

**INDIAN ASSOCIATION OF PHYSICS TEACHERS**  
**NATIONAL STANDARD EXAMINATION IN BIOLOGY 2014-15**

Date of Examination: 23<sup>rd</sup> November, 2014

Time: 1500 to 1700 Hrs.

Paper Code: **B-302**

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*Write the question paper code mentioned above on YOUR answer sheet (in the space provided), otherwise your answer sheet will NOT be assessed. Note that the same Q.P. Code appears on each page of the question paper.*

**Instruction to Candidates -**

1. Use of mobile phones, smartphones, ipads during examination is **STRICTLY PROHIBITED**
2. In addition to this question paper, you are given answer sheet along with Candidate's copy.
3. On the answer sheet, make all the entries carefully in the space provided ONLY in **Block Capitals** as well as properly darkening the appropriate bubbles.

**Incomplete /incorrect/carelessly filled information may disqualify your candidature.**

4. On the answer sheet, use only **BLUE or BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. Question paper has 80 multiple choice questions. Each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q. No. 22    (a)        (c)    (d)

6. A correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer.
7. Any rough work should be done only in the space provided.
8. Use of **non-programmable** calculator is allowed.
9. No candidate should leave the examination hall before the completion of the examination.
10. After submitting your answer paper, take away the candidate's copy for your reference.

**Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the answer sheet.**

**Answer sheet are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED.**

**Scratching or overwriting may result in a wrong score.**

**DO NOT WRITE ON THE BACK SIDE OF THE ANSWER SHEET.**

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**Instructions to Candidates (continued)-**

**Read the following instructions after submitting the answer sheet.**

11. **Comments regarding this question paper, if any, may be sent by email only to [iaptpune@gmail.com](mailto:iaptpune@gmail.com) till 25<sup>th</sup> November, 2014.**
12. **The answers/solutions to this questions paper will be available on our website - [www.iapt.org.in](http://www.iapt.org.in) by 3rd December, 2014.**
13. **CERTIFICATES and AWARDS –**  
Following certificates are awarded by the IAPT to students successful in NSEs  
(i) Certificates to “Centre TOP 10%” students  
(ii) Merit Certificates to “Statewise Top 1%” students  
(iii) Merit Certificates and a book prize to “National Top 1%” students
14. Results sheets and the “Centre TOP 10%” certificates will be dispatched to the Prof-in charge of the centre by January, 2015.
15. List of students (with centre number and roll number only) having score above MAS will be displayed on your website ([www.iapt.org.in](http://www.iapt.org.in)) by 22<sup>nd</sup> December, 2014. See the Eligibility Clause in the Student’s brochure on our website.
16. Students eligible for the INO Examination on the basis of selection criteria mentioned in student’s brochure will be informed accordingly.
17. Gold medals will be awarded to TOP 35 students in the entire process.

1. Under which of the following circumstances, will there be a temporary shift from non cyclic to cyclic electron flow during light reaction of photosynthesis ?
- (a) Rise in level of  $\text{NADPH}_2$   
 (b) Absence of PS II  
 (c)  $[\text{Chlorophyll-a}] < [\text{Chlorophyll-b}]$   
 (d) Rise in level of ATP

**Sol.** Rise in level of  $\text{NADPH}_2$  may cause temporary shift from non cyclic to cyclic photo phosphorylation.  $\text{NADPH}_2$  level rises when it is not converted to  $\text{NADP}^+$  (may be due to fall in ATP level) and this unavailability does not allow enzyme FNR (Ferredoxin - NADP reductase) to function properly. Thus non cyclic photo phosphorylation is inhibited.

2. A researcher treats cells with a chemical that blocks DNA synthesis. This treatment would arrest the cells in which phase of the cell cycle ?
- (a) G1 phase                      (b) S phase                      (c) Metaphase                      (d) Anaphase

**Sol.** DNA synthesis (replication) occurs during S phase and unreplicated DNA arrest cell cycle in S phase.

3. There are 10 flowers in our individual plant of Solanum. Each microsporangium of every stamen contains 25 microspore mother cells. How many microspores would be formed from this plant.
- (a) 4,000                      (b) 5,000                      (c) 10,000                      (d) 20,000

**Sol.** 10 Flowers of solanum ..... 50 stamens (5 Stamen in Androecium)

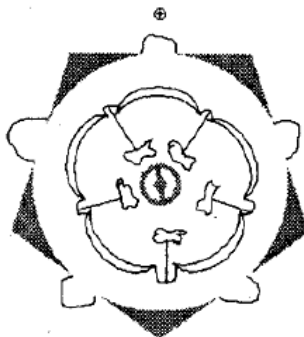
Each stamen ..... 4 microsporangia

1 Microsporangia ..... 25 microspore mother cell (MMC)

Meiosis produce 4 microspores from each microspore mother cell

Total microspores

4. Which of the following statements is correct with reference to the accompanying floral diagram ?



- (a) There is adhesion between corolla and androecium  
 (b) Calyx as well as corolla have imbricate aestivation  
 (c) The flower is bracteate  
 (d) Placentation is parietal.

**Sol.**

5. A variety of pea plant with round yellow seeds and violet flowers (RRYYCC) was crossed with a plant having wrinkled green seeds and white flowers (rryycc). The frequency of plants with genotype RrYyCc in the F<sub>2</sub> generation would be:
- (a) 1/2                      (b) 1/8                      (c) 27/64                      (d) 9/64

**Sol.** F<sub>1</sub> generation RrYyCc x RrYyCc

F<sub>2</sub> probability of RrYyCc

$$\frac{2}{4} \times \frac{2}{4} \times \frac{2}{4} = \frac{8}{64} = \frac{1}{8}$$

6. In Drosophila, the yellow gene(y) and white gene(w) showed 1.3% recombination while white(w) and miniature wing gene(m) showed 37.2% recombinations. this indicates that :
- (a) w and m are on different chromosomes  
(b) w and m are closer than w and y.  
(c) w and y are on the same chromosome while m is on a different chromosome  
(d)w and y are closer than w and m.

**Sol.** Lesser the % of recombinants closer are the genes

7. A few statements regarding viruses are made.
- (i) They are the simplest unicellular organisms  
(ii) They contain ribose or deoxyribose nucleic acid enclosed in a protein coat.  
(iii) They are the most primitive organisms.  
(iv) They exhibit inheritance of characters and can undergo mutations.

Which of the statements are correct?

- (a) i, iii and iv  
(b) i and iii only  
(c) ii and iv only  
(d) i, ii and iii only

**Sol.** Viruses do not have cellular structure. They are membranous or non membranous nucleocapsids

8. Exobiologists analyzed samples of certain microorganisms collected from space. They noticed 34 types of amino acids in their proteins. However, their nucleic acids were composed of the same four nitrogenous bases as that found on the Earth. each codon of these organisms is expected to have :

- (a) 2 nucleotides              (b) 3 nucleotides              (c) 4 nucleotides              (d) 6 nucleotides

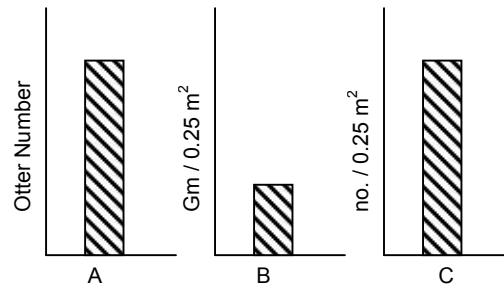
**Sol.** (Number of nitrogenous bases) size of codon = Total genetic codes

For given question

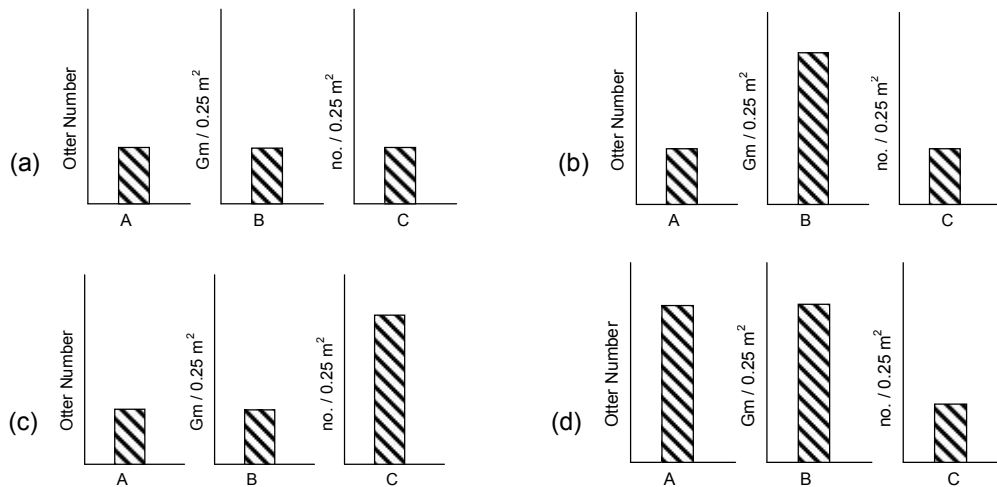
$$(4)^x = 34; \text{ Smallest values of } x = 3$$



9. A food chain consisting of kelps sea urchin sea otters in the large areas off the coast of Western Alaska was being studied. The graph depicting the sea otter abundance (A), sea urchin biomass (B) and kelp density (C) for the habitat on the year 1985 is depicted below.



An increase in the number of killer whale species in the area by the year 1997 would result in which of the following ?



**Sol.** Killer whales feed on sea otters and thus their increases would cause fall in number of sea otters. This will cause rise in biomass of sea urchin due to fall in predation and finally there will be rise in kelp density. Sea otters are key stone species.

10. Reproductive barriers are mechanisms which help maintain species over time. Three examples of reproductive barriers in certain species are given below:

(A) Two species of garter snakes occur in the same area but one lives in water while the other is terrestrial.

(B) Some Salamander subspecies of genus *Ensatina* live in the same region and occasionally hybridize resulting in frail individuals in the next generation.

(C) Blue-footed boobies (a type of bird) mate only after a courtship display wherein the male draws the female's attention to its bright blue feet.

Indicate whether these are examples of pre-zygotic or post-zygotic reproductive barriers.

- (a) A : Pre-zygotic      B : Pre-zygotic      C : Pre-zygotic  
 (b) A : Post-zygotic      B : Post-zygotic      C : Pre-zygotic  
 (c) A : Pre-zygotic      B : Pre-zygotic      C : Post-zygotic  
 (d) A : Pre-zygotic      B : Post-zygotic      C : Pre-zygotic

**Sol.**

11. Melting of DNA is the process of separation of the complementary strands by heating which of the following DNA molecules would melt at the lowest temperature ?

(a) GGACGGCTACCGG

CCTGCCGATGGCC

(b) CTACCGCGCTTCGG

GATGGCGCGAAGCC

(c) ATGGAATTCTTACT

TACCTTAAGAATGA

(d) GGGTCGGAACCCGT

CCCAGCCTTGGGCA

**Sol.** 3 Hydrogen bonds are present between G and C bases and thus more the number of G-C higher will be the melting point.

12. In a frog leaping frantically to escape a predator, which of the following modes of respiration is likely to occur?

I. Cutaneous

II. Buccal

III. Pulmonary

(a) i, ii & iii

(b) ii & iii only

(c) i & ii only

(d) i & iii only

**Sol.** While leaping frantically  $O_2$  requirement would be very high and thus all modes of respiration would be involved simultaneously.

13. Many varieties of ants are engaged in fungus gardening. This helps them in:

(a) devouring fungal biomass

(b) cultivating fruiting bodies of fungi as food

(c) fermenting leaves into products they can devour

(d) developing toxins to fight enemies

**Sol.** Ants are fungal farmers, and they cultivate fungi on leaf pieces. In return they consume fungi as food.

14. Which of the following have a positive influence on the rate of speciation ?

i. Species richness of habitat

ii. Heterogeneity of habitats

iii. Long generation time

(a) (i), (ii) and (iii)

(b) Only i and ii

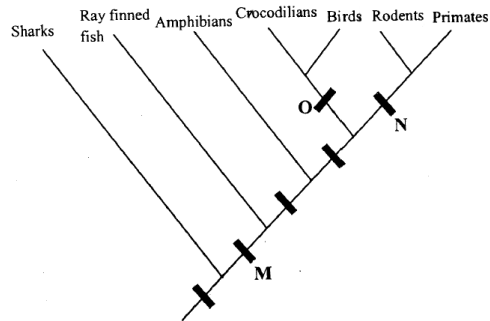
(c) Only i and iii

(d) Only ii and iii

**Sol.** Short generation time would quickly produce new variation.



15. Classification of a few animals is shown in the cladogram. The characters M, N, and O respectively represent :



- (a) vertebrae, sweat glands, amniotic egg.  
 (b) bony skeleton, hair, eggs with shell.  
 (c) vertebrae, amniotic egg, feathers  
 (d) notochord, four legs, aminotic eggs.

**Sol.** Sharks do not have bony skeleton. Eggs of birds and crocodilians are cleidoic.

16. Babita made squash preparation of body portion of a specimen. When observed under microscope, the preparation showed cnidocytes. The specimen must be:

- (a) sponge                      (b) molluse                      (c) coelenterate                      (d) annelid

**Sol.** Stinging cells or cniocytes are present in coelentrates only

17. A cross between AabbCCDd and aaBBccdd would yield offspring in the ratio of :

- (a) 27 : 9 : 9 : 9 : 3 : 3 : 3 : 1                      (b) 9 : 3 : 3 : 1  
 (c) 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1                      (d) 1 : 1 : 1 : 1

**Sol.** Aa bb CC Dd aaBBccdd

$\downarrow$                        $\downarrow$   
 AbCD                      aBcd  
 abCd  
 AbCd  
 abCD

No. of Gametes =  $2^n$   
 n = No. of Heterozygous traits

Off spring genotypes and ratios

(AaBbCcCd)    (aaBbCcdd)    (AaBbCcdd)    (aaBbCcDd)  
 1            :            1            :            1            :            1

18. If a double stranded DNA has 20% of cytosine, the percent of adenine in the DNA would be:

- (a) 20%                      (b) 30%                      (c) 40%                      (d) 50%

**Sol.** DNA has 20% C, So G = 20% (Chargaff's rule)

A + T = 60%  
 A = 30% = T

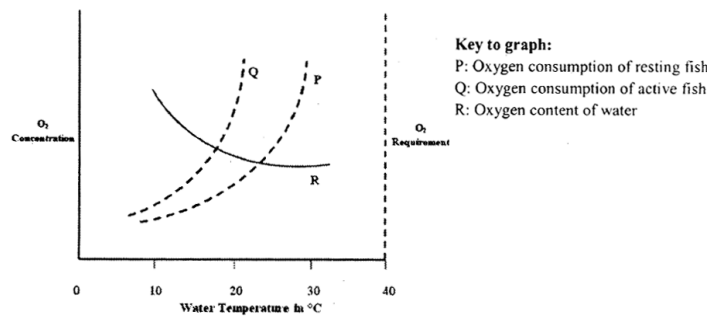
19. Damage to the right parietal lobe of human brain causes a condition called Contralateral Neglect Syndrome. In this syndrome the person :
- (a) tends to ignore stimuli from the left side of the body
  - (b) tends to ignore stimuli from the right side of the body
  - (c) is not able to co-ordinate between the stimuli from the right and left sides of the body.
  - (d) shows more sensitivity towards the stimuli from the left side of the body.

**Sol.** In contralateral control right hemisphere influences and is influenced by the left side of body.

20. In an ecosystem keystone species are:
- (a) species that are predatory in nature
  - (b) species that exert influence out of proportion to its abundance
  - (c) species that decrease the flow of energy through ecosystems.
  - (d) species that create an abundance in species-richness of that ecosystem

**Sol.** The keystone species have out of proportion influence compared to their abundance. Removal of Keystone species cause fall in biodiversity and it is less appropriate to state that they increase abundance.

21. Which of the following statements can be deduced from the graph.
- i. Fish need more  $O_2$  when water is warmer.
  - ii. Warm water carries less  $O_2$  than cold water
  - iii. An active fish uses more  $O_2$  than an inactive fish.
  - iv. Fish prefers cooler water for feeding.



- (a) i, ii, iii and iv      (b) i and ii only      (c) i,ii and iii only      (d) Only i

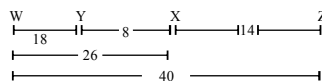
**Sol.** Fishes are cold blooded and thus as temperature rises their metabolic rate also rises and so is  $O_2$  requirement.

Active fish have higher  $O_2$  requirement due to higher muscles activity.

When temperature rise dissolved  $O_2$  starts escaping.

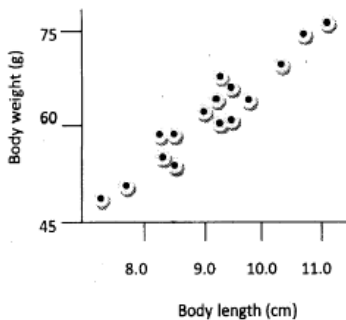
22. The distances between genes W,X,Y and Z on a chromosome are as follows: W-Y is 18 units, W-X is 26 units, W-Z is units, X-Y is 8 units and X-Z is 14 units. The sequence of these genes would be:
- (a) W, X, Y, Z      (b) W, Y, X, Z      (c) X, Y, W, Z      (d) Y, W, X, Z

**Sol.** Linkage map of WYXZ

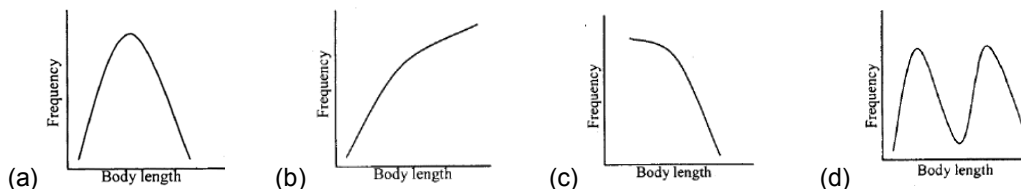




23. A sample of sunfish population was studied for two parameters namely body length and weight. The following graph was obtained.



If the data is converted into a frequency polygon to study the distribution of body lengths, the pattern obtained would be:



**Sol.** Extreme phenotypes (body wt. and length) are less frequent and more abundant are fishes with average or mean phenotypes.

24. If a bacteriophage with a lytic life cycle infects bacteria in a culture medium containing radioisotope of sulphur, the subsequent generation of the phage will have:

- (a) radioactive core      (b) radioactive coat      (c) radioactive core and coat  
(d) no radioactivity

**Sol.** Bacteriophage coat is made up of protein and contains sulphur containing amino acids like cysteine and methionine. DNA does not have sulphur.

25. Which of the following could be generally attributed to k-selected species?

- i. Strong territorial behaviour  
ii. Mass spawning behaviour  
iii. significant parental care  
iv. Distinctive developmental stages after hatching

- (a) i & iii                      (b) i & iv                      (c) ii & iii                      (d) ii & iv

**Sol.** K Selected species are large sized, produce lesser offsprings and show parental care.

26. Two nearby seashores A and B were compared using dominance and diversity indices. It was found that the diversity index of A was better than that of B while the dominance index of B was better than that of A. Which of the following can be true?

- (a) Eutrophication has occurred at A                      (b) Eutrophication has occurred at B  
(c) Habitat loss could be a problem at A                      (d) Indicator species are present at B

**Sol.** In B seashore eutrophication may have occurred causing fall in diversity and only resistant species have survived.

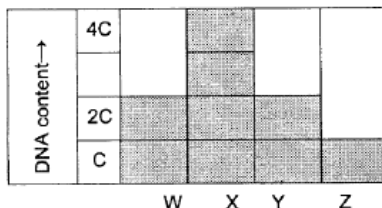
(Indicator term is mostly used for sensitive species)

27. A bare rock is exposed for colonization of life forms. The correct sequence of seres will be:

- (a) Lichen, fern, moss, grass, herb                      (b) Fern, moss, grass, herb, lichen  
 (c) Moss, fern, grass, lichen, herb                      (d) Lichen, moss, fern, grass, herb

**Sol.** In Xerarch succession Lichens comprise pioneer community and are followed by mosses and ferns.

28. The amount of DNA present per cell during a nuclear division is represented as a bar diagram below.



What phases are represented X and Y ?

- (a) X- Prophase-I, Y - S phase  
 (b) X- Prophase-I, Y - Prophase II  
 (c) X -Metaphase II, Y - Prophase II  
 (d) X- Anaphase I, Y - Telophase I

**Sol.** In prophase I (of meiosis I) DNA content is 4C i.e. genome is diploid and all chromosomes are replicated.

Meiosis I cause genome to become haploid in daughter cells and in prophase II DNA content is 2C.

Thus X - 4C

Y - 2C

29. Human red blood cells when suspended in solution of varying osmolarities, change shape either by shrinking or swelling or do not change shape. Which of the following statements are true ?

- i. They will shrink in plasma while swell in tap water.  
 ii. They will shrink in sea water but swell in tap water  
 iii. They will remain unchanged in plasma but shrink in tap water.  
 iv. They will remain unchanged in plasma but shrink in sea water.

- (a) i, ii & iv                      (b) ii, iii & iv                      (c) ii & iv                      (d) i & iii

**Sol.** Seawater have higher osmolarity (> 1000 mM) and is hypertonic to RBC. Tap water is hypotonic and plasma is isotonic.

30. Three clear glass bottles (A,B,C) were filled with clean, fresh, natural pond water and capped tightly. bottle A was kept in sunlight for two hours. Bottle B was completely covered with a black paper and was incubated in dark for two hours. The oxygen content in water from bottle A and B were measured at the end of two hours (O<sub>a</sub> and O<sub>b</sub> respectively), while that of bottle C was measured immediately after collection (O<sub>c</sub>). Which of the following statements is true?

- (a) O<sub>a</sub> and O<sub>c</sub> will give an estimate of oxygen content due to gross primary production.  
 (b) [ O<sub>a</sub> – (O<sub>c</sub> – O<sub>b</sub>) ] will give an estimate of oxygen content due to net primary production.  
 (c) [ O<sub>a</sub> – (O<sub>b</sub> + O<sub>c</sub>) ] will give an estimate of oxygen content due to net primary production.  
 (d) [ O<sub>a</sub> + O<sub>b</sub> – O<sub>c</sub> ] will give an estimate of oxygen content due to net primary production.

31. Sportsmen who required sustained muscular efforts for long periods of time normally undergo training to control their heart functions. The changes that occur as a result of this training would be:
- (a) decreased stroke volume
  - (b) increased heart rate and increased stroke volume
  - (c) decreased heart rate and increased stroke volume
  - (d) decreased stroke volume and increased rate of breathing.

**Sol.** Developmental of cardiac efficiency occurs by proper training and this increases stroke volume (SV). Due to increase in S.V. normal heart rate (HR) can be decreased maintaining the same Cardiac output.  

$$\text{Output} = \text{H.R.} \times \text{S.V}$$

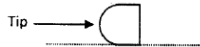
32. During DNA replication, the synthesis of the lagging strand involved the activity of following enzymes:
- i. DNA polymerase I (exonuclease)
  - ii. DNA polymerase III
  - iii. DNA ligase
  - iv. RNA primase

The correct order in which they act is:

- (a) iv → ii → i → iii    (b) iv → i → ii → iii    (c) iii → ii → i → iv    (d) ii → iv → i → iii

**Sol.** RNA primase form RNA primer on which DNA-P III synthesize DNA. DNA - P I removes primer and replace it with DNA. DNA ligase joins fragments.

33. During the study on auxins, the coleoptile tip was cut and placed horizontally for some time :



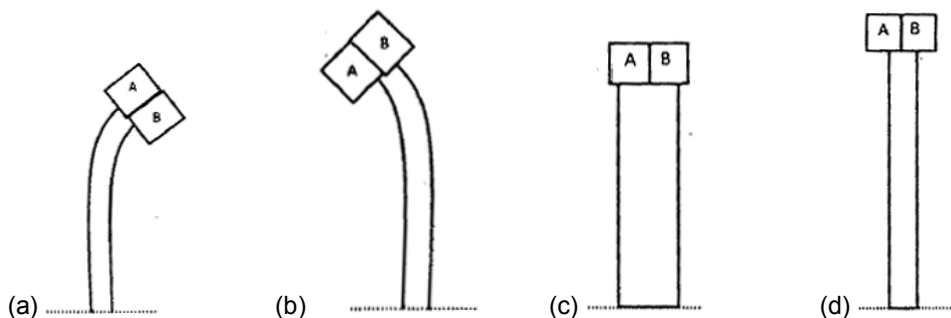
A piece of agar block, separated into two halves by a thin metal plate, was placed in contact with it as shown in the figure below;



The entire block was placed on a cut shoot tip as shown below.



What effect would be observed?



**Sol.** Auxin conc. will be more in B region and thus when placed on cut shoot tip will promote more growth and thus bending occurs.

**34.** The path of light as it passes through the human eye would be:

- (a) conjunctiva cornea aqueous humor lens vitreous humor retina
- (b) cornea conjunctiva vitreous chamber lens aqueous chamber retina
- (c) cornea lens conjunctiva aqueous chamber vitreous chamber retina
- (d) conjunctiva lens cornea aqueous chamber vitreous chamber retina

**Sol.**

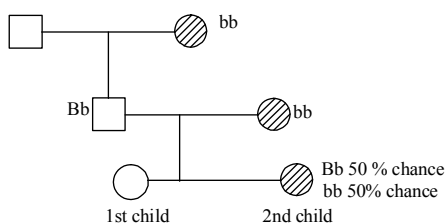
**35.** A bird was found to have a long narrow curved beak, long tongue and lacked a gizzard. It could most probably be :

- (a) a frugivore
- (b) a scavenger
- (c) a graminivore
- (d) a nectarivore

**Sol.** Long beak is involved in nectar sucking absence of gizzard prevents grinding of food i.e. food may be in liquid form.

**36.** Blue eye colour in humans is an autosomal recessive trait. Black-eyed son of a blue eyed mother marries a blue eyed girl. If the first child is blue eyed; what is the probability of the second child also being blue-eyed ?

- (a) 0%
- (b) 25%
- (c) 50%
- (d) 100%



**Sol.**

**37.** In a graft, the stock has 40 chromosomes and the scion has 20 chromosomes. How many chromosomes would be present in the root and egg cells respectively?

- (a) 20 and 10
- (b) 40 and 20
- (c) 10 and 40
- (d) 40 and 10

**Sol.** Stock  $\Rightarrow$  Root  $\Rightarrow 2n = 40$

Scion  $\Rightarrow$  Flower  $\Rightarrow 2n = 20$

Egg cell  $n = 10$

Root cell  $2n = 40$

**38.** A few statements regarding sugarcane and pineapple are given below;

- i. Sugar cane is adapted to avoid photorespiration while pineapple is not
- ii. In both the plants, 4- carbon acid is the first stable product of photosynthesis
- iii. Both the plants exhibit Kranz anatomy.
- iv. In sugarcane, there is spatial separation of initial  $\text{CO}_2$  fixation and Calvin cycle, while in pineapple there is temporal separation of the two.

The correct statements are;

- (a) i, ii and iii
- (b) i, ii and iv
- (c) only i and iv
- (d) only iii and iv

**Sol.** Sugarcane is  $\text{C}_4$  plant whereas pineapple is CAM plant.

In both  $\text{C}_4$  and CAM plant first stable product is 4 carbon compound.

In  $\text{C}_4$  plants light reaction occurs in Mesophyll cells and Calvin cycle occurs in Bundle sheath cell.

Thus there is physical separation. In CAM plants fixation of  $\text{CO}_2$  occurs in night and light reaction occurs in day

temporal separation occurs.

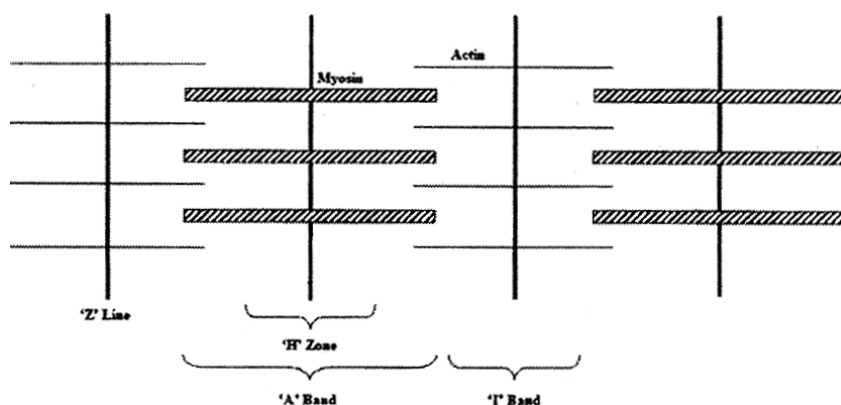
39. How much assimilatory power is required for the formation of 5 glucose molecules in photosynthesis ?  
 (a) 18 ATP & 12 NADPH (b) 12 ATP & 18 NADPH  
 (c) 90 ATP & 60 NADPH (d) 60 ATP & 90 NADPH

Sol. 1 Glucose assimilation in Calvin cycle requires 18 ATP and 12 NADPH

$$\therefore 5 \times 18 = 90 \text{ ATP}$$

$$5 \times 12 = 60 \text{ NADPH}$$

40. A sarcomere shows characteristic striations due to particular arrangement of acting and myosin filaments A schematic representation of sarcomere is shown below.



During muscle contraction, which of the following would disappear?

- (a) I band (b) Z line (c) A band (d) Actin

Sol. Due to sliding of actin on myosin I band disappears.

41. A germinal cell has 10 chromosomes when it enters the gamete formation phase. What will be number of chromosomes and chromatids in it during Metaphase-II of meiosis ?  
 (a) 20 & 20 (b) 10 & 20 (c) 10 & 10 (d) 5 & 10

Sol. Chromosome number will be reduced / halved to 5 however each chromosome still have 2 sister chromatids totalling 10.

42. Gibberellins are known to break seed dormancy in cereal seeds. This dormancy break is due to the activity of:  
 (a) protease (b) lipase (c) -amylase (d) cellulase

Sol. Gibberellins synthesized by the embryo diffuse to aleurone layer of endosperm and induce amylase synthesis and secretion to digest starch stored in endosperm cells.

43. Following are the lengths of processed m-RNA molecules. Which of them can produce a polypeptide composed of 15 amino acids ?  
 (a) 45 bases (b) 48 bases (c) 57 bases (d) 167 bases

Sol. Triplet codon for coding a amino acid and STOP codon to end translation required.

$$\therefore \text{total length} = 15 \times 3 = 45 + 3 = 48 \text{ bases}$$



44. Which of the following is not a hormone but acts like one in enhancing the uptake of calcium from food and preventing loss of calcium in urine?  
 (a) Vitamin D (b) Prostaglandins (c) Reduced glutathione  
 (d) Cytochrome P450

**Sol.** Vitamin D is also synthesized in skin and thus considered "hormone like".

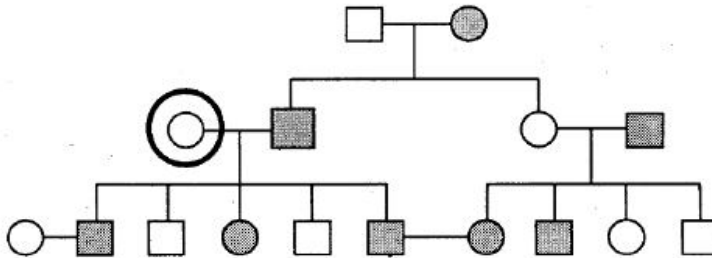
45. In an experiment, when an amoeba was transferred from container A to container B, the activity of contractile vacuole increased. However, the vacuole activity decreased when the amoeba was transferred back to container A. The containers A and B respectively contain:  
 (a) fresh and marine water (b) marine and fresh water  
 (c) dilute HCl and distilled water (d) distilled water and dilute HCl

**Sol.** Contractile vacuole functions as osmoregulatory cell organelle and drains out water entering in cell. Thus in hypotonic medium contractile vacuole is functional and in hypertonic medium they disappear.

46. Which of the following measures can directly, increase the carrying capacity of a habitat ?  
 i. Animals are encouraged to reduce their home ranges.  
 ii. Older animals are protected from diseases by regular immunization  
 iii. Water holes are provided during summer to tackle scarcity.  
 iv. Dams are built across perennial streams to store water.  
 (a) i & iii (b) ii & iii (c) i & iv (d) ii & iv

**Sol.**

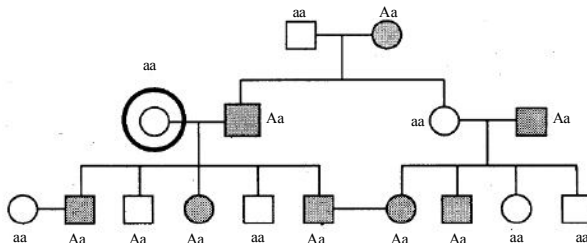
47. The pedigree given below is for a dominant trait, caused by a gene A.



The possible genotype/s for the circled individual in the pedigree would be:

- (a) AA only (b) Aa only (c) AA or Aa (d) aa only

**Sol.**



48. A patient received his medical report showing that he has higher percentage of high density lipoproteins (HDLs) and lower levels of low density lipoproteins (LDLs). This kind of lipid profile indicates that:
- he may be at high risk of developing atherosclerotic heart disease.
  - there could be higher probability of blockages occurring in his arteries
  - he may stay fit and healthy
  - there could be deposition of abdominal fats.

**Sol.** HDL removes excess cholesterol from blood high  $\frac{\text{HDL}}{\text{LDL}}$  ratio prevents atherosclerosis.

49. A normal woman has a haemophilic son besides three normal daughters. The genotypes of the woman and her husband with respect to haemophilia would respectively be:

(a) XX and  $X^h Y$       (b)  $X^h X$  and  $X^h Y$       (c)  $X^h X^h$  and XY      (d)  $X^h X$  and XY

**Sol.** Hemophilia is X linked disorder and thus show criss cross inheritance.

Since boy receives X chromosomes from mother it is likely that woman is carrier  $XX^h$  in given case. Also no daughter is affected thus her husband is normal XY.

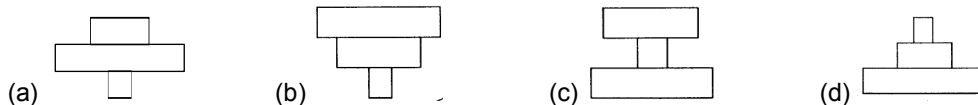
50. Data collected after survey in an evergreen forest patch was;

\* 425 Trees

\* 2,80,000 Primary consumers

\* 2,05,000 Secondary consumers

Which of the following pyramid of biomass correctly represents the data ?



**Sol.** Pyramid of biomass is upright for a forest ecosystem.

51. Facilitated diffusion of a solute across the plasma membrane:

- is also known as active transport
- does not require concentration gradient across the membrane
- required energy in the form of ATP
- occurs through solute specific channel proteins

**Sol.**

52. Four couples having blood groups as shown below (i to iv) registered a claim on a baby having blood group AB surviving the fire in maternity hospital.

i. A and B

ii. A and O

iii. O and O

iv. AN and O

The couple with which blood groups must have sired the baby ?

(a) i and iv      (b) ii and iv      (c) only i      (d) only iv

**Sol.** Since baby has AB blood group his parent cannot have O blood group.



53.  $\beta$ -thalassaemia is an autosomal recessive disorder. A couple, both being carriers for this trait, decided to have children. What will be the probability that their children will also be carriers ?
- (a) 1/4                      (b) 1/2                      (c) 3/4                      (d) 1

**Sol.** 
$$\begin{array}{ccc} Bb \times Bb & \Rightarrow & (Bb) \\ \text{Carrier Carrier} & & \text{Carrier probability is } \frac{2}{4} \end{array}$$

b = defective allele  
B = Normal allele

54. When a culture medium is supplemented with radio-labeled cysteine, the label appears in succession in the following cell organelles.

- (a) Golgi body  $\rightarrow$  RER  $\rightarrow$  Nuclear Envelope  
(b) RER  $\rightarrow$  Nuclear Envelope  $\rightarrow$  Vesicle  
(c) RER  $\rightarrow$  Golgi Body  $\rightarrow$  Vesicle  
(d) SER  $\rightarrow$  RER  $\rightarrow$  Golgi Body

**Sol.** Cysteine is incorporated in protein synthesis and thus will appear in RER.  
Vesicular Traffic in cell is RER  $\rightarrow$  Golgi  $\rightarrow$  Vesicle.

55. What is true about the hepatic portal system ?

- i. It regulates nitrogen metabolism in the body.  
ii. It drains blood from all parts of the body into the liver.  
iii. It helps in removing the toxins from the food.  
iv. It helps in regulating composition of blood

- (a) i, ii, iii, & iv              (b) Only i, iii & iv              (c) Only iii & iv              (d) Only i & iii

**Sol.** Hepatic portal system is blood supply from small intestine to liver.  
Liver remove toxin and maintains blood composition.

56. Members of a population residing in a valley migrated to higher altitudes of a nearby mountain and over generations. Adapted to the colder habitats of the mountain tops. The migrant population adaptively radiated from the parent population of the valley. This is an example of

- (a) Genetic drift                      (b) disruptive selection  
(c) Directional selection              (d) Temporal selection

**Sol.** At high altitude  $O_2$  tension is low and thus directional selection occurs to obtain more  $O_2$ . Increase in RBC count, selection of enzymes working at low temperature and other directional changes may occur.

57. Which of the following plant pigments can appear in the urine of a consumer?

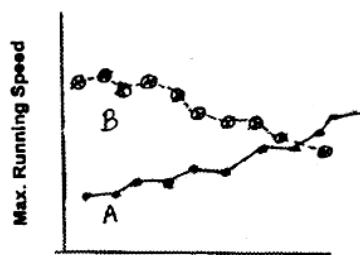
- i. Phycoerythrins  
ii. Carotenoids  
iii. Chlorophylls  
iv. Betalains

- (a) i, ii, iii & iv              (b) Only i & iv              (c) Only ii & iii              (d) Only iv

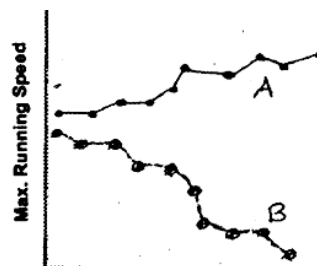
**Sol.** Phycoerythrin is a protein pigment complex.  
Carotenoides and chlorophyll pigments are fat soluble.  
Betalains are nitrogenous compounds and are water soluble.



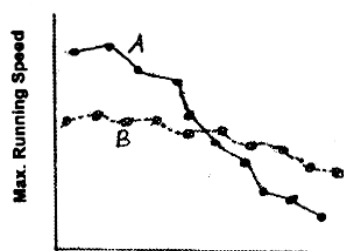
58. In an experiment, two groups of trained athletes ran 10 short sprints as fast as possible. Group A has been trained as sprinters and group B as long distance runners between each sprint they rested for half a minute. Which of the following graphs describes maximum running speed of both the groups correctly?



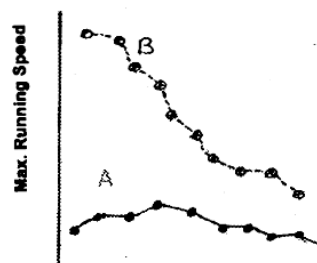
(a)



(b)



(c)

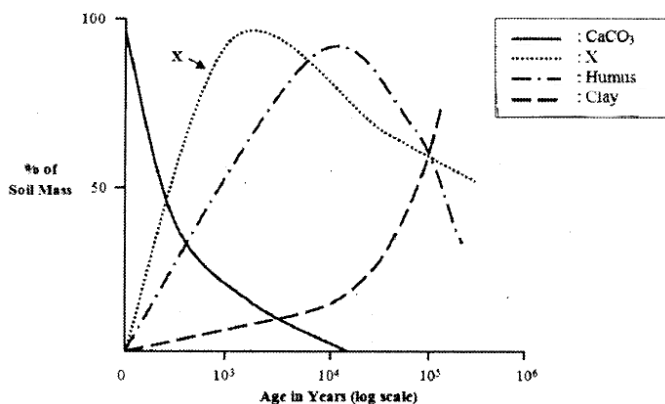


(d)

**Sol.** Group A is trained such that white / Fast twitch fibres are more abundant in them. They achieve fast speed quickly but also get fatigued quickly.

Group B is trained such that Red/ Slow Twitch fibres are more abundant. These fibres maintain uniformity and do not get fatigued easily.

59. The accompanying diagram depicts change in certain constituents of soil expressed as percent of soil mass. The factor "X" can be;



- (a) Phosphates      (b) Nitrates      (c) Biomass      (d) Moisture

**Sol.** Humus formation occurs from biomass or soil organic matter and thus graph of humus is lagging parallel to that of Biomass.



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64. A student inoculated a drop of pond water into a liquid culture medium which mainly contained extract of dry leaves. She incubated the culture bottle and microscopically observed a drop from the culture on the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> day after the commencement of the experiment. The organisms that she observed on each of these days were

On 2<sup>nd</sup> day → mainly bacteria

On 3<sup>rd</sup> day → mainly Paramecia

On 4<sup>th</sup> day → mainly Rotifers

The domains that these organisms belong to respectively are;

- (a) Eubacteria, Eubacteria, Eukaryota                      (b) Archaeobacteria, Eubacteria, Eukaryota  
 (c) Eubacteria, Eukaryota, Eubacteria                      (d) Eubacteria, Eukaryota, Eukaryota

65. Production efficiency is a term used in ecology to denote the fraction of energy stored in food that is not used for respiration. The equation for production efficiency is as follows.

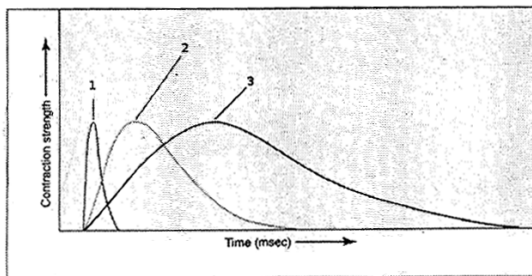
Production efficiency = Net production / Total assimilation

If a grasshopper which consumes leaf tissue containing 120J of energy, uses 30J for respiration and excretes out 50J in its faeces, then what would be the production efficiency?

- (a) 28.6%                      (b) 57.14%                      (c) 58.3%                      (d) 75%

Sol.  $\frac{120 - (30 + 50)}{120 - 50} = \frac{40}{70} = 57.14\%$

66. If a muscle is stimulated with a single electric shock, it will quickly contract and relax in a response called a twitch. Given graph represents twitch pattern from three different muscles.



The muscle type correctly matching with the twitch type will be;

- (a) 1 : Eye muscle                      2 : Calf muscle                      3 : Deep muscle of leg  
 (b) 1 : Eye muscle                      2 : Deep muscle of leg                      3 : Calf muscle  
 (c) 1 : Deep muscle of leg                      2 : Calf muscle                      3 : Deep muscle of leg  
 (d) 1 : Deep muscle of leg                      2 : Eye muscle                      3 : Calf muscle

Sol. Eye muscle is fastest contracting with minimum twitch time = 7.5 mili sec.  
 Deep muscle of leg has longest twitch time of 90 mili sec.  
 Calf muscle has intermediate twitch time of 40 mili sec.

67. Ribosomes are found in and/or attached to :
- (a) cytoplasm, mitochondria, nucleus, rough endoplasmic reticulum, smooth endoplasmic reticulum  
 (b) cytoplasm, mitochondria, rough endoplasmic reticulum, smooth endoplasmic reticulum  
 (c) cytoplasm, mitochondria, rough endoplasmic reticulum  
 (d) cytoplasm, nucleus, rough endoplasmic reticulum

Sol. Mitochondria is semi autonomous cell organelle and it bears prokaryotes(70s) like ribosome.



72. A hydrophyte showed the presence of lance shaped (narrow with pointed ends) leaves and broader heart shaped leaves in the same plant. This plant is most likely to be :
- (a) emergent hydrophyte (b) submerged hydrophyte  
(c) free floating hydrophyte (d) rooted hydrophyte with floating leaves

**Sol.** Heterophily i.e. production of 2 types of leaves for 2 different types of environments. The leaves on the surface are heart shaped and floating and inside water leaves are lance shaped.

73. The data for the following parameters were collected for two plants:

| No.  | Parameter   | Plant 1 | Plant 2 |
|------|---|---------|---------|
| i.   | Total leaf area (cm <sup>2</sup> )                                  | 18.65   | 12.45   |
| ii.  | Total plant weight (g)  | 0.245   | 0.133   |
| iii. | Total area of leaves per unit plant weight (cm <sup>2</sup> /g)     | 76      | 93.7    |
| iv.  | Total area of leaves per unit weight of leaves (cm <sup>2</sup> /g) | 334     | 392     |

Which parameter/s indicate/s that plant 2 is most likely a shade plant?

- (a) i & ii (b) ii & iii (c) iii & iv (d) only iii

**Sol.** Shade plants receive diffuse light and thus they have high surface area/mass ratio as adaptive strategy.

74. The cells of the leaf tip of a plant contain sixteen chromosomes. Each cell of the pollen tetrad of such a plant would contain:
- (a) 4 chromosomes (b) 8 chromosomes (c) 16 chromosomes (d) 24 chromosomes

**Sol.** Leaf tip is diploid  $2n = 16$

Each cell of pollen tetrad is haploid (n) and thus have 8 chromosomes.

75. Counter current mechanism has no role to play in :
- (a) Fish gills (b) Whale fin (c) Human lungs (d) Penguin Legs

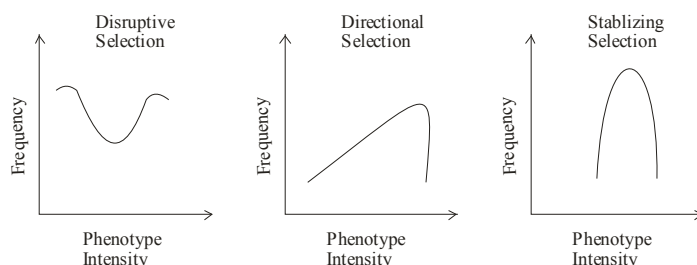
**Sol.** In fish gills counter current mechanism helps in effective gaseous exchange.

In fins of whale and penguin legs counter current mechanism helps in thermoregulation.

76. A few statements regarding natural selection are made. Mark the correct one:

- (a) Directional selection is represented by a bell shaped curve where majority of the individuals have values close to the average value for a trait
- (b) disruptive selection is represented by a positively skewed curve where majority of the individuals acquire values higher than the average value for a trait
- (c) Disruptive selection is represented by bell shaped curve where very few individuals acquire values for a trait peripheral to the average value
- (d) Stabilizing selection is represented by bell shaped curve where majority of individuals acquire values close to the average value for a trait.

**Sol.**



77. When the nucleus of a white blood cell (WBC) from blood is highly magnified under the microscope :
- (a) all 46 chromosomes can be counted as WBC is a diploid cell
  - (b) chromosomes cannot be counted as some blood cells are enucleated
  - (c) chromosomes cannot be counted as they are in the form of reticulum
  - (d) only 45 chromosomes can be counted as one of the sex chromosomes is highly condensed.

**Sol.**

78. Events that take place in eutrophication are listed below :

- i. Excessive growth of aquatic vegetation
- ii. Depletion of dissolved  $O_2$
- iii. Bacteria feed on dead vegetation
- iv. Aquatic ecosystem becomes rich in phosphates

The correct order in which these events occur is :

- (a) i, iv, iii, ii                      (b) iv, i, iii, ii                      (c) i, ii, iii, iv                      (d) iv, iii, ii, i

**Sol.** Eutrophication occurs when excess phosphates enter in a water body causing algal bloom and this is followed by fall in biodiversity.  $BOD \uparrow$  as microbes consumes dead organisms and thus dissolved oxygen falls.

79. Which of the following can be termed as temporary endocrine gland :

- (a) Pineal gland                      (b) Thymus                      (c) Placenta                      (d) Kidney

**Sol.** Placenta secrete hormones like HCG , Relaxin, human somatomammotropin (lactogen), Progesterone, Estrogen etc. and it is formed in females only during gestation period.

80. Identify the example/s of plants in which chloroplasts transform into chromoplasts :

- (a) Tomato                      (b) Beet root                      (c) Lady finger                      (d) Cotton

**Sol.** In tomato chloroplast (green) transforms to chromoplast (red) on maturity (Ripening). Beet root have anthocyanin pigmentation in their vacuole.