CHAPTER

3 HUMAN REPRODUCTION

Syllabus

➢ ***Human Reproduction :*** *Male and female reproductive systems; anatomy of testis and ovary; gametogenesis–spermatogenesis and oogenesis; menstrual cycle; fertilization, embryo development upto blastocyst formation, implantation; pregnancy and placenta formation (elementary idea); parturition (elementary idea); lactation (elementary idea).*

Chapter Analysis

List of Topics		2016		2017		2018
		D	OD	D	OD	D/OD
Male Reproductive system	• Sectional view of seminiferous tubules			1 Q (3 M)		
Gametogenesis	• Structure of human sperm					1 Q (3 M)
Menstrual cycle	• Phases of menstrual cycle • Contraception		1 Q (5 M)			1 Q (5 M)
Fertilisation and implantation	• Events of fertilisation • Implantation + Role of Placenta	1 Q (5 M)			1 Q (5 M)	
Pregnancy and embryonic development	• Hormones secreted in women during pregnancy			1 Q (5 M)		
Parturition and Lactation	• Role of placenta as endocrine gland					

- *On the basis of above analysis, it can be concluded that this is also an important chapter from which a major five mark question is usually asked. The important topics for 5 mark questions are menstrual cycle, hormones secreted in women during pregnancy, events of fertilisation and implantation. Other important topic is placenta and hormones secreted by it. Many diagram based questions like sectional view of a human seminiferous tubule, structure of human sperm have also been asked. So, practice drawing neat and well labelled diagram.*

TOPIC-1
Male and Female Reproduction System

Revision Notes

Male Reproductive System

➢ **It consists of :**

(a) A pair of testes
(b) Accessory ducts
(c) Accessory glands
(d) External genitalia

Testes

- Testes are the primary sex organs that produce sperms and testosterone.
- Testes are contained in the scrotum located between upper thighs.
- The low temperature (2 – 2.5°C less than the normal internal body temperature) of scrotum helps for proper functioning of testes and for spermatogenesis.
- Each testis is oval in shape.
- Each testis has about 250 (200 – 300) compartments called testicular lobules.
- Each lobule is filled with connective tissue and contains 1-3 coiled yellow seminiferous tubules in which sperm are produced.
- Seminiferous tubule is lined internally with spermatogenic cells called spermatogonia or primary male germ cells and sertoli cells or supporting cells.
- Spermatogonia undergo meiotic divisions and leads to sperm formation.
- Sertoli cells give shape and nourishment to developing spermatogenic cells and therefore also called as **nurse cells.**
- The regions outside the seminiferous tubules are the interstitial spaces which contain small blood vessels and interstitial cells or Leydig cells.
- The Leydig cells are endocrine in nature and secrete testicular hormones called androgens.
- Immunologically competent cells are also present.

Accessory Ducts

- The duct system includes rete testis, vasa efferentia, epididymis and vas deferens.
- The seminiferous tubules open into the vasa efferentia through rete testis.
- The vasa efferentia open into epididymis.
- The epididymis leads to vas deferens that ascends into the abdomen and loops over the urinary bladder.
- It receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.
- These ducts store and transport the sperms from the testis to the outside through urethra.
- The urethra originates from the urinary bladder and extends through the penis to its external opening called urethral meatus.

Accessory Male Genital Glands

- It includes paired seminal vesicles, prostate and paired bulbourethral glands (Cowper's glands).
- The secretions of these glands constitute the seminal plasma, which is rich in fructose, calcium and certain enzymes.
- Seminal vesicles produce seminal fluid and form 60 – 70% of semen.
- The secretion of bulbourethral glands is alkaline and is rich in mucus. It helps in the lubrication of the penis, supplies nutrient to sperms and provides an alkaline medium to counteract the acidity of the uterus.

External Genitalia

- The penis is the male external genitalia.
- It is made up of special tissue that helps in erection of the penis to facilitate insemination.
- The enlarged end of penis called the glans. Penis is covered by a loose fold of skin called foreskin.

The Female Reproductive System

- It includes a pair of Ovaries, Accessory ducts and External genitalia.

Ovaries

- They are the primary female sex organs which produce ova or the female gametes. It secretes a number of steroid ovarian hormones such as estrogen and progesterone.
- Ovaries are located on both side in the lower abdomen.
- Each ovary is about 2-4 cm in length.
- The ovaries are connected to the pelvic wall and uterus by ligaments.
- Each ovary is covered by a thin epithelium which encloses the ovarian stroma.
- The stroma has outer cortex and inner medulla.
- Ovary contains groups of cells known as Ovarian or Graafian follicles.
- Each follicle carries a centrally placed ovum.

Accessory Ducts

- It includes two oviducts or fallopian tubes, a uterus and vagina.
- Each oviduct is 10-12 cm long and has four parts namely, infundibulum, ampulla, isthmus and uterine part.

(a) Infundibulum

- It is the funnel-shaped opening provided with many finger-like fimbriae for catching released ovum.
- It helps to collect the ovum after its release from the ovary.

(b) Ampulla

- The infundibulum leads to the curved and dilated part called ampulla.

(c) Isthmus

- It is the last straight part of the oviduct.
- It has a narrow lumen and joins the uterus.

(d) Uterine part

- It is about 1 cm long part of oviduct which passes into the uterus.

Uterus

- It is single and also called womb.
- The shape of the uterus is like an inverted pear.
- It is supported by ligaments attached to the pelvic wall.
- The uterus opens into vagina through a narrow cervix.
- The cavity of the cervix is called cervical canal which along with vagina forms the birth canal.
- The wall of the uterus is thick and muscular and is differentiated into three layers of tissue namely,
  (a) The external thin membranous perimetrium
  (b) The middle thick layer of smooth muscle, myometrium.
  (c) The inner glandular layer called endometrium
- The endometrium undergoes cyclic changes during menstrual cycle while the myometrium exhibits strong contraction during delivery of the baby.
- Vagina opens to the exterior between urethra and anus.
- The lumen of vagina is lined by a glycogen-rich mucous membrane consisting of sensitive papillae and Bartholin's glands.
- The secretions of Bartholin's glands lubricate the penis during sexual act.

External Genitalia

- It includes mons pubis, labia majora, labia minora, hymen and clitoris. The external genitalia are collectively called vulva.
- Mons pubis is a cushion of fatty tissue covered by skin and pubic hair.
- The labia majora are a pair of large thicker fleshy folds of tissue, which surround the vaginal opening.
- The labia minora are a pair of narrow fleshy folds of tissue found below labia majora.
- The opening of the vagina is often covered partially by a membrane called hymen.
- The hymen is often torn during the first coitus (intercourse) or accidentally.
- The clitoris is a tiny finger-like structure which lies at the upper junction of the two labia minora above the urethral opening.

Mammary Glands

- A pair of mammary glands containing glandular tissue and fat is present in the chest region.
- Glandular tissue of each breast has 15-20 mammary lobes containing clusters of cells called alveoli.
- The cells of alveoli secrete milk which is stored in the cavities or lumen of alveoli.
- The alveoli open into mammary tubules.
- The tubules of each lobe join to form a mammary duct.
- Several mammary ducts join to form a wider mammary ampulla which is connected to lactiferous duct through which milk is sucked out.

IMPORTANT DIAGRAMS:

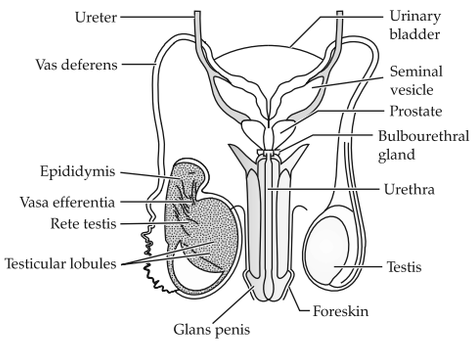


Fig 3.1: Human Male Reproductive System

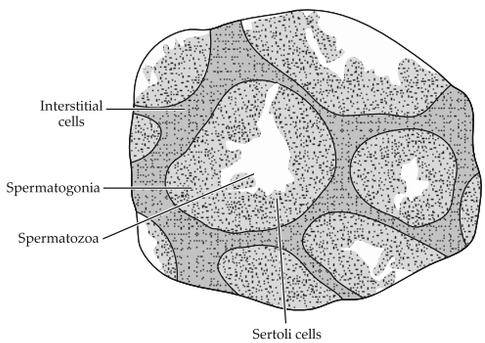


Fig 3.2: Diagrammatic sectional view of seminiferous tubule

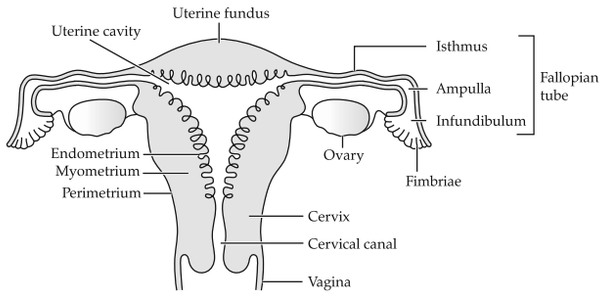


Fig 3.3: Human Female Reproductive system

Very Short Answer Type Questions (1 mark each)

Q. 1. Name the pouch in which the human testes are present. R **[Outside Delhi Set-I, 2014]**

Ans. Scrotum. **[CBSE Marking Scheme, 2014] 1**

Q. 2. List different parts of human oviduct through which the ovum travels till it meets the sperm for fertilization. R **[Delhi Set-I, Comptt. 2014]**

Ans. Fimbriae, infundibulum, ampulla and ampullary-isthmic junction. **1**

Commonly Made Error

- Students often list incorrect sequence of flow of ovum through human oviduct.

Answering Tip

- While studying the reproductive system, stress on the structure and function of every part.

Q. 3. Name the cells that nourish the germ cells in the testes. Where are these located in the testes ? R **[Outside Delhi Set-III, Comptt. 2013]**

Ans. Name of cells—Sertoli cells. ½

Location—They are found lining-up the inner surface of seminiferous tubules. ½

Q. 4. Write the function of Seminal vesicle. R **[Delhi Set-I, 2012]**

Ans. Seminal vesicle produces an alkaline secretion. It neutralizes the acidic environment of female reproductive tract and male urethra during coitus. **1**

Q. 5. Write the location and function of the Sertoli cells in humans. R **[Delhi Set-I, 2012]**

Ans. In the seminiferous tubules of testis. ½

Function : Nourishes the sperms or germ cells. ½

[CBSE Marking Scheme, 2012]

Commonly Made Error

- Students often confuse Sertoli cells with Leydig cells. Instead of Sertoli cells, they write location and function of Leydig cells.

Answering Tip

- Understand the location and function of sertoli cells and leydig cells carefully in tabular form or flow chart.

AI **Q. 6. Give reasons for the following :**
The human testes are located outside the abdominal cavity. U **[Outside Delhi Set-II, 2012]**

Ans. For spermatogenesis, it is essential to maintain the temperature 2-2.5°C lower than normal internal body temperature. ½ + ½

[CBSE Marking Scheme, 2012]

Q. 7. Write the location and function of Leydig cells in humans. R **[Foreign, 2012]**

Ans. Leydig cells are present at interstitial region between seminiferous tubules. They synthesize and secrete androgens. **1**

Short Answer Type Questions-I (2 marks each)

Q. 1. Write the location and functions of myometrium and endometrium. R **[Foreign Set-I, 2016]**

Ans. Myometrium : Middle layer of uterus, contractions of the uterus during delivery/child birth/parturition. ½+½

Endometrium : Inner layer of uterus, cyclic changes during menstruation/implantation of embryo.

[CBSE Marking Scheme, 2016] ½+½

AI **Q. 2. Write the location and functions of the following in human testis :**

(i) Sertoli cells

(ii) Leydig cells

R **[Outside Delhi Set-II, 2014]**

Ans. (i) Location : Lined inside the seminiferous tubules. ½

Function : Provide nutrition to the germ cells / sperms. ½

(ii) Location : Outside seminiferous tubules / Interstitial space. ½
Function : Synthesize or secrete male hormones / Testicular hormones / Androgens. ½

[CBSE Marking Scheme, 2014]

Answering Tip

- Lay stress on understanding the structure and function of Leydig cells and Sertoli cells. Students often get confused between the structure and functions of two.

Q. 3. Why are the human testes located outside the abdominal cavity ? Name the pouch in which they are present. R **[Outside Delhi Set-I, II, III, 2014]**

Ans. Testes are located outside the abdominal cavity within a sac called scrotal sac or scrotum. Scrotum keeps the testes temperature at 2°C lower than the body temperature. The lower temperature is required for proper functioning of testes and for spermatogenesis. **2**

Commonly Made Error

- Students often write incorrect explanation. It seems they are unaware about the scrotum and its requirement for the proper functioning of testes.

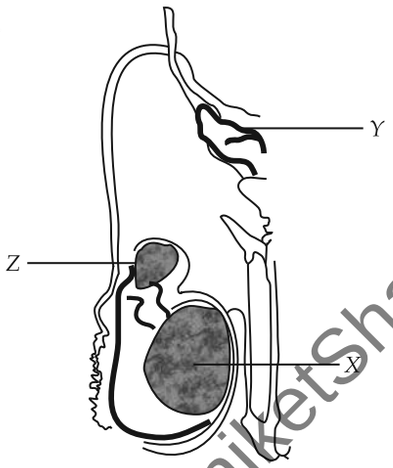
Answering Tip

- Students should thoroughly understand about Scrotum and its requirement for proper functioning of testes.

Short Answer Type Questions-II

(3 marks each)

AI **Q. 1.**



The above diagram shows human male reproductive system (one side only).
(i) Identify 'X' and write its location in the body.
(ii) Name the accessory gland 'Y' and its secretion.
(iii) Name and state the function of Z.

A **[Delhi Set-I, Comptt. 2015]**

Ans. (i) X — Testicular lobules, location : Testis, outside the abdominal cavity scrotum.
(ii) Y — Seminal vesicle, seminal plasma.
(iii) Z — Epididymis, function : Storage of sperms.

[CBSE Marking Scheme, 2015] 1 +1+1

Detailed Answer :

(i) X- is testicular lobules found in testis. The testes are located outside the abdominal cavity within a pouch like structure called '**scrotum**'.

(ii) The accessary gland **Y** is seminal vesicle. It produces an alkaline secretion called seminal fluid which forms 60–70% of semen by volume.

(iii) Z is epididymis. It stores sperm and also it secretes fluid containing the nutrients required for the maturation of spermatozoa.

Answering Tips

- While studying the reproductive system, stress on the structure and function of every part.
- Give importance to the secretions of male accessory glands and their role in the production of semen.

Q. 2. Differentiate between vas deferens and vasa efferentia. U **[Outside Delhi Set-III, 2014]**

Ans.

S. No.	Vas deferens	Vasa efferentia
(i)	Carries sperm from epididymis to urethra.	Carries sperm from testis to epididymis.
(ii)	One in number from each testis.	Many in number.

[CBSE Marking Scheme, 2014] 1½ + 1½

Detailed Answer :

S. No.	Vas deferens	Vasa efferentia
(i)	They are long and curved tubes.	They are short and straight tubes
(ii)	They develop from cauda epididymis.	They develop from rete testis.
(iii)	They are broader and muscular.	They are narrower and delicate.
(iv)	They conduct sperm through muscular activity.	Sperm conduction takes place by ciliary current.

Commonly Made Error

- Students often get confused between various parts of male reproductive system. They write opposite points. It seems they get confused between these parts.

AI **Q. 3. Name the male accessory glands in humans and write their functions.**

U **[Delhi -2017, Set - I, II, III (Comptt.)]**

Ans. (Paired) seminal vesicles, prostate, bulbourethral glands (paired) ½ × 3
Functions : Secretions constitute the seminal plasma, which is rich in fructose / calcium and certain enzymes, lubrication of penis ½ × 3
[CBSE Marking Scheme, 2017]

Detailed Answer :

Male accessory glands include a pair of seminal vesicle, prostate and paired bulbourethral glands (cowper's glands.)

Functions :

(i) Seminal Vesicles : Produce seminal fluid which forms 60 - 70% of semen. The fluid activates the sperms and have fructose, citrate, inositol and proteins for nutrition of sperms.

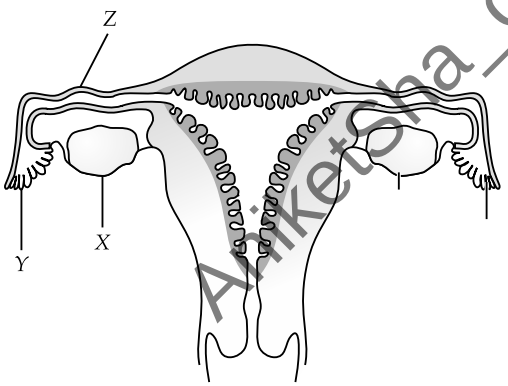
(ii) Prostate Gland : The gland secretes thin, milky and alkaline secretion which neutralises the acidic secretion in female vagina.

(iii) Cowper's Gland (Bulbourethral gland) : Helps in secretion of mucus which lubricates urinogenital tract.

Q. 4. Draw a labelled diagrammatic view of human male reproductive system.
[Outside Delhi Set-II, 2014]

Ans. Refer to Topic 1/ Revision Notes/ Important Diagrams/ Fig 3.1
[CBSE Marking Scheme, 2014] 3

Q. 5.



The above diagram shows a part of the human female reproductive system.

(i) Name the gamete cells that would be present in 'X' if taken from a newborn baby.

(ii) Name Y and write its function.

(iii) Name Z and write the events that take place here.
[Outside Delhi Set-I, Comptt. 2015]

Ans. **(i)** X = Primary oocytes
(ii) Y = Fimbriae, collection of ovum
(iii) Z = ampullary – isthmic junction/fallopian tube, the ovum encounters the sperms/ fertilization takes place.
[CBSE Marking Scheme, 2015] 1+1+1

Q. 6. Draw a labelled diagram of the human female reproductive system.
[Delhi Set-I, 2011] (NCERT)

Ans. Refer Topic 1/ Revision Notes/ Important diagrams/ Fig 3.3

Q. 7. Name and explain the role of inner and middle walls of the human uterus.
[Delhi Set-I, 2014; Outside Delhi Set-III, 2014]

Ans. **Inner :** Endometrium. ½
Supports foetal growth, helps in placenta formation after implantation. ½+½
Middle : Myometrium. ½
Exhibits strong contraction during delivery of baby.
[CBSE Marking Scheme, 2014] 1

Detailed Answer:

The inner wall of uterus is called as **endometerium.** It is involved in cyclic changes during menstruation and implantation of embryo.
The middle wall of the uterus is called **myometrium.** It is involved in strong contractions during delivery of baby.

Answering Tip

- Learn the names and function of different layers of human uterus in tabular form for easy understanding and retention.

Long Answer Type Question (5 marks)

AI Q. 1. (i) Draw a labelled diagrammatic view of human male reproductive system. **[Delhi, 2014]**

(ii) Differentiate between :

(a) Vas deferens and vasa efferentia

(b) Spermatogenesis and spermiogenesis.

Ans. **(i)** Refer to Topic 1/ Revision Notes/ Important Diagram/ Fig 3.1

(ii) **(a)** Refer: SAQ-II/ Q 2.

(b)

Spermatogenesis	Spermiogenesis
(i) It is the process of formation of haploid spermatozoa from germinal cells.	**(i)** It is the process of differentiation of spermatozoa from a spermatid.
(ii) A spermatogonium forms four spermatozoa.	**(ii)** Here, a spermatid forms a single spermatozoon.

2 + 1½ + 1½

TOPIC-2
Gametogenesis and Menstrual Cycle

Revision Notes

Gametogenesis

- The process of formation of gametes or sex cells is known as gametogenesis.
- It includes spermatogenesis and oogenesis.

Spermatogenesis

- It is the process of formation of sperms in seminiferous tubules of testes.
- It has two stages namely,
  (a) Formation of spermatids
  (b) Spermiogenesis
- During the formation of spermatids, the spermatogonia *i.e.,* Sperm mother cells or immature male germ cells produce spermatids.
- In spermiogenesis, the spermatids are transformed into sperm.
- Each primary spermatocyte undergoes meiosis-I and produces two haploid secondary spermatocytes.
- Each secondary spermatocyte divides by meiosis-II and produces two haploid spermatids.
- Thus, four spermatids are formed from each primary spermatocyte.
- The spermatids, under the influence of FSH of anterior pituitary are converted into spermatozoa. The process is called spermiogenesis.
- After spermiogenesis, sperm head become embedded in the Sertoli cells and are finally released from seminiferous tubules. The process of release of mature spermatozoa from the sertoli cells into the lumen of seminiferous tubules is known as spermiation.

Hormones in Spermatogenesis

- Hypothalamus releases large amount of Gonadotropin releasing hormone (GnRH).
- GnRH stimulates the anterior pituitary gland to secrete two gonadotropins namely Luteinizing hormone (LH) and follicle stimulating hormone (FSH).
- LH acts on the Leydig cells and stimulates synthesis and secretion of androgens which in turn stimulate the spermatogenesis.
- FSH acts on the Sertoli cells and stimulates secretion of some spermogenic factors which help in the process of spermiogenesis.

Structure of Sperm

- It is a microscopic structure.
- A mature sperm measures about 60 µm (0.06 mm) long.
- A plasma membrane envelops the whole body of sperm.
- Sperm consists of four parts namely, head, neck, a middle piece and a tail region.

(a) Head

- It is oval shaped, consisting of nucleus and acrosome.
- Acrosome is formed from Golgi complex which contains lytic enzymes, that help in fertilisation of the ovum.

(b) Neck

- Behind the head is a neck containing proximal and distal centrioles.
- The distal centriole of the neck is connected to axial filament.

(c) Middle Piece

- It is composed of axial filament surrounded by numerous mitochondria and cytoplasm.
- Mitochondria produce energy for the sperm motility.

(d) Tail

- It consists of a central axial filament.
- The sperm moves in fluid medium and female genital tract by the undulating movement of the tail.
- Sperms are transported through the accessory ducts.
- The secretions of epididymis, vas deferens, seminal vesicle and prostate are essential for maturation and motility of sperms.
- The seminal plasma and sperms together constitute the semen.
- The human male ejaculates about 200-300 million sperms during a coitus ejaculation.
- For normal fertility at least 60% sperms must have normal shape and size and 40% of them must show vigorous motility.

Oogenesis

- It is the process of formation and maturation of ovum.
- It takes place in Graafian follicles.
- It is initiated in embryonic stage when millions of egg mother cells (oogonia) are formed within each ovary.
- No oogonia are formed and added after birth.
- Oogonia multiply to form primary oocytes which enter into prophase-I of the meiosis and get temporarily arrested at that stage.
- Each primary oocyte gets surrounded by a layer of granulosa cells to form primary follicle.
- A large number of primary follicles degenerate during the phase from birth to puberty.
- Therefore at puberty only 60,000-80,000 primary follicles are left in each ovary.
- The primary follicles get surrounded by more layers of granulosa cells and a new theca to form secondary follicles.
- The secondary follicles get transformed into a tertiary follicle.
- It has a fluid filled cavity (antrum).
- The theca layer forms an inner theca interna and an outer theca externa.
- The primary oocyte within the tertiary follicle grows in size and undergoes first unequal meiotic division to form a large haploid secondary oocyte and a tiny first polar body.
- The secondary oocyte retains the nutrient rich cytoplasm of the primary oocyte.
- It is unknown, whether the first polar body divides further or degenerates.
- The tertiary follicle further changes into the mature follicle (Graafian follicle).
- The secondary oocyte forms a new membrane (zona pellucida).
- The Graafian follicle now ruptures to release the secondary oocyte (ovum) from the ovary. This is called ovulation.

Structure of Ovum

- It is spherical or oval and non-motile female gamete.
- It is about 0.2 mm in diameter.
- Human ovum is non cleidoic (without shell) and alecithal (without yolk).
- Ovum has four membranes namely,
  - **(a) Plasma membrane (Oolemma) :** Innermost layer.
  - **(b) Vitelline membrane :** Attached to plasma membrane.
  - **(c) Zona pellucida :** Transparent non-cellular, thick, glycoprotein rich layer found outer to the vitelline membrane.
  - **(d) Corona radiata :** Outer layer formed of follicle cells. These cells are held together by mucopolysaccharide called hyaluronic acid.

Menstrual Cycle

- The reproductive cycle in the human female and related primates is called menstrual cycle.
- The first menstruation begins at puberty (at the age of 10-12 years) 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 during the middle of each menstrual cycle.
- The 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 form the liquid that comes out through vagina.
- Menstruation occurs only if the released ovum is not fertilised.
- Lack of menstruation may be indicative of pregnancy or 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 follicular 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.
- Both LH and FSH attain a peak level in the middle of cycle (about 14^{th} 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 (ovulation).
- The ovulation (ovulatory phase) is followed by the luteal phase during which the remaining parts of the Graafian follicle transform as the corpus luteum.
- The corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium.

- During pregnancy, all events of the menstrual cycle stop and there is no menstruation.
- In the absence of fertilisation, the corpus luteum degenerates. This causes disintegration of the endometrium leading to menstruation, marking a new cycle.
- In human beings, menstrual cycle ceases at around 50 years of age and is termed as menopause.
- Cyclic menstruation is an indicator of normal reproductive phase and extends between menarche and menopause.

IMPORTANT DIAGRAMS:

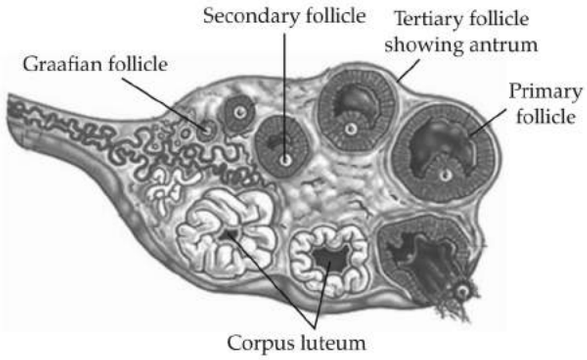


Fig 3.4: Sectional view of Ovary

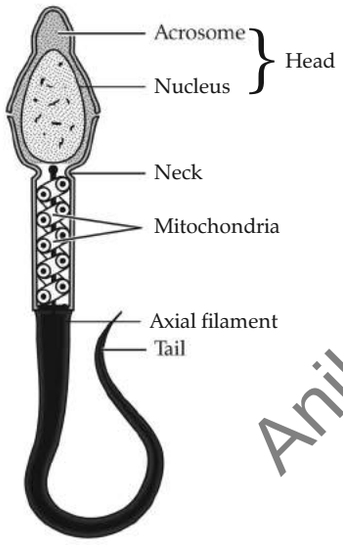


Fig 3.5: Structure of a Sperm

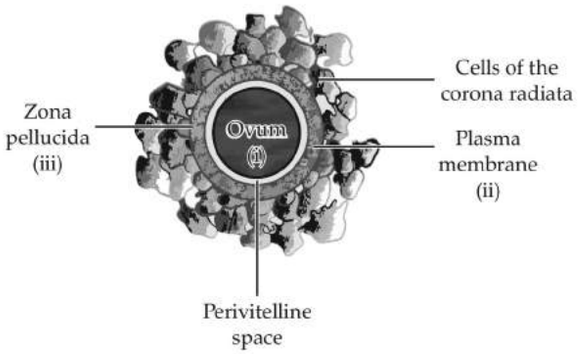


Fig 3.6: Structure of human ova

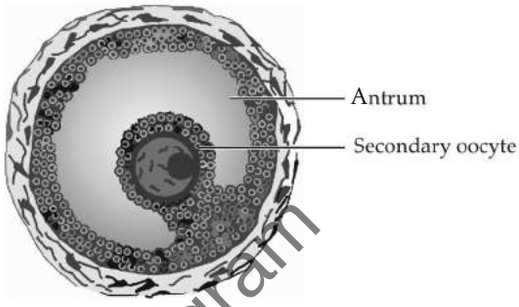


Fig 3.7: Graafian follicle

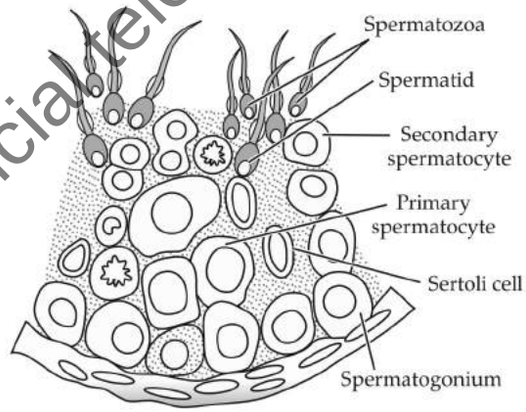


Fig 3.8: Sectional view of human seminiferous tubule

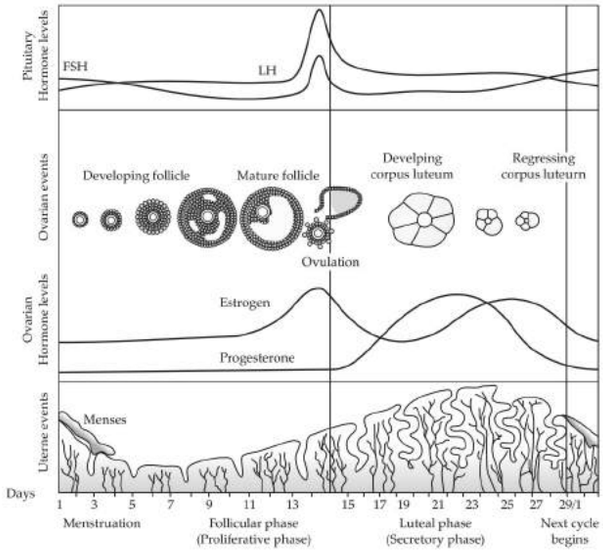


Fig 3.9: Various events during Menstrual Cycle

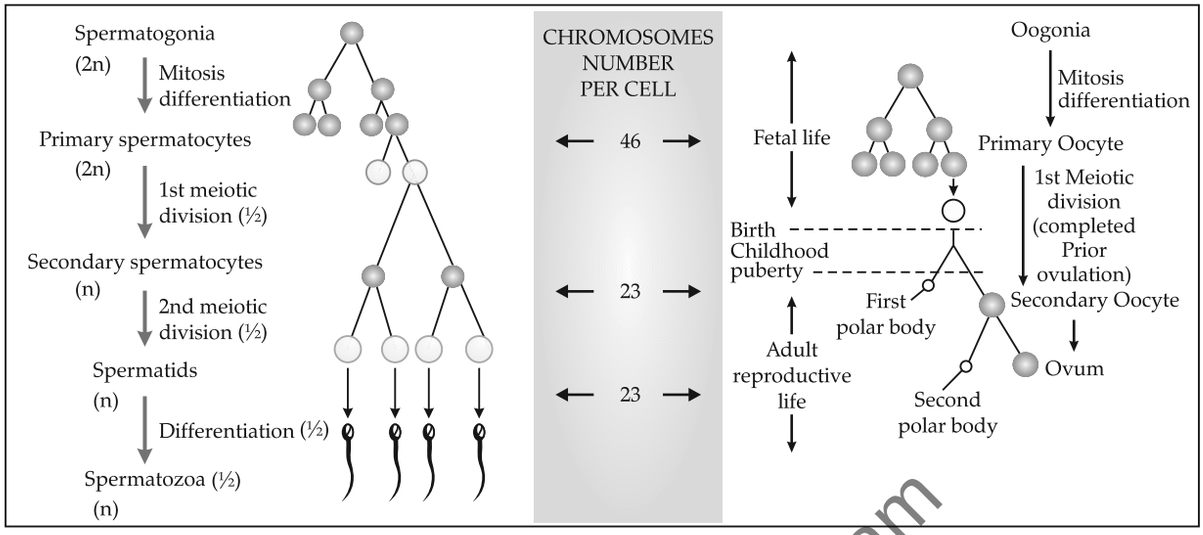


Fig 3.10: Schematic representation of (a) Spermatogenesis (b) Oogenesis

Very Short Answer Type Questions (1 mark each)

Q. 1. Differentiate between spermatogenesis and spermiogenesis. U **[Outside Delhi Set-III, 2014]**

Ans.

S.No.	Spermatogenesis	Spermiogenesis
(i)	Production of sperms (by meiosis).	Spermatids are transformed to spermatozoa.

[CBSE Marking Scheme, 2014] 1

Q. 2. Mention the difference between spermiogenesis and spermiation. U **[Delhi Set-III, 2012]**

Ans. Spermiogenesis is the process of development of spermatozoan from spermatids, while spermiation is the maturation and releasing of sperms.
Spermiogenesis occurs over sertoli cells while during spermiation, the sperms detach from sertoli cells. **1**

Commonly Made Error
- Students often consider both the terms similar.

Q. 3. When do the oogenesis and the spermatogenesis initiate in human females and males, respectively ? R **[Delhi Set-II, 2012]**

Ans. Oogenesis starts in female in their foetal stage while spermotogenesis in males starts at puberty.
½ + ½ = 1

Q. 4. How does the sperm penetrate through the zona pellucida in the human ovum ? R **[Delhi Set-II, Comptt. 2013]**

Ans. Acrosome present at the tip of the sperm helps to penetrate through the zona pellucida in human ovum. **1**

Q. 5. Where is acrosome present in humans ? Write its function. R **[Delhi Set-II, Comptt. 2013]**

Ans. It is present at the tip or head of the sperm. It helps to penetrate through the zona pellucida in human ovum. **1**

Q. 6. Write the function of each of the following : AI
(i) Luteinizing hormone in human males
(ii) Middle piece of human sperm.
R **[Delhi Set-II, 2012]**

Ans. (i) Luteinizing hormone (LH) stimulate leydig cell to secrete androgens which in turn stimulate spermatogenesis.
(ii) There are numerous mitochondria in the middle piece of sperms which produce energy which is required for the movement of sperms.
½ + ½

Q. 7. Where is acrosome present in humans ? Write its functions. R **[Outside Delhi Set-I, 2012]**

Ans. The acrosome is a cap like structure, present in the head region of human sperm. It contains enzymes which help in dissolving the envelop of ovum to facilitate the entry of sperm into the ovum through zona pellucida and plasma membrane. **1**

Answering Tip
- While learning the structure of human sperm, stress on the function of each part.

Q. 8. Write the physiological reason, why a woman generally cannot conceive a child after 50 years of age ? U **[Outside Delhi Set-II, Comptt. 2013]**

Ans. In human beings, menstrual cycle ceases around at 50 years of age and there will be no production of egg. It is the phase in a woman's life when menopause occurs, ovulation and menstruation stop. Hence, a woman cannot conceive a child after 50 years of age. **1**

Q. 9. Write the effect of the high concentration of L.H. on a mature graafian follicle.
R **[Delhi Set-III, 2014]**

Ans. Rupture of graafian follicle, release of ovum / oocyte / ovulation. **1**

[CBSE Marking Scheme, 2014]

Detailed Answer :

High level of LH induces rupture of graafian follicle so as to release the secondary oocyte or ovum from the ovary by a process called ovulation.

Commonly Made Error

- Many students fail to write the correct explanation.

Answering Tip

- Menstrual cycle should be learned with respect to: changes in the uterus and ovary, hormonal involvement.

Short Answer Type Questions-I

(2 marks each)

Q. 1. Name the stage of human embryo at which it gets implanted. Explain the process of implantation.

R **[Delhi Set-I, 2015]**

Ans. The embryo gets implanted at blastocyst stage.

The trophoblast gets attached to the endometrium uterine wall of mother by a process called implantation and the inner mass of cells gets differentiated as embryo. After attachment the uterine cells divide rapidly and cover the blastocyst. As a result the blastocyst gets embedded in the endometrium of the uterus. **2**

AI **Q. 2. How is 'oogenesis' markedly different from 'spermatogenesis' with respect to the growth till puberty in the humans ?**

U **[Delhi Set-I, 2011]**

Ans. Oogenesis is initiated at the embryonic stage. **1**
Spermatogenesis begins only at puberty. **1**

[CBSE Marking Scheme, 2011]

Commonly Made Error

- Students often get confused between the terms oogenesis and spermatogenesis.
- Carefully understand the differences between the two with the help of flow chart.

Q. 3. Enumerate the events in the ovary of a human female during :

(i) Follicular phase,

(ii) Luteal phase of menstrual cycle.

R **[Delhi Set-I, 2011]**

Ans. **(i) Follicular phase :** Follicular phase is also called the proliferative phase. During the phase, the FSH released by the pituitary stimulates the growth of the primary ovarian follicles and also causes maturation of the primary oocyte in this follicle. The follicular cells of the Graafian follicle secrete estrogen.

Due to an increased level of estrogen the uterine endometrium becomes thick, more vascular and more glandular. This phase lasts for about 10 to 14 days or until ovulation occurs.

(ii) Luteal phase : Development of corpus luteum, secretion of progesterone.

[CBSE Marking Scheme, 2011] 2

Commonly Made Error

- Many students write in general about the phases of the menstrual cycle whereas the role of hormones was asked. Some only mentioned the names of hormones without their specific functions.

Answering Tip

- While learning about events in menstrual cycle, stress upon the various hormones along with their functions.

Q. 4. Mention the relationships between pituitary and ovarian hormones during a menstrual cycle.

A **[Foreign 2017, Set - II]**

Ans. FSH stimulate follicular development and secretion of estrogen. **1**
LH induces ovulation and development of corpus luteum which secretes progesterone. **1**

[CBSE Marking Scheme, 2017]

Answering Tip

- The teacher must stress upon the various hormones along with their functions in the cycle during different phases.

Q. 5. Mention the relationship between concentration of luteinising hormone and maintenance of endometrium in the human uterus.

A **[Foreign 2017 Set - II]**

Ans. (Mid cycle) LH surge → formation of corpus luteum → progesterone, maintain the growth of endometrium. **½ × 4 = 2**

[CBSE Marking Scheme, 2017]

AI **Q. 6. (i) Arrange the following hormones in sequence of their secretion in a pregnant woman.**

(ii) Mention their source and the function they perform : hCG; LH; FSH; Relaxin.

R **[Delhi - 2017 Set - I]**

Ans. **(i)** FSH, LH, hCG, relaxin (all four hormones in correct sequence = **(1 if less than four correct = ½)**

(ii) FSH : Anterior pituitary, ½
stimulates follicular development ½
LH : Anterior pituitary, ½

rupture of Graafian follicle to release ovum / ovulation / dev. of corpus luteum ½

[CBSE Marking Scheme, 2017]

Commonly Made Error

- Many students misplaced the names of the hormones and hence could not write the correct logical sequence.

Short Answer Type Questions-II

(3 marks each)

Q. 1. (i) How many primary follicles are left in each ovary in a human female at puberty ?

(ii) Draw a sectional view of the ovary showing the different follicular stages of a human female in her pre-ovulatory phase of menstrual cycle.

R **[Outside Delhi Set-I & III, Comptt. 2016]**

Ans. (i) 60000-80000 primary follicles **1**

(ii) Refer to Topic 2/ Revision Notes/ Important Diagrams/ Fig 3.4 ½×4=2

[CBSE Marking Scheme, 2016]

Q. 2. Explain the events in a normal woman during her menstrual cycle on the following days :

(i) Ovarian event from 13-15 days

(ii) Ovarian hormones level from 16 to 23 days

(ii) Uterine events from 24 to 29 days.

A **[Delhi Set-I, Comptt. 2015]**

Ans. (i) Rupture of Graafian follicle leads to ovulation/ release of ovum.

(ii) Estrogen level is low.

(iii) Disintegration of endometrium and menstrual cycle begins again.

[CBSE Marking Scheme, 2015] 1+1+1

Q. 3. Explain the events in a normal woman during her menstrual cycle on the following days :

(i) Pituitary hormone levels from 8 to 12 days

(ii) Uterine events from 13 to 15 days

(iii) Ovarian events from 16 to 23 days.

A **[Outside Delhi Set-I, Comptt. 2015]**

Ans. (i) FSH and LH levels – low

(ii) Endometrium is highly vascularised, proliferative phase of uterine lining.

(iii) Formation of corpus luteum, secretion of progesterone.

[CBSE Marking Scheme, 2015] 1+1+1

Answering Tip

- Lay stress on the role of pituitary hormones and ovarian hormones in the events that takes place during menstrual cycle.

Q. 4. Draw a diagram of human sperm. Label only those parts along with their functions that assist the sperm to reach and gain entry into the female gamete. R **[Delhi Set-I, II, III, 2014]**

[NCERT]

Ans. Refer Topic 2/ Revision Notes/ Important Diagrams/ Fig 3.5 **1½**

Functions :

(i) Acrosome : Filled with enzymes that help enter the ovum. ½

(ii) Mitochondria (middle piece) : Energy source for movement of sperm to reach ovum. ½

(iii) Tail : For motility.

[CBSE Marking Scheme, 2014] ½

Q. 5. Draw a diagram of a mature sperm. Label any three parts and write their functions.

K **[Delhi/Outside Delhi, 2018]**

Ans. For diagram: Refer Topic 2/ Revision Notes/ Important Diagram/ Fig 3.2

Plasma membrane : Envelope of the sperm

Acrosome : Filled with enzyme that help fertilization of ovum

Mitochondria : Energy source for swimming

Middle Piece : Possess mitochondria which is the energy source for swimming

Tail : For movement of sperm

Nucleus : Containing chromosomal material

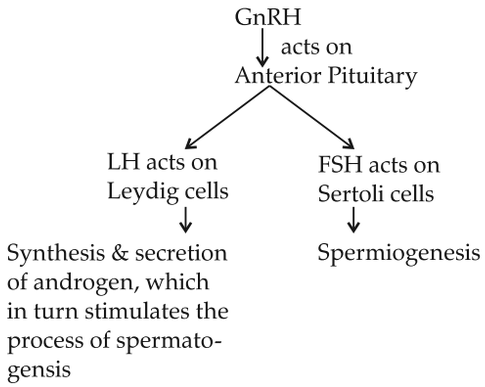
(Functions of the parts labelled)

[1½+1½ = 3 marks]

[CBSE Marking Scheme, 2018]

Q. 6. Explain the hormonal control of spermatogenesis in humans. R **[Delhi Set-II, 2014]**

Ans. Spermatogenesis is under the control of endocrine hormones. In human male reproductive system, spermatogenesis starts at the age of puberty due to significant increase in the secretion of gonadotropin-releasing hormone by hypothalmus. The increased level of GnRH then acts on the anterior pituitary gland and stimulates secretion of the two gonadotropins : Luteinising hormone (LH) and follicle stimulating hormone (FSH). LH acts on leydig cells and stimulates synthesis and secretion of androgens like testosterone which stimulates spermatogenesis. FSH acts on the sertoli cells and stimulates secretion of some factors which help in the process of spermiogenesis. Excess of testosterone inhibits the secretion of LH and GnRH. A glycoprotein called inhibin suppresses FSH synthesis. Thus normal release of testosterone is under negative feed back control.



3

Commonly Made Error

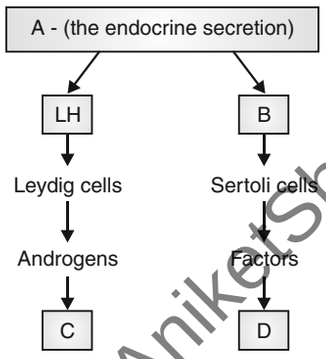
- Students often get confused between the name of hormones.

Answering Tip

- Use charts to learn the name of hormones and their role in spermatogenesis and oogenesis.

Q. 7. Identify A, B, C and D with reference to gametogenesis in humans in the flow chart given below :

A **[Outside Delhi Set-III, Comptt. 2012] [DDE]**



Ans. A - Pituitary
B - FSH
C - Spermatogenesis
D - Spermiogenesis **3**

Commonly Made Error

- Spelling mistakes are commonly observed.

Answering Tip

- Practice all spellings of technical word by writing on a piece of a paper.

AI **Q. 8. Draw a sectional view of human ovary and label the different follicular stages, ovum and corpus luteum.** R **[Delhi Set-I, 2011]**

Ans. Refer to Topic 2/ Revision Notes/ Important Diagrams/ Fig 3.4 **3**

Commonly Made Error

- Students often draw the female reproductive system instead of human ovary. The correct sequence of follicular growth is not shown by many students.

Q. 9. Give a schematic representation, showing the events of spermatogenesis in human male. R **[Outside Delhi Set-I, 2011]**

Ans. Refer to Topic 2/ Revision Notes/ Important Diagrams/ Fig 3.10 (a) **3**

Q. 10. Draw a labelled diagrammatic sectional view of a human seminiferous tubule. R **[Delhi 2017 Set - I, II, III]**

Ans. Refer- Topic 2/ Revision Notes/ Important Diagrams/ Fig 3.8

(Any three correct labelling) 1 × 3 = 3

OR

Topic 1/ Revision Notes/ Important diagrams/ Fig 3.2 **[CBSE Marking Scheme 2017]**

AI **Q. 11. (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. R **[Delhi Set-II, 2013]**

Ans. (i) Refer Topic 2/ Revision Notes/ Important Diagrams/ Fig 3.6

(ii) Function of zona pellucida : It is a glycoprotein layer surrounding the plasma membrane. It ensures that only one sperm can fertilize an ovum, because it induces certain changes in the membrane which block the entry of other sperms into the ovum just after fusion.

1½ + 1½ = 3

Q. 12. When do the oogenesis and spermatogenesis initiate in human females and males respectively ? [Delhi Set-II, 2012]

Ans. Oogenesis in females is initiated in the foetal or embryonic stage whereas spermatogenesis in males start at puberty. Sperm formation (spermatogenesis) in men continues even upto old age but formation of ovum in women ceases at about the age of 50 years with menopause. **3**

Long Answer Type Questions **(5 marks each)**

AI **Q. 1. (i) Explain the menstrual phase in a human female. State the levels of ovarian and pituitary hormones during this phase.**

(ii) Why is follicular phase in the menstrual cycle also referred as proliferative phase ? Explain.

(iii) Explain the events that occur in a graafian follicle at the time of ovulation and thereafter.

(iv) Draw a graafian follicle and label antrum and secondary oocyte.

R **[Outside Delhi Set-I, 2016]**

Ans. (i) Menstrual phase occurs when released ovum not fertilised, break down of endometrial lining (of the uterus) and its blood vessel form the liquid that comes out through the vagina , lasts for 3 to 5 days. **½ × 3 = 1**

Level of ovarian and pituitary hormones fall ½

(ii) Primary follicle grows into graafian follicle under the influence of LH & FSH, regeneration of endometrium (under the influence of estrogen). **½ × 2 = 1**

(iii) Graafian follicle ruptures to release the ovum (secondary oocyte) , remaining parts of the Graafian follicle transform into corpus luteum. **½ × 2 = 1**

(iv) For diagram: Refer to Topic 2/ Revision Notes/ Important Diagrams/ Fig 3.7 **1½**

[CBSE Marking Scheme, 2016]

Detailed Answer :

(i) Menstrual phase is the first phase of menstrual or sexual cycle of human females and all related primates.

It begins at puberty. The first menstruation that begins at puberty is called Menarche.

The cycle of events, starting from one menstruation till the next one is called menstrual cycle. In human females, menstruation occurs once in 28 to 29 days. These changes are brought about by ovarian and pituitary hormones. Menstrual phase refers to the beginning of menstruation wherein the endometrium along with its rich blood supply is shed (menses). During this phase, the levels of both the ovarian and the pituitary hormones are low. The level of follicle stimulating hormone starts to increase during the later stages of this phase. 1½

(ii) The menstrual phase is followed by the follicular phase wherein the primary follicles mature into the Graafian follicle under the influence of FSH and LH. The developing follicles release oestrogen which causes the regeneration of the endometrium. Since, the follicles and the endometrium proliferate during the follicular phase; it is also known as proliferative phase. 1½

(iii) At the time of ovulation, the release of gonadotrophins (LH and FSH) increases. The LH and FSH are at their peak in the middle of the cycle (14^{th} day). The increased level of LH causes the rupturing of Graafian follicle and release of ovum into the fallopian tube. The release of ovum from ruptured Graafian follicle is known as ovulation. The remains of the Graafian follicle get converted into the corpus luteum, which secretes progesterone for the maintenance of the endometrium in case of pregnancy. **1**

Answering Tip

- Learn menstrual cycle with respect to: changes in the uterus and ovary, and hormonal involvement.

Q. 2. (i) Briefly explain the events of fertilization and implantation in an adult human female.

(ii) Comment on the role of placenta as an endocrine gland. R **[Delhi Set-I, 2016]**

Ans. (i) (a) On the 14^{th} day of menstrual cycle, ovulation takes place which releases secondary oocyte.

(b) This secondary oocyte is caught by fimbriae and it starts moving up the fallopian tube.

(c) In the meantime, sperms which have been deposited in vagina start moving up and reach the fallopian tube.

(d) The two meet at ampullary isthmus junction and fuse together.

(e) After entry of sperm secondary oocyte completes its meiosis II, changes the ovum and fuse with sperm's pronuclei leading to zygote formation.

(f) This zygote after sometime starts dividing. It changes to morula (8-16 celled), which continues to divide to form the blastocyst. The morula moves further into the uterus.

(g) The cells in the blastocyst are arranged into an outer trophoblast and an inner cell mass.

(h) The trophoblast gets attached to the uterine endometrium and the process is called implantation. This leads to pregnancy. The inner cell mass gets differentiated to form the embryo. **3**

(ii) Placenta as endocrine gland produces :

(a) hCG (Human Chorionic Gonadotropin)

(b) hPL (Human Placental Lactogen)

(c) Oestrogen

(d) Progesterone

(e) In the later stages of pregnancy, it also releases relaxin. These hormones support foetal growth and help in maintaining pregnancy. **2**

Q. 3. (i) Where does spermatogenesis occur in human testis ? Describe the process of spermatogenesis upto the formation of spermatozoa.

(ii) Trace the path of spermatozoa from the testis upto the ejaculatory duct only. [Foreign Set-I, 2016]

Ans. (i) Seminiferous tubules

Diagram: Refer Topic 2/ Revision Notes/ Important Diagrams/ Fig 3.10 (a) **½ × 6 = 3**

(ii) Seminiferous tubules → rete testis → Vasa efferentia → Epididymis → vas deferens → (ejaculatory duct) **½ + ½ + ½ + ½**

[CBSE Marking Scheme, 2016]

Detailed Answer :

(i) Spermatogenesis

(a) It is the process of formation of sperms in seminiferous tubules of testis.

(b) It has two stages namely, Formation of spermatids and Spermiogenesis

(c) In the formation of spermatids, the spermatogonia i.e., Sperm mother cells or immature male germ cells produce spermatids.

(d) In spermiogenesis, the spermatids are transformed into sperm.

(ii) As above

Answering Tips

- Understand the proper sequence of events in spermatogenesis.
- Understand the topics- oogenesis and spermatogenesis separately with the help of flow chart.

Q. 4. Explain the process of spermatogenesis in humans. U **[Outside Delhi Set-I & III, Comptt. 2016]**

Ans. Spermatogenesis is the formation of sperm in seminiferous tubules of testis. It has two stages :

(i) Formation of Spermatids

(ii) Spermiogenesis.

In the formation of spermatids, the sperm mother cells or Spermatogonia produce spermatids and in spermiogenesis, the spermatids are transformed into sperms or spermatozoan. At the time of sexual maturity, the primary germ cells divide mitotically to form a large number of spermatogonia which later on grow in size and form primary spermatocytes. The primary spermatocyte undergo meiosis-I to produce small haploid secondary spermatocytes which divide by meiosis II to form spermatids. The spermatids under the influence FSH is metamorphosed into spermatozoa. **The schematic representation of spermatogenesis is as follows :**

Refer Revision Notes/ Important Diagrams/ Fig 3.10 (a). **5**

AI **Q. 5. Differentiate between spermatogenesis and oogenesis.** U **[CBSE, SQP, 2018]**

Ans. Oogenesis is different from that of spermatogenesis in the following ways: -

(a) In spermatogenesis, continuous production of sperms takes place from puberty to old age. Whereas, in oogenesis, the oocytes are generated before birth/ in the foetus. **1**

(b) A large number of these oocytes degenerate during the phase from birth to puberty. The oocytes continuously decrease in number and it gets completely exhausted at menopause. **1**

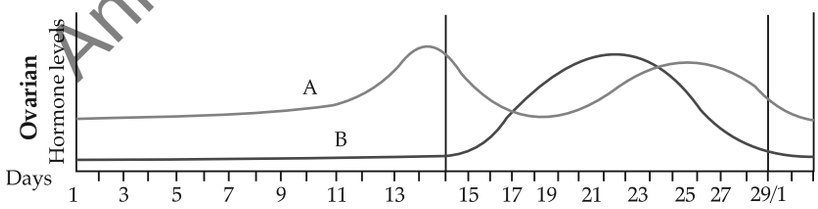
(c) A primary spermatocyte completes the first meiotic division leading to formation of two equal sized secondary spermatocytes whereas, Primary oocyte divides unequally by the first meiotic division resulting in the formation of a large haploid secondary oocyte and a tiny first polar body. 1

(d) Meiotic division of secondary oocyte gets temporarily arrested at Prophase-I stage. It is completed only when a sperm comes in contact with the zona pellucida layer of the ovum. There is no such event in spermatogenesis. 1

(e) Spermatogonium produces 4 functional spermatozoa whereas an oogonium produces one functional ovum and 3 non-functional polar bodies. 1

[CBSE Marking Scheme, 2018]

Q. 6. The graph given below shows the variation in the levels of ovarian hormones during various phases of menstrual cycle : E & A **[CBSE SQP, 2017-18]**



(i) Identify 'A' and 'B'.

(ii) Specify the source of the hormone marked in the diagram.

(iii) Reason out : why A peaks before B.

(iv) Compare the role of A and B.

(v) Under which condition will the level of B continue to remain high on the 28th day?

Ans. (i) A–Estrogen ½ × 2 = 1
B–Progesterone

(ii) A–Maturing ovarian follicle/Graafian follicle ½ × 2 = 1
B–Corpus luteum

(iii) Formation of Graafian follicle (releases estrogen) is followed by the formation of corpus luteum (releases progesterone) **1**

(iv) Role of A (Estrogen)—Leads to changes in the ovary and uterus/regeneration of endometrium through proliferation ½

Role of B (Progesterone)—Maintenance of endometrium for implantation of the fertilized ovum/ maintenance of other events of pregnancy ½

(v) In case of pregnancy. **1**

[CBSE Marking Scheme, 2016]

AI **Q. 7. (i) Name the hormone that initiates spermatogenesis in humans. Describe the process of spermatogenesis in sequence mentioning the ploidy of the cells at each step.**

(ii) Draw the diagram of a mature human sperm and label the parts that

(a) helps it reaching to the ovum.

(b) providing energy for it to reach the ovum.

(c) helping it to gain entry into the ovum.

R **[Delhi Set-III, Comptt. 2015]**

Ans. (i) Gonadotropin releasing hormone/ GnRH. **1**

Process of spermatogenesis :

(a) The spermatogonia (present on inside wall of seminiferous tubules) are diploid (2N).

(b) Primary spermatocytes undergo Ist meiosis leading to the formation of two equal haploid cells (N) called secondary spermatocyte.

(c) The secondary spermatocytes undergo the second meiotic division to form 4 equal haploid (N) spermatids. **2**

(d) Now spermatids transform into spermatozoa (N)

(ii) For diagram Refer to Topic 2/ Revision Notes/ Important Diagrams/ Fig 3.5 ½

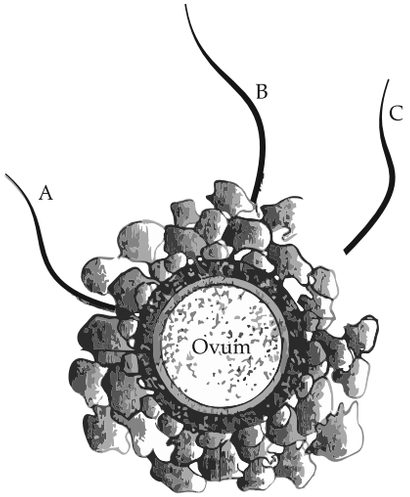
(a) Tail ½

(b) Middle piece/mitochondria ½

(c) Acrosome ½

[CBSE Marking Scheme, 2015]

Q. 8. Given below is the diagram of a human ovum surrounded by a few sperms. Observe the diagram and answer the following questions :



(i) Compare the fate of sperms shown in the diagram.

(ii) What is the role of zona pellucida in this process ?

(iii) Analyze the changes occurring in the ovum during the process.

(iv) How is the entry of sperm into the ovum facilitated ?

(v) Specify the region of female reproductive system where the event represented in the diagram takes place.

E & A **[CBSE SQP, 2017-18]**

Ans. (i) A is able to penetrate / fertilize the ovum, whereas B and C are unable to penetrate / fertilize // B and C will degenerate. **½ × 2 = 1**

(ii) Zona pellucida ensures the entry of only one sperm into the ovum 1

(iii) Induces completion of meiotic division of the secondary oocyte, formation of second polar body and a haploid ovum ½ × 2 = 1

(iv) Enzymes of acrosome help (½ mark if only acrosome' is written) 1

(v) Ampullary - isthmic junction of the fallopian tube 1

[CBSE Marking Scheme, 2017]

Q. 9. (i) Explain the hormonal regulation of spermatogenesis in humans.

(ii) Draw the diagram of a human sperm. Label and write the functions of the components of its head.

R **[Foreign 2017 Set-I]**

Ans. (i) Initiation by GnRH from hypothalamus which acts on Anterior lobe of Pituitary gland to release FSH & LH (Gonadotropins) **1**

LH acts on cells of Leydig / Interstitial cells to secrete androgens. ½

Androgens in turn stimulates the process of spermatogenesis. ½

FSH acts on Sertoli cells and stimulates the secretions of some factors that stimulate spermiogenesis. **1**

(ii) Refer Topic 2/ Revision Notes/ Important Diagrams/ Fig 3.5

(Label any two parts of the head) **1**

Function of plasma membrane : Envelopes the whole body of sperm.

Acrosome : Contains enzymes for fertilization.

Nucleus : Contains haploid chromosomal material. **(Any two = ½ + ½ = 1)**

[CBSE Marking Scheme, 2017]

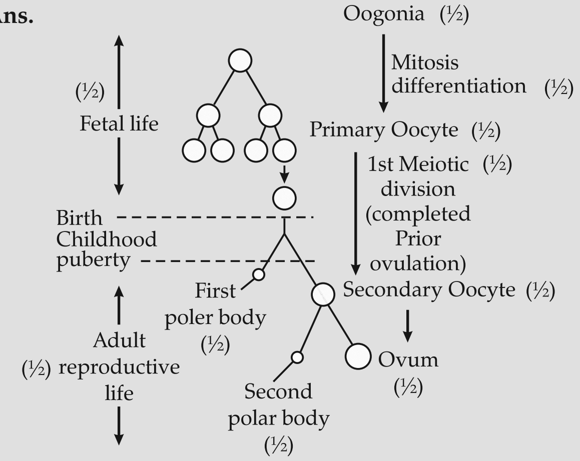
Commonly Made Error

- Many students mention the names of hormones without their specific functions. Very few candidates mentioned the role of GnRH.

Q. 10. Explain the process of development of a mature human female gamete from the time it is initiated till the formation of ootid.

R **[Foreign 2017 Set - III]**

Ans.



[CBSE Marking Scheme 2017] 5

Detailed Answer :

Oogenesis is initiated in embryonic stage when millions of egg mother cells are formed within each ovary. Oogonia multiply to form primary oocytes which enter into prophase-I of the meiosis and get temporarily arrested at that stage. Each primary oocyte then get surrounded by a layer of granulosa cells and is called the primary follicle. A large number of these follicles degenerate before reaching puberty and the remaining ones get surrounded by more layers of granulosa cells and a new theca. These are now called secondary follicles. The secondary follicles are then converted into tertiry follicles that have characteristic fluid filled cavity called antrum. In this stage, the primary oocyte present within the tertiary follicle completes meiosis, which results in the formation of haploid secondary oocyte and a tiny polar body. This tertiary follicle further changes into the graafian follicle. The secondary oocyte in the graafian follicle is surrounded by the zona pellucida. Then graafian follicle ruptures to release the ovum by ovulation.

Answering Tip

- Make sure you draw the graphic representation of Oogenesis in proper sequence. Practice thorougly.

Q. 11. (i) Draw a sectional view of a seminiferous tubule of human. Label sertoli cell, spermatogonia and leydig cell on it and write their functions.

(ii) Explain the role of pituitary and sex hormones in the process of spermatogenesis.

R [Outside Delhi Set-I, Comptt. 2015]

Ans. (i) For diagram: Refer Topic 1/ Revision Notes/ Important diagrams/ Fig 3.2 **½ × 3 = 1½**

Functions : Sertoli cells - secrete factors which help in the process of spermiogenesis/provide nutrition to germ cells.

Spermatogonia - divide to produce spermatids /sperms.

Leydig cells - synthesis or secretion of androgens/testosterone. **1½**

(ii) Pituitary hormones - LH (luteinising hormone) – acts on Leydig cells and stimulates synthesis and secretion of androgens.

FSH/follicle stimulating hormone - acts on sertoli cells and simulates secretion of some factor that help in spermiogenesis.

Sex hormone - (Androgen/testosterone) stimulate process of spermatogenesis. 2

[CBSE Marking Scheme, 2015]

Q. 12. When and where are primary oocytes formed in a human female ? Trace the development of these oocytes till ovulation (in menstrual cycle). How do gonadotropins influence this developmental process ? **U [Delhi Set-I, 2014]**

Ans. (i) The primary oocytes are formed in the foetal ovary during the development of the foetus. The ovum is formed by the process of oogenesis. **1**

(ii) During embryonic growth, millions of gamete mother cells (oogonia) are formed in the foetal ovary. These cells undergo meiosis, but get temporarily arrested at prophase and are called primary oocytes. Before reaching puberty, a large number of primary oocytes degenerate and the remaining ones get surrounded by layers of granulosa cells and a new theca. These are called secondary follicles. The secondary follicles are then converted into tertiary follicles that have characteristic fluid-filled cavity called antrum. At this stage, the primary oocyte present within the tertiary follicle completes meiosis, which results in the formation of haploid secondary oocyte and a tiny polar body. This tertiary follicle further changes into the Graafian follicle. The secondary oocyte in the Graafian follicle is surrounded by the zona pellucida. Then, the Graafian follicle ruptures to release the ovum by ovulation. **2**

(iii) Role of gonadotropins : The gonadotropins (Follicle Stimulating Hormone and the Luteinising Hormone) are released by the anterior portion of the pituitary gland. The maturation of the primary follicles into the Graafian follicles occurs during the follicular phase. The secretion of gonadotropins increases during this phase, cause follicular growth and the growing follicles produce oestrogen. The LH and FSH are at their peak in the middle of the cycle (14^{th} day) and cause the rupture of the Graafian follicles to release ovum. This phase is called the ovulatory phase. **2**

Q. 13. Explain the ovarian and uterine events that occur during a menstrual cycle in a human female, under the influence of pituitary and ovarian hormones respectively.

U [Outside Delhi Set-II, 2014]

Ans. Menstrual cycle is the reproductive cycle in all primates and begins at puberty (menarche). In human females, menstruation occurs once in 28 to 29 days. The cycle of events starting from one menstruation till the next one is called the menstrual cycle. During the middle of the menstrual cycle,

one ovum is released (ovulation). The cycle starts with the menstrual flow (3 to 5 days), caused due to the breakdown of the endometrium of the uterus. Blood vessels ruptures, causing bleeding. But this occurs only when the ovum is not fertilised.

It is followed by the follicular phase where the primary follicles mature into Graafian follicles. This causes the regeneration of the endometrium. These changes are brought about by ovarian and pituitary hormones. In this phase, the release of gonadotropins (LH and FSH) increases. This causes follicular growth and the growing follicles produce oestrogen. The LH and FSH are at their peak in the middle of the cycle (14^{th} day) and cause the rupture of the Graafian follicles to release ovum. This phase is called the ovulatory phase. The remains of the Graafian follicles get converted into the corpus luteum, which secretes progesterone for the maintenance of the endometrium. In the absence of fertilisation, the corpus luteum degenerates, thereby causing the disintegration of the endometrium and the start of a new cycle. 5

Q. 14. (i) Write the specific location and the functions of the following cell in human male :

(a) Leydig cells

(b) Sertoli cells

(c) Primary spermatocyte

(ii) Explain the role of any two accessory glands in human male reproductive system.

[Delhi Set-I, 2011]

Ans. (i) (a) Leydig cells : Refer Q. 2 (ii) 'SA-I' of topic I. **½ + ½ = 1**

(b) Sertoli cells : Refer Q. 2 (i) 'SA-I' of topic I. **½ + ½ = 1**

(c) Primary spermatocytes found in the inner lining of seminiferous tubules. They undergo meiosis and form sperms. **½ + ½ = 1**

(ii) The accessory glands are seminal vesicle, prostate gland, bulbourethral gland. **(Any two) ½ + ½ = 1**

Secretion of these glands constitute seminal plasma which is rich in fructose, calcium and certain enzymes provide nourishment to sperms, secretion of bulbourethral glands also help in lubrication of penis. **(Any two) ½ + ½ = 1**

Q. 15. (i) Draw a diagram of a human sperm. Label the different components in its head and middle piece region.

(ii) Explain the process of fertilisation in human female.

[Delhi 2017 Set - III (Comptt.]

Ans. (i) For diagram: Refer to Revision Notes/ Topic 2/ Important diagram/ Fig 3.5

Any 6 correct labelling in head and middle piece ½ × 6

(ii) A sperm comes in contact with zona pellucida layer of ovum and induces changes in the membrane that block the entry of additional sperm, secretions of acrosome help the sperm to enter into cytoplasm of ovum (through zona pellucida and plasma membrane), this induces completion of unequal meiotic division of secondary oocyte which leads to formation of a second polar body and haploid ovum, soon haploid nucleus of sperm and ovum fuse to form zygote (fertilization)

[CBSE Marking Scheme 2017] ½×4=2

Q. 16. (i) Draw a diagram of a sectional view of human ovary and label (i) Primary follicle; (ii) Tertiary follicle; (iii) Graafian follicle and; (iv) Corpus luteum.

(ii) Write the function of corpus luteum.

[Outside Delhi 2017 Set - I, II, III]

Ans. (i) For diagram: Refer to Topic 2/ Revision Notes/ Important diagram/ Fig 3.4 3

(ii) Corpus luteum secretes progesterone, which is essential for maintenance of endometrium.

[CBSE Marking Scheme, 2017] 2

Q. 17. (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. **[Outside Delhi, Set I, II, III, 2017]**

Ans. (i) (a) Menstrual phase : First 3-5 days of the cycle where menstrual flow occurs due to break down of endometrial lining of uterus, if the released ovum is not fertilised **½ + ½**

(b) Follicular phase : From 5th to 14th day of the cycle where the primary follicles grow to become a fully mature Graafian follicle, endometrium of uterus regenerates, Graafian follicle ruptures to release ova (ovulation on 14^{th} day) **½ × 3**

(c) Luteal Phase : During 15^{th} to 28th day, remaining parts of graafian follicle transform into corpus luteum, secretion of progesterone (essential for maintenance of endometrium) **½ × 2**

All these phases are under the influence of varying concentrations of pituitary and ovarian hormone ½

(ii) Yes, can take appropriate precautions between 10^{th} to 17^{th} day of the menstrual cycle when the chances of fertilisation are high. **½ + ½**

[CBSE Marking Scheme, 2017]

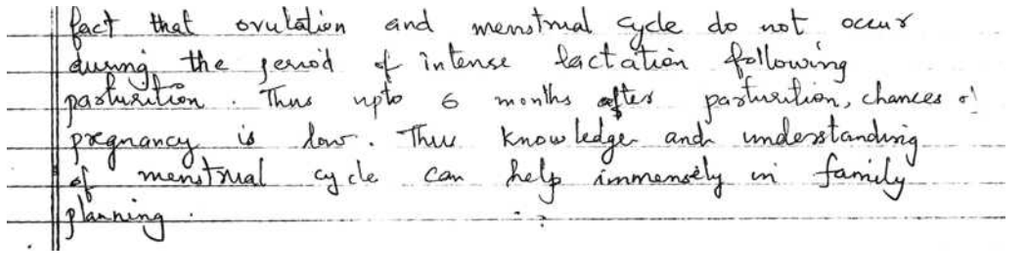
OR

i). Menstrual phase :- It lasts for 3-5 days during which menstrual flow occurs due to the breakdown of endometrium and its blood vessels. This occurs due to decrease in the level of luteinising hormone (LH) which results in regression of corpus luteum, thereby decreasing progesterone level. This leads to breakdown of endometrium. Menstruation is indicature of normal reproductive cycle and its absence may be indicating pregnancy or stress, poor health etc

Follicular phase :- This phase follows the menstrual phase. The FSH levels are high initially which results in the selection of 1 1° follicle from one ovary. It develops into 2°, 3° and finally mature graafian follicle. The developing follicular cells secrete estrogen, which controls this phase. Estrogen gives a negative feed back to FSH, so as to decrease its level and prevents further selection of 1° follicle. It also rebuilds the endometrium through rapid proliferation. At the middle of the cycle, the FSH& LH level will be maximum. The rapid secretion of LH causing the maximum level of LH is known as LH surge which induces ovulation. The release of 2° oocyte arrested at Metaphase II occurs. The ruptured graafian follicle transforms into corpus luteum, which starts secreting progesterone. Estrogen level falls down. Thus the cycle moves to next phase.

Luteal phase :- is under the control of progesterone. It continues rebuilding of endometrium. It also quitens the uterus expecting fertilisation and implantation. When fertilisation does not occur, the high progesterone level gives negative feedback to LH. Decrease in LH regresses corpus luteum, progesterone level falls. The endometrium breakdown moving into next menstrual cycle.

The understanding of menstrual cycle can be applied in family planning through the use of natural methods of contraception. One of the methods known as periodic abstinence is based on the fact ovulation occurs at the middle of menstrual cycle. By abstaining from coitus during day 10 to 17 of menstrual cycle, conception can be avoided since this is period during which ovulation is expected. This is called fertile period since chances of fertilisation is very high during this period. Another method, lactational amenorrhea is based on the


fact that ovulation and menstrual cycle do not occur during the period of intense lactation following pasturition. Thus upto 6 months after pasturition, chances of pregnancy is low. Thus knowledge and understanding of menstrual cycle can help immensely in family planning.

[Topper's Answer 2017]

Commonly Made Error

- Some students explain the entire menstrual cycle with phases and events.

Answering Tip

- Students should be aware about the concept of menstrual cycle.

Q. 18. (a) Explain menstrual cycle in human females.

(b) How can the scientific understanding of the menstrual cycle of human females help us a contraceptive measure ?

pK [Delhi/Outside Delhi, 2018]

Ans. (a) (i) Menstrual Phase : Menstrual flow occurs / due to breakdown of endometrial lining of uterus, when fertilization does not occur.

(ii) Follicular Phase : Primary follicles grow into mature graafian follicles and endomentrium regenerates through proliferation, changes induced by pituitary and ovarian hormones.

(iii) Ovulatory Phase : LH surge, induces rupture of graafian follicle and release of secondary oocyte /ovum during middle of cycle (i.e. 14th day).

(iv) Luteal phase : Ruptured graafian follicle transforms into corpus luteum which secrete large amount of progesterone, essential for maintaining endometrium. **1 × 4**

(b) Because ovulation occurs during mid cycle chances of fertilization are very high so, couples should abstain from coitus between day 10 – 17. ½ + ½

[CBSE Marking Scheme, 2018]

Answering Tip

- Menstrual cycle should be taught with respect to: changes in the uterus and ovary, hormonal involvement.

AI **Q. 19. (i) Draw a diagrammatic sectional view of a seminiferous tubule (enlarged) of human male and label (i) Spermatogonium (ii) Sertoli cell, (iii) Primary spermatocyte. Write the function of each labelled part.**

(ii) Differentiate between spermatogenesis and spermiogenesis.

R **[Delhi 2017, Set - II Comptt.]**

Ans. (i) For diagram: Refer Topic 2/ Revision Notes/ Important Diagram/ Fig 3.7 ½ × 3

Spermatogonium - multiply by mitotic division to increase in number. ½

Sertoli cells - provide nourishment to developing sperms. ½

Primary spermatocytes - undergo meiosis to form haploid secondary spermatocytes. ½

(ii) Spermatogenesis - Development of sperms in testis from spermatogonium. **1**

Spermiogenesis - Maturation of spermatids into spermatozoa / sperms. **1**

[CBSE Marking Scheme, 2017]

Q. 20. Draw a human sperm and label acrosome and middle piece. Mention their functions.

R **[Delhi Set-I & III, Comptt. 2016]**

OR

Draw the microscopic structure of human sperm and relate its different parts with their functions.

[Outside Delhi Set-II & III Comptt. 2016]

Ans. For Diagram: Refer Topic 2/ Revision Notes/ Important diagram/ Fig 3.5

Functions of parts :

(i) Plasma membrane—envelops the whole body of sperm.

(ii) Acrosome—filled with enzymes that help in fertilization of the ovum.

(iii) Middle piece—Contains numerous mitochondria which produce energy for the movement of tail.

(iv) Tail—facilitates sperm motility, essential for fertilization.

(v) Mitochondria—produce energy.

(vi) Nucleus—Carries haploid set(n) of genes.

1+4=5

[CBSE Marking Scheme, 2016]

Q. 21. (i) Draw diagrammatic sectional view of the female reproductive system of human and label the parts :

(a) Where the secondary oocytes develop

(b) Which helps in collection of ovum after ovulation

(c) Where fertilization occurs.

(d) Where implantation of embryo occurs.

(ii) Explain the role of pituitary and the ovarian hormones in menstrual cycle in human females.

U **[Delhi Set-I, 2013]**

Ans. **(i) (a)** Ovary

(b) Fimbriae

(c) Isthmus and ampulla junction

(d) Endometrium

For diagram: Refer Topic 1/ Revision Notes/ Important diagram/ Fig 3.3 **3**

(ii) (a) Role of pituitary hormones : FSH (Follicular Stimulating Hormone) and LH (Luteinising hormone) are the pituitary hormones which are secreted during menstrual cycle in human females. FSH stimulates the growth of primary oocyte into secondary oocyte and graafian follicle while LH induces ovulation.

(b) Role of ovarian hormones : Oestrogen and progesterone are the ovarian hormones. Oestrogen stimulates the proliferation of endometrium of uterine wall, while progesterone has an important role in the maintenance of endometrium for implantation of fertilized ovum and in other events of pregnancy. **2**

TOPIC-3
Fertilization and Post-Fertilization Events

Revision Notes

Fertilization

- The process of fusion of male gamete (sperm) with the female gamete (ovum) is called fertilization.
- During copulation, semen is released through the penis into the vagina (insemination).
- After insemination, the sperms swim through the cervix and enter into the uterus and reach the ampullary-isthmic junction of the oviduct where fertilization takes place.
- The process of fertilization takes place as follows :

Sperms → vagina → cervical canal → uterus → isthmus

↓

Fertilization ← Ampullary-isthmic Junction

↑

Ovum (from ovary) → fimbriae → infundibulum → ampulla

- Fertilization (sperm + ovum → zygote) occurs only if ovum & sperms are transported simultaneously. So all copulations do not lead to fertilization and pregnancy.
- As soon as sperm contacts with zona pellucida, it induces changes in the membrane that block entry of additional sperms.
- With the help of enzymes of the acrosome, which dissolve the zona pellucida and plasma membrane of the ovum, the sperm enters into the cytoplasm of the ovum. This induces second meiotic division of the secondary oocyte to form a second polar body and a haploid ovum (ootid).
- The haploid nuclei of the sperm and ovum fuse together to form a diploid zygote.

Implantation

- The mitotic division (cleavage) starts as the zygote moves through the isthmus of oviduct towards the uterus and forms 2, 4, 8, 16 daughter cells called blastomeres.
- The embryo with 8-16 blastomeres is called a morula.
- Morula continues to divide and transforms into a large mass of cells called blastocyst, which moves further towards the uterus.
- The blastomeres in the blastocyst are arranged into an outer layer (trophoblast) and an inner group of cells (inner cell mass) attached to trophoblast.
- The trophoblast layer then gets attached to endometrium and the inner cell mass gets differentiated to three germ layers namely, outer ectoderm, middle mesoderm and inner endoderm forming 3-layered structure (gastrula) leading to the formation of embryo.
- After attachment, uterine cells divide rapidly and cover the blastocyst.
- As a result, the blastocyst becomes embedded in the endometrium of the uterus. This is called implantation.

Pregnancy and Embryonic Development

- After implantation, the finger-like projections called chorionic villi appear on the trophoblast which is surrounded by the uterine tissue and maternal blood.
- The chorionic villi and uterine tissue become interdigitated with each other and form a structural and functional unit between developing embryo and the maternal body called placenta.
- The placenta is a structural and functional unit between embryo (foetus) and maternal body.
- Placenta is connected to the embryo by an umbilical cord.
- The umbilical cord helps to transport substances to and from the embryo.

Functions of Placenta

- It acts as barrier between the foetus and mother.
- Soluble inorganic and organic materials, nutrients, hormones, antibodies etc can pass through the placenta from the mother to foetus.
- It helps in the gas exchange between mother and foetus.
- It helps to eliminate nitrogenous wastes of foetus.
- It acts as an endocrine gland by secreting several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), oestrogens, progesterone and relaxin.

Pregnancy

- During pregnancy, levels of estrogen, progestogen, cortisol, prolactin, thyroxine etc are also increased in maternal blood.
- They support the fetal growth, metabolic changes in the mother and maintain pregnancy.
- Three germ layers (ectoderm, endoderm, mesoderm) give rise to all tissues (organs) in adults.
- The stem cells in inner cell mass have the potency to give rise to all the tissues and organs.
- Human pregnancy (gestation period) lasts 9 months (for cats : 2 months, dogs : 2 months, elephants : 21 months).

Changes in Embryo during Pregnancy

- After one month of pregnancy : Heart is formed.
- End of second month : Limbs and digits are developed.
- End of 12 weeks (first trimester) : The major organs such as limbs, external genital organs etc., are well developed.
- During 5th month : First movement of foetus and appearance of hair on the head.
- End of 24 weeks (second trimester) : Body is covered with fine hair, eyelids separate and eye lashes are formed.
- End of 9 months : Ready for delivery.

Parturition (Labour) and Lactation

- The process of giving birth to young ones after the gestation period of nine months is known as parturition.
- Parturition is induced by neuroendocrine mechanism.
- The signals originating from the foetus and placenta induce mild uterine contractions (fetal ejection reflex). This causes the release of oxytocin from maternal pituitary.
- Oxytocin causes stronger uterine muscle contractions which in turn stimulate further secretion of oxytocin. This process is continued leading to expulsion of the baby out of the uterus through the birth canal.
- After parturition, the umbilical cord is cut off.
- The placenta and remnants of umbilical cord are expelled from the maternal body after parturition. This is called "after birth".

Lactation

- The mammary glands produce milk towards the end of pregnancy by the process called lactation.
- The yellowish milk produced during the initial few days of lactation is called colostrum.
- The colostrum contains several antibodies essential to develop resistance for the new born babies.

IMPORTANT DIAGRAM:

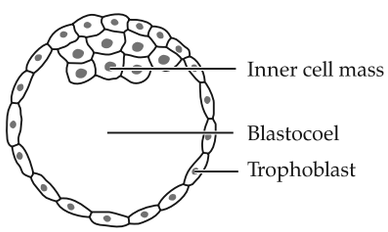


Fig 3.11: Diagram of a Blastocyst

Very Short Answer Type Questions (1 mark each)

Q. 1. Name the embryonic stage that gets implanted in the uterine wall of human female.

R **[Delhi Set-I, 2014]**

Ans. Blastocyst. **[CBSE Marking Scheme, 2014] 1**

Q. 2. How is the entry of only one sperm and not many ensured into an ovum during fertilization in humans? U **[Outside Delhi Set-II, 2012]**

Ans. During fertilization, 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. **1**

Q. 3. Mention the function of trophoblast in human embryo. R **[Delhi Set-I, 2011]**

Ans. It helps in implantation and leads to pregnancy. **1**

AI **Q. 4. What stimulates pituitary to release the hormone responsible for parturition ? Name the hormone.** R **[Outside Delhi Set-I, 2011]**

Ans. Foetal ejection reflex that originates from the fully developed foetus and placenta is responsible for parturition. The hormone is oxytocin. ½ + ½ = **1**

Q. 5. Explain the function of myometrium and endometrium in human females.

U **[Delhi Set-I, Comptt. 2011]**

Ans. **(i)** The myometrium exhibits strong contraction during parturition.

(ii) Endometrium prepares uterus for pregnancy by undergoing cyclic changes. ½ + ½ = **1**

Q. 6. Explain the function of umbilical cord.

R **[Outside Delhi Set-I, 2012]**

Ans. Umbilical cord connects placenta with the foetus. It helps in the transport of nutrients, respiratory gases and metabolic wastes to and fro between mother and foetus. **1**

Q. 7. During fertilization hundreds of sperms are in the vicinity of an egg cell; but only one sperm enters the ovum. How is this achieved.

E & A **[Outside Delhi Set-II, 2012]**

Ans. During fertilization when a sperm comes in contact with the egg it induces changes in zona pellucida of ovum and this blocks the entry of any other sperm. This ensures the entry of only one sperm. **1**

Short Answer Type Questions-I (2 marks each)

Q. 1. State the role of Oxytocin in parturition. What triggers its release from the pituitary ?

R **[Foreign Set-II, 2016]**

Ans. Oxytocin acts on uterine muscle, and cause stronger uterine contraction, leading to expulsion of the foetus/baby out of uterus. ½ × 3 = 1½
The signals from fully formed foetus and the placenta which induce mild uterine contraction/ foetal ejection reflex triggers release of oxytocin.
[CBSE Marking Scheme, 2016] ½

Q. 2. Explain the events that follow upto fertilization when the sperms come in contact with the ovum in the fallopian tube of a human female.

U **[Foreign Set-III, 2016]**

Ans. The secretion of the acrosome help the sperm to enter into the cytoplasm of ovum through zona pellucida and the plasma membrane, this induces the completion of second meiotic division of the secondary oocyte, forming second polar body and a haploid ovum, soon the haploid nucleus of the sperm and the ovum fuse together to form a diploid zygote.
[CBSE Marking Scheme, 2016] ½ × 4 = **2**

Q. 3. When and where do chorionic villi appear in humans ? State their function.

R **[Delhi Set-I, III, 2013]**

Ans. Chorionic villi are finger like projections that arise from the trophoblast layer that develops in the blastocyst after it has undergone implantation in the uterus. The chorionic villi and uterine tissue get interdigitated with each other to form a structural and functional unit between embryo (foetus) of maternal body, called as placenta. Placenta is connected with the embryo by umbilical cord. It helps to transport substances to and from the embryo. **1+1=2**

Q. 4. Name the stage of the human embryo that gets implanted in the uterus and draw its labelled diagram.

R **[Outside Delhi Set-II, Comptt. 2013]**

Ans. Blastula or Blastocyst (32-celled stage).

For diagram: Refer to Topic 3/ Revision Notes/ Important diagrams/ Fig 3.11 **1 + 1 = 2**

AI **Q. 5. (i) Where do the signals for parturition originate from in humans ?**

(ii) Why is it important to feed the newborn babies on colostrum ? R **[Delhi Set-II, 2012]**

Ans. **(i)** From the fully developed foetus / placenta / foetal ejection reflex. **1**

(ii) It contains antibodies (IgA), provides immunity to the child. ½ + ½
[CBSE Marking Scheme, 2012]

Detailed Answer :

(i) The signals for parturition in humans originate from the fully developed foetus and the placenta which induce mild uterine contractions called foetal ejection reflex.

This causes the release of oxytocin from maternal pituitary.

(ii) The milk that comes out of the mammary glands during initial period of lactation and after parturition is called colostrum. It contains several antibodies, nutrients and is low in fat contents. It provides immunity to the child. Therefore, it is important to feed the new born babies colostrum. Breast feeding is also recommended by doctors for bringing up a healthy baby.

AI **Q. 6. Write the function of each one of the following :**

(i) (Oviducal) Fimbriae

(ii) Oxytocin R **[Outside Delhi Set-I, 2012]**

Ans. (i) Collection of ovum released by ovary.

(ii) Causes uterine contraction for parturition / promotes milk ejection. **1 × 2 = 2**

[CBSE Marking Scheme, 2016]

Detailed Answer :

(i) Help in collection of ovum from ovary after ovulation.

(ii) Oxytocin cause uterine contraction for parturition. It also promotes lactation and milk ejection from mammary glands.

Q. 7. Differentiate between morula and blastocyst.

U **[Delhi Set-I, Comptt. 2012]**

Ans. Morula is a mulberry like solid mass of 8-16 cells called blastomeres, formed by cleavage of zygote, while the blastocyst is a hollow sphere of 64 cells formed by the rearrangement of blastomeres of morula. It has a cavity called blastocoel and an inner cell mass within. It also has an outer envelop of cells called the trophoblast. **2**

Q. 8. What happens to corpus luteum in human female if the ovum is (i) fertilized, (ii) not fertilized?

U **[Outside Delhi Set-I, Comptt. 2015]**

Ans. (i) Corpus luteum continues to secrete progesterone to maintain pregnancy, it persists and produces progesterone.

(ii) It disintegrates and changes into corpus albicans. **1+1=2**

[CBSE Marking Scheme, 2015]

Q. 9. Where does fertilization occur in humans ? Explain the events that occur during this process.

R **[Outside Delhi Set-I, 2014]**

Ans. Fertilization in humans occurs at ampullary-isthmic junction of the fallopian tube. Secretions of acrosome of sperms help it to enter the ovum through zona pellucida and plasma membrane. It induces meiosis II to form haploid ovum (oocyte/ ootid). The fusion of sperm and ovum to form zygote is called fertilization. **2**

Short Answer Type Questions-II

(3 marks each)

Q. 1. Draw a labelled diagram of the embryonic stage that gets implanted in the human uterus. State the functions of the two parts labelled.

R **[Foreign Set-I, 2016]**

Ans. For Diagram: Refer to Topic 3/ Revision Notes/ Important diagrams/ Fig 3.11

(i) Trophoblast - helps in implantation / attachment to endometrium / attachment to uterus.

(ii) Inner cell mass - gets differentiated into an embryo.

[CBSE Marking Scheme, 2016] 3

Q. 2. State any three functions of placenta in human female. R **[Delhi Set-I, Comptt. 2016]**

Ans. (i) Supply oxygen to the embryo/nutrients to the embryo.

(ii) Removes carbon-dioxide/removes waste material produced by the embryo.

(iii) Produces hormones like hCG—human Chorionic Gonadotropin/hPL—human Placental Lactogen/ estrogen/progesterone. **3**

[CBSE Marking Scheme, 2016]

Answering Tip

- Functions of placenta should be categorized into: (i) endocrine functions (ii) Nutritive (iii) Placenta as a barrier.

AI **Q. 3. Describe the process of parturition in humans.**

U **[Delhi Set-I, 2015]**

Ans. (i) Signals originate from the fully developed foetus and placenta.

(ii) Induce mild uterine contractions (foetal ejection reflex).

(iii) Triggers release of oxytocin (from maternal pituitary).

(iv) Oxytocin acts on uterine muscles and causes stronger uterine contractions.

(v) Stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contraction.

(vi) Expel the baby from the uterus.

½ + ½ + ½ + ½ + ½ + ½

[CBSE Marking Scheme, 2015]

Detailed Answer :

(i) Parturition is the process of giving birth to a baby.

(ii) The physical activities like uterine and abdominal contractions, dilation of cervix for passage of baby are involved in this process which are collectively called as **labour** and the discomfort or agony caused by it is known as labour pains.

(iii) Parturition is controlled by a complex neuroendocrine mechanism.

(iv) Signals originate from fully formed foetus and placenta which induce mild uterine contractions called **foetal ejection reflex**. This causes the release of oxytocin from maternal pituitary.

(v) Oxytocin causes stronger uterine muscle contraction which in turn stimulate further secretion of Oxytocin. This process is continued leading ultimately to expulsion of baby out of the uterus through the birth canal.

(vi) After parturition, the umbilical cord is tied and cut off. The placenta is separated from the uterus and is expelled out due to series of strong uterine contractions.

Commonly Made Error

- Students often use the word 'babies' instead of 'foetus' while explaining parturition.

Q. 4. After implantation, interdigitation of maternal and foetal tissues takes place. Identify the tissues involved and justify their role.

A **[CBSE SQP 2015]**

Ans. After implantation, interdigitation of maternal and foetal tissues results in the formation of structural and functional unit between embryo and maternal body called placenta. **1**

It facilitates supply of oxygen and nutrients to the embryo, removal of carbon dioxide and excretory material. Also acts as endocrine tissue and produces hormones like hCG, hPL, estrogen, progesterone, relaxin. **2**

[CBSE Marking Scheme, 2015]

Q. 5. (i) How is placenta formed in the human female ?
(ii) Name any two hormones which are secreted by it and are also present in a non–pregnant woman.

U **[Outside Delhi Set-II, 2014]**

Ans. (i) After implantation, the chorionic villi that appear on trophoblast, interdigitate with the uterine tissue, jointly form placenta. **2**

(ii) Estrogen, progesterone. ½ + ½

[CBSE Marking Scheme, 2014]

Q. 6. Describe the embryonic development of a zygote upto its implantation in humans.

U **[Foreign 2017 Set-I, II, III]**

Ans. Zygote moves through isthmus and undergoes cleavage (forming morula), morula continues to divide and transform into blastocyst (as it moves further into uterus), Blastomeres in the blastocyst are arranged into an outer layer trophoblast, and inner cell mass, the trophoblast layer gets attached to endometrium, uterine cells divide and cover the blastocyst. **3**

[CBSE Marking Scheme, 2017]

Long Answer Type Questions (5 marks each)

Q.1. (a) Draw a diagram of the adult human female reproductive system and label the different:
(i) parts of fallopian tube
(ii) layers of uterus wall
(b) Explain the events during fertilization of an ovum in humans. R **[Comptt, Set-1,2,3, 2018]**

Ans. (a) For diagram, Refer Topic 1/ Revision Notes/ Important diagrams/ Fig 3.3 **2**

(b) When a sperm comes in contact with Zona pellucida of ovum this induces changes in the membrane that blocks entry of additional sperms secretions of acrosome helps sperm to enter into the cytoplasm of ovum through zona pellucida and plasma membrane, this induces completion of meiotic division of secondary oocyte and formation of a haploid ootid / ovum (and a second polar body), haploid nucleus of ovum fuses with sperm nucleus to form diploid zygote (fertilization occurs). **3**

[CBSE Marking Scheme, 2018]

AI **Q. 2. (i) Briefly explain the events of fertilization and implantation in an adult human female.**
(ii) Comment on the role of placenta as an endocrine gland. U **[Delhi Set-I, II, 2016]**

Ans. (i) Fertilization :

(a) Sperm comes in contact and enters the secondary oocyte.

(b) Activates/induces secondary oocyte to complete meiosis II, leads to formation of ovum/ootid.

(c) The haploid nucleus of sperm and ovum fuse to form a diploid zygote completing the process of fertilization. ½ × 3 = 1½

Implantation :

(a) Trophoblast layer of blastocyst attaches to the endometrium (of the uterus).

(b) The uterine cells divide rapidly and cover the blastocyst.

(c) The blastocyst becomes embedded in the endometrium and the implantation is completed. ½ × 3 = 1½

(ii) (a) hCG (human chorionic gonadotropin)
(b) hPL (human placental lactogen)
(c) estrogen
(d) progesterone ½ × 4 = 2

[CBSE Marking Scheme, 2016]

Detailed Answer :

(ii) The placenta acts as an endocrine gland because it produces many hormone like human chorionic-Gonadotropin (hCG), human placental Lactogen (hPL), Oestrogen, progesterone and estrogen. In the later phase of pregnancy, a hormone called as relaxin is also secreted by the ovary. hCG, hPL and relaxin hormone are produced in women only during pregnancy.

Answering Tip

- Emphasis on terms such as, 'fertilisation, capacitation, implantation, gestation, parturition', while studying 'Human Embryonic Development'.

Q. 3. Arrange the terms given below in their order of occurrence describing their structure and function in the early development of the human embryo: Implantation; cleavage; inner cells mass; trophoblast; blastomeres; endometrium; morula; blastocyst. R **[Delhi Set I & II, Comptt. 2016]**

Ans. **Correct order** = cleavage, blastomeres, morula, blastocyst, trophoblast, inner cell mass, endometrium, implantation.

Cleavage : Mitotic division starts as the zygote moves through the oviduct towards the uterus and form (2/4/8/16) daughter cells called **blastomeres.** Embryo with 8 to 16 blastomeres is called a **morula.** Morula continues to divide and transforms into a blastocyst. Blastomeres in blastocyst are arranged into an outer layer called **trophoblast** and an inner group of cells attached to trophoblast called the **inner cell mass.** The trophoblast layer then gets attached to the **endometrium** and inner cell mass differentiates as the embryo. Ultimately blastocyst becomes embedded in the endometrium of uterus. This is called **Implantation.** **5**

[CBSE Marking Scheme, 2016]

Q. 4. (i) Describe the techniques that can help a healthy married woman who is unable to produce viable ova but wants to bear a child.

(ii) Draw a labelled diagram of a human ovum.

(iii) How is polyspermy prevented in humans ?

C **[Foreign Set II, 2017]**

Ans. **(i)** GIFT/Gamete Intra Fallopian transfer - Transfer of an ovum collected from a donor, into the fallopian tube of a healthy married female, who does not produce viable eggs, but can provide suitable environment for fertilisation.

(ii) For diagram: Refer to Topic 2/ Revision Notes/ Important diagrams/ Fig 3.6

(iii) During fertilisation, a sperm comes in contact with the zona pellucida layer of the ovum, induces changes in the membrane and block the entry of additional sperms.

[CBSE Marking Scheme, 2017] 2 + 2 + 1 = 5

Q. 5. Mention the site of fertilisation of a human ovum. List the events that follow in sequence until the implantation of the blastocyst. R **[Delhi Set-I, Comptt. 2015]**

Ans. The site of fertilisation is the ampullary isthmic junction (fallopian tube). ½

Events :

Fertilization (Zygote formation), → Cleavage, → 8-16 Blastomeres stage – Morula → Continuously divides and transforms into Blastocyst (as it moves into uterus) → Blastomeres in the Blastocyst arrange to form outer layer trophoblast and inner cell mass → Trophoblast attaches to endometrium and inner cell mass differentiates as embryo → After attachment of blastocyst the uterine cells cover it → Embed blastocyst in the endometrium – implantation. **9 × ½ = 4 ½**

[CBSE Marking Scheme, 2015]

Q. 6. (i) Where in the fallopian tube does fertilization occur in humans ? Describe the development of a fertilized ovum upto implantation.

(ii) How is polyspermy prevented in humans ?

A **[Delhi Set - III, 2017]**

Ans. **(i)** Ampullary region / ampullary isthmic junction. **1**

(a) Cleavage occurs in zygote to form 2 - 4 - 8 - 16 daughter cells / upto 16 daughter cells called blastomeres.

(b) 8 - 16 / 16 blastomeres stage called morula.

(c) Morula continues to divide and transform blastocycst (as it moves further into uterus).

(d) Blastomeres in the blastocyst are arranged into an outer layer called trophoblast which gets attached to endometrium.

(e) Inner group of cells called inner cell mass get differentiated into embryo.

(f) Uterine cells divide rapidly and covers blastocyst / implantation. **½ × 6**

(ii) When a sperm comes in contact with a zona pellucida layer of ovum, it induces changes in membrane to block entry of additional sperms. **½ + ½**

[CBSE Marking Scheme, 2017]

Q. 7. During the reproductive cycle of a human female, when, where and how does a placenta develop? What is the function of placenta during pregnancy and embryo development ? A **[Delhi Set-I, 2015]**

Ans. After implantation uterus, chorionic villi and uterine tissue become interdigitated (physically fused). **1 + 1 + 1=3**

Placenta facilitates supply of oxygen / nutrients to the embryo. ½

Removal of carbon dioxide / waste material / excretory material produced by the embryo.

Production of hCG/hPL/estrogens/progesterone.

[CBSE Marking Scheme, 2015] (Any two) 2

Detailed Answer :

After implantation, the cells of inner cell mass of blastocyst differentiate to form the embryo. The trophoblast differentiates into two layers, the outer layer secretes enzymes to dissolve the endometrium of uterus. The inner layer grows out as finger like projections called chorionic villi into the uterine stroma. They are surrounded by the uterine tissue

and maternal blood vessels. The chorionic villi and the uterine tissue become interdigitated to form the structural functional unit called placenta.

The placenta secretes hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens and progesterone that are necessary to maintain pregnancy.

Placenta also facilitates supply of oxygen and provides nutrients to the embryo through umbilical cord.

Commonly Made Error

- While writing the functions of the placenta, students often write that it function as 'shock absorber' or 'protection'. Very few of them write about diffusion of substances from mother to foetus and vice versa. This is the main important function of placenta. The functions of placenta should be categorized into: (i) endocrine functions (ii) Nutritive (iii) Placenta as a barrier.

Q. 8. Where does fertilization occur in humans ? Explain the events that occur during this process.

R **[Delhi Set-I, 2014]**

Ans. **(i)** Ampullary Isthmic junction in fallopian tube / fallopian tube.

(ii) The sperms come in contact with zona pellucida.

(iii) Induces change in the membrane.

(iv) Blocks entry of other sperms / ensures only one sperm fertilizes the ovum / prevents polyspermy.

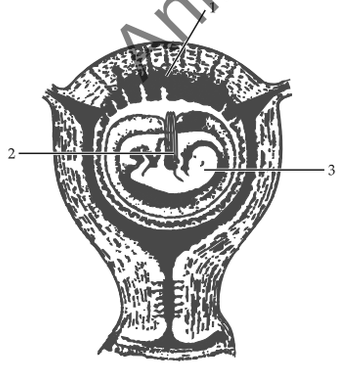
(v) The secretion of acrosome helps the sperm to enter the cytoplasm.

(vi) Entry of sperm induces completion of second meiotic division forming ovum and 2nd polar body.

(vii) The haploid nucleus of sperm and ovum fuse.

(viii) Formation of diploid zygote, fertilisation completed. **[CBSE Marking Scheme, 2014] 5**

Q. 9.



(i) Identify the parts labelled 1, 2 and 3 in the diagram given.

(ii) Draw a labelled diagram of a human blastocyst.

(iii) What is parturition and how is it induced at the end of pregnancy in a human female ?

R **[Delhi - 2017, Set - I, II]**

Ans. **(i) 1.** Placental Villi

2. Umbilical cord (with its vessels)

3. Embryo

(ii) For diagram: Refer Topic 3/ Revision Notes/ Important Diagrams/ Fig 3.11

(iii) Process of delivery of the foetus (at the end of pregnancy)

The signals for parturition originate from the fully developed foetus and placenta which induce mild uterine contractions / called foetal ejection reflex, this triggers release of oxytocin from the maternal pituitary which acts on uterine muscle and causes stronger uterine contraction which stimulates further secretion of oxytocin, the stimulatory reflex between uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions leading to parturition.

1½ + 2 + 1½ = 5

[CBSE Marking Scheme, 2017]

Q. 10. (i) Name the hormones secreted and write their functions :

(a) By corpus luteum and placenta (any two).

(b) During Follicular phase and parturition.

(ii) Name the stages in a human female where :

(a) Corpus luteum and placenta co-exist.

(b) Corpus luteum temporarily ceases to exist.

[Delhi - 2017, Set - II]

Ans. **(i) (a) Corpus luteum :** progesterone, essential for maintenance of the endometrium.

Placenta : hCG/human chorionic gonadotropin, produce during pregnancy / stimulates and maintains the corpus luteum / to secrete progesterone / growth of mammary glands. HPL / human placental lactogen, produced during pregnancy.

Estrogen, maintenance of pregnancy / supporting foetal growth / metabolic changes in mother (Any two)

(b) Follicular phase : LH / FSH, stimulates follicular development / secretion of estrogen by growing follicles.

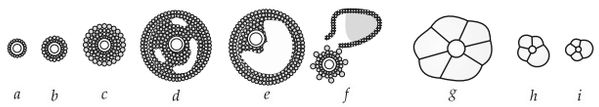
Parturition : oxytocin causes stronger uterine contraction / relaxin, secreted during (later stage) the pregnancy / softens symphysis pubis.

(ii) (a) Pregnancy / gestation.

(b) Menstruation / proliferative phase / ovulatory phase / follicular phase. **3 + 1 + 1 = 5**

[CBSE Marking Scheme, 2017]

Q. 11. The following is the illustration of the sequence of ovarian events "a" to "i" in a human female :



(i) Identify the figure that illustrates corpus luteum and name the pituitary hormone that influences its formation.

(ii) Specify the endocrine function of corpus luteum. How does it influence the uterus ? Why is it essential?

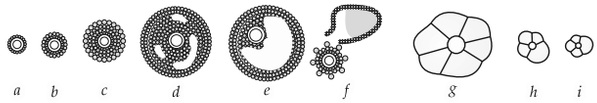
(iii) What is the difference between "d" and "e" ?

(iv) Draw a neat labelled sketch of Graafian follicle.

E & A **[Delhi Set-II, 2014]**

Ans. (i) 'g' Luteinising hormone (LH).
(ii) Produces the hormone progesterone causes proliferation of the endometrium which gets highly vascularised. It is essential for the implantation of the fertilized ovum and to maintain the same during pregnancy.
(iii) "d" is the developing tertiary follicle.
"e" is the Graafian follicle.
(iv) For diagram: Refer to Topic 2/ Revision Notes/ Important diagrams/ Fig 3.7 **5**
[CBSE Marking Scheme, 2014]

AI **Q. 12. The following is the illustration of the sequence of ovarian events (a - i) in a human female.**



(i) Identify the figure that illustrates ovulation and mention the stage of oogenesis it represents.
(ii) Name the ovarian hormone and the pituitary hormone that have caused the above mentioned event.
(iii) Explain the changes that occur in the uterus simultaneously in anticipation.
(iv) Write the difference between '*c*' and '*h*'.
(v) Draw a labelled sketch of the structure of a human ovum prior to fertilization. R **[Delhi Set-I, 2010]**

Ans. (i) *f* is the secondary oocyte. ½ + ½
(ii) estrogen, LH ½ + ½
(iii) Endometrium proliferate (glands become corkscrew shaped) highly vascularised, high regeneration anticipating implantation of the fertilized ovum. ½ + ½
(iv) '*c*' is developing follicle while '*h*' is regressing corpus luteum. ½ +½
(v) For diagram: Refer to Topic 2/ Revision Notes/ Important diagrams/ Fig 3.6 **1**
[CBSE Marking Scheme, 2010]

Q. 13. 'Parturition is induced by a complex Neuro endocrine mechanism'. Justify
A **[CBSE SQP, 2018]**

Ans. Parturition is a process where vigorous contraction of the uterus at the end of pregnancy causes expulsion/delivery of the foetus. **1**
The signals for parturition originate from the fully developed fetus and the placenta which induce mild uterine contractions called foetal ejection reflex. **1**
This triggers release of oxytocin from the maternal pituitary. Oxytocin acts on the uterine muscles and causes stronger uterine contractions, which in turn stimulates further secretion of oxytocin. **1**
The stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions. **1**
This leads to expulsion of the baby out of the uterus through the birth canal – parturition, after the infant is delivered; the placenta is also expelled out of the uterus. **1**
[CBSE Marking Scheme, 2018]

Know the Terms

- **Spermatogenesis :** It is the process of formation of sperms (spermatozoa) from the immature germ cells in males.
- **Spermiogenesis :** It is the process of transformation of non-motile, rounded haploid spermatid into a functional and motile spermatozoan.
- **Spermiation :** It is the process when mature spermatozoa are released from the sertoli cells into the lumen of seminiferous tubules.
- **Oogenesis :** It is the process of formation of a mature ovum from the oogonia in female.
- **Menstrual cycle :** The cyclic events starting from one menstruation till the next that take place during the reproductive period is called menstrual cycle.
- **Fertilisation :** The process of fusion of sperm and the ovum to form a single cell called zygote is called fertilization.
- **Morula :** The embryo with 8-16 blastomeres is called a Morula.
- **Parturition :** The birth of the fully developed foetus is termed as parturition.

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