

Human Reproduction

INTRODUCTION

HUMAN MALE REPRODUCTIVE SYSTEM

- Human male reproductive system consists of:
 - The primary sex organs, i.e., a pair of testes.
 - The secondary sex organs i.e., the duct system and associated glands and
 - External genitalia.

Testes

- Located outside the abdominal cavity (extra-abdominal) with in a pouch called scrotum; scrotum provides a temperature $2.0 - 2.5^{\circ}\text{C}$ lower than the body temperature necessary for spermatogenesis.
- Each testis is oval in shape and measure about 4 to 5 cm in length, 2–3 cm in width and about 3 cm in thickness.
- The testis is covered by a dense covering called tunica albuginea.
- Internally the testis is divided into about 250 compartments, called testicular lobules.
- Each lobule contains 1–3 highly coiled seminiferous tubules (the structural and functional units of testis) in which sperms are produced.
- The seminiferous tubule has a tunic of connective tissue and is internally lined by seminiferous or germinal epithelium.
- The seminiferous epithelium consists of two types of cells: (1) Sertoli cells and (2) spermatogonia, that form the male germ cells or spermatozoa.
- Sertoli cell provide nutrition and shape to the developing germ cells and spermatozoa.
- The spermatogonia undergo cell divisions to form spermatozoa.
- The spaces called interstitial spaces, between the seminiferous tubules have connective tissue, which includes blood vessels and Leydig cells (also called Interstitial cells); Leydig cells synthesise and secrete the male sex hormones called androgens of which testosterone is the principal one.

Definitions

Primary	Sex	Organs:
Reproductive or sex organs which produce gametes and sex hormones.		
Secondary Sex Organs: Organs which perform important functions in reproduction, but do not produce gametes or secrete sex hormones.		

Rack Your Brain



Which part of the testes acts as thermoregulator?

Rack Your Brain



What will be the affect on sperm formation if the temperature inside the testes is 37°C ?

Rack Your Brain



What is the ploidy of nurse cells or sertoli cells?

Previous Year's Question



Male hormone is produced in the testis by cells of

- (1) Sertoli
- (2) epithelial
- (3) spermatocytes
- (4) Leydig

Duct System

- The intratesticular duct system starts with tubuli refti, which are the short and straight end segments of the seminiferous tubules; these tubes open into vasa efferentia, through rete testis.
- Vasa efferentia conduct the sperms out from the testis and open into the epididymis.
- Epididymis is a single convoluted tubule that is located along the posterior surface of the testis.
- The epididymis continues as the vas deferens that ascends into the abdominal or pelvic cavity through inguinal canal.
- It loops over the urinary bladder and receives a duct from the seminal vesicle (of its side) to form ejaculatory duct that runs through the prostate and opened into the prostatic urethra, just after its other gene from the urinary bladder.
- The urethra receives the ducts of prostate gland and the bulbourethral (Cowper's) glands a little ahead and runs through the penis to its external opening; called urethral meatus.

Accessory Glands

- The accessory glands of male reproductive system include:
 - a pair of seminal vesicles,
 - a prostate gland and
 - a pair of bulbourethral glands (also called Cowper's glands)
- Their secretions are collectively called as seminal plasma.
- Seminal plasma is rich fructose, calcium, and certain enzymes; it provides nutrition and a medium for the spermatozoa to swim in the female reproductive tract.
- The seminal plasma along with the spermatozoa, is called semen.

Rack Your Brain



Cilia are present in which of the following?

Vasa efferentia, vasa deferentia or penis.

Previous Year's Question



Vasa efferentia are the ductules leading from

- (1) testicular lobules to rete testis
- (2) rete testis to vas deferens
- (3) vas deferens to epididymis
- (4) epididymis to urethra

Rack Your Brain



Physiological maturation of sperms occurs in which part of the male reproductive system?

Previous Year's Question



Seminal plasma in human males is rich in

- (1) fructose and calcium
- (2) glucose and calcium
- (3) DNA and testosterone
- (4) ribose and potassium



External Genitalia

- Penis is the external genitalia in human males.
- It is made up of special erectile tissue, that helps in erection of the penis to facilitate insemination.
- The enlarged tip of the penis is called glans penis; it covered by a loose fold of skin called foreskin of prepuce.

Gray Matter Alert!!!

Leydig cells are the characteristic feature of mammalian testes. These are absent in the testes of frog.

HUMAN FEMALE REPRODUCTIVE SYSTEM

- Human female reproductive system consists of:
 - The primary sex organ i.e., A pair of ovaries.
 - The secondary sex organs i.e., The duct system consisting of a pair of fallopian tubes, a uterus, cervix and vagina.
 - The external genitalia and
 - Mammary glands

Ovaries

- Ovaries are the primary female sex organs that produce the female gametes (called ova) and secrete the ovarian or sex hormones.
- The ovaries are located in the abdominal/pelvic cavity, one on each side near the kidney.
- Each ovary is an almond-shaped body about 3 cm long, 1.5 cm broad and 1 cm thick.
- It is attached to the pelvic wall and uterus by ligaments.
- The ovary is covered by a thin epithelium, which encloses the ovarian stroma.
- The stroma is divided into two regions: (1) a peripheral cortex and (2) and inner medulla.
- The ovarian follicles are found in various stages of development in the cortex.

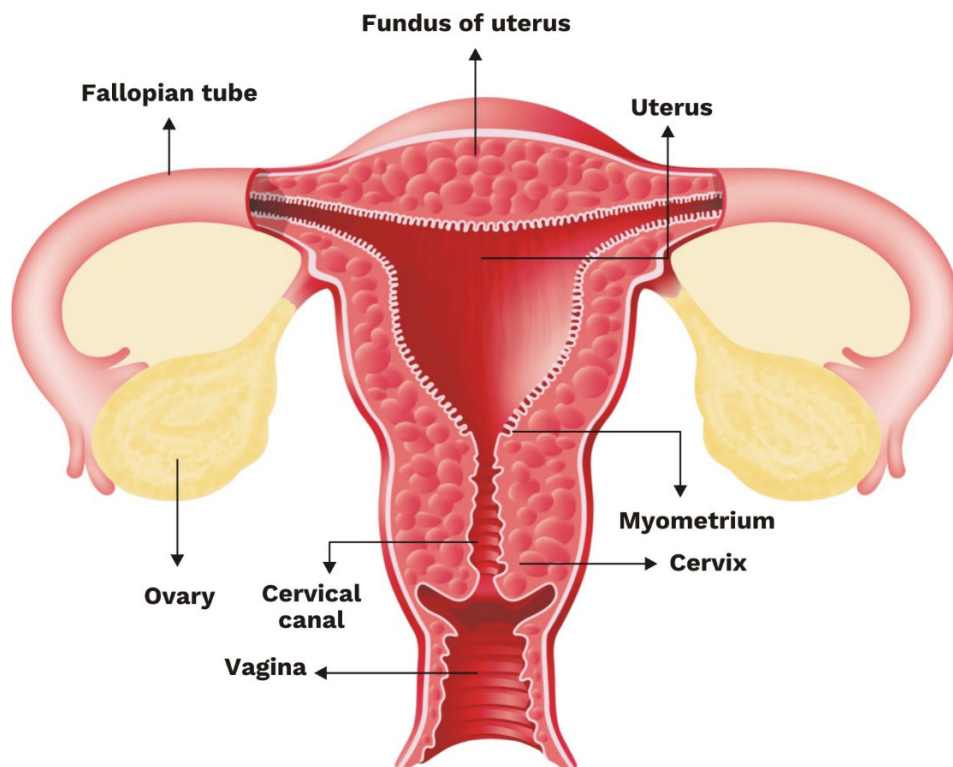


FIG. FEMALE REPRODUCTIVE SYSTEM

The Duct System

Fallopian Tube

- A fallopian tube extends from the periphery of each ovary to the uterus; it is a muscular tube of about 10–12 cm long situated above and behind the urinary bladder.
- The part of fallopian tube closer to the ovary is funnel-shaped and is called infundibulum.
- The edges of the infundibulum possess finger-like projections, called fimbriae, that help in collecting the ovum during ovulation.
- The infundibulum leads into a wider part of the fallopian tube or oviduct, called ampulla.
- The last part of the fallopian tube that joins the uterus is narrow and it is called isthmus.

Previous Year's Question

How many sperms are formed from a secondary spermatocyte?

- (1) 4
- (2) 8
- (3) 2
- (4) 1

Previous Year's Question

The part of Fallopian tube closest to the ovary is

- (1) isthmus
- (2) infundibulum
- (3) cervix
- (4) ampulla



Uterus

- It is an inverted pear-shaped muscular structure, attached to the pelvic wall and supported by ligaments.
- The wall of the uterus has three layers of tissues.
- The outermost or external layer is the thin, membranous perimetrium.
- The middle thick layer of smooth muscles is called myometrium.
- The innermost glandular layer is endometrium, which lines the uterine cavity.
- The contractions of the smooth muscles of the myometrium are responsible for the expulsion of the baby during parturition.
- The endometrium undergoes cyclic changes during menstrual cycle.
- The uterus opens into the vagina through a narrow cervix.

Vagina

- It is a muscular tube-like structure that opens to the outside.
- The vagina is partially covered by a membrane called hymen.
- The cervix and the vagina together constitute the birth canal.
- The functions of vagina are to
 - receive the male gametes during insemination.
 - serve as the birth canal during parturition.

External Genitalia

- The female external genitalia include:
 - mons pubis
 - Labia majora
 - Labia minora
 - Clitoris
 - Hymen
- Mons pubis is a cushion-like fatty tissue covered by skin and pubic hair.

Rack Your Brain



Where does the foetus develop in female genital tract?

Previous Year's Question



Which of the following is primary sex organ?

- (1) Vagina
- (2) Ovaries
- (3) Uterus
- (4) Fallopian tubes

Previous Year's Question



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

- (1) Rete testis → Efferent ductules → Epididymis → Vas deferens
- (2) Rete testis → Epididymis → Efferent ductules → Vas deferens
- (3) Rete testis → Vas deferens → Efferent ductules → Epididymis
- (4) Efferent ductules → Rete testis → Vas deferens → Epididymis

- It extends down as a pair of fleshy folds of tissue, called labia majora and surround the vaginal opening.
- The labia minora are paired folds of tissue under the labia majora; it also surrounds the vaginal opening.
- The labia minora enclose a space posteriorly, called vestibulum and anteriorly unite and form a conical projection, called clitoris, above the urethral opening.
- Hymen is the membrane that partially covers the vaginal opening; it becomes ruptured due to vigorous physical activities or during the first coitus.

Mammary Glands

- A human female has a pair of functional mammary glands that consist of glandular tissues and variable quantity of fat.
- The glandular tissue is divided into 15–20 mammary lobes; each lobe contains clusters of cells, called alveoli, which open into mammary tubules.
- The mammary tubules of each lobe join to form a mammary duct.
- Several mammary ducts join to form a wider mammary ampulla that is connected to lactiferous duct, through which milk comes out.
- The milk is actually secreted by the cell of alveoli and is stored in the lumen of alveoli.

SPERMATOGENESIS

- It is the process of formation of spermatozoa in the testis; the process starts at puberty.
- The spermatogonial cells present on the inner wall of semiferous tubule multiply by mitotic division.
- Some of the spermatogonia serve as stem cells for spermatogenic lineage.
- Other spermatogonia function as progenitor cells or the precursors of spermatozoa.

Rack Your Brain



Observe the relationship and fill up the blank.

Male: Penis:: Female:

Rack Your Brain



Name the essential hormones for the development of secondary sexual characters in females.

Definitions

Spermatogenesis: Formation of spermatozoa (sperms) in the seminiferous tubules of the testes.

Spermiogenesis: Transformation of spermatids (non-motile) into spermatozoa (sperms).

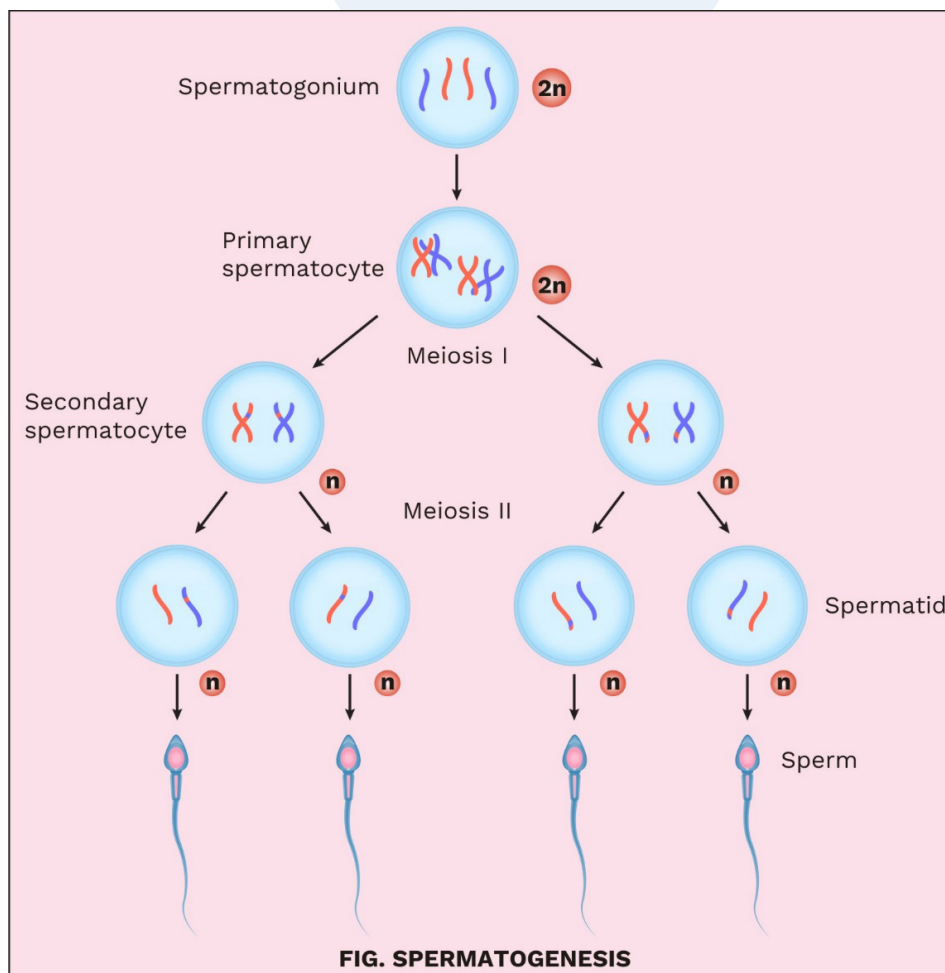
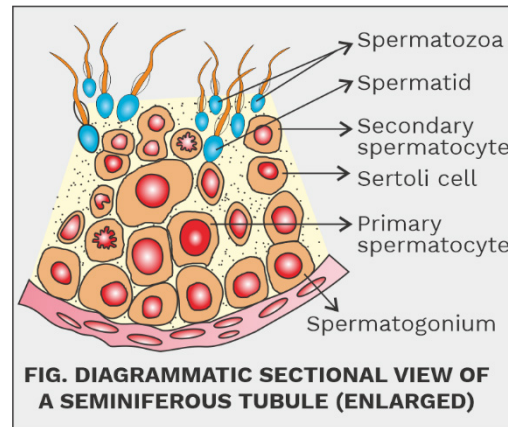
Spermiation: Release of the spermatozoa from the seminiferous tubules.

Previous Year's Question



Capacitation occurs in
 (1) epididymis
 (2) vas deferens
 (3) female reproductive tract
 (4) rete testis

- They undergo changes by accumulating food materials and grow almost double in size and become the primary spermatocytes.
- Each primary spermatocyte undergoes the first meiotic division and forms two haploid secondary spermatocytes.
- The secondary spermatocytes undergo the second meiotic division leading to the formation of four equal sized, haploid spermatids.
- The spermatids are transformed into spermatozoa by process of spermiogenesis.
- The sperm heads become embedded in the Sertoli cells and are ultimately released from the seminiferous tubules by the process of spermiation.





HORMONAL CONTROL OF SPERMATOGENESIS

- Spermatogenesis is initiated due to an increase in the secretion of gonadotropin-releasing hormone (GnRH) by the hypothalamus at the age of puberty.
- The increased level of GnRH act on the anterior pituitary and stimulate the secretion of two gonadotropins, i.e., luteinizing hormone (LH) and follicle stimulating hormone (FSH).
- LH acts on the Leydig cells and stimulates them to secrete testosterone.
- FSH acts on the Sertoli cells and stimulates secretion of some factors, which help in spermiogenesis.

STRUCTURE OF A SPERMATOZOAN

- The whole body of a spermatozoan is enveloped by a plasma membrane.
- A human sperm is composed of four parts; head, neck, middle piece and tail.

Head

- Head contains an elongated, compact, haploid nucleus, i.e., concentrated DNA.
- The anterior end has a cap-like structure, called acrosome; the acrosome contains enzymes that help in dissolving membranes of the ovum for fertilization.

Neck

- Neck contains two centrioles, a maximal centriole, which is necessary for the first cleavage division of zygote and a distal centriole, that is connected to the tail filament.

Middle Piece

- Middle piece contains a number of mitochondria, that provide energy for the motility of sperms.

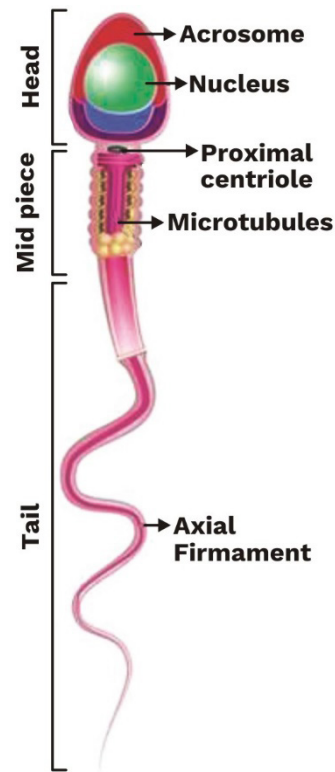


FIG. STRUCTURE OF A SPERM

Gray Matter Alert!!!

Viability of human sperm is 24 hours.



Tail

- It consists of an axial filament surrounded by the plasma membrane.
- It helps the sperm to move in the female reproductive tract towards the female gamete (ovum) for fertilization.

OÖGENESIS

- Oogenesis is the process of formation of female gametes or ova in the ovary.
- Oogenesis is initiated during embryonic development in a female foetus.
- All the oogonia (about a million) are formed in the ovary of the foetus of 25 weeks; no new oogonia are formed after birth.
- The oogonial cells which enter meiosis I, are the primary oocytes but the division remains suspended in prophase I; other cells form the granulosa/follicle cells and forego the potential of forming ova.
- The primary oocyte becomes surrounded by a layer of granulosa cells and is called the primary follicle.
- A large number of these follicle degenerate before puberty (follicular atresia) and only about 60000 – 80000 are left in the ovary.
- The primary follicles become surrounded by more layers of granulosa cells and a thecal layer; at this stage they are called secondary follicles.
- As development continues, a cavity develops in the secondary follicle around the primary oocyte; it is called antrum and is filled with a fluid called, liquor folliculin.
- Simultaneously, the thecal layer becomes organized into an outer theca externa and at this stage the structure, is called tertiary follicle.
- As the tertiary follicle continues its development, the primary oocyte completes its meiosis I and forms a large-cells, the secondary oocyte and a tiny cell, first polar body.

Previous Year's Question



Middle piece of mammalian sperm possesses

- (1) mitochondria and centriole
- (2) mitochondria only
- (3) centriole only
- (4) nucleus and mitochondria

Definition



Follicular Atresia: Degeneration of a number of primary follicles in the ovary of a human female from birth to puberty.

Previous Year's Question



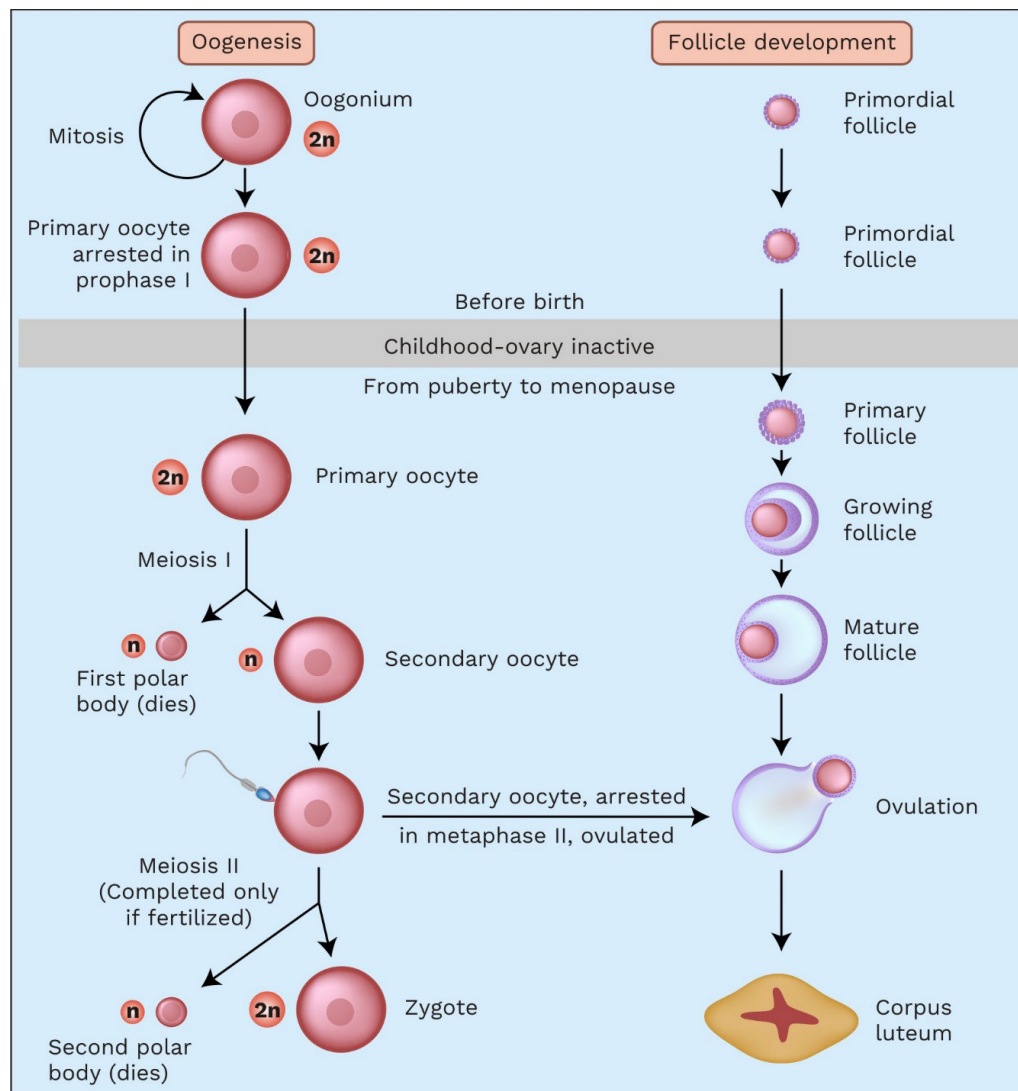
Egg is liberated from ovary in -

- (1) secondary oocyte stage
- (2) primary oocyte stage
- (3) oogonial stage
- (4) mature ovum stage

Definition



Ovulation: Rupture of a mature or Graafian follicle and release of the ovum (secondary oocyte) from it.



- The secondary oocyte grows in size with a bulk of nutrient-rich cytoplasm.
- The tertiary follicle becomes changed into a mature follicle, called Graafian follicle.
- The secondary oocyte forms a new membrane, called zona pellucida, around it.
- The secondary oocyte starts its second meiotic division, but it is suspended in metaphase II, until a sperm enters it.
- At this stage, the Graafian follicle ruptures to release the secondary oocyte from the ovary.

Previous Year's Question



Which of the following cells during gametogenesis is normally diploid?

- (1) Spermatogonia
- (2) Secondary polar body
- (3) Primary polar body
- (4) Spermatid



MENSTRUAL CYCLE

- The cyclic changes that occur in the reproductive organs of primate females (monkeys, apes and human beings), constitute the menstrual cycle.
- The cycle of events starts from one menstruation till the onset of the next and lasts for about 28/29 days (a mensem).
- The beginning of menstruation at puberty, is called menarche.
- One ovum is released during the middle of each menstrual cycle.
- The events in a menstrual cycle can be studied under four phases:

Menstrual phase

- The cycle starts with this phase and the menstrual flow (menstruation) lasts for 3–5 days.
- It results due to the breakdown of endometrial lining of the uterus and its blood vessels, along with the unfertilized ovum.

Follicular phase or Proliferative Phase

- In this phase, the primary follicles in the ovary grow and become a fully mature Graafian follicle.
- The endometrium of the uterus is regenerated by proliferation of its cells.
- These changes are due to an increased level of pituitary hormones, FSH and LH and ovarian hormone, estrogen.
- FSH controls the follicular phase; it stimulates the growth of follicles and secretion of estrogen by the growing follicles.
- Both FSH and LH reach their peak level in the middle of the cycle (about 14th day)

Ovulatory Phase

- The peak level of LH (called LH surge) induces the rupture of the mature Graafian follicle and thereby the release of ovum; this process is called ovulation.

Definitions

Menarche: The beginning of menstruation at puberty in human females.

Menopause: Stoppage of menstruation and the menstrual cycle in human females at the age of 45–50 years.

Rack Your Brain



Withdrawal of which hormone is the immediate cause of menstruation?

Previous Year's Question



The mammalian corpus luteum produces
(1) luteotrophic hormone
(2) luteinizing hormone
(3) estrogen
(4) progesterone



Luteal phase/Secretory Phase

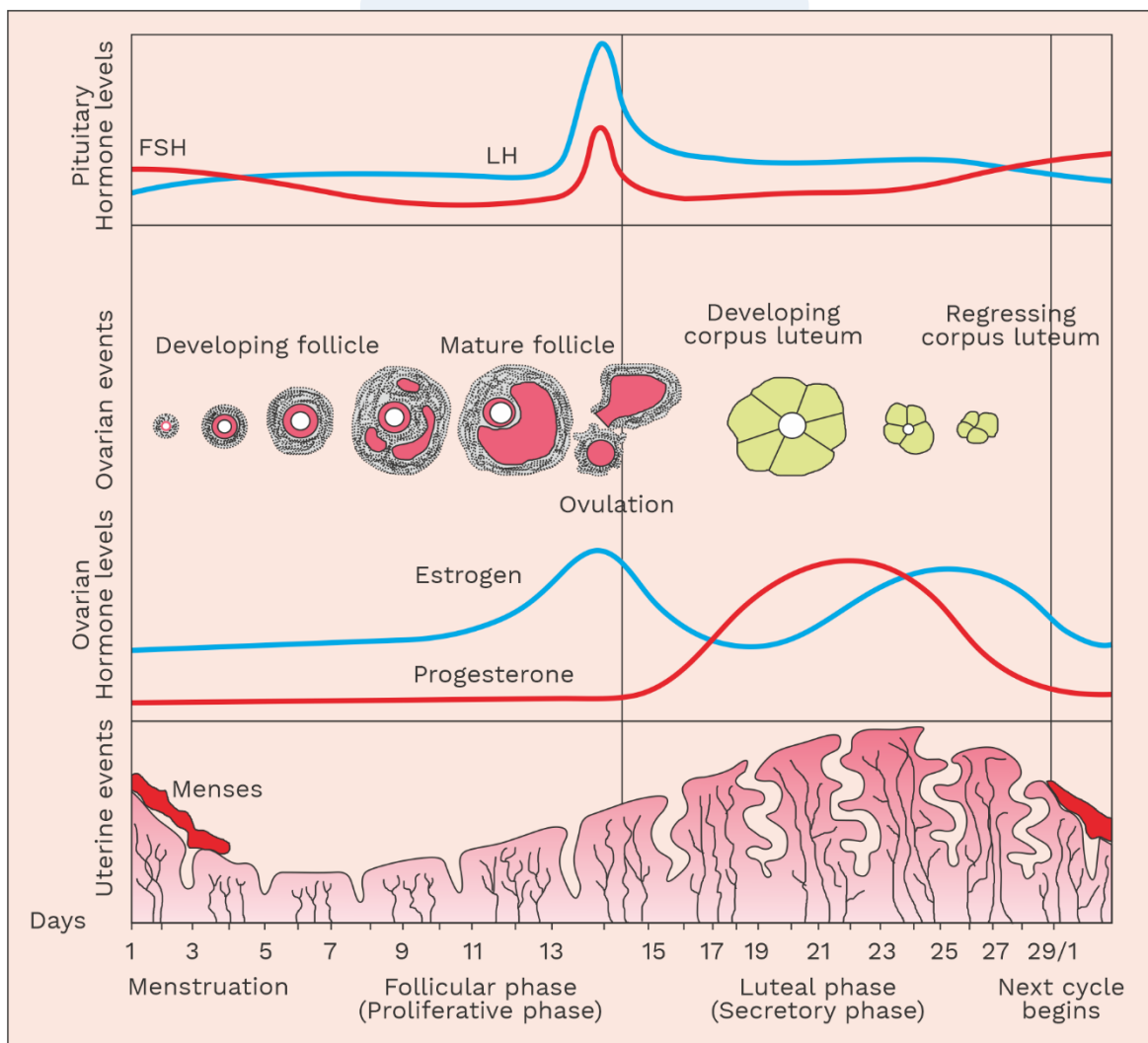
- During this phase, the ruptured follicle is transformed into corpus luteum.
- It secretes large quantities of progesterone, needed to maintain the endometrium.
- The endometrium thickens further and their glands secrete a fluid into the uterus.
- In the absence of fertilisation, corpus luteum degenerates and this causes disintegration of the endometrium leading to menstruation.

Previous Year's Question



After ovulation Graafian follicle regresses into

- (1) corpus artesia
- (2) corpus callosum
- (3) corpus luteum
- (4) corpus albicans



- The menstrual cycles cease at the age of about 45–50 years; it is called menopause.

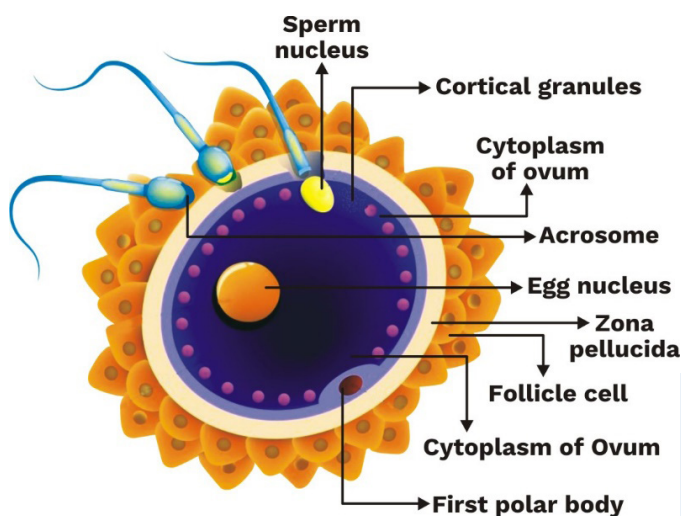


Fig. Fertilization

FERTILISATION

- During copulation, the semen is released by the penis into the vagina; this process is called insemination.
- The motile sperms move through the cervix, enter the uterus and reach the ampullary-isthmic junction of the fallopian tube.
- The ovum released from the ovary also reaches the ampullary-isthmic junction, where fertilization takes place.
- As sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane to block entry of other sperms; thus, only one sperm can enter an ovum (secondary oocyte).
- The enzymes of the acrosome of sperm help to dissolve zona pellucida and plasma membrane of the ovum for the entry of the sperm into the cytoplasm of the ovum (secondary oocyte).
- The entry of sperm induces the completion of second meiotic division of the secondary oocyte, that results in the formation of a haploid ootid and a small second polar body.

Previous Year's Question



Select the incorrect statement.

- (1) LH and FSH decrease gradually during the follicular phase.
- (2) LH triggers secretion of androgens from the Leydig cells.
- (3) FSH stimulates the sertolicells which help in spermiogenesis.
- (4) LH triggers ovulation in ovary

Rack Your Brain



Observe the relationship and fill in the blank.

LH: Ovulation:: Progesterone:

Definitions



Semen: The fluid mixture of seminal plasma and the spermatozoa is called semen.

Insemination: Deposition of sperms (semen) into the female genital tract.

Previous Year's Question



In human females, meiosis- II is not completed until

- (1) uterine implantation
- (2) birth
- (3) puberty
- (4) fertilisation



- Even before the nucleus of the ootid is organised, it fuses with the sperm nucleus (fertilization) to form a diploid zygote.

DEVELOPMENT OF ZYGOTE

Cleavage

- The zygote undergoes successive (mitotic) division, called cleavage, as it moves through the isthmus of fallopian tube towards the uterus.
- The daughter cells are called blastomeres.

Morula

- The embryo with 8 to 16 blastomeres, is called morula; at this stage it is a solid sphere.

Blastocyst

- Cell divisions continue in the morula and the blastomeres become arranged along the periphery leaving a central cavity, called blastocoel; the embryo at this stage, is called a blastocyst.
- The cells now become arranged as an outer layer, called trophoblast and an inner group of cells, called inner cells mass, that is attached to trophoblast and projecting into the blastocoel.

Previous Year's Question

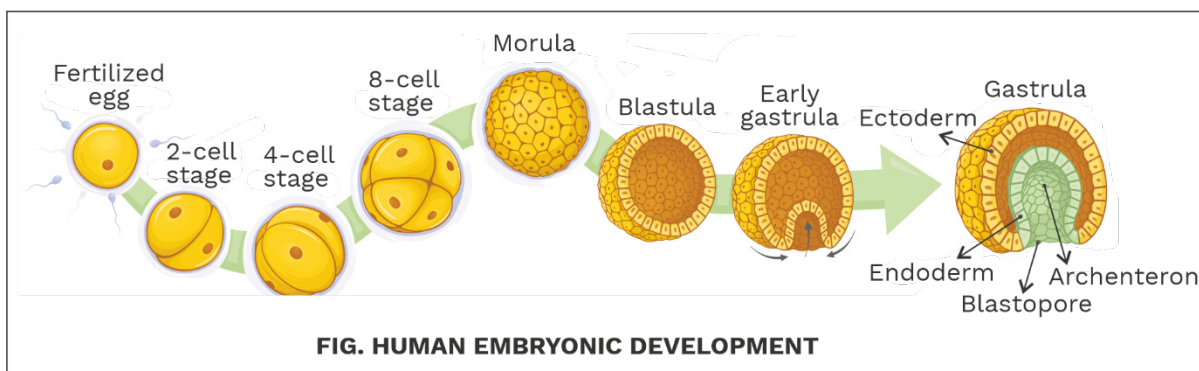


Extrusion of second polar body from egg nucleus occurs

- (1) after entry of sperm before completion of fertilization
- (2) after completion of fertilization
- (3) before entry of sperm
- (4) without any relation of sperm entry

Definition

Cleavage: First phase of embryonic development where the zygote undergoes several mitotic divisions to become an embryo (multicellular structure).



Rack Your Brain



Observe the relationship and fill in the blank.

Fertilization: Fallopian tube::

Implantation:



IMPLANTATION AND PLACENTA FORMATION

- The trophoblast layer gets attached to the endometrium.
- The cells of endometrium divide rapidly and cover the blastocyst.
- So, the blastocyst gets embedded in the endometrium; this process is called implantation; it leads to pregnancy.
- After implantation, finger-like projection, called chorionic villi appear from the trophoblast; they are surrounded by the uterine tissue and material blood vessels.
- The chorionic villi and the uterine tissue become interdigitated to form placenta, the structural and functional unit, between the foetus/embryo and the uterine wall of the mother.
- Umbilical cord, the structure that connects the placenta with the foetus, helps in transport of substances to and from the foetus.
- Placenta performs the following functions:
 - It facilitates supply of oxygen and nutrients to the foetus.
 - It also helps in the removal of carbon dioxide and other excretory products from the foetus.
 - It acts as an endocrine tissue and secretes and following hormones:
 - ◆ human chorionic gonadotropin (hCG)
 - ◆ human placental lactogen (hPL)
 - ◆ progesterones and
 - ◆ estrogens; these are necessary for the foetal growth and maintenance of pregnancy.
- The levels of other hormones like estrogens, progesterones, control, prolactin, thyroxine, etc also increase several-folds in the material blood.

PREGNANCY AND EMBRYONIC DEVELOPMENT

- Simultaneous with the development of placenta, the inner cell mass differentiates into an outer layer, called ectoderm, and an inner layer, called endoderm.

Definition

LH-Surge: Maximum level of LH during middle of menstrual cycle.

Definition

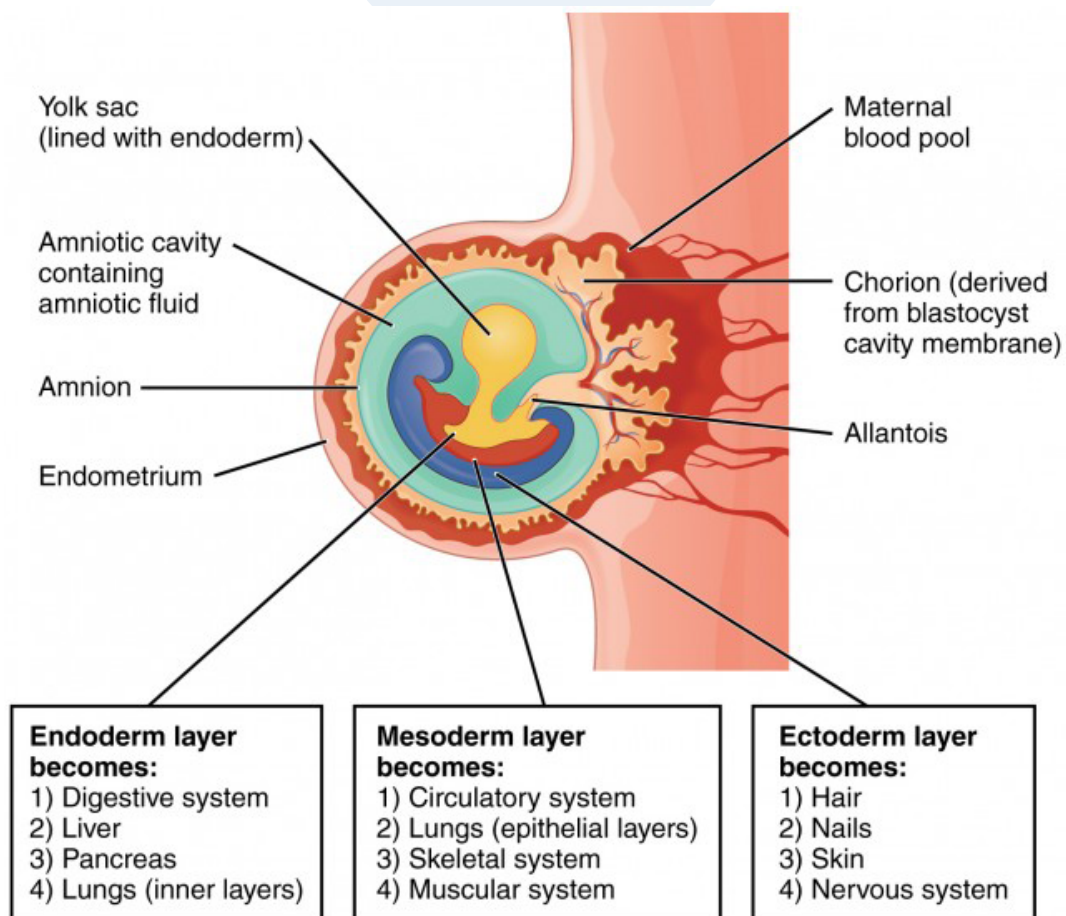
Umbilical Cord: Cord like structure that connects the placenta with the foetus.

Definition

Implantation: When the embryo gets attached to the wall of the uterus.



- A middle layer, called mesoderm appears between the ectoderm and endoderm.
- These primary germ layers give rise to all the tissues and organs of the adult.
- After one month of pregnancy, the heart is formed; the first sign of growing foetus is the heartbeat.
- By the end of second month, the foetus develops limbs and digits.
- By the end of third month (first trimester) most of the organ systems are formed.
- During the fifth month eruption of hair on the head is observed; the foetus also shows movement.
- By the end of six month (second trimester) the body is covered with fine hair, eyelids separate and eyelashes are also formed.





- By the end of eight month of pregnancy, the testes (in case of a male foetus) descend into the stratum.
- By the end of nine months of pregnancy, the foetus is completely developed and is ready for its delivery.
- Ovary secretes a hormone, called relaxin towards the end of pregnancy.

PARTURITION

- The average duration of pregnancy (gestation period) is about nine months.
- The ovary at this period secretes a hormone, called relaxin, that facilitates parturition by softening the connective tissue of symphysis pubica.
- Parturition is induced by a complex neuroendocrine mechanism that involves cortisol, estrogens and oxytocin.
- The signals for parturition arise from the fully-developed foetus and the placenta; they induce mild uterine contractions, called foetal ejection reflex, which triggers the release of oxytocin from the posterior pituitary of the mother.
- Oxytocin acts on the uterine muscles and causes stronger uterine contractions, which in turn stimulates secretion of more oxytocin.
- The stimulatory reflex between the uterine contraction and oxytocin secretion continues and result in stronger and stronger contraction of uterine muscles, leading to the expulsion of the fully-developed foetus (now, the infant) from the uterus through the birth canal, i.e., parturition is achieved.
- It is followed by the expulsion of placenta and the remains of umbilical cord.

LACTATION

- The mammary glands also undergo certain development during pregnancy under the influence of hormones like prolactin (hPL) and progesterone.

Definition

Foetal Ejection Reflex: The initial mild contractions of the uterus initiated by the fully developed foetus and the placental hormones.

Definition

Parturition: Birth or delivery of foetus.

Previous Year's Question



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

- (1) ovary
- (2) placenta
- (3) Fallopian tube
- (4) pituitary

- They start producing milk towards the end of pregnancy and the milk is used for feeding the new-born (lactation).
- The milk that comes out of the mammary glands of the mother during the initial few days of lactation, is called colostrum; it contains several antibodies needed to develop resistance in the new-born baby.

Definition

Colostrum: Milk produced by the mammary glands, during the initial few days after child birth.

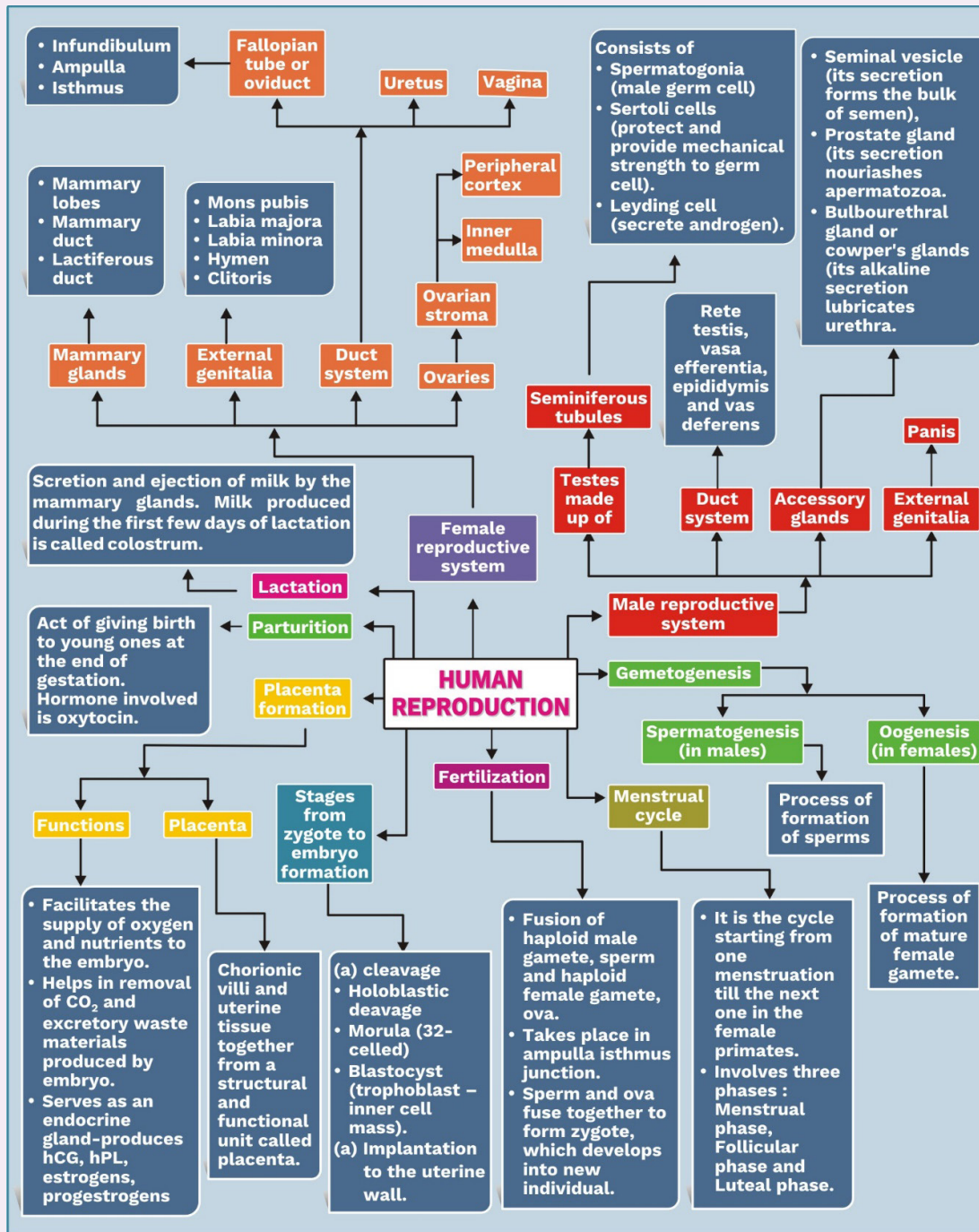
Rack Your Brain



Which hormone is responsible for milk ejection from the mammary glands just after parturition?



Summary





Solved Exercise

- 1. The testes in humans are situated outside the abdominal cavity inside a pouch called scrotum. The purpose served is for -**
- (1) maintaining the scrotal temperature lower than the internal body temperature**
 - (2) escaping any possible compression by the visceral organs**
 - (3) providing more space for the growth of epididymis**
 - (4) providing a secondary sexual feature for exhibiting the male sex.**

Sol. (1)
The testes are situated outside the abdominal cavity within a pouch called scrotum. The scrotum helps in maintaining the low temperature of the testes (2–2.5°C lower than the normal internal body temperature) necessary for spermatogenesis

- 2. If for some reason, the vasa efferentia in the human reproductive system get blocked, the gametes will not be transported from -**
- (1) testes to epididymis**
 - (2) epididymis to vas deferens**
 - (3) ovary to uterus**
 - (4) vagina to uterus.**

Sol. (1)
The male sex accessory ducts include rete testis, vasa efferentia, epididymis and vas deferens. The seminiferous tubules of the testis open into the vasa efferentia through rete testis. The vasa efferentia leave the testis and open into epididymis located along the posterior surface of each testis. So if vasa efferentia gets blocked, the gametes will not be transported from testes to epididymis.

- 3. Sertoli cells are regulated by the pituitary hormone known as**
- (1) LH**
 - (2) FSH**
 - (3) GH**
 - (4) prolactin**



Sol. (2)
Sertoli cells are present in the germinal epithelium of the seminiferous tubules. These cells nourish the developing sperms. These cells differentiate spermatogonia into sperms. They are under the influence of FSH released by anterior pituitary gland.

- 4. In human female the blastocyst -**
(1) forms placenta even before implantation
(2) gets implanted into uterus 3 days after ovulation
(3) gets nutrition from uterine endometrial secretion only after implantation
(4) gets implanted in endometrium by the trophoblast cells.

Sol. (4)
Implantation in endometrial uterine wall takes place at blastocyst stage of embryonic development. Before implantation, the blastomeres of early blastocyst get arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called inner cell mass. It is the trophoblast layer through which blastocyst gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.

- 5. In humans, at the end of the first meiotic division, the male germ cells differentiate into the**
(1) spermatids
(2) spermatogonia
(3) primary spermatocytes
(4) secondary spermatocytes.

Sol. (4)
During embryonic development the primordial germ cells migrate to the testis where they become spermatogonia. At puberty the spermatogonia proliferate rapidly by mitosis. Some undergo growth phase to become primary spermatocytes that further undergo through meiotic division I to become secondary spermatocytes. After completion of meiotic division II the secondary spermatocytes produce spermatids which differentiate to form spermatozoa.



- 6. In human adult females oxytocin -**
(1) stimulates pituitary to secrete vasopressin
(2) causes strong uterine contractions during parturition
(3) is secreted by anterior pituitary (4) stimulates growth of mammary glands.

Sol. (2)
In human adult female oxytocin is a hormone released by the pituitary gland (neurohypophysis), that causes contraction of the uterus during labour and stimulates milk flow from the breasts by causing contraction of muscle fibres in the milk ducts.

- 7. Foetal ejection reflex in human female is induced by**
(1) release of oxytocin from pituitary
(2) fully developed foetus and placenta
(3) differentiation of mammary glands
(4) pressure exerted by amniotic fluid.

Sol. (2)
Parturition is induced by a complex neuroendocrine mechanism. The signals for parturition originate from the fully developed foetus and the placenta which induce mild uterine contractions called foetal ejection reflex. This triggers release of oxytocin from the maternal pituitary. Oxytocin acts on the uterine muscle and causes stronger uterine contractions, which in turn stimulates further secretion of oxytocin. The stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions. This leads to expulsion of the baby out of the uterus through the birth canal.

- 8. Gonads develop from embryonic**
(1) ectoderm
(2) endoderm
(3) mesoderm
(4) both mesoderm and endoderm

Sol. (3)
Gonads, muscles, dermis, kidneys, etc., develop from mesoderm. Ectoderm produces epidermis, glands, nervous system, etc. Pancreas, lining of urinary bladder, etc., develop from endoderm.



- 9. Freshly released human egg has**
- (1) one Y- chromosome**
 - (2) one X- chromosome**
 - (3) two X- chromosome**
 - (4) one X- chromosome and one Y- chromosome**

Sol. (2)
The egg released is haploid (has only one X-chromosome and 22 autosomes) as it is formed due to meiotic division of diploid primary oocyte having XX chromosome and 44 autosomes.

- 10. In the 28 day human ovarian cycle, the ovulation takes place typically on**
- (1) day 14 of the cycle**
 - (2) day 28 of the cycle**
 - (3) day 1 of the cycle**
 - (4) day 5 of the cycle**

Sol. (1)
Ovulation is the releasing of egg by ruptured graafian follicle. The wall of graafian follicle is ruptured by sudden increase in the level of luteinising hormone. The length of menstruation cycle is 28 days (average) from the start of one menstruation period to the start of the next. At about 14th day of the cycle, the distended follicle ruptures and the ovum is extruded into the Fallopian tube.

