

- Na^+ ions move in
- Depolarisation of sarcolemma (post-synaptic membrane)
- Generation of action potential
- Hydrolysis of transmitter, cholinesterase (enzyme) is there for hydrolysis of acetylcholine.

**ADVANCED LEVEL BIOLOGY NATIONAL EXAMINATION PAPER 2015
(BCG, MCB, PCB)**

SECTION A: Answer ALL questions /70 marks

01. a) The scientific name for human beings is Homo sapiens. Using this information and your knowledge of classification, fill the missing parts in gaps in the table below. **4 marks**

Kingdom:

Phylum:

Class: mammalia

Order: primates

..... : Homo

..... : Homo sapiens

c) The system of classification shown above is described as hierarchical. What does this mean? **2 marks**

Answer:

a) **Kingdom: Animalia**

Phylum: chordate

Class: mammalia

Order: primates

Family: Homidadae

Genus: Homo

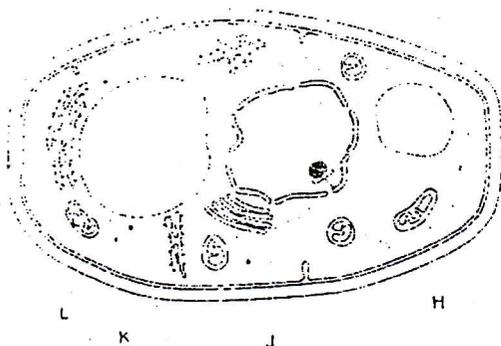
Species: Homo sapiens

b) Refers to a series of groups starting with the largest group called kingdom to the smaller group according to their shared characteristics.

Or it is the grouping from the highest to the lowest group

Or Is a grouping from kingdom to species

02. The diagram below shows the structure of yeast-like fungus that lives in human lungs. It is eukaryotic.



- a) Name structures H, J, K, and L. **4 marks**
 b) State two ways in which the structure of a prokaryotic cell differs from the one shown above. **2 marks**

Answer:

a)

H: nucleus

I: Golgi apparatus/ golgi body or golgi complex

K: cell wall

L: vacuole membrane

b) Prokaryotic cell lacks:

- True nucleus
- Golgi body
- Mitochondrion
- Large vacuoles
- Endoplasmic reticulum

03. a) What is the function of ribosomes? **1 mark**

b) In each of the following, name the organelle being referred to:

- i) Possesses structures called cristae
 - ii) Contains chromatins
 - iii) Synthesises glycoproteins
 - iv) Digests worn out organelles
- 4 marks**

Answer:

a) **Synthesis of proteins**

b) i) **Mitochondrion**

ii) **Nucleus**

iii) **golgi apparatus**

iv) **Lysosome**

04. Polysaccharides, such as glycogen, amylopectin and amylose, are formed by polymerization of glucose.

- a) Describe how the structure of glycogen differs from the structure of amylose. **2 marks**

- b) Describe the advantages of organisms in storing glycogen rather than storing glucose.
3 marks

Answer:

a)

Glycogen	Amylase
Branched molecule	Unbranched molecule
1, 6 and 1, 4 glycosidic links	1, 4- glycosidic bonds
Uncoiled molecule	Coiled molecule
More glucose molecules	Less glucose molecules
Many links	Few or no more link

- b) - Glycogen is insoluble so it does not easily diffuse out of cells
- It has no osmotic effects
- Glucose is soluble, lowers water potential of cells causing water to be drawn in cells by osmosis and would cause all bursting.

Glycogen	Glucose
Insoluble in water	Soluble in water
No osmotic effects	Osmotic effects
Provides more energy	Provides less energy
Glycogen is less reactive	Glycogen is more reactive
Glycogen is compact and occupies less spaces	Glucose is not compact and occupies large space

05. a) The protein. haemoglobin has a globular structure. What does this mean? 2 marks

- b) How is the structure of globular protein linked to its function? 4 marks

Answer:

- a) Polypeptide chain wound up or folded into a ball shape or has a tertiary structure

Or quaternary structure or compact structure or spherical, circular shape.

- b) Most of the hydrophilic amino acids groups are alined on the outside of molecule so globular proteins are soluble, more stable and have precise shape for enzymes/ antibodies or hormones.

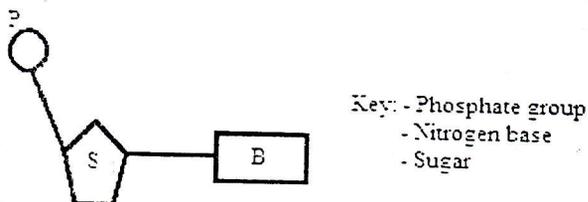
06. a) What are the basic components of a nucleotide? 3 marks

- b) In terms of structure of DNA molecule, explain why the base pairing are not adenine with guanine and thymine with cytosine. 3 marks

- c) The bases on one strand of DNA are TGGAGACT. What is the base sequence on the other strand? 1 mark

Answer:

- a) - A pentose sugar (deoxyribose or ribose) or 5-carbon sugar
- Phosphate group/ phosphoric acid (H_3PO_4)
- Organic nitrogenous base/ nitrogenous base or A, G, C, T, U



- Without key
- With key

b) Adenine and guanine are purines which means double ringed box, while cytosine and thymine are pyrimidines which means they have single ring.

Bonding adenine to guanine would produce a wider structure while cytosine to thymine would produce a narrow structure.

When adenine bonds to thymine two hydrogen bonds are formed while three hydrogen bonds are formed between cytosine and guanine. For stability purposes of DNA the bonding will follow that pattern.

Basing on the number of nitrogenous bases, the amount of adenine must always be equal to the amount of thymine. Also the amount of cytosine must equal the amount of guanine.

Adenine is only complementary to thymine while cytosine is only complementary to guanine.

c) ACCTCTGA

07. a) Plasmodium falciparum is the causative agent of most severe forms of malaria. It is distributed throughout the tropics. Explain why malaria is restricted to the tropics. 3 marks

b) Cholera is transmitted by food and water that is contaminated with faecal matter. Suggest three measures that might be used to limit the spread of this disease. 3 marks

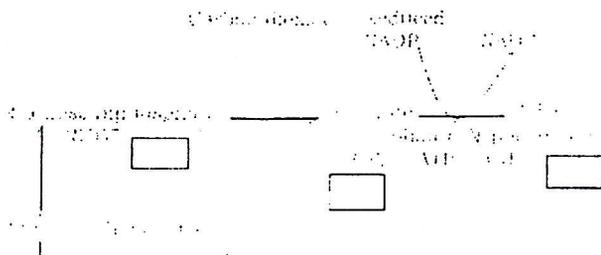
Answer:

a) Tropical climates provides the best breeding and living conditions for the anopheles mosquito which transmits malaria. Plasmodium needs temperature in excess of 20°C for it to complete its life cycle within the mosquito. The mosquito life cycle requires areas of stagnant water and these are common within the tropics.

- b) - Proper sanitation
- Proper hygiene: washing hands after visiting toilets
 - Use boiled water
 - Treatment of water
 - Educating the masses
 - Sewage treatment
 - Isolation of sick people fast

- Isolation of carriers

08. The diagram below shows the main stages in the light-independent reaction in photosynthesis.



- a) Write in the boxes in the diagram the number of carbon atoms in each of the relevant substances. **1 mark**
- b) What is the role of ATP in the conversion of:
- Glycerate -3-Phosphate to triose phosphate. **1 mark**
 - Ribulose phosphate to Ribulose biphosphate. **1 mark**
- c) A plant was allowed to photosynthesise normally. The light was then switched off. Explain why there was a rise in the amount of glycerate-3-phosphate in the chloroplast of this plant. **2 marks**

Answer:

a)

5

3

3

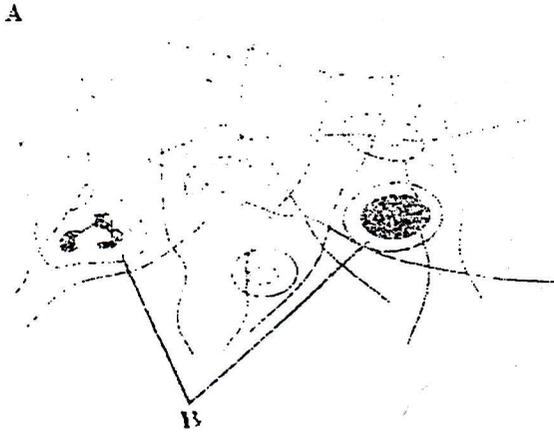
b) i) Transfers energy

ii) Supplies phosphate and transfers energy

c) - There was reduction of NADPH_2 and ATP needed to convert glycerate -3 phosphate to triose phosphate.

- Photosynthesis has got both the light and dark stages. When light is switched off, the dark stage will be favoured to produce more glycerate - 3 - phosphate.

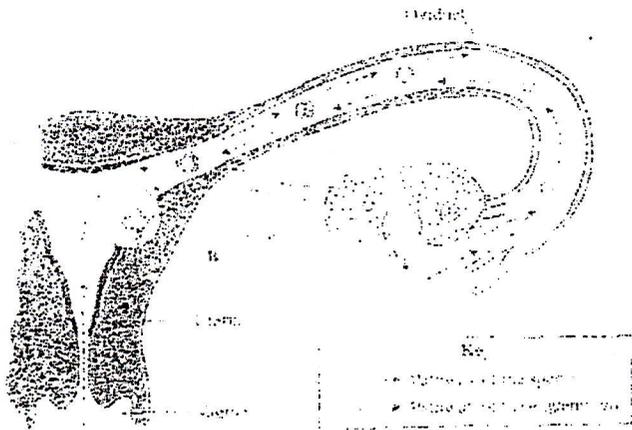
09. The diagram below shows a blood clot



- a) i) Name the type of blood cells labeled A. **1 mark**
 ii) What is the function of blood cells labeled A? **1 mark**
 iii) How does blood cell labelled B defend the body? **2 marks**
- b) When you cut yourself, you bleed and quickly a blood clot form to prevent further bleeding. Explain how this helps a person to stay healthy. **3 marks**

Answer:

- a) i) Red blood cells/ Erythrocytes
 ii) Transports oxygen (O₂) and carbon dioxide (CO₂)
 iii) – Phagocytosis/ engulf bacteria
 - Makes antibodies/ antitoxins
- b) Stops loss of blood and prevents entry of bacteria and prevents infection disease by holding the cut together, physical protection for wound healing.
10. The diagram shows part of the female reproductive organs



- a) Name the process shown at A. **1 mark**
- b) i) Write the letter X on the diagram to show where exactly fertilization occurs. **1 mark**

ii) After fertilization, implantation occurs. What will then form in the position marked B on the diagram? 1 mark

iii) If fertilisation did not occur, what would happen? 2 marks

Answer:

a) Ovulation or egg release/ release secondary oocyte

b) i)



ii) Placenta/ villi/ blood vessels

iii) - Breakdown of uterus lining

- Loss of blood/ menstruation, menstrual cycle/ period via vagina
- Egg degeneration
- Corpus luteum degenerated
- Levels of progesterone reduces

11. A man claims to be the father of a child who is blood group AB. The man is blood group O and the mother of the child is blood group A. State with reasons whether the man could be the father of the child. 3 marks

Answer:

The man is not the father.

Reason: The child who is blood group AB has alleles $I^A I^B$ or $I^A I^O$ or $I^A I^A$. In either case she could be have provided the I^A allele to the child but not the I^B allele.

The I^B must have come from the real father. The supposed father is blood group O and therefore has allele $I^O I^O$ and therefore cannot provide an I^B .

Possible blood groups genotypes of the mother are AO, AA

	A	A
O	AO	AO
O	AO	AO

100% A blood group

	A	O
O	AO	OO
O	AO	OO

50% A blood group

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50% O blood group

There is no AB blood group among offspring, therefore the man is not the father of the kid/ child.

12. a) Define selection as used in evolution. 1 mark
 b) Distinguish between directional and stabilizing selection. 2 marks

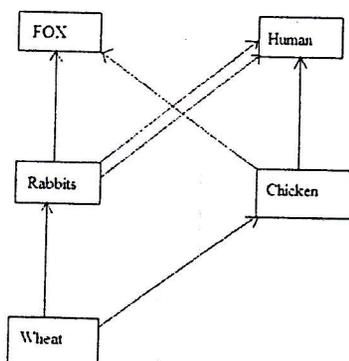
Answer:

- a) Selection is a process by which organisms that are better adapted to their environment survive and breed, while those less well adapted fail to do so.

b)

Directional selection	Stabilizing selection
Favour/ select phenotypes at one extreme of population	Favour/ select phenotypes around the mean of a population.
Change characteristics of a population	Preserves the characteristics of a population
Distribution curve remains the same shape but the mean shifts to the left or right	Distribution curve becomes narrower and higher but mean does not change.
There is competition	There is no competition

13. The diagram below shows a simple food web.



- a) Use the diagram to name: 3 marks
 i) A herbivore
 ii) An omnivore
 iii) A producer.
- b) The animals in food web get their energy from the food they eat. From where do the wheat plants get their energy? 1 mark
- c) Draw a pyramid of energy for the following food chain.
 Wheat → Rabbits → Fox 2 marks

Answer:

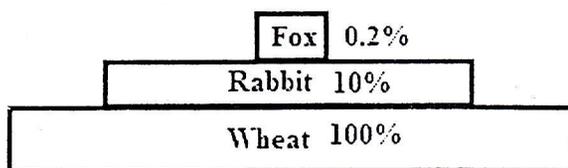
- a) i) Rabbit or chicken
 ii) Human or none
 iii) Wheat

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b) Sun or light

c)



Those are percentage energies

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

14. a) Compare the roles of the endocrine and nervous system in control and coordination in animals. 6 marks

b) Explain the roles of synapses in the nervous system. 4 marks

Answer:

a) Differences:

Endocrine system	Nervous system
Communication is by chemicals called hormones	Communication is by nerve impulse
Transmission is by the blood system	Transmission is by nerve fibres
Hormones are produced by ductless glands and transported in the blood stream	Nerve impulses originate in receptors and transmitted through neurons to effectors
Hormones travel to all parts of the body but only target organs respond	Nerve impulses travel to specific parts of the body.
Transmission is usually slow	Transmission is very rapid
Effects are widespread	Effects are localized
Response is slow	Response is rapid
Response is long lasting	Response is short lived
Effect may be permanent and irreversible	Effect is temporary and reversible

Similarities

- Both are means of communication/ coordinator
- Both are controlled by the brain
- Both are chemicals
- Both are triggered by stimulus
- Both provide response
- The target organ of endocrine system is equivalent to the effectors of nervous system
- Both require energy.

b) - Synapses convey impulses from one neuron to the next and it is from this basic function that all others arise. They can only pass impulses in one direction or

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unidirectional because only the presynaptic neuron has vesicles containing the neurotransmitters and only the presynaptic neuron has receptors for neurotransmitters.

- Synapses act as junction allowing nerve impulse to diverge and converge. This allows a single stimulus to create a number of simultaneous responses. They also filter out low level stimulus.

- Some synapses are inhibitor whereby they make it less likely that they will create a new action potential in a post-synaptic neuron or bring about summation of impulses.

- It is thought that synapses have a role in the brain where they are involved in memory and learning.

- Play an important role in integration

- Play an important role in amplification of impulses.

15. a) Explain how meiosis and fertilisation can result in genetic variation amongst offsprings. 5 marks

b) Explain how the environment may affect the phenotype of an organism. 5 marks

Answer:

a) Meiosis produces haploid gametes that fuse randomly at fertilization. Or Haploid gametes fuse to restore the diploid state, each gamete is different and their random fusion therefore produces a variety in the offsprings.

b) - Nutrition or food supply will affect the rise of organism

- Temperature will cause organisms to have bigger or small appendages

- Availability of water which will affect the size of plants.

- Light or sunlight will affect the skin colour of animals and colour of flowers in plants.

- Radiations will affect skin colour of animals

- Chemicals or cosmetic products will affect the skin texture.

- Soil structure and composition will affect growth of plants and all edophic factors.

- Biotic factors such as predators, parasite

16. Mass flow hypothesis describes the movement of sucrose solution from high to low pressure. What evidence is there for and against mass flow hypothesis? 10 marks

Answer:

Evidence:

- There is a higher concentration of sucrose in the leaves than in the roots
- Sucrose solution is flowing under pressure shown by phloem
- Some chemicals applied to the leaves are only translocated when light is present. Light allows photosynthesis and buildup of sugars which attract water causing hydrostatic pressure only during light hours.

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- When sucrose increases in the leaf, this is followed by an increase of sucrose in the phloem, suggesting it is transferred from leaves to phloem.
- A rise in sucrose concentration in the phloem occurs with increasing light intensity, suggesting a direct link between light, leaf and phloem (or more light intensity causes a rise in sucrose concentration)
- Observation of microscopic sections of living sieve cells shows a unidirectional flow of contents.

Evidence against:

- A mass flow is a passive and does not need ATP except where sugar is pumped into the sieve phloem.
 - Companion cells have lots of mitochondrion producing ATP with no obvious function.
 - Use of potassium cyanide, a metabolic poison which stops respiration, also stops translocation.
 - Does not explain the use of ATP during loading of sugars in phloem
 - The role of sieve plates in translocation is unclear or does not explain how sugars cross numerous sieve plates.
 - Does not explain how different nutrients move at different rates.
 - Does not explain the bi-directional flow of nutrients.
 - Does not explain the role of living cells
17. a) Explain the importance of a human being maintaining a constant internal temperature. **4 marks**
- b) Describe the role of the hypothalamus in the regulation of body temperature. **3 marks**
- c) Explain why in a normal healthy individual, the blood glucose level fluctuates very little. **3 marks**

Answer:

- a) Body temperature does not fluctuate as much as that of the environment; this allows humans to live in different places. To low temperatures would result in low enzyme activity hence low metabolism. Too high temperature would denature enzymes and disrupt the balance of substances produced during metabolism.
- b) - Hypothalamus receives information about temperature from skin receptors.
 - Hypothalamus detects changes in blood temperature.
 - It interprets/ analyses/ monitors body temperature change
 - It sends appropriate instruction to effectors.
- c) This is because the body produces two types of hormones such as insulin and glucagon.
 Insulin will decrease the high levels of blood glucose while glucagon will raise the low levels of blood glucose.

18. What are the main functions of water to:

- a) Plants? 4 marks
- b) Animals? 3 marks
- c) All organisms? 3 marks

Answer:

a) **To plants:**

- Osmosis and turgidity
- Reagent in photosynthesis
- Water cools the plant due to transpiration
- Germination of seeds
- Seed and fruit dispersal
- Translocation
- Causes mineral salts ascent due to transpiration pull
- Gamete transport
- Pollination

b) **To animals:**

- Transport and locomotion
- Osmoregulation
- Cool by evaporation, sweating
- Lubrication
- Support in hydrostatic skeleton
- Protection
- Maintain body mass
- Habitat
- In excretion
- Universal solvent

c) **To all organisms:**

- **Structure:** high water content of protoplasm
- **Solvent:** Medium of diffusion
- **Reagent:** In hydrolysis, medium for many reactions
- **Support:** In aquatic organisms
- **Fertilization:** By swimming gametes
- **Transport**
- **Habitat**
- **Body mass**
- **Constituent of many secretions/ hormones**

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