Paper Details : 1S00143 - S.Y.B.Sc. (Sem. III) (Choice Base) /79513 - Life Sciences: Paper I
Date :25-03-2019 **Time :02:30 pm - 05:30 pm**
Q P Code :51989 **Marks : 100**

Answer Key
Q. 1. A) Define / Explain the following terms: (07)
1. Thermoregulation
Thermoregulation is a process that allows your body to maintain its core internal temperature. All**thermoregulation** mechanisms are designed to return your body to homeostasis. This is a state of equilibrium. A healthy internal body temperature falls within a narrow window.
2. Down regulation
The process of reducing or suppressing a response to a stimulus specifically : reduction in a cellular response to a molecule (as insulin) due to a decrease in the number of receptors on the cell surface
3. Vasoconstriction
Vaso" actually means blood vessel. Vasoconstriction is narrowing or constriction of the blood vessels. It happens when smooth muscles in blood vessel walls tighten. This makes the blood vessel opening smaller. Vasoconstriction may also be called vasospasm.
4. Goiter
Goiter: A noncancerous enlargement of the thyroid gland. With a goiter, the levels of thyroid hormones may be normal (euthyroid), elevated (hyperthyroidism), or decreased (hypothyroidism)
5. Hypoglycemia
Hypoglycemia refers to low levels of sugar, or glucose, in the blood. Hypoglycemia is not a disease, but it can indicate a health problem.

All the body's cells, including the brain, need energy to function. Glucose supplies energy to the body. Insulin, a hormone, enables the cells to absorb and use it.

Signs of low blood sugar include hunger, trembling, heart racing, nausea, and sweating. In severe cases, it can lead to coma and death.

Hypoglycemia can occur with several conditions, but it most commonly happens as a reaction to medications, such as insulin. People with diabetes use insulin to treat high blood sugar.

6. Corpora allata
In insect physiology, the **corpus allatum** (plural: **corpora allata**) is an endocrine gland which generates juvenile hormone; as such, it plays a crucial role in metamorphosis.
7. Adenylate cyclase
An enzyme that catalyses the formation of cyclic adenylic acid from adenosine triphosphate.

Q.1.B. Match the Column: **(07)**

a) – iv) ; **b)** – i); **c)** – vii) ; **d)** – iii) ; **e)** – ii) ; **f)** – v) ; **g)** – vi)

Q. 1. **C): State whether True or False: (06)**
1. Double fertilizations is observed in pteridophtes group of plants. **False**

2. Honey bee has three types of individuals. **True**
3. Ovule in Angiosperms is also called as microsporangium. **False**
4. Tapetum is the inner layer of wall of anther. **True**
5. Genital ridge is unipotential. **False**
6. Worker honey bee has diploid chromosome sets. **True**

Q.2. A) Answer any one of the following: (10)
1. Describe in detail the hormones produced by anterior pituitary gland.

The Anterior Lobe

The anterior lobe contains six types of secretory cells, all but one of which (#2 above) are specialized to secrete only one of the anterior lobe hormones. All of them secrete their hormone in response to hormones reaching them from the hypothalamus of the brain.

Thyroid Stimulating Hormone (TSH)

TSH (also known as thyrotropin) is a glycoprotein consisting of:

- a **beta** chain of 118 amino acids and
- an **alpha** chain of 92 amino acids. The alpha chain is identical to that found in two other pituitary hormones, FSH and LH as well as in the hormone chorionic gonadotropin. Thus it is its beta chain that gives TSH its unique properties.

The secretion of TSH is

- stimulated by the arrival of **thyrotropin releasing hormone** (**TRH**) from the hypothalamus.
- inhibited by the arrival of **somatostatin** from the hypothalamus.

As its name suggests, TSH stimulates the thyroid gland to secrete its hormone **thyroxine** (**T_4**). It does this by binding to transmembrane G-protein-coupled receptors (GPCRs) on the surface of the cells of the thyroid.

Some people develop antibodies against their own TSH receptors. When these bind the receptors, they "fool" the cell into making more T_4 causing **hyper**thyroidism. The condition is called thyrotoxicosis or Graves' disease.

Hormone deficiencies

A deficiency of TSH causes **hypo**thyroidism: inadequate levels of T_4 (and thus of T_3 [Link]).

Physicians occasionally encounter patients who are homozygous for mutant TSH **receptors** or mutant TRH **receptors**. In either case, they suffer from hypothyroidism.

A deficiency of TSH, or mutant TSH receptors, have also been implicated as a cause of osteoporosis. Mice, whose TSH receptors have been knocked out, develop increased numbers of bone-reabsorbing osteoclasts.

Follicle-Stimulating Hormone (FSH)

FSH is a heterodimeric glycoprotein consisting of

- the same alpha chain found in TSH (and LH)
- a beta chain of 118 amino acids, which gives it its unique properties.

Synthesis and release of FSH is triggered by the arrival from the hypothalamus of **gonadotropin-releasing hormone** (**GnRH**). The effect of FSH depends on one's sex.

FSH in females

In sexually-mature females, FSH (assisted by LH) acts on the follicle to stimulate it to release **estrogens**.

FSH produced by recombinant DNA technology (Gonal-f®) is available to promote ovulation in women planning to undergo in vitro fertilization (IVF) and other forms of assisted reproductive technology.

FSH in males

In sexually-mature males, FSH acts on spermatogonia stimulating (with the aid of testosterone) the production of sperm.

Luteinizing Hormone (LH)

LH is synthesized within the same pituitary cells as FSH and under the same stimulus (**GnRH**). It is also a heterodimeric glycoprotein consisting of

- the same 92-amino acid **alpha** subunit found in FSH and TSH (as well as in chorionic gonadotropin);
- a **beta** chain of 121 amino acids that is responsible for its properties.

The effects of LH also depend on sex.

LH in females

In sexually-mature females,

- a surge of LH triggers the completion of meiosis I of the egg and its release (**ovulation**) in the middle of the menstrual cycle;

- stimulates the now-empty follicle to develop into the **corpus luteum**, which secretes **progesterone** during the latter half of the menstrual cycle.

Women with a severe LH deficiency can now be treated with human LH (Luveris®) produced by recombinant DNA technology.

LH in males

LH acts on the interstitial cells (also known as Leydig cells) of the **testes** stimulating them to synthesize and secrete the male sex hormone, **testosterone**.

LH in males is also known as **interstitial cell stimulating hormone** (**ICSH**).

Prolactin (PRL)

Prolactin is a protein of 198 amino acids. During pregnancy it helps in the preparation of the breasts for future milk production.

After birth, prolactin promotes the synthesis of milk.

Prolactin secretion is

- stimulated by **TRH**
- repressed by **estrogens** and **dopamine**.

In pregnant mice, prolactin stimulates the growth of new neurons in the olfactory center of the brain.

Growth Hormone (GH)

Human growth hormone (HGH; also called somatotropin) is a protein of 191 amino acids. The GH-secreting cells are stimulated to synthesize and release GH by the intermittent arrival of **growth hormone releasing hormone** (**GHRH**) from the hypothalamus. GH promotes body growth by:

- binding to receptors on the surface of liver cells.
- This stimulates them to release **insulin-like growth factor-1** (**IGF-1**; also known as **somatomedin**)
- IGF-1 acts directly on the ends of the long bones promoting their growth

Things that can go wrong.

- In childhood,
    - **hypo**secretion of GH produces a short but normally-proportioned body.

  - Growth retardation can also result from an inability to **respond** to GH. This can be caused by inheriting two mutant genes encoding the **receptors** for
    - **GHRH** or
    - **GH** (causing Laron syndrome, a form of dwarfism) or
    - homozygosity for a disabling mutation in *STAT5b*, which is part of the "downstream" signaling process after GH binds its receptor.
  - **hyper**secretion leads to **gigantism**
- In adults, a **hyper**secretion of GH or GHRH leads to **acromegaly**.

Hormone-replacement therapy

GH from domestic mammals like cows and pigs does not work in humans. So for many years, the only source of GH for therapy was that extracted from the glands of human cadavers. But this supply was shut off when several patients died from a rare neurological disease attributed to contaminated glands.

Now, thanks to recombinant DNA technology, **recombinant human GH** (r**HGH**) is available. While a benefit to patients suffering from GH deficiency or the short stature associated with Turner syndrome, there has also been pressure to use it to stimulate growth in youngsters who have no deficiency but whose parents want them to grow up tall. And so, in the summer of 2003, the U.S. FDA approved the use of human growth hormone (HGH) for

- boys predicted to grow no taller than 5′3″ and
- for girls, 4′11″

even though otherwise perfectly healthy.

ACTH — the adrenocorticotropic hormone

ACTH is a peptide of 39 amino acids. It is cut from a larger precursor **proopiomelanocortin** (**POMC**).

ACTH acts on the cells of the **adrenal cortex**, stimulating them to produce

- **glucocorticoids**, like **cortisol**;
- **mineralocorticoids**, like **aldosterone**;
- **androgens** (male sex hormones, like **testosterone**).
- In the fetus, ACTH stimulates the adrenal cortex to synthesize a precursor of estrogen called **dehydroepiandrosterone sulfate** (**DHEA-S**) which helps prepare the mother for giving birth.

Production of ACTH depends on the intermittent arrival of **corticotropin-releasing hormone** (**CRH**) from the hypothalamus.

Hypersecretion of ACTH is a frequent cause of Cushing's syndrome.

Alpha Melanocyte-Stimulating Hormone (α-MSH)

Alpha MSH is also a cleavage product of proopiomelanocortin (POMC). In fact, α-MSH is identical to the first 13 amino acids at the amino terminal of ACTH.

2. Give an account on the physiological functions of the gonadal hormone.

The hormonal role of the gonads—the male testes and female ovaries—which produce the sex cells (sperm and ova) and secrete the gonadal hormones. The roles of the gonadotropins released from the anterior pituitary (FSH and LH) were discussed earlier.

The primary hormone produced by the male testes is **testosterone**, a steroid hormone important in the development of the male reproductive system, the maturation of sperm cells, and the development of male secondary sex characteristics such as a deepened voice, body hair, and increased muscle mass. Interestingly, testosterone is also produced in the female ovaries, but at a much reduced level. In addition, the testes produce the peptide hormone **inhibin**, which inhibits the secretion of FSH from the anterior pituitary gland. FSH stimulates spermatogenesis.

The primary hormones produced by the ovaries are **estrogens**, which include estradiol, estriol, and estrone. Estrogens play an important role in a larger number of physiological processes, including the development of the female reproductive system, regulation of the menstrual cycle, the development of female secondary sex characteristics such as increased adipose tissue and the development of breast tissue, and the maintenance of pregnancy. Another significant ovarian hormone is **progesterone**, which contributes to regulation of the menstrual cycle and is important in preparing the body for pregnancy as well as maintaining pregnancy. In addition, the granulosa cells of the ovarian follicles produce inhibin, which—as in males—inhibits the secretion of FSH.During the initial stages of pregnancy, an organ called the placenta develops within the uterus. The placenta supplies oxygen and nutrients to the fetus, excretes waste products, and produces and secretes estrogens and progesterone. The placenta produces human chorionic gonadotropin (hCG) as well. The hCG hormone promotes progesterone synthesis and reduces the mother’s immune function to protect the fetus from immune rejection. It also secretes human placental lactogen (hPL), which plays a role in preparing the breasts for lactation, and relaxin, which is thought to help soften and widen the pubic symphysis in preparation for childbirth. The hormones controlling reproduction are summarized in Table 6.

Reproductive Hormones (Table 6)

Gonad	Associated hormones	Chemical class	Effect

Reproductive Hormones (Table 6)			
Gonad	**Associated hormones**	**Chemical class**	**Effect**
Testes	Testosterone	Steroid	Stimulates development of male secondary sex characteristics and sperm production
Testes	Inhibin	Protein	Inhibits FSH release from pituitary
Ovaries	Estrogens and progesterone	Steroid	Stimulate development of female secondary sex characteristics and prepare the body for childbirth
Placenta	Human chorionic gonadotropin	Protein	Promotes progesterone synthesis during pregnancy and inhibits immune response against fetus

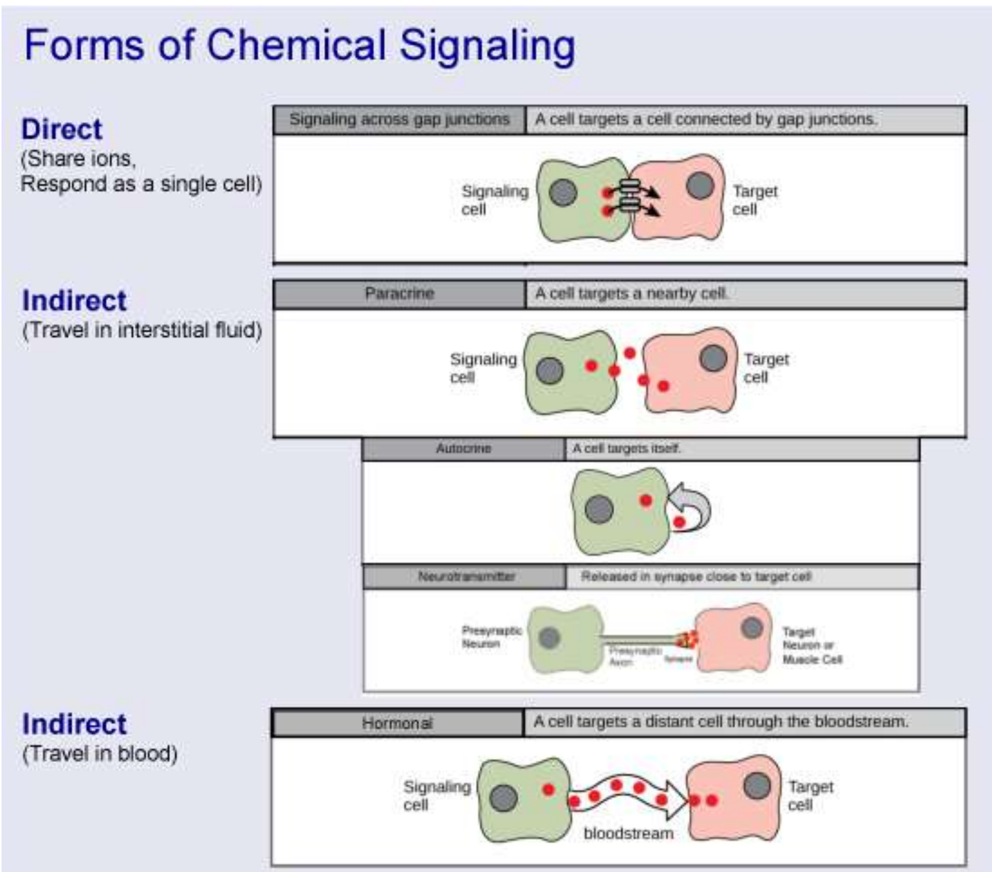
Q. 2. B) Answer any two of the following: (10)
1. Differentiate between direct and indirect cell signaling.

Intercellular Communication Mechanisms

There are two fundamentally different forms of communication between cells, **direct and indirect**. Direct communication occurs between cells that are physically connected. The signals pass from one cell to another through cytoplasmic fluid. Indirect communication involves chemical diffusion across the interstitial fluid between cells.

Direct communication in animal cells takes place through gap junctions. These water-filled channels between the cells allow small signaling molecules, called **intracellular mediators**, to diffuse between the two cells. Small molecules, such as calcium ions (Ca^{2+}), are able to move between cells, but large molecules like proteins and DNA cannot fit through the channels. The specificity of the channels ensures that the cells remain independent but can quickly and easily transmit signals. The transfer of signaling molecules communicates the current state of the cell that is directly next to the target cell; this allows a group of cells to coordinate their response to a signal that only one of them may have received. In plants, the equivalent of gap junctions (plasmodesmata) are ubiquitous, making the entire plant into a giant, communication network.

Indirect communication always involves the release of the signal into interstitial fluid outside the signaling cell and diffusion of the signal molecules to surrounding cells. With one major exception the target cells are within diffusion distance of the signaling cell. The exception is found in signal molecules that are released into an area of dense capillary beds. In this case the signal molecules diffuse from the interstitial fluid into the blood stream where they are distributed into the interstitial fluid throughout the body.



2. Explain Ecdysone, is a moulting hormone.

Ecdysone is a steroidal prohormone of the major insect molting hormone 20-hydroxyecdysone, which is secreted from the prothoracic glands. Insect molting**hormones** (ecdysone and its homologues) are generally called ecdysteroids.

Ecdysone is the major steroid hormone in insects and plays essential roles in**coordinating** developmental transitions such as larval molting and metamorphosis through its active metabolite 20-hydroxyecdysone (20E).

Ecdysone is a steroidal prohormone of the major insect molting hormone 20-hydroxyecdysone, which is secreted from the prothoracic glands. Insect molting hormones (ecdysone and its homologues) are generally called ecdysteroids. Ecdysteroids act as moulting hormones of arthropods but also occur in other related phyla where they can play different roles. In *Drosophila melanogaster*, an increase in ecdysone concentration induces the expression of genes coding for proteins that the larva requires, and it causes chromosome puffs (sites of high expression) to form in polytene chromosomes

3. Describe the mechanism of G-protein mediated cAMP synthesis.

G protein-coupled receptors (GPCRs) are a large family of integral membrane proteins that respond to a variety of extracellular stimuli. Each GPCR binds to and is activated by a specific ligand stimulus that ranges in size from small molecule catecholamines, lipids, or neurotransmitters to large protein hormones. When a GPCR is activated by its extracellular ligand, a conformational change is induced in the receptor that is transmitted to an attached intracellular heterotrimeric G protein complex. The G_s alpha subunit of the stimulated G protein complex exchanges GDP for GTP and is released from the complex

In a cAMP-dependent pathway, the activated G_s alpha subunit binds to and activates an enzyme called adenylyl cyclase, which, in turn, catalyzes the conversion of ATP into cyclic adenosine monophosphate (cAMP). Increases in concentration of the second messenger cAMP may lead to the activation of

- cyclic nucleotide-gated ion channels
- exchange proteins activated by cAMP
- popeye domain containing proteins
- an enzyme called protein kinase A (PKA)

The PKA enzyme is also known as cAMP-dependent enzyme because it gets activated only if cAMP is present. Once PKA is activated, it phosphorylates a number of other proteins including:

- enzymes that convert glycogen into glucose
- enzymes that promote muscle contraction in the heart leading to an increase in heart rate
- transcription factors, which regulate gene expression

Also phosphorylate AMPA

Specificity of signaling between a GPCR and its ultimate molecular target through a cAMP-dependent pathway may be achieved through formation of a multiprotein complex that includes the GPCR, adenylyl cyclase, and the effector protein

4. Explain the mechanism of biosynthesis of Cytokinin.

Biosynthesis of Cytokinins:

Two mechanisms have been proposed for cytokinin biosynthesis, one leading to tRNA cytokinins and the other to free cytokinins. Since certain tRNAs contain cytokinin, synthesis and turnover of tRNA is the possible route to free cytokinin formation. Evidences suggest that biosynthesis via tRNA may not be a major source of cytokinins.

So, it seems unlikely that any significant amount of free hormonal cytokinin in plants is derived from the degradation of tRNA. There is also evidence that free cytokinins do not take part in the synthesis of tRNA cytokinins. On the contrary, tRNAs are first made by conventional method and then polymerized into the final tRNA molecule.

After this, the isopentenyl groups are transferred from isopentenyl pyrophosphate (IpPP) by an enzyme known as prenyl transferase which belongs to a group of enzymes required for the synthesis of other isoprenoid compounds.

Such prenyl transferase which synthesizes tRNA cytokinins does not utilize free AMP as a substrate, rather it has the property to recognize a specific base sequence in the tRNA molecule and transfer the isopentenyl group to the adenosine adjacent to the 3′ end of the anticodon.

Free cytokinins are synthesized in a different manner. For the direct synthesis of free cytokinins, an enzyme called isopentenyl pyrophosphate: AMP isopentenyl transferase, also known as cytokinin synthase catalyzes the conversion of 5-AMP and isopentenyl pyrophosphate into i^6ADE.
It has also been noticed that cytokinin synthase involved in the synthesis of free cytokinins is also a type of prenyl transferase but is not the same transferase that is involved in the synthesis of tRNA cytokinins. Although the i^6ADE or its ribotide derivative are not the major cytokinins of higher plants, it can be readily converted to zeatin and other major cytokinins.
It has been observed that crown gall tumors of plants produced upon infection by the bacterium Agrobacterium tumefaciens, can grow in culture without the inclusion of auxin or cytokinin in the culture medium. This proves that crown gall tumor tissues contain substantial amounts of both auxin and cytokinin.

Agrobacterium contains a large, circular extra-chromosomal DNA known as the Ti plasmid. At the time of infection, a small portion of the Ti plasmid, known as the T-DNA is incorporated into the nuclear DNA of the host plant cell chromosomes. Genes necessary for the biosynthesis of auxin and cytokinin are carried by the T-DNA of bacteria.

It is only after crown gall transformation, a special class of nitrogen-containing compounds called opines are synthesized in plants. It is interesting to note that the opines are utilized only for bacterial nutrition and are of no use to the plants.

The T-DNA contains a number of genes for hormone biosynthesis. We know that an isopentenyl transferase enzyme transfers the isopentenyl group from IpPP to AMP to form the cytokinin, isopentenyl adenine ribotide. This transferase enzyme is encoded by ipt (isopentenyl transferase) gene that is one of the T-DNA genes.

Q.3. A) Answer any one of the following: (10)

1. Explain the mechanism of conduction/propagation of Nerve impulses.

A nerve impulse is the electric signals that pass along the dendrites to generate a nerve impulse or an action potential. An action potential is the movement of ions in and out of the cell. It specifically involves sodium and potassium ions. They are moved in and out of the cell through sodium and potassium channels and sodium-potassium pump.

Conduction of nerve impulse occurs due to the presence of active and electronic potentials along the conductors. Transmission of signals internally between the cells is achieved through a synapse. Nerve conductors comprise of relatively higher membrane resistance and low axial resistance. The electrical synapse has its application in escape reflexes, heart and in the retina of vertebrates. They are mainly used whenever there is a requirement of fast response and timing being crucial. The ionic currents pass through the two cell membrane when the action potential reaches the stage of such synapse.

Mechanism of Transmission of Nerve Impulse

The axon or nerve fibers are in the form of a cylinder wherein the interior of the axon is filled with axoplasm and the exterior is covered with axolemma. The nerve fibers are immersed in ECF. The solution is in ionic form that is present in axoplasm and extracellular fluid or ECF.

Mechanism of Transmission of Nerve Impulse

Outside the axon, the negatively charged chloride ions are neutralized in the presence of positively charged sodium ions. Negatively charged protein molecules are neutralized in the presence of potassium ions within the axoplasm. The membrane of a neuron -ve inside and +ve outside. Resting potential would be the difference in charge. The difference in charge might vary from seventy to ninety millivolts, as a result, the membrane would be polarized. Sodium potassium metallic pump operates to keep resting potential in equilibrium.

The pump is placed on the axon membrane. Now the potassium ions are pumped from ECF to axoplasm and sodium ions are placed from axoplasm to ECF. The concentration level of sodium ions would be between twenty-eight to thirty times more inside the neuron membrane and the concentration level of sodium ions would be fourteen times more in outside the neuron membrane.

The sodium-potassium pump stops operating when a stimulus is applied to a membrane of a nerve fiber. The stimulus could be either electrical, chemical or mechanical. The potassium ions rush outside the membrane and sodium ions rush inside the membrane as a result negative charges are present outside and positive charges are present inside.

The nerve fibers are either depolarized or they are said to be in action potential. The action potential traveling along the membrane would be the nerve impulse. It is around + 30 mV. The sodium-potassium pump starts to operate once the action potential is completed. As a result, the axon membrane will obtain a resting potential by repolarization.

Now the process takes place in a reverse order. It is a reversal of the process that has taken place during an action potential. Here, potassium ions will be rushed inside and sodium ions will be rushed outside. Impulse would not be transmitted through the nerve fiber during the refractory period.

In a case of white fibers, saltatory propagation takes place. That is impulse jumps from node to node and it increases with increase in speed of nerve impulse. It is around twenty times faster compared to that of the non-medullated nerve fibers. The transmission of nerve impulse would rely upon the diameter of the fiber. For instance, the nerve impulse of a mammal is one twenty meters per second whereas nerve impulse of a Frog is 30 meters per second.

2. Describe the learned behaviour with any suitable example.

Learned Behavior

Behavior is a response to a stimulus. **Learned behaviors** means the behaviour which are acquired changes in behavior during one's lifetime. Eg.such as classical and operant conditioning.

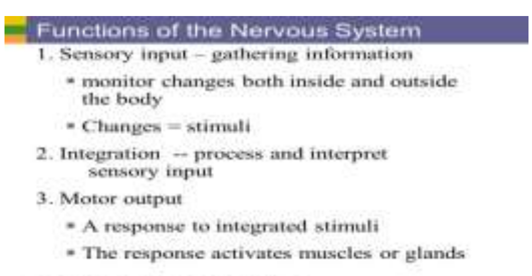
Classical Conditioning –Pavlov's Dog- Bell- Food Expt.

Operant Conditioning:

B.F. Skinner and his work with operant conditioning. Skinner would place animals such as pigeons or rats in a chamber that is known as a Skinner Box. Once the animal performed a specific task, such as pushing a lever, the animal would immediately receive a reward - generally food or water - or a punishment - generally a loud sound or small electric shock. Craig's desire to avoid getting a speeding ticket is operant conditioning, as he has learned to not repeat this behavior in order to avoid a punishment.

Q. 3. B) Answer any two of the following: (10)

1. Give the functions of the Nervous system.



2. Explain the nervous system in Star fish.

Starfish do not have brains, but they do have what people would call a "distributed brain". Starfish have a complex nervous system which has a network of interlacing nerves known as nerve plexus which lies within, as well as under the skin. The oesophagus, commonly known as the gullet, is also surrounded by a central ring which sends radial nerves into each of the arms. The ring nerves and radial nerves coordinate the starfish's balance and direction. Starfish do not have many sensory inputs but are sensitive to touch, light, temperature, and the status of the water around them. The tube feet which is a small hallow appendages, and spines are sensitive to touch, the eyespots are sensitive to light, and the tube feet are sensitive to chemicals and can be used to locate food.

3. Explain Taxes Movements of locomotion.

Taxis (taxic response; tactic movement) The movement of a cell (e.g. a gamete) or a microorganism in response to an external stimulus. Certain microorganisms/Cell have a light-sensitive region that enables them to move towards or away from high light intensities (positive and negative phototaxis respectively). Many bacteria/cells move in response to chemical stimuli (*chemotaxis*); a specific example is *aerotaxis*, in which atmospheric oxygen is the stimulus. Taxic responses are restricted to cells that possess cilia, flagella, or some other means of locomotion. The term is usually not applied to the movements of higher animals.

4. What are the components and function of the ANS?

Autonomic nervous system, in vertebrates, the part of the nervous system that controls and regulates the internal organs without any conscious recognition or effort by the organism. The autonomic nervous system comprises two antagonistic sets of nerves, the sympathetic and parasympathetic nervous systems. The sympathetic nervous system connects the internal organs to the brain by spinal nerves. When stimulated, these nerves prepare the organism for stress by increasing the heart rate, increasing blood flow to the muscles, and decreasing blood flow to the skin. The nerve fibres of the parasympathetic nervous system are the cranial nerves, primarily the vagus nerve, and the lumbar spinal nerves. When stimulated, these nerves increase digestive secretions and reduce the heartbeat.

Q.4. A) Answer any one of the following: (10)

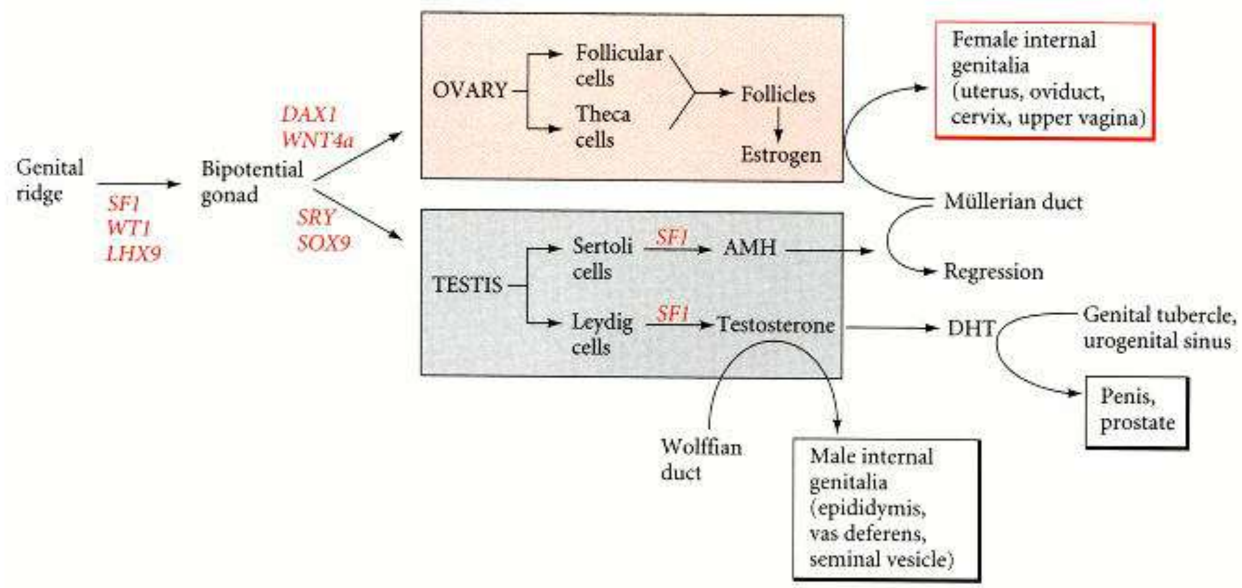
1. Describe development of embryo in dicotyledonous plants.

Zygote divides into apical cell and basal cell. Steps of development of basal cell to form suspensor. Hypophysis cell gives rise to apex of radical. Apical embryonal cell forms quadrant,octant, from octant surface cells are cut which eventually form dermatogens. This is football stage. Followed by heart shaped, torpedo like structure. Finally 2 cotyledons, a plumule and radical is formed within the ovule.

Diagrams should be considered.

2. Explain differentiation of gonads in mammals. Discuss role of genes in sex determination.

Bipotential nature of genital ridge. In absence of male stimulus, female development proceeds. In humans, the gonadal rudiments appear in the intermediate mesoderm during week 4 and remains sexually indifferent until week 7. The gonadal rudiments are paired regions of the intermediate mesoderm; they form adjacent to the developing kidneys. The ventral portions of the gonadal rudiments are composed of the genital ridge epithelium. During the indifferent stage, the genital ridge epithelium proliferates into the loose connective mesenchymal tissue above it These epithelial layers form the **sex cords**. The germ cells migrate into the gonad during week 6, and are surrounded by the sex cords. In both XY and XX gonads, the sex cords remain connected to the surface epithelium.
If the fetus is XY, the sex cords continue to proliferate through the eighth week, extending deeply into the connective tissue.



Discuss SRY, SOX9 .
Diagram can be considered.

Q. 4. B) Answer any two of the following: (10)

1. Describe embryo sac in Angiosperms.

Embryo sac in angiosperms is 7 celled, 8 nucleated. It is the female gametophyte. It develops inside the nucellus, near micropylar end. The egg apparatus is towards micropylar end and it consists of cental egg, with 2 synergids on either side. Towards chalazal end 3 antipodal cells are precent. The secondary nucleus lies in the centre, with 2 fused nuclei.
Diagram should be drawn.

2. Explain menstrual cycle.

All the 4 phases of menstrual cycle with hormonal changes should be explained. Diagram can be considered.

3. Explain interaction between fig and Fig wasp.

Symbiotic developmental relationship between fig and fig wasp, for mutual reproduction. Wasps carry cross pollination for the plant. Receives place to lay eggs in hypanthodium/syconus inflorescence of Fig. the structure of fig to facilitate this interaction. Diagrms can be considered.

4. Describe fertilized egg of Frog.

Fertilized egg structure animal pole, vegetal pole, cone of reception, grey cresent. Describe all.
Diagram should be drawn.

Q.5. Write short notes on any four of the following: (20)

1. Process of homeostasis.

Homeostasis

Homeostasis refers to stability, balance, or equilibrium within a cell or the body. It is an organism's ability to keep a constant internal environment. Homeostasis is an important characteristic of living things. Keeping a stable internal environment requires constant adjustments as conditions change inside and outside the cell. The adjusting of systems within a cell is called homeostatic regulation. Because the internal and external environments of a cell are constantly changing, adjustments must be made continuously to stay at or near the set point (the normal level or range). Homeostasis can be thought of as a dynamic equilibrium rather than a constant, unchanging state.

Feedback Regulation Loops

The endocrine system plays an important role in homeostasis because hormones regulate the activity of body cells. The release of hormones into the blood is controlled by a stimulus. For example, the stimulus either causes an increase or a decrease in the amount of hormone secreted. Then, the response to a stimulus changes the internal conditions and may itself become a new stimulus. This self-adjusting mechanism is called feedback regulation.

Feedback regulation occurs when the response to a stimulus has an effect of some kind on the original stimulus. The type of response determines what the feedback is called. **Negative feedback** occurs when the response to a stimulus reduces the original stimulus. **Positive feedback** occurs when the response to a stimulus increases the original stimulus.

Thermoregulation: A Negative Feedback Loop

Negative feedback is the most common feedback loop in biological systems. The system acts to reverse the direction of change. Since this tends to keep things constant, it allows the maintenance of homeostatic balance. For instance, when the concentration of carbon dioxide in the human body increases, the lungs are signaled to increase their activity and exhale more carbon dioxide, (your breathing rate increases). Thermoregulation is another example of negative feedback. When body temperature rises, receptors in the skin and the hypothalamus sense the temperature change. The temperature change (stimulus) triggers a command from the brain. This command, causes a response (the skin makes sweat and blood vessels near the skin surface dilate), which helps decrease body temperature. Figure 1 shows how the response to a stimulus reduces the original stimulus in another of the body's negative feedback mechanisms.

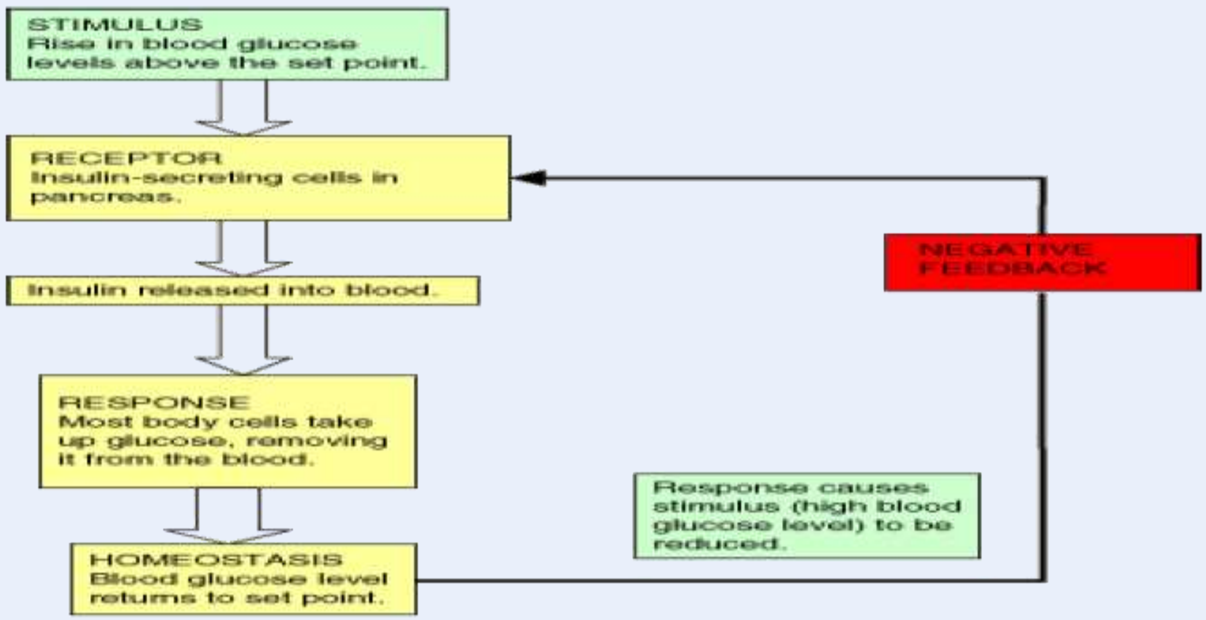


Figure 1: Control of blood glucose level is an example of negative feedback. Blood glucose concentration rises after a meal (the stimulus). The hormone insulin is released by the pancreas, and it speeds up the transport of glucose from the blood and into selected tissues (the response). Blood glucose concentrations then decrease, which then decreases the original stimulus. The secretion of insulin into the blood is then decreased.

Positive feedback is less common in biological systems. Positive feedback acts to speed up the direction of change. An example of positive feedback is lactation (milk production). As the baby suckles, nerve messages from the mammary glands cause the hormone prolactin, to be secreted by the pituitary gland. The more the baby suckles, the more prolactin is released, which stimulates further milk production.

Not many feedback mechanisms in the body are based on positive feedback. Positive feedback speeds up the direction of change, which leads to increasing hormone concentration, a state that moves further away from homeostasis

2. Posterior pituitary hormones.

The posterior lobe of the pituitary releases two hormones — both synthesized in the hypothalamus —

- **vasopressin** and
- **oxytocin**

into the circulation.

Vasopressin

Vasopressin is a peptide of 9 amino acids (Cys-Tyr-Phe-Gln-Asn-Cys-Pro-Arg-Gly). It is also known as **arginine vasopressin** (AVP) and the **antidiuretic hormone** (ADH).

Vasopressin acts on the collecting ducts of the kidney to facilitate the reabsorption of water into the blood. Thus it acts to reduce the volume of urine formed (giving it its name of antidiuretic hormone).

- A deficiency of vasopressin or
- inheritance of mutant genes for its **receptor** (called **V2**)

leads to excessive loss of urine, a condition known as **diabetes insipidus**. The most severely-afflicted patients may urinate as much as 30 liters (almost 8 gallons!) of urine each day. The disease is accompanied by terrible thirst, and patients must continually drink water to avoid dangerous dehydration.

Vasopressin and the Circadian Clock

Mice are nocturnal and become active at the start of the night. This is a circadian rhythm that persists for a time even after the lights in the lab are turned off each day 8 hours sooner (like arriving in London after a flight from Los Angeles, California). Only after 8–10 days do the mice overcome their "jet lag", adjusting to the new dark-light schedule. (It also takes us about one day to reset our circadian rhythms for each hour that our day-night schedule is shifted.)

It turns out that arginine vasopressin, acting on the suprachiasmatic nucleus (SCN), plays a role in this resistance to resetting their circadian clock. Mice with their genes for the V1a and V1b receptors knocked out adjust much more quickly (2–4 days) to the change. What evolutionary advantage this resistance to resetting the circadian clock confers is not clear, but understanding the mechanism raises the possibility of using drugs to speed getting over jet lag and also to help those whose work shifts are periodically altered. (Read about this work in Yamaguchi, Y., *et al.* in the 4 October 2013 issue of **Science**.)

Oxytocin

Oxytocin is a peptide of 9 amino acids (Cys-Tyr-Ile-Gln-Asn-Cys-Pro-Leu-Gly).

It acts on certain smooth muscles:

- stimulating contractions of the uterus at the time of birth;
- stimulating release of milk when the baby begins to suckle.

Oxytocin is often given to prospective mothers to hasten birth.

In rodents, oxytocin also acts on the nucleus accumbens and amygdala in the brain where it enhances:

- bonding between males and females after they have mated;
- bonding between a mother and her newborn.

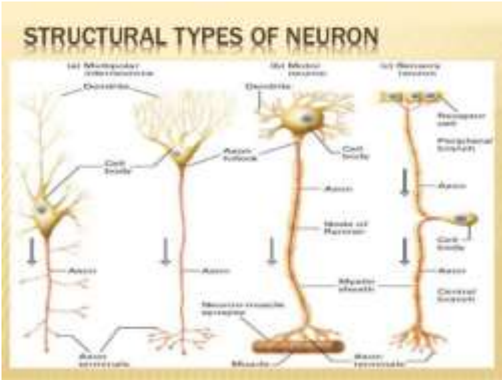
In mice, oxytocin acts on striated muscle stem cells to promote repair after they have been injured.

In humans, oxytocin increases the level of one's trust in other people.

3. Any one type of tropism with suitable example.

Plants, like animals and other organisms, must adapt to their constantly-changing environments. Plant tropisms are mechanisms by which plants adapt to environmental changes. A tropism is a growth toward or away from a stimulus.Eg. Phototropism is the directional growth of an organism in response to light. Growth toward light, or positive tropism is demonstrated in many vascular plant, such as angiosperms, gymnosperms, and ferns. Stems in these plants exhibit positive phototropism and grow in the direction of a light source. Photoreceptors in plant cells detect light, and plant hormones, such as auxins, are directed to the side of the stem that is furtherest from the light. The accumulation of auxins on the shaded side of the stem causes the cells in this area to elongate at a greater rate than those on the opposite side of the stem. As a result, the stem curves in the direction away from the side of the accumulated auxins and toward the direction of the light. Plant stems and leaves demonstrate positive phototropism, while roots (mostly influenced by gravity) tend to demonstrate negative phototropism**.** Since photosynthesis conducting organelles, known as chloroplasts, are most concentrated in leaves, it is important that these structures have access to sunlight. Conversely, roots function to absorb water and mineral nutrients, which are more likely to be obtained underground. A plant's response to light helps to ensure that life preserving resources are obtained.

4. Diagrammatic representation of neurons on the basis of their structures.



5. Hormonal and barrier method of birth control.
Hormonal – oral contraceptives, injection, emergency contraceptions
Barrier – Spermicides, Male Condom, Female Condom, Diaphragm, Cervical Cap
Description of any 2 methods

6. Sex reversal.
Explain: Normal XX female, XY male. Reverse XX male and XY female.
SRY deletion from Y
SRY translocation to X. Justification with role of SRY in development of male gomads.