ANSWER KEY & MARKING SCHEME · CBSE CLASS 12

Human Reproduction

Biology · Chapter 2 · Use this with the Board Paper · Companion to Quick Drill

HOW TO USE

Attempt the Board Paper first (closed-book, full time). Then come here. For 2-mark+ questions, compare your answer to the model. For 3-4 mark questions, also consult the **Topper Templates** below — these show the exact step-by-step structure that scores full marks per CBSE marking-scheme conventions.

MODEL ANSWERS · BOARD PAPER

Section A (1-mark questions)

Q1. Name the site of fertilisation in the human female reproductive tract. [1 mark]

Ans: Ampulla of the fallopian tube.

Q2. Which hormone surge directly triggers ovulation? [1 mark]

Ans: Luteinising hormone (LH) surge.

Q3. Name the cell of the testis stimulated by FSH. [1 mark]

Ans: Sertoli cell.

Q4. What is colostrum, and why is it important? [1 mark]

Ans: Colostrum is the first milk secreted in the few days post-delivery; it is rich in IgA antibodies and provides passive immunity to the newborn.

Q5. Name the hormone detected by home pregnancy tests. [1 mark]

Ans: Human chorionic gonadotropin (hCG), secreted by the trophoblast/placenta.

Section B (2-mark questions)

Q6. Differentiate between spermatogenesis and oogenesis with respect to (i) site and (ii) number of functional gametes produced. [2 marks]

Ans: (i) Spermatogenesis occurs in seminiferous tubules of the testis; oogenesis occurs in the ovary. (ii) Spermatogenesis yields 4 functional spermatozoa per spermatogonium; oogenesis yields 1 functional ovum + 2-3 polar bodies (which degenerate) per oogonium.

Q7. List the four phases of the menstrual cycle with their day ranges in a 28-day cycle. [2 marks]

Ans: (1) Menstrual phase — Day 1-5; (2) Follicular/proliferative phase — Day 6-13; (3) Ovulatory phase — Day 14; (4) Luteal/secretory phase — Day 15-28.

Q8. Name the three accessory glands of the male reproductive system and state ONE function of any one. [2 marks]

Ans: Seminal vesicles, prostate, and bulbourethral (Cowper's) glands. Function: Seminal vesicles contribute ~60% of semen volume and provide fructose for sperm energy. (Alternatively: Prostate secretes a slightly alkaline fluid that neutralises vaginal acidity; bulbourethral glands secrete mucus for lubrication.)

Section C (3-mark questions)

Q9. Draw a labelled diagram of T.S. of a seminiferous tubule. Label Sertoli cell, spermatogonia, and Leydig cell. [3 marks]

Ans: Diagram: A circular cross-section. Label (1) outermost ring = SPERMATOGONIA (2n); concentric rings as you move inward: primary spermatocyte → secondary spermatocyte → spermatid → SPERMATOZOA (in the central lumen). Label SERTOLI CELL as a tall, elongated columnar cell extending between germ cells INSIDE the tubule. Label LEYDIG (interstitial) CELL OUTSIDE the tubule, in the interstitial connective tissue. Include arrows showing FSH → Sertoli and LH → Leydig.

Q10. Explain the role of the placenta during pregnancy. [3 marks]

Ans: (1) STRUCTURAL — The placenta is the feto-maternal connection formed by chorionic villi of the embryo interdigitating with maternal endometrium. (2) PHYSIOLOGICAL — Supplies O2, glucose, amino acids from mother to fetus; removes CO2 and nitrogenous wastes from fetus to mother (functions as the fetal lung + kidney + gut). (3) ENDOCRINE — Secretes hCG (maintains corpus luteum), hPL (mammary gland preparation), estrogen, progesterone (after corpus luteum regresses), and relaxin.

Q11. Describe parturition and the role of oxytocin. [3 marks]

Ans: Parturition is the act of childbirth. It is induced by a complex neuroendocrine mechanism — signals from the fully-developed fetus and placenta trigger the FETAL EJECTION REFLEX, inducing mild uterine contractions. This stimulates OXYTOCIN release from the maternal posterior pituitary. Oxytocin causes stronger uterine contractions, which stimulate further oxytocin release — a POSITIVE FEEDBACK loop that culminates in the expulsion of the baby, followed by the placenta.

Section D (5-mark questions)

Q12. Explain the menstrual cycle in a human female with respect to the changes in hormone levels (FSH, LH, estrogen, progesterone). Draw a labelled graph to support your answer. [5 marks]

Ans: The menstrual cycle is a cyclical reproductive cycle in human females, averaging 28 days. Day 1 = first day of menstrual bleeding. FOUR PHASES: (1) MENSTRUAL (Day 1-5) — endometrium and unfertilised oocyte are shed; (2) FOLLICULAR/PROLIFERATIVE (Day 6-13) — FSH stimulates growth of follicles; the dominant Graafian follicle secretes estrogen, which rebuilds the endometrium; (3) OVULATORY (Day 14) — a SHARP LH SURGE (and smaller FSH peak) triggers rupture of the Graafian follicle, releasing the secondary oocyte; (4) LUTEAL/SECRETORY (Day 15-28) — the corpus luteum (from the ruptured follicle) secretes PROGESTERONE (peaks Day 21-22), making the endometrium glandular and ready for implantation. If no fertilisation, the corpus luteum regresses, progesterone falls, and menstruation begins. GRAPH: Draw 4 hormone curves across days 1-28: FSH (small peak Day 12-13), LH (SHARP SPIKE at Day 14), Estrogen (peak Day 13), Progesterone (peak Day 21-22). Annotate 'Day 1 = bleeding' and 'Day 14 = ovulation'. Below the graph sketch endometrial thickness: thin (1-5) → thickening (6-13) → thick + glandular (15-22) → shed.

Q13. Describe spermatogenesis in humans with a schematic representation. Mention the ploidy at each stage and the hormones involved. [5 marks]

Ans: Spermatogenesis is the process by which spermatogonia produce mature spermatozoa. SITE: seminiferous tubules of the testis. TIMING: from puberty, continuous throughout life. STAGES: (1) Spermatogonia (2n, 46 chromosomes) — diploid stem cells lining the tubule wall; some divide by mitosis (replenishing stock), others enlarge to (2) Primary spermatocytes (2n). (3) Meiosis-I (reductional) yields 2 SECONDARY SPERMATOCYTES (n, 23 chromosomes). (4) Meiosis-II yields 4 SPERMATIDS (n). (5) SPERMIOGENESIS — spermatids reshape into 4 motile SPERMATOZOA: head with acrosome cap, midpiece packed with mitochondria, and tail. NET YIELD: 1 spermatogonium → 4 spermatozoa. HORMONAL CONTROL: GnRH from hypothalamus → anterior pituitary → FSH (acts on Sertoli cells, supports spermatogenesis) and LH (acts on Leydig cells → testosterone, essential for spermatogenesis). SCHEMATIC: Vertical flowchart: Spermatogonium (2n) →[mitosis]→ Primary spermatocyte (2n) →[meiosis I]→ 2 Secondary spermatocytes (n) →[meiosis II]→ 4 Spermatids (n) →[spermiogenesis]→ 4 Spermatozoa. Label all arrows with the type of division.

★ TOPPER TEMPLATE — Describe spermatogenesis with a schematic representation.

Annual (5 marks)

Step 1 [1 mark]	**Define + site**	Spermatogenesis is the process by which immature germ cells (spermatogonia) produce mature spermatozoa. It occurs in the SEMINIFEROUS TUBULES of the testis from puberty onwards.
Step 2 [2 marks]	**Stages with ploidy**	Spermatogonia (2n, 46) divide by mitosis and some enter meiosis as PRIMARY SPERMATOCYTES (2n). Meiosis-I produces 2 SECONDARY SPERMATOCYTES (n, 23). Meiosis-II produces 4 SPERMATIDS (n). Spermatids undergo SPERMIOGENESIS — they reshape into motile SPERMATOZOA (n). Net yield: one spermatogonium → 4 sperm.
Step 3 [1 mark]	**Hormonal control**	Hypothalamus secretes GnRH → anterior pituitary releases FSH (acts on Sertoli cells, supports spermatogenesis) and LH (acts on Leydig cells → testosterone, which is essential for spermatogenesis).
Step 4 [1 mark]	**Schematic diagram**	Draw a vertical flow: Spermatogonium (2n) → [mitosis] → Primary spermatocyte (2n) → [meiosis-I] → 2 Secondary spermatocytes (n) → [meiosis-II] → 4 Spermatids (n) → [spermiogenesis] → 4 Spermatozoa. Label arrows.

COMMON LOSS OF MARKS:

- Forgetting ploidy labels (2n / n) at each stage — examiners specifically look for these.
- Confusing FSH and LH targets (FSH acts on Sertoli, LH on Leydig).
- Missing 'spermiogenesis' as the distinct final reshaping step.

★ TOPPER TEMPLATE — Describe the menstrual cycle with hormone levels.

Annual (5 marks)

Step 1 [1 mark]	**Define + length**	The menstrual cycle is the cyclical reproductive cycle in human females, averaging 28 days, from menarche to menopause. Day 1 is the FIRST day of menstrual bleeding.
Step 2 [2 marks]	**Four phases**	Phase 1 — MENSTRUAL (1-5): endometrium sheds. Phase 2 — FOLLICULAR/ PROLIFERATIVE (6-13): FSH stimulates a Graafian follicle; estrogen rebuilds endometrium. Phase 3 — OVULATORY (Day 14): sharp LH SURGE triggers release of the secondary oocyte. Phase 4 — LUTEAL/SECRETORY (15-28): corpus luteum secretes PROGESTERONE; endometrium becomes glandular. If no fertilisation, corpus luteum regresses → progesterone falls → menstruation.
Step 3 [1 mark]	**Hormone graph**	Draw 4-curve hormone graph across days 1-28: (i) FSH small peak day 12-13; (ii) LH SHARP SPIKE day 14; (iii) Estrogen peaks just before ovulation (day 13); (iv) Progesterone peaks day 21-22.
Step 4 [1 mark]	**Endometrial correlate**	Beneath the hormone graph, sketch the endometrium thickness: thin (1-5), thickening (6-13), thick + glandular (15-22), shed (1-5 of next cycle). Mark 'OVULATION ↓' under day 14.

COMMON LOSS OF MARKS:

- Placing Day 1 at ovulation instead of bleeding day.
- Forgetting the LH SURGE as the trigger of ovulation.
- Drawing a single 'hormone' curve instead of 4 separate ones.

★ TOPPER TEMPLATE — Differentiate spermatogenesis and oogenesis.

Frequent (3 marks)

Step 1 [1 mark]	**Site + start time**	Spermatogenesis: in seminiferous tubules of testis; begins at PUBERTY; continuous throughout life. Oogenesis: in ovary; begins in FETAL LIFE; primary oocytes formed before birth; cyclical from puberty to menopause.
Step 2 [1 mark]	**Number of gametes**	Spermatogenesis: one spermatogonium → 4 functional spermatozoa. Oogenesis: one oogonium → 1 functional ovum + 2-3 polar bodies (which degenerate).
Step 3 [1 mark]	**Meiotic arrests**	Spermatogenesis: no major arrest; meiosis I and II proceed in sequence. Oogenesis: TWO arrests — Prophase-I (fetal life → puberty, released per cycle) and Metaphase-II (at ovulation, released ONLY after sperm entry).

COMMON LOSS OF MARKS:

- Writing '4 ova' for oogenesis output (it is 1 ovum).
- Missing the two arrest points in oogenesis.
- Saying spermatogenesis begins in fetal life — it starts at puberty.

★ TOPPER TEMPLATE — Explain the role of the placenta during pregnancy.

Frequent (3 marks)

Step 1 [1 mark]	**Structural role**	The placenta is the FETO-MATERNAL connection formed by chorionic villi of the embryo interdigitating with the uterine endometrium. It is the structural and functional link between the mother and the developing fetus.
Step 2 [1 mark]	**Physiological functions**	Supplies O2 and nutrients (glucose, amino acids) from mother to fetus, and removes CO2 and nitrogenous wastes from fetus to mother. Functions as the fetal 'lung + kidney + gut' through the umbilical cord.
Step 3 [1 mark]	**Endocrine role**	The placenta acts as an ENDOCRINE GLAND, secreting hCG (maintains corpus luteum in early pregnancy), hPL (human placental lactogen — prepares mammary glands), estrogen and progesterone (later in pregnancy after corpus luteum regression), and relaxin.

COMMON LOSS OF MARKS:

- Missing the endocrine role entirely (1 mark direct loss).
- Calling hCG 'a fetal hormone' — it is placental/trophoblast-derived.
- Forgetting relaxin (high-scoring detail).

★ TOPPER TEMPLATE — Describe parturition and lactation.

Occasional (3 marks)

Step 1 [1 mark]	**Parturition trigger**	Parturition (childbirth) is induced by a complex neuroendocrine mechanism. Signals from the fully-developed fetus and placenta trigger the FETAL EJECTION REFLEX, inducing mild uterine contractions. This stimulates oxytocin release from the maternal pituitary.
Step 2 [1 mark]	**Positive feedback loop**	OXYTOCIN causes stronger uterine contractions → which stimulate further oxytocin release — a POSITIVE FEEDBACK loop that culminates in expulsion of the baby, followed by the placenta.
Step 3 [1 mark]	**Lactation**	Mammary glands fully differentiate during pregnancy. After delivery, PROLACTIN drives milk synthesis; OXYTOCIN causes milk ejection (let-down). The first few days' milk — COLOSTRUM — is rich in IgA antibodies and is essential for the newborn's passive immunity.

COMMON LOSS OF MARKS:

- Not naming the 'positive feedback' nature of oxytocin → mild loss.
- Saying 'milk has antibodies' without specifying colostrum / IgA.
- Confusing prolactin (synthesis) with oxytocin (ejection).

MARKING SCHEME — GENERAL NOTES

- Diagram-based questions: half marks for the diagram (clean lines, proportional) and half for accurate labelling. Unlabelled diagrams earn ZERO labelling marks.
- For menstrual cycle questions: the LH SURGE must be explicitly named/drawn — a generic 'hormone peak' without identifying LH loses 1 mark.
- For spermatogenesis/oogenesis: ploidy values (2n/n) at each stage are mandatory — missing ploidy loses 1 mark even if the flowchart is otherwise correct.
- Sertoli vs Leydig confusion (swapped labels) is the most common 1-2 mark loss — examiners flag this every year.
- Fertilisation site: answer must be 'ampulla of fallopian tube' — answering 'uterus' or just 'fallopian tube' earns partial or zero marks.
- For placenta-role questions, all three roles (structural / physiological / endocrine) must be addressed for full marks. Missing the endocrine role = 1 mark loss.
- For oogenesis, mentioning both arrest points (Prophase-I + Metaphase-II) is required for the 'arrests' mark.
- Acceptable variations: writing 'Cowper's glands' in place of 'bulbourethral glands' is fully accepted.