CHAPTER : 3

HUMAN REPRODUCTION

STUDY-NOTES

Sexual mode of reproduction takes place in humans that includes the various events like formation of gametes (gametogenesis), i.e., sperms in males and ovum in females, transfer of sperms into the female genital tract (insemination) and fusion of male and female gametes (fertilisation) leading to formation of zygote. This is followed by formation and development of blastocyst and its attachment to the uterine wall (implantation), embryonic development (gestation) and delivery of the baby (parturition).

MALE REPRODUCTIVE SYSTEM

The male reproductive system has four main parts: testes, accessory ducts, glands, external genitalia.

Testes (Singular Testis)

- These are located in the pelvic region outside the abdominal cavity within a pouch called as **scrotum**.
- Scrotum is a muscular sac that contains and protects the testes. It is a part of the external male genitalia and is located behind the penis. The testes are placed outside the abdominal cavity so as to maintain a temperature that is 2–2.5°C lower than the average human body temperature. The lower temperature in testes is required for spermatogenesis.
- Testis is oval in shape. It is 4-5cm long and 2-3cm wide. Each testis has about 250 compartments called testicular lobules.
- Each lobule contains 1-3 highly coiled seminiferous tubules.
- Seminiferous tubules are the site for meiosis that leads to the formation of spermatozoa.

Seminiferous tubules

- The inner lining of each seminiferous tubule consists of two types of cells: **spermatogonia** and **Sertoli cells**.
- Spermatogonia are the immature male germ cells that undergo meiosis that leads to formation of sperms and are diploid and contains 46 chromosomes.
- Sertoli cells provide nutrition to the spermatogonia.
- **Interstitial spaces** are the regions outside the seminiferous tubules. They contain small blood vessels, and called **Leydig cells**.
- **Leydig cells** are the cells that synthesise and secrete testicular hormones called **androgens**.

Male Accessory Ducts

The accessory ducts transport the sperms from the testes to the urethra for their release outside the body. There are four accessory ducts in the male reproductive system: Rete Testis, Vasa efferentia, Epididymis, Vas deferens

- **Rete testis:** These are the ducts that connect the seminiferous tubules of the testes to the vasa efferentia.
- **Vasa efferentia:** These ducts leave the testes and open into the epididymis that is located in the posterior surface of each testis.
- **Epididymis:** It is located on the posterior surface of each testis and opens into the vas deferens.
- **Vas deferens:** It is a duct that ascends into the abdominal cavity and loops over the urinary bladder. It receives a duct from the seminal vesicle and opens into the urethra as an ejaculatory duct.

- **Ejaculatory duct:** They store and transport the sperms from the testis to the outside through the urethra.
- **Urethra:** It is a thin muscular tube. It originates from the urinary bladder. It then passes through the penis to its external opening called the **urethral meatus**.

Male Accessory Glands are seminal vesicles, prostate gland, bulbourethral glands

- These glands secrete products that mix with the sperms to nourish and protect them and together is known as semen.
- **Seminal vesicles:** They contribute approximately 60-75% of the fluid in semen. The secretions are rich in proteins, enzymes, fructose, vitamin C, phosphoryl choline and prostaglandins. The high fructose content provides nutrient energy for the spermatozoa.
- **Prostate Gland:** It secretes a slightly alkaline milky fluid. This helps in the survival of sperms in the acidic vaginal environment. The secretions also improve the motility of the sperms.
- **Bulbourethral glands:** The secretions of this gland lubricate the penis and neutralise any residual acidity in the urethra.

FEMALE REPRODUCTIVE SYSTEM

The parts of the female reproductive system are: 1. a pair of ovaries, 2. a pair of oviducts, 3. uterus 4. cervix, 5. vagina, 6. external genitalia, 7. mammary glands

Ovaries

- These are the primary female sex organs and produce the female gamete- ovum.
- They also produce steroid hormones (ovarian hormones).
- Each ovary is covered by a thin epithelium enclosing an ovarian stroma.
- Ovarian stroma: It is the matrix of the ovary and is divided into two zones
  (i) Peripheral cortex
  (ii) Inner medulla

Female Accessory Ducts

These are the oviducts, uterus and the vagina.

Oviduct (Fallopian Tube)

- Each fallopian tube is 10-12 cm long and extends from the periphery of each ovary to the uterus.
- **Infundibulum:** It is the funnel shaped part closer to the ovary.
- **Fimbriae:** They are the finger like projections at the edges of the infundibulum that aid in collecting the ovum after ovulation.
- **Ampulla:** It is the wider part of the oviduct after the infundibulum.
- **Isthmus:** It is the last part of the oviduct. It has a narrow lumen and joins the uterus.

Uterus

- It is a pear-shaped organ also called the womb. It is attached to the pelvic wall by ligaments.
- The uterus is the part where the embryo develops into the foetus. It opens into the vagina through a narrow cervix.
- Uterine wall has three layers of tissues: perimetrium, myometrium and the endometrium.
- **Perimetrium:** It is the thin external membranous layer.
- **Myometrium:** It is the thick middle layer made up of smooth muscle. It exhibits strong contractions during the delivery of the baby.
- **Endometrium:** It is the inner glandular layer that lines the uterine cavity. It undergoes periodic changes during the menstrual cycle.

Cervix

- It is a narrow canal connecting the uterus to the vagina. Cervical canales is the cavity of the cervix.
- **Birth canal:** The cervical canal along with the vagina forms the birth canal.

Female External Genitalia

They include mons pubis, labia majora, labia minora, hymen and cletoris

Mons pubis: It is a mass of fatty tissue covered by skin and hair.

Labia majora: They are fleshy folds of tissue that extend from the mons pubis and cover the vaginal opening.

Labia minora: They are the paired folds of tissue under the labia majora.

Hymen: It is a membrane that partially covers the opening of the vagina. It is often torn during the first intercourse or coitus. It can also be broken by active participation in some sports like horseback riding, cycling, etc., a sudden fall or jolt, insertion of a vaginal tampon, etc. The presence or absence of hymen is not a reliable indication of virginity or sexual experience.

Clitoris: It is a tiny finger-like projection that lies at the junction of the labia minora above the urethral opening.

Mammary Glands

- These are the paired structures of breasts that contain glandular tissue and variable amounts of fats.
- Glandular tissue in each mammary gland consists of 15-20 mammary lobes that have clusters of cells called alveoli.The cells of alveoli secrete milk then milk is stored in the lumen or cavities of the alveoli. The alveoli open into mammary tubules. The tubules join to form a mammary duct.
- All these mammary ducts join to form a wider mammary ampulla. The mammary ampulla is connected to a lactiferous duct through which milk is sucked out.

GAMETOGENESIS

- It is the process by which the primary male and female sex organs produce haploid gametes from diploid germ cells.
- Spermatogenesis is the process by which the immature male germ cells or spermatogonia produce mature sperm cells in the testis.
- Oogenesis is the process by which the immature oogonia in the ovaries produce mature ovum.

Spermatogenesis

The process begins at puberty and proceeds for whole life.

- The spermatogonia multiply by mitosis to increase in number, present in the inner wall of the seminiferous tubules. Each spermatogonium contains 46 chromosomes.
- Firstly spermatogonia called the primary spermatocytes periodically undergo meiosis to form two equal, haploid cells called the secondary spermatocytes. They contain 23 chromosomes.
- The secondary spermatocytes produce four equal haploid cells after they undergo second meiotic division.
- Spermatids-contain 23 chromosomes. The spermatids undergo spermiogenesis to form spermatozoa or sperms.
- The sperm heads are embedded in the sertoli cells and finally released from the seminiferous tubules by the process of spermiation.
- **Spermiation** is the process by which mature spermatozoa are released from the seminiferous tubules of the testis.

Role of hormones in spermatogenesis

- Gonadotropin releasing hormone (GnRH) is secreted by the hypothalamus. The increased levels of GnRH stimulates the release of two gonadotropins – Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH), from the anterior pituitary.
- Follicle Stimulating Hormone (FSH) acts on the Sertoli cells and stimulates the release of some factors that help in the process of spermatogenesis.

- Luteinizing Hormone (LH) acts on the Leydig cells and stimulates the synthesis and secretion of androgens which in turn stimulate the process of spermatogenesis.

Structure of Sperm

- It consists of a head, neck, middle piece and a tail and plasma membrane covers the whole body of the sperm.
- The head portion contains a haploid nucleus and anterior portion of the head contains an acrosome.
- Acrosome is a structure that is filled with digestive enzymes that help in the dissolving the membrane of the egg cell and help in fertilisation of the ovum.
- Middle piece contains numerous mitochondria that produce energy for the movement of the tail.
- During ejaculation 200-300 million sperms are released. At least 60% of them should have normal shape and size and at least 40% should show vigorous motility.
- Semen is a white organic fluid released by the penis during ejaculation. It consists of the sperms and the fluids secreted by the accessory ducts and the accessory glands.
- The testicular hormones (androgens) maintain the functions of the male accessory ducts and glands.

Oogenesis

The process of formation of a mature female gamete that is ova is oogenesis and initiated during the embryonic developmental stage. During this stage a couple of million gamete mother cells or oogonia are formed in the foetal ovary. No more oogonia are formed and added after birth.

- The oogonia start the process of meiosis and get arrested at the stage of Prophase I. These cells are called **primary oocytes**.
- Each primary oocyte gets surrounded by a layer of granulosa cells and is now called the primary follicle.
- At puberty, there are only about 60,000-80,000 primary follicles in the ovary.
- These primary follicles get surrounded by more layers of granulosa cells as well as a new theca. They now form the secondary follicle.
- The secondary follicle then gives rise to the tertiary follicle. The tertiary follicle is characterised by the presence of a fluid filled cavity called **antrum**. The theca is organised into two layers-inner **theca** interna and the outer theca externa. The primary oocyte grows in size and completes the first meiotic division. It is an unequal division forming a large secondary oocyte and a tiny first polar body.
- Secondary oocyte retains much of the nutrient rich cytoplasm. The tertiary follicle changes into the mature Graafian follicle. The secondary oocyte forms a new layer called the zona pellucida around it.
- The Graafian follicle now ruptures to release the secondary oocyte (ovum) from the ovary by the process of ovulation.

Menstrual Cycle

- It is the rhythmic change in the reproductive organs of the females.
- The cycle is essential for the production of oocytes and for the preparation of uterus for pregnancy. The cycle repeats 28-35 days and normally one egg is released per cycle.
- **Menstruation** is the process by which blood and mucosal tissues are regularly discharged in a periodic manner from the inner lining of the uterus through the vagina.
- **Menarche:** Menarche is the first menstruation for a human female. It begins at puberty.
- **Menopause:** Menopause is the permanent ceasing of menstrual cycle in females due to the depletion of oocytes as a result of aging. The average age of menopause is between 45-50 years.

Phases of the Menstrual Cycle

Menstrual cycle follows four phases:

(i) Menstrual phase (ii) Follicular phase (iii) Ovulation (iv) Luteal Phase

- During pregnancy all events of the menstrual cycle stop.
- In absence of pregnancy the corpus luteum degenerates. This causes **breakdown** of the endometrium leading to menstruation and thus starting the new cycle.

FERTILISATION AND IMPLANTATION

- Fertilisation is the fusion of the sperm and the egg. During fertilisation the sperm induces changes in the zona pellucida layer of the ovum that block the entry of additional sperms ensuring that only one sperm can fertilise an ovum.
- It occurs in the fallopian tube only if the ovum and sperms are simultaneously transferred into the ampullary region of the fallopian tube.
- The secretions of the acrosome of the sperm help the sperm to enter the ovum through the zona pellucida and the plasma membrane.
- This induces the secondary oocyte to complete meiosis. This is again an unequal division. It results in the formation of a second polar body and a haploid ovum.
- The haploid nuclei of the sperm and the ovum fuse to form a diploid zygote. The zygote contains 46 chromosomes.
- The sex of the foetus is determined by the sex chromosome present in the sperm. As the female is XX the ovum will always carry the X chromosome. Males are XY and therefore, the sperm can contain either X or Y.
- The zygote undergoes mitotic cleavage and forms 2, 4, 8 and 16 daughter cells called blastomeres.
- **Morula** is the embryo with 8-16 blastomeres. It continues division as it moves further along into the uterus. The blastomeres get arranged into an outer layer called the **trophoblast**. The inner cell mass is attached to the trophoblast.
- The trophoblast attaches to the endometrium.
- The inner cell mass differentiates to form the embryo.
- The cells of the uterus divide rapidly and cover the blastocyst. The blastocyst thus embeds in the uterine wall. This is called **implantation**. This leads to pregnancy.

PREGNANCY AND EMBRYONIC DEVELOPMENT

- After implantation finger-like projections called chorionic villi appear on the trophoblast surrounded by uterine tissue and maternal blood. It causes the formation of a structural and functional unit between the developing foetus and the maternal body called the **placenta**.
- The placenta is connected to the embryo through umbilical cord. The embryo transports nutrients and wastes to and from the placenta through the umbilical cord.
- Additionally the placenta produces several hormones such as human chorionic gonadotropin (hCG), human placental lactogen (hPL), oestrogens, progesterone, etc.
- During pregnancy, production of various hormones is increased like oestrogens, progesterone, cortisol, thyroxine, prolactin, etc. These hormones are essential for supporting foetal growth, metabolic changes in pregnancy as well as maintenance of pregnancy.
- Soon after implantation the embryo differentiates into the outer ectoderm and the inner endoderm. The mesoderm develops soon after. These three tissues soon give rise to the tissues in the body.
- The inner cell mass contains **stem cells** that have the ability to give rise to all the tissues and organs in the body.

Foetal development

1 month—heart is formed.
2 months—limbs and digits are formed.
3 months—most of the major organ systems are formed.
5 months—appearance of hair on the head and the first movements of the foetus.
6 months—body is covered with fine hair, eyelids separate, eyelashes are formed.
9 months—foetus is fully developed and ready for delivery.

PARTURITION

- The process of childbirth by which the foetus is expelled or delivered due to vigorous contractions of the uterus is parturition.

- **Gestation Period** is the average duration of pregnancy. In humans the gestation period is 9 months.
- A fully developed foetus and placenta induces parturition. This causes mild uterine contractions called **foetal ejection reflex**.
- This triggers the release of oxytocin from the mother's pituitary. Oxytocin stimulates stronger uterine contractions which stimulates more production of oxytocin.
- This leads to stronger and stronger contractions till the baby is expelled out of the uterus through the birth canal.
- Soon after the foetus is delivered and the placenta is also expelled out of the uterus.

LACTATION

- The production of milk by the mammary glands of the females towards the end of the pregnancy is called **lactation**.
- **Colostrum** is the milk produced during the initial few days of lactation. It is rich in antibodies that provides resistance and immunity to the new-born.

QUESTION BANK

MULTIPLE CHOICE QUESTIONS

1. Fertilizin is a chemical substance produced from

(a) polar bodies (b) middle piece of sperm (c) mature eggs (d) acrosome

2. In the fertile human female, approximately on which day of the menstrual cycle does ovulation take place?

(a) Day 14 (b) Day 18 (c) Day 1 (d) Day 8

3. The mammalian corpus luteum produces

(a) luteotrophic hormone (b) luteinizing hormone (c) estrogen (d) progesterone

4. Egg is liberated from ovary in

(a) secondary oocyte stage (b) primary oocyte stage
(c) oogonial stage (d) mature ovum stage

5. The extra embryonic membranes of the mammalian embryo are derived from

(a) trophoblast (b) inner cell mass (c) formative cells (d) follicle cells

6. Corpus luteum secretes large amounts of progesterone after

(a) day 14 of the cycle (b) day 28 of the cycle (c) day 1 of the cycle (d) day 5 of the cycle

7. Extrusion of second polar body from egg nucleus occurs

(a) after entry of sperm before completion of fertilisation
(b) after completion of fertilisation
(c) before entry of sperm
(d) without any relation to sperm entry

8. Termination of gastrulation is indicated by

(a) obliteration of blastocoel (b) obliteration of archenteron
(c) closure of blastopore (d) closure of neural tube

9. In telolecithal egg the yolk is found

(a) all over the egg (b) on one side (c) both the sides (d) centre

10. Fertilisation in humans is practically feasible only if

(a) the ovum and sperms are transported simultaneously to ampullary–isthmic junction of the cervix
(b) the sperms are transported into cervix within 48 hrs of release of ovum in uterus
(c) the sperms are transported into vagina just after the release of ovum in fallopian tube
(d) the ovum and sperms are transported simultaneously to ampullary–isthmic junction of the Fallopian tube

11. Select the incorrect statement.

(a) LH and FSH decrease gradually during the follicular phase.
(b) LH triggers secretion of androgens from the Leydig cells.
(c) FSH stimulates the sertoli cells which help in spermiogenesis.
(d) LH triggers ovulation in ovary.

12. Identify the correct statement on 'inhibin'.

(a) It is produced by granulosa cells in ovary and inhibits the secretion of LH.
(b) It is produced by nurse cells in testes and inhibits the secretion of LH.
(c) It inhibits the secretion of LH, FSH and prolactin.
(d) It is produced by granulosa cells in ovary and inhibits the secretion of FSH.

13. In human females, meiosis II is not completed until

(a) uterine implantation (b) birth (c) puberty (d) fertilisation

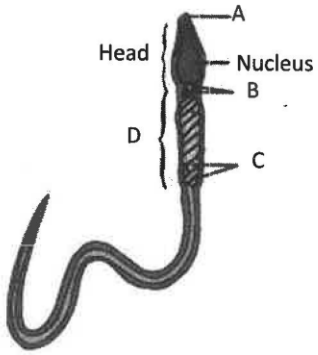
14. Which of the following layers in an antral follicle is acellular?

(a) Stroma (b) Zona pellucida (c) Granulosa (d) Theca interna

15. Secretions from which one of the following are rich in fructose, calcium and some enzymes?

(a) Male accessory glands (b) Liver (c) Pancreas (d) Salivary glands

16. Identify the part C in a male gamete:



(a) Head (b) Golgi (c) Mitochondria (d) Acrosomes

17. Capacitation occurs in

(a) epididymis
(b) vas deferens
(c) female reproductive tract
(d) rete testis

18. Which of the following depicts the correct pathway of transport of sperms?

(a) Rete testis → Efferent ductules → Epididymis → Vas deferens
(b) Rete testis → Epididymis → Efferent ductules → Vas deferens
(c) Rete testis → Vas deferens → Efferent ductules → Epididymis
(d) Efferent ductules → Rete testis → Vas deferens → Epididymis

19. Match the Column I with Column II and select the correct option using the codes given below.

Column I	Column II
A. Mons pubis	(i) Embryo formation
B. Antrum	(ii) Sperm
C. Trophectoderm	(iii) Female external genitalia
D. Nebenkern	(iv) Graafian follicle

(a) A (iii), B (iv), C (ii), D (i)
(b) A (iii), B (iv), C (i), D (ii)
(c) A (iii), B (i), C (iv), D (ii)
(d) A (i), B (iv), C (iii), D (ii)

20. Several hormones like hCG, hPL, estrogen, progesterone are produced by

(a) ovary (b) placenta (c) fallopian tube (d) pituitary

21. Changes in GnRH pulse frequency in females is controlled by circulating levels of

(a) progesterone only
(b) progesterone and inhibin
(c) estrogen and progesterone
(d) estrogen and inhibin

22. Which of the following events is not associated with ovulation in human female?

(a) Release of secondary oocyte
(b) LH surge
(c) Decrease in estradiol
(d) Full development of Graafian follicle

23. Ectopic pregnancies are referred to as

(a) implantation of defective embryo in the uterus
(b) pregnancies terminated due to hormonal imbalance
(c) pregnancies with genetic abnormality
(d) implantation of embryo at site other than uterus

24. Which of the following cells during gametogenesis is normally diploid?

(a) Spermatogonia (b) Secondary polar body (c) Primary polar body (d) Spermatid

25. In human female the blastocyst

(a) forms placenta even before implantation
(b) gets implanted into uterus 3 days after ovulation
(c) gets nutrition from uterine endometrial secretion only after implantation
(d) gets implanted in endometrium by the trophoblast cells

26. Capacitation refers to changes in the

(a) ovum after fertilisation
(b) sperm after fertilisation
(c) sperm before fertilisation
(d) ovum before fertilisation

27. What is the correct sequence of sperm formation?

(a) Spermatogonia, spermatozoa, spermatocytes, spermatids
(b) Spermatogonia,spermatocytes, spermatids, spermatozoa
(c) Spermatids, spermatocytes, spermatogonia, spermatozoa
(d) Spermatogonia, spermatocytes, spermatozoa, spermatids

28. The chromosomal structure of human egg is

(a) 22X + Y chromosomes
(b) 22X + X chromosomes
(c) 22X + XY chromosomes
(d) 23X chromosomes

29. Location and secretion of Leydig's cells are

(a) liver–cholesterol
(b) ovary–estrogen
(c) testis–testosterone
(d) pancreas–glucagon

30. Middle piece of mammalian sperm possesses

(a) mitochondria and centriole
(b) mitochondria only
(c) centriole only
(d) nucleus and mitochondria

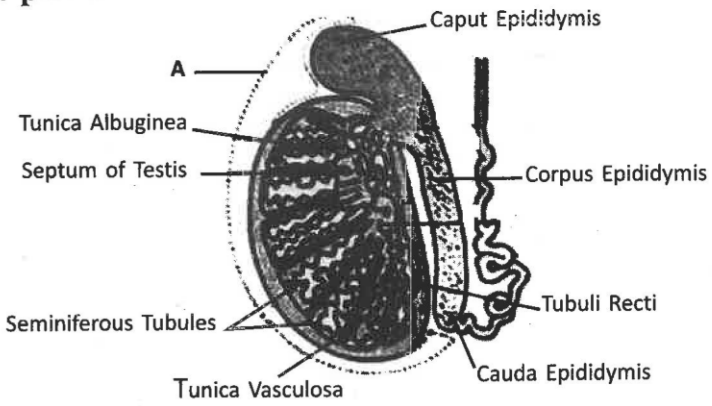
31. Gonads develop from embryonic

(a) ectoderm
(b) endoderm
(c) mesoderm
(d) both mesoderm and endoderm

32. In a normal pregnant woman, the amount of total gonadotropin activity was assessed. The result expected was

(a) high level of circulating FSH and LH in the uterus to stimulate implantation of the embryo
(b) high level of circulating hCG to stimulate endometrial thickening
(c) high levels of FSH and LH in uterus to stimulate endometrial thickening
(d) high level of circulating hCG to stimulate estrogen and progesterone synthesis

33. Identify and name the part marked as A.



(a) Epididymis (b) Vas deferens (c) Testis (d) Rete testis

34. The Leydig's cells as found in the human body are the secretory source of

(a) progesterone (b) intestinal mucus (c) glucagon (d) androgens

35. Which extraembryonic membrane in humans prevents desiccation of the embryo inside the uterus?

(a) Yolk sac (b) Amnion (c) Chorion (d) Allantosis

36. Which part of ovary in mammals acts as an endocrine gland after ovulation?

(a) Stroma (b) Germinal epithelium (c) Vitelline membrane (d) Graafian follicle

37. In the human female, menstruation can be deferred by the administration of

(a) combination of FSH and LH (b) combination of estrogen and progesterone

(c) FSH only (d) LH only

38. Sertoli cells are regulated by the pituitary hormone known as

(a) LH (b) FSH (c) GH (d) prolactin

39. Identify the human developmental stage shown below as well as the related right place of its occurrence in a normal pregnant woman, and select the right option for the two, together.

(a) Late morula – Middle part of Fallopian tube

(b) Blastula – End part of Fallopian tube

(c) Blastocyst – Uterine wall

(d) 8 celled morula – Starting point of Fallopian tube

40. The secretory phase in the human menstrual cycle is also called

(a) luteal phase and lasts for about 6 days (b) follicular phase and lasts for about 6 days

(c) luteal phase and lasts for about 13 days (d) follicular phase and lasts for about 13 days

41. If for some reason, the vasa efferentia in the human reproductive system get blocked, the gametes will not be transported from

(a) testes to epididymis (b) epididymis to vas deferens

(c) ovary to uterus (d) vagina to uterus

42. The testes in humans are situated outside the abdominal cavity inside a pouch called scrotum. The purpose served is for

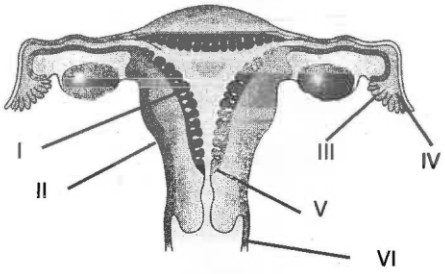
(a) maintaining the scrotal temperature lower than the internal body temperature

(b) escaping any possible compression by the visceral organs

(c) providing more space for the growth of epididymis

(d) providing a secondary sexual feature for exhibiting the male sex

43. The figure given below depicts a diagrammatic sectional view of the human female reproductive system. Which set of three parts out of I–VI have been correctly identified?



(a) (II) endometrium, (III) infundibulum, (IV) fimbriae

(b) (III) infundibulum, (IV) fimbriae, (V) cervix

(c) (IV) oviducal funnel, (V) uterus, (VI) cervix

(d) (I) perimetrium, (II) myometrium, (III) Fallopian tube

44. What happens during fertilisation in humans after many sperms reach close to the ovum?

(a) Secretions of acrosome helps one sperm enter cytoplasm of ovum through zona pellucida.

(b) All sperms except the one nearest to the ovum lose their tails.

(c) Cells of corona radiata trap all the sperms except one.

(d) Only two sperms nearest the ovum penetrate zona pellucida.

45. About which day in a normal human menstrual cycle does rapid secretion of LH normally occurs?

(a) 14th day (b) 20th day (c) 5th day (d) 11th day

46. Sertoli cells are found in

(a) ovaries and secrete progesterone

(b) adrenal cortex and secrete adrenaline

(c) seminiferous tubules and provide nutrition to germ cells

(d) pancreas and secrete cholecystokinin.

47. Vasa efferentia are the ductules leading from

(a) testicular lobules to rete testis (b) rete testis to vas deferens

(c) vas deferens to epididymis (d) epididymis to urethra

48. Seminal plasma in human males is rich in

(a) fructose and calcium (b) glucose and calcium

(c) DNA and testosterone (d) ribose and potassium

49. The first movements of the foetus and appearance of hair on its head are usually observed during which month of pregnancy?

(a) Fourth month (b) Fifth month (c) Sixth month (d) Third month

50. Seminal plasma in humans is rich in

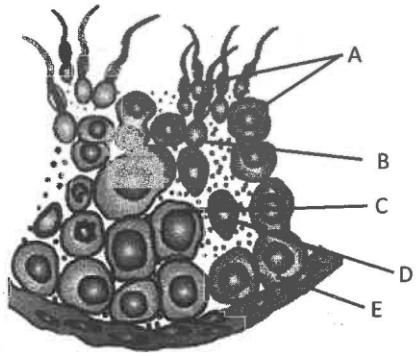
(a) fructose and calcium but has no enzymes

(b) glucose and certain enzymes but has no calcium

(c) fructose and certain enzymes but poor in calcium

(d) fructose, calcium and certain enzymes

51. Which of the following is marked as primary spermatocytes in the given diagram.



(a) A (b) B (c) C (d) D

52. Which one of the following is the correct matching of the events occurring during menstrual cycle?

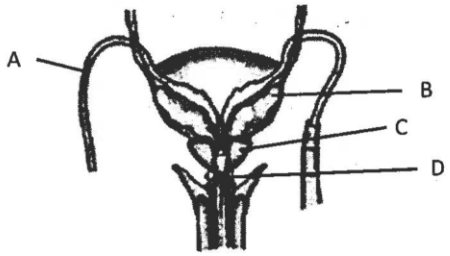
(a) **Proliferative phase:** Rapid regeneration of myometrium and maturation of Graafian follicle.

(b) **Secretory phase:** Increased secretion of corpus luteum and of progesterone.

(c) **Menstruation:** Breakdown of myometrium and ovum not fertilised.

(d) **Ovulation:** LH and FSH attain peak level and sharp fall in the secretion of Graafian follicle.

53. Given below is a diagrammatic sketch of a portion of the human male reproductive system. Select the correct set of the names of the parts labelled A, B, C, D.



(a) A- Vas deferens, B- Seminal vesicle, C- Prostate, D- Bulbourethral gland

(b) A- Vas deferens, B- Seminal vesicle, C- Bulbourethral gland, D- Prostate

(c) A- Ureter, B- Seminal vesicle, C- Prostate, D- Bulbourethral gland

(d) A- Ureter, B- Prostate, C- Seminal vesicle, D- Bulbourethral gland

54. A change in the amount of yolk and its distribution in the egg will affect

(a) pattern of cleavage (b) number of blastomeres produced

(c) fertilisation (d) formation of zygote

55. In humans, at the end of the first meiotic division, the male germ cells differentiate into the

(a) spermatids (b) spermatogonia

(c) primary spermatocytes (d) secondary spermatocytes

56. In human adult females oxytocin

(a) stimulates pituitary to secrete vasopressin (b) causes strong uterine contractions during parturition

(c) is secreted by anterior pituitary (d) stimulates growth of mammary glands

57. Which one of the following statements is incorrect about menstruation?

(a) At menopause in the female, there is especially abrupt increase in gonadotropic hormones.

(b) The beginning of the cycle of menstruation is called menarche.

(c) During normal menstruation about 40 mL blood is lost.

(d) The menstrual fluid can easily clot.

58. Withdrawal of which of the following hormones is the immediate cause of menstruation?

(a) Progesterone (b) Estrogen (c) FSH (d) LH

59. Grey crescent is the area

(a) at the point of entry of sperm into ovum

(b) just opposite to the site of entry of sperm into ovum

(c) at the animal pole

(d) at the vegetal pole

60. Signals from fully developed foetus and placenta ultimately lead to parturition which requires the release of

(a) estrogen from placenta (b) oxytocin from maternal pituitary

(c) oxytocin from foetal pituitary (d) relaxin from placenta.

61. If mammalian ovum fails to get fertilised, which one of the following may unlikely happen?

(a) Corpus luteum will disintegrate. (b) Progesterone secretion rapidly declines.

(c) Estrogen secretion further increases. (d) Primary follicle starts developing.

62. Ovulation in the human female normally takes place during the menstrual cycle

(a) at the mid secretory phase (b) just before the end of the secretory phase

(c) at the beginning of the proliferative phase (d) at the end of the proliferative phase

63. Which of the following hormones is not a secretion product of the human placenta?

(a) Human chorionic gonadotropin (b) Prolactin

(c) Estrogen (d) Progesterone

64. During embryonic development, the establishment of polarity along anterior/posterior, dorsal/ventral or medial/lateral axis is called

(a) organiser phenomenon (b) axis formation

(c) anamorphosis (d) pattern formation

65. What is true for cleavage?

(a) Size of embryo increases. (b) Size of cells decreases.

(c) Size of cells increases. (d) Size of embryo decreases.

66. Which set is similar?

(a) Corpus luteum - Graafian follicles (b) Sebum - Sweat

(c) Bundle of His - Pacemaker (d) Vitamin B7 - Niacin

67. Blastopore is the pore of

(a) archenteron (b) blastocoel (c) coelom (d) alimentary canal

68. The middle piece of the sperm contains

(a) proteins (b) mitochondria (c) centriole (d) nucleus

69. After ovulation Graafian follicle regresses into

(a) corpus artesia (b) corpus callosum

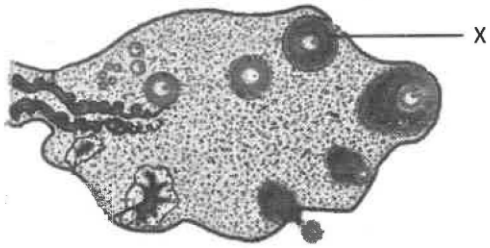
(c) corpus luteum (d) corpus albicans

70. In an egg, the type of cleavage is determined by

(a) the amount and distribution of yolk (b) the number of egg membranes

(c) the shape and size of the sperm (d) the size and location of the nucleus

71. It is the important characteristic of tertiary follicle, identify the marked part X in the given diagram.



(a) Egg (b) Antrum (c) Primary oocyte (d) Corpus luteum

72. What is true about cleavage in the fertilised egg in humans?

(a) It starts while the egg is in the fallopian tube. (b) It starts when the egg reaches the uterus.
(c) It is meroblastic. (d) It is identical to normal mitosis.

73. Acrosome reaction in sperm is triggered by

(a) capacitation (b) release of lysine (c) influx of Na^+ (d) release of fertilizin

74. Male hormone is produced in the testis by cells of

(a) Sertoli (b) epithelial (c) spermatocytes (d) Leydig

75. Eye lens is formed from

(a) ectoderm (b) mesoderm
(c) endoderm (d) ectoderm and mesoderm

76. The opening of gastrocoel is also called

(a) neutral tube (b) blastopore
(c) future anterior end of embryo (d) gastula

77. The semen constitute the seminal plasma along with

(a) immature eggs (b) mature eggs (c) sperms (d) polar bodies

78. During cleavage, what is true about cells?

(a) Nucleocytoplasmic ratio remains unchanged. (b) Size does not increase.
(c) There is less consumption of oxygen. (d) The division is like meiosis.

79. How many sperms are formed from a secondary spermatocyte?

(a) 4 (b) 8 (c) 2 (d) 1

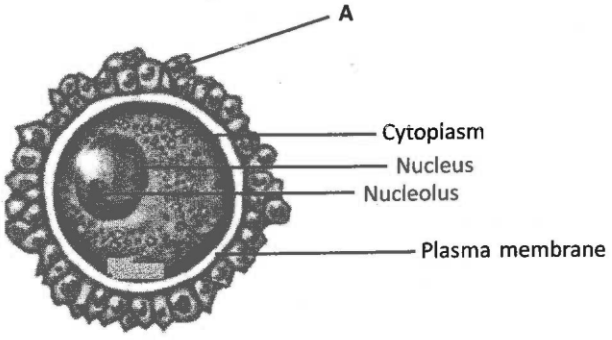
80. When the cells become variable in morphology and function in different regions of the embryo, the process is called

(a) differentiation (b) metamorphosis (c) organisation (d) rearrangement

81. Foetal ejection reflex in human female is induced by

(a) release of oxytocin from pituitary (b) fully developed foetus and placenta
(c) differentiation of mammary glands (d) pressure exerted by amniotic fluid

82. Which of the region is marked as A among the following options in the given diagram?



(a) Zona pellucida (b) Nucleus (c) Corona radiata (d) Vitelline membrane

83. Morula is the embryonic stage with

(a) 8–16 blastomeres (b) 2–4 blastomeres (c) 4–8 blastomeres (d) 1–4 blastomeres

84. Which one of the following is the most likely root cause for menstruation not taking place in regularly human females?

(a) Maintenance of the hypertrophical endometrium lining
(b) Maintenance of high concentration of sex hormones in the blood stream
(c) Retention of well developed corpus luteum
(d) Fertilisation of the ovum

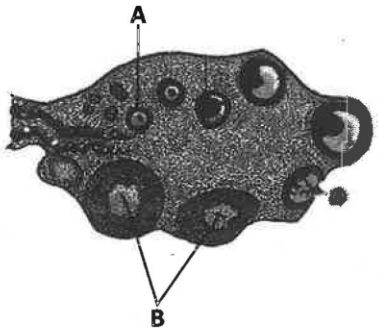
85. Which one of the following is not the function of placenta?

(a) Facilitates removal of carbon dioxide and waste material from embryo
(b) Secretes oxytocin during parturition
(c) Facilitates supply of oxygen and nutrients to embryo
(d) Secretes estrogen

86. Which of the following stimulates the growth of eggs in ovaries?

(a) Oxytocin (b) Vasopressin (c) Progesterone (d) FSH

87. The figure shows a section of the human ovary. Select the option which gives the correct identification of either A or B with function/characteristic.



(a) B- Corpus luteum secretes progesterone
(b) A- Tertiary follicle forms Graafian follicle
(c) B- Corpus luteum secretes estrogen
(d) A- Primary oocyte, in the prophase I of the meiotic division

88. In our society women are blamed for producing female children. Choose the correct answer for the sex determination in humans.

(a) Due to some defect like aspermia in man
(b) Due to the genetic make up of the particular sperm which fertilises the egg
(c) Due to the genetic make up of the egg
(d) Due to some defect in the women

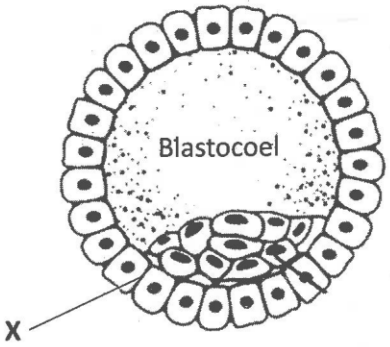
89. The foetal ejection reflex in humans triggers the release of

(a) oxytocin from foetal pituitary
(b) human chorionic gonadotropin (hCG) from placenta
(c) human placental lactogen (hPL) from placenta
(d) oxytocin from maternal pituitary

90. Which one of the following statements is false in respect of viability of mammalian sperm?

(a) Sperm is viable for only up to 24 hours.
(b) Survival of sperm depends on the pH of the medium and is more active in alkaline medium.
(c) Viability of sperm is determined by its motility.
(d) Sperms must be concentrated in a thick suspension.

91. Identify the marked part X in the given diagram :



(a) inner cell mass (b) antrum (c) trophoblast (d) blastocoel

92. Signals for parturition originate from

(a) both placenta as well as fully developed foetus (b) oxytocin released from maternal pituitary
(c) placenta only (d) fully developed foetus only

93. Hysterectomy is surgical removal of

(a) vas deferens (b) mammary glands (c) uterus (d) prostate gland

94. Which of these is not an important component of initiation of parturition in humans?

(a) Release of oxytocin (b) Release of prolactin
(c) Increase in estrogen and progesterone ratio (d) Synthesis of prostaglandins

95. The shared terminal duct of the reproductive and urinary system in the human male is

(a) urethra (b) ureter (c) vas deferens (d) vasa efferentia

96. The main function of mammalian corpus luteum is to produce

(a) estrogen only (b) progesterone
(c) human chorionic gonadotropin (d) relaxin only

97. Select the correct option describing gonadotropin activity in a normal pregnant female.

(a) High level of FSH and LH stimulates the thickening of endometrium.
(b) High level of FSH and LH facilitates implantation of the embryo.
(c) High level of hCG stimulates the synthesis of estrogen and progestogens.
(d) High level of hCG stimulates the thickening of endometrium.

INPUT-TEXT BASED QUESTIONS

Read the following paragraphs and answer the following questions.

I. In testis, the immature male germ cells (spermatogonia) produce sperms by spermatogenesis that begins at puberty. They are present on the inside wall of seminiferous tubules multiply by mitotic division and increase in numbers. Each spermatogonium is diploid and contains 46 chromosomes. Some of the spermatogonia called primary spermatocytes periodically undergo meiosis. A primary spermatocyte completes the first meiotic division (reduction division) leading to formation of two equal, haploid cells called secondary spermatocytes, which have only 23 chromosomes each.

1. The secondary spermatocytes undergo the second meiotic division to produce four equal, haploid cells. They are called

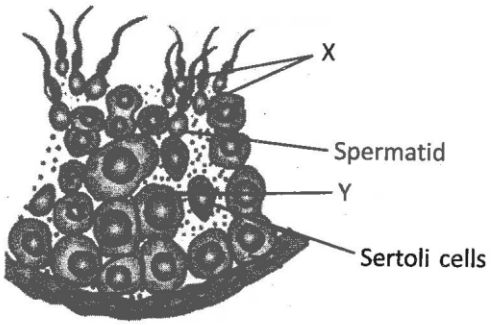
(a) Spermatogonium (b) Sertoli cells (c) Spermatids (d) Spermatogonia

2. Which of the following is/are part of testis? Choose the correct option.

(i) Sertoli cells (ii) Seminiferous tubule
(iii) Seminal vesicle (iv) Epididymis

(a) (i) and (iv) (b) (ii) and (iv) (c) (i) and (ii) (d) (i) and (iii)

3. Look at the diagram of spermatogenesis in seminiferous tubule.



X and Y in the diagram are
(a) Secondary spermatocytes and primary spermatocytes respectively
(b) sperms and secondary spermatocytes respectively
(c) sperms and primary spermatocytes respectively
(d) sperms and leydig cells respectively

4. Two types of cells are found in each seminiferous tubules. They are
(a) Sertoli cells and leydig cells (b) Spermatogonia and sertoli cells
(c) Leydig cells and interstitial cells (d) Spermatogonia and leydig cells

5. Which of the following is/are true from the following?
(i) Primary spermatocytes are diploid in number.
(ii) Secondary spermatocytes have 46 chromosomes.
(iii) Secondary spermatocytes are produced by mitotic divisions.
(iv) Spermatids are transformed into sperms by spermiogenesis.
(a) (i) and (iv) (b) (ii) and (iv) (c) (i) and (ii) (d) (ii) and (iii)

II. The reproductive cycle in the female primates is called menstrual cycle. The first menstruation begins at puberty and is called menarche. In human females, menstruation is repeated at an average interval of about 28/29 days, and the cycle of events starting from one menstruation till the next one is called the menstrual cycle. One ovum is released (ovulation) during the middle of each menstruation cycle.

1. Ovulation occurs on which day of menstrual cycle?
(a) 7th day (b) 10th day (c) 14th day (d) 28th day

2. In follicular phase, the secretion of two horomes gradually increases and stimulates the follicular development alongwith secretion of estrogens. The two hormones are
(a) GH and TSH (b) TSH and FSH (c) LH and FSH (d) LH and GH

3. Which of the following statements is/are true? Choose the correct option.
(i) Rupture of Graafian follicle occurs during luteal phase of the cycle.
(ii) Lack of menstruation may be indicative of pregnancy.
(iii) In the absence of fertilisation, the corpus luteum degenerates.
(iv) Menstrual phase is followed by follicular phase.
(a) (i), (ii) and (iv) (b) (ii), (iii) and (iv) (c) (i), (ii) and (iii) (d) (i), (ii), (iii) and (iv)

4. Large amount of progesterone is secreted during
(a) Follicular phase (b) Menstrual phase (c) Luteal phase (d) All of these

5. Which of the following is/are true?
(i) The estrogen level is high during ovulation phase.
(ii) Rupture of Graafian follicles indicates the release of ovum.
(iii) The corpus luteum secretes large amounts of estrogen.
(iv) In case of fertilisation, the corpus luteum degenerates.
(a) (i) and (iv) (b) (ii) and (iv) (c) (i) and (ii) (d) (ii) and (iii)

III. The menstrual cycle starts with the menstrual phase, when menstrual flow occurs and it lasts for 3-5 days. The menstrual flow results due to breakdown of endometrial lining of the uterus and its blood vessels which forms liquid that comes out through vagina. Menstruation only occurs if the released ovum is not fertilised. Lack of menstruation may be indicative of pregnancy. However, it may also be caused due to some other underlying causes like stress, poor health etc. The menstrual phase is followed by the follicular phase. During this phase, the primary follicles in the ovary grow to become a fully mature Graafian follicle and simultaneously the endometrium of uterus regenerates through proliferation. These changes in the ovary and the uterus are induced by changes in the levels of pituitary and ovarian hormones. The secretion of gonadotropins (LH and FSH) increases gradually during the follicular phase, and stimulates follicular development as well as secretion of estrogens by the growing follicles.

1. The breaking of endometrium is a characteristic of
   (a) proliferatery phase (b) ovulatory phase (c) luteal phase (d) menstrual phase
2. Which hormone attains the peak level during the ovulatory phase?
   (a) FSH (b) Progesterone (c) LH (d) Both (a) and (c)
3. Withdrawal of which hormone results into degeneration of corpus luteum?
   (a) FSH (b) Progesterone (c) LH (d) Estrogen
4. Which days in the menstrual cycle marks the proliferative phase?
   (a) 1-5 (b) 6-13 (c) 10-14 (d) 15-28

ANSWERS

1. (c)	**2.** (a)	**3.** (d)	**4.** (a)	**5.** (a)	**6.** (a)	**7.** (a)	**8.** (a)	**9.** (b)	**10.** (d)
11. (a)	**12.** (d)	**13.** (d)	**14.** (b)	**15.** (a)	**16.** (c)	**17.** (c)	**18.** (a)	**19.** (b)	**20.** (b)
21. (c)	**22.** (b)	**23.** (d)	**24.** (a)	**25.** (d)	**26.** (c)	**27.** (b)	**28.** (b)	**29.** (c)	**30.** (a)
31. (c)	**32.** (d)	**33.** (a)	**34.** (d)	**35.** (b)	**36.** (d)	**37.** (b)	**38.** (b)	**39.** (c)	**40.** (c)
41. (a)	**42.** (a)	**43.** (b)	**44.** (a)	**45.** (a)	**46.** (c)	**47.** (b)	**48.** (a)	**49.** (b)	**50.** (d)
51. (c)	**52.** (b)	**53.** (a)	**54.** (a)	**55.** (d)	**56.** (b)	**57.** (d)	**58.** (a)	**59.** (b)	**60.** (b)
61. (d)	**62.** (d)	**63.** (b)	**64.** (a)	**65.** (b)	**66.** (a)	**67.** (a)	**68.** (b)	**69.** (c)	**70.** (a)
71. (b)	**72.** (a)	**73.** (b)	**74.** (d)	**75.** (a)	**76.** (b)	**77.** (c)	**78.** (b)	**79.** (c)	**80.** (a)
81. (b)	**82.** (c)	**83.** (a)	**84.** (b)	**85.** (b)	**86.** (d)	**87.** (a)	**88.** (b)	**89.** (d)	**90.** (a)
91. (c)	**92.** (a)	**93.** (c)	**94.** (b)	**95.** (a)	**96.** (b)	**97.** (c)			

EXPLANATION

1. Fertilizin is a chemical substance that is secreted by the mature egg. It helps in binding sperm to the ovum.

9. Telolecithal is defined as the uneven distribution of yolk in the cytoplasm of ovums found in birds, reptiles, fishes. The yolk is concentrated at one pole of the egg separated from the developing embryo.

12. Inhibin is the chemical substance synthesised and secreted by granulosa cells and specifically inhibits FSH synthesis.

23. Ectopic pregnancy occurs when a fertilised egg grows outside a woman's uterus, somewhere else in her belly. *For example–* the egg implants in a fallopian tube.

59. Grey crescent is the area in the fertilised egg just opposite to the site of entry of sperm into ovum. It marks the future dorsal side of the embryo.

Input-Text Based Answers

I.	**1.** (c)	**2.** (c)	**3.** (c)	**4.** (b)	**5.** (a)
II.	**1.** (c)	**2.** (c)	**3.** (b)	**4.** (d)	**5.** (c)
III.	**1.** (d)	**2.** (c)	**3.** (c)	**4.** (b)	