Chapter 2

Human Reproduction

Exercise-2.1

1 marks

1. Fill in the blanks:

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

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

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

(d) Male and female gametes are _____. (diploid/haploid)

(e) Zygote is _____. (diploid/haploid)

(f) The process of release of ovum from a mature follicle is called _____.

(g) Ovulation is induced by a hormone called _____.

(h) The fusion of male and female gametes is called _____.

(i) Fertilisation takes place in _____.

(j) Zygote divides to form a _____which is implanted in the uterus.

(k) The structure which provides a vascular connection between the foetus and uterus is called the _____.

Solution:

(a) Humans reproduce **sexually**.

(b) Humans are **viviparous.**

(c) Fertilisation is **internal** in humans.

(d) Male and female gametes are **haploid.**

(e) Zygote is **diploid.**

(f) The process of release of ovum from a mature follicle is called **ovulation.**

(g) Ovulation is induced by a hormone called **luteinising hormone (LH).**

(h) The fusion of male and female gametes is called **fertilisation.**

(i) Fertilisation takes place in the **ampulla of the oviduct.**

(j) Zygote divides to form a **blastocyst,** which is implanted in the uterus.

(k) The structure which provides a vascular connection between the foetus and the uterus is called the **placenta.**

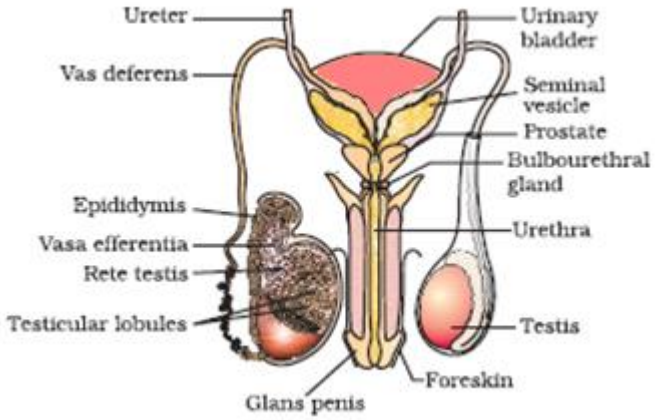
Exercise-2.2

2 marks

1. Draw a labelled diagram of the male reproductive system.

Solution:

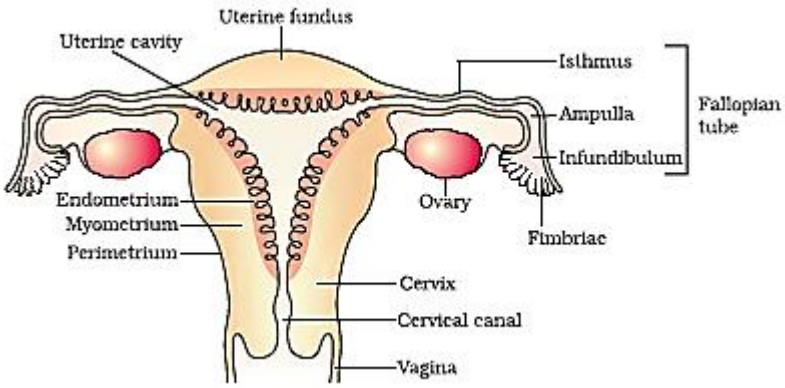
The diagram of the male reproductive system is as follows:



2. Draw a labelled diagram of the female reproductive system.

Solution:

The diagram of the female reproductive system is as follows:



3. Write two major functions, each of the testis and ovary.

Solution:

Two major functions of the testis and ovary are as follows:

Testis:

- The process of spermatogenesis produces sperms through the seminiferous tubules
- Testosterone, the male sex hormone, is secreted by the Leydig cells

Ovary:

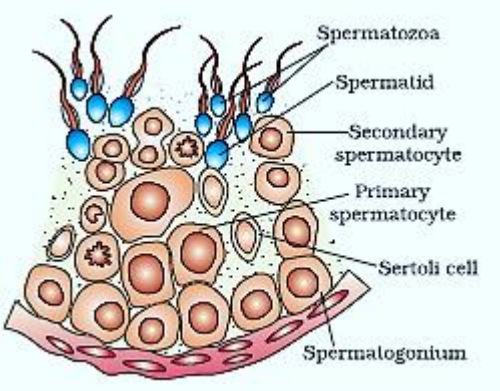
- In the process of oogenesis, ovaries produce ova
- Progesterone and oestrogen, the female sex hormones, are secreted

4. Describe the structure of a seminiferous tubule.

Solution:

The structure of seminiferous tubules is listed below:

- Seminiferous tubules are found in the testicular lobules and are highly coiled structures. It is here that the production of sperm in the testes occurs
- Each of the seminiferous tubules has a lining of germinal epithelium
- On the inner side, it is lined by two types of cells – Sertoli cells and spermatogonia
- Spermatogonia – they are the male germ cells that produce the primary spermatocytes through the process of meiotic divisions. Further, the primary spermatocytes undergo meiotic divisions for the formation of secondary spermatocytes and, ultimately, spermatids. Later on, spermatids metamorphosise into the male gametes, termed as spermatozoa
- Sertoli cells are referred to as nurse cells of the testes. It is because they nourish the germ cells.
- Just adjacent to the seminiferous tubules, there are large polygonal cells referred to as leydig cells or interstitial cells, which secrete testosterone – the male hormone.



5. What is spermatogenesis? Briefly describe the process of spermatogenesis.

Solution:

The phenomena of sperm production from the immature germ cell in males is termed as spermatogenesis. The process occurs in the seminiferous tubules located inside the testes. In this process, a diploid male germ cell or spermatogonium enlarges (in size) to form a diploid primary spermatocyte, which in turn goes through the first meiotic division or meiosis I. This division is a reductional division for the formation of two equal haploid secondary spermatocytes, each of which further undergoes a second meiotic division or meiosis II for the formation of two equal haploid spermatids.

Subsequently, four haploid spermatids are formed from a diploid spermatogonium. The spermatids, hence produced, alter to form spermatozoa (sperm) through the process of spermiogenesis.

6. Name the hormones involved in the regulation of spermatogenesis.

Solution: Some hormones involved in the regulation of spermatogenesis are as listed below:

- Luteinising hormone (LH) – It serves as Leydig cells triggering synthesis & secretion of androgens
- Gonadotrophin-releasing hormone (GnRH) – It is a hypothalamic hormone that is secreted at the age of puberty, acting at the anterior pituitary gland and stimulating the secretion of LH & FSH
- Follicle-stimulating hormone (FSH) – It acts on Sertoli cells, stimulating the secretion of factors which aid in the spermiogenesis process
- Androgens – It triggers inhibin production regulating the spermatogenesis process

Exercise-2.3

4 marks

1. Define spermiogenesis and spermiation.

Solution:

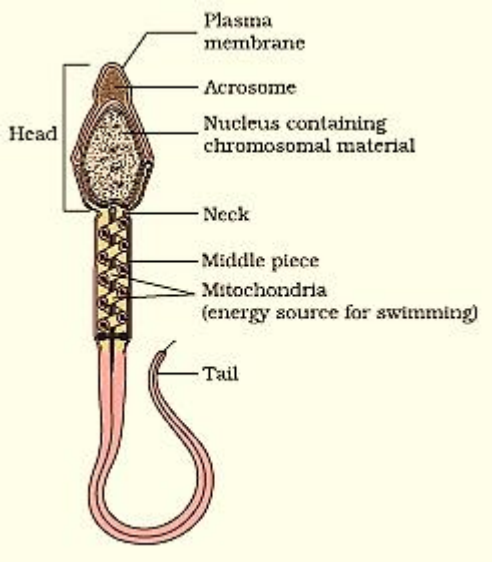
Spermiogenesis – It is the phenomenon of the transformation of non-motile spermatids to mature, motile spermatozoa.

Spermiation – It is the phenomenon where mature spermatozoa are released from the Sertoli cells into the lumen of the seminiferous tubules of the testes.

2. Draw a labelled diagram of sperm.

Solution:

The diagram of sperm is as below:



3. What are the major components of seminal plasma?

Solution:

The major components of seminal plasma are as follows:

- Secretions of the accessory sex glands of males – prostate gland, seminal vesicles, bulbourethral glands.
- Mainly composed of – calcium, fructose, and other enzymes.

4. What are the major functions of male accessory ducts and glands?

Solution:

The major functions of the male accessory ducts and glands are as follows:

Male accessory ducts	Vasa efferentia	Conducts sperms from the rete testis to the epididymis
	Rete testis	Stores sperms that are produced by seminiferous tubules
	Vasa deferentia	Conducts sperms from epididymis to the urethra
	Epididymis	Physiological maturation of sperms, storage & nourishment
Male accessory gland	Seminal vesicles	Activates and provides energy to facilitate sperm motility after ejaculation
	Prostate gland	Nourishes and activates sperms, enhances sperm motility, provides alkalinity to the ejaculate, neutralises urine acidity
	Cowper's gland	Enhances mobility & survival potentiality of sperms in the genital tract of the female reproductive system, neutralises the activity of acidic female vaginal secretions

5. What is oogenesis? Give a brief account of oogenesis.

Solution:

Oogenesis is the phenomenon of the formation of haploid female gametes known as ova from diploid oogonia in the ovary, Graffian follicles, to be precise. This process is discontinuous, which is initiated during the period of foetal development that is terminated only after puberty sets in.

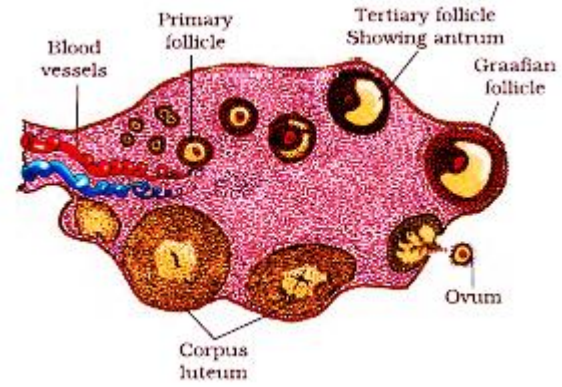
The process of oogenesis takes place in three phases, and they are listed below:

- Multiplicative phase – Follicle cells are differentiated from the germinal epithelium of the ovary due to repeated mitosis division. Few follicle cells enlarge and are termed as egg mother cells and undergo mitosis to multiply, which is referred to as oogonia.
- Growth phase – One of the oogonia of the egg nest differentiates while the rest change into surrounding nutritive follicular epithelium. There is an increase in the size of the differentiated isolated oogonium as it gets nourished from the girdling follicle cells, thereby transforming into a diploid primary oocyte.
- Maturation phase – The diploid primary oocyte in this phase passes through two maturation divisions. Meiosis I – the first meiotic division splits the diploid primary oocyte into two haploid cells, wherein the larger one is the secondary oocyte, and the minor one is the polar body (polocyte). In meiosis II, or the second meiotic division, the secondary oocyte splits to form one large ootid and a tiny second polar body. Furthermore, the first polar body splits through mitosis to form two polar bodies. The ootid matures into a functional haploid ovum. Therefore, one primary oocyte produces one large ovum and three polar bodies, which in turn degenerate. They degenerate as they do not participate in reproduction, thus leaving behind one functional ovum.

6. Draw a labelled diagram of a section through the ovary.

Solution:

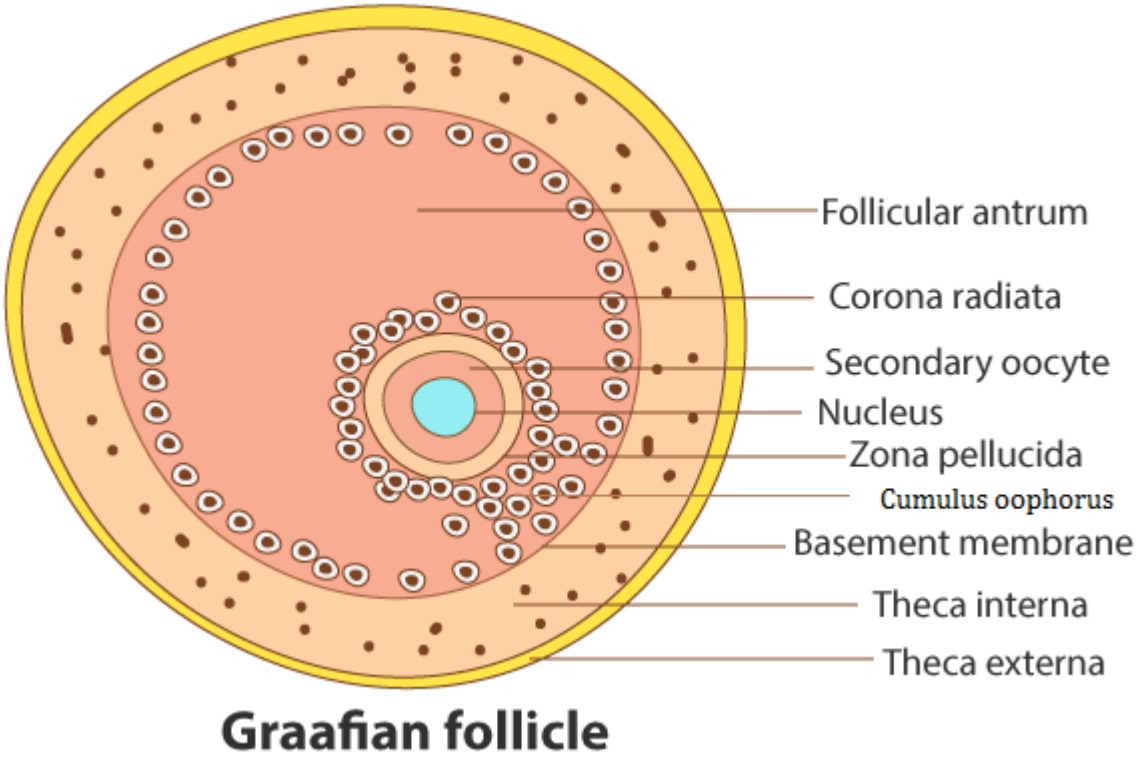
The diagram of a section of an ovary is as follows:



7. Draw a labelled diagram of a Graafian follicle.

Solution:

The diagram of a Graafian follicle is as follows:



8. Mention the functions of the following:

(a) Corpus luteum (b) Endometrium

(c) Acrosome (d) Sperm tail

(e) Fimbriae

Solution:

The functions are as follows:

(a) Corpus luteum – It is formed when the Graafian follicle ruptures. The corpus luteum secretes the hormone progesterone during the luteal phase of the menstrual cycle. When progesterone is secreted at high levels, the secretion of LH and FSH is inhibited, which further prevents ovulation. The corpus luteum facilitates the endometrium of the uterus to proliferate and prepare for the process of implantation.

(b) Endometrium – As the name suggests, the endometrium is the innermost lining of the uterus comprising glands that undergo cyclic changes during different stages of the menstrual cycle in order to prepare themselves for the embryo-implantation process.

(c) Acrosome – The acrosome is located in the anterior section of the head of the sperm, resembling a cap-like structure. It consists of the hyaluronidase enzyme that hydrolyses the outer membrane of the egg, which facilitates the sperm to perforate through the egg during fertilisation.

(d) Sperm tail – the sperm tail makes up for the longest part of the sperm, enabling the movement of the sperm once it has entered the female reproductive tract.

(e) Fimbriae – Towards the ovarian end of the fallopian tube, finger-like projections emerge. These are the Fimbriae which assist in gathering the ovum after the ovulation process. This is facilitated by the beating of the cilia.

9. Identify True/False statements. Correct each false statement to make it true.

(a) Androgens are produced by Sertoli cells. (True/False)

(b) Spermatozoa get nutrition from Sertoli cells. (True/False)

(c) Leydig cells are found in the ovary. (True/False)

(d) Leydig cells synthesise androgens. (True/False)

(e) Oogenesis takes place in the corpus luteum. (True/False)

(f) Menstrual cycle ceases during pregnancy. (True/False)

(g) Presence or absence of a hymen is not a reliable indicator of virginity or sexual experience. (True/False)

Solution:

a. False.
   Androgens are produced by the Leydig cells that are present in the seminiferous tubules
b. True
c. False
   Leydig cells are present in the seminiferous tubules of the testis in males.
d. True
e. False
   Oogenesis occurs in the ovary.
f. True
g. True

10. What is the menstrual cycle? Which hormones regulate the menstrual cycle?

Solution:

- It is a cycle observed to be taking place in females, lasting around 28 days on average to complete.
- It is a series of cyclic physiological changes occurring in the female reproductive tract in primates, the end of which is combined with the collapsing of the uterine endothelium that is liberated in the form of blood and mucus through the vaginal opening, which is termed menses.
- The different hormones that regulate the menstrual cycle are LH – luteinising hormone, FSH – follicle-stimulating hormone, progesterone and estrogen.
- During the follicular phase, the levels of LH and FSH that are secreted from the anterior pituitary gland increase. The FSH that is secreted under

the effect of the releasing hormone (RH) from the hypothalamus triggers the primary follicle to convert into a Graafian follicle.

- There is a gradual increase in the level of LH, which causes the follicle to grow, also causing the secretion of estrogen.
- Estrogen obstructs the FSH secretion, triggering the secretion of the LH, which also results in the thickening of the uterine endometrium.
- The amplified secretion of LH also results in the Graffian follicle rupturing, thereby causing the release of the ovum into the fallopian tube.
- This ruptured Graafian follicle transforms into corpus luteum, which secretes the hormone – progesterone during the luteal phase.
- The hormone progesterone assists in maintaining and preparing the endometrium for the process of embryo-implantation
- When the progesterone level in the blood is high, the FSH and LH secretion decreases, which furthermore hinders the process of ovulation.

11. What is parturition? Which hormones are involved in the induction of parturition?

Solution:

Parturition is the process wherein a fully developed foetus from the mother's womb is expelled after the completion of the gestation period.

The two critical hormones that are involved in the induction of parturition are as follows:

- Oxytocin – It directs the full-term foetus towards the birth canal, as it causes the contraction of the smooth muscles of the myometrium of the uterus, leading the baby to be expelled out
- Relaxin – It relaxes the pelvic ligaments, widening the pelvis to assist in an easier childbirth

12. In our society, women are often blamed for giving birth to daughters. Can you explain why this is not correct?

Solution:

We know that human beings have 23 pairs of chromosomes, and out of these, 22 pairs are autosomes, and the last pair varies in males and females. Males are heterogametic – they produce two types of male gametes or sperms, where 50% of the sperms carry the 'X' chromosome, while the rest 50% carry the 'Y'

chromosome. On the other hand, females are homogametic – they produce only one type of gamete, the ova, each of which carries the ‘X’ chromosome only.

Once the male and female gametes have fused to form the zygote, it would carry either XX chromosome or XY chromosome, depending on whether sperm carrying X or Y fertilised the ovum. Hence, if the sperm carrying ‘X’ fertilises the ovum (zygote XX), it will develop into a female baby, and if the sperm carrying ‘Y’ fertilises the ovum (zygote XY), it will develop into a male baby. Both of these cases are attributed to the sperm that carries the chromosome fertilising the ovum. Hence, we can say that the sex of the child is determined by the father and not the mother. This is why it is incorrect to blame women for the gender of the child.

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

Solution:

Typically in a month, human ovaries release only one egg, rarely two.

In the case of identical twins or monozygotic twins, one egg is released by the ovary, which splits into two post-fertilisation. This is why identical twins exhibit the same genetic features. On the other hand, in fraternal twins or dizygotic twins, two eggs are released, which are fertilised by two different sperms causing the fraternal twins to exhibit different genetic characteristics.

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

Solution:

In order to have given birth to six puppies, the ovary of the female dog released six eggs. Hence, six zygotes were formed for each to develop into a puppy.