Questions

1) Discuss ovulation

2) Differentiate between meosis 1 and meosis 2

3) Discuss the stages involved in fertilization

4) Differentiate between monozygotic twins and dizygotic twins

ANSWERS:

QUESTION ONE

Ovulation is the release of an egg from one of a woman's ovaries, which happens every month and a woman is most fertile during this period. This is the release of an oocyte from the ovarian follicle. Ovulation typically lasts one day and occurs in the middle of a woman's menstrual cycle, about two weeks before she expects to get her period. Ovulation is a part of the menstrual cycle.

It occurs when an egg is released the ovary, When the egg is released it may or may not be fertilized by the sperm, if fertilized the egg may travel to the uterus and implant to develop into a pregnancy if left unfertilized, the egg disintegrates and the uterine lining is shed during your period. Understanding how ovulation happens and when it takes place can help you achieve or prevent pregnancy. It can also help in diagnosing certain medical conditions.

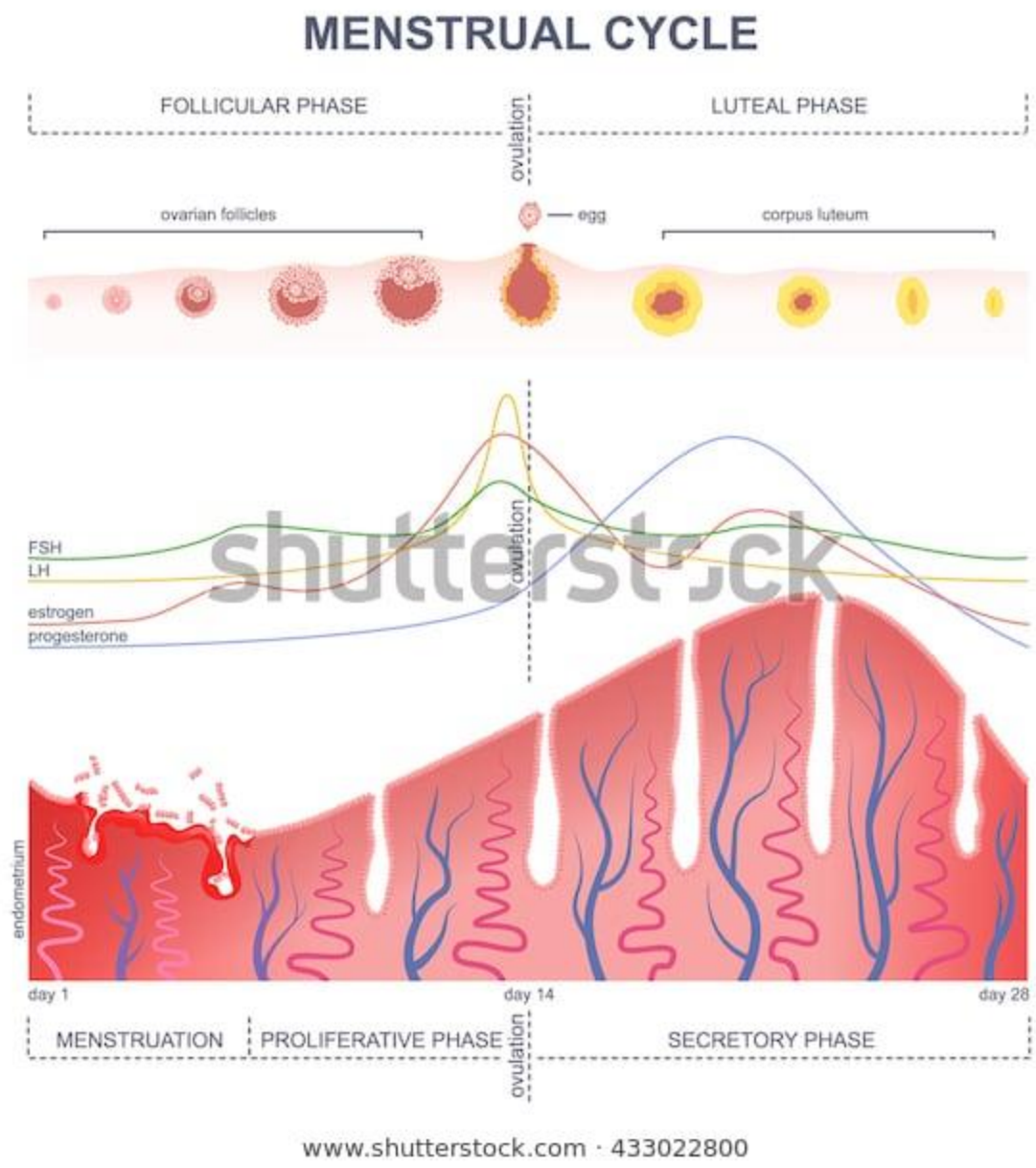
In a few days before ovulation, under the influence of FSH and LH, the secondary follicle grows rapidly to a diameter of about 25mm to become mature vesicular or mature secondary or Graafian follicle.

Signs and Symptoms of Ovulation

1) The basal body temperature may fall slightly: For most women prior to ovulation the basal body temperature is rather consistent.
2) The cervical mucus becomes clearer and thinner with a more slippery consistency similar to that of egg whites.
3) The cervix softens and opens up.
4) Feeling of a slight twinge of pain or mild cramps in the lower abdomen.
5) Sex drive may increase
6) Tenderness of breast
7) Swollen Vulva or Vagina
   Ovulation can be said to be a form of assistance for women trying to conceive for example, the use of Ovulation Prediction Kits (OPK'S) to detect LH surge, which occurs 12-36 hours before ovulation, having sex at just the right period for conception is sure.

Coincident with final development of the vesicular follicle, there is an abrupt increase in LH that causes;

1) The primary oocyte to complete meiosis I
2) And the follicle to enter the preovulatory mature vesicular stage
   Meiosis II is also initiated, but the secondary oocyte is arrested in metaphase approximately 3 hours before ovulation.
   In the meantime, the surface of the ovary begins to bulge locally, and at the apex, an avascular spot, the stigma appears.



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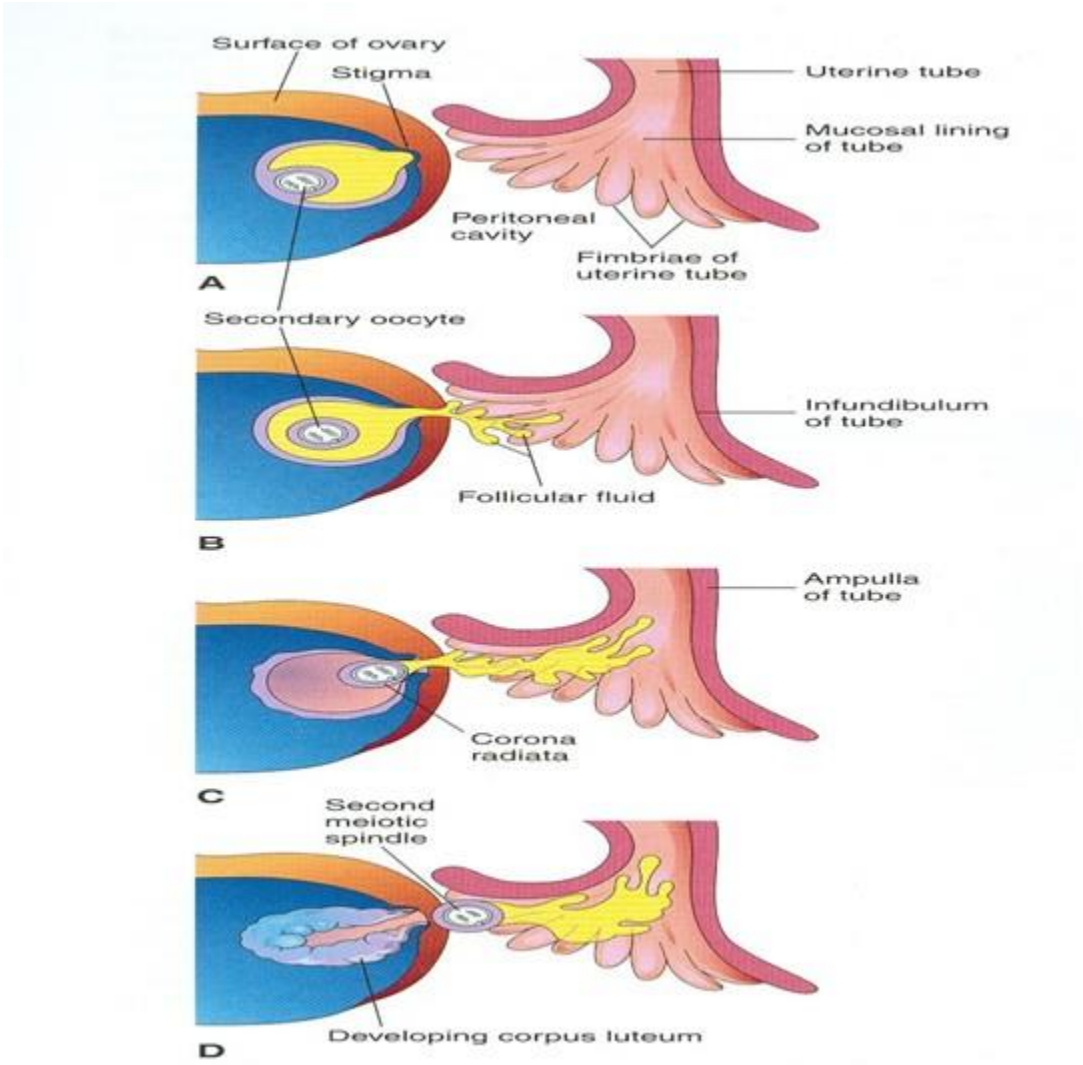
For the oocyte to be released, two events occur which are caused by LH surge:

1) It increases the collagenase activity, resulting in digestion of collagen fibers (connective tissue) surrounding the follicle.
2) Prostaglandin levels also increase in response to the LH surge and cause local muscular contractions in the ovarian wall.
   Those contractions extrude the oocyte, which together with together with its surrounding follicular (granulosa) cells from the region of the cumulus oophorus.

This causes ovulation in which oocyte floats out of the ovary.
Some of the cumulus oophorus cells then rearrange themselves around the zona pellucida to form the corona radiata.
Ovulation is triggered by a surge of LH production
Ovulation usually follows the LH peak by 12 to 24 hours.
The LH surge, elicited by the high estrogen level in the blood, appears to cause the stigma to balloon out, forming a vesicle.



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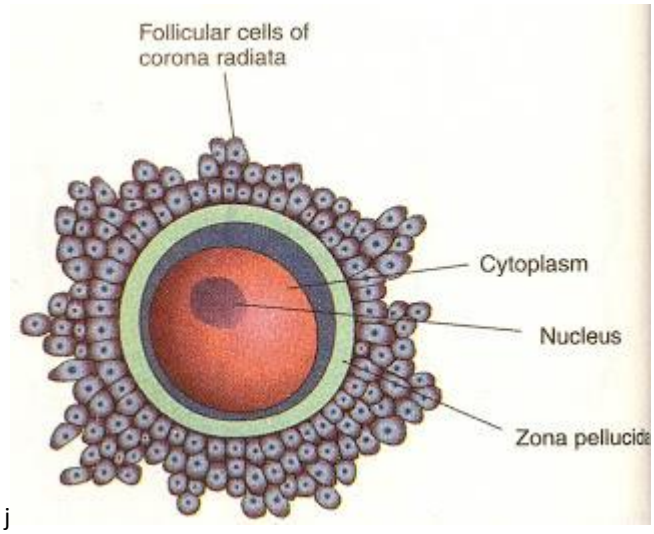
Follicular cells of
corona radiata
Cytoplasm
Nucleus
Zona pellucida
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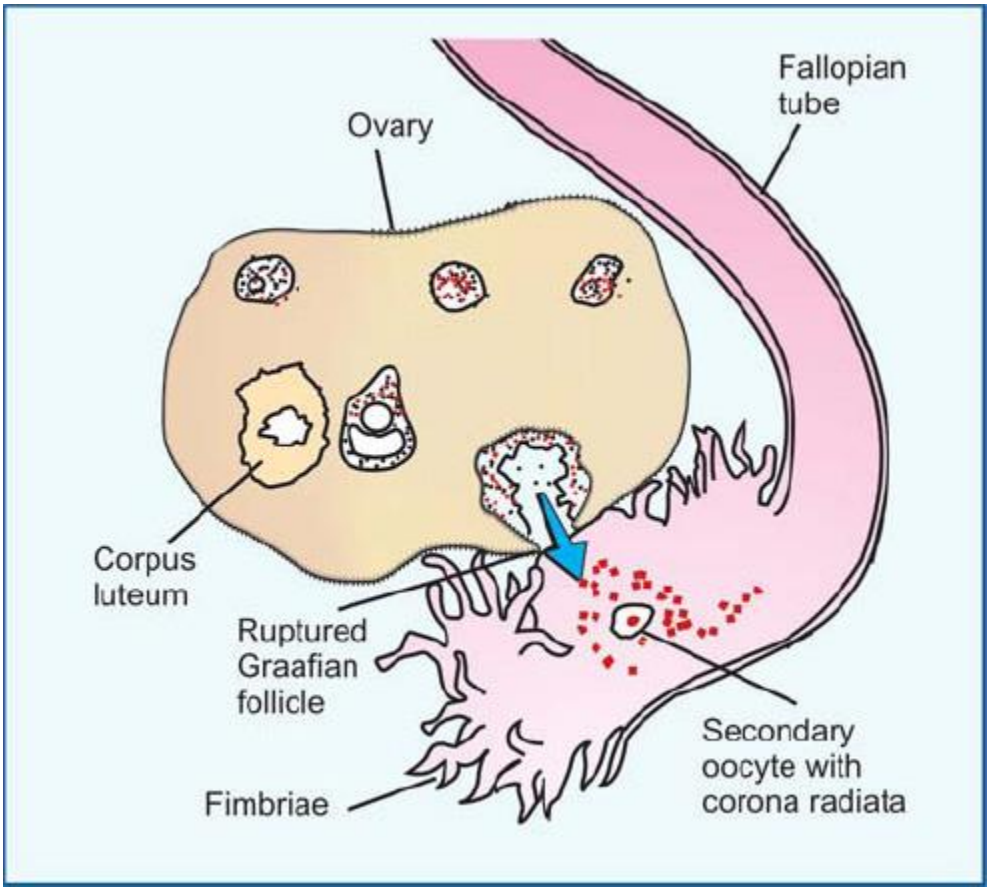

Fallopian
tube
Ovary
Corpus
luteum
Ruptured
Graafian
follicle
Secondary
oocyte with
corona radiata
Fimbriae

Clinical Correlates

During ovulation, some women feel a variable amount of abdominal pain, usually one-sided called Mittelschmerz also known as middle pain because it normally occurs near the middle of the menstrual cycle most times this pain does not require medical attention.

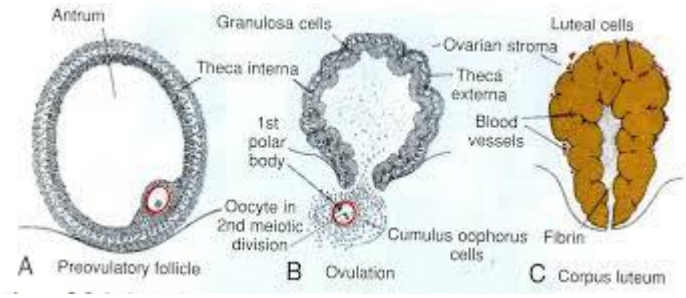
In these cases, ovulation results in slight bleeding into the peritoneal cavity, which results in sudden constant pain in the lower abdomen.

Middle pain may be used as a symptom of ovulation, but there are better symptoms, such as the slight drop in basal body temperature.

Some women fail to ovulate, this is called anovulation, because of a low concentration of gonadotropins.

In these cases, administration of an agent to stimulate gonadotropin release and hence ovulation can be employed.

Although such drugs are effective, they often produce multiple ovulations, so that the risk of multiple pregnancies is ten times higher in these women than in the general population.



QUESTION TWO

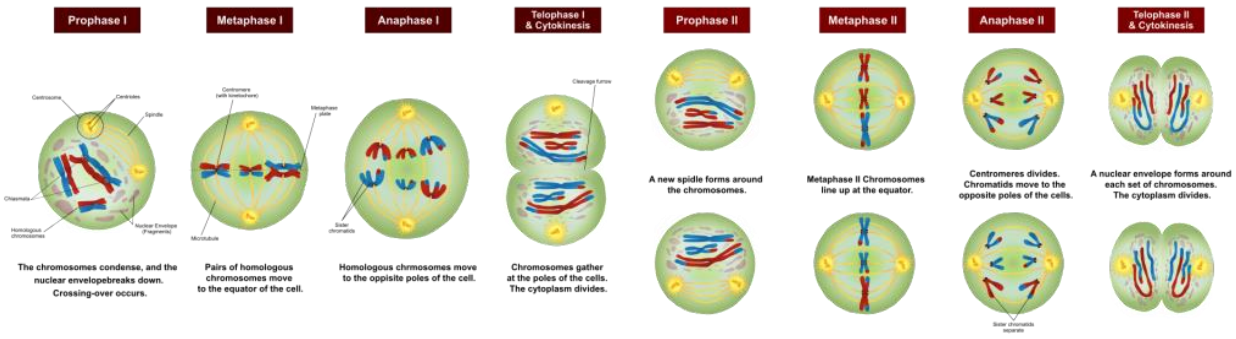
MEIOSIS I

It is referred as a "reduction division" where the 2N set of parental chromosomes are reduced to 1N set of chromosomes after due exchange of parental genetic information. So at the end of meiosis I two daughter cells are formed which are haploid in nature, 1N set of chromosomes.

MEIOSIS II

IS like normal somatic cell division where at the end the two daughter cells of meiosis I become four daughter cells which are haploid in nature, this facilitates to maintain our species specific number of chromosomes without any change.

Meiosis I	Meiosis II
Is a heterotypic division	Is a homotypic division
Reduces the chromosome number in the daughter cell	Equalizes the chromosome number of both parents and daughter cells
Homologous chromosomes are present at the beginning	Individual, bivalent chromosomes are present at the beginning
Prophase I, Metaphase I, Anaphase I and Telophase I are the four phases	Prophase II, Metaphase II, Anaphase II and Telophase II are the four phases
Individual chromosomes are present in the daughter nuclei	Sister chromosomes are present in the daughter nuclei
Chromosomal cross over occurs during Prophase I	No chromosomal cross-over occurs during Prophase II
A complex division and takes more time	Comparatively less simple and takes less time
Preceded by Interphase	No interphase takes place

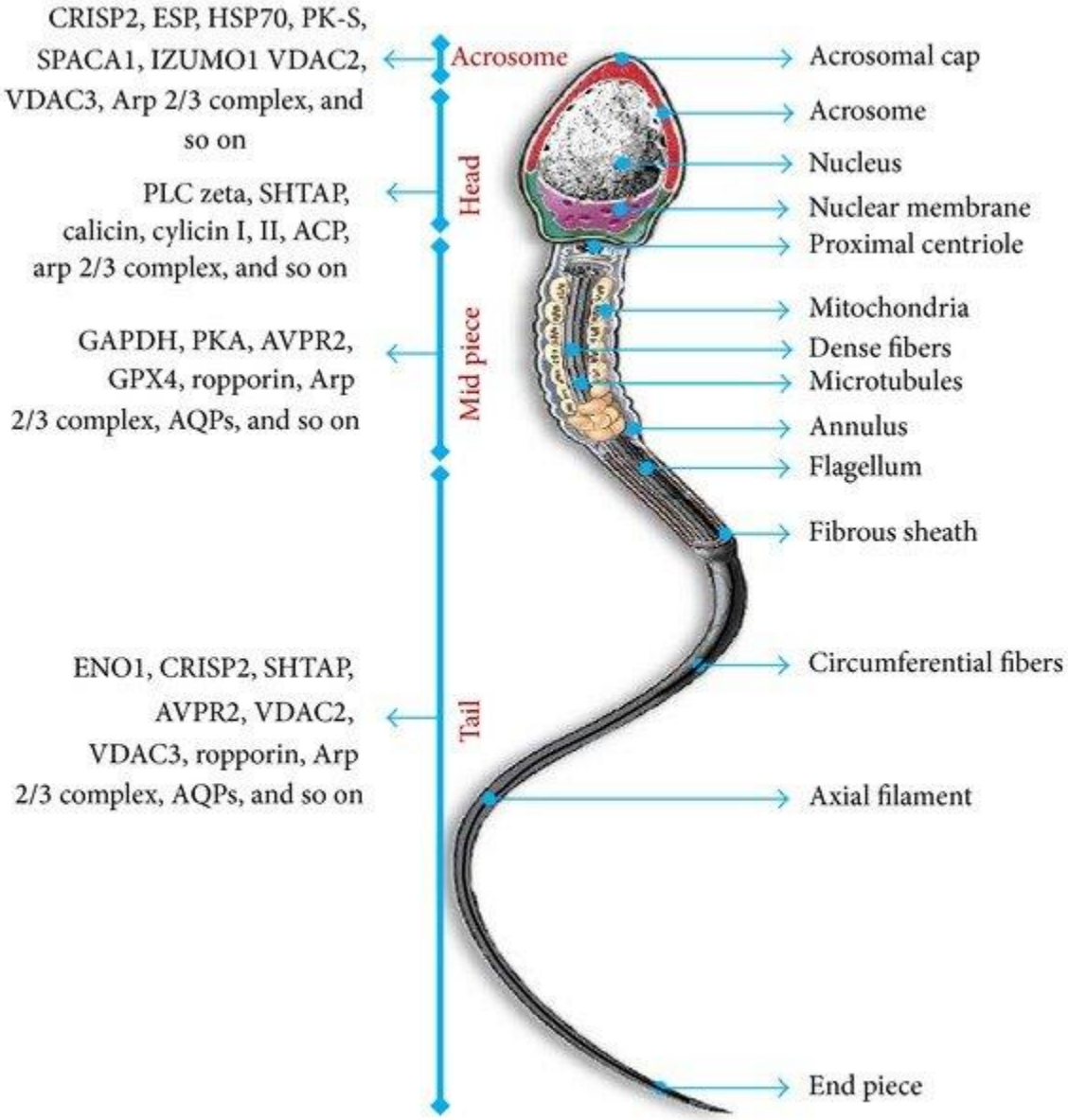


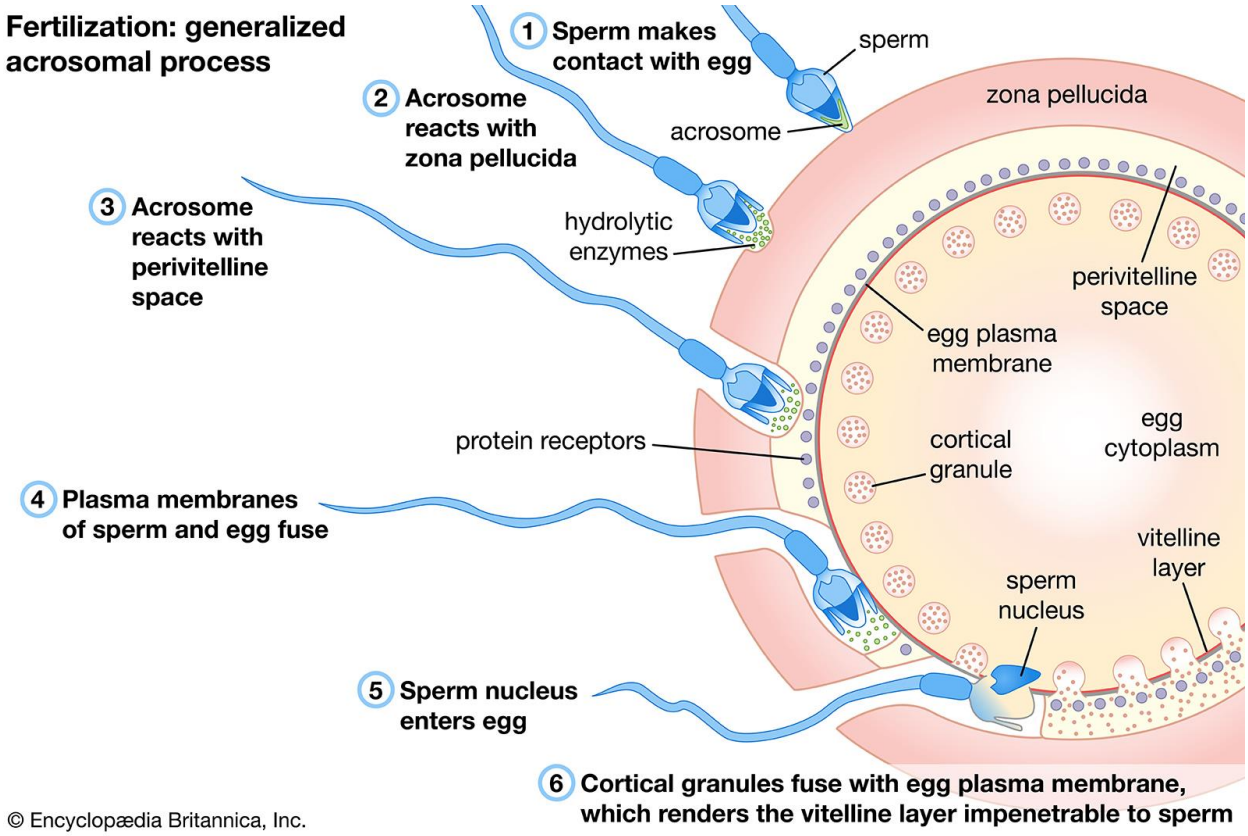
QUESTION THREE

Fertilization is the union of sperm and oocyte. The action or process of fertilizing an egg, involving the fusion of male and female gametes.
The usual site of fertilization is ampulla of the uterine tube this is the widest part of the tube and is close to the ovary.
The result of this union is the production of a zygote cell, or fertilized egg, initiating prenatal development.
This process takes approximately 24 hours.
It is a sequence of coordinated events which include;

I)Passage of sperm through the corona radiata;
For sperms to pass through the corona radiata, they must first be capacitated the passage of sperm through corona radiata depends on the enzyme action of hyaluronidase and tubal mucosal Enzymes.

II) Penetration of Zona pellucida:
The zona pellucida is the extracellular coat, a glycoprotein shell surrounding the egg acting as a selective filter before fertilization that can only be penetrated by sperm that have completed the acrosome reaction. It facilitates and maintains sperm binding and induces acrosome reaction.
The intact acrosome of the sperm binds with a zona glycoprotein (ZP3/zona protein 3) on the zona pellucida.
Release of acrosomal enzymes (acrosin) allows sperm penetrate the egg's protective coat which is the zona pellucida, thereby coming in contact with the plasma membrane of the oocyte.
As soon as the head of a sperm comes in contact with the oocyte surface, the permeability
Of the zona pellucida changes.
When a sperm comes in contact with the oocyte surface, lysosomal enzymes are released from cortical granules lining the plasma membrane of the oocyte.


CRISP2, ESP, HSP70, PK-S, SPACA1, IZUMO1 VDAC2, VDAC3, Arp 2/3 complex, and so on
Acrosome
Acrosomal cap
Acrosome
Nucleus
Nuclear membrane
Proximal centriole
PLC zeta, SHTAP, calicin, cylicin I, II, ACP, arp 2/3 complex, and so on
Head
Mitochondria
Dense fibers
Microtubules
GAPDH, PKA, AVPR2, GPX4, ropporin, Arp 2/3 complex, AQPs, and so on
Mid piece
Annulus
Flagellum
Fibrous sheath
Circumferential fibers
ENO1, CRISP2, SHTAP, AVPR2, VDAC2, VDAC3, ropporin, Arp 2/3 complex, AQPs, and so on
Tail
Axial filament
End piece



Acrosin alter properties of the zona pellucida (zona reaction)to:
Prevent sperm penetration and
Inactivate binding sites for spermatozoa on the zona pellucida
Other spermatozoa have been found embedded in the zona pellucida, but only one seems to be able to penetrate the oocyte.

III) Fusion of plasma membrane of the oocyte and sperm
The initial adhesion of sperm to the oocyte is mediated in part by the interaction of integrins on the oocyte and their ligands, disintegrins, on sperm. After adhesion, the plasma membrane of the sperm and egg fuseSperm-egg fusion is a cell-cell membrane fusion event essential for the propagation of sexually reproducing organisms. In gamete fusion, as in other fusion events, such as intracellular vesicle fusion. The plasma or cell membranes of the oocyte and sperm fuse and break down at the area of fusion. The head and tail of the sperm enter the cytoplasm of the oocyte but, the sperm's plasma membrane remains behind.

IV) Completion of the second meiotic division of oocyte and formation of female pronucleus
Penetration of the oocyte by a sperm by a sperm activates the oocyte into completing the second meiotic division and forming a mature oocyte and a second polar body.
The nucleus of the mature ovum/oocyte is now called the female pronucleus.
Formation of the male pronucleus

Within the cytoplasm of the oocyte, the nucleus of the sperm enlarges to form the male pronucleus and the tail of the sperm degenerates.
The 2 pronuclei fuse into a single diploid aggregation of chromosomes, the ootid becomes a zygote.
The chromosomes in the zygote become arranged on a cleavage spindle in preparation for cleavage of zygote.

QUESTION FOUR

Monozygotic twins are twins which develop from one zygote, which splits and forms two embryos, when one zygote created with one egg and sperm, splits into two instead of having one just one embryo. It results from fertilization of one secondary oocyte by one sperm
The resultant zygote forms a blastocyst in which inner cell mass (embryoblast) splits into two
Therefore, the monozygotic twins are genetically identical
These twins are of the same sex and look alike
They have:
Common chorionic and amniotic sacs
The placenta is one
With two umbilical cords
Sometimes two independent placenta are formed, which may fuse with each other, but do not have anastomosis of blood vessels
The zygote normally develops till morula stage
But when it is converted into blastocyst, two inner cell masses (two embryoblasts) from within it.
Each of which develops into the fetus.
In this condition, the two fetuses have a common placenta, but each lies in an independent amniotic sac.

Dizygotic twins occur when two eggs are fertilized by two separate sperm. Dizygotic twins are also known as fraternal or non-identical twins. They are the most common type of twins and unlike monozygotic twins do not share common genes.
About 2/3rd of twins are dizygotic
Their incidence increases with maternal age (7-10 per 1000 births)
They result from fertilization of two different secondary oocytes by two different sperms
The resultant two zygotes from two blastocysts
Each of which implants separately into the uterine endometrium
They do not look alike and can be of different sex
In such twins
Placenta, Chorionic, and Amniotic sacs are separated and independent. But the chorions and placentas may be fused

Monozygotic Twins	Dizygotic Twins
Bear a high risk for TTTS	Bear a low risk for TTTS
One-third of the twins in the world are monozygotic	Two-thirds of the twins in the world are dizygotic
Appearance is extremely similar but may be affected by environmental factors	Appearance is similar as any other siblings
Genetic codes are nearby identical	Genetic codes are same as any other sibling
Can either be Di-Di, Mono-Di or Mono-Mono	Only Di-Di twins

Development of Monozygotic Twins

- 3 to 4 per 1000 births leads to identical twins.
- Usually occurs at the blastocyst stage, but can occur at bilaminar disc stage.
- They can develop their own placenta, share a placenta, and in some cases will have a common amniotic cavity.