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Human Reproduction

Fastrack Revision

- ▶ Human beings are sexually reproducing organisms and are viviparous.
- ▶ Sexual reproduction in humans gives rise to offsprings of their own type.
- ▶ The events of sexual reproduction in human beings are:
 - ▶ **Gametogenesis:** The process of formation of gametes is called as gametogenesis.
 - ▶ **Insemination:** The process of transfer of sperms into the ovum is called insemination.
 - ▶ **Fertilisation:** The process of fusion of male and female gamete to form a single-celled zygote is called fertilisation.
 - ▶ **Implantation:** The process of attachment of embryo to the endometrial wall of uterus of female is called implantation.
 - ▶ **Gestation:** The period of embryonic development is called gestation, also referred as pregnancy.
 - ▶ **Parturition:** The process of delivery of the baby is called parturition.

▶ Male Reproductive System

Male reproductive system is located in the pelvis region. It consists of a pair of **testes**, **accessory ducts**, **glands**, **external genitalia**.

▶ Testes

- Smooth organ situated outside the abdominal cavity within a pouch called **scrotum**.
- The scrotum helps in maintaining the low temperature of the testis that is 2-2.5°C which is below than the normal internal body temperature.

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Moving the testis away from the abdomen and increasing the exposed surface area allow a faster dispersion of excess heat. This is done by means of contraction and relaxation of the cremaster muscle and the dartos muscle in the scrotum.

- Each testis is 4-5 cm in length and 2-3 cm in width in adults.
- Each testis contains about 250 compartments called **testicular lobules**.
- Each testicular lobule contains one to three highly coiled **seminiferous tubules**, in which sperms are produced.
- The wall of each seminiferous tubule is lined by two types of cells called **male germ cells** (spermatogonia) and **Sertoli cells**.
- The male germ cells undergo meiosis leading to sperm formation and Sertoli cells provide nutrition to the germ cells.
- The regions outside the seminiferous tubules called interstitial spaces, contain small blood vessels and **interstitial cells** or **Leydig cells**.

- Leydig cells synthesise and secrete testicular hormones called androgens.

▶ Accessory Ducts

- The male accessory ducts include **rete testis**, **vasa efferentia**, **epididymis** and **vas deferens**.
- The seminiferous tubules of the testis open into the vasa efferentia through rete testis.
- The vasa efferentia leave the testis and open into epididymis located along the posterior surface of each testis.
- The epididymis leads to vas deferens that ascends to the abdomen and loops over the urinary bladder.
- Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.
- The urethra originates from the urinary bladder and extends through the penis to its external opening called **urethral meatus**.

▶ Accessory Glands

- The male accessory glands include paired **seminal vesicles**, **prostate gland** and paired **bulbourethral glands**.
- Accessory glands secrete seminal plasma which is rich in fructose, calcium and some enzymes.
- Secretion of bulbourethral gland also helps in lubricating the penis.

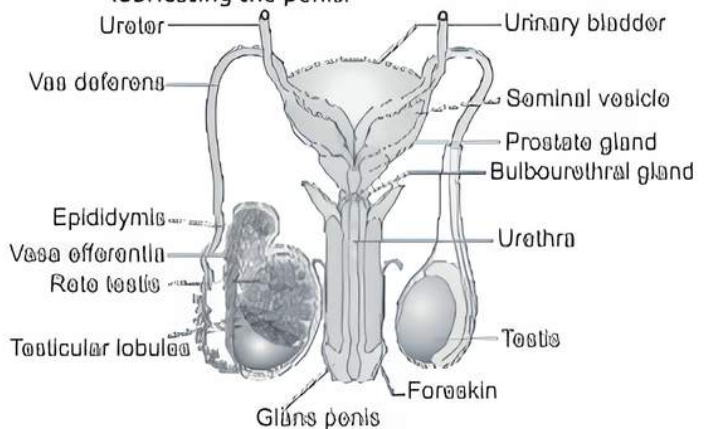


Fig. Male reproductive system

▶ External Genitalia

- The penis is the male external genitalia.
- Some special tissues make up the penis which helps in the erection of the penis.
- The enlarged end of penis is called the glans penis.
- **Foreskin**, a loose fold of tissue, covers the glans penis.

▶ Female Reproductive System

Female reproductive system is located in the pelvic region. It consists of a pair of **ovaries**, a pair of **oviducts**, **uterus**, **corvix**, **vagina** and the **external genitalia**. A pair of **mammary glands** is also integrated structurally

and functionally with the parts of female reproductive system to support the process of ovulation, fertilisation, gestation, parturition and care of the baby after birth. A pair of oviducts, uterus, cervix, vagina constitute the female accessory ducts.

► Ovaries

- The primary female sex organs that produce the ovum and several ovarian hormones, and are steroid in nature.
- They are located one on each side of the lower abdomen.
- Each ovary is covered by a thin epithelium which encloses the ovarian stroma.
- The ovarian stroma is divided into two zones – a peripheral cortex and an inner medulla.

► Oviduct (Fallopian tube)

- Each Fallopian tube is about 10-12 cm in length.
- It extends from the periphery of each ovary to the uterus.
- Part closer to the ovary is funnel-shaped.
- **Fimbriae** are the finger-like projections located on the edges of the **infundibulum**.
- Fimbriae help in collection of the ovum after ovulation.
- The infundibulum leads to the **ampulla** which is the wider part of the oviduct.
- The last part of the oviduct is **isthmus** which has a narrow lumen and it joins the uterus.

► Uterus

- Uterus is also called **womb**.
- The shape of the uterus is like an inverted pear.
- Ligaments attached to the pelvic wall support the uterus.
- The narrow cervix opens the uterus into the vagina.
- **Cervical canal** is the cavity of the cervix which forms birth canal along with vagina.
- Three layers of tissues are present in the uterus wall- the outer thin membrane bound **perimetrium**, middle thick layer of smooth muscle called **myometrium** and inner glandular layer called **endometrium**.
- Endometrium lines the uterine cavity.
- During menstrual cycle, endometrium undergoes cyclical changes but the myometrium exhibits strong contraction during parturition (delivery of the baby).

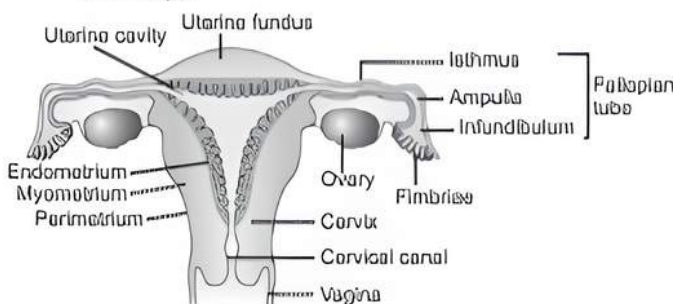


Fig. Female reproductive system

► External Genitalia

- Vagina is the female external genitalia.
- Vagina includes **mons pubis**, **labia majora** (labia majus), **labia minora** (labia minus), **hymen** and **clitoris**.

- Mons pubis is a cushion of fatty tissue covered by skin and pubic hair.
- The labia majora are fleshy folds of tissue which extend down from the mons pubis and surround the vaginal opening.
- Under the labia majora, there are paired tissues folded to form labia minora.
- Hymen is membrane covering the opening of the vagina partially.
- A tiny finger-like structure which lies at the upper junction of the two labia minora above the urethral opening is called **clitoris**.

► Mammary Glands

- These are paired structures containing glandular tissues and fats where the amount of fat varies from person to person.
- The glandular tissue of each breast is divided into 15-20 mammary lobes containing clusters of cells called **alveoli**.
- The cells of alveoli secrete milk, which is stored in the cavities called as **lumens** of alveoli.
- The alveoli open into mammary tubules and the tubules of each lobe join to form a **mammary duct** which further joins to form a wider mammary ampulla.
- Mammary ampulla is connected to **lactiferous duct** through which milk is sucked out.

► Gametogenesis

The process of formation of gametes in primary sex organs is called gametogenesis.

► Gametogenesis includes:

- Spermatogenesis and spermiogenesis in males.
- Oogenesis in females.

► The process of formation of sperms is called spermatogenesis.

► The conversion of spermatids into sperms is called spermiogenesis.

► The process of formation of a mature female gamete is called oogenesis.

► Spermatogenesis

The process of formation of sperms is called spermatogenesis. It involves three phases: multiplication phase, growth phase, maturation phase.

► In multiplication phase, male germ cells also called as **spermatogonia** undergo mitotic divisions to form large number of spermatogonia.

► In growth phase, spermatogonia increase their size by accumulation of nutrition in the cytoplasm and are ready for meiotic division. These spermatogonia are called as **primary spermatocytes** with 46 chromosomes.

► In maturation phase, a primary spermatocyte completes the first meiotic division leading to the formation of two equal, haploid cells called **secondary spermatocytes**, which have only 23 chromosomes each and the secondary spermatocytes undergo the second meiotic division to produce four equal, haploid **spermatids**.

► Spermiogenesis

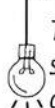
► The spermatids are transformed into sperms, also called as spermatozoa, by the process called spermiogenesis.

- After spermiogenesis, sperm heads become embedded in the **Sertoli cells** and are released from the seminiferous tubules by the process called **spermiation**.

► Hormonal Control of Spermatogenesis

- Spermatogenesis starts at the age of puberty due to significant increase in the secretion of Gonadotropin Releasing Hormone (GnRH) from hypothalamus.
- The increased level of gonadotropin releasing hormone stimulates the anterior pituitary to secrete Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH).
- LH acts at the Leydig cells and stimulates synthesis and secretion of androgens.
- Androgens stimulate the process of spermatogenesis.
- FSH acts on the Sertoli cells and secrete two factors: **Androgen Binding Protein (ABP)** and **Inhibin** which helps in spermiogenesis.

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 The mature ovum or egg or secondary oocyte is spherical in shape, contains nucleus and is the largest cell in the body.

► Structure of a Sperm

- It is a microscopic, motile structure composed of a head, neck, a middle piece and a tail.
- Whole body of sperm is covered by plasma membrane.
- The sperm head contains an elongated haploid nucleus and the anterior portion is covered by a cap-like structure called **acrosome**.
- The middle piece contains numerous mitochondria which produce energy for sperm motility needed for fertilisation.
- Tail helps the sperm cell to swim to reach the egg cell.
- Seminal plasma along with sperm constitutes the **semen**.

► Oogenesis

The process of formation of a mature female gamete is called oogenesis.

- Some of the germinal epithelial cells divide by mitosis to produce a large number of gamete mother cells or **oogonia**.
- Oogonia multiply by mitosis and form **primary oocytes**.

► Growth Phase

- Each primary oocyte then gets surrounded by a layer of granulosa cells and is called as **primary follicle**.
- The primary oocytes enlarge and mature by obtaining food from follicle cells.
- The primary follicles get surrounded by more layers of granulosa cells and a new theca and are called as **secondary follicles**.
- The secondary follicle soon transforms into a tertiary follicle which is characterised by a fluid filled cavity called **antrum**.
- The theca layer is organised into an inner theca interna and an outer theca externa.
- The primary oocyte within the tertiary follicle grows in size and completes its first meiotic division which is an unequal division and forms a large haploid **secondary oocyte** and tiny first polar body.
- The tertiary follicle changes into the mature follicle or **Graafian follicle**.

- The secondary oocyte forms a new membrane called **zona pellucida**.
- The Graafian follicle then ruptures to release the secondary oocyte from the ovary by the process called **ovulation**.
- If a sperm can enter the secondary oocyte through zona pellucida layer, the secondary oocyte completes meiosis II and thus results in the formation of second polar body and an ovum.

► Menstrual Cycle

The reproductive cycle, starting from one menstruation till the next one, in the female primates is called menstrual cycle. The first menstruation, which begins at puberty, is called **menarche**. The cycle is repeated at an interval of 28-29 days. Menstrual cycle involves three phases: **menstrual phase, follicular phase and luteal phase**.

► Menstrual Phase

- Menstrual flow occurs and lasts for about 3-5 days.
- The endometrial lining of the uterus breaks along with the blood vessels which forms a red fluid and results in menstrual flow.
- If the ovum is fertilised by a sperm, menstrual flow does not occur and hence indicates pregnancy.

► Follicular Phase

- In this phase, the primary follicles in the ovary grow to become a fully matured Graafian follicle.
- Endometrium of uterus regenerates through proliferation.
- Changes in pituitary hormone and ovarian hormones induce the formation of Graafian follicle and regeneration of endometrium.
- The secretion of gonadotropins like Luteinizing hormone and follicular stimulating hormone increases gradually during this phase and stimulates follicular development as well as secretion of estrogens by the growing follicles.
- Both LH and FSH attain a peak level in the middle of cycle i.e. about 14th day.
- Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum known as **ovulation**.

► Luteal Phase

- In this phase, the ruptured part of Graafian follicle transforms into yellow body called **corpus luteum**.
- The corpus luteum secretes large amount of progesterone hormone which maintains the endometrium for implantation of the fertilised ovum.
- During pregnancy, all events of the menstrual cycle stop and there is no menstruation.
- In the absence of fertilisation, the corpus luteum degenerates and hence causes disintegration of the endometrium leading to menstruation and a new cycle begins.
- In human beings, menstrual cycles cease around 50 years of age and is known as **menopause**.

► Fertilisation

- The fusion of haploid male gamete, sperm and haploid female gamete, ovum is called fertilisation.
- During copulation (coitus), sperm is released by male partner into the vagina of the female partner which is called as **insemination**.

- The motile sperms swim and pass the cervix to enter into the uterus and finally to reach the ovum released by the ovary in the ampulla-isthmic junction of the Fallopian tube.

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According to fertilisation theory proposed by F.R. Lillie, an ovum secretes a chemical called fertilizin and sperms have protein substance on their surface called antifertilizin. The fertilizin of egg interacts with antifertilizin of sperm of same species, making sperms stick to the egg's surface.

- Fertilisation takes place in the ampulla-isthmic junction.
 - All copulations do not lead to fertilisation because fertilisation can only occur if the ovum and sperms are transported simultaneously to the ampulla-isthmic junction.
 - The sperm, after reaching the ovary in the ampulla-isthmic junction, comes in contact with the zona-pellucida layer of the ovum and block the entry of the additional sperms. Thus, only one sperm fertilises the ovum.
 - The secretions of acrosome help the sperm to enter into the ovum through zona pellucida and the plasma membrane. Thus, secondary oocyte completes meiosis II and results in the formation of a second polar body and haploid ovum (ootid).
 - The haploid nucleus of the sperm and ovum fuse together to form a diploid zygote which develops into new individual.
- **Sex Determination in Humans**
 - Male has two sex chromosomes—X and Y, hence male produces 50% of sperms carrying X and 50% carrying Y, while female has two X—chromosomes.
 - After fusion of the male and female gametes, the zygote would carry either XX or XY depending on whether the sperm carrying X or Y fertilised the ovum.
 - The zygote carrying XX would develop into a female baby and that carrying XY would form a male.
- **Cleavage**
 - Cleavage is the mitotic division which starts as the zygote moves through the isthmus of the oviduct towards the uterus and forms 2, 4, 8, 16 daughter cells called as **blastomeres**.
 - The embryo with 8 to 16 blastomeres is called a **morula**.
 - The morula divides further as it moves further into the uterus and transforms into blastocyst.
 - The blastomeres in the blastocyst are arranged into an outer layer called **trophoblast** and inner mass of cells attached to trophoblast is called as **inner cell mass**.
 - The trophoblast layer then gets attached to the endometrium of the uterus and the inner cell mass divides to cover the blastocyst. Hence blastocyst becomes embedded in the endometrium of the uterus and the process is called as **implantation** which leads to pregnancy.
- **Pregnancy and Embryonic Development**
 - After implantation, finger-like projections appear on the trophoblast called as **chorionic villi**.
 - Uterine tissue and maternal blood surrounds the chorionic villi.
- The chorionic villi and uterine tissue together form a structural and functional organic structure between developing embryo and tissues of the mother called as **placenta**.
- **Functions of Placenta**
 - The placenta facilitates the supply of oxygen and nutrients to the embryo.
 - It helps in the removal of carbon dioxide and excretory/waste materials produced by the embryo.
 - The placenta is connected to the embryo through an umbilical cord which helps in the transport of substances to and from the embryo.
 - Placenta also acts as an endocrine tissue and produces several hormones like **human Chorionic Gonadotropin (hCG)**, **human Placental Lactogen (hPL)**, **estrogens**, **progestogens** etc.
 - A hormone called **relaxin** is secreted by the ovary in the later phase of pregnancy.
 - hCG, hPL and relaxin are produced in women only during pregnancy.
 - Levels of other hormones like estrogens, progestogens, cortisol, prolactin, thyroxine, etc. are increased several folds in the maternal blood.
 - Increased production of all the hormones is essential for supporting the fetal growth, metabolic changes in the mother and maintenance of pregnancy.
 - After implantation, the inner cell mass is differentiated into an outer layer called **ectoderm** and an inner layer called **endoderm** with a middle layer called **mesoderm**.
 - Three layers give rise to all organs in adults.
 - The cells which have the potency to give rise to any types of cells in the body are called **stem cells**.
 - The human pregnancy lasts for 9 months, heart develops after one month of pregnancy, limbs develop by the end of second month, and major organ systems are formed by the end of 3 months.
 - First movement and appearance of hair on the head are observed during 5th month of pregnancy.
 - By the end of 24 weeks, the body covers with fine hair, eye-lids separate and eyelashes are formed.
 - By the end of 9 months, the foetus fully develops and gets ready for delivery.
- **Parturition and Lactation**
 - The average duration of human pregnancy is about nine months called as the **gestation period**.
 - Vigorous contraction of the uterus at the end of pregnancy causes expulsion/delivery of the foetus called as **parturition**.
 - The signals for parturition originate from the fully developed foetus and the placenta which induces mild uterine contraction is called **foetal ejection reflex**.
 - Foetal ejection reflex releases oxytocin hormone from the pituitary gland of mother which acts on the uterine muscle and causes contraction of uterus which in turn stimulates further oxytocin secretion.
 - Production of milk at the end of pregnancy by the differentiation of mammary glands is called **lactation**.
 - The milk produced during the first few days of lactation is called **colostrum**.
 - Colostrum contains antibodies necessary to develop resistance against diseases for the new born baby.



Practice Exercise



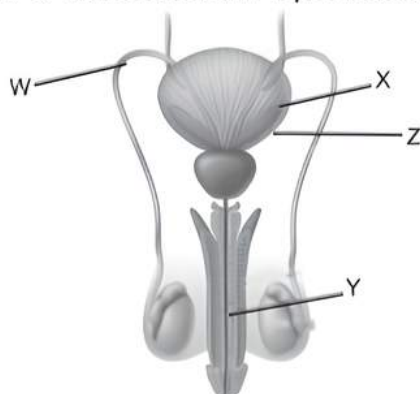
Multiple Choice Questions

Q 1. Leydig cell is found in:

- a. liver
- b. testis
- c. kidney
- d. Intestine

Q 2. The release of eggs from the ovary of human female is called:

Q 4. Given below is a diagrammatic view of the human male reproductive system.



Identify the correct labelling for W, X, Y and Z and choose the correct option from the table below:

	W	X	Y	Z
a.	Epididymis	Prostate gland	Glans penis	Bulbourethral gland
b.	Bulbourethral gland	Glans penis	Prostate gland	Epididymis
c.	Vas deferens	Seminal vesicle	Urethra	Prostate gland
d.	Rete testis	Bulbourethral gland	Epididymis	Glans penis

Q 5. Fertilisation takes place in human:

- a. In uterus
- b. In vagina
- c. In ovary
- d. In Fallopian tubes

Q 6. Which hormone is responsible for regulating ovulation?

- a. TSH
- b. ACTH
- c. ADH
- d. FSH and LH

Q 7. Gestation period in human female is:

- a. 30 days
- b. 90 days
- c. 9 months
- d. 7 months

Q 8. The cavity of blastula is:

- a. blastocoel
- b. coelome
- c. archentron
- d. homocoel

Q 9. An accessory genital gland of man is:

- a. prostate gland
- b. seminal gland
- c. Cowper's gland
- d. All of these

Q 10. The uterus is single and it is also called:

- a. fimbriae
- b. Isthmus
- c. ampulla
- d. womb

Q 11. The last part of the oviduct is called:

- a. Isthmus
- b. ampulla
- c. fimbriae
- d. infundibulum

- a. plantation
- c. ovulation

- b. gestation
- d. parturition

Q 3. Penetration of the sperm in the ovum is followed by:

(CBSE SQP 2021, Term-1)

- a. formation of first polar body
- b. completion of meiosis II
- c. first meiosis
- d. dissolution of zona pellucida

(CBSE 2021, Term-1)

Q 12. Figure A shows the front view of the human female reproductive system and Figure B shows the development of a fertilised human egg cell:

(CBSE SQP 2021, Term-1)

Figure A

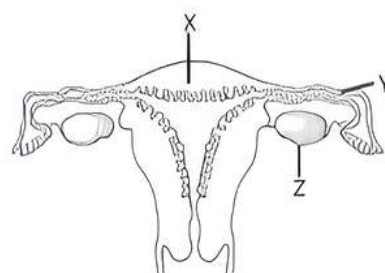
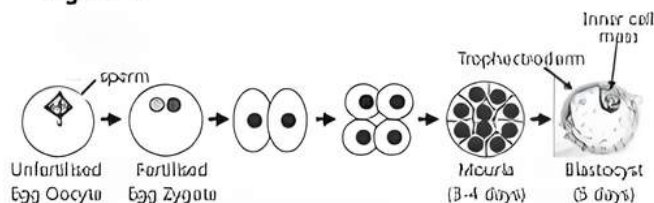


Figure B



Identify the correct stage of development of human embryo (Figure B) that takes place at the site X, Y and Z respectively in the human female reproductive system (Figure A).

Choose the correct option from the table below:

	X	Y	Z
a.	Morula	Fertilised egg	Blastocyst
b.	Unfertilised egg	Fertilised egg	Morula
c.	Blastocyst	Fertilised egg	Unfertilised egg
d.	Fertilised egg	Morula	Blastocyst

Q 13. Which of the following statements are correct with respect to hormones secreted by placenta?

(CBSE SQP 2021, Term-1)

- (i) Placenta secretes relaxin during later stage of pregnancy.
- (ii) Placenta secretes high amount of FSH during pregnancy.
- (iii) Placenta secretes relaxin during Initial stage of pregnancy.
- (iv) Placenta secretes hCG and hPL during pregnancy.

- a. (i) and (iv)
- b. (i), (ii) and (iv)
- c. (iii) and (iv)
- d. (ii), (iii) and (iv)

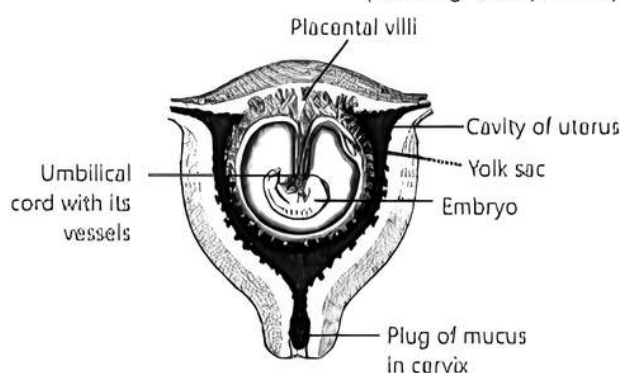
Q 14. The correct sequence of hormone secretion from beginning of menstruation is:

(CBSE SQP 2021, Term-1)

- a. FSH, progesterone, estrogen
- b. estrogen, FSH, progesterone
- c. FSH, estrogen, progesterone
- d. estrogen, progesterone, FSH

Q 15. Concentration of which of the following substances will decrease in the maternal blood as it flows from embryo to placenta through the umbilical cord?

(CBSE SQP 2021, Term-1)



The human foetus within the uterus

- (i) Oxygen
- (ii) Amino acids
- (iii) Carbon dioxide
- (iv) Urea
- a. (i) and (ii)
- b. (ii) and (iv)
- c. (iii) and (iv)
- d. (i) and (iv)

Q 16. During human embryonic development, the heart in the embryo is formed after:

(CBSE 2021, Term-1)

- a. 16 days of pregnancy
- b. 30 days of pregnancy
- c. 45 days of pregnancy
- d. 60 days of pregnancy

Q 17. The uterus opens into the vagina through a narrow:

(CBSE 2021, Term-1)

- a. Ampulla
- b. Isthmus
- c. Cervix
- d. Infundibulum

Q 18. Choose the correct option for the features of functional mammary gland of all female mammals from the statements below:

(CBSE 2021, Term-1)

- (i) Glandular tissue with variable amount of fat.
- (ii) Mammary lobes, 30-40 in number called alveoli.
- (iii) Mammary ducts joining to form mammary tubules.
- (iv) Mammary ampulla connected to lactiferous duct.

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

Q 19. Milk is sucked out from the:

- a. mammary lobes
- b. mammary glands
- c. mammary ducts
- d. lactiferous duct

Q 20. The glandular tissue of each breast is divided into 15-20:

- a. mammary ducts
- b. mammary glands
- c. mammary lobes
- d. None of these

Q 21. First menstrual cycle at the time of puberty is called:

- a. ovum
- b. sperm
- c. menses
- d. menarche

Q 22. Progesterone hormone is formed by:

- a. corpus callosum
- b. corpus uteral
- c. corpus luteum
- d. corpus albicans

Q 23. Which of the following options correctly matches the name of the hormone to its site of production in the human body?

(CBSE 2023)

Name of the Hormone	Site of Production
P. Oxytocin	(i) Placenta
Q. Relaxin	(ii) Corpus luteum
R. hCG	(iii) Pituitary gland
S. Progesterone	(iv) Ovaries
a. P-I, Q-III, R-II, S-IV	b. P-I, Q-IV, R-III, S-II
c. P-III, Q-IV, R-I, S-II	d. P-II, Q-III, R-I, S-IV



Assertion & Reason Type Questions

Directions (Q.Nos. 24-28): Each of the following questions consists of two statements, one is Assertion (A) and the other is Reason (R). Select the correct answer to these questions from the codes a, b, c and d as given below.

- a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
- b. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
- c. Assertion is true, but Reason is false.
- d. Assertion is false, but Reason is true.

Q 24. Assertion (A): Interstitial spaces outside the seminiferous tubule have blood vessels and Sertoli cells.

Reason (R): Sertoli cells provide nutrition to the germ cells. (CBSE 2021, Term-1)

Q 25. Assertion (A): Clitoris of female is homologous to tip of penis.

Reason (R): Both have same origin and richly supplied with nerves and blood vessels.

Q 26. Assertion (A): Corpus luteum secretes the female hormone progesterone.

Reason (R): After ovulation, a ruptured follicle turns into yellowish solid mass of cells called corpus albicans.

Q 27. Assertion (A): Corpus luteum contains blood clot and fibrin.

Reason (R): Corpus luteum is formed by the germinal epithelium.

Q 28. Assertion (A): Placenta acts as a major endocrine organ.

Reason (R): In mammals, fetal components of the placenta derive initially from the chondroblast.

Answers

1. (b) testis

Leydig cells are interstitial cells located adjacent to the seminiferous tubules in the testis. The best established function of Leydig cells is to produce the androgen, testosterone, under the control of luteinizing hormone.

2. (c) ovulation

3. (b) completion of meiosis II

The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. This induces the completion of the meiotic division of the secondary oocyte. Thus, penetration of the sperm in the ovum is followed by completion of meiosis II.

4. (c) W = Vas deferens, X = Seminal vesicle, Y = Urethra, Z = Prostate gland.

5. (d) in Fallopian tubes

6. (d) FSH and LH

Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH) are called gonadotropins because they stimulate the gonads in males, the testes and in females, the ovaries.

7. (c) 9 months

Gestation period is defined as the time during which a fetus develops. This time begins from fertilisation of the egg by the sperm and ends at childbirth. Gestation period varies from species to species. For humans, it is 270 days or 9 months and consists of 3 trimesters.

8. (a) blastocoel

9. (d) All of these

Male accessory glands in humans are the seminal vesicles, prostate gland and the Cowper's glands. The products of these glands serve following functions:

(i) Nourish and activate the spermatozoa.

(ii) Clear the urethral tract prior to ejaculation.

(iii) Serve as the vehicle of transport of the spermatozoa in the female tract.

10. (d) womb

11. (a) Isthmus

12. (c) X = Blastocyst, Y = Fertilised egg, Z = Unfertilised egg.

13. (a) (i) and (iv)

14. (c) FSH, estrogen, progesterone

15. (a) (i) and (ii)

16. (a) 16 days of pregnancy

At around 18 to 19 days after fertilisation, the heart begins to form. Early in the fourth week, around day 22 the developing heart starts to beat and to pump circulating blood. The heart begins to develop near the head of the embryo in the cardogenic area. Hence, the correct option is (a).

17. (c) Cervix

The uterus is a bag-like muscular secondary sex organ. The development of the foetus takes place in the uterus or the womb. The posterior end of the uterus is the cervix which opens into the vagina.

18. (c) (i) and (iv)

19. (d) lactiferous duct

20. (c) mammary lobes

21. (d) menarche

22. (c) corpus luteum

The corpus luteum in the ovaries is the major site of progesterone production in humans, progesterone is also produced in smaller quantities by the ovaries themselves, the adrenal glands and during pregnancy, the placenta.

23. (c) P-III, Q-IV, R-I, S-II.

24. (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

25. (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Homologous organs mean the two shared common developmental path. Clitoris of a female is homologous to the tip of a penis. The embryological precursor of both the organs is same i.e., urogenital folds. Both are formed with corpora cavernosa, both have a high blood supply and are rich in vascular and nerve tissues.

26. (c) Assertion is true, but Reason is false.

27. (c) Assertion is true, but Reason is false.

28. (c) Assertion is true, but Reason is false.



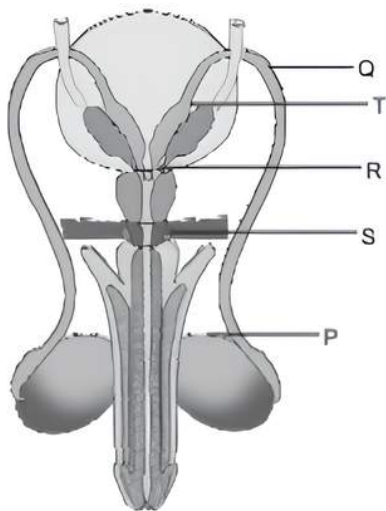
Case Study Based Questions

Case Study 1

Male Reproductive System

Human male reproductive system comprises of a pair of testes, primary sex organs associated with formation of gametes and production of sex hormone. Study the given figure of human male reproductive system and answer the following questions.





- Q 1. Which of the following is correct for labelled part P?**
- P is rete testis which transports sperms to outside.
 - P is epididymis which secretes fluid that nourishes the sperms.
 - P is epididymis that carries sperms and secretion of seminal vesicles.
 - P is rete testis which lies along inner side of each testis and stores the sperms.
- Q 2. Identify the correctly matched pair:**
- | | |
|----------------------|-----------------------|
| a. Q-Vasa efferentia | b. R-Ejaculatory duct |
| c. S-Seminal vesicle | d. T-Cowper's gland |
- Q 3. Which statement is incorrect for Q?**
- It carries spermatozoa from epididymis to ejaculatory duct.
 - Q is only 2 in number.
 - It arises from rete testis.
 - It constitutes male sex accessory duct.
- Q 4. Which structure passes through the prostate gland and carries sperms and secretion of seminal vesicle?**
- | | | | |
|------|------|------|------|
| a. P | b. T | c. S | d. R |
|------|------|------|------|
- Q 5. Assertion (A):** Mucus present in secretion of bulbourethral gland decreases the number of sperms damaged during ejaculation.
Reason (R): Mucus lubricates the end of penis and lining of the urethra.
- Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
 - Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
 - Assertion is true but Reason is false.
 - Assertion is false, but Reason is true.

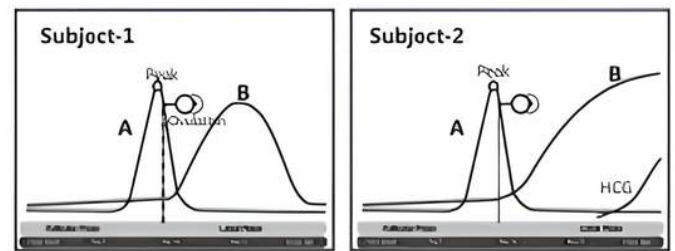
Answers

1. (b) 2. (b) 3. (c) 4. (d) 5. (a)

Case Study 2

Different Level of Hormones

To answer the questions, study the graphs below for subject 1 and 2 showing different levels of certain hormones.



(CBSE SQP 2021, Term-1)

- Q 1. The peak observed in subject-1 and 2 is due to:**
- estrogen
 - progesterone
 - Luteinizing hormone
 - follicle stimulating hormone
- Q 2. Subject-2 has higher level of hormone B, which is:**
- estrogen
 - progesterone
 - Luteinizing hormone
 - follicle stimulating hormone
- Q 3. If the peak of hormone A does not appear in the study for subject-1, which of the following statement is true?**
- Peak of hormone B will be observed at a higher point in the graph
 - Peak of hormone B will be observed at a point lower than what is given in the graph
 - There will be no observed data for hormone B
 - The graph for hormone B will be a sharp rise followed by a plateau
- Q 4. Which structure in the ovary will remain functional in subject-2?**
- | | |
|----------------------|----------------------|
| a. Corpus luteum | b. Tertiary follicle |
| c. Graafian follicle | d. Primary follicle |
- Q 5. For subject-2 it is observed that the peak for hormone B has reached the plateau stage. After approximately how much time will the curve for hormone B descend?**
- | | |
|-------------|-------------|
| a. 28 days | b. 42 days |
| c. 180 days | d. 280 days |
- Q 6. Which of the following statements is true about the subjects?**
- Subject-1 is pregnant
 - Subject-2 is pregnant
 - Both subject 1 and 2 are pregnant
 - Both subject 1 and 2 are not pregnant

Answers

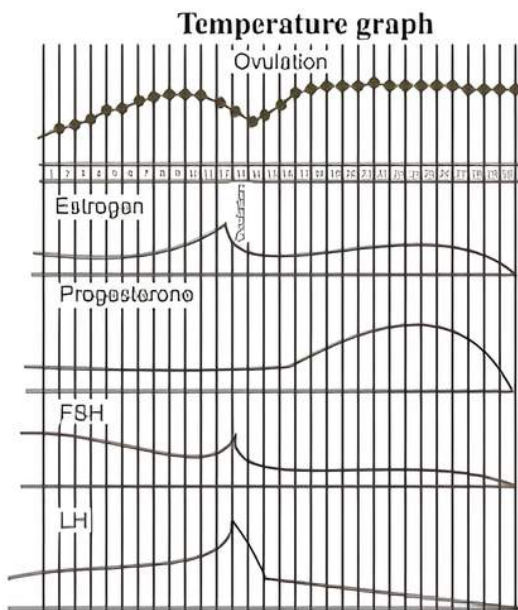
1. (c) 2. (b) 3. (c) 4. (a) 5. (d) 6. (b)

Case Study 3

Menstrual Cycle

A group of medical students carried out a detailed study on the impact of various factors on the different hormones during the menstrual cycle in a human female. They collected the data with different factors. Given below is the graph plotted from the data collected showing the morning temperature and concentration of hormones FSH, LH, estrogen and progesterone during normal menstrual cycle in a woman.

(CBSE 2021, Term-1)



Study the graph and answer the given questions.

- Q 1. The early morning recording of temperature in the graph during actual menstruation and during ovulation respectively are:
 - a. low, high
 - b. high, low
 - c. low, low
 - d. high, high
- Q 2. The time of ovulation is of importance in cases of:
 - (i) Couples having difficulty in conception.
 - (ii) To know the safe period for prevention of pregnancy,
 - (iii) To inhibit the process of ovulation.
 - (iv) To stimulate ovarian follicular development.
 - a. (i) and (iv)
 - b. (ii) and (iv)
 - c. (i) and (ii)
 - d. (iii) and (iv)
- Q 3. The increase in the level of progesterone is maximum under the influence of LH during:
 - a. secretory phase
 - b. follicular phase
 - c. menstruation
 - d. proliferative phase
- Q 4. Which of the following hormone/hormones is/are showing rapid surge leading to changes in Graafian follicle just before ovulation?
 - a. LH
 - b. FSH
 - c. FSH and estrogen
 - d. FSH and LH
- Q 5. The human corpus luteum starts regressing days after ovulation. (Identify the correct choice for the blanks).
 - a. 10 – 11
 - b. 14 – 15
 - c. 16 – 17
 - d. 18 – 20

Q 6. As per the data plotted in the graph, in which period of the menstrual cycle is the chance of fertilisation very high in human female?

- a. 3rd – 9th days
- b. 10th – 17th days
- c. 18th – 23th days
- d. 23rd – 28th days

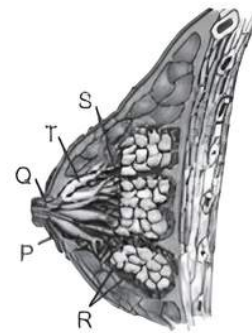
Answers

1. (c)
2. (c)
3. (a)
4. (d)
5. (b)
6. (b)

Case Study 4

Mammary Glands

A functional mammary gland is characteristic of all female mammals. Mammary glands are paired structures that contain glandular tissue and variable amount of fat. Refer to the given figure of a mammary gland and answer the following questions.



Read the given passage carefully and give the answers of the following questions:

Q 1. What do you mean by mammary gland?

Ans. A mammary gland is an exocrine gland in humans and other mammals that produces milk to feed young offspring.

Q 2. Mammary glands are modified form of which type of glands?

Ans. Mammary glands are modified sweat glands.

Q 3. Identify P, Q and S in the above figure.

Ans. P-Areola; Q- Lactiferous duct and S-Mammary duct.

OR

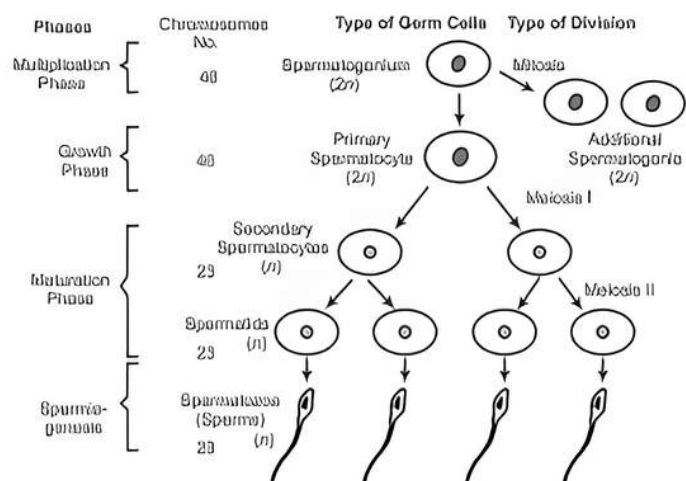
What is areola?

Ans. Circular pigmented area of skin around nipple is called areola.

Case Study 5

Spermatogenesis

In testis, the immature male germ cells produce sperms by spermatogenesis that begins at puberty. It occurs in the seminiferous tubules of the testes. Seminiferous tubules are lined by germinal epithelium. Study the schematic representation of spermatogenesis and answer the following questions.



Read the given passage carefully and give the answer of the following questions:

Q 1. Which cell division occurs during multiplication phase?

Ans. Mitosis occurs during multiplication phase.

Q 2. How many chromosomes are present in secondary spermatocyte and spermatid respectively?

Ans. 23 chromosomes are present in each of secondary spermatocyte and spermatid.

Q 3. What is the process of formation of flagellated spermatozoa from spermatids called?

Ans. The process of formation of flagellated spermatozoa from spermatids is called spermateliosis.

OR

Which hormone acts on spermatogonia to stimulate sperm production?

Ans. FSH acts on spermatogonia to stimulate sperm production.

Case Study 6

Oogenesis

Oogenesis is the process of formation of ovum in ovaries. It consists of three phases: multiplication, growth and maturation. Oogenesis is controlled by hormones GnRH, LH, FSH. GnRH secreted by the hypothalamus stimulates the anterior lobe of pituitary gland to secrete LH and FSH.

Read the given passage carefully and give the answer of the following questions:

Q 1. What is the function of hormone FSH?

Ans. Hormone FSH stimulates the growth of Graafian follicles.

Q 2. Which hormone induces the rupture of the mature Graafian follicle?

Ans. Lutalizing hormone induces the rupture of the mature Graafian follicle.

Q 3. Identify the functions of LH.

Ans. The functions of LH are:

- Release of secondary oocyte from Graafian follicle.
- Stimulates corpus luteum to secrete progesterone.

OR

Oogenesis is controlled by which hormones?

Ans. Oogenesis is controlled by hormones GnRH, LH and FSH.



Very Short Answer Type Questions

Q 1. Why are male testes located outside the abdominal cavity?

OR

Failure of testes to descend from abdominal cavity leads to sterility. Why?

Ans. The male testes are located in the scrotum outside the abdominal cavity as the scrotum provides low temperature than the normal body temperature required for spermatogenesis.



TIP

Do not be confused between high and low temperature. High temperature of abdomen kills the spermatogenic tissue of the testes, so no sperms are formed.

Q 2. How many sperms will be produced from 10 primary spermatocytes and how many eggs will be produced from 10 primary oocytes?

Ans. 40 sperms and 10 eggs.

Q 3. The spermatogonial cell has 46 chromosomes in human male. Give the number of chromosomes in (i) Primary spermatocyte (ii) Spermatid.

Ans. (i) 46 in primary spermatocyte
(ii) 23 in spermatid.

Q 4. What is semen?

Ans. The seminal plasma along with the sperms constitute the semen.

Q 5. Name the substance present in the sperm acrosome and which help in sperms entry into egg?

Ans. Acrosome contains enzymes e.g. hyaluronidase that helps in dissolving membrane of ovum.

Q 6. Where is acrosome present in humans? Write its function.

Ans. Acrosome is present in the anterior portion of the head of human sperm. It possesses hydrolytic enzyme or sperm lysins that helps in penetration of sperm into egg during fertilisation.

Q 7. In ovary which structure transforms as corpus luteum and name the hormone secreted by corpus luteum?

Ans. Follicular cells of empty Graafian follicle transforms as corpus luteum and corpus luteum secretes hormone, progesterone.

Q 8. "Each and every coitus does not result in fertilisation and pregnancy". Justify the statement.

OR

Where does fertilisation normally takes place in a human female?

Ans. Ovum and sperm should reach simultaneously to the ampulla (Fallopian tube) where fertilisation takes place.



COMMON ERROR

As fertilisation takes place in oviduct at ampulla part, do not write ampullary - Isthmic junction.

Q 9. Define parturition.

Ans. The vigorous contraction of the uterus that results into the delivery of the child at the end of pregnancy is called parturition.

Q 10. State from where the signals for parturition originate in human females. (CBSE 2019)

OR

What stimulates pituitary to release the hormone responsible for parturition? Name the hormone.

Ans. Foetal ejection reflex generated by fully developed foetus and placenta stimulates pituitary to release the hormone, oxytocin responsible for parturition.



TIP

Do not be confused between the hormones. Oxytocin is also known as love hormone because due to this hormone, there is a strong connection between newborn baby and mother.

Q 11. Name the layer of cells that forms the outer wall of blastocyst.

Ans. Trophoblast forms the outer wall of blastocyst.

Q 12. At what stage is the mammalian embryo implanted in uterus?

Ans. Mammalian embryo is implanted in uterus at blastocyst stage.

Q 13. Despite the presence of so many sperms in the vicinity of an egg cell, only one sperm enters the ovum. Why?

Ans. This is because when a sperm comes in contact with ovum (zona pellucida) it induces changes in membrane to block entry of other sperms.

Q 14. Mention the function of trophoblast in human embryo.

Ans. Trophoblast is the outer layer of blastocyst which helps in the attachment of blastocyst to the endometrium of the uterus.

Q 15. How many polar bodies are given out in production of one egg during oogenesis?

Ans. Two polar bodies are given out in production of one egg during oogenesis.



Short Answer Type Questions

Q 1. Write the location and functions of the following in human testes:

- (i) Sertoli cells (ii) Leydig cells

Ans. (i) Sertoli cells

Location: Lines inside the seminiferous tubules.

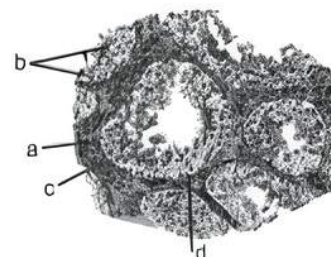
Functions: Provide nutrition to the germ cells sperms.

(ii) Leydig cells

Location: Outside seminiferous tubules in interstitial

Functions: Synthesise or secrete male hormones or androgens.

Q 2. Study the sectional view of human testis showing seminiferous tubules given below. Answer the questions that follow:



(i) Identify a, b and c.

(ii) Write the functions of a and d.

Ans. (i) a-Spermatogonia b-Interstitial cells c-Spermatozoa
Functions:

(ii) a: The spermatogonia or male germ cells undergo meiotic divisions leading to sperm formation.

d: Sertoli cells provide nutrition to the germ cells.

COMMON ERROR

Do not be confused in labelling of parts of human testis so practice making diagrams with correct parts as well as their functions.

Q 3. Write the function of each of the following:

(i) Middle piece in human sperm.

(ii) Luteinizing hormone in human males.

Ans. (i) Middle piece in human sperm provides energy for movement.

(ii) LH in human males stimulates synthesis and secretion of androgens or male hormones for spermatogenesis.

Q 4. Write the function of each of the following:

(i) Seminal vesicle.

(ii) Acrosome of human sperm.

Ans. (i) Seminal vesicle is responsible for storage and transport of sperms. It provides secretions for motility and nourishment of sperms.

(ii) Acrosome helps the sperm to enter into the cytoplasm of the ovum through the zona pellucida and provides enzymes for fertilisation.

Q 5. Spermatogenesis in human males is a hormone regulated process. Justify.

OR

Explain the process of hormonal regulation of spermatogenesis. (CBSE SQP 2023-24)

Ans. Hormonal control of spermatogenesis:

(i) Spermatogenesis is initiated at the age of puberty by the Gonadotropin Releasing Hormone (GnRH) secreted by the hypothalamus.

- (ii) The increased levels of GnRH stimulate the anterior pituitary which then secretes the FSH (Follicle Stimulating Hormone) and LH (Luteinizing Hormone). FSH stimulates Sertoli cells to secrete some factors which help in spermatogenesis.
- (iii) LH acts on the Leydig cells and causes the secretion of testosterone from the testes.

Q 6. List four different human male accessory ducts.

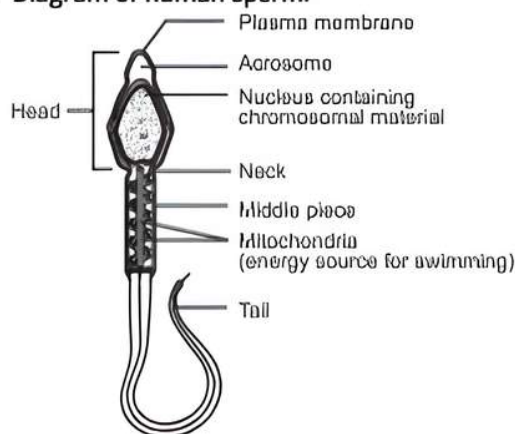
(CBSE 2020)

Ans. Different male accessory ducts are:

- (i) Vasa efferentia (ii) Epididymis
(iii) Vas deferens (iv) Rete testis

Q 7. Draw a labelled diagram of human sperm.

Ans. Diagram of human sperm:



Tip

Practice making diagrams with proper labelling.

Q 8. List the three hormones produced in women only during pregnancy. What happens to the level of estrogen and progesterone during pregnancy?

(CBSE 2020)

Ans. The hormones produced in women only during pregnancy are:

- (i) Human chorionic gonadotropin
(ii) Relaxin
(iii) Human placental lactogen

The levels of estrogen and progesterone during pregnancy increases.

Q 9. Mention the relationship between concentration of Luteinizing hormone and maintenance of endometrium in the human uterus. (CBSE 2017)

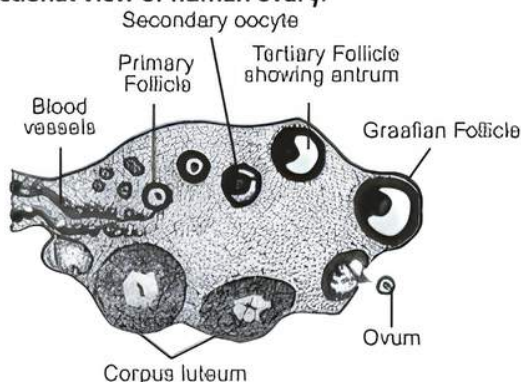
Ans. The relationship can be described as:

- (i) When Luteinizing hormone reaches its peak level, there is ture of Graafian follicle and ovulation.
- (ii) Corpus luteum is formed from the ruptured Graafian follicle and it secretes large quantity of progesterone.
- (iii) Progesterone is necessary to maintain the endometrium.
- (iv) When the level of Luteinizing hormone decreases, the corpus luteum starts degenerating in the absence of progesterone, and endometrium cannot be maintained.

Q 10. Draw a sectional view of human ovary and label the following parts:

- (i) Primary follicle (ii) Graafian follicle
(iii) Corpus luteum (iv) Secondary oocyte

Ans. Sectional view of human ovary:

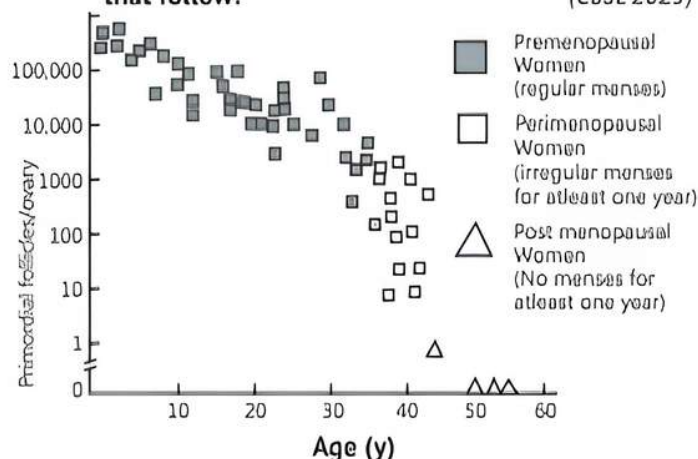


Q 11. Differentiate between menarche and menopause.

Ans. Menarche is the beginning of menstrual cycle at puberty. It starts at the age of 13-15 years.

Menopause is the cessation of menstrual cycle. It happens around 50 years of age.

Q 12. The graph given below shows the number of primordial follicles per ovary in women at different ages. Study the graph and answer the questions that follow: (CBSE 2023)



(i) What is the average age of the women at the onset of menopause?

(ii) At what age are maximum primordial follicles present in the ovary, according to the given graph?

Ans. (i) 50 years. (ii) 10 years.

Q 13. Name the hormones influencing

(i) Ovulation, (ii) Development of corpus luteum.

Ans. (i) Ovulation: Gonadotropins like Luteinizing hormone and follicular stimulating hormone and estrogen.

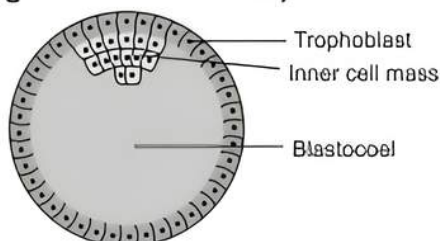
(ii) Development of corpus luteum: Luteinizing hormone and progesterone.

Q 14. Placenta acts as an endocrine tissue. Justify.

Ans. Placenta produces several hormones like human Chorionic Gonadotropin (hCG), human Placental Lactogen (hPL), estrogens, progesterones that are essential to maintain pregnancy. This way placenta acts as an endocrine tissue.

Q 15. Draw a labelled diagram of a human blastocyst. How does it get implanted in the uterus?

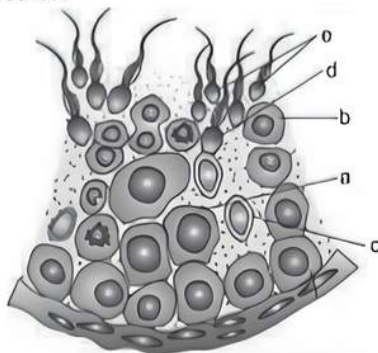
Ans. Diagram of human blastocyst:



The trophoblast layer of the blastocyst gets attached to the cells of the endometrium and the inner cell mass gives rise to the embryo. The cells of endometrium divide rapidly and cover the blastocyst. So, the blastocyst gets embedded in the endometrium of the uterus.

Long Answer Type-I Questions

Q 1. Given below is a diagrammatic sectional view of a seminiferous tubule. State the developmental process of: (CBSE 2023)

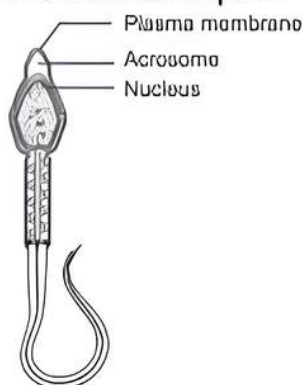


(A) (i) 'b' from 'a' (ii) 'e' from 'd' (iii) 'd' from 'b'.
(B) Identify 'a', 'b' and 'c'.

Ans. A. (i) Meiosis I
(ii) Spermiogenesis
(iii) Spermatidogenesis
B. (a) Primary spermatocyte
(b) Secondary spermatocyte
(c) Sertoli cell

Q 2. Draw labelled diagram of a mature human sperm. Label any three parts and write their functions. (CBSE 2018)

Ans. Diagram of a mature human sperm:



Plasma membrane: It is an envelope of the sperm.

Acrosome: It is filled with enzyme that helps in fertilisation of ovum.

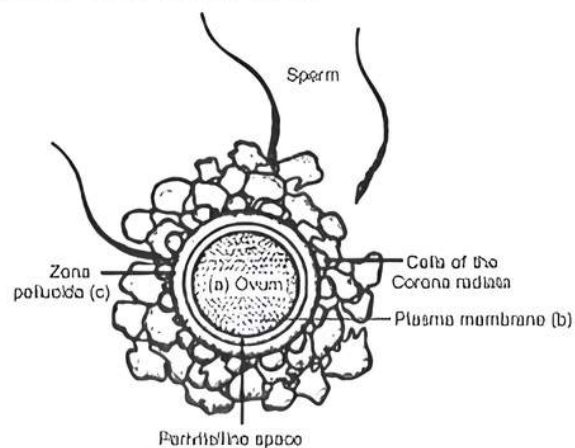
Nucleus: It contains chromosomal material.

Q 3. (i) Draw a diagram of the structure of a human ovum surrounded by corona radiata. Label the following parts:

(a) Ovum (b) Plasma membrane
(c) Zona pellucida

(ii) State the function of zona pellucida.

Ans. (i) Structure of human ovum:



(ii) Zona pellucida allows the entry of one sperm into the cytoplasm of the ovum and then undergoes changes to prevent the entry of additional sperms.

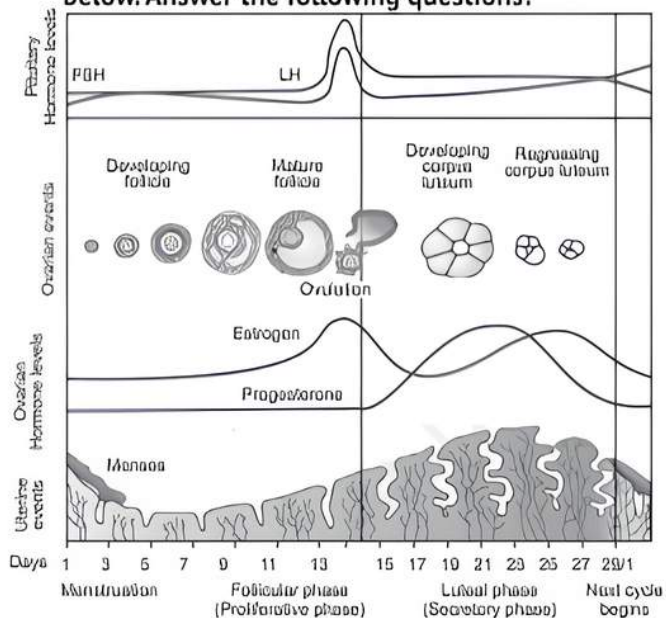
Q 4. Mention the target cells of Luteinizing hormone in human males and females. Explain the effect and the changes which the hormone induces in each case.

Ans. The target cells of Luteinizing Hormone (LH) in males are the Leydig cells and in females are the mature growing follicles.

LH in males stimulates the Leydig cells (interstitial cells) of testes to synthesise and secrete androgens which in turn stimulate the process of spermatogenesis.

LH in females stimulates the ovulation (release of ovum) and transformation of Graafian follicle into corpus luteum to secrete progesterone which prepares the endometrium to receive and implant blastocyst.

Q 5. The events of the menstrual cycle are represented below. Answer the following questions:



(i) State the levels of FSH, LH and progesterone simply by mentioning high or low around 13th and 14th day and 21st to 23rd day.

(ii) In which of the above mentioned phases does egg travel to Fallopian tube?

(iii) Why is there no menstruation after fertilisation?

Ans. (i) 13th and 14th day and 21st -23rd day

FSH - High Low

LH - High Low

Progesterone - Low High

(ii) The egg travels to Fallopian tube towards the end of follicular or proliferative phase.

(iii) Menstruation does not occur during pregnancy upon fertilisation due to high level of progesterone secreted by persisting corpus luteum and placenta.

Q 6. The figure given below shows three sperms A, B and C. (CBSE SQP 2023-24)

(i) Which one of the three sperms will gain entry into the ovum?

(ii) Describe the associated changes induced by it on P and Q.

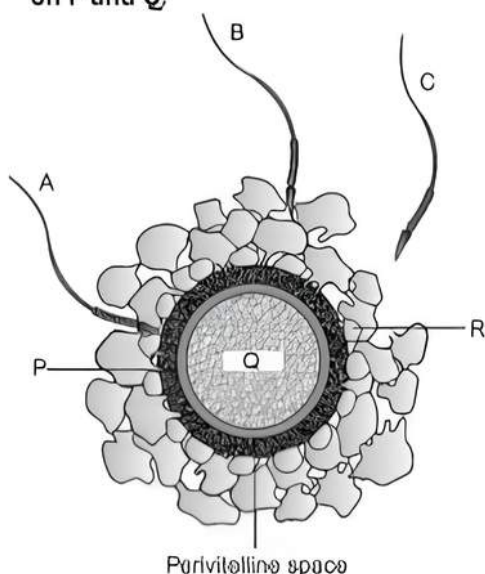


Fig: Ovum surrounded by few sperms

Ans. (i) Sperm A.

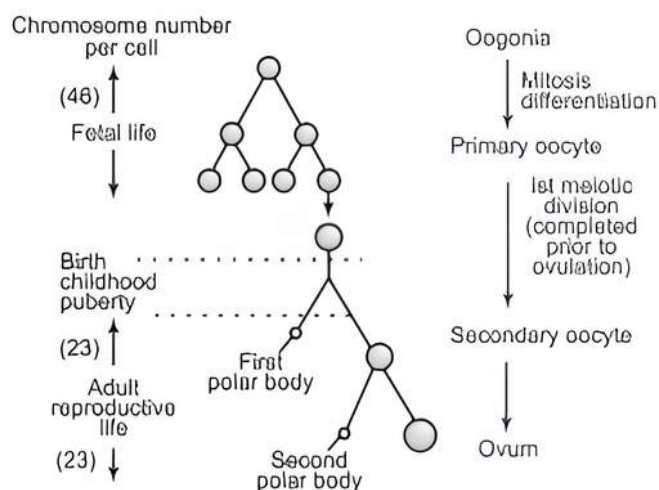
(ii) In the given figure, Sperm 'A' has come in contact with the zona pellucida layer (P) of the ovum (Q). it will induce changes in the membrane that will block the entry of additional sperms (B and C). Thus, it ensures that only one sperm can fertilize the ovum.

(a) The secretions of the acrosome of sperm A will help it to enter into the cytoplasm of the ovum (Q) through the zona pellucida (P) and the plasma membrane. this will induce the completion of the meiotic division of the secondary oocyte (Q).

(b) The second meiotic division in Q being unequal will result in the formation of a second polar body and a haploid ovum. Then, the haploid nucleus of the sperm 'A' and that of the ovum (Q) will fuse together to form a diploid zygote.

Q 7. Construct a flowchart exhibiting sequential events of oogenesis. (CBSE 2019)

Ans. The process of formation of a mature female gamete is called oogenesis. The flowchart showing sequential events of oogenesis is as given:



Q 8. Medically it is advised to all young mothers that breast feeding is the best for their new-born babies. Do you agree? Give reason in support of your answer. (CBSE 2018)

Ans. The milk produced during the initial few days of lactation is called colostrum. It contains several antibodies, absolutely essential, to develop resistance for the new-born babies. It is the most hygienic food for the baby and it also develops a bond between mother and child.

Q 9. What is hymen? Why is it considered that the presence or absence of hymen is not an indication of virginity?

Ans. Hymen is the membrane that partially covers the vaginal opening.

Presence or absence of hymen cannot indicate virginity due to the following reasons:

(i) The hymen gets torn during the first coitus.

(ii) It can also be torn by active participation in sports like horse-riding, cycling, or by a sudden fall or jolt and insertion of vaginal tampon.

Q 10. Distinguish between:

(a) Corona radiata and Zona pellucida

(b) Blastula and Gastrula.

Ans. (a) Corona radiata and Zona pellucida

S. No.	Basis of distinction	Corona radiata	Zona pellucida
(i)	Constitution	It consists of <u>follicle cells.</u>	It is a <u>single membrane.</u>
(ii)	Location	It <u>envelops the egg outside the zona pellucida.</u>	It is above the <u>vitelline membrane making the membrane thick.</u>

(iii)	Function	The cells provide nourishment to the egg at the time of release from the ovary.	It protects the egg.
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(b) Blastula and Gastrula.

S. No.	Basis of distinction	Blastula	Gastrula
(i)	Layers	It is a <u>single-layered embryo</u> .	It is a <u>three-layered embryo</u> .
(ii)	Cavity	The <u>cavity of the blastula is known as the blastocoel</u> .	The <u>cavity of the gastrula is known as archenteron</u> .
(iii)	Formation	It results after the <u>cleavage</u> .	It is formed from blastula due to the <u>movement of cells into three germ layers</u> .

COMMON ERROR

Never write difference in passage form but always write it in tabular form.

Q 11. Explain the phases in embryonic development from the morula stage till the establishment of pregnancy in a human female. (CBSE SQP 2023-24)

Ans. The embryo with 8 to 16 blastomeres is called a morula.

- The morula continues to divide and transforms into blastocyst as it moves further into the uterus.
- The blastomeres in the blastocyst are arranged into an outer layer called trophoblast.
- An inner group of cells attached to trophoblast is called as inner cell mass.
- The trophoblast layer then gets attached to the endometrium of the uterus and the inner cell mass gets differentiated as the embryo.
- After attachment, the uterine cells divide rapidly and covers the blastocyst.
- As a result, the blastocyst becomes embedded in the endometrium of the uterus. This is called implantation and it leads to pregnancy.

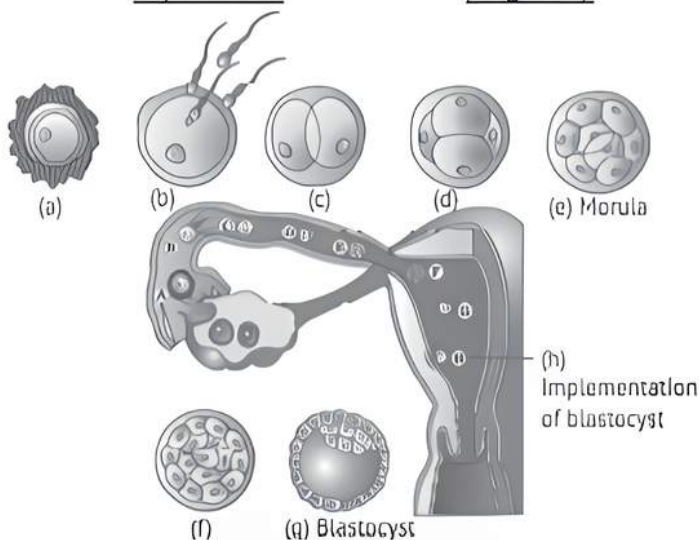
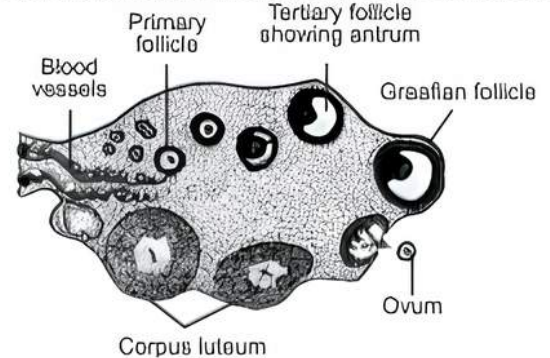


Fig. : Fertilisation and passage of growing embryo in fallopian tube

Long Answer Type-II Questions

- Q 1. (i) Draw the sectional view of a seminiferous tubule of human. Label its any six parts.**
(ii) Name the pituitary hormones involved in the process of spermatogenesis. State their functions. (CBSE 2020)

Ans. (i) Sectional view of a seminiferous tubule of human:



- (ii) The pituitary hormones involved in the process of spermatogenesis are: GnRH, FSH and LH**
(a) Spermatogenesis is initiated at the age of puberty by the Gonadotropin Releasing Hormone (GnRH) secreted by the hypothalamus.
(b) The increased levels of GnRH stimulate the anterior pituitary which then secretes the FSH (Follicle Stimulating Hormone) and LH (Luteinizing Hormone). FSH stimulates Sertoli cells to secrete some factors which help in spermiogenesis.
(c) LH acts on the Leydig cells and causes the secretion of testosterone from the testes.

Q 2. Differentiate between:

- (i) Vas deferens and Vasa efferentia.**
(ii) Spermatogenesis and Spermiogenesis.

Ans. (i) Vas deferens and Vasa efferentia.

S. No.	Basis of difference	Vas deferens	Vasa efferentia
(i)	Origin	• Vas deferens arises from <u>epididymis</u> and opens into <u>urethra</u> .	Vasa efferentia arise from <u>rete testis</u> and open into <u>epididymis</u> .
(ii)	Sperm conduction	• This conducts the <u>sperm to the urethra</u> and then to outside.	They <u>conduct the sperms out of the testes</u> .
(iii)	Ducts	• It <u>receives ducts of the associated glands</u> .	They <u>do not receive ducts of any associated glands</u> .
(iv)	Location	• It <u>ascends into the abdominal cavity</u> .	They <u>remain inside the scrotum (extra abdominal)</u> .

(II) Spermatogenesis and Spermiogenesis.

S. No.	Basis of difference	Spermatogenesis	Spermiogenesis
(i)	Process	It is the <u>process of formation of spermatozoa in the testes.</u>	It is the <u>process of transformation of spermatids into spermatozoa.</u>
(ii)	Cell division	It <u>involves cell divisions.</u>	It <u>does not involve any cell division.</u>
(iii)	Organs involved	<u>Spermatogonia of the seminiferous tubules are involved.</u>	<u>Sertoli cells of the seminiferous tubules are involved.</u>

Q 3. (i) Explain menstrual cycle in human females.

(ii) How can the scientific understanding of the menstrual cycle of human females help as a contraceptive measure? (CBSE 2018)

Ans. (i) Menstrual Cycle:

- The reproductive cycle in the female primates (e.g. Monkeys, apes and humans) 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 menstrual cycle.
- The phases of menstrual cycle are as follows:

- Menstrual phase:** 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.
- Follicular phase:** It lasts for 8-10 days. 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. The secretion of LH and FSH increases gradually.
- Ovulatory phase:** It lasts for 1 day. There is release of ovum in this phase.
- Luteal phase:** It lasts for 13 days. There is LH surge in this phase. It induces the remaining parts of Graafian follicle to transform as corpus luteum and it secretes progesterone.

(e) If fertilisation occurs, endometrium starts preparing for implantation. In the absence of fertilisation, corpus luteum degenerate.

(ii) Scientific understanding of menstrual cycle of human females is very important as a contraceptive measure. It helps in following ways:

(a) **Safe period (Rhythm method)**

A week before and a week after menstrual bleeding is considered as safe period for sexual intercourse.

The idea is based on the following facts:

- Ovulation occurs on 14th day of cycle and ovum survives for about 2 days.
- Sperms remain alive for about 3 days. This method reduces the chances of pregnancy by about 80%.

(b) **Pills** It used by females are also dependent on menstrual cycle. The pills have to be taken daily for a period of 21 days starting preferably within first five days of menstrual cycle. It is repeated again after a period of 7 days. These inhibit ovulation and implantation as well as alter the quality of cervical mucus to prevent/retard entry of sperms.

Q 4. (i) Explain the following phases in the menstrual cycle of a human female:

(a) Menstrual phase (b) Follicular phase (c) Luteal phase.

(ii) A proper understanding of menstrual cycle can help immensely in family planning. Do you agree with the statement? Provide reasons for your answer. (CBSE 2017)

Ans. (i) (a) Menstrual phase:

- The soft tissue of endometrial lining of the uterus disintegrates causing bleeding.
- The unfertilised egg and soft tissues are discharged.
- It lasts for 3-5 days.

(b) Follicular phase/Proliferative phase:

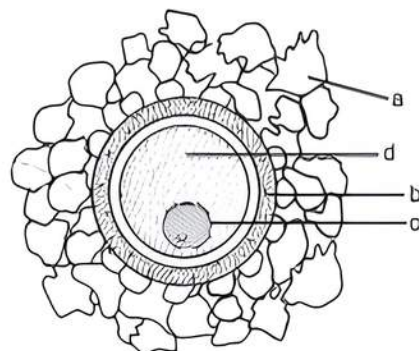
- The primary follicles in the ovary grow and become a fully mature Graafian follicle.
- The endometrium regenerates.
- It lasts for about 10 to 14 days.

(c) Luteal phase (15 days to 28/29 days)

- In this phase, the ruptured follicle changes into corpus luteum in the ovary and it begins to secrete hormone, progesterone.
- The endometrium thickens further.
- If ovum is not fertilised, the corpus luteum undergoes degeneration and this causes disintegration of endometrium leading to menstruation.

(ii) Yes, a proper understanding of menstrual cycle can help immensely in family planning. As day 10 to 17 of the menstrual cycle is called as fertile period of human female. If coitus is done during this period, it increases the chances of conception but coitus is abstained in this period, so pregnancy can be prevented.

Q 5. Given below is a diagrammatic representation of a human ovum.



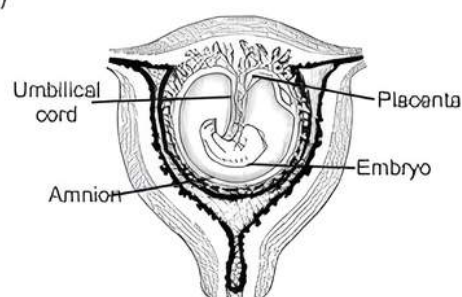
- (i) Identify the parts 'a', 'b' and 'c'.
- (ii) This ovum is released from the ovary with incomplete meiotic division. When, where and how is the meiotic division completed?
- (iii) How does an ovum ensure the entry of a single sperm during fertilisation? (CBSE 2023)

Ans. (i) a is corona radiata, b is plasma membrane and c is nucleus of an ovum.

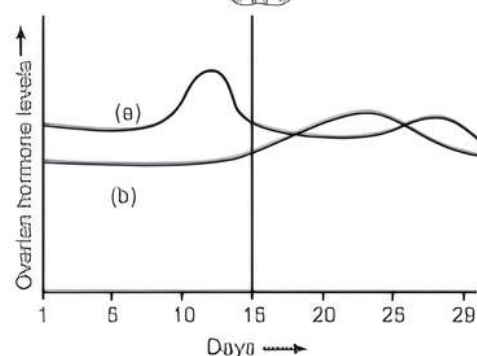
(ii) Meiotic division of the secondary oocyte is arrested at the metaphase II phase of meiosis II. The division is completed at the time of fusion of a sperm with an ovum in the Fallopian tube.

(iii) During fertilisation a sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane that blocks the entry of additional sperms. Thus, it ensures that only one sperm can fertilise an ovum.

(ii)



Q 7.



Read the graph given above and correlate the uterine events that take place according to the hormonal levels:

- (i) Specify name of the hormones mentioned in the graph.
- (ii) (a) 6-15 days (b) 16-25 days
(c) 26-28 days (if the ovum is not fertilised)

Ans. (i) (a) Estrogen
(b) Progesterone

(ii) (a) Estrogen first increases and then decreases but progesterone almost remains constant. There is regeneration of endometrium.

(b) In 16-25 days, progesterone increases but estrogen remains constant. Uterus gets highly vascularised, and gets ready for embryo implantation.

(c) In 26-28 days, progesterone decreases and estrogen increases. There is disintegration of the endometrium leading to menstruation.

- Q 6. (i) Explain the formation of placenta after the implantation in a human female. (CBSE 2023)
- (ii) Draw a diagram showing human foetus within the uterus and label any four parts in it.

Ans. (i) The placenta is an organ found in the mammals only during the development of the foetus. After around 12 weeks of pregnancy, the chorionic villi and uterine tissue become interdigested with each other and together form a structural and functional unit between developing embryo (foetus) and maternal body called placenta. A tough cord called umbilical cord is also formed during this time which connects the embryo to the uterus through the placenta. Placenta provides nutrients to the embryo.

- Q 8. Mention the source and the function of following hormones: FSH, LH, hCG, Relaxin. (CBSE 2017)

Criteria	FSH	LH	hCG	Relaxin
Source	<u>Anterior pituitary</u>	<u>Anterior pituitary</u>	<u>Placenta</u>	<u>Ovary</u>
Functions	(i) <u>Stimulates growth and maturation of ovarian follicles.</u> (ii) <u>Secretion of estrogens by follicular cells.</u>	(i) <u>Stimulate ovulation.</u> (ii) <u>Formation of corpus luteum.</u> (iii) <u>Secretion of progesterone by corpus luteum.</u>	(i) <u>Support fetal growth.</u> (ii) <u>Metabolic changes in the mother.</u> (iii) <u>Maintenance of pregnancy.</u>	<u>Softening of pubic symphysis for parturition.</u>



Chapter Test

Multiple Choice Questions

- Q 1. The immature male germ cells undergo division to produce sperms by the process of spermatogenesis. Choose the correct one with reference to given.
- a. Spermatogonia have 46 chromosomes and always undergo meiotic cell division.

- b. Primary spermatocytes divide by mitotic cell division.
- c. Secondary spermatocytes have 23 chromosomes and undergo second meiotic division.
- d. Spermatozoa are transformed into spermatids.

- Q 2. Each compartment of scrotum encloses:
- testis and epididymis
 - testis, epididymis, a spermatic cord
 - testis, spermatic cord and a part of vas deferens
 - testis, epididymis, a spermatic cord and part of vas deferens
- Q 3. Given below are various structures of male reproductive system and their characteristics.
- Vasa efferentia-Arise from rete testis
 - Epididymis-Leads to vas deferens
 - Suspensory ligament-Found at the tip of penis
 - Number of suspensory-Four ligaments
- Choose the option containing incorrectly matched pairs.
- I and II
 - II and IV
 - III and IV
 - I and III

Assertion and Reason Type Questions

Directions (Q.Nos. 4-5): Each of the following questions consists of two statements, one is Assertion (A) and the other is Reason (R). Select the correct answer to these questions from the codes a, b, c and d as given below.

- Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
 - Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
 - Assertion is true but Reason is false.
 - Both Assertion and Reason are false.
- Q 4. **Assertion (A):** In human male, testes are extra abdominal and lie in scrotal sacs.
Reason (R): Scrotum acts as thermoregulator and keeps testicular temperature lower by 2°C for normal spermatogenesis.
- Q 5. **Assertion (A):** Infundibulum is a funnel-shaped part closer to ovary.
Reason (R): The edges of Infundibulum helps in collection of the ovum after ovulation.

Case Based Questions

Case Study 1

- Q 6. The first menstruation is called menarche that usually occurs between 12 and 15 years. In human females, menstruation is repeated at an average interval of about 28/29 days and is called menstrual cycle. It is regulated by certain hormones, as pituitary gland is stimulated by releasing factors produced in the hypothalamus. The hormones produced by pituitary gland influence the ovaries. The hormones secreted by the ovaries affect the walls of the uterus.
- (i) The breakdown of endometrium is characteristic of:
- proliferative phase
 - luteal phase
 - ovulatory phase
 - menstrual phase

- (ii) Which days of the menstrual cycle marks the proliferative phase?
- 1-5
 - 15-28
 - 6-13
 - 10-14
- (iii) Which of the following occurs during secretory phase?
- Empty Graafian follicle changes into corpus luteum.
 - Primary follicle changes into Graafian follicle.
 - Endometrium rebuilds and estrogen secretion increases.
 - LH surge inducing release of an ovum.
- (iv) Identify the hormones that attain peak level during ovulatory phase.
- FSH
 - Progesterone
 - LH
 - Both a. and c.
- (v) Withdrawal of which hormone causes degeneration of corpus luteum?
- FSH
 - LH
 - Progesterone
 - Estrogen

Case Study 2

- Q 7. Oogenesis is the process of formation of ovum in ovaries. It consists of three phases; multiplication, growth and maturation. Oogenesis is controlled by hormones GnRH, LH, FSH, GnRH secreted by the hypothalamus stimulates the anterior lobe of pituitary gland to secrete LH and FSH.

Read the given passage carefully and give the answer of the following questions:

- What is the function of FSH hormone?
- Which hormone induces the rupture of the mature Graafian follicle?
- Which cell division is involved in the formation of secondary oocyte?

Very Short Answer Type Questions

- Q 8. How the entry of only one sperm and not many is ensured during fertilisation?
- Q 9. Name the thin clear coat around the mammalian egg.
- Q 10. The basal parts of the endometrium remain intact during menstruation. Give reason.

Short Answer Type Questions

- Q 11. Mention the two functions of the placenta.
- Q 12. Write the functions of the following:
- Corpus luteum
 - Endometrium

Long Answer Type-I Question

- Q 13. Where is morula formed in humans? Explain the process of its development from zygote.

Long Answer Type-II Question

- Q 14. What is menstruation? What are the specific action of FSH, LH, oestrogen and progesterone in the menstrual cycle?