

# UACE BIOLOGY PAPER 1 (2000-2019)

**A-level**

UACE Biology 2000 paper 1  
Section A

NUMBER	Choice	Justification
1	B	
2.	C	
3	D	
4	C	
5	D	
6.	B	
7	C	
8	D	
9	B	
10	C	
11	A	
12	B	
13	A	
14	B	
15	D	
16	C	
17	B	
18	A	
19	B	
20	C	
21	A	
22	A	
23	D	
24	D	 Download from Dreamstime.com This watermarked comp image is for previewing purposes only.
25	B	
26	C	
27	D	
28	B	
29	C	
30	A	
31	A	
32	B	
33	A	
34	C	
35	A	

36	C	
37	D	
38	A	
39	A	
40	B	

41. Explain the following observations in human

(a) Production of large volumes of dilute urine on cold day

On cold day little or no sweating occurs, loss of water through the skin is thus reduced and thus excess water is lost in urine

(b) Urine production almost stops as a result of serious blood loss

Loss of blood leads to reduction in blood pressure, this stops ultrafiltration in the Bowman's capsules leading to reduction in urine production

(c) Presence of sugar in urine

This condition is called glycosuria and occurs when blood sugar levels rise above normal such that the filtered load exceeds what the kidney can absorb. This could be due to failure of the pancreas to secrete enough insulin in blood

(d) Feeling hungry faster in cold weather

On cold day there is high metabolic rate to supply heat to maintain body temperature hence need for high food consumption.

42. (a) Describe how the following tissues bring about growth in higher plants

(i) Apical meristem

- The apical meristem consists of the tunica and corpus
- The cells of the tunica region divide repeatedly by mitosis, perpendicular to the surface. This results in elongation of the shoot or root.
- The corpus region cells divide by mitosis parallel to the surface. This increase the breadth of the stem.
- Apical meristem also produce auxins which promote cell division and elongation, resulting into increase in length or primary growth of the stem or roots

(ii) Vascular cambium

- This is located between xylem and phloem and its activity causes secondary growth or increase in girth.
- The vascular cambium consists of two types of cells fusiform initials and ray initials.
- The cells of fusiform divide by mitosis tangentially to form secondary xylem on the inside and secondary phloem on the outside
- Cells of the ray initials divide by mitosis to form secondary parenchyma cells which accumulate to form rays between neighboring xylem and phloem.
- The accumulation of secondary tissue results into increase in girth of the stem and hence secondary growth

(b) How does growth in mammals differ from that in flowering plants?

Growth in mammals	Growth in plants
Growth occurs in all body parts	Growth is limited to particular parts called meristem
Growth is limited for some time	Perennial plants growth is unlimited
Growth is allometric	Growth is isometric
Growth factors are not sensitive to	Growth factors are sensitive to

environmental factors such as light	environmental factors such as light
-------------------------------------	-------------------------------------

43. (a) State three ways in which water has similar functions in both plants and animals.

- water is a reactant in metabolic reactions
- Water is solvent
- Water provides support in plants and animals
- Evaporation of water from plants and animals causes cooling
- Water is a habitant
- It is a medium of transport
- It is a medium of transport of gametes

(b) Give two ways, in each case in which flowering plants minimize water loss through

(i) behavioral means

- some plants shade off their leaves during water shortage to reduce surface area for transpiration.
- Some plants close their stomata during hot day to reduce the rate of transpiration
- Wilting during hot day to reduce surface area to water loss

(ii) physiological means

- Some rise the osmotic pressure of their roots e.g. taking up salts from the soil actively to increase the rate of water uptake to replace water lost
- Some leaves reverse stomata rhythms closing stomata during day and open them at night
- Some concentrate abscisic acid in their leaves to induce stomata closure during hot day.
- Some close the stomata during bright light to reduce transpiration

44. The capture recapture method was used to estimate the population of dragon flies

The following results were obtained

On the first day; 300 dragon flies were captured and marked. Two days later 450 dragon flies were captured out of which 100 had been marked.

(a) Using this information, estimate the population size of dragon flies.

100 dragon flies are found in 450 flies

$$300 \text{ dragon flies will be contained in } \frac{450 \times 300}{100} = 1350 \text{ flies}$$

Thus estimate population size = 1350

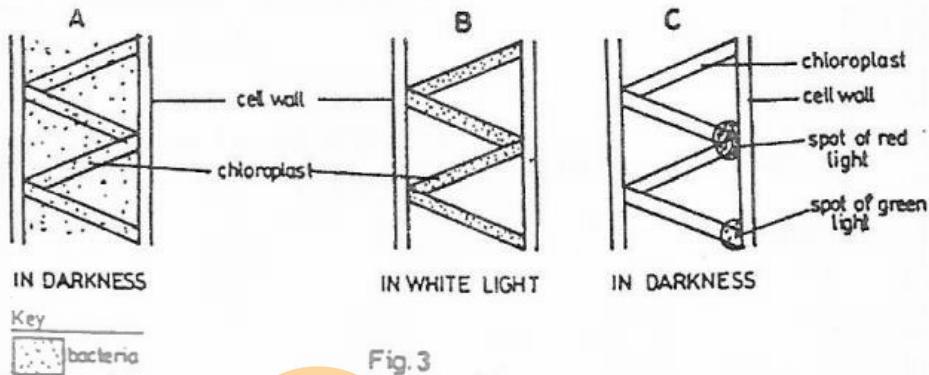
(b) State four assumptions, and two precautions, which are taken into account while using this method in estimating population size

- The organisms are randomly distributed
- The organisms do not show sudden changes in population size due to migration, immigration or emigration
- Negligible predation
- Marks are permanent during the study period
- Marks do not affect distribution of organism
- Sampling is random
- Relative large samples is used

(c) State any three sources of error in using this method of estimating population size.

- Some flies die or get damaged during the capture and marking process
- Samples used may be too small
- Marks used may affect random mixing of the flies

45. One strand of spirogyra was placed on each of three microscope slides A, B and C. The spirogyra was in water which contained aerobic, free-moving bacteria. The three slides were placed under conditions as shown in figure 3 below. After one hour of incubation, the results were as shown in figure 3.



- (a) Describe the distribution of bacteria on the three slides A, B and C.

Slide A: the bacteria are evenly or uniformly distributed all over the slide

Slide B: the bacteria are evenly distributed along the spirogyra strands only

Slide C: the bacteria are restricted to the spirogyra portions that received a spot of light. There are more bacteria at the red spot and green spot of light

- (b) Explain the distribution of bacteria on each slide

Slide A: in the dark no photosynthesis occurs and the available oxygen is uniformly distributed leading to uniform distribution of the bacteria

Slide B: in white light spirogyra photosynthesise and produce oxygen, high oxygen concentration along the spirogyra strand attracts the bacteria

Slide C: the spirogyra strand photosynthesise only at the spots that receive light and produce oxygen that attracts the bacteria. The fact that red light is more effective for photosynthesis than green light, more oxygen is produced at the spots that receive red light than those that receive green light. The higher concentration of oxygen at the spots that receive red light attract higher number of bacteria than the spots that receive green light

45. The figure below shows how sickle cell anemia has affected a family line. Sick cell

anemia is a recessive genetic defect which is not sex linked individuals are numbered

1 2 3.....12

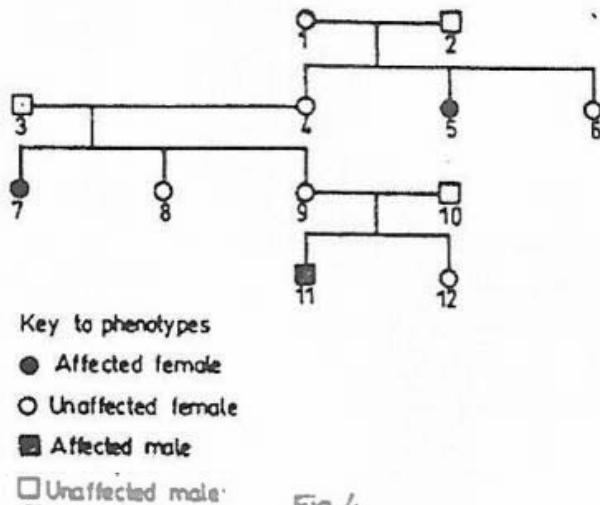


Fig. 4

- State the number of all individuals in the family line that are certain to be heterozygous for this gene (2marks)
- What is the probability that individual 6 is heterozygous for this gene? (show your working)
- The parasite which cause malaria digest hemoglobin in the red blood cells. Suggest two reasons an individual who is heterozygous for this gene may show resistance to malaria.
- State the difference between individuals who have sickle cell anemia and those that have sickle cell trait. (3marks)

### Solution

(a) 4, 9

Note that 3 and 3, 9 and 10 must be heterozygous to produce affected person of their offspring. But 3 and 10 are just partners while 4 and 9 belong to the family line.

(b) Possible heterozygous include: 1, 2, 3, 4, 6, 8, 9, 10, 12

Number of possible heterozygotes = 9

Probability that 6 is heterozygous = 1/9

(c)

- some of their red blood cells have reduced capacity of oxygen that they may not be able to support intracellular parasite
- the sickle shaped have reduced life span to complete the life span of parasite
- haemoglobin S may not be digestible

(d) Individuals with sickle cell anemia have over 60% of their red blood cells containing haemoglobin S which is defective. While those with the sickle cell trait have not more than 50% of abnormal haemoglobin S.

Name ..... Centre / Index No. .... / .....

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P530/1  
**BIOLOGY**  
Paper 1  
Nov. / Dec. 2001  
2½ hours



**UGANDA NATIONAL EXAMINATIONS BOARD**

**Uganda Advanced Certificate of Education**

**BIOLOGY**

**Paper 1**

2 hours 30 minutes

**INSTRUCTIONS TO CANDIDATES**

*Answer all questions in both sections A and B.*

**SECTION A**

*Answers to this section must be written in the boxes provided.*

**SECTION B**

*Answers to this section should be written in the spaces provided and not anywhere else. No additional sheets of paper should be inserted in this booklet.*

**For Examiner's Use Only**

SECTION A: 1-40	
SECTION B: 41	
42	
43	
44	
45	
46	
<b>TOTAL</b>	

## SECTION A (40 marks)

1. Which one of the following is a ~~chance~~ mechanism of coping with low environment in a mammalian body?

- A. Vasoconstriction.
- B. Shivering.
- C. Raising of body hair.
- D. Insulation by the subcutaneous fat.

2. Which one of the following concentrations in the blood would produce the highest frequency of impulses from the carotid nerve?

- A. Low carbon dioxide and high oxygen.
- B. High carbon dioxide and high oxygen.
- C. Low carbon dioxide and low oxygen.
- D. High carbon dioxide and low oxygen.

3. Which one of the following is the role of reduced NADP in the dark stage of photosynthesis?

- A. Combines with carbon dioxide.
- B. Provides energy.
- C. Provides hydrogen.
- D. Acts as an electron acceptor.

4. Which one of the following adaptations helps a desert succulent plant to reduce water loss?

- A. Possesses deep roots.
- B. Has reduced number of stomata.
- C. Possesses extensive roots.
- D. Sheds its leaves during dry season.

5. Which one of the following is the function of manganese in the human body?

- A. Essential for the formation of erythrocytes.
- B. Activates enzymes.
- C. Acts as a growth factor in bone development.
- D. Utilised as a component of bone and teeth.

6. In which one of the following situations would population growth occur?  
When the number of

- A. births equals the number of deaths.
- B. births plus the number of immigrations is less than the number of deaths plus the number of emigrations.
- C. births plus the number of immigrations is greater than the number of deaths plus the number of emigrations.
- D. deaths plus the number of emigration is greater than the number of births plus the number of immigration.

7. Which one of the following is the mRNA strand that corresponds to the DNA strand TACGGC?

- A. AUCCGU
- B. UUCCGU
- C. CGAAUC
- D. UAGGCU

8. Which of the following features are most useful to amphibians in living in an aquatic habitat?

- A. Moist skin, membrane around eggs, and gills.
- B. Membrane around eggs, gills and webbed feet.
- C. Long hind limbs, short fore limbs and gills.
- D. Webbed feet, moist skin and gills.

9. Which one of the following is an intracellular parasite?

- A. Trypanosome.
- B. Plasmodium.
- C. Schistosome.
- D. Hook worm.

10. There is a limited biomass at each trophic level in a food chain because at each level, there is progressive

- A. reduction in numbers of organisms.
- B. loss of energy.
- C. reduction in size of organisms.
- D. reduction in amount of food.

11. In flowers, the heterozygous condition of the alleles for Red petals (R) and White petals (W), are pink. Which one of the following proportions and colour of petals is correct if a pink flowered plant is crossed with a red flowered plant?

- A. 3 red : 1 white.
- B. 3 red : 1 pink.
- C. 1 pink : 1 red.
- D. 1 pink : 1 white.

12. Which one of the following conditions would most likely result into a miscarriage in humans?

- A. High level of progesterone and low level of oestrogen in the blood.
- B. High level of oestrogen and low level of progesterone in the blood.
- C. Low levels of progesterone and oestrogen in the blood.
- D. High levels of progesterone and oestrogen in the blood.

13. Figure 1 below shows an animal cell during meiosis.

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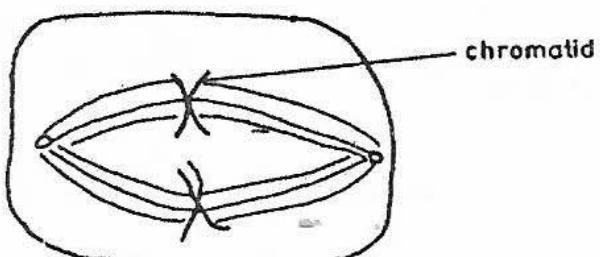


Fig.1

Which one of the following stages is illustrated?

- A. Prophase I.
- B. Prophase II.
- C. Metaphase I.
- D. Metaphase II.

14. Which one of the following best describes association learning?

- A. Preying bird avoiding to eat a bright coloured caterpillar.
- B. Rat eventually learning to traverse a maze if rewarded.
- C. Chick following the first moving-object it sees after hatching.
- D. Chimpanzee using a stick to reach an object.

15. Figure 2 below shows part of an earthworm in motion.

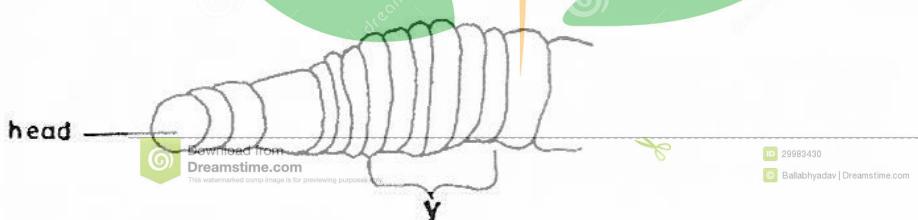


Fig.2

In what state are the circular and longitudinal muscles in the region labelled Y?

- A. Circular muscles are contracted and longitudinal muscles relaxed.
- B. Longitudinal muscles are contracted and circular muscles relaxed.
- C. Circular muscles and longitudinal muscles are relaxed.
- D. Circular muscles and longitudinal muscles are contracted.

16. Which one of the following structures operate independently of nervous control ?  
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- A. Cilia of *Paramecium*.
- B. Flagella of *Euglena*.
- C. Stinging cells of coelenterates.
- D. Pigment cells of fishes.

17. Which one of the following would be the best indicator that a cell is responding to a hormone ?

- A. High concentration of cyclic AMP.
- B. Low concentration of AMP in the cell.
- C. Low concentration of adenyl cyclase in the cell.
- D. High amount of ATP in the cell.

18. Which one of the following would result into the production of concentrated urine by an animal ?

- A. Possession of large glomeruli.
- B. Possession of long loops of Henle.
- C. Failure to produce ADH.
- D. Possession of many glomeruli.

19. Which one of the following does not directly affect the pH of the soil ?

- A. Absorption of bases by plant roots.
- B. Production of carbon dioxide by plant roots.
- C. Leaching.
- D. Water logging.

20. Which one of the following does not involve mass flow ?

- A. Blood flow in the arteries.
- B. Uptake of food by the tapeworm.
- C. Movement of food and water in the gut.
- D. Transport of water and mineral salts by the xylem.

21. Which of the following is not true about both the blood circulatory and lymphatic systems in mammals ? The fluid contains

- A. excretory products.
- B. leucocytes.
- C. plasma proteins.
- D. dissolved food.

22. Which one of the following types of sound waves travels farthest along the basilar membrane? The sound wave with

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- A. high frequency and high amplitude.
- B. low frequency and high amplitude.
- C. high frequency and low amplitude.
- D. low frequency and low amplitude.

23. Which one of the following does not occur when the buccal cavity contracts during breathing in a fish?

- A. Mouth valve closes.
- B. Opercular valve closes.
- C. Opercular volume increases.
- D. Mouth opens.

24. In which one of the following does anaerobic respiration not occur?

- A. Skeletal muscle.
- B. Yeast cell.
- C. Bacteria.
- D. Smooth muscle.

25. Which one of the following colours of light are most effective in photosynthesis?

- A. Green and red
- B. Blue and red
- C. Blue and yellow
- D. Blue and green.

26. Which of the following features would be prominent in mucus secreting cells?

- A. Large nucleus and dense matrix.
- B. Numerous rough endoplasmic reticulum and Golgi body.
- C. Numerous mitochondria and lysosomes.
- D. Dense matrix and smooth endoplasmic reticulum.

27. Which one of the following would not reduce the development of Graafian follicles in mammalian ovaries?

- A. High levels of oestrogen.
- B. High levels of progesterone.
- C. Deficiency in the pituitary gland.
- D. Low levels of luteinising hormone.

28. Figure 3 represents a tetrapod in motion.

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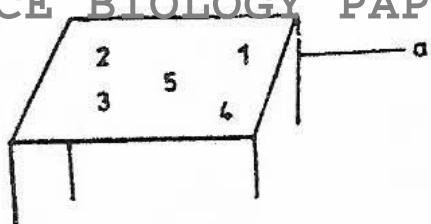


Fig. 3

If the animal lifted limb a during its movement, in which position would it shift its centre of gravity in order to remain most stable?

- A. 2
- B. 3
- C. 4
- D. 5
29. Which one of the following belongs to a different phylum?

- A. Octopus.
- B. Scorpion.
- C. Millipede.
- D. Crab.

30. Which one of the following features of red blood cells does not contribute to their high absorptive nature of oxygen? They
- A. possess a thin flexible membrane.
- B. possess a biconcave disc shape.
- C. are filled with haemoglobin.
- D. are manufactured at a high rate.

31. The camel family is found only in North Africa, Asia and South America. This is an example of
- A. adaptive radiation.
- B. convergent radiation.
- C. divergent distribution.
- D. discontinuous distribution.

32. How many reproductive stages does the malarial parasite undergo to complete the life cycle?
- A. 1
- B. 2
- C. 3
- D. 4

Use the information below to answer questions 33 and 34

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In mice, yellow fur (Y) is dominant over grey fur (y). When two mice were mated, the offspring were in the ratio of 2 yellow to 1 grey.

33. From the results, which of the following were the likely genotypes of the parents ?

- A. Both were homozygous dominant.
- B. Both were heterozygous.
- C. One was heterozygous and the other homozygous dominant.
- D. Both were homozygous recessive.

34. Which of the following best explains the results ?

- A. Double recessive allele for fur colour is lethal.
- B. Heterozygous condition for fur colour is lethal.
- C. Fur colour could be sex linked.
- D. Double dominant allele for fur colour is lethal.

35. Which one of the following is true of diploid parthenogenesis ?

The eggs are formed by

- A. meiosis and develop without being fertilized.
- B. mitosis and develop after fertilization.
- C. meiosis and develop after fertilization.
- D. mitosis and develop without being fertilized.

36. Which one of the following factors least affects the gliding speed of a bird ?

- A. Weight of the bird.
- B. Size of the bird.
- C. Shape of the wings.
- D. Length of the wings.

37. Which one of the following hormones is secreted by the neurosecretory cell in mammals ?

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A. Adrenaline.  
B. Antidiuretic hormone.  
C. Insulin  
D. Thyroxin

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38. Which one of the following concentrations of proteins in mammals is correctly indicated ? High in

- A. the glomerular filtrate and urine.
- B. the blood plasma, usually absent in glomerular filtrate and urine.
- C. both blood plasma and glomerular filtrate but low in urine.
- D. blood plasma , glomerular filtrate and urine.

39. Which one is true of the respiratory system of an organism whose section is shown in figure 4 below?

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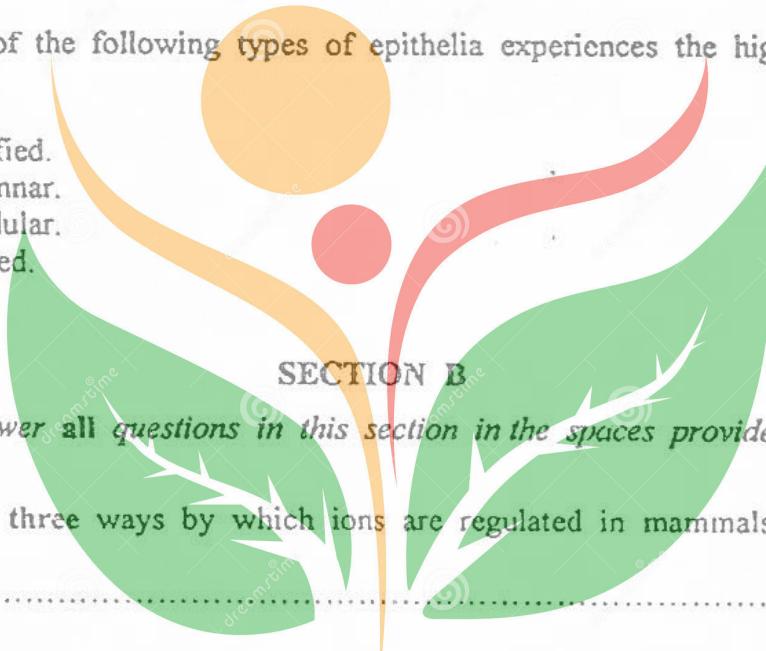
Fig. 4

The system requires

- A. a transport mechanism and a ventilation mechanism.
- B. ventilation mechanism and no transport mechanism.
- C. a transport mechanism and no ventilation mechanism.
- D. neither transport mechanism nor a ventilation mechanism.

40. Which one of the following types of epithelia experiences the highest rate of wearing?

- A. Stratified.
- B. Columnar.
- C. Glandular.
- D. Ciliated.



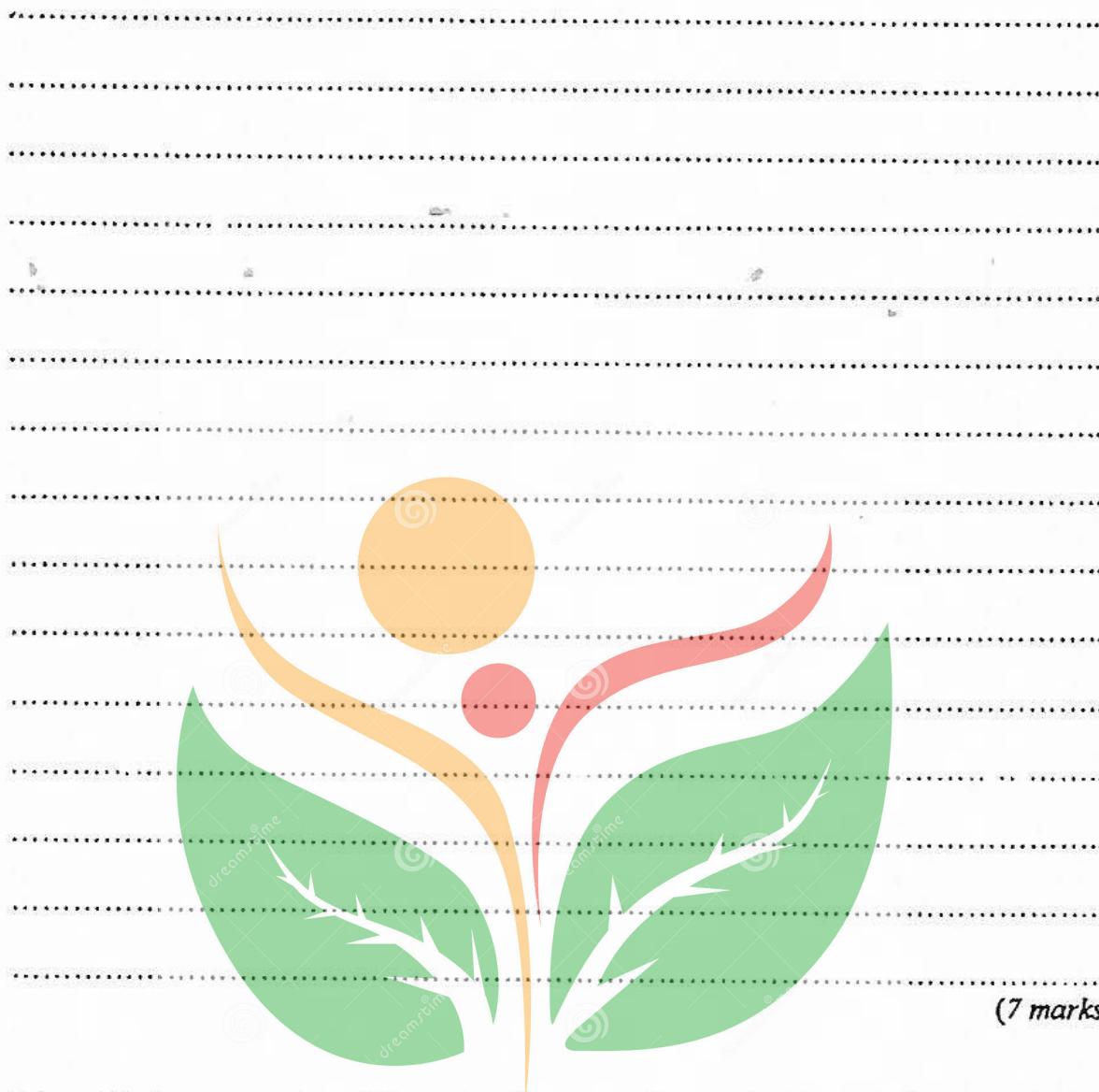
41. (a) State three ways by which ions are regulated in mammals.

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.....  
.....

.....  
.....  
.....  
.....  
.....  
.....

(3 marks )

- (b) The pH of blood and tissue fluid in humans remains constant at about 7.4 inspite of metabolic activities which produce hydrogen ions. Explain how this constancy is maintained by the kidneys.

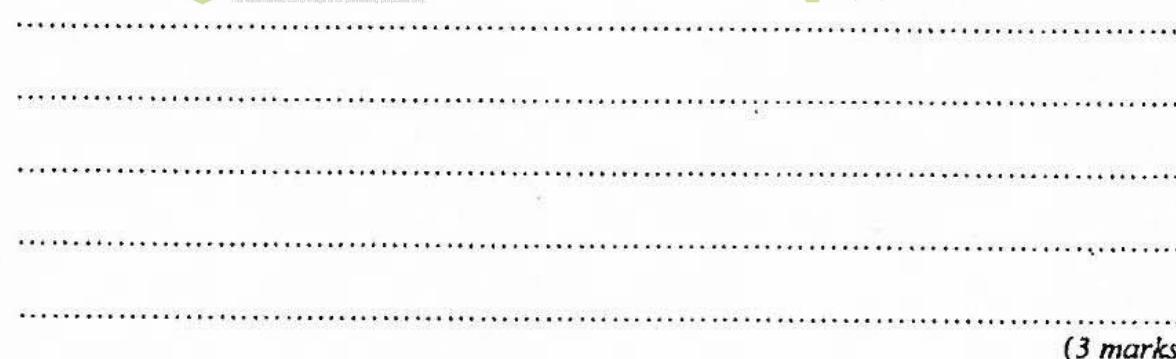


(7 marks)

42. (a) Giving examples, differentiate between photosynthetic and chemosynthetic bacteria.

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(3 marks)

- (b) Explain how certain bacteria which require light for photosynthesis, survive  
Under weeds in ponds and backyards



(7 marks)

43. (a) What do you understand by gene pool?



(2 marks)

- (b) What may cause a gene pool of a population to be static?

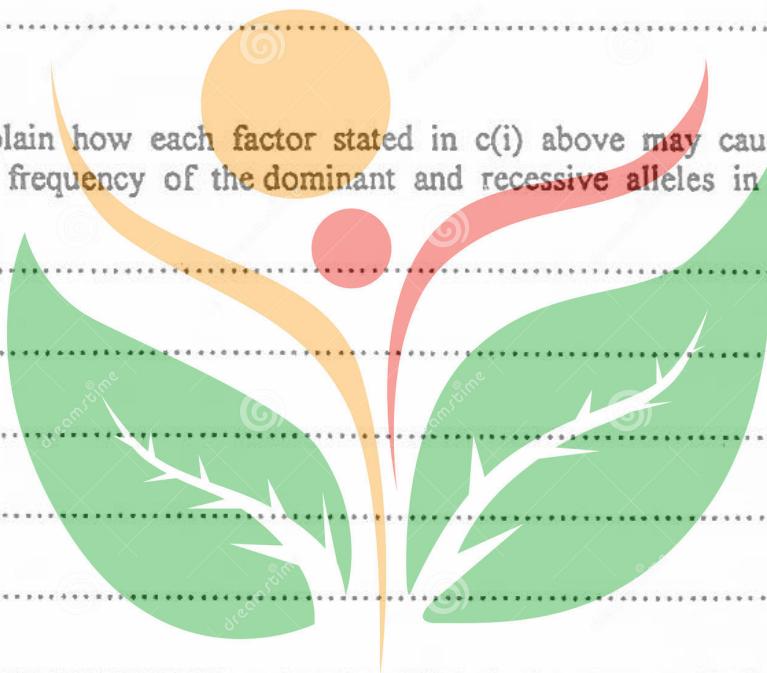
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(2 marks )

- (c) (i) State three factors that may contribute to the change in frequency of dominant and recessive alleles in a population.

(3 marks)

- (ii) Explain how each factor stated in c(i) above may cause changes in the frequency of the dominant and recessive alleles in a population.



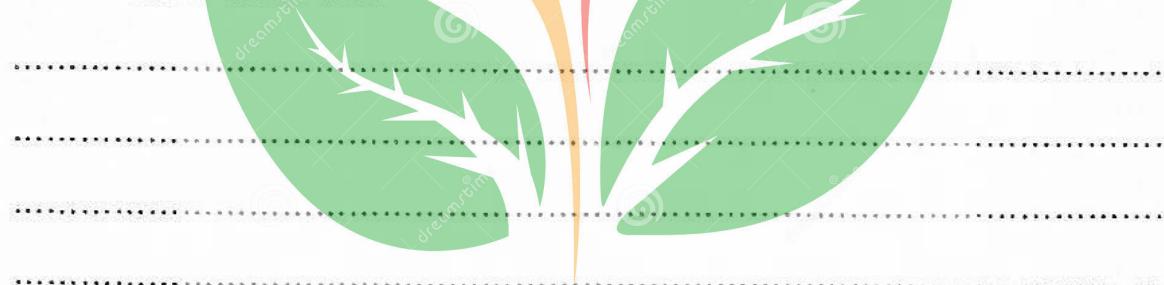
(3 marks)

44. In poultry, feather colour is controlled by two sets of alleles, W(white) dominant over w(coloured) and B(black) dominant over b(brown). A fowl heterozygous for both alleles (WwBb) is white.

(a) Explain why the genetic constitution of  $WwBb$  is white.

(2 marks )

(b) Work out to show the phenotypic ratio of crossing a white cock (WwBb), with a brown hen.



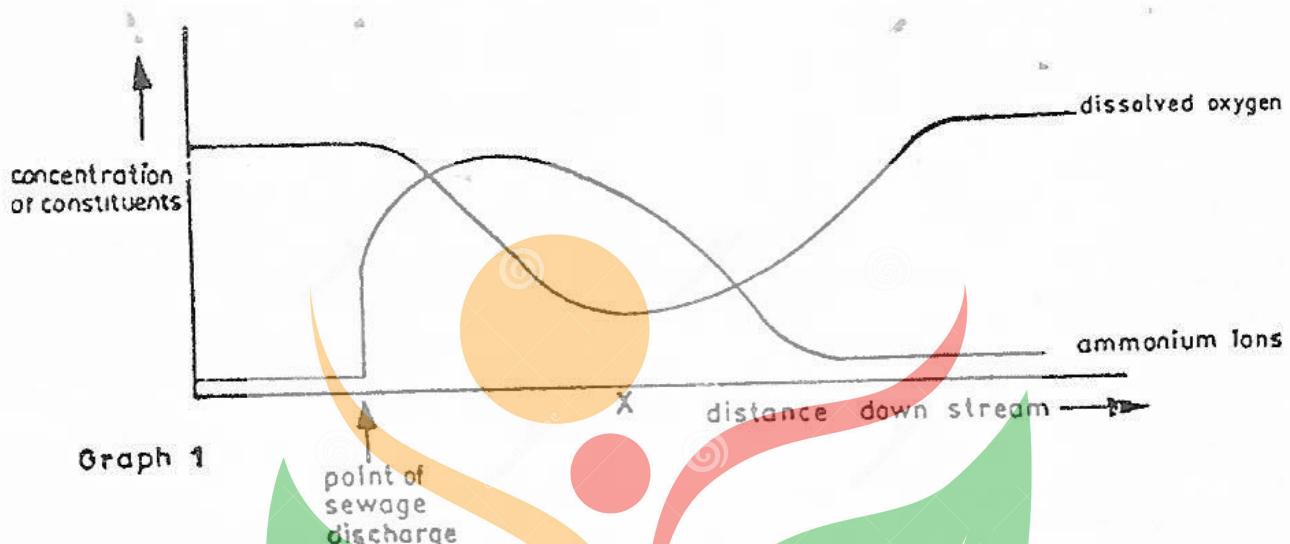
(7 marks)

(c) State the possible genotypes of a black fowl.

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*(1 mark)*

45. Graph 1 below shows the effect of sewage discharge on some chemical constituents of a river at increasing distances down stream from the point of sewage discharge.



- (a) Give explanations for the variation in concentration of ammonium ions and dissolved oxygen, down stream from the point of sewage discharge.

(i) Ammonium ions

(ii) Dissolved oxygen



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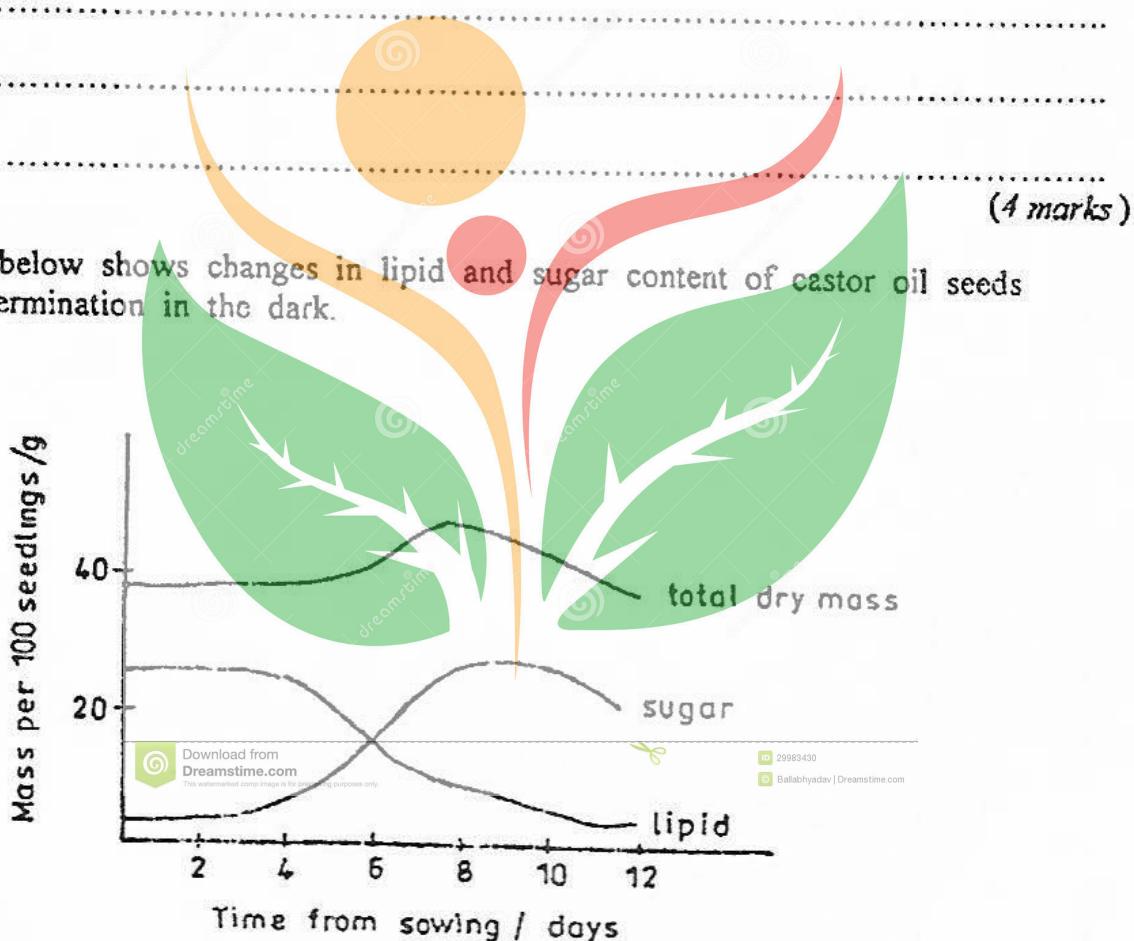
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(6 marks)

- (b) Describe the effect of the sewage on the ecosystem at distance X down stream.

(4 marks)

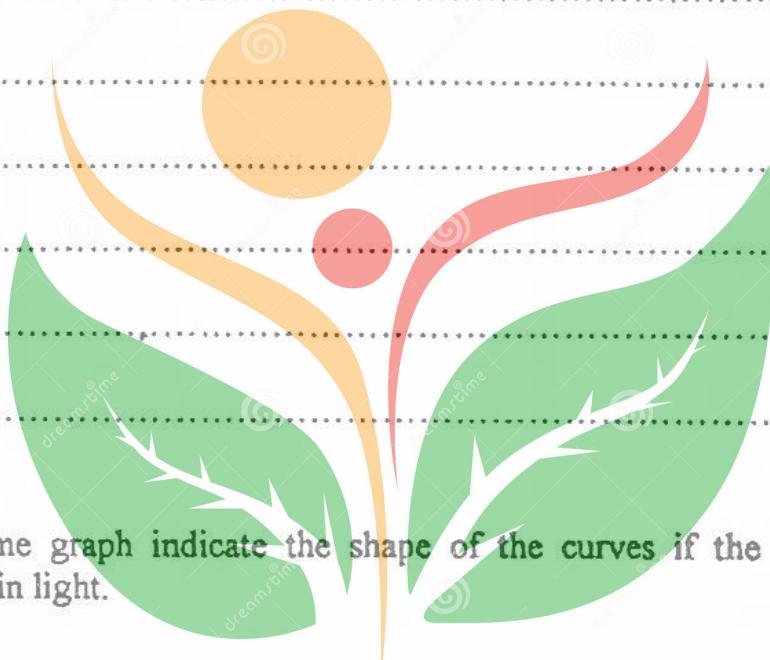
Graph 2 below shows changes in lipid and sugar content of castor oil seeds during germination in the dark.



Graph 2

- (a) Explain the changes in lipid and sugar content and total dry mass during the experimental period

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(8 marks)

- (b) On the same graph indicate the shape of the curves if the seeds were to germinate in light.

(2 marks)



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**A-level**

UACE Biology 2001 paper 1  
Section A

NU MB ER	Choic e	Justification																								
1	B	Shivering increase metabolic rate that generate heat chemically																								
2.	D																									
3	C																									
4	B	Reduced number of stomata reduce transpiration Deep and extensive root system increase water absorption Few desert plants may have leaves to shed																								
5	B and C																									
6.	C																									
7	A	In formation RNA from DNA, T pairs with U NOT A																								
8	B	Membrane around eggs protect them from predators Gills are useful for gaseous exchange Webbed feet for swimming																								
9	B	Plasmodium mainly reside in the liver cells																								
10	B																									
11	C	The alleles for red and white are codominant when the phenotype of heterozygotes is intermediate.																								
		<table border="1"> <tr> <td style="text-align: center;">Parents phenotypes</td> <td>Pink</td> <td>X</td> <td>Red</td> </tr> <tr> <td style="text-align: center;">Parent genotype</td> <td>RW</td> <td></td> <td>RR</td> </tr> <tr> <td style="text-align: center;">Gametes</td> <td>R + W</td> <td></td> <td>R</td> </tr> <tr> <td colspan="4" style="text-align: center;">↓</td> </tr> <tr> <td style="text-align: center;">Offspring genotype</td> <td>RR</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">Offspring phenotype</td> <td>1Red</td> <td></td> <td>1Pink</td> </tr> </table>	Parents phenotypes	Pink	X	Red	Parent genotype	RW		RR	Gametes	R + W		R	↓				Offspring genotype	RR			Offspring phenotype	1Red		1Pink
Parents phenotypes	Pink	X	Red																							
Parent genotype	RW		RR																							
Gametes	R + W		R																							
↓																										
Offspring genotype	RR																									
Offspring phenotype	1Red		1Pink																							
12	B	Progesterone prevents miscarriage High concentration of estrogen increases the sensitivity of the uterine walls to oxytocin																								
13	D																									
14	B																									

15	B	Longitudinal and circular muscles are antagonistic, when one relax another one contact. In this case the longitudinal muscle are contracted that is why the segment are closure.
16	C	Stinging cells of coelenterates protect the animal from danger and auto controlled
17	A	cyclic AMP (cAMP, adenine monophosphate) a molecule thought to act as an intermediary between a hormone and the biochemical process of its target cell. The process is thought to be <ol style="list-style-type: none"> <li>the hormone arrives at the target cell and becomes complexed to receptor sites in the cell membrane;</li> <li>the adenyl cyclase enzyme is activated, enabling conversion of <u>ATP</u> to cAMP;</li> <li>specific cellular enzymes are activated by cAMP starting a chain reaction.</li> </ol>
18	B	Long loop of Henle concentrates urine through counter-current multiplier effect of concentrating salts in the medulla
19	D	Leaching may lower the pH of the soil when it carries away basic ion of potassium, sodium, magnesium, and calcium from the soil.
20	B	Uptake of food by a tape worm is by diffusion. In mass flow mechanisms all particles move in the same direction at the same speed.
21	C	Lymphatic system does not contain plasma proteins because these are too big to filter in blood capillary membranes.
22	B	Sound waves with low frequency and high amplitude cause longer lasting vibration of the basilar membrane and travel farthest along it
23	D	When the buccal cavity in fish contract, the mouth closes
24	D	
25	B	
26	D	Smooth Endoplasmic Reticulum (SER) is mainly concerned with the synthesis of carbohydrate and lipids, and sometimes, with their metabolism
27	A	Estrogen negative feedback on LH production in the early part of the menstrual cycle. However, once estrogen levels reach a critical level as oocytes mature within the ovary in preparation for ovulation, estrogen begins to exert

		positive feedback on LH production, leading to the LH surge.
28	B	A tetrapod at rest is like a four legged table, the center of gravity falling somewhere inside the area delineated by its four legs. When it lifts one of the limbs during movement, the tetrapod becomes a tripod and center of gravity shifts within the triangle to remain stable
29	A	Octopus is in phylum Mollusca while the rest are in phylum Arthropoda
30	D	Thin membrane reduces diffusion distance Biconcave shape increases surface area for absorption of gases Hemoglobin has high affinity for oxygen
31	D	Adaptive radiation, convergent radiation deal with structural modification Terminology of divergent distribution is non-existent.
32	D	The four stages are
33	B	
34	D	
35	D	
36	D	
37	B	ADH is secreted by posterior pituitary gland
38	B	Plasma proteins are too big to pass through glomerular filtration membrane
39	B	Blood in open circulation does not transport gases therefore transport mechanism is not necessary.
40	A	Stratified epithelia are located on areas such as skin and virgin

## SECTION B

41. (a) Give three ways in which ions are regulated in the body

(b) The pH of blood and tissue fluid in human remains constant at about 7.4 in spite of metabolic activities which produce hydrogen ions. Explain how this constancy is maintained by the kidney.

(a) Hormones regulate the concentration of ions by

- (i) controlling uptake of ions from the gut
- (ii) controlling release of ions from storage organs such as bones

(iii) controlling their elimination from the kidney

(b)

- In the cells of proximal convolute tubule, carbon dioxide reacts with water to form carbonic acid. the reaction is catalyzed by carbonic anhydrase enzyme
- Carbonic acid dissociated into hydrogen and bicarbonate ions.
- The hydrogen ions are pumped into the lumen by an ATP dependent  $\text{Na}^+/\text{H}^+$  exchanger.
- Here hydrogen ions are buffered by sodium hydrogen phosphate to form sodium dihydrogen phosphate.
- When the pH of the renal fluid falls too low, the cells of the distal convoluted tubules produce ammonia from glutamine.
- Ammonia combines with excess hydrogen ions to form ammonium ions that are excreted.
- When the pH of renal fluid rises too high, the cells of distal convoluted tubules excrete bicarbonate ions and retain hydrogen ions

**42. (a) Giving examples, differentiate between photosynthetic and chemosynthetic bacteria**

**(b) Explain how certain bacteria, which require light for photosynthesis, survive under weeds in ponds and rocks**

- (a) (i) Photosynthetic bacteria have chlorophyll and use energy for photosynthesis derived from sunlight. Examples are cyanobacteria or blue-green bacteria  
 (ii) chemosynthetic bacteria lack chlorophyll and derive their energy from oxidation of inorganic compounds example, iron bacteria, hydrogen bacteria
- (b) Rocks and ponds have abundant supply of hydrogen sulphide from decomposition of organic matter. Hydrogen sulphide is the source of hydrogen for reduction of carbon dioxide to produce carbohydrates.  
 Bacteria in that situation have bacterial chlorophyll that uses different wavelength of light from those used by plants. These wavelengths of light pass through to the bacteria unabsorbed.

**43. (a) what is a gene pool**

**(b) What causes a gene pool to be static?**

**(c) (i) state three factors that may contribute to the change in frequency of dominant and recessive alleles in a population**

**(ii) Explain how each factor stated in (e) (i) above may cause changes in the frequency of dominant and recessive alleles in a population.**

**Solution**

- (a) A gene pool is the total variety of genes an alleles present in a sexually reproducing population
- (b) – when genetic variation are inadequate to bring about evolutionary change
  - Lack of destructive influences like mutation, emigration, immigration or environmental change
  - When mating is random
- (c) (i) – genetic drift
  - Mutation
  - Natural selection
  - Nonrandom mating
  - Environmental change

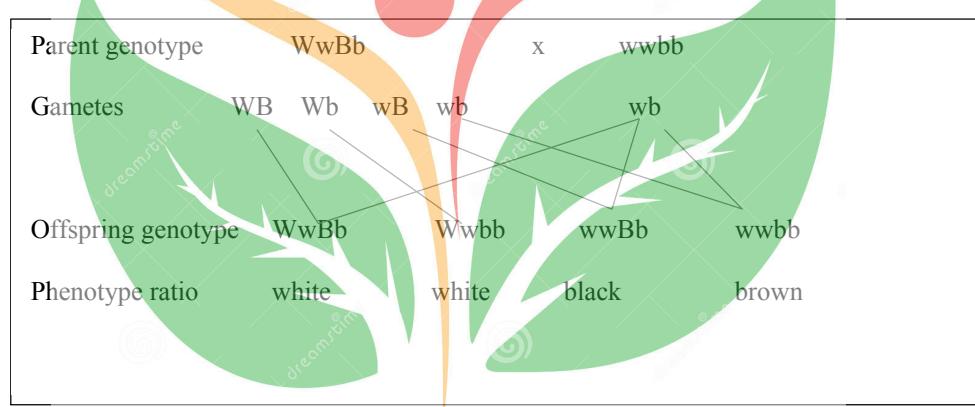
- (ii) - Genetic drift is the change in gene frequency due to chance rather than natural selection for example when the only organism that carry a particular gene dies before reproduction
- Interbreeding may result into a population gaining or losing alleles or allowing genetic change
- Nonrandom mating may promote some genes in a population
- Mutation introduces new alleles in a population or alter genes and chromosomes.
- Environmental change cause alteration in selection pressure that may favor certain alleles than others.
- Natural selection, favorable alleles are promoted while unfavorable alleles are eliminated.

44. In Poultry feather color is controlled by two sets of alleles, W(white) dominant over w(colored) and B(black) dominant over (brown), a fowl heterozygous for both alleles (WwBb) is white.

- Explain why the genetic constitution (WwBb) is white.
- Work out to show the phenotypic ratio of crossing, a white cock (WwBb), with a brown hen.
- State the possible genotypes of a black fowl

(a) When both genes are present in a genotype, gene W prevents the expression of Gene B in the phenotype, a condition called epistasis.

(b)

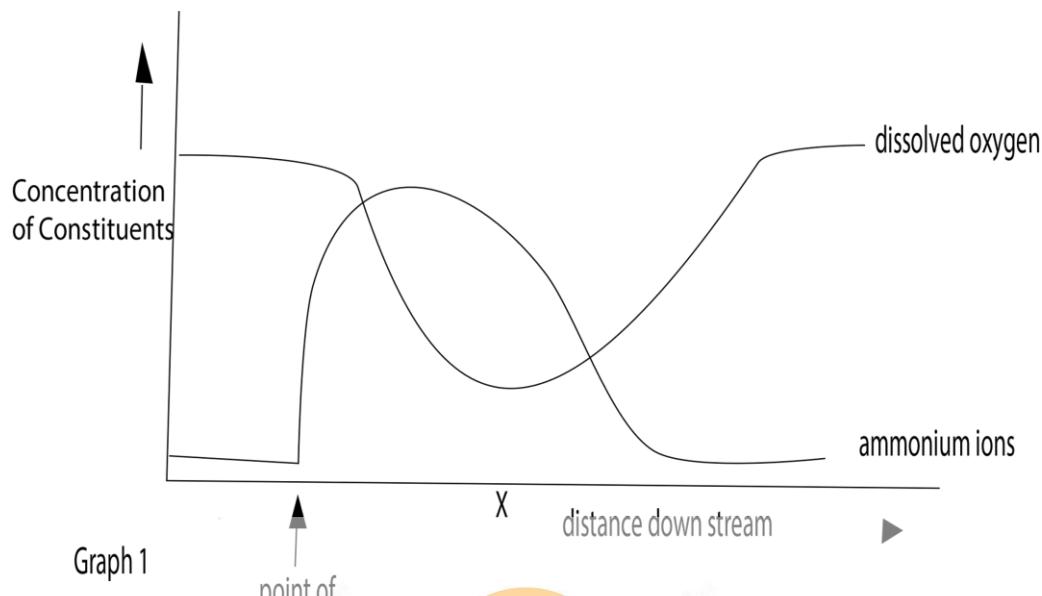


(c) A black fowl may have phenotypes: wwBB and wwBb

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45 The graph below shows the effect of sewage discharge on some chemical constituent of a river at increasing distance down stream from the point of sewage



- (a) Give explanations for the variation of ammonium ions and dissolved oxygen, down stream from the point of sewage discharge.**
- Ammonium ions
  - Dissolved oxygen
- (b) Describe the effect of sewage on ecosystem at distance X down stream. (04marks)**

**Solution**

- (i) Ammonium ions

**Variation**

Ammonium ions level downstream increase rapidly at the point of sewage discharge then decreases gradually and exponentially to a low almost constant level farther down stream

**Explanation**

- Sewage contains ammonium ions from decomposition of organic dead matter that is added to the stream at the point of discharge.
- Down stream the concentration ammonium ions decrease due to dilution and being converted to nitrites and nitrates by bacteria

- (ii) Dissolved oxygen

**Variation**

- Oxygen in solution decreases exponentially first just after the discharge of sewage into the stream the gradually to a low level and latter increases gradually further downstream to a normal value.

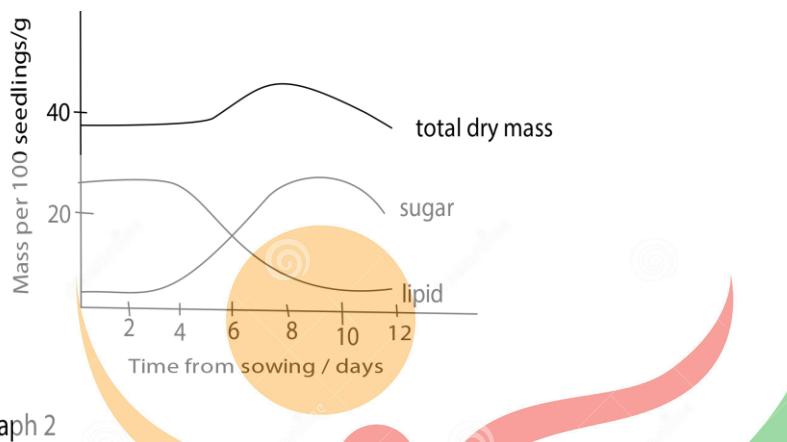
**Explanation**

Sewage contains aerobic bacteria that use oxygen to decompose organic matter. The oxygen concentration later increases to normal due photosynthetic algae activities that adds oxygen to water and mixing with water full of oxygen.

(b)

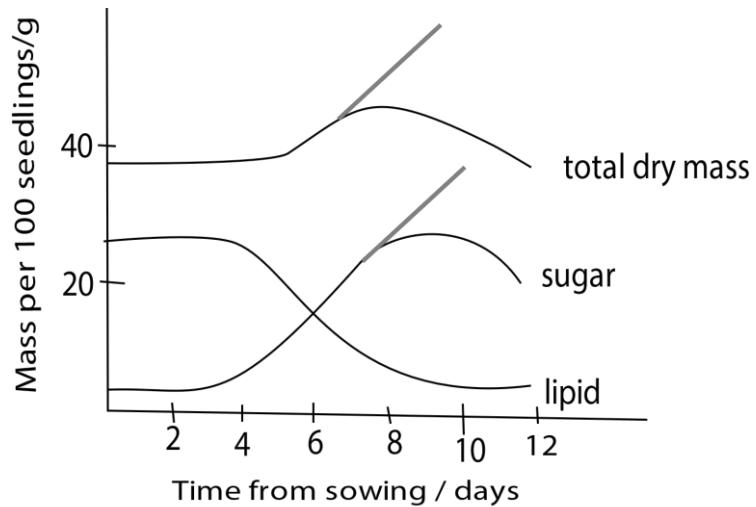
- proliferation of algae and other aquatic organism due to availability of nitrates
- less light penetration
- reduction of oxygen content in water may lead to death of fish and other aquatic mammals
- bad odor

46. Graph 2 below shows changes in lipid and sugar content of castor oil seed during germination in the dark



Graph 2

- Explain the changes in lipids and sugar content and total dry mass during experimental period.
- On the same graph, indicate the shape of the curves if the seed were to germinate in light
  - The main storage food reserve is lipid
    - During germination, lipids decrease as they are broken down to fatty acids and glycerol
    - The fatty acids are either used directly for respiration or are converted to sugars. The sugar content therefore rises.
    - Sugar is translocated to the embryo
    - The dry mass at day 6, because of assimilation of sugars to structural materials and growth occurs.
    - Dry mass then fall because the lipids are exhausted and sugar decrease due to respiration



Graph 2



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P530/ 1  
**BIOLOGY**  
( Theory )  
Paper 1  
Nov. / Dec. 2002



## UGANDA NATIONAL EXAMINATIONS BOARD

### Uganda Advanced Certificate of Education

#### BIOLOGY

#### Paper 1

2 hours 30 minutes

#### INSTRUCTIONS TO CANDIDATES

*Answer all questions in both sections A and B.*

#### SECTION A

*Answers to this section must be written in the boxes provided.*

#### SECTION B

*Answers to this section should be written in the spaces provided and not anywhere else. No additional sheets of paper should be inserted in this booklet.*

#### For Examiner's Use Only

SECTION A: 1-40	
SECTION B: 41	
42	
43	
44	
45	
46	
<b>TOTAL</b>	

## SECTION A ( 40 marks )

Write the letter corresponding to the best answer, (in the box provided).

1. Which one of the following would be a characteristic of a poorly adapted parasite ?  
A. Employing vectors.  
B. Inflicting mild harm to the host.  
C. Having a dormant stage during the life cycle.  
D. Inflicting severe harm to the host.
2. Which of the following is true about a population where there is no environmental resistance ? The population  
A. grows exponentially.  
B. growth decelerates.  
C. remains constant.  
D. grows slowly.
3. Which one of the following is caused by a defect on a recessive sex linked allele ?  
A. Albinism  
B. Colour blindness.  
C. Sickle cell.  
D. ABO blood group system.
4. In short-day plants, which one of the following will induce flowering ?  
A. Period of light longer than a critical length.  
B. Period of darkness longer than a critical length.  
C. Period of light shorter than a critical length.  
D. Period of darkness shorter than a critical length.
5. All the following are stimulated by the luteinising hormone except  
A. Proliferation of the uterine wall.  
B. Development of the corpus luteum.  
C. Stimulation of corpus luteum to produce progesterone.  
D. Ovulation.
6. Which one of the following foetal blood vessels carries the most oxygenated blood ?  
A. Pulmonary artery.  
B. Dorsal aorta.  
C. Posterior vena cavae.  
D. Umbilical vein.

7. Among the following sets of organs, which one contains homologous structures only?

- A. Bat wing, bird wing, human forearm.
- B. Fish pectoral fin, human forearm, insect wing.
- C. Bird wing, bat wing, insect wing.
- D. Fish pectoral fin, bat wing, human forearm.

8. Pancreatic juice contains the enzymes:

- A. amylase, peptidase, trypsinogen, renin.
- B. amylase, pepsin, trypsinogen, peptidase.
- C. lipase, amylase, trypsinogen, peptidase.
- D. lipase, amylase, pepsin, maltase.

9. In sexually reproducing organisms, maintenance of a species is achieved at meiosis by

- A. halving DNA amount.
- B. doubling DNA amount.
- C. maintaining DNA amount.
- D. increasing DNA amount by fourfold.

10. Which one of the following cell organelles would be most active at sites where substances move against diffusion gradient?

- A. Ribosomes.
- B. Lysosomes.
- C. Mitochondria.
- D. Golgi bodies.

11. The two strands of DNA easily separate during replication because of the

- A. helical nature of the nucleotides.
- B. the closeness of the base pairs.
- C. weak hydrogen bonds between base pairs.
- D. the weak hydrogen bonds between phosphate and sugar.

12. In the blood plasma, proteins can act as bases or acids depending on the

- A. temperature of the medium.
- B. hydrogen ion concentration of the medium.
- C. nature of the proteins.
- D. concentration of the solutes in the plasma.

13. Wearing a coarse shirt causes a tickling sensation but later the sensation disappears. Which one of the following is not an explanation of this observation?

- A. Supply of transmitter substance gets exhausted.
- B. Discharge of impulses at the afferent nerves ceases.
- C. The membrane surrounding the generator region becomes less permeable to sodium ions.
- D. Generator potential falls below threshold value.

14. Which one of the following features of a structure of an organism is **not** suitable for classifying the organisms? Its

- A. size.
- B. number.
- C. shape.
- D. presence or absence.

15. Which one of the following is not correct about viruses? They

- A. can only reproduce in living cells.
- B. are the smallest living organisms.
- C. are facultative parasites.
- D. do not have a cellular structure.

16. In flowering plants, the number of chromosomes in the structure which gives rise to the embryo sac is

- A. n.
- B. 2n.
- C. 3n.
- D. 4n.

17. Among the following compounds, one that cannot be hydrolysed is

- A. glycogen.
- B. galactose.
- C. lactose.
- D. maltose.

18. Which of the following substances are not transported in the mammalian blood?

- A. urea and glucose.
- B. insulin and pepsin.
- C. ATP and pepsin.
- D. carbon dioxide and sodium chloride.

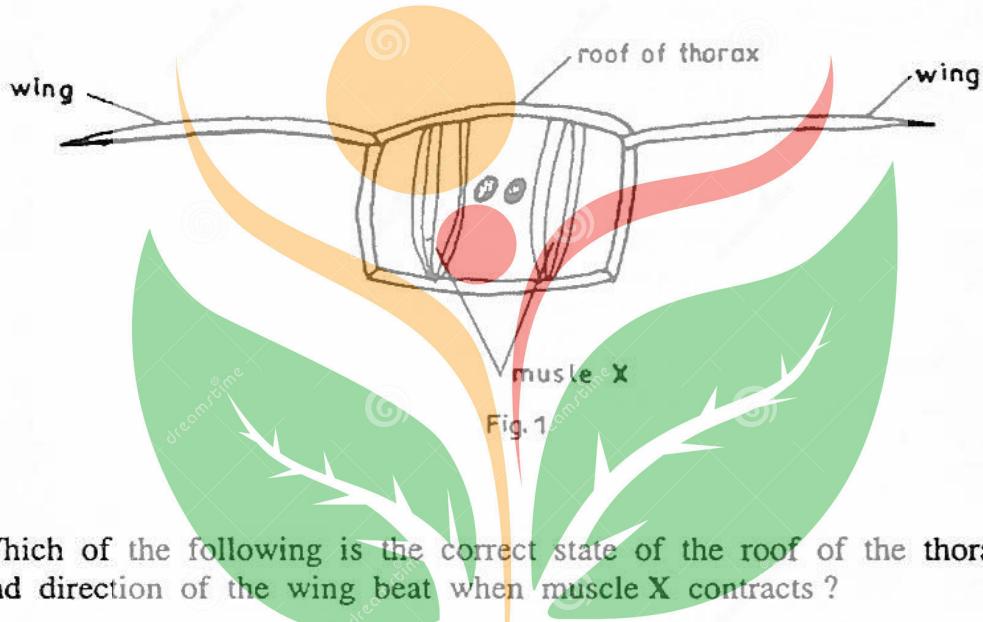
19. If a father has blood group A and the mother blood group AB then the number of possible genotypes of the offspring is

- A. 2.
- B. 3.
- C. 4.
- D. 6.

20. Antidiuretic hormone is produced by the

- A. adrenal gland and decreases urine production.
- B. pituitary gland and decreases urine production.
- C. adrenal gland and increases urine production.
- D. pituitary gland and increases urine production.

21. Figure 1 shows a transverse section through the thorax of an insect.



Which of the following is the correct state of the roof of the thorax and direction of the wing beat when muscle X contracts?

State of roof of thorax	Direction of wing beat
A. Raised	Upstroke.
B. Flattened.	Upstroke.
C. Raised.	Down stroke.
D. Flattened.	Down stroke.

22. Double fertilisation in flowering plants refers to fusion of two male nuclei with

- A. antipodal nuclei and polar nuclei.
- B. egg nucleus and polar nuclei.
- C. egg nucleus and antipodal nuclei.
- D. two egg nuclei.

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**SCIENCE BIOLOGY PAPER 1 (2000-2019) AB** then the number of possible genotypes of their offspring is

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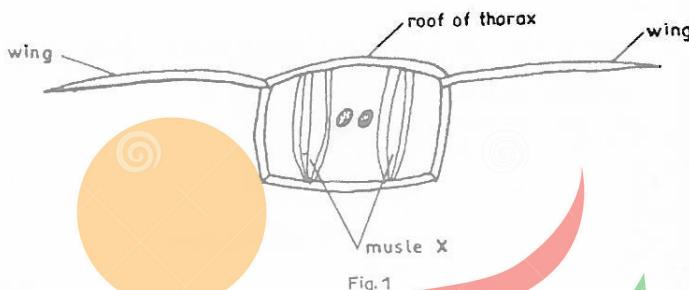


Fig. 1

Which of the following is the correct state of the roof of the thorax and direction of the wing beat when muscle X contracts ?

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A. Raised.	Upstroke.
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C. Raised.	Down stroke.
D. Flattened.	Down stroke.

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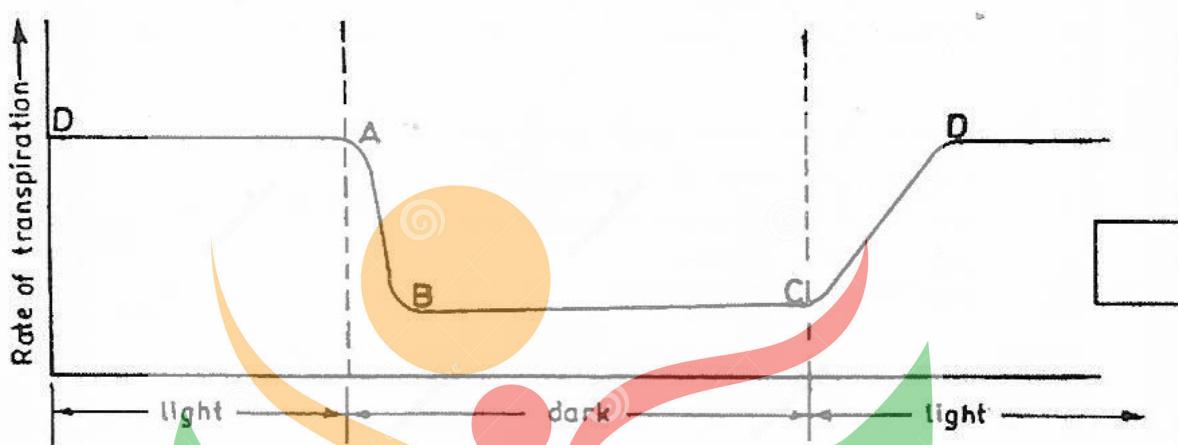
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**Turn Over**

23. Which one of the following methods of controlling malaria would cause least damage to the environment?

- A. Draining swamps.
- B. Spraying swamps and ponds with insecticide.
- C. Spreading oil over stagnant water.
- D. Introducing fish into the swamps and ponds.

24. Figure 2 shows the rate of transpiration of a hibiscus shoot under different light conditions



From the graph, at which of the stages indicated did the stomata begin to open?

25. Fig.3 shows a parallel flow across a gill plate of a fish.

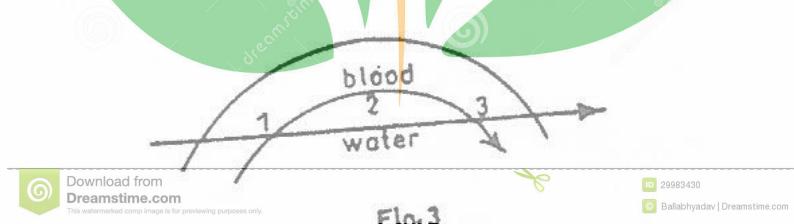


Fig. 3

At which regions is the highest diffusion gradient for oxygen and most oxygenated blood?

Highest diffusion gradient	Most oxygenated blood.
A. 1	2
B. 1	3
C. 2	3
D. 3	1

26. The main problem of single circulation is the  
A. ~~UACCE~~ speed of blood to the tissues. 1 (2000-2019)   
B. mixing of oxygenated and de-oxygenated blood.  
C. low rate of oxygenation of blood.  
D. slow speed of blood to the heart.
27. Which one of the following occurs as a result of a low pH in the guard cells ?  
A. conversion of sugar to starch reducing osmotic pressure.  
B. conversion of starch to sugar reducing osmotic pressure.  
C. conversion of sugar to starch increasing osmotic pressure.  
D. conversion of starch to sugar, increasing osmotic pressure.

28. The mycorrhiza on some plant roots serve to  
A. fix nitrogen from the atmosphere.  
B. absorb mineral salts from the soil.   
C. break down humus.  
D. synthesize carbohydrates.

29. In the duodenum, the products ready for absorption are those of the digestion of  
A. lipase and amylase.  
B. amylase only.   
C. trypsin and lipase.  
D. lipase only.

30. Fig.4 shows conditions on two sides of a semi-permeable membrane.

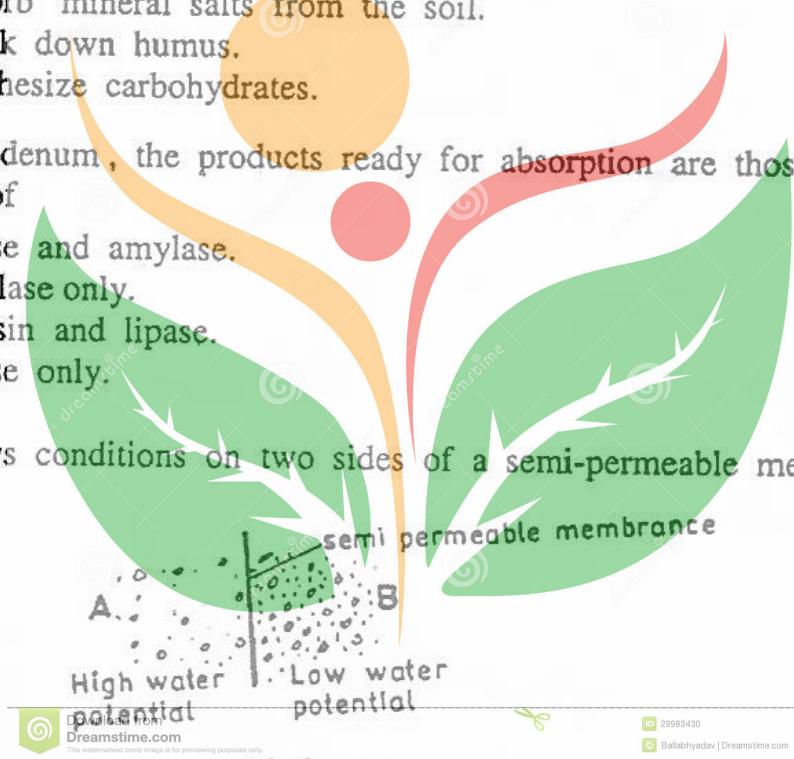


Fig.4

Which one of the following would occur if the water potential was the same on both sides of the membrane ?

- A. Movement of water molecules would stop.  
B. Solute molecules would move at same rate to both sides of the membrane.   
C. Solute molecules would move to side A.  
D. Water molecules would move at same rate to both sides of the membrane.

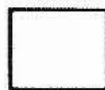
31. Lactic acid accumulation in the muscles of an athlete during action is due to  
**UACE BIOLOGY PAPER 1 (2000-2019)**  
A. oxygen debt.  
B. anaerobic respiration.  
C. panting.  
D. high rate of respiration.

32. Which one the following occurs when the axon membrane depolarises ?

- A. Sodium ions enter the axon and potassium ions leave.  
B. Both sodium and potassium ions leave the axon.  
C. Potassium ions enter the axon and sodium ions leave.  
D. Both sodium and potassium ions enter the axon.

33. The importance of mutual inhibition in the mammalian eye is to

- A. reduce the frequency of impulse transmission.  
B. increase contrast between light-dark boundaries.  
C. reduce sensitivity of the eye.  
D. increase ability to resolve close stimuli separately.



34. A mother, who lacked milk in her breasts at the birth of her baby was diagnosed to have a brain damage. Which one of the following parts of the brain is most likely to have been affected ?

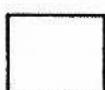
- A. Posterior lobe of the pituitary gland.  
B. Pineal body.  
C. Anterior lobe of the pituitary gland.  
D. Cerebrum.



35. At which of the following stages does meiosis occur in the life cycle of a fern ? During the formation of the

- A. gametes.  
B. gametophyte.  
C. spores.  
D. sporophyte.

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36. If a messenger RNA has a base sequence of CUGACGAGU, which one of the following would be the possible maximum number of amino acids coded for, if the code is overlapping?

- A. 7
- B. 6
- C. 4
- D. 3

37. Which one of the following is characteristic of all vertebrates?

- A. Homeothermy.
- B. A cranium.
- C. Double circulation.
- D. Pentadactyl limb.

38. The end-product of glycolysis is

- A. glucose diphosphate.
- B. lactic acid.
- C. citric acid.
- D. pyruvic acid.

39. Which one of the following processes does not require respiratory energy?

- A. Synthesis of cellulose.
- B. Meiosis.
- C. Loss of water from the stomata.
- D. Mineral salt absorption.

40. Which one of the following would not lead to evolution?

- A. Better suited phenotypes in a specific environment increasing in number.
- B. The environment remaining stable for a long time.
- C. Organisms producing more offspring than the environment can support.
- D. A large number of offspring dying before reproduction.

**SECTION B ( 60 marks )**

**UACE BIOLOGY PAPER 1 (2019)**

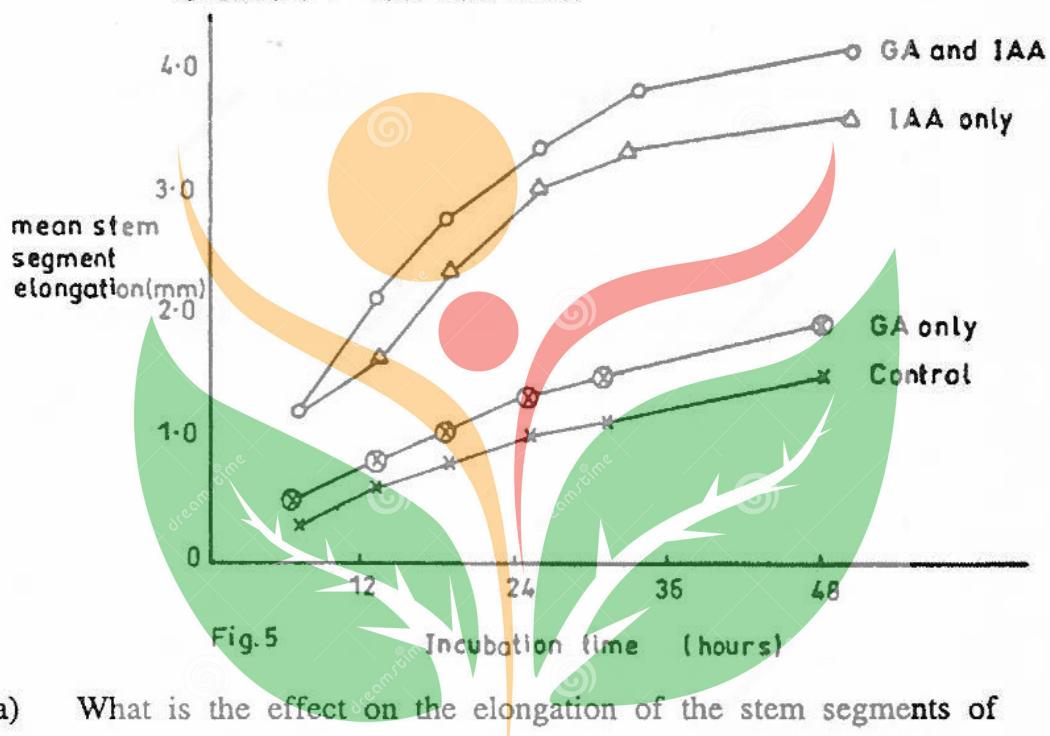
41. (a) Figure 5 shows the results of an experiment to find out the effects of indole acetic acid (IAA) and gibberellic acid (GA), on elongation of the stem. Segments from the stem internodes of young pea seedlings were used in four cultures which were kept in the same identical conditions except for the treatments outlined below.

Culture 1 — Control , no plant growth substances added.

Culture 2 — GA only.

Culture 3 — IAA only.

Culture 4 — GA and IAA.



- (a) What is the effect on the elongation of the stem segments of  
 (i) GA and IAA separately ? ( 4 marks )

- (ii) GA and IAA combined ? ( 1 mark )

- (b) What type of interaction is shown by the two growth substances ?  
**UACE BIOLOGY PAPER 1 (2000-2019) mark**
- .....

- (c) Over which period of the experiment do the plant growth substances have their greatest effect ? Suggest a reason for your answer. (2 marks )
- .....
- .....
- .....
- .....

- (d) (i) State two other effects of IAA in plants , other than stem elongation. ( 1 mark )
- .....
- .....

- (ii) For each effect in d(i), state a commercial application of IAA. ( 1 mark )
- .....
- .....
- .....

42. How is each of the following suited for its function ?

- (a) A red blood cell (4 marks )
- .....
- .....
- .....
- .....
- .....
- .....
- .....

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(b) A xylem vessel

( 6 marks )

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43. (a) (i) What is meant by natural selection? (2 marks)

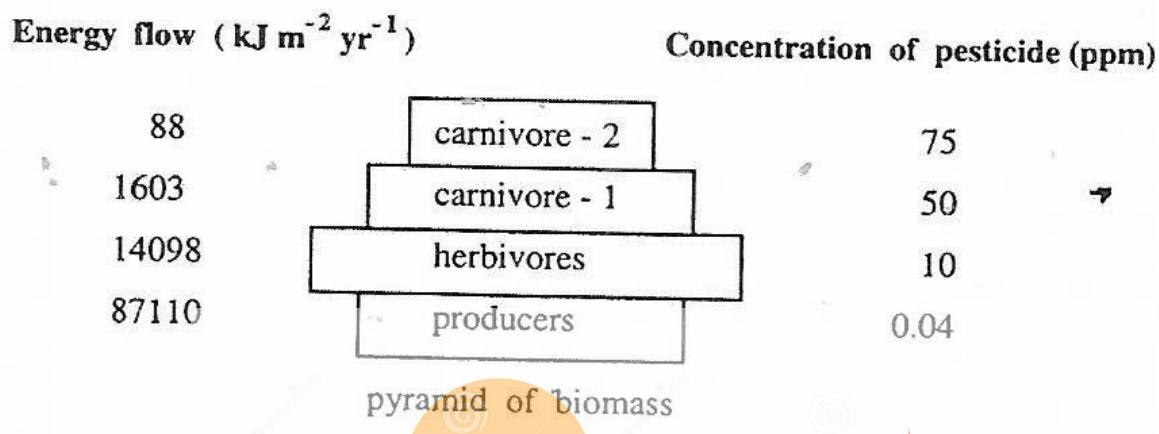
## (ii) How does it occur?

( 6 marks )

- (b) What is the importance of natural selection ? ( 2 marks )

44. In an aquatic ecosystem which was affected by an insecticide, analysis of energy flow and concentration of the pesticide at each trophic level in a food chain was made.

The results are shown on a pyramid of biomass of the ecosystem, in figure 6.



(a) What does the width of each bar of the pyramid represent? (1 mark)

(b) Explain why, from producers to secondary consumers,

(i) the levels of the pesticide increase? (2 marks)

(ii) the flow of energy decrease? (2 marks)

- (c) From the biomass, explain how the producers can sustain the herbivores. **JACE BIOLOGY PAPER 1 (2000-2019 marks)**
- .....  
.....  
.....  
.....

- (d) Give **three** ecological problems that may arise through the use of pesticides. **( 3 marks )**
- .....  
.....  
.....  
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- 45.** (a) (i) Outline the general features a physiological homeostatic system must have. **( 3 marks )**

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- (ii) What are the qualities of an efficient homeostatic system? **( 2 marks )**
- .....  
.....  
.....  
.....

- (b) Fig.7 shows the metabolic rates of the arctic fox (curve WX ) and the Kangaroo rat (curve YZ ), in relation to the environmental temperature.

**UACE BIOLOGY PAPER 1 (2000-2019)**

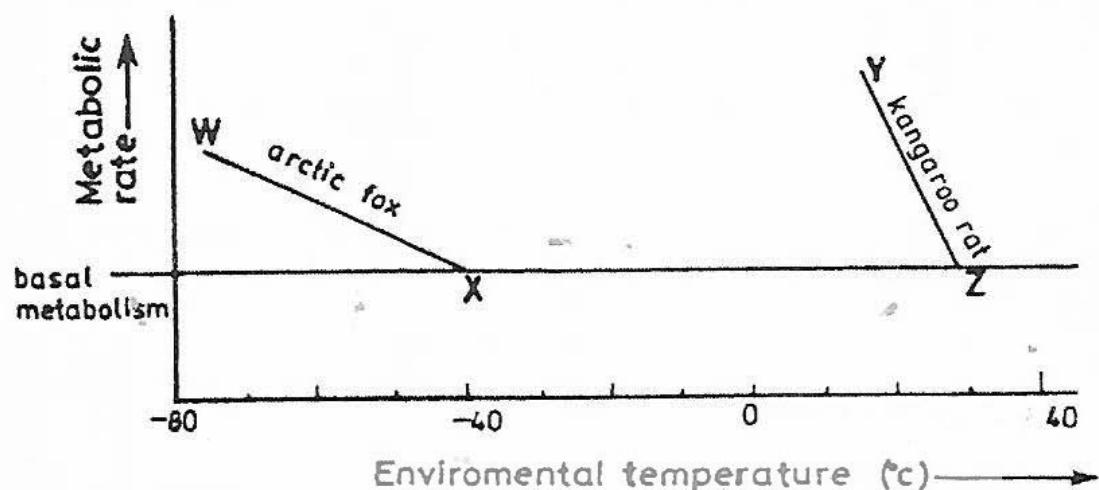


Fig. 7

(i) What do points X and Z stand for? (1 mark)

(ii) Give two differences in metabolic rates of the Kangaroo rat and the arctic fox in relation to environmental temperature. (2 marks)

(iii) What do the differences you have stated in (b)(ii) imply? (2 marks)

46. (a) In the space below , draw and label the structure of a synapse.  
**UACE BIOLOGY PAPER 1 (2000-2019)** (*4 marks*)



(b) How does an impulse cross a synapse ?

( 6 marks )

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# UACE BIOLOGY PAPER 1 (2000-2019)

## A-level

### UACE Biology 2002 paper 1

#### Section A

NUMBER	Choice	Justification
1.	D	
2.	A	
3.	B	
4.	B	
5.	A	
6.	D	
7.	A	Homologous structures have similar ancestral origin <b>and basic</b> structural pattern but may be modified to perform <b>different</b> functions
8.	C	
9.	A	
10.	C	Mitochondria supply energy for active transport
11.	C	
12.	B	
13.	B	
14.	A	
15.	C	Viruses are obligate parasites because cannot reproduce in absence of host cells
16.	A	Embryo sac is produced by meiosis
17.	B	Galactose, glucose and fructose are simple sugars
18.	C	
19.	B	
20.	B	
21.	B	
22.	B	
23.	D	
24.	C	Rate of transpiration begins to increase
25.	A	Download from Dreamstime.com This watermarked copy image is for previewing purposes only.
26.	A	
27.	A	
28.	C	
29.	D	
30.	D	
31.	B	
32.	A	
33.	B	Mutual inhibition (lateral inhibition) is the phenomenon in which two photoreceptor cells close together fire impulses at lower frequency than each illuminated alone, with light of the same intensity. This increases contrast.
34.	C	
35.	C	
36.	A	

37.	B	
38.	D	
39.	C	
40.	B	

41(a) the effect on the elongation of the stem segments of

- (i) GA and IAA separately
  - Both growth substances when given separately cause greater elongation than the control
  - IAA caused greater elongation than GA given separately
  - GA cause a slight stem elongation than the control
  - IAA caused much stem elongation, more than double the control
- (ii) GA and IAA combined
  - Cause bigger elongation than the control or than GA or IAA given alone

(b) Type of interaction shown is potentiation/synergism/positive interaction

(c) 12 to 24hours because the graph showed steep increase in mean stem segment elongation

(d) (i) Other effects of IAA on plant

- Cause fruit setting in absence of pollination in a natural environment
  - Promote root growth
  - Inhibits abscission
- (ii) Commercial application of IAA
- Induce fruit formation in un-pollinated flowers
  - Induce root growth in root tubers such as cassava
  - Inhibiting abscission to promote leaf growth in some plant like tea and tobacco whose leaves are of commercial value.

42. (a) Adaptations of a Red blood cell

- It contains hemoglobin which has a high affinity for oxygen
- Has thin membrane to reduce diffusion gradient of gases
- Biconcave to increase surface area for gaseous exchange
- Has no nucleus to contain more hemoglobin
- Contain carbonic anhydrase enzyme to enhance the transport of carbon dioxide
- It is highly flexible and can change shape to squeeze through narrow capillaries to deliver oxygen

(b) Adaptations of xylem vessel

- The vessels are placed end to end with no cross barrier between them for continuous flow
- Has empty lumen for easy passage of water and mineral salts
- Lignin deposits in its cell walls provide mechanical strength and prevent the vessel from collapsing
- Lignified for strength and prevent water from leaking out and prevent water wastage
- Bordered pits on the vessel wall allow vessel to vessel lateral transport
- Spiral and annular thickening on vessels provide high tensile strength to prevent vessels from collapsing

## UACE BIOLOGY PAPER 1 (2000-2019)

43. (a) (i) Natural selection is the process by which organisms that are better adapted to their environments survive while the least adapted are wiped out from the population.

(ii) – organisms which a population show variation

- Some organisms bear characteristic that are favored while others have unfavorable characteristics
- Individuals with favorable variations survive and pass on their favorable characteristics to the next generation while those with unfavorable variations are weeded out, in the struggle for existence.

(b)

- Population size of a given environment is controlled within supportable limits
- Natural selection favors emergence of new species under constantly changing environmental conditions.
- Organism that are best adapted for a particular environment are allowed to survive
- Deleterious genes are eliminated from the population

44. (a) total mass of organisms at each trophic level

(b) (i) – the pesticide is persistent or non-biodegradable

- it accumulates in tissue without being metabolized

(ii) Energy is lost between trophic levels as heat, death and decay, in excretion, respiration and part is used to maintain life in the organisms.

(c) By having a higher turnover than the herbivores so the productivity of the producer is higher than that of primary producer.

(d)

- a few pests may become resistant leading to pest resurgence
- may kill useful organism in ecosystem
- the killed pest may be the only source of food to some organism in ecosystem

45. (a)(i) A physiological homeostatic system must have

- receptor mechanism capable of detecting changes in environment
- set point
- control mechanisms that initiate corrective measures
- effectors that carry out the corrective measures

(ii) - it should keep fluctuations to the norm in narrow range and restores any deviations from the norm rapidly .

(b) (i) X and Z represent low critical temperature of arctic fox and kangaroo rat respectively

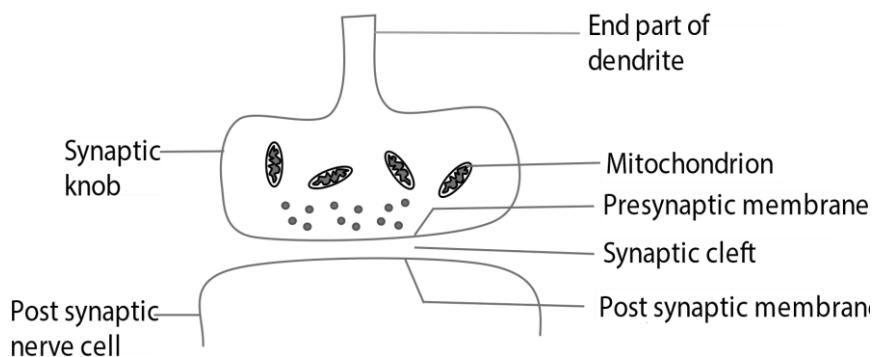
(ii) Metabolic rate starts to rise at much lower critical temperature for the artic fox than kangaroo rat.

Below the lower critical temperature, the metabolic rate of kangaroo rat increases faster than that of arctic fox.

(iii) The artic fox can survive better in cold environments than kangaroo rat

The arctic fox is better insulated for maintaining body temperature in cold environment than kangaroo rat.

46. Drawing showing structure of synapse



(b) Transmission across a synapse.

- Arrival of an impulse at the synaptic causes an influx of  $\text{Ca}^{2+}$  ions into the knob from the synaptic cleft.
- The  $\text{Ca}^{2+}$  ion causes the synaptic vesicles to move towards the pre-synaptic membrane.
- The vesicles fuse with the pre-synaptic membrane and release a transmitter substance into the synaptic cleft by exocytosis.
- The transmitter substance diffuses across the synaptic cleft and attaches to specific receptor sites on the post synaptic membrane.
- This causes an influx of  $\text{Na}^+$  ion into post-synaptic membrane, resulting in local depolarization of the membrane. If the  $\text{Na}^+$  ion surge is large enough, an action potential (impulse) is generated in the post-synaptic neuron.

**UACE BIOLOGY PAPER 1 (2000-2019)**

**A-level**

**UACE Biology 2001 paper 1**

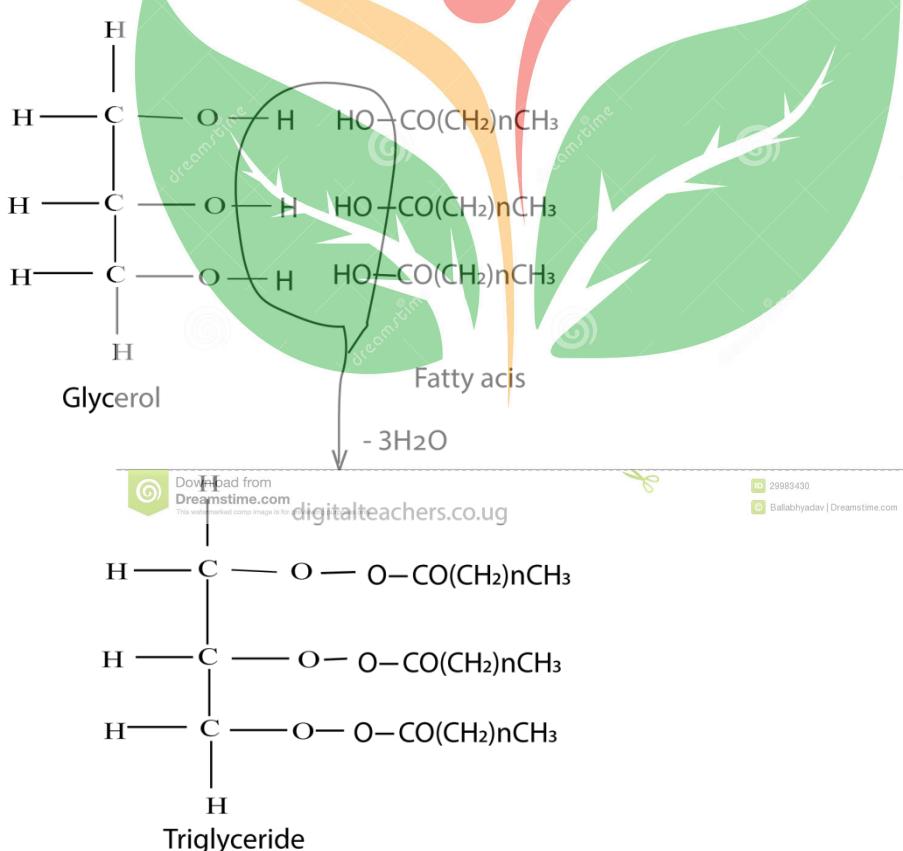
**Section A**

NUMBER	Choice	Justification
1	D	Fibrinogen is a soluble fibrous protein found in blood Used in blood clotting.
2	A	
3	B	
4	C	The rate of sugar break down in a cell is determined by the amount of ATP used up. If a lot of ATP is being used, then more sugar will automatically be broken so as to synthesize more ATP. However , the specific factor controlling the rate of sugar break down is the amount of ADP and inorganic phosphate (Pi)
5	A	Length of the wing is variable
6	D	
7	D	1/4 of the seed (tt) failed to develop. The heterozygous if 2/3 of 600 = 400
8	C	
9	C	
10	A/D	
11	D	
12	B	
13	C	
14	A	
15	C	
16	D	
17	C	Corpus luteum develop after ovulation to produce progesterone.
18	A	<p>Parent genotype      ttbb      x      TtBb</p> <p>Gamete                  tb      TB      Tb      tB</p> <p>Offspring genotype      TtBb      Ttbb      ttBb      ttbb</p> <p>Offspring phenotype      1 tall      1 tall      1 short      1 short</p> <p>                            Blue      white      blue      white</p>
19	B	In the retina, the cones are concentrated in the centre and rods are scattered in the periphery. Excellent detection of movement at the lateral edges is attributed to the rods which are stimulated peripherally. This also explains why clear vision in dim light is excellent when an object is looked at from the side than directly.
20	A	Iron bacteria are chemosynthetic bacteria
21	C	
22	B	
23	D	
24	D	

25	A	Thyroid hormone increase metabolic rate
26	D	
27	B	Pressure potential is zero, while osmotic potential is not zero
28	B	Endoplasmic reticulum is used to transport materials in a cell.
29	C	
30	A	Species extinction may not be caused by deforestation
31	B	Light opens the stomata, which carry away saturated air with moisture increasing a diffusion gradient for water vapour.
32	A/C	Magnesium is used to manufacture chlorophyll
33	B	ATP is produced by cyclic and non cyclic photophosphorylation during the light stage of photosynthesis
34	D	Squamous epithelium is thin to reduce diffusion gradient
35	B	
36	C	A large surface area increases the rate of diffusion
37	C	
38	B	When milk is given growth increases
39	B	Not all bacteria have flagella
40	C	The more hosts the more chance of survival

Number 41

(a) Formation of triglyceride from glycerol and fatty acids



**(b) Properties of fats as storage compounds**

- Has high energy content than carbohydrates
- It is lighter
- It is compact and requires less space
- It is a raw material for hormones
- Insoluble in water that they have low osmotic value

**(c) (i) Structural functions**

- Make up cell membrane
- Protection: lipids are constituents of the waxy cuticle of plants and insects
- Lipids are water repellent thus prevent water loss from or entry into an animal skin
- Their spongy nature protects delicate organs as shock absorbers.
- Being bad conductors, they reduce water loss from the body when deposited beneath the skin for insulation
- Storage ; they are better storage compounds than carbohydrates due high calories value, due to high hydrogen content, they are light, insoluble in water, compact to fit in a small volume and are easily used when required.

**(ii) Physiological functions**

- Source of metabolic water
- Store fat soluble vitamins (ADEK)
- Source of metabolic water
- Raw materials for hormones

**Number 42**

**(a) Adaptive radiation** is specialization of homologous structures to serve different functions. For example, the fore limbs of man (arms) are modified for manipulation while those of bird (wings) for flight.

**(b) Importance of adaptive radiation**

It enables organisms with the structures to exploit different ecological niches hence reduce competition.

**(c) (i) Presence of homologous structure which have been modified to perform different functions in apparently similar organisms to adapt different environmental conditions and modes of life, is an indication of evolution from common ancestor.**

**(ii) Presence of structures with the same basic plan or fundamentally similar in different organism, though, modified to serve different functions in different environment is an indication of evolution from common ancestor**

**.Number 43**

**(a) (i) the brain mature rapidly to take over the overall control of the body system**

## UACE BIOLOGY PAPER 1 (2000-2019)

- (ii) Lymph tissue which produces white blood cells to fight infections, grows rapidly in early life when the risk of disease is greater as the immunity has not been acquired.
- (iii) The reproductive organs grow slowly such that they are mature when the organism is body is ready to support the fetus and to take care of the offspring.
- (iv) Whole body grows fast up to about 7 years, gradual growth up to about 11 years and thereafter very rapid growth up to maturity size because there is much tissue formation in the early years and rapid elongation in the latter years

### (b) Allometric growth

#### Number 44

- (a) What do you understand by **biological control?** (2marks)

*Use of a living organism (predator/parasite) to control a population of pest*

- (b) What consideration must be made before application of a biological pest control method? (2marks)

- *Whether the control agent is specific to intended pest*
- *Rate of reproduction of both pest and control organism*
- *Control organism should feed on all life stages of the pest*
- *Potential predators of control organism must be identified*
- *Control agent must be specific feeding on only the pest hence die when the pest is exhausted*

- (c) (i) state **two** ways in which chemical pest control method can upset ecosystem(2marks)

- The chemical may kill other organisms in ecosystem reducing biodiversity
- The chemical may accumulate in tissue along the food chain killing unintended organism
- The chemical may lead to water pollution
- Natural predator of the pest may be deprived of food

- (ii) Suggest **two reasons** why pests eventually flourish after a period of pesticide application. (2marks)

- *Resistant strain to the pesticide may evolve*
- *Pesticide may kill the predators to the pest such that the pest increases in absence of the predator*

- (d) Suggest three characteristics of a good pesticide (3marks)

- *Should be highly specific to the pest.*
- *Should be biodegradable*
- *Low toxicity to other organism*
- *Cheap*
- *Readily available*

#### Number 45

- (a) Explaining the position of the curves for lungworm and pigeon in reference to that for human

- (i) Lungworm

Curve lies to the left of that on human because hemoglobin of lungworm has a higher affinity for oxygen than that of human. This enables it to load oxygen in its environment of low oxygen tension.

- (ii) Curve lies to the right of that on human because hemoglobin of pigeon has a lower affinity for oxygen than that of human. This enables it to release oxygen easily in order to fuel its high metabolic activity.

(b) (i)

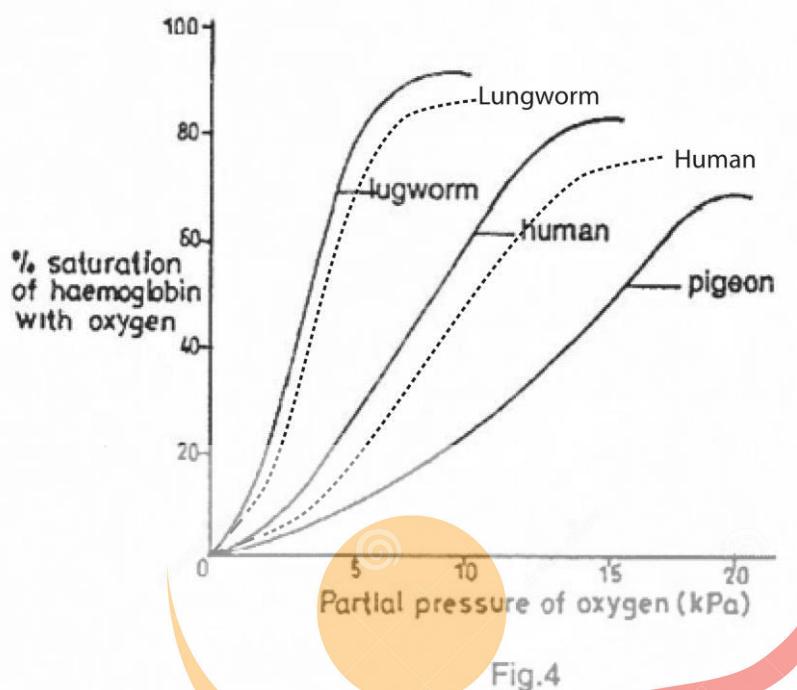


Fig.4

(ii) The curve for lungworm shifts slightly to right because its hemoglobin is less sensitive to change in the concentration of carbon dioxide. While that of human shifts more because human hemoglobin is more sensitive to changes in concentration of carbon dioxide.

Number 46

- (a) Photophosphorylation is the formation of ATP from ADP and inorganic phosphate using sunlight as the source of energy.
- (b) Cyclic photophosphorylation occurs in thylakoid membranes in chloroplast.
- (c)
  - (i) Light strikes chlorophyll molecule PSI
  - (ii) an electron is excited, passes through electron carrier system and return to PSII
  - (iii) in the process,  $H^+$  builds up in the thylakoid space creating a gradient. Then the passage of  $H^+$  out of the thylakoid provides energy for synthesizing ATP.

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**A-level**

UACE Biology 2004 paper 1

Section A

NUMBER	Choice	Justification
1.	D	Inbreeding does not cause variation in genes
2.	B	Cohesion is force of attraction between like molecules
3.	C	$\frac{4 \times 10^{-3}}{400} = 10 \times 10^{-6}m = 10\mu m$
4.	B	1 male nuclei fuses with egg cell while a second male nuclei fuse with polar nuclei.
5.	D	
6.	C	
7.	B	
8.	B	
9.	A	
10.	B	
11.	C	
12.	C	
13.	B	
14.	A	
15.	D	
16.	C	
17.	B	Spores are haploid and are produced by meiosis
18.	D	
19.	B	
20.	D	
21.	C	
22.	B	 Download from Dreamstime.com This watermarked comp image is for previewing purposes only.
23.	C	
24.	B	Variation reduces due to inbreeding
25.	B	Spirogyra filament breaks into pieces that develop into mature organism
26.	D	
27.	A	A large surface area lead to high rate heat loss
28.	A	
29.	C	
30.	B	
31.	B	
32.	A	A stigma higher than anther encourages cross pollination

33	B	
34	C	
35	D	
36	D	
37	C	
38	C	
39	A	
40	A	

**41.** (a) What is meant by eutrophication?

- (b) State two human activities that may encourage eutrophication.
- (c) What is the effect of eutrophication?
- (d) Effects of eutrophication are more severe in water bodies where thermal pollution occurs. Explain

**Solution**

- (a) Eutrophication is the heavy nutrient enrichment and low oxygen content of a water body because of excessive discharge of nitrate and phosphate fertilizers into the water body.
- (b)
  - (i) Excessive use of nitrogen fertilizers
  - (ii) release of untreated sewage into the water bodies
- (c)
  - (i) algae biomass increase
  - (ii) oxygen content in the water body decrease
  - (iii) water turbidity increase
  - (iv) light penetration into water decrease
  - (v) species diversity decrease
  - (vi) Nitrates and phosphates accumulate in water body
  - (vii) Sedimentation increase
- (d)
  - (i) high temperature reduce the solubility of oxygen in water
  - (ii) high temperature increases the metabolic activity of aquatic organism the further depletes the amount of oxygen in water leading to death of organism.

**42.** (a) state where each of the following is found in a cell

- (i) DNA
- (ii) RNA



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(b) Give three structural differences between DNA and RNA

(c) What is the genetic significance of DNA replication?

(d) Give two ways that suggest that DNA is hereditary material.

**Solution**

- (a) (i) DNA is found in the nucleus, mitochondria and chloroplast
- (ii) RNA is found both in the nucleus (as mRNA) and cytoplasm (as mRNA and as tRNA)

(b)

DNA	RNA
(i) Double helix	(i) Single strand
(ii) Has thymine	(ii) Has no thymine
(iii) Lack uracil	(iii) Contain uracil
(iv) Has hydrogen bonds	(iv) Has no hydrogen bond

- |                                  |                             |
|----------------------------------|-----------------------------|
| (v) Pentose sugar is deoxyribose | (v) Pentose sugar is ribose |
|----------------------------------|-----------------------------|
- (c) (i) allows maintenance of a constant amount of genetic information within an organism of a population  
 (ii) Allow passing over of genetic information from parents to offspring in constant amount from generation to generation  
 (iii) enables the cell to control physiological responses of the cell by synthesis of vital proteins  
 (d) (i) has ability to replicate and form identical copy  
 (ii) it is the major component of chromosomes that are believed to carry hereditary material.  
 (iii) it is chemically stable  
 (iv) it is constant in a given species

**43. Explain the changes in the concentration of sodium ions in renal fluid along the**

- (a) descending limb of loop of Henle
- (b) ascending limb of limb of Henle
- (c) collecting duct

**Solution**

- (a) Sodium ion concentration increases down the descending loop of Henle due to loss of water by osmosis into the hypertonic medulla
- (b) Sodium ion concentration decreases in the ascending limb because sodium ions are actively pumped out from the renal fluid into the medulla
- (c) There may be increase in concentration of sodium ion due to passive absorption of water or the concentration may decrease absorption of  $\text{Na}^+$  due to action of aldosterone hormone.

**44. (a) How does resistance of malarial parasite to antimalarial drugs occur?**

**(b) How may each of the following lead to speciation**

- (i) genetic drift
- (ii) Un random mating

**Solution**

- (a)
  - (i) Failure of the parasite to absorb the drug
  - (ii) Formation of inaccessible forms during its development life cycle in man (tissue hypnozoites)
  - (iii) Parasite may use alternative biosynthetic pathway not affected by the drug.
  - (iv) The parasite tissue may become tolerant to drug molecules
  - (v) Drug actively pumped out the parasite reducing its effectiveness

**(b)(i) Genetic drift**

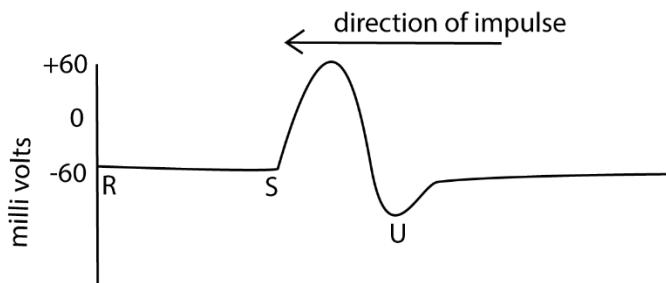
- variation in gene frequencies within population can occur by chance rather than natural selection, a phenomenon called genetic drift. Loss of gene from or increase in allele frequency of gene in population may alter the selection pressure in a population leading development of new species.

**(ii)un random mating**

- un random mating or sexual selection occur naturally when the presence of heritable characteristic increases the likelihood of bringing about successful fertilization. If the

gene for the characteristic increase in successive generation a new species may develop.

45. Figure3 shows changes in polarity in an axon as an impulse passes along axon.



**Fig.3**

- (a) What is the state of the axon membrane between  
 (i) R and S (01mark)  
 (ii) S and T (01mark)
- (b) Describe the movement of ions across the axon membrane between  
 (i) R and S (2marks)  
 (ii) S and T  
 (iii) T and U
- (c) Why is it difficult to stimulate an axon shortly after it has transmitted an impulse? (02marks)

Solution

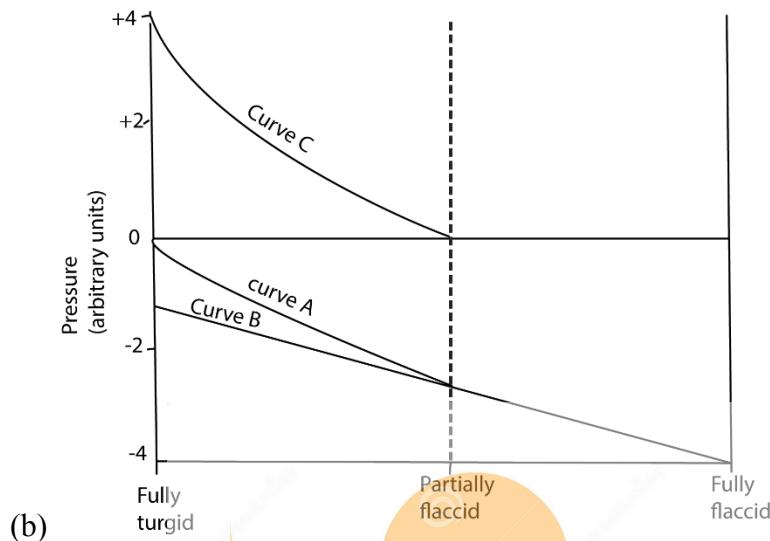
- (a)(i) membrane polarized  
 (ii) membrane depolarized
- (b) (i) Sodium ions move out the cell while potassium ion move into of the cell actively against their concentration gradient by potassium/sodium pump.  
 (ii) Sodium channel open and sodium ion diffuse into axon causing depolarization.
- (iii) Potassium gates open potassium ions diffuse out of axoplasm to polarise the membrane. Sodium gates close and permeability to sodium ions close.

- (c) Time has to be allowed for the membrane to repolarise in order to respond to electrical impulse.

- 46 (a) what is meant by water potential of a plant cell? (01mark)  
 (b) A fully turgid cell was placed in a hypertonic sugar solution and left until it was fully flaccid.  
 Sketch on Figure 4, curves to show the following pressure changes within the cell during the time of the experiment.  
 (i) Curve A – changes in water potential of the cell (01mark)  
 (ii) Curve B – changes in osmotic potential of the cell sap (01mark)  
 (iii) Curve C – changes in pressure potential (01mark)
- (i) Curv A- c
- (c) state the importance of active transport in guard cells.

Solution

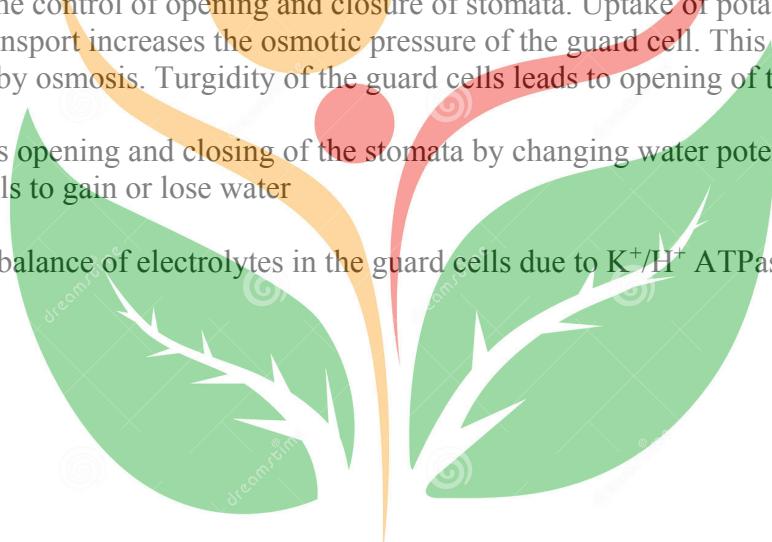
(a) Water potential is the capacity of the cell to lose water by osmosis.



(b)

(c) Help in the control of opening and closure of stomata. Uptake of potassium ion by active transport increases the osmotic pressure of the guard cell. This leads to uptake of water by osmosis. Turgidity of the guard cells leads to opening of the stomata.

- (d) – controls opening and closing of the stomata by changing water potential of the guard cells to gain or lose water
- Enable balance of electrolytes in the guard cells due to  $K^+/H^+$  ATPase



**UACE BIOLOGY PAPER 1 2005 marking guide**

**SECTION A**

1. Which one of the following is not a reason for classifying a mouse and a frog in one phylum?

Presence of

- A. pharyngeal gill slits.
- B. post-anal tail.
- C. notochord.
- D. endoskeleton.

Answer is D

2. In photosynthesis, the major advantage of the C<sub>4</sub> pathway is to

- A. fix carbon dioxide in the Calvin cycle.
- B. concentrate carbon dioxide in the cells of leaves.
- C. fix carbon dioxide from the atmosphere into the leaves.
- D. store carbon dioxide in form of organic acids.

Answer is B

3. An athletic competition organized on high lands required participants from low lands to report

## UACE BIOLOGY PAPER 1 (2000-2019)

three months before the competition in order to enable them

- A. get familiar with the place.
- B. develop strong muscles.
- C. acquire high red blood cell count.
- D. have extensive deposition of fat under their skins.

Answer is C

4. The main distinguishing character of a eukaryotic cell is

- A. membranous organelles.
- B. lack of nuclear membrane.
- C. presence of nucleus.
- D. presence of DNA double strands.

Answer is A

5. Starch, glycogen and cellulose are all composed of

- A.  $\alpha$ -glucose
- B.  $\beta$ -glucose.
- C. monosaccharides
- D. polysaccharides.

Answer is C

6. Which of the following organelles would most likely be abundant in the tail of a tadpole at a time of its reabsorption during metamorphosis?

- A. Centrioles.

**UACE BIOLOGY PAPER 1 (2000-2019)**

- B.** Lysosomes.  
**C.** Golgi apparatus.  
**D.** Endoplasmic reticulum.
7. If the rate of transpiration lags behind that of absorption, movement of water up to the plant is mainly by
- A.** root pressure.  
**B.** capillary.  
**C.** mass flow.  
**D.** transpiration pull.
8. An impulse crosses a synapse by means of
- A.** sodium ions.  
**B.** potassium ions.  
**C.** calcium ions.  
**D.** neurotransmitter chemical.
9. Which of the following increases the rate of phosphorylation of hexose sugar during the normal respiration process?
- A.** An increase in-ADP concentration.  
**B.** An increase in ATP concentration.  
**C.** An increase in concentration of hexose sugar.  
**D.** A decrease in concentration of phosphorylated sugar.
10. Which of the following factors would contribute least to the development of new species?

**UACE BIOLOGY PAPER 1 (2000-2019)**

- A. Gene mutation.
  - B. Chromosomal mutation.
  - C. Geographical isolation.
  - D. Environmental stability.
11. Which one of the following explains why digestion of fats does not occur in the human stomach?
- A. Absence of fat-digesting enzymes.
  - B. Low pH for the fat-digesting enzymes.
  - C. High pH for the fat-digesting enzymes.
  - D. Absence of bile salts that emulsify the fats.
12. Which one of the following would contribute to the greenhouse effect
- A. Use of nuclear power.
  - B. Use of fossil fuels.
  - C. Excessive use of fertilizers.
  - D. Accumulation of sewage in water bodies.
13. The increase in supply of blood to heavily respiring tissues, is caused high
- A. ventilation rate.
  - B. concentration of oxygen in the inhaled air.
  - C. carbon dioxide concentration in the blood.
  - D. carbon dioxide concentration in the tissues.
14. Impulse transmission in mammals is usually faster than it is in amphibians because

**UACE BIOLOGY PAPER 1 (2000-2019)**

- A. axons in amphibians lack myelin sheath.
- B. mammals have axons with larger diameter.
- C. mammals usually have higher body temperature.
- D. the distance between the nodes of Ranvier in mammals is shorter.
15. Which one of the following would occur at the onset of an action potential in a neuron?
- A. Potassium ions enter.
- B. Sodium ions leave.
- C. Potassium ions leave.
- D. Sodium ions enter.
16. Which of the following applies to the cones of the retina? They
- A. show visual acuity.
- B. perceive dim light.
- C. show much retinal convergence.
- D. contain rhodopsin pigment.
17. The flagellum and skeletal muscle are structurally similar in that they have
- A. microtubules.
- B. actin and myosin tubules.
- C. a pattern of 9+2 microtubules.
- D. light and dark bands.
18. During the light stage of photosynthesis, water is an important raw material in that it

**UACE BIOLOGY PAPER 1 (2000-2019)**

- A. gives off oxygen.
- B. provides hydrogen that reduces NAD.
- C. reduces carbon dioxide to carbohydrates.
- D. provides electrons.**

19. Which one of the following activities in living organisms can result in a respiratory quotient of less than 1.0?

- A. when carbohydrates are respiration.**
- B. During extensive laying down of fat in livestock.
- C. At compensation point, during photosynthesis.
- D. When the rate of exhalation equals that of inhalation.

20. Which of the following is a difference between flowers of dicotyledonous plants and those of monocotyledonous plants? Flowers of dicotyledonous plant usually

- A. lack sepals.
- B. possess superior ovaries.
- C. bear floral parts in groups of 4s and 5s.**
- D. possess fused petals.

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21. Deciduous plants in temperate zones shade off their leaves during winter.

- A. because of water shortage.
- B. to cut down the process of guttation.**
- C. because of too much water availability.
- D. to avoid freezing temperatures.

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22. Which of the following is true about non-competitive inhibition in enzyme catalyzed reactions?

- A. The degree of inhibition decreases with increase in substrate concentration.
- B. The inhibitor has a similar structure and chemical composition with the substrate.
- C. The degree of inhibition is independent of the substrate concentration.
- D. The shape of the enzyme is not affected by the inhibitor.

23. Which of the following is not true of conifers?

- A. Lack vessels in xylem.
- B. Bear reproductive structures on leaves.
- C. Bear sporangia on cones.
- D. Possess unprotected ovules.

none

24. The lack of a nucleus in the red blood cells enables it to

- A. have a high affinity for oxygen.
- B. be more permeable to oxygen.
- C. give up oxygen more readily.
- D. contain more haemoglobin.

25. Which one of the following types of behavior is least learnt?

- A. Association.
- B. Instinct.**
- C. Imprinting.

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D. Insight.

26. The primary meristematic tissue in plants which gives rise to the cortex is the

- A. ground meristem.
- B. procambium.
- C. protoderm.
- D. protoxylem.

27. Which one of the following organisms does not possess simple eyes?

- A. Spider.
- B. Millipede.
- C. Butterfly.
- D. Centipedes.

28. Contraction of longitudinal muscles in insects during flight, results into

- A. flapping of wings.
- B. moving down of wings.
- C. holding wings horizontally.
- D. moving up of wings.

29. During fertilization in plants, the

- A. vegetative nucleus fuses with the pollen nucleus.
- B. generative nucleus fuses with the egg nucleus.
- C. vegetative nucleus fuses with the egg nucleus.
- D. generative nucleus fuses with the antipodal cell nucleus.

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30. A desert mammal's lower lethal temperature is higher than that of a mammal living in cold regions because a desert mammal has

- A. small extremities.
- B. poor insulation mechanisms.**
- C. thick fur.
- D. a small surface area: volume ratio,

31. In the energy transfer in an ecosystem, the greatest loss in energy is between

- A. primary producers and primary consumers.**
- B. primary consumers and secondary consumers.
- C. secondary consumers and tertiary consumers.
- D. tertiary consumers and decomposers

32. A rhesus positive foetus whose mother is rhesus negative may not be born alive because the

- A. mother's body produces antigens against foetal antibodies.
- B. foetus lacks antibodies against the mother's antigens.
- C. mother's body produces antibodies against the foetal antigens.**
- D. mother's red blood cells mix with the foetal blood.

33. From a bush, 120 beetles were collected, marked and released back into the bush. A few days later, 120 beetles were collected from the same place, and 30 of them carried the mark. The estimated number of beetle in the bush is

- A. 240
- B. 360

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C. 480

D. 560

34. Insects have different mouth parts modified to suit their different modes of feeding, this shows

A. speciation.

B. convergent evolution.

C. divergent evolution.

D. development of analogous structures.

35. Which one of the following is true of linked characteristics? They

A. are always transmitted as a single block

B. are allelic to each other.

C. occur on non-homologous chromosomes.

D. can be transmitted independently.

36. Which one of the following may act as a respiratory surface in animals?

A. Spiracle.

B. Bronchus.

C. Skin.

D. Trachea.



37. Which one of the following pairs of responses in plants is caused by unequal distribution of auxins?

A. Photoperiodism and phototropism.

B. Geotropism and phototropism.

C. Nastic movement and geotropism.

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- D. Photoperiodism and abscission.
38. The amount of progesterone in the blood increases steadily from ovulation to menstruation, then it begins to decline because
- luteinizing hormone inhibits its production.
  - it is washed out with blood during menstruation.
  - implantation of a zygote occurs.
  - its work of repairing the uterine wall gets complete.

39. Figure 1 shows the relationship between temperature and rate of photosynthesis in two plant species A and B.

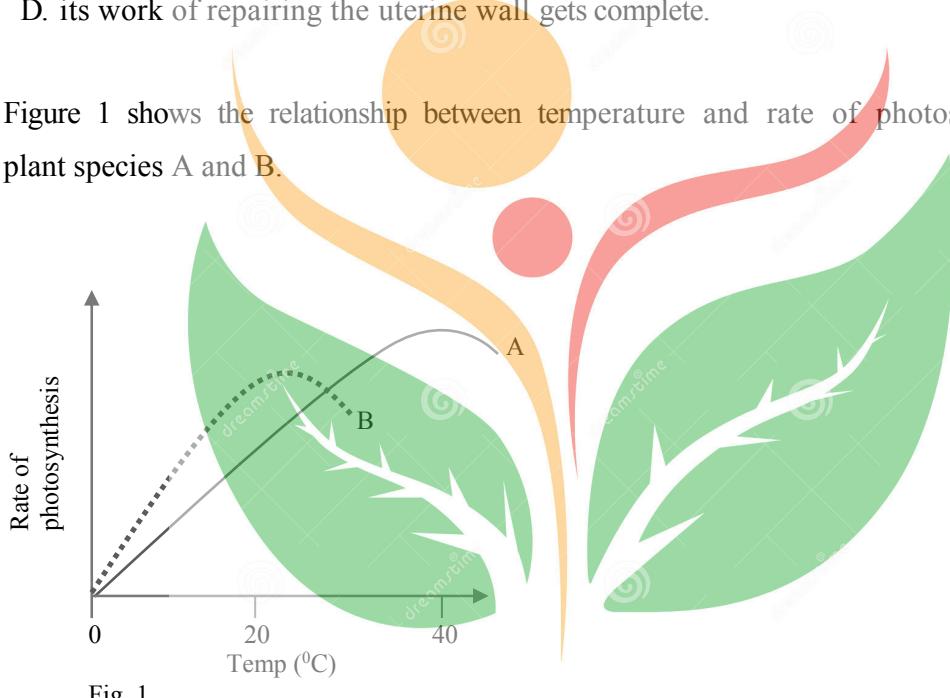


Fig. 1

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Which one of the following is a correct conclusion from the results?

- B is a shade plant while A is a sun plant.
- A has a lower compensation point than B.
- A has a higher optimum temperature for photosynthesis than B.
- Photorespiration does not occur in A but occurs in B.

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40. The absorption of amino acids after eating a heavy proteneous meal is aided by

- A.** diffusion and active transport.
- B.** osmosis and diffusion.
- C.** diffusion and pinocytosis.
- D.** active transport only.



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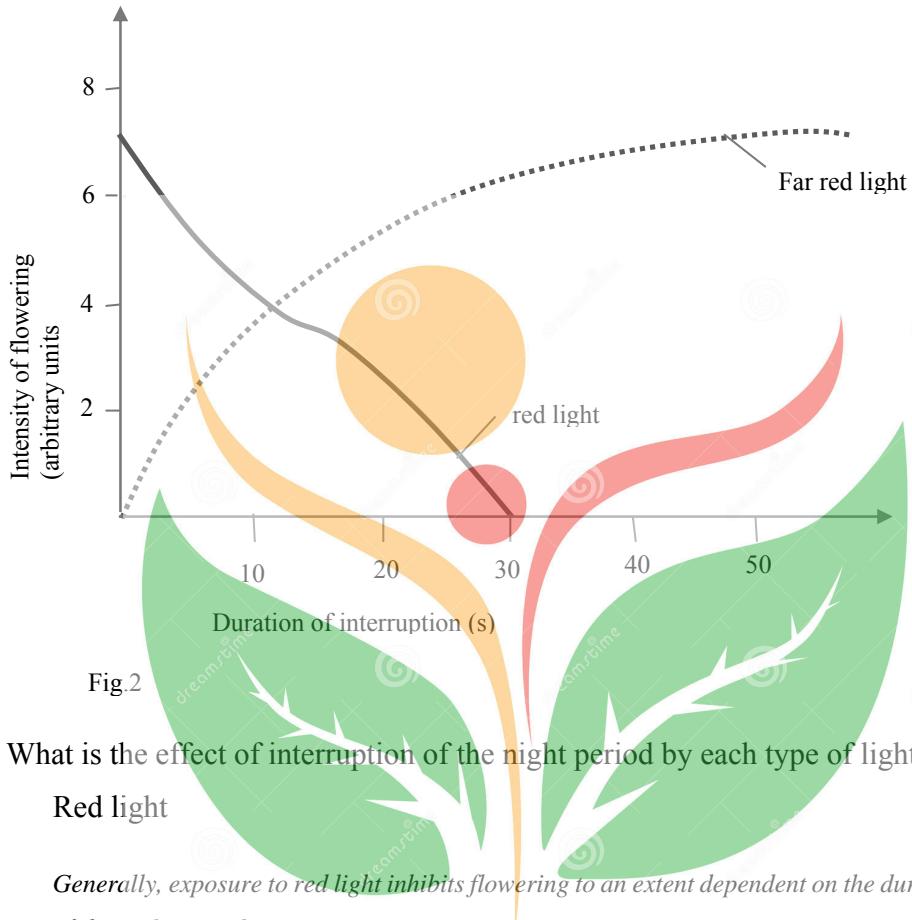


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## SECTION B

41. Figure 2 show the effect of red light interruption of night period, on flowering of a plant.



- (ii) Far-red light

Exposure to far red light promotes flowering increasing with the duration of light interruption

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- (b) Suggest the type of plant that would exhibit responses to light treatments as shown in figure 2.

Short plant because Pfr promotes formation of Pr that promotes flowering in short day.

- (c) How can the knowledge of the effect of red light and far-red light on flowering be utilized in commercial growing of flowers?

Red light and far-red light stimulate flowering in long day and short-day plants respectively, thus the two types of lights can be used to enhance flower harvest in different plant types.

42. Figure 3 shows diagrams of two types of blood circulatory systems A and B in animals. The arrows show the direction of blood flow.

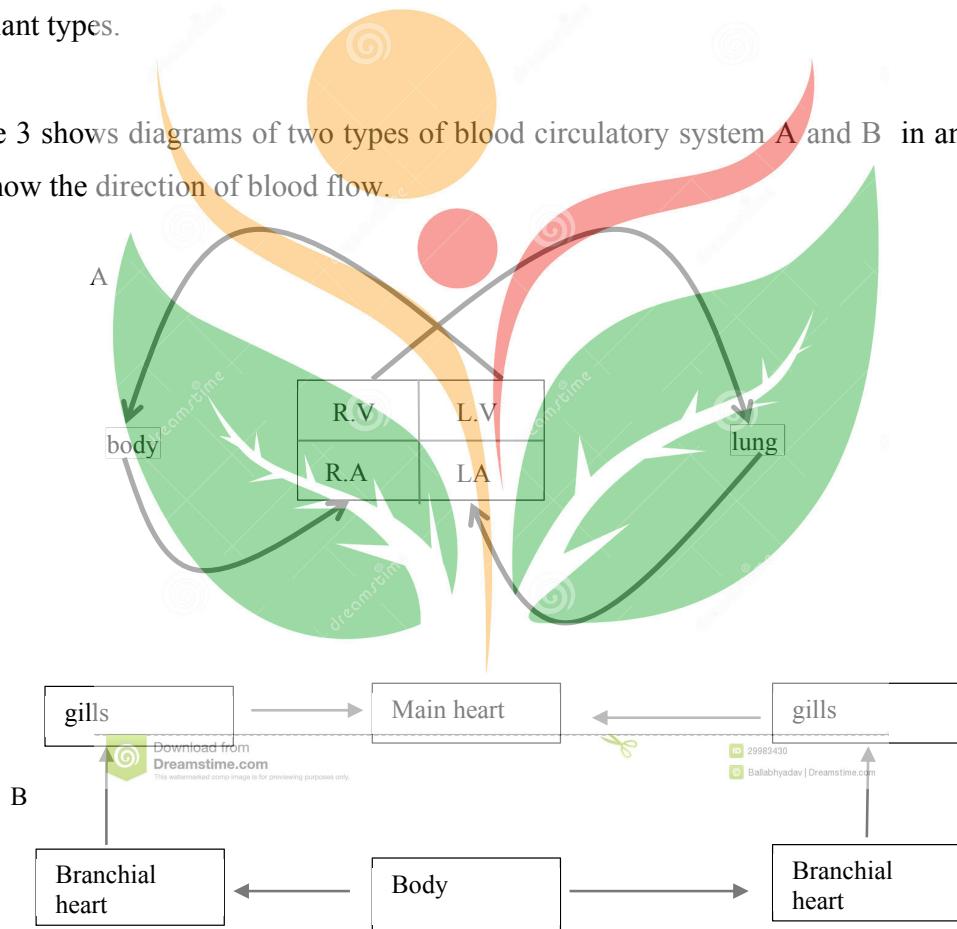


Fig.3

- (a) Describe each circulatory system

(i) A

- Blood flows from the right atrium into right ventricle, from where it is pumped to the lungs

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- It then flows to the left atrium and then into the left ventricle, from where it is pumped to the rest of the body.
- From the body blood returns to the heart through the right atrium
- The cycle repeats.

(ii) B

- From the heart, blood is pumped into the body, from where it flows to the branchial hearts on either side.
- The branchial hearts pump blood to the gills from where it returns to the main heart and the cycle repeats.

(b) How does each system maintain a high blood pressure?

(i) A

- In this double circulation system, the contraction of the heart muscles pumps the blood first to the lungs and then to the rest of the body in each circuit of the circulation. This ensures that pressure is restored in the blood after leaving the capillaries.

(ii) B

- The main heart's contraction generates sufficient pressure to push the blood through the vessels in the body
- The branchial hearts then maintain the pressure of the blood by continuing to pump the blood into the gills and back to the main heart.

(c) What is the advantage of maintaining a high blood pressure over a fluctuating pressure in a circulatory system of an animal?

- high blood pressure helps to propel blood at a high speed along the arteries to the body tissue. This facilitates faster delivery of oxygen and nutrients to the body tissues and removal of waste products from the body.

43. (a) Give one ecological importance of each of the following structural arrangements in plants

(i) Monoecious

(02marks)

- Increases chances of pollination and seed production

(ii) Dioecious

(02marks)

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- Increases chances of genetic variation among offspring with increased chances of survival in different habitats.

(b) explain why

(i) in dioecious plants, plants are usually associated with dry soils while female plants are associated with moist soils (02 marks)

- Male plants are associated with dry soil to produce dry light pollen grains to be blown to stigma of female flowers while females prefer moist soils to allow their stigmas be moist and sticky to receive pollen grain and enable proper development of seeds.

(ii) nearly all dioecious plants are wind pollinated. (02marks)

- Male and female flowers occur on different distant plants thus wind pollination increases chances of pollination where the male plant produces a lot of pollen grain.

(c) Give one reason why dioecious plants are rarer than monoecious plants (02marks)

- Only half of the plants produce seeds

44. (a) State the importance of the following elements in plant metabolism.

(i) Calcium

- It activates several enzymes e.g. ATPase
- It is important for translocation of carbohydrate
- It is a constituent of the plant walls
- It is important in cell division and cell enlargement
- It plays an important role in lipid metabolism
- Development of root apex
- Detoxification of heavy metal ions

(ii) Magnesium

- It is a constituent of chlorophyll

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- It activates enzymes in protein synthesis
- It is co-factor for many enzymes e.g. ATPase

(b) How does water logging of soil affect its nitrate content?

- It reduces the concentration of nitrates in the soil through dilution, leaching and reduced nitrification because oxygen level in the soil is reduced.

(c) Describe three special ways of obtaining essential by some plants growing in soils deficient of those elements.

- Some plants have mycorrhiza, an association of root and fungi; the fungi decompose humus into soluble nutrients (nitrogen and phosphorus) and also increases the surface area for their absorption by the roots. Plants that lack chlorophyll also obtain carbohydrates and proteins from the fungi.
- Legumes such as peas, beans and soya bean have nitrogen fixing bacteria in their root nodules for fixation of nitrogen.
- Plants in nitrogen deficient are feed on insects to obtain nitrogen.
- Some plants are parasitic e.g. dodder plant

45 (a) State two human activities that increase the levels of carbon dioxide in the atmosphere.

- Burning fossil fuel
- Burning bushes and firewood
- Deforestation
- industrialization

(b) What is effect of high levels of each of the following gases in the atmosphere?

(i) Carbon dioxide

- Promotes photosynthesis in plants
- Dissolves in and reduces pH of rain water
- Leads global warming

(ii) sulphur dioxide.

- Acidic gas
  - Acidic rain
  - Acidic soil
- These damages trees, lichen, skin and causes death of aquatic organisms.

(c) State one indicator in the environment where there is prevalence of high levels of sulphur dioxide in the atmosphere.

- Disappearance of lichen and mosses
- Discoloration and damage to building, sculptures and fabric
- Chlorosis and necrosis of vegetation

46. In Drosophila the gene for broad abdomen and long wings are dominant over the genes for narrow abdomen and vestigial wing. Pure breed strains of double dominant variety were crossed with a double recessive variety and a test cross was carried out on F1 generation.

(a) Using suitable symbols, work out the expected phenotypic ratio of the test cross of F1 generation if the genes for abdomen width and length of the wing are linked. (07marks)

Let N and n represent alleles for broad body and narrow body respectively

Let A and a represent alleles for long and vestigial wings respectively

F1 genotype NnAa

Test cross

Parents phenotype: Broad body, long wing

Parent genotype:

Meiosis

Gametes

F1 phenotype

F1 phenotype: Broad body, long wing      x      Narrow body, vestigial wing

F1 phenotype ratio      1                          1

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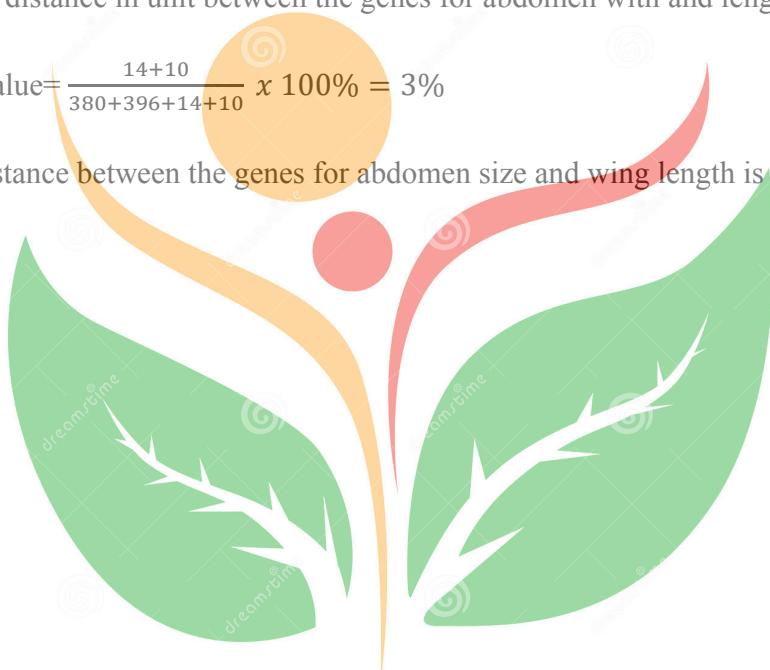
(b) It was however observed that when the test cross of the F1 generation was carried out the following results were obtained

Broad abdomen, long wing	380
Narrow abdomen, vestigial wing	396
Broad abdomen, vestigial wing	14
Narrow abdomen, long wing	10

Calculate the distance in unit between the genes for abdomen with and length of wing

$$\text{Cross over value} = \frac{14+10}{380+396+14+10} \times 100\% = 3\%$$

Hence the distance between the genes for abdomen size and wing length is 3 units



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**UACE BIOLOGY PAPER 2006 marking guideSection A**

1. Which one of the following does not contribute to the short reaction times in insects?
- A. Large size of ommatidia.
  - B. High flicker fusion frequencies.
  - C. Rapid transmission of impulses.
  - D. Large coverage of head by compound eyes.

The answer is A

Reaction time is the duration between reception of a stimulus and response to it. Since response to a stimulus involves its transmission from receptor to control center and to effectors, the speed of transmission is very important.

Insects have short reaction times because of;

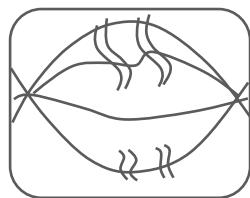
High flicker fusion frequencies that help in quick synchronization of reception of stimulus to response.

Rapid transmission of impulses.

Large coverage of head compound eyes. This ensure that receive stimuli from a very wide field.

2. Figure 1 below represents a stage of cell division.

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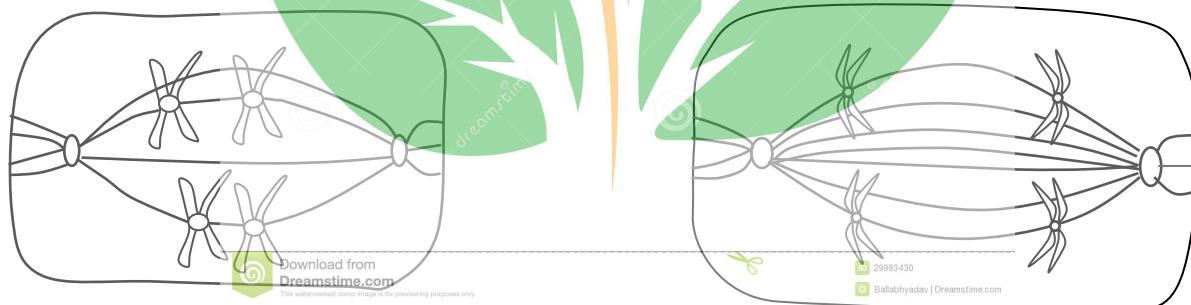
Which one of Fig. 1 figures is represented in figure?

- A. Metaphase of mitosis.
- B. Interphase.
- C- Anaphase.
- D. Metaphase I of meiosis.

The answer is D

During metaphase I of meiosis, homologous chromosome pairs arrange themselves on the equator of the spindle.

These are oriented so that each of the pairs of homologous chromosomes move to the opposite pole during anaphase 1. Thus;



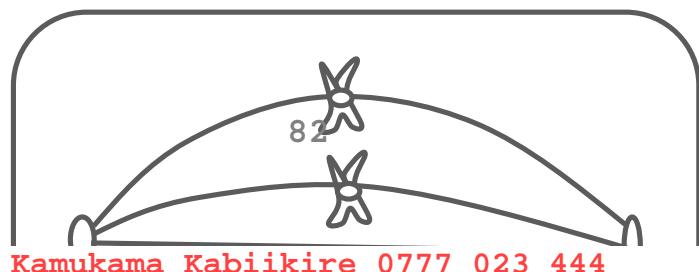
**Metaphase 1**

Homologous chromosome Pairs together at the equator of spindle

**Anaphase 1**

Homologous chromosomes part company and migrate to opposite poles of the cells

Note: In metaphase of mitosis, homologous chromosomes do not pair up and each chromosome arranges itself at the equator of the spindle, independent of the other.

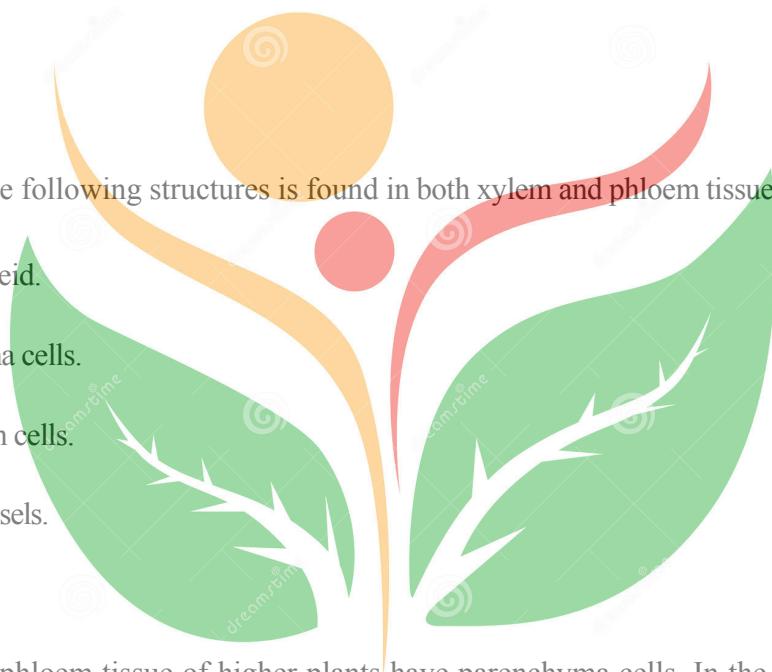


**Metaphase of mitosis**

3. Which of the following structures is found in both xylem and phloem tissues of higher plants?

- A. Sieved tracheid.
- B. Parenchyma cells.
- C. Companion cells.
- D. Hollow vessels.

The answer is B



Both xylem and phloem tissue of higher plants have parenchyma cells. In the xylem, they form xylem parenchyma while in the phloem form phloem parenchyma.

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4. Which one of the following pairs of events occur together to increase the oxygen concentration in the alveoli of the lungs?

- A. Contraction of diaphragm muscles and internal intercostal muscles.
- B. Relaxation of diaphragm muscles and internal intercostal muscles.
- C. Contraction of diaphragm muscles and external intercostal muscles.
- D. Relaxation of the diaphragm muscles and external intercostal muscles.

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The answer is C

The oxygen concentration in the alveoli increase during inspiration. This occur when the diaphragm muscles contract to flatten out the diaphragm and the external intercostal muscles contract to move the ribs upward and outward. This has an overall effect of increasing the volume of the thoracic cavity. The intrathoracic pressure thus decreases the air enters into the thorax along a pressure gradient.

5. Loud and low pitched sound is caused by sound waves of

- A. large amplitude and high frequency.
- B. low frequency and large amplitude.
- C. high frequency and small amplitude.
- D. small amplitude and low frequency.

The answer is B

Loudness/intensity of sound depends on the amplitude of the sound waves while pitch/quality depends on the frequency.

The larger the amplitude, the louder the sound, the higher the frequency, the higher the pitch and vice versa.

6. During flight in insects, upstroke is brought about by

- A. contraction of direct flight muscles.
- B. relaxation of indirect flight muscles.
- C. contraction of indirect flight muscles.
- D. sudden up thrust of the body.

The answer is C

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The indirect muscles are the major muscles of locomotion in insects. They include; the longitude and dorso-vertral muscles. Contraction of the longitudinal muscles causes down stroke.

Note:

The direct muscles are attached directly to the base of the wings and serve to stabilize the wings at rest. During flight, direct muscles do not play a big role. Their contraction would instead make the wing rigid (stable) and resist motion either in upstroke or down stroke.

7. The following are characteristics of amphibians.

- (i) Have moist skins.
- (ii) Carry out external fertilization.
- (iii) Use gills at early stage for respiration.
- (iv) Use lungs for respiration.

Which one of the following pairs of characteristics limit them from inhabiting a totally terrestrial environment?

- A. (i) and (ii).
- B. (ii) and (iii).
- C. (iii) and (iv)
- D. (i) and (iv).

The answer is B

In amphibians, use of gills at early stage for respiration and carrying out external fertilization require a good supply of water.

These are adaptations to aquatic life.

8. Figure 2 shows an ovule of a flowering plant.

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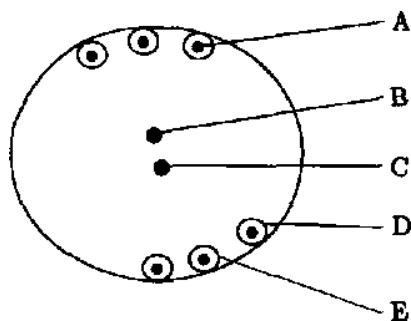


Fig. 2

A triploid nucleus is formed by fusion of a male nucleus with

- A. D and C.
- B. B and C.
- C. A and B.
- D. D and E.

The answer is B



During double fertilization in plants, the triploid nucleus (primary endosperm nucleus) is formed when a male nucleus fuses with the polar nuclei. In the figure, Band C represent the polar nuclei.

9. Which one of the following is not a function of progesterone?

- A. Increasing the sensitivity of uterine muscles.
- B. Inhibiting release of follicle stimulating hormone.
- C. Inhibiting release of prolactin.
- D. Promoting growth of mammary glands.

The answer is A

Progesterone has the following functions;

Causes proliferation maturation of the lining in preparation for implantation

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Inhibits the release of follicle stimulating hormone (FSH)

Inhibits the release of prolactin

During pregnancy, it is responsible for promoting growth of the mammary glands.

Note:

The increasing sensitivity of the uterine muscle to oxytocin is due the increased synthesis of estrogens.

10. Which one of the following pairs of adjustments at a respiratory surface would increase its efficiency?

- A. Decreasing the rate of ventilation and increasing blood supply.
- B. Increasing the rate of blood flow and the rate of ventilation.
- C. Increasing the ventilation rate and the distance of diffusion of molecules.
- D. Decreasing the blood supply and the distance of diffusion of molecules.

The answer is B

Efficiency of a respiratory surface is affected by how fast the respiratory gases can diffuse across it.

Increasing the rate and the rate ventilation a steep diffusion gradient across a respiratory surface increasing efficiency.



11. Which of the following have a sole function of offering support to the plant?

- A. Sclerenchyma and vessel elements.
- B. Vessel elements and tracheid.
- C. Sclerenchyma and collenchyma.
- D. Parenchyma and collenchyma.

The answer is C

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Sclerenchyma and collenchyma tissues are the main supporting tissue in a plant.

This is their sole function in the plant.

Note:

- Vessel elements and tracheid are responsible for transport of material in the plant.
- Parenchyma is the ground tissue that, in most plants, acts as storage tissue though it also provides support in non-woody plants.

12. The bacteria which converts nitrates to nitrites during the nitrogen cycle are an example of

- A. nitrogen fixing bacteria.
- B. nitrifying bacteria.
- C. decomposing bacteria.
- D. denitrifying bacteria.

The answer is D

Conversion of nitrates to nitrites reduces the nitrate content of the soil and is called denitrification, accordingly, the bacteria that affect this process are called denitrifying bacteria.

- Nitrifying bacteria convert nitrates to nitrites
- Decomposing bacteria are responsible for decay/ decomposition of organic matter.
- Nitrogen fixing bacteria convert/fix nitrogen in the atmosphere to nitrites in the soil

13. The significance of vascularization of the endometrium before implantation is to

- A. ensure firm attachment of the foetus onto the uterine wall.
- B. prevent menstruation.
- C. assist in producing hormones which maintain pregnancy.
- D. facilitate food and oxygen supply to the foetus.

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The answer is D

Vascularization refers to the development of blood vessels in tissue.

It occurs in the endometrium before implantation in order to facilitate food and oxygen supply to the foetus via the placenta during pregnancy.

14. In a human with a non-functional pancreas, digestion of starch in the intestines

- A. be possible because of the suitable pH due to bile.
- B. not occur for absence of enzymes.
- C. would be possible because succus entericus contains the necessary enzymes.
- D. would not occur because of the acidic pH of chyme.

The answer is B

The pancreas produces pancreatic juice which contains; pancreatic amylase, pancreatic lipase; trypsinogen, chymotrypsin and bicarbonate ions, among other. With a non-functioning pancreas, these substances would not be secreted.

Accordingly, digestion of starch in the duodenum would not occur because of absence of pancreatic amylase.

15. Which one of the following is true about sex linked characters in humans?

- A. Females never suffer from the trait.
- B. Fathers do not pass on the character to their sons.
- C. Females are either normal or carriers.
- D. Males are either carriers or sufferers.

The answer is B

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Sex-linked characters are those determined by genes located on the sex chromosomes and are transmitted along with sex. Most of these characters are determined by recessive genes located on the X-chromosomes. They can only manifest in the female when in homozygous recessive state.

Note:

- Father can only pass on such genes to their daughters and never to their sons.
- Males can never be carriers. In the presence of such a gene, males are always sufferers because the chromosome is genetically empty
- Females can be normal, carriers or sufferers.

16. The similarities of the skeletal structures of moles, monkeys and whales lead to the conclusion that they

- A. belong to the same class.
- B. originate from the same environment.
- C. descend from a common ancestor.
- D. evolved convergently.

The answer is C

According to the principle of comparative anatomy, organisms with structures showing similar morphological make-up must have descended from a common ancestor (divergent evolution).

For example, similarities of the skeletal structures of moles, monkeys and whales (pentadactyl limb) show that they have descended from a common ancestor.

17. Which one of the following sets of characters is an adaptation in mammals to desert conditions?

- A. Uric acid production and short loop of Henle.
- B. Long loop of Henle and urea production.

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C. Ammonia production and long loops of Henle.

D. Short loop of Henle and urea production.

The answer is B

In the desert, animals face a big problem of lack of water yet the tendency to lose that already in the body is high. The mammals in desert have long loops of Henle to reabsorb most of the water from the urine back into the body and produce urea which requires relatively less water for excretion compared to ammonia.

18. Which of the following cannot be parents of a child of blood group O?

A. Man of blood group A and woman of blood group B.

B. Both man and woman of blood group A.

C. Both man and woman of blood group B.

D. Man of blood group AB and woman of blood group O.

The answer is D

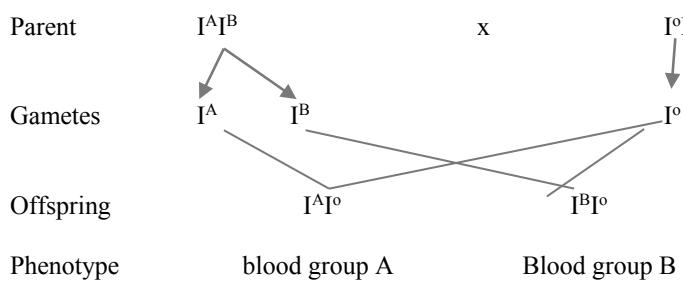
Let  $I^A$  be the gene blood group A

$I^B$  the allele for blood group B

$I^O$  the allele for blood group O

A man with blood group AB has genotype  $I^A I^B$  while a woman with blood group O has genotype

$I^O I^O$ . Thus a cross between these cannot produce a child with blood group O. thus,



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Note:

The other combinations can produce a child with blood group O ( $1^0 1^0$ ) if the person with blood group A has genotype  $1^A 1^0$ , and one with blood group B has genotypes  $1^B 1^0$

19. Which of the following characteristics is not used in classifying amphibians and reptiles together? Possession at some stage of

- A. post - and tail
- B. two pairs of pentadactyl limbs.
- C. notochord.
- D. nerve cord.

The answer is D

Amphibians and reptiles are classified together in the phylum chordate because

- They have a post anal tail at some stage during development.
- They have a notochord at some stage of development
- They have two pairs of pentadactyl limbs.

Note:



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None of these has a nerve cord. The ventral nerve cord is found in insects.

20. If carbon dioxide containing radioactive carbon was added to a suspension of photosynthesizing algae, in which one of the following compounds would the radio-active carbon show first?

- A. Glucose.

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- B. Phosphoglyceric acid.
- C. Ribulose biphosphate
- D. Triose phosphate.

The answer is B

If the plant absorbs carbon dioxide containing radioactive carbon, the carbon will first be shown in the first stable product of photosynthesis [phosphoglyceric acid (PGA)]

Recall:

In the dark stage of photosynthesis, CO<sub>2</sub> reacts with ribulose biphosphate (RUBP) to form a non-stable, 6-carbon compound in presence of RUBP carboxylase.

The 6-carbo compound readily breaks down to form 2 molecules of phosphoglyceric acid the first stable product of photosynthesis.

21. Etiolation in plants is usually a response to
- A. insufficient nutrients.
  - B. low temperatures.
  - C. insufficient light,
  - D. too much water.

The answer is C

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Etiolation is the growth of plants in response to insufficient lights supply.

It is characterized by growth

- Yellow leaves
- Small folded leaves
- Increased distance between successive nodes.

22. Figure 3 shows changes in electrical potentials in an axon membrane when an impulse is transmitted.

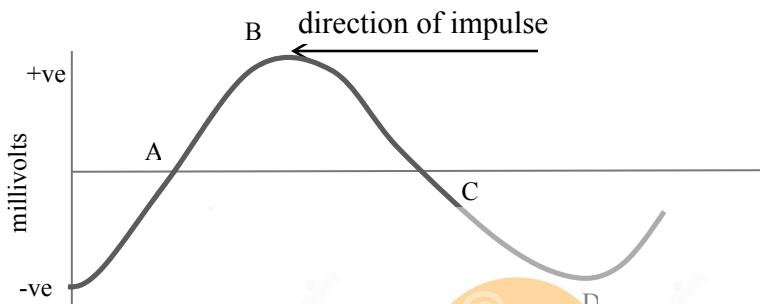


Fig.3

At which stage of the electrical potentials marked, is the axon most permeable to sodium ions?

The answer is A

During an action potential the permeability of sodium ions is highest during the depolarization phase which is occurring at A.

23. Which one of the following is a disadvantage of a trachea system for gaseous exchange in insects?

- A. Ventilation is limited.
- B. Tracheoles are impermeable.
- C. Spiracles are too small.
- D. The system does not supply all body parts.

The answer is A

The tracheal system of an insect consists of a branched network of tubes called trachea. These branch repeatedly to ramify all through the body tissue by means of the minute, highly permeable tracheoles. As such, the tracheal system allows oxygen to diffuse from the outside air directly to the tissues, without the need of a transport system. Efficient though it appears, the tracheal system

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is disadvantaged by an inadequate ventilation mechanism. Ventilation is dependent of the movement of the thorax and abdomen, yet their range of expansion is limited. Thus less air is exchanged through the tracheal system, a fact that limits the size of insects.

Note:

Air enters and leaves the tracheal system via numerous pores in the abdomen and thorax called spiracles. Although they appear small, their large number increases the effective surface area for entry and exit of gases.

24. A climax community is one in which

- A. succession is at its peak.
- B. a carrying capacity has been reached.
- C. succession has ceased.
- D. death rate of organisms is at its lowest.

The answer is C

In a climax community of succession, the community is stable and succession has ceased.

25. Which one of the following is not a function of the skeleton in insects

- A. Support of body.
- B. Protection of delicate body parts.
- C. Prevention of desiccation.
- D. Secretion of wax.

The answer is D

The skeleton of insects is external –a exoskeleton. It serves the following functions:

- Support the body
- Protects the delicate internal structures.

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- Prevent desiccation

Note;

Wax secreted from within the body and just deposited on the cuticle. It is not secreted by the exoskeleton.

26. Which of the following structures is haploid?

- A. Primary oocyte.
- B. Spermatogonium.
- C. Secondary oocyte.
- D. Germinal epithelium.

The answer is C

During gametogenesis, the germinal epithelium, primary gametes (primary oocyte) the primary spermatocyte), oogonia and spermatogonia are diploid ( $2n$ ). However, the secondary oocyte secondary spermatocyte, spermatid, spermatozoan and ovum are haploid ( $n$ )

27. In higher plants, the problem of obtaining oxygen for respiration is solved by leaves possessing

- A. large intercellular spaces.
- B. compact palisade layer.
- C. thin lower epidermis.
- D. numerous stomata on lower epidermis.

The answer is D

To obtain enough oxygen for respiration, leaves of plants have numerous stomata especially on the lower epidermis. This reduces resistance to entry of oxygen into the leaf.

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28. Which one of the following is a method used by marine bony fish to overcome the problem of possessing body fluids that are hypotonic to the surroundings?

- A. Increase high glomerular filtrate.
- B. Extensive reabsorption of salts.
- C. Retention of urea.
- D. Elimination of non-toxic nitrogenous waste.

The answer is D

Marine bony fish have body fluids which are hypotonic to sea water leading to a greater tendency of water to move into the sea by osmosis. This problem is overcome by the following processes:

- By swallowing sea water and having a kidney with a relatively low filtration rate.
- By actively extruding salts by means of chloride secretary cells in the gills.
- By eliminating nitrogenous waste in form of compound which is soluble and non-toxic. This compound is trimethylamine oxide which comparatively little water for its elimination.

29. Good drainage and ploughing of soil reduces the process of

- A. nitrification.
- B. decomposition.
- C. denitrification
- D. nitrogen fixation

The answer is C

The answer is Good drainage and ploughing improves soil aeration which in turn improves the delivery of oxygen to the soil. This reduces the activity of anaerobic bacteria in the soil. Since anaerobic bacteria are responsible for the process of denitrification, improved aeration reduces this process.

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Note:

Nitrification, decomposition and nitrogen fixation are carried out by aerobic bacteria.

If the solute potential/ osmotic pressure (concentration) of the external solution is higher than that of the cell, then the external solution is said to be hypertonic to the cell solution.

Note:

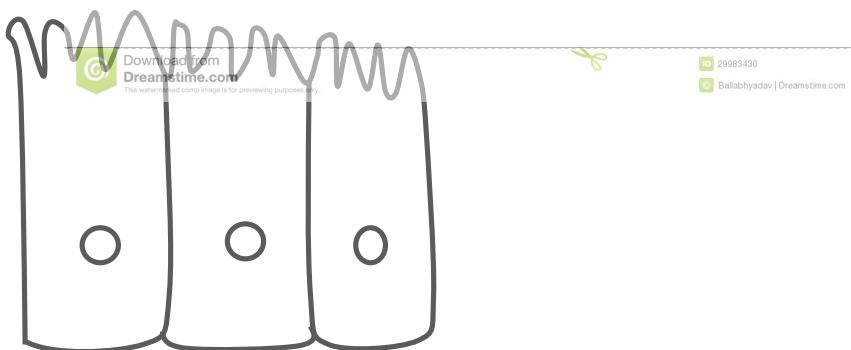
- If it is lower the external solution is hypotonic to the cell solution
- If it has the same concentration, the external solution is isotonic to the cell solution

30. If the solute potential of the external solution is higher than that of the cell, the solution is said to be

- A. hypotonic to the cell solution.
- B. hypertonic to the cell solution.
- C. isotonic to the cell solution.
- D. of lower osmotic pressure than the cell solution.

Answer is B

31. Which one of the parts of a mammal possesses an epithelial tissue as shown in Fig. 4?



**Fig. 4**

- A. Oviduct.
- B. Ileum.
- C. Respiratory tract.
- D. Loop of Henle.

Answer is B

The ileum is lined with columnar epithelium possessing microvilli on their free surface to increase absorptive surface

32. The type of learning that involves the immediate understanding and responding is
- A. imprinting.
  - B. associative learning.
  - C. insight learning.
  - D. habituation.

The answer is C

Learning may be classified into five categories.

- **Insight, learning** is the immediate comprehension and response to a new situation without trial and error. It involves mental reasoning/ intelligence.
- **Habituation** is a process which an animal gradually ceases to respond to a stimulus. If this is presented repeatedly in the same amount and fashion for a long time.
- **Associative learning** is when an animal learns to associate a particular response with a reward or punishment.
- **Conditioning** is when an animal learns to respond to a previously non-stimulating stimulus as a result of it being presented repeatedly in pairs with a usual stimulus. For example, a dog learning to salivate at the sound of the bell.

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- **Trial and error learning.** Occur when an animal learns to associate a particular behavior with an unexpected reward, for example, a dog rewarded with food each times it jumps onto a chair eventually learns to jump onto that chair each time it enters the room.
- **Imprinting** is form of behavior in which younger animals learn to follow the parents right from the time they are born.

33. Prolonged menstrual period may be caused by

- A. high levels of progesterone.
- B. a decrease in production of follicle stimulating hormone.
- C. high levels of luteinizing hormone.
- D. a deficiency in oestrogen.

The answer is D

Just after menstruation, the anterior lobe of the pituitary gland starts secreting follicle stimulating hormone, this stimulates the walls of the secondary follicle and tissues of the ovary to secrete another hormone oestrogen.

The immediate effect of oestrogen is to bring about healing and repair of the uterine wall following menstruation. As a result, deficiency of oestrogen delays the healing process and longs menstrual flow.

34. Auxins are often used as selective weed killers on lawns because

- A. same dosage of auxins affects different plant parts, differently.
- B. they can be manufactured artificially
- C. auxins always kill dicotyledonous plant.
- D. Auxins remain on the vegetation long after application.

The answer is A

Auxins usually affect different plant parts differently at the dosage.

For example, high concentrations of auxin inhibit root growth promotes shoot growth. The reverse is true for low auxin concentration.

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For this reason, 2,4-Dchlorophenoxyacetic acid (an artificial auxin) is used commercially as a selective weed killer, to rid lawns of unsightly broad-leaved plants without destroying the grass. This is because, 2,4-D selectively induces distorted growth and excessive respiration in broad-leaved plants, leading to their death.

35. The compounds which act as oxidizing agents during anaerobic respiration in plants are

- A. NAD and pyruvic acid.
- B. ethanol and NAD.
- C. NAD and FAD
- D. NADP and pyruvic acid.

No answer

An oxidizing agent is a substance that accepts hydrogen.

In respiration (aerobic or anaerobic) NAD accepts hydrogen atom to form  $\text{NADH}_2$  during the first step of glycolysis.

During anaerobic respiration in plants, pyruvic acid from glycolysis is decarboxylated to acetaldehyde (ethanal) which accepts hydrogen to form ethanol.

36. In any ecosystem, a continued input of energy is required because

- A. matter is continually used in metabolic process.

B. biological succession occurs very slowly.

C. of the continued increase in population in the ecosystem.

D. energy is lost each time it is transferred between organisms.

The answer is D

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In an ecosystem, energy is lost at each trophic level in form of heat and respiration. As a result, a continued input of energy is required in order to sustain life in the ecosystem.

37. During the heat of the day, control of stomatal movements to reduce excessive water loss is due to

- A. active accumulation of mineral ions in the guard cells.
- B. synthesis of abscisic acid.
- C. inter-conversion of glucose and starch in the guard cells.
- D. synthesis of glucose during photosynthesis.

The answer is B

During water stress, as occurs in the heat of the day, Abscisic acid is produced by cells in the leaves and initiate immediate closure of stomata. This reduces excessive loss of water from the plant during these conditions.

Recall: The scarcity of water and intense solar radiation induce synthesis of Abscisic acid

38. Sucrose is a non-reducing sugar because it

- A. it is not fully digested.
- B. lacks reducing groups.
- C. is a disaccharide molecule.
- D. is a ketose sugar.

The answer is B

Sucrose is a non-reducing sugar because it lacks reducing groups.

Recall: Reducing sugars have reducing group which are capable of reducing  $\text{Cu}^{2+}$  to  $\text{Cu}^+$  ions in solution.

39. Which of the following animals have the most efficient system of gaseous exchange?

## UACE BIOLOGY PAPER 1 (2000-2019)

- A. Insects.
- B. Bony fish.
- C. Mammals.
- D. Amphibians

The answer is B

Fish does not mix inhaled and exhaled air thus maintains the highest diffusion gradient

40. Which one of the activities contributes least to the greenhouse effect?

- A. Use of CFCs.
- B. Deforestation.
- C. Excessive use of fertilizers.
- D. Burning fossils fuels.

The answer is C

Accumulation of CO<sub>2</sub> in the atmosphere prevents heat energy from escaping from the earth. This result in accumulation of heat energy on the earth's surface a phenomenon known as greenhouse effect

Any activity which result in accumulation of CO<sub>2</sub> in the atmosphere will therefore contribute to green house. These include; deforestation and burning of fossil fuels.



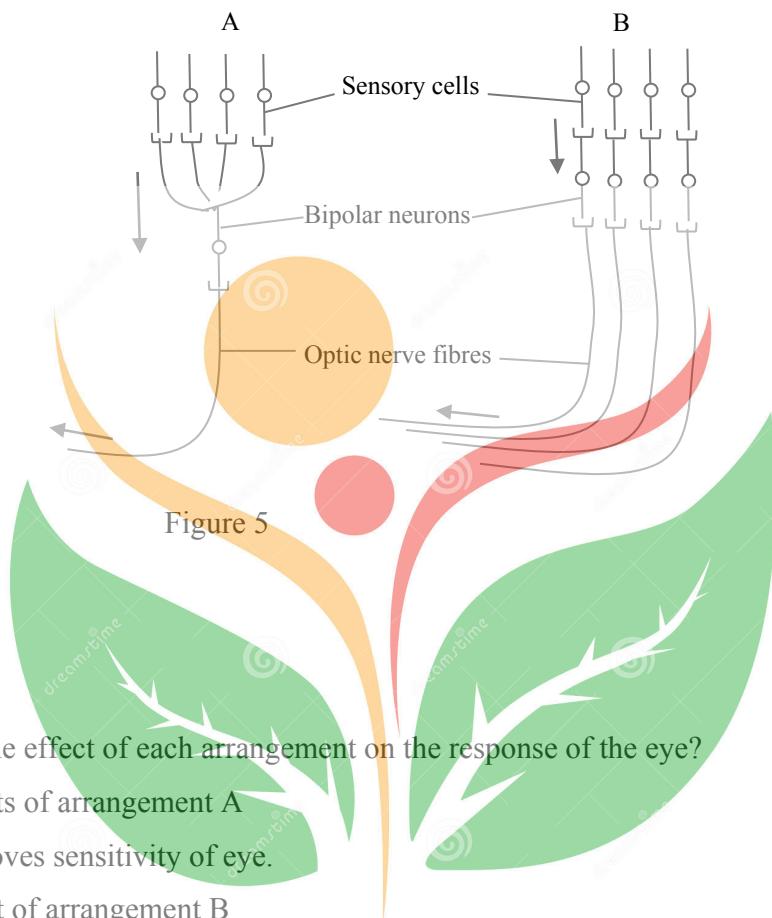
Note :

Use of CFCs (chlorofluorocarbons) result in depletion of the ozone layer thereby leading global warming rather than greenhouse effect.

Nevertheless, excessive use of fertilizers contributes least, if at all, to the greenhouse effect.

## SECTION B

41. Figures 5 shows types of arrangements, A and B, of sensory cells in the mammalian eye.



(a) What is the effect of each arrangement on the response of the eye?

(i) Effects of arrangement A

Improves sensitivity of eye.

(ii) Effect of arrangement B

Improves the visual acuity of the eye.

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(b) Explain how the effect of each arrangement is brought about.

(i) Effect of arrangement A.

- Many sensory cells synapse on a single bipolar neuron
- Sub-threshold stimuli failing on individual sensory cells create depolarization potentials which summate to form an action potential in bipolar neuron.
- The action potential travels to the brain which perceives an image of the area illuminated. This improves sensitivity of the eye.

(ii) Effect of arrangement B.

- Each sensory cell synapse on a separate bipolar neuron
- Light energy from parts of an object which are close together can fall on separate sensory cells.
- If the light energy is large enough an action potential is built up in each cell which is transmitted individually to the brain.
- Thus, the brain interprets these as two or more separate points on the object.

(c) Under which light conditions is each arrangement most effective and why?

(i) Arrangement A.

Dim light or light of low intensity.

**Reason:**

Only sub threshold potentials can summate into an action potential in the bipolar neuron. These can be attained by low light intensity.

(ii) Arrangement B

Bright light or light of high intensity

**Reason :**

Each sensory cells conveys its own information and thus, requires enough stimulus to evoke an action potential in it.



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42. (a) What is meant by water stress in relation to plants?

Water stress is a condition in which a plant has a greater tendency to lose water to the environment through transpiration than it can obtain by the root system.

(b) What is the effect of water stress in green plants?

- It causes wilting
- It causes reduction in rate of photosynthesis
- It may lead to shedding of plant leaves

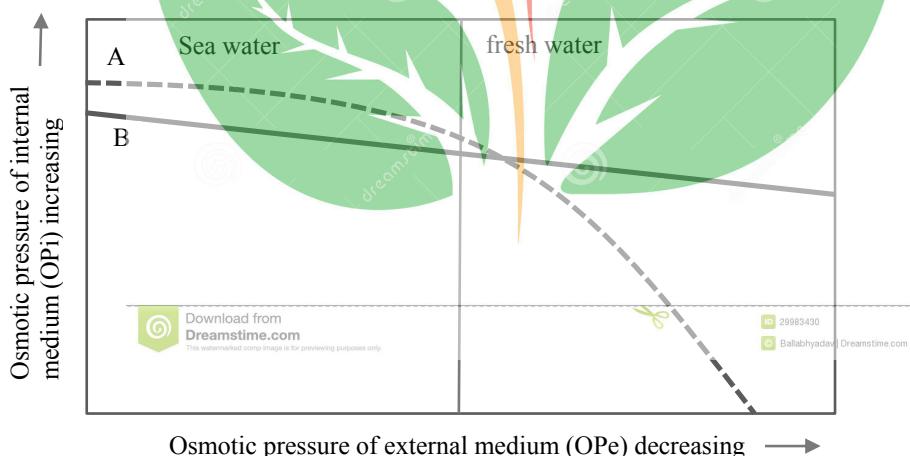
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- I cause rapid closure of stomata.

(c) Outline the structural adaptation of the xylem vessel for long distance transport to water and mineral salts?

- Had elongated cylindrical cells connected end- to –end to form a continuous pipe/vessel.
- Has a dead cell with no protoplasm to create room for unimpeded flow of water.
- Walls of its cells are highly lignified and therefore, water –tight to avoid leakage during transport.
- Tubes narrow and lignified to increase capillarity
- End-walls of the cells are completely dissolved to form a continuous open pipe/vessel to allow easy flow of water.

43. Figure 6 shows the effect of changing the osmotic pressure of the external medium ( $O_{Pe}$ ), on the osmotic pressure of the blood ( $O_{Pi}$ ), of sea animals A and B



(a) Explain the effect of decreasing the  $O_{Pe}$  on the  $O_{Pi}$  of each animal.

(i) Animals A

$O_{Pi}$  of A decreases with decrease in  $O_{Pe}$  gradually in sea water but very rapidly to zero in fresh water.

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### Explanation

As OPe decrease, the cells of A absorb water from the external environment by osmosis which decreases its OPi. This continues up to a point when OPi equals OPe in fresh water, OPe A decreases rapidly to equilibrium where OPe = 0

### (ii) Animals B

OPi first decreases gradually in sea water but becomes constant with further decrease in OPe in fresh water.

### Explanation

Decrease in OPi is due to absorption of water from the external environment by osmosis as OPe decreases.

Later, the animal resists further decrease in OPi despite reduction in OPe by regulation of mineral ion concentration in its body fluids by:

- Secretion of ions into body fluids;
- Retention of ions from swallowed water.
- Excretion of nearly pure water.

(b) Using the information provided, suggest an ecological advantage animals B has over animals A

Animals B can tolerate both sea water and fresh water while animals A can only survive in sea water but not in fresh water.

(c) What is the main osmotic problem faced by sea animals whose opi is less than ope?

- Tendency of losing water to the external environment with subsequent plasmolysis of the body cells.
- High energy expenditure on maintenance of OPe.

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44 (a) What is meant by alternation of generation?

Alternation of generation is a life cycle of plants which consist of water alternating stages of growth (generation); a haploid gametophyte which produces gametes by mitosis and a diploid saprophyte which produces spore by meiosis

The life cycle is complete when the plant passes through both stage as seen in bryophytes and pteridophytes

(b). Ferns and mosses show alternation of generation. State the dominant stage in each case

(i) ferns: sporophyte

(ii) Mosses: gametophyte

(c) Give important of alternation of generation in the life cycle of an organisms

- It promotes variation through meiosis, which then ensures that only the better adapted organisms survive.
- It enables the organism to colonize more than one habitat of varying environment conditions.
- It leads to rapid colonization of habitat as by an organism since several spores are produced.

(d) Outline the limitations that mosses face in growing in terrestrial inhabitants

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- Mosses lack a cuticle hence are prone to desiccation
- Leaves are small and sessile and provide a small surface area for trapping sunlight for photosynthesis.
- Thallus provides a large surface area for water loss thus liable to desiccation.
- Leaves are pale-green and thus have chlorophyll content inadequate for photosynthesis
- False roots are superficial and incapable of absorbing enough water.

## UACE BIOLOGY PAPER 1 (2000-2019)

45. (a) Outline the cause of gene reshuffling

- Crossing over prophase 1 in meiosis
- independent assortment at metaphase 1 of meiosis
- Random assortment of chromosomes in metaphase I
- Random fusion of gametes from two parents during fertilization.

(b) In what way may variation resulting from gene reshuffling differ from that caused by mutation?

- Gene reshuffling new combination of the same alleles and as a result leads to variation in combinations of the same characters.
- Mutations lead to formation of completely new alleles leading to production of completely new characters.

(c) What is the importance of variation in a population?

- May lead to emergence of new species.
- Increase chances of organisms to survive in different habitats.
- Increase chance of resistance of organisms to diseases and toxic substances.
- increases chance of population size control by natural selection
- Reduces competition for natural resources.

(d) Explain how constancy of species may be maintained through natural selection

- Species in a population show variation in characteristic. These act as the basis for genes of the next generation.
- Individuals with characteristic favored by the environment survive to pass on their genes to the next generation.
- Those with unfavorable characteristics are weeded out.
- This naturally controls the population size as selection pressures are constantly changing as do the adaptations of organisms from time to time.

**UACE BIOLOGY PAPER 1 (2000-2019)**

46. Table 1 shows the amount of DDT measured in parts per million (ppm) found in a variety of organisms associated with a fresh water lake.

Where the DDT level measured	Amount of DDT/ppm
Water	0.0003
Phytoplankton	0.006
Zooplankton	0.004
Herbivorous fish	0.39
Carnivorous fish	1.8
Fish-eating birds	14.3

- (i) Calculate how many times the DDT is more concentrated in carnivorous fish compared with its concentration in water.

$$\text{Concentration index} = \frac{(\text{DDT}) \text{ carnivorous fish}}{(\text{DDT}) \text{ fresh water}}$$

$$= \frac{1.8}{0.003}$$

$$= 6000 \text{ times}$$

- (ii) What do the results in a (i) show?

That DDT accumulates in the tissue of organisms along the food chain.

- (b) Explain why the concentration of DDT changes from water to carnivorous fish.

DDT is very resistant to bio-degradation yet has a very high lipid solubility. In animal tissue, it becomes concentrated and accumulates in fat tissue along the food chain.

- (c) State two effects of DDT to organisms.

- It interferes with the conduction of nerve impulses in the nervous system.

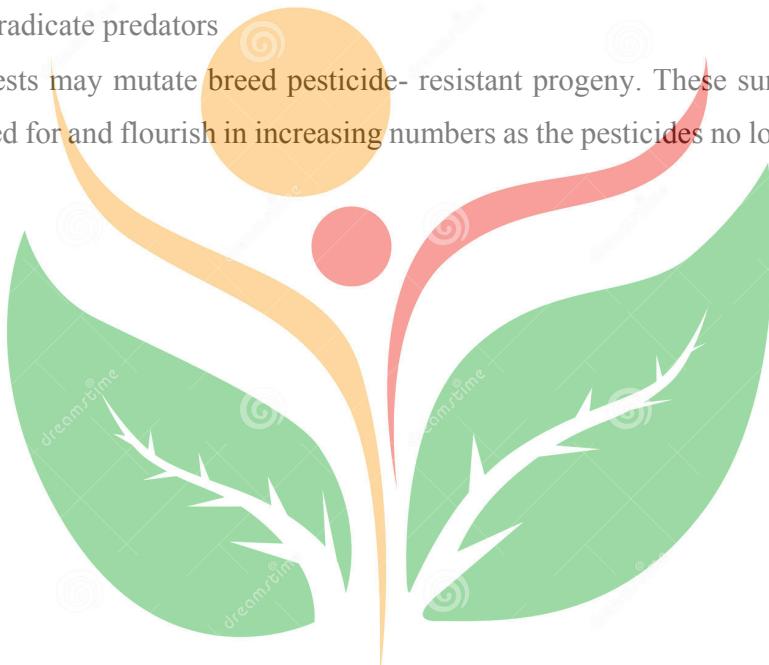
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- In birds, it interferes with proper formation of egg shells.
- DDT has a possible mutagenic effect especially on pests which may end up flourishing later with its continued use.
- Kill pests
- Interfere with sperm formation

(d) Explain how a pest sprayed with a pesticide may flourish afterwards.

Solution:

- May eradicate predators
- The pests may mutate breed pesticide- resistant progeny. These survive and become selected for and flourish in increasing numbers as the pesticides no longer has effect on them.



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PAPER 1: UNEB 2007 guide

**Answer all questions**

- SECTION A
1. Which one of the following is a simple branched tubular gland?
- A. Brunner's glands
  - B. Salivary gland
  - C. Sweat gland
  - D. Mammary gland

The answer is A

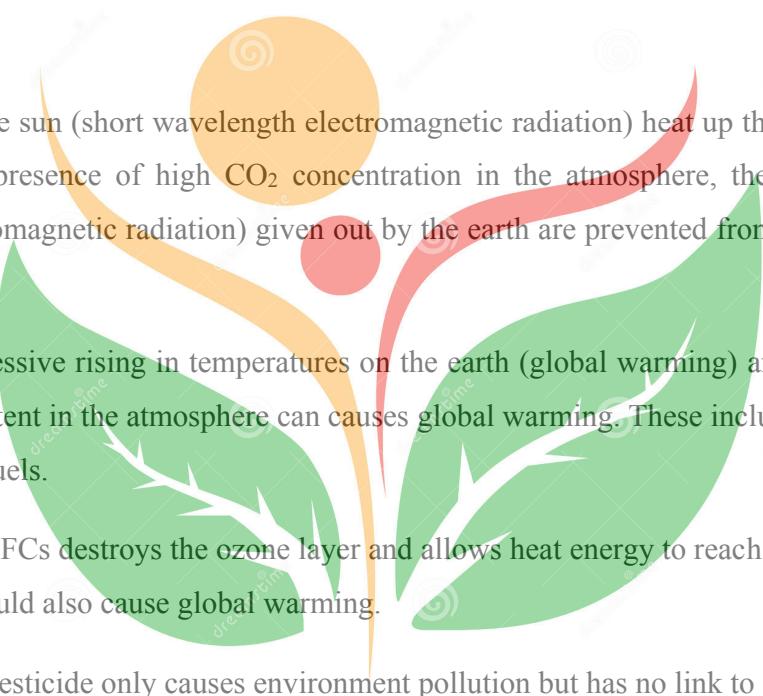
The glands presented in this case are of the following types;

Gland	Types of gland
• Brunner's gland	Simple branched tubular gland
• Salivary gland	Compound tubular gland
• Sweat gland	Coiled tubular gland
• Mammary gland	Compound saccular gland

2. Which one of the following activities does not contribute to global warming?

- A. Use of pesticides.
- B. Deforestation.
- C. Burning fossil fuels.
- D. Use of CFCs.

The answer is A



Light rays from the sun (short wavelength electromagnetic radiation) heat up the earth's surface. However, in the presence of high CO<sub>2</sub> concentration in the atmosphere, the heat rays (long wavelength electromagnetic radiation) given out by the earth are prevented from escaping by the CO<sub>2</sub>.

This causes progressive rising in temperatures on the earth (global warming). Any activity which increases CO<sub>2</sub> content in the atmosphere can cause global warming. These include; deforestation, burning of fossil fuels.

However, use of CFCs destroys the ozone layer and allows heat energy to reach the earth directly from sun. This would also cause global warming.

Note: The use of pesticide only causes environment pollution but has no link to global warming.



3. The significance of etiolation to a germinating seed in the soil is that it

- A. leads to rapid elongation of the hypocotyl in monocotyledonous plants.
- B. allows maximum growth in length with minimum use of food reserves.
- C. allows the seedling to grow in the dark.
- D. ensures that leaves remain small to break through the soil.

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The answer is B

Etiolation is a phenomenon which occurs when a seedling is allowed to grow in the dark and is characterized by;

- Yellowing of the leaves.
- Failure of growth/ increase in size of leaf.
- Increase in node –node length (stem elongation)

To a germinating seed, etiolation allows maximum growth in length with minimum use of food reserves to allow the plant reach light.

4. Dioecious plants are rare in spite of having the advantages of cross pollination because

- A. anthers and stigmas mature at different times.
- B. the male and female plants are usually apart.
- C. half of the individuals do not produce seeds.
- D. only few agents of dispersal are involved.

The answer is C

In dioecious plants, only the female bearing plant produces seeds while the male plants are usually non-seed producing. As a result, the male plants are rare, leading to reduced chances of fertilization of the female, hence rarity of the species.

5. Which one of the following substances would be produced by plants under conditions of water stress?

- A. Indoleacetic acid.
- B. Ethene.
- C. Gibberellins.
- D. Abscisic acid.

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The answer is D

Water stress is a situation in which a plant is liable to lose more water by transpiration than it can gain by absorption from the soil. If this situation continues, the stomata close rapidly as the leaves wilt thereby cutting down water loss to a minimum. This rapid response is brought about by the hormone Abscisic acid secreted by the cells in the wilted leaves.

6. Which one of the following does not lead to change in allele frequency of a population?

A. Mutation

B. Selection

C. Sexual recombination

D. Genetic drift.

The answer is C

According to the Hardy Weinberg principle, the allele frequency of a population remains constant provided that:

- Mutation do not occur
- Selection does not occur
- There is no chance disappearance of genes (genetic drift)

However, sexual recombination does not change the allele frequency of a population.

7. Birds learn to ignore a scare crow that is left in the same spot for a longtime. This type of behaviour is called

A. habituation.

B. associative learning.

C. imprinting.

D. conditioning.

The answer is A

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Learning may be classified into five categories.

- Habituation , is a process by which an animals gradually ceases to respond to a stimulus if this is presented repeatedly in the same amount and fashion for a long time.
- Associative learning is when an animals learn to associate a particular response with a reward or punishment.
- Conditioning is when animals learns to respond to a previously non- stimulating stimulus as a result of it being presented repeatedly in pairs with a usual stimulus. For example, a dog learning to salivate at the sound of the bell.
- Trial and error learning, occur when an animal learns to associate a particular behavior with an unexpected reward. For example, a dog rewarded with food each time it jumps onto a chair eventually learns to jump onto that chair time it enters the room.
- Imprinting is a form of behavior in which younger animals learn to follow the parents right from the time they are born.
- Insight learning is the immediate comprehension and response to a new situation without trial and error. It involves mental reasoning (intelligence)

8. Mendelian expected probabilities of genotypes in a cross occur when

- A. small numbers of offspring are produced
- B. migrations occur in a population
- C. mutations arise.
- D. fertilization is random.

The answer is D

When fertilization is random, all alleles in the population are equally likely to occur in the offspring. This increases chances of obtaining typical Mendelian probabilities in the genotypes of the organisms.

Mutation migration and small population size causes biased selection for or against certain alleles. This makes the alleles of a population unequally likely to appear in the offspring.

## UACE BIOLOGY PAPER 1 (2000-2019)

9. Which one of the following is not correct about cells of a tissue? They

- A. have similar function.
- B. are of same origin.
- C. are of one type.
- D. have physical linkage.

The answer is C

A tissue is a group of physically linked and associated intracellular substances that are specialized for a particular function(s). The cells are of a common origin, but are not necessarily of one type e.g. blood tissue.

10. When a foetus receives antibodies from the mother through the placenta, it acquires.

- A. active immunity.
- B. long—term immunity.
- C. passive immunity.
- D. artificial immunity.

The answer is C

Reception of performed antibodies by an organism is called passive immunity. These antibodies can be injected directly in blood or cross the placenta to reach the foetus.

Note: Active immunity occurs when antigens are injected into the body of an organism and later the body develops its own antibodies against them.

11. Worker bees are

- A. sterile females developed from fertilized eggs.
- B. fertile males developed from unfertilized eggs.

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- C. sterile males developed from unfertilized eggs.
- D. fertile females developed from unfertilized eggs.

The answer is A

In the honey bee colony there is a single fertile (the queen), several thousand sterile females (workers) and a few hundred males (drones). Fertilized eggs are diploid and develop into females while unfertilized eggs are haploid and develop into males. The type of food provided for female larvae determines whether they will become queens or workers. The food called royal jelly is fed to queens to make them fertile.

12. The process of changing the information on mRNA into formation of polypeptides is known as

- A. transcription.
- B. translation.
- C. transduction.
- D. transformation.

The answer is B

The process of changing information on mRNA into formation of polypeptides is called translation. This occurs in the cytoplasm of the cell.

Note:



- Transcription, is the process by which information (instruction) found in DNA is converted into a chains of base sequence in mRNA. It takes place in the nucleus of the cell.
- Transduction, refers to the process by which DNA is transferred from one bacterium to another by a microphage (bacteriophage or virus e.g. HIV)

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- Transformation is the process by which bacteria DNA is changed as a result of direct uptake and incorporation of foreign DNA from its surrounding through the cell membrane.

13. Which one of the following is an essential feature for successful terrestrial life of flowering plants?

- A. Reduction of gametophyte to spores.
- B. Development of pollen tube to transfer male gametes.
- C. Possession of well-developed vascular system.

- D. Reduction of sporophyte to seeds.

The answer is B

The biggest problem with terrestrial life is desiccation

Development of pollen tube to transfer male gametes is therefore an essential feature for successful terrestrial life of flowering plants.

14. Which one of the following movements in fish is counteracted by the vertical horizontal!

- A. Rolling
- B. Backward drag
- C. Pitching

- D. Yawing

The answer is A

A fish is liable of three kinds ability: yawing, pitching and rolling.

⇒ Rolling is the rotation of the body about the longitudinal axis. It is counteracted by both the vertical and horizontal fins acting like the stabilizers on slips.

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- ⇒ Yawning is the lateral deflection of the anterior part of the body resulting from the propulsive action of the tail. It is counteracted by the general massiveness of the head and the pressure of water against the side of the body and the vertical fins.
- ⇒ Pitching is the tendency for the nose to plunge vertically downwards. It is counteracted by dorso-ventral flattening of the body and the large flap-like horizontal fins.

15. During which transfer of energy is most energy lost in an ecosystem?

- A. Producers — primary consumers.
- B. Primary consumers — secondary consumers
- C. Secondary consumers — tertiary consumers
- D. Tertiary consumers — decomposers.

The answer is A

Highest energy loss during transfer in the ecosystem occurs from producers to primary consumers. This is because herbivores make less efficient use of their food. This is due to the fact that plants contain a high proportion of cellulose and sometimes wood which are relatively indigestible and, therefore, unavailable as energy source for most herbivores.

16. The role of oestrogen during birth is

- A. causing contraction of the uterine wall.
- B. increasing the sensitivity of the muscles to oxytocin.
- C. inhibiting the production of progesterone.
- D. promoting milk production in the mammary glands.

The answer is B

During birth, oestrogen increases the sensitivity of the uterine muscle of the contractile effect of oxytocin. It has no direct contractile effect on the uterus.

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17. Which one of the following does **not** contribute to the movement of water from the root system to the leaves in a flowering plant?

- A. Root pressure.
- B. Cohesion forces.
- C. Transpiration pull.
- D. Atmospheric pressure.

The answer is D

Root pressure, cohesion force, and transpiration pull facilitate movement of water through the xylem vessels. Atmospheric pressure plays no role.

18. Arthropods have a lower visual acuity compared to vertebrates because

- A. the ommatidia are less sensitive than rods and cones.
- B. compound eyes contain fewer rods and cones.
- C. the ommatidia are big and only few are packed in an equal area.
- D. the ommatidia contain photochemical pigments which are less readily bleached.

The answer is C

Visual acuity of arthropods is lower than that of vertebrates. The ommatidia have a larger size than cones and so are few in number per unit comparable area. Thus, light from two close points fall on a single ommatidium and the points are perceived as one. The same light would fall on separate a cone which perceives them as two different points.

19. High carbon dioxide concentration in respiring tissues is important because it causes

- A. local vasodilation, allowing more blood into the tissues.
- B. low pH in the tissues leading to unloading of oxygen.

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C. local vasoconstriction creating high blood pressure.

D. increased heartbeat.

The answer is B

Increased metabolic rate results in carbon dioxide building up in the muscle tissues. This combines with water to form carbonic acid that releases hydrogen ions, i.e. causes low pH in the tissue. The hydrogen ions stabilize deoxyhaemoglobin, thus leading to unloading of oxygen.

20. A major difference between respiration and burning is that

- A. no heat is produced during respiration.
- B. burning is a faster process.
- C. burning is a chemical process.
- D. chemical energy is stored in respiration.

The answer is D

Chemical energy released from respiration is stored in form of ATP but physical energy (heat) produced in burning cannot be stored.

Note: both respiration and burning produce heat energy, i.e. they are chemical and exothermic processes

21. Which one of the following is the main form of the photosynthetic product transported through the phloem?

- A. Starch
- B. Amino acid
- C. Sucrose
- D. Glucose

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The answer is C

Most of the photosynthetic products are transported through the phloem in form of sucrose.

This is because it is relatively, highly water soluble and an efficient energy store, hence it does not take part in chemical reaction as it is being transported.

Note:

Glucose is highly reactive and this would result in some intermediate reactions as it is being transported.

Starch is insoluble in water so it cannot be transported in the phloem.

22. Which one of the following structures supplies oxygenated blood to the foetus?

- A. Umbilical cord.
- B. Umbilical vein.
- C. Placenta villi.
- D. Umbilical artery.

The answer is B

The blood rich oxygen and nutrients flows via the umbilical vein from the placenta to the fetus.

From the fetus, blood containing waste products carbon dioxide flows towards the placenta through an umbilical artery.

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23. Which one of the following best describes basal metabolic rate?

- A. Average amount of energy produced by the body.
- B. Average amount of energy produced when at rest.
- C. Amount of energy produced by an average body.
- D. Amount of energy produced when all voluntary movements have ceased.

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The answer is B or D

Basal metabolic rate (BMR) is the rate at which the minimum amount of energy required to maintain vital organ functions such as breathing, heart rate, temperature regulation, etc. is produced by the body while an organism is completely at rest or asleep.

Under these circumstance all voluntary movement ceases.

24. A property of cells in a multicellular organism is that they are

A. small sized

B. less functional.

C. less specialized.

D. dependent.

The answer is D

According to the organism theory, a multicellular organism consists of interdependent cells whose functions are dictated by the needs of the whole organism.

25. Which one of the following tissues has the least power of regeneration?

A. Blood tissue.

B. Epithelium tissue.

C. Bone tissue.

D. Nerve tissue.

The answer is D

Nerve tissue has the least power of regeneration in the body while epithelial tissues have the highest power of regeneration.

Note: cells in nerve tissue are not capable of dividing.

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26. Which one of the following is likely to occur if a photosynthesizing plant was suddenly removed from light?

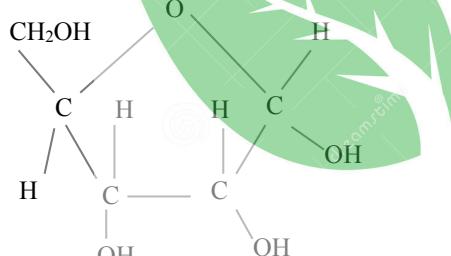
- A. Reduction in PGA
- B. Accumulation of PGAL.
- C. Accumulation of PGA.
- D. No change in amount of PGAL

The answer is C

When light is suddenly removed, a photosynthesizing plant only carries out light – independent stage of photosynthesis, fixing CO<sub>2</sub> to produce PGA. Because there is no light, ATP and NADPH<sub>2</sub> from the light- dependent stage are not available.

Since the reduction of PGA to PGAL requires ATP and NADPH<sub>2</sub> then this reaction will not take place. As a result, PGA accumulates.

27. Which one of the following molecules is represented in Figure 1?



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- A. Fatty acid
- B. Deoxyribose
- C. Glucose
- D. Ribose.

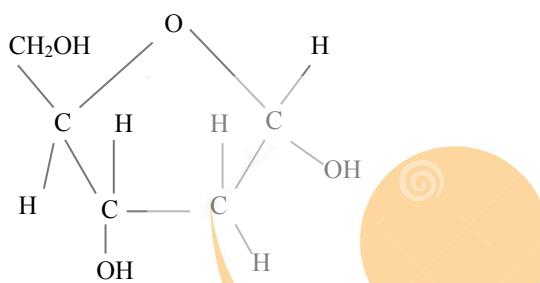
The answer is D

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The carbon atom at position 2 of the pentose (5C-sugar) bear both H and OH groups and so it is ribose.

The carbon atom at position 2 lacked. Note: if the carbon atom at position 2 lacked an ‘O’ atom, the molecule then would have been deoxyribose. Thus.

### Structure of deoxyribose



28. Establishing the genotype of an organism by crossing it with a homozygous recessive individual is carrying out a

- A. test cross.
- B. dihybrid cross
- C. back cross.
- D. monohybrid cross.

The answer is A

A test cross is carried out to establish the genotype of an organism exhibiting a dominant character.

Thus by crossing it with a homozygous recessive individual.

29. In guinea pigs, the allele for rough coat (R) is dominant over one for smooth coat(r) and that for black coat(B) is dominant over one for white coat(b).

The alleles for coat type and colour are not linked. A cross between rough black guinea pig and rough white one produced 28 rough black, 31 rough white, 11 smooth black and 10 smooth white. Which one of the following could be the genotype of the parents?

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- A. RrBb x Rrb
- B. RRBB x RRbb
- C. RRBb x Rrb
- D. RrBB x Rrb

The answer is A

30. Which one of the following is the reason why insects usually hatch rapidly into larvae?

- A. Eggs have little yolk.
- B. Hatching is controlled by external factors.
- C. It is a way of avoiding predators
- D. Due to excessive production of juvenile hormone.

The answer is A

Yolk is the nutrient storage of an embryo in the egg. Insects produce eggs with very little yolk that is not sufficient to nourish the embryo for a long time. Thus their eggs hatch rapidly into larvae which can feed themselves to maturity.

31. Higher concentration of some ions in the cell sap of some fresh water algae compared to the external water is due to

- A. diffusion.
- B. active transport.
- C. pinocytosis.
- D. osmosis.

The answer is B

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The cell sap of the algae is hypertonic to the fresh water. Therefore, some ions are actively transported from the external water into the cell sap, leading to their higher concentration in the sap.

32. Mixing of oxygenated and deoxygenated blood in amphibians is minimized by

- A. rapid contraction of the ventricle.
- B. spongy nature of heart muscles.
- C. spiral valve in the truncus arteriosus.
- D. columnae carnae in the ventricular

The answer is C

- The heart of amphibians has two atria and one ventricle. Blood from the ventricle flows directly into truncus arteriosus from where it flows to vessels leading to the lungs and body.
- To prevent mixing of oxygenated with deoxygenated blood, the ventricle has several folds in its wall and the truncus (conus) arteriosus has a spiral valve that divides its lumen into two.

33. Which one of the following describes the state of the membrane during resting potential?

- A. Polarized.
- B. Neutral
- C. Depolarized
- D. Discharged.

The answer is A

At rest, the membrane of nerve cell is positively charged on the outside in relation to the inside.

Thus a positive pole exists on the outside and negative pole on the inside. The membrane in this is said to be polarized.

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34. Which one of the following tissues would be stained deepest red by a dye that stains nucleic acid red?

A. Sieve tube.

B. Tracheid.

C. Collenchyma.

D. Cambium

The answer is D

Cells collenchyma and cambium tissues are living and nucleated. Being meristematic in nature, cambial cells are continually dividing and as such, they contain a larger amount of genetic material. Therefore, they contain more prominent nuclei compared to collenchyma cells. As a result, they would be stained deepest red by the dye.

Note:

- Tracheid are made up of dead cells.
- Sieve tubes of the phloem are up of living, non-nucleated cells called sieve elements.

35. In which one of the following parts of a chloroplast are water splitting enzymes mostly located?

A. Stroma

B. Intergrana

C. Cytoplasm

D. Grana

The answer is D

The splitting of water by light energy (photolysis) occurs in the thylakoid membrane of the grana in the chloroplast.

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36. In which of the following may sporophytes contain haploid, diploid and triploid cell at some stage?

- A. Conifers.
- B. Mosses.
- C. Flowering plants.
- D. Ferns.

The answer is C

On flowering plant, the sporophyte may contain haploid cells (embryo sac), diploid cells (embryo) and triploid cells (endosperm).

37. Compared to carbohydrates, fats have higher energy value because fats

- A. have long chain of fatty acids.
- B. have a higher proportion of hydrogen.
- C. are more compact in structure.
- D. have a high proportion of oxygen.

The answer is B

The energy of a food substance is amount of energy obtained when 1g of the substance is completely oxidized.

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38. Which one of the following would delay flowering in a short day plant?

- A. Twelve hours of darkness.
- B. More than ten hours of light.
- C. Interruption of dark period with a flash of light.
- D. Less than twelve hours of darkness.

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The answer is C

Short-day plants are actually long-night plants. If they are grown in short days but the long night is interrupted with a flash of light, flowering is prevented.

Note:

Long-day plants (short-night plants) will flower in short days if the long night is interrupted. Short dark interruption; however, do not cancel the effect of long days.

39. Which one of the following nitrogenous wastes is suitable for elimination by a fresh water fish?

- A. Urea
- B. Uric acid
- C. Ammonia
- D. Trimethylamine oxide

The answer is C

Ammonia is a very toxic nitrogenous waste that requires a lot of water for its dilution during excretion. In fresh water animals, water is readily available ammonia is the excretory product of choice.

40. Which one of the following is correct about the sympathetic nervous system?

- A. Nerve endings produce nor-adrenaline.
- B. Preganglionic fibres are long and postganglionic fibres are short,
- C. Nerve endings produce acetylcholine.
- D. Ganglia are embedded in the walls of the effector organs.

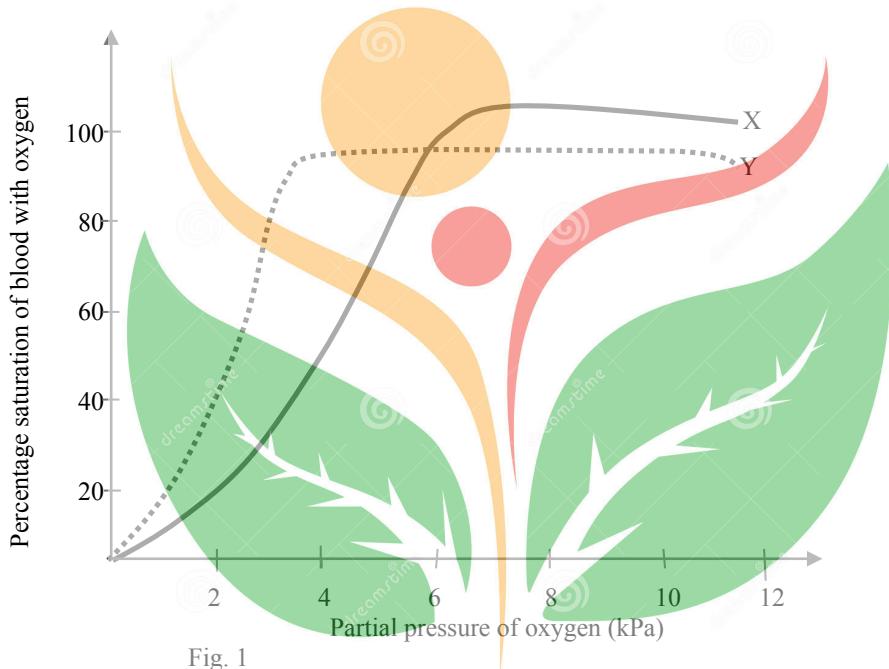
The answer is A

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Most nerve endings in the sympathetic nervous system produce Noradrenalin. These nerves have short preganglionic fibers and long post-ganglionic fibers. Their ganglia are far away from the organs they innervate: they are found along the vertebral column (Para-vertebral ganglia).

### SECTION B

41. Figure 2 show oxygen dissociation curves for haemoglobin of two animals, X and Y, living in different habitats.



(a) From the figure state three differences in the behavior of haemoglobin of the two animals.

(2marks)

(b) Has a lower affinity for oxygen. (c) Has a lower rate of oxygen saturation (d) Releases oxygen slowly at lower oxygen partial pressures	Has a higher affinity for oxygen Has a higher rate of oxygen saturation Releases oxygen rapidly at lower oxygen partial pressures.
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Other:

X	y
Becomes fully saturated only at oxygen partial pressures greater than 8kpa	Becomes fully saturated only at oxygen partial pressures greater than 5kpa
Has a higher full saturation capacity (above 80%)	Has a lower full saturation capacity (about 80%)

(e) (i) Outline the characteristics of the haemoglobin of animals y. (3marks)

- Has a higher oxygen affinity
- Releases oxygen at low partial pressure
- Has a high rate of oxygen uptake at lower oxygen partial pressures

(ii). From characteristics in (b) (i) suggest the nature of the habitat in which animal y lives (01mark)

Animal y live in a habitat with low oxygen partial pressures such as at high altitude.

(c). Human haemoglobin has a higher affinity for carbon monoxide than oxygen. What is the effect of the fact? (03marks)

In the haemoglobin molecule,, carbon monoxide readily replaces oxygen. It binds irreversibly with haemoglobin molecules and thus reduces oxygen carriage of the blood. As a result, the body tissues are deprived of oxygen leading to tissue death.

42. (a) Differentiate between respiratory quotient (RQ) and basal metabolic rate (BMR).

Respiratory quotient is the ratio of the volume of carbon dioxide given out to the volume of oxygen consumed when one mole of respiratory substrate is completely oxidized in the body.

Basal metabolic rate is the rate at which the minimum amount of energy needed to maintain vital processes of the body cells such as temperature regulation and breathing, is released when the body is completely at rest.

(b) Table 1 shows the respiratory quotients in germinating seeds under different treatments.

Table 1

Treatment	RQ
(i) 4hr soaking in water	6.0
(ii) 4hr soaking then 4 hour exposure to air	1.8
(iii) 4hr soaking then 24hr exposure to air	1.0

Explain the different respiratory quotients of the germinating seeds under the different treatments.

**(i) 4hrs of soaking in water**

When the seeds are not exposed to air, there is inadequate oxygen supply and absorption. The seeds respire anaerobically to produce carbon dioxide.

The volume of carbon dioxide released by the seeds in respiration far exceeds that of oxygen consumed and the RQ is greater than 1.0.

**(ii) When the seeds are soaked in water, then 4hour exposure to air**

The volume of oxygen absorbed by the seeds increases. Then, here is a combination of aerobic and anaerobic respiration occurring. However, the volume of carbon dioxide produced exceeds that of oxygen consumed and the RQ is still above 1.0. Anaerobic respiration is greater than aerobic respiration.

**(iii) 4 hour soaking then 24hour exposure**

The volume of oxygen absorbed is adequate for the plant to rely solely on aerobic respiration for its energy needs.

Since carbohydrate are the main energy substrate in the seed, complete respiration consumes the same volume oxygen as the volume of carbon dioxide produced and so the RQ is 1.0.

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(c) Explain why the BMR varies with the age of the individual.

At rest, the energy requirements of the body vary with age to keep pace with the energy requirement at a particular age, BMR also varies with age.

43. Table 2 show the increase in size of a leaf of a plant with time.

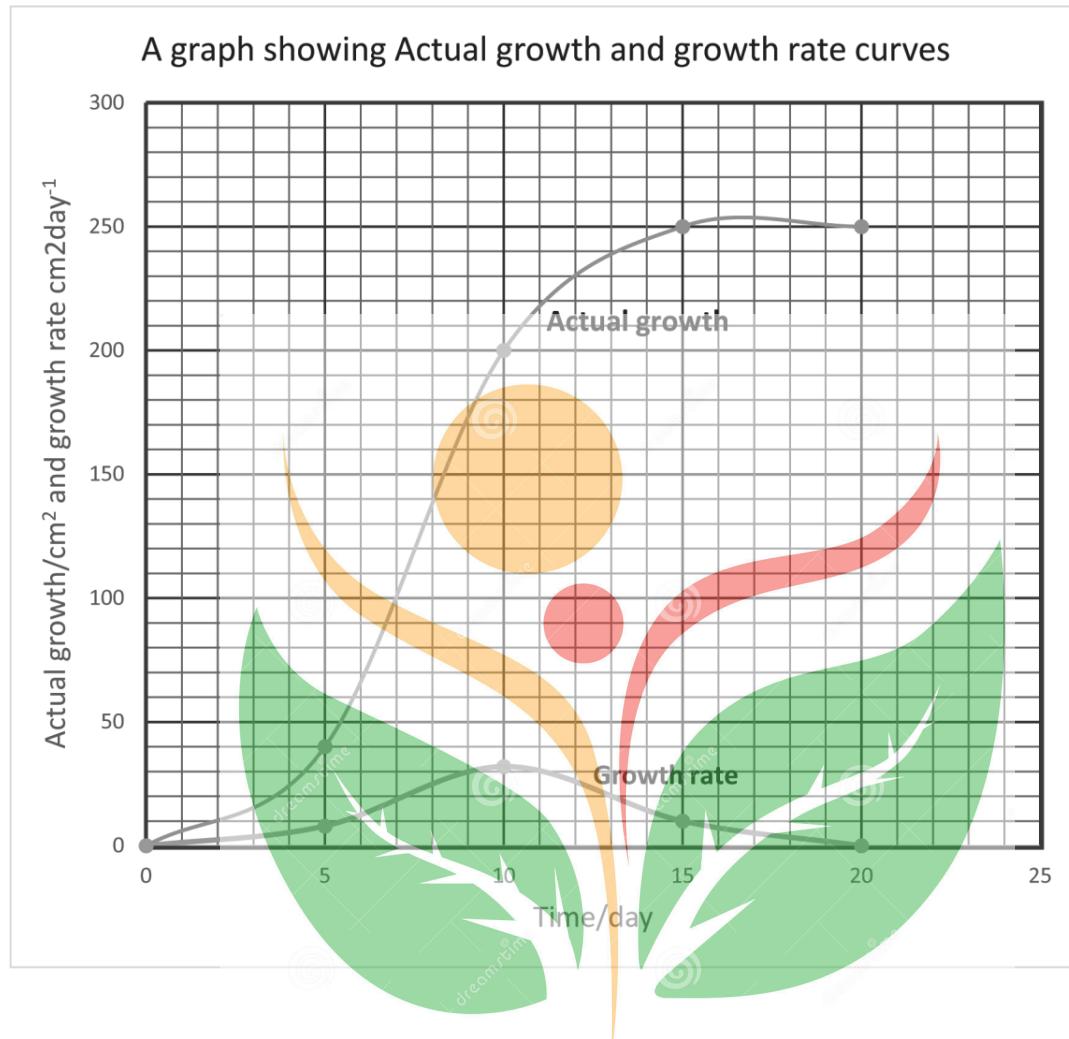
**Table 2**

Days	Area of leaf ( $\text{cm}^2$ )	Rates of growth ( $\text{cm}^2/\text{day}$ )
0	0	
5	40	
10	200	
15	250	
20	250	

(a) Complete the table by working out the growth rate at 5 days intervals

Days	Area of leaf ( $\text{cm}^2$ )	Rates of growth ( $\text{cm}^2/\text{day}$ )
0	0	
5	40	$\frac{40-0}{5} = 8$
10	200	$\frac{200-40}{5} = 32$
15	250	$\frac{250-200}{5} = 10$
20	250	$\frac{250-250}{5} = 0$

(b) In the space provided, plot actual growth and growth rate.



(c) State main differences between growth in plants and that in animals.

- Growth in plants is located in a few plant cells while in animals growth occurs in all body cells
- Growth in plants is unlimited while in animals it is limited
- Growth factors in plants are sensitive to light while in animals are not
- The secretion of growth factors in animals can be by nervous system absent in plants

(d) What are the limitations of measuring leaf as a way of measuring growth in a plant?

- It does not account for girth or volume

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- Different parts of the plant may grow at different rates
- The method is not accurately measured using simple instrument
- Leaf growth is not uniform in all dimensions

44.(a) (i) Describe how the quadrat method can be used to determine species density.

- A square frame of metal /wood of side  $xm$  is placed randomly I an area on ground (quadrat) containing species to be identified and counted
- The number of species in the area enclosed is determined and recorded.
- The procedure is repeated randomly in  $n$  locations on the same piece of land. The total number of species counted is recorded; let it be  $N$

Species density is then calculated from.

$$\text{Species density} = \frac{\text{population estimate}}{\text{total area of study}} = \frac{N}{nx^2} \text{ species } / \text{m}^2$$

(ii) State the advantage and disadvantage of the method.

**Advantages**

- it is accurate
- it marks out a small area within which determination of the number of species present is easy.
- It gives a good sample size of immobile species.
- Can be used to compare different areas and species
- Provides an absolute measure of abundance

**Disadvantages**

- It is time consuming to count all individuals in sampled area
- It cannot be used to determine density of rapidly mobile/ flying species.

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- It is very tiresome to count species in several small area in order to come up with a representative sample.

(b) Why is it important to estimate population size?

- To monitor population change
- To establish feeding relationship within a habitat
- To construct food chain, food web and pyramid of numbers
- To determine carrying capacity of a given habitat
- For proper planning of distribution of resources e.g. in human

(ii). In estimating the number of fish in a small lake, 625 fish were caught, marked and released, after one week, 290 fish caught and of these, 150 had been marked

What was the estimated size of fish population?

150 marked fish is contained in 290 fish

$$625 \text{ marked fish will be contained in total population} = \frac{625 \times 290}{150} = 3833 \text{ fish}$$

(iii) In using the method I b (ii) to estimate the population size of fish, state two assumption that were made.

- That fish mix randomly within the population.
- That organisms disperse randomly within the geographical area of the population.
- That change in the population size due to immigration, birth and deaths within the time of experiment are negligible.
- Time allowed is enough for random mixing
- Markings do not affect random mixing

45. (a) With reason, give example of animals which produce each of the following excretory products.

(i) Ammonia

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Ammonia is highly toxic and very soluble and thus requires a lot of water for excretion; it is thus a suitable excretory product for fresh water aquatic animals such as bony fish, protozoa, cnidarians, Platyhelminthes that live in abundant water

(ii) uric acid

Uric acid is insoluble, nontoxic and requires minimal amount of water for excretion; it is a suitable excretory product for terrestrial animals such as birds, reptile and insects

(b) State

(i) Why the pH of the fluid in a human body is kept constant

All metabolic reactions in the body are controlled by enzymes that work within narrow pH range

(ii) Three ways of keeping the pH in b(i) constant

- controlled elimination of  $H^+$  ions and anions by the kidneys.
- Controlled rate of elimination of carbon dioxide from the body by breathing.
- Hydrogen ion buffering by plasma proteins in blood.

46. (a) What is displacement activity?

Displacement activity is when an animal, faced with conflicting situation, performs an act which is trivially irrelevant to the situation in order to release the tension developed thereof. for example, after being annoyed, a man bangs a table

(b) State the ecological importance of each of the following forms of behavior

(i) Territorial behavior

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- Provide defense of an area in which organisms live against organisms of the same or different species.
- The mating pair of organisms of the same species and their offspring are well spaced to receive the available resources, e.g. food, space and shelter.
- The available resource is protected and shared amongst the population

Others:

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- Actual fighting between organisms, which would be detrimental to the species is rare and replaced by mere threats.
- Intraspecific competition is reduced.
- It minimizes spread disease and parasites.
- Genes from strong organisms or the fittest are passed on to the next generation.

### (ii) Courtship behavior

- It leads to rise levels of reproductive hormones
- It stimulates organisms to sexual activity.
- It tightens pair bonding between the mating pair.
- It synchronizes time to produce offspring in right seasons.
- It induces mating of individuals who accept each other.
- It synchronizes gonad development, enabling gametes to mature at the same time, this ensures that fertilization occurs when mating takes place.

### (c) Give two ways in which animals avoid predation.

- Mimicry
- Camouflage.
- Keen eye-sight
- Adoption of nocturnal life
- Alarms
- Fast runner
- Glossy body surface
- Production of poisonous substance as is the case of toads and frogs
- Adoption of nocturnal life style
- Production of unpleasantly smelling substance that repel predators
- Possession of thorn-like structure on the body surface, making them unpleasant to predators e.g., the Hedgehog
- Possession of hard non palatable covering as in tortoises, beetles and snails

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**SECTION A**

**Answer all questions**

1. In the body, proteins may combine with acids or bases depending on the
- A. temperature of the medium.
  - B. hydrogen ion concentration in the medium.
  - C. number of solvent molecules present in the medium.
  - D. number of amino acid molecules in the protein.

The answer is B

Proteins are amphipathic (amphoteric) molecules; they combine with acid or bases depending on the PH (hydrogen ion concentration of the medium in which they are).

2. Epithelial type lining the mammalian alveoli is
- A. columnar. Champions
  - B. cuboid.
  - C stratified.
  - D- squamous.

The answer is D

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The epithelium of the mammalian alveoli is simple squamous epithelium. This is a single layer of cells over the alveolar surface to reduce diffusion distance for respiratory gases.

3. Which one of the following is correct about first division of meiosis but not that of mitosis?

- A. Nucleolus disappears.
- B. Spindle is formed.
- C. Centrioles move to opposite pole of the nucleus.
- D. Homologous chromosomes associate to form bivalents.

The answer is D

In the first division of meiosis, homologous chromosomes associate to form bivalents in process called synapsis. This does not occur during mitosis.

4. Worker bees and the queen bee are polymorphic forms which differ in their fertility as a

Result of

- A. feeding on different diets.
- B. worker's eggs not being fertilized.
- C. workers being produced parthenogenetically.
- D. the queen having diploid cells while the workers have haploid cells.

The answer is A



Worker bees and the queen bee are both females but the worker bee is sterile while the queen is fertile. This results from the different diets on which the two feed during development. The queen feeds on Royal jelly that makes it fertile.

5. Which of the following ions move from the plasma into the red blood cells to maintain electro-neutrality during the uptake of carbon dioxide by the blood in the tissues?

- A.  $\text{Cl}^-$

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- B.  $\text{CO}_3^{2-}$
- C.  $\text{K}^+$
- D.  $\text{HCO}_3^-$

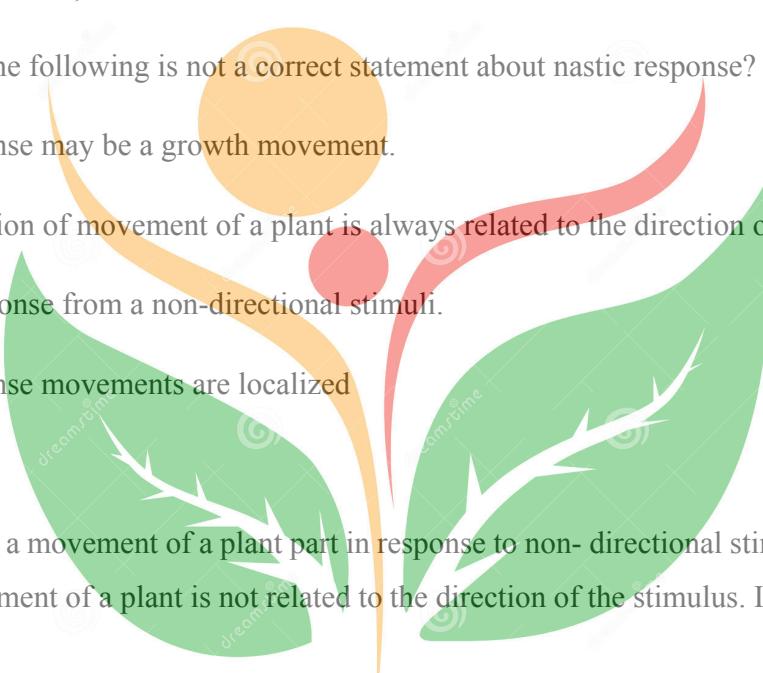
The answer is A

During transport of carbon dioxide by blood,  $\text{HCO}_3^-$  ions move from the red blood cell into plasma. This makes the interior of the red blood cell to be more positive. To maintain electroneutrality inside the red blood cell,  $\text{Cl}^-$  ions move out of the red blood cell. This is called the chloride shift.

6. Which one of the following is not a correct statement about nastic response?

- A. The response may be a growth movement.
- B. The direction of movement of a plant is always related to the direction of the stimulus.
- C. It is a response from a non-directional stimulus.
- D. The response movements are localized

The answer is C



Nastic response is a movement of a plant part in response to non-directional stimulus. That is, the direction of movement of a plant is not related to the direction of the stimulus. It may be a growth movement.

7. Long-day plants may be stimulated to flower if

- A. the period of darkness is interrupted with flashes of light.
- B. provided with more than 10 hours of light.
- C. provided with 12 hours of complete darkness.
- D. the light period is interrupted with short dark period.

The answer is A

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Long plants require photoperiod of more than a critical length in order to flower. They require either a relatively small period of darkness at all. They flower best in continuous light. Interruption of the light period with a small period of darkness inhibits flowering while a flash of light during the dark period induces flowering in these plants.

8. Wearing a coarse shirt causes unpleasant sensation at first but later the discomfort disappears because

- A. with continued stimulus, generator potential falls below threshold value.
- B. the post-synaptic surfaces fail to release the transmitter substance.
- C. nervous system stops carrying sensory impulses.
- D. continued stimulation leads to fusion of generator potentials.

The answer is A

In the process called habituation continuous stimulation of a part of the body with the same stimuli leads to progressive increase in generator potential until it becomes sub-threshold and is no longer perceived.

9. Which one of the following is the correct shape, in the region of the body of an earth worm where its circular muscles are contracted?

- A. Short and thick.
- B. Long and thin.
- C. Short and thin
- D. Long and thick.

The answer is B

During locomotion in an earth worm, when the longitudinal muscles contract, the region becomes thick and short and moves forward. When the circular muscles contract and longitudinal muscles relax, the region becomes thin and long.

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10. Chiroleples, the desert frog flourishes in the desert because it

- A. has a water proof skin.
- B. is nocturnal.
- C. has few and small glomeruli.
- D. reabsorbs metabolic water

The answer is B

Chiroleples is a nocturnal frog that **hides** during day when temperature is **high** and **becomes active** during the night when temperature is **low**. This makes it capable of surviving in the desert.

11. Which one of the following is the ultimate hydrogen acceptor during anaerobic respiration in animals?

- A. Lactic acid.
- B. NAD
- C. Pyruvic acid.
- D. Acetyladehyde.

The answer is C

During anaerobic respiration pyruvic acid produced in glycolysis directly reduction by  $\text{NADH}_2$  to lactic acid. In this reaction, pyruvic acid is the hydrogen acceptor.

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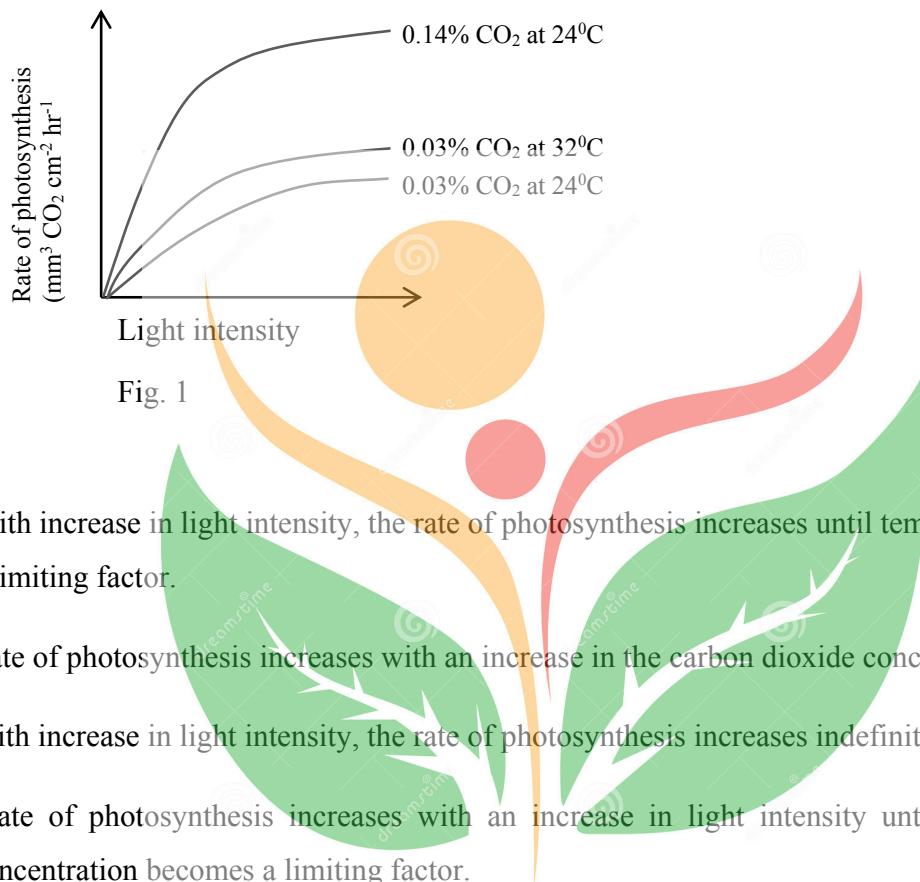
12. Which one of the following is unlikely to be found in the body cells of obligate anaerobes?

- A. Glycolytic enzymes.
- B. ATP
- C. Mitochondria.
- D. Sugars.

The answer is C

Obligate anaerobes are organisms that live exclusively in anaerobic condition. Such organisms would have no need for mitochondria which carries out reaction of aerobic respiration.

13. Which one of the following is illustrate Figure 1?



The answer is D

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In the figure, the rate of photosynthesis increases with an increase in light intensity until  $\text{CO}_2$  concentration becomes a limiting factor. That is why increasing  $\text{CO}_2$  concentration from 0.03% to 0.14% at  $24^\circ\text{C}$  increases photosynthetic rate more than increasing temperature from  $24^\circ\text{C}$  to  $32^\circ\text{C}$  at 0.03%  $\text{CO}_2$  concentration.

This is in accordance with the law of limiting factors which: when a chemical process is affected by more than one factor its rate is limited by that factor which is nearest its minimum value.

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14. Which one of the following is not a fibrous protein?

- A. Keratin
- B. Globulin
- C. Elastin.
- D. Collagen

The answer is B

Collagen, elastin and keratin are fibrous protein while globulin is a globular protein

15. Which one of these activities would result into a low respiratory quotient?

- A. Respiration in muscles during heavy exercise.
- B. Formation of calcareous shells.
- C. Fattening livestock.
- D. Preparation for hibernation in a mammal.

The answer is B

$$RQ = \frac{\text{carbon dioxide produced}}{\text{Oxygen used}}$$



During heavy muscle exercise, the muscle cells resort to anaerobic respiration, production a lot of carbon dioxide with no use of oxygen. Therefore, a high RQ results. Also, in preparation for hibernation and fattening stock there is conversion of carbohydrates to fat, this release carbon dioxide with no oxygen use hence increasing the RQ.

However, in processes such as construction of calcareous shells and photosynthesis there is a low RQ.

16. A probable function of the endoplasmic reticulation is to

- A. control the entry and exit of materials in cells.
- B. facilitate intracellular transport of materials.
- C. act as a template in protein synthesis.
- D. enable substances diffuse against concentration gradient.

The answer is B

Endoplasmic reticulum is an intracellular channel system that facilitates intracellular transport material

17. The rapid stomatal closure during wilting is due to

- A. increase in Abscisic acid.
- B. rapid conversion of sugar to starch.
- C. rapid accumulation of carbon dioxide in the guard cells.
- D. reduction in the level of mineral ions in the guard cells.

The answer is A

Abscisic acid (ABA) acts as a stress hormone.

If plants are subjected to serve drought, ABA is synthesized in the leaves and induces rapid closure of stomata. This reduces water loss through them.

18. Cartilagenous fish retain urea in the blood in in order to

- A. avoid dehydration.
- B. reduce entry of salts into the tissue.
- C. avoid loss of excess water by excreting it.

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- D. maintain an internal ionic concentration in balance with the external medium.

The answer is A

Cartilaginous fish face a high tendency to lose water to the surrounding saline waters. They retain urea in blood in order to maintain a higher blood osmotic potential so as to continually absorb water from their environment. This prevents dehydration.

19. Which one of the following organisms does not belong to the same phylum as the rest?

- A. Tape worm.
- B. Liver fluke.
- C. Planaria
- D. Leech.

The answer is D

Tapeworm, fluke and planaria belong to phylum Platyhelminthes (flat worm) while leeches belong to phylum Annelida (segmented worms), together with clam worms and earthworms.

20. A cockroach has a respiratory system while an earthworm does not because

- A. earthworms do not need much oxygen.
- B. the surface volume ratio in a cockroach is small.
- C. earthworms can be parasitic.
- D. the respiratory system provides shape in a cockroach.

The answer is B

The earthworm has a very large surface area volume ratio so that diffusion alone can suffice its gaseous exchange needs. However, the Cockroach has a smaller surface area to volume ratio ad so would require a respiratory system for gaseous exchange.

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21. Which one of the following structures is not homologous with the rest?

- A. Bat wing.
- B. Human fore arm.
- C. Insect wing.
- D. Bird wing.

The answer is B

Homologous structures have a similar structural composition but may be adapted to perform different functions. Example includes; bat wing human fore arm, and bird wing (all have a pentadactyl limb system). However, the insect wing, bat wing and bird wing are analogous in being able to perform a similar function though they differ in structure.

22. Which one of the following has the greatest biomass in an ecosystem?

- A. Tertiary consumers.
- B. Primary producers.
- C. Secondary consumers.
- D. Primary consumers.

The answer is B

In most cases, the greatest amount of biomass is contained in primary producers.



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23. Which one of the following is an effect of the luteinizing hormone?

- A. Development of the Graafian follicles.
- B. Ovulation.
- C. Stimulation of sperm production.
- D. Repair of the uterine wall.

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The answer is B

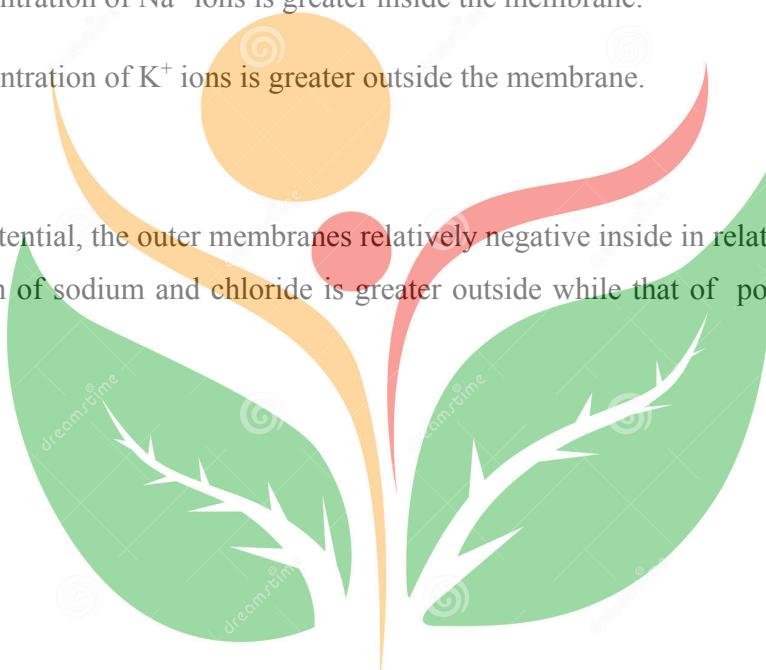
Luteinizing hormone is responsible for ovulation in the female reproductive cycle.

24. Which one of the following is a correct statement about a neurone membrane during resting potential?

- A. The inside of the neurone membrane is negatively charged.
- B. The  $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{Cl}^-$  ions are evenly distributed on either side of the membrane.
- C. The concentration of  $\text{Na}^+$  ions is greater inside the membrane.
- D. The concentration of  $\text{K}^+$  ions is greater outside the membrane.

The answer is A

During resting potential, the outer membranes relatively negative inside in relation to the outside. The concentration of sodium and chloride is greater outside while that of potassium is greater inside the neuron.



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25. Which one of the following statements is not correct about a test cross?
- A. It is carried out on an organism with a dominant phenotype.
  - B. The offspring of the cross may all have dominant phenotype.
  - C. The organism of the unknown genotype is crossed with a homozygous dominant individual.
  - D. The offspring of the cross may have either a ratio of 1 dominant phenotype: 1 recessive phenotype.

The answer is C

A test cross is carried out between an organism with a dominant character and one with a recessive character in order to find out the genetic constitution of the organism carrying the dominant character.

26. Which of the following conditions result from gene mutation?
- A. Klinefelter's syndrome.
  - B. Turner's syndrome.
  - C. Sickle cell anaemia.
  - D. Down's syndrome.

The answer is C

Sickle cell anemia is caused by a gene mutation in the gene coding for the  $\beta$  haemoglobin chains.

This leads to substitution of glutamic acid for valine. On the other hand, Klinefelter's syndrome, Turner's syndrome and Down's syndrome are chromosomal mutations.

27. If the triplet of mRNA is AAG what is the complementary triplet of the bases on the tRNA molecule?

- A. TTC

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- B. UUC
- C. CCT
- D. CCU

The answer is B

In RNA adenine teams with Uracil (A - U) while guanine teams with cytosine (G -C). Thus for the mRNA triplet AAG, the complementary tRNA sequence would be; UUC.

28. Which one of the following factors does not increase the chances of fertilization in mammals?

- A. Seasonal breeding cycles.
- B. Female receptiveness to the male only during ovulation.
- C. Internal fertilization.
- D. Development of secondary sex characteristics

The answer is D

Development of secondary sexual characteristic has no direct effect on the fertility or chances of fertilization in mammals.

29. Which one of the following is not a problem that endoparasites face in their transmission?

- A. Leaving the host.
- B. Entering the host.
- C. Living away from the host.
- D. Identifying the host.

The answer is A

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Endoparasites never find problem getting out of (leaving) the host because this is always facilitated by the host's excretory mechanisms. However, entering the host, identifying the host and living away from the host can be bg problems for the endoparasite.

30. Which one of the following statements is/are correct about the exponential phase in the population growth?

- A. Death rate and birth rate are equal.
- B. Numbers of individuals and rate of growth increase.
- C. The numbers outstrip the supply of factors for support.
- D. Slow growth of the population.

The answer is A

During the exponential phase of population growth, the number of individual are rate of growth increase. The birth rate is much higher than the death rate.

31. An organism living in a oxygen deficient environment has

- A. haemoglobin that easily picks up oxygen.
- B. its oxygen dissociation curve to the right.
- C. haemoglobin that readily releases its oxygen.
- D. haemoglobin that less readily picks up oxygen

The answer is A

An organism living in an oxygen deficient environment has haemoglobin that has a high affinity for oxygen hence easily picks up oxygen. Its oxygen dissociation curve to the left of that of human haemoglobin.

32. Which one of the following is not a purpose for courtship behaviour among animals?

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- A. Ensuring that both partners are sexually mature.
- B. Establishing a pair-bond.
- C. Ensuring that both partners are ready for mating.
- D. Establishing territories.

The answer is D

Courtship behavior does not help in establishing territories but ensure that;

- Both partners are sexually mature
- A strong bond pair is established
- Both partners are ready for mating

33. Which one of the following statements is not correct about seed dormancy?

- A. It allows further development of the seed.
- B. It is induced by internal factors.
- C. It increases the chances of survival of the seed.
- D. It is ended by external factors.

The answer is D

Seed dormancy

- Allows further development of the seed
- Is induced by internal factors
- Increases the chances of survival of the seed

But may not always be ended by external factors.

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34. Figure 2 shows that

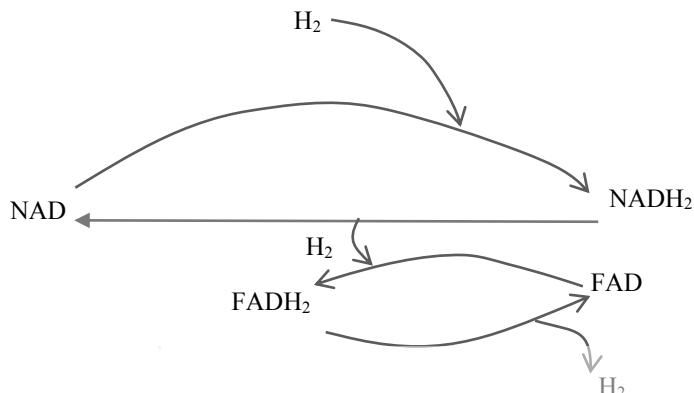


Fig.2

- A. NAD is oxidized to  $\text{NADH}_2$ .
- B.  $\text{NADH}_2$  reduces FAD to  $\text{FADH}_2$ .
- C.  $\text{FADH}_2$  is reduced to FAD.
- D.  $\text{NADH}_2 + \text{H}_2 \rightarrow \text{NAD}$

The answer is B

In the figure,  $\text{NADH}_2$  gives its  $\text{H}_2$  to FAD. Thus,  $\text{NADH}_2$  is oxidized to  $\text{NAD}^+$  while  $\text{FAD}^+$  is reduced to  $\text{FADH}_2$ .

35. The number of organisms in each trophic level reduce as one moves up a food chain because

- A. energy is lost in moving from one trophic level to another.
- B. energy is lost from the top trophic levels.
- C. organisms in higher trophic levels are less productive.
- D. high level of predation at the top trophic levels.

The answer is A

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The number of organisms supported at any trophic level depends largely on the amount of energy available at that level. Since energy is lost in moving from the trophic level to the next up a food chains, the number of organisms reduces in the same order.

36. Anaerobes thrive better than aerobic organisms experiencing thermal pollution because

- A. high temperatures kill aerobic organisms.
- B. anaerobes possess enzymes that work best at high temperatures.
- C. high temperatures reduce solubility of oxygen.
- D. high temperatures encourage multiplication of aerobes predators.

The answer is C

High temperature reduces oxygen solubility in the water. Thus anaerobic organisms thrive better than aerobic organisms in waters experiencing thermal pollution because such waters contain less dissolved oxygen.

37. Which one of the following is correct about parallel flow of water across the gills?

- A. water has higher oxygen concentration at each point of contact.
- B. low blood oxygen concentration is attained.
- C. Diffusion occurs over the whole region of the gill filament.
- D. High blood oxygen concentration is achieved.

The answer is B

In parallel flow of water across the gill, low blood oxygen concentration is attained. This is because the water progressively loses oxygen to blood as it flows along the gill in the same direction as blood is flowing in the gill. This continues until equilibrium is reached when no more oxygen can be extracted from the water.

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38. Which one of the following adaptations of xerophytes does not reduce transpiration?

- A. Hairy leaves.
- B. Leaves with thick waxy cuticle.
- C. Small sized leaves.
- D. Succulent stems.

The answer is D

Possession of hairy, small sized leave with a thick waxy cuticle reduces transpiration in xerophytes. But possession of succulent stems the store water does not reduce transpiration.

39. The influx of water in fresh water bony fish is offset by possession of

- A. numerous, large glomeruli and reabsorption of salts from the renal fluid.
- B. numerous, small glomeruli and uptake of salts from the body.
- C. few large glomeruli and uptake of salts.
- D. many small glomeruli and uptake of salts.

The answer is A

In fresh water fish, there is a high tendency for their plasma to be diluted by influx of fresh water from the surrounding. However, numerous, large glomeruli ensure that a large glomerular filtrate is formed and much water filtered from plasma. Reabsorption of salts from the renal fluid enable them to maintain a uniform osmotic potential of the body fluids.

40. The main difference between endotherms and ectotherms is that ectotherms

- A. gain their body heat from internal sources.
- B. gain less heat than endotherms
- C. gain the body heat from external sources.

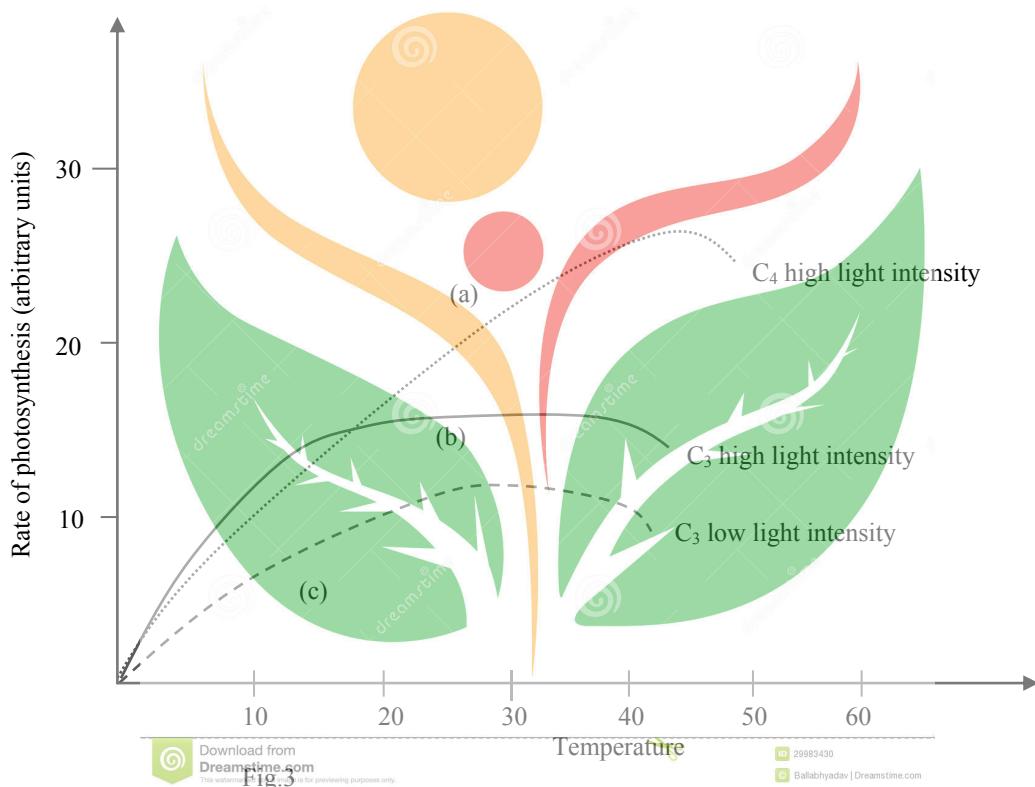
- D. are lower animals while endotherms are higher animals.

The answer is C

Ectotherms gain heat from external source while endotherms generate heat within, to maintain body temperature.

## 8. 2 Section B

41. Figure 3 show the variation of rate photosynthesis with temperature in C<sub>3</sub> and C<sub>4</sub> plants, at different light intensities.



- (a) Using the figure, state how differently temperature affects the rate of photosynthesis in C<sub>3</sub> plants from C<sub>4</sub> plants at high intensity.
- Maximum rate of photosynthesis is higher for C<sub>4</sub> plants than C<sub>3</sub> plants.
  - At temperature below 10° C, C<sub>3</sub> plants have a higher rate of photosynthesis

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- At temperature above  $20^{\circ}\text{C}$ , the rate of photosynthesis in C<sub>3</sub> plants is lower than that in C<sub>4</sub> plants.
- In C<sub>4</sub> plants, rate of photosynthesis is increase rapidly with temperature up to a maximum at  $40^{\circ}\text{C}$ . for C<sub>3</sub> plants, rate of photosynthesis increases gradually at a decreasing rate with temperature, to a maximum about  $35^{\circ}\text{C}$ .

- (b) Explain the differences in the effect of temperature on the rate of photosynthesis in C<sub>3</sub> and C<sub>4</sub> plants at high light intensities stated in (a).

In C<sub>3</sub> plants, plants, increase in temperature reduces the affinity of RUBP carboxylase for carbon dioxide but increase its affinity for oxygen. As a result, more CO<sub>2</sub> is lost and less is fixed photosynthesis.

PEP- carboxylase's affinity for carbon dioxide in C<sub>4</sub> is not affected by temperature. Instead, temperature increases the rate of the enzyme action by increasing the kinetic energy of the reacting molecules and enhances the process of photosynthesis.

- (c) Explain the pattern of curve (c) in the figure.

- Rate of photosynthesis increases gradually, until a maximum at about  $35^{\circ}\text{C}$  and then decreases rapidly at higher temperature.

**Explanation**

- At high temperature, RUBP carboxylases gives up CO<sub>2</sub> and pick up O<sub>2</sub>. CO<sub>2</sub> then lost in photorespiration.
- However, temperature increases kinetic energy of reactants leading to the initial gradual increase in photosynthetic rate. The rate soon reaches a maximum as the enzyme becomes denatured by high temperatures, and drops rapidly.

42. (a) What is meant by apical dominance?

Apical dominance is a phenomenon that occurs in plants where the presence of the apical bud inhibits the growth of lower axillary buds, yet when the epical bud is removed, growth of the lower buds resumes.

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(b) State the causes of each of the following

(i) Apical dominance

- Auxins produced in the apical bud travel down the stem to the lateral buds and inhibit their growth.
- Presence of the apical bud promotes apical dominance

(ii) Seed dormancy

- Premature embryo
- Presence of hard impermeable testa/seed coat.
- Presence of germination inhibitors such as abscisic acid.

(c) what is the ecological importance of

(i) Apical dominance

- Enable the plant to grow first vertically so as to access sunlight.
- Enable the plant to outcompete other individuals in the vicinity for sunlight.
- In case of damage to the apical bud, it ensures continuity of plant species by allowing the lateral buds to grow thereafter.

(ii) Seed dormancy

- Enable the seeds to survive unfavorable conditions like drought.
- Prevents the seeds from developing in the pods
- Allows for seed dispersal, which ensures colonization of new habitats

43. (a) Explain the absence of a yolk sac in the development of a human foetus while it is an important structure in the development of birds.

The yolk sac produces red blood cells in the human embryo but its function is quickly taken over by the liver in the foetus. It then degenerates, as it no longer serve any other function.

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In the birds, the yolk sacs are very important source nourishment throughout the development of the embryo and cannot be done without. In the human foetus nourishment is provided through the placenta.

(b) State the reproductive adaptation of birds to terrestrial life.

- Fertilization is internal. This increases chances of success of the process of fertilization.
- They lay eggs with shells in which the embryo grows with all the nutrients and protection provided.
- The birds usually incubate their eggs, keeping them at the right temperature for growth of the embryo and protecting them from external harm.
- They exhibit sexual dimorphism with a well-developed courtship behavior ensuring that mating occurs at the right time.

(c) Give three form of parental care provided by mammals.

- Breast feeding of young ones.
- Carrying, playing with young ones i.e. showing young one's parental love.
- Protection of young ones from external harm/ dander.
- Development of young ones from inside the mother womb.

44. (a) What is instinctive behavior?

Instinctive behavior refers to species – specific, protective or procreation activities of an individual in the environment influence.

(b) State two factors that influence instinctive behavior.

- Species type
- Genetic constitution
- Exposure to behavior provoking stimuli.

(c) Territorial behavior is common among animal species. Give

(i) Four advantage of this behavior

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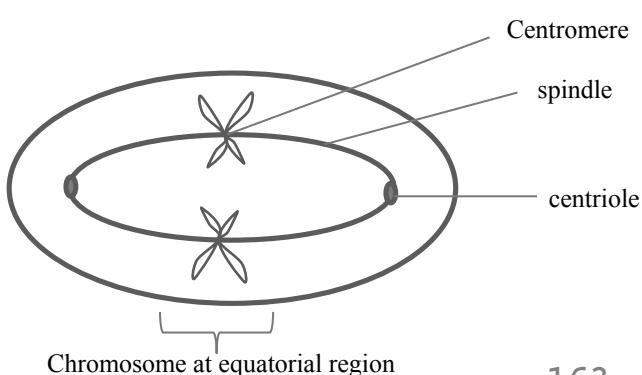
- The mating pair of organisms of the same species and their offspring are well spaced to receive the available resource e.g. food, space. Shelter.
- The available resources are protected and shared evenly amongst the population.
- Provides defense of an area in which organism live against organisms of the same or different species.
- It minimizes spread of diseases and parasites.
- Actual fighting between organisms which would detrimental to the species is rare and replaced by mere threats.
- The species protect and achieve maximum utilization of the habitat.
- Population growth is easily controlled.
- Intraspecific competition is reduced.
- Genes from strong organisms or the fittest are passed on to the next generation

(ii) Three disadvantages of this territorial behaviour.

- A lot of energy is lost in guarding the territory against intruders.
- May lead to death of weak individuals.
- Unfavorable genes carried by strong individuals end up being propagated to future generations.
- Individuals in the territory have limited choices of food and mates because tier supply is limited to those present in the territory.
- In case of a diseases outbreak, all individuals in the territory may die without escaping from it for fear of being killed by animals in other territories.

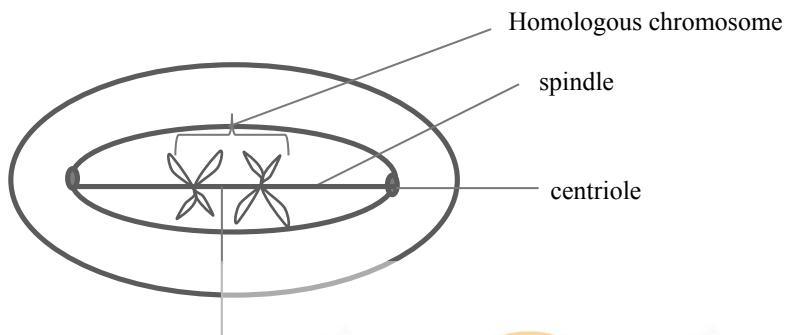
45. (a) Illustrate with a cell of one pair of homologous chromosomes, draw diagrams in the space below to show.

(i) mitotic metaphase



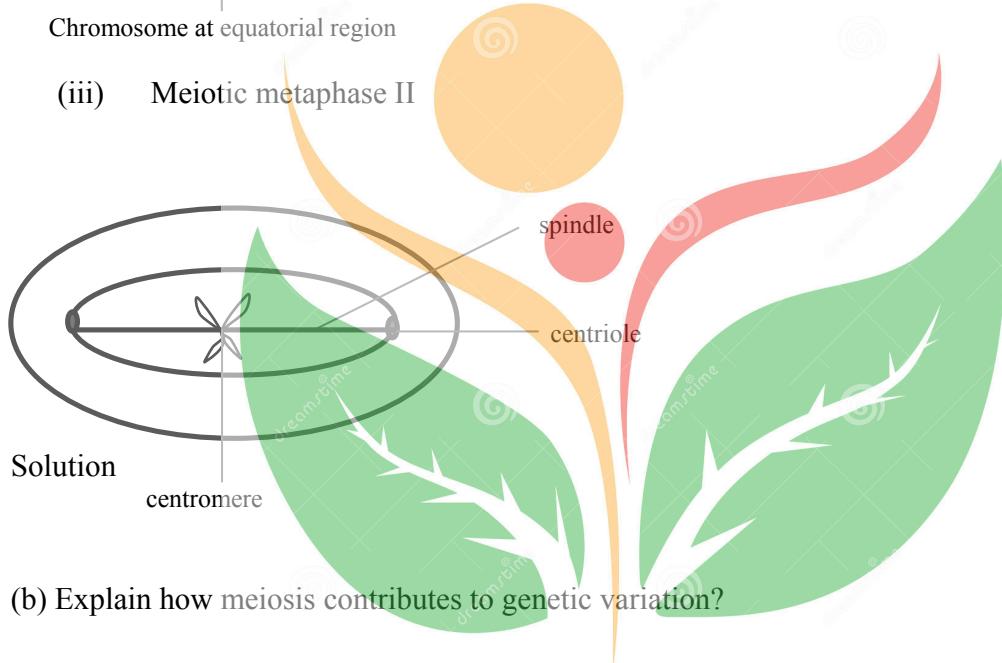
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(ii) meiotic metaphase 1



Chromosome at equatorial region

(iii) Meiotic metaphase II

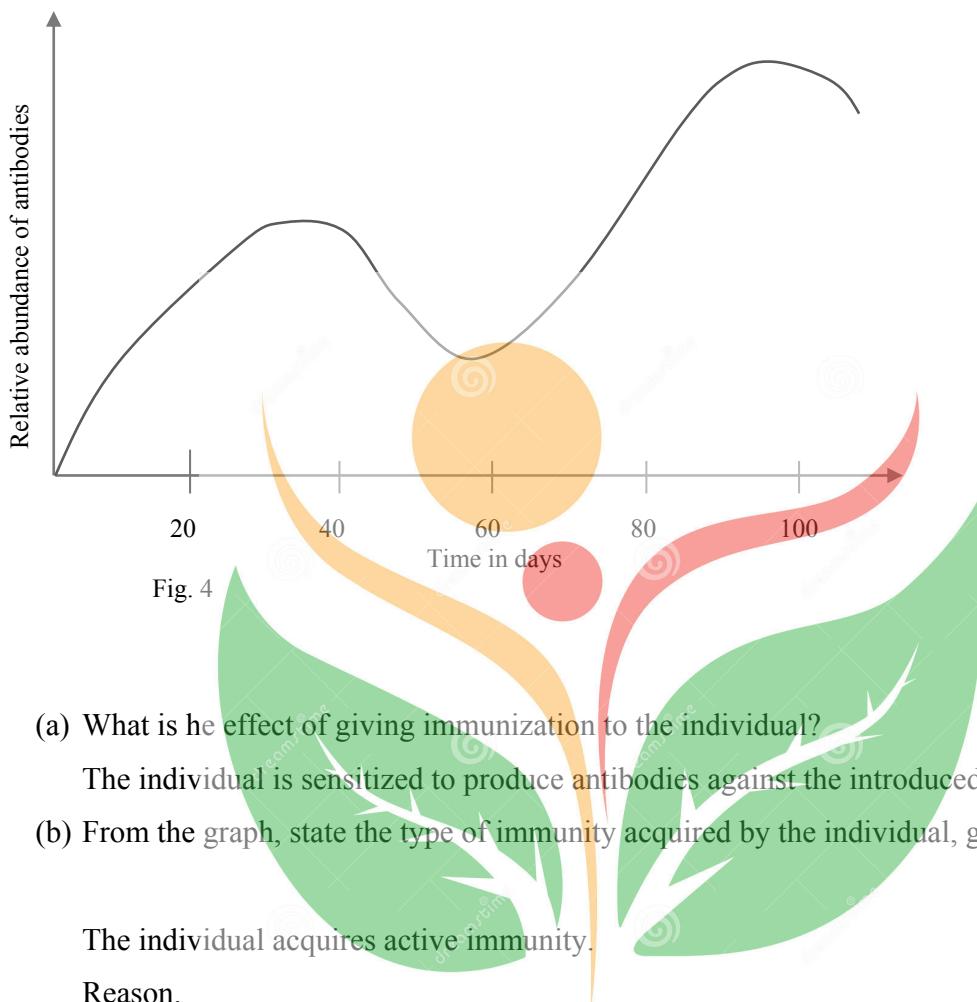


(b) Explain how meiosis contributes to genetic variation?

- During prophase of meiosis I, homologous chromosomes pair, from chiasmata and there is subsequent crossing over, this result in exchange of genetic material between the two homologues.
- The bivalents are randomly oriented and distributed in metaphase 1 and anaphase 1 respectively. This leads to new combinations of genetic material leading to genetic variation in the population.

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46. Figure 4 shows the immune response of a person's blood after vaccination are given on day one and 60 days later.



He becomes sensitized to produce antibodies against the antigen by prior exposure of the antigen through the vaccine.

(c) Explain the shape of the graph

- Relative number of antibodies rises gradually in the first 40 days, reaching a maximum at about day 40, it then reduces rapidly to near zero by day 60. After day 60, the number of antibodies rises rapidly to a higher maximum value at about day 90 from whence it reduces gradually.

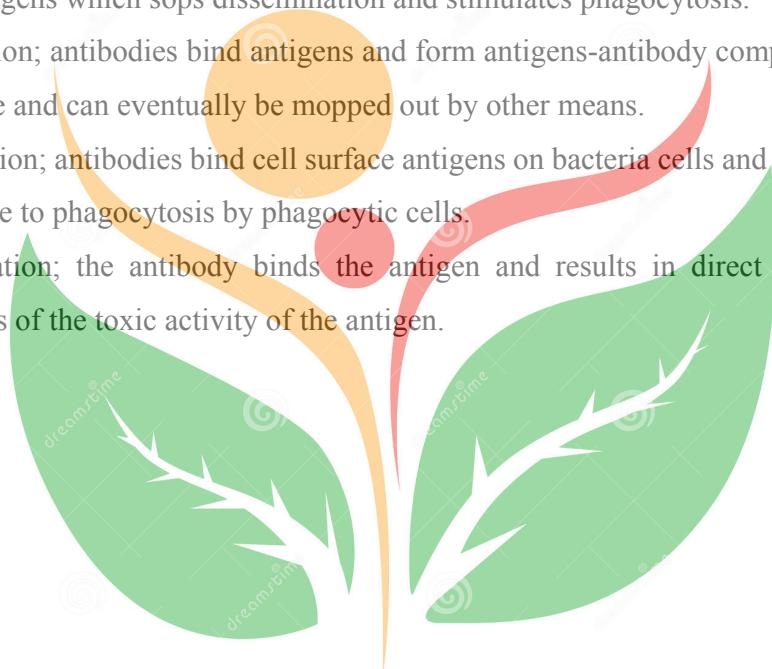
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### Explanation

- Initially, the vaccine activates the B- cells which release antibodies against the vaccine at an increasing rate until the antigen is mopped out.
- On re-introduction of the antigen, the existing memory cells proliferate and release antibodies at a faster rate than before.

(d) Describe three ways in which antibodies combat antigens.

- Agglutination; antibodies bind more than one antigen at a time. This leads to aggregation of the antigens which stops dissemination and stimulates phagocytosis.
- Precipitation; antibodies bind antigens and form antigens-antibody complexes which may precipitate and can eventually be mopped out by other means.
- Opsonisation; antibodies bind cell surface antigens on bacteria cells and makes them more susceptible to phagocytosis by phagocytic cells.
- Neutralization; the antibody binds the antigen and results in direct neutralization by inhibition of the toxic activity of the antigen.



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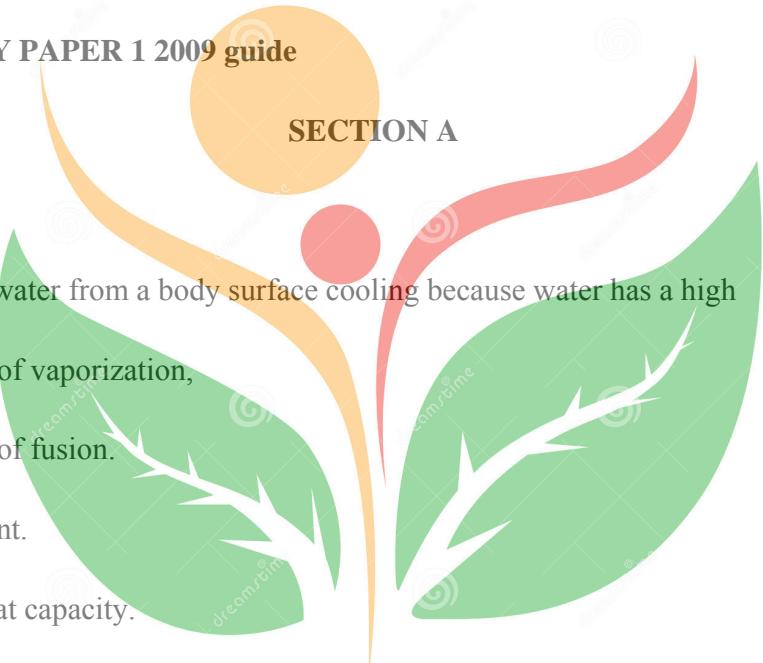
**UACE BIOLOGY PAPER 1 2009 guide**

**SECTION A**

**Do all numbers**

1. Evaporation of water from a body surface cooling because water has a high

A. latent heat of vaporization,  
B. latent heat of fusion.  
C. boiling point.  
D. specific heat capacity.



The answer is A

Water has a high **very latent heat of vaporization**. During evaporation, the water absorbs heat energy equivalent to its latent heat of vaporization from the body surface. This is converted to kinetic energy of the water molecules that escape into the vapour phase during evaporation. This eventually leads to cooling of the body that provided the latent heat of vaporization water.

2. In a multi-enzyme controlled reaction.

A enzyme 1 → B enzyme 2 → C enzyme 3 → X

If an excess of X controls the metabolic pathway of the reaction, the control mechanism is known

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as,

- A. multi-enzyme control.
- B. excess inhibition.
- C. end product inhibition.
- D. negative feedback

The answer is D

When the end product of a metabolic pathway begins to accumulate, it may act as an allosteric inhibitor of the enzyme controlling the first step of the pathway. Thus the product starts to switch off its own production as it builds up. This is called end product inhibition or negative feedback inhibition.

However, in a normal physiological process, as the end product is used up, its production is switched back on again. Such kind of mechanism in which the amount of the end-product controls its own production is called negative feedback mechanism.

In the reaction above, an excess of X allosterically inhibits enzymes 1 (end -product inhibition) and eventually controls the metabolic pathway (negative feedback).

Recall:

An allosteric inhibitor is a compound, without structural resemblance to an enzyme substrate, that binds to a site away from the active site of an enzyme and changes the enzyme's active sites which in turn affects the ability of the substrate to bind to the enzyme.

3. A biochemical analysis of a DNA sample showed that 34% of the bases were guanine. The percentage of the adenine in the sample is

- A. 32
- B. 16

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C. 17

D. 34

The answer is B

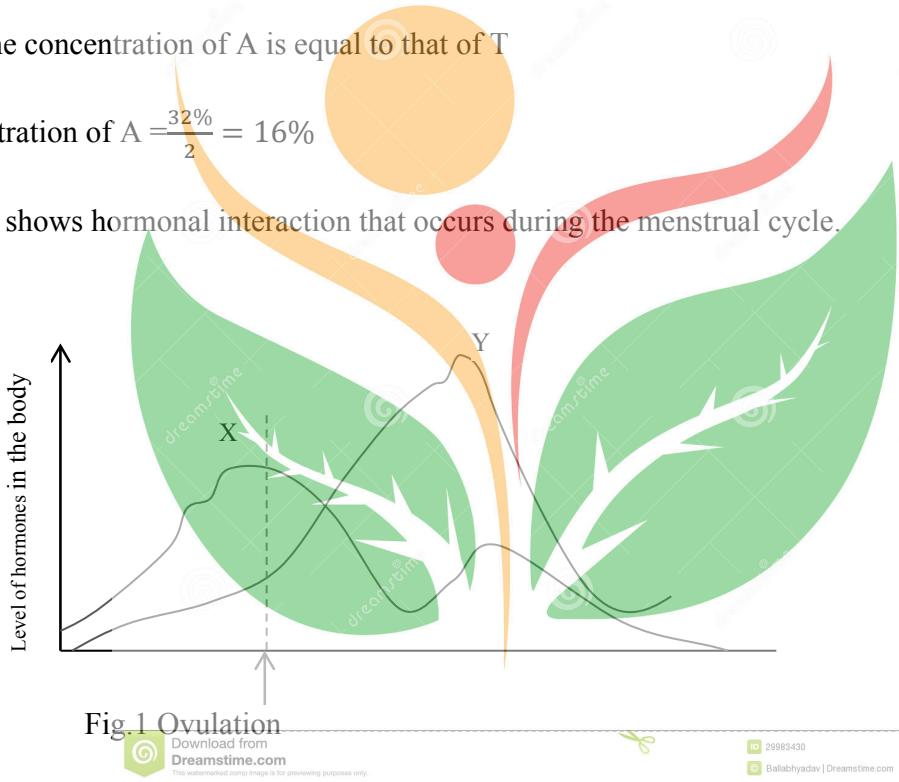
According to Chargaff's rules of base pairing Adenine – Thymine (A-T) base pairs occur in equal amounts to Guanine – Cytosine (G-C) base pair in any DNA segment. Therefore, the concentration of guanine and cytosine in DNA is the same. The concentration adenine and thymine will be;

$$[100 - (34 \times 2)]\% = 32\%$$

Since the concentration of A is equal to that of T

$$\text{Concentration of A} = \frac{32\%}{2} = 16\%$$

4. Fig 1 shows hormonal interaction that occurs during the menstrual cycle.

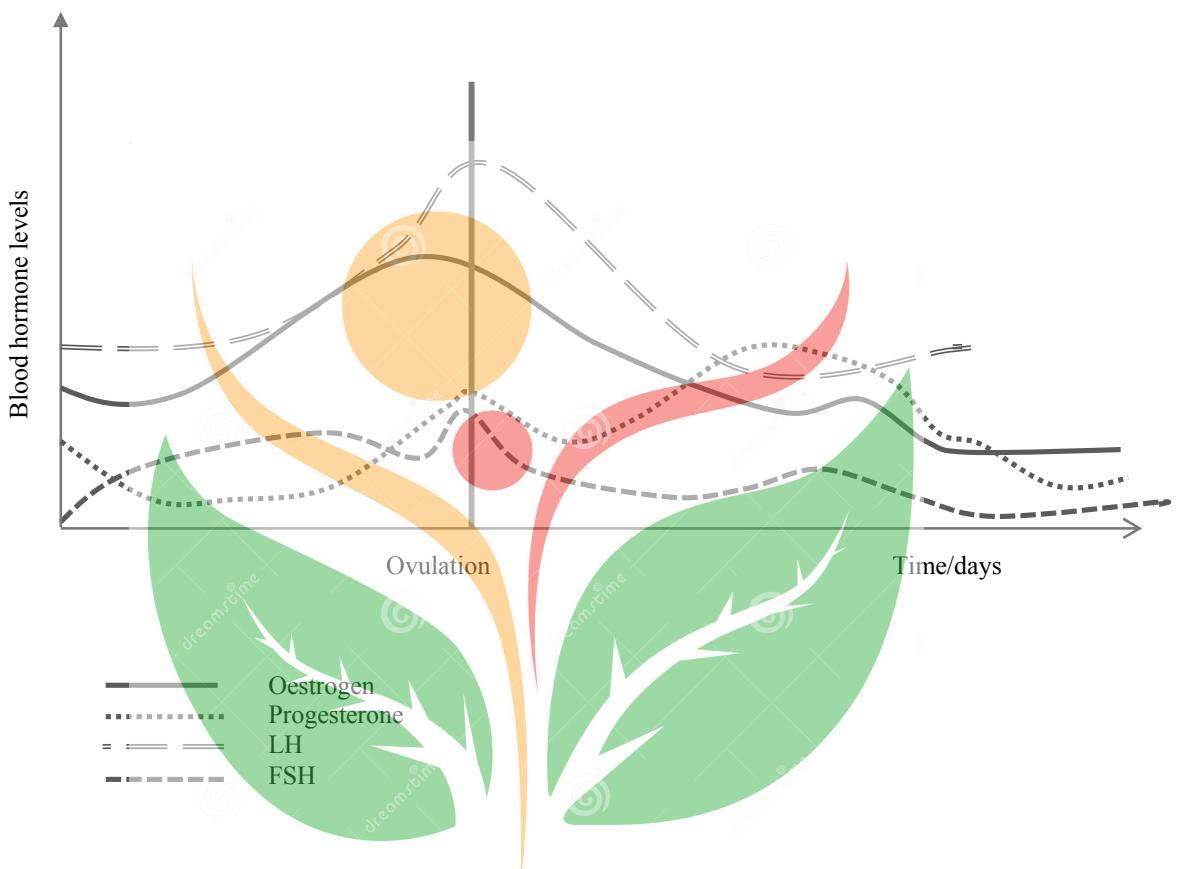


Hormone X and Y are respectively

- A. luteinizing hormone and oestrogen
- B. oestrogen and progesterone
- C. progesterone and oestrogen
- D. luteinizing hormone and follicle stimulating hormone.

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The answer is B\the hormones shown are oestrogen (x) and progesterone (Y). LH and FSH show sharp peaks at ovulation while the variation in X and Y show smooth change with a rise I X (oestrogen) before ovulation and that of Y (progesterone) after ovulation.



5. An adaptation by plants to obtain nitrogen include all the following except

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- A. mycorrhiza on plant roots.
- B. bacteria in root nodules.
- C. possession of aerial roots.
- D. being insectivorous.

The answer is C

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As adaption to obtain nitrogen from their environment, plant mat;

- Contain nitrogen fixing bacteria in root nodules;
- Contain mycorrhiza in association with plant roots.
- Being insectivorous

However; nitrogen in air is molecular very stable. It cannot be used b plants hence aerial roots do not obtain nitrogen to be used by the plant.

6. Which one of the following is a difference between fungi and plants?

- A. Fungi are heterotrophic while plants are autotrophic.
- B. Plant cells contain plastids while those of fungi do not.
- C. Fungi produce asexually while plants produce sexually.
- D. Fungi cells are not divided unlike those of plants.

The answer is A

Fungi are heterotrophic (cannot manufacture their own food) while plants are autotropic (can manufacture their own food)

7. In plants, the growth substances which interact to cause cell enlargement are

- A. ethylene and abscisic acid.
- B. cytokinins and ethylene.
- C. gibberellins and auxins.
- D. cytokinins and abscisic acid.

The answer is C

The growth substance that promote cell enlargement are gibberellins and auxins.

Note:

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Cytokinins stimulate cell division and prevent onset of senescence in tissue but have little or no effect on growth.

Ethylene enhances fruit ripening. It induces senescence in the leave but has no effect on plant growth.

Abscisic acid is a natural growth inhibitor which retards or suppresses growth

8. Table 1 shows the rate of breathing and volume of air exchanged with each breath for a person at rest and during exercise.

**Table 1**

State of the individual	Breaths per minute	Volume of each breath (cm <sup>3</sup> )
At rest	12	500
During exercise	24	1000

The increase in volume of air exchanged per minute when an individual does exercise from rest is

- A. 500cm<sup>3</sup>
- B. 600cm<sup>3</sup>
- C. 15000cm<sup>3</sup>
- D. 18000cm<sup>3</sup>

The answer is D

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Volume exchanged per minute = volume of each breath x breaths per minute

At rest;

Volume exchanged per minute

$$\begin{aligned}
 V_{r} &= 12 \times 500 \\
 &= 6000 \text{ cm}^3
 \end{aligned}$$

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During exercise

Volume exchanged per minutes,

$$\begin{aligned} V_r &= 24 \times 1000 \\ &= 24,000 \text{ cm}^3 \end{aligned}$$

Therefore, increase in volume exchanged per minute

$$\begin{aligned} &= V_e - V_r \\ &= 42,000 - 6,000 \\ &= 18,000 \text{ cm}^3 \end{aligned}$$

9. A biological advantage of a monoecious condition is that

- A. many offspring result from each fertilization.
- B. every individual is capable of producing offspring.
- C. self-fertilization is encouraged.
- D. male and female gametes mature at the same time.

The answer is B

Dioecious plant species have separate male and female plants. Self-pollination is therefore impossible. Monoecious plants have separate male and female flowers on the same hermaphrodite plant. This favours both cross-pollination and self-pollination.

As a result, monoecious plants have a survival advantage in that every individual is capable of producing offspring. On the other hand, because only half of the Dioecious plant are capable of producing offspring, they are disadvantaged.

Also, there is a large wastage of pollen in dioecious plants which is a disadvantage in terms of material and energy resources.

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10. After an action potential, repolarization of the membrane begins by

- A. entry of sodium ions into the cell
- B. sodium ions diffusing out of the cell.
- C. entry of potassium ions into the cell.
- D. potassium ions diffusing out of the cell.

The answer is D

The membrane of a neuron is selectively permeable.  $K^+$  ions can freely move across it but  $Na^+$  ions cannot. After an action potential,  $K^+$  ions diffuse freely out of the neuron down their concentration gradient, causing repolarization. However, complete return to resting membrane potential is enhanced by the  $Na^+/K^+$  pump.

11. The more variation in a population, the greater is its potential to

- A. give rise to gene flow.
- B. adapt to new changes in its environment.
- C. produce more offspring.
- D. grow fast.

The answer is B

When a population shows vast variation; the possibility is high that organisms produced shall withstand new changes in the environment with tendency towards emergence of new species well adapted to the conditions. This is consistent with Darwin's theory of evolution.

12. The pathway which allows water to move from cell to cell through the cytoplasm is

- A. apoplast
- B. vacuolar
- C. symplast

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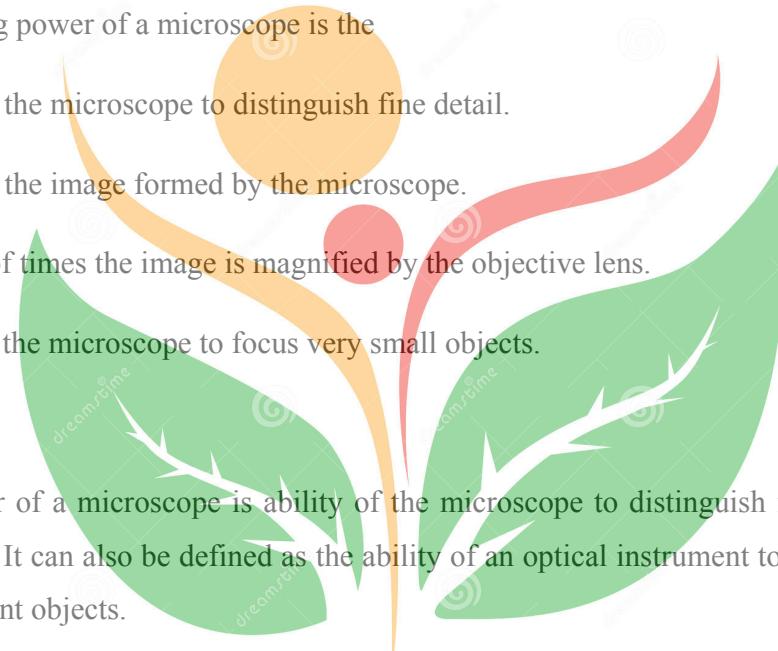
D. cuticular

The answer is A

Water can from cell to cell in a plant through;

- Symplast pathway – through the cytoplasm
- Apoplast pathway – through the cell wall
- Vacuolar pathway- through the cell vacuole.

13. The resolving power of a microscope is the

- 
- A. ability of the microscope to distinguish fine detail.
  - B. clarity of the image formed by the microscope.
  - C. number of times the image is magnified by the objective lens.
  - D. power of the microscope to focus very small objects.

The answer is A

Resolving power of a microscope is ability of the microscope to distinguish fine details of the object observed. It can also be defined as the ability of an optical instrument to distinguish small or closely adjacent objects.

14. Bryophytes and pteridophytes cannot fully exploit terrestrial life mainly because they

- 
- A. lack well developed vascular systems
  - B. depend on water for fertilization.
  - C. lack roots.
  - D. are covered with a thin cuticle.

The answer is B

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Both bryophytes and pteridophytes depend on water to propagate their male gametes to the female gametes. Thus both these type of organisms cannot fully exploit terrestrial life where water, needed to facilitate their fertilization, is not readily available as compared to aquatic life.

Note: pteridophytes, such as ferns have a well-developed vascular system.

15. Which one of the following refers to groups of individuals of at least two species living together?

- A. Community.
- B. Population.
- C. Habitat.
- D. Niche.

The answer is A

A group of organisms of the same species constitute a population. Each population live in a habitat and every member of a population occupies its own niche in the habitat. Several populations live together in a community.

16. Blood flows in the heart of an insect as a result of

- A. raising the perivisceral membrane.
- B. contraction of the alary muscles.
- C. relaxation of the heart ligaments.
- D. increase in the pericardial pressure.

The answer is B

Blood flows into the insect heart during diastole when the heart chamber expands. During this the alary muscles contract putting stretch to the heart ligaments which then pull the walls of the heart outward and open the ostia to allow in, the reverse occur during systole.

## UACE BIOLOGY PAPER 1 (2000-2019)

17. Which one of the following does not have an effect on a non-competitive inhibition?

- A. Temperature change.
- B. pH change.
- C. Enzyme concentration.
- D. Substrate concentration.

The answer is D

Non- competitive inhibition is not affected in any way by substrate concentration, but it can be affected by pH, temperature and enzyme concentration.

18. Migration of birds during winter from temperate regions to the tropics is an example

- A. habituation.
- B. insight learning.
- C. imprinting.
- D. exploratory learning.

The answer is D

As part of exploratory learning, birds migrate during winter from temperate regions to the tropics where they eventually find more favorable conditions.

19. Net primary productivity in C<sub>4</sub> plants is higher than that in C<sub>3</sub> plants because

- A. C<sub>4</sub> plants have a higher turn-over rate.
- B. energy accumulates at a higher rate in C<sub>4</sub> plants.
- C. photophosphorylation occurs in C<sub>3</sub> plants.
- D. the rate of respiration is higher in C<sub>3</sub> plants.

The answer is D

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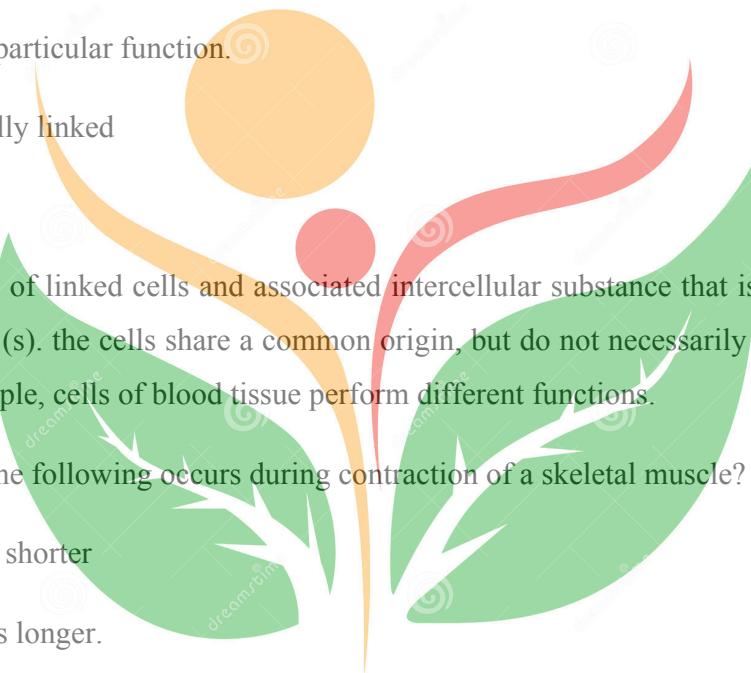
Net primary productivity (NPP) is the net amount energy retained by plants as absorbed from the sun after energy losses in the form of respiration and photorespiration are deducted.

In C<sub>3</sub> plants, the rate of photorespiration is high. This compromises the photosynthetic rate, and diminishes the net primary productivity in C<sub>3</sub> plants.

20. Which one of the following is not correct about cells of a tissue? They

- A. are of one type.
- B. have same origin
- C. have same particular function.
- D. are physically linked

The answer is **C**



A tissue is a group of linked cells and associated intercellular substance that is specialized for a particular function (s). The cells share a common origin, but do not necessarily perform the same function. For example, cells of blood tissue perform different functions.

21. Which one of the following occurs during contraction of a skeletal muscle?

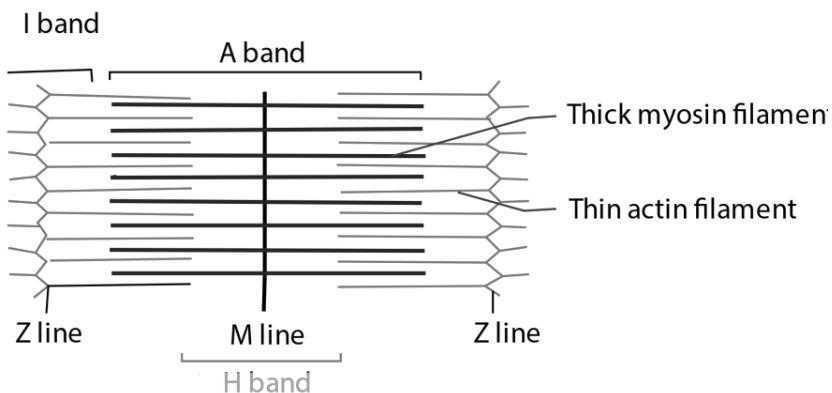
- A. I-band becomes shorter
- B. A-band becomes longer.
- C. Sarcomere remains unchanged.
- D. H-zone becomes wider.

The answer is **A**

During skeletal muscle contraction the actin and myosin filaments slide parallel to one another.

This shortens the sarcomere. The I-band becomes shorter; the H-zone becomes shorter while the A-band remains unchanged, as illustrated below.

### Sarcomere



### When contracted

- H-zone shorten
- I bond shorten
- the A-band remains unchanged.
- the sarcomere shortens.

22. Large steroid molecules diffuse easily through surface membranes because the membranes
- consist of non-polar molecules.
  - are semi-permeable.
  - are freely permeable.
  - are made of polysaccharides.

The answer is A



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The cell membrane is predominantly lipid (non-polar), as a result, steroid molecules, lipid in nature, can easily diffuse through the surface membranes by simple diffusion because of similarity in chemical nature.

23. Functional resemblance of wings of a butterfly and a bird although from different origins, is an example of
- homology

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- B. autology
- C. analogy
- D. phylogeny

The answer is C

Analogy is the existence of structures with different ancestral origin but serving a similar function. Homology is the existence of structure with similar physical make-up and ancestral origin but serving different functions in the adult organisms.

24. The following are trisomic conditions except

- A. Klinefelter's syndrome
- B. Turner's syndrome
- C. Down's syndrome
- D. XXX female

The answer is B

Trisomic conditions are those in which an individual contains one more chromosome than the diploid chromosome number in its genetic constitution; examples include;

XXXfemale syndrome in which 3 instead of 2 chromosomes exist, i.e, XXX instead of XX.

Down's syndrome in which 3 instead of 2 chromosomes 21 exist.

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Klinefelter's syndrome in which the male individual has 2 instead of 1 X chromosome, i.e., XXY.

On the other hand, the condition in which one chromosome is missing is called monosomy

Examples include, Turner's syndrome (XO instead of XX).

These condition develop as a result of non-disjunction of chromosomes during cell division

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25. Which one of the following is a form of vegetative propagation?

- A. Spore formation
- B. Conjugation
- C. Budding
- D. Diploid parthenogenesis

The answer is C

Vegetative propagation is a form of sexual reproduction in plants where part of the plant becomes detached and develops into a new self-supporting individual.

Budding is a form of vegetative propagation (a sexual reproduction) in which a new individual is produced as an outgrowth (bud) of the plant, and is later released as an independent, identical copy of the parent.

Note:

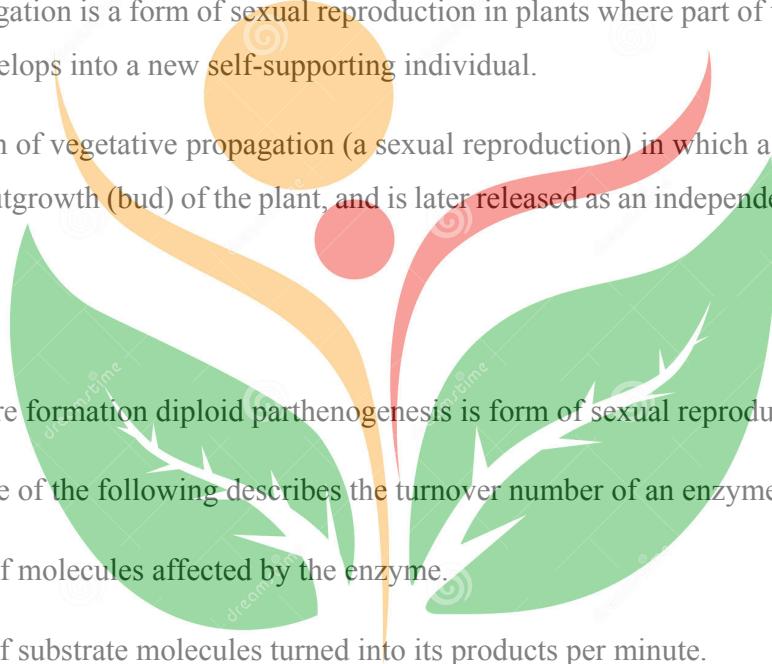
Conjugation, spore formation diploid parthenogenesis is form of sexual reproductions

26. Which one of the following describes the turnover number of an enzyme?

- A. Number of molecules affected by the enzyme.
- B. Number of substrate molecules turned into its products per minute.
- C. Number of product molecules formed.
- D. Number of substrate molecules catalyzed per minute.

The answer is B

Turn over number of an enzyme is the substrate molecules that the enzyme turns into products per minute.



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27. Which one of the following is not likely to bring about evolutionary change in a population?

- A. Crossing over
- B. Migration
- C. Mutation
- D. Genetic drift.

The answer is B

Crossing over, mutation and genetic drift all can cause genetic change in a population which in turn can lead to evolutionary change. However, migration has no effect on the genetic constitution of organisms and also cannot lead to evolutionary change.

28. Which part of the vestibular apparatus responds to the vertical movement of the head?

- A. Vestibular canal
- B. Saccule
- C. Utricle
- D. Semi-circular canal

The answer is D

Movements of the head in all direction in space, while at rest (static equilibrium), are detected by the semicircular canals in the inner ear.

However, during motion, the otoliths in the saccule and utricle respond to dynamic changes in the position of the head. These are responsible for dynamic equilibrium while the semi-circular canals for static equilibrium. The vestibular canal has no function in balance.

29. Which one of the following ecological pyramids may be used to determine productivity in an ecosystem?

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- A. Pyramid of energy.
- B. Pyramid of biomass.
- C. Pyramid of numbers.
- D. Pyramid of productivity.

The answer is A

Productivity of an ecosystem is the measure of the net energy output at each trophic level. This can only be illustrated by the pyramid of energy.

30. The first carbohydrate made in photosynthesis is

- A. ribose sugar
- B. ribulose
- C. Phosphoglyceric acid
- D. Phosphoglyceraldehyde

The answer is D

The final stage of the process of photosynthesis take place in the stroma of the chloroplast. Ribulose bisphosphate (RUBP) combine with  $\text{CO}_2$  in the presence of RUBP carboxylase, to form an unstable 6-C compound. This readily breaks down to form 2 molecules of phosphoglyceric acid (PGA); the first stable product of photosynthesis.

PGA is then reduced by  $\text{NADPH}_2$ , using energy from one molecule of ATP, to form

Phosphoglyceraldehyde (PGAL); the first carbohydrate of photosynthesis.

31. In an endergonic reaction, the products of the reaction contain

- A. more energy than the reactants and energy is released
- B. less energy than the reactants and energy is absorbed
- C. more energy than the reactants and energy is supplied

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- D. less energy than the reactants and energy is released.

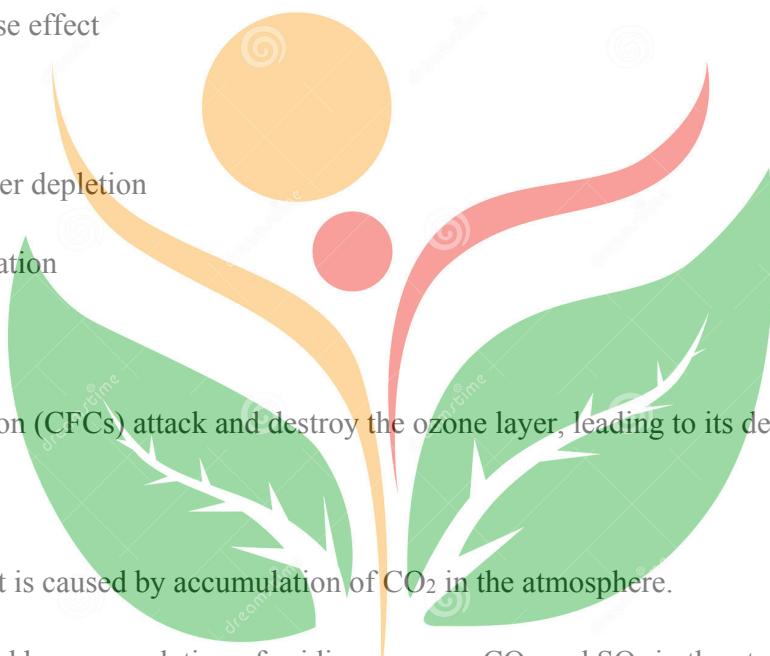
The answer is C

An endergonic reaction absorbs energy from the environment and this energy must be supplied. If the reaction is to proceed. Thus the product contains more energy than the reactants and energy should be supplied to the reaction to proceed.

32. Which one of the following forms of environmental hazards is attributed to application of CFCs?

- A. Greenhouse effect
- B. Acid rain
- C. Ozone layer depletion
- D. Eutrophication

The answer is C



Chlorofluorocarbon (CFCs) attack and destroy the ozone layer, leading to its depletion.

Note:

Greenhouse effect is caused by accumulation of CO<sub>2</sub> in the atmosphere.

Acid rain is caused by accumulation of acidic gases e.g. CO<sub>2</sub> and SO<sub>2</sub> in the atmosphere

Eutrophication is caused by disposal of nitrate rich waste into water bodies.

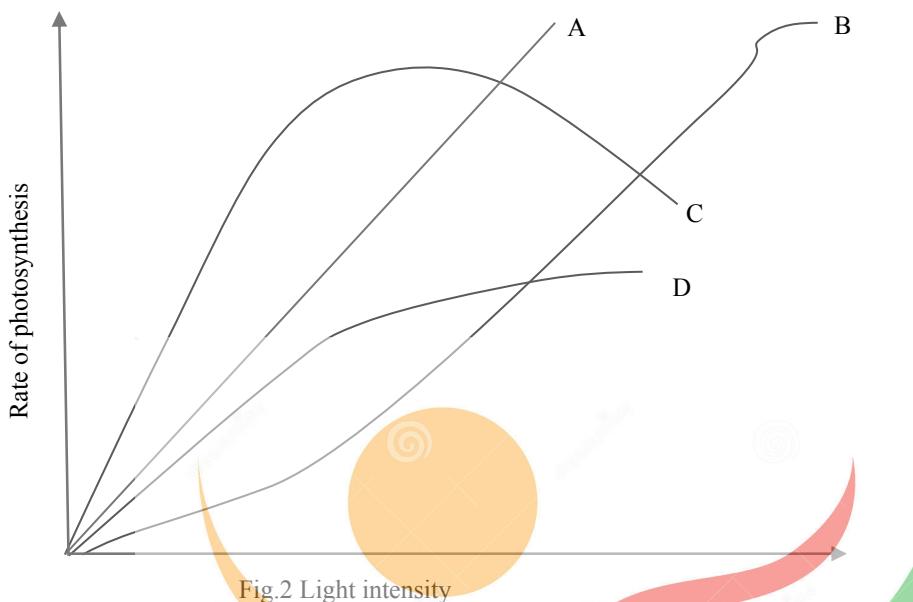
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33. Which one of the curves in figure 2 correctly represents plants adapted for low light intensity?



The answer is D

For a plant adapted to low light intensity, rate of photosynthesis is **optimum to low light intensity** and have a **low saturation**. At high light intensities, the rate of photosynthesis is constant as it is limited by other factors. Thus curve D is the one that conforms to these observations.

34. Which one of the following processes does not affect the "biochemical oxygen demand"?

- A. Ammonification
- B. Nitrogen fixation
- C. Nitrification
- D. Denitrification

The answer is D

Bacteria that are involved in Nitrogen fixation, nitrification are aerobic and so require oxygen.

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Therefore, their activity increases the demand for O<sub>2</sub> (BOD) in an aquatic habitat. However, denitrifying bacteria are anaerobic and their activities do not require oxygen. They thus do not alter the biological oxygen demand (BOD)

35. The lung fish living in mud has its oxygen dissociation curve to the left of that for humans because

- A. there is a high level of carbon dioxide concentration in the mud.
- B. the lung fish's haemoglobin has a higher affinity for oxygen than that of humans.
- C. of the lower temperature of the h
- D. of low level of oxygen concentration in the mud.

The answer is B

Situation of the oxygen dissociation curve of the lung fish to the left of the human means that its haemoglobin has higher affinity for oxygen than that of humans.

36. During locomotion, bones of a tetrapod are subjected to the following forces except

- A. shearing.
- B. compression.
- C. tension.
- D. expansion.

The answer is D

Bones of tetrapod's experience force of shearing, compression and tension during locomotion but not expansion.

37. Heat loss is most efficiently reduced in body extremities of endotherms by having

- A. veins and arteries parallel and close to each other.
- B. thick fur.

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C- thick subcutaneous layer.

D. few sweat glands.

The answer is A

Body extremities of endothermic animals have a special arrangement of blood vessels. Veins are arranged close parallel to arteries. Heat is lost to veins as blood in the arteries goes to the extremes hence less heat is available in the extremes to be lost of the surrounding. This is called counter-current heat exchange system. In addition to this the extremes are also reduced in size.

38. Which one of the following constitutes the most energy transfer?

A. Praying mantis feeding on flies.

B. Aphids feeding on plant sap.

C. Cat feeding on small mammals.

D. Beetle larvae feeding on dung

The answer is B

Primary consumers receive more energy from their food compared to other consumers. This is because as energy is being transferred from the producer it becomes less due to energy losses.

Aphids feeding on the plant sap are primary consumers.

39. Which one of the following when at high levels in the blood, increases the rate of heart beat?

A. Carbon dioxide.

B. Thyroxine.

C. Oxygen.

D. Adrenaline.

The answer is D

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Adrenaline has a direct effect on the heart. In high concentration, it increases the rate and force of heart beat. Carbon dioxide and thyroxin concentration increase heart beat only indirectly, in part through release of adrenaline.

40. During locomotion in an earth worm, when longitudinal muscles contract in a region, the becomes

A. thin and short.

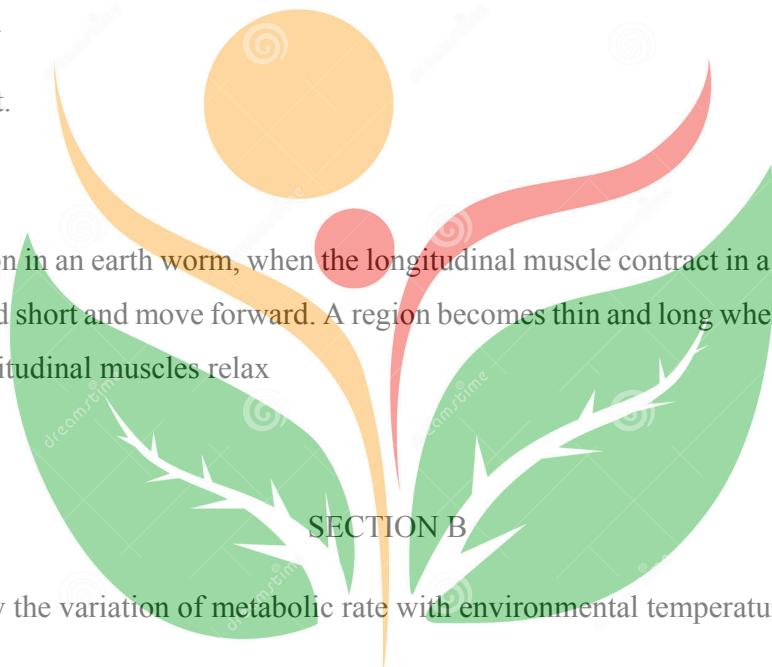
B. thin and long.

C. thick and long.

D. thick and short.

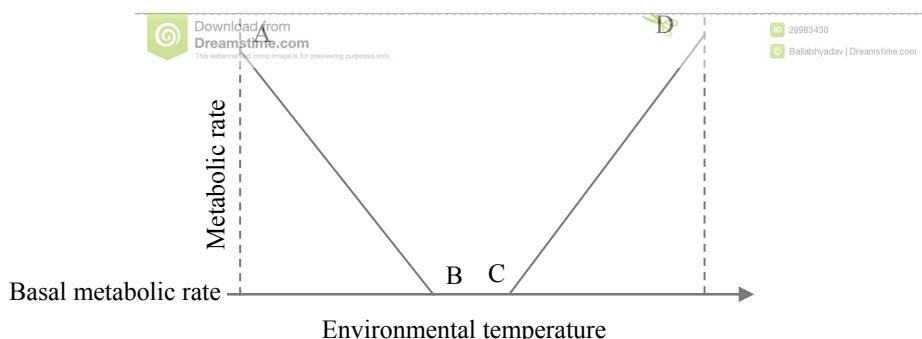
The answer is D

During locomotion in an earth worm, when the longitudinal muscle contract in a region, the region becomes thick and short and move forward. A region becomes thin and long when circular muscles contract and longitudinal muscles relax



41. Figure 3 show the variation of metabolic rate with environmental temperature in a mammal.

Structure of a graph



(a) What do point B and C represent?

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(i) B: low critical temperature

(ii) C: High critical temperature

(b) Explain why the metabolic rate?

(i) Is constant between point B and C

Between B and C, physical and behavioral mechanisms alone can regulate the body temperature. Thus, metabolic rate remains constant.

(ii) Increases from point B and A

From B to A, temperature is below the low critical temperature for the mammal. Physical mechanisms are augmented by chemical means to maintain body temperature. Metabolic rate increase in order to produce the excess heat required to make up for that lost to the environment.

(iii) Increases from point C and D

From C to D, temperature go above the high critical temperature for the mammal. The body's physical cooling mechanisms fail and metabolism increases with temperature. As temperature rises, more energy is supplied to rise the metabolic rate higher in a form of a positive feedback mechanism. This may continue until the body tissue of the mammal burn out.

(c) Explain how point B would differ between an animal's living in cold regions and that living in warm region.

B would be lower for animals living in cold regions and higher for one living in warm regions.

Reason;

Animals in cold regions have better insulating mechanism and can stand lower temperatures without change in metabolic rate compared to those from warm regions.

42. Figure 4 shows dendrites from neurons A and B forming synapse with neuron C

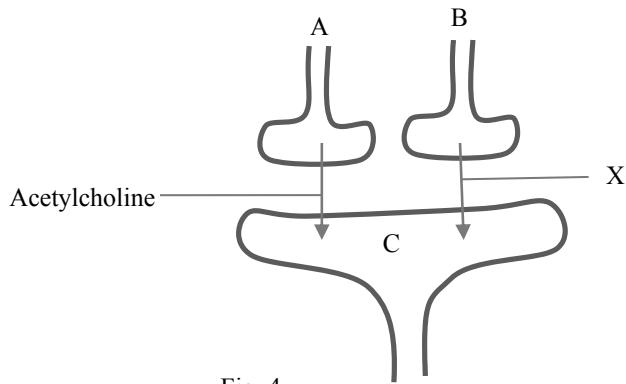


Fig. 4

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Explain what would happen if

- (i) Acetylholine increased the permeability of the post synaptic membrane to  $\text{Na}^+$  ions  $\text{Na}^+$  ions move into the neuron C causing membrane depolarization. If the  $\text{Na}^+$  ions surge into the neuron C is large enough, an action potential is generated in neuron C and an impulse is eventually transmitted from A and C.
- (ii) X increased the permeability of the post synaptic membrane to  $\text{Cl}^-$  ions.  $\text{Cl}^-$  ions would move into neuron C reducing level of membrane polarization. If the  $\text{Cl}^-$  surge is large enough, it would keep the membrane of C at such very low polarization levels (hyperpolarization) that no action potential can be elicited in C. this prevents transmission of an impulse from B to C

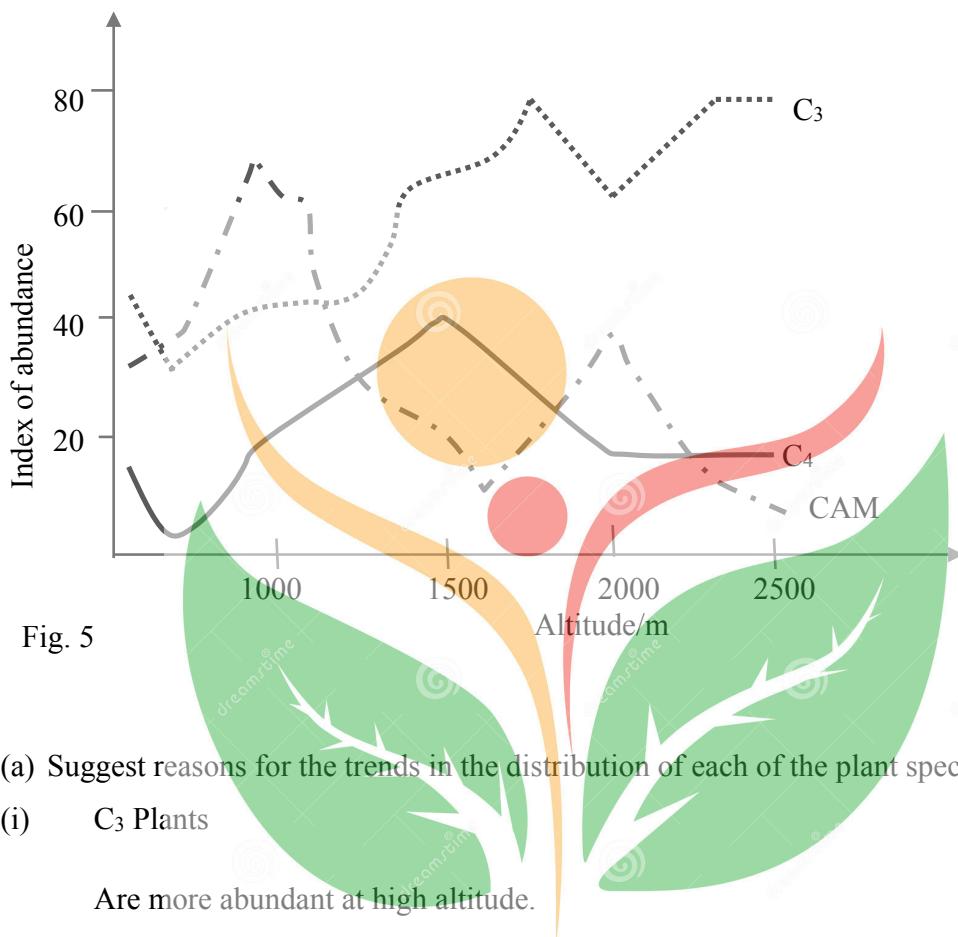
- (b) State a benefit of neuron C forming synapses with two neuron A and B

It allows selective transmission of impulses to neuron C; A facilitating transmission while B inhibiting it.

- (c) State three functions synapses.

- They facilitate transmission of impulses from one neuron to another.
- They may inhibit transmission of certain impulses from one neuron to another.
- They control the transmission of impulses from neuron in the nervous system.
- They allow for summation of impulses.
- Ensures integration of information from different parts of the euro system
- Provide a mechanism for filtering out non-essential information
- It ensures new impulses move in one direction
- Transmit information betweenneuron

43. Figure 5 shows the distribution of C<sub>3</sub>, C<sub>4</sub> and CAM plants at different altitudes



(a) Suggest reasons for the trends in the distribution of each of the plant species

(i) C<sub>3</sub> Plants

Are more abundant at high altitude.

**Reason (s)**

At high altitude, the partial pressure of oxygen and temperatures are lower. This reduces competition between carbon dioxide and oxygen for RUBP carboxylase enzyme and enhance carbon dioxide fixation.

Thus, C<sub>3</sub> plants are more abundant at high altitude where they can photosynthesize more efficiently.

(ii) C<sub>4</sub> plants

Are more abundant at mid-altitude levels.

**Reason (s)**

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Since PEP carboxylase is not affected by oxygen concentration, temperature is the major limiting factor of photosynthesis in C<sub>4</sub> plants.

At low altitudes, temperatures are very high than at high altitude. Only moderate temperature of mid-altitude levels favor efficient photosynthesis in C<sub>4</sub> plant, making them more abundant there.

### (iii) CAM plants

Are more abundant at low altitudes

Reason (S)

CAM plants adapted to photosynthesizing more efficiently at higher temperatures. Such temperature can only be experienced at low altitudes, explaining their more abundance there.

(b) State four physiological differences between C<sub>3</sub> and C<sub>4</sub> plants.

C <sub>3</sub> plants	C <sub>4</sub> plants
Carbon dioxide acceptor is RUBP	Carbon dioxide acceptor is PEP
First stable product is PGA	First stable product is Oxaloacetic acid (OAA).
Photorespiration occurs	Photorespiration does not occur.
Requires 18 ATP for the synthesis of one glucose molecule	Requires 30 ATP for the synthesis of one glucose molecule.

44. (a) Describe two forces that enable water to move up the xylem vessels in a continuous column.

- Water molecules are held together by cohesive force, loss of water from the leaves by transpiration exerts a tension or pull (transpiration pull) on the water in the xylem vessels. This pull is transmitted down from the petiole of the stem and finally to the roots, leading to continuous upward movement of water.

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- Absorption of water by root hairs into the xylem vessels creates hydrostatic force (root pressure) that pushes water up a tall tree.

(b) Explain how light influences stomatal opening in a plant that has been previously in the dark.

When exposed to light, starch of the guard cells is converted into malic acid. Malic acid dissociate into malate and H<sup>+</sup> ions in the guard cells.

H<sup>+</sup> ions are transported to epidermal cells and H<sup>+</sup> and K<sup>+</sup> ions enter the guard cells.

Increase in K<sup>+</sup> and malate ions in the guard cells increases their osmotic pressure and more water enters from the surrounding cells by osmosis.

The turgidity of the guard cells increases, making them to draw the stomata open apart opening the stomata.

45. Figure 6 shows three population growth curve patterns a, b and c that occur naturally

Structure

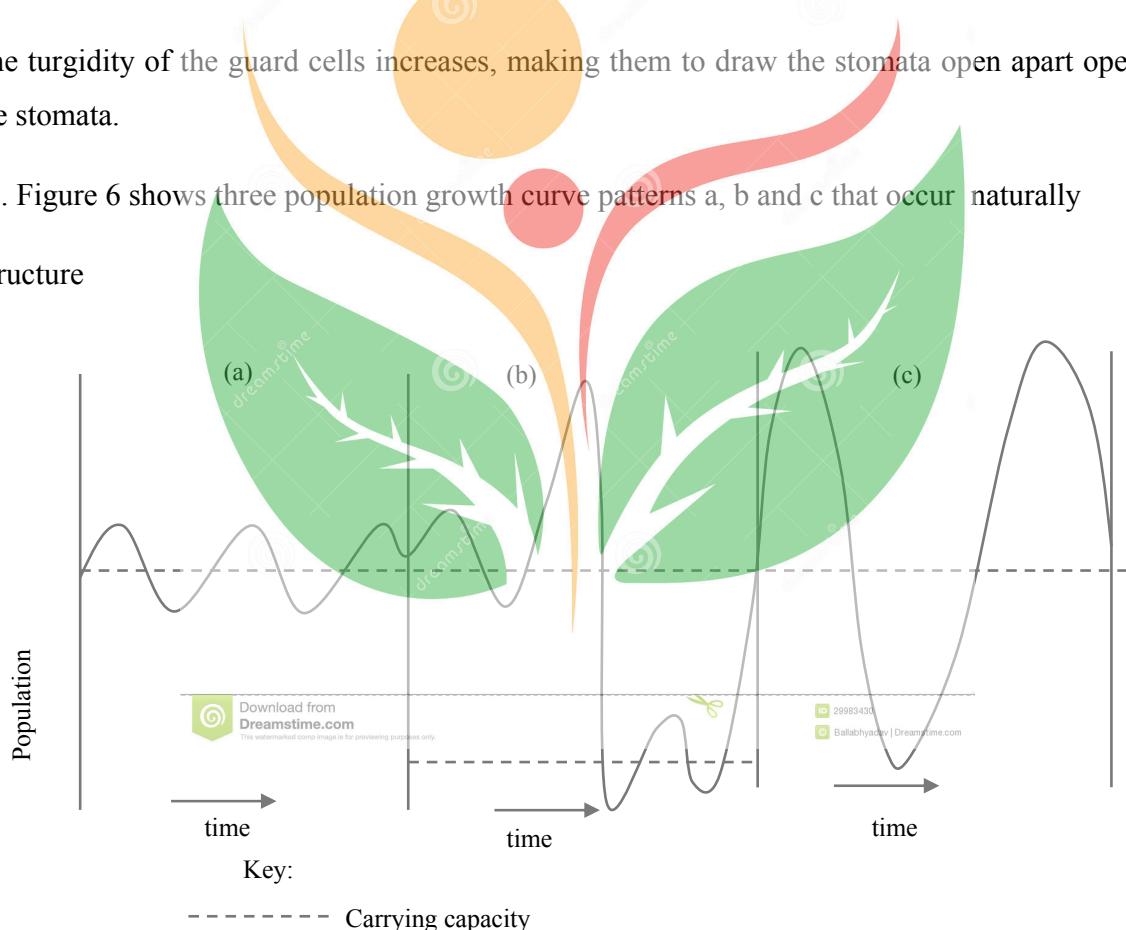


Fig. 6

Describe and suggest reason for the observed pattern of each population growth curve.

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(a) shows small rapid cyclic variation of population about the carrying capacity

Reason

Rapid changes in environmental resistance occur in the population in either direction. Positive population change is rapidly cancelled by an equal negative population change leading to equilibrium maintenance of population about carrying capacity.

(b) Show cyclic variation at first followed a very high population rise and a huge drop to a new carrying capacity.

Reason

In an equilibrium population, there appears a factor such as emergence of food resources that causes a rapid rise in population density. The large numbers deplete the resources available to such a low level that it can only support fewer numbers than before.

(c) shows cyclic variation of population, of large amplitude about the carrying capacity

Reason

The population is controlled by presence or absence of another organisms acting as a predator or prey. Increase in either causes reduction in the population of the other or vice versa, over a long period of time.

46. In an oil seed plant species, the allele for tallness is dominant over that for dwarfness. Meanwhile the allele for chlorophyll production and non-chlorophyll show incomplete dominance. The heterozygous plants are variegated.

(a) Using suitable symbols, construct a diagram of a cross between a tall plant with green leaves and a dwarf plant with variegated leaves, to show the genotype and phenotypes of the offspring

Solution

(a) let

T be the allele for tall plant,

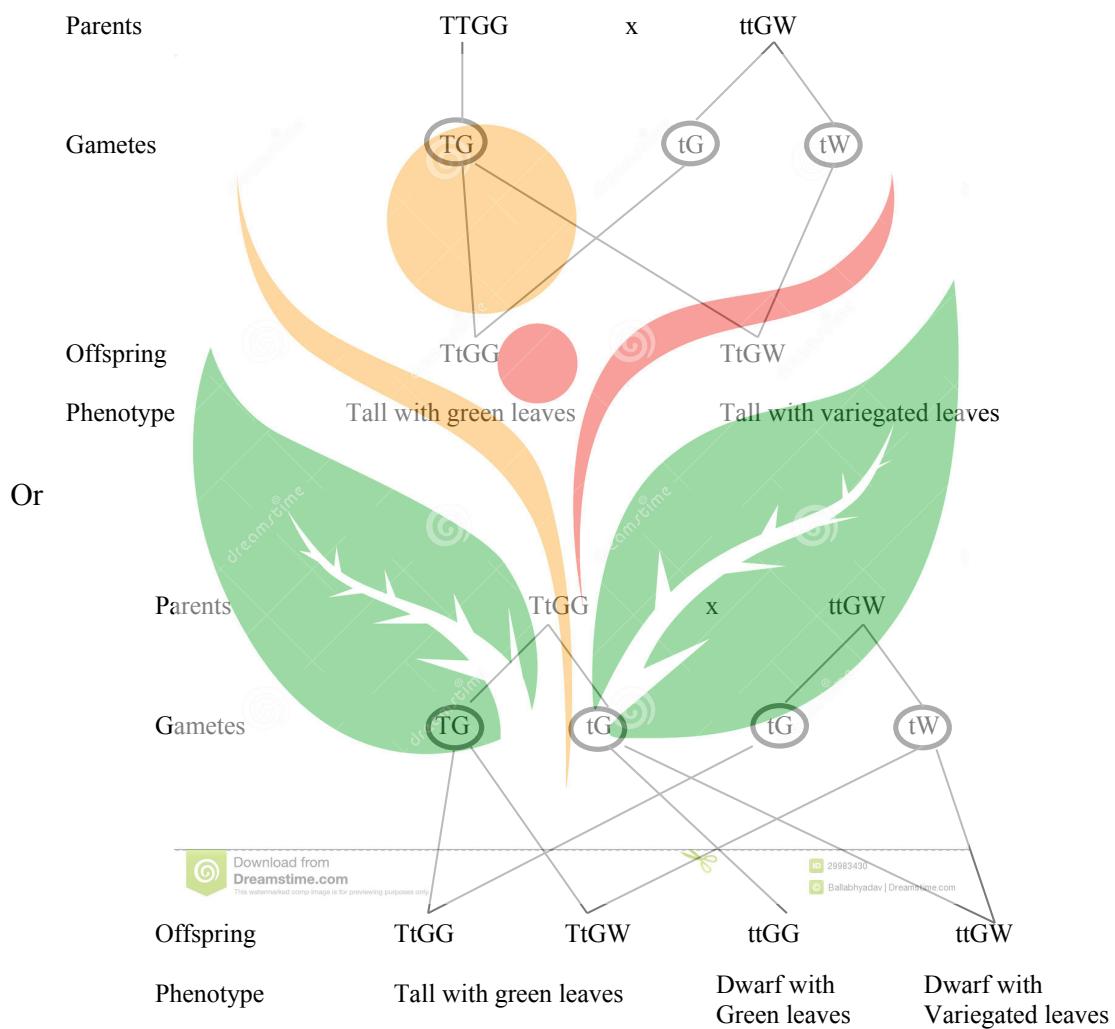
t be the allele for dwarf plant

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G be the allele for chlorophyll production

W be the allele for non- chlorophyll production

A tall plant with green leaves would have genotype TTGG or TtGG. While the dwarf plant with variegated would have genotype ttGW. Two crosses are possible in this case.



(b) Explain why 25% of the offspring of the cross in (a) would fail to survive.

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In the second cross, 25% of the offspring survival disadvantage in being dwarf with variegated leave. They cannot reach out for enough light do not have enough chlorophyll to absorb light for photosynthesis.



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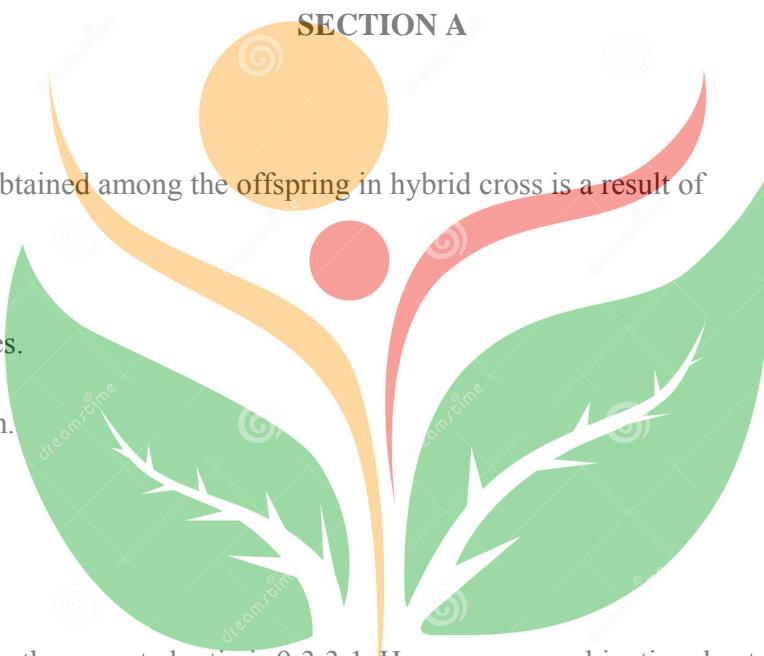
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**SECTION A**

**Do all question**

1. A ratio of 3:1 obtained among the offspring in hybrid cross is a result of
- A. crossing over.
  - B. linkage of genes.
  - C. non-disjunction.
  - D. dominance.

The answer is B



In a dihybrid cross the expected ratio is 9:3:3:1. However, recombination due to linkage produces a phenotypic ratio typical of a mendelian monohybrid cross. That is; 1:2:1 or 3:1.

Suppose the genes for length and colour of leaf are linked.

Let.

**G** be the gene for green leaf

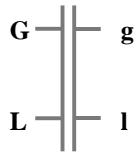
**g** be the gene for variegated leaf

**L** be the gene for long leaf

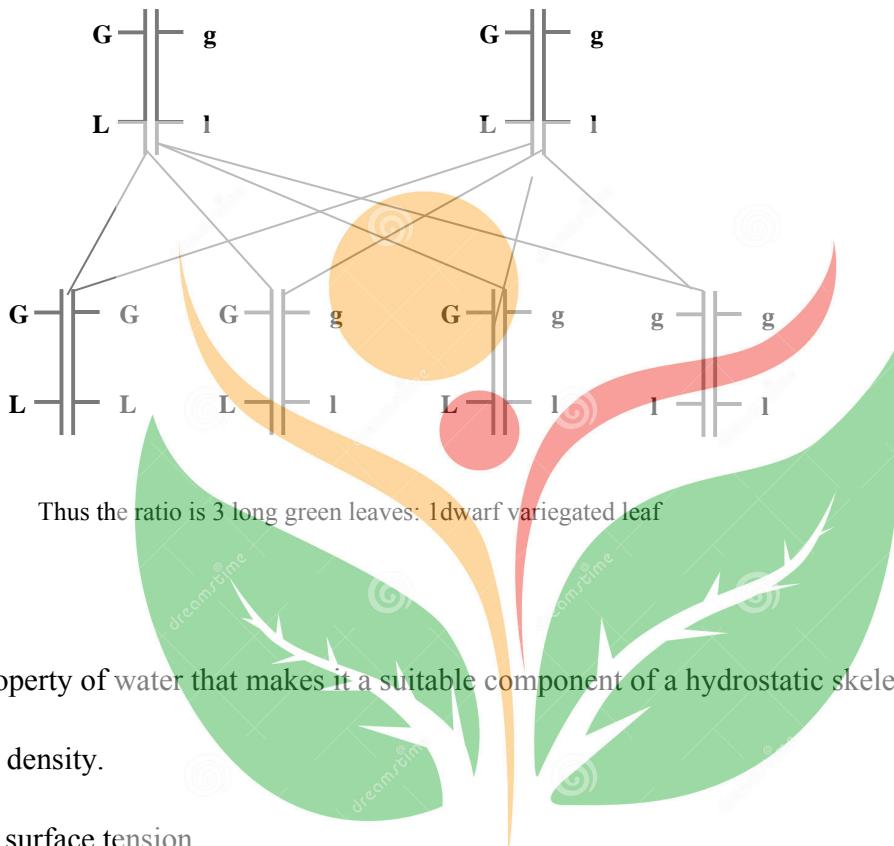
**I** be the gene for dwarf leaf.

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For pure breeding parents, the F1 offspring shall have genotype (**GgLi**) linked as shown;



On selfing F1 offspring



2. A property of water that makes it a suitable component of a hydrostatic skeleton is its
- high density.
  - high surface tension.
  - low viscosity.
  - incompressibility.

The answer is D

A hydrostatic (fluid) skeleton occurs in annelids where it serves three main functions; namely support, protection and locomotion.

Water is a suitable component of this skeleton because it is incompressible.

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Therefore, contraction of the body wall muscles can change the shape of the annelid but not its volume.

Note: for this purpose, the density, viscosity and surface tension of water are not of importance.

3. In humans, the hormone which stimulates the maturation of germ cells is

A. luteinizing hormone.

B. progesterone.

C. oestrogen.

D. follicle stimulating hormone.

The answer is D

In both males and female, the follicle stimulating hormone (FSH) stimulates the maturation of germ cells. Just after menstruation, the anterior lobe of the pituitary gland starts secreting follicle stimulating hormone (FSH). FSH stimulates the wall of the follicle to develop in the ovary, from germ cells and secrete yet another hormone called oestrogen. Oestrogen brings about healing and repair of the uterine wall following menstruation. Levels of oestrogen increase up to a point when it stops the anterior pituitary from secreting FSH and instead stimulates it to secrete luteinizing hormone (LH). LH sudden increase brings about ovulation and causes the Graffian follicle to change into a corpus luteum. Corpus luteum secretes another hormone, progesterone which causes continued proliferation and maturation of the uterine lining in preparation for implantation.

4. Fig. 1 represents a human tissue.

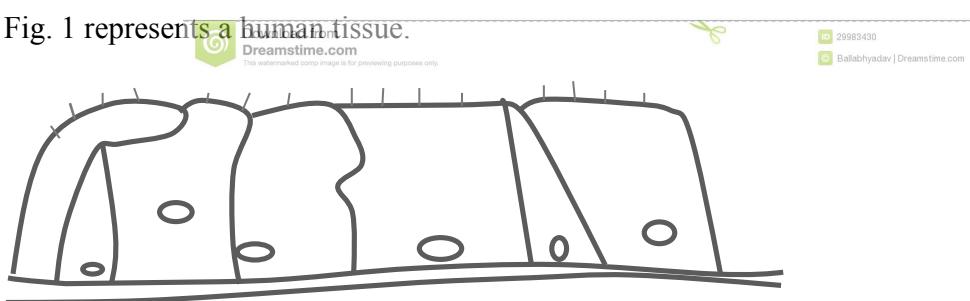


Fig.

The tissue would most likely be lining the

A. salivary glands.

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- B. stomach.
- C. ileum.
- D. oviduct.

Answer is D

The tissue is most likely be oviduct

5. Which one of the following pairs of reactants is not required for the light-independent reactions of photosynthesis?

- A. NADPH and ATP.
- B. ATP and carotenoids.
- C. RUBP and free oxygen.
- D. Carbon dioxide and enzymes.

The answer is B or C

During the right-independent (dark) reactions of photosynthesis, the products of the light-dependent stage (NADPH and ATP) are used.

In these reactions, RUBP combines with carbon dioxide, a reaction catalyzed by the enzyme RUBP carbonylase.

Thus, the following reactants are required in these reactions:

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- NADPH and ATP (from the light stage)
- RUBP.
- Carbon dioxide
- Enzymes.

- Note:
  - Free oxygen and carotenoids are not reactants in the light-independent reactions.

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6. The latent heat of evaporation of sweat is  $3.15 \text{ kJ cm}^{-3}$ . What is the percentage of energy lost by sweating from a manual worker who loses  $2 \text{ dm}^3$  per day of sweat and has a daily energy intake of  $40,000 \text{ kJ}$ ?
- A. 6.30.  
 B. 7.88.  
 C. 8.25.  
 D. 15.75

The answer is D

Volume of sweat lost by worker,  $V_w$

Given:

Latent heat of vaporization,  $L_v$

$\therefore$  Heat lost,  $Q_1$

Daily energy intake  $Q_i$

$$\Leftrightarrow \text{Percentage energy loss per day} = \frac{Q_1}{Q_i} \times 100$$

$$\Leftrightarrow \text{Percentage energy lost per day} = 15.75\%$$

Hence the percentage of energy lost per sweating is 15.75%

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7. Figure 2 represents a

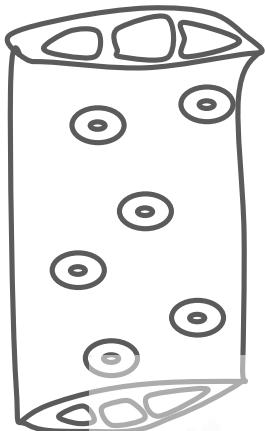


Fig. 2

- A. tracheid.
- B. xylem vessel element.
- C. sieve tube.
- D. phloem parenchyma cells.

The answer is B

A xylem vessel is formed of a chain of elongated cylindrical cells placed end to end. Their end walls break down partially or completely and their side walls are perforated by numerous pits.

Note:



Tracheids are similar to vessels except that they typically have five or six sides in cross-section and instead of being open at each end their tapering end walls are performed by pits.

A sieve tube is long and cylindrical but has no pits. It has end walls perforated with tiny pores.

Phloem parenchyma cells are elongated but not cylindrical. They are living and have a nucleus.

8. Which one of the following describes the chloride shift during transportation of carbon dioxide in mammals?

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- A. Hydrogen carbonate ions leave the erythrocytes as chloride ions from tissues, enter.
- B. Chloride ions leave the erythrocytes as hydrogen carbonate ions from tissues, enter.
- C. Chloride ions enter the lungs as hydrogen carbonate ions leave the erythrocytes.
- D. Hydrogen carbonate ions enter the lungs as chloride ions leave the erythrocytes.

The answer is A

During the chloride shift. Hydrogen carbonate ions in the red blood cell diffuse out readily into plasma. This tends to develop a net positive charge inside the cell because the membrane is relatively impermeable to positive ions. To maintain electro neutrality, chloride ions from plasma enter into red blood cell. This is called the chloride shift.

9. A common features belonging to annelids and arthropods is the

- A. exoskeleton.
- B. jointed body form.
- C. metameric segmentation.
- D. chitinous cuticle.

The answer is C

A feature common to both annelid and arthropods is the metamerism limited to arthropods



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Note:

Exoskeleton, jointed body form and chitinous cuticle are characteristics limited to arthropods

10. Which set of products is liberated during both aerobic and anaerobic respiration in plants?

- A. Carbon dioxide and energy.
- B. Ethanol and water.

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- C. Water and carbon dioxide.
- D. Carbon dioxide and ethanol.

The answer is A

During aerobic respiration in plants, glucose produces carbon dioxide, water and energy in the presence of oxygen. Thus



During anaerobic respiration in plants, glucose ferments to produce ethanol, carbon dioxide and energy. Thus



11. Myelinated axons of a frog conduct impulses three times less fast as those of same diameter in a rat because the

- A. myelin sheath in axons of frogs is thinner.
- B. rat is endothermic.
- C. neurons of a frog have more synapses.
- D. frog lives in water which is cold.

The answer is B

Myelinated axons of same diameter are expected to conduct impulses at the same speed. However, the speed of conduction is faster in the rat than in the frog. This is because the rat is endothermic and maintains high body temperature while the body temperature of the frog depends on the temperature of the surrounding which is usually low.

Since increase in temperature increases rate of impulse conduction is faster in a rat than in a frog along myelinated axons of same diameter

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12. Which one of the following is an adaptation in organisms for aquatic conditions?

- A. Development of pollen tube.
- B. Shelled eggs.
- C. Internal fertilization.
- D. Flagellated sperms.

The answer is D

Flagella are long whip-like structures attached to cells and used for locomotion (swimming in an aquatic environment). Therefore, possession of flagellated sperm is an adaption for aquatic conditions

Note: shelled eggs, development of a pollen tube and internal fertilization are adaptations of organisms for terrestrial conditions.

13. Which pair of structures counteracts the stability due to rolling in fish?

- A. vertical and horizontal fins.
- B. Mass of head and vertical fins.
- C. Body flattening and caudal fin.
- D. Streamlined body and horizontal

The answer is A



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A fish is liable to three kinds of instability: rolling, yawing and pitching.

Rolling is the rotation of the body about the longitudinal axis. It is counteracted by both the vertical and horizontal fins acting like the stabilizers on ships.

Recall:

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Yawning is the lateral deflection of the anterior part of the body resulting from the propulsive action of the tail. It is counteracted by the general massiveness of the head and the pressure of the water against the side of the body and the vertical fins.

'Pitching is the tendency for the nose to plunge vertically downwards. It is counteracted by dorso-ventral flattening of the body and the large flap-like horizontal fins.

14. Oxygen from myoglobin is released after oxy-haemoglobin supplies are exhausted because of myoglobin

- A. acts as a store of oxygen in resting muscles.
- B. works better when the partial pressure of oxygen is high.
- C. is produced in skeletal muscles when the oxygen demand is low.
- D. has a lower affinity for oxygen than haemoglobin.

The answer is A

Myoglobin is functionally similar to haemoglobin but has a dissociation curve well to the left of that of haemoglobin. It is found in muscle where it remains fully saturated with oxygen at partial pressures well below that required for haemoglobin to give its oxygen.

Myoglobin stores oxygen, only to release it when the partial pressure of oxygen falls very low. As in vigorous muscle activity.

Note:



Myoglobin is responsible for the color of 'red muscles' and is particularly abundant in active animals which are liable to suffer from oxygen shortage.

15. Increased permeability of a post synaptic membrane to allow chloride ions in, and potassium ions out of the cell causes

- A. depolarization of the cell membrane.
- B. polarization of the membrane.

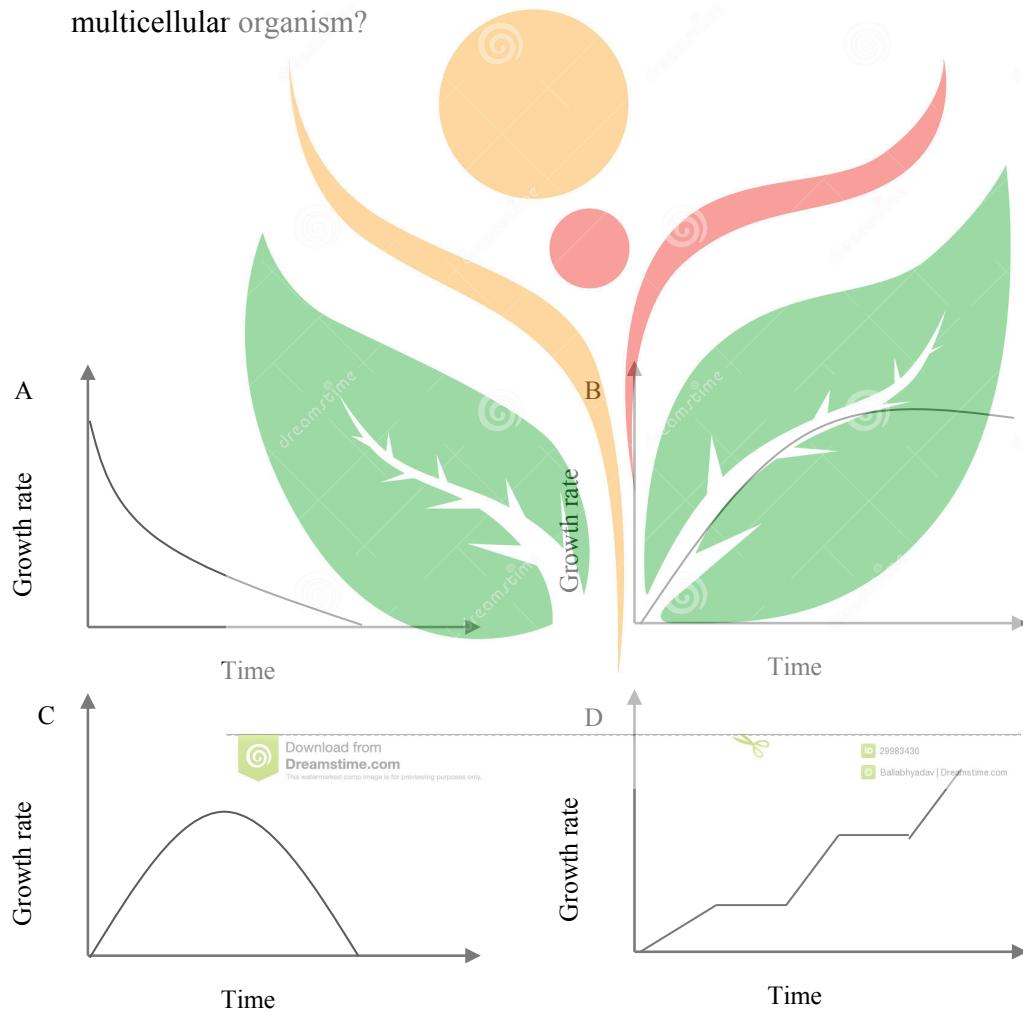
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- C. excitation of the membrane.
- D. hyper polarization of the membrane.

The answer is D

Movement of potassium ions out of a cell and chloride ions into it increases the negative charge inside the cell to a higher than that of the cell in resting state (polarized state). As a result, the cell is said to be hyperpolarized. The resting membrane potential of the cell becomes more negative.

16. Which one of the following graphs in Figure 3 correctly represents the growth rate of a multicellular organism?



The answer is C

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The general pattern of growth is the same for most multicellular organisms.

Growth rate increases gradually until it reaches a maximum. After which it gradually decreases giving a bell-shaped curve.

17. Production of hypertonic urine in animals is mainly achieved by the

- A. Bowman's capsule.
- B. loop of Henle.
- C. proximal convoluted tubule.
- D. distal tubule.

The answer is D

The concentration of urine produced in an animal depends on the amount of water reabsorbed from the glomerular filtrate. Reabsorption of water is controlled by the antidiuretic hormone (ADH) which acts on the distal tubule (and collecting duct) to increase reabsorption of water from the urine. In the presence of ADH, much water is reabsorbed from urine in the distal tubule, leading to formation of hypertonic urine.

18. The sporophyte generation of flowering plants has a mixture of cells with different nucleic acid contents because

- A. of chromosomal mutation in some cells.
- B. they produce megasporangia and microsporangia.
- C. of double fertilization.
- D. the flowers produce fruits and seeds.

The answer is C

In the sporophyte generation of flowering plants, a mixture of cells with different nucleic acid content occurs as a result of double fertilization taking place during zygote formation.

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These cells include:

Endosperm cells (triploid)

Body cells (diploid)

Gamete cells (haploid)

19. Algae have much smaller biomass compared to large producers such as trees but may have the same productivity because

A. a lot of materials and energy are locked up in the dead xylem tissue of the tree.

B. the algae have a very high turn-over.

C. Algae have a high rate of reproduction.

D. the rate of growth and death in algae is

The answer is B

Productivity is the amount of food produced at a trophic level to support organism present at a particular time.

Small reproducers such as algae would have a smaller productivity than larger producer such as tree. However, due to their high turnover rate, the algae, small though they are, may have the same productivity as large producers such as trees which have a low turnover rate.

20. Which one of the following is likely to cause a faster rate of evolution of organisms?

A. stabilizing selection.

B. Directional selection.

C. Disruptive selection.

D. Slow changing environment.

The answer is C

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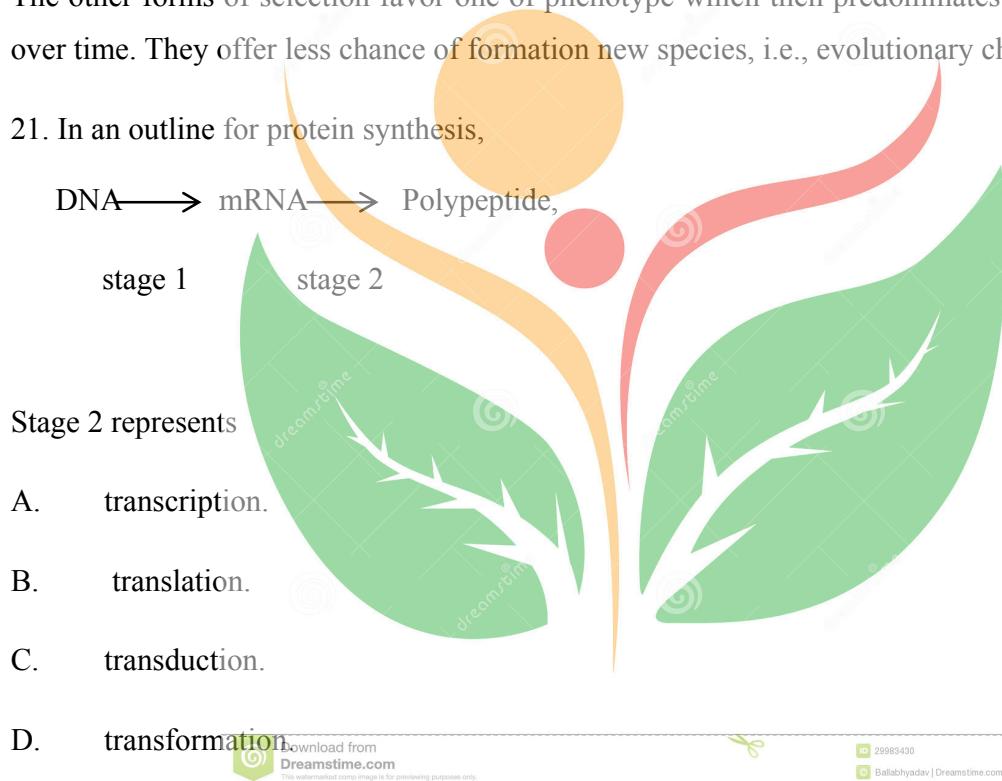
Disruptive selection is the rarest form of selection but can be very important in bringing about evolutionary change. Fluctuating conditions within the environment may favor the presence of more than one phenotype within the population as a result of increased competition may push the phenotypes away from the population mean towards the extremes of the population.

This can split the population into two sub – population. If gene flow between subpopulation is prevented, each population may give rise to a new species.

### Note:

The other forms of selection favor one phenotype which then predominates in the population over time. They offer less chance of forming new species, i.e., evolutionary change.

21. In an outline for protein synthesis,



The answer is B

The process by which the sequence of bases in mRNA is converted into a sequence of amino acid in a polypeptide is called translation. This occurs in ribosomes occurring either free in cytoplasm of the cell or attached endoplasmic reticulum.

Note:

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- Transcription is the process by which the base sequence of a section of DNA representing a gene is converted into the complete base sequence of mRNA. This occurs in the nucleus.
- Transduction refers to the process by which DNA is transferred from one bacterium to another by a microphage (bacteria phage or virus, e.g. HIV)
- Transformation is the process by which bacteria DNA is changed as a result of direct uptake and incorporation of foreign DNA from its surroundings through the cell membrane.

22. It is difficult to observe individual chromosomes during interphase because

- A. the DNA is not yet replicated.
- B. they uncoil to form long, thin strands.
- C. they are dispersed.
- D. homologous chromosomes do not pair up until division starts.

The answer is B.

Interphase follows telophase and marks the beginning of the next division cycle for the cells.

During telophase the chromatids uncoil and lengthen to form chromatin, losing the ability to be seen clearly.

Therefore, during interphase, the chromosomes are still uncoiled and lengthened and are therefore, unable to be seen clearly.

23. Predators in top trophic levels in a food chain are most severely affected by persistent pesticides

because

- A. their systems are highly sensitive to chemicals.
- B. they have rapid reproductive rates.
- C. they cannot store the pesticides in their tissues.
- D. the pesticides become concentrated in their prey.

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The answer is D

Persistent pesticides usually accumulate in the tissue of organisms up the food chain. This phenomenon is called bio-accumulation. As a result, predators in top trophic levels of the food chain feed on prey in whose tissue the pesticide has accumulated and are therefore most severely affected by the pesticide.

24. Aquatic organisms survive under solidified water bodies because

- A. water solidifies from bottom to top of the lakes.
- B. ice is less dense than water at  $4^{\circ}\text{C}$ .
- C. cold water is denser than hot water and falls to the bottom.
- D. warm water floats on top of cold water.

The answer is B

The density of water decreases below  $4^{\circ}\text{C}$  so that ice tends to float on water.

The ice at the surface insulates the water below from heat loss and thus increases chance of survival of organisms under the water.

Note:

Water usually solidifies from top to bottom in lakes and streams but not others ways round. Thus its temperature increases from top to bottom during winter.

25. Which one of the following correctly represents the effect of increasing substrate concentration on the degree of inhibition in a competitive and non-competitive inhibition reaction?

- A. Decreased      Increased.
- B. Decreased      No change.
- C. Increased      Decreased

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- D. No change      Increased

The answer is B

Increase in substrate concentration decreases the degree of competitive inhibition has no effect on non-competitive inhibition.

26. The genetic condition of the spores produced in the sporophyte capsule of the bryophytes is

- A. tetraploid.
- B. haploid.
- C. Polyploid.
- D. diploid.

The answer is B

In sporophytes spores are formed by meiosis. Therefore, spores are haploid ( $n$ ).

27. Cells are limited to small size in order to

- A. keep their volume down.
- B. allow movement of materials in and out of the cells
- C. cut down energy requirements.
- D. enable the nucleus control the cell effectively.

The answer is D

The size of cell is limited by the ability of the nucleus to control the activities of the protoplasm.

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28. Which one of the following enzymes is not secreted by the lining of the ileum?

- A. Lipase.
- B. Sucrase.
- C. Enterokinase.
- D. Lactase.

The answer is A

The lining of the ileum secretes a juice called succus entericus . this contains enzymes which complete the process of digestion. These enzymes include;

Sucrase, lactase, maltase, exopeptidases and enterokinase.

However, lipase is secreted only by the pancreas in pancreatic juice.

29. Which one of the following substances would be released by a plant under conditions of water stress?

- A. Ethene.
- B. Gibberellins.
- C. Indole acetic acid.
- D. Abscisic acid.

The answer is D



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Water stress is a situation in which a plant is liable to lose more water by transpiration than it can gain by absorption from the soil. If this situation continues, the stomata close rapidly the leaves with thereby cutting down water loss to a minimum. This rapid response is brought about by the hormone abscisic acid secreted by the cell in the wilted leaves.

30. The more the variation in a population, the greater is its potential to

- A. give rise to gene flow.

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- B. adapt to new changes in the environment.
- C. produce more offspring.
- D. grow fast.

The answer is B

When a population shows vast variation, the possibility is high that organisms produced shall withstand new changes in the environment with tendency towards emergence of new species well adapted to the conditions. This is consistent with Darwin's theory of evolution.

31. The correct order of transmission of electrical impulses to initiate the heart beat is

- A. sino-atrio node — artria — atrio-ventricular node — purkinje tissue — ventriles.
- B. sino-atrio node — ventriles — atrio-ventricular node — purkinje tissue — atria
- C. atrio-ventricular node — atria — sino-atrio node — purkinje tissue — ventriles
- D. atrio-ventricular node — purkinje tissue — ventriles — artria — sino-artrio node.

The answer is A

During transmission of electrical impulses to initiate a heartbeat, the impulses originate in the sino-atrial node (SAN) and spread over the atria. From the atria, they pass through the atrio-ventricular node (AN), through the purkinje tissue to the ventricle.

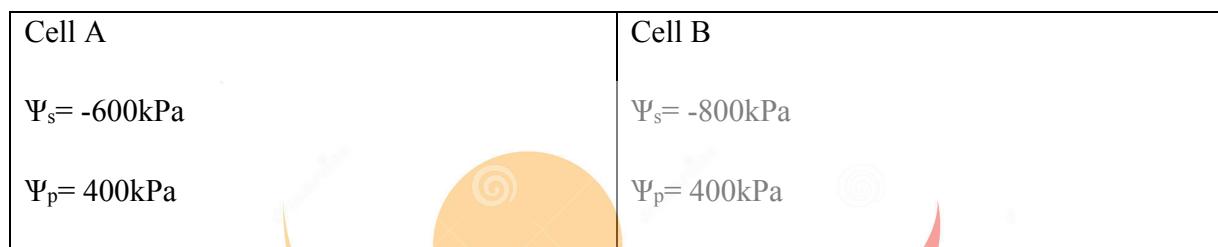
32. Large steroid molecules diffuse quickly through cell surface membranes suggesting that the membranes.
- A. consist of non-polar molecules.
  - B. are semi-permeable.
  - C. are freely permeable.
  - D. are made of polysaccharides.

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The answer is A

The cells membrane is predominantly lipid (non-polar). As a result, steroid molecules, lipid in nature can easily diffuse through the surface membranes by simple diffusion because of similarity in chemical nature.

33. Figure 4 shows a system of two cells separated by a semi-permeable membrane.



Which one of the following statements is correct about the movement of water in the system?

- A. Water moves out of both cells A. and B.
- B. Water moves from cell B to A.
- C. There is no net movement of water between the cells.
- D. Water moves from cell A to B.

The answer is A

For any two solution separated by a semi permeable membrane, water moves out of each solution into the other but at a higher rate from one with a higher water potential (ie. less negative  $\Psi_w$ )

Recall:  $\Psi_w = \Psi_s + \Psi_p$  (cell equation)

Therefore, water moves out of both cells A and B

34. Hydrophytes do not have wax-covered leaves because.

- A. they need much air for fast respiration.
- B. they do not need to conserve water.

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C. the wax would make the leaves heavy and sink.

D. their leaves cannot synthesize wax.

The answer is B

Wax-covered leaves is an adaption to prevent water from a plant through transpiration. Since hydrophytes live in condition of abundant fresh water supply, they need not conserve water. Therefore, their leaves are not wax-covered.

35. Cartilaginous fish extract less oxygen from water than bony fish because the former

A. live in sea water.

B. are relatively bigger in size.

C. employ parallel flow system of gaseous exchange.

D. possess large gills with small surface area volume ratio.

The answer is C

Bony fishes extract more oxygen from water because they employ a counter-current flow system of gaseous exchange. This system is actually prevented in cartilaginous fish which employ predominantly a parallel flow system. As a result, cartilaginous fish extract less oxygen from the water.

36. Usually,  $\text{Na}^+$  and  $\text{K}^+$  are actively pumped out of a red blood cell. When the cell is treated with a metabolic poison, it bursts because

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A. the metabolic poison weakens the cell surface.

B. accumulation of  $\text{Na}^+$  and  $\text{K}^+$  inside the cell alters its water potential.

C. the influx of  $\text{K}^+$  damages the structure of the surface.

D. accumulation of  $\text{Na}^+$  inside the cell alters its water potential.

The answer is D

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The metabolic poison switches off the active  $Na^+ / K^+$  pump (which requires ATP) in the membrane of the red blood cell. As a result,  $Na^+$  accumulates in the cell and causes reduction in water potential within the red blood cell. Water then freely enters by osmosis into the cell, causing it to swell beyond the elastic limit of its membrane. The cell eventually bursts as more water enters into it.

Note: normally, there is more  $K^+$  and less  $Na^+$  inside a cell than outside. When the  $Na^+ / K^+$  pump is switched off, the two ions diffuse along their concentration gradients. That is,  $K^+$  out of the cell and  $Na^+$  into the cell. Therefore, it is the accumulation of  $Na^+$  inside the cell that leads to its osmotic bursting.

37. Which of the following statements is true?

- A. Meiosis produces gametes for sexual reproduction or spores for asexual reproduction.
- B. Only diploid cells can divide by meiosis but both haploid and diploid cells can divide by mitosis.
- C. If mitosis produces a multi-cellular organism after fertilization, but before meiosis that organism is haploid.
- D. Mitosis produces a multi-cellular organism but meiosis occurs before fertilization, that organism is haploid.

The answer is A

It is true that gametes for sexual reproduction and spores for asexual reproduction are produced by meiosis



**Note:**

It is not true that only diploid cells divide by meiosis; polyploid cells can also divide by meiosis.

38. Nitrifying bacteria convert ammonia into nitrates in order to

- A. enrich the soil.
- B. generate energy for synthesis of organic compounds.

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- C. maintain the nitrogen cycle.
- D. reduce the amount of nitrogen in the atmosphere.

The answer is B

Nitrifying bacteria are chemosynthetic bacteria. They obtain energy for synthesizing organic material from oxidizing ammonia to nitrites and nitrites to nitrates. They include Nitrosomonas and Nitrococcus.

39. Which one of the following couples is likely to produce a fetus suffering from foetal erythroblastosis?

- A. Rh<sup>+</sup> mother and Rh<sup>-</sup> father.
- B. Rh<sup>-</sup> mother and Rh<sup>-</sup> father.
- C. Rh<sup>+</sup> mother and Kh<sup>+</sup> father.
- D. Rh<sup>-</sup> mother and Rh<sup>+</sup> father.

The answer is D

Foetal erythroblastosis is also known as hemolytic disease of the new-born. It arises when a Rhesus factor negative mother carries a rhesus positive baby, i.e., marries a Rh<sup>+</sup> man.

Occasionally, Rh<sup>+</sup> red blood cells enter the mother's circulation and cause the mother to produce rhesus antibodies. These antibodies cross the placenta to the foetus and destroy the foetal red blood cells. As a result, the baby is born premature, anaemic and jaundiced (with a yellow skin) and its blood needs to be completely replaced by a transfusion of healthy blood.

40. Three counts of 103, 46 and 20 of a plant species, were made using a quadrant of 25cm<sup>2</sup>. The density of the plant per m<sup>2</sup> is

- A. 169.
- B. 56.3.
- C. 225.

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D. 676.

There is NO correct answer.

Given;

$$C_1 = 103 \text{ plant species}$$

$$C_2 = 46 \text{ plant species}$$

$$C_3 = 20 \text{ plant species}$$

$\Rightarrow$  Average number of plant species,  $C$  captured is given by:

$$C = \frac{C_1 + C_2 + C_3}{3}$$

$$= \frac{103 + 46 + 20}{3}$$

$$= \frac{169}{3}$$

$$= 56\frac{1}{3}$$

$$\therefore C = 56.3 \text{ plant species}$$

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$$\text{Density of the plant, } D = \frac{C}{\text{Area in } m^2}$$

$$= \frac{56.3}{25 \times 10^{-3}}$$

$$\therefore D = 22520 \text{ species per } m^2$$

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### SECTION B

41. (a) How does the synthesis of organic compound in photosynthetic bacteria differ from that in

- (i) green plants

The hydrogen for reducing carbon dioxide come from hydrogen sulphide while in green plants, the hydrogen come from water.

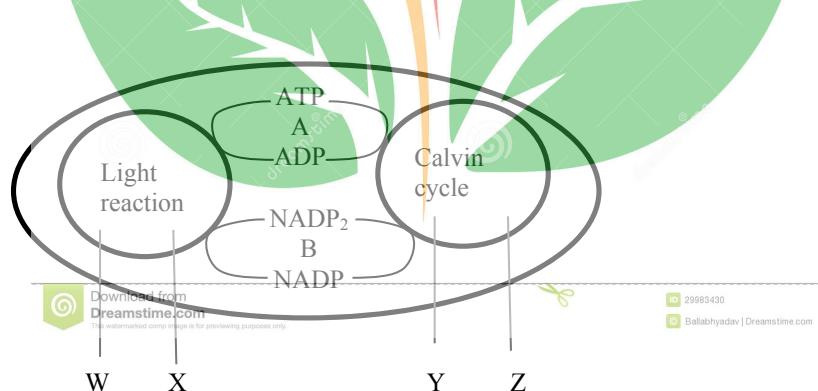
Oxygen is not given off during the synthesis of organic compounds in photosynthetic bacteria as it is in green plants

- (ii) chemosynthetic bacteria?

They obtain energy from sunlight while chemosynthetic bacteria obtain the necessary energy from oxidation of inorganic compounds other than sugar.

They do not give off any gaseous product during the processes while some chemosynthetic bacteria give off methane gas.

b). Figure 5 show a scheme of reactions occurring in a chloroplast during photosynthesis.



- (i) Name the chemical substance represented by letter W, X, Y and Z

W-water

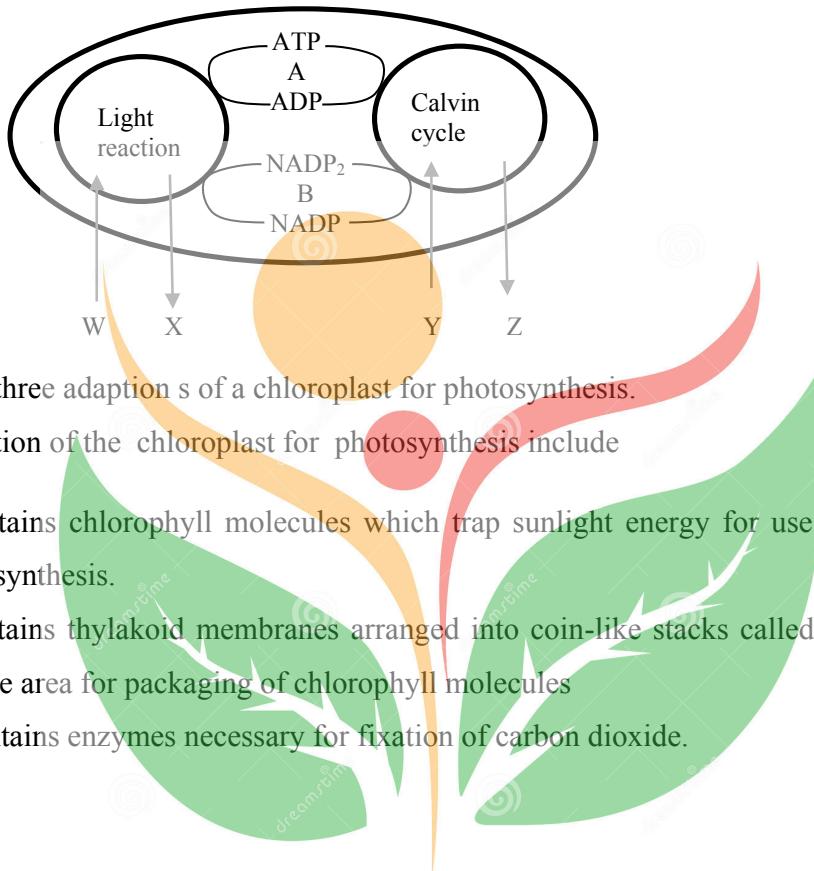
X- oxygen

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Y – Carbon dioxide

Z- phosphoglyceradehyde (PGAL)

- (ii) Indicate by means of arrow o the diagram, the direction of transfer of substance occurring in cycle A and B



- (a) State three adaptions of a chloroplast for photosynthesis.

Adaptation of the chloroplast for photosynthesis include

- it contains chlorophyll molecules which trap sunlight energy for use in the process of photosynthesis.
- it contains thylakoid membranes arranged into coin-like stacks called grana to increase surface area for packaging of chlorophyll molecules
- it contains enzymes necessary for fixation of carbon dioxide.

42. Fat and glycogen energy storage compounds in animals.

- (a) Compare the suitability of the two substances as storage compounds.

Similarities

- They are both compactly arranged to take up little space.
- they are both less soluble in water and little or none can be lost in solution
- both can be hydrolyzed to form soluble substances once mobilized from storage to provide energy
- both are formed by condensation reaction,

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- both are relatively inert hence when stored do not interfere with metabolism

### Differences

Fat	Glycogen
- composed of fatty acids and glycerol	- composed of glucose
Has a high calorific value.	Has a lower calorific value.
Has a higher hydrogen- oxygen content and can yield more metabolic water.	Has a lower hydrogen- oxygen content and yield less metabolic water
Has less weight and keeps body weight to a minimum which allows buoyancy	Is heavier and can lead to overweight.
Different forms of fat occur due to different constituents of fatty acid	Glycogen molecules show no different forms
Stored in liver, subcutaneous tissue and in seeds	Stored in muscles

(b) State the advantage of storing fat over glycogen.

- Fat is completely insoluble in water and none can be lost in solution unlike glycogen which is slightly soluble in water
- Fat forms an insulating layer under the skin that helps in temperature regulation.
- Fats yield more energy per gram/has a high calorific value
- Fat has a low density hence provide buoyancy in aquatic animals.
- Fats yield more metabolic water due to higher hydrogen to oxygen content
- Fats are more compact and thus occupy little space

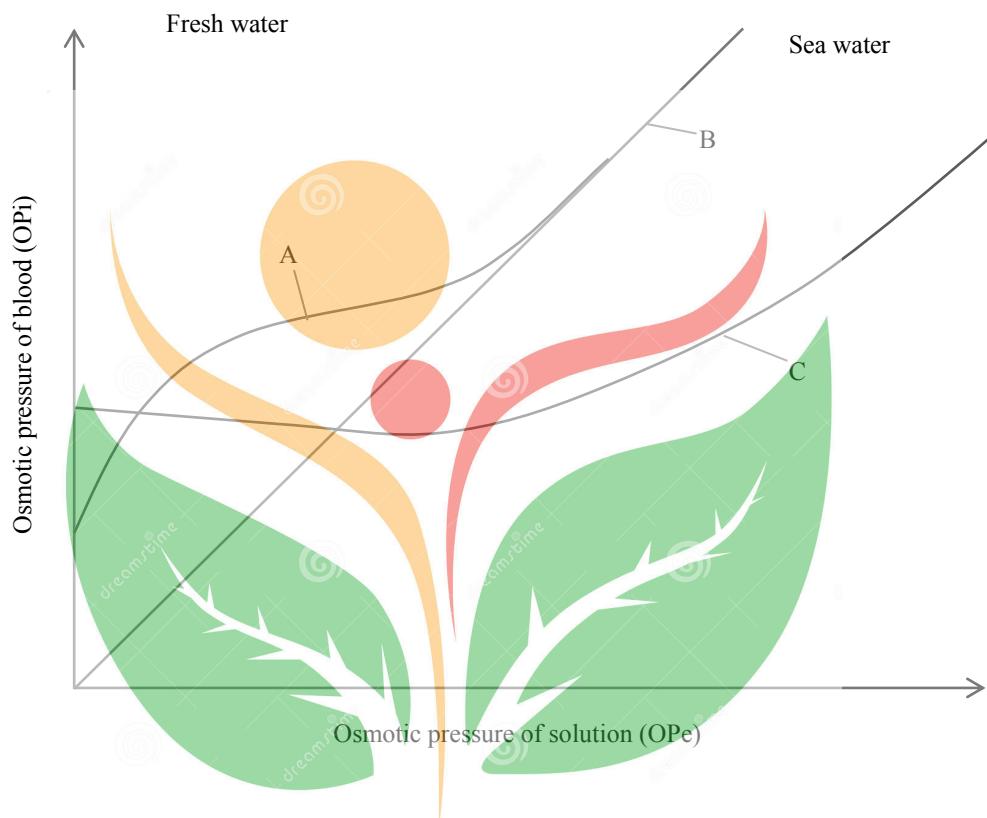
(c) Why is glycogen a more suitable energy compound in muscles than fat?

- Glycogen provides is hydrolyzed faster to provide energy
- Glucose from glycogen can be respired anaerobically

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- Liver has more abundant enzymes for glycogen metabolism than fat metabolism

43. Figure 6 show the relation between the osmotic pressure of blood and external medium of three animals A, B and C



(a) Suggest the likely habitat for each animal, giving reason in each case.

A is an estuarine animal because it can only osmoregulate in ranges of OPi midway between fresh water and sea water.

B is a sea water (marine) animal because it cannot osmoregulate at all such that its OPi is always equal to OPe in all media.

C is fresh water animal because it can osmoregulate in fresh water ranges of OPe but not in sea water.

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(b) Explain the osmoregulatory problems of each of the following animals

(i) Fresh water teleosts

They face a danger of dilution of their tissues.

Explanation

The osmotic pressure of their body fluids is higher than the osmotic pressure of the surrounding waters.

As a result, there is an osmotic influx of water across the exposed semi-permeable surface of the body.

(ii) Marine teleosts

They face a danger of dehydration of their tissues.

Explanation:

The osmotic pressure of their body fluids is lower than the osmotic pressure of the surrounding waters

As a result, there is an osmotic outflow of water across the exposed semi-permeable surface of the body.

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44. Three healthy, unrelated species of flowering plants A, B and C were subjected to a range different light and dark treatments. The results are shown in the table below.

	Treatments					
	1	2	3	4	5	6
Hour of light	15	14	13	12	11	10
Hour of darkness	9	10	11	12	13	14
Species A	+	+	+	+	-	-
B	-	-	-	-	+	+
C	+	+	+	+	+	+

Key: + = flowering, - = no flowering

- (a) State the photoperiodic group to which each species belong, giving a reason in each case
- A is long-day plant because decreasing duration of light inhibits flowering.
  - B is short-day plant because decreasing duration of light favours flowering
  - C is day-neutral plant because varying duration of light does not affect flowering

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- (b) Describe how the phytochrome controls flowering response exhibited in species A and B

- (i) Species A

Phytochrome ( $P_{FR}$ ) promotes while  $P_R$  inhibits flowering in this species. Long duration of light promotes conversion of  $P_R$  to  $P_{FR}$  and thus promotes flowering in this species.

- (ii) Species B

Phytochrome  $P_{fr}$  inhibits  $P_R$  promotes flowering in this species. During a long duration of light,  $P_{FR}$  predominates and inhibits flowering. In the dark,  $P_{FR}$  is

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sufficiently converted of PR which promotes flowering in this species in short light duration.

(c) What would be the effect of flashing light during darkness, on each of the specimens?

- (i) A: A flash of light during darkness would promote flowering
- (ii) B: A flash of light during darkness would inhibits flowering
- (iii) C: A flash of light during darkness would have no effect on flowering

45. (a) How can predation be beneficial to the prey species?

- Reduces intraspecific competition in prey
- It weeds out weak individuals maintaining a healthy population

(b) Give factors that may affect predator-prey balance in nature.

- Insufficient supply of food for the prey organisms
- Insufficient supply of water in the habitat of predator and prey.
- Diseases that may affect predator or prey
- Accumulation of toxic waste in the predator or prey population
- Presence of parasites of predator or prey
- Lack shelter or hiding place for prey
- Presence of adverse climatic conditions

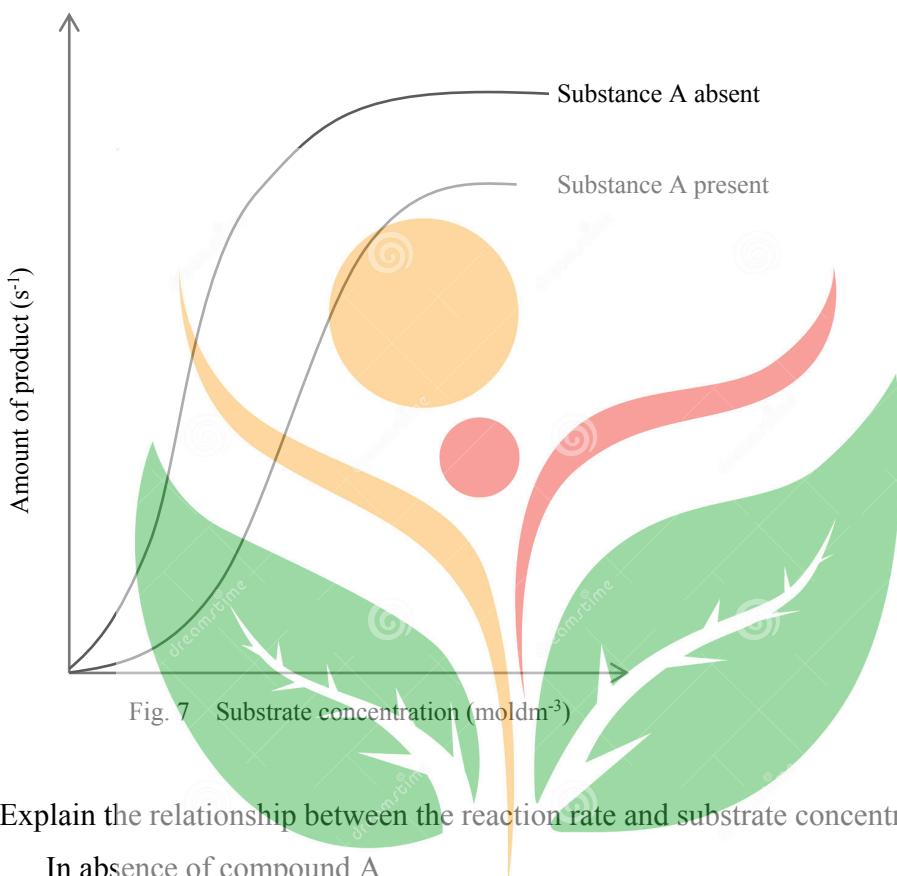
(c) Outline ways by which humans have affected the predator-prey balance resulting into harmful consequences.

- Deforestation has reduced availability of shelter for both predator and prey.
- Deliberate hunting and killing of predator has led to increase in numbers of certain prey organisms
- Water pollution has led to death of certain prey organisms with the result that certain predator organisms has greatly reduced in number.
- Deliberate capturing certain prey organisms for human consumption has greatly reduced the population of certain predator organisms.

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- Mechanization and improved prey have encroached on the natural environment of certain predator-prey organisms. This has led to extinction of some feeding pairs.

46. Figure 7 show the effect of varying substrate concentration on an enzyme-catalyzed reaction, in absence and presence of compound A



(a) Explain the relationship between the reaction rate and substrate concentration

(i) In absence of compound A

Reaction rate increase rapidly with substrate concentration. Rate then increase gradually before it becomes constant at higher substrate concentration

**Explanation**

Initially, the number of enzymes molecules available for reaction is higher than the number of substrate molecules; any available substance will react to form a product.

As the substrate concentration increase, the number of enzymes molecules occupied by substrate at a given time increase, hence more amount of product is formed per unit time. This continues until all the enzymes molecules are occupied so that a substrate has to wait

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for the active site of the enzymes to be freed before it can bind the enzymes, in order to react. The rate of formation of products therefore becomes constant.

(ii) In presence of compound A

Rate of reaction increase slowly with substrate concentration and reaches a lower maximum at a higher substrate concentration.

Explanation:

Compound A competes with the substrate for the active sites of the enzyme molecules.

As a result, the number of enzymes molecules available for binding the substrate at a given time is lower.

As the substrate concentration increase, the probability of the substrate to bind with the enzyme increase although at a lower rate. The enzymes molecules become saturated at a higher substrate concentration. However, at this point, the output is lower because some enzyme molecules are occupied by compound A and cannot react with substrate.

(b) State two factors which would have to be constant in this experiment

- Temperature of the reaction medium
- PH of the reaction medium
- The amount of the enzyme.

(c) What would be the effect of increasing the concentration of compound A in the experiment

The rate of reaction would decrease with increase in amount of compound A added until the reaction stops altogether at higher concentrations of compound A because at high concentration, A out competes the substrate for the active site

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**UACE Biology paper 2011 marking guide**

**Answer all questions**

1. In Bryophytes, gametes are produced by

- A. gametophytes through mitosis.
- B. sporophytes through meiosis.
- C. sporophytes through mitosis.
- D. gametophytes through meiosis.

The answer is A

Bryophytes undergo alternation of generation in which a haploid gametophyte generation alternates with a diploid sporophyte generation. Production of gametes by the gametophyte is by mitosis so that the gametes are also haploid. The gametes then fuse to form a diploid zygote which grows into a diploid sporophyte. The sporophyte produces spores by meiosis and so the spore are also haploid. Spores then germinate and grow into the gametophyte.

2. Squamous epithelium is made up of thin and delicate sheets of cells as an adaptation to

- A. rapid cell division.
- B. facilitation of liquid movement.
- C. shortening diffusion distance.
- D. protecting the body from abrasion,

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The answer is C

Diffusion of materials across an epithelium occurs across the thickness of the cells constituting the epithelium. Being thin and delicate, the cells of the squamous epithelium shorten the diffusion distance, i.e. the distance across which materials have to move during diffusion.

3. In a non-dividing cell, the percentage of guanine is 40%. The percentage of adenine in the cell is

- A. 30
- B. 20
- C. 40
- D. 10

The answer is D.

According to the rules of base pairing, guanine (G) pair with cytosine (C) and adenine (A) pairs with thymine (T).

As such the ratio of G:C is 1:1 and that of A : T is also 1:1 thus, if G is 40% even C is 40%.

As such A and T constitute 20% which they share in a ratio 1:1 thus, A constitutes 10% and T also 10%

4. Which one of the following is a likely character in a human population, illustrated in figure 1.

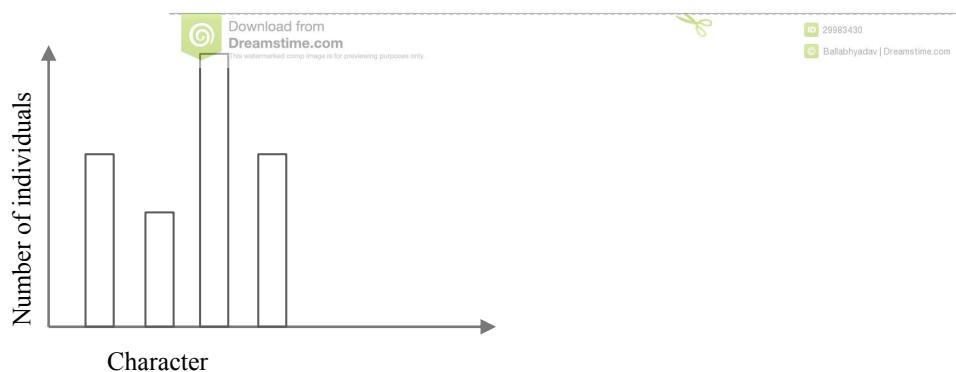


Fig. 1

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- A. Height.
- B. Ear size.
- C. Blood groups.
- D. Finger length.

The answer is C

The graph indicates discrete values of the character with no intermediate, i.e. separate bars. This is a representation of discontinuous variation. Such variation is only possible for qualitative characteristics such as Blood groups; tongue rolling; skin colour; eye colour etc.

Note: continuous variation occurs for quantitative characters such as height. Ear size, finger length etc. such characters can take on any value and may have intermediate values. Continuous variation is represented by a histogram, i.e.

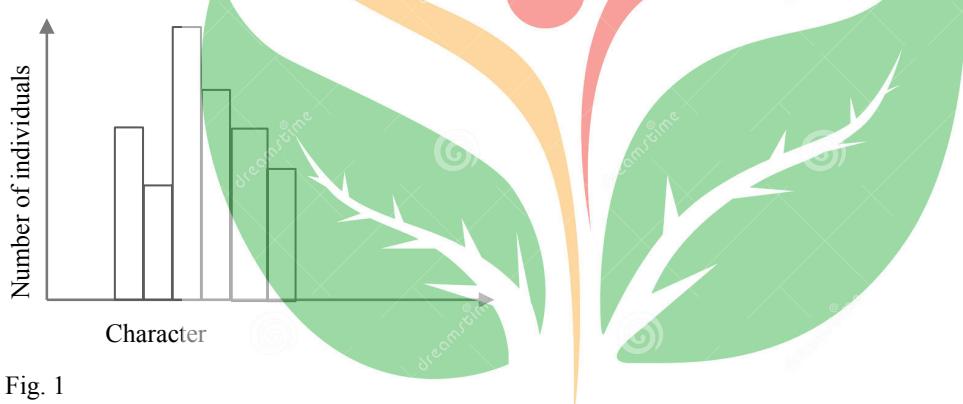


Fig. 1

5. Which one of the following properties of water facilitates its efficient transportation of glucose?

- A. Forms hydrogen bonds with other molecules.
- B. Has high surface tension.
- C. Has a low freezing point.
- D. Has a high boiling point.

The answer is A

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Glucose is a polar molecule which is capable of forming hydrogen bonds water is also polar and forms hydrogen bonds with itself and other polar molecules. This property facility the dissolution of glucose in water which it is transported.

6. Figure 2 shows the banding pattern of a myofibril when relaxed.

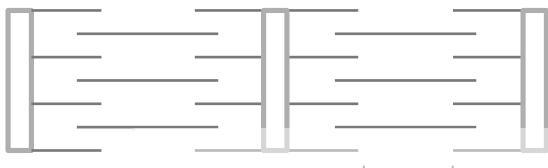


Fig. 2

Which one of the following occurs in reference to the A band when the myofibril is contracted?

- A. Becomes lighter.
- B. Becomes narrower.
- C. Disappears.
- D. Becomes wider.

The answer is B

During skeletal muscle contraction the actin and myosin filaments slide parallel to one another.

This shortens the sarcomere. The 1-band (the A- band in the question) becomes narrower.

7. A companion cell has a large nucleus because

- A. it supports the sieve tube element which lacks a nucleus.
- B. it controls a large volume of cytoplasm.
- C. movement of materials in the sieve tubes is an active process.
- D. of its high metabolic rates.

The answer is D

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The nucleus of a cell controls all the metabolic activities of the cell and such, the size of the nucleus of a cell is directly proportional to the metabolic activity of the cells.

The companion cell is a site of intense metabolic activity and thus has a large nucleus.

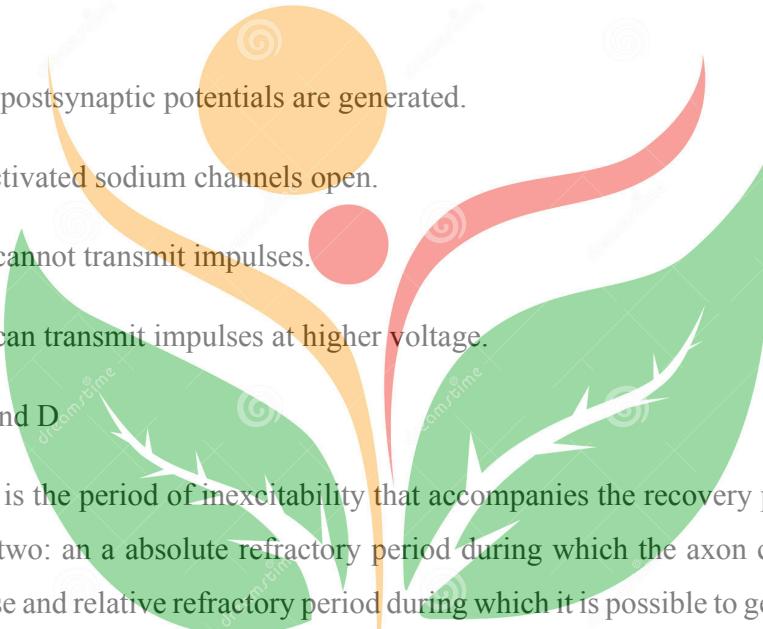
Note:

Although the sieve element is metabolically inert, it is just mere speculation that the companion cell provides for its metabolic needs.

8. Which one of the following is correct about the refractory period in an axon of a nerve fibre?

- A. Inhibitory postsynaptic potentials are generated.
- B. Voltage activated sodium channels open.
- C. The axon cannot transmit impulses.
- D. The axon can transmit impulses at higher voltage.

The answer is C and D



Refractory period is the period of inexcitability that accompanies the recovery phase of the axon. It is divided into two: an absolute refractory period during which the axon completely cannot transmit an impulse and relative refractory period during which it is possible to generate an impulse provided that the stimulus is stronger than usual, i.e. of higher voltage.

Note:



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During this period, the sodium ion channels are closed.

Inhibitory post synaptic potential is concerned with synaptic transmission only.

9. What would be the water potential of a cell if its pressure potential is 500 kPa and its solute potential is  $-Q$  4900kPa?

- A. -4400 kPa

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- B. 4400 kPa
- C. 5400 kPa
- D. -5400 kPa

The answer is A

Water potential ( $\Psi$ ), solute potential ( $\Psi_s$ ) and pressure ( $\Psi_p$ ) are related by the following equation.

$$\Psi = \Psi_s + \Psi_p \quad (\text{the cell equation})$$

$\Psi_s$  is negative while  $\Psi_p$  is positive.

$$\begin{aligned} \Rightarrow \Psi_s &= -4900 \text{ kPa}; & \Psi_p &= +500 \text{ Pa} \\ \Rightarrow \Psi &= -4900 \text{ kPa} & + & 500 \text{ kPa} \\ \Rightarrow \Psi &= -4400 \text{ kPa} \end{aligned}$$

Hence the water potential of the cell is -4400 kPa

10. Which one of the following results when a gamete with non-disjunction is fertilized?

- A. Duplication
- B. Translocation
- C. Monosomy
- D. Polyploidy

The answers is C



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Non-disjunction is the failure of sister chromatids to separate during meiosis.

As a result, some gametes are produced with a diploid genetic constitution while others are empty. When such gametes fertilized, a higher degree of chromosome complement is formed.

11. In an individual whose energy intake is 50,000 kJ per day, loses 1 dm<sup>3</sup> of sweat in a day during manual work. Given that the latent heat of vaporization of sweat is 2.45 kJ cm<sup>-3</sup>, the percentage of energy lost by the individual during the work is

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- A. 4.22.
- B. 5.0.
- C. 4.90.
- D. 7.65.

The answer is C.

$$\text{Volume of sweat, } V_s = 1 \text{ dm/day.}$$

$$L_u \text{ of sweat} = 2.45 \text{ kJ cm}^{-3}$$

$$\Rightarrow \text{heat lost in sweat, } Q_{out} = V_s \times L_v$$

$$= (1000 \times 2.45)$$

$$= 2450 \text{ kJ/day}$$

$$\text{Energy intake, } Q_{in} = 50,000 \text{ KJ/day}$$

$$\Rightarrow \% \text{ energy loss} = \frac{Q_{out}}{Q_{in}} \times 100$$

$$\Rightarrow = \frac{2540}{50000} \times 100$$

$$\therefore \text{energy loss} = 4.90\%$$

Hence percentage energy loss during work is 4.90 %

12. The volume and surface area of four A, B, C and D are shown in the following table:

Animals	Volume /cm <sup>3</sup>	Surface area /cm <sup>2</sup>
A	1	6
B	8	24
C	64	96
D	64	28

Which one of the organisms would need a specialized respiratory system?

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The answer is D

An organism that most needs a specialized respiratory system is one that has the least surface area to volume ratio. In such an animal, diffusion alone cannot suffice its respiratory needs.

The surface area to volume ratio of these different animals are as shown;

Animals	S.A / V ratio
A	$6/1 = 6$
B	$24/8 = 4$
C	$96/ 64 = 1.5$
D	$28/64 = 0.4374$

Hence animal that has the least surface area to volume ratio and therefore needs specialized respiratory system.

13. Figure 3 shows pyramids of energy A, B, C and D in different areas of an ecosystem.

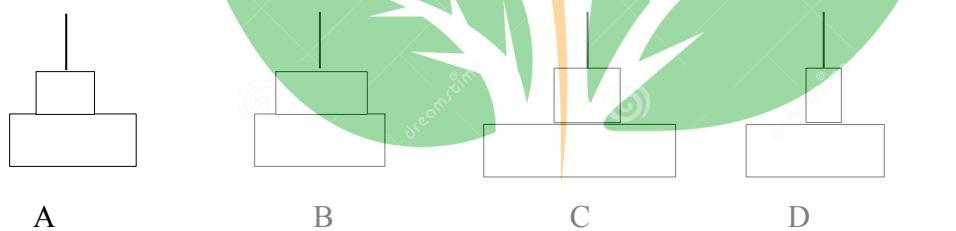


Fig. 3

In which pyramid does the primary consumer make most efficient use of the producer?

The answer is B

In energy pyramid, bars are proportional to the total energy utilized to each trophic level. Those shown indicate three trophic levels: producers, primary consumer and secondary consumers. In this case, the larger the size bar that corresponds to primary consumers, the

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more the energy they obtain from the producer and therefore the more efficient they utilize their producers. This is shown by pyramid B.

14. Which one of the following factors has the greatest limiting influence on the population growth of an alga at the bottom of a pond?

- A. Light.
- B. Carbon dioxide,
- C. Minerals.
- D. Oxygen.

The answer is A

Algae are photosynthetic organisms. As such factors limiting their population so by limiting their photosynthetic activity.

The pond surface is usually covered with a layer of lower plants which limit the amount of light reaching the bottom of the pond. Therefore, the greatest limiting factor of population growth of algae at the bottom of the pond is light.

15. A non-mutualistic role of bacteria in ruminant animals is that they

- A. secrete enzymes for hydrolysis of carbohydrates.
- B. break down food into small fragments to ease enzyme action.
- C. produce bacterial protein which is used by the ruminant.
- D. are preyed on by the ruminants.

The answer is D

In a mutualistic relationship both organisms involved benefit and no harm is done to either organism.

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If any of the organism does harm to the other, then relationship becomes non-mutualistic. Therefore, that the bacteria in the gut of ruminant animals are preyed on them is a non-mutualistic role.

16. Photosynthetic bacteria differ from green plants in that

- A. they lack chlorophyll.
- B. their source of energy is through oxidation of hydrogen sulphide.
- C. their source of energy is through oxidation of iron salts.
- D. their source of hydrogen is hydrogen sulphide.

The answer is D

Photosynthetic bacteria also obtain energy from sunlight like the green plants. However, they differ from green plants in that source of their hydrogen is hydrogen sulphide instead of water which is used by green plants.

17. Gametes are haploid because

- A two replications of DNA occur during meiosis.
- B homologous chromosomes separate during meiosis.
- C crossing over occurs during prophase.
- D chromatids do not separate during meiosis.

The answer is B.

Gametes are haploid because homologous chromosomes separate during anaphase I of meiosis

In the second division, which occurs without further duplication of DNA, each chromosome is divided into two chromatids that move to two different daughter cell.

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Hence each (daughter cell) gametes has half the genetic material of that of the parent cell, i.e. is haploid.

18. Which one of the following would be the immediate problem to a fish when taken out of water?

- A. Insufficient oxygen supply.
- B. Lack of support.
- C. Drying up of gills.
- D. Lack of food.

The answer is A

When a fish is taken out of water, the gills clamp up together. This reduces their effective surface area for gaseous exchange. Therefore, the immediate problem to a fish when taken out of water is insufficient oxygen supply.

19. Which one of the following is least likely to occur when organisms of similar species compete for same limited resources?

- A. Range restriction.
- B. Aggression towards each other.
- C. Extinction
- D. Co-existence.

The answer is D

According to the competitive exclusion principle, no two organisms of the same species can occupy the same ecological niche. That is similar species of organisms that compete with each other for the same resources cannot co-exist.

However, they may impose restriction on their range of living or develop aggression towards each other. Otherwise, they may evolve into new separate species needing different resources, hence to extinction of the competing strains.

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20. Parthenogenesis differs from asexual reproduction, parthenogenesis involves

- A. two organisms of different sexes.
- B. fertilization.
- C. formation of gametes.
- D. mixing of genetic material.

The answer is C or D

Parthenogenesis is the development of a new individual from an unfertilized egg. There are two kinds of parthenogenesis: diploid and haploid parthenogenesis. In diploid parthenogenesis, the eggs (gametes) are diploid because they are formed by mitosis while in haploid parthenogenesis the eggs (gametes) are haploid because they are formed by meiosis.

No fertilization is necessary and only one sex is necessary. Also some degree of genetic mixing occurs due to crossing over at prophase 1 of meiosis.

In a sexual reproduction, no gametes are formed and there is no genetic mixing.

21. Which one of the following factors does not affect the distribution and abundance of an organism?

- A. Mimicry.
- B. Predation.
- C. Human species.
- D. Speciation.

The answer is D

Mimicry, predation and human activities are some of the factors that affect the distributions of an organism.

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Note:

Speciation is the process by which one or more species arise from previously existing species. It only affects the number of species present in an area but does not affect distribution and abundance of a given species of organisms.

22. Which one of the following processes decreases the glucose level in the blood?

- A. Break down of fats.
- B. Synthesis of glycogen.
- C. Breakdown of proteins.
- D. Breakdown of glycogen.

The answer is B

The liver is the major organ that regulates the blood glucose level. One way in which it reduces the blood glucose level when it is higher than normal is by synthesizing glycogen from glucose.

Note:

When the blood glucose level is lower than normal, the liver can increase the glucose level by; breakdown of glycogen to glucose, and break down of proteins and fats to produce residues that can be used to synthesize glucose by the process of gluconeogenesis

23. Which one of the following is true about active transport?

- A. Requires a semi-permeable membrane.
- B. Occurs in both living and non-living cells.
- C. Uses up oxygen.
- D. Involves movement of molecules along a concentration gradient.

The answer C

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Active transport is the process by which materials are transported across a living cells membrane against a concentration gradient, using metabolic energy in form of ATP.

As such, active transport:

- Uses up oxygen
- Is inhibited by metabolic poisons
- Does not occur in non-living cells.

Note:

Although active transport it takes place across a semi permeable membrane, this is not major requirement. The most important requirement is metabolic energy in form of ATP. This is why it cannot take place in non-living cells even though their membranes may still be semi-permeable.

24. Which one of the following is not involved in a physiological homeostatic process?

- A. Positive feedback.
- B. Receptors.
- C. Effectors.
- D. Control mechanism

The answer is A

A physiological homeostatic process involves:

- Receptors
- Control mechanism
- Effectors.
- Norm or set point.

Note:

Positive feedback is a destabilizing mechanism which creates more instability of a system and therefore cannot be used as a homeostatic mechanism. The normal mechanism employed in

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physiological homeostatic process is negative feedback. Here, a change in the value of the controlled factor initiate a series of processes that bring back the factor to normal.

25. Lack of iodine in the diet causes cretinism because iodine
- controls metabolism.
  - is essential in the formation of metabolic enzymes.
  - influences growth of bones.
  - is required for synthesis of thyroxine.

The answer is D

Iodine is the most important reagent in the formation of thyroxine. Thyroxine is an important metabolic hormone that is also important in influencing the growth of bones.

Cretinism is a condition in which the amount of thyroxine is very low in blood as a result of iodine deficiency in the diet. It is characterized by:

- Poor bone development leading to stunted growth
- Mental retardation.

This condition is diagnosed in infancy. If it goes unnoticed, it results in myxedema later in life. This is characterized by slow mental activity, decreased metabolic rate and swelling of face, tongue and loss of scalp hair.

26. Plant species where  $2n = 12$ , the chromosome number in its endosperm cells after fertilization is



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- 6.
- 12.
- 18.
- 24.

The answer is C

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Given  $2n = 12$

$\Rightarrow n = 6$

$\Rightarrow$  however, the endosperm cell are triploid, i.e.  $3n$

$\Rightarrow$  number of chromosomes in endosperm cells

$= 3 \times 6$

$= 18$

27. Individuals lacking desired qualities are prevented from mating during artificial selection using the following methods except

A. extermination.

B. segregation.

C. sterilisation.

D. cross-breeding.

The answer is D.

Artificial selection is the process by which humans encourage the breeding of animals with desired qualities while preventing those with undesired qualities from breeding. This is done by:

- Segregation: animals with desired characters are bred together in a segregated area so that they do not mate with others whose characteristics are not desired.
- Sterilization: animals with undesired characters are sterilized so that they are unable to mate and therefore they cannot pass their characters onto the next generation.
- Extermination: animals with undesired characters are killed before they reach reproductive age.

Note:

Cross-breeding is part of artificial selection but is not a means of preventing individuals with undesired qualities from mating.

28. Fats yield more energy per unit mass molecule than carbohydrates because fats possess

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- A. more carbon atoms.
- B. more hydrogen atoms.
- C. fewer carbon atoms.
- D. fewer oxygen atoms.

The answer is B

Fats have a higher caloric value, i.e. yield more energy per unit mass on oxidation than carbohydrates. This is because fats possess a higher proportion of hydrogen and an almost insignificant proportion of oxygen compared with carbohydrates. The hydrogen is used in the respiratory chain in the mitochondria to form ATP

29. Which one of the following human activities can lead to acid rain?

- A. Mining coal.
- B. Use of fossil fuels.
- C. Sewage disposal in water bodies.
- D. Commercial farming.

The answer is B.

Fossil fuels yield carbon dioxide when burnt. Carbon dioxide is an acid gas. It dissolves in rain water to form acid rain. The other gas produced from the use of fossil fuels is sulphur dioxide which is also acidic and causes acid rain.

Note:

Coal mining does not yield any gas but use of coal as a fuel yield carbon dioxide which is an acidic gas

Sewage disposal in water bodies only causes eutrophication but does not cause acid rain.

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Commercial farming reduces the incidence of acid rain production because the plant absorb the excess carbon dioxide from the atmosphere.

30. According to Mendel, all the following are correct except

- A. each characteristic of an organism is controlled by a pair of alleles.
- B. each allele is transmitted from generation to generation in a discrete unit.
- C. there are several varieties of alleles from each parent.
- D. each organism inherits one allele of each pair, from each parent.

The answer is C

According to Mendel, characteristics of diploid organisms are controlled by alleles occurring in pairs and of a pair of such alleles. Only one is carried in a single gamete, i.e. each parent has only one variety of an allele of each pair.

Also, each offspring inherits one allele of each pair, one from each parent.

Each allele is transmitted from generation to generation in a discrete unit.

31. Which one of the following illustrates a tropic response?

- A. Capitulum of flowers closes in low light intensity.
- B. Closed petals of tulip flowers open at high temperatures.
- C. Pollen tubes grow towards the micropyle of the ovule in a flower.
- D. Leaves of mimosa fold down when touched.

The answer is C

Tropism is a growth movement of part of a plant in response to a directional stimulus.

In tropic responses, the direction of the response is related to that of the stimulus and, in almost all cases, the plant part moves towards or away from the stimulus. Each response is named according to the nature of the stimulus.

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Thus:

<b>Stimulus</b>	<b>Names of response</b>	<b>Example</b>
Air	aerotropism	Pollen tubes away from air
Light	phototropism	Plant shoots towards light
Gravity	geotropism	Plant roots grow downwards
Water	hydrotropism	Plant roots towards moisture
Chemical	chemotropism	Fungal hyphae grow towards nutrients
touch	thigmotropism	Tendrils of peas twine around their support.

Note:

The other objectives indicate nastic responses; movement of a plant to non-directional or diffuse stimulus

Both tropic responses and nastic responses occur in plants

32. Which one of the following is an adaptation of the kidney in a fresh water fish?

- A. Large glomeruli.
- B. Long loop of Henle.
- C. Well-developed collecting duct.
- D. Few glomeruli.

The answer is A

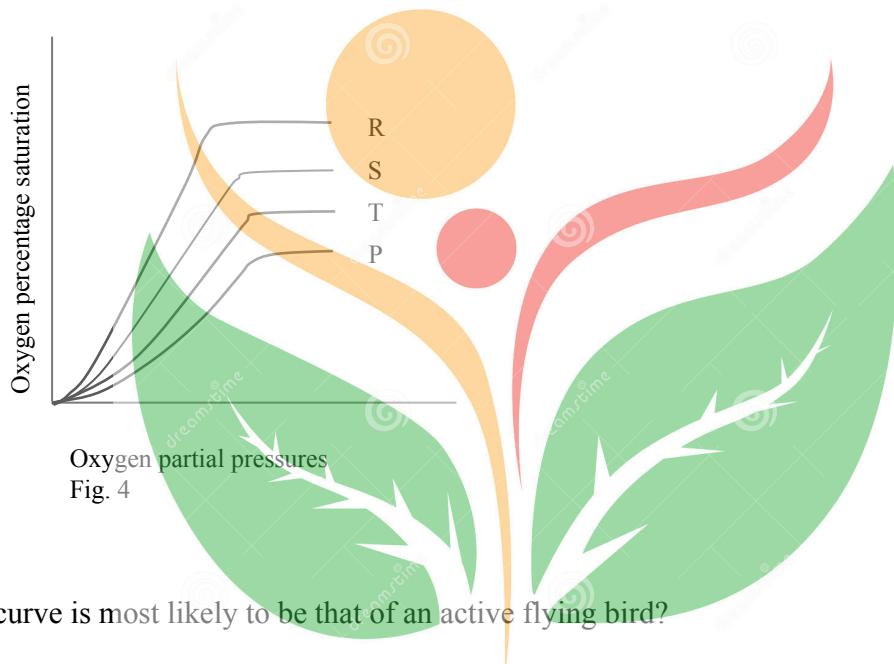
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Fresh water fishes are liable to osmotic influx of water across the gills part and lining of the mouth and pharynx..

The overcome this problem in three ways:

- possessing numerous large glomeruli
- extensive reabsorption of salt from the glomerular filtrate
- active uptake of salt by chloride secretary cells in the gills.

33. Figure 4 shows the oxygen dissociation curves for mudfish, human foetus, adult human and an active flying bird.



Which curve is most likely to be that of an active flying bird?

- A. R.
- B. S.
- C. T.
- D. P.

The answer is D

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A active flying bird demands much energy and therefore has high metabolic rate. To supply oxygen to the tissue rapidly, their haemoglobin must release it readily. This is the reason why it has its dissociation curve to the far right of all the organisms represented.

Note:

Mudfish, live in muddy water logged burrow where oxygen tension is very low. Its haemoglobin has very high affinity for oxygen and is represented by curve R, i.e. lies to the far left.

Foetal haemoglobin has higher affinity for oxygen than for an adult human because it has to pick oxygen from maternal blood; its curve is to the left of that of an adult human. Thus curve S represents foetal haemoglobin while T is for adult human.

34. A layer of wax is deposited over chitin in exoskeletons because

- A. wax reduces the weight of the exoskeletons.
- B. Chitin is permeable to water.
- C. wax allows flexibility of the body.
- D. Chitin alone is not hard enough for protection.

The answer is B

- Chitin is highly permeable to water. Therefore, if the exoskeleton of an insect were made up of chitin alone. It would lose a lot of water from its body by evaporation.
- Wax is water repellent and impervious. Therefore, layer of wax on the chitin of the exoskeleton prevents water loss from the body of the insect and prevents desiccation.

35. Which one of the following conditions may limit the chances of variation in the offspring plants?

- A. Dioecism.
- B. Self-incompatibility.
- C. Protandry.

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D. Hermaphrodism.

The answer is D

Variation in flowering plants occurs as a result of cross-fertilization. Therefore, any feature of flowering plant that prevent cross-pollination limits variation. Hermaphrodism is one such character that encourages self-pollination and therefore limits chances of variation

Note:

Dioecism, protandry and self-incompatibility encourage cross-fertilization and therefore promote variation.

36. Which one of the following would be an effect of increased competition on a stable population?

- A. Increasing the environmental resistance thereby increasing the population.
- B. Lowering the environmental resistance thereby increasing the population.
- C. Lowering the environmental resistance thereby decreasing the population.
- D. Increasing the environmental resistance thereby decreasing the population.

The answer is B

Competition is one of the factors that constitute environment resistance. others include, predation, diseases, etc. Therefore, reduction in competition reduces environmental resistance and thus encourages population growth.

37. Which one of the following occurs to the axon membrane during an action potential? It is

- A. polarized with inside negative while outside is positive.
- B. depolarized with inside negative while outside is positive.
- C. depolarized with inside positive while outside is negative.
- D. polarized with inside positive while out side is negative.

The answer is C

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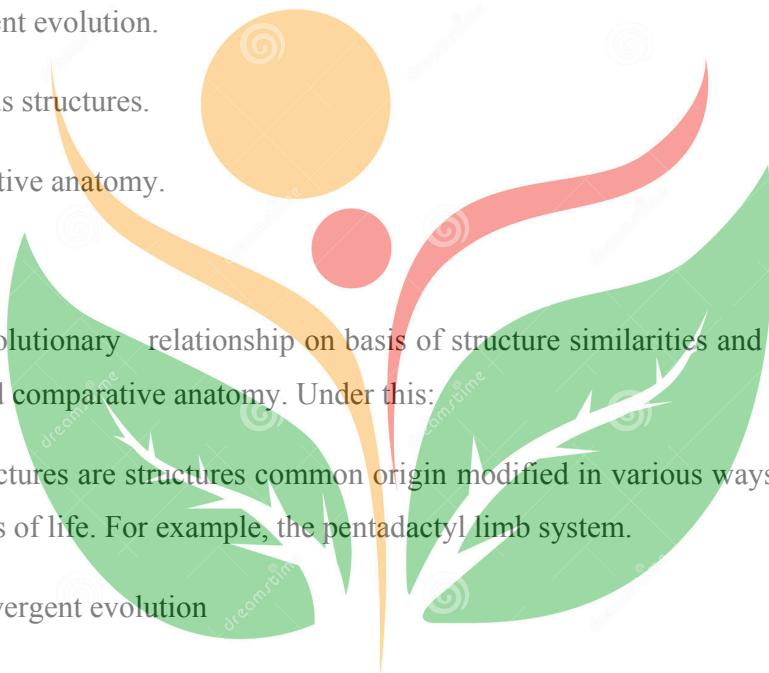
In resting state, the axon members are polarized with the outside positive and the inside negative.

During an action potential, the cell membrane becomes more permeable to sodium ions so that there is an influx of sodium ions in the cell. This depolarizes the membrane; the inside becomes positive while the outside negative.

38. Structures of common origin modified in various ways to adapt animals to different modes is an illustration of

- A. Homologous structures.
- B. convergent evolution.
- C. analogous structures.
- D. comparative anatomy.

The answer is A



Analogous structures have different origin but are adapted to perform similar functions.

For example, wing of birds and insects. This is a case of convergent evolution.

39. Which one of the following is an advantage of social behaviour among animals?

- A. No incidence of cannibalism.
- B. Decreased susceptibility to disease.
- C. Increased reproductive efficiency.
- D. Decreased competition.

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The answer is C

Social behaviors animals have the following advantages

- Increased reproductive efficiency resources.
- Improved protection of available resource
- Improved degree of protection against predators and /or intruders.

Its disadvantages include;

High incidence of cannibalism

Increased susceptibility to diseases.

Increased competition for resources

40. Which one of the following classes does a centipede belong to?

- A. Arachnida.
- B. Diplopoda.
- C. Chilopoda.
- D. Crustacea.

The answer is C.

A centipede belongs to phylum Arthropoda, subphylum myriapoda and class chilopoda

Note:

Diplopoda is the class to which millipedes belong

Class Arachnida include the tick and spider

Class Crustacea include a wide range of aquatic arthropods, e.g. crayfish, water flea and the wood louse.

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### SECTION B

41. Fungi were originally classified under the plant kingdom.

(a) Outline the feature of the fungi made it necessary to place them in their own kingdom

- They lack chlorophyll and therefore unable to photosynthesize.
- They are heterotrophic feeders.
- The body is usually a mycelium; a network of fine tubular filaments called hyphae.
- They store glycogen instead of starch
- They reproduce by means of spores.
- Their cell walls are made of chitin not cellulose.
- They have multinucleated cells i.e. coenocytic

(b) Explain why the fungi are wide spread and in vast numbers.

- They reproduce asexually. This increases their chance of multiplication as only one organism is required
- They reproduce by means of spores which are usually produced in large numbers and dispersed over a wide area.
- Spores can withstand severe conditions and therefore allow fungi to colonize a diverse range of habitats
- They are saprophytic feeders and therefore can grow on any kind of decaying organic matter.
- Fungi can live mutualistically with other organisms
- They can feed parasitically on other living organisms, both plants and animals.

(c) what is the economic importance of fungi?

- Yeast is used in fermentation to produce alcohol
- Yeast is also used in baking of bread.
- Most mould decompose organic matter may lead to rotting of fruit and food
- They decompose and recycle nutrients

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- Some fungi are agents of diseases in both plants and animals
- Penicillins produced penicillium natatum, a fungus, is an antibiotic.
- The fungus in mycorrhiza relationships provides plants with mineral salts and water.
- They enable disposal of wastes and dead organisms in sewage
- In research as genetic investigations

42. (a) Explain the meaning of the Hardy-Weinberg equilibrium principle

Provided there are no disruptive influence such as mutations or selection, the frequency of alleles in a population remains constant, generation after generation. There is continued movement of gene (gene flow) within the population due to breeding but the overall gene frequencies remain constant. This stability is referred to as genetic equilibrium.

(b) State four conditions that must be fulfilled in order for the principle to hold true

- No mutation occurs
- Mating must be random
- The population must be large.
- No emigration or immigration from or into the population should occur
- Generations should not overlap
- All genotypes should be equally fertile, so that no selection occurs.

(c) Brown eyes in a human population is caused by a dominant. If in a population, 84% of the people have brown eye, using Hardy-Weinberg formula, determine the percentage of the population who are.

(i) Heterozygous for eye colour. Show your working.

Let the allele for brown eyes be B

The allele for other eye colour be b

Frequency of allele B be p

Frequency of allele b be q

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Given BB+ Bb constitute 84%

The hardy-Weinberg equation states

$$\begin{aligned} P^2 + 2pq + q^2 &= 1 \\ \text{given } p^2 + 2pq &= 0.84 \\ q^2 &= 1 - 0.84 \\ q^2 &= 0.16 \\ \Rightarrow q &= 0.4 \end{aligned}$$

$$\text{Also } p + q = 1$$

$$\begin{aligned} P &= 1 - 0.4 \\ P &= 0.6 \\ \Rightarrow (0.6)^2 + 2pq &= 0.84 \\ 2pq &= 0.84 - 0.36 \\ 2pq &= 0.48 \end{aligned}$$

Hence 0.48% of the population are heterozygous.

(ii) Homozygous dominant for eye colour. Show your working

from (c)(i) above

$$\begin{aligned} P &= 0.6 \\ \Rightarrow BB &= p^2 = (0.6)^2 \\ \therefore BB &= 0.36 \\ \% \text{ of } BB &= 36\% \end{aligned}$$

hence, the percentage of individual homozygous dominant for eye colour is 36%

43. (a) Describe the adaption of each of the following tissue for their functions, giving one example of a site where each of them is found.

(i) Stratified tissue

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Stratified epithelium consists of a number of layers of cells. It's therefore thick, forming a tough impervious barrier.

- Cells are continually replaced from the mitotic divisions of the germinal layer. This allows the epithelium to withstand the continued force of wear and tear.
- In some areas, the cells on the surface are transformed into a dead horny layer of keratin. This protects the inner cells from abrasion.
  - External skin surface
  - Lining of the buccal cavity
  - Lining of the vagina
  - Lining the upper third of the esophagus

### (ii) Collagen tissue

- Collagen tissue is flexible but strong and non-stretchable. This allows it to withstand the stress of movement of connective tissue.
- It has a fibrous structure which allows it to bond structures together in connective tissue, tendons by which muscles are attached to bones are composed of collagen tissue

(a) Explain how the structure of proteins enable them to form body tissue and structure

### Solution

Structural proteins such as keratin have a secondary structure in the form of an extended spiral helices with cross linking disulphide bridge between neighboring chains. This provides hardness allowing keratin to be found in wool, hair and nails.

Other structural proteins with parallel polypeptides chains-linked at many points are collagen and elastic. They are both found in muscles.

44. (a) Explain what is meant by alternation of generation.

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Alternation of generation is the alternation between a diploid spore producing sporophyte generation and a haploid gametes gametophyte generation in a single life cycle of a plant in the same cycle. The alternates between a diploid ( $2n$ ) sporophyte generation and haploid ( $n$ ) generation.

(b) State two difference and two similarities between pollen grains of a flowering plant and the spore of moss.

(i) Differences

Spore	Pollen grains
Can germinate into an independent plant structure	Cannot form an independent plant structure.
Not gametes	Male gametes
Smaller	Larger
Remain viable over a long period of time	Are viable for only a limited time
Formed by asexual process	Formed by sexual process

(ii) Similarities

- They are both formed by meiosis
- They are both haploid
- They are both light and dispersed by wind.

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(c) How are ferns better adapted to live on land than mosses?

- Ferns are vascular plants containing vascular tissue made up of xylem ad phloem
- They sporophyte generation has true roots, stems and leaves
- Their bodies are supported by xylem because it contains lignified cells of great strength and rigidity.
- The true leave trap more light for photosynthesis

(a) Suggest why Bryophytes are

(i) Restricted to growing in damp environment

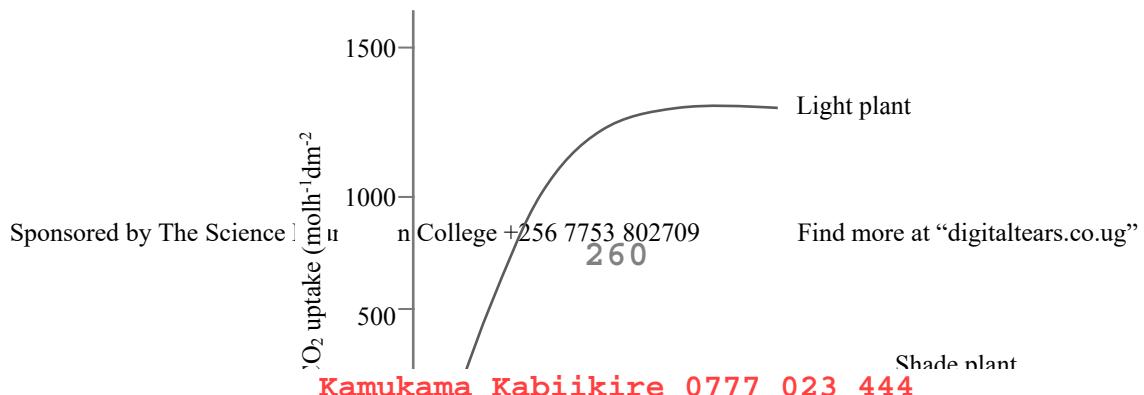
- They lack a well-developed root system and rely on diffusion across the whole plant body and the root like rhizoids to obtain water
- They are delicate and small.
- They lack a cuticle; they can easily be subjected to desiccation in drier environment
- They depend on water for the movement of male gametes towards female gametes during fertilization.

(ii) Able to grow successfully on land

- Have chlorophyll and are therefore capable of photosynthesizing
- They grow in clusters and therefore strengthen their positions on the soil.
- They reproduce both sexually and asexually. This increases their chances of survival on land



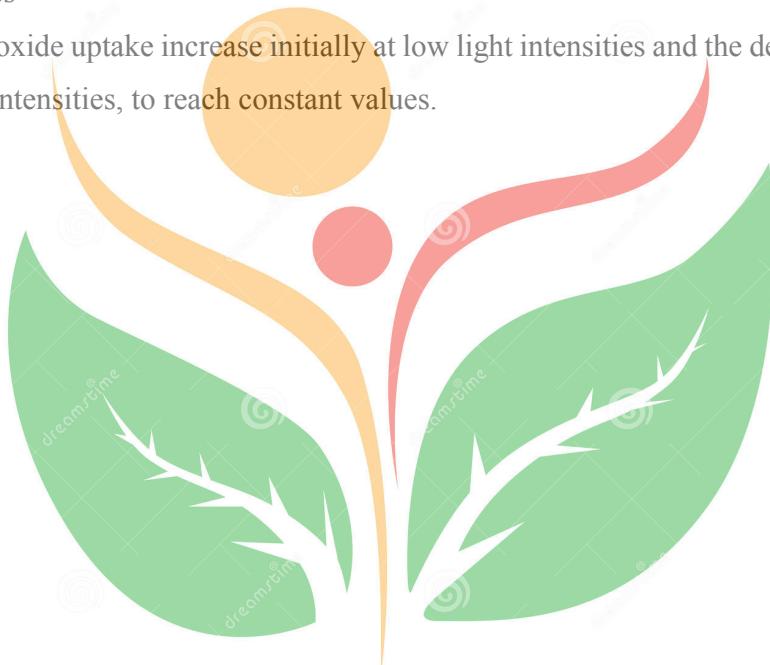
45. Figure 5 show light saturation curve of photosynthesis for plants of same species growing under different light intensities.



(a) Compare the effect of intensity on the carbon dioxide uptake in the types of plants.

Similarities

Carbon dioxide uptake increase initially at low light intensities and the decreases gradually at higher intensities, to reach constant values.



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### Differences

Light plants	Shade plants
<ul style="list-style-type: none"> <li>- Initial rate of carbon dioxide uptake is high at low light intensities</li> <li>- Carbon dioxide uptake starts below zero.</li> <li>- reach a constant at a higher light intensity.</li> <li>- higher saturation value</li> </ul>	<ul style="list-style-type: none"> <li>- Initial rate of uptake carbon dioxide is high at low light intensities</li> <li>- Carbon dioxide uptake starts at zero</li> <li>- reach a constant at a lower light intensity.</li> <li>- lower saturation value</li> </ul>

(b) Describe the state of the light plants at point P

The plant is in a state of compensation point at point P. Here is no net uptake of carbon dioxide because the rate of photosynthesis equals the rate of respiration.

(c) Explain what happens biomass in region Y

In region Y the plant biomass decrease  
Explanation

The rate of respiration of the plants is higher than photosynthesis. There is more food breakdown than synthesis.

(d) State an environment factor that affects the shape of the graph other than carbon dioxide  
Temperature

46. Figure 6 illustrates two different mechanisms of gaseous exchange in fish A and B

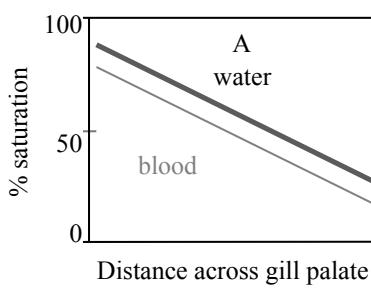
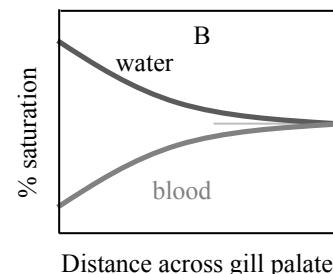
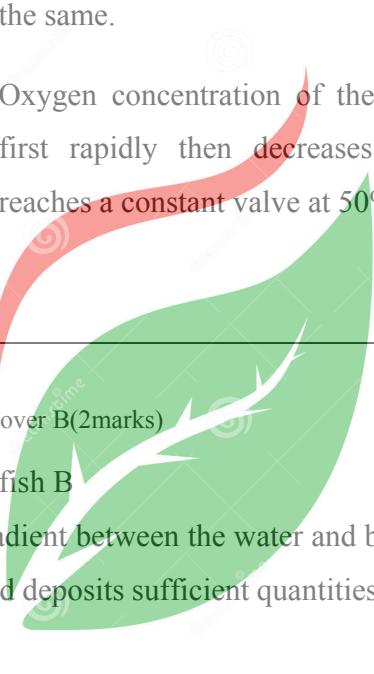


Fig. 6



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(a) State two differences between the two systems of oxygen concentration (2marks)

Fish A	Fish B
<p>-oxygen concentration of blood is above 50% at the end of the gill plate.</p> <p>- water always has a higher oxygen concentration than blood</p> <p>Other</p> <p>Oxygen concentration of the blood increase linearly along the gill plate.</p> 	<p>-oxygen concentration of the blood is about 50% at the end of the gill plate.</p> <p>Initially water has a higher oxygen concentration, but at the end of the gill plate, the oxygen concentration blood and water are the same.</p> <p>Oxygen concentration of the blood increase first rapidly then decreases gradually and reaches a constant value at 50%</p> 

(b) Explain the physiological advantage of fish A over B(2marks)

Fish A maximizes gaseous exchange than fish B

Fish A maintains a steep concentration gradient between the water and blood that the fish picks up enough oxygen from the water and deposits sufficient quantities of excess carbon dioxide in it.

(c) Describe how a gill is structurally adapted as a respiratory surface (4marks)

- Highly folded into filaments to increases surface area gaseous exchange
- It is covered with a thin highly permeable membrane to reduce the diffusion distance.
- It has a rich blood to increases the efficiency to gaseous exchange.
- It's wet in order to increase chance of picking up gases readily dissolve in the moisture.
- Numerous filaments increase the surface area

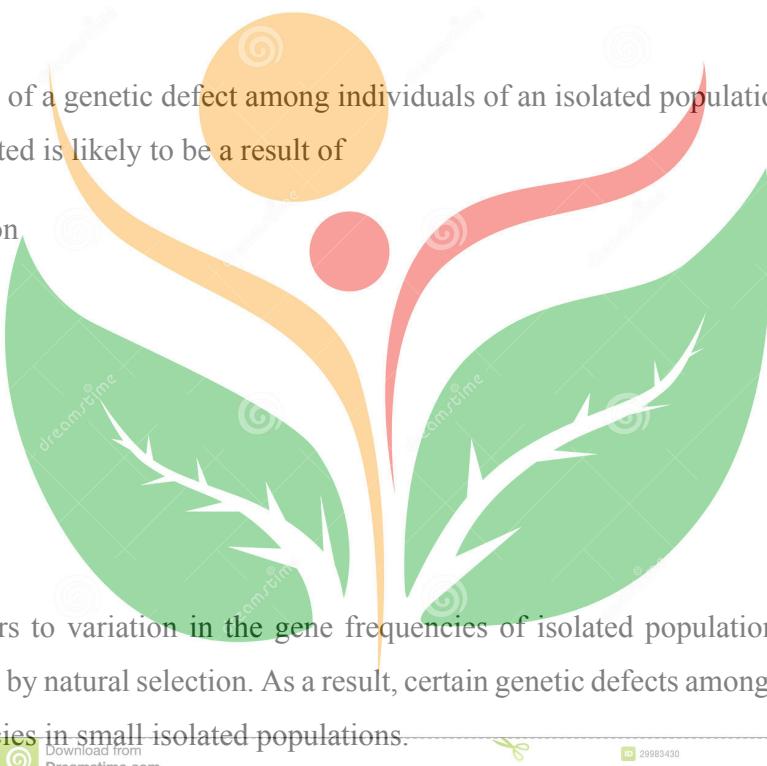
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**Do all numbers**

1. The occurrence of a genetic defect among individuals of an isolated population in a percentage higher than expected is likely to be a result of

- A. natural selection
- B. speciation
- C. adaptation
- D. genetic drift

The answer is D



Genetic drift refers to variation in the gene frequencies of isolated population which occur by chance rather than by natural selection. As a result, certain genetic defects among individuals occur at higher frequencies in small isolated populations.

2. While many fresh water animals possess vacuoles which contract to expel excess water, plants living in fresh water do not have such vacuoles.

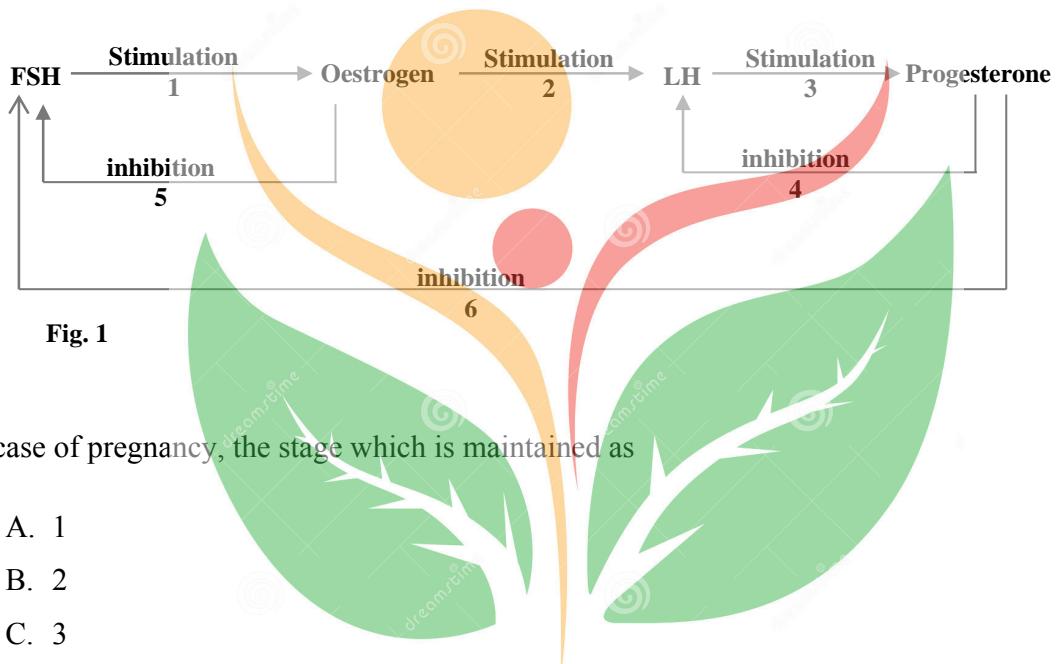
- A. plant cell walls are impermeable to water
- B. plant cell sap is of much lower concentration than animal protoplasm
- C. water movement into plant is controlled by root
- C. the water potential inside and outside such plant cells is the same.

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The answer is D

Freshwater animals have cells with contents of lower water potential compared to the surrounding water so that there is a high frequency for water to enter their cells by osmosis. To counter this, these animals have contractile vacuoles into which they secrete the excess water, from where it is discharged to the outside. Fresh water plants have rigid cellulose cell walls which do not allow the cell to expand beyond a given limit. This acts as a regulatory mechanism resisting any further net osmotic inflow of water from outside.

3. Figure 1 shows the control of production of hormones in the menstrual cycle.



In case of pregnancy, the stage which is maintained as

- A. 1
- B. 2
- C. 3
- D. 6

The answer is D  
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During pregnancy, growth of more Graafian follicles in the ovary must cease. As a result, progesterone, the main hormone that maintains pregnancy, inhibits the secretion of follicle stimulating hormone (FSH) by the pituitary gland.

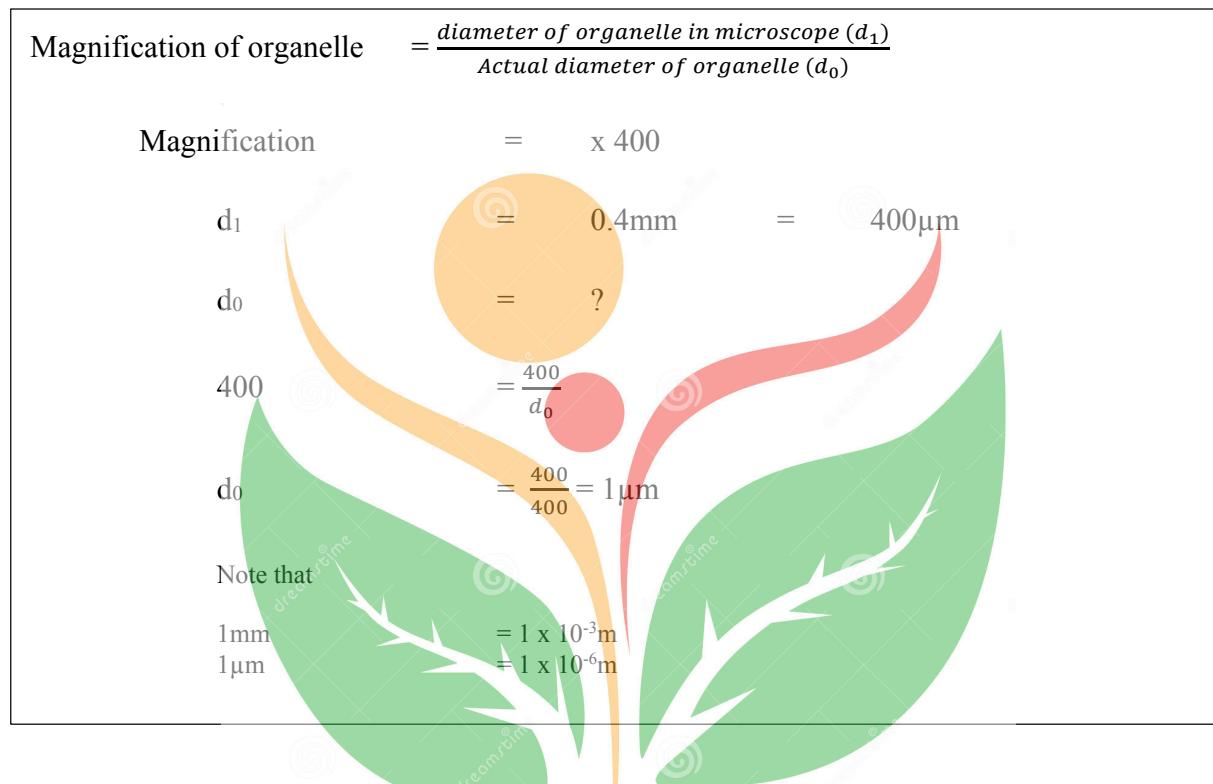
4. The actual diameter of a cell organelle which measure 0.4 mm at a magnification of x400

- A.  $0.01\mu m$

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- B.  $0.1\mu m$
- C.  $1.0\mu m$
- D.  $0.001\mu m$

The answer is C



5. Viruses are living organisms because they possess

- A. a nucleus
- B. Genetic material.
- C. a cell membrane.
- D. oxidative enzymes.

The answer is B

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Viruses resemble living organism because they possess their own genetic materials (DNA or RNA).

6. Which one of the following pairs of structures are not homologous?

- A. arms of humans and wings of birds.
- B. Legs of insects and those of mammals.
- C. pods of beans and pericarps of maize grains.
- D. pectoral fins of fish and arms of humans.

The answer is B

Homologous structures are those that similar structure form having common ancestral origin but are adapted to perform different functions.

Examples include arms of humans, wings of bird and pectoral fins of fish, which are based on the pent dactyl limb system. Pods of beans and pericarps of maize grains both originate from the ovary wall.

On the other hand, legs of insects and those of mammals consist of different structure forms but are all adapted to perform similar functions; they are analogous structure.

7. Which one of the following occurs in the human female body, following menstruation?

- A. corpus luteum develops.
- B. unfertilized cell is removed from the body.
- C. placenta develops
- D. proliferation of the uterine wall starts.

The answer is D

Following menstruation in the human female, the wall of the uterus to proliferate (grow) under the influence of oestrogen. This causes repair and development to the uterine wall.

Note:

The unfertilized egg is removed during not after menstruation.

Development of corpus luteum and then placenta occur only when fertilization takes place.

Now, occurrence of menstruation signifies failure of fertilization and so these cannot occur.

8. Which one of the following parts would show a distinct blue colour if a cross section of a root of a dicotyledonous plant was stained with iodine solution?

- A. Pericycle.
- B. Piliferous layer.
- C. Endodermis.
- D. Pith.

The answer is C

In a dicotyledonous plant, endodermis cells have a high content of starch grains. As such, they show a distinct blue colour in a cross-section of root stained with iodine. It is for this reason that the endodermis is also sometime called the starch sheath.

9. Figure 2 shows a pyramid of numbers for a food chain.

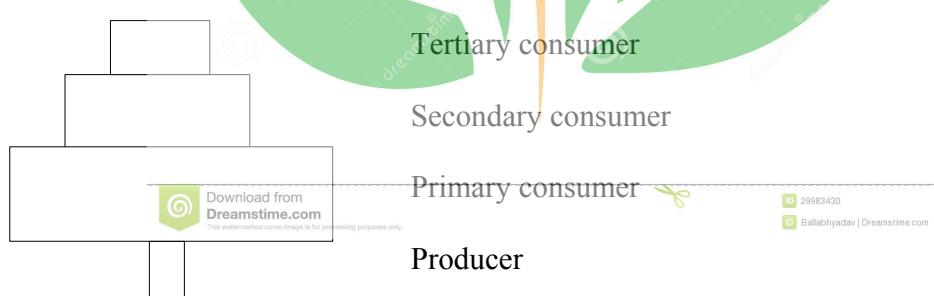


Fig 2

The most likely mode of nutritional relationship between producers and primary consumers is

- A. mutualistic.
- B. symbiotic.
- C. parasitic.
- D. autotrophic.

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The answer is C

The pyramid shows few producers supporting very many consumers. This is often true if the primary consumer is a parasite.

10. Photorespiration does not occur in C<sub>4</sub> plants because they

- A. use phosphoenol pyruvic acid for fixing carbon dioxide.
- B. mainly grow at high altitudes.
- C. are more abundant in cold regions.
- D. have succulent leaves which lower the internal temperature.

The answer is A

Photorespiration is the process by which a plant takes in oxygen and expels carbon dioxide in chloroplasts without the production of ATP. It occurs only in C<sub>3</sub> plants because, at high oxygen partial pressures or at high temperatures, RuBP carboxylase has a higher affinity for oxygen than for carbon dioxide. Therefore, it takes up oxygen and releases the fixed carbon dioxide. In C<sub>4</sub> plants, this does not occur because PEP carboxylase has no affinity for oxygen.

11. Which one of the following changes occurs in a mammalian body, at the onset of an exercise?

- A. Increase in the pH of the blood.
- B. Decrease in the rate of contraction of the diaphragm muscles.
- C. Increase in the rate of tissue respiration.
- D. Decrease in the amount of water vapor in the breath.

The answer is C

At the onset of exercise, the adrenaline secretion which occurs in anticipation of exercise induces an increase in tissue respiration in order to generate enough energy for the exercise.

Note:

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Before and during the early stage of the exercise, the sympathetic nervous system is alerted and adrenaline is secreted into the blood stream. Adrenaline causes an increase in cardiac output and general vasoconstriction of arterioles except those serving vital organs so that blood under high pressure is diverted to the active muscles. This induces an increase in tissue respiration in order to generate enough energy for the exercise.

During exercise there is an increase in both the rate and depth of ventilation, which is matched to the increased metabolic rate so that arterial blood carbon dioxide partial pressure remains normal.

The metabolic rate of the active muscles increases so greatly that the demand for oxygen rises and eventually exceeds its supply. As a result, the muscle starts respiring anaerobically forming lactic acid. This accumulates during the race but afterward is oxidized via the Krebs' cycle or circulated to the liver where it is converted back to glycogen. For this to happen, oxygen is required, constituting the so-called oxygen-debt and accounts for the heavy panting that ensues after the race.

12. Water has a comparatively high surface tension and boiling point in relation to other substances of similar sized molecules because its molecules are
- A. doubly bonded.
  - B. polar.
  - C. ionic.
  - D. covalent.

The answer is B

Water molecules have polar bonds and therefore form hydrogen bonds with each other. This makes water molecules stick together more strongly than any other molecules of similar size. This explains why water has a high surface tension and boiling point.

13. Depletion of the ozone layer is caused by

- A. greenhouse effect.
- B. release of carbon dioxide in the atmosphere.
- C. penetration of the ultraviolet rays.

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- D. release of the chlorofluorocarbons in atmosphere.

The answer is D

Chlorofluorocarbons (CFCs) are chemical compounds which directly attack and deplete the ozone layer.

14. When are gibberellins formed in the germinating starchy seed?

- A. After water absorption.      B. After production of amylase.  
C. When the radicle emerges.      D. During the production of amylase.

The answer is A

During germination of a starchy seed, Gibberellins are formed in the embryo after absorption of water (imbibition). Gibberellins diffuse to the aleurone layer where they stimulate synthesis of several enzymes including  $\alpha$ -amylase. These enzymes catalyze the breakdown of food reserves in the endosperm and the products of digestion diffuse to the embryo where they are used in growth and development.

15. The following can result in some variation of the offspring except

- A. haploid parthenogenesis.
  - B. conjugation.
  - C. fragmentation.
  - D. self-fertilization.

The answer is C

Fragmentation occurs by breaking up of a whole structure of an organism so that individual fragments develop into complete new organisms. It does not usually result in variation as these fragments possess the same genetic material as that of the parents.

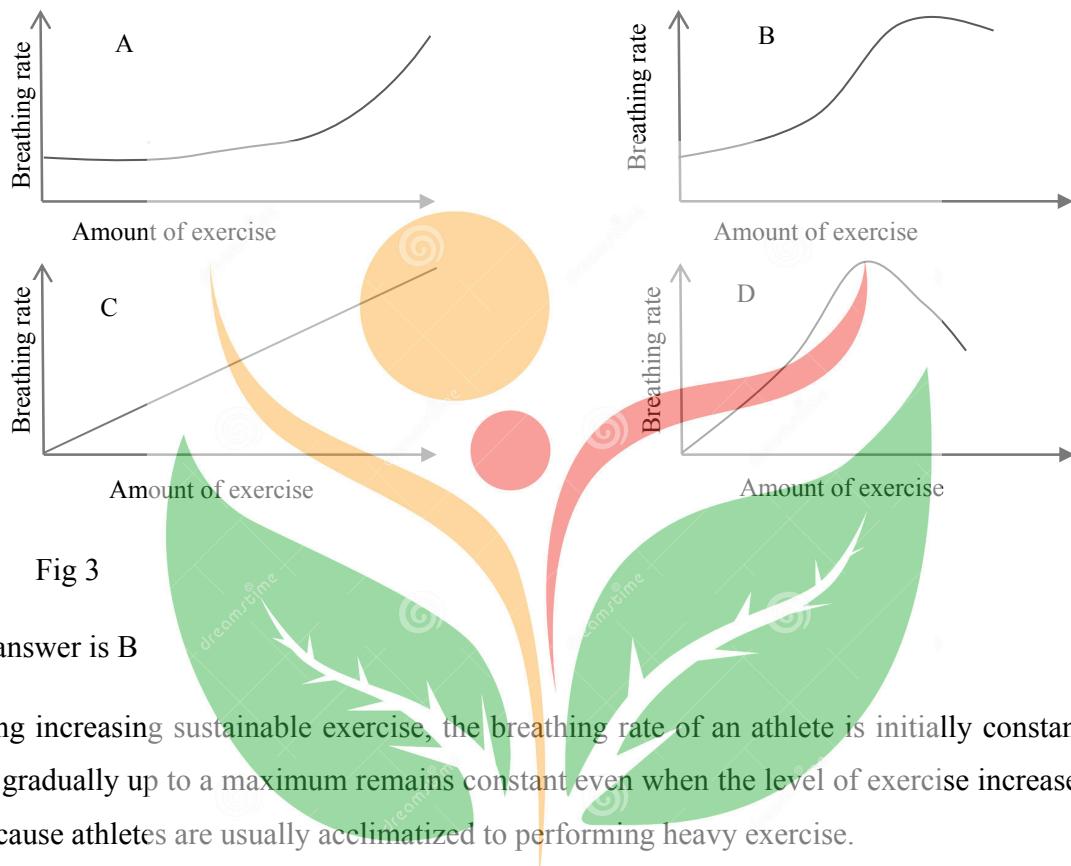
### Note:

Haploid parthenogenesis and self-fertilization involve meiosis during gamete formation. As a result, variation in offspring is very likely to occur due to the new gene combinations introduced in the gametes by meiosis.

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Conjugation involves mixing of gene of the two participating individuals and is therefore very likely to result in new gene combination in the offspring.

16. Which one of the following curves in fig 3 correctly represents the breathing rate of an athlete under increasing sustainable exercise?



Note:

In the early phase of the exercise, the muscles of the athlete have sufficient source of oxygen and energy for the exercise in from of myoglobin and creative phosphate respectively. Therefore, there is no need to increase the breathing rate.

As the levels of exercise increase, these stores get progressively depleted in the muscle. Breathing rate increase in order to provide oxygen for immediate respiration. Also, due to heavy anaerobic respiration taking place in the muscle, much lactic acid is produced. This must quickly be converted to pyruvic acid and utilized to provide energy, or he muscle will fatigue. This requires

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amount of oxygen called the oxygen debt. In an athlete, the oxygen debt is paid during exercise. Therefore, the breathing rates increase up to that level when the oxygen provided to muscles is sufficient to pay the oxygen debt immediately in the muscles and then stops.

At this level, the muscle is respiring both aerobically and anaerobically but lactic acid does not accumulate in the muscles of the athlete because the oxygen debt is paid sufficiently immediately.

17. The type of succession where recolonisation of an area results into a different community from the original one is known as

A. primary.    B. dominant.

C. deflected.    D. secondary.

The answer is C

When an established community is destroyed and then allowed to regenerate, sometimes recolonization of the habitat leads to establishment of a climax community different from the original climax community. This usually occurs as a result of effects of human activities on the environment. The new communities are referred to as a plagioclimax and occur by a process of succession termed deflected succession.

Note:

- A succession developing on a newly emerged land (bare rock) or water is called primary succession
- A succession that develops following a fire or similar major disruption to an established community is called secondary succession.

18. Radioactive rays are particularly dangerous in nature because they

- A. cannot be absorbed by plants so they only affect animals.
- B. accumulate in animals and return to the soil when animals die.
- C. cause extremely high temperatures in the environment.
- D. accumulate in high concentrations at high trophic levels.

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The answer is C

Radioactive rays often cause extremely high temperatures in the environment by giving up their high energies to materials through which they pass. This is a great disadvantage in nature.

19. Hormones influence behaviour in the following two ways **except**

- A. affecting the growth of nerve connections in the brain.
- B- directly affecting nerve cells and synapses within the central nervous system.
- C. altering the sensitivity of peripheral receptors.
- D. inducing RNA changes to quicken the learning process.

The answer is D

Hormones never induce changes in DNA but usually stimulate rapid transcription of DNA and translation of RNA to form required proteins.

Note:

Hormonal influence of behavior occurs by:

- Altering the sensitivity of peripheral synapses.
- Directly affecting nerve cells and synapses within the central nervous system.
- Affecting the growth of nerve connection in the brain.

20. The type of feeding mechanism shown in figure 4 is

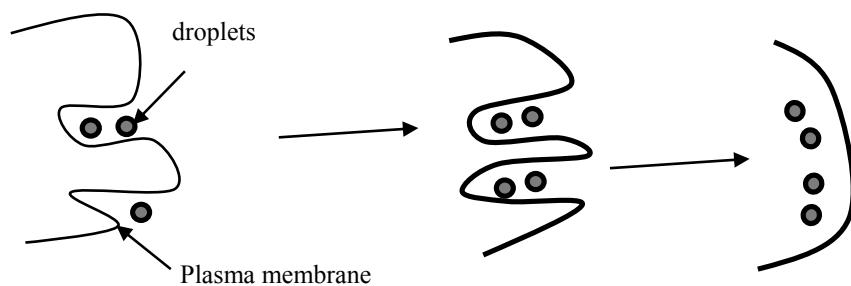


Fig 4

- A. pinocytosis.      B. phagocytosis.  
C. predation.      D. phagocytosis.

The answer is A

A form of bulk transport across the plasma membrane in which the cell membrane invaginates and takes in liquid droplets is called pinocytosis (cellular drinking).

Note:

If the material taken into the cell is solid, the process is called phagocytosis (cellular eating). Both processes constitute a form of bulk intake of material into cells, called endocytosis

21. Which one of the following phyla has a dominant gametophyte?

- A. chlorophyta.      B. Spermatophyta.  
C. pteridophyta.      D. Bryophyta.

The answer is D

The phylum Bryophyta (mosses and liverworts) consists of organisms which undergo alteration of generation in which the gametophyte is dominant.

Note:



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- Pteridophyta (ferns) and flowering plants (spermatophyte) have dominant sporophyte
- Chlorophyta does not undergo alteration of generation

22. From the following sources of variation, which one has the highest chance of producing new species?

- A. crossing over      B. Independent assortment  
C. mutation.      D. Random fusion of gametes.

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The answer is C

Mutation causes a total change in the nature of the gene and therefore has the highest chance of reproducing new species.

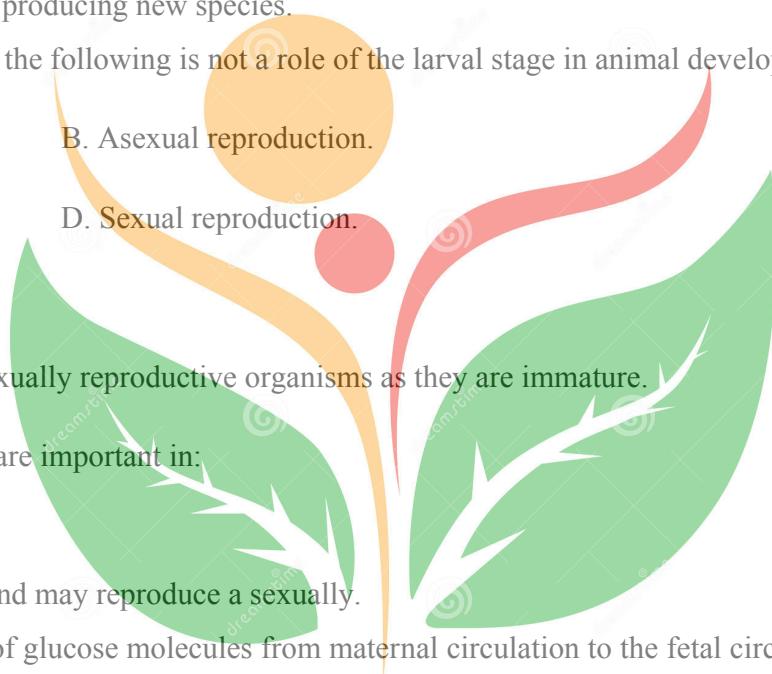
Note:

- Crossing over and independent assortment simply introduce variation among organism of the same species but with the same nature of genes.
- Random fusion of gametes has the least chance of introducing variation and therefore least chance of producing new species.

23. Which one of the following is not a role of the larval stage in animal development?

- A. Dispersal.      B. Asexual reproduction.  
C. Feeding.      D. Sexual reproduction.

The answer is D



24. The passage of glucose molecules from maternal circulation to the fetal circulation across the placenta is by

- A. facilitated diffusion.      B. osmosis.  
C. active transport.      D. simple diffusion.

The answer is A.

Passage of Glucose molecules from maternal to the foetal circulation across the placenta occurs by facilitated diffusion.

Note:

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- Water crosses the placenta by osmosis.
- Ions such as sodium, potassium, ion and calcium cross mainly by active transport though some diffusion takes place.
- Amino acids and vitamins cross by active transport.
- Respiratory gases cross by simple diffusion.
- Excretory products cross by simple diffusion

25. The role of calcium ions in muscular contraction is to enable

- A. tropomyosin bind      B. actin bind to myosin.  
C. myosin bind on actin.      D. tropomyosin bind on actin.

The answer C

Calcium ions are necessary for binding of myosin on actin in order to facilitate sliding of these filaments to bring muscle contraction.

Note:

Contraction of the muscle occurs following the binding of actin filaments to the myosin bridges. Calcium ion bind to actin filaments and expose their binding sites so that they can bind to myosin bridges. Also calcium ions activate the ATPase activity of the myosin bridges so that ATP is hydrolyses. Releasing energy which is used in the contraction process

26. Ferns are considered to be more advanced land plants than mosses because sporophytes of ferns

- A. are able to produce spores.      B. have green leaves.  
C. develop rhizoids.      D. have a well-developed vascular system.

The answer is D

Ferns are more adapted to life on land than Moses because they have true roots and a well-developed vascular system vascular system. This allows them to draw water from the deeper layers of the soil.

27. Figure 5 is a simplified diagram of a tetrapod in a stationary position.

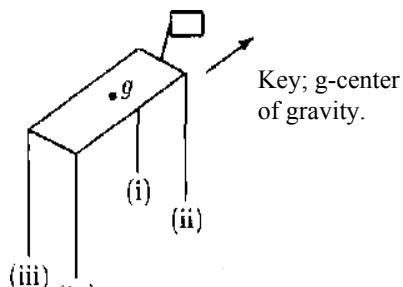


Fig. 5

Which one of the following would be the correct order of limb movement in the tetrapod if it is to move in the direction shown?

- A. (ii), (iv), (iii), (i)
- B. (i), (iv), (ii), (iii)
- C. (i), (iii), (ii), (iv)
- D. (iii), (iv), (ii), (i)

The answer B

During motion of a tetrapod, three feet forming a continuous triangle must always remain on the ground in order to move forward, there are two possibilities: (i), (iv), (ii), (iii) or (ii), (iii), (i), (iv).

28. One disadvantage of the multicellular state is that individual cells

- A. are always small in size.
- B. lose independence.
- C. become less functional.
- D. become less specialized.

The answer is B

In Multicellular organisms, cells often become specialized to perform certain functions and therefore lose ability to perform other functions. As a result, cells become dependent on each other for the function(s) which they are not specialized to perform.

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29. A property of water which facilitates its efficient transportation of glucose is its

- A. ability to form hydrogen bonds with other molecules.
- B. high surface bonds with other molecules.
- C. low freezing point.
- D. high boiling point.

The answer is A

Being polar, water molecules form hydrogen bonds with each other and with polar molecules. Glucose is a polar molecule and therefore forms hydrogen bonds with water and subsequently dissolves in the water.

30. Which one of the following is correct about the counter current mechanism in teleosts?

- A. Blood with low oxygen concentration flows in the same direction with water of high oxygen concentration.
- B. Water of low oxygen concentration flows near blood of high oxygen concentration.
- C. Blood with high oxygen concentration flows in opposite direction to water of high oxygen concentration.
- D. Water of high oxygen concentration flows in opposite direction to blood of low oxygen concentration.

The answer is D.



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In a countercurrent mechanism in teleosts;

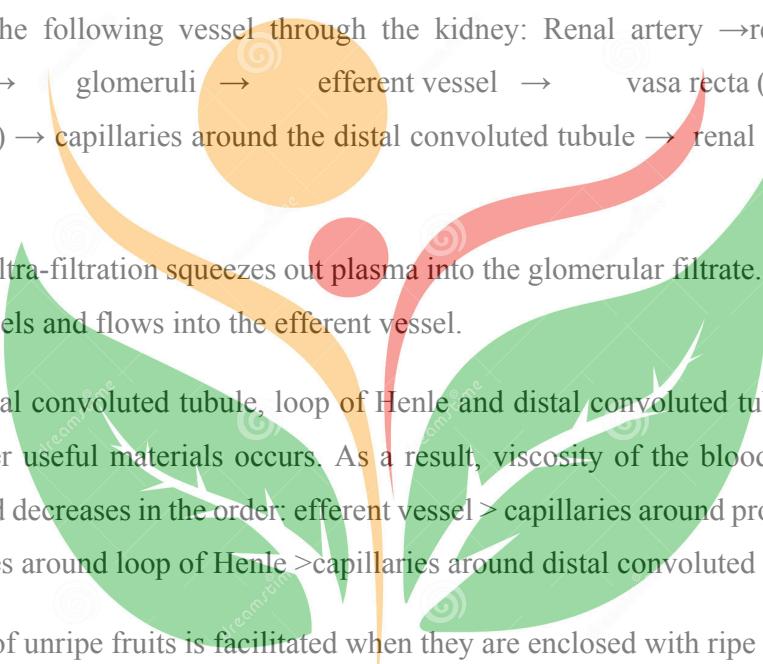
- Blood and water flow in opposite directions (countercurrent flow)
- Water of high oxygen concentration flows past blood of low of oxygen concentration so that there is always a concentration gradient facilitating diffusion of oxygen from water in to the blood.

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31. In which part of the mammalian kidney is blood likely to be most viscous as it flows?
- A. In the afferent vessel.
  - B. In the capillaries at the proximal convoluted tubule.
  - C. In the afferent vessel.
  - D. In the capillaries at the distal convoluted tubule.

The answer is B

Blood flows in the following vessel through the kidney: Renal artery → renal arterioles → afferent vessel → glomeruli → efferent vessel → vasa recta (capillaries around the loop of Henle) → capillaries around the distal convoluted tubule → renal venules → renal vein.



In the glomeruli ultra-filtration squeezes out plasma into the glomerular filtrate. Proteins and cells remain in the vessels and flows into the efferent vessel.

Along the proximal convoluted tubule, loop of Henle and distal convoluted tubule, reabsorption of water and other useful materials occurs. As a result, viscosity of the blood is highest in the efferent vessel and decreases in the order: efferent vessel > capillaries around proximal convoluted tubule > capillaries around loop of Henle > capillaries around distal convoluted duct.

32. Ripening of unripe fruits is facilitated when they are enclosed with ripe ones because
- A. IAA is produced by the ripe fruits to initiate ripening of others.
  - B. ripe fruits produce ethene which facilitates ripening of others
  - C. ripe fruits increase the temperature which enhances ripening.
  - D. the unripe fruits absorb moisture from ripe fruits which speeds up ripening.

The answer is B

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Fruit ripening is indeed by plant hormone ethene. Mixing of ripe with unripe fruits facilitates ripening of the unripe fruits because ripe fruits produce ethene which diffuses in to the unripe fruits.

33. Determining the commonest plant species a large habitat within a short time can best carried out using the

- A. line transect.      B. quadrat.
- C. direct count.      D. aerial view method

The answer is A

A line transect involves the use of tape or sting running along ground in a straight line between two designated points. Sampling is rigorously confined to species actually touching the line. This gives a quick method of identifying the commonest plant species in a large habitat.

Note:

Quadrat and direct count methods are more time consuming while aerial method is not suitable for plant species.

34. Which one of the following is not a characteristic of chordates?

- A. Dorsal hollow nerve tube.      B. Gill pouches.
- C. Vertebral column.      D. Tail notochord

The answer is D

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There is no embryonic structure called tail notochord.

Note:

Chordates are characterized by:

- A notochord, which is an embryonic like structure that lies between the dorsal nerve tube and the gut. In adults, it forms the vertebral column.
- Possession of gill pouches or pharyngeal clefts

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35. Excessive use of pesticides in the long term affects mostly

- A. carnivores.                      B. parasites.  
C. producers.                      D. herbivores

The answer is A

Pesticides have a property of bioaccumulation; a phenomenon by which the pesticides occur in increasing concentration among organisms at higher trophic levels. As a result, they affect carnivores mostly because they are at a higher trophic level than producers and herbivores.

36. The walls of collenchyma cells are stained deep blue by methylene blue but not aniline hydrochloride. This shows that the walls

- A. are not thickened.  
B. are thickened by lignin.  
C. contain living protoplasm.  
D. are thickened by materials other than lignin.

The answer is D

Thickening of plant cell occurs by deposition of extra layers cellulose or deposition of lignin or suberin (cork). These materials are identified in microscopy by their ability to take up certain stains.

Lignin, for example, stains yellow with aniline hydrochloride but not stain with methylene blue

Cellulose does not stain with aniline hydrochloride but stains deep blue with methylene blue.

37. Which one of the following is true about the environment of a forest floor under a thick canopy?

- A. Has wide temperature fluctuations.  
B. Receives far red light.  
C. Develops dense plant growth.

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- D. Has heavy soil erosion.

The answer is B

In the presence of a thick canopy, ordinary light cannot penetrate to reach the plants under the canopy. However, far red light has more energy and can therefore penetrate the canopy, therefore, it is far light that is received and utilized by the plants under the canopy.

38. When the shoot apex of a growing plant is removed, lateral growth is encouraged because

- A. auxins are activated in buds.
- B. growth of lateral buds is stimulated by gibberellins.
- C. more abscisic acid is produced to promote lateral growth.
- D. cytokinins are activated in the absence of auxins at the apex.

The answer is D

In presence of the shoot apex, auxins produced by the apex suppress the actions of cytokines in the axillary buds so that the buds will not grow as long as the shoot apex is intact. This is called apical dominance. When the shoot apex is removed, no more auxins are produced so that the cytokinins in the axillary buds are activated to encourage lateral growth.

39. Which one of the following features in a bony fish makes it more efficient in swimming than a cartilaginous fish?

- A. Strong bony skeleton
- B. Highly coordinated neuromuscular activity.
- C. Swim bladder.
- D. Stream lined body.

The answer is C

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Bony fish more efficient swimmers than cartilaginous fish because they contain an air-filled structure, called the swim bladder, which enhances their buoyancy during locomotion in water.

40. During germination of a seed, there is an initial negative growth due to

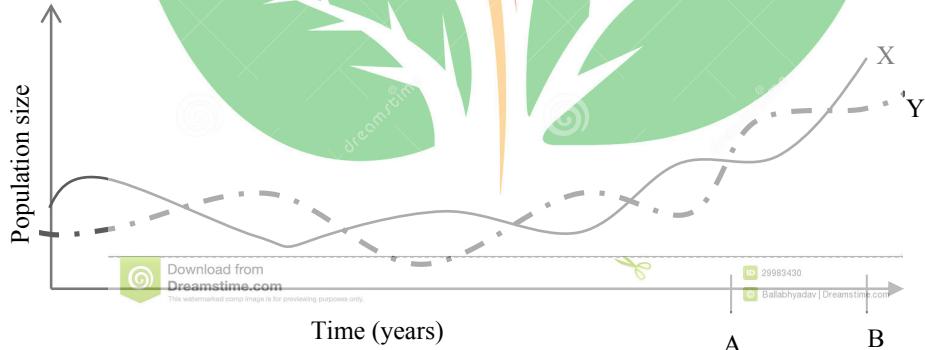
- A. the increase in metabolic rate.
- B. imbibed water which does not contribute to the dry mass of the seed.
- C. the breaking of the testa as the seed expands.
- D. respiration of food reserves.

The answer is D

During the initial phase of germination, breakdown respiration of food reserves occurs in order to provide energy for development of the embryo. This occurs at the expense of the dry mass of the seedling and therefore accounts for the initial negative growth.

### Section B

41. Figure 6 shows changes in the size of a population of a producer and consumer in a lake over time.



- (a) State which curve represents the
  - (i) Producer: X
  - (ii) Consumer : Y
- (b) Explain the interaction between the two populations before point A.

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The population of consumers and producers fluctuate because consumer depends on producers for food.

When the population of consumer is high, they feed on producers at rate which is higher than the producers can reproduce. The population of the consumers increases as that of the producer decreases.

When the population of producers falls, that of the consumers also falls due to death of some consumers from starvation. This allows the population of producers to recover and the cycle continues.

- (c) Suggest how human activities could result in the interaction of the population between points A and B

Between A and B, the population of both organisms increases. This may be due to:

Excessive use of fertilizers near the lake.

Dumping of untreated sewage into the lake

Deposition of detergents into the lake.

All these activities increase the nutrient content of the lake (eutrophication) thus accelerating the growth of producer which in turn support a larger population of consumers.

42. When extensive lake that existed in Bunyoro was reduced to isolated pools many years ago, four species of fish evolved as a result.

- (a) Suggest how the drying up of the lake system to isolated pools could have resulted in the evolution of the four new fish species.

Isolated pools form different geographical micro-environments. This causes geographic isolation of fish in different pools. It prevents interbreeding and thus no gene flow occurs.

Since conditions are different in the different pools, different characteristics are selected for in each of the pools.

- (b) Describe how environmental factors act as stabilizing force to natural selection in an isolated pool after the evolution of a new species.

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When environmental conditions in each pool change, fish which is better adapted to the condition in each pool survive while fish with unfavorable characteristics are selected against and do not survive. Since the pools have different conditions, different strains of fish evolve.

- (c) Suggest what would happen to the fish if water levels rose and the isolated pools once again formed an extensive lake system.

All the different fish species mix up again and:

Competition between species may reduce the number of some species of fish. The better adapted will survive while others die and may become extinct.

If restricted to different area (niches of the lake, there will be less competition. As a result, most or all species may survive so that a lake with different species of fish is formed.

There may be restriction of interbreeding so that the different species exist separately in the lake.

If interbreeding occurs, more new species of fish evolve in the lake.

43. (a) State four situations where Mendel's laws would not apply.

Multiple alleles

Linkage

Gene interaction e.g., epistasis complementary genes or polygenic inheritance

Lethal genes

Gene/alleles showing co-dominance

Mutation

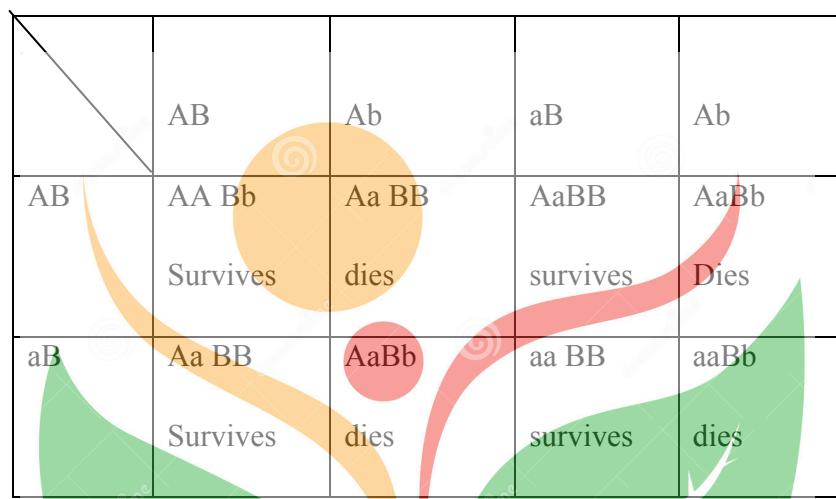
- (b) In an animal species, individuals that are homozygous for gene A or its allele die. Another independent gene B in the homozygous state, blocks this lethal effect, otherwise gene B has no other effect on the organism.

- (i) Work out the expected phenotypic ratio of the viable offspring in a cross of individuals of AaBb and AaBB genotypes.

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	male	x	female
Parental genotype	AaBb	X	AaBB
Gametes	AB, Ab, aB, ab		AB, aB

Cross are shown in the pannet square below:



From the table, there are 4 viable offspring and 4 non-viable offspring.

(ii) State the type of gene interaction in (b) (i)

Epistasis

44. (a) what is chemosynthesis?

Chemosynthesis is the process by which organic compounds are synthesized from inorganic raw material using energy from oxidation of inorganic compounds.

(b) Outline three ways in which photosynthesis in purple sulphur bacteria differs from that of higher plants.

Purple sulphur bacteria	Higher plants
Source of hydrogen (reducing power) is hydrogen sulphide.	Source of hydrogen (reducing power) is water
Produce solid globules of sulphur as bi-product.	Do not produce any solid bi-product
Do not give off oxygen during photosynthesis	Give off oxygen during photosynthesis
Use bacteriochlorophyll as the pigment	Use chlorophyll as the pigment
Absorb uv and far red light	Absorb visible and red light

(c) Explain why it is possible for photosynthetic and chemosynthetic bacteria to co-exist in oxygen free environment.

Photosynthetic bacteria release oxygen during photosynthesis, which they both use in respiration. They also produce organic compounds which are used by the chemosynthetic bacteria for metabolism.

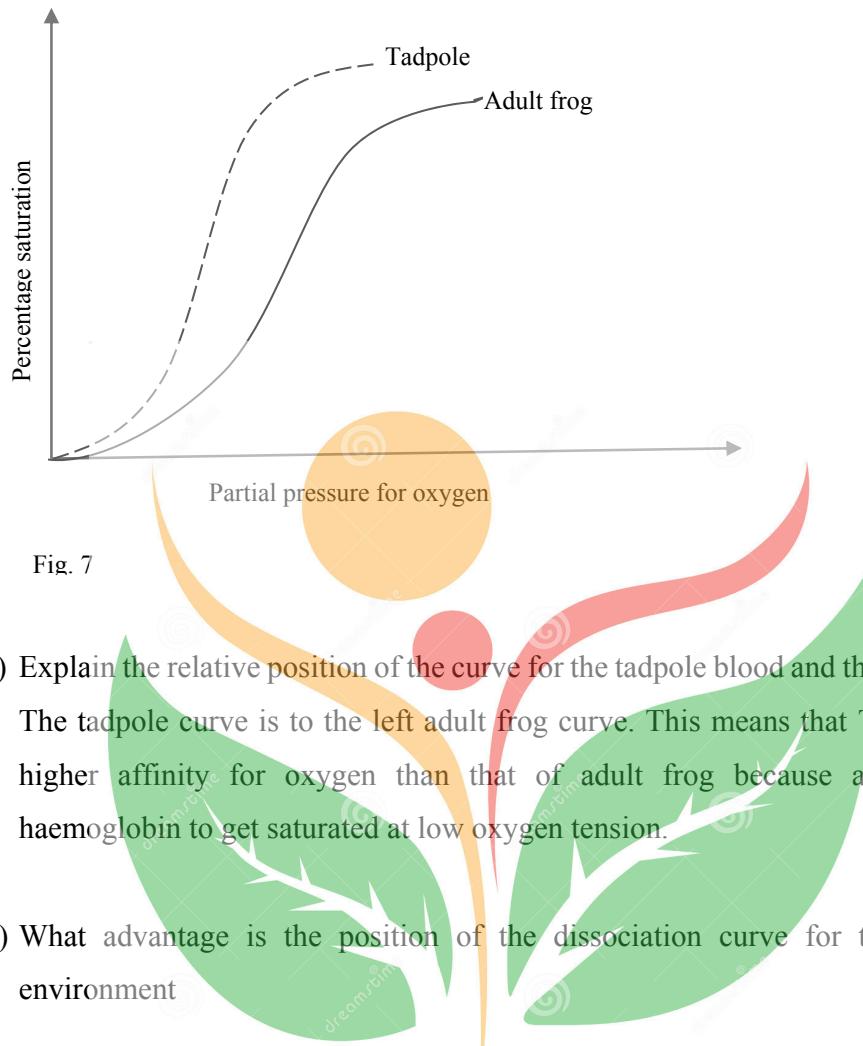
Chemosynthetic bacteria produce inorganic substrate like hydrogen sulphide which are used by the photosynthetic bacteria in their metabolism.

(d) State the importance of chemosynthetic bacteria in nature

- Chemosynthetic bacteria are important in the decomposition of nitrogenous waste in the environment and thus enrich the soil and water with nutrients.
- They release energy in their metabolism that is used by other organism in synthesis of organic compounds.
- They are producers manufacturing organic compounds that can be utilized by other organism.

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45. Figure 7 shows the oxygen dissociation curve for a tadpole blood and that of adult frog



(a) Explain the relative position of the curve for the tadpole blood and that of an adult frog.

The tadpole curve is to the left adult frog curve. This means that Tadpole blood has higher affinity for oxygen than that of adult frog because affinity allows its haemoglobin to get saturated at low oxygen tension.

(b) What advantage is the position of the dissociation curve for the tadpole in its environment

- Tadpole haemoglobin becomes fully saturated at low environmental partial pressure of oxygen. This allows it to thrive in the low oxygen tension environment.
- Tadpole blood releases oxygen quickly to the tissue that are at very low oxygen allowing the tadpole to be active

(c) How is the skin of an adult frog adapted for gaseous exchange?

- It is thin to reduce diffusion distance
- It permeable to respiratory gases to allow easy diffusion
- It is moist to dissolve respiratory gases for easy diffusion

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- It presents a large surface area for gaseous exchange
- It is highly vascularized to readily transport gases and maintain diffusion gradient

46. (a) State three ecological problem which arise from the accumulation of domestic waste in urban communities

- Untreated sewage may end up in water bodies, causing eutrophication
- Destruction of habitats for living organism in place where it is piled.
- Decay of the waste in absence of oxygen produces methane a greenhouse gas
- Leads to transmission of deadly communicable diseases that may lead to destruction of lives.
- Causes soil degradation
- Causes air pollution.

(b) Give two ways reducing domestic waste.

- Recycling of non-biodegradable materials in domestic waste.
- Burying biodegradable rubbish.
- Burning rubbish to treating it with chemicals to reduce bulk.
- Use of organic waste to generate power (biogas)
- Use of organic waste to produce fertilizers. use of biodegradable packaging
- Stopping usage of plastic materials
- Use of chemicals to decompose the domestic wastes
- Making crafts out of domestic wastes



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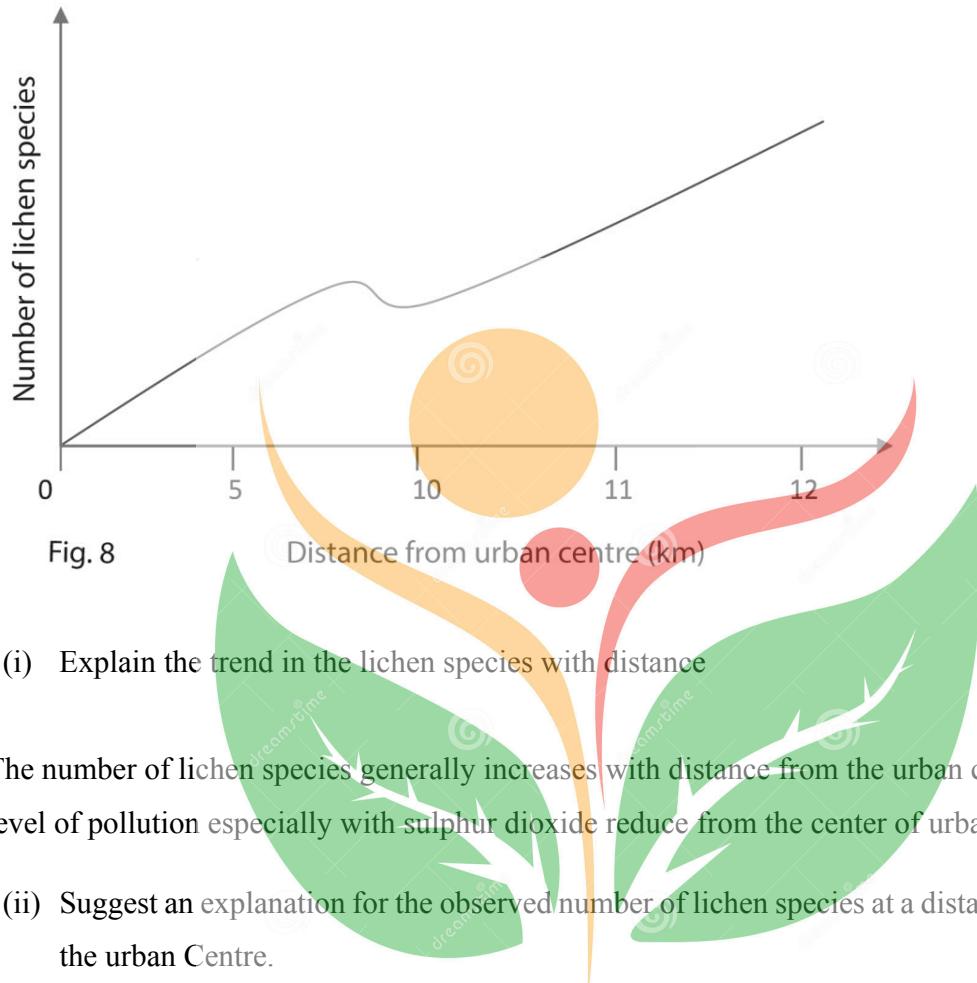
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(c) Figure 8 show lichen species growing along a 20km transect from urban Centre.



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**Do all numbers**

1. The oxygen dissociation curves for aquatic animals are usually to the left of those of terrestrial ones because

- A. there is less oxygen in water.
- B. air is less dense than water.
- C. aquatic animals are less active.
- D. aquatic animals use less oxygen.

The answer is A

Situation of the oxygen dissociation of an organism to the left of another usually indicates higher affinity for oxygen by its haemoglobin. Such organisms inhabit area of low oxygen partial pressures.

2. Staying in a dark room for a long time increases the sensitivity of the eye to light because photochemical pigments are

- A. not broken down.
- B. formed faster than they are broken down.
- C. destroyed.
- D. not synthesized.

The answer is B

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In the presence of light, rhodopsin, the visual pigment in rods, is readily broken down (bleached) to scotopsin and retinene. In the dark, the pigment is synthesized faster than it can be broken down and therefore available in its functional form. Since the rods are very sensitive to light, this increase sensitivity of the eye to light when one is in a dark room.

3. Which one of the following is correct about organisms in an ecosystem?

- A. Some organisms exist in isolation.
- B. Every organism can be independent.
- C. All organisms interact with each other.
- D. Each organism has a different source of food.

The answer is C

An ecosystem consists of different organisms that interact continuously with one another in their environment. They often compete with each other for food, shelter and available resources.

Recall:

An ecosystem is any unit of the environment composed of living and non-living components whose interactions result in a stable self-perpetuating system.

4. Figure 1 shows a glandular tissue.



Fig 1

In which part of the mammalian body is the tissue likely to be?

- A. Ileum.
- B. Lungs.
- C. Stomach.
- D. Skin.

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The figure shows a coiled tubular gland which is typical of sweat gland

5. Which one of the following changes in a cell would increase its water potential?

- A. Decrease in turgor pressure.
- B. Increase in solute potential.
- C. Decrease in osmotic potential.
- D. Increase in pressure potential.

The answer is C

Water potential of a solution increases when its solute concentration is decreased, i.e. when its osmotic/ solute potential is decreased. This reduces the force of attraction that the solute particles impose on the water molecules so that the water molecules are then more free to leave the solution.

6. Sprinters usually take off at an angle rather than in upright position in order to increase

- A. The speed of movement.
- B. The upward force.
- C. Effective length of the limbs.
- D. Forward force

The answer is D

Taking off at an angle to the ground increases the forward force. In form of reaction from the ground, which helps the sprinter to start the race. In upright position, the reaction would push the body upward instead to forward.



7. Table 1 shows the effect of temperature on the rates of apparent photosynthesis and respiration in a plant

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Temperature ( $^{\circ}\text{C}$ )	7	10	15	19	22	28
Rate of apparent photosynthesis ( $\text{mgCO}_2\text{g}^{-1}\text{h}^{-1}$ )	1.3	2.3	2.8	3.1	2.8	2.5
Rate of respiration ( $\text{mgCO}_2\text{g}^{-1}\text{h}^{-1}$ )	0.3	0.6	0.7	1.2	1.8	2.1

The temperature in ( $^{\circ}\text{C}$ ), at which the plant is least, efficient photosynthetically is

- A. 7.
- B. 10.
- C. 22.
- D. 28.

The answer is A

From the table, the temperature at which photosynthesis is least is  $7^{\circ}\text{C}$ . This represent the least efficient temperature for photosynthesis in the plant in question.

Recall:

The rate of photosynthesis increases with temperature up to a maximum and then decreases with further increase in temperature. This is because reactions of photosynthesis are controlled by enzymes whose activity increase with temperature up to an optimum value and then become denatured as temperature is increased further.

8. The hormone which enables plants to respond to drought is

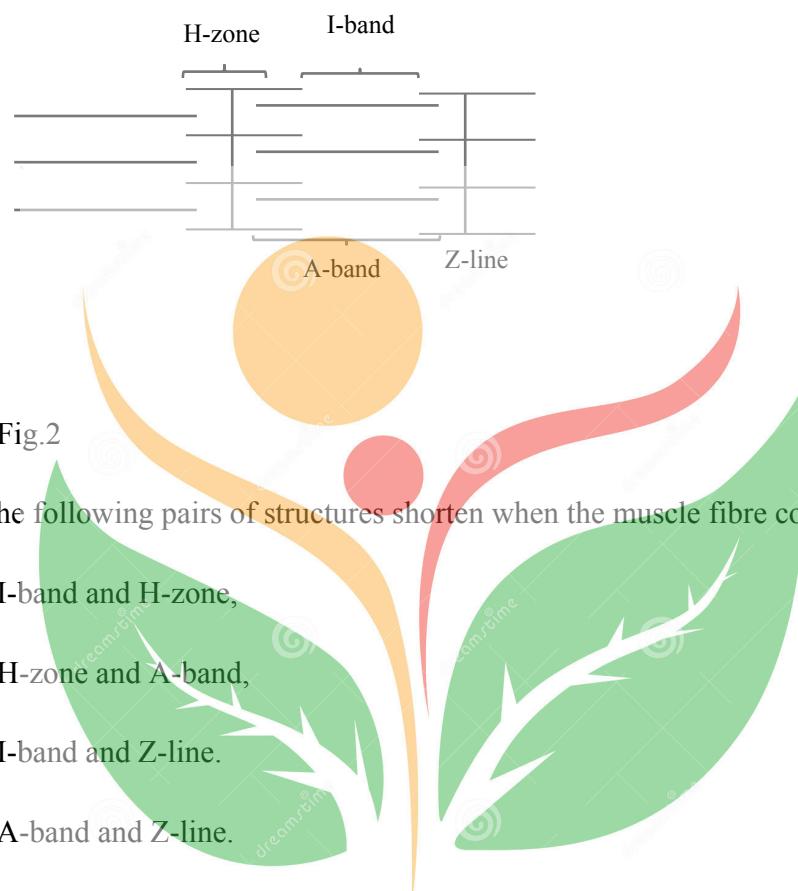
- A. gibberellins.
- B. abscisic acid.
- C. auxins.
- D. cytokinin.

The answer is B

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Abscisic acid (ABA) is a stress hormone produced by cells in the leaves of plants in conditions of water stress, e.g. drought, it causes closure of stomata of wilted leave to cut down any further loss of water from them by transpiration.

9. Figure 2 represents a longitudinal section through part of a striated muscle fibre.



Which one of the following pairs of structures shorten when the muscle fibre contracts?

- A. I-band and H-zone,
- B. H-zone and A-band,
- C. I-band and Z-line.
- D. A-band and Z-line.

The answer is A

During muscle contraction, the actin (thin) filaments slide past the myosin (thick) filaments. As a result, the A band remains the same since the filaments do not shorten while the H-zone and I – band shorten as the overlap of the filaments increases.

10. Which one of the following would occur to a plant requiring at least 14 hours of dark period daily in order to flower?

- A. No flowering occurs if the dark period is interrupted with a flash of light.
- B. Flowering occurs if the days are 14hours long.

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- C. No flowering occurs if the dark period is more than 14 days.  
D. Flowering occurs if the dark period is interrupted with a flash of light.

The answer is A

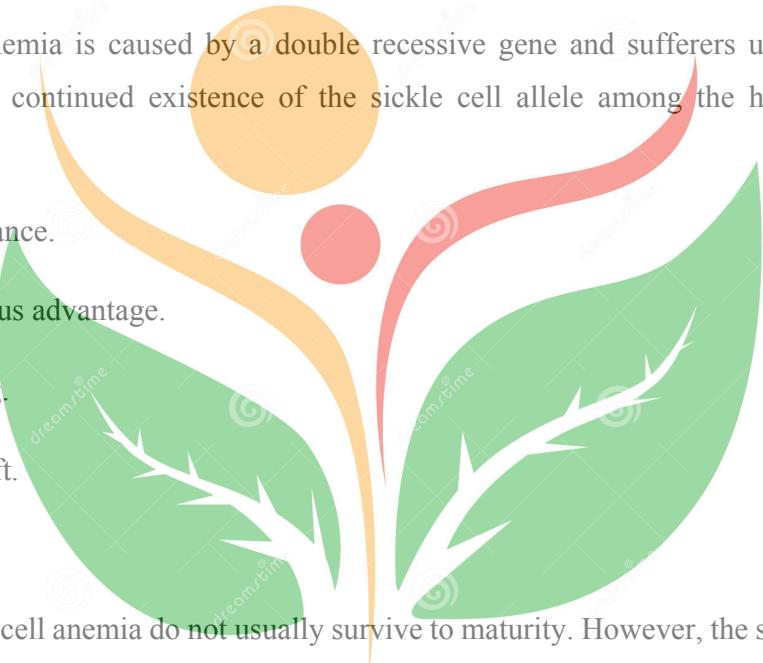
A plant requiring at least 14 hours of dark period daily in order to flower is an example of a short day plant. In such a plant, darkness is more important than light in promoting flowering.

Interrupting the dark period with a flash of light reduces the length of effective dark period and flowering does not occur.

11. Sickle Cell anemia is caused by a double recessive gene and sufferers usually die before maturity. The continued existence of the sickle cell allele among the human population demonstrates.

- A. drug resistance.
- B. heterozygous advantage.
- C. in-breeding.
- D. genetic drift.

The answer is B



Sufferers of sickle cell anemia do not usually survive to maturity. However, the sickle cell carriers (heterozygotes) rarely suffer from malaria. This confers to them a survival advantage in malaria endemic areas. As a result, heterozygotes survive and pass on their sickle cell allele to the next generation. This is an example of heterozygous advantages, where the recessive gene gives one a survival advantage.

12. Which one of the following consists of tissues specialized for support?
- A. Parenchyma and collenchyma.
  - B. Collenchyma and sclerenchyma.
  - C. Parenchyma and sieve tubes.

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### D. Xylem and phloem.

The answer is B.

Collenchyma and sclerenchyma are plant tissue specialized for support.

Note:

Parenchyma is a packing tissue, filling space in plant organs, between other tissues. It also functions as a storage tissue but may also be involved in support, especially when turgid, in non-woody plants.

Sieve tubes are the main functional components of phloem and responsible for transport as manufactured food within the plant.

Xylem is primarily responsible for transport of water mineral salts, but its lignified walls serve as extra support for the plant.

13. When same response is given to same stimulus on different occasions, the behavior is said to be

- A. instinctive.
- B. conditioned.
- C. imprinted.
- D. stereotyped.

The answer is D



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Instinctive or innate behaviours responses shown by organisms of the same species to the same set of stimuli. In such organism, the same stimulus always elicits the same response on all occasions. The response/behavior is then said to be stereotyped, i.e. always the same (invariant).

Behavior is said to be conditioned when an animal learns to respond to another stimulus which did not initially elicit a response, when that stimulus is associated with another stimulus to which the animal normally responds. For example, a dog learning to salivate at the sound of a bell as a result

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of prior ringing of the bell before food is provided to it. Such responses are not permanent and usually fade or even disappear with time.

Imprinting is a form of learning in which behavior is associated with organism identifying themselves with their older ones so that they learn to respond in a way the older ones do.

These are often permanent but are subject to change by experience.

14. Which one of the following statements on reproduction is true?

- A. Asexual reproduction always results into identical offspring.
- B. Gametes are always produced by meiosis.
- C. Mitosis always produces diploid cells.
- D. Gametes are always haploid.

The answer is D

In reproduction gametes are always haploid.

Note:

Gametes may not always be produced by meiosis. For example, in Bryophytes, gametes are haploid but are produced by mitosis from a haploid gametophyte.

Mitosis does not always produce diploid. For example, in Bryophytes, gametes are haploid but produced by mitosis.

A sexual reproduction does not always produce identical offspring due to mutation may occur.

15. C<sub>3</sub> plants are less efficient than C<sub>4</sub> plants fixing carbon dioxide at low carbon dioxide and high oxygen partial pressures because

- A. C<sub>3</sub> plants use more energy.
- B. in C<sub>3</sub> plants, energy is lost.
- C. RuBP carboxylase is inactivated by high oxygen partial pressures.

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- D. PEP carboxylase has a high affinity for oxygen.

The answer is C

Fixation of carbon dioxide by RuBP carboxylase is inactivated by high oxygen partial pressure because oxygen them competes more favorably for the binding sites of the enzyme than carbon dioxide phenomenon called photorespiration. This occurs mainly in C<sub>3</sub> plants at low carbon dioxide and high oxygen partial pressure.

16. Which one of the following is the significance of etiolation in plants?

- A. Allows small-sized leaves to break through the soil.
- B. Leads to rapid elongation of hypocotyl in monocotyledonous plants.
- C. Allows maximum growth in length using the available food reserves.
- D. Enables a plant to grow in darkness.

The answer is C

Etiolation occurs as a result of growth of a plant in the dark. The significance of etiolation that it allows maximum growth in length to occur with minimum use of food reserves which in absence of light, the plant cannot obtain by photosynthesis to enable the plant to reach light out of the soil.

Characteristic of etiolated plant are:

- Chlorotic shoot as a result of lack of chlorophyll: the shoots appear yellow or white instead of green.
- Shoot internodes become elongated and thin
- Leaves remain small and unexpanded in dicotyledonous plants, while in monocots, they remain rolled up. This may be useful in germination as it allows the plant to break through the soil with minimum resistance to reach light.

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17. Which one of the following methods of estimating population has the highest chances of error?

- A. Removal method.
- B. Quadrat method.
- C. Capture-recapture method.
- D. Direct count method.

The answer is C

The removal, quadrat and direct count methods involve actual identification and counting of individual organisms in the environment, therefore, they have lower chance of error. On the other hand, the capture-recapture method is based on a small representative sample of organisms and therefore has higher chance of error.

18. Which one of the following is the correct state of structures in the mammalian eye during accommodation for far objects?

- |   |  |   |
|---|--|---|
| <p>Ciliary muscle</p> <p>A. relaxed</p> <p>B. Contracted</p> <p>C. relaxed</p> <p>D. Contracted</p> | <p>Suspensory ligament</p> <p>taut</p> <p>taut</p> <p>relaxed</p> <p>relaxed</p> | <p>Lens curvature</p> <p>decreased</p> <p>increased</p> <p>decreased</p> <p>increased</p> |
|---|--|---|

The answer is A

During accommodation for a far object, the eye is generally relaxed and is sometimes said to be un accommodated. The ciliary muscles are relaxed, the suspensory ligament is taut such that the lens is elongated and thin, i.e. is less curved. As a result, the refractive power of the lens is reduced.

Note: the reverse occurs during accommodation for a near object.

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19. Which one of the following is the respiratory surface for a mammalian fetus?

A. Alveolus.

B. Placenta.

C. Chorionic villi.

D. Amnion.

The answer is B

The mammalian fetus receives its requirements from the mother's blood across the placenta.

Therefore, the placenta is its respiratory, absorptive and excretory surface (organ).

Note:

Within the womb, the mammalian fetus does not breathe. Therefore, the alveoli are not used as a respiratory surface.

Chorion is the outer layer of cells of the zygote which form finger like projections (chorionic villi) that grow into the endometrium. These serve to anchor the fetus to the endometrial wall.

Amnion is a thin membrane covering the embryo like an umbrella and has a protective function. It secretes amniotic fluid which supports the embryo and protects it from mechanical shock.

20. Which one of the following is the correct order of vents in the heart after the contraction of the atria?



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A. Atrio -ventricular valves open, ventricles contract, semi lunar valves close.

B. ventricles contract, atrio-ventricular valves close, semi lunar valves open.

C. ventricles contract, atrio-ventricular valves semi lunar valves open.

D. Atrio- ventricular valves open, semilunar valves open, ventricles contract

The answer is B

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Following contraction of the atria, the ventricles fill with blood. The ventricles contract and push blood up into the aorta pulmonary arteries. Atrio- ventricular valves close to prevent backflow of blood into the atria and semi lunar valves (aortic and pulmonary valves) open to allow blood into these vessels.

21. Which one of the following features characterizes the omnivore gut?

- A. Large divided stomach.
- B. Poorly developed appendix and caecum.
- C. Long pouched colon.
- D. Short ileum and colon.

The answer is B

Omnivorous animals feed on plant, animals and fungal organic matter. Human beings are examples of omnivorous animals. In such animals, the appendix and caecum are less functional and therefore poorly developed.

Note:

In non – ruminant herbivores as rabbit, cellulose digestion is effected by micro- organisms in caecum and appendix. In such animals, they are well developed. In omnivores, cellulose is of no nutritional values and therefore not digested in their gut. As a result, the appendix and caecum are less developed in omnivores.

22. High concentration of carbon dioxide in the tissues leads to

- A. Increase in the affinity for oxygen by haemoglobin.
- B. Increase in the loading tension of haemoglobin.
- C. Shifting the dissociation curve to the left.
- D. Lowering of the affinity for oxygen by haemoglobin.

The answer is D

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High carbon dioxide concentrations in the tissues cause lowering of the PH, which result in the shifting of the oxygen dissociation curve to the right ( Bohr effect). This has the effect of reducing the affinity of haemoglobin for oxygen.

Recall:

Bohr Effect is the shifting of the haemoglobin oxygen dissociation curve downwards and to the right as a result of increased carbon dioxide concentration or reduced PH of the blood

23. Which one of the following environmental factors has a direct effect on all organisms?

- A. Light.
- B. Humidity.
- C. Temperature.
- D. Rainfall.

The answer is C

Unlike other environment factors, temperatures directly affect all organism since it affects the rate of enzyme- controlled reactions. Which occur in all organisms?

Note: light affects mainly plants because it is an important energy input in the process of photosynthesis. In animals, light only affects vision.

Humidity only directly affects plant and higher animals, especially when the environment is hot. In plants, it affect the process of transpiration while in higher animals it affect the process of heat loss by evaporation from the body surface.

Rainfall only directly affects plants because it is vital source of water to replenish soil water which is absorbed by plants.

24. Which one of the following factors reduces interspecific competition in a community?

- A. Resource partitioning.
- B. High intraspecific competition.

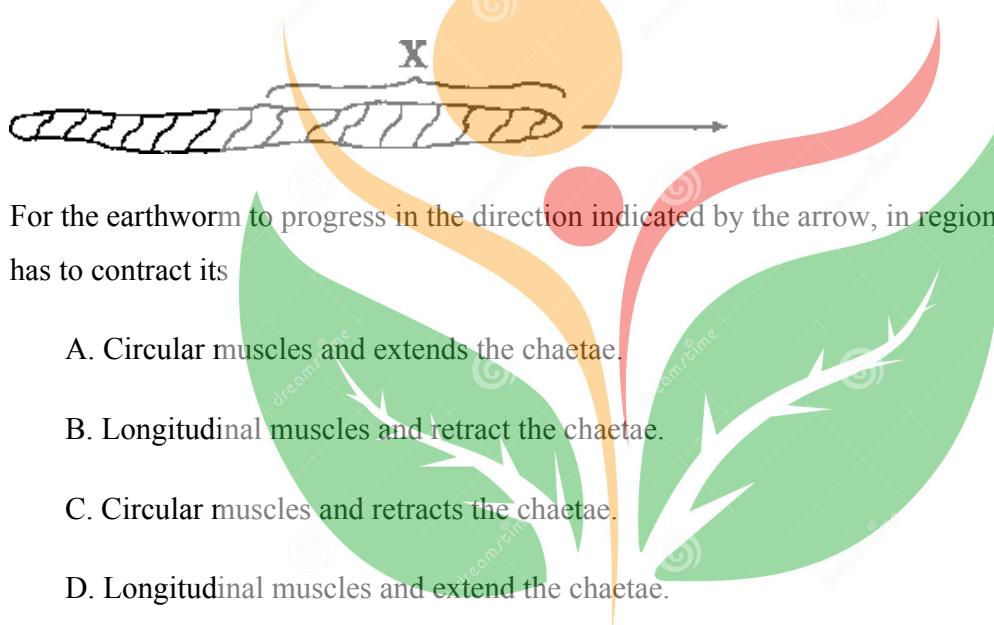
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- C. Large number of species.
- D. Similar predator-prey strategies among the species.

The answer is A

Interspecific competition in a community is competition which occurs among organism of different species. Resource partitioning, the allocation of a particular class of resource to a given group of species, reduces this kind of competition by ensuring that organism of a given species are entitled to particular resource, leaving other resource to the other species.

25. Figure 3 shows an earthworm in a stationary position.



For the earthworm to progress in the direction indicated by the arrow, in region X, the earthworm has to contract its

- A. Circular muscles and extends the chaetae.
- B. Longitudinal muscles and retract the chaetae.
- C. Circular muscles and retracts the chaetae.
- D. Longitudinal muscles and extend the chaetae.

The answer is C

For the earthworm to move forward, circular contraction in the region X and the longitudinal muscles relax, thereby retracting the chaetae and elongating the worm forwards.

26. Albinism in corn plants is due to a double recessive gene which causes them to die before maturity. The trait however continues to appear in new generations because
- A. Albino plants can develop chlorophyll when exposed to light.
  - B. Normal green plants may carry recessive alleles.

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C. New varieties may be produced by crossing over in albino plants.

D. Mutation may occur to change albino plants to green.

The answer is B

Since plant albinism is caused by a recessive allele, normal green may carry the recessive allele in heterozygous state. This will trap the albino trait in the corn plant population so that even when the affected plant die, the trait will continue appearing in the population when the heterozygous individuals are crosses.

27. Which one of the following may cause adaptive radiation to a variety of species?

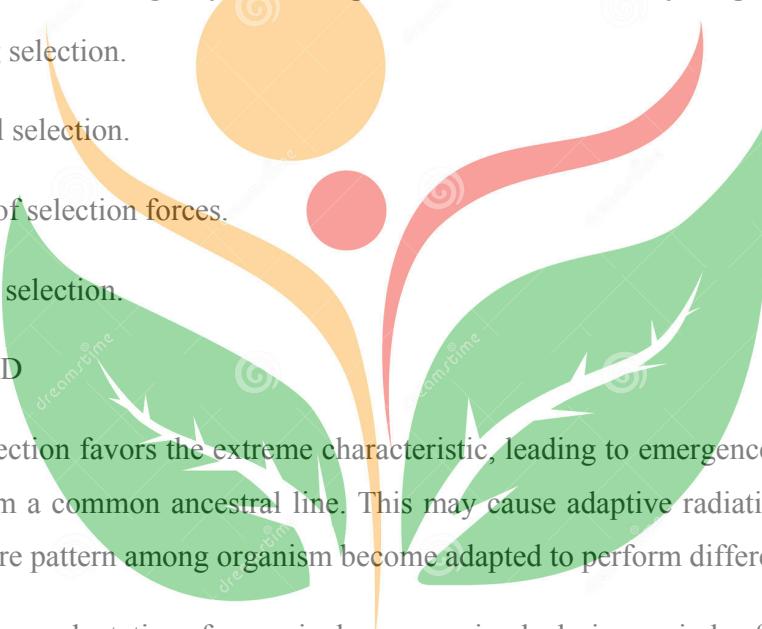
A. Stabilizing selection.

B. Directional selection.

C. Cessation of selection forces.

D. Disruptive selection.

The answer is D



28. The following are adaptations for survival among animals during periods of water shortage.

(i) Tolerance to water loss,

(ii) Biochemical production of water,

(iii) Reduction in water loss,

(iv) Evasion of hot environment.

Which one of the following is a correct set used by the camel?

A. (i) and (ii) only.

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B. (i), (ii) and (iii}.

C. (i), (ii) and (iv).

D. (iii) and (iv) only.

The answer is B

To survive in the conditions of water shortage in deserts, the camel uses the following means:

- Having tissue that are tolerant of water loss/ desiccation.
- Producing metabolic water: biologically produced water from fat metabolism
- Reducing water loss from the body.

Note: the camel never evades the hot environment in order to escape shortage but uses the above strategies to withstand condition in the desert.

29. The equation for complete oxidation of a substrate is



The respiratory quotient for the oxidation is

A. 0.70.

B. 1.4.

C. 0.9.

D. 1.0.

The answer is A



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$$\text{R.Q.} = \frac{\text{No. of moles of CO}_2 \text{ produced}}{\text{No. of moles of O}_2 \text{ utilized}}$$

$$= \frac{36}{51}$$

$$\text{R.Q.} = 0.71 \text{ (this is close to 0.70)}$$

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30. A likely effect of inhibiting the action of cholinesterase at a synapse is

- A. Cessation of impulse transmission.
- B. Speeding up of impulse transmission.
- C. Continuous impulse transmission.
- D. Slowing down of impulse transmission

The answer is C

Acetylcholinesterase is the enzyme responsible for breaking down acetylcholine into acetyl-CoA and choline, thereby stopping its action on receptor at the synapse, thus, when the action of acetylcholinesterase is inhibited, the acetylcholine continues to stimulate the receptors at the synapse, resulting in continuous transmission of impulses at the synapse.

31. Which one of the following processes does not affect the biochemical oxygen demand in an environment?

- A. Nitrification.
- B. Ammonification.
- C. Nitrogen fixation.
- D. Denitrification.

The answer is D



Denitrification occurs in anaerobic conditions. Using nitrate as the oxidizing agent. As such, it does not affect the biological oxygen demand (BOD) in an environment.

Note:

The other processes, nitrification, ammonification and nitrogen fixation require oxygen in order to occur and therefore directly affect the biological oxygen in an environment.

32. At which one of the following stages of division does a cell have the same nucleic content as

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that at metaphase I?

- A. Anaphase I.
- B. Metaphase II.
- C. Telophase II.
- D. Prophase II.

The answer is A

Anaphase I follows metaphase I in the first meiotic division and the cell in anaphase I contains the same nucleic content ( $4n$ ) as that in metaphase I. In both phases, each chromosome occurs in duplicate having replicated during interphase.

33. When a lipid is combined with a phosphate group, it becomes

- A. saturated.
- B. a complex molecule.
- C. water soluble.
- D. amphoteric.

The answer is C

A phosphate ( $\text{PO}_4^{3-}$ ) is a charged group and therefore highly soluble in water. Therefore, addition of a phosphate to a lipid makes it polar and therefore more water soluble.

34. Which of the following animal groups body segments and closed circulatory system?

- A. Crustaceans.
- B. Platyhelminthes.
- C. Annelida.
- D. Insect.

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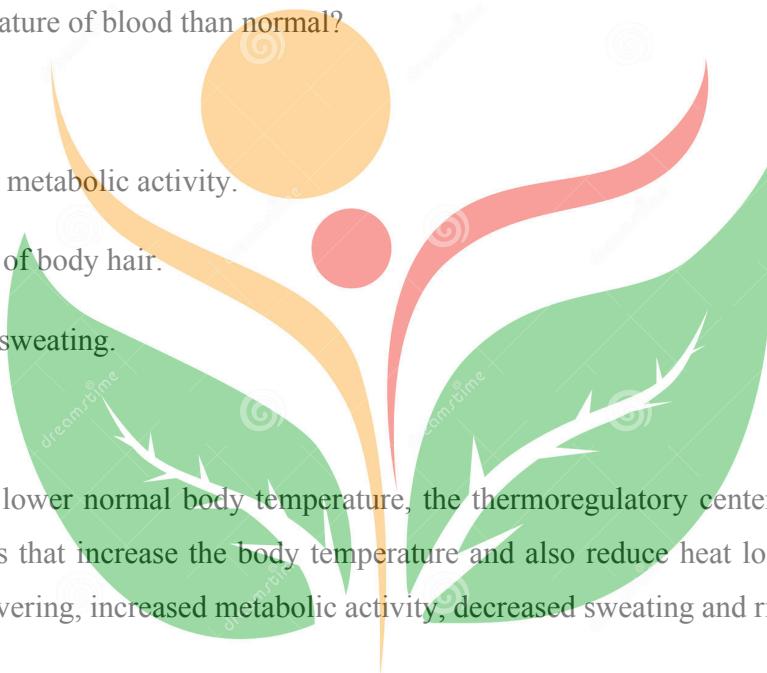
The answer is C

Annelids are segmented animals with a closed circulatory system. An example is the earthworm.

Note: crustaceans and insects (Arthropods) have segmented bodies but with an open blood circulatory system

Platyhelminthes (flatworms) are often parasitic. They have body segments called proglottides but lack a circulatory system.

35. Which one of the following occurs in a mammal when its thermoregulatory centre detects a lower temperature of blood than normal?



- A. Shivering.
  - B. Decreased metabolic activity.
  - C. Flattening of body hair.
  - D. Increased sweating.

The answer is A

In response to a lower normal body temperature, the thermoregulatory center sets in motion a series of activities that increase the body temperature and also reduce heat loss from the body. These include shivering, increased metabolic activity, decreased sweating and rising of body hair.

36. Which one of the following may occur to a community of organisms as a result of natural  
Section?  Download from   29983430



- A. Increase in the number of species.
  - B. Adapting to the environment by all the organisms.
  - C. Extinction of species.
  - D. Reduction in the level of mutation

The answer is C.

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Natural selection may lead to extinction of species that have unfavorable characters from given environment and emergence of new species with favorable characters.

Recall:

Natural selection is a phenomenon where organisms with favorable characters live longer and reproduce in an environment of contrasting characteristic while those with unfavorable traits die or are selected against.

37. Which one of the following parts of the nephron contributes to the production of hypertonic urine?

- A. Bowman's capsule.
- B. Proximal convoluted tubule.
- C. Distal convoluted tubule.
- D. Loop of Henle.

The answer is D

Concentration of urine occurs by reabsorption of water it flows through the collecting ducts. This occurs partly because the collecting ducts pass through a region of high salt concentration in the medulla. This is created by the countercurrent multiplier system of the loop of Henle and depends on the length of the loop of Henle.

38. An occurrence of a phenotypic ratio 3:1 in a dihybrid cross is an indication of

- A. linked genes.
- B. crossing over of chromosomes.
- C. failure of homologous chromosomes to separate.
- D. dominance

The answer is A

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Linkage of genes always produce a phenotypic ratio of 3: 1 in the F<sub>2</sub> generation of a dihybrid cross instead of the typical 9: 3: 1 ratio.

Recall:

Linkage is the occurrence of different genes on the same chromosomes so that they are inherited together. As a result, such genes do not show independent assortment during meiosis and therefore fail to conform to Mendel's 9:3:3:1 ratio of dihybrid inheritance in the F<sub>2</sub> generation instead, they show a 3:1 ratio.

Note:

Crossing over of chromosomes is the process by which pieces of chromosomes are exchanged during prophase I of meiosis. It leads to new combination in gametes but does not affect the phenotypic ratio (9:3:3: 1) in the F<sub>2</sub> generation as the genes are not altered.

When homologous chromosomes fail to separate, we say non-disjunction has occurred. Gametes are then formed with abnormal numbers of chromosomes, fertilization of which result in an organism very different from the parents. However, the ratio obtained is neither 9:3:3:1 nor since an organism with totally different characteristic is formed.

Dominance has no effect on the phenotypic ratio in a dihybrid cross.

39. Which one of the following is not exhibited by a well-adapted parasite?

- A. Inflicting moderate harm to its host.
- B. employing an intermediate host.
- C. killing the host.
- D. using more than one host.

The answer is C

A well-adapted parasite never kills nor does it cause great harm to its host. However, it may.

Inflict moderate harm to its host

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Employ an intermediate host.

Use more than one host.

40. Which one of the following is not a requirement for the working of a physiological homeostatic mechanism?

- A. Receptors.
- B. Skin capillaries.
- C. Control mechanisms.
- D. Effectors.

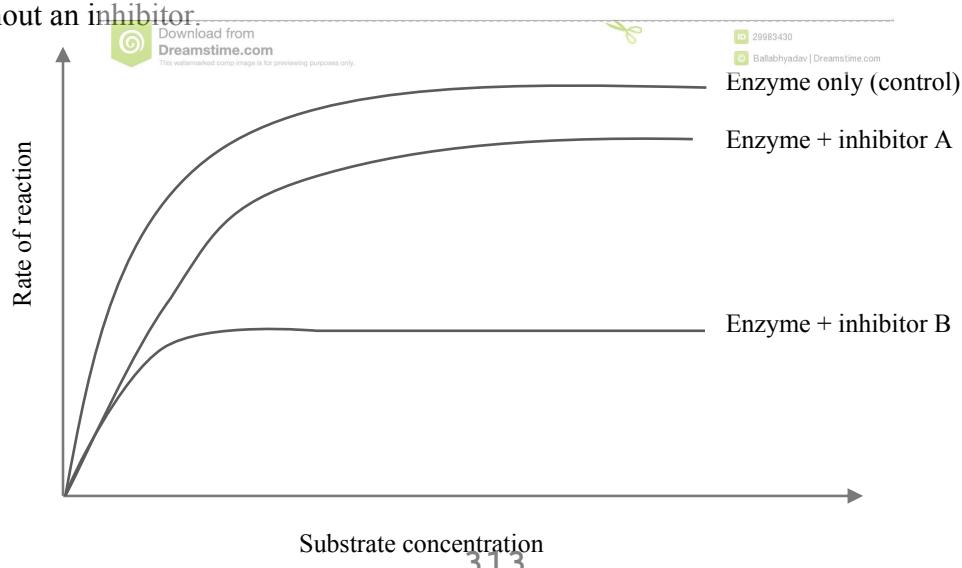
The answer is B

The proper working of a physiological homeostatic mechanism reception, effectors and control mechanism.

Note: skin capillaries are not important in all homeostatic mechanisms, except in the which controls body temperature in mammals and birds (where they actually act as effectors)

### Section B

1. Figure 4 show the effect of increasing the concentration of a substrate on the rate of an enzyme controlled reaction in presence of inhibitors A and B, in relation to the control experiment without an inhibitor.



(a) Describe the effect of each inhibitor on the rate of reaction.

(i) Inhibitor A

Inhibitors A reduced of reaction initially but as substrate concentration increase the rate of reaction also increase at a lower rate than the control. It attains a lower maximum but at a higher substrate concentration than the control.

(ii) Inhibitor B

Inhibitors B greatly reduces rate of reaction, however, rate increase gradually with substrate concentration to a very low maximum at a lowest substrate concentration than all.

(b) Explain the difference in the effect of inhibitors A and B on the rate of reaction

Inhibitor A is reversible competitive inhibitors of the enzyme. It competes with the substrate to bind to the active site of the enzyme, being structurally similar to the substrate.

At low substrate concentration, the inhibitors out compete the substrate for the active site. Fewer than normal substrate molecules combine with the enzyme and the reaction is slower than the control.

As substrate concentration increase, the substrate competes more favorable for the active site and the reaction increase with the substrate concentration up to saturation.

Saturation is slightly lower than control since some enzyme active sites still occupied by inhibitors A molecules.

Inhibitor B is a non-competitive inhibitor. It binds with the enzyme permanently and prevents the substrate from binding to the enzyme. This reduces effective enzyme molecules and the reaction proceeds as it would occur if the enzyme concentration was lower than the control.

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2. Figure 5 show two forms of population growth curve of animals.

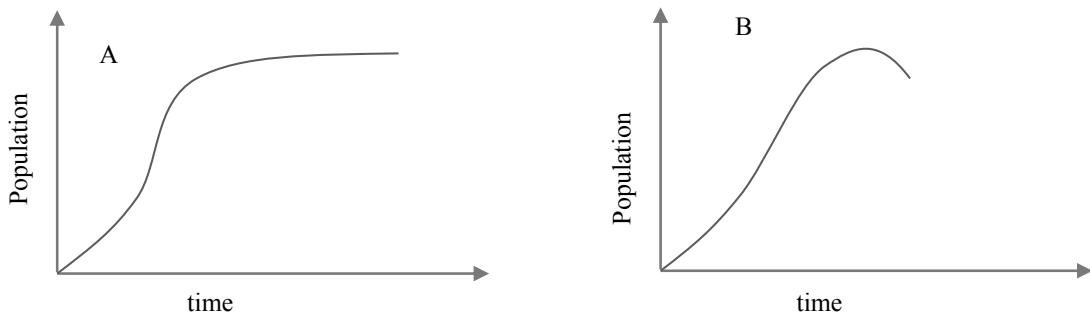
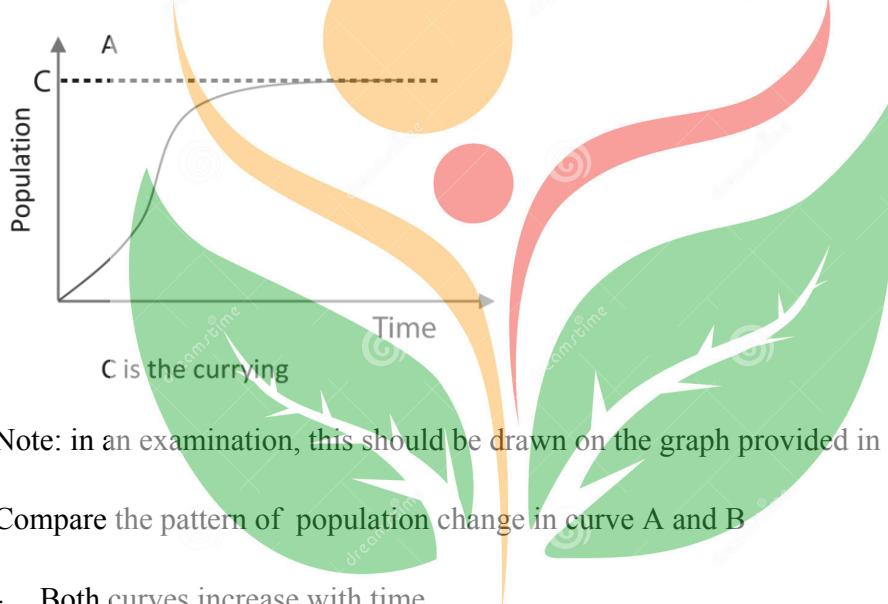


Fig. 5

(a) Indicate by growing on curve A the carrying capacity of the environment.



Note: in an examination, this should be drawn on the graph provided in the question

(b) Compare the pattern of population change in curve A and B

- Both curves increase with time
- Both population increased to the maximum
- Population remained constant at maximum in group A but decreased rapidly after maximum in group B

(c) Suggest an explanation for the population changes in curve B

Initially, the growth rate is slow because

- A few animals have reached reproductive maturity.
- The animals are not yet adapted to the conditions of environment.

Later, growth rate is rapid because

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- The animals are now well adapted to environment.
- There are many reproducing animals

The declining rate available occur as a result of environmental stresses such as:

- Competition for available resource such as food and shelter
- Accumulation of waste products
- Reproductive failure
- Predation

The decline after a maximum is a result of

- reduction in sources in the environment to support the animal population.
- Predation
- Competition
- Parasitism

(d) Suggest three biotic factors which can result into a change in carrying capacity, in an environment.

- Increase or decrease in the number of parasites
- Change in migration patterns
- Change in type and extent of competition
- Change in predation or grazing intensity
- Change in pathogens load and hence disease
- Change in pollination and dispersal patterns

43. (a) Distinguish between hybrid and hybrid vigour

A hybrid is an offspring of a cross between two closely related but genetically distinct populations.

A hybrid vigour, on the other hand, refer to phenotypes of hybrids showing characteristics which are superior to either of the parental stock.

(b). Explain how each of the following may alter the gene frequency

(i) Closeness of population

Allows free movement of individuals between neighboring populations, which results in loss or gain of alleles in the population. It may also allow free interbreeding among members of the populations and emerge to form one gene pool. Interbreeding reduces genetic variability and hence decrease the ability of members to survive in changing environment. This may cause extinction and hence loss of genes.

(ii) Small population size

In small population not all alleles representative of a species are present.

Genetic drift in small isolated population may result in elimination of a particular allele from a population or cause it to drift to a particular frequency by chance. This makes the population more divergent from the parent population.

44. (a) Name two areas in plants where each of the following tissues is found

(i) Sclerenchyma

Sclerenchyma is found in:

- Vascular bundles.
- Hypodermis of monocotyledonous stems.
- Others
- Pericycle of dicotyledonous stems, in form of strands of secondary xylem and secondary phloem.
- Sclerenchymatous fibres on the surface of seeds, e.g. cotton
- Endocarp of nut.
- Gritty mass in the pulp skin of pears and guava fruits

(ii) Collenchyma

- In petiole and leaf lamina, flowers
- Stems of herbaceous plants.

(b) Give three structure adaption of the sclerenchyma tissue for its function.

- Cells have highly lignified thick walls provide enough resistance to forces of the environment.
- Cells are dead and therefore place no extra metabolic demand on the plant.
- Sclerenchyma fibre are elongated and arranged in sheets or stands to increase their strength

Others:

- Sclerenchyma fibre are interlocked to enhance their combined strength
- Sclerenchyma is the strength mechanical tissue of leave and young stems. It supplements the effects of turgid parenchyma in maintaining shape and form of leave and young stems.

(c) Explain the importance of collenchyma tissue in leaves and young stems

- It can stretch allowing for growth
- Collenchyma cells have deposition of extra cellulose at their corners to offer additional mechanical support.

(d) Outline three structure difference between the collenchyma and sclerenchyma tissue

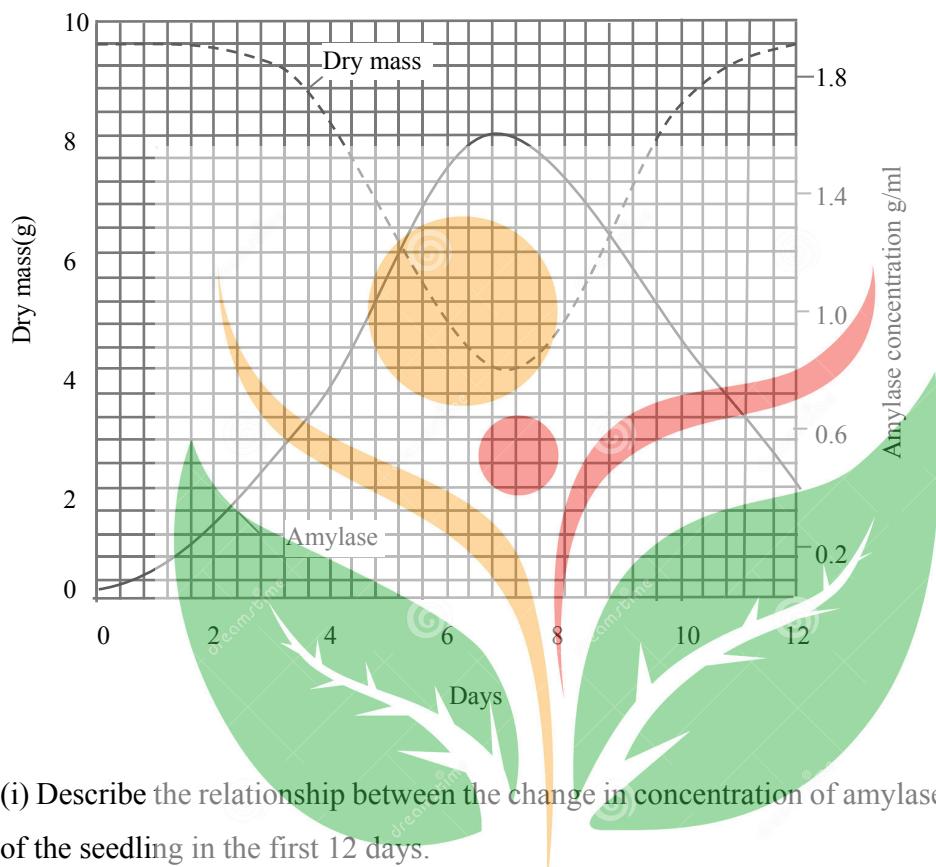
Collenchyma	sclerenchyma
Consists of living cells	Consists of dead cells
Cell wall is thickened with cellulose	Cell wall is thickened with mainly lignin
Cell wall thickening is non -uniform	Cell wall thickening is uniform

others

Collenchyma	sclerenchyma
May contain chloroplasts	Does not contain chloroplasts
Cell cavity is wide	Cell cavity is very narrow or even closed

Has no pores/pits	May be perforated with pore in the walls
-------------------	--

45. Figure 6 show result obtained in an investigation on maize seedling to determine the amount of amylase enzyme produced by the seedlings and the dry mass of the seedling during germination for 12 days



(a) (i) Describe the relationship between the change in concentration of amylase and the dry mass of the seedling in the first 12 days.

Dry mass of the seedling decreases with increase in concentration of amylase up to the 7<sup>th</sup> day and then increases as the concentration of amylase decreases thereafter up to the 12th day.

(ii) Explain the relationship described in (a) (i)

Starch is the main food stored in the maize grain. Amylase is the enzyme that hydrolyses starch to glucose. Thus, increase in amylase concentration leads to increased breakdown of starch to glucose and vice versa.

(b) Explain the change

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- (i) In dry mass of the seedling during 7<sup>th</sup> day

During the 7<sup>th</sup> day, the dry mass of the seedling starts to increase from a minimum at about day 6.8

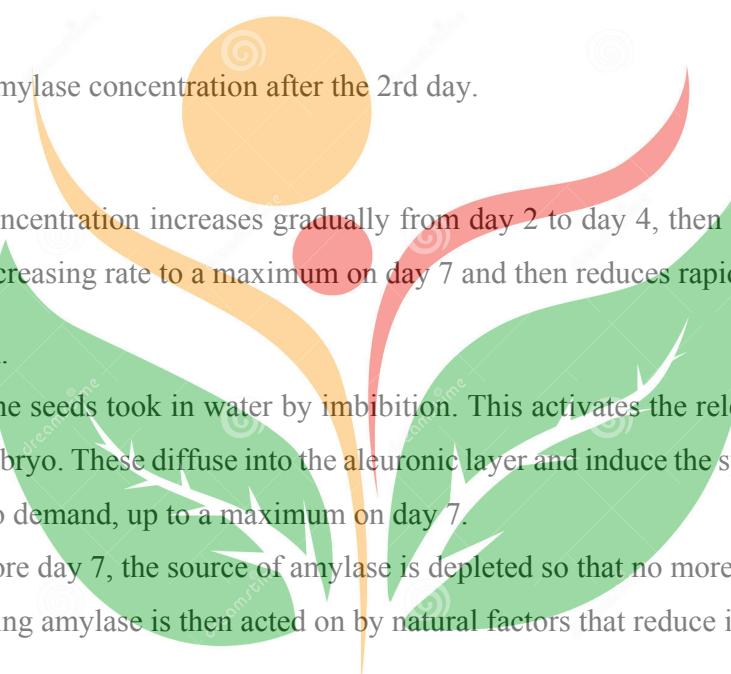
Explanation

Dry mass was minimum because stored food was used up

The first foliage leaves appear which start to photosynthesize, producing organic matter which is incorporated into the seedling.

Amylase concentration has reached its maximum and is starting to reduce so that the rate of food reserve breakdown reduces.

- (ii) In amylase concentration after the 2nd day.



Amylase concentration increases gradually from day 2 to day 4, then rapidly up to day 6 then at a decreasing rate to a maximum on day 7 and then reduces rapidly thereafter.

Explanation.

On day 2, the seeds took in water by imbibition. This activates the release of gibberellins from the embryo. These diffuse into the aleuronic layer and induce the synthesis of amylase according to demand, up to a maximum on day 7.

Shortly before day 7, the source of amylase is depleted so that no more is synthesized.

The remaining amylase is then acted on by natural factors that reduce it more rapidly

46. (a) Explain the following

- (i) Breathing in pure oxygen at higher pressures than atmospheric is dangerous

The tissue metabolizes rapidly at first to keep with the oxygen supply. As oxygen builds up, it inhibits certain enzymes involved in the Krebs cycle, thus interfering with cell respiration. This often leads to muscle twitching followed by impaired vision breathing difficulties. Confusion and lack of coordination and finally convulsion and death.

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- (ii) Breathing in air rich in carbon dioxide is dangerous.

It increases the acidity of the blood and tissue fluids, inhibiting enzymes and stopping essential metabolic processes.

It also reduces the affinity of haemoglobin for oxygen so that little oxygen is delivered to the tissue from the lungs

Accumulation of carbon dioxide also interferes with respiration at the cellular level by inhibiting respiratory enzymes.

This may eventually cause tissue death as a result of lack of enough oxygen

- (b). Outline three adaptations of animals that live in environments of low oxygen tension

- Increased affinity of their haemoglobin for oxygen.
- Increased haemoglobin concentration in their blood.
- Increased number of red blood cells in their blood.
- Higher concentration of myoglobin in their muscles
- Increased force and rate of heart contraction.
- Increased rate of breathing.
- Increased affinity of haemoglobin for oxygen.

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**Attempt all questions**

1. Which of the following is synthesized at interphase during mitosis?

- A. rRNA
- B. mRNA
- C. DNA
- D. tRNA

The answer is C

During interphase of mitosis, there is synthesis of a duplicate copy of DNA (replication of DNA) in the nucleus so that at the end of the process, each daughter cell receive exactly one copy of the DNA molecule.

2. High levels of luteinizing hormone in the blood leads to the following except

- A. ovulation.
- B. production of progesterone.
- C. formation of corpus luteum.
- D. development of the Graafian follicle.

The answers is D

Luteinizing hormone has the highest level in the in the blood at about the 14<sup>th</sup> of the menstrual cycle. It has the following effects:

- Causes ovulation
- Stimulates the remaining of the Graafian follicle to develop into corpus luteum
- It stimulates the corpus luteum to secrete progesterone

Note:

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LH has no effects on the development of Graafian follicles

FSH, a hormone released by the pituitary gland, is the one responsible of the development of Graafian follicles

3. Chordates have the following characteristics except

- A. dorsal notochord extending into head.
- B. gill clefts.
- C. dorsal hollow nerve tube.
- D. Post anal tail.

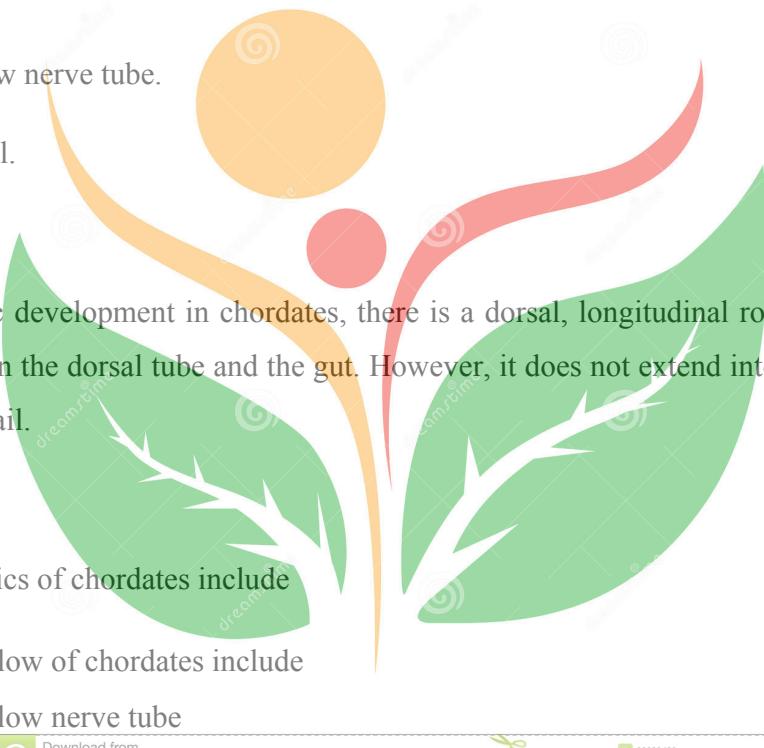
The answer is A

During embryonic development in chordates, there is a dorsal, longitudinal rod (the notochord) which lies between the dorsal tube and the gut. However, it does not extend into the head neither does it reach the tail.

Note:

Other characteristics of chordates include

- Dorsal hollow of chordates include
- Dorsal hollow nerve tube
- Post anal tail
- Pharyngeal pouches/ gill clefts



4. The function of the nucleoli in a cell is to form

- A. the nuclear membrane
- B. ribosomes.
- C. the spindle during nuclear division

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D. centrioles.

The answer is B

The nucleolus is the site of synthesis of ribosomal RNA which is combined with proteins in the cytoplasm to make ribosomes.

Note:

The nuclear membrane is organized from membranes of endoplasmic and Golgi body during telophase.

The centrioles arise from pre-existing centrioles by replication during interphase.

The spindle fibres are synthesized from microtubules in the cytoplasm during prophase using the centrioles as microtubule- organizing. They span the cell from end to end, forming a structure which, because of its shape, is called the spindle apparatus

5. Some bacteria when infected with microphages, may make a particular amino acid they could not make before. This is due to

- A. transformation,
- B. mutation.
- C. transduction.
- D. conversion.

The answer C



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Transduction in bacterial refers to the process by which DNA is transferred from one bacterium to another by a microphage (bacteriophage or virus, e.g. HIV) to genetic material of the microphage (a vector) is incorporated into the DNA of the bacterium so that the bacterium now functions as a machine that manufactures the phage amino acids.

Note:

Transformation is the process by which bacterial DNA is changed as a result of direct uptake and incorporation of foreign DNA from its surroundings through the cell membrane.

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Mutation refers to the change in the structure or quantity of the DNA.

Conversion is meaningless in this context.

6. During strenuous activity, the pyruvic acid in the muscle may accept hydrogen from reduced NAD to become

- A. acetyl CoA.
- B. lactic acid.
- C. ethanol.
- D. citric acid.

The answer is B

Pyruvic acid accepts hydrogen from reduced NAD to form lactic acid during anaerobic respiration which occurs in muscles as a result exercise. This is called lactic acid fermentation.

7. Which of the following is the correct sequence representing the action of nitrifying bacteria?

- A. Nitrites — nitrates — ammonium salts.
- B. Ammonium salts — nitrites — nitrates.
- C. Nitrites — ammonium salts — nitrates.
- D. Ammonium salts — nitrates — nitrites.

The answer is B

Nitrifying bacteria convert ammonium salts into nitrites, which they then oxidize to nitrates

Recall:

Nitrifying bacteria include *Nitrococcus*, *Nitosomoas* and Nitrobacter.

*Nitrococcus* and *Nitosomoas* oxidize ammonia and ammonium salts to nitrites while Nitrobacter oxidize nitrites.

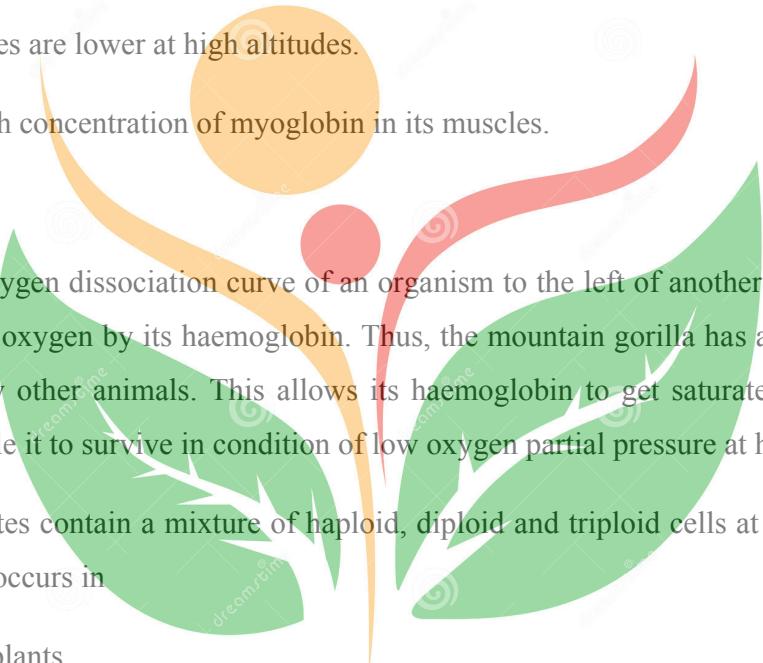
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Therefore, when they work together, *Nitosomoas* and Nitrobacter oxidize ammonia and ammonium salts to nitrates.

8. The mountain gorilla lives at high altitudes and has its oxygen dissociation curve located at the left of many animals. This suggests that

- A. there is low carbon dioxide tension at high altitudes.
- B. its hemoglobin has a higher affinity for oxygen than many animals.
- C. temperatures are lower at high altitudes.
- D. it has a high concentration of myoglobin in its muscles.

The answer is B



Location of the oxygen dissociation curve of an organism to the left of another usually indicates higher affinity for oxygen by its haemoglobin. Thus, the mountain gorilla has a high affinity for oxygen than many other animals. This allows its haemoglobin to get saturated at low oxygen tension. This enables it to survive in condition of low oxygen partial pressure at high altitudes.

9. Some sporophytes contain a mixture of haploid, diploid and triploid cells at some point. This condition only occurs in

- A. flowering plants.
- B. mosses.
- C. ferns.
- D. conifers.

The answer is A



It is only the sporophyte of a flowering plant that may at some time contain a mixture of haploid, diploid and triploid cells. The haploid cells are the gametes (pollen and ovum), the diploid cells are the main plant body cells while triploid cells are endosperm cells.

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10. Which one of the following equations shows the correct relationship between gross primary productivity (GPP) and net primary productivity (NPP) in plants?

- A.  $GPP = NPP - \text{photosynthesis}$ .
- B.  $NPP = GPP - \text{photosynthesis}$ .
- C.  $GPP = NPP - \text{plant respiration}$ .
- D.  $NPP = GPP - \text{plant respiration}$ .

The answer is D

Productivity of a plant is the rate at which energy is stored in the producers in form of organic substance.

Gross primary productivity (GPP) is the rate at which chemical energy derived from the sun is stored by the plants.

Net primary productivity (NPP) is the net gain of organic material in photosynthesis after allowing for losses due to respiration

That is

$$NPP = GPP - \text{plant respiration}$$

11. If a metabolic poison was taken up by a plant, which one of the following processes would be affected immediately?

- A. Evaporation of water from leaf surfaces.
- B. Movement of food from leaves to roots.
- C. Movement of water within the stem.
- D. Movement of water within leaves.

The answer is C

Movements of water within is assumed to be partly as a result of root pressure, which is an active process. It is assumed that the endodermis cells of the root actively secrete ions into the vascular

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tissue. This increase the osmotic pressure in the xylem vessel, resulting in an osmotic inflow of water into the xylem.

Thus, uptake of a poison by a plant immediately affects the movement of water in the stem as a result of inhabiting the active root pressure.

Note:

The movement of food (e.g. sucrose) from leaves to roots also partly involves active transport. This particularly occurs in the loading and unloading of the sieve tubes. The sucrose in the photosynthetic cells is actively transported against a concentration gradient to the companion cells. This increases the osmotic pressure in the companion cells, with the result that water enters by osmosis. Thus a pressure is created which forces the sucrose through the plasmodesmata into sieve tubes.

However, this accounts for only a small portion of the entire process. It is majorly accounted for by the pressure flow (mass flow) hypothesis which is a passive process.

Therefore, the process of movement of food from the leaves to the roots is not immediately affected by the metabolic poison

12. During an exercise, the breathing rate of an individual was 20 breaths per minute while the tidal volume was  $0.5 \text{ dm}^3$ . The ventilation rate in  $\text{dm}^3 \text{ min}^{-1}$  of the individual during the exercise was

A. 40.

B. 20.5.

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C. 19.5.

D. 10.

The answer is D

$$\begin{aligned}\text{Ventilation rate} &= \text{breathing rate} \times \text{tidal volume} \\ &= 20 \times 0.5 \text{ dm}^3 \text{ min}^{-1}\end{aligned}$$

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$$\text{Ventilation rate} = 10 \text{dm}^3 \text{min}^{-1}$$

13. A mammal eats more food than a reptile of equivalent body weight because the mammal

- A. lives longer.
- B. controls its body temperature.
- C. egests more food.
- D. does not absorb heat from its surroundings.

The answer is B

A mammal is an endothermic organism while a reptile is ectothermic. As a result, a mammal requires much more energy to regulate its body temperature by biochemical means, thereby requiring more food than a reptile of equivalent body weight.

14. Insects and some vertebrates living on land have jointed limbs for locomotion. This is an example of

- A. convergent evolution.
- B. adaptive radiation.
- C. divergent evolution.
- D. natural selection.

The answer is A



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The jointed limbs in insects and vertebrates are analogous structures. This is because they have similar function but have no close phylogenetic links.

The existence of analogous structures suggests the occurrence of convergent evolution.

On the other hand, the existence of homologous structures suggests divergent evolution.

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15. Which one of the following is not correct about instinctive behavior?

- A. Is a permanent adaptive trait.
- B. Can be developed in animals reared in isolation.
- C. Allows synchronization of sexual behaviour.
- D. Develops independently of the environment.

The answer is A

Instinctive behavior is an innate (inborn), stereotyped response to one or more environment stimuli, characteristics of organism of a given species

Characteristic of instincts include:

- Are inherited and not acquired. That is, they develop independent of the environment
- Are usually of immediate adaptive values to the organism.
- Are produced unconsciously in response to sudden change in the environment.
- Are similar in all members of a species and develop even in isolation.

Note: Synchronization of sexual behavior in organism is a function of courtship behavior.

16. Which one of the following is the correct sequence in which hormones are produced in the menstrual cycle?

- A. Progesterone, luteinizing hormone, oestrogen, follicle stimulating hormone
- B. Follicle stimulating hormone, progesterone, luteinising hormone, oestrogen.
- C. Follicle stimulating hormone, oestrogen, luteinizing hormone, progesterone.
- D. Luteinizing hormone, oestrogen, follicle stimulating hormone, progesterone

The answer is C

FSH from the pituitary gland stimulates development of several follicles. Then the granulose cells of the developing Graafian follicle start to produce the female sex hormone oestrogen.

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At the midpoint of the cycle, oestrogen triggers the secretion of LH from the pituitary gland.

LH and oestrogen are released in a surge. LH causes ovulation and also stimulate the corpus luteum to secrete progesterone.

17. The complexity and variety of organic molecules is due to the ability of the carbon to

- A. form covalent and ionic bonds.
- B. form covalent bonds in three dimension:
- C. form strong chemical bonds.
- D. bond with atoms of many other elements

The answer is D

The complexity and variety of organic is due to the ability of carbon atoms to form covalent bonds with itself and with atoms of other elements in three dimensions.

18. The fusion of parts of the vertebral column in birds, aids flight by

- A. restricting flexibility.
- B. reducing weight.
- C. strengthening the skeleton.
- D. reducing friction.

The answer is A



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Fusion of party of the vertebral column in birds improves rigidity of the vertebral column thus reducing flexibility which would increase resistance during flight.

19. Which one of the following effects of deforestation will least affect the gene pool of populations in a forest?

- A. Accumulation of carbon dioxide in the atmosphere.
- B. Decrease in the number of individuals at each trophic level.

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- C. Loss of habitats for animal species.
- D. Decrease in the number of trophic levels in the forest ecosystem.

The answer is A

The gene pool of a population will be affected mainly by gene flow. Accumulation of carbon dioxide in the atmosphere has no effect on the genetic constitution of organisms and is least likely to affect the gene pool of forest organisms, though it actually occurs following deforestation.

Recall:

A gene pool is the total variety of genes and alleles present in a sexually reproducing population.

20. The Common method of reproduction in organisms which have a large number of undifferentiated cells is

- A. conjugation.
- B. fragmentation.
- C. sporulation.
- D. fission.

The answer is B

Fragmentation is the main method of a sexual reproducing common to organisms with a large number of undifferentiated cells. Each fragment that splits from the main organism can easily grow mitotically into a complete new organism.

21. When a tall red flowered plant was crossed with a short and white flowered plant, all the offspring were tall and red flowered. When the F<sub>1</sub> plants were selfed, the F<sub>2</sub> plants phenotypes were in the ratio of 3: 1. This occurrence suggests the occurrence of

- A. epistasis
- B. recombination.

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C. crossing over

D. Linkage.

The answer D

Linkage is genes usually leads to a phenotypic ratio of 3:1 in the F2 generation of a dihybrid cross, instead of the typical 9: 3 :3 :1

Note:

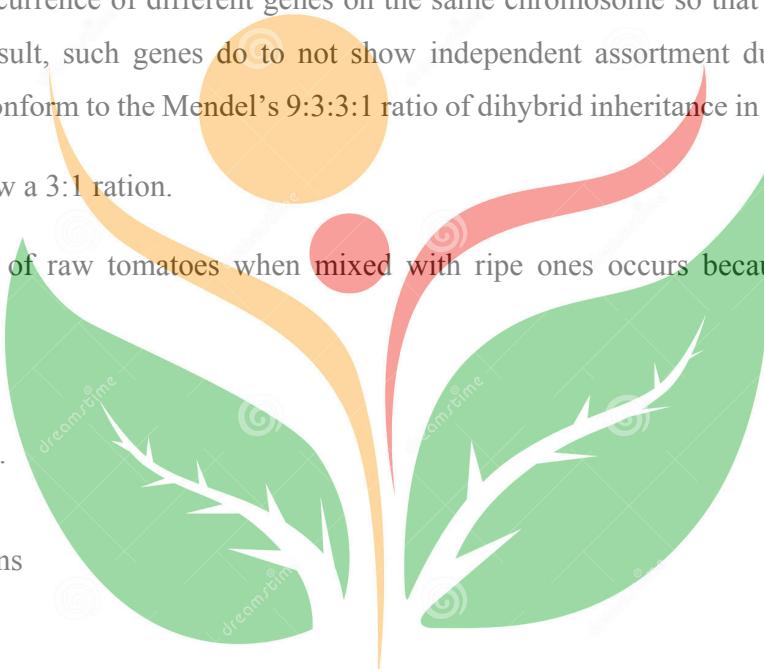
Linkage is the occurrence of different genes on the same chromosome so that they are inherited together. As a result, such genes do not show independent assortment during meiosis and therefore fail to conform to the Mendel's 9:3:3:1 ratio of dihybrid inheritance in the F2 generation.

Instead, they show a 3:1 ration.

22. The ripening of raw tomatoes when mixed with ripe ones occurs because ripe tomatoes produce.

- A. warmth.
- B. cytokinins.
- C. ethene.
- D. Gibberellins

The answer is C



Ethene is a plant hormone that promotes ripening of fruit. Raw tomatoes will ripen mixed with ripe ones because ethene diffuses from the ripe tomatoes and caused ripening of the raw ones.

23. Which one of the following plant tissues performs both storage and supportive functions?

- A. Parenchyma.
- B. Sclerenchyma.
- C. Collenchyma.
- D. Phloem.

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The answer is A

Parenchyma is the plant tissue that has both storage and supportive function. It store water and starch in most plants and also serves as the main supporting tissue in non-woody plants.

24. The function of meiosis in gamete formation is to

- A. Maintain the chromosome number and produce genetically similar gametes.
- B. Halve the chromosome number and produce genetically similar gametes.
- C. Halve the chromosome number and produce genetically variable gametes.
- D. Maintain the chromosome number and produce genetically variable gametes.

The answer is C

Meiosis involves a single replication of DNA during interphase in the parent cell and two cycles of nuclear divisions and cell divisions (meiosis I and meiosis II). Thus the chromosome number is halved from the diploid number ( $2n$ ) to the haploid number ( $n$ ).

Also during prophase I of meiosis there is crossing over in which homologous chromosomes exchange genetic materials. This results in genetic variation in the gametes.

Therefore, meiosis halves the chromosome number and also introduces inheritable variation in the gametes.

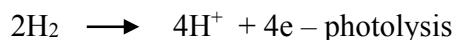
25. Which one of the following occurs during the light dependent stage of photosynthesis?

- A. Formation of ADP.
- B. Production of NADPH<sub>2</sub>.
- C. Formation of PGAL.
- D. Production of NADP<sup>+</sup>.

The answer is B

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During the light-dependent stage of photosynthesis, light energy is trapped by chlorophyll molecules in the thylakoids and used to synthesize ATP, a process called photophosphorylation. During non-cyclic photophosphorylation, splitting of water occurs in the presence of light (photolysis). This generates hydrogen ions which, together with electrons from chlorophyll, are used to reduce  $\text{NADP}^+$  to  $\text{NADPH}_2$ . That is:



Then



NADPH<sub>2</sub> and ATP are used to carry hydrogen and energy respectively into the light-independent stage

26. Which one of the following activities does not contribute to the greenhouse effect?
- A. Deforestation.
  - B. Use of CFCs.
  - C. Burning of fossil fuels.
  - D. Emission of gases from industries.

The answer is B

Accumulation of carbon dioxide in the atmosphere prevents heat energy from escaping from the earth's surface. This results in accumulation of heat energy on the earth's surface, a phenomenon called greenhouse effect.

Any activity that increases carbon dioxide concentration in the atmosphere will lead to greenhouse effect. Such activities include deforestation, burning fossil fuels and industrial emissions.

Note:

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Use of chlorofluorocarbons (CFCs) causes depletion of the ozone layer and causes sun rays reaches the earth directly. This causes direct global warming but not through greenhouse effect.

27. Figure 1 shows an epithelial tissue

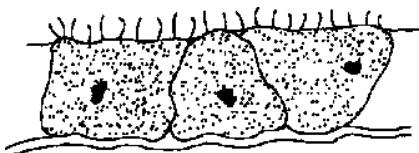


Fig. 1

The function of the tissue is to

- A. increase surface area for absorption of materials.
- B. provide smooth lining for movement of materials.
- C. act as a junction between different tissues.
- D. move materials along the surface.

The answer is D

The epithelium shown is a ciliated epithelium. The beating of the cilia creates a current of fluid which moves material along the surface lined by this kind of epithelium.

Recall

- To increase surface area for absorption of material, epithelial surfaces are often highly folded and sometimes the membrane of individual cells are finely folded into microvilli
- A smooth lining is provided by simple squamous epithelium
- Tissues that act as a junction between different tissue are not epithelia but connective tissue fibres.

28. Growth in size of a single cell is limited by the

- A. cytoplasm.
- B. nucleus.

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C. cell vacuole.

D. cell membrane.

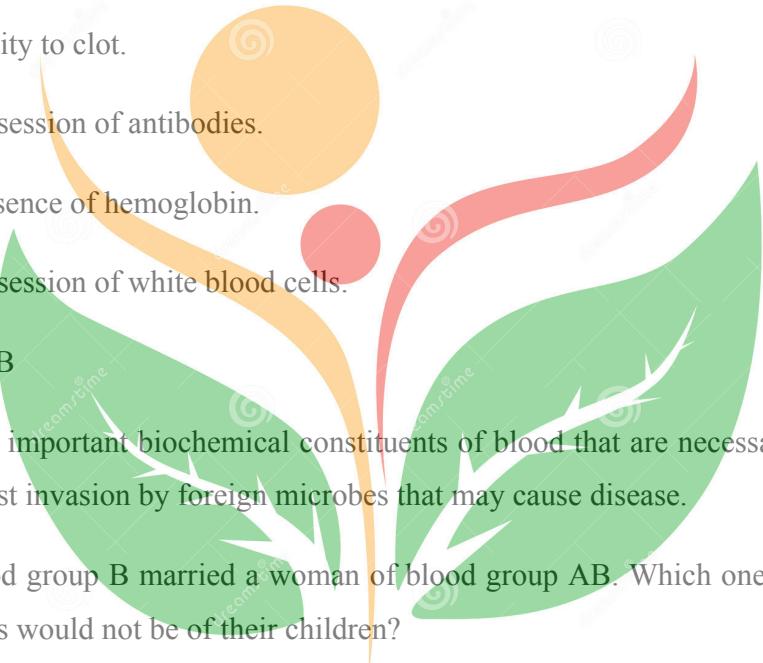
The answer is B

The nucleus directly dictates the size of a cell because it directs the formation of materials that sustain cell content. Since the genetic constitution of the nucleus is content, a cell grows only up to a size that the nucleus can sustain.

29. The biochemical property of blood essential for its protective function of the body is the

- A. ability to clot.
- B. possession of antibodies.
- C. presence of hemoglobin.
- D. possession of white blood cells.

The answer is B



Antibodies are important biochemical constituents of blood that are necessary for protecting the body against invasion by foreign microbes that may cause disease.

30. A man of blood group B married a woman of blood group AB. Which one of the following blood genotypes would not be of their children?

- A. AO.
- B. BO.
- C. AA.
- D. BB.

The answer is C

A man of blood group B has either genotype BO or BB while the woman of blood group AB has genotype AB. Suppose the man is of genotype BO, a cross with the woman will yield AB,

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BB, AO and AO as genotype of the offspring. If is of genotype BB, a cross with the woman yield AB and BB as genotypes of the offspring. Thus genotype AA is not possible.

31. Which one of the following is a way of minimizing water loss in a desert animal?

- A. Drinking a lot of water.
- B. Possession of few glomeruli.
- C. Feeding on succulent vegetation.
- D. Having a short loop of Henle.

The answer is B

One of the adaption of desert animal to minimize water loss in a desert environment is reduction in the volume of glomerular filtrate. This is usually achieved by having few glomeruli.

32. Interruption of the period of darkness by a brief red light prevents flowering in a short day plant because

- A. florigen is produced rapidly.
- B. the concentration of Pfr lowers.
- C. the concentration of Pfr increases.
- D. Pr is converted to Pfr.

The answer is D

In a short day plant, pr promotes flowing while Pfr inhibits it. Now, red light promotes the conversion of Pr to Pfr and therefore a brief flash of red light would prevent flowering in short day plants.

33. Which one of the following factors is least likely to contribute to the development of new species?

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- A. Gene mutation.
- B. Reproductive isolation.
- C. Geographical isolation.
- D. Stabilizing selection.

The answer is D

In stabilizing selection, the extremes are eliminated. This does not encourage genetic variation of, among organisms and therefore is least likely to contribute of the development of new species.

34. Production of uric acid in insects is an adaptation for

- A. conserving water.
- B. minimizing energy loss.
- C. conserving mineral salts.
- D. removing excess water.

The answer is A

Production of uric acid require a lot of energy but, being least toxic and least water soluble, it can be excreted in solid form, with minimum loss of water. Thus, it helps the animal that excretes it to conserve water available in its tissue.

35. Stomatal closure occurs when

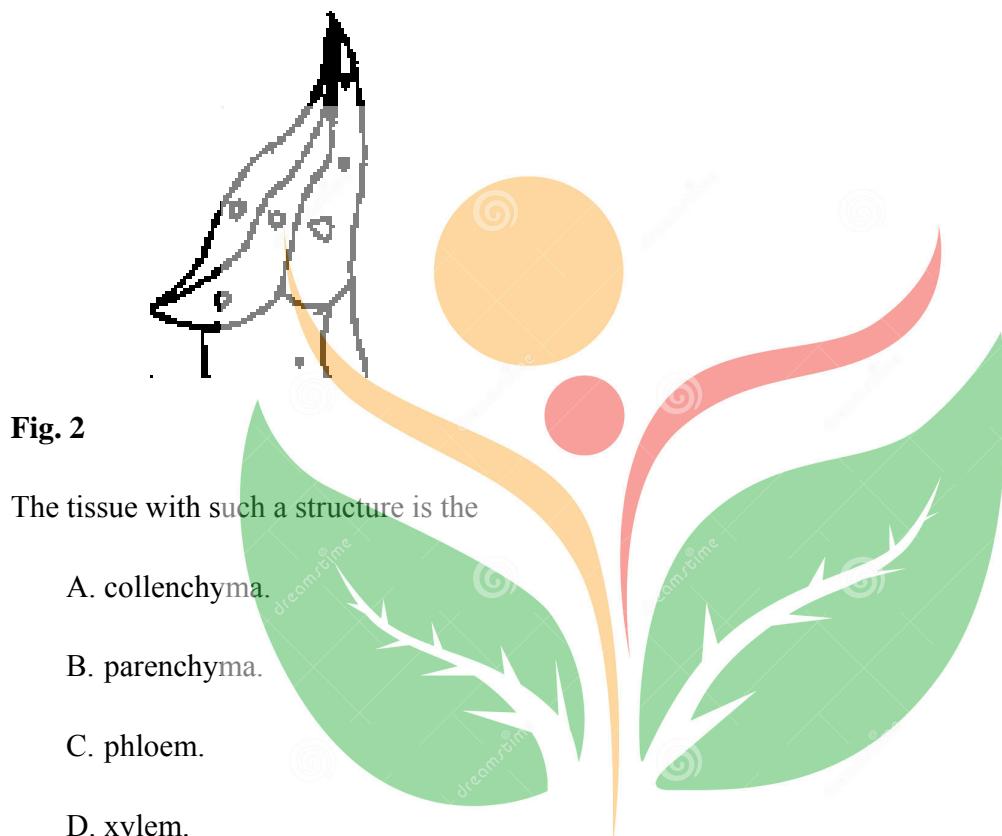
- A. turgor in the guard cells rises.
- B. the pH in the guard cells increases.
- C. the osmotic potential in the guard is more than that in surrounding cells.
- D. starch in the guard cells is converted to sugar.

The answer is B

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Increase in pH of the guard cells lead to the conversion of sugar of starch in the guard cells. This increases the water potential of the guard cells and encourage exist of water from them by osmosis, into the neighboring epidermal cells. This results in a reduction in the turgidity the guard cells, thereby closing stomata.

36. Figure 2 shows a section of a structure a plant tissue.



The answer is D  
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The structure shows a type of cell called a tracheid. This constitutes the xylem tissue

Recall:

Tracheids are elongated, cylindrical structure; typically five –or six- sided in cross section with tapering end whose end- walls are perforated by pits.

37. Primary growth in plants is mainly the activity of

- A. lateral meristems.

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- B. apical meristems.
- C. primary meristems.
- D. intercalary meristems.

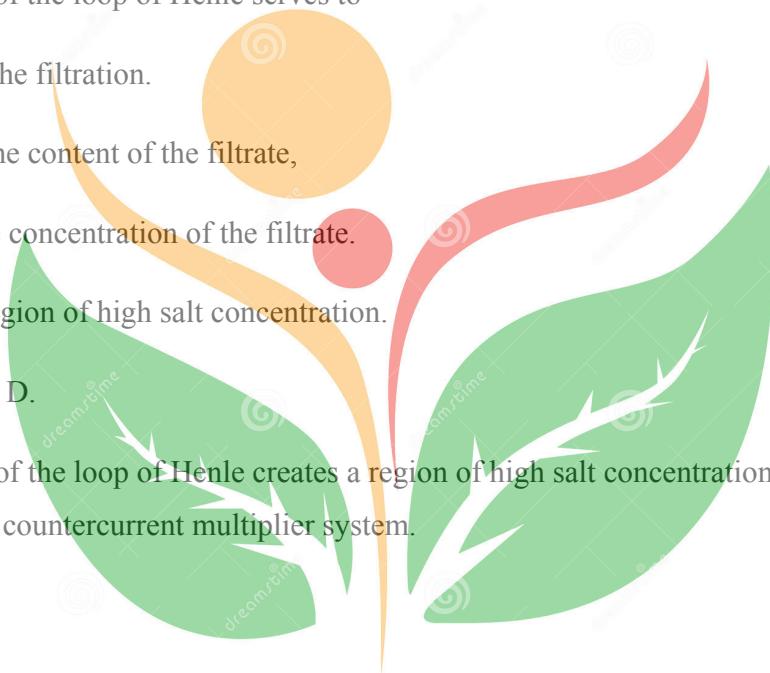
The answer is B

Primary growth in plants is an activity of apical meristems. Other meristems are responsible for secondary growth.

38. The U-shape of the loop of Henle serves to

- A. speed up the filtration.
- B. increase the content of the filtrate,
- C. reduce the concentration of the filtrate.
- D. create a region of high salt concentration.

The answer is D.



The u- shape of the loop of Henle creates a region of high salt concentration in the medulla of the kidney by countercurrent multiplier system.

Note:

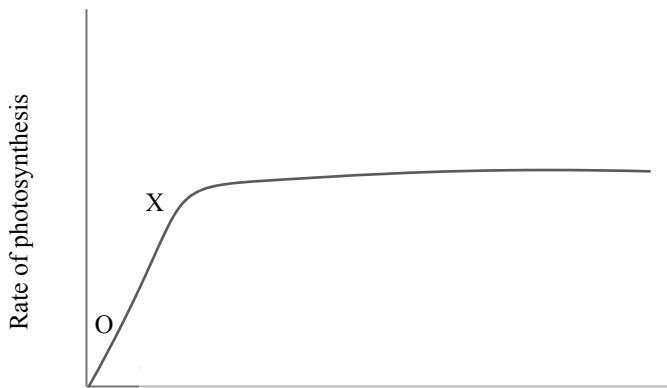
There is active transfer of sodium accompanied by chloride and potassium ions from the tubular fluid of the a scending limb of the loop of Henle into the medulla. The a scending limb is impermeable to water and therefore the fluid in it becomes progressively dilute as it flows up the tubule. The high concentration of the solution in the medullary tissue makes water to leave the permeable walls of the descending limb of the loop of Henle by osmosis.

The water is taken up the blood vessels.

The loop is called a counter- current multiplier because the fluid flows in directions in its two limbs. The multiplying effect is seen in the progressive increase in the concentration of the medulla from 300 to 1500 molts

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39. The graph in figure 3 shows the rate of photosynthesis at different light intensities.



The factor limiting the rate of photosynthesis between point O and X is

- A. light intensity.
- B. Temperature.
- C. carbon dioxide,
- D. oxygen.

The answer is A

According to the law of limiting factors, a process is limited by a factor that is nearest its minimum so that increasing this factor directly increases the rate of the process. From the graph, rate of photosynthesis increases linearly with increase in light intensity along OX. Thus light intensity is the limiting factor in this region of the graph.

40. Loss of water from the blood in human body can result into is the

- A. Lowering of body temperature.
- B. Slowing down the rate of breathing.
- C. Lowering of the blood pressure.
- D. Slowing down of the heartbeat.

The answer is C

Volume of blood is a direct contributing factor to the pressure of the blood in the vessels. Thus loss of water from the blood decreases blood volume and therefore the blood pressure.

SECTION B

41. Give the meaning of each of the following:

(i) Chloride shift

Chloride shift is the movement of chloride ions into red blood cells as bicarbonate ions leave during carbon dioxide transport from the tissue by the blood. It helps to restore electro-neutrality within the red blood cells in tissue capillaries when bicarbonates ions diffuse into plasma.

(ii) Bohr effect.

Bohr effect is a rightward and downward shift of the haemoglobin oxygen dissociation curve that as a result of increased carbon dioxide partial pressure or decrease in blood pH. It has the effect of reducing the affinity of haemoglobin for oxygen.

(b) Explain the effect of each of the following on the oxygen dissociation curve of haemoglobin in mammals

(i) Increase in environmental temperature

Increase in environment temperature causes a right shift of the oxygen dissociation curve. This is because the bond between oxygen and haemoglobin is thermo-labile and therefore weakens with increase in temperature. Therefore, the haemoglobin becomes less efficient at picking up oxygen but more efficient at releasing it.

(ii) High the carbon dioxide levels in body tissues.

High carbon dioxide levels in the tissues cause a shift of the oxygen dissociating curve to the right.

This is because carbon dioxide reacts with water to form carbonic acid which dissociate of liberate hydrogen ions into plasma. The hydrogen ions stabilize deoxyhaemoglobin and therefore encourage the conversion of oxyhaemoglobin to deoxyhaemoglobin, so reducing haemoglobin affinity for oxygen.

(c) Explain the physiological advantage of a high concentration of myoglobin in skeletal muscles

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Myoglobin has a higher affinity for oxygen compared to haemoglobin. It holds onto its oxygen and only release it when the oxygen partial pressures have become very low. As a result, it acts as an oxygen store, releasing its oxygen to the issue when oxyhaemoglobin becomes depleted (as during exercise)

42. (a) What is meant by parasitism?

Parasitism is a close association between two organisms of different species in which one organism (the parasite benefits while the other (the host) is harmed.

(b) State three physiological adaptations of endo-parasites.

- Ability to respire adequately anaerobic conditions
- Production of digestive enzymes to aid penetration into host.
- Chemo-sensitivity in order to reach the optimum location in the host's body
- Production of an anticoagulant in blood feeders.
- They have chemo-receptors to reach the optimum location in host's body
- Secrete chemicals that turn off host's defense mechanisms
- Secrete large quantity of mucus for protection

(c) Give three advantages of parasitic mode of life to a parasite

- Nutrients are always readily available and so there is no loss energy in searching for food.
- They live in a homeostatically regulated environment and so there is no need for osmoregulation.
- They are usually provided with already digested food nutrients and so there's no need for digestive system.
- The parasite is always accorded enough protection shelter and therefore not prone to predation

(d) Describe three ways of parasite-host relationship which ensure the success of a parasite

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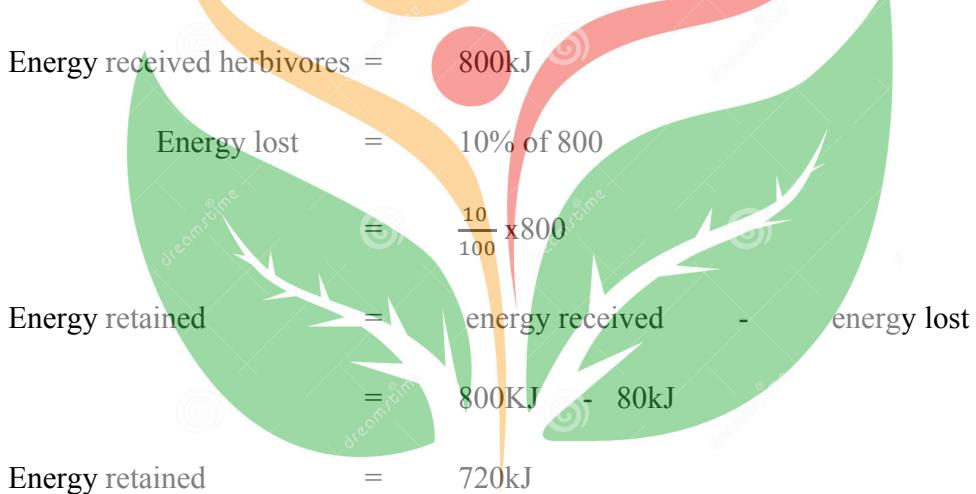
- Inflicting only moderate to the host
- Inhabiting more than one host.
- Using a secondary host as a vector for transmission to the definitive host.

43. Figure 4 shows energy flow in a food chain.

The figure shows energy flow in a food chain



(a) (Assuming 10% of the energy received by herbivores is lost, calculate the energy retained. (03marks)



(b) Explain why

- (i) Energy transfer from herbivores to carnivores is more efficient than that from producers to herbivores. (3marks)

Producers (plants) contain a high proportion of cellulose and sometimes wood which are relatively indigestible and therefore unavailable as energy sources for most herbivores.

The herbivore transfers animal tissue to the carnivore, which is easily digestible and can therefore be utilized by the carnivore. As a result, a large percentage of energy is transferred from herbivores to carnivores than from producers to herbivores

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(ii) The efficiency of energy transfer from herbivores to carnivores is less than 100%. (02marks)

- Some energy is lost through respiration, egestion, excretion to sustain life of herbivores.
- Some animal tissues and organ are not eaten by herbivores
- Not all herbivores are eaten by carnivores

(c) State the factors which limit the number of trophic levels in a food chain. (02marks)

- Amount of energy received by producers
- Proportion of received energy that is converted into primary productivity (NPP)
- Extent of energy loss at each trophic level.

44. In human albinism is caused by an autosomal recessive allele. On average, 1 person in 10,000 is an albino.

(a) Give two characteristic of an albino.

Light coloured skin

White hair

Others:

Pink eyes.

(b) Using Hardy formula  $P^2 + 2Pq + q^2 = 1$ , determine the

(i) Frequency of the albino allele in the human population.

(a) frequency of the albino allele =  $q$

$$\text{Frequency of albinism } (q^2) = \frac{1}{10000}$$

$$\text{i.e. } q^2 = 0.0001$$

$$= \sqrt{0.0001}$$

$$q = 0.01$$

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Hence the frequency of the albino allele in the human population is 0.01.

(ii) Frequency of the heterozygous genotypes in the population.

$$P + q = 1$$

$$P + 0.01 = 1$$

$$\text{But } p + 2pq + q = 0.99$$

$$\text{But } p^2 + 2pq + q^2 = 1$$

$$(0.99)^2 + 2pq + (0.01)^2 = 1$$

$$0.9801 + 2pq + 0.0001 = 1$$

$$2pq = 1 - 0.9802$$

$$2pq = 0.0198$$

Hence the frequency of the heterozygous in the population is 0.0198.

(c) Explain why it is difficult to eliminate allele from a population.

- Recessive alleles are masked in heterozygous state and are not acted on by the selection pressure
- Recessive alleles in heterozygous state may offer selective advantage



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45. Explain why

(a) Rode show high sensitivity to light

Several rod cells make synaptic connections with a single neuron, and then connected to the brain via a single optic nerve.

When a small stimulus which would not cause stimulation of rod cell fall on the rod cells depolarization are produced in each rod cell and summate an action potential on the bipolar cell. The action potential is eventually registered by the brain. Thus, the rods show sensitivity to light.

(b) Cones show high visual acuity

Cones are closely packed into the fovea and each cell has its direct connection to the brain.

Light energy from close points on an object on two different cone cells and be separately interpreted the brain. Each cone synapses with one bipolar neuron hence each part of the object is detected by a different cell and, as a result, interpreted differently by the brain.

(c) It is difficult to catch a fly.

The visual field of an insect is so wide it can detect movement over a wider area of its surrounding.

Also the speed of transmission of impulses to the brain is so rapid that reaction time for an insect are much reduced.

Thus, when you try to catch a fly, it will detect the movement of your hand very quickly and react quickly to it by flying away before your hand reaches it.

46. A moss alternates between two distinct forms in its life cycle; as a gametophyte and sporophyte

(a) Describe how

(i) A gametophyte forms a sporophyte

The gametophyte is haploid produces gametes by mitosis. The gametes fuse to produce a diploid zygote which grow by mitosis into the diploid sporophyte.

(ii) A sporophyte forms a gametophyte.

The sporophyte produces spores by meiosis. Spores are therefore haploid. They are small, light and readily dispersed by wind. On a suitable surface, and when conditions are favorable, spore germinate and grow by mitosis into a haploid gametophyte.

(b) Explain why mosses are restricted to living in wet environment.

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- Body is not covered with cuticle. Therefore, they need water for protection from desiccation.
- They lack vascular tissue. Therefore, they need water to be supplied to their various parts osmosis.
- They need water for swimming of gametes before fertilization can occur.
- They lack true roots to sufficiently absorb water



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**UNEBC 2015**

### SECTION A

1. Which one of the following is a characteristic of members of the monera kingdom?

- A. Possession of a true nucleus.
- B. Being single celled.
- C. Possession of Flagella.
- D. Being heterotrophic.

The answer is B

The kingdom monera contains bacteria. Their main features are:

- They are unicellular (single-celled), but some bacteria such as blue-green bacteria may form single rows of cells.
- Have varied methods of nutrition including autotrophic and heterotrophic modes
- Reproduce asexually by binary fission and sexually by conjugation
- All bacteria are prokaryotes, i.e. they have no membrane-bound organelles such as a nucleus

2. Which one of the following cells is haploid?

- A. Primordial germ cell.
- B. Primary spermatocyte.
- C. Spermatogonium.
- D. Secondary spermatocyte.

The answer is D

During spermatogenesis, the diploid **primordial germ** cells proliferate by mitosis to form spermatogonia. The diploid spermatogonia grow to become diploid primary spermatocytes, which then undergo meiosis.

The primary spermatocyte goes through the first meiotic division to form two haploid secondary spermatocytes.

These then undergo the second meiotic division to form four haploid spermatids, which then mature into sperm cells.

3. The number of trophic levels in a food chain is mainly determined by the

- A. Efficiency of Energy Transfer between Levels.
- B. Biomass of the Producers.
- C. Net Productivity of the Ecosystem.

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### D. Species Diversity in the Ecosystem.

The answer is A

The number of trophic levels in a food chain or the length of the food chain is limited by the energy wasted as it is transferred from organism, i.e. by the efficiency of energy transfer between trophic levels

Other factors are the availability of sufficient food of the preferred types and territorial space

4. Some bacteria when infected by microphages may make a particular amino acid they could not make before. This is due to

- A. Transformation.
- B. Mutation.
- C. Transduction.
- D. Conjugation

The answer is C

Transduction in bacteria refers to the process by which DNA is transferred from one bacterium to another by a microphage (bacteriophage or virus, e.g. HIV).

The genetic material microphage (a vector) is incorporated into the DNA of the bacterium so that the bacterium now functions as a machine that manufacture the phage amino acids

Note: Transformation is the process by which bacterial DNA is changed as a result of direct uptake and incorporation of foreign DNA from its surroundings through the cell membrane. Bacterial conjugation is the genetic material between bacterial cells by direct cell to cell. Mutation refers to the change in the structure or quantity of the DNA

5. Which one of the following characteristics of a parasite is **not** a means of ensuring continuity of the species of the parasite?

- A. Degeneration of redundant body structures.
- B. Means of penetrating another organism.
- C. Protection against host enzymes.
- D. Means of dispersing offspring.

The answer is A

Degeneration of redundant body structures is an adaption of a parasite to its mode of life, but does not directly ensure continuity of its species.

Note: some of the adaption of a parasite that ensure continuity of the parasite species include

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- Possession of penetrative devices for gaining entrance into the host.
- Possession of protective devices which prevent the parasite from being harmed by the host's digestive processes. For example, gut parasites inhibitor substance which inactivate the host's digestive enzymes.
- Having a means of dispersing its offspring. For example, employing a secondary (intermediate) host which disperses the parasite over a wide area.
- Producing a large number of offspring to increase the chance of success in getting from one host to another as is the case in a parasitic fungus and malaria (*plasmodium*) parasite
- Production of chemicals which protect some parasite against the host's defense mechanisms.

6. One problem faced by terrestrial organisms with lungs is that

- A. breathing requires much energy.
- B. oxygen diffuses very slowly in the air.
- C. gas exchange involves water loss.
- D. lungs are deep in the chest thus increasing diffusion distance.

The answer is A

Terrestrial organisms with lungs face a problem of using a lot of energy to bring air close to the respiratory surface (alveoli), found deep in the chest.

This energy is used in the contraction of muscles which bring about ventilation (particularly inspiration)

7. The gene for albinism is recessive to that for normal skin pigment in humans. In a population where the frequency of the albinism-causing allele is 10%, the expected proportion of the albinos in the population would be

- A. 0.1
- B. 0.01
- C. 0.8
- D. 0.9

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The answer is B

Let the allele for normal skin color be A  
The allele for albinism be a  
The frequency for allele A be p  
The frequency for allele a be q  
From Hardy – Weinberg formula

$$P^2 + 2pq + q^2 = 1.0$$

Since the allele for albinism is recessive, then it can be expressed in homozygous recessive (aa) condition

Thus the expected proportion of albinos is  $q^2$

But given that  $q = 0.1$

$$= q^2 = (0.1)^2 = 0.01$$

Hence the expected proportion of the albinos in the population would be 0.01

8. During which one of the following is the respiratory quotient most likely to be high?

- A. In plants during bright sunlight.
- B. In animals during laying down of fat.
- C. During egg laying in birds.
- D. During lactic acid formation in animals.

The answer is B

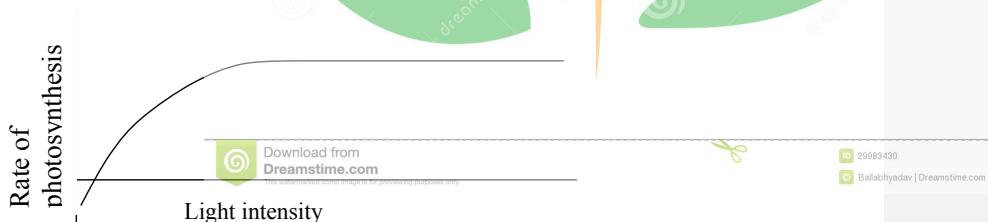
Respiratory quotient (RQ) is the amount of carbon dioxide produced divided by the amount of oxygen used in a given period of time.

$$RQ = \frac{\text{carbon dioxide produced}}{\text{oxygen used}}$$

High RQs result from conversion of carbohydrate to fat as in animals laying down fats, e.g. when preparing to hibernate. This is because carbon dioxide is being liberated in the process with no use of oxygen,

It is also high during anaerobic respiration

9. Figure 1 shows the rate of photosynthesis against light intensity.



Which one of the following statements is the cause of flattening of the curve?

- A. Photosynthetic pigments are saturated with light.
- B. Too much carbon dioxide is available.
- C. The plant has attained its maximum rate of photosynthesis.

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- D. There is a factor other than light which is limiting the rate of photosynthesis.

The answer is D

The flattening of the curve is caused by a factor other than light (such as temperature) which is limiting the rate of photosynthesis.

This is explained by the law of limiting factors which states: when a chemical process is affected by more than one factor, its rate is limited by that factor which has its minimum value.

10. Which one of the following representations of genotypes would produce only one type of gametes?

- A. TtHh.
- B. ttHh.
- C. TTHh.
- D. tthh.

The answer is D

The genotype tthh can only form one type of gametes, i.e. those containing the only.

Other options in the question produce gametes with many possible genotypes.

11. One reason why lipids are better energy sources than carbohydrates is that they

- A. Are Insoluble.
- B. Do Not Form Hydrogen Bonds With Water.
- C. Are More Compact.
- D. Have a Higher Proportion of hydrogen.

The answer is D

Lipids are better energy source than carbohydrates because they have a higher proportion of hydrogen and an almost insignificant proportion of oxygen compared with carbohydrates. Thus a given mass of lipids yields more energy on oxidation than an equal mass of carbohydrate.

12. Which one of the following events occurs both in mitosis and meiosis?

- A. Synapsis.
- B. DNA synthesis.
- C. Crossing over.
- D. Halving of chromosome number.

The answer is B

Before both mitosis and meiosis occur, there is preparation for the division. This stage of preparation is called interphases in it there is DNA synthesis and replication of organelles



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Note: Synapsis refers to the pairing of the homologous chromosomes in prophase I of meiosis. This is followed by crossing over and halving of the chromosome number by the end of meiosis II. All these events occur exclusively in meiosis.

13. Which one of the following could result from low levels of progesterone during gestation?

- A. Miscarriage.
- B. Parturition.
- C. Menstruation.
- D. Lactation.

The answer is A

The gestation period is the time from fertilization to birth.

The fall of progesterone during gestation causes miscarriage as the uterine contraction are no longer inhibited.

Note: the drop in both progesterone and oestrogen levels (but not progesterone alone causes lactation

Parturition refer to the act of giving birth. This occurs after gestation

14. What is the advantage of fragmentation over conjugation as a means of reproduction in spirogyra?

- A. Varied offspring are produced.
- B. Fast-growing offspring are produced.
- C. Many offspring are produced.
- D. More resistant offspring are produced.

The answer is C

A spirogyra reproduces both asexually by fragmentation and sexually by conjugation.

Fragmentation, like all other modes of asexual reproduction, has the advantage of producing more offspring than sexual reproduction mode in a given time

Note: Conjugation, like other form of sexual reproduction, allows for mixing of genetic material (genetic variability). Thus it results in offspring which may be more resistant to some conditions, e.g. disease

15. Which one of the following epithelial tissues lines blood capillaries?

- A. Cuboidal tissue.
- B. Squamous tissue.

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C. Columnar tissue.

D. Glandular tissue.

The answer is B

The simple squamous epithelium lines the blood capillaries. This is because it is thin (single layer of cells) and so easily allow diffusion of materials through it.

Note:

Epithelial tissue	location
Cuboidal	Salivary ducts
Columnar	Intestines
glandular	Dermis of skin

16. Which one of the following processes does not involve osmosis?

- A. Movement of water into guard cells.
- B. Movement of water through the xylem.
- C. Entry of water into the vacuole.
- D. Passage of water across the endodermis.

The answer is B

Osmosis is the movement of water from regions of its high concentration to regions of its low concentration across a semi-permeable membrane.

The movement of water through the xylem is not by osmosis because there is no semi-permeable membrane but just an open lumen.

Note: The cells of the endodermis actively transfer salts to the xylem. This causes water to move across the endodermis into the xylem by osmosis. The subsequent movement of water movement of water into the guard and into the vacuole are both process involving osmosis.

17. The biomass of consumers is always less than that of producers because

- A. producers have to support consumers.
- B. consumers have a low productive rate.
- C. energy is lost through body processes of consumers.
- D. consumers are small in size.

The answer is C

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The producers always have more biomass than the consumers because energy is lost during body process, e.g. respiration and excretion of the consumers. The consumers have less energy and therefore less biomass that can be supported by such energy than the producers.

Note: the progressive loss of energy at each trophic level puts levels puts a limit on the total biomass at each trophic level and the number of trophic levels

18. Marine cartilaginous fish solves its osmoregulatory problems by

- A. Swallowing Sea Water and having few glomeruli.
- B. Actively extruding salts.
- C. Retaining urea to increase the osmotic potential of the body fluids.
- D. Excreting trimethylamine oxide.

The answer is C

Marine cartilaginous fish (elasmobranchs) such as dog fish and sharks have solved their osmoregulatory problems by retaining urea to increase the osmotic potentials of their body fluids to slightly above that of sea water. As a result, the little water that flows in readily expelled by the kidneys

In addition, they have that are impermeable to urea.

Note: the other options are osmoregulatory strategies used by marine teleosts (marine bony fish)

19. If a long-day plant has a critical night length of 10 hours, which one of the following conditions would allow flowering in the plant?

- A. 8 hours light and 16 hours darkness.
- B. 16 hours light and 8 hours darkness.
- C. 12 hours light and 12 hours darkness.
- D. 10 hours light and 14 hours darkness.

The answers is B

Long day plants flower when exposed to their critical night or less. In other words, they require a photoperiod of more than their critical day length in order to flower. In this case the plant requires exposure to more than 14 hours of light (its critical day length). Hence the condition of 16 hours light and 8 hour darkness will allow flower in the plant

20. Which one of the following patterns of behavior in rats would be a result of latent learning?

- A. Avoiding to eat poisoned food.
- B. Associating smell with presence of food.
- C. Young rats following their mother.

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- D. Being aware of escape routes.

The answer is D

Latent learning is the form of learning that is not immediately expressed in an overt response.  
Latent learning is used by animal to navigate a maze more efficiently by finding escape routes

21. Which one of the following plant tissues, have cells with walls least adapted for support?

- A. Sclerenchyma.
- B. Collenchyma.
- C. Tracheids.
- D. Xylem vessels.

The answer is B

Sclerenchyma xylem vessels and tracheid are lignified and as much have increased tensile strength to provide support to the plant.  
Collenchyma tissue only has extra depositions of cellulose and pectin in the cell wall which compared to other support tissue is the least adapted for this function.

22. Analysis of a sample of DNA showed that 33% of the bases were adenine. The percentage of guanine bases in the sample was

- A. 34.
- B. 33.
- C. 17.
- D. 28.

The answer is C

According to Chargatt's rule of base pairing

Adenine (A) pairs with thymine (T)

Guanine (G) pair with cytosine (C)

As such the ratio of A: T is 1:1 and that of G: C is also 1:1

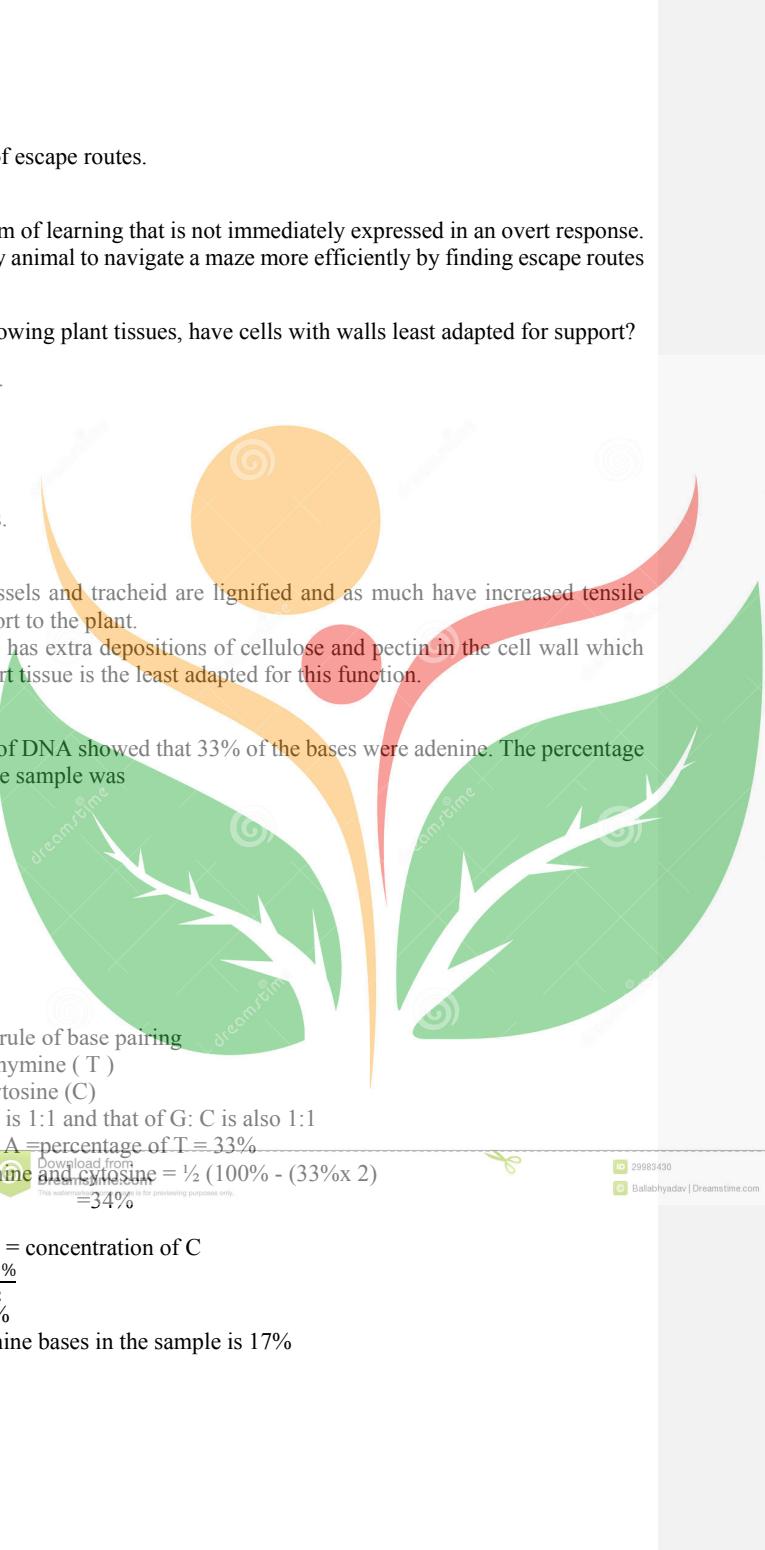
Therefore, percentage of A = percentage of T = 33%

Thus, percentage of guanine and cytosine =  $\frac{1}{2} (100\% - (33\% \times 2))$   
= 34%

Since concentration of G = concentration of C

$$\text{Concentration of G} = \frac{34\%}{2} \\ = 17\%$$

Hence the percentage of guanine bases in the sample is 17%



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23. A man with an allele for normal colour vision is married to a woman whose father was colour blind. The probability of the couple getting a child with a defective allele is

- A.  $\frac{1}{4}$
- B.  $\frac{1}{2}$
- C.  $\frac{1}{3}$
- D.  $\frac{3}{4}$

The answer is B

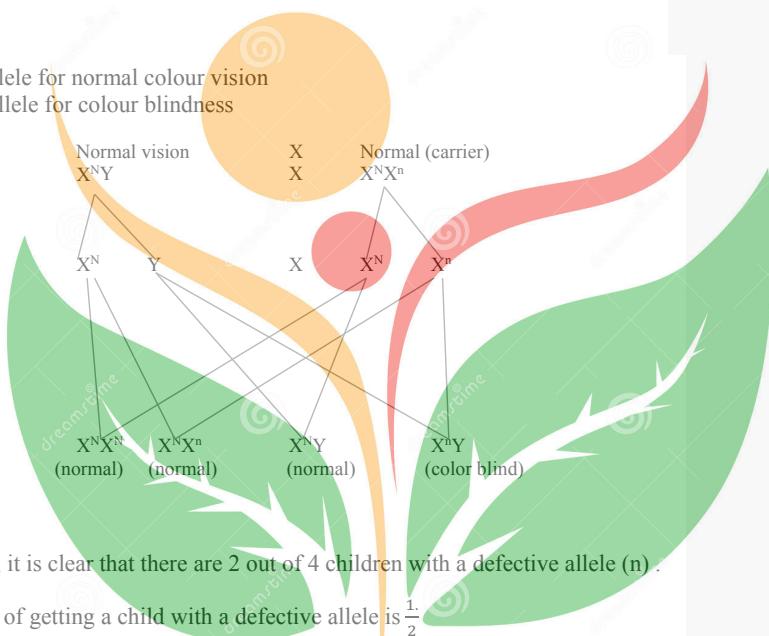
Let N represent the allele for normal colour vision  
n represent the allele for colour blindness

Parental phenotypes  
Parental genotype

Meiosis  
Gametes

Random fertilization

Offspring genotype  
Offspring phenotype



From the cross above, it is clear that there are 2 out of 4 children with a defective allele (n).

Hence the probability of getting a child with a defective allele is  $\frac{1}{2}$ .

Note: The woman whose father was colour blind is a carrier ( $X^N X^n$ )

The probability of getting a child with a defective allele ( $\frac{1}{2}$ ) is different from that of getting a child who is colour blind.

24. Which one of the following does not occur during photorespiration?

- A. Oxygen is used up.
- B. Wasteful loss of carbon as carbon dioxide.
- C. Carbon dioxide is used up.

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D. Wasteful loss of energy.

The answer is C

Photorespiration refers to the process whereby oxygen is added to ribulose biphosphate (RuBP) thereby breaking it down into carbon dioxide and water.

The process thus uses up oxygen, leads to loss of carbon, as carbon dioxide, and energy.

However, no carbon dioxide is used up, it is instead produced.

Photorespiration occurs only in C<sub>3</sub> plants due to high oxygen and low carbon dioxide partial pressure and / or high temperature. In such conditions, oxygen outcompetes carbon dioxide for the enzyme RuBP carboxylase, which then takes up the oxygen and releases the fixed carbon dioxide.

25. In estimating the population of Tilapia in a fish pond, 60 fish were captured, marked and released. After 2 days, 50 were captured and out of which 10 were marked. The population of Tilapia in the fish pond was

- A. 300
- B. 400
- C. 200
- D. 100

The answer is A

In the capture methods the formula below is used to estimate the population size

$$\text{Estimated population} = \frac{\text{number of organisms in first sample} \times \text{number of organisms in second sample}}{\text{Number of organisms recaptured}}$$
$$= \frac{60 \times 50}{10}$$
$$= 300 \text{ fish}$$

26. In sponges, the different types of cells are independent of each other in function because

- A. the different cells show division of labour.
- B. collar cells maintain the flow of water.
- C. sponges are made up of collar flagellates.
- D. the cells are not coordinated.

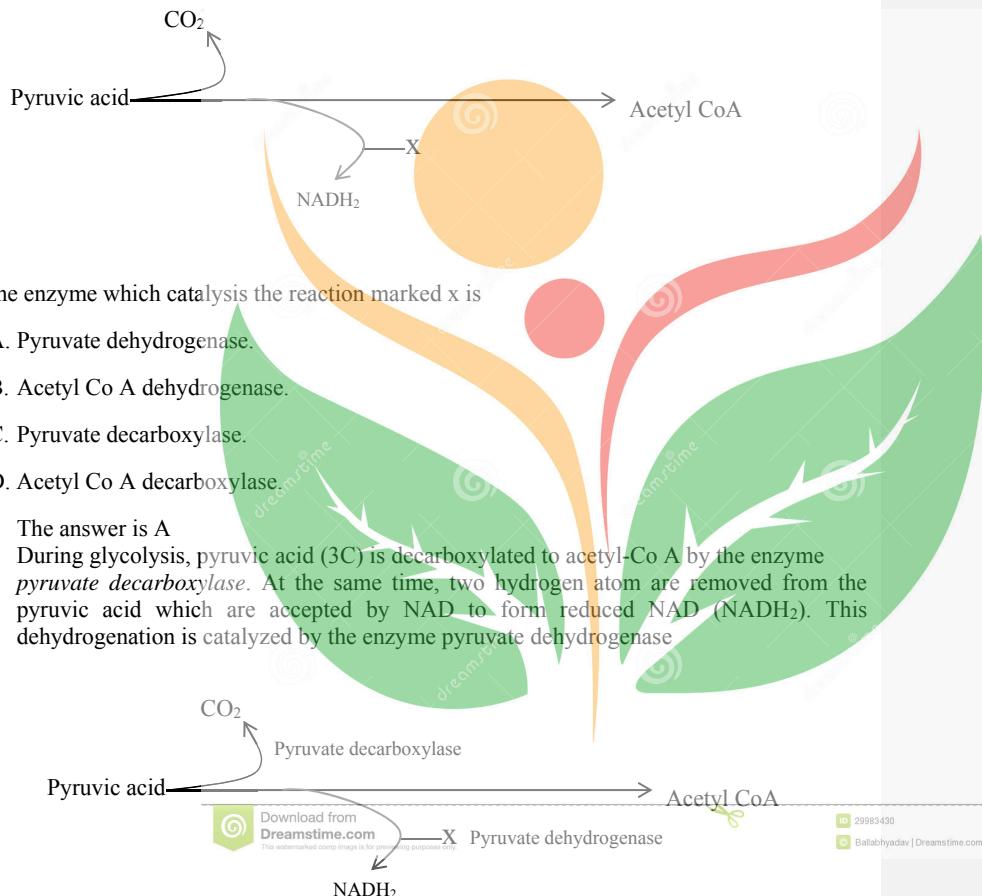
The answer is D

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In sponges the different types of cell are functionally independent of one another as there is no trace of a nervous system to coordinate the cells.

This is called colonial organization and sponges are best regarded as colonies of single cells.

27. Figure 2 shows some reactions in the respiratory pathway.



28. A good pesticide is one which

- A. kills a wide range of organisms.

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- B. persists for a long time after its application.
- C. kills pests at different trophic levels.
- D. easily transforms to non-toxic forms.

The answer is D

- A good pesticide has three properties:
- It must be specific
- It must remain for a short time in the environment i.e. easily transform to a non- toxic form
- It must kill the designated population only or should be specific.

29. Which one of the following is correct about ectotherms?

- A. Have cold blood which is warmed by the surroundings.
- B. Regulate body temperature mainly by metabolic reactions.
- C. Much of the heat in their bodies is gained from the surroundings.
- D. Lack means to regulate body temperature.

The answer is C

Ectoderms are animals that gain heat from the environment

Note: The blood of ectoderms is not actually cold

Also, ectoderms regulate their body temperatures by behavioral means

30. Which one of the following conditions reduces the affinity of hemoglobin for oxygen?

- A. High oxygen concentration.
- B. High carbon dioxide concentration.
- C. Low body temperature.
- D. High pH of the blood.

The answer is B

The affinity of haemoglobin for oxygen is reduced by

- Low oxygen concentration.
- High carbon dioxide concentration
- High body temperature
- Low PH

High carbon dioxide concentration (or low PH) has the effect of establishing deoxyhaemoglobin. This favors the unloading of hemoglobin hence reducing its affinity for oxygen.

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31. The insect compound eye receives more stimuli per unit time than the mammalian eye because the

- A. insect eye occupies a larger part of the head than the mammalian eye.
- B. time lapse between reception of light stimulus and recovery is short.
- C. insect eye has more focusing units than the mammalian eye.
- D. insect eye has a wider field of view.

The answer is B

The compound eye has high flicker response

32. A couple had children with a disorder that appeared only in sons. Which one of the following statements is true about this occurrences? The disorder is

- A. sex linked and the mother is a carrier.
- B. caused by multiple alleles.
- C. sex linked and both parents are carriers.
- D. sex limited to males and the father is a carrier.

The answer is A

A sex – linked character is one which is controlled by a gene carried on the sex chromosomes and is inherited along with sex. Such a character is determined by a recessive allele located on the X- chromosomes.

Since males are heterogametic (XY) and the Y – chromosomes is genetically empty, then males can never be carriers; they are either normal (e.g.  $X^H Y$ ) or sufferers (e.g.  $X^h Y$ ). also, for the same reason, the father can never pass on such genes to their sons; he can only pass it on to his daughters.

Females are homogametic (X X). as such females can normal (e.g.  $X^H X^H$ ), carriers ( e.g.  $X^H X^h$  ) or sufferers (e.g.  $X^h X^h$  ).

We thus conclude that the disorder is sex- linked and mother is a carrier. This can be illustrated with hemophilia as below.



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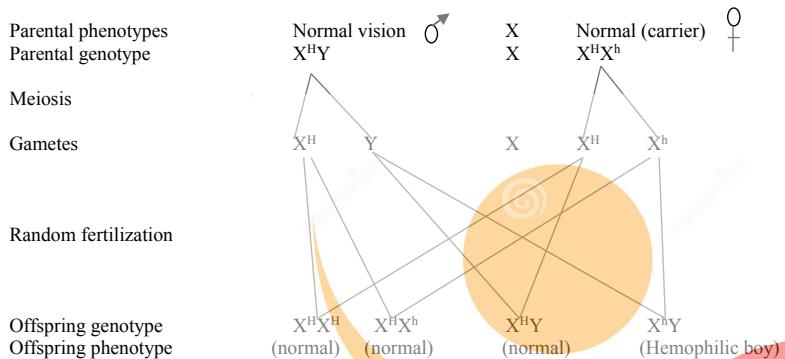


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Let H represent the allele for normal blood clotting  
 h represent the allele for hemophilia



From the cross above, it is clear that there are 2 out of 4 children with a defective allele (h).

Hence the probability of getting a child with a defective allele is  $\frac{1}{2}$

Note: The woman whose father was colour blind is a carrier ( $X^N X^n$ )

The probability of getting a child with a defective allele ( $\frac{1}{2}$ ) is different from that of getting a child who is colour blind, which is  $\frac{1}{4}$

Multiple alleles are two or more alternative forms of a gene controlling a particular characteristic, of which any two may occupy the same gene loci on homologous chromosomes.

For example, the three alleles controlling the ABO blood group system in humans and those controlling eye colour in mice.

33. A cell is said to have full turgor pressure when

- A. the cell membrane is just touching the cell wall.
- B. water enters the vacuole by osmosis.
- C. water leaves the vacuole by osmosis.
- D. the cell wall cannot be stretched any-more.

The answer is D

When a plant cell is placed in a hypotonic solution, water enters its vacuole by osmosis. This makes the volume of the protoplast to increase, so causing it to press against the cell wall.

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This outward pressure, called **turgor pressure**, stretches the cell wall and opposed by an inward pressure (pressure potential) exerted by the cell wall against the cell's contents.

Turgor pressure reaches its maximum values called **full turgor pressure** when the cell wall cannot be stretched anymore. At full turgidity, the pressure potential ( $\Psi_p$ ) is equal and opposite to the osmotic potential ( $\Psi_s$ ) of the cell, i.e.  $\Psi_p = \Psi_s = \Psi_s$  (since  $\Psi_s$  is always negative)

Note: when a plant cell placed in a hypertonic solution, water leaves the cell vacuole by osmosis. As a result, the protoplast shrinks and eventually pulls away from the cell wall, a process called **plasmolysis**. The point at which plasmolysis is just about to happen, i.e. when the protoplast (cell membrane) is just about to lose contact with the cell wall is referred to as **incipient plasmolysis**

34. Which one of the following is not used to describe a population of organisms?

- A. Density.
- B. Biodiversity.
- C. Size.
- D. Distribution.

The answer is B

Population is a group of individual organisms, usually belonging to the same species, within a community

The density, size and distribution are used to describe population.

Population size refers to the number of individual in the group.

Population density refers to the number of organisms in the group per unit area.

Population distribution refers to the pattern or spread of organisms in a given area.

Note: Biodiversity is the variety of species on earth is not used to describe a population.

35. Mosses growing on the bark of a tree form an association with the tree called

- A. Mutualism.
- B. Parasitism.
- C. Commensalism.
- D. Predation.



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The answer is C

Commensalism is an association between two organisms in which one organism (the commensal) gains while the other (the host) neither losses nor gains.

The mosses gain both nutrients and shelter from the tree, but the tree does not receive any benefit or harm.

Note: Mutualism is an association between two organisms in which both organisms benefit.

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Parasitism is an association between two organisms in which one (the parasite) lives temporarily or permanently in or the other (the host), deriving benefit from it and causing harm to it.

Predation is an ecological interaction in which one organism (the predator) feeds on another organism (the prey).

36. Which one of the following is responsible for increasing the pressure of blood flowing in veins, back to the heart?

- A. The pumping action of the heart.
- B. Contraction of skeletal muscles.
- C. Closing of valves.
- D. Inspiratory movements of muscles.

The answer is B

Contraction of skeletal muscles such as gastrocnemius squeeze blood flowing in veins, so increasing its pressure. This propels blood towards the heart.

This is added by the negative pressure developed in the thorax during inspiration which tends to draw blood towards the heart.

Note: The semi-lunar valves in the veins serve to prevent backflow of blood, thereby maintaining a one-way flow of blood.

The pumping action of the heart moves blood from the heart through arteries at high pressure to the lungs and the rest of the body.

37. Which one of the following represents the correct order of events that occurs at the synapse during impulse transmission?

- A.  $\text{Ca}^{2+}$  ion influx, release of transmitter substance, depolarization.
- B. Depolarization, release of transmitter substance,  $\text{Ca}^{2+}$  ion influx.
- C. Release of transmitter substance,  $\text{Ca}^{2+}$  ion influx, depolarization.
- D. Release of transmitter substance, depolarization,  $\text{Ca}^{2+}$  ion influx.

The answer is A

The post-synaptic membrane. Arrival of an impulse at the synaptic causes an influx of  $\text{Ca}^{2+}$  ions into the knob from the synaptic cleft.

The  $\text{Ca}^{2+}$  ion causes the synaptic vesicles to move towards the pre-synaptic membrane.

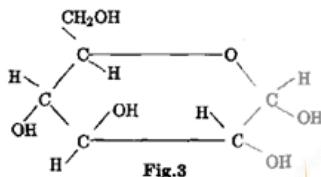
The vesicles fuse with the pre-synaptic membrane and release a transmitter substance into the synaptic cleft by exocytosis.

The transmitter substance diffuses across the synaptic cleft and attaches to specific receptor sites on the post-synaptic membrane.

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This causes an influx of  $\text{Na}^+$  ion into post-synaptic membrane, resulting in local depolarization of the membrane. If the  $\text{Na}^+$  ion surge is large enough, an action potential (impulse) is generated in the post-synaptic neuron.

38. Figure 3 represents the structure of



- A. Amino acid.
- B. Glucose.
- C. Ribose.
- D. Fatty acid.

The answer is B

The structure is of glucose. This is because it is an hexose (6 C sugar),  $\text{C}_6\text{H}_{12}\text{O}_6$ , with an alcohol ( $\text{CH}_2\text{OH}$ ) group 6 to its ring structure.

Note: Ribose is a pentose (5C sugar),  $\text{C}_5\text{H}_{10}\text{O}_5$

Amino acids have a general formula which contains an amino group ( $\text{NH}_2$ ) and a carboxyl group ( $\text{COOH}$ ), thus:



Fatty acids are long carbon chain carboxylic acids of the formula:  $\text{CH}_3(\text{CH}_2)_n\text{COOH}$ , where  $n$  is around 16

39. Which one of these is **not true** about the lock and key theory in an enzyme-catalyzed reaction?

- A. A small change in the active site alters the enzyme effectiveness.
- B. The substrate and active site are complementary.
- C. Enzyme catalyzed actions go through the enzyme-substrate complex stage.
- D. A molecule which fits in the active site is a substrate.

The answer is D

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According to the lock and key theory, an enzyme active site has a shape and size which is complementary to its specific substrate. Thus anything which alter the shape or size of the active site makes the substrate no longer able to fit in, hence affecting the effectiveness of the enzyme.

A substrate with a complementary configuration binds to the active site of the enzymes to form an enzyme- substrate complex, in much the way as a key fits in its lock

Substrate molecules react together to form an enzyme – product complex.

This then dissociate to release the product and regenerates the enzymes free active site, ready to bind other substrates. Thus



Note: Not all molecules that fit in the active site of an enzyme are substrate. For example, a competitive inhibitor can also fit, but it is not termed substrate.

40. The following occur during senescence except

- A. Hardening of arteries.
- B. Shrinking body size.
- C. Increased sensitivity.
- D. Mental senility.

The answer is C

Senescence refers to the body change that lead to a decreasing life expectancy with age.

These change include:

- Mental senility i.e. mental deterioration
- Atherosclerosis and arteriosclerosis which lead to hardening of arteries.
- The speed of impulse conduction in nerves decreases and so does sensitivity.
- Shrinking in body size
- Osteoporosis
- Hair becomes grey etc.
- Decrease in body sensitivity

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### SECTION B

41. (a) (i) What is meant by negative feed- back in homeostasis?

Negative feedback is a control system in which a change in a condition from the ideal or set point sets into motion a corrective mechanism which returns the condition to its set point

(ii) Give two characteristics of an efficient homeostatic system.

- Must respond quickly to deviations from the set norm
- Should allow only small deviations from the norm

(b) Marine invertebrates have body fluids which have same solute concentration as sea water.

State one advantage and one disadvantage of this situation.

Advantage

There is no need for these organisms to carry out osmoregulation

Disadvantage

Their habitat is restricted to the sea

(c ) Halophytes lives in salty marshes

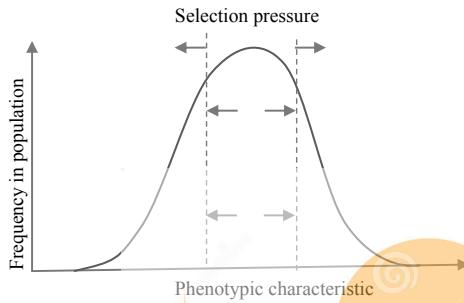
(i) What physiological problem do they face?

- Can lose water to the surrounding water by osmosis
- They also face a problem of high concentrations of ions building up in their cells
- Can experience physiological drought

(ii) Suggest how the problem are overcome

- The possess tissues that tolerant to physiological drought
- Some store water in succulent stems and leaves
- Some regulate their salt content by excreting salts from salt gland at the leaf margins e.g., sea milk worth
- Halophytes have root hairs a higher solute concentration than those of ordinary plants, which enables them to absorb water by osmosis in the normal way
- Air spaces in leaves provide buoyancy and make air available in water logged anaerobic mud
- Their leaves have reduced number of stomata to reduce the rate transpiration

42. Figure 4 illustrates selection acting on a population of butterflies.



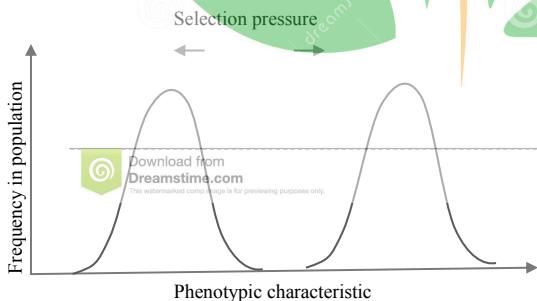
(a) State the types of natural selection being exhibited in the figure.

Disruptive selection

(b) Explain how this type of natural selection affects the phenotypic characteristics of the population

Selection pressure acting from within the population as a result of increased competition may push the phenotypic characteristics away from population mean towards the extremes of the population  
Thus the intermediate phenotypic characteristics are selected against in favor of the two extremes of the phenotypic characteristics.

(c) (i) in the space below sketch the distribution curve that would result after many generations of this type of natural selection shown in (a)



(ii) What ecological effect does the type of selection have on the population?

- It split the population into two subpopulations, each which may give rise to a new species
- It can also lead to appearance of different phenotypes within the population, i.e. polymorphism.
- Reduces intraspecific competition leading to better survival of the subpopulations

(d) State the importance of genetic variation in natural selection

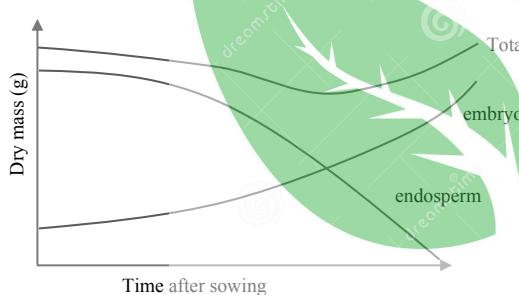
Genetic variation leads to phenotypic variation within a population, upon which natural selection acts.

Note: selection is the process by which those organisms which are physically, physiologically and behaviorally better adapted to the environment survive and reproduce; those organisms not well adapted either fail to reproduce or die.

There are 3 types of selection:

- Stabilizing selection
- Direction selection
- Disruptive selection

43. Figure 5 shows change in dry mass of the embryo, endosperm and total mass of maize seeds germinating in light condition.



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(a) Explain the changes in relative dry mass of the

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(i) Endosperm

The dry mass of the endosperm first decreases gradually and then rapidly because food reserves are resupplied and some are reallocated to the embryo

(ii) embryo

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The dry mass of embryo gradually increase due to food reserved obtained from the endosperm and later from photosynthesis

- (b) Explain why the total dry mass of the seedling initially decreases then later increases

The initial decrease in the total dry mass is due to the aerobic respiration occurring. This consumes sugar in both the embryo and endosperm.

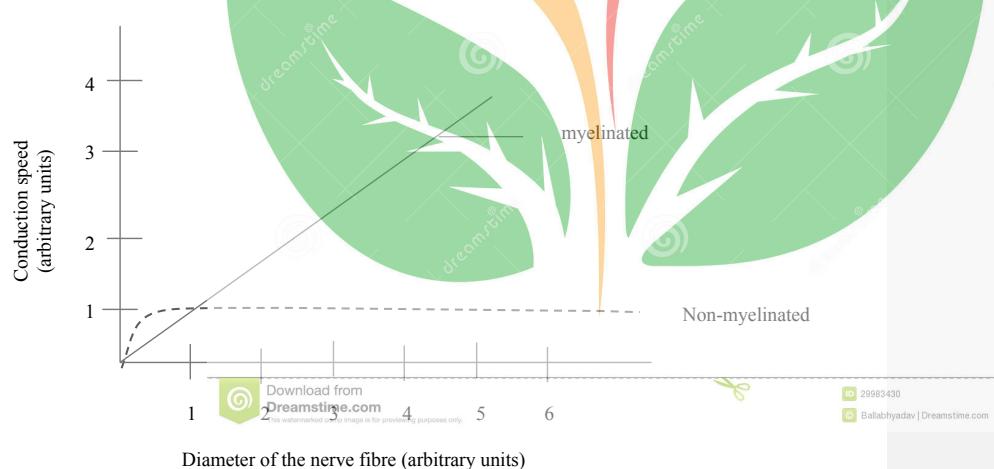
Later, the total dry mass increases as the first foliage leaf emerges and starts to photosynthesize. The carbohydrate formed more than compensate for the respiration losses so that there is a net increase in total dry mass.

- (c) Suggest with reason, what would happen to the total dry mass of seedling if the seeds were germinated in the dark

The total dry mass of the seedling would continue to decrease gradually with no subsequent increases.

This is because the food store would be depleted by respiration and no photosynthesis would occur in the dark compensate for the loss.

44. Figure 6 show the variation of a nerve impulse conduction speed with diameter, of myelinated and non-myelinated fibres



- (a) Compare the variation of speed of conduction with diameter I the two types of fibres

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### Similarities

- In both myelinated fibre, the conduction speed increases with increase in the diameter of the nerve fibre.
- At diameter 1 unit the conduction speed is the same

### Differences

- At diameters below 1 arbitrary unit conduction speed is higher in non-myelinated fibers
- At diameter above 1 arbitrary unit conduction speed is higher in myelinated fibres

(b) Explain the difference in the conduction speed of the two fibres.

- Generally conduction speed is higher in myelinated than non-myelinated fibres because there is saltatory conduction, where impulses jump from one node of Ranvier to another

(c) Suggest the significance of transmission speed in nervous communication

- Fast transmission of impulse from receptor to muscles allow rapid responses to stimuli, thus enabling the animal to escape danger.
- Quick impulse transmission enables an organism to respond rapidly to changes in the environment, which is important for its survival.

Note:

Conduction speed of impulses along axon is determined by three factors

- The larger the diameter of axon the faster the speed.
- Myelination speeds up conduction speed
- The higher the temperature the higher the conduction speed

45. (a) Give the meaning of each of the following forms of behavior



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(i) Habituating

- Habituation is a form of learning in which an animal gradually ceases to respond to a continuously repeated stimulus not associated with reward or punishment.

(ii) Imprinting

- Imprinting is a form of behavior in which a young animal learns to recognize and follow its parent right from the time it is born.

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### (iii) Instinctive behaviours

- Instinctive behavior is the immediate comprehension and response to a new situation without trial and error.

### (b) State the benefit of each of the form of behaviour to an animal

#### (i) Habituation

- Habituation enables a young animal to understand neutral elements in the environment such as movements due to wind.
- It enables an animal to save energy by not responding to non-harmful stimuli over and over again.
- It enables the animal to adjust to live in the environment with high intensity of some stimuli which may not be harmful to its life

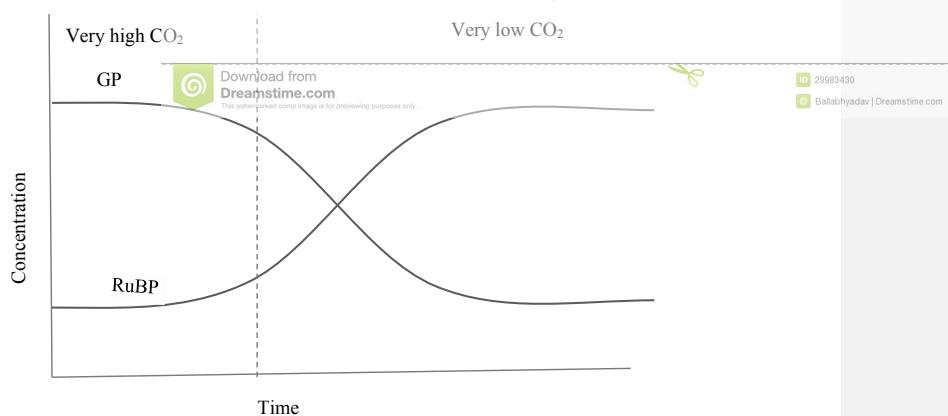
#### (ii) imprinting

- Imprinting enables a young animal to acquire rapidly skill possessed by the parents
- It also enables a young animal to closely follow its parents which gives it protection and food
- It enables the offspring to associate and identify with the species. This enables mating among members of the same species
- The young ones are able to recognize their parents among other members of the species

#### (iii) instinctive behaviour

- Instinctive behavior enables an animal to solve quickly new problem without mistakes.
- It enables an animal to use its past experience in one situation to easily solve a similar problem.
- It is important in animals that live solitary life and cannot learn from others.

46. Figure 7 shows the concentration of phosphate (GP) and ribulose biphosphate (RuBP) during an investigation in which a sample of chlorella was allowed to photosynthesize at very low and very high carbon dioxide levels.



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- (a) Explain the change in concentration of RuBP at  
 (i) High carbon dioxide levels

The concentration of RuBP is low because RuBP combines with carbon dioxide and water to form glycerate- 3 phosphate (GP).

Note:



- (ii) Very low carbon dioxide levels

The concentration of RuBP is high. This is because RuBP is being regenerated from triose phosphate, but since carbon dioxide concentration is low, RuBP is not being used hence it accumulates.

- (b) Suggest why the concentration of GP falls when the levels of carbon dioxide is reduced

Carbon dioxide combine with RuBP in the presence of RuBP carboxylase to generate GP. Hence low carbon dioxide levels lead rate of formation of GP.

- (c) Name two factors which must have been kept constant in the investigation

Temperature

Light intensity

- (d) Give two difference between cyclic and noncyclic photophosphorylation

Cyclic photophosphorylation	Non – cyclic photophosphorylation
<ul style="list-style-type: none"> <li>Involves cyclic pathway of electrons.</li> <li>Photo system 1 is the first electron donor.</li> <li>Photo system 1 is the last electron acceptor</li> <li>Product is ATP only</li> <li>Only photo system 1 is involved</li> </ul>	<ul style="list-style-type: none"> <li>Involves non –cyclic pathway of elections.</li> <li>Water is the first electron donor</li> <li>NADP is the last electron acceptor</li> <li>Products are ATP, reduced NADP and oxygen.</li> <li>Both photo system 1 and 11 are involved.</li> </ul>

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Note: phosphorylation is the process by which ATP is synthesized from ADP and an inorganic phosphate using energy.

In photosynthesis the energy is supplied by light, hence the process is called photophosphorylation. It can be cyclic or non- cyclic

The ATP is formed is formed in the light-dependent stage is used to transfer energy to the light independent stage.



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**UACE Biology 2016 paper 1**

**Section A (40marks)**

1. In estimating the number of fish in a small lake, 625 fish were netted, marked and released.

After a week, 873 fish were netted and of these 129 had been marked. The estimated size of the population of fish is

- A. 92      B. 180

Answer is A

129 are in 873

625 are in 4230

- C. 631      D. 4230

2. Which one of the following if increased to an Elodea plant in water at  $30^{\circ}\text{C}$ , would lead to arise in the number of bubbles released from the plant?

- A. Light      B. temperature      C. wind velocity

Answer is A

Increase in light intensity increase the rate of photosynthesis and hence the amount of oxygen released

- D. humidity

3. In breeding, the propagation of a variety with desirable characters is referred to as

- A. hybridization      B. artificial selection      C. cross breeding

- D. inbreeding

Answer is B

4. Animals A, B, C and D have their body volumes and surface areas as shown below

Animal	Volume ( $\text{cm}^3$ )	Surface area ( $\text{cm}^2$ )	Surface area to volume ratio
A.	32.0	61.1	1.9
B.	1.2	3.0	2.5
C.	3.3	8.2	2.5
D.	7.5	49.0	6.5



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Which one of them would have the greatest need for a respiratory system?

From surface area to volume ratio, the answer is A

5. In mammalian eye, rods have a poorer visual acuity than cones because they are

- A. fewer in number  
B. smaller in size  
C. more than one rod cell share an optical nerve  
D. less sensitive to light

Answer is C

6. Facultative parasites are more difficult to control than the obligatory ones because they
  - A. are capsulated
  - B. have many hosts
  - C. can change the mode of feeding
  - D. live in colonies

Answer is C

Facultative parasite may resort to parasitic activity but does not absolutely rely on any host for completion of its life cycle. Therefore can live on different host or change its mode of feeding while obligate parasite are ones that cannot complete their life cycle without a particular host

7. The beginning of the recovery process in an axon is marked by
  - A. sodium ions leaving the axon
  - B. potassium ions entering the axon
  - C. sodium ions entering the axon
  - D. potassium ions leaving the axon

Answer is D

8. The high heat capacity of water has a biological importance of
  - A. minimizing temperature changes in animal fluids
  - B. cooling animals
  - C. preventing freezing of cell contents
  - D. controlling heat lost in animals

Answer is A

9. Which one of the following statements is correct about base pairing in nucleic acid?
  - A. Purines only pair with pyrimidine
  - B. Guanine is paired with adenine
  - C. Hydrogen bonds only occur between pyrimidine
  - D. Purine bases pair with other purines

Answer is A

10. All the alleles present in the population of a species are called the population's
  - A. Gene frequency
  - B. gene pool
  - C. genome
  - D. genotype

Answer is B

11. Which one of the following sets of conditions in the guard cells would lead to opening of the stoma?
  - A. High carbon dioxide concentration and low sugar concentration
  - B. Low carbon dioxide concentration and high sugar concentration
  - C. High sugar concentration and high carbon dioxide concentration
  - D. Low pH and high starch concentration

Answer is B

12. Lignification of plant cells has effect of
  - A. widening the cell and making them more permeable
  - B. making cells impermeable and lengthening them
  - C. strengthening cell and making them more permeable
  - D. making the cells more rigid and killing them

Answer is D

13. Which one of the following would not apply to a population whose size is growing exponentially?
  - A. Absence of predators
  - B. Reproduction rate being higher than death rate

- C. Shortage of reproducing individuals
  - D. Absence of competition for resources
- Answer is C
14. Which one of the following sets consists of functionally related substances?
- A. Chitin, keratin, cellulose
  - B. Haemoglobin, myosin, starch
  - C. Collagen, keratin, glycogen
  - D. Glucose, starch, chitin
- Answer is A
15. During respiration in absence of oxygen, pyruvic acid is converted into
- A. Lactic acid and water in animals
  - B. Ethanol and carbon dioxide in plants
  - C. Lactic acid and carbon dioxide in animals
  - D. Ethanol and water in plants.
- Answer is B
16. Which one of the following is the first step during protein synthesis
- A. Translation
  - B. transportation
  - C. transcription
  - D. DNA replication
- Answer is C
17. An efficient physiological homeostatic mechanism is one which
- A. allows large fluctuation
  - B. responds to deficiency than excess
  - C. responds to small fluctuations
  - D. allows positive feedback
- Answer is C
18. In single circulation, the blood pressure is low because
- A. the blood passes through two capillary systems
  - B. animals that have sing circulation have single-chambered heart
  - C. the single circulation system lacks valves
  - D. the main vessels in single circulation are capillaries
- Answer is A
19. Figure 1 shows a schematic diagram of a portion of a reaction chain
- 
- ATP  
NAD<sup>+</sup>  
NAD + H<sup>+</sup>  
FAD + H<sup>+</sup>
- Fig. 1
- Download from Dreamstime.com
- Which one of the following is true of the reaction?
- A. FAD is reduced
  - B. ATP is used in the reaction
  - C. Hydrogen passes from reduced NAD to FAD
  - D. NAD is oxidised
- Answer is B
20. A tissue viewed under microscope showed numerous lysosomes in the cells. Which one of the following is the possible cause
- A. Active transport



- B. Infections
- C. High rate of internal transport
- D. High rate of protein synthesis

Answer is B

Lysosomes contain hydrolytic enzymes to destroy infectious organisms

21. During locomotion in a tetrapod, which of the following is the correct order of movement of limbs after the animal has moved its left hind limb?

- A. Left fore, right hind, right fore
- B. Left fore right fore, right hind
- C. Right hind, left fore, right fore
- D. Right fore, left fore, right hind

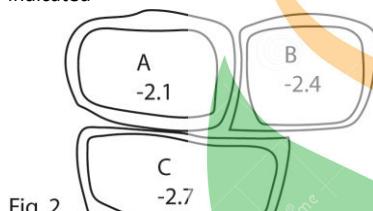
Answer is C

22. What would be the phenotypic ratio of the offspring when a test cross is carried out on an individual who is a carrier for albinism?

- A. 3:1
- B. 1:2:1
- C. 1:1
- D. 9:3:3:1

Answer is C

23. Figure 2 represents plant cells A, B and C with their respective water potential in kPa indicated



Which of the following is correct direction of water movement between the cells?

- A. C to A
- B. A to B
- C. C to B
- D. B to A

Answer is B

24. In drosophila, there are red-eyed and white eyed types, the red-eyed being dominant over white. Genes controlling eye colour are sex linked. The ratio of the phenotypes resulting from mating a red-eyed male XY and white-eyed female (XX) is

- A. 1 red-eyed: 2 white-eyed
- B. 1 red-eyed: 1 white-eyed
- C. All red eyed
- D. 2 red-eyed: 1white-eyed

Answer is B

25. The purple sulphur bacteria live at the bottom of ponds under green algae because the bacteria

- A. Absorb light of different wavelength from that of algae
- B. Are parasites
- C. Are shielded from direct sunlight
- D. Do not require light for photosynthesis

Answer is A

26. Vertebrates A and B belong to same species and A in dry environment while B lives in a wet environment. The kidney structure of A would differ from that of B by having

- A. fewer and bigger glomeruli with shorter loop of Henle
- B. more numerous and small glomeruli with longer loop of Henle



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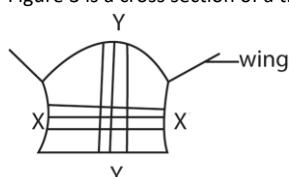
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- C. more numerous and bigger glomeruli with shorter loop of Henle
- D. fewer and smaller glomeruli with longer loop of Henle

Answer is C

numerous bigger glomeruli with shorter loop of Henle lead to removal excess water from the body

27. Figure 3 is a cross section of a thorax showing flight muscles in an insect



Which action of the muscle lower the wing?

- A. Relaxation of Y
- B. Contraction of Y and relaxation of X
- C. Contraction of X
- D. Contraction of X and relaxation of Y

Answer is D

28. Insects have been able to occupy diverse terrestrial habitats mainly because of their ability to

- A. Move swiftly
- B. Conserve water
- C. Live as parasites on other organisms
- D. withstand high temperature

Answer is B

The major challenge of terrestrial habitant is scarcity of water

29. In an experiment, a respiratory quotient of 1.3 was observed in a skeletal muscle of vertebrates. Which one of the following is the possible explanation

- A. The muscle was fatigued
- B. The vertebrate was oxidising fats
- C. Lactic acid accumulation
- D. Some anaerobic respiration had occurred

Answer is D

30. What type of learning is exhibited by a predator when it avoids eating a brightly coloured prey

- A. Exploratory
- B. Habituation
- C. Associative
- D. trial and error

Answer is C

31. Beetroot cells contain a water soluble red pigment. Two treatments on beetroot were set up as shown

Table 1

Test tube	Treatment
Test tube 1	Pieces of washed raw beetroot in water
Test tube 2	Pieces of washed beetroot in water containing a respiratory poison

After 30 minutes, the water in test tube 2 contained the red pigment while that in test tube 1 did not. Which statement explains the colour in test tube 2

- A. retention of the pigment in cells is an active process
- B. pigments molecules passed out and carried the soluble pigment with it
- C. the poison made the cell membrane semi permeable
- D. water passed out by osmosis and carried the soluble pigment with it

Answer is A

32. An advantage of larval form during development is to

- A. Provide protection for the young
- B. Reduce competition between the young and adult
- C. Allow rapid growth of the young
- D. Allow sufficient time for development

Answer is B

33. Which one of the following would lead to convulsive muscular contraction resulting from impulse transmission?

- A. Prevention of the action of acetylcholine
- B. Inhibition of acetylcholine formation
- C. Destruction of acetylcholine as it's formed
- D. Inhibition of the formation of cholinesterase formation

Answer is D

34. Which one of the following features does not contribute to the efficiency of a red blood cell?

- A. Biconcave shape
- B. Being filled with haemoglobin
- C. Being numerous in number
- D. Absence of a nucleus

Answer is C

35. Which one of the following does not determine the order in which amino acids line up in protein synthesis?

- A. Base sequence in DNA
- B. The sequence of base triplets in mRNA
- C. The number ribosomes involved
- D. The sequence of anticodons in the tRNA

Answer is C

36. During water stress, there is reduced photosynthesis mainly due to shortage of

- A. Carbon dioxide
- B. water
- C. light
- D. minerals salts'

37. A fragment of an earthworm can regenerate into a new worm because earth worm

- A. reproduce asexually
- B. possess high number of undifferentiated cells
- C. are hermaphrodites
- D. have a high rate of cell division

answer is B

38. Which one of the following structures are characteristic of a floating plant?

- A. Light, thin leaves with hairy surface
- B. Broad, thick leaves with thin cuticle
- C. Light, thin leaves with thick cuticle
- D. Broad, thin leaves with aeronchyma

Answer is D

Broad and thin leaves facilitate transpiration and loss of excess water

Aeronchyma enable the plant to float

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39. The human eye and an octopus' eye are example of

- A. Homology
- B. Divergent evolution
- C. Analogy
- D. Adaptive radiation

Answer is C

40. A disadvantage parallel flow in fish gill is that

- A. Water flows to slowly over the respiratory surface
- B. Blood does not get saturated enough with oxygen
- C. Blood and water are not close enough
- D. Water flows to rapidly overfills

Answer is B

**SECTION B (60 MARKS)**

41. (a) State the role of cell membrane (01mark)

- It separates the contents of the cell from the external environment.
- Controls exchange of materials between the cells and external environment
- It separates compartment with specialized functions inside the cell
- Acts as receptor site for recognizing external stimulus such as hormones.
- Allows uptake of materials by phagocytosis and pinocytosis.
- Support enzymes of complex metabolic pathways in place for close proximity.
- Protect inner content
- Insulate nerves

(b) Why is transport across cell membrane necessary? (04mark)

- To excrete waste substances
- To secrete useful substance
- To maintain electro-neutrality
- To maintain osmolarity
- Muscular activity/stomata movements
- 

(c) Give three differences between active transport and diffusion (03marks)

Active transport	Diffusion
Require energy	Does not require energy
Movement in one direction	Movement in both direction
Selective	Non selective
Involve protein carrier	May not involve protein carrier
Stopped by metabolic poisons	Not affected by metabolic poison
Occur in living things	Occur in both living and non-living things
Equilibrium is not established	Equilibrium is established

(d) Give two examples of processes in plants that requires active transport (02marks)

- Loading and unloading of sugars into or out of the phloem
- Absorption of ions from soil
- Electro-osmosis
- Cytoplasmic streaming

- Pumping of proton or H<sup>+</sup> across inter-membrane space to produce ATP

42. Figure 4 shows the variation of metabolic rate with environmental temperature in a mammal

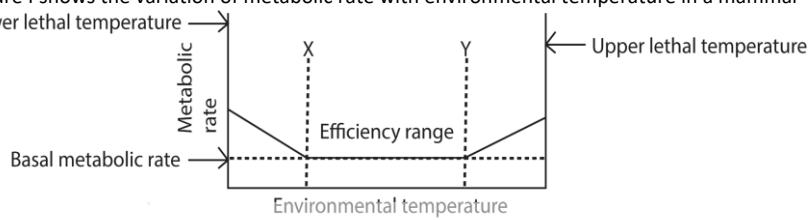


Figure 4

(a) What do temperatures X and Y represent? (01 mark)

X - lower critical temperature

Y - upper critical temperature

(b) What does the efficiency range mean? (02 marks)

These are temperatures at which physical mechanisms are enough to regulate body temperatures

(c) Explain the variation of metabolic rate with environmental temperature outside efficiency range. (05marks)

Below the lower critical temperature metabolic rate increase to generate heat to maintain body temperature

Above the upper critical temperature metabolic rate increase due to increase in enzyme activity with increase in temperature

(d) The efficiency range is not fixed but differs from animal to animal. Giving reason, state how points would differ between animal living in cold environment and living in hot environment. (02marks)

Lower critical temperature X is lower for animals living in cold due to better insulation mechanism

Upper critical temperature Y is higher for animals living in hot environment due to lack of insulation

43. How do high levels of each of the following gases in atmosphere affect the environment

(a) Sulphur dioxide (03marks)

Dissolve and lower pH of rain water which damage animals and plants

(b) Carbon dioxide (04marks)

Carbon dioxide lead to global warming: and the effects of global warming are

- Habitat destruction
- Climatic change
- Desertification
- Flooding
- Species extinction

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(c) Chlorofluorocarbons (CFCs) (03marks)

- Depletes ozone layer
- Contribute to global warming

44. (a) Describe four problems faced by terrestrial plants. (06marks)

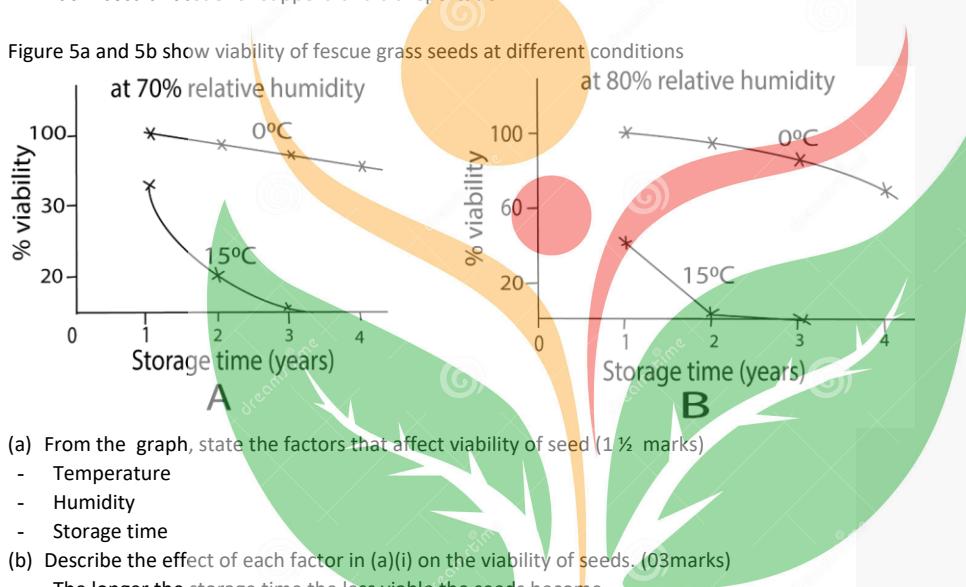
- excessive water loss that may lead to desiccation and death of a plant

- reproduction necessary mechanism are required to transfer pollen grain from the anthers to the stigma
- support to expose their leaves to light for photosynthesis
- gaseous exchange: plant require to exchange oxygen and carbon dioxide with the surrounding
- anchorage into the soil: plant required deep root system to anchor to the soil
- absorption of water: plant need extensive root system to absorb adequate water from the soil

(b) In what ways are mosses poorly adapted to terrestrial life? (04mark)

- leaves lack a cuticle
- need water during fertilization
- lack roots to absorb water
- lack vascular tissue for support and transportation

45. Figure 5a and 5b show viability of fescue grass seeds at different conditions



(a) From the graph, state the factors that affect viability of seed (1½ marks)

- Temperature
- Humidity
- Storage time

(b) Describe the effect of each factor in (a)(i) on the viability of seeds. (03marks)

- The longer the storage time the less viable the seeds become
- The higher the temperature the less viable the seeds become
- The higher the humidity the less viable the seeds become

(c) Explain the effect of each factor in (a) on the viability of the seeds. (5½ marks)

- Storing seed for long time leads to depletion of food reserves and accumulation of toxic wastes leading a decrease in viability of seed
- High temperature and humidity accelerate respiratory enzymes leading to faster depletion of food reserves and also promote pests that destroy the seeds.

46. (a) Table 2 shows blood group system in humans.

Table 2

Blood group	Antigen	Antibodies	Agglutination/no agglutination when receives blood of AB blood group
A	A	b/anti-B	X
B	B	a/ anti-A	X
AB	A and B	None	✓
O	none	a and b	X

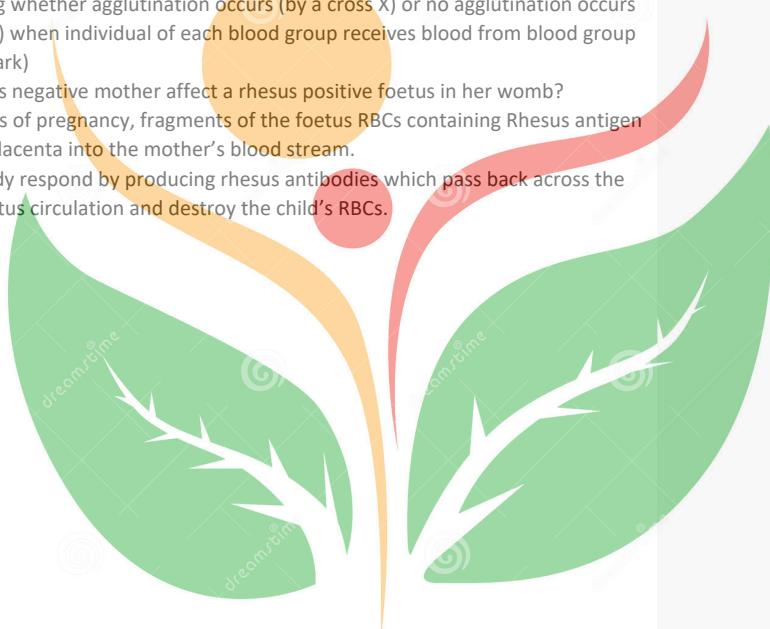
(a) Complete the table by

- (i) Filling in the antigens and antibodies for each blood group
- (ii) Indicating whether agglutination occurs (by a cross X) or no agglutination occurs (by a tick) when individual of each blood group receives blood from blood group AB (06mark)

(b) How can a Rhesus negative mother affect a rhesus positive foetus in her womb?

In the last months of pregnancy, fragments of the foetus RBCs containing Rhesus antigen pass across the placenta into the mother's blood stream.

The mother's body respond by producing rhesus antibodies which pass back across the placenta into foetus circulation and destroy the child's RBCs.



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**UACE Biology 2017 paper 1**

1. Which one of the following pairs of hormones when released increase the level of blood sugar in the body?
  - A. Secretin and adrenaline
  - B. Adrenaline and glucagon
  - C. Insulin and antidiuretic hormone
  - D. Secretin and thyroxine

Answer is B

2. The inheritance of comb shape in fowl is controlled by two dominant alleles P and R. What is the probability of producing a homozygous double recessive fowl with no comb, from parents of genetic constitution PpRr and PpRR?
  - A. 0%
  - B. 25%
  - C. 50%
  - D. 100%

Answer is A

The parent with genotype PpRR lacks a recessive gene, r

3. The surface area and volume of four animals A, B, C and D are given in table 1. Which one of them would experience the highest rate of heat loss when cold?

Animal	Surface area (cm <sup>2</sup> )	Volume (cm <sup>3</sup> )	Surface area: volume ratio(cm <sup>-1</sup> )
A	20	5	4
B.	40	80	0.5
C.	60	60	1
D.	80	100	0.8

Answer is A

Rate of heat loss is proportional to ratio of surface area to volume

4. Which one of the following genetic abnormalities does not result from non-disjunction?

- A. Klinefelter's syndrome
- B. Turner' syndrome
- C. Haemophilia
- D. Down's syndrome

Answer is C

5. The earth worm does not require a special respiratory organ because

- A. it is not very active metabolically
- B. its moist cuticle allows gases to dissolve and diffuse easily
- C. its surface lacks a cuticle
- D. it has large surface area to volume ratio

Answer is D

6. Variation among organisms which reproduce by fission can be due to

- A. crossing over    B. mutation    C. random fertilization    D. Independent assortment

Answer is B

Fission is asexual reproduction where crossing over, random fertilization and independent assortment do not occur.

7. Which one of the following types of plants is likely to have the most thin leaf cuticle?

A. mesophytes    B halophytes    C. hydrophytes    D. Xerophyte

Answer is C

Hydrophyte live in water thin cuticle allows them to lose excess water

8. The cutting of a plant apex encourages the growth of many side branches because

A. it encourages the interaction of auxins and gibberellins  
 B. secondary growth increases in the stem  
 C. auxins transfer downwards along the stem  
 D. apical dominance is removed

Answer is D

9. Dioecious plants are rare because

A. they separate male and female flowers on the same plant  
 B. there is self-incompatibility of the gametes  
 C. part of each species of Dioecious plant rarely mature at the same time  
 D. Part of each species of Dioecious plant does not bear fruits

Answer is D

In Dioecious plants male plants do not bear fruits and hence seeds

10. During protein synthesis, the anticodon base sequence on tRNA is AUG. What is the base sequence on the template DNA strand

A. UAC    B. ATG    C. AUG    D. TAC

Answer is B

11. The figure 1 shows changes in dry mass of a growing seedling with time.

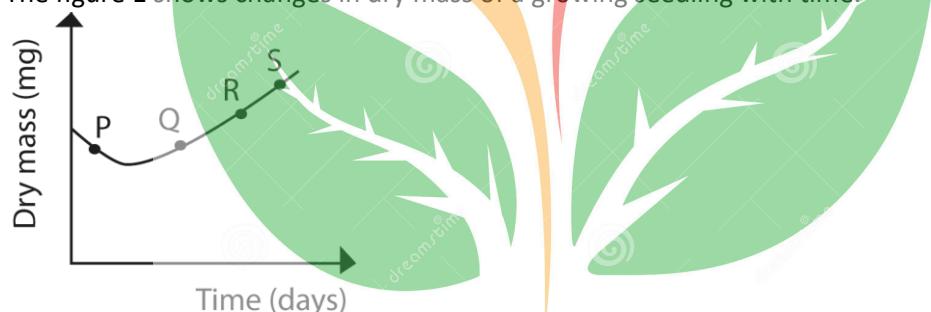


Fig. 1

Which part of the curve indicates growth where respiration is higher than photosynthesis?

A. R    B. S    C. P    D. Q

Answer is C

12. Cones have better visual acuity than rods because cones

A. Have little retinal convergence  
 B. Are more sensitive to light  
 C. Connect with a single nerve fibre  
 D. Are more concentrated at the fovea

Answer is A

13. Figure 2 shows parallel flow across a gill plate in fish

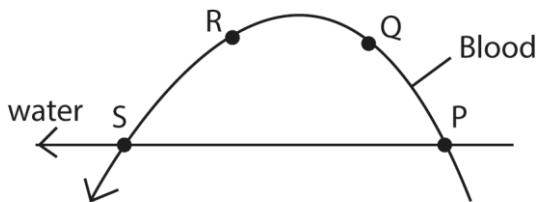


Fig. 2

Which one of the points indicated on the figure would have the highest diffusion gradient?

- A. R      B. P      C. Q      D. S

Answer is B

At P water has the highest concentration of oxygen and lowest value of carbon dioxide concentration while blood has the lowest oxygen concentration and high concentration of carbon dioxide

14. A common aspect between photosynthetic and chemosynthetic bacteria is that they both

- A. use water as source of hydrogen
- B. release oxygen during the synthesis of organic compound
- C. contain energy absorbing compound
- D. use carbon dioxide as a raw material

Answer is D

15. A plant which is not lignified, has poorly developed xylem tissue with large air spaces in stem and leaves belongs to a group of

- A. mesophytes      B. hydrophytes
- C. halophytes      D. xerophytes

Answer is B

16. Which one of the following organisms possesses a heart which pumps out only deoxygenated blood?

- A. Birds      C. mammals
- B. C. amphibians      D. fish

Answer is D

17. Which one of the following cells formed by mitosis

- A. Ovum      B. secondary spermatocyte
- C. Primary spermatocytes      D. secondary oocyte

Answer C

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18. Which one of the following changes in guard cells will lead to the opening of the stomata?

- A. increase in pressure potential
- B. increase in the hydrogen ion concentration
- C. increase in water potential
- D. reduction in sugar level

Answer is A

When a plant cell become turgid, pressure potential increases

19. Which one of the following groups comprises the organism with least common features?

- A. species      B. genus      C. family      D. order

Answer is D

## UACE BIOLOGY PAPER 1 (2000-2019)

Closeness of organisms decrease from species > genus > family > order > class > phylum > kingdom

20. The purpose of immunizing an individual against a disease is to
- stop the disease-causing organisms from attacking the individual
  - enable the individual produce antigens to combat pathogens
  - ensure that the individuals body is strong
  - induce the production of antibodies to combat disease causing features

Answer D

21. Sucrose is a major transport solute in plants because it
- is highly soluble so can be in high concentration in the sap
  - Can be easily converted into glucose and fructose
  - Is insoluble so it cannot be used in chemical reaction
  - Can be oxidized by the living parts

Answer is A

22. Which one of the following is the tidal volume in an individual whose ventilation rate is  $2000\text{dm}^3$  and takes 10 breathes per minute?

- A.  $0.2\text{dm}^3$  B.  $2.0\text{dm}^3$  C.  $200\text{dm}^3$  D.  $20\text{dm}^3$

Answer is C

$$\text{Tidal volume} = \frac{\text{ventilation rate}}{\text{number of breaths per minute}} = \frac{2000}{10} = 200\text{dm}^3$$

23. Imprinting can be described as

- a behaviour that involves recognising a print mark
- an innate behaviour that require practice
- learning that occurs at critical period in early development
- learning that require a sign stimulus

Answer is C

24. The following equation summarizes aerobic respiration of glucose



If the energy released on complete oxidation of one mole is 2880kJ and one ATP contain 30.6kJ of energy; what is the percentage efficiency of aerobic respiration of glucose in the equation?

- A. 40% B. 38% C. 68.65% D. 94.1%

Answer is A

$$\begin{aligned} \text{Efficiency} &= \frac{\text{useful energy}}{\text{total energy}} \times 100\% \\ &= \frac{38 \times 30.6}{2880} \times 100\% \\ &= 40\% \end{aligned}$$

25. Which one of the following cell types provides strength with flexibility in plant tissues?

- A. Parenchyma B. collenchyma C. tracheid D. sieve tubes

Answer is B

Collenchyma cells contain thickened walls which provide strength and flexibility

26. If a plant cell is placed in a hypertonic solution, its water potential becomes

- A. Zero B. more negative C. positive D. none

Answer B

27. Figure 3 shows the frequency of a trait among a group of students

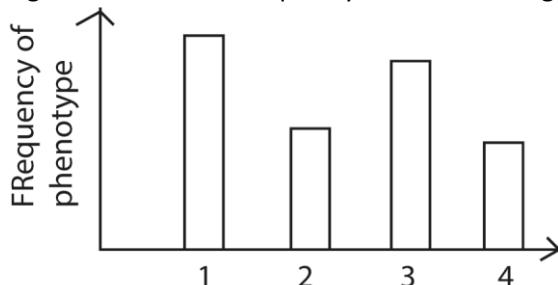


Fig. 3

Phenotype

The difference in phenotypes is due to

- A. the altitudes where individual live
- B. genotypic make up
- C. frequency of disease among individuals
- D. different diet among individuals

Answer is B

Genotypic make up cause discontinuous variation

28. A specimen observed under an electron microscope measures 50mm and actual specimen measures 5.0 $\mu\text{m}$ . the magnification under the microscope is

- A. 10
- B. 55
- C. 150
- D.  $10 \times 10^3$

$$\text{Magnification} = \frac{\text{image size}}{\text{object size}} = \frac{50 \times 10^{-3}}{5 \times 10^{-6}} = 1 \times 10^4$$

29. Saturated fatty acids and unsaturated fatty acids are similar in

- A. the number of carbon to carbon bonds they possess
- B. their consistency at room temperature
- C. the number of oxygen atoms present
- D. the number of hydrogen atoms they contain

Answer is C

Each contain a carboxylic group with two oxygen atom

30. What would be the estimated fish population in a lake if 350 fish were captured, marked and released, and later 450 fish including 150 marked were captured?

- A. 116
- B. 1050
- C. 650
- D. 250

Answer is B

150 fish are contained in 450 fish

$$350 \text{ fish will be contained in } \frac{450 \times 350}{150} = 1050$$

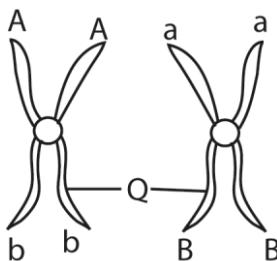
31. Which one of the following substances is not transported by the blood circulatory system in arthropod?

- A. nutrients
- B. hormones
- C. respiratory gases
- D. nitrogenous wastes

Answer is C

In arthropods oxygen and carbon dioxide are transported by tracheal system

32. Figure 4 represents a pair of homologous chromosomes during meiosis



If crossing over at point marked Q, the genotypes in gametes formed would be

- A. AA, BB    B. AA, bb    C. Ab, AB    D. AB, ab

Answer is D

33. Promotion of cell division by cytokinins only in the presence of auxins is an interaction known as

- A. synergistic    B. antagonistic    C. summative    D. complementary

Answer is A

34. Which one of the following activities results into release of nitrogen into atmosphere?

- A. water logging in the soils    B. overgrazing of pasture  
C. growing of legumes    D. uptake of mineral salts by the plant

Answer is A

35. Which one of the following is true of what occurs at excitatory synapse when an impulse arrives?

- A. Chloride ions channels close  
B. Receptor sites close  
C. Post synaptic membrane become impermeable to calcium ions  
D. Sodium channels open

Answer is D

36. Stretching of the urinary bladder is made possible by presence of

- A. Squamous epithelium  
B. Transitional epithelium  
C. Columnar epithelium  
D. Stratified epithelium

Answer is B

37. Figure 5 shows the rate of photosynthesis of a plant at varying conditions.

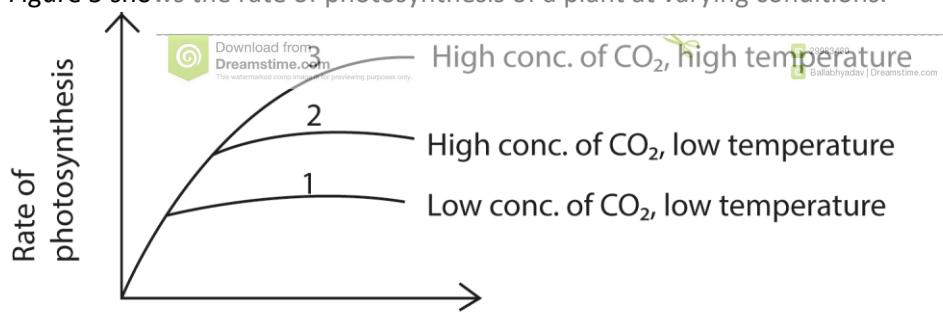


Fig. 5

Light intensity

Which factor is limiting photosynthesis in curve 2?

- A. carbon dioxide    B. pH    C. light intensity    D. temperature

Answer is D

Increasing temperature from 2 increases the rate of photosynthesis

38. The desert frog has solved the problem of osmoregulation by

- A. having unique habitat

- B. possessing few glomeruli
- C. having a water proof skin
- D. possessing a long loop of Henle

Answer is B

39. Which one of the following is true of a fully contracted muscle fibre?

- A. the H-zone disappears
- B. the filaments shorten
- C. the band widens
- D. the sarcomere widens

Answer is A

40. Which one of the following is a function of the autonomic sympathetic system?

- A. Constriction of bronchioles
- B. Stimulation of tear glands
- C. Acceleration of heart beat
- D. Speeding up of gut movements

Answer is C

#### **SECTION B (60MARKS)**

41. (a) Explain the role of consumer and producer in recycling of carbon in nature

(i) Consumers (03marks)

- Respire and release carbon dioxide used by plants
- Are eaten by other animals and transfer carbon from one organism to another
- Die and decomposed by saprophytes that obtain carbon
- Die to form peat and fossil oil

(ii) Producers (02marks)

- Fix carbon dioxide during photosynthesis
- Respire to release carbon dioxide
- Die to form peat and fossil oil
- Decompose to release carbon compounds used by plants

(b) Give five reasons why all carbon in plants is not accessible to herbivores (5marks)

- some plants are not accessible
- some plant material such as cellulose are not digestible
- some plants are not eaten
- some plants are poisonous
- carbon compounds are respired

42. Figure 6 shows the effect of temperature on the rates of photosynthesis and respiration in well illuminated leaves.

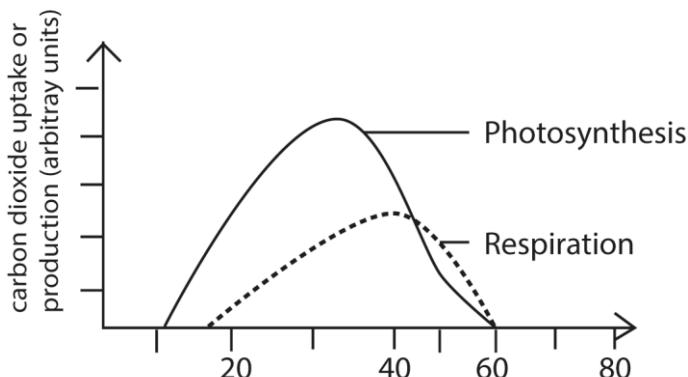


Fig. 6 Temperature /°C

(a) Compare the effect of temperature on the rate of photosynthesis and respiration.(04marks)

Similarities

- Increase in temperature causes both rates to increase
- Temperature beyond 40°C lead to decrease in both rates
- Rates are the same at 52°C and 60°C

Difference

- Rate of photosynthesis attains a peak at lower temperature than that of respiration
- Rate of photosynthesis begins to increase at lower temperature
- Photosynthesis attains a higher peak
- Beyond 52°C, the rate of respiration is higher than that of photosynthesis

(b) Explain the shapes of the curves (06marks)

Increase in temperature increases the rate of enzyme activity up to 40°C and beyond 40°C the rate of enzyme activities decrease because enzymes are denatured.

43. (a) Give one function of synapse in the nervous system (01mark)

- Transmit impulses between neurons
- Pass impulses in one direction
- Amplify impulses
- Allows adaptations to stimuli
- Allow coordination of impulses between different neurons

(b) When an action potential arrives at the synapse, calcium ions enter the neuron through presynaptic membranes.

(i) Explain how the calcium ions enter the neuron (02marks)

Arrival of the impulse causes calcium gates to open and causes Calcium ions diffuse into presynaptic knob

(iii) Describe the events which occur as a result of the entry of calcium ions to cause depolarization of post synaptic membrane. (05marks)

Calcium ions cause presynaptic vesicles to fuse with presynaptic membrane and release their transmitter substances into the synaptic cleft. The transmitter substance diffuse through the cleft and fuse post synaptic membrane cause to depolarization

(c) Explain the role of cholinesterase at synapse.

Cholinesterase inactivates acetylcholine preventing continuous firing of impulses.

44. Figure 7 shows a relationship between a pest and a biological control agent

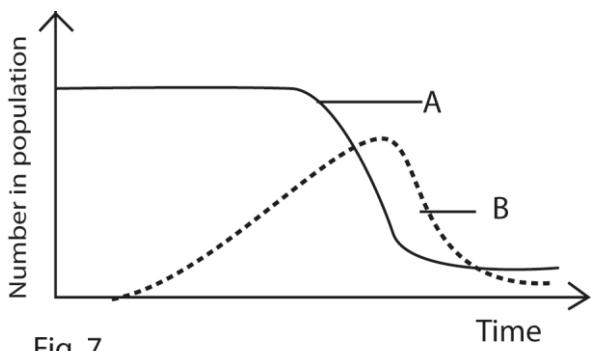


Fig. 7

(a) Giving a reason state which curve represents the

- (i) Pest (01mark)  
B, because it is more abundant initially
- (ii) Control agent (01mark)  
A, begins with small number

(b) Explain the changes in population of the pest and the control agent (05mark)

The population of the pest control increase due to availability of food; population of the prey decreases because is being feed on, the population of control agent then decrease due to lack of food until a dynamic equilibrium is established

(c) Suggest what would happen if the pest was completely wiped out (02marks)

- the pest control may die out due to lack of food or;
- the pest control may find alternative food source

(d) Explain characteristics of a good biological control agent (01mark)

It should be specific

45. (a) Explain how changes in the solute potential of a cell affects its turgidity (04marks)

Increase in solute potentials cause water to enter a cell by osmosis; while a decrease in solute potential causes a cell to lose water by osmosis.

(b) A plant cells with solute potential of -1240kPa and pressure potential of 350kPa was immersed in a sucrose solution whose water potential was -530kPa

(i) calculate the water potential gradient between the cell and sucrose solution (03marks)

$$\begin{aligned}\Psi_{cell} &= \Psi_s + \Psi_p \\ &= -1240 + 350 \\ &= -890 \text{kPa}\end{aligned}$$

$$\text{Water potential gradient} = -890 - (-530) = -350 \text{ Pa}$$

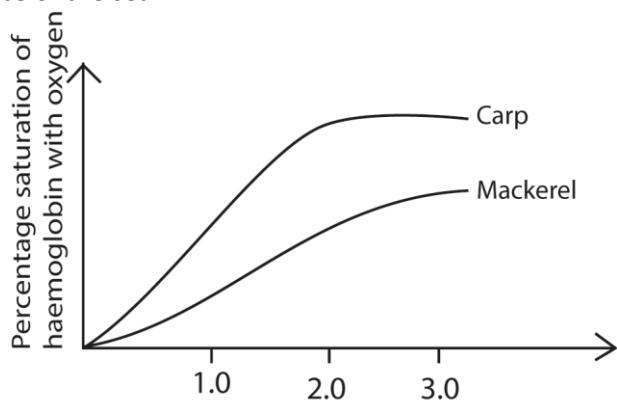
(ii) State the direction in which the water will flow (01mark)

From the sucrose solution into the cell

(c) Outline the difference between plasmolysis and wilting (02marks)

Plasmolysis	Wilting
Only the protoplasm shrinks leaving the cell wall behind	The whole cell including the cell wall shrinks
Occurs when a plant cell loses water to a hypertonic solution by osmosis	Occurs when a plant cell loses water through evaporation

46. Figure 8 shows the oxygen dissociation curves for two species of fish, the carp and the mackerel. The carp lives in a pond with decomposing vegetation while the mackerel lives in the surface of the sea.



**Fig. 8** Partial pressure of oxygen (kPa)

- (a) Describe how the percentage saturation of haemoglobin with oxygen changes with change in partial pressure of oxygen in the two species.
- Carp (01mark)  
Percentage saturation increases rapidly reaching maximum saturation at a lower oxygen partial pressure
  - Mackerel (01mark)  
Percentage saturation increases gradually reaching maximum saturation at higher oxygen partial pressure
- (b) Explain the changes in percentage saturation of haemoglobin with the partial pressure of oxygen in the two species
- Carp (04marks)  
Lives in a habitat of low oxygen partial pressure due to oxygen usage by aerobic bacteria; therefore, carp's haemoglobin has higher affinity for oxygen to pick oxygen at low partial pressure
  - Mackerel (04marks)  
Mackerel lives in a habitat of adequate oxygen partial pressure and therefore its haemoglobin has a lower affinity for oxygen.



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**UACE Biology 2018 paper 1**

**SECTION A (40 marks)**

1. Which one of the following would be the effect of increasing the partial pressure of carbon dioxide in blood?

- A. Increase in the ventilation rate
- B. variation of ventilation rate
- C. Reduction in ventilation rate
- D. cessation of ventilation

Answer is A

2. Which one of the following is true of ammonia a nitrogenous waste? It

- A. Require little energy for its excretion
- B. required much water for its excretion
- C. is excreted in a solid form
- D. is excreted by sea animals

Answer is A and B

Ammonia is made up of simple molecules which require less energy to make (this makes A correct) and it is highly toxic that it require much water to be eliminated in very dilute solution (this make B correct)

3. The equation for respiration of a substance is



What is the respiratory quotient of the substance?

- A. 0.70
- B. 0.80
- C 0.90
- D. 1.0

Answer is A

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$$\text{Respiratory quotient} = \frac{\text{volume of carbon dioxide produced}}{\text{volume of oxygen used}} = \frac{102}{145} = 0.7$$

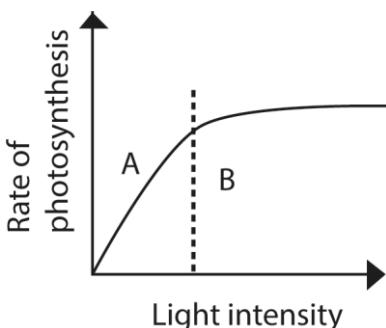
4. If a new baby suffers from haemolytic disease, it means that the

- A. mother is rhesus positive
- B. father is rhesus negative
- C. baby is rhesus negative
- D. father is rhesus positive

Answer is D

When the father is rhesus positive, son is also rhesus positive, the rhesus negative mother produces antibodies against the foetus causing haemolytic disease

5. Figure 1 shows the variation of the rate of photosynthesis with light intensity.



The factor limiting the rate of photosynthesis in region A is

- A. light      B. carbon dioxide concentration      C. water      D. temperature

Answer is A

Increase in light intensity increases the rate of photosynthesis

6. Flowers of the same type were subjected to different temperature and light conditions and they responded as shown in Table 1

Light intensity (arbitrary units)	Temperature (°C)	Flower response
20	25	Closes
20	30	Closes
30	25	Opens

This shows that the opening of flowers is stimulated by

- A. both light and temperature  
B. high light intensity  
C. low light intensity  
D. low temperature

Answer is B

Increasing light intensity from 20 to 30 caused opening of the stomata at constant temperature of 25°C.

7. A rigid cuticle of an insect allows some movement because
- It is made of chitin which makes the limbs flexible
  - During moulting enzymes dissolve the old cuticle as a new one is formed
  - The overlapping plates of the cuticle are not continuous at the joints
  - The exoskeleton is periodically shed off for the insect to move

Answer is C

8. The onset of depolarisation of an axon occurs when the axoplasm temporarily becomes

- A. more negative      C. more positive      D. less positive

Answer is B

9. Which of the following can be used to indicate levels of pollution in an environment?
- temperature
  - oxygen levels
  - lichen diversity
  - Humidity levels

Answer is C

10. In plants, ripening of fruits and falling of leaves are respectively caused by

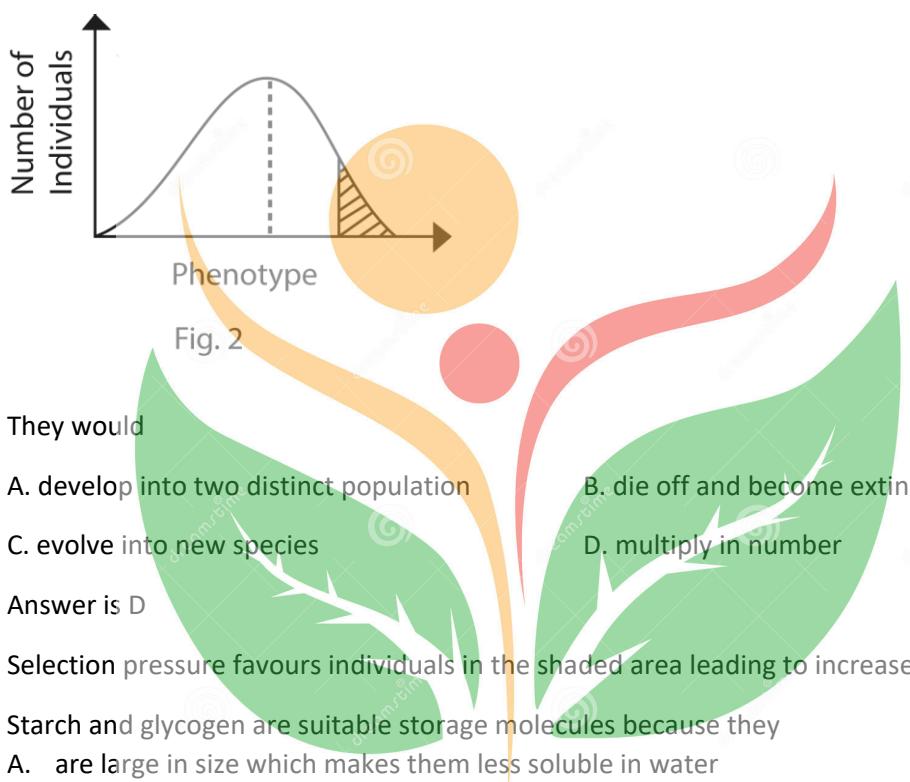
- A. auxin and gibberellins      B. cytokinins and auxin  
C. gibberellins and florigen      D. ethene and abscisic acid

Answer is D

Hormone	Functions
Auxin	<ul style="list-style-type: none"> <li>- Stimulate stem elongation</li> <li>- Stimulates growth of roots</li> <li>- Stimulates cell differentiation</li> <li>- Inhibit branching</li> </ul>

	<ul style="list-style-type: none"> <li>- Stimulates development of fruit</li> <li>- Stimulates apical dominance, photoperiodism, and geotropism</li> </ul>
Gibberellins	<ul style="list-style-type: none"> <li>- Promotes seed and bud germination, stem elongation, leaf growth, flowering and development of fruits</li> </ul>
Ethene	<ul style="list-style-type: none"> <li>- Promotes fruit ripening</li> </ul>
Abscisic Acid	<ul style="list-style-type: none"> <li>- Causes falling of leaves, and fruits</li> <li>- Promotes senescence</li> <li>- Promotes seed dormancy</li> <li>- Causes stomatal closure</li> </ul>

11. Which of the following would happen to individuals of the population in shaded area of figure 2 if selection pressure continued for generations acting on the phenotype?



12. Starch and glycogen are suitable storage molecules because they

- A. are large in size which makes them less soluble in water  
B. are chemically reactive in the cell  
C. can easily be hydrolysed  
D. exert an osmotic pressure in the cell

Answer is A

Starch and glycogen are polysaccharides insoluble in water and thus retained in the cell

13. In which of the following structures of a moss does meiosis occur?

- A. Gametophyte      B. sporophyte      C. archegonium      D. antheridium

Answer is B

14. A total of 180 black jack plants were recorded after throwing a 2m<sup>2</sup> quadrat 30 times in an area of the 160,000m<sup>2</sup>. The estimated number of black jack in the area were

- A. 53,333      B. 192,000      C. 480,000      D. 960,000

Answer is C

$$\text{Average number of plant in } 2\text{m}^2 = \frac{180}{30}$$

$$\text{Number of plants in } 160,000\text{m}^2 = \frac{180}{30} \times \frac{160,000}{2} = 480,000$$

15. Two cells A and B have water potential of -2000kPa and -1000kPa respectively. Which one of the following statements is true about cell B?

- A. Cell A has higher concentration of water molecules than cell B
- B. Cell A has higher solute potential than cell B
- C. There is a net movement of water from cell A to cell B
- D. Cell A has less solute concentration than cell B

Answer is D

Increase in concentration of solutes lowers water potential

16. Which one of the following is the role of capillary network around alveoli in mammals?

- A. makes the alveoli more permeable
- B. increase the surface area of the alveoli
- C. maintain a steep diffusion gradient
- D. makes the alveoli cell thinner

Answer is C

Capillary network supplies deoxygenated blood and removes oxygenated blood from alveoli thereby maintaining a steep diffusion gradient

17. Which one of the following organelles would be abundant at a site where some embryonic tissues are being discarded?

- A. mitochondria
- B. Ribosome
- C. Golgi apparatus
- D. Lysosomes

Answer is D

Lysosomes destroy worn out tissues

18. Gaseous exchange in earthworm occurs at the body surface because the body is

- A. moist
- B. elongated
- C. segmented
- D. flattened

Answer is D

Flattening increase the surface area volume ratio

19. Figure 3 shows energy transfer in ecosystem

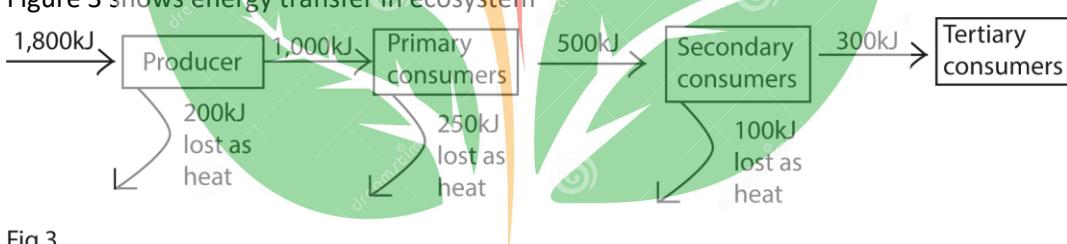


Fig.3

The percentage of energy used for other activities in trophic level 2 is

- A. 25%
- B. 50%
- C. 75%
- D. 100%

Answer is A

$$= \frac{1000 - (500 + 250)}{1000} \times 100\% = 25\%$$

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20. Which one of the following properties of water enables its movement through apoplast pathway in a plant?

- A. high latent heat of vaporization
- B. polarity of its molecules
- C. high adhesion-cohesion force
- D. high surface tension

Answer is C

In a poplast pathway water moves across cell walls of adjacent cells.

21. Which one of the following conditions would lead to Bohr Effect in a mammal?

- A. Decrease in the pH of the blood
- B. Increase in the partial pressure of oxygen in the environment

- C. Decrease in the metabolic rate
- D. Increase in environmental temperature

Answer is A

Increase in carbon dioxide concentration in tissue lower pH leading to release of oxygen from haemoglobin

22. Which one of the following can be concluded from the reproductive process in figure 4?



Fig. 4

The

- A. Process occurs fast
- B. offspring are identical
- C. offspring are many
- D. offspring are resistant

Answer is B

The diagram represents mitosis

23. Some animals living in arid habitats excrete uric acid because

- A. nontoxic
- B. highly soluble in water
- C. heart toxic
- D. insoluble in water

Answer is D

Excretion of uric acid require little water therefore conserves water in an animal

24. Which one of the following is not of benefit in territorial behaviour?

- A. pair bonding
- B. rights to defend a home range
- C. increased reproductive success
- D. saving energy used to chase away invaders

Answer is D

Territorial behaviour involves protection of boundaries within which an animal(s) feed, shelter or mate. Here there is no need for patrolling around and chasing away of intruders

25. A partially closed ductus arteriosus in an individual causes

- A. High blood pressure
- B. Shortage of oxygen to tissues
- C. Heart attack
- D. Anaemia

Answer is B

The ductus arteriosus is a normal blood vessel that connects two major arteries — the aorta and the pulmonary artery — that carry blood away from the heart. Therefore blood to the body does not pass through the lungs to pick oxygen

26. Which one of the following chromosomal mutations causes Down's syndrome?

- A. Non-disjunction
- B. deletion
- C. inversion
- D. duplication

Answer is A

Down's syndrome is aneuploidy condition resulting from failure of separation the 21 chromosome/non disjunction.

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27. Which one of the following is the correct state in the guard cells in relation to the neighbouring cells, when the stoma is open

- A. low pH
- B. sugar being converted to starch
- C. little acid present
- D. Higher water potential

Answer is C

During day carbon dioxide is used for photosynthesis, the increase in pH causes conversion of starch to sugars. The osmotic potential of guard cells increase leading to osmotic uptake of water from neighbouring epidermal cells.

28. A fresh water bony fish solves its osmoregulatory problems by

- A. Possessing few glomeruli
- B. Having a long loop of Henle
- C. Possessing many glomeruli
- D. Actively secreting salts into water

Answer is C

This enables the fish to get rid of excess water

29. Which one of the following is the major form in which carbon dioxide travels to the lungs from tissues?

- A. Carbonic acid
- B. sodium bicarbonate
- C. carboxyhaemoglobin
- D. Bicarbonate ions

Answer is B

Carbon dioxide diffuses into haemoglobin for carriage, it combines with water to form carbonic acid. At high pH carbonic anhydrase catalyses dissociation of carbonic acid into  $H^+$  and  $HCO_3^-$  ions. The  $HCO_3^-$  ions combine with  $Na^+$  to form  $NaHCO_3$  to be carried to the lungs

30. In Drosophila, the alleles for width of abdomen and length of wings are linked. When a Drosophila with long wings and broad abdomen was mated with one possessing vestigial wings and narrow abdomen, the following offspring were obtained

Long wings, broad abdomen = 686

Long wings, narrow abdomen = 211

Vestigial wings, broad abdomen = 206

Vestigial wings, narrow abdomen = 465

What was the cross over value?

- A. 133.3%
- B. 26.6%
- C. 49.4%
- D. 73.4%

Answer is B

$$\begin{aligned} \text{Cross over value} &= \frac{\text{number of recombinants}}{\text{total number of offspring}} \times 100\% \\ &= \frac{(211+206)}{(686+211+206+465)} \times 100\% \\ &= 26.6\% \end{aligned}$$

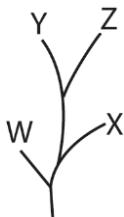
31. If the magnification of a microscope is 50,000 times and the size of the image viewed is 5mm, the actual size of the object is

- A.  $1 \times 10^{-4}\mu\text{m}$
- B.  $0.01\mu\text{m}$
- C.  $0.1\mu\text{m}$
- D.  $1.0\mu\text{m}$

Answer is C

$$\text{Size of the object} = \frac{\text{size of the image}}{\text{magnification}} = \frac{5 \times 10^{-3}}{50\ 000} = 1 \times 10^{-7}\text{m} = 0.1\mu\text{m}$$

32. Figure 5 shows the relationship between four different species W, X, Y and Z.



Which pairs of the species would have the least competition for resources if they lived together?

- A. X and Y      B. X and W      C. Y and Z      D. Z and W

Answer is D

Z and W are distantly related.

33. Which one of the following is not true of a contracted muscle fibre?

- |                    |                        |
|--------------------|------------------------|
| A. M-line shortens | B. sarcomere shortens  |
| C. H-zone shortens | D. light band shortens |

Answer is A

34. Which one of the following describes facilitated diffusion?

- |   |
|---|
| A. Molecules are moved by proteins from a region of high concentration to a region of low concentration |
| B. Water molecules move across a semi-permeable membrane  |
| C. Molecules move from a region of high to low concentrations   |
| D. Energy is used when molecules are moved across a cell membrane                                       |

Answer is A

35. Larval forms and their adult forms do not come into direct competition because the larvae

- |  |
|--|
| A. are independent organisms                     |
| B. are different in structure and feeding habits |
| C. have restricted mobility                      |
| D. reproduce asexually                           |

Answer is B

36. The most important adaptation of a plant in a salty environment is the possession of

- |  |  |
|--|--|
| A. Deep roots                          | B. root hairs sap with low water potential |
| C. many superficial adventitious roots | D. tissues with large air spaces           |

Answer is B

To prevent loss of water from roots to the salty water

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37. Which one of the following is the major cause of slow growth of population of individuals when they have just migrated to a new area?

- |  |
|--|
| A. Insufficient food in the new area       |
| B. Pressure from predators                 |
| C. Small number of reproducing individuals |
| D. Diseases which kill many individuals    |

Answer is C

38. Which one of the following changes of activities occur when adrenaline is released in mammalian body?

- |  |
|--|
| A. Reduction in oxidation of glucose                 |
| B. Conversion of glucose to glycogen                 |
| C. Conversion of fat in adipose tissues into glucose |

# UACE BIOLOGY PAPER 1 (2000-2019)

- D. Increase in the uptake of glucose by tissue cells

Answer is D

Glucose is taken up by muscle cells to be oxidised to produce energy

39. Which one of the following actions in photosynthesis are most affected by low temperature?

- A. Absorption of light
- B. Splitting of water
- C. Fixation of carbon dioxide
- D. Formation of ATP

Answer is C

40. Which one of the following is true about the state of an axon membrane during the absolute refractory period? It is

- A. Depolarised
- B. inexcitable
- C. polarized
- D. excitable with a stimulus stronger than usual

answer is B

## SECTION B (60marks)

41. Table 2 shows the relative contribution of aerobic and anaerobic respiration to the total energy of an individual during exercise

Table 2

Duration of exercise (min)	From aerobic respiration	From anaerobic respiration
0.5	83	17
2.0	40	60
10.0	9	91
60.0	1	99

- (a) Compare the relative contribution of aerobic and anaerobic respiration to the total energy output with duration of exercise. (03marks)

Similarity

Both aerobic and anaerobic respiration contribute to the total energy of an individual during exercise

Differences

The contribution of aerobic respiration to the total energy decreases as the duration of exercise increases while the contribution anaerobic respiration increases as the duration of exercise increases.

- (b) Explain the changes in the relative contributions of aerobic and an aerobic respiration with duration of the exercise.(04marks)

In short duration of exercise the oxygen supply is enough to sustain aerobic respiration.

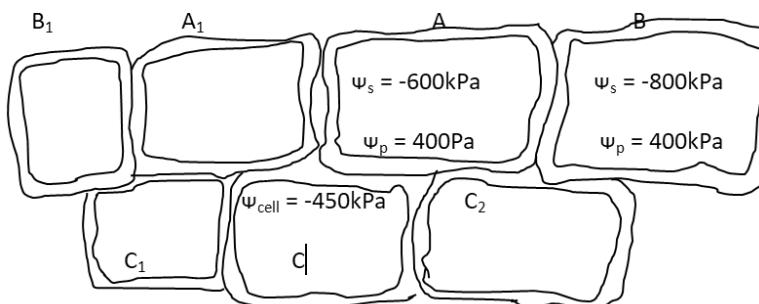
With increase in the duration of exercise, demand for energy exceed that that can be supplied by aerobic respiration due to shortage of oxygen. This necessitates the muscles to respire anaerobically.

- (c) Explain why diving mammals have reduced heart beat rate (03marks)

Diving mammals experience oxygen deprivation, heart beat rate is low to prolong the use of oxygen available

42. Figure 6 shows two guard cells A and A<sub>1</sub>, with adjacent cells B, and B<sub>1</sub>, C, C<sub>1</sub> and C<sub>2</sub>. The values of the solute potential and pressure potential shown in cells A and B are exactly the

same as those for cells  $A_1$  and  $B_1$  respectively. Similarly, the water potential indicated in cell C is the same as that in cell  $C_1$  and  $C_2$ . Use the figure to answer the questions that follow.

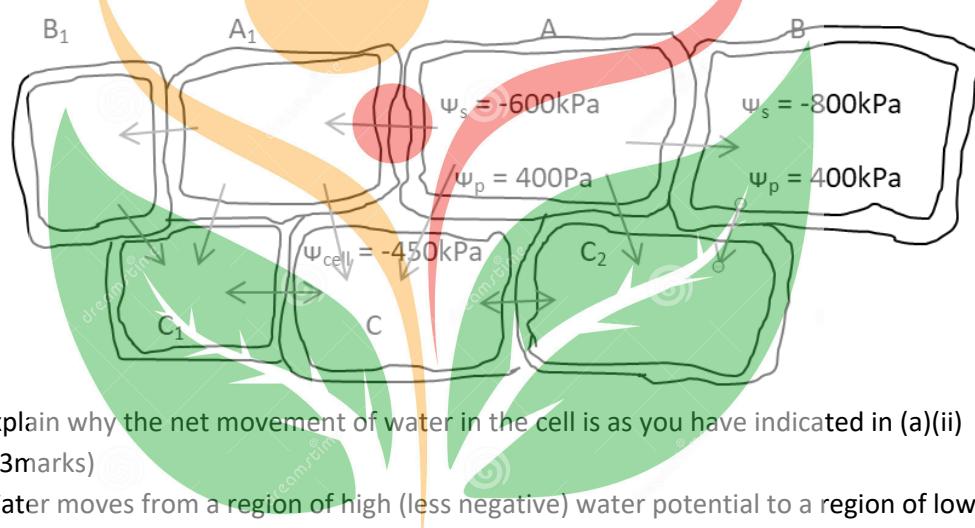


- (a) (i) calculate the water potential of cell A and B (02marks)

$$\text{Water potential of cell A} = -600 + 400 = -200 \text{ kPa}$$

$$\text{Water potential of cell B} = -800 + 400 = -400 \text{ kPa}$$

- (ii) Show by means of arrows the movement of water in the seven cells (03marks)



- (b) Explain why the net movement of water in the cell is as you have indicated in (a)(ii) (03marks)

Water moves from a region of high (less negative) water potential to a region of low (more negative) water potential

- (c) What would be the effect of the net movement of water indicated in (a)(ii) to guard cells a and  $A_1$ ?

The guard cells lose turgidity and the stomata close

43. (a) What is meant by primary productivity? (01marks)

It is the rate at which primary producer produce organic matter per unit area per unit time

- (b) Explain how each of the following affects primary productivity in plants

- (i) Water stress (05marks)

Stomatal closure occurs in order to reduce water loss. Carbon dioxide is cut off reducing the rate of photosynthesis and primary productivity decrease

- (ii) chlorosis (04marks)

Chlorophyll content reduces, this reduces the amount of light absorbed for photosynthesis. The rate of photosynthesis decreases and hence primary productivity decrease.

## UACE BIOLOGY PAPER 1 (2000-2019)

44. (a) Explain the function of antigens and antibodies in the immune system

- (i) Antigen (01mark)  
Stimulate production of antibodies
- (ii) Antibodies (01mark)  
Bind with antigens rendering them harmless

(b) State two ways in which passive immunity may be acquired naturally by a young child.

(02marks)

- through breast feeding
- diffuse through the placenta to the foetus

(c) During vaccination against tuberculosis (T.B), children are injected with a weakened strain of T.B bacteria. Explain how this procedure can result in long term defence against T.B. (06marks)

- Weakened strains of T.B induce B-lymphocytes to divide rapidly by mitosis forming a clone of B-cells.
- Some of the B-cells differentiate into memory cells which retain the ability to recognise T.B germs.
- Reinfection by the same T.B bacteria causes the memory cells to divide faster than the bacteria producing antibodies which attack the bacteria and render them harmless

45. (a) Distinguish between continuous and discontinuous variation (02marks)

Continuous variation is a type of variation which show complete graduation in characteristic of individuals from one extreme to another while discontinuous variation is one where there is clear cut difference in the type of characteristic and there is no intermediates.

(b) Explain how each of the following causes variation in sexually reproducing organisms

(i) Crossing over during meiosis. (03marks)

During prophase I of meiosis, equivalent portions of homologous chromosomes are exchanged. In this way linked genes are separate and gametes with new gene combination are produced.

(ii) Independent assortment of chromosomes during meiosis. (05marks)

The orientation of bivalents at the equator of the spindle during metaphase I and orientation of chromosomes at equator in metaphase II are random. Chromosomes in each bivalent and chromatids of each chromosome separate independently of others during anaphase I and II respectively giving different gene combinations in the gametes

46. (a) What is meant by inhibition of enzyme? (01mark)

This is the stopping or slowing down of enzyme activity

(b) Explain how an end-product inhibition in an enzyme controlled reaction is a negative feedback (07marks)

In an enzyme controlled reaction which occurs in series, high concentration of final product acts as an allosteric inhibitor of the enzyme controlling the first step of the pathway so that further formation of end product is temporarily inhibited.

When the product molecule are few, inhibition of the enzyme is reduced, more end product forms

(c) Explain the role of active sites of an enzyme in specificity? (02marks)

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Each active site has a specific configuration into which only a substrate with complementary shape can fit ensuring specificity.



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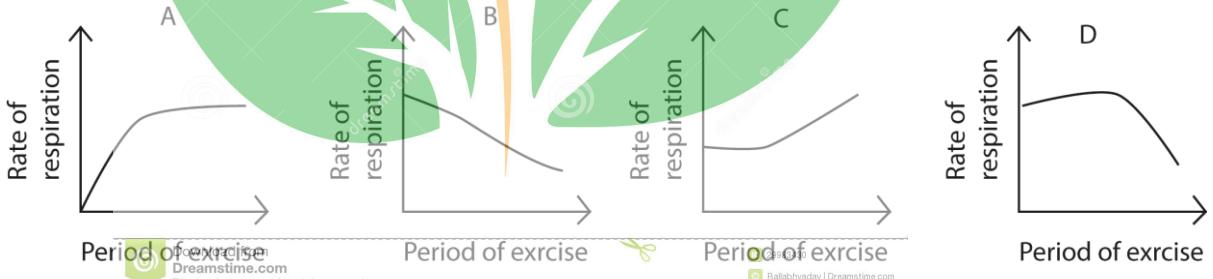
**UACE Biology 2019 paper 1**

1. In birds hatching following the first thing they see is an example of  
 A. Insight      B. association    C. habituation   D. imprinting

Answer is D

- Imprinting is learning of a behaviour that is limited to a specific time period in animal's life and that is usually irreversible. Young chicks at that level of development follow first object after hatching.
- Insight learning is when an animal uses past experience to solve a particular new problem without try and error.
- Association is the ability of an animal to relate one stimulus to another e.g. associate food with smell
- Habituation is a form of non-associative learning in which an innate response to a stimulus decreases after repeated or prolonged presentation of the stimulus. For example a person ceases to feel the irritating pain of a sweater without a shirt after some time

2. Which one of the following graphs shows the correct relationship between the rate of breathing with increase in amount of exercise in an athlete?



Answer is A

The rate of breathing increases to provided oxygen for increased rate of respiration up to a maximum when the rate of breathing meets the demand of oxygen for the tissues.

3. Which one of the following methods is used by the bony fish to regulate its internal environment?  
 A. Actively take up salts through its gills  
 B. Constantly drinks water  
 C. Produce isotonic urine in small quantities  
 D. Produces dilute urine in large quantities

Answer is A

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Bony fish are fresh water organisms whose internal environment is hypertonic and the surrounding water has little salts. Salts are actively taken up from the external medium to counteract the diluting effect of the inflowing water by osmosis.

4. Which one of the following animal tissues serves a similar function like the parenchymal tissue in plants?

A. Collagen tissue      B. Cartilage tissue      C. Elastic tissue      D. Areolar tissue

Answer is D

Both parenchymal and areolar tissues are storage connective tissues

5. The DNA of an organism contains 17.5% cytosine nucleotides. What would be the percentage of thymine nucleotides in its DA?

A. 96.5      B. 65.0      C. 60.0      D. 32.5

Answer is D

Percentage of cytosine = percentage of guanine and percentage of thymine = percentage of Adenine

$$\% \text{C} + \% \text{G} + \% \text{T} + \% \text{A} = 100$$

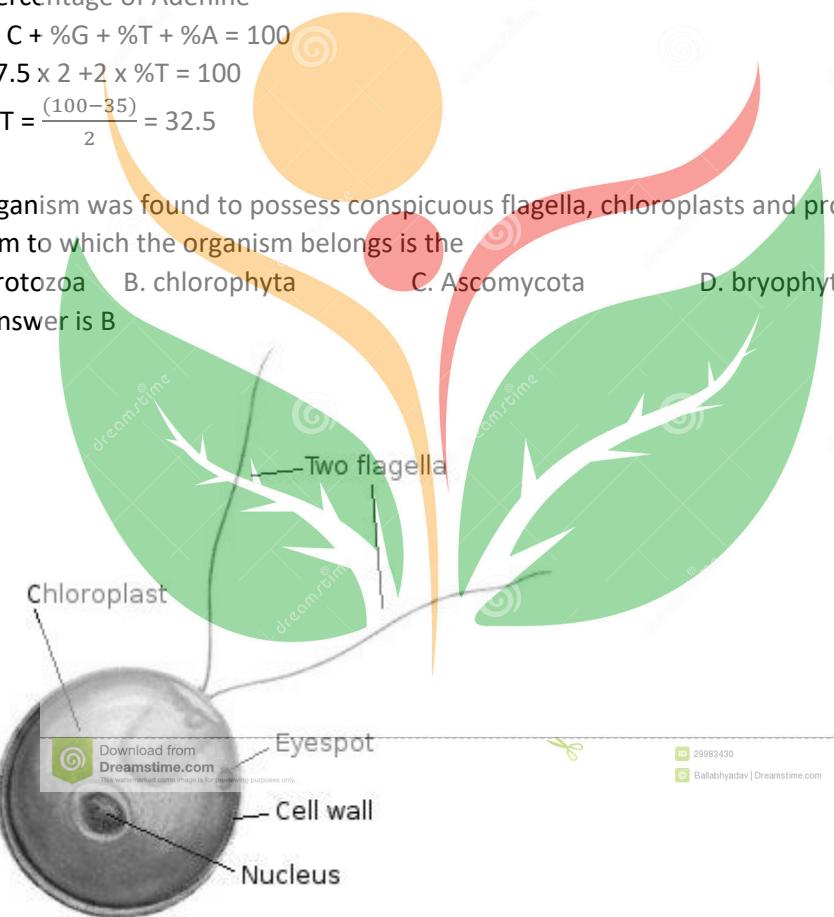
$$17.5 \times 2 + 2 \times \% \text{T} = 100$$

$$\% \text{T} = \frac{(100 - 35)}{2} = 32.5$$

6. An organism was found to possess conspicuous flagella, chloroplasts and protein coat. The phylum to which the organism belongs is the

A. Protozoa      B. chlorophyta      C. Ascomycota      D. bryophyte

Answer is B



Phylum Chlorophyta consists of **green algae** which typically do not contain pigments other than chlorophyll. *Chlamydomonas*, shown in the picture above, is a typical green alga. Notice that this species has two flagella, and is thus able to swim freely through the water. (When looking through a microscope, you should be aware that the algae's flagella are only visible under extremely high magnification).

7. Which one of the following situations could result in evolution? When

A. Organism have adapted to the new environment.

B. There is inbreeding

## UACE BIOLOGY PAPER 1 (2000-2019)

- C. Genetic equilibrium is upset
- D. There is no gene flow in a population

Answer is C

- The genetic structure of a population is defined by its allele and genotype frequency which remain in non-evolving population, a condition known as genetic equilibrium. Any factor that changes the genetic pool may lead to evolution
- Inbreeding, lack of gene flow and adaptation to new environment all lead to genetic equilibrium

8. In a heavily polluted ecosystem, the group of organisms with the highest concentration of pollutants in their bodies are the

- A. Tertiary consumers
- B. Secondary consumers
- C. Primary consumers
- D. Primary producers

Answer is A

This is due to accumulation from producer to primary and secondary consumer

9. Haemophilia is a sex-linked trait by a recessive gene. When a normal man marries a carrier woman for haemophilia, the probability of the couple producing normal son is

- A. 0%
- B. 25%
- C. 50%
- D. 75%

Answer is C

Half the sons receive recessive allele and half receive normal allele from the mother.

10. Which one of the following is not an advantage of insects having larval forms that are markedly different from adults?

- A. Allow the species to survive predators
- B. Enable adults to recognise their young ones easily
- C. Allow the species to exploit different food source
- D. Limits stiff competition between adults and larvae

Answer is B

In insects there is no parental care

11. A plant has 20 chromosomes in its receptacle cells. What would be the number of chromosomes in its endosperm cells?

- A. 80
- B. 40
- C. 30
- D. 10

Answer is C

Cells of endosperm contain  $3n$  while other plant cells contain  $2n$

12. During photosynthesis, the carbon fixing compound is produced from

- A. Glucose
- B. glycerate-3-phosphate
- C. Unstable 6-carbon sugar
- D. triose phosphate

Answer is D

It is glyceraldehyde-3-phosphate which is used to synthesise Ribulose biphosphate used to fix carbon dioxide in Citrus cycle.

13. During muscular contraction, the release of  $\text{Ca}^{2+}$  causes

- A. Myosin binding sites to be exposed
- B. Tropomyosin to attach myosin
- C. Myosin to detach from actin
- D. Troponin to bind with actin

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Answer is A

- When the skeletal muscle is at rest, myosin binding sites on actin molecule are blocked by a regulatory protein called tropomyosin. Another protein troponin complex controls the position of tropomyosin on the thin filaments.
- Arrival of the stimulus cause influx of  $\text{Ca}^{2+}$  from sarcoplasmic reticulum into the cytoplasm of muscle cells where it binds to troponin complex. This triggers the change in shape of tropomyosin to expose myosin sites, initiating binding of myosin to actin. A is correct
- Tropomyosin attaches to myosin does not bind with myosin, but with actin at myosin binding sites in absence of  $\text{Ca}^{2+}$ . B is wrong
- Myosin detaches from actin when myosin head binds with ATP at the end of muscle contraction
- Troponin is always bound to actin even in absence of  $\text{Ca}^{2+}$ . D is wrong

14. Which one of the following organisms A, B, C and D would require a vascular system

Organism	Surface area ( $\text{cm}^2$ )	Volume ( $\text{cm}^3$ )	Surface area to volume ratio
A.	1	0.2	5
B.	6	3	2
C.	16	10	1.6
D.	12	8	1.5

Answer is D

Has the lowest surface area to volume ratio thus requires a transport system

15. Which one of the following least favours the emergence of species?

- A. Selective breeding
- B. Stable environmental conditions
- C. Artificial selection
- D. Gene in a population

Answer is B

16. Which one of the following is responsible for destroying worn out organelles in the cell?

- A. Lysosome
- B. ribosome
- C. endoplasmic reticulum
- D. mitochondria

Answer is A

This is the function of lysosomes

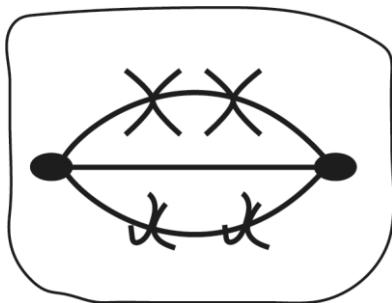
17. Which one of the following features of fungi differentiate them from other heterotrophs?

- A. Storing carbohydrates as glycogen
- B. Absorbing nutrients by active transport
- C. Digesting food outside the body
- D. Obtaining carbon from organic materials

Answer is C

→ Fungi carry out extracellular digestion and absorb nutrients.

18. What stage of cell division as shown in figure 1?



- A. Metaphase of mitosis
- B. Metaphase of meiosis
- C. Prophase II of meiosis
- D. Metaphase I of meiosis

Answer is D

19. The rate of an enzyme controlled reaction become constant at a certain point with increase in substrate concentration because

- A. Enzymes are denature
- B. Active sites become fully occupied
- C. End-product inhibition occurs
- D. Cofactors become used up

Answer is B

20. Which one of the following would occur at the synapse treated with a poison which renders cholinesterase inactive?

- A. Conduction of impulse ceases
- B. Conduction speed of impulses reduces
- C. Conduction of impulses in post synaptic neurone continues
- D. The direction of impulses reverses.

Answer is C

Cholinesterase inactivates acetylcholine after depolarizing post synaptic membrane, therefore when inactivated, the action of acetylcholine continues

21. The oxidation of respiratory substrate occurs according to the following equation



What is its respiratory quotient after complete oxidation in the body?

- A. 0.7
- B. 0.8
- C. 0
- D. 1.0

Answer is A

$$\text{Respiratory quotient} = \frac{\text{amount of carbon dioxide produced}}{\text{amount of oxygen used}} = \frac{18}{26} = 0.7$$

22. Which one of the following explains why sucrose is a good transport substance in Plants? It

- A. Can easily be hydrolysed
- B. Easily enters the general metabolic pathways
- C. Has high solubility thus forming high concentration
- D. Is highly abundant in plants

Answer is C

23. The mammalian eye receives fewer stimuli per unit time compared to insect compound eye because the

- A. Mammalian eye occupies a smaller part on the head than the insect eye.
- B. Mammalian eye has less focusing units than the insect eye
- C. Time lapse between reception of light stimulus and recovery is shorter in the insect eyes
- D. Mammalian eye has a smaller field of view

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Answer is C

24. The type of learning that prevents the animal from responding to repeated stimulation is  
A. Insight      B. conditioning      C. imprinting      D. habituation

Answer is D

25. What are the triplet bases on the DNA strand if the anticodon of tRNA is ACG?  
A. ACG      B. UGC      C. TGT      D. GGC

Answer is A

26. Denitrifying bacteria reduce nitrates in order to  
A. Release energy for their respiration  
B. Take up carbon dioxide in environment  
C. Release carbon dioxide in the environment  
D. Release oxygen for their respiration

Answer is D

Nitrates are oxygen rich and denitrifying bacteria breaks down nitrates to utilize oxygen for their respiration. It is this respiration that releases energy

27. Which one of the following is an effect of auxin in plant growth? It inhibits  
A. Fruit formation  
B. The development of side branches  
C. Growth of the entire plant  
D. Growth of adventitious roots

Answer is B

28. Which one of the following occurs in haploid parthenogenesis? Eggs are formed by  
A. Meiosis and develop without being fertilized  
B. Mitosis and develop without being fertilized  
C. Meiosis and are fertilized  
D. Mitosis and are fertilized

Answer is A

29. Which one of the following is true about the contracted mammalian muscle fibril? The  
A. Light part of the A band increases  
B. I-band and H-zone increase  
C. Dark ends of the A-band increase  
D. Dark ends of the A-band decrease

Answer is C

30. An individual with diabetes insipidus feels thirsty most of the time because  
A. Glucose in the urine causes less water to be lost in form of urine  
B. There is dehydration due to much water loss  
C. Glucose removed from blood stream appears in small amounts in urine  
D. Glucose regulation in an endothermic reaction in which heat energy is absorbed.

Answer is B

Diabetes insipidus is due to deficiency of ADH not insulin, thus the urine of the patient does not contain glucose

31. Mosquitoes are successful feeders on human blood because they  
A. Possess specialized mouth parts  
B. Employ many phases in their development  
C. Release anti-coagulants into the human blood  
D. Have attachment devices

Answer is C

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The anti-coagulant prevents blood clotting enabling the mosquito to continue sucking blood.

32. Which of the following is true when the ovum is not fertilized in humans?

- A. The Graafian follicle increases in size
- B. The uterine lining thickens
- C. The Graafian follicle degenerates
- D. Ovulation occurs

Answer is A

In absence of fertilization, FSH is released to promote growth of Graafian follicle

33. An adult whose diet consists of only milk suffers from

- A. Insufficient iron synthesis
- B. Low energy content
- C. High fat content which blocks the bone marrow
- D. Break down of red blood cells

Answer is A

Dairy products such as cheese, cottage cheese, milk and yogurt, although rich in calcium, have negligible iron content

34. Which of the animals A, B, C and D would have the highest rate of diffusion across its surface

Animal	Surface area ( $\text{mm}^2$ )	Volume ( $\text{mm}^3$ )	Surface area to volume ratio
A.	2	1	2
B.	4	10	0.4
C.	6	20	0.3
D.	8	40	0.2

Answer is A

It has large surface area to volume ratio

35. In which of the following organism is the gametophyte dominant generation

- A. Ferns      B. Mosses      C. conifers      D. flowering plants

Answer is B

36. Which of the following explains why intercellular fluid is drawn back at the venous end of the capillary?

- A. Fewer blood capillaries at the venous side
- B. Low levels of ultra-filtration at the venous end
- C. High blood pressure at the venous end
- D. High osmotic pressure of plasma proteins

Answer is D

37. In estimating the population of a weed in an area of  $1000\text{m}^2$ . A  $1\text{m}^2$  quadrant was thrown 50 times and the total number of weed counted were 60. What was the estimated population of the weed?

- A. 20      B. 300      C. 833      D. 1200

Answer is D

Average number of weeds per square meter =  $60/50 = 1.2$

Number of individual in  $1000\text{m}^2 = 1.2 \times 1000 = 1200$

38. Whales and sharks are aquatic animals with streamlines shapes dorsal fins flippers and larger tails yet are not of the same class. This is an example of

- A. Divergent evolution
- B. Convergent evolution

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- C. Adaptive radiation
- D. Natural selection

Answer is B

39. Dioecious plants are rare despite the advantages of cross pollination because of
- A. Increased distance between individual plants which requires a lot of space
  - B. increased competition among plants for resources
  - C. production of few seed
  - D. large wastage of pollen

Answer is C

half the population produces seeds

40. The following processes are involved in bulk transport of materials in a cell except
- A. Exocytosis
  - B. Phagocytosis
  - C. Diffusion
  - D. Pinocytosis

Answer is C

## SECTION B (60MARKS)

41. (a) What is a limiting factor? (03marks)

A limiting factor is a factor which is in short supply in a chemical reaction that is affected by more than one factor.

- (b) Describe a state where carbon dioxide is a limiting factor of photosynthesis. (04marks)

When light and temperature are optimum while carbon dioxide concentration is low, the rate of photosynthesis can't increase further.

- (c) Give three differences between the light dependent and light independent reaction of photosynthesis. (03marks)

Differences between light dependent and light independent stage

Light dependent	Light independent
Occurs in thylakoids	Occurs in stroma
Requires light	Does not require light
Forms ATP	Uses ATP
Reduces NADP	Oxidizes NADPH
Oxygen is given off	No oxygen is given off
Products are ATP and NADPH	Products are sugars and oxidized NADPH

42. (a) Explain the effects of the following

- (i) Heterozygote advantage in a population with increasing gene (04marks)

Increasing gene flow reduces the probability of recessive alleles or disadvantageous alleles in the population as it introduces new alleles. This reduced the selection pressure for heterozygote advantage.

- (ii) Isolation of individuals of a population for generations (02marks)

In isolated populations mutations and natural selection occurs differentially leading to evolution of new species

- (b) Explain why sickle cell trait is prevalent in malaria prone areas

Sickle cell trait is caused by a recessive allele in heterozygote state. Malaria acts as a selection pressure for heterozygote promoting their high occurrence in a population

**43. (a) Give importance of synapses in the nervous system. (04marks)**

- Allow nerve impulse to move in one direction
- Amplifies strength of nerve impulse
- Produces coordinated response by integrating stimuli from different source
- Prevents damage to effector through adapting fatigue.
- Allows weak stimuli to cause a response through facilitation

**(b) Explain why the**

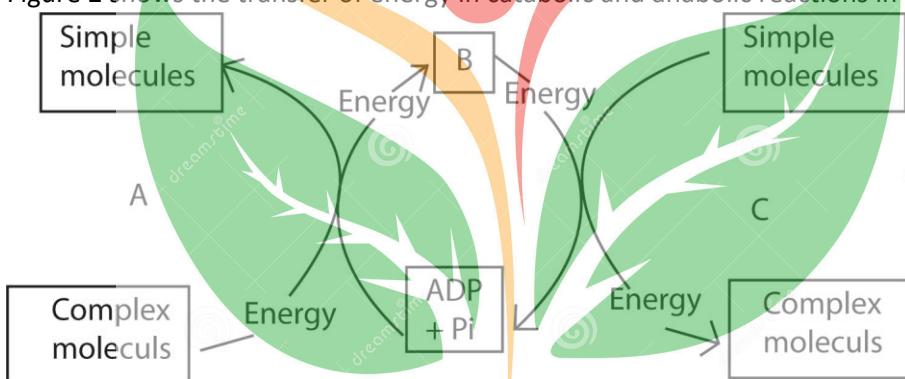
**(i) production of acetyl cholinesterase at the synapse is important during impulse transmission. (04marks)**

Acetyl cholinesterase hydrolyses acetyl choline into choline and acetyl. This prevents continuous firing of impulse/action potential.

**(ii) impermeability of an axon membrane to sodium ion in part of a neuron helps to maintain resting potential in that part**

Impermeability of the membrane prevents entry of sodium ions which would cause depolarization

**44. Figure 2 shows the transfer of energy in catabolic and anabolic reactions in a living cell.**



**(a) Using arrows X and Y show the direction of catabolic and anabolic reactions respectively on the figure2.(02marks)**

X- complex to simple molecules

Y- simple to complex

**(b) Name the compound marked B and one example of the process represented by A and C. (03marks)**

A – respiration

B-ATP

C- photosynthesis

**(c) Outline two roles of ATP in living cells. (02marks)**

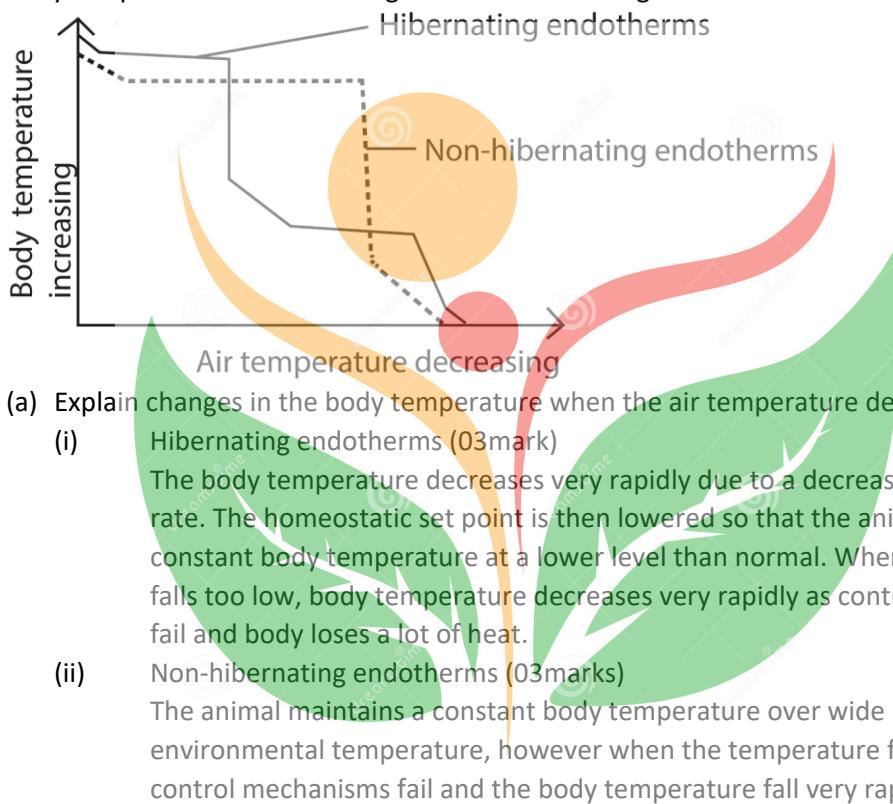
- Supply energy
- Temporarily store energy
- Supply phosphate group during phosphorylation

- (d) Give three differences between oxidative-phosphorylation and photophosphorylation (03marks)

Differences between oxidative-phosphorylation and photophosphorylation

Oxidative phosphorylation	Photophosphorylation
Energy is obtained from oxidation of chemicals	Energy is obtained from light
Produces ATP and water	Produces ATP, NADPH and oxygen
Last electron acceptor is oxygen	Last electron acceptor is NADP
Occurs in mitochondria	Occurs in the chloroplast
Occurs in all organisms	Occurs in photosynthetic organisms

45. Figure 3 shows the relationship between air temperature from summer through winter and body temperature of hibernating and non-hibernating endotherms



- (a) Explain changes in the body temperature when the air temperature decreases in
- Hibernating endotherms (03mark)  
The body temperature decreases very rapidly due to a decrease in metabolic rate. The homeostatic set point is then lowered so that the animal maintains a constant body temperature at a lower level than normal. When air temperature falls too low, body temperature decreases very rapidly as control mechanisms fail and body loses a lot of heat.
  - Non-hibernating endotherms (03marks)  
The animal maintains a constant body temperature over wide range of environmental temperature, however when the temperature falls too low, the control mechanisms fail and the body temperature fall very rapidly.
- (b) What is the importance of hibernation in mammals that live in regions? (02marks)  
Reduces food consumption and utilization of stored reserves as metabolic rate lowers
- (c) Explain why it is mainly small animals that hibernate. (02marks)  
Small animals have large surface area to volume ratio and lose heat more rapidly. They have small food stored in their body

46. (a) (i) Distinguish between water potential and solute potential. (02marks)

Water potential is the capacity of a system to lose or gain water while solute potential is the measure of the change in water potential of a system due to presence of solute molecules.

- (ii) Explain why the water potential in the root is higher than the water potential in the leaves in plants (02marks)

In leaves water is lost by evaporation (also photosynthesis produces sugars) hence lowering water potential while in roots there is absorption of water from the soil increases water potential.

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(b) Describe how the

(i) root pressure contributes to the transport of water in plants. (03marks)

Root pressure is generated when the endodermal cells actively secrete salts into the xylem tissue creating a lower water potential in the xylem. This draws water into the xylem by osmosis which cause a pressure in the roots that pushes water up the xylem.

(ii) structure of cells of endodermis is adapted for their role of transport of water in plants. (03marks)

- Cells have an impermeable strip of suberin, the Caspary strip which diverts the passage water into the xylem
- Infoldings of the cell walls which increase surface area of the cell membrane for transfer of solutes
- Numerous mitochondria to provide energy for active transport
- Numerous starch grains in endodermal cells which act as energy source.



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