2014 Advanced Level Biology paper I Analysis.

Part 1 – MCQ

The questions of the paper are divided among the units as follows.

	Unit	Question no.	Total no. of questions
1	Introduction to Biology.	-	-
2	Chemical and cellular basis of life.		8
	• Cellular basis	5	
	• Chemical basis	1,2	
	• Enzymes	-	
	• Photosynthesis	6 ,41	
	• Respiration	3,4,7	
3	Diversity of organisms	8,9,10,11	4
4	Nutrition	12,42(both from animal nutrition)	2
5	Respiration	13	1
6	Transportation		3
	• Animal	14,15	
	• Plant	16	
7	Coordination and homeostasis		5
	• Nervous	17,18,19,20	
	• Hormonal	45	
8	Excretion	21,46	2
9	Support and Movement	22,23,44	3
10	Reproduction ,Growth and development		
	• Plant		
	• Animal	27,28,43,47 24,25,26	7
11	Heredity	29,30,31,32,33,49	6
12	Environmental biology	34,35,36,37	4
13	Microbiology	38,39,40,50	4
14	Applied biology*	-	-

*Applied biology was not tested in since the introduction of new syllabus (2012) up to now.

Official answers for Multiple Choice Questions

Question no.	Correct response	Question no.	Correct response
1.	3(Three)	**2.**	2(Two)
3.	2(Two)	**4.**	2(Two)
5.	2(Two)	**6.**	1(One)
7.	2(Two)	**8.**	3(Three)
9.	3(Three)	**10.**	2(Two)
11.	2(Two)	**12.**	4(Four)
13.	4(Four)	**14.**	4(Four)
15.	4(Four)	**16.**	3(Three)
17.	5(Five)	**18.**	2(Two)
19.	4(Four)	**20.**	3(Three)
21.	4(Four)	**22.**	4(Four)
23.	2(Two)	**24.**	4(Four)
25.	3(Three)	**26.**	2(Two)
27.	1(One)	**28.**	1(One)
29.	5(Five)	**30.**	4(Four)
31.	4(Four)	**32.**	2(Two)
33.	4(Four)	**34.**	3(Three)
35.	1(One)	**36.**	1(One)
37.	3(Three)	**38.**	1(One)
39.	3(Three)	**40.**	4(Four)
41.	5(Five)	**42.**	4(Four)
43.	4(Four)	**44.**	1(One)
45.	2(Two)	**46.**	3(Three)
47.	4(Four)	**48.**	4(Four)
49.	4(Four)	**50.**	1(One)

MCQ analysis

1. This question tests the student's knowledge on chemical composition of biological macromolecules. The following table summarizes the chemical composition of them required at advanced level.

Biological macromolecule	Chemical composition
Carbohydrates *	C,H,O
Proteins	C,H,O,N & sometimes S
Lipids	C,H,O& sometimes P and /or N
Nucleic acids	C,H,O,N,P

*carbohydrates include both simple molecules and macromolecules.

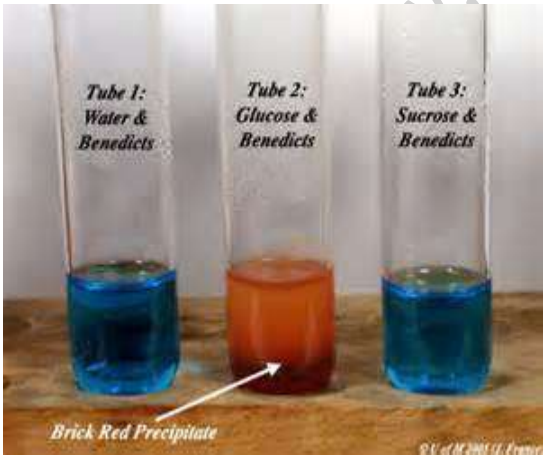
Since albumin is a globular protein of tertiary level, present in human blood, synthesized by liver it contains C, H, O, N, S. So the correct ans. is (3)

2. This question tests the student's knowledge on chemical tests for biological macromolecules. The following are the test required to be known by the student.

Macromolecule	Test
Carbohydrates	Benedict test and Fehling's *(for aldoses only), iodine test(for starch)
Proteins	Biuret test, (Milons test & Xanthoproteic tests are out of syllabus)
Lipids	Sudan ii, iii or iv. (Grease spot test is out of syllabus)

*Fehling's although not required in biology, is in chemistry syllabus.

Glucose which is an aldohexose can be identified by Benedict's reagent. Ans. (2)



Benedict's test


Biuret test results


Sudan test

3. Anaerobic respiration occurs in the absence of oxygen. In yeasts this property is used in ethanol fermentation.

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2\,CO_2$$

So ethanol and carbon dioxide are the final products. Ans. (2)

4. This question is regarding electron acceptors. Once a compound accepts an electron, it is reduced. Similar thing happens when H is given out. The following tables summarize the H and electron acceptors required at advanced level.

Type & Stage of respiration	Final H acceptor
Aerobic	*O_2
Anaerobic	
• **Ethanol fermentation**	Acetaldehyde
• **Lactic acid fermentation**	Pyruvate

*O_2 also acts as the final electron acceptor.

Type of photophosphorylation in photosynthesis	First electron donor	Last electron acceptor
cyclic	Photo system I	Photo system I
Non-cyclic	water	NADP

Therefore the answer is (2).

5. The word prokaryotic refers to "before nucleus", meaning they have no organized nucleus. Their nuclear material is not enclosed by a membrane, but concentrated in a region called the Nucleiod.

	DOMAIN		
Feature	**Archaea**	**Bacteria**	**Eukarya**
Amino acid that initiates protein synthesis	Methionine	Formyl-methionine	Methionine
Introns	Present in some genes	Absent	Present
Membrane-bounded organelles	Absent	Absent	Present
Membrane lipid structure	Branched	Unbranched	Unbranched
Nuclear envelope	Absent	Absent	Present
Number of different RNA polymerases	Several	One	Several
Peptidoglycan in cell wall	Absent	Present	Absent
Response to the antibiotics streptomycin and chloramphenicol	Growth not inhibited	Growth inhibited	Growth not inhibited

Table (from raven biology 9e) # introns are out of syllabus

Prokaryotes include archae and bacterial domains. All them have no cytoskeleton, no membrane bound organelles, are small in size have 70s ribosomes, simple flagella without microtubules and not bound by membrane. Since peptidoglycan is only found in bacteria and not in archae answer is (2).

6. This question is about c_4 pathway. Initial carboxylation is done to PEP at the mesophyll cell , while at the bundle sheath cell RuBP is carboxylated again ,for Calvin cycle .this is catalyzed by RuBP Carboxylase.therefore ans(1)

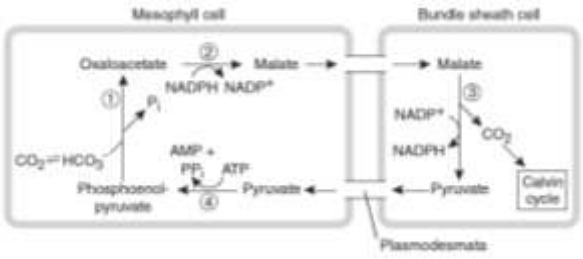
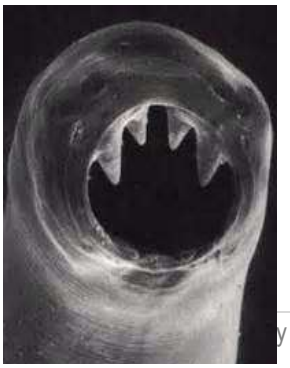


Figure (from Molecular mechanisms of photosynthesis, Robert E Blankenship .Blackwell)

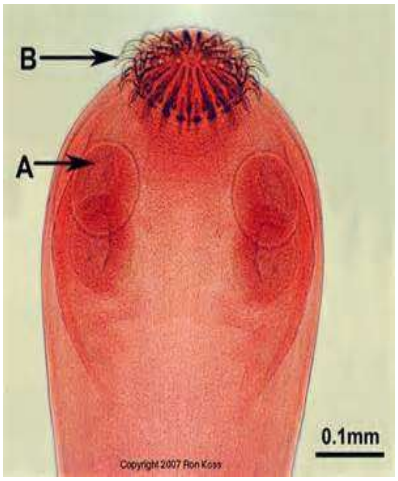
Note that the standard form of writing "RUBISCO "is RuBisCO which stands for Rubulose Bisphosphate Carboxylase Oxygenase. This is often mistaken in standard books.

7. Oxygen plays the role of last electron acceptor in aerobic cellular respiration. In anaerobic forms various organisms use different compounds such as sulfur, nitrate, and carbon dioxide as the final electron acceptor in place of oxygen (not relevant to the syllabus). One such process is fermentation, where organic compounds are used as final electron acceptors. Fermentation is a process of extraction of energy from organic compounds in absence of oxygen where electrons generated from glycolysis are donated to organic compounds. This process relies on glycolysis to produce ATP. Among the given answers Krebs cycle yield ATP (actually GTP) but requires the presence of oxygen .Electron transport chain requires oxygen as final electron acceptor. Fixation of carbon dioxide does not yield ATP .Photophosphorylation happens along with photolysis of water, i.e. in an oxygen containing environment. Therefore ans(2).



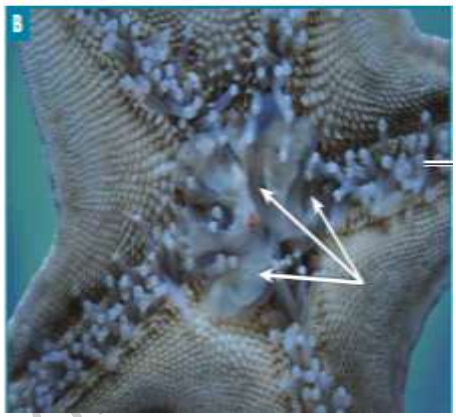
Mouth of a nematode

8. This question is on diversity of animals .It is strictly recommended to refer the tables given in the teachers instructional manual for diversity ,since everything is finalized there, and it is what taken into consideration in preparation of the marking scheme. Suckers are external structures located in cestodes and trematodes of phylum platyhelminthes,hirudineans of phylum annelida ,and cephalapods like octopus in phylum mollusca, asteroids, echinoids and holothuroids in phylum Echinodermata.nematodes have no suckers . therefore ans(3)



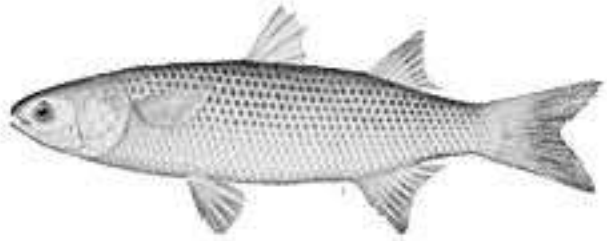
Suckers of tapeworm (marked A)

Suckers in an octopus seen as white dots



Tiny tube feet end in suckers (from a Photographic atlas of marine Biology)

9. Animal groups which show internal fertilization include flatworms, nematodes, annelids, mollusks, arthropods, cartilaginous fishes, some amphibians, reptiles, birds and mammals. For a question like this go through the options which have at least one animal out of the above groups. It is easily recognizable that mullet does not belong since it's a bony fish .Or else we can go through the principle of elimination: response1,2,4,5, does not contain any animal showing external fertilization so finally what is left is ans.(3)



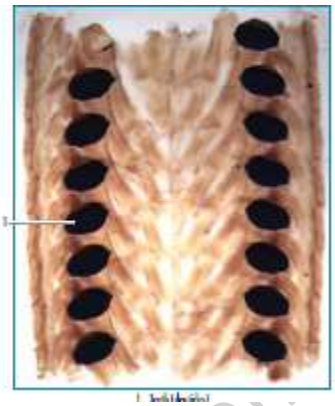
Mullet (from Wikipedia)

Mytilus- a mussel with byssus threads (from Wikipedia)

10. This gives examples of mollusks, all them are stated in the teachers guide. Hence examples given in the guide are of vital importance. For this type of correct combination question all 5 responses have be checked. Mussels and oysters being in class bivalvia have no eyes, no tentacles ,and no radula and have two external valves. Snails have a univalved shell, radula and tentacles .squids of class cephalapoda has an internal shell, radula, conspicuous eyes and tentacles. All ABCD live in marine environment .only snail live in terrestrial environment. Snails ,mussels live in freashwater.So

response (1)is wrong since oysters do not have eyes.response (3) is wrong since mussel have no radula.(4)is wrong since squids have no external shell.(5)is wrong since oysters have no tentacles.

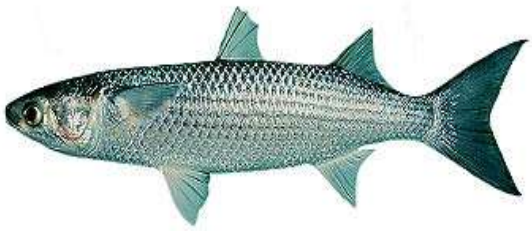
A Squid (from a Photographic atlas of marine Biology)



Radula (from a Photographic atlas of marine Biology)

Oyster

11. This question tests the knowledge of students in external anatomy of several specimens. All these specimens are given as examples in the teachers guide .so it's important to show attention on those examples given in the syllabus. The following pictures show s the specimens.



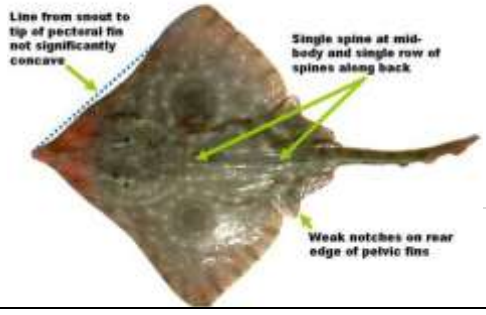
Grey mullet

Ichthyophis

Carangid

Tuna

Shark



As seen from the diagrams grey mullet, tuna and Shark have two dorsal fins. Blackish longitudinal lines can be seen in Tuna. A yellow band on either side of body is seen in *Ichthyophis.* The carangid has two spines separated from anal fin. Therefore ans. is (2)

12. Vitamins. This is a section were questions are frequently asked.(1)vitamin D (a group steroids where vit D_3 is most important for humans)can be synthesized by using UVB rays by cholesterol in skin(7-dehydrocholestrol) deficiency causes osteomalacia in adults and rickets in children.(2)vitamin A is essential for healthy eyes(to produce rhodopsin)and skin. vertebrates have the capability to produce this vitamin by β-carotene .cereals are not a good source of vitamin A. Dark green and orange vegetables are a good source.(3)osteomalacia is occurred in deficiency of vitamin d in adults.(4) vitamin E is a good antioxidant. Antioxidants prevent the oxidation of other molecules and inhibit the formation of free radicals that starts chain reactions inside cells that ultimately lead to cell death. Here, vitamin E stops the production of reactive oxygen species formed when fat undergoes oxidation.(5)intrinsic factor is a glycoprotein produced by parietal cells of gastric glands in stomach that is necessary for the absorption of vitaminB12 in the intestine. Ans (4)

13. (1)Alveoli are the major sites of gaseous exchange in human respiratory system. Since the main function of human respiratory system is gaseous exchange .It can be said that alveoli are the functional units of lungs. Note that this is not very accurate.

(2) Vital capacity is the total volume of air that can be inhaled and exhaled after a forced inspiration and expiration. Its equal to tidal volume (about 500ml) +inspiratory reserve volume (about 1500ml) + expiratory reserve volume (about 1500ml) totally 3500ml.note that these values are found in the teacher's guide and measurements are given to an average adult man. These measurements of lung volumes is done using a spirometer and the values depends on age, sex, mass, height, ethnicity and the activity of the person when the measurement is taken (vital capacity thus ranges from 3-5dm3)

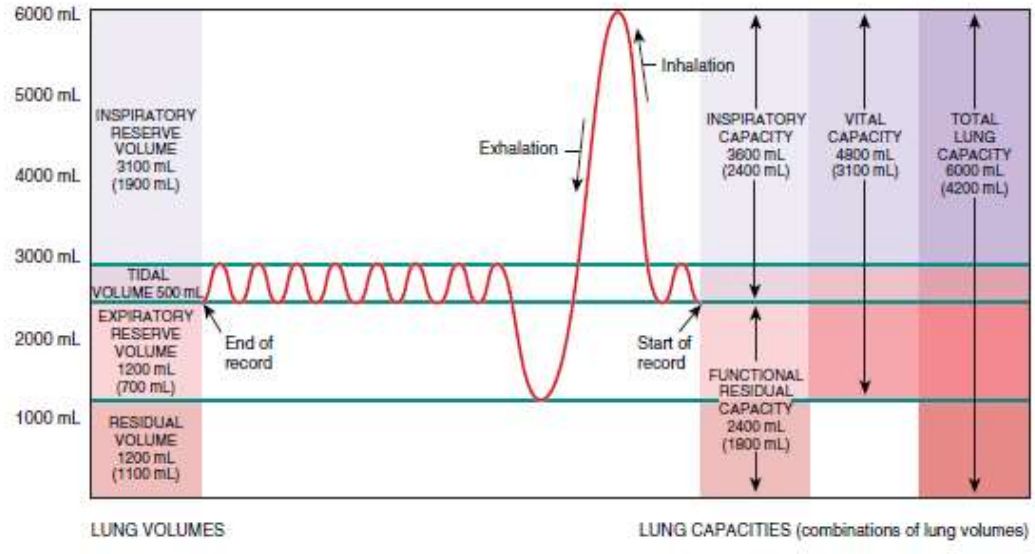
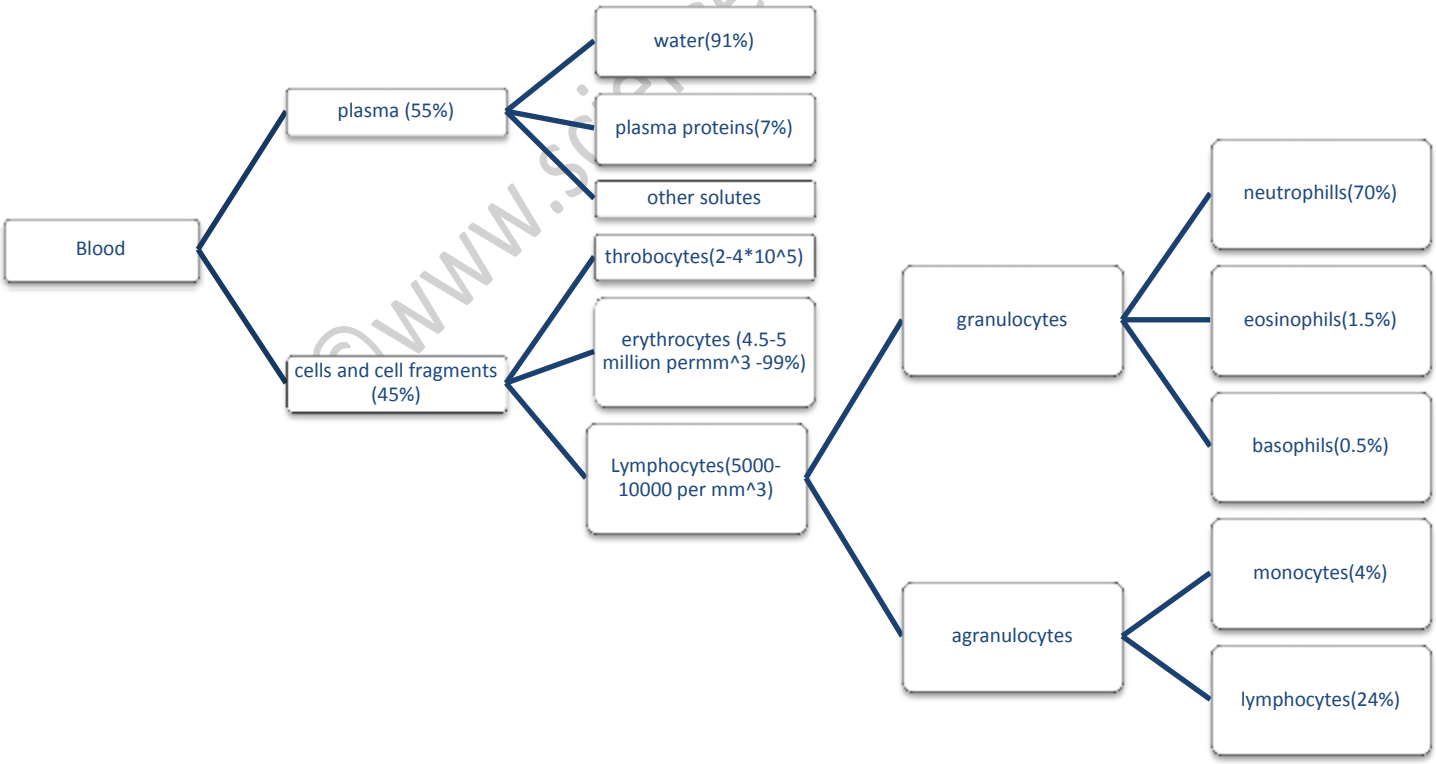


Figure: A spirogram. (Principles of anatomy and physiology, G.J.Tortora, B.Derrikson).note that values may differ .. Anatomic dead space volume is 150ml.

(3)Most of the parts of respiratory system are lined by pseudo stratified ciliated columnar epithelium with goblet cells. Major variations occur in oropharynx which is lined by Squamous stratified epithelium, and as bronchioles divide the epithelium change from pseudo stratified to cuboidal and finally to simple squamous.(4)cartilages(hyaline) are present as incomplete horizontal rings in trachea and bronchi, while cartilages are gradually lost to in bronchioles. Therefore cartilages are considered not to be present in bronchioles.(5) Pharynxes or throat is a tube extending from internal nares up to some part of larynx up to circoid cartilage of larynx.) It's divided into three regions as nasopharynx, oropharynx and laryngopharynx.naso,oro,and laryngo pharynx are regions associated with nasal cavity, buccal cavity and larynx respectively. Therefore is connected to both oral and nasal cavities. Thus incorrect ans is (4).

14. Human blood is a liquid connective tissue consisting of liquid matrix plasma, blood cells, and cell fragments and dissolved proteins. Blood consist of 55% straw colored blood plasma and the rest cells and other suspended materials.



Substances in Blood Plasma

CONSTITUENT	DESCRIPTION	FUNCTION
Water (91.5%)	Liquid portion of blood.	Solvent and suspending medium. Absorbs, transports, and releases heat.
Plasma proteins (7%)	Most produced by liver.	Responsible for colloid osmotic pressure. Major contributors to blood viscosity. Transport hormones (steroid), fatty acids, and calcium. Help regulate blood pH.
Albumins	Smallest and most numerous plasma proteins.	Help maintain osmotic pressure, an important factor in the exchange of fluids across blood capillary walls.
Globulins	Large proteins (plasma cells produce immunoglobulins).	Immunoglobulins help attack viruses and bacteria. Alpha and beta globulins transport iron, lipids, and fat-soluble vitamins.
Fibrinogen	Large protein.	Plays essential role in blood clotting.
Other solutes (1.5%)		
Electrolytes	Inorganic salts; positively charged (cations) Na^+, K^+, Ca^{2+}, Mg^{2+}; negatively charged (anions) Cl^-, HPO_4^{2-}, SO_4^{2-}, HCO_3^-.	Help maintain osmotic pressure and play essential roles in cell functions.
Nutrients	Products of digestion, such as amino acids, glucose, fatty acids, glycerol, vitamins, and minerals.	Essential roles in cell functions, growth, and development.
Gases	Oxygen (O_2).	Important in many cellular functions.
	Carbon dioxide (CO_2).	Involved in the regulation of blood pH.
	Nitrogen (N_2).	No known function.
Regulatory substances	Enzymes.	Catalyze chemical reactions.
	Hormones.	Regulate metabolism, growth, and development.
	Vitamins.	Cofactors for enzymatic reactions.
Waste products	Urea, uric acid, creatine, creatinine, bilirubin, ammonia.	Most are breakdown products of protein metabolism that are carried by the blood to organs of excretion.

Table (from Principles of anatomy and physiology, G.J.Tortora, B.Derrikson)

Blood is slightly alkaline with a pH of 7.4. Most leucocytes are granulocytes accounting for 72% of leucocytes.

Blood groups (ABO) are assigned according to the presence of A and B agglutinogens on the surface of RBCs. The following table summarizes it.

Blood group	Agglutinogen
A	A
B	B
AB	AB
O	-

Therefore a person with O blood group has no Agglutinogen surface of RBCs.

Homeostatic involvement blood is vital for us. Any constituent in blood not being available at right amounts ,can affect the whole body. Blood being the extracellular fluid maintains the concentration of various substances such as glucose ,carbon dioxide, and various ions at optimum level as required by cells. Thus ans. is (4)

15. Human heart is a hollow muscular organ is the only organ where cardiac muscles are found.

Figure ,(from Anatomy and Physiology,Saladin)the dark vertical bands seen are intercalated disks. The white areas are glycogen, and nuclei are stained purple.

As seen in the diagram cardiac muscle fibers are short and branched. They are not cylindrical(as skeletal muscle fibers)

The right atrioventricular valve is tricuspid .(you can remember this like this: the word right has more letters than left similarly, the right AV valve has more cusps than the left)

Sympathetic nervous system has excitatory effect while parasympathetic system has an inhibitory general effect. So the rate of heart beat is increased by stimuli from sympathetic system.

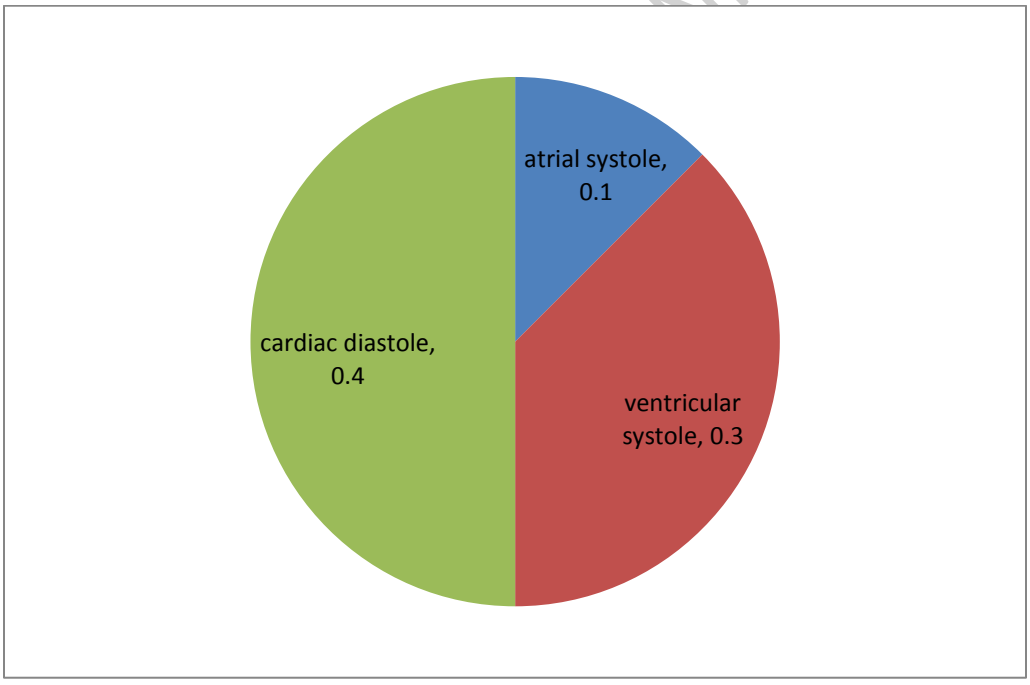
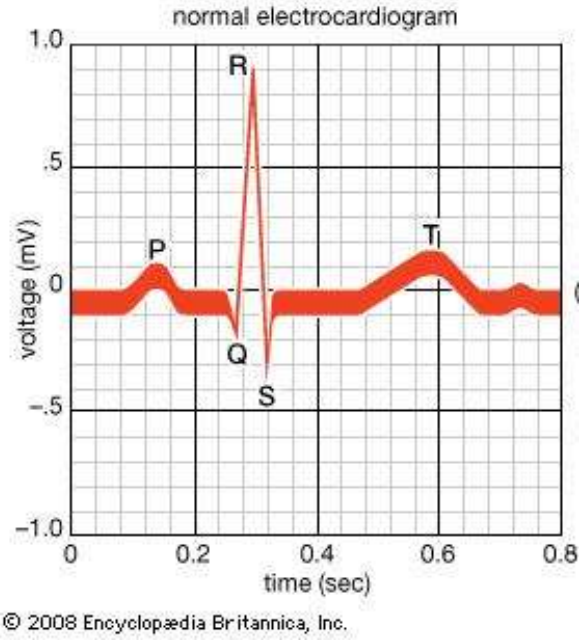


Chart 1.The cardiac cycle(0.1 0.3 indicates time in seconds)

Thus the duration of atrial systole is 0.1s .in advanced levels cardiac cycle is divided into 3 parts., which is incorrect. But since what is prescribed in syllabus is the division of cardiac cycle into 3 parts, it's recommended to follow it.

ECG or EKG refers to electrocardiogram which is a tracing of patterns of electric activity in the cardiac muscle during cardiac cycle. This is obtained by attaching electrodes on to the surface of the body. The following diagram illustrates it.



The wave P represents <u>atrial depolarization</u> that occurs during atrial systole.

The wave QRS represents <u>ventricular depolarization</u> which occurs during ventricular systole.

The wave T represents <u>cardiac repolarisation</u> which occurs during cardiac diastole.

Therefore the correct ans. is (4).

16. Active transport is transport of substances using metabolic energy .i.e. ATP energy. Transport of water in a plant is a passive process and takes place in simple diffusion,imbibitions,osmosis and mass flow. It is tedious to remember each and every exam that comes under active transport. What can be done is to check whether the given statements come under any of the above mentioned modes of passive transport. Let's analyze one by one.(1)remember mineral transport from living cells to cells is usually active. So from apoplast pathway(which consist of majorly free spaces in the cell wall)to symplast(which consist of interconnected cytoplasms of adjacent cells).If mineral ions are to transported ,it must be done by <u>active transport</u> with the aid of special carrier proteins.(2)this is phloem loading which is the transport of phloem sap <u>actively i</u>nto the sieve tube elements through transfer cells.(3)transport of phloem sap through the sieve tubes happens through mass flow due to a hydrostatic pressure gradient.(4)k+ uptake or k+ influx is the uptake of k+ ions by the guard cell actively using a proton pump to decrease the water potential of the cell generating a water potential gradient finally opening the stomatal aperture.(5) mineral ions must cross plasma membranes of cells to move into the vascular pathway. Hence it's active too. Therefore ans . is (3)

17. A receptor is a cell or group of cells organized and specialized to receive a stimulus and to respond to particular threshold value of the stimuli. They act as biological transducers i.e. they are able to convert one form of energy to electric energy as action potentials.(this is called transduction.) an impulse is an action potential which passes along an axon as a wave of depolarization. So (1) is correct. (2)The activity of a receptor is to detect the stimuli and transduce, it to an action potential. To form continuous action potentials ,the stimuli must be given keeping a specific time interval of 2 milliseconds called the refractory period. Thus continuous stimulation may not give an output (formation of action potentials) corresponding to the input. So we can say that the activity of receptors diminishes at continuous stimulation. Receptors in human body are chemo receptors; gustatory and olfactory. Thermorecepters, electromagneticreceptors; photoreceptors ,mechanoreceptors ;pressure and stretch, and pain receptors. Following are receptors in skin.

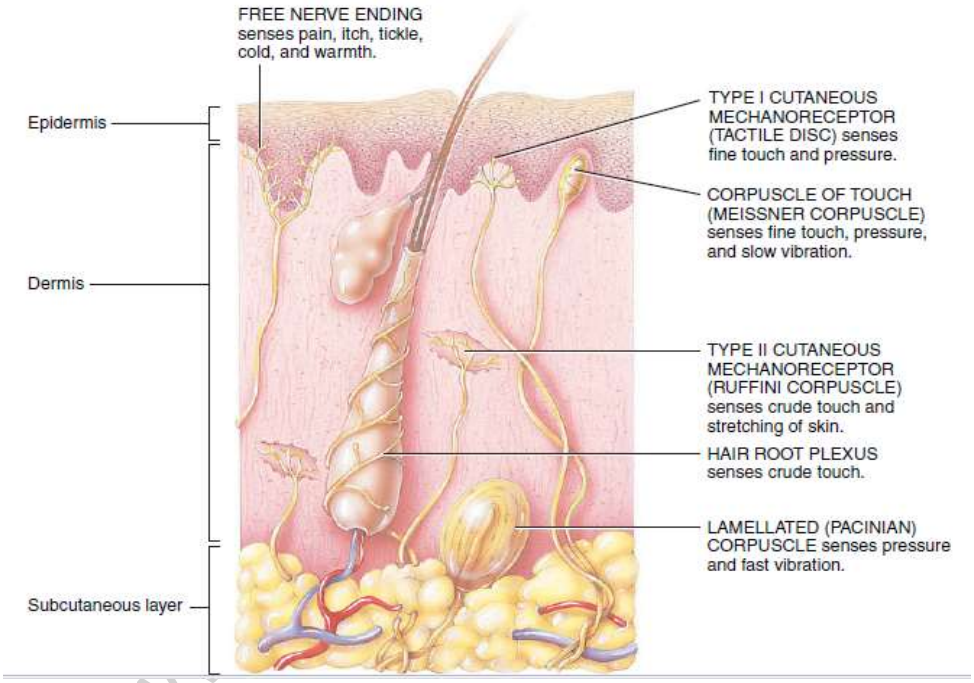


Figure :Human skin receptors (from Principles of anatomy and physiology, G.J.Tortora, B.Derrikson).tactile discs= merkels disks

Pacinian corpuscles are deep in the dermis. So they can sense strong pressures. Pressure is a mechanical stimulus so statement(3) is correct.Krauses end bulbs sense cold temperatures and Ruffini corpuscles senses high temperatures. This can be easily memorized as Ruffini as 'rusne'(in Sinhala).so(5)is incorrect. Organ of corti is sensitive to vibrations ,it's the movement of endolymph that causes the hair cells to get stimulated. Therefore ans. is (5).

18. Human brain has an ectodermal origin. Various parts of adult brain originate from three parts of embryonic brain as shown below.

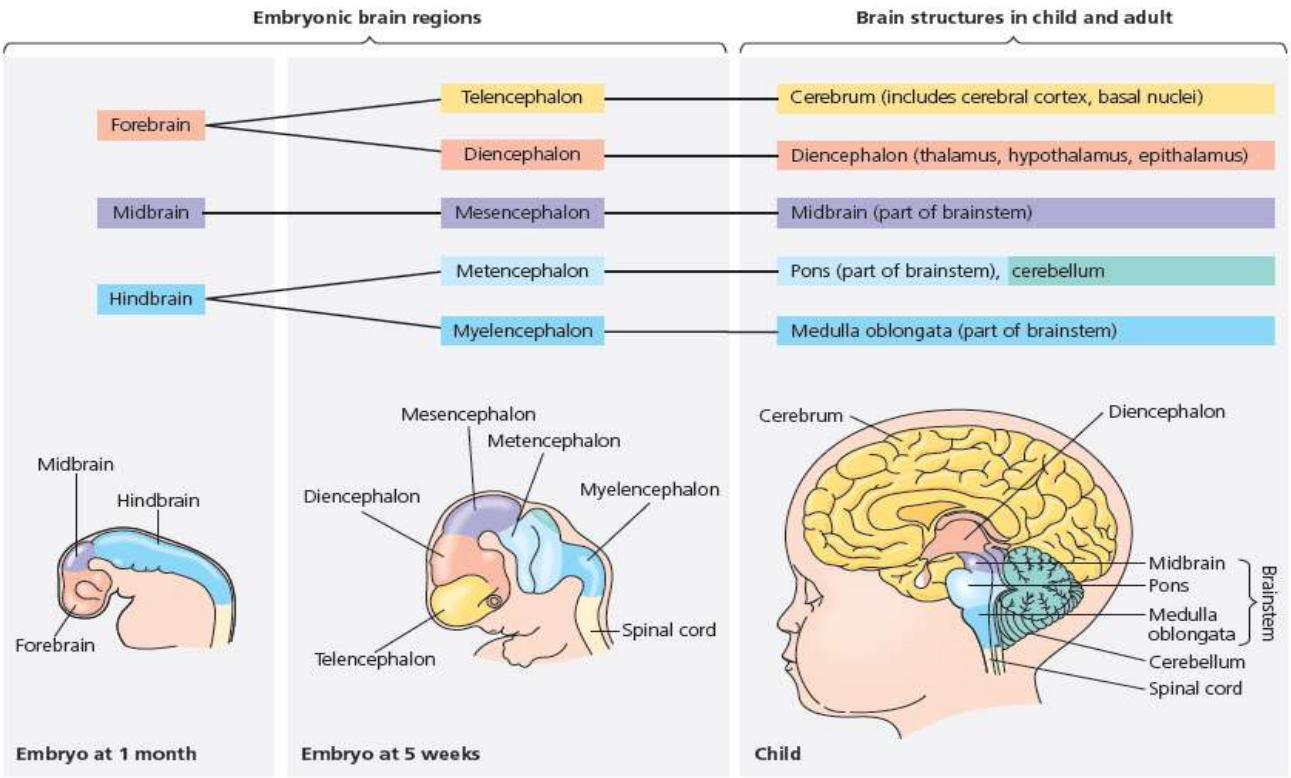


Figure (from Campbell biology 10e).note that telencephalon, diencephalon, mesencephalon, metencephalon, myelencephalon are out of the scope of advanced level biology. (Including epithalamus).and red nucleus is originated from embryonic midbrain.

Therefore thalamus is derived from embryonic forebrain.

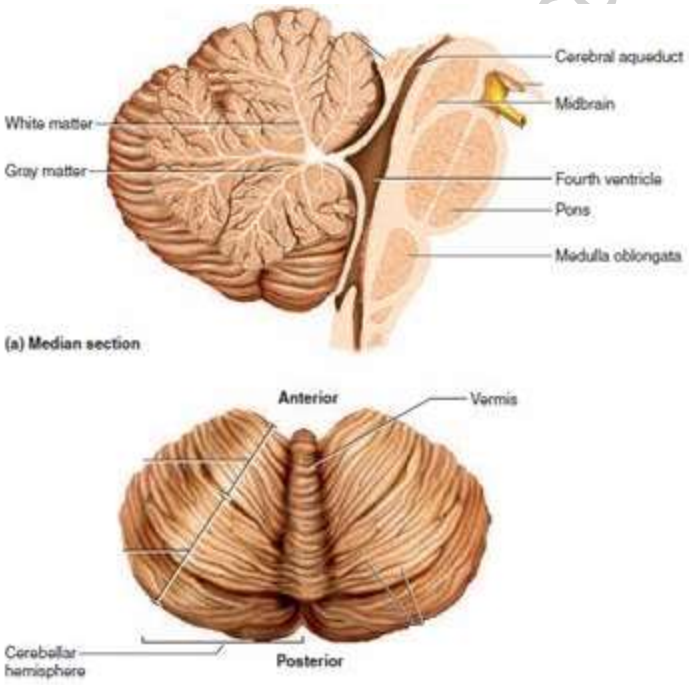


Figure (from Anatomy and Physiology, Saladin)

(2) Cerebellum as shown below consist of two hemispheres joined by a narrow part called vermis. Consist of outer grey mater and inner white matter. (As same as in cerebrum)this as inverted in spinal cord where grew matter is in and white matter out.

(3)Within the brain are four expanded cavities called ventricles. These are lined by ciliated epithelium. These cavities are filled with cerebrospinal fluid secreted by the anterior and posterior choroid plexus. The following diagram shows them.

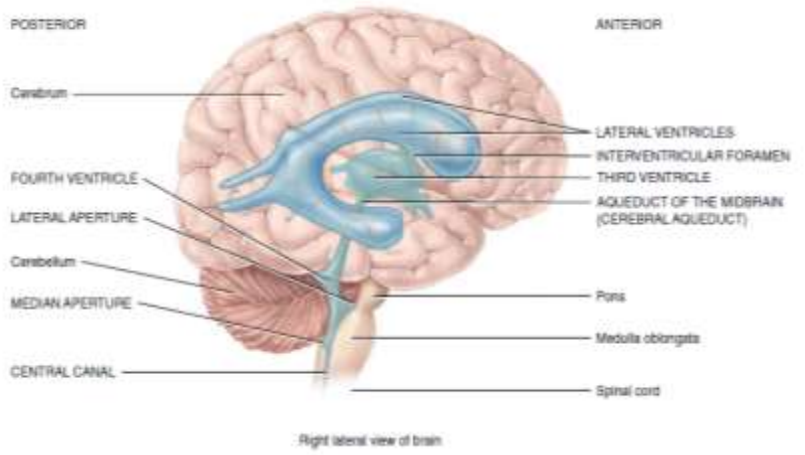


Figure (from Principles of anatomy and physiology, G.J.Tortora, B.Derrikson)

(4)Pituitary the main gland of endocrine system secretes 6 hormones (TSH,ACTH,FSH,LH,GH,Prolactin).all which is controlled by releasing hormones of the hypothalamus(respectively TRH,CRH,GnRH,PRH)and 2 inhibiting hormones .further posterior pituitary releases ADH and Oxytocin secreted by the hypothalamus. Thus hypothalamus plays a major role in release and secretion of hormones from pituitary.

(5) Human cerebral cortex is divided into functional areas upon the regional specializations for different functions. These include 3 major types of areas sensory areas that receive sensory areas that receive sensory information and involved in perception., motor areas involved in control of voluntary muscles and associated areas that deal with more complex integrative functions such as memory reasoning ,interpretation, recognition etc and storing of sensory information. The following diagram shows them.

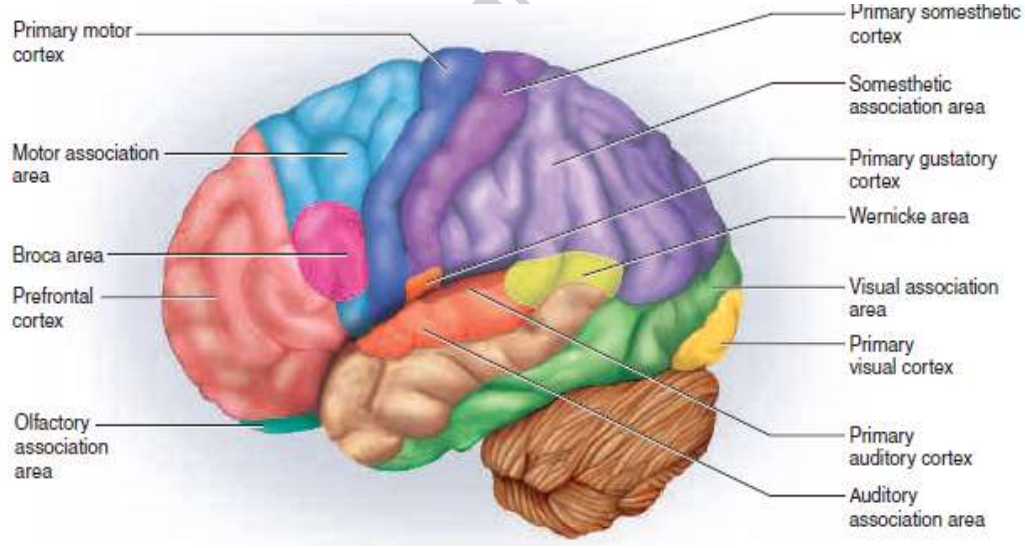


Figure (from Anatomy and Physiology, Saladin) somesthetic refers to somatosensory. prefrontal cortex=frontal area

The motor cortex or somatic motor area involves in control of voluntary muscles. It is devoted to muscles of various areas of the body at different proportions this is given by motor and sensory homunculus as follows.

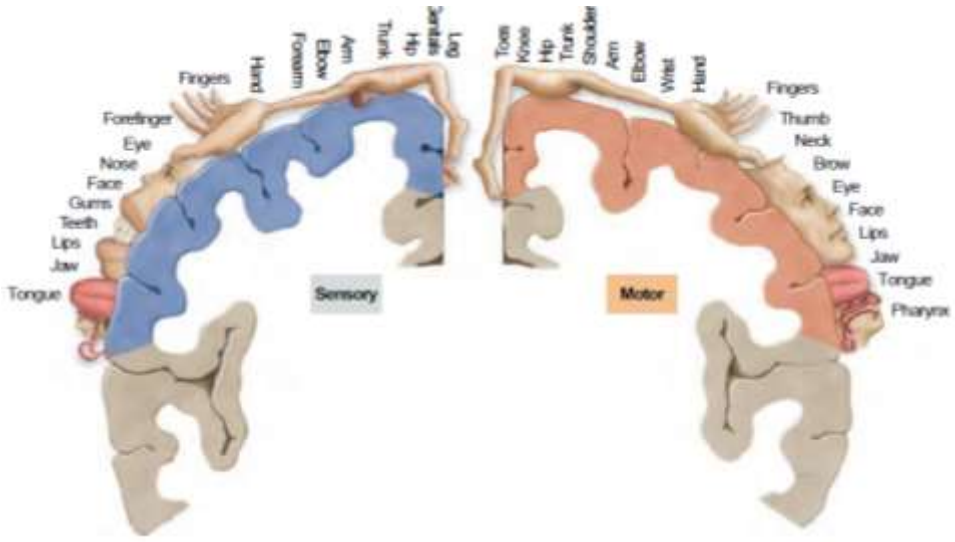


Figure (from raven biology9e) the motor and sensory homunculus.

It can be seen that a large part of cortex is devoted for various parts of the hand. So the statement is correct. Therefore ans. is (2)

19. Coordination is the perfect connection between different systems to pay appropriate responses to stimulus .generally coordination is of two types nervous and chemical, done by nervous and endocrine systems respectively. In addition for chemical coordination the circulatory system is essential for it provides a medium for the transport of hormones. Movement ,one of the essential activities of animals is coordinated by the muscular ,skeletal and nervous systems. Movement of food along the digestive system and mechanical digestion is coordinated by muscular and nervous systems. Thus when comparing the importance of muscular system with digestive system, digestive system is of least importance. Therefore ans.is (4)

20. As stated earlier the nerve impulse is a moving action potential .the following figure summarizes how an action potential is created.

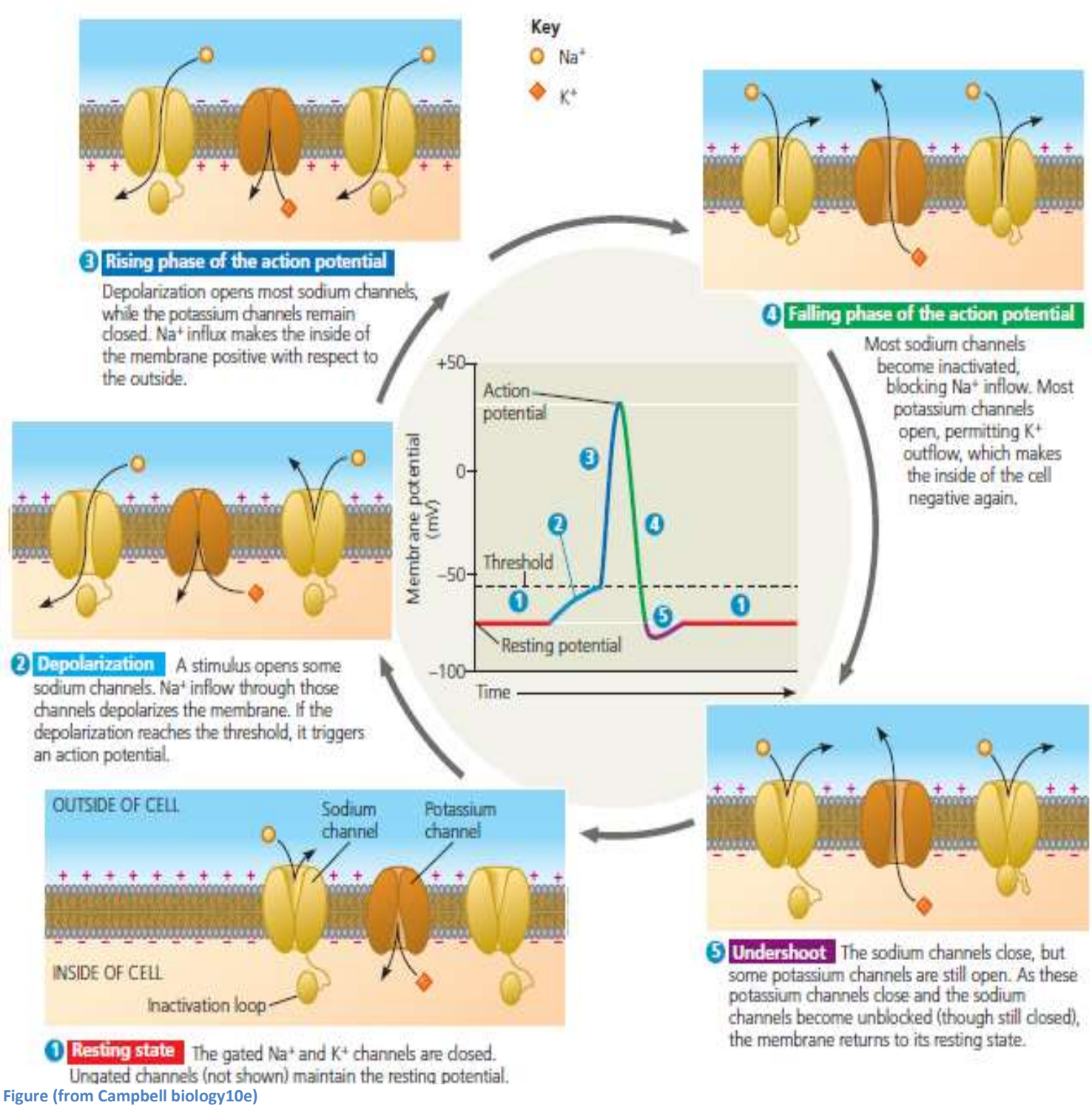
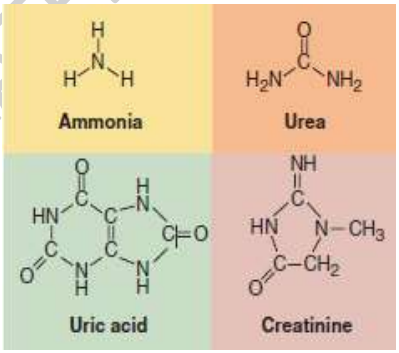


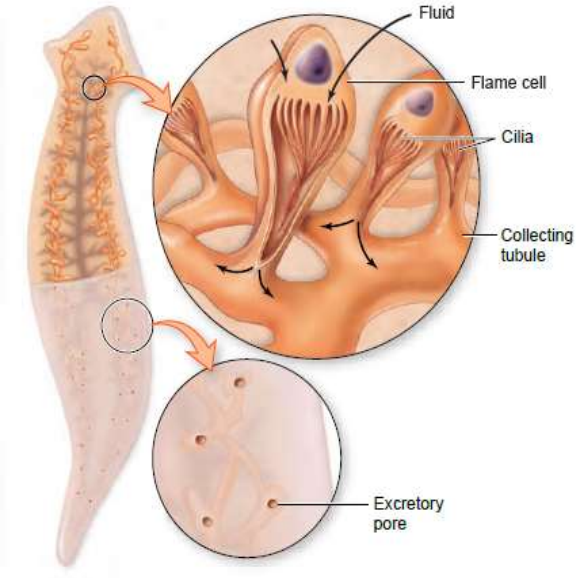
Figure (from Campbell biology10e)

(c) Immediately after an action potential anther action potential cannot be applied for 2milliseconds.This period is known as the refractory period. This prevents the reverse conduction of the impulse ans.(3)

21. Excretion is the removal of toxic and excess waste products of metabolism from the body. Bilirubin (yellow) is a breakdown product of haem group of hemoglobin. Bilirubin is formed by activity of an enzyme on biliverdin (green) which is also a product of haem catabolism. Both Bilirubin and biliverdin are bile pigments. Bilirubin gives yellow color to feces and straw color to urine. Therefore Bilirubin is a product of metabolism and also an excretory product. All animals whatever their body organization is or wherever they live produce ammonia as the first nitrogenous excretory product during catabolism of proteins, nucleic acids etc. the conversion of ammonia to any other form is considered by 3 factors namely. The environment they live, the extent to which they can conserve water and the presence of necessary enzymes for conversion. Ammonia is converted to urine in live by ornithine cycle .uric acid is a breakdown product of purins. When comparing the advantages and disadvantages we refer to 3 factors; carbon loss, toxicity, and water conservation. In reference to carbon loss it can be seen as shown below. Carbon loss from uric acid is 5 atoms per molecule.

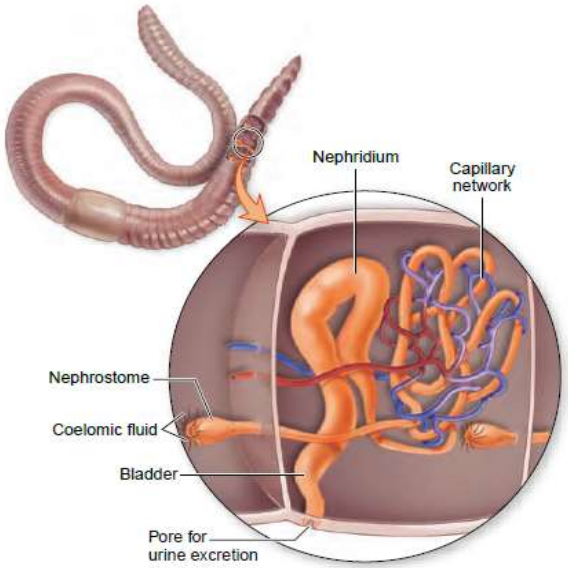


- In man urea is synthesized in liver not in kidneys.
- Nephredia are of two types Protonephredia and metanephredia. Protonephredia are seen in flatworms as shown below.



(From raven biology9e)

- Protonephredia are blunt ended the ends of tubules is capped by a flame cell in flatworms .They open only to exterior.



(From raven biology9e)

- Metanephredia seen in annelids as shown .open to both interior (coelom) and exterior (as pores).

These consist of tubules that receive a filtrate of coelomic fluid, which enters the funnel-like nephrostomes. Salt can be reabsorbed from these tubules, and the fluid that remains, urine is released from pores into the external environment. Here in this statement nephredia refers to metanephredia (as they are the real nephredia) therefore ans. is (4)

22. The procedure of lifting a small object by hand includes grasping the object by broad hand (palm) in pronated position, then supinating the hand. The load is bore by the strong humerous. Precision grip is unwanted here. power grip is used in grasping .therefore the ans. is (4)
23. Smooth muscles are involuntary, non striated (myofibrils not organized to sacromeres.), neurogenic muscles .smooth muscles are made out of smooth muscle fibers .These are spindle shaped, unbranched cells tapering at their ends containing a single nucleus at the center of the cell.

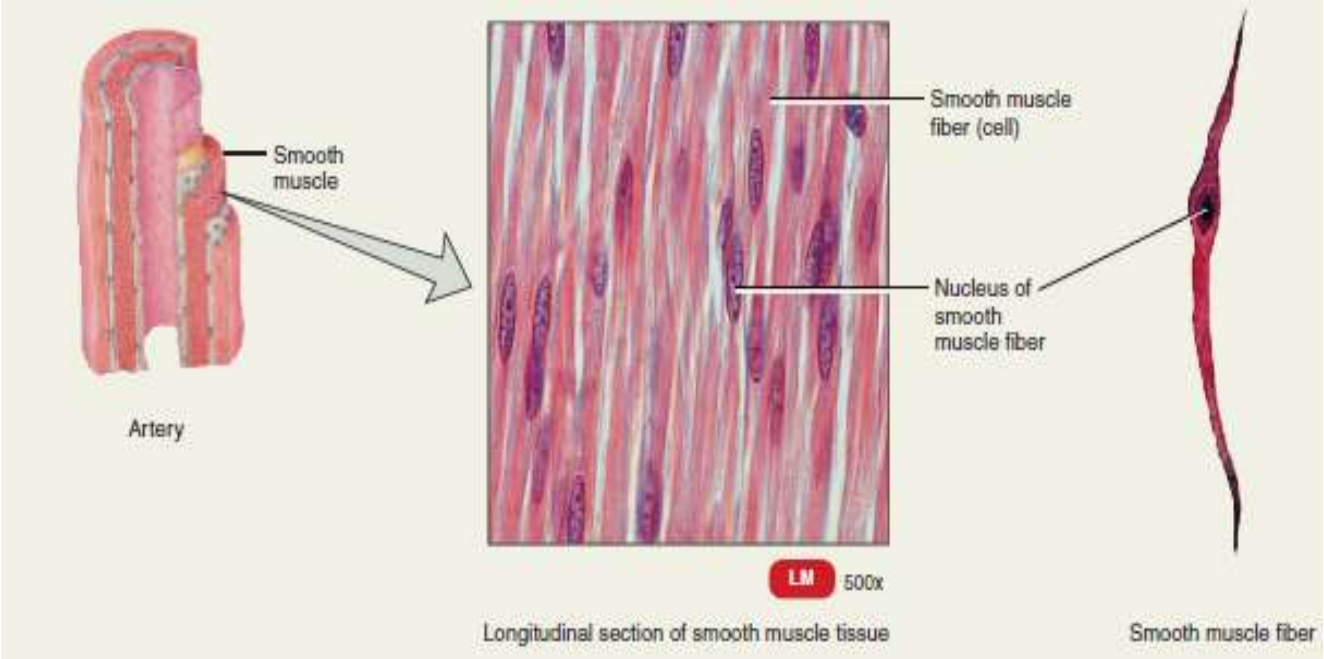


Figure (from Principles of anatomy and physiology, G.J.Tortora, B.Derrikson)

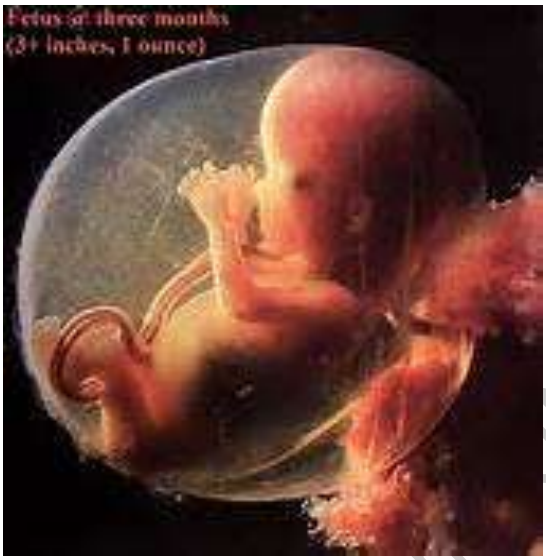
These muscles are innervated by autonomic nervous system. Some show rhythmic activity while others don't. They fatigue slowly. Elasticity is common to all types of muscles. Therefore ans. is (2)

24. Contraception is the prevention of unwanted pregnancies by using birth control methods. It includes temporary methods such as contraceptive pills, IUD loops, and Depo- provera for females and condoms for males. Vasectomy and tubal ligations are permanent methods for males and females respectively.
    - Oral contraceptives contain hormones such as estrogen & progesterone, designed to prevent pregnancy. Their primary function is to inhibit ovulation by suppressing FSH and LH levels in blood. The low levels of FSH and LH usually prevent the development of a

mature follicle in the ovary. As a result, levels of estrogens do not rise, the LH surge does not occur, and ovulation does not take place. Even if ovulation does occur, as it does in some cases, they may also block implantation in the uterus and inhibit the transport of ova and sperm in the uterine tubes. Progesterone thickens cervical mucus and makes it more difficult for sperm to enter the uterus.

- An intrauterine device (IUD) is a small object made of plastic, copper, or stainless steel that is inserted by a health-care professional into the cavity of the uterus. IUDs prevent fertilization from taking place by blocking sperm from entering the uterine tubes and also causing an inflammatory reaction.
- Depo provera is a hormone injection containing progesterone preventing implantation by making endometrium thin, prevent sperm transport by thickening of cervical mucosa and prevent ovulation.
- A male condom is non porous, latex covering placed over the penis that prevents deposition of sperm in the female reproductive tract
- In vasectomy a portion of each ductus deferens is removed. Next the ducts are located and cut, each is tied in two places with stitches. Although sperm production continues in the testes, sperm can no longer reach the exterior. The sperm degenerate and are destroyed by phagocytosis. Because the blood vessels are not cut, testosterone levels in the blood remain normal.
- In tubal ligation both uterine tubes are tied closed and then cut. The result is that the secondary oocyte cannot pass through the uterine tubes, and sperm cannot reach the oocyte.
- Lactation is the production and ejection of milk from mammary glands. A principal hormone in promoting milk production is prolactin throughout the pregnancy period secretion of prolactin is inhibited by high levels of progesterone in blood as the levels of estrogen and progesterone falls ,at birth, due to the loss of placenta that inhibitatory effect is ceased,and alveoli are stimulated to secrete milk by prolactin., suckling of milk causes the hypothalamus to get stimulated this causes more Oxytocin to be released .During breast-feeding, suckling stimulates the hypothalamus and causes it to produce neurotransmitters that suppress the release of gonadotropin-releasing hormone(GnRH). As a result, production of LH and FSH decreases, and ovulation is inhibited
  Ans (4)

25. Duration of pregnancy in humans is approximately from fertilization is approximately 40 weeks. Early signs of pregnancy include cessation of mensus,morning sickness, food cravings, breast tenderness, frequent urination and ,presence of hCG in urine in 14 days or in blood after 10 days. In some change in color of areola in breast and constipation.
    - Major fetal changes during each trimester of pregnancy are given in the following table.

Trimester	Major fetal changes*		
	Length /cm	Weight /g	Other changes.
First 	7.5	25-30	• Eyes fully developed with fused eyelids • Nose developed • External ears present • Appendages fully formed • Nails developed • Heart beat detectable with major blood vessels developed • Head is large and more disproportionate **
second 	25-35	550-700	• Eyelids separated and eyelashes formed. • Skin wrinkled. • Face with more human features • Hair present. • Fine hair covers the body. • Many bones ossified • Head is large and is less disproportionate.
Third	50	3000	• Fine hair covering the body is shed. • Nails extend up to the end of fingers.

			• Testis descended to scrotum. • Bones of head hardened except fontanelles. • All organ systems well developed. • Head and body more proportionate.

*changes are indicated as by the end of each trimester.

** Proportion of head is considered by comparing the head with the body.

- Hormones associated with pregnancy include estrogen, progesterone, and hCG
  During the first 3 to 4 months of pregnancy, the corpus luteum in the ovary continues to secrete progesterone and estrogens, which maintain the lining of the uterus during pregnancy and prepare the mammary glands to secrete milk. The chorion of the placenta secretes hCG into the blood. In turn, hCG stimulates the corpus luteum to continue production of progesterone and estrogens which required to prevent menstruation. From 16 weeks through the remainder of the pregnancy, the placenta itself provides the high levels of progesterone and estrogen required. A high level of progesterone ensures that the uterine myometrium is relaxed and that the cervix is tightly closed. Towards the end of pregnancy level of estrogen increases highly .High levels of estrogens cause the number of receptors for Oxytocin on uterine muscle fibers (myometrium) to increase, which is required in the process of birth. After delivery, estrogen and progesterone in the blood decrease to normal levels. Therefore the ans. is(3) as seen in the table .

26. Fertilization is the fusion of two gametes from either sex to form a diploid zygote. Let's look at fertilization in microscopic level. Followed by the deposition of sperms in female reproductive tract, sperms are subjected to capacitation .capacitated sperms after moving up to the first one third from the distal end in the fallopian tube, meet the ova for fertilization. Initially it has to move through the cells of cumulus oophorus, penetrate through corona radiata reaching zona pellucida .At this point acrosomal reaction occurs which digest a pathway through zona pellucida up to vitaline membrane. Head of sperm fuses with vitaline membrane triggering a depolarization in it. This acts as a fast block of polyspermy*.simultaneously cortical reaction occurs causing the thickening of zona pellucida which acts as a slow block for polyspermy. The entry of sperm stimulates the completion of 2nd meiotic division of secondary oocyte secondary polar body released

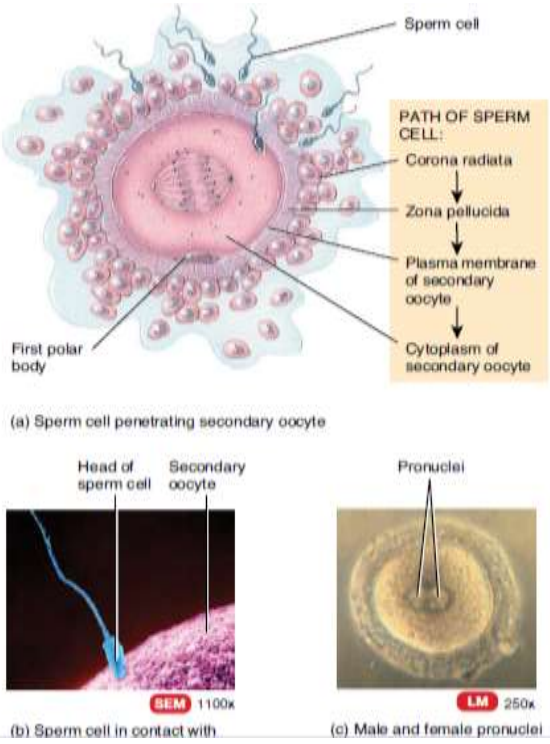


Figure (from Principles of anatomy and physiology, G.J.Tortora, B.Derrikson)

from this process is degenerated immediately. pronuclei are formed and both nuclei fuse to form the diploid zygote. At this process the entire sperm does not enter the ovum ,it has lost its acrosome by that time.so response (4) is incorrect.Fertilisation must occur by 24 hours after fertilization because the lifetime so the ovum is about 24 hours. So (2) is correct. Fertilization can be done outside the female tract in vitro conditions for assisted reproduction so (5) is incorrect. fertilization does not occur in lower one-thirds of fallopian tube but first one third from the distal end in the fallopian tube. These are two different locations. So (1) is incorrect.* depolarization of the vitaline membrane is less significant in mammals .it is not effective and lasts a small time period. Some books say that it is even absent. The exact nature of fast block in humans is not well defined. Thus polyspermy is mainly prevented by thickening of zona pellucida not depolarization of vitaline membrane. The best answer is (2)

27. A fruit is a developed and matured ovary or ovaries together often with adjacent floral organs. (Sepals etc.).Fruits may contain one or more number of seeds or no seeds in the case of parthenocarpy. fruits may be simple formed by a single ovary ,aggregated fruit formed from single compound flower containing multiple ovaries ,or or multiple fruits (pineapple) formed by the fused ovaries of multiple flowers. The fruit wall originated from the wall of the ovary is called the pericarp. It can be either parenchymatous fleshy, in the case of fleshy fruits and dry in the case of dry fruits (rice).in the case of grains such as in rice, the pericarp and seed coat is fused into one layer. Thus the matured ovule is the seed, the fused carpals form the ovary .the remains of embryo sacs occurs as the embryo of the seed. Ans.(1)

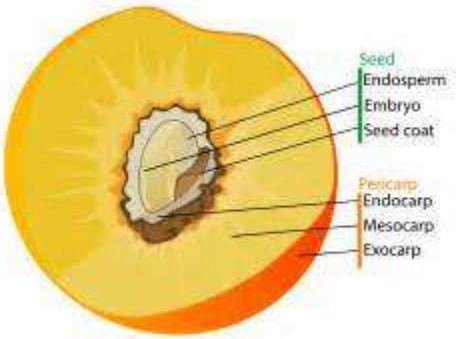


Figure: anatomy of a fruit (from Wikipedia)

28. Gymnosperms are open seeded plants i.e. they are not enclosed in fruits. Angiosperms have closed seeds i.e. enclosed in a fruit. Both these are seed plants. The vascular plants other than gymnosperms and angiosperms include ferns (phylum pterophyta) and lycophytes. alternation of generations is a common feature seen in all plant members of the plant kingdom so option(1) is incorrect.(2)seeds are formed by the ovules. An ovule is a matured megaspore covered by the integuments and the outer wall of megasporangium.Seeds are not found in seedless plants so ovules aren't too.(3)integuments are only found in seed plants.(4)pollen grains (mature male gametophyte)are found in gymnosperms and anthophytes not in other seedless vascular plants.

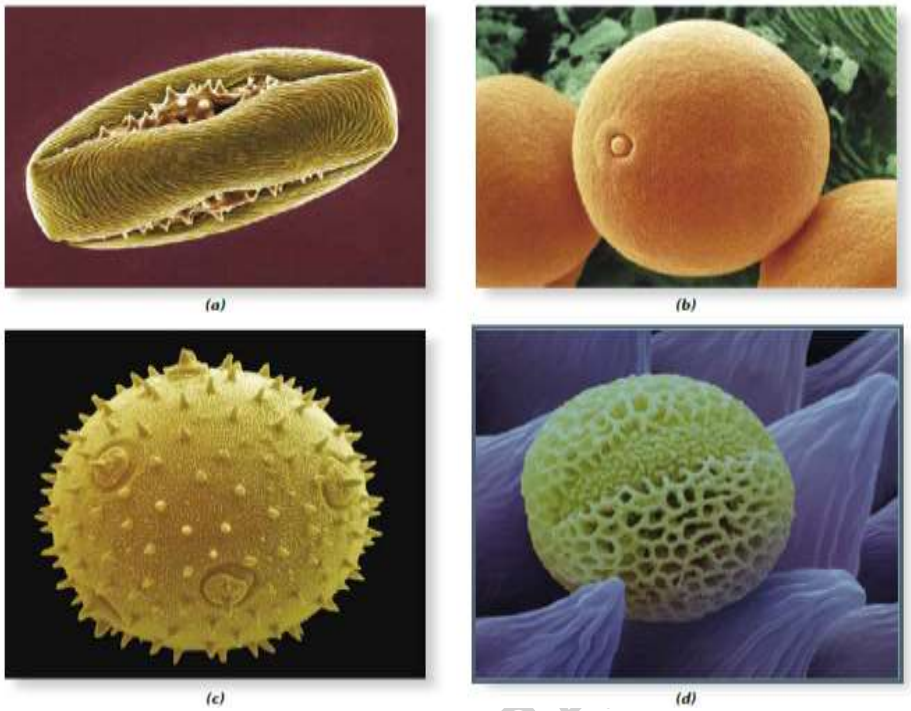


Figure: pollen grains of angiosperms (from raven biology of plants 8e)

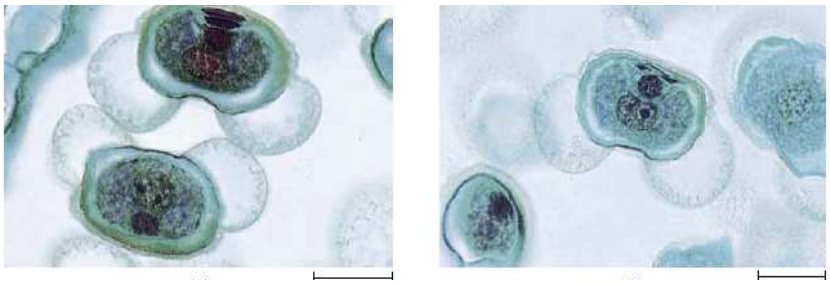


Figure: winged pollen grain of *Pinus* (from raven biology of plants 8e)

(5)Gametophytes in gymnosperms and angiosperms depend on sporophyte so does *Sellaginella* gametophytes. Therefore the ans is(1).

29. DNA replication is the production of two identical daughter molecules of DNA from a single mother molecule .as proven by experiments it is done as the semi conservative model of DNA replication where reach daughter molecule consists of one strand from mother molecule and another newly synthesized strand. Basically for replication the double helix must unwind. Free nucleotides must assemble in front of the corresponding complementary bases as Chargaff's rules. And the phosphodiester bonds must be formed in between each nucleotide. Initially DNA helicases unwind the parental DNA molecules. Each strand acts as a template for the formation of new strand .Free nucleotides (actually this is nucleoside triphosphate; a nucleoside is nucleotide without the phosphate group. In addition this molecule consists of 3 phosphate groups bound at the same place as in the nucleotide).DNA polymerase catalyzes the addition of these monomers to the 3' (3 -prime) end of the DNA molecules. As each monomer joins the growing end of DNA strand it removes two phosphate groups as pyrophosphate **P-P_i**. Hydrolysis of pyrophosphates into inorganic phosphate is an exergonic reaction (reaction that releases free energy).this energy drives the polymerization reaction which is an anabolic reaction. Thus no ATP is required for this process.DNA polymerases add nucleotides only to the 3' end .thus the DNA strand can elongate only in 3' to 5' direction. Since the DNA molecule consists of two antiparalell strands .only one new strand can be formed continuously this is called the leading strand. And the other strand is made in fragments called **Okasaki fragments** and since it delays to form a single continuous strand it is called the lagging strand. Later Okasaki fragments are joined to each other by ligases to form a continuous strand.

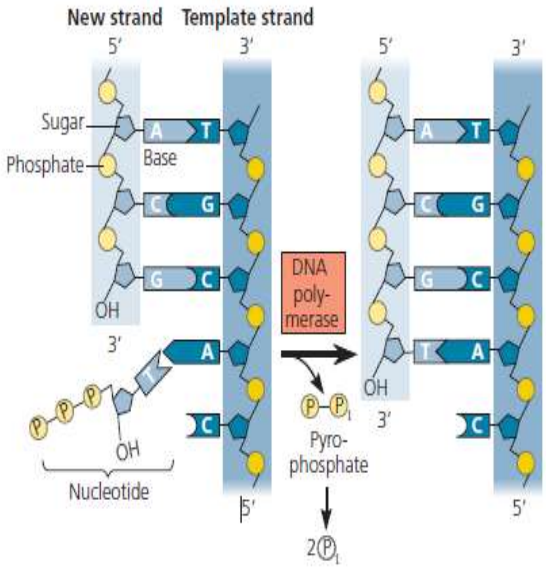


Figure (from Campbell biology 10e)

Therefore the ans. is (5).

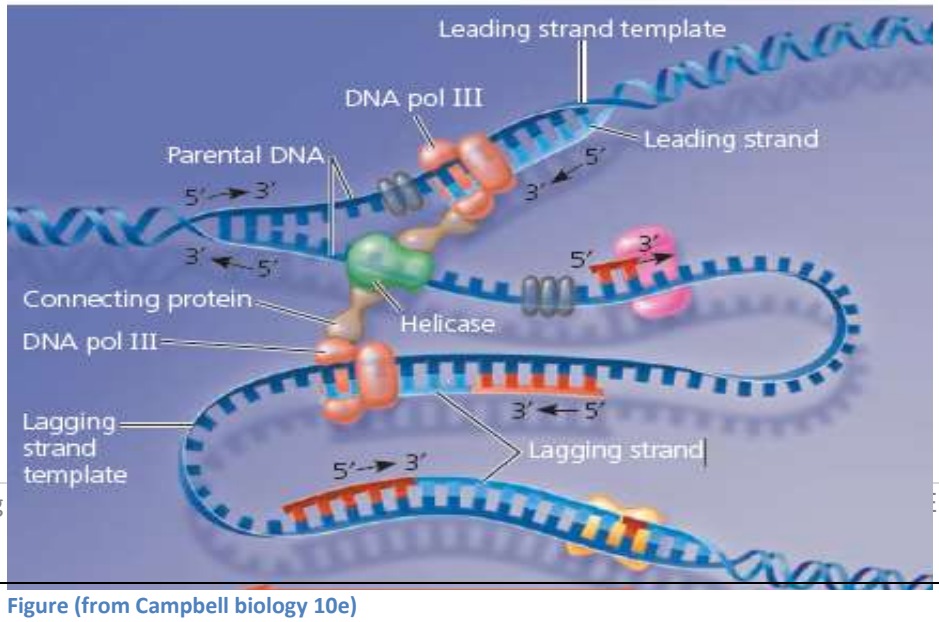


Figure (from Campbell biology 10e)

30. The ratio of the phenotypes of the progeny is approximately 1:1 .As one parent plant is crossed with a homozygous recessive plant, this cross is a test cross. Since the phenotypic ratio is 1:1 .parents may be showing either incomplete linkage or just dihybrid nature. When we look at the responses given., it is obviously clear that they don't exhibit incomplete linkage. Thus this is a dihybrid test cross. The genotype of homozygous recessive parent is **rrll** and other plant having dominant phenotype must have a genotype of **R_L_.**The cross is given below.

P **red seed long pods** × **yellow seed short pods**

R_L_ × **rrll**

G

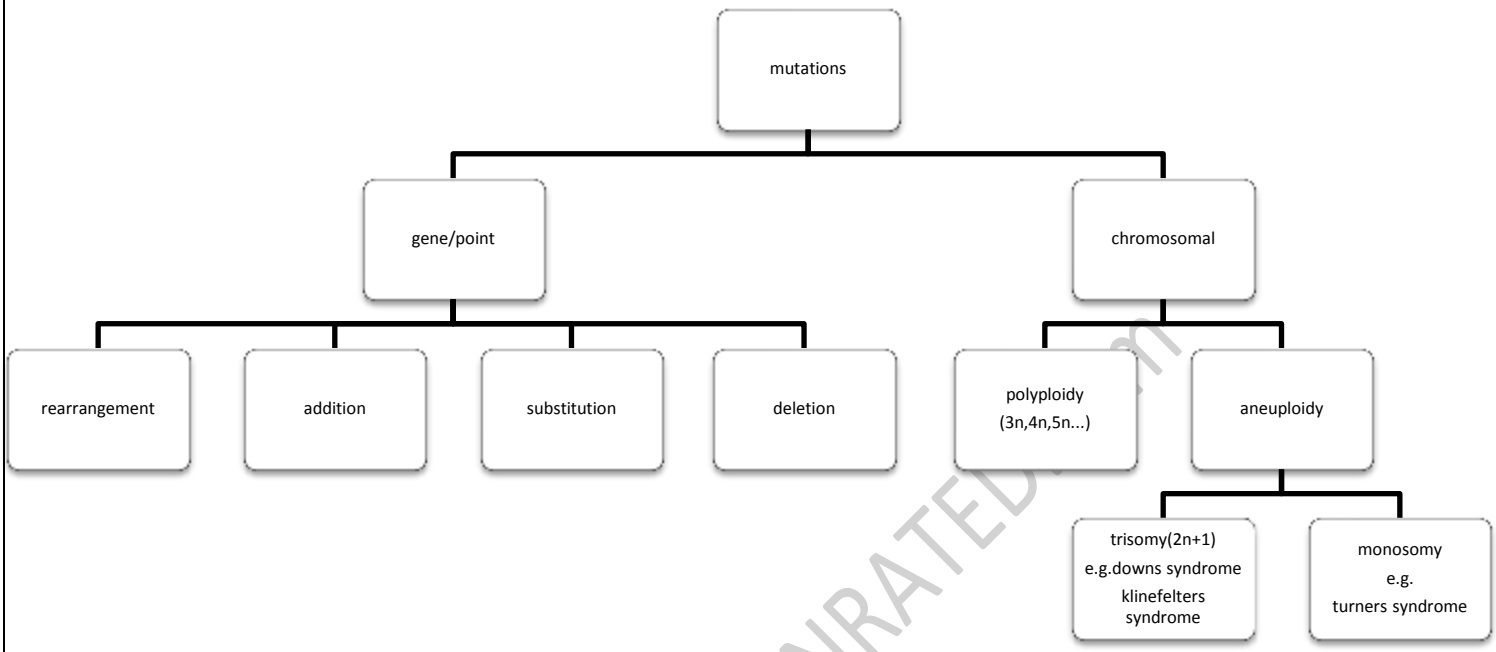
F1 **R_L_** **R_ll**

Red seeds long pods **red seeds short pods**

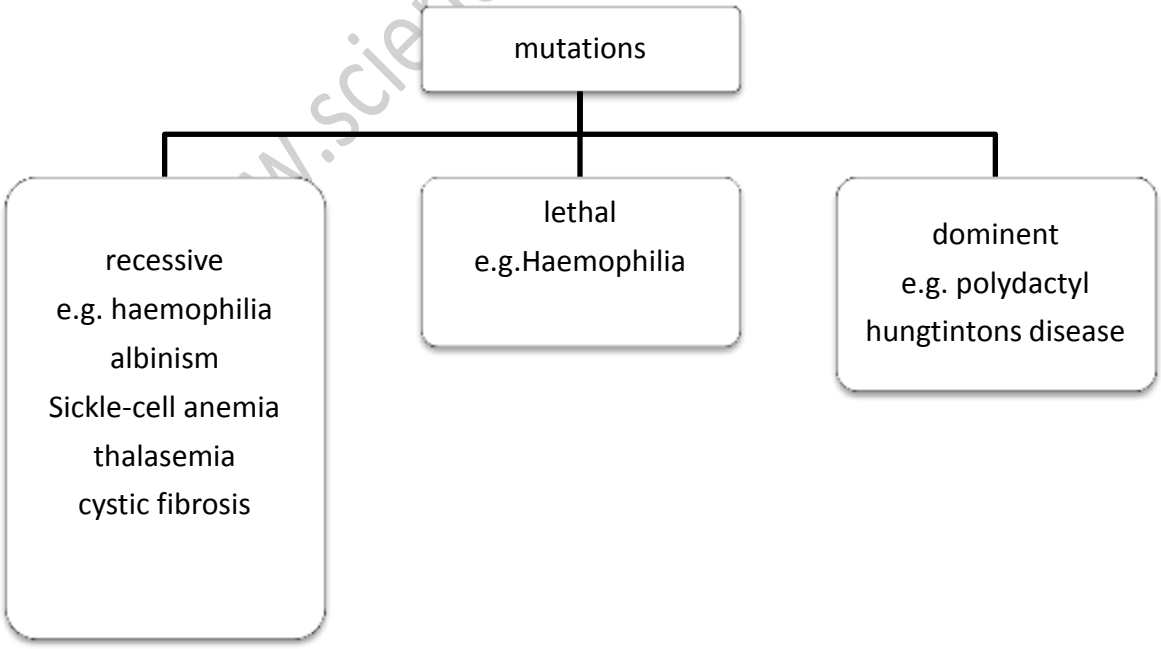
1 : **1**

As shown above since two phenotypes are obtained in F1 generation two gametes must be given by **red seed long pods plant** when only one game is given by homozygous recessive plant. As both plants are with red seeds ,both alleles for red in **red seed long pods** plant must be dominant . if one is recessive one plant in f1 generation will be yellow seeded and since short pods are found in one in F1 generation one recessive allele must come from **red seed long pods** **plant. Thus the genotype of red seed long pods parent plant** must be **RRLl.ans (4)**

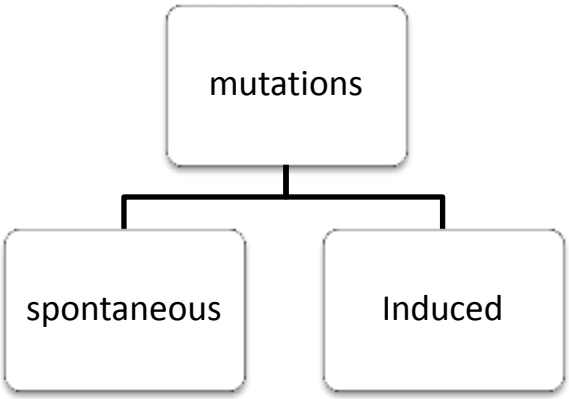
31. Mutations are changes in genetic material that can be transmitted to the future generations. They may be classified as follows.



Based on the way of expression, they can be further classified as;



Further can be classified based on causes,



(1)External mutagens can cause spontaneous mutations. Chemical &physical mutagens (different types of rays) mutations cause induced mutations. So statement is not always correct.(2)Haemophilia is a recessive lethal mutation, not dominant.(3)cancer is usually a somatic mutation. chromosomal mutations are mutations in chromosomes that are heritable.(4)polydactyl is a dominant mutation as shown above.(5) albinism is a recessive mutation but not a lethal mutation. Therefore ans. is (4).

32. The following is a list of microorganisms used in gene technology

Micro organism	Use
E.coli	Model organism for genetic studies
Agrobacterium tumifaciens	Its Ti plasmid is used as a vector to transfer genes to make crops such as weedicide resistant crops, herbicide resistant crops etc.
Bacillus thuringiensis(Bt)	Gene obtained to make pest resistant plants.
Erwinia uredovora	Gene obtained to make golden rise

Thiobacillus thioxidans is used to extract copper like metals from low grade metal ores.

Therefore the ans is (2)

33. Recombinant DNA technology is the joining DNA molecules obtained from different species to make a functional single DNA molecule. It is used in medicine, agriculture, and various other industries. In medicine it is used to make important proteins and hormones such as human insulin.GH,human interferon,AAT(a-1-antitrypsin)etc and vaccines such as Hepatitis B vaccine. In agriculture to make transgenic plants such as herbicide resistant, weedicide resistant, pest resistant, virus resistant, drought resistant ,wilt resistant plants etc. in industries it is used to produce enzymes, food additives and in bioremediation.(1)GH is used in treating dwarfism.(2) vaccines are produced as stated above.(3) virus resistant plants are produced such as for papaya ring spot virus ,TMV etc.(4) no modification of human genome is done due to ethical concerns.

Therefore the ans. is (4)

Relative Duration of Eons	Era	Period	Epoch	Age (Millions of Years Ago)	Some Important Events in the History of Life
Phanerozoic	Cenozoic	Quaternary	Holocene	0.01	Historical time
			Pleistocene	2.6	Ice ages; origin of genus *Homo*
		Neogene	Pliocene	5.3	Appearance of bipedal human ancestors
			Miocene	23	Continued radiation of mammals and angiosperms; earliest direct human ancestors
		Paleogene	Oligocene	33.9	Origins of many primate groups
			Eocene	55.8	Angiosperm dominance increases; continued radiation of most present-day mammalian orders
			Paleocene	65.5	Major radiation of mammals, birds, and pollinating insects
Proterozoic	Mesozoic	Cretaceous		145.5	Flowering plants (angiosperms) appear and diversify; many groups of organisms, including most dinosaurs, become extinct at end of period
		Jurassic		199.6	Gymnosperms continue as dominant plants; dinosaurs abundant and diverse
		Triassic		251	Cone-bearing plants (gymnosperms) dominate landscape; dinosaurs evolve and radiate; origin of mammals
	Paleozoic	Permian		299	Radiation of reptiles; origin of most present-day groups of insects; extinction of many marine and terrestrial organisms at end of period
		Carboniferous		359	Extensive forests of vascular plants form; first seed plants appear; origin of reptiles; amphibians dominant
		Devonian		416	Diversification of bony fishes; first tetrapods and insects appear
		Silurian		444	Diversification of early vascular plants
		Ordovician		488	Marine algae abundant; colonization of land by diverse fungi, plants, and animals
Archaean		Cambrian		542	Sudden increase in diversity of many animal phyla (Cambrian explosion)
		Ediacaran		635	Diverse algae and soft-bodied invertebrate animals appear
				1,800	Oldest fossils of eukaryotic cells appear
				2,500	
				2,700	Concentration of atmospheric oxygen begins to increase
Hadean				3,500	Oldest fossils of cells (prokaryotes) appear
				3,850	Oldest known rocks on Earth's surface
				Approx. 4,600	Origin of Earth

Table (from Campbell biology 10e)

34. The geological time scale is shown above. Vertebrates originated during Cambrian explosion around 500 million years ago. Colonization of land by plants took place around 480 millions ago; colonization of land by animals took place around 420 million years ago. Conifers appeared during Permian period around 280 million years ago. All these things are given as point in the teachers guide .so referring it would have a better advantage. Ans.(3)
35. This question seeks the least acceptable ans. so all the options must be carefully studied. (2) it says us that Q is an invasive species. An invasive species is a non native species which has the ability to spread beyond its introduction site and become established in new locations where it may cause a deleterious effect on local biodiversity. Nonnative invasive species can often cause significant changes to ecosystems. Thus Q being an invasive species is probable.(3)P could also have been overexploited by man which has caused their extinction.(4)P could be sensitive to pollution which may have led them to extinction. Q cold tolerate the pollution in the lagoon.(5) salinity increase may have harmful effects on organisms. P could have been unsuccessful to adapt to the change, but Q could have adapted to it.(1)parasitic species are species that cause harm to the host. So to carry on their activities the host is essential ,it is least probable for the parasite to be abundant when there is no host. Therefore ans. is (1).
36. The IUCN red data book is an inventory for the global conservation status of plant and animal species. There are 9 categories of threatened species at present .following table gives them.

Category	Examples given in the syllabus*
Extinct (EX)	• Dodo • Wooly mammoth • Southern shrub toad
Extinct in wild(EW)	• Giant tortoise in Seychelles • *Alphonsea hortensis*
Critically endangered(CR)	• *Macrognathus aral* – lesser spiny eel • *Dermocheyls coreacea*-leather back turtle
Endangered (EN)	• *Caretta caretta* –loggerhead turtle
Vulnerable(VU)	• *Elephas maximus* –*Asian elephant*
Near threatened(NT)	• *Melanochelus trijuga* –Rock terrapin
Least concern(LC)	• *Crocodylus palustris*-marsh crocodile
Data deficient(DD)	• *Mystus keletius*-Yellow catfish
Not evaluated(NE)	• *Oecophyla smaragdina*- tailor ant • *Chroxylon swietenia*-satin wood

*it is given as "students need not memorize the scientific names" in the syllabus. But these have been tested in MCQs in the past years. Thus it means that students must be able to identify the scientific names in the syllabus but not study the proper spellings in these scientific names .In other places such as in microbiology, it is strictly required for the students to study proper spellings in scientific names. **NO marks will be awarded for scientific names with wrong spellings at the exam.**

37. Coal with higher content of sulphur, when combusted to obtain thermal energy in thermal energy plants, releases a lot of SO_2 . Sulphur dioxide and nitrogen oxides are the principle substances that cause acid rain. The major direct effect of acid rain from the options given is erosion of buildings. Reduction of crop harvest could occur indirectly as acid rain deceases

soil fertility, decrease photosynthesis and reduce populations of nitrogen fixing soil organisms. Impaired vision occurs due to carbon monoxide. Skin cancer occurs due to depletion of ozone layer. Drowsiness may occur due to CO and hydrocarbons.ans.(3)

38. Acquired immunity is a form of immunity acquired by the body by external means naturally or artificially. It includes the following.

Type of acquired immunity	Activate immune system(+)or not(-)*	How acquired
Naturally acquired active	+	Exposure to a foreign antigen(usually from pathogens of an infection)e.g. Chicken pox, measles mumps
Naturally acquired passive	-	Antibodies received from mother to fetus, or from mother to baby during breast feeding.
Artificially acquired active	+	Vaccination of body with attenuated microbial cells or with their toxoids. e.g.Polio,BCG, MMR(Mumps, measles and Rubella)
Artificially acquired passive	-	Artificial administration of presynthesized antibodies of another host through vaccines. e.g. antirabies antitetanus

* it can be seen from the table that active immunity activates the immune system and passive does not .active immunity allows the immune system to produce antibodies required, passive supplies antibodies directly and thus d9oes not require the activation of immune system.

Thus as seen from the table antitetanus vaccine is an example of Artificially acquired passive immunity. Ans(1).

39. The following table gives the list of micro organisms used in various industries.

Industry *	Microorganisms
Food and food supplements	*Pleurotus, Lentinus,Agaricus,Canthrellus* Yeast,*Spirulina ,Chlorella*
Fermentation • **Alcoholic beverages** • **Vinegar** • **Bakery** • **Lactic acid** • **Yogurt** • **Curd** • **Cheese** • **Butter**	 *Saccharomyces cerevisiae,Saccharomyces ellipoideus in wine,S.carlsbergensis* *Saccharomyces cerevisiae,Acetobacter aceti,Gluconobacter oxydans* *Saccharomyces cerevisiae* *Lactobacillus bulgaricus,Lactococcus* *Lactobacillus bulgaricus,Streptococcus thermophilus, Streptococcus lactis* *Lactobacillus bulgaricus,Streptococcus thermophilus, Streptococcus lactis* *Streptococcus lactis* *Streptococcus lactis*

Enzyme • **Amylase** • **Cellulase** • **Glucose oxidase** • **Invertase** • **Lipase** • **Protease**	 *Aspergillus niger ,Aspergillus oryzae,Bacillus subtilis* *Aspergillus niger* *Aspergillus niger* *Saccharomyces cerevisiae* *Rhizopus spp* *Aspergillus oriyzae*
Vaccines	Hepatitis virus for Hepatitis B vaccine
Biofertilisers	*Rhizobium,Anabaena*
Biopesticides	*Bacillus thuringiensis , Bti*
Bioleaching	*Thiobacillus ferroxidans, Thiobacillus thiooxidans*

*Antibiotics are given in next question.

Thus as seen in the table ans is (3)

40. The antibiotics given in the syllabus are as follows.

Microorganism	Antibiotic	Function
Fungi		
Penicillium notatum	Penicillin	inhibition of the synthesis of bacterial cell wall
Penicillium griseofulvum	Griseofulvin	Binds to tubulin, interfering with microtubule function, thus inhibiting mitosis.
Cephalosporium	Cephalothin	inhibit cell wall synthesis of the bacteria
Actinomycetes		
Streptomyces nodosus	Amphoterecin B	
Streptomyces venezuelae	Chloramphenicol	Is a bacteriostatic by inhibiting protein synthesis
Streptomyces aureofaciens	Chlorotetracycline and tetracycline	Inhibit protein synthesis
Streptomyces erythraeus	Erythromycin	inhibition of synthesis of bacterial protein
Streptomyces griseus	Streptomycin	inhibition of synthesis of bacterial protein
Micromonospora purpurea	Gentamicin	inhibition of synthesis of bacterial protein
Streptomyces noursei	Nystatin	Binds to fungal cell membrane and forms pores in it leading to cell death
Streptomyces fradiae	Neomycin	excellent activity against Gram-negative bacteria
Gram positive rods		
Bacillus subtilis	Bacitracin	interfere with cell wall and peptidoglycan synthesis
Bacillus polymyxa	Polymixin	inhibition of the permeability

		of bacterial cell membrane
synthetic		
-	Ciprofloxacin	inhibition of the synthesis of bacterial DNA
-	Ketoconazole/ Clotrimazole	inhibition of synthesis of fungal cell membrane

Therefore the ans is (4)

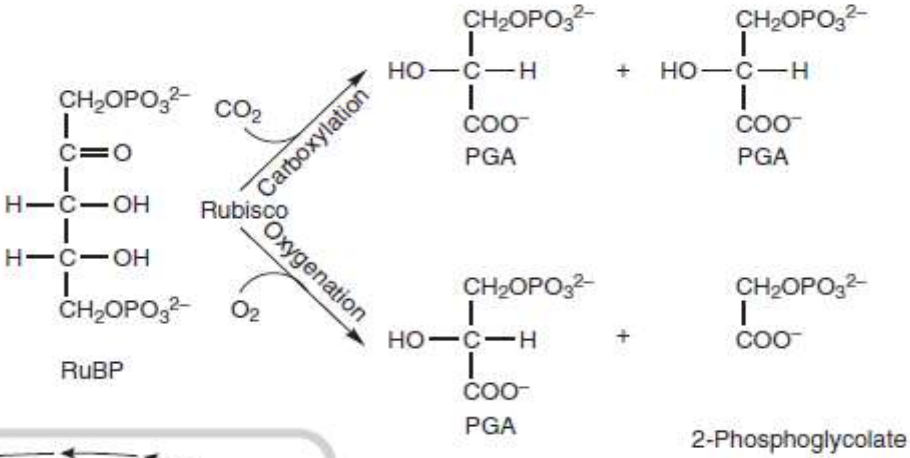


Figure (from Molecular mechanisms of photosynthesis, Robert E Blankenship .Blackwell)

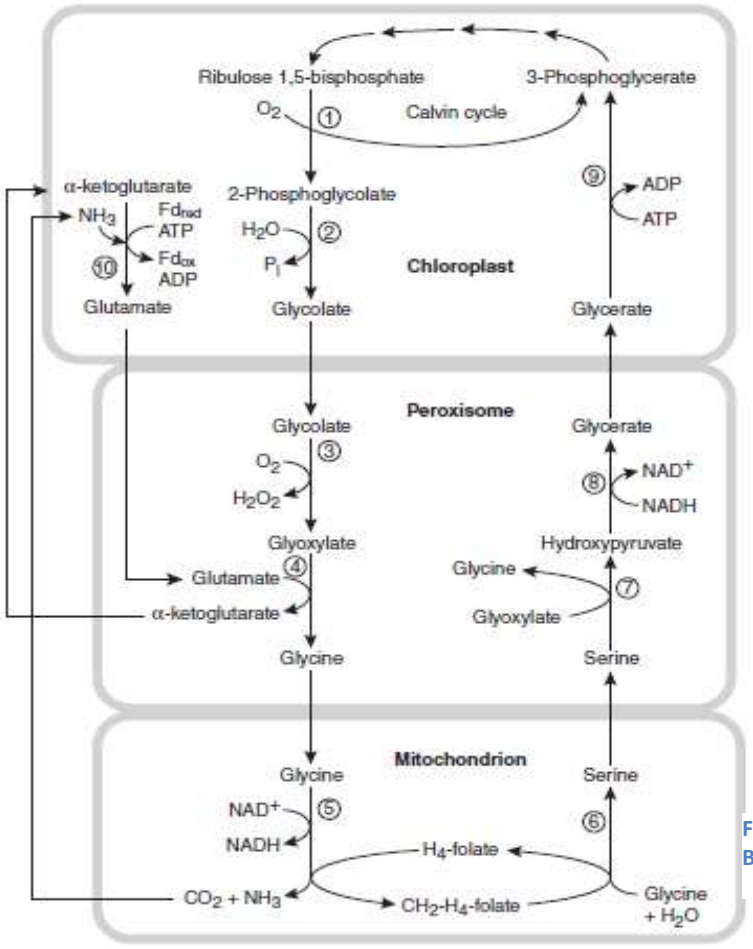


Figure (from Molecular mechanisms of photosynthesis, Robert E Blankenship .Blackwell)

41.

Photorespiration is the process by which RuBP selects oxygen as its substrate in a deficiency of carbon dioxide; this converts RuBP into PGA molecule and 2-phosphoglycolate (as shown in the figure.)This is catalyzed by RuBisCO enzyme.

2-phosphoglycolate thus formed cannot be used directly .this must be converted to PGA to be used in Calvin cycle. The oxygenation of RuBP and the conversion of 2-phosphoglycolate to PGA is called photorespiration. This conversion involves three organelles chloroplast, mitochondria and peroxisome as shown below.

This process is considered as a wasteful process, since the conversion requires one ATP and one NADH and it releases one Carbon dioxide and ammonia .ammonia is poisonous .thus ammonia has to be metabolically detoxified which is also a waste of energy.

42. Human pancreatic juice contains the mostly water, some salts, sodium bicarbonate and some enzymes. Sodium bicarbonate gives an alkaline pH that buffers acidic gastric juice in chyme, stops the action of pepsin from the stomach, and creates the proper pH for the action of digestive enzymes in the small intestine. The enzymes in pancreatic juice include pancreatic amylase, trypsin, chymotrypsin, carboxypeptidase, and elastase (elastase in out of syllabus); pancreatic lipase and ribonuclease and deoxyribonuclease .The proteolitic enzymes are secreted in inactive forms called tripsinogen, chymotrypsinogen, procarboxypeptidase, and proelastase. When trypsinogen reaches the lumen of the small intestine, it encounters an activating brush-border enzyme called enterokinase, which splits off part of the trypsinogen molecule to form trypsin. In turn, trypsin acts on the inactive precursors produce chymotrypsin, carboxypeptidase, and elastase respectively.(enterokinase also activate the inactive precursors.).Secretions of alimentary tract are increased by stimulations from parasympathetic nervous system.Secretin stimulates the pancreas to increase the secretion of HCO_3^- rich pancreatic juice. Emulsification is the breakdown of globules into small uniformly distributed particles. This is mainly accomplished by bile salts sodium torocolate and sodium glycolate. This is the preparatory step for chemical digestion; it increases the surface areas for the action of enzymes. Therefore options C & D are correct .ans. (4).

43. There are 5 main phytohormones or plant growth substances .the following is a summary of them. *not all in the table are considered to be correct in our syllabus

Hormone(s)	Chemical Nature	Sites of Biosynthesis	Transport	Effects
Auxins	Indole-3-acetic acid (IAA) is the principal naturally occurring auxin. Possibly synthesized via tryptophan-dependent and tryptophan-independent pathways.	Primarily in leaf primordia and young leaves and in developing seeds.	Auxin is transported both polarly (unidirectionally) and nonpolarly.	Apical dominance; tropic responses; vascular tissue differentiation; promotion of cambial activity; induction of adventitious roots on cuttings; inhibition of leaf and fruit abscission; stimulation of ethylene synthesis; inhibition or promotion (in pineapples) of flowering; stimulation of fruit development.
Cytokinins	Cytokinins are N^6-adenine derivatives, phenyl urea compounds. Zeatin is the most common cytokinin in plants.	Primarily in root tips.	Cytokinins are transported in the xylem from roots to shoots.	Promotion of cell division; promotion of shoot formation in tissue culture; delay of leaf senescence; application of cytokinin can cause release of lateral buds from apical dominance and can increase root development in arid conditions.
Ethylene	The gas ethylene (C_2H_4) is synthesized from methionine. It is the only hydrocarbon with a pronounced effect on plants.	In most tissues in response to stress, especially in tissues undergoing senescence or ripening.	Ethylene, a gas, moves by diffusion from its site of synthesis.	Fruit ripening (especially in climacteric fruits, such as apples, bananas, and avocados); leaf and flower senescence; leaf and fruit abscission.
Abscisic acid	Abscisic acid is synthesized from a carotenoid intermediate. The name is a misnomer because the hormone has little to do with abscission.	In mature leaves and roots, especially in response to water stress. May be synthesized in seeds.	Abscisic acid is exported from leaves in the phloem; from roots in the xylem.	Stomatal closure; induction of photosynthate transport from leaves to developing seeds; induction of storage-protein synthesis in seeds; embryogenesis; may affect induction and maintenance of dormancy in seeds and buds of certain species.
Gibberellins	Gibberellic acid (GA_3), a fungal product, is the most widely studied. Gibberellins are synthesized via the terpenoid pathway.	In young tissues of the shoot and developing seeds. It is uncertain whether synthesis also occurs in roots.	Gibberellins are probably transported in the xylem and phloem.	Hyperelongation of shoots by stimulating both cell division and cell elongation, producing tall, as opposed to dwarf, plants; induction of seed germination; stimulation of flowering in long-day plants and biennials; regulation of production of seed enzymes in cereals.

Table (from raven biology of plants)

Auxins are transported through parenchyma polarly, basipetal in shoots and acropetal in roots. Abscisic acid is synthesized in root caps and transported in xylem to leaves in response of water stress to close the stomata. Natural cytokines are compounds related to adenine, produced at root apices and dividing cells of many tissues, transported through xylem. Gibberellins or gibberellic acids are produced mainly in young leaves, roots and germinating seeds, transported through parenchyma cells. Ethylene produced mainly in fruits and parenchyma cells of several other tissues and transported in parenchyma cells and phloem .Therefore the ans is (4).

44. Adult human skeletal system consist of 206 bones which are categorized into 2 parts.; As axial and appendicular skeletons .out of the bones in the axial skeleton 22 bones are found within the skull.

The Bones of the Adult Skeletal System

DIVISION OF THE SKELETON	STRUCTURE	NUMBER OF BONES
Axial skeleton	Skull	
	Cranium	8
	Face	14
	Hyoid bone	1
	Auditory ossicles (see Figure 17.18)	6
	Vertebral column	26
	Thorax	
	Sternum	1
	Ribs	24
	Number of bones = 80	
Appendicular skeleton	Pectoral (shoulder) girdles	
	Clavicle	2
	Scapula	2
	Upper limbs	
	Humerus	2
	Ulna	2
	Radius	2
	Carpals	16
	Metacarpals	10
	Phalanges	28
	Pelvic (hip) girdle	
	Hip, pelvic, or coxal bone	2
	Lower limbs	
	Femur	2
	Patella	2
	Fibula	2
	Tibia	2
	Tarsals	14
	Metatarsals	10
	Phalanges	28
	Number of bones = 126	
	Total bones in an adult skeleton = 206	

Figure (from Principles of anatomy and physiology, G.J.Tortora, B.Derrikson)

Human skull is made out of 2 parts; the cranium and the face. The cranium consists of bones that form the cranial cavity within which the brain is protected. The cranium has a capacity of about 1.5 L so statement (A) is incorrect. It is made out of 8 bones; one frontal, two temporal, two parietal, one occipital, one ethmoid and one sphenoid bones. Facial region consist of 14 bones; two nasal bones, two maxillae (or maxillas), two zygomatic bones, the mandible, two lacrimal bones, two palatine bones, two inferior nasal conchae, and the vomer.ao statement (D) is incorrect.(naming all facial bones is not required in syllabus.)The following diagram shows the lateral view of skull.

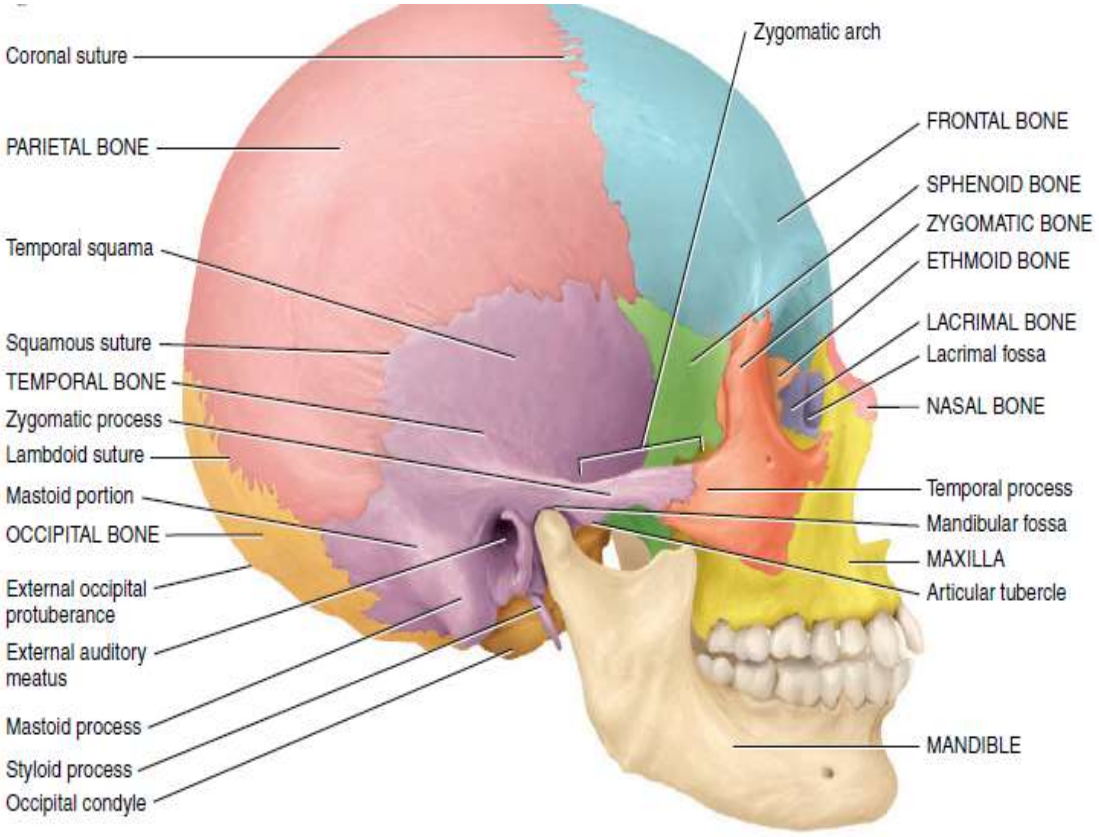


Figure (from Principles of anatomy and physiology, G.J.Tortora, B.Derrikson)

The processes located in the cranium include two mastoid processes and two styloid processes. Processes are projections or outgrowths of the bone .as seen in the diagram the mastoid process is an outer growth of temporal bone. so statement (B) is incorrect. Air sinuses or air filled cavities are found in 4 bones of the skull which include the frontal the sphenoid, the ethmoid and maxillary bones. so statement (c) is correct. The following diagram shows them.

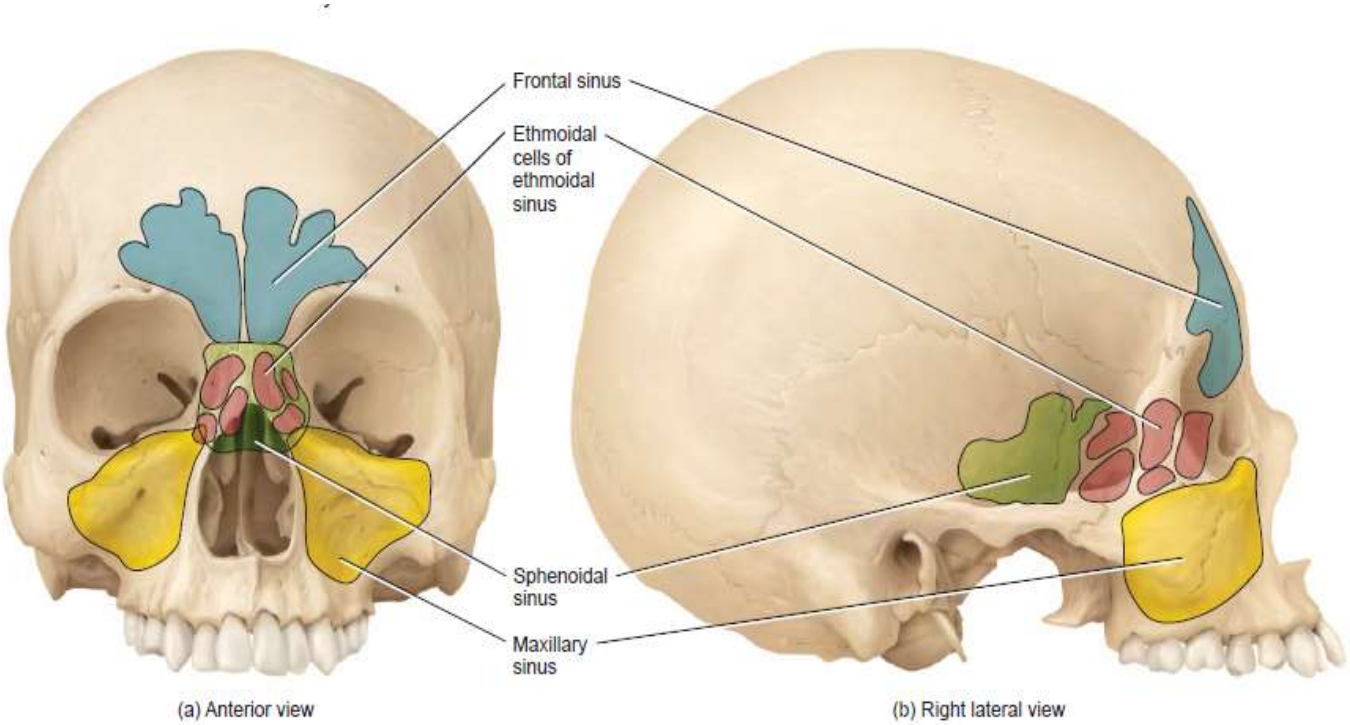


Figure (from Principles of anatomy and physiology, G.J.Tortora, B.Derrikson)

The upper jaw, the maxillae as shown below articulate with every bone of the face except the mandible. The alveolar process of the maxilla is a ridge like arch that contains the alveoli (sockets) for the maxillary (upper) teeth. The teeth in upper jaw include 4 incisors ,2 canines,4 premolars and six molars in an adult. So statement (E) is correct.

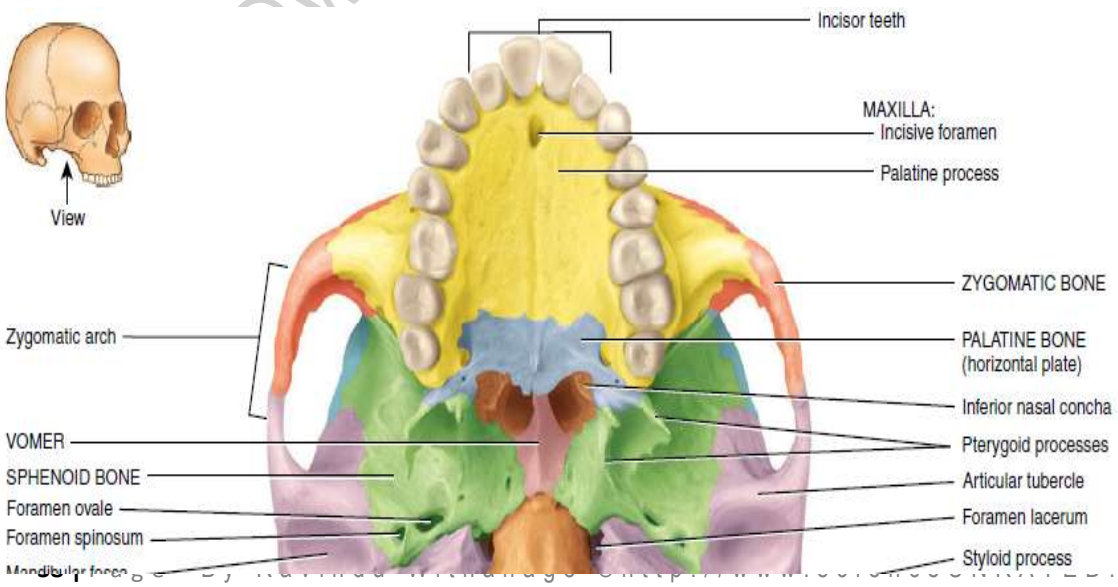


Figure (from Principles of anatomy and physiology, G.J.Tortora, B.Derrikson)

45. Erythropoietin the only hormone synthesized by kidney as on red bone marrow to stimulate the production of RBCs.prolactin stimulates the production and secretion of milk. Not releasing which is done by oxytoxin.glucagon converts glycogen to glucose while corticosol increases blood glucose level.ADH increases the permeability of DCT and collecting duct for water, aldesterone increases the osmotic pressure in blood thereby increase the volume of water in blood. Parathyroid hormone increases the calcium level in blood. Not decreases. therefore the ans is (2)

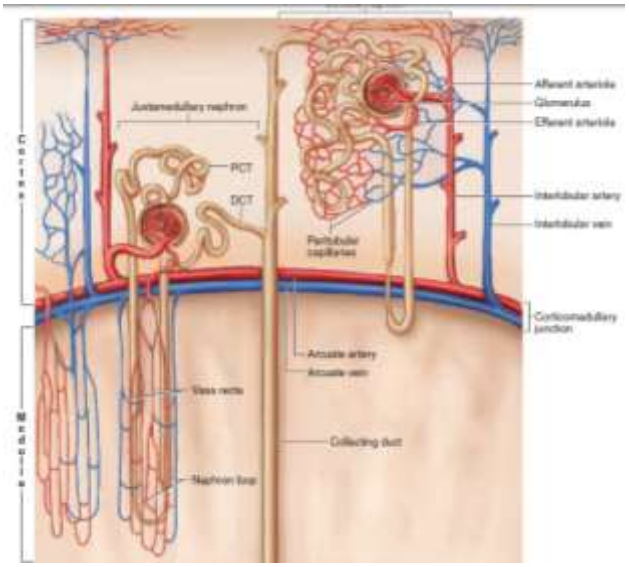


Figure (from Anatomy and Physiology, Saladin)

46.

Human nephrons are the structural and functional units of human kidney. It is involved in the formation of urine. The process of formation of urine consists of 3 steps: ultra filtration, selective reabsorption and secretion. Ultra filtration is the filtration of the blood under high pressure into the cavity of Bowman's capsule. The substances that are filtered are water, glucose, amino acids, urea, vitamins, drugs, ions and hormones. The substances that are not filtered are blood cells & plasma proteins. Selective reabsorption involves in reabsorption of substances needed by the body actively or passively from the glomerular filtrate. Secretion involves in removal of various substances actively by secretion. The following table summarizes them.

Location of nephron	Substances reabsorbed *		Substances secreted*
	Actively	Passively	
PCT	• 80% Na • All glucose* • Amino acids	• 80% water • Cl^- • HCO_3^- • 50% urea • K^+	• H^+ • NH_4^+ • creatinine
Descending loop of henle	Na^+	5% water	-
Ascending loop of henle	Na^+	Cl^-	-
DCT	Na^+	• 15% water in presence of ADH • HCO_3^- • Cl^-	• H^+ • NH_4^+ • K^+ • Some drugs • Vitamin B
Collecting duct	-	4.5% water in presence of ADH	-

*these substances are given in the syllabus

No reabsorption of water takes place in ascending loop of Henle so. Statement (A) is incorrect. Urea is reabsorbed passively in PCT. so. Statement (B) is incorrect. Na^+ reabsorption occurs always actively. so. Statement (D) is correct.two types of nephrons are found in human kidney: cortical and juxtamedullary nephrons .the above diagram shows them. As seen juxtamedullary nephrons have long loops of Henle while cortical nephrons have short loops of Henle. So Statement (C) is correct. Human nephrons help in maintaining blood volume by decreasing and increasing the permeability of DCT and collecting duct for water in absence or presence of ADH. So Statement (E) is correct.ans(5).

47. Sclerenchyma cells are lignified non living cells at maturity. They are found in sites which require more mechanical strength such as vascular tissues; both xylem and phloem

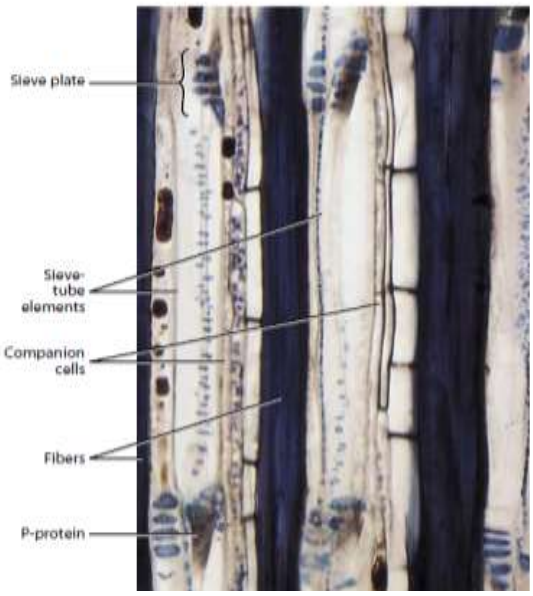
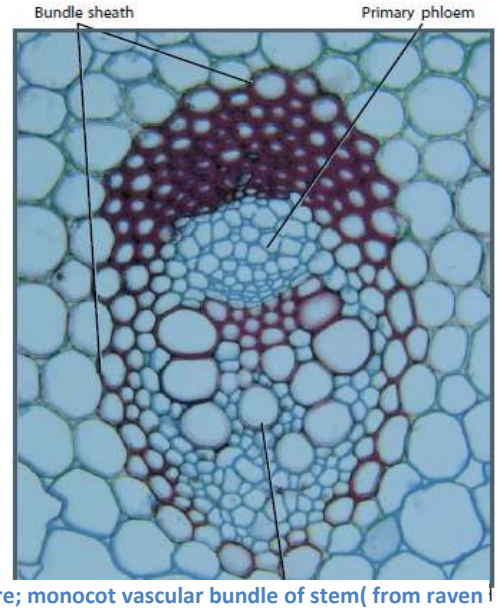


Figure: LS of phloem. Phloem fibers can be seen(from raven biology of plants)



Figure; monocot vascular bundle of stem(from raven biology of plants)

They are seen in the bundle sheath of monocot stems, and not in bundle sheath of leaves. And not in cortex of primary stems.it occurs as sclerenchymatous pericycle in dicot primary stem.Ans.(4).

48. Spermatogenesis is development of mature sperms from spermatogonia in seminiferous tubule. Primordial germ cells of the embryonic testes differentiate into spermatogonia (2n). At the beginning of puberty primary spermatocytes (2n) are produced repeated mitosis and growth. Then Haploid secondary spermatocytes are produced by first meiotic division. Each secondary spermatocyte completes the second stage of meiosis division and forms spermatids (n).Later Spermatids differentiate into mature spermatozoa. This process takes about 72days.once started at puberty it lasts until death. It occurs optimally at 1-2 ^{0}C less than the body temperature. So scrotum lies outside the body. This process is regulated by FSH and LH.FSH initiates spermatogenesis. LH stimulates secretion of testosterone.

49. Change in the no. of chromosomes takes place either in aneuploidy or polyploidy. Polyploidy involves an increase in the whole set of chromosomes i.e. from 2n to 3n, 4n….
Aneuploidy involves in an increase (Trisomy)or decrease (Monosomy)in one chromosome.
The following are the aneuploid conditions in our syllabus.

Condition	Description
Down's syndrome	Trisomy of 21st chromosome
Klinefelters syndrome	Trisomy of sex chromosomes(XXY)
Turner's syndrome	Monosomy of sex chromosomes(XO)

So (C) and (D) are correct .ans.(4).

50. Production of vinegar involves in two steps; a. Fermentation of carbohydrates to produce ethanol by *Saccharomyces cerevisiae*

$C_6H_{12}0_6 \longrightarrow 2C_2H_5OH + 2\ CO_2$

b. Oxidative conversion of ethanol to acetic acid by *Acetobacter aceti or Gluconobacter oxydans*.

$C_2H_5OH+2\ O_2 \longrightarrow 2CH_3COOH + H_2O$.

Therefore ans is (1)