MARKING OF ADVANCED LEVEL BIOLOGY NATIONAL EXAMINATION 2021-2022

SECTION A: ANSWER ALL QUESTIONS

1) a) Which eukaryotic kingdoms contain:
   i) Autotrophic organism: **plantae, protista, monera/Eubacteria**
   ii) Heterotrophic organisms**: animalia, fungi, protista, monera /Eubacteria**

   b) Classify each of the following organisms: cockroach, honeybee and maize under the following taxa, kingdom, phylum and class.

Organisms	**Kingdom**	**Phylum**	**Class**
Cockroach	Animalia	Arthropoda	Insecta
Honeybee	Animalia	Arthropoda	Insecta
Maize	Plantae	Magnoliophya/ Angiospermatophyta / Anthophyta / Spermatophyta	Liliopsida / Monocotyledonae

2) a) The plasma membrane contains the transport proteins which are involved in active transport.
It contains carrier molecules which combine with molecules to be transported and carry them across the membrane.
Formation of vesicles during endocytosis and exocytosis

   b) Another function of cell membrane: carbohydrates on the cell membrane can help to bind cells in tissues; contains receptors for hormones; can help in cell recognition…
   Respiration in prokaryotes
   Enclosing the cytoplasm and cell organelle

   c) i) Centrioles / centrosome
   ii) Centrioles are very important in ***cellular division***, where they arrange the mitotic spindles that pull the chromosome apart during mitosis.
   Formation of cilia and flagella

3)

Procedure	**Observation**	**Conclusion**
To 1cm^3 of test solution add 1cm^3 of dilute sodium hydroxide solution followed by 2 drops of copper II sulphate solution and mix. No heating is required. **(Biuret test)**	A **mauve** or **purple** colour develops slowly. The colour remains blue	**Proteins are present in the test solution** **Proteins are absent in the test solution**
To 2 cm^3 of test solution, add 2 cm^3 of Millon's reagent and heat. **(Millon's test)**	A Pink / Red coagulated precipitate Solution remains colourless	Protein present Protein absent
To 2 cm^3 of test solution, add 2 cm^3 of concentrated nitric acid and heat. (**Xanthoproteic test**)	Yellow precipitate Solution remains colourless	Protein present Protein absent

4) a)

Amylose	**Amylopectin**
Glucose joined by 1-4 glycosidic bonds	Glucose joined by 1-4 glycosidic bonds and 1-6 glycosidic bonds
Molecule is unbranched	Molecule is branched
High molecular weight	Low molecular weight
5000-100000 D-Glucose	200-5000 D-glucose
S I M I L A R I T I E S	
Formed from alpha glucose	
Glucose units linked by glycosidic bonds	

b) Water

5) a) The turnover number is **the maximum number of molecules of substrates that an enzyme can convert to products per unit of time.**

b)

Column 1	Column B
a	Active site
b	Enzyme
c	Substrate

c) Enzyme $\rightleftharpoons$ Enzyme + Product

Enzymes are not destroyed by the reaction they catalyze and so can be used again.
An enzyme can work in either direction.
Enzymes are specific in the reaction they catalyze.

6)

i) C*yclic photophosphorylation*: electron emitted by chlorophyll of photosystem I returns to chlorophyll by a series of carriers**;** *Non cyclic photophosphorylation*: electron emitted by chlorophyll of photosystem II does not return to that chlorophyll (but is absorbed by photosystem I and electron emitted by photosystem I is absorbed by NADP**).** The electron lost by chlorophyll is replaced by the electron from the photolysis of water.

Cyclic photophosphorylation	**Non cyclic photophosphorylation**
• Electron emitted by chlorophyll a of photosystem I returns to chlorophyll a by a series of carriers. • Only photosystem I is involved • ATP only produced • Photolysis of water does not occur • Last electron acceptor is PSI • First electron donor is PSI	• Electron emitted by chlorophyll of photosystem II don't return to that chlorophyll but are absorbed by photosystem I and electron emitted by photosystem I is absorbed by NADP. • PSI and PSII are both involved • Products include ATP, oxygen and NADPH • Last electron acceptor is NADP • Water is the first electron donor • Photolysis of water does occur.

ii) *Photophosphorylation*: synthesis of ATP using light energy in photosynthesis in a chloroplast**;** *oxidative phosphorylation*: synthesis of ATP using energy released from the electron transport chain in aerobic respiration in a mitochondrion**.**

Photophosphorylation	**Oxidative phosphorylation**
• Synthesis of ATP using light energy in photosynthesis in a chloroplast • Is independent of oxygen	• Synthesis of ATP using energy released from electron transport chain in aerobic

• Takes place in chloroplast • Final electron acceptor is NADP or PsI • Products are ATP, Oxygen and hydrogens • Hydrogen acceptor is NADP	respiration in a mitochondrion. • Occurs in presence of oxygen • Takes place in mitochondria • Final acceptor of electrons is oxygen. • Products are ATP and water • Hydrogen acceptor is NAD

7) a) i) Translocation is the transport of food in a plant.

ii) Importance of translocation to a life of a plant:

- **Transport of water**: due to transpirationnal pull, water is raised and rapidly distributed to all parts of the plants, where it performs various functions of the plant.
- **Cooling of the plant**
- **Distribution of minerals**: The movement of water and ions in the xylem vessels also brings about the distribution of mineral ions to all parts of the plant, especially to meristems where rapid growth takes place.

b) Even though transpiration is useful to the plant, too much transpiration can lead to the loss of mechanical support of the plant/decrease in cell turgidity. Too much transpiration can lead to the death of the plant.

8) a) A mouse has a large surface area to volume ratio than a cat; for this reason, the rat loses heat faster than a cat and it will require a high amount of energy than that required by a cat.

b) The end products of anaerobic respiration in:
i) Plants**: Ethanol/ethyl alcohol and energy**
ii) Animals**: Lactic acid and energy**

c) Hydrogen peroxide is formed in presence of oxygen. Hydrogen peroxide is toxic and toxifies the cells thus killing them.

9) Applications of anaerobic respiration:

- Production of beer
- Production of cheese
- Production of bread (baking)
- Production of wine
- Production of biogas

- Production of yoghurt
- Decomposition of organic waste
- Making silage

10) a) Sino atria node is called pacemaker because the contractions of the heart are self-initiated by SAN i.e. they are autonomic. In other words, it creates the electrical signals/impulses that initiate the heartbeat.

(a) b) Atrial fibrillation is an irregularity in heartbeat caused by involuntary contractions of small areas of heart wall muscle.
Fibrillation is when the atria do not beat in a synchronized way. This means the heart chambers are unable to fill properly and so the heart cannot pump the correct amount of blood at each beat.

11) a) Animals need to move from one place to another:
- To search for food
- To avoid predators
- To search mates
- To avoid unfavourable situations
- To search for water

b) The three types of skeletons in animals:
- Hydrostatic skeleton ex: earthworm
- Exoskeleton ex: spider
- Endoskeleton ex: human

12) The behavioural rhythms allow animals of different species to share the same food resources without direct competition because some animals are nocturnal and others are diurnal. The advantage of having a built-in method of responding to light and darkness.
Some examples of Behavioural rhythms include hibernation, estivation, migration, torpor…
The circadian rhythm is a rest activity cycle that is centered on light. Humans are active when there is light and rest when there is dark.

13)
(a) **A** is healthier

(b) The picture A shows the lungs with healthy alveoli, health blood vessels, healthy trachea and bronchus.
The lungs of B are coated with tar.

14) Yes. Reason: the sperm can live for up 72 hours or 3 days.
The egg will be released from the ovary (ovulation) while the sperm is still alive and fertilization will take place.

15) Low blood sugar level is harmful to the body because our body cells will be starved by the lack of glucose which is the main energy source for our body cells. Low blood sugar level reduces osmotic pressure of blood. It also reduces tissue respiration and this reduces energy in the body and may cause death.

16) Chemical reactions which provide energy. Chemosynthetic organisms use energy from chemical reactions to produce organic compounds as food for themselves. They are chemical reactions mainly involving oxidation of chemical substances.

17) Yes, if the mother has at least one allele for color blindness, and the father has colorblindness.

Suitable symbols could be: N allele for normal color vision; n allele for red-green color blindness; X^NX^N: normal female; X^NX^n: carrier (normal) female; X^NY: normal male; X^nY: male with color blindness.

Parents: X^NX^n and X^nY

Gametes are X^N; X^n and X^n; Y

Gametes	X^n	Y
X^N	X^NX^n	X^NY
X^n	X^nX^n	X^nY

1 Normal (carrier) female: 1 female with colorblindness: 1 normal male: 1 male with colorblindness.

Or Parents: X^nX^n and X^nY

Gametes are X^N; X^n and X^n; Y

Gametes	X^n	Y
X^n	X^nX^n	X^nY
X^n	X^nX^n	X^nY

2 females with colorblindness: 2 males with colorblindness.

18)

b) A mutation in a DNA triplet of a plasmid, changing TTT to TTG, gives an E. coli bacterium resistance to streptomycin.

d) Sensitive bacteria die in the presence of streptomycin as a selective agent.

f) The resistant bacterium has a selective advantage and survives.

c) The resistant bacterium divides and passes copies of R plasmid (plasmid with gene for resistance to antibiotic) to its offsprings.
e) The frequency of the mutated gene in the population increases.
a) Most of the population of E. coli are resistant to streptomycin.

Section B: Attempt any three questions

19)

a) Photosynthesis

b) Carnivorous / Secondary consumer.

c) Terrestrial ecosystem and aquatic / marine ecosystem.

d) Algae → Zooplankton → Small fish → Bird J → Hawk

e) The number of snails would increase
The number of hawks would decrease.
There would be increase in population of bird M because of more food as snails increase in number.
There would be reduction in green plants because of more snails eating them.

20) a) Homeostasis is the maintenance of a constant internal environment. Factors maintained constant in our body include the body temperature, blood pH, blood glucose concentration, …

b) The homeostatic functions of the liver:

- **Regulation of sugar:** Glucose is converted to glycogen under the influence of insulin hormone secreted by the pancreas and the reverse with hormone glucagon.
- **Deamination:** The liver breaks down excess amino acids. The amino group is removed as ammonia which combines with the carbon dioxide to form urea. The carbon skeleton may be converted to glucose for respiration.
- **Detoxification:** Ammonia from deamination is converted to less toxic urea in the liver. Toxins, hydrogen peroxide, alcohol and drugs are converted to less toxic substances by liver cells.

Others include:

- Regulation of plasma proteins
- Storage of vitamins A,B,D,E and K

- Heat production
- Inactivation of hormones and drugs.
- Storage of blood.
- Regulation of metabolism.

21)

- Fungi such as mushrooms can be **eaten.**
- Fungi help in the recycling of matter.
- Fungi produce many products used in nonfood industries. For example, ***Penicillium*** **species produce penicillin**, and **cephalosporium** species produce cephalosporin antibiotics..
- The yeast *Saccharomyces cerevisiae* is an important tool in genetic engineering. Yeast is also used to produce ethanol, a main ingredient in the automobile fuel gasohol.
- **Penicillin** is an important antibiotic derived from the mold *Penicillum notatum*. Penicillin is effective against a wide range of disease-causing bacteria. Penicillin acts by killing bacteria directly or by inhibiting their growth.
- The traditional brewer's and baker's yeasts (*Saccharomyces cerevisiae*) are ascomycetes. *Saccharomyces cerevisiae* makes bread rise and **ferments grapes to make wine and grain to make beer**.
- Production of bread
- Sometimes humans accidently **eat poisonous mushrooms**. For example, *Amanita* species contain extremely dangerous toxins that can destroy a person's liver in one week. The danger of Amanita species is reflected in their nicknames "death angel" and "destroying angel".
- Other fungal **poisons include the aflatoxins**, poisons produced by some species of *Aspergillus*. Aflatoxins cause liver cancer. Fungi that make aflatoxin may be found as contaminants in peanuts and in grains such as corn and grain sorghum.

22) **(i) Habitat loss:** Human alteration of habitat is the single greatest threat to biodiversity throughout the biosphere. Habitat loss has been brought about by agriculture, urban development, forestry, mining, and pollution.

(ii) Introduced Species: also called **non-native or exotic species**, are those that humans move, either intentionally or accidentally, from the species' native locations to new geographic regions. Rapid human travel by ship and airplane has accelerated the transplant of species. Free from the predators, parasites, and pathogens that limit their populations in their native habitats, such transplanted species may spread very rapidly through a new region.

(iii) Overexploitation: The term **overexploitation** refers generally to the human harvesting of wild organisms at rates exceeding the ability of

populations of those species to rebound. Species with restricted habitats, such as small islands, are particularly vulnerable to overexploitation.

(iv) AIR POLLUTION: Until fairly recently air pollutants were generally considered a local problem associated with urban and industrial centers. Now it has become apparent that pollutants may be transported long distances in the air, causing adverse effects in environments far removed from the source of emission. Air pollution and its control is thus a global issue demanding international cooperation. Important atmospheric pollutants include gases such as chlorofluorocarbons (CFCs), sulphur dioxide (SO_2), hydrocarbons and the oxides of nitrogen. Increasing levels of natural gases, such as carbon dioxide, in the atmosphere as a result of human activity can also be considered as a form of pollution.

(v) WATER POLLUTION: Until recently water pollution has been a relatively local problem of the developed world. **Eutrophication** is the most common problem, where inland waters and rivers are polluted with nitrogen and phosphorus run-off from fertilizers used in intensive agriculture and discharge of phosphate-rich sewage effluents. Such problems are increasingly occurring on a worldwide basis and now affect marine as well as freshwater ecosystems. Eutrophication is a process by which nutrients, particularly phosphorus and nitrogen, become highly concentrated in a body of water, leading to increased growth of organisms such as algae or cyanobacteria.

(vi) OIL POLLUTION: Oil pollution is a major hazard for marine and coastal environments. The main sources of marine oil pollution are:

- Damage to oil tanker ships through collision with other ships, explosion, or wrecking;
- Seepage from offshore installations;
- Flushing of tanker holds.

(vii) Mining

- Dust settles on plant leaves and block stomata reducing gaseous exchange and transpiration in plants.
- Dust blocks sunlight from reaching the leaves thus reducing photosynthesis.
- Dust causes respiratory diseases in animals.

(viii) Industrialisation

- Soot from fossil fuels cause cancer.
- Soot clogs stomata and block sunlight from reaching the leaves, thus reducing photosynthesis.
- Soot blacken walls of buildings
- Hydrocarbons cause cancer

- Presence of Sulphur dioxide in smog may lead to the formation of acid rain which destroys buildings and kills organisms in water and on land
- Carbon dioxide in smog causes global warming.

(ix) Farming

Using pesticides and herbicides may cause poisoning if inhaled. Chemicals can get into water and kill aquatic organisms. Herbicides can also kill non targeted organisms.

23) a) A gene / trait / allele carried on a sex chromosome / X or Y.
Or Genes attached to the sex chromosomes and are inherited with the chromosome.

b) Parental Phenotypes: Normal Father x Normal Mother
Genotypes X^BY X^BX^b

Gametes: X^B, Y and X^B, X^b

	X^B	X^b
X^B	$X^B X^B$ Angela	$X^B X^b$ Susan
Y	X^B Y George	X^b Y John