Or again
It occurs in cytoplasm;
- hexose is phosphorylated using ATP;
- hexose phosphate is split into two triose phosphates;
- oxidation by removal of hydrogen; (do not accept hydrogen ions/protons)
- conversion of NAD to NADH (+H+);
- net gain of two ATP / two ATP used and four ATP produced;
- pyruvate produced at the end of glycolysis;

c) In the second half of glycolysis, energy is released in the form of 4 ATP molecules and 2 NADH molecules.

- The net energy release in glycolysis is a result of two molecules of glyceraldehyde-3-phosphate entering the second half of glycolysis where they are converted to pyruvic acid.
- Substrate-level phosphorylation, where a substrate of glycolysis donates a phosphate to ADP, occurs in two steps of the second-half of glycolysis to produce ATP.
- The availability of NAD+ is a limiting factor for the steps of glycolysis; when it is unavailable, the second half of glycolysis slows or shuts down.

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SECTION A: Answer ALL questions /70 marks

01. a) Give two advantages of the electron microscope over a light microscope. **2 marks**
b) What is the difference between magnification and resolution? **3 marks**

Answer:

a) Two advantages of the electron microscope over a light microscope:
- The resolution is 0.1 nm(2000x more than in the light microscope)
- Electron microscope can be used to produce detailed images of the structures (organelles) inside cells.
- Sees greater details/ can see in 3D image
- Sees smaller organelles/objects/ structures
- Has greater magnification
- Has greater resolving power

b) Magnification is the number of times greater an image is than the object while Resolution is the ability to distinguish two separate points as distinct from each other.

02. Give at least four differences between Eukaryotic and Prokaryotic cells. **4 marks**

Answer:

Differences between Eukaryotic and prokaryotic cells

Eukaryotic cells	Prokaryotic cells
Have true nucleus	No true nucleus
Have linear DNA associated with protein histone	Have circular DNA not associated with protein
Membranes bound organelles	No membranes bound organelles
Large ribosomes (80s)	Small ribosomes(70s)
Cells are large	Cells are small
If flagella is present, it has 9+2 arrangement of microtubules	If flagella is present mad of single microtubule
Use mitochondria for respiration	Use mesosomes for respiration
If cell wall is present, it is made of cellulose of	If cell wall is present, it is made of peptidoglycan or murein
Cells divide by mitosis and meiosis	Cells divide by binary fission/ DNA replication
Found in multicellular and unicellular organisms	Found only in unicellular organisms
Found in multicellular and unicellular organisms	Found only in unicellular organism
Are evolved	Are primitive
Lack pili/ Fimbrae	Have pili/ Fimbrae
No plasmids	Have plasmid

03. The table below refers to features of animal, plant and Prokaryotic cells. Copy the table and place (√) in the appropriate box if the feature is present and (X) if the feature is absent.

Feature	Animal cell	Plant cell	Prokaryotic cell
Cell wall made of cellulose			
Endoplasmic reticulum			
Mesosome			
Ribosome			
Golgi apparatus			

Answer:

Feature	Animal cell	Plant cell	Prokaryotic cell
Cell wall made of cellulose	X	√	X
Endoplasmic reticulum	√	√	X
Mesosome	X	X	√
Ribosome	√	√	√
Golgi apparatus	√	√	X

04. Explain which way water will move by osmosis in each of the following sets of cells. **6 marks**

N°1

Cell A	Cell B
Y = -50 kpa	Y = -250 kpa

N° 2

Cell A	Cell B
Y= -500 kpa	Y= 0 kpa

N°3

Cell A	Cell B
Y = -200 kpa	Y = -200 kpa

Psi = Y_w = water potential
Kpa = kilopascals

Answer:

N°1: Water will move from cell A to cell B

Explanation: Cell A has higher water potential hence water moves from higher water potential to a lower water potential

N°2: Water will move from cell B to Cell A

Explanation: B has higher water potential due to being pure water.

N°3: Water will move in both directions/ no osmosis, no net movement.

Explanation: There is no net movement of water on either direction since water can easily move in both cells. i.e: have the same water potential.

05. a) Given two similarities between DNA replication and transcription. **2 marks**
b) Give two differences between DNA replication and translation. **2 marks**

Answer:

a) Similarities

- **Both involve copying a specific DNA base.**
- **Both involve breaking of hydrogen bond**
- **Both take place in the nucleus, mitochondria and chloroplasts**
- **In both polymerization occurs from 5'to 3' end**
- **Both require enzymes, ex: DNA helicase**
- **Both rely on the complementary of base**
- **Both require energy (ATP)**

b)

DNA replication	DNA Translation
Occurs mainly in the nucleus	Occurs in cytoplasm
Occurs on chromosome	Occurs on ribosome
No amino acid involved	Assembles amino acids to form a polypeptide
Catalysed by DNA polymerase	Catalyzed by peptidyl-transferase and amino acyl tRNA synthetase
Involves unzipping into two strands	Involves joining with tRNA
Leads to formation of two daughter DNA molecules	Leads to formation of polypeptide/ protein
Needs DNA template	Needs mRNA template to either side

06. Vaccination, together with identification and isolation of infectious persons as helped to eradicate smallpox, but not measles, tuberculosis, malaria and cholera. Giving one reason

for each of the four diseases, explain why each one is more difficult to eradicate than smallpox. 4 marks

Answer:

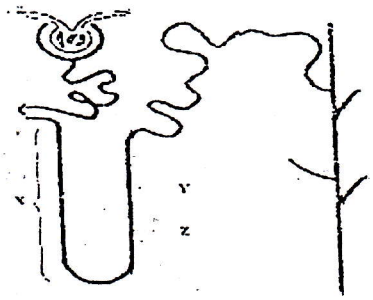
1. Measles: Incubation period is shorten than small pox hence difficult to identify and isolate before they become infections.
   - It is transmitted through carrier mother to health children hence marking it hard to eradicate.
   - It targets young children who like planning with each and when the vaccine is down in their body are prone (in danger) of spreading it or catching it.

2. Tuberculosis: Patient can carry pathogens and be infections without showing symptoms. Therefore they are difficult to identify and isolate.
   - The pathogens that cause TB are resistant and can stay longer in form of dust. This makes their eradication hard and increase the disease transmission.
   - The disease is common among the poor whose feeding and accommodation are insufficient. This makes the rooms over-crowded and if one is sick, the other family members can get the disease.
   - Disease is associated with HIV/ AIDS patients that have reduced immunity
   - The medication of TB is longer (i.e 6-8 months). Hence patients give up when not fully heated. The pathogens form endospores that surface after stopping to take medicine.
   - The disease also spread through milk of infected animals hence hard to vaccinate all animals.
   - T.B is spread in air medium which is dynamic hence cannot be resisted to a particular place. This increases the spread of pathogens especially in open.

3. Malaria:
   - Has no effective vaccine
   - The pathogens exist in mosquitoes
   - The plasmodium has become resistant to different drugs.
   - Ignorance of some people towards the disease and how it spread.

4. Cholera:
   - Vaccine not very effective
   - Pathogen can survive in water
   - Poor sanitation especially in camps.

07. The diagram below represents a Nephron from a human kidney.



a) Name the part labeled X. **1 mark**

b) Sodium chloride is actively pumped out of Z into the medulla of the kidney. This sodium chloride moves back into Y. Explain the effect of the sodium chloride concentration in the medulla of the kidney on the reabsorption of water from the collecting duct. **2 marks**

c) Most of the sodium chloride filtered into the glomerular filtrate is reabsorbed. From which part of the nephron does this reabsorption take place? **2 marks**

Answer:

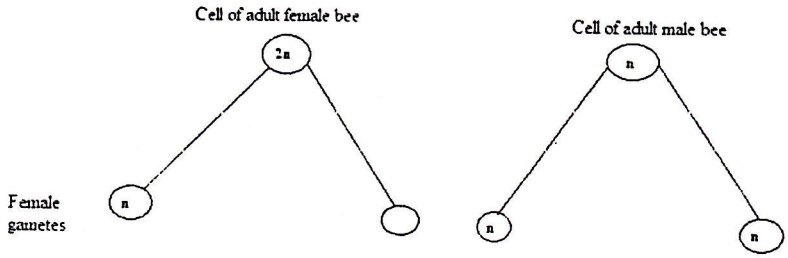
a) Loop of Henle or descending limb.

b) Water leaves collecting duct by osmosis in response to increase osmotic gradient in the medulla.

Or it increases the osmotic potential causing more water to leave the collecting duct.

c) Proximal convoluted tubule

08. The queen honey bee can lay both fertilized and unfertilized eggs. Fertilised eggs develop into diploid females and unfertilized eggs develop into haploid males. The diagram below shows the formation of gametes in female bees and male bees.



a) Giving a reason for your answer in each case, name the type of cell division in the bee that produces:

i) Female gamete. **2 marks**

ii) Male gamete. **2 marks**

b) The table below shows some features which contribute to variation in the offspring of bees. Copy and complete the table with a tick (☐)if the feature may contribute or a cross (x) if it does not. **3 marks**

Feature	Female offspring	Male offspring
Crossingover		
Independent segregation of chromosomes		
Random fusion of gametes		

Answer:

a) **i) Meiosis: This is because the number of chromosomes is halved.**
ii) Mitosis: because the number of chromosomes is maintained.

b)

Feature	Female offspring	Male offspring
Crossingover		
Independent segregation of chromosomes		
Random fusion of gametes		**X**

09. a) Explain the meaning of the term' 'gene frequency''. **2 marks**
b) List three factors which may alter the gene frequency in a small population. **3 marks**

Answer:

a) **Gene frequency: it is a number of individuals with a specific allele/ gene within a population. Or it is the ratio or proportion of a given allele in a population. Or again The occurrence of an allele is a population in relation to all alleles of that gene at the same locus, expressed as a fraction. Or again the rate at which a specific gene can be expressed in a population.**

b) **Factors:**

- **Mutation**
- **Random mating**
- **Sexual selection**
- **Crossing over (gene recombination)**
- **Migration**
- **Natural selection**
- **Genetic drift (founder effect or bottle neck effect)**
- **Gene flow**
- **Independent assortment**
- **Sterility**

10. The temperature control centre coordinates the mechanism which regulates body temperature.
a) Where is the temperature control centre in the brain? **1 mark**
b) Describe how the temperature control centre detects a rise in body temperature and produces an increase in the rate of sweating. **2 marks**

Answer:

a) **Hypothalamus**

b) **The hypothalamus receives impulses from peripheral receptors and from temperature sensors in the blood vessels impulses to the dermal arterioles cause vasodilation hence causing sweat glands to increase secretion of sweat on the skin surface.**

Or Increase in skin temperature [illegible]

11. In the world, forests are being burned and ploughed for agriculture. How is this likely to affect the carbon content of:
    a) the air **2 marks**
    b) The soil? **2 marks**
    Explain your answer.

Answer:

a) **Burning the forest will increase the CO_2 in the air due to less photosynthesis that will be caused by plant reduction.**
b) **It reduces, because ploughing reduces the carbon strored in the soil. Since increased aeration of soil increases activity of decomposers converting organic carbon to carbon dioxide which goes to air.**

12. Explain the following ecological terms:
    a) Pyramids of biomass. **2 marks**
    b) Net primary production. **2 marks**
    c) Community. **2 marks**

Answer:

a) **Pyramid of biomass: Diagrams showing total weight (or dry mass) of organisms at each trophic level in a particular ecosystem/ habitat at any time.**
b) **Net primary production: The rate of production of new biomass or energy by producers of a particular ecosystem. It equals the gross production minus respiratory losses of plants. Or it is the potential food which is available for primary consumers.**
c) **Community: All population/ organisms of different species living in a particular ecosystem/ habitat.**

13. With reference to flowering plants, distinguish between:
    a) Pollination and fertilization. **2 marks**
    b) Pollen grain and male gamete. **2 marks**

Answer:

a) **Pollination: is the transfer of pollen grain from anthers to the stigma while fertilization is a fusion of male and female gamete nuclei.**
b) **Pollen grain: is microspore containing two haploid nuclei, while a male gamete is a haploid cell formed from division of one of the nuclei of pollen grain.**

A pollen grain has got a cell wall made up of two layers (intine and exine) while male gamete has a cell membrane only.

14. a) There are two sounds during each heartbeat. Explain the source of these sounds. **2 marks**

    b) What is the function of the smooth muscle in the walls of thearteries? **2 marks**

    Answer:

    a) **Heart sounds are produced when heart valves close. The closure of atri-ventricular values causes the first sound and the closure of semilunar values causes the second sound.**

    b) **The smooth muscle in the arterioles can contract and relax. When the circular muscle contracts, it shortens and the lumen diameter is narrowed. This reduces the blood flow to the adjacent capillaries relaxation of muscle widens the lumen and more blood flows through. Therefore the smooth muscle controls blood flow. Or The smooth muscle controls the blood flow/ pressure by vaso-dilation and vaso-constriction.**

15. Explain the following terms in relation to the nervous system.

    a) Action potential. **2 marks**

    b) Refractory period. **2 marks**

    Answer:

    a) **Action potential: Potential difference across the axon membrane produced by a sudden increase in the axon permeability to Na^+ ions which enter the axons. It produces a propagated depolarization.**
    Or it is a propagated change in the trans membrane potential that once initiated, affects an entire excitable membrane.

    b) **Refractory period: The period when an axon membrane cannot respond to further depolarization.**
    Or It is a brief period in which an axon is not able to transmit another impulse following passage of an earlier one.
    Or again it is the period in which resting potential is being restored.

SECTION B: ATTEMPT ONLY THREE QUESTIONS. (30 marks)

16. a) What is meant by the terms:

    i) ''Continuous variation'? **2 marks**

    ii) ''Discontinuous variation''? **2 marks**

    b) How does each of the variations arise? **6 marks**

    Answer:

    a) **i) Continuous variation: This refers to the situation where a single phenotypic characteristic shows a complete gradation from one extreme to another without any break. Eg: mass, shape, colour, ...**
    Or it is a situation where there is no clear cut difference among individuals.

ii) Discontinuous variation: This refers to the situation where a single phenotypic characteristic appears in a limited number of distinct forms. Eg: blood groups
Or This is a situation where there is clear cut difference among individuals. Eg: blood groups, sex etc.

b) i) Causes of continuous variation:

- Combined effect of many genes forming a special gene complex called polygenic system. The individual effect of each of these genes would have no effect upon the phenotype.
- Environmental influences such as food supply, temperature and health.
- Genetic effect of reciprocal, crossing over of genes during meiosis.
- Orientation of chromatids during metaphase
- Random nature of fusion of gametes.

ii) Causes of discontinuous variation:

- Effect of genetic segregation, genetic reassortment
- Random fusion of gametes
- Major sources are due to gene or chromosome mutation
  Example: sickle cell anaemia
  Down's syndrome

17. Fats and glycogen are energy storage compounds in animals.
    a) Compare the suitability of the two substances as storage compounds. **4 marks**
    b) State the advantage of storing fats over glycogen. **3 marks**
    c) Why is glycogen a more suitable energy compound in muscles than fat? **3 marks**

Answer:

a) **Similarities between glycogen and fats:**

- Both are less soluble in water. None of the substance is cost in solution
- Both are less chemically reactive, can be stored over a long time.
- Both are compactly arranged; may/can occupy a small space.
- Both are sources of energy.
- Both are organic compounds (i.e: contain; C, H and O)
- Both yield metabolic water on respiration.

Differences between fats and glycogen:

Fats	Glucogen
- Yield more energy - Has less weight - Yield more metabolic water - Stored in adipose tissue - Hydrolysis yields glycerol and fatty acids	- Yield less energy - Has more weight - Yield less metabolic water - Stored in liver and muscles - Hydrolysis glucose

b) **Advantages of storing fats over glycogen:**

- **Fats yield more metabolic water upon oxidation**
- **Fats yield more energy per gram on oxidation**
- **Fats are completely insoluble in water**
- **Fats form an insulating layer under the skin which helps in temperature regulation.**
- **Fats are lighter than glycogen and helps to keep body weight minimum.**

c)

- **Break down of fats to fatty acids which can be utilized, is a slow process because it involves use of hormones.**
- **Conversion of glycogen to glucose is fast because it involves use of enzymes.**
- **Glucose from glycogen enters directly in glycolis to produce energy while fats undergo Beta oxidation.**
- **Oxidation of fats produces more heat which would burn out muscles.**
- **Anaerobic respiration of fats produce keton acids leading to lethal acid accumulation in muscle.**

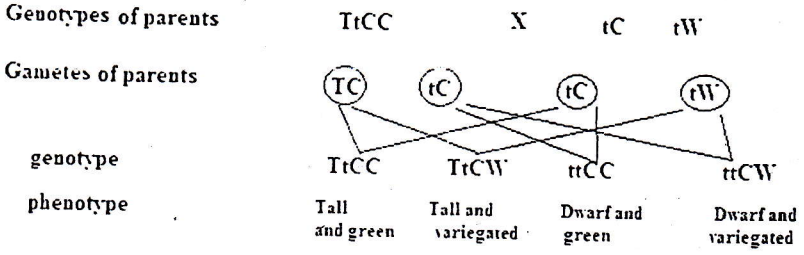
18. In an oil seed plant species, the allele for tallness is dominant over that for dwarfness. Meanwhile the allele for chlorophyll production and non-chlorophyll production show incomplete dominance. The heterozygous plants are variegated.
    a) Using suitable symbols, construct a diagram of a cross between a tall plant with green leaves and a dwarf plant with variegated leaves, to show the genotypes of the offsprings. **8 marks**
    b) Explain why 25% of the offsprings above would fail to survive **2 marks**

Answer:

a) **Let T represents allele for tall plants**
Let t represents allele for dwarf plants
Let C represents allele for chlorophyll production
Let W represents allele for non chlorophyll production
The tall plants with green leaves would have genotype TTCC or TtCC while dwarf plants with variegated leaves would have genotype ttCW.
Two possible crosses would be:
i) 1st case:

Parental phenotypes	**Tall green plant**	**X**	**dwarf variegated plant**	
Genotypes	**TTCC**	**X**	**ttCW**	
Gametes	**TC**		**tC**	**tW**
F1 genotype	**TtCC**		**TtCW**	
F1 phenotype	**Tall plants with green leaves**		**Tall plants with variegated leaves**	

ii) second case:



b) In the second cross above, 25% of the offsprings will not survive because they are dwarf and variegated (ttCW). They cannot reach out for enough light and don't have enough chlorophyll for photosynthesis.

19. a) Define the term ''parasitism''. **2 marks**

b) Give all possible ways which enable a parasite to live with its host. **8 marks**

Answer:

a) Parasitism: is the relationship between two organisms of different species where one (the parasite) benefits from the other (host) and harms it. i.e: gets benefits from the host.

b)

- **Having structures for attachment or boring into host tissue.**
- **Having ability to secrete substances that allow facilitate them to penetrate into the host.**
- **Having ability to resist the host's defensive mechanism.**
- **Having lost some body organs, example: endoparasites have eyes**
- **Having intermediate hosts**
- **Many are hermaphrodites**
- **Ability to produce many offsprings**
- **Having anticoagulants**
- **Having reproductive bodies eg: cysts and eggs**
- **Have a variety of hosts etc.**

20. Describe the sequence of events that occur when a nerve impulse arrives at a neuromuscular junction. **10 marks**

Answer:

- **Arrival of impulse at presynaptic membrane**
- **Increased permeability of membrane to Ca^{2+} ions**
- **Ca^{2+} enters**
- **Vesicles fuse with presynaptic membrane**
- **Transmitter of acetycholine/ noradrenaline/ adrenaline released into synaptic gap.**
- **Attachment to receptors of post synaptic membrane**

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- **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.**

ADVENCED 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 you 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.