

ADVANCED LEVEL BIOLOGY NATIONAL EXAMINATION PAPER 2016
(BCG, MCB, PCB)

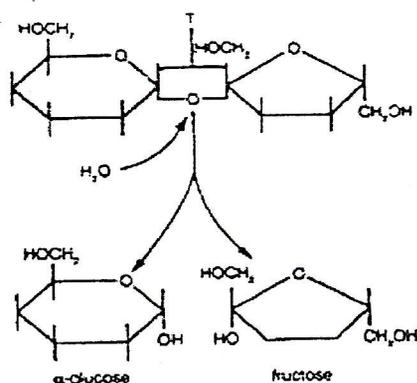
SECTION A: Answer ALL questions /70 marks

01. What are the four characteristics that all members of a species share? 4 marks

Answer:

- Have similar genes/genome
- Resemble one another/ Have similar physical appearance/morphological
- Capable of breeding/ to produce fertile offsprings
- Have common ancestry
- Occupy same ecological niche
- Have a similar number of chromosomes
- Have same physiological processes
- Have the same anatomical structure/ internal structure
- Have the same behaviors/ interactive behavior
- Have the same biochemical composition

02. The figure below shows the breakdown of a sucrose molecule.

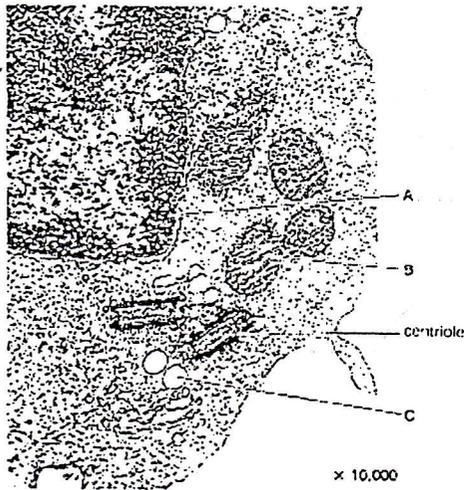


- a) Name the bond indicated by letter T. 1 mark
- b) State the name of this type of reaction in which water is involved. 1 mark
- c) State any two roles of water within plant cells other than taking part in breakdown reactions. 2 marks

Answer:

- a) Glycosidic bond/ 1,4-glycosidic bond(linkage)
- b) Hydrolysis reaction
- c)
 - Raw material of biochemical reactions (e.g: photosynthesis)
 - Solvent in all reactions resulting in excretion, secretion, etc.
 - Transport medium of different substances
 - Necessary for opening and closing of stomata through the osmosis resulting in turgidity or plasmolysis of guard cells.

03. The figure below is an electron micrograph of a part of an animal cell. A centriole is labeled.



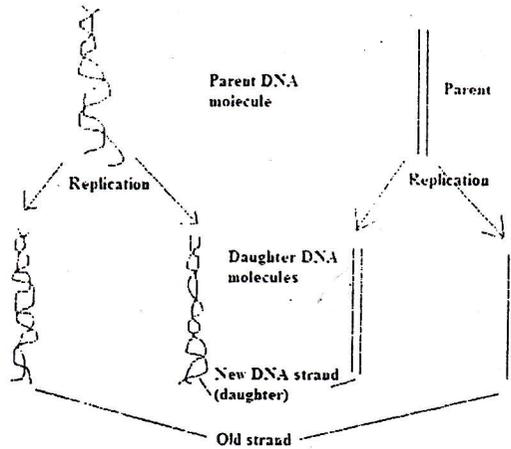
- a) Name the structures A, B and C. 3 marks
 b) Describe the roles of centrioles in animal cells. 3 marks

Answer:

- a) A – Nuclear envelop/ nuclear membrane
 B – Mitochondrion/ Cristae of mitochondrion (inner membrane of mitochondrion/ inner mitochondrial membrane)
 C - Golgi vesicle/ vacuole/ lysosome
- b) - Centrioles are involved in cell division by:
- Being involved in the formation of spindle fibers;
 - Orienting the movement of chromosomes during it;
 - Being involved in the formation of asters at opposite pole of the animal cell
 - Being involved in the arrangement of chromosomes during metaphase/ anaphase (phases of cell division)
- Centrioles are responsible of the formation of cilia, flagellum and cytoskeleton microtubules.
- Centriole is the organizing centre of microtubules
- Centrioles replicate allowing the cell division to occur
04. a) Explain why DNA replication is described as semi-conservative. 2 marks
 b) The enzyme that catalyses the replication of DNA checks for errors in the process and corrects them. This makes sure that the cells produced in mitosis are genetically identical. Explain why checking for errors and correcting them is necessary. 3 marks

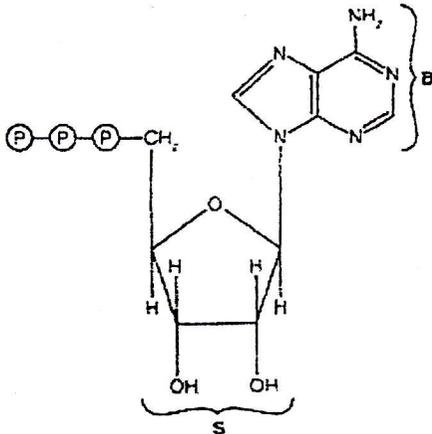
Answer:

- a) A DNA molecule has two polynucleotide strands. Both of them DNA strands act as a template for the formation of complementary DNA strand. The newly formed double helix retains one parent strand and has one new strand.



- b) - To avoid mutation and other genetic abnormalities
 - To maintain the DNA stability
 - To avoid the production of non-useful protein or the non-production of protein
 - To avoid the production of protein non recognized by immune system and which can be rejected.
 - To ensure the production of new DNA molecules similar to their parental DNA molecule.
 - To avoid problems resulting from mutation (variation)

05. The figure below shows the structure of ATP.



- a) i) Name the nitrogenous base labeled B. 1 mark
 ii) Name the sugar labeled S. 1 mark
 b) ATP is described as having a universal role as the energy currency in all living organisms. Explain why it is described in this way. 4 marks

Answer:

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- a) i) Adenine
ii) Ribose
- b) ATP has a universal role because it is found in most cells of all organisms. It is the energy currency because it releases energy when it is hydrolyzed. The released energy is used in cell reactions.

ATP

06. a) Cholera is transmitted by food and water that is contaminated by faecal matter. Suggest a reason why, in countries where cholera is common, babies who are breast fed are affected by cholera far less often than babies who are bottle fed. **3 marks**
- b) Suggest reasons why injecting antibiotics into the blood can be effective in killing the cholera bacterium while the same antibiotic taken orally (by mouth) is not. **4 marks**

Answer:

- a) Breast milk does not contain the bacterium that causes cholera. It contains antibodies that provide some resistance to it. Bottle fed babies have milk made up with water that may be contaminated with bacteria that cause cholera.
- b) - The antibiotic may be digested by enzymes and therefore not function.
- The antibiotic may be too large to diffuse across the intestinal epithelium
- Severe diarrhea/ vomiting is a symptom of cholera. Therefore any antibiotic taken orally may pass through the intestine so rapidly that is passed out of the body before it comes into contact with the cholera bacterium
- Vomiting may cause also prevents antibiotics taken
- Taken via the blood, the antibiotic is not digested and does not diffuse into the body and reaches the bacterium and kills it fastly.
07. Homozygous purple stemmed tomatoes were crossed with green stemmed plants. When the F₁ were all purple stemmed. When the F₁ plants were allowed to self-pollinate, the resulting F₂ produced 310 purple stemmed plants and 120 green stemmed plants.
- a) Which is the dominant allele? **1 mark**
- b) Draw a genetic diagram to show the F₁ and F₂ crosses. **5 marks**

Answer:

a) Purple stemmed/ purple

b) Purple P

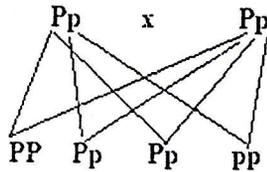
Green p

Parent genotypes PP x pp

Gametes P p

F₁ generation Pp 100% purple stemmed

F₂ F₁x F₁



Monohybridism with dominance

08. a) State one similarity and one difference between active transport and facilitated diffusion. **2 marks**
 b) The presence of many mitochondria is typical of cells that carry out active transport. Explain why this is so. **2 marks**

Answer:

- a) **Similarity:** - Involved in the transport of substances across the membrane
 - Assisted by membranal protein/ proteins/ carrier protein.
 - Both transport solute molecules

Differences:

Active transport	Facilitated diffusion
- Use of energy ATP/ energy is needed	- No use of energy (ATP)/ energy is not needed
- Substances move against the concentration gradient	- Substances move down the concentration gradient
- Use carrier proteins	- Use both carrier and channel proteins
- Active process	- passive process

- b) Active transport requires energy in the form of ATP. Mitochondria supply more ATP in cells and therefore they are numerous in cells carrying out active transport.
09. In the making of urine, glucose is initially lost from the blood but is then reabsorbed back into blood by kidney cells. Explain why it is important that this reabsorption occurs by active transport rather than diffusion. **4 marks**

Answer:

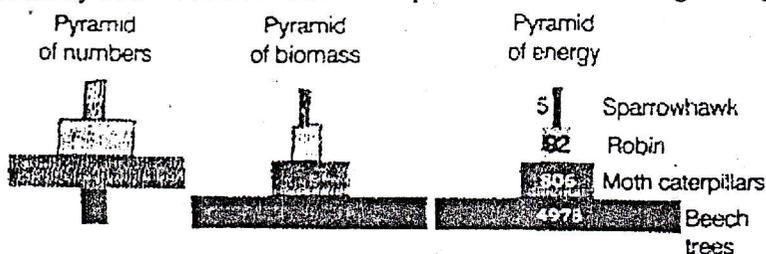
Diffusion at best can only reabsorb 50% of glucose lost from the blood. The other 50% will be lost from the body.

Active transport can absorb all the glucose, leaving none lost from the body.

Diffusion	Active transport
- some glucose 50% will be reabsorbed	- All glucose will be reabsorbed
- Absorbs some glucose	- Absorbs all glucose

- The reabsorption as done by active transport, the glucose will move from the nephron lumen to the blood from low glucose concentration of nephron lumen to high glucose concentration of the blood.

10. A study of a woodland food chain produced the following ecological pyramids:



- Which organisms are the primary consumers? **1 mark**
- Calculate the percentage efficiency with which energy is transferred from moth caterpillars to robins. Show your working. **2 marks**
- Suggest suitable units for the figures shown in the pyramids of energy. **1 mark**
- In the pyramids of numbers, the block representing beech trees is smaller than that of moth caterpillars. In other pyramids it is larger. Explain this difference. **3 marks**

Answer:

a) **Moth caterpillars**

b) $\frac{305}{4970} \times 100$ or $\frac{51}{305} \times 100$

c) **KJm⁻²year⁻¹ or Kcal m⁻²y⁻¹**

d) - Each beech tree has many caterpillar on it. Hence the beech tree block is smaller in the pyramid of numbers. Each beech tree is large and so has a greater biomass and more energy than all the moth caterpillars. Hence the beech tree block is larger in the biomass and energy pyramid.

- On beech tree can be fed by many parasites (caterpillars)

11. Explain why animals are dependent on light energy. **4 marks**

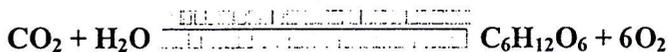
Answer:

- Light is important for photosynthesis. Animals depend on plants directly or indirectly for survival.

- Light energy is needed for photosynthesis. Photosynthetic organisms are at the beginning of almost all food chains. Animals are therefore dependent on plants, either directly or indirectly for their energy and materials.

- Animals are heterotrophs getting energy to make their own food through the photosynthesis.

Or



12. a) Plant cells that have a water potential of -600 kPa are placed in solutions of different water potentials. State in each of the following cases whether, after 10 minutes the cells would be:

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- Turgid
- Plasmolysis
- Incipient plasmolysis

Solution A = -400kPa

Solution B = -600kPa

Solution C = -900kPa

Solution D = Pure water.

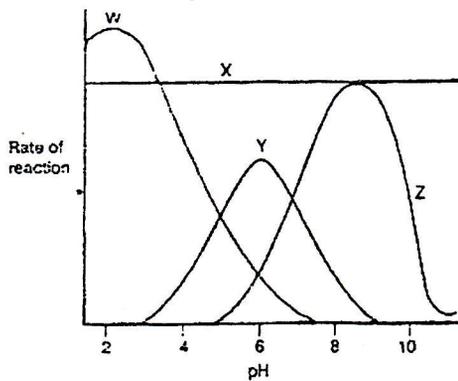
b) If an animal cell with a potential of -700 kPa was placed in each of the solutions above: in which solutions is it likely to burst? **1 mark**

Answer:

a)

b) In solution C

13. The graphs below show the rate of reaction of four different protein-digesting enzymes over a range of pH.



- a) Suggest which enzyme would be most suitable to use to tenderize meat (break up meat fibres to make it easier to chew). **4 marks**
- b) Why are proteins so important to living organisms? **4 marks**

Answer:

- a) Enzyme, because the rate of reaction for enzyme is high over the complete range of pH. It will therefore tenderize meat whatever its pH. The other enzymes only work efficiently around a narrow range of pH.
- b) - They are highly specific biological catalysts
 - They control cellular metabolism by determining which carbohydrate, lipid, nucleic acid to be present in the cell.
 - They are involved in:
- Repairing of damaged tissues
 - Protection of body against foreign bodies
 - In locomotion
 - In blood clotting. E.g: fibrin, thrombin, prothrombin
 - In vision e.g: opsins

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- In cellular transport; e.g: carrier, channel proteins
- They are affected by the change in temperature, they can be denatured, inactivated or work in good conditions.
- They are affected by the change of pH
- Is source of energy

SECTION B: ATTEMPT ANY THREE QUESTIONS ONLY. (30 MARKS)

14. The mammalian oestrous cycle is controlled by hormones secreted by pituitary gland and the ovaries. Describe the roles of the following hormones in the control of this cycle:
- a) The pituitary hormones FSH and LH. 5 marks
 - b) The ovarium hormones, oestrogen and progesterone. 5 marks

Answer:

- a) **FSH** – Stimulates the growth of follicles (help in maturing of follicles)
 - Maturing follicles secrete oestrogen**LH:** - Triggers the ovulation/ initiates (determines) the release of the secondary oocyte (oocyte II)
 - Induces the production of the progesterone by follicles and the formation of the yellow body/ corpus lutein that will go on producing the progesterone if the fertilization is done (production of progesterone)
- b) **Oestrogen** secreted by maturing follicles
 - Stimulates and repairs the uterine wall after the menses
 - Stimulates the growth of milk producing tissues in mammary glands
 - Its low levels inhibits the pituitary gland to secrete the LH (negative feedback at low concentration)
 - Its increased levels in blood stimulate the hypothalamus to secrete the GnRH (gonado trophin-releasing hormone), Hormone leading to increase of FSH and LH (bringing about ovulation) (positive feedback at high concentration)**Progesterone:**
 - Acts on last reparations of the uterine wall
 - Stimulates breast development
 - prepares uterine wall for a possible pregnancy
 - Inhibits further production of FSH and LH

15. Copy and complete the table below.

Plant growth substance	Site of synthesis	Effect in plant
Auxin		
Gibberellin		
Cytokinin		
Abscisic acid		
Ethene		

Answer:

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Plant growth substance	Site of synthesis	Effect in plant
Auxin	- Apical meristems - Young leaves - Young/ developing fruits	- Stem elongation/ cell elongation - root initiation - apical dominance - fruit formation - inhibition of leaf abscission - cell differentiation/ division
Gibberellin	Throughout shoots, seeds, leaves	- Stem elongation/ internode growth - Fruit development - seed germination - flower development - Enhance function of auxin - Involved in pollen development and pollen tube elongation - Inhibits seed dormancy
Cytokinin	Meristems/root apex Shoot apex Endosperm of seeds	- Development of roots - Development of lateral buds - Cell division - Delays senescence - Promotes flowering - Promotes seed germination - Influence the synthesis of protein
Abscisic acid	Most organs of plant/ seeds	- Abscission/ leaf fall and flower fall - Seed dormancy (promotes) - Stomatal closure and opening - Inhibits growth/ cell division of stem and roots.
Ethene	Throughout the plant	- Ripening of fruits and seeds - Abscission - Promotes dormancy in seeds - Sprouting of potato tubers and bulbs - Promotes senescence/ aging - Promotes flowering

16. a) Define the term chromosomal aberration. 2 marks
b) Describe different forms of chromosomal aberration. 8 marks

Answer:

- a) Chromosomal aberration refers to any change in the chromosome structure and chromosome number in an organism/ arrangement.

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Or

Chromosomal aberration: is a mutation resulting from a change in the amount of DNA or arrangement of DNA.

b) Different forms of chromosomal aberration can be: to a structure we find:

- Inversion occurring when a region of chromosome is broken and rotates through 180° before rejoining the chromosome. No change in genotype occurs as a result of inversion but phenotypic changes may be seen.
- Translocation involves a region of chromosome breaking off and rejoining either the other end of the same chromosome or another non-homologous chromosome.
- Duplication involves addition of a set of genes on the same chromosome.
- Deletion involves the loss of a region of chromosome either from the end or internally.

To a number we find:

- Euploidy/ polyploidy: change in the number of whole set of chromosome. e.g: triploid, tetraploid etc
- Aneuploidy/ e.g : turner syndrome XO,
Winefelter syndrome XXX

Aneuploidy : is a change which affect part of chromosomes or change by loss or gain form a set of chromosomes. E.g: monosomy, trisomy, tetrasomy, nullisomy

17. a) Describe characteristics of enzymes. 5 marks

b) Explain how a non-competitive inhibitor affects the rate of an enzyme-catalysed reaction. 5 marks

Answer:

a) Some characteristics of enzymes:

- They are effective in small amounts
- They are affected in the change of temperature
- They reduce the activation energy of reactants in a short period of time.
- They are globular proteins/ soluble
- They are specific. i.e: acting only one kind of substrate
- They remain unchanged at the end of reaction
- They act mostly rapidly in particular degree of pH (acidity, alkalinity)
- They are biological catalysts/ speed up biochemical reactions
- Being proteins, they are coded by DNA
- They catalyse reversible reactions

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- They are affected by inhibitors, poisons
 - They need cofactor to function
- b) Non-competitive inhibitors have a shape different from substrate molecules and attach to enzymes at a position other than the active/allosteric site. On attaching, they change the shape of the enzyme's active site. Hence the substrate will not fit in the active site.
- This will then slow (reversible non-competitive enzyme) or stop (irreversible non-competitive enzyme) the enzyme reaction.

Note:

- Non-competitive reversible → allosteric site
- Irreversible → active site and allosteric site

18. Describe the processes that are involved in protein synthesis. 10 marks

Answer:

- **Transcription**: takes place in the nucleus. Length of DNA unwinds using RNA polymerase, one strand of DNA acts as a template to produce mRNA with complementary bases to DNA. The RNA messages leave the nucleus via nuclear pore to the cytoplasm.
- **Translocation** takes place in the cytoplasm. The mRNA attaches to ribosome. tRNA in the cytoplasm initiates and holds amino acids to the ribosome. Amino acids are identified by their anticodons. The anticodon pairs with codon on mRNA; peptide bonds form between adjacent amino acids forming a chain of polypeptide. [Polyribosome allows multiple copies of the same polypeptide chain to form]