing after puberty.

Step 2. Arrest: primary oocytes stop in prophase I for years and resume one at a time each cycle.

Step 3. Unequal split: meiosis I gives one big secondary oocyte (n) and a small polar body; meiosis II (at fertilisation) gives the ovum and another polar body, so only one ovum results.

Why this matters. The "one ovum per cycle" point is exactly what Question 20 about identical and fraternal twins tests.

Final Answer: Oogenesis: foetal oogonia → arrested primary oocyte → secondary oocyte (+ polar body) → one functional ovum.

Q 2.13 Draw a labelled diagram of a section through ovary.

SOLUTION

Concept used. A section through the ovary shows follicles at different stages of growth, a corpus luteum, blood vessels and the secondary oocyte being released. We embed and label the NCERT sectional view.

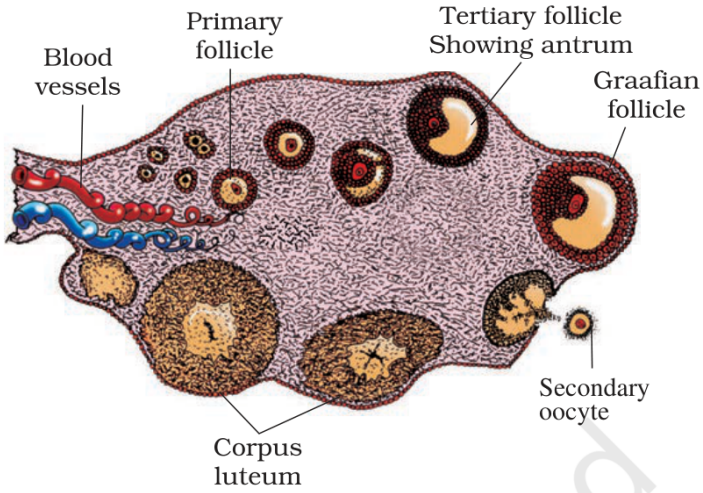

Figure 2.7 Diagrammatic Section view of ovary

Fig. 2.7 Diagrammatic sectional view of ovary. NCERT Class 12 Biology, Chapter 2.

Step 1. The **primary follicle** is an early follicle, a primary oocyte surrounded by a layer of granulosa cells.

Step 2. The **tertiary follicle** has a fluid-filled cavity, the **antrum**; it matures into the **Graafian follicle**.

Step 3. At **ovulation** the Graafian follicle ruptures and releases the **secondary oocyte**.

Step 4. The empty ruptured follicle becomes the **corpus luteum**, which secretes large amounts of progesterone.

Step 5. **Blood vessels** supply the ovary and support follicle growth and hormone secretion.

Final Answer: The labelled ovary section (Fig. 2.7) shows blood vessels, primary follicle, tertiary follicle (with antrum), Graafian follicle, secondary oocyte and corpus luteum.

EXPERT'S SOLUTION *: Yash Gupta, M.Sc Zoology, Banaras Hindu University*

Picture-first. Draw the ovary as an oval and place follicles around its edge in increasing size, this shows the maturation sequence at a glance and earns the labelling marks.

- Edge, small to large: primary → secondary → tertiary → Graafian follicle.
- After release: empty follicle becomes the corpus luteum.
- Supporting: blood vessels at the hilum; secondary oocyte leaving at ovulation.

Step 1. Sketch the oval ovary and add a series of follicles around its rim in growing sizes.

Step 2. Mark the Graafian follicle bursting and the secondary oocyte leaving the surface.

Step 3. Add the corpus luteum and blood vessels and verify each label against Fig. 2.7.

Why this matters. This single picture shows the follicle growth used in oogenesis (Q12), ovulation (Q15a) and the menstrual cycle (Q17).

> **Final Answer:** A labelled ovary section with the follicle growth series, Graafian follicle, secondary oocyte, corpus luteum and blood vessels is the complete answer.

Q 2.14 Draw a labelled diagram of a Graafian follicle.

SOLUTION

Concept used. The **Graafian follicle** is the mature ovarian follicle just before ovulation. It contains the secondary oocyte surrounded by follicular layers and a fluid-filled antrum. The NCERT chapter shows it inside the sectional view of the ovary (Fig. 2.7); we use that and label its parts.

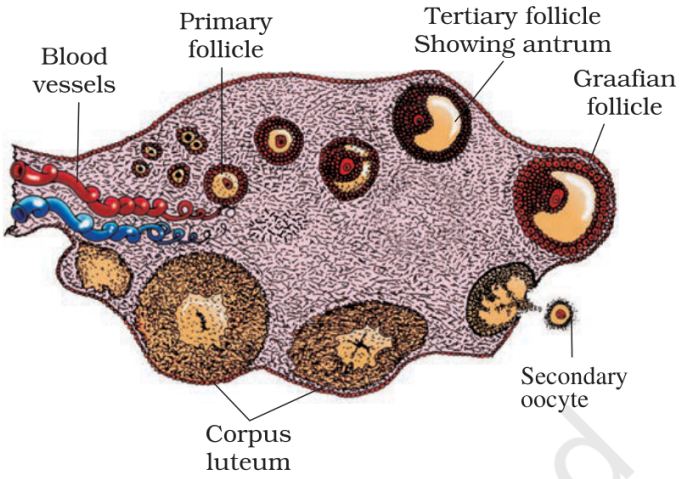

Figure 2.7 Diagrammatic Section view of ovary

Fig. 2.7 Diagrammatic sectional view of ovary, with the mature Graafian follicle labelled. NCERT Class 12 Biology, Chapter 2.

Step 1. At the centre lies the **secondary oocyte** (the cell that will be released as the ovum).

Step 2. The oocyte is surrounded by a new membrane called the **zona pellucida**, around which lie the granulosa (follicular) cells.

Step 3. A large fluid-filled cavity, the **antrum**, develops within the follicle.

Step 4. The whole follicle is enclosed by layers of theca cells. At maturity this Graafian follicle bursts to release the secondary oocyte, the event called ovulation.

> **Final Answer:** The Graafian follicle (mature follicle in Fig. 2.7) shows the secondary oocyte, zona pellucida, granulosa cells, the fluid-filled antrum and the theca layers; it ruptures at ovulation.

♥ Why this matters

The Graafian follicle is the bridge between oogenesis and the menstrual cycle: it both completes oocyte growth and, after rupture, becomes the corpus luteum that secretes progesterone for the next phase.

EXPERT'S SOLUTION *: Priya Mehta, M.Sc Biotechnology, AIIMS Delhi*

Picture-first. Draw the Graafian follicle as a ring of cells around a big fluid space, with the oocyte sitting to one side. Label from the centre outward.

Step 1. Place the secondary oocyte off-centre and draw the zona pellucida as a clear ring around it.

Step 2. Draw the granulosa cells surrounding the oocyte and the large antrum (fluid cavity) filling most of the follicle.

Step 3. Enclose everything in the theca layers and note that rupture of this follicle is ovulation; cross-check labels with Fig. 2.7.

Why this matters. Knowing the Graafian follicle's parts explains both ovulation (Q15a) and how the corpus luteum forms.

> **Final Answer:** A labelled Graafian follicle (secondary oocyte, zona pellucida, granulosa cells, antrum, theca layers) is the complete answer.

Q 2.15 **Name the functions of the following:**
(a) Corpus luteum (b) Endometrium (c) Acrosome
(d) Sperm tail (e) Fimbriae

SOLUTION

Concept used. Each of these is a named reproductive structure; the question asks only its function. We give one clear function per structure, naming the hormone or process involved.

Step 1. **(a) Corpus luteum.** The corpus luteum secretes large amounts of **progesterone**, which is essential for maintaining the endometrium and supporting pregnancy.

Step 2. **(b) Endometrium.** The endometrium is the inner lining of the uterus; it undergoes cyclic changes and is the site of **implantation** of the blastocyst and is essential for pregnancy.

Step 3. **(c) Acrosome.** The acrosome is the cap over the sperm head; it is filled with **enzymes** that help the sperm penetrate and fertilise the ovum.

Step 4. **(d) Sperm tail.** The tail provides **motility**: its lashing movement propels the sperm so it can reach the ovum (this motility is essential for fertilisation).

Step 5. **(e) Fimbriae.** The fimbriae are finger-like projections of the infundibulum; they help in **collection of the ovum** after ovulation.

Final Answer: (a) secretes progesterone (maintains endometrium/pregnancy); (b) site of implantation and supports pregnancy; (c) enzymes for sperm to penetrate the ovum; (d) motility to reach the ovum; (e) collect the released ovum.

EXPERT'S SOLUTION *: Aditya Singh, M.Sc Zoology, Banaras Hindu University*

Quick reading. Each part needs just one verb. I pick the single most important action for each structure so the answer is sharp and complete.

- Corpus luteum → secretes progesterone.
- Endometrium → supports implantation.
- Acrosome → enzymes to enter the ovum.
- Sperm tail → swimming (motility).
- Fimbriae → catch the ovum.

Step 1. Read each structure and recall whether it is hormonal (corpus luteum), structural-supportive (endometrium, fimbriae) or sperm-related (acrosome, tail).

Step 2. Assign the one defining function to each, using the hormone or process name where there is one.

Step 3. State the five functions as a labelled list so each scores independently.

Why this matters. These five functions reappear across fertilisation, the menstrual cycle and pregnancy, so a one-line function for each is high-value revision.

Final Answer: Progesterone; implantation site; sperm-entry enzymes; sperm motility; ovum collection, respectively.

Q 2.16 **Identify True/False statements. Correct each false statement to make it true.**
(a) Androgens are produced by Sertoli cells. (True/False)
(b) Spermatozoa get nutrition from Sertoli cells. (True/False)
(c) Leydig cells are found in ovary. (True/False)
(d) Leydig cells synthesise androgens. (True/False)
(e) Oogenesis takes place in corpus luteum. (True/False)
(f) Menstrual cycle ceases during pregnancy. (True/False)
(g) Presence or absence of hymen is not a reliable indicator of virginity or sexual experience. (True/False)

SOLUTION

Concept used. We test each statement against a single known fact and, if it is false, replace only the wrong word so the statement becomes true. Key facts: Leydig cells (not Sertoli cells) make androgens; Sertoli cells nourish germ cells; Leydig cells are in the testis; oogenesis occurs in the ovary; ovarian cycling stops during pregnancy; the hymen is not a virginity indicator.

Step 1. **(a) False.** Androgens are produced by the Leydig cells, not Sertoli cells. Corrected: "Androgens are produced by *Leydig* cells."

Step 2. **(b) True.** Sertoli cells (nurse cells) provide nutrition to the developing spermatozoa.

Step 3. **(c) False.** Leydig cells are found in the testis, not the ovary. Corrected: "Leydig cells are found in the *testis*."

Step 4. **(d) True.** Leydig cells synthesise and secrete the testicular androgens.

Step 5. **(e) False.** Oogenesis takes place in the ovary (in the germ cells/follicles), not in the corpus luteum. Corrected: "Oogenesis takes place in the *ovary*."

Step 6. **(f) True.** During pregnancy the menstrual cycle ceases, because high progesterone prevents new cycles.

Step 7. **(g) True.** The presence or absence of the hymen is not a reliable indicator of virginity or sexual experience.

Final Answer: (a) False (Leydig cells); (b) True; (c) False (testis); (d) True; (e) False (ovary); (f) True; (g) True.

EXPERT'S SOLUTION *: Karan Bhat, M.Sc Microbiology, JNU*

Quick reading. For true/false-and-correct, do not rewrite the whole sentence, swap only the single wrong term. This is faster and scores the correction mark cleanly.

- Cell-role pairs: Sertoli = nurse; Leydig = hormone. Use this to settle (a), (b), (d).
- Location: Leydig in testis, oogenesis in ovary. Settles (c), (e).
- Whole-body facts: pregnancy halts cycling (f); hymen is not a virginity test (g), both true as stated.

Step 1. Check (a)–(d) with the "Sertoli nurses, Leydig hormones" rule: (a) false (swap Sertoli→Leydig), (b) true, (c) false (swap ovary→testis), (d) true.

Step 2. Check (e) with the location rule: oogenesis is in the ovary, so false (swap corpus luteum→ovary).

Step 3. Accept (f) and (g) as true; they are direct textbook statements needing no correction.

Why this matters. The "minimal correction" habit also helps in assertion-reason questions, where pinpointing the one wrong word is the whole task.

Final Answer: F, T, F, T, F, T, T, with corrections: Leydig cells (a), testis (c), ovary (e).

Q 2.17 What is menstrual cycle? Which hormones regulate menstrual cycle?

SOLUTION

Concept used. The **menstrual cycle** is the cyclic change in the reproductive tract of primate females, repeating about every 28 days. It is controlled by the same hypothalamus–pituitary–ovary axis: pituitary hormones (FSH, LH) and ovarian hormones (oestrogen, progesterone).

Step 1. **Definition.** The menstrual cycle is the monthly cycle of changes (in the ovary and uterine endometrium) in human females from puberty (**menarche**) up to menopause; one cycle is the period from one menstruation to the next, about 28 days.

Step 2. **Phases.** It has the menstrual phase (breakdown of the endometrium, bleeding

for 3–5 days), the follicular (proliferative) phase, ovulation (around day 14), and the luteal (secretory) phase.

Step 3. **Pituitary hormones.** **FSH** stimulates follicle growth; a mid-cycle surge of **LH** (the LH surge) induces ovulation.

Step 4. **Ovarian hormones.** The growing follicle secretes **oestrogen**; after ovulation the corpus luteum secretes **progesterone**, which maintains the endometrium.

Step 5. Falling oestrogen and progesterone (if no pregnancy) cause the endometrium to break down, starting the next cycle.

> **Final Answer:** The menstrual cycle is the ~ 28-day cyclic change in the female reproductive tract; it is regulated by the pituitary hormones FSH and LH and the ovarian hormones oestrogen and progesterone (under hypothalamic GnRH).

☞ Exam Tip

A common 3-mark answer: define the cycle, name its four phases, then list the four regulating hormones (FSH, LH, oestrogen, progesterone) with one action each. State the LH surge $\rightarrow$ ovulation link explicitly; it is frequently asked.

EXPERT'S SOLUTION *: Sanya Kumar, Ph.D Molecular Biology, NCBS Bangalore*

Strategic angle. Tie each hormone to the phase it drives. Hormones are not a loose list, they form a timeline across the 28 days.

Step 1. Days 1–5 (menstrual): low oestrogen and progesterone cause endometrial shedding.

Step 2. Days 6–13 (follicular): FSH grows the follicle, which secretes oestrogen and rebuilds the endometrium.

Step 3. Day 14 (ovulation): the LH surge bursts the Graafian follicle.

Step 4. Days 15–28 (luteal): the corpus luteum secretes progesterone to maintain the endometrium; if no pregnancy it regresses and the cycle restarts.

Why this matters. This timeline links directly to ovulation (Q15) and to why pregnancy stops the cycle (Q16f).

> **Final Answer:** Menstrual cycle $= \sim 28$-day reproductive cycle; regulated by FSH, LH (pituitary) and oestrogen, progesterone (ovary).

Q 2.18 What is parturition? Which hormones are involved in induction of parturi-

tion?

SOLUTION

Concept used. Parturition is the process of delivery of the foetus, that is, childbirth, at the end of pregnancy. It is induced by a complex neuroendocrine mechanism involving signals from the fully developed foetus and the placenta.

Step 1. **Definition.** Parturition is the expulsion of the fully developed foetus from the mother's uterus at the end of gestation, brought about by vigorous contractions of the uterus.

Step 2. **Trigger.** Signals from the fully developed foetus and the placenta produce mild uterine contractions called the **foetal ejection reflex**.

Step 3. **Oxytocin.** This reflex triggers release of **oxytocin** from the maternal pituitary. Oxytocin acts on the uterine muscle and causes stronger uterine contractions.

Step 4. **Positive feedback.** Stronger contractions stimulate more oxytocin secretion, and the cycle of contraction and oxytocin release continues (positive feedback) until the baby is delivered, followed by expulsion of the placenta. **Relaxin** also assists by relaxing the pelvic ligaments.

> **Final Answer:** Parturition is childbirth, the expulsion of the foetus from the uterus at the end of pregnancy; it is mainly induced by oxytocin (with relaxin assisting), driven by a foetus-and-placenta signal in a positive-feedback loop.

EXPERT'S SOLUTION *: Pranav Iyer, M.Sc Biotechnology, AIIMS Delhi*

Strategic angle. Explain parturition as a positive-feedback loop. Naming oxytocin and the loop is the high-mark content.

Step 1. State what parturition is: delivery of the fully developed foetus by uterine contractions.

Step 2. Name the start signal: the foetal ejection reflex from the mature foetus and placenta.

Step 3. Name the key hormone and loop: oxytocin causes contractions; contractions cause more oxytocin (positive feedback) until delivery; relaxin softens the pelvis to help.

Why this matters. Parturition is the textbook example of a positive-feedback hormonal loop, a concept reused across physiology chapters.

> **Final Answer:** Parturition = childbirth; induced mainly by oxytocin (plus relaxin) through a foetal-signal positive-feedback contraction loop.

Q 2.19 **In our society the women are often blamed for giving birth to daughters. Can you explain why this is not correct?**

SOLUTION

Concept used. The sex of a child is decided by the **sex chromosomes**. Human females are **XX** and males are **XY**. The mother can give only an X; the father gives either X or Y. So it is the father's sperm, not the mother, that determines the child's sex.

Step 1. All eggs (ova) made by the mother carry one X chromosome, because the mother is XX. The mother can never pass a Y.

Step 2. The father is XY, so he makes two kinds of sperm: half carry an X chromosome and half carry a Y chromosome.

Step 3. If an **X-bearing sperm** fertilises the egg, the zygote is XX, a girl. If a **Y-bearing sperm** fertilises the egg, the zygote is XY, a boy.

$$\underbrace{X}_{\text{ovum}} + X_{\text{sperm}} \rightarrow XX \text{ (girl)}; \qquad \underbrace{X}_{\text{ovum}} + Y_{\text{sperm}} \rightarrow XY \text{ (boy)}.$$

Step 4. Therefore the sex of the baby depends entirely on which sperm (X or Y) of the *father* fertilises the egg. The mother has no role in deciding it, so blaming the woman for the child's sex is scientifically wrong and unjust.

> **Final Answer:** The mother contributes only an X chromosome; the father's sperm (X or Y) decides the child's sex. So the sex of the child is determined by the father, not the mother, and blaming women for the birth of daughters is biologically incorrect.

♥ Why this matters

This question links biology to society. The genetics here (XX/XY) is the same concept used in the Principles of Inheritance chapter, and it gives a clear, evidence-based answer to a harmful social belief.

EXPERT'S SOLUTION *: Riya Joshi, M.Sc Zoology, Banaras Hindu University*

Strategic angle. Settle it with a one-line genetic cross. The mother's contribution is fixed; only the father's varies, so the "blame" is misplaced.

Step 1. Write the parents: mother $= XX$, father $= XY$.

Step 2. Write the gametes: every ovum $= X$; sperm $= X$ or Y in equal numbers.

Step 3. Combine: $X \times X = XX$ (girl), $X \times Y = XY$ (boy). Since the variable gamete comes only from the father, the father determines the sex; the mother cannot

influence it.

Why this matters. A simple Punnett-style argument turns a social misconception into a clear scientific fact, useful for value-based exam questions too.

> **Final Answer:** Sex is set by the father's X- or Y-sperm; the mother always gives X. Blaming the woman is biologically incorrect.

Q 2.20 **How many eggs are released by a human ovary in a month? How many eggs do you think would have been released if the mother gave birth to identical twins? Would your answer change if the twins born were fraternal?**

SOLUTION

Concept used. A human female is normally **uniparous**: one secondary oocyte (egg) is released per menstrual cycle (per month). **Identical (monozygotic) twins** come from *one* fertilised egg that splits; **fraternal (dizygotic) twins** come from *two* eggs fertilised by two sperms.

Step 1. **Eggs per month.** In humans, generally only one ovum is released by one of the two ovaries in one menstrual cycle, so **one egg** is released per month.

Step 2. **Identical twins.** Identical twins develop from a *single* fertilised egg (zygote) that divides into two embryos. So even for identical twins, only **one egg** was released.

Step 3. **Fraternal twins.** Fraternal twins develop from *two* different eggs, each fertilised by a different sperm. So if the twins were fraternal, **two eggs** must have been released. Hence the answer *does change*: one egg for identical, two eggs for fraternal.

> **Final Answer:** One egg is released per month. For identical twins, still only one egg (it splits after fertilisation). For fraternal twins the answer changes to two eggs (two eggs fertilised by two sperms).

✗ Common Pitfall

Do not assume "twins always means two eggs". Identical twins come from *one* egg; only fraternal twins need two eggs. The type of twin decides the egg count.

EXPERT'S SOLUTION *: Neha Kapoor, M.Sc Zoology, Banaras Hindu University*

Quick reading. Separate "eggs released" from "embryos formed". One egg can still give two identical babies if it splits.

Step 1. Baseline: humans release one ovum per cycle, so one egg per month.

Step 2. Identical twins: one egg, fertilised once, then the zygote splits into two, egg count stays one.

Step 3. Fraternal twins: two eggs released, each fertilised by its own sperm, so the count becomes two; therefore the answer does change with twin type.

Why this matters. This is the practical test of the "one ovum per cycle" fact from oogenesis (Q12) and explains the next question about a dog.

> **Final Answer:** 1 egg/month; identical = 1 egg; fraternal = 2 eggs (answer changes).

Q 2.21 How many eggs do you think were released by the ovary of a female dog which gave birth to 6 puppies?

SOLUTION

Concept used. A dog is a **polyovulatory** (multiparous) animal: unlike humans, its ovaries release *many* eggs in one cycle, so it can produce a litter. Each puppy normally develops from its own fertilised egg.

Step 1. In multiparous animals such as the dog, more than one ovum is released from the ovary at the time of ovulation.

Step 2. Each puppy in the litter develops from a separate egg fertilised by a separate sperm.

Step 3. Since the female dog gave birth to 6 puppies, at least 6 **eggs** must have been released by its ovary (assuming one puppy per fertilised egg).

> **Final Answer:** At least 6 eggs were released, because the dog is a polyovulatory animal and each of the 6 puppies develops from a separate fertilised egg.

EXPERT'S SOLUTION *: Ankit Mehta, M.Sc Zoology, Banaras Hindu University*

Quick reading. Match egg count to offspring count for polyovulatory animals: one egg per offspring, so six puppies need six eggs.

Step 1. Recognise the species type: dogs are multiparous (polyovulatory), releasing several eggs per cycle.

Step 2. Apply one-egg-per-offspring: 6 puppies $\Rightarrow$ 6 fertilised eggs.

Step 3. Conclude at least 6 eggs were ovulated (more may be released but 6 is the minimum needed for 6 puppies).

Why this matters. Contrasting the dog (polyovulatory) with the human (uniparous, Q20) sharply fixes the idea that egg number depends on the species, not on having a litter.

Final Answer: Six eggs (one per puppy) were released by the dog's ovary.

Read the Full Human Reproduction Revision Notes →

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Key Takeaways

- Humans reproduce sexually: internal fertilisation, haploid gametes, a diploid zygote, and viviparous development.
- The testis makes sperms and androgens; the ovary makes ova and oestrogen/progesterone, every gonad is a "factory plus a gland".
- Spermatogenesis gives four sperms per spermatocyte; oogenesis gives only one ovum per cycle (the rest are polar bodies).
- GnRH $\rightarrow$ FSH/LH $\rightarrow$ sex hormones controls both spermatogenesis and the ~ 28-day menstrual cycle; the LH surge triggers ovulation.
- Fertilisation occurs in the ampulla; the zygote becomes a blastocyst that implants, and the placenta links foetus and mother.
- The father's X- or Y-sperm decides the child's sex; humans are uniparous (one egg/month) while dogs are polyovulatory.

End of NCERT Exercises