

CBSE Board
Class XII Biology
Sample Paper – 3 (Solution)

Section A

Answer 1.

Gametes possess half the number of chromosomes as in meiocytes.

Answer 2.

It cuts the DNA into fragments at specific sites.

Answer 3.

Beer is produced without distillation while whiskey is produced after distillation; hence it is more concentrated and pure.

Answer 4.

It is the introduction of foreign genes into plant or animal cells using micropipettes.

Answer 5.

Agrobacterium tumifaciens.

Answer 6.

It is necessary for the immune system to function.

Answer 7.

A marine fish will not survive in fresh water aquarium because of the osmotic problems it would face.

Answer 8.

It indicates the amount of organic matter in sewage water.

Section B

Answer 9.

Sporopollenin is a complex substance of an oxidative polymer of carotenoids which makes the exine of the pollen grain. It is the most resistant to biological materials that helps in fossilization of pollen grains.

Answer 10.

(i) Heterozygous: $I^A I^B$, Bb, $I^B i$, Aa

Homozygous: AA, aa, r, BB, ii.

(ii) AA and Aa have the same phenotype;

BB and Bb have the similar phenotype.

Answer 11.

Parents ... Tall and Yellow × Tall and Green

Genes ... DdYy × Ddyy

Gametes ... DY, Dy, dY, dy × Dy, dy

Answer 12.

DNA is better genetic material than RNA:

- (i) DNA is chemically less reactive and structurally more stable as compared to RNA.
- (ii) The two strands separated by heating come together when appropriate conditions are provided. But OH' group present at every nucleotide in RNS is a reactive group and makes RNS labile and easily degradable.
- (iii) The presence of thymine at the place of uracil confers additional stability to DNA.
- (iv) DNA and RNA are able to mutate. RNA being unstable mutates at a faster rate.

Answer 13.

Two core techniques that have enables the birth of modern biotechnology:

- (i) Genetic engineering: This technique refers to change in the genetic material and its introduction into host organisms for changing the phenotype of the host organism.
- (ii) Maintenance of sterile medium: It enables the growth of only the desired microbes in large quantities for the manufacture of biotechnological products like antibiotics, vaccines and enzymes etc.

Answer 14.

Enzymes used in Recombinant DNA technology are:

- (i) Restriction endonulease which cut DNA into short pieces.
- (ii) DNA ligase which joins segments of DNA.
- (iii) Vectors used in this technique are:
 - a. Plasmids
 - b. Viruses (Phage)

Answer 15.

These people have physiological adaptation of having higher red blood cell count than people living in the plains. Their body remains adapted to low oxygen availability by increasing red blood cell production, decreasing the binding capacity of hemoglobin and by increasing breathing rate.

Answer 16.

Consequences of deforestation:

- (i) Enhancement in the carbon dioxide concentration.
- (ii) Loss of biodiversity due to habitat destruction.
- (iii) Disturbance in hydrological and nutrient cycle.
- (iv) Desertification.

Answer 17.

CNG is better than diesel due to following reasons:

- (i) CNG burns most efficiently unlike petrol or diesel in the automobiles and very little of it is left unburnt.
- (ii) CNG is cheaper than petrol or diesel and cannot be adulterated like petrol or diesel.

Answer 18.

Cell mediated immune system is carried out by highly specialized cells. Immune system recognizes the 'non-self' and self. The foreign molecules are called antigens. When such an antigen enters the body, the cell mediated cytotoxicity as well as antibody mediated mechanisms produce enough antibodies in the host which form complexes with donor tissue.

Or

Study of biology has helped to control infectious diseases in following ways:

- (i) The use of vaccines and immunization programmes has enabled us to completely eradicate a deadly disease like small pox.
- (ii) The use of antibiotics and various other drugs has effectively treated many infectious diseases.

Section C

Answer 19.

In the asexual reproduction, the progeny arises from the somatic cells of the parent body and that remains identical to their parents (clone). All the divisions occurring during asexual reproduction are mitotic and no variations are observed in the offspring.

In sexual reproduction, the offspring is produced from the germinal cells of the parent body which show variation due to genetic recombination. Meiotic division occurs during the gametogenesis and mitosis at the time of zygote formation. The offspring remain better adapted to environmental conditions.

Answer 20.

Similarities between spermatogenesis and oogenesis:

- (i) Both the processes occur in three phases – multiplicative phase, growth phase and maturation phase.
- (ii) Both the processes lead to the formation of haploid gametes.
- (iii) In the multiplicative phase, mitosis division in both the processes differentiates the primordial germ cells of testes and ovaries into gametogonia (spermatogonia and oogonia).

Answer 21.

Process of elongation:

- (i) The t-RNA loaded with corresponding amino acid (anti-codon on t-RNA) binds with matching codon in the m-RNA at the A site in the presence of GTP.
- (ii) A peptidyl transferase results in the formation of a peptide bond between the carboxyl (-COOH) group of first amino acid at P site and amino (-NH₂) group of second amino acid at A site.
- (iii) The t-RNA at P site removes the GTP and t-RNA bound at A site carries a dipeptide.
- (iv) The linkage between methionine and its t-RNA at P site is broken. The uncharged t-RNA gets removed from the P site.
- (v) The t-RNA carrying polypeptide chain moves from the A to P site leaving the A site vacant.

Answer 22.

$F_2 \times F_2$ (Selfed) = White x White: Purple x Purple

- (i) White flowers of F_2 on selfing produced only white flowers in F_3 generation because white colour in this cross is recessive and it is always true breeding.
- (ii) Purple flowers of F_2 on selfing produced:
 - a. Purple flowers which are true-breeder they constituted the $1/3$ of the F_2 generation.
 - b. The remaining $2/3$ of the purple F_2 generation is not true-breeding like F_1 generation and so produced purple and white in the ratio of 3 : 1.

Answer 23.

Pathogen: Round worm (*Ascaris*) – an intestinal parasite.

Mode of transmission: Contaminated water, vegetables and fruits etc.

Symptoms: Internal bleeding, muscular pain, fever, anemia, and blockage of the intestinal passage.

Answer 24.

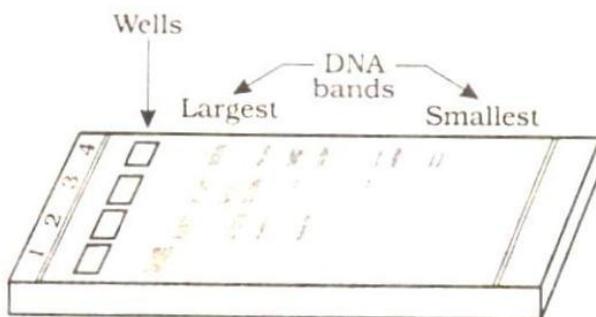
Sewage: It is the municipal waste water containing large amounts of organic matter and microbes.

The sewage promotes the growth of phytoplanktons. Their excessive growth depletes the oxygen in the water. This reduction of oxygen and the presence of poisonous wastes affect the fish population and are unsafe for human consumption. The sewage water contains disease germs, detergents and other decomposing substances and excreta. These cause severe diseases as typhoid, cholera, dysentery and jaundice in human population.

Answer 25.

Gel electrophoresis is a technique of separating DNA fragments, formed by the action restriction endonucleases. The fragments of DNA are placed in a typical agarose gel under an electric field. The DNA fragments move towards the anode as these fragments are negatively charged molecules. The DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. The smaller the fragment size, the farther it moves.

The separated DNA fragments are stained with ethidium bromide followed by exposure to UV radiation. The DNA fragments are seen as orange coloured and are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified in this way are used in constructing recombinant DNA by joining them with cloning vectors.

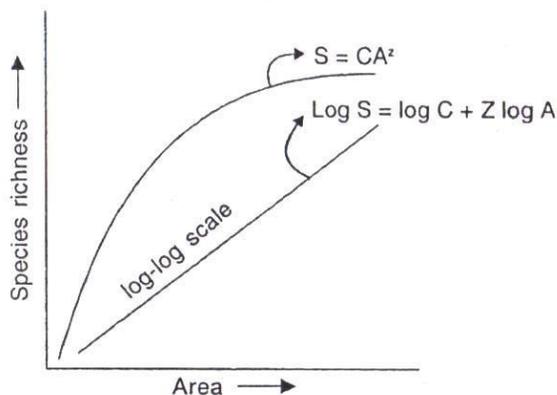


Answer 26.

Within a region, the species richness increases with increasing explored area but only up to a limit. The relationship between species richness and area for a wide variety of taxa turns out to be rectangular hyperbola. On a logarithmic scale, the relationship is a straight line.

$$\log S = \log C + Z \log A.$$

The value of Z lies in the range of 0.1 to 0.2 regardless of taxonomic group or the region. If the species-area relationship is for very large areas like entire continent, the slope of the line will be much steeper (Z values in the range of 0.6 to 1.2)

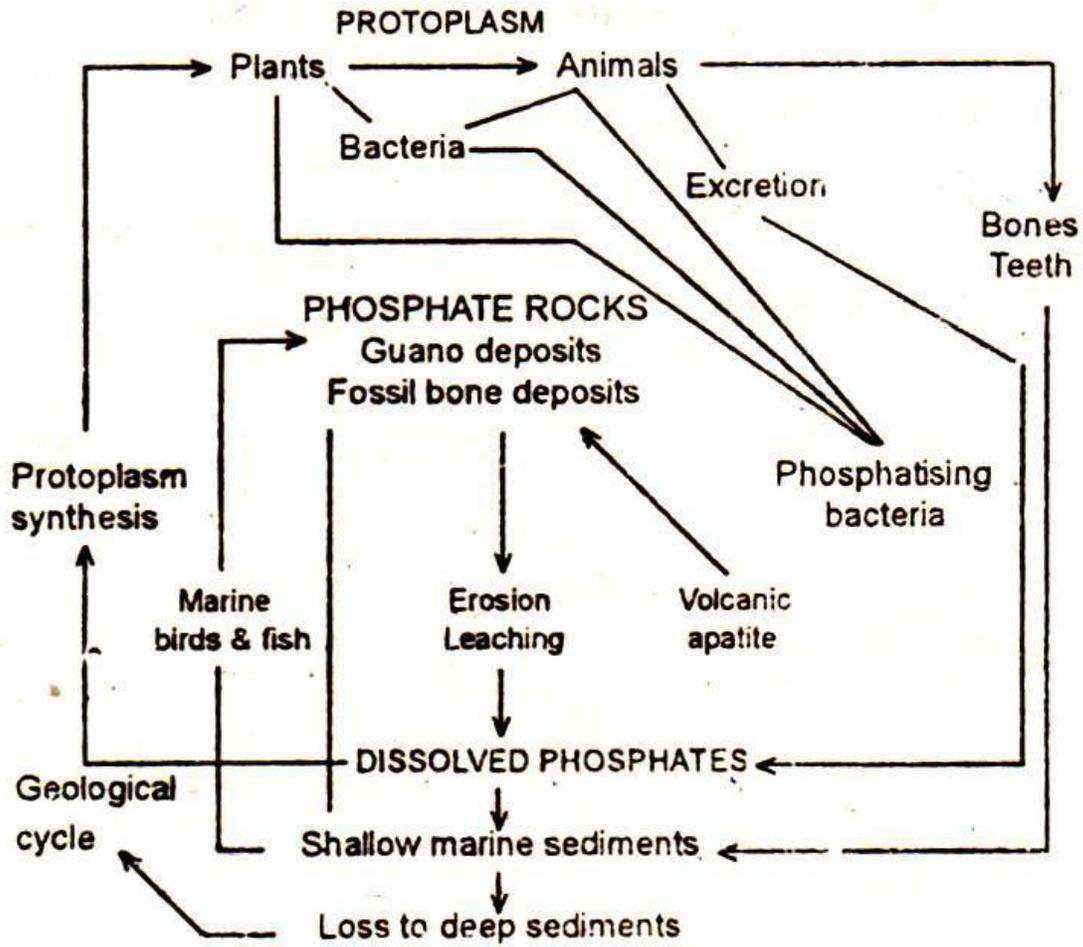


Showing species area relationship. Note that on log scale the relationship becomes linear.

Answer 27.

Humans maintain their body temperature constant at 37°C. In summer, the outside temperature is more than the body temperature. In this condition, the human sweats profusely. This brings down the body temperature (cooling) when the sweat evaporates. Similarly in winter, the outside temperature is much lower than 37°C. In this condition, the skin contracts to conserve the body and to raise the body temperature.

Or

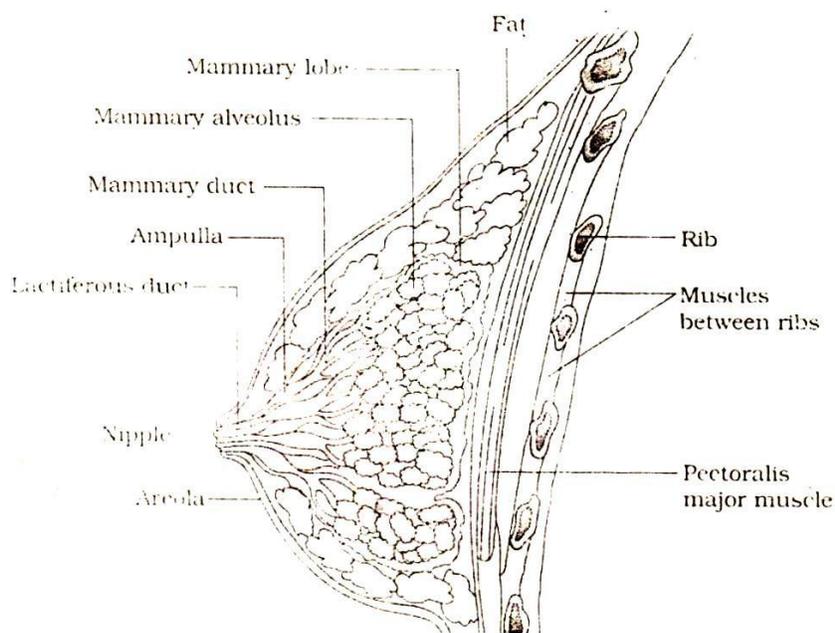


Phosphorus Cycle

Section D

Answer 28.

Each mammary gland consists of 15-25 lobules of the compound tubule-alveolar type. Each lobe is separated from the others by dense connective and adipose tissues and represents a gland. The cells of alveoli secrete milk which is stored in the cavities (lumens) of alveoli. The alveoli open into mammary tubules. The tubules of each lobe join to form a mammary duct. Several mammary ducts join to form a wider mammary ampulla which is connected to lactiferous duct through which milk reaches out. The excretory lactiferous ducts emerge independently in the nipple, which has 15-25 openings, each about 0.5 mm in diameter.



Mammary gland—A diagrammatic sectional view.

Or

Spermiogenesis – It is the process where spermatids undergo series of complex changes and result in the development of mature spermatozoa.

The following changes occur during spermiogenesis:

- (i) The spherical nucleus of spermatid changes into an elongated structure due to loss of water from it. DNA becomes concentrated; RNA and nucleolus reduces to minimum.
- (ii) Golgi apparatus become granular and then coalesces into a large globule, the acrosomal vesicle. This vesicle gets attached to the outer portion of nuclear membrane of head of sperm and forms the acrosomal cap.
- (iii) Centrioles migrate to the opposite end of the spermatid and form the proximal and distal centriole in the neck region of sperm.
- (iv) The distal centriole forms the axial filament of the slender tail.
- (v) The mitochondria of spermatid migrate and form the mitochondrial spiral (nebenkern) around the axial filament in the middle piece of sperm.
- (vi) The cytoplasm of the spermatid is lost except a thin, condensed sheath around the tail of the sperm (manchette).

After spermatogenesis, sperm heads become embedded in the sertoli cells and are finally released from the seminiferous tubules by the process called spermiation.

Answer 29.

Transcription: It is the formation of m-RNA strand on a DNA strand in the nucleus. The mechanism of m-RNA synthesis is analogous to DNA replication where only one of the two strands (sense strand) acts as a template. The formation of m-RNA takes place in 5' – 3' direction so the sequence of nucleotides on DNA template (sense strand) must be in 3' – 5' orientation.

This process involves unwinding of DNA and transcription starts at a specific point called as promoter region. DNA-dependent RNA polymerase enzyme binds to the 'Pribnow box' at the promoter region and starts the transcription process. RNA-polymerase enzyme contains a detachable sub-unit called the sigma (σ) factor. It helps the enzyme to bind firmly to the DNA. The RNA core polymerase (minus sigma factor) moves down the DNA at a faster pace and this continues to synthesize new RNA chain. It requires the building block of uracil (U), adenine (A), cytosine (C) and guanine (G). The base sequence in DNA decides the base sequence in m-RNA as A pairs with U and G pairs with C. The m-RNA is synthesized on DNA template in 5' – 3' direction and so successive nucleotides are attached at 3' –OH end of the growing m-RNA strand. So, the information of DNA coded in the sequence of base of cistron is transcribed to m-RNA. This process remains continued until it reaches the terminator sequence in the sense DNA strand (3' AAAAAAT – 5'). At this point, another protein particle, the rho (ρ) factor forms a complex with RNA-polymerase. This cause the enzyme to go off the DNA track and thus, new m-RNA is released. Many m-RNA are synthesized in rapid succession along a cistron. The completed m-RNA moves away from the nucleus and binds to a group of ribosomes in the cytoplasm.

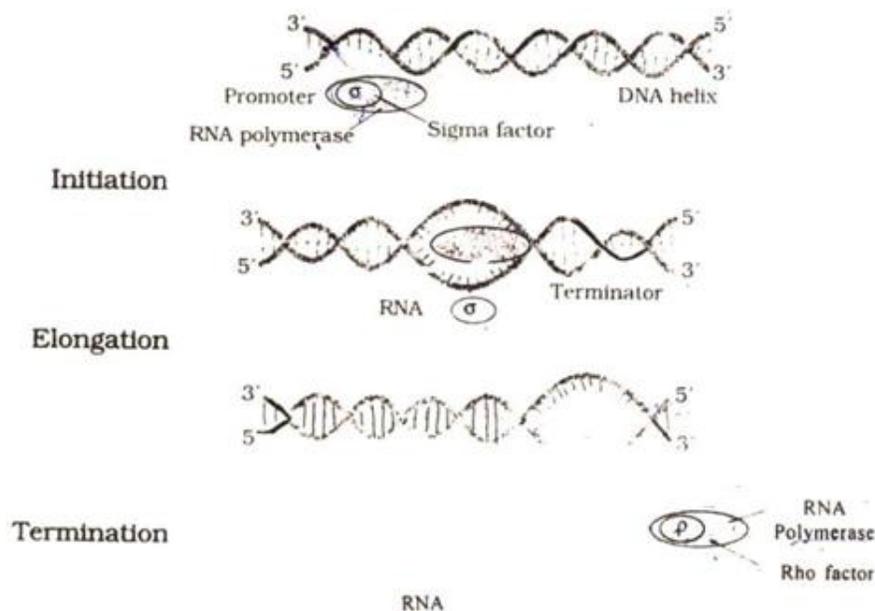


Diagram showing the mechanism of transcription.

Or

Features of the double-helix structure of DNA:

- (i) It is made of two polynucleotide chains where the backbone is constituted by sugar-phosphate and the base project inside.
- (ii) The two chains run in anti-parallel directions. The one chain has the polarity 5' – 3' and the other has 3' – 5'.
- (iii) The bases in two strands are paired through hydrogen bond (H – bounds). Adenine forms two hydrogen bonds with thymine from opposite strand vice-versa. Similarly, Guanine is bonded with cytosine with three H-bonds.
- (iv) The two chains are coiled in a right-handed fashion. The pitch of the helix is 3.4 nm and these are roughly ten base pairs in each turn. The distance between a base pair in a helix is approximately equal to 0.34 nm.
- (v) The plane of one base pair stacks over the other in double helix. This, in addition to H-bonds, confers stability of the helical structure.

Answer 30.

- (a) He feels energetic because nicotine raises blood pressure and increases heart beat. This is not good for his health.
- (b) CO binds to haemoglobin and reduces concentration of oxygen.
- (c) Other ill effects include cancer of lungs, throat, and emphysema.
- (d) Values:
 - (i) Awareness about health
 - (ii) Consciousness.
 - (iii) Critical thinking.