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एन सी ई आर टी
NCERT

Orientation of Teacher Educators in Designing Questions of Different Competency Level Based on Learning Outcomes at Secondary Level (as per NEP 2020)

PAC 23.44

Year - 2022-23

Dr. Daksha M. Parmar
Programme Coordinator

REGIONAL INSTITUTE OF EDUCATION (NCERT), BHOPAL

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A constituent Unit of National Council of Educational Research and Training, New Delhi

Approach Paper

Schools need to recognize learners' capacity to construct knowledge as a natural learner and the knowledge as an outcome of engagement with the world around when learner explores, responds, invents and makes meaning of it. Focus must be on the process of learning in place of product of learning, emphasizing competency-based educational process.

Assessment has always been an area of much concerned amongst the learners, parents and teachers. Higher Order Thinking Skills HOTS are important aspects in teaching and learning and is an area of sustaining interest as it prepares the learners not only in content but also for the futures. Thinking skills are fundamental in educational process. A person's thought can affect the ability, speed and effectiveness of learning. Therefore, thinking skills is associated with learning process. Higher-order questions are those that the students cannot answer just by simple recollection or by reading the information "verbatim" from the text. Higher-order questions put advanced cognitive demand on the part of the students. They encourage students to think beyond literal questions.

NEP-2020 states that "The current nature of secondary school exams, including Board exams and entrance exams - and the resulting coaching culture of today - are doing much harm, especially at the secondary school level, replacing valuable time for true learning with excessive exam coaching and preparation. These exams also forces students to learn a very narrow band of material in a single stream, rather than allowing the flexibility and choice that will be so important in the education system of the future".

In order to translate process based learning and assessment into practice, the NCERT brought out Learning Outcomes at Elementary Stage in 2017 and at Secondary Stage in 2019. As a follow-up of NEP 2020 discussions, it was felt essential that the entire school education to centre around competency based teaching-learning. Henceforth, NCERT undertook the task of developing learning outcomes for the higher secondary stage. The '*Learning Outcomes at Higher Secondary Stage'* aims to cover the whole spectrum of school education along with the other two documents on learning Outcomes. Learning Outcomes at higher secondary stage have been delineated in terms of curricular expectations and suggested pedagogical processes.

The curriculum in Biology should provide learners with sufficient conceptual clarity of biological phenomena which will provide the basic understanding required to further learn about the intricacies of the concepts by developing higher order thinking skills.

The items of HOTs have been an integral part of various higher secondary boards of the country ranging from CBSE (Higher Order Thinking Skills (HOTS) for Biology has been tested by CBSE in year 2011) to various state boards. HOTs items preparation revolves around the spirit of enquiry, independent thinking, creativity, thinking out of box, collaborative thinking, and conceptualizing new ideas. HOTs question for Biology test the analytical skills of the students. The students are given various situations and are asked to solve the situation based on the concepts they have learned in the subject. The student has to carefully read, understand, analyze, interpret the HOTs questions provided, apply various learning's and then provide solution to the questions. It's expected that students who are preparing for their exams will have to understand HOTs and increase more focus on HOTs so that they can shift away from rote learning and can start applying the learning into practical situation. Hence the programme was conceptualized keeping above in mind.

The present programme was designed keeping in mind the emphasis placed by the NEP-2020 and the shift away from rote memorization.The present programme is the outcome of previous year's programme entitled **"Development of items for enhancing Higher Order Thinking Skills in Biology for Classes-XI and XII using NCERT Textbooks"** which was conducted in two phases i.e. 17-21 January, 2022 and 21-25 February, 2022 (both were online) at RIE, Bhopal for the formation of test items, and on the basis of these the present training programme is planned keeping in view the Teachers at PGT level. With the coming of the New Education Policy (NEP-2020) there will be a shift in the curriculum followed by syllabus and textbooks after the preparation of NCF which is likely to take place in the near future.

Thus the focus of the programme remained higher secondary Biology syllabus using NCERT textbook as a reference point. All HOTS items have been made as per CBSE, NCERT syllabus by the best and experienced teachers of all subjects having many years of experience of teaching. An attempt is made to cover the entire syllabus, however certain topics because of the nature of the content could not be dealt with, and however being the first attempt of its kind, it serves the purpose.

The success of this training programme will be ensured by how far the teachers can motivate the students to solve these test items at their level.

Hopefully the programme will do the needful for which it is designed in a meticulous manner keeping desired weight age.

(Dr. D. M. Parmar)
Programme Coordinator

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LEARNING OUTCOMES FOR THE BIOLOGY HIGHER SECONDARY STAGE

Introduction:

Biology is the story of life on earth. It is the science of life forms and living processes. Biological systems often appear to challenge physical laws that govern the behaviour of matter and energy in our world. Historically, biological knowledge was ancillary to knowledge of human body and its function. The latter as we know, is the basis of medical practice. However, parts of biological knowledge developed independent of human application. Fundamental questions about origin of life, the origin and growth of biodiversity, the evolution of flora and fauna of different habitats, etc., caught the imagination of biologists.

The very description of living organisms be it from morphological perspective, physiological perspective, taxonomical perspective, etc., engaged scientists to such an extent that for sheer convenience, if not for anything else, the subject matter got artificially divided into the subdisciplines of botany and zoology and later into even microbiology. Meanwhile, physical sciences made heavy inroads into biology, and established biochemistry and biophysics as new subdisciplines of biology. Mendel's work and its rediscovery in the early twentieth century led to the promotion of study of genetics. The discovery of the double-helical structure of DNA and the deciphering of three dimensional structures of many macromolecules led to the establishment of and phenomenal growth in the dominating area of molecular biology. In a sense, functional disciplines laying emphasis on mechanisms underlying living processes, received more attention, support, intellectual and social recognition. Biology, unfortunately, got divided into classical and modern biology. To the majority of practising biologists, pursuit of biological research became more empirical rather than a curiosity and hypothesis driven intellectual exercise as is the case with theoretical physics, experimental physics, structural chemistry and material science. Fortunately and quietly, general unifying principles of biology were also being discovered, rediscovered and emphasised.

In the nineteenth and twentieth century's, Physics and Chemistry were applied to Biology and the new science of Biochemistry soon became the dominant face of biology. On one hand Biochemistry was integrating with Physiology, becoming almost synonymous with it. On the other hand it gave rise to Structural Biology (structure of biomacromolecules), originally called Molecular Biology. The work of eminent biologists established a modern version of

Molecular Biology dealing with life processes at molecular level. Physics and Chemistry dominated public perception of science for a long time. Day-to-day

life of man was influenced by developments in Physics, Chemistry and their respective manufacturing industries. Slowly and steadily, Biology, not to be left behind, demonstrated its utility for human welfare. Medical practice, especially diagnostics, green revolution and the newly emerging biotechnology and its success stories made the presence of biology felt by the common man. Patent laws brought biology into political domain and commercial value of biology became obvious.

Thus, the subject Biology has emerged as one of the separate disciplines of science at higher secondary level. Although the nature of biology and nature of physical sciences share many common aspects, however, focus of biology creates unique philosophical, methodological and ethical premises on which biology should be understood and assessed. The curriculum in

Biology should provide learners with sufficient conceptual clarity of biological phenomena which will provide the basic understanding required to further learn about the intricacies of the concepts by developing higher order thinking skills.

Curricular expectations:

At higher secondary stage learners who have opted for biology as one of the disciplines for study, are expected to:

1. Identify and develop understanding of concepts, principles, theories, and laws governing the physical world around a biological entity.
2. Develop ability to acquire and use the methods and processes of science, such as observing, questioning, planning investigations, hypothesising, collecting, analysing and interpreting data, communicating explanations with evidences, justifying explanations, thinking critically to consider and evaluate alternative explanation, etc., in the biological perspectives.
3. Build upon the perceptive of basic tools and techniques used in concepts to analyse various issues in biology.
4. Conduct experiments, also involving quantitative measurements in biology.
5. Appreciate how concepts of biology evolve with time giving importance to its historical perspective.
6. Develop scientific temper with respect to biological phenomena (objectivity, critical thinking, creative skills, freedom from fear and prejudice, etc.).
7. Nurture natural curiosity, aesthetic sense, and creativity in biological processes and phenomena.
8. Imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment.

9. Develop respect for human dignity and rights, equity and equality.
10. Connect biological concepts to real life problems and develop innovative problem-solving abilities to solve problems related to life situations through understanding of biological concepts.
11. Widen skills to illustrate linkages of elementary aspects of biology with complex phenomena.
12. Apply biological discoveries/ innovations in everyday life.
13. Integrate and interrelate the biological concepts with other areas of knowledge by underlying common principles.

Class XI

Suggestive Pedagogical Processes	**Learning Outcomes**
The learners may be provided with opportunities individually or in groups and encouraged to — •explore surroundings and observe, group or classify organisms, phenomena and processes based on certain characteristics and salient features, such as; cell types, cell walls, mode of nutrition, etc., by performing various activities/ experiments/ investigations. Based on the observations, a discussion may be facilitated to help arrive at the appropriate conclusions. •ask questions on the basis of observations such as how to group organisms in various taxonomic categories? How to do Hydroponic plant production? •design and carry out activities/experiment/investigations to find the answer to their queries, such as, Separating the mixture of plant pigments using paper chromatography and their absorption spectrum using	Learner 1. differentiates organisms, phenomena and processes based on certain characteristics and salient features, such as, prokaryotes and eukaryotes, plant cell and animal cell, diffusion and osmosis, meristematic tissues and permanent tissues; squamous epithelium and cuboidal epithelium, diploblastic and triploblastic organisation; metacentric, submetacentric, acrocentric and telocentric chromosomes; etc. 2. classifies organisms, phenomena and processes, based on certain characteristics / salient features systematically in more scientific and organized manner; such as five kingdom classification system of organisms under various hierarchical structural organizations; natural resources, etc. 3. relates processes and phenomena with causes and effects, such as, characteristics of living with cell

spectrophotometer, or effect of light intensity on the rate of photosynthesis, followed by peer group discussion to generalise. •connect with the daily life experiences, through interdisciplinary approach by using various available resources including textbooks, newspapers, internet etc; such as; using leaves of neem (Azadirachta indica) in storing food grains due to the presence of bioactive compounds in neem leaves as result of secondary metabolism and their pesticidal effects. •conduct survey to understand the process of spreading of diseases. They may be encouraged to collect data from doctors and nurses about various diseases. They can prepare a report on spread, causes, prevention, and cure of diseases. They may share their findings with the community through role plays, skits and also campaign in the community for prevention. •present their observations/ ideas/ learning through flow charts/ concept maps/ graphs/ floral diagram and ICT tools, etc. •gather data for calculating different physical quantities, such as determination of population density, productivity, percentage of pollen germination, etc, which can be shared and discussed in groups or with peers. Uses rubrics to assess the conversion of units and reporting results. •Draw diagrams / sketches/ flow charts, concept maps, floral diagrams, painting	as basic unit of life, transpiration pull with absorption of water by roots of plants; tissues with their functions, deficiency symptoms of essential elements, pumping of heart with circulation of blood, hormones with various physiological functions, digestive enzymes electrocardiograph (ECG) and heart diseases; smoking and lung diseases; etc. 4. applies scientific terminology for organisms, processes, and phenomena based on internationally accepted conventions, such as, systematic technical description of flowers, taxonomic study of plants and animals; Binomial nomenclature of organisms; coelom, bisymmetric body etc; bisexual and unisexual organisms, actinomorphic and zygomorphic flowers, aestivations, placentations, physiological processes, cardiac cycle; organ structures; SA node; AV node; etc. 5. explains efficiently systems, relationships, processes and phenomena such as; organ systems in frog, cockroach and earthworms, structures and function of cell organelles, photosynthesis, respiration, mechanism of contraction of skeletal muscles, etc. 6. describes contribution of scientists/researchers all over the world in systematic evolution of concepts, scientific discoveries and inventions in the field of biology

etc, of organisms and processes etc; may be sometimes by using software tools such as paint and brush etc •collect and analyse wide variety of graphs from newspapers, magazines or the internet. They may be encouraged to draw, analyse and interpret the graphs, for example, substrate concentration graphs, growth versus time graphs, etc. •write chemical formulae of bio-molecules, bio-chemical equations, etc., using 3-D models. •write floral formulae of flowers using live specimens, etc. •select and use appropriate devices for understanding of structural and physiological and other intricacies of living organisms. •collect information from books, e-books, magazines, journals, libraries, internet, etc., to appreciate the efforts of scientists made over time, for example, discovery of microscope, etc., and showcase it in the form of a project or role play. •observe various technological devices and innovative exhibits such as waste management kits, water filtration system, using low-cost or no-cost eco-friendly materials, develop them and showcase it in science exhibitions, clubs and parent-teacher meets. •share and discuss their beliefs and views regarding myths, taboos, superstitions, etc., by initiating an open ended debate, discussion/arguments leading to the alignment of their beliefs to the scientifically proven facts. They may also	based on historical scientific events/ timelines etc; such as; Anton Von Leeuwenhoek described alive cell and later, Robert Brown discovered the nucleus; in classification systems of living organisms, Aristotle was the earliest and then Linnaeus proposed two kingdom classification and later R. H. Whittaker proposed five kingdom classification, etc. 7. makes linkages at the interface of Biology with other disciplines by relating various interdisciplinary concepts such as; mathematical models on arithmetic and geometric growth rates in plants/ organisms, absorption and transfer of light energy in photosynthesis; secondary metabolites, structure of protein, structure of DNA, etc. 8. draws labelled diagrams, flow charts, concept maps, graphs and **floral diagrams,** such as, floral diagrams of given flowers, parts of flowers, modified roots external features of earthworm, cockroach and frog, Z-scheme of light reaction, calvin cycle, etc. 9. writes floral formulae in technical language based on floral diagrams of different flowers such as flowers of pea, makoi and onion etc 10. prepares slides for study the structural intricacies of life forms and structural organisations, such as, transverse sections of root, stem and leaves, mitosis and meiosis;

be involved in awareness campaigns in the community	pollen germination, etc. 11. handles laboratory tools, and apparatuses, instruments and devices properly for performing activities/ experiments/ investigations such as; uses foldscope/microscope for observing internal structure of transverse section of root, stem and leaves, intricacies of chloroplasts, stomata, etc.; digital balance/scale for weighing chemicals; pipette for drawing liquid, etc. 12. plans and conducts investigations and experiments to arrive at and verify the facts, principles, phenomena, or to seek answers to queries on their own, such as, what is the pattern and structure of organisms in nature?, Does *Pisum sativum* carry bisexual and zygomorphic flowers, how do plants grow in length?, Do plants breath?, What does (mainly which gas) our breath contains?, What happens to cooked rice when we chew and when we do not chew? etc. 13. analyses and interprets graphs and figures such as, Enzyme activity temperature, pH and substrate concentration graphs, growth versus time graphs, oxygen dissociation curve etc. 14. uses scientific conventions, symbols, and equations to represent various quantities, elements, and units, such as, SI units, symbols of

	elements, formulae of simple compounds, pathways of aerobic and anaerobic respiration, organic compounds in living organisms, etc. 15. draws conclusion on the basis of data collected in activities / experiments and investigatory projects conducted by them, such as, roots, stem and leaves modify to perform various functions, deficiency of nutrients affect physiological processes in plants, deficiency of protein in diet causes protein-energy malnutrition (PEM), etc. 16. communicates the findings and conclusions effectively, such as, those derived from experiments, activities, and projects both in oral and written form using appropriate figures, tables, graphs, and digital forms, takes part in the discussions, argumentations etc. 17. applies scientific concepts of Biology in daily life and solving problems, such as; by mowing the grass of a lawn assuming that due to lateral meristem grass will regrow, determine the age of a fallen tree by counting concentric rings present on the transverse cut of tree trunk, drinking less/more water changes the concentration and volume of urine, etc. 18. appreciates technological applications and processes in Biology towards the improvement in the quality of life and sustainable development, such as, Hydroponic

	plant production, uses of algae as commercially like *Algin* (brown algae), *Carrageen* (red algae), *Agar*; *Chlorella* uses as food supplement in space; dialysis for kidney failure patients; uses of artificial arms and limbs, etc. 19. exhibits creativity in designing models using eco-friendly resources / preparing charts / paintings / sketching/ etc. on different topics; such as; structure of cockroach, etc. 20. exhibits ethics and values of honesty, objectivity, rational thinking and freedom from myth and superstitious beliefs while taking decisions, such as, reports and records experimental data accurately, reveals respect for life by using weed plant for investigatory studies/ activities, etc., 21. makes efforts to conserve environment realizing the inter-dependency and inter-relationship in the biotic and abiotic factors of environment, such as, by appreciating use of weed plants in the study, using eco-friendly waste material, etc. 22. applies learning to hypothetical situations, such as, possibility of life on other planets, etc.

Class XII

Suggestive Pedagogical Processes	Learning Outcomes
The learners may be provided with opportunities individually or in groups and encouraged to — •explore surroundings and observe, group or classify organisms, phenomena and processes based on certain characteristics and salient features, such as; cell types, cell walls, mode of nutrition, etc., by performing various activities/experiments/ investigations. Based on the observations, a discussion may be facilitated to help arrive at the appropriate conclusions. •ask questions on the basis of observations such as how to group organisms in various taxonomic categories? How to do Hydroponic plant production? •design and carry out activities/experiment/investigations to find the answer to their queries, such as, Separating the mixture of plant pigments using paper chromatography and their absorption spectrum using spectrophotometer, or effect of light intensity on the rate of photosynthesis, followed by peer group discussion to generalise. •connect with the daily life experiences, through interdisciplinary approach by using various available resources including textbooks, newspapers, internet etc; such as; using leaves of neem (Azadirachta indica) in storing food grains due to the presence of bioactive	Learner 1. differentiates organisms, phenomena and processes based on certain characteristics and salient features, such as, prokaryotes and eukaryotes, plant cell and animal cell, diffusion and osmosis, meristematic tissues and permanent tissues; squamous epithelium and cuboidal epithelium, diploblastic and triploblastic organisation; metacentric, submetacentric, acrocentric and telocentric chromosomes; etc. 2. classifies organisms, phenomena and processes, based on certain characteristics / salient features systematically in more scientific and organized manner; such as five kingdom classification system of organisms under various hierarchical structural organizations; natural resources, etc. 3. relates processes and phenomena with causes and effects, such as, characteristics of living with cell as basic unit of life, transpiration pull with absorption of water by roots of plants; tissues with their functions, deficiency symptoms of essential elements, pumping of heart with circulation of blood, hormones with various physiological functions, digestive

compounds in neem leaves as result of secondary metabolism and their pesticidal effects. •conduct survey to understand the process of spreading of diseases. They may be encouraged to collect data from doctors and nurses about various diseases. They can prepare a report on spread, causes, prevention, and cure of diseases. They may share their findings with the community through role plays, skits and also campaign in the community for prevention. •present their observations/ ideas/ learning through flow charts/ concept maps/ graphs/ floral diagram and ICT tools, etc. •gather data for calculating different physical quantities, such as determination of population density, productivity, percentage of pollen germination, etc, which can be shared and discussed in groups or with peers. Uses rubrics to assess the conversion of units and reporting results. •Draw diagrams / sketches/ flow charts, concept maps, floral diagrams, painting etc, of organisms and processes etc; may be sometimes by using software tools such as paint and brush etc •collect and analyse wide variety of graphs from newspapers, magazines or the internet. They may be encouraged to draw, analyse and interpret the graphs, for example, substrate concentration graphs, growth versus time graphs, etc. •write chemical formulae of biomolecules, bio-chemical equations, etc., using 3-D	enzymes electrocardiograph (ECG) and heart diseases; smoking and lung diseases; etc. 4. applies scientific terminology for organisms, processes, and phenomena based on internationally accepted conventions, such as, systematic technical description of flowers, taxonomic study of plants and animals; Binomial nomenclature of organisms; coelom, bisymmetric body etc; bisexual and unisexual organisms, actinomorphic and zygomorphic flowers, aestivations, placentations, physiological processes, cardiac cycle; organ structures; SA node; AV node; etc. 5. explains efficiently systems, relationships, processes and phenomena such as; organ systems in frog, cockroach and earthworms, structures and function of cell organelles, photosynthesis, respiration, mechanism of contraction of skeletal muscles, etc. 6. describes contribution of scientists/researchers all over the world in systematic evolution of concepts, scientific discoveries and inventions in the field of biology based on historical scientific events/ timelines etc; such as; Anton Von Leeuwenhoek described a live cell and later, Robert Brown discovered the nucleus; in

models. •write floral formulae of flowers using live specimens, etc. •select and use appropriate devices for understanding of structural and physiological and other intricacies of living organisms. •collect information from books, e-books, magazines, journals, libraries, internet, etc., to appreciate the efforts of scientists made over time, for example, discovery of microscope, etc., and showcase it in the form of a project or role play. •observe various technological devices and innovative exhibits such as waste management kits, water filtration system, using low-cost or no-cost eco-friendly materials, develop them and showcase it in science exhibitions, clubs and parent-teacher meets. •share and discuss their beliefs and views regarding myths, taboos, superstitions, etc., by initiating an open ended debate, discussion/arguments leading to the alignment of their beliefs to the scientifically proven facts. They may also be involved in awareness campaigns in the community.	classification systems of living organisms, Aristotle was the earliest and then Linnaeus proposed two kingdom classification and later R. H. Whittaker proposed five kingdom classification, etc. 7. makes linkages at the interface of Biology with other disciplines by relating various interdisciplinary concepts such as; mathematical models on arithmetic and geometric growth rates in plants/organisms, absorption and transfer of light energy in photosynthesis; secondary metabolites, structure of protein, structure of DNA, etc. 8. draws labelled diagrams, flow charts, concept maps, graphs and **floral diagrams,** such as, floral diagrams of given flowers, parts of flowers, modified roots external features of earthworm, cockroach and frog, Z-scheme of light reaction, calvin cycle, etc. 9. writes floral formulae in technical language based on floral diagrams of different flowers such as flowers of pea, makoi and onion etc 10. prepares slides for study the structural intricacies of life forms and structural organisations, such as, transverse sections of root, stem and leaves, mitosis and meiosis; pollen germination, etc. 11. handles laboratory tools, and apparatuses, instruments and

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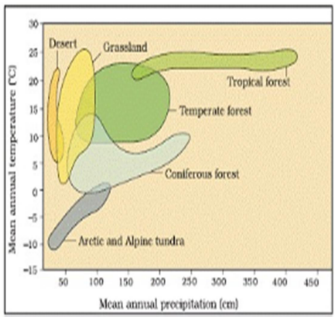
Organisms and Population					
Sr. No.	**Skill**	**Learning Outcome**	**Questions**	**Answers**	**Marks**
1	Analyse and evaluate	Interpretation of the graph	From the given graphical representation explain 'formation of various biomes on our planet is the result of combined effect of average yearly rainfall and average temperature.  	1. Biome is defined d as a large terrestrial area with similar climatic conditions. 2. Climatic conditions of any area are determined by the two factors shown in the graph i.e. average temperature and average rainfall. 3. By itself low average rainfall is a characteristic of many areas but combined with average or mean temperature they can either be deserts or tundra. 4. High mean temperature can be found in tropical forests , grasslands deserts. These biomes are made so on the basis of average rainfall. Tropical forests receive maximum rainfall and deserts	5 marks

				get minimum rainfall.	
2.	Analyse and evaluate	Uses scientific terminologies and explain the same	With different examples explain how different animals can occupy same niche in different habitats.	1. Habitat is the physical environment in which an animal lives and adapts to survive. 2. niche is the role played by animal in any habitat. 3. Role or niche of top carnivore is occupied by both lion and tiger in their respective habitats. 4. tiger is a solitary animal, hunts by staling its prey and hence it is the top carnivore or predator in forest habitat. 5. Lions on the other hand are social animals which work pack or pride to run down or chase their prey in open grasslands. 6. Thus both lions and tigers are perfectly adapted to their respective habitat and occupy	3 marks

				the niche of top carnivore in their respective habitats.	
3.	Analyse and evaluate	Explains relationship between biotic and abiotic communities.	Explain the effect of availability of water on organisms that are found in any habitat.	1.Availabiulity of free water in liquid state is a limiting factor for plant growth and also the animals. 2. Snow is an alternate form of water but of no direct use unless it melts. 3. Even if all or many other abiotic factors like soil, temperature , light are same , it is this availability of water which makes biomes like coniferous forests and alpine tundra.	2 marks
4.	Analyse and evaluate	Application of knowledge to unknown situations	'in response to onset of harsh winter conditions like heavy snowfall, decrease in temperature , etc. forest animals start hibernation or winter sleep . Give the name of this type of response shown by animals. Discuss the pros and cons of this response type.	1. In order to survive in changing climatic conditions animals and plants show various responses like-regulate, conform, migrate and suspend. 2. suspending regular life activities occurs when	5 marks

				environmental conditions are too harsh to regulate or even to conform. 3. hibernation is the response when an animal suspends its daily routine. 4. Pros of hibernation / suspend:- Energy efficient Better probability of survival. 5. Cons of hibernation / suspend Requires fat build up Failure to prepare, may lead to death Exposure to prolonged conditions in suspended condition may lead to death.	
5.	Analyse and evaluate	Convergent evolution and homologous organs.	'although fish and whale both show aquatic adaptations ' there are some fundamental differences between them," explain.	1. Fish -Primary aquatic adaptations a. fins either paired or unpaired b. gills c. scales	

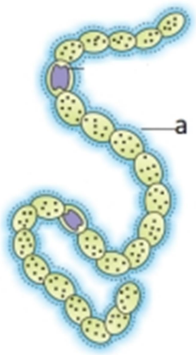
				d. swim bladder 2. Whale – Secondary aquatic adaptations , ancestors were land dwelling a. tail fluke b. flipper c. skeleton d. loss of fur e. blow hole	
6.	Evaluate	Application of scientific terminology	An ecological niche is exemplified by a. all animals and birds in any habitat b. all animals in an ecosystem c. all granivorous birds of a habitat. d. all herbivores of a habitat.	c. all granivorous birds of a habitat.	1 mark
7.	Evaluate	Application of scientific terminology	Which of the following options will necessarily decrease the population density of a habitat? a. Natality < mortality b. immigration > emigration c. Natality > mortality d. Natality + immigration < mortality emigration	d. Natality + immigration < mortality emigration	1 mark
8.	Evaluate	Application of scientific	Which of the following groups of plants controls the availability	c. tall trees	1 mark

		terminology	of light on forest floor? a. shrubs b. herbs and grasses c. tall tress d. climbers		
9.	Evaluate	Application of scientific terminology	A protist reproduces by binary fission. What will be their number at the end of 10 th generation ? a. 1 X 10 b. 2 X 10 c. 1^{10} d. 2^{10}	d. 2^{10}	1 mark
10.	Evaluate	Application to unknown situations	A rare medicinal plant was collected from the forest and planted in the garden. It will----- a. continues to grow as it was in the forest b. grows vigorously due to more sunlight c. grows slowly at first and then dies d. be affected by the changes in the microclimate and hence may or may not survive.	d. be affected by the changes in the microclimate and hence may or may not survive.	1 mark
11.	Evaluate	Application to unknown situations	What is the difference between predation and parasitism?	1. In both one species is dependent on the other for food. 2. In predation the prey is killed and	1 mark

				eaten up by the predator. E.g. tiger and deer. 3. In parasitism, the host is infected by the parasite for food only. It never kills the host. E.g. mosquito and humans.	
12.	Create	Unknown situation	What is brood parasitism? Explain adaptations for brood parasitism with example.	1. When female of one species uses resources of another species to raise its own chicks it is called as brood parasitism. 2. Example. Female koel lays its eggs in the nest of other bird's nest specially crow. 3. These parasite eggs hatch faster allowing koel chicks to destroy other yet unhatched eggs. 4. Eggs match in colour, pattern and size to those of host species.	

CHAPTER 2 :- BIOLOGICAL CLASSIFICATION					
1.	Analyse	Identifies organism based on certain characteristics	Mention the name of the organism which resembles with a parasite but it is a saprophytic protist.	Myxomycetes (also called as plasmodium)	1 mark
2.	Apply	Binomial nomenclature of organism	Choose the correctly written scientific name of mango:- a. *Mangifera Indica* *b. Mangifera indica* *c. Mangifera indica C.L.* *d. Mangifera indica* Linn.	d. *Mangifera indica* Linn.	1 mark
3.	Apply and analyse	Differentiates organisms based on certain characters	While answering the question Write characters of fungi. Amita has written that fungi are plants without chlorophyll. Is it correct ?Why?	She described fungi with a wrong character. Fungi are classified as separate kingdom. They not only lack chlorophyll but also roots, stem and leaves. They have hypha for absorption.	2 marks
4.	Analyse	Cause and effect	To collect the samples of lichens Neeta went to central bus stand but she couldn't find any .Explain why?	Lichen is considered as indicator of pollution. It is not found in the polluted areas so she couldn't find it near bus stand. It is polluted area.	1 mark

5.	Apply and analyse	Differentiate organisms on the basis of characters.	Name the smallest living cell which lacks cell wall and lives independently. a. virus b. mycoplasma c. bacteria d. fungi	b. mycoplasma	1 mark
6.	Apply	Identifies organism based on certain characters.	In which of the following group maximum nutritional diversity is seen. a. animalia b. plantae c. fungi d. Monera	d. Monera	1 mark
7.	Analyse	Systematic-ally classifies organism	Sunil and John had an argument about viruses. Sunil's opinion was that viruses are non-living while John suggested that they are living. Write on what basis they must have said this.	According to Sunil viruses are the particles which can be crystallized, inactive nd lack cell machinery. John said they are active inside the living cell, replicate to make their copies and are obligate parasites. So, both are correct partly. Viruses are considered on the border line of	3 marks

				living and non-living.	
8.	Application	Relates process with cause and effect	Farmers add cattle dung , remains of crops etc. to biogas plant. Give reason	Methanogens are archaebacteria. They are present in the gut of ruminants like cows and buffaloes. Thus, these pass to dung and are responsible for production of methane.	2 mark
9.	Apply	Relate characteristics and functions	In the given figure, identify 'a' and state its function. Write the name organism. 	Ans. 'a' is heterocyst. It is a site of nitrogen fixation. The organism is Nostoc.	3 marks
10	Apply and analyse	Cause and effect	Nikita went to Florida with her parents. There she saw red tide and wanted to swim but her mother denied. Guess the reason.	Red tide appears due to Dinoflagellates> They undergo rapid multiplication and make the sea appear red. On coastal regions	3 marks

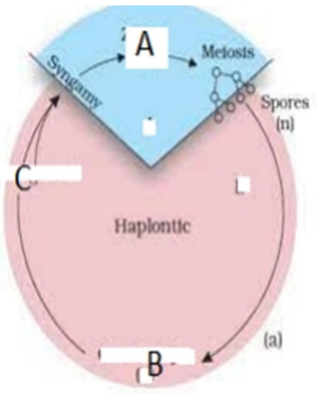
				of America this can be seen. Toxins released by such large number and can cause skin infections and burning sensations to eyes. Hence her mother denied to swim in water.	
11.	Evaluation	Relates process, cause and effect	Write a short on group of fungi which are involved in mineral cycling of litter. Also give two examples of the same.	Commonly known as imperfect fungi because they reproduce only through asexual reproduction. Asexual reproduction by spore known as conidia. The mycelium is septate and branched. Some are saprophytes or parasites while a large number are decomposers. These help in mineral cycling. Alternaria and Trichoderma are examples.	5 marks
12.	Application	Salient features characters	Which living organism shows alternation of generation? Write brief about them	Among the living forms, plants show alternation of	4 marks

				generation. Life cycle of plants shows two distinct phases as diploid sporophytic and haploid gametophytic. Following things vary among different groups of plants 1. length of the phases 2. Free or dependent nature of the generation	
3. PLANT KINGDOM					
1.	Analyse	Appreciates technological applications and find out algae as commercially important	Which one of the following statements is not correct? a. agar is obtained for Gelidium and Gracilaria b. Algin is obtained from brown algae and carrageen from red algae c. laminarian and sargassum are used as food. d. algae increase the level pf dissolved oxygen in the immediate environment.	Ans . b Algin is obtained from brown algae and carrageen from red algae	1 mark
2.	Analyse	Differentiates organism	In which of the following plants , gametophyte is not independent? a. Funaria b. Marchantia	Ans. d Pinus	1 mark

			c. Pteris d. Pinus		
3.	Analyse	Classifies organisms based on their life cycle.	Chlamydomonas , volvox, and spirogyra comes under a. haplontic life cycle b. diplontic life cycle c. haplodiplontic life cycle d. diplohaplontic life cycle	Ans . a haplontic life cycle.	1 mark
4.	Analyser	Differentiates organisms based on certain characteristics	Among following statements which one is wrong a. Mucor has biflagellate zoospores b. Haploid endosperm is typical feature of gymnosperms. c. brown algae have chl-a, chl-c and fucoxanthin d. archegonia are found in bryophytes, Pteridophyta and gymnosperms.	Ans .a Mucor has biflagellate spore.	1 mark
5.	Analyse	Learns life cycle patterns based on haploid and diploid conditions	In protonema , how many statements are wrong? 1. haploid and found in mosses 2. diploid and found in liverworts 3. diploid and found in Pteridophyta 4. haploid and found in Pteridophyta a. one b. two c. three d. four	Ans. c- three	1 mark

6.	Application	Classifies organisms based on characteristics	Angiosperms include a. vascular plants with naked seeds b. vascular plants with covered seeds c. few vascular plants with naked seeds d. few vascular plants with covered seeds Find correct answers and give characters of angiosperms.	Ans. b . vascular plants with covered seeds 1. vascular plants with covered seeds 2. Show double fertilization and triple fusion 3. Presence of vessels in xylem Companion cells in phloem	3 ,marks
7.	Analyse	Replats processes and phenomenon like double fertilization	Double fertilization is unique character of a. angiosperms b. gymnosperms c. Pteridophyta d. dicots only Justify your answer.	Ans. a . angiosperms In angiosperms as double fertilization , both the male gametes are involved in fertilization . So viable and dominant plants are produced.	3. marks
8.	Analyse	Relates the processes and based on characters differentiates the plants	Consider the following and specify they are correct or wrong a. the sporophyte in liverworts is more elaborate than the mosses b. Salvinia is heterosporous c. life cycle in seed bearing plant is diplontic. d. in Pinus, male and female	Ans. c statements A and D are wrong. Salvinia is a pteridophyte shows heterosporous condition. This is	3 marks

			cones are borne on different trees. Which two are wrong. Write a note on heterospores condition.	a recursot seed habit , considered as important step in evolution.	
9.	Analyse	Relates processes and study essential elements present in plants	Statement 1:- Algae are useful to man. Statement 2:- At least half of the total CO2 fixation on earth is by algae. a. both statements are correct and second is the correct explanation of 1 b. Statement 1 is correct but statement 2 is not the explanation of 1 c. Statement 1 is true and statement 2 is false d. Both statements are false. Find correct answer and write uses of algae.	Ans. a. both statements are correct and second is the correct explanation of 1 Uses of algae as food for human and fodder for animals.	2 marks
10.	Analyse	Classify organisms on characters	Prothallus is the gametophyte of a. bryophytes b. algae c. Pteridophyta d. gymnosperms Differentiate between prothallus and protonema.	An. C Prothallus is gametophyte and haploid in nature. It is independent stage of pteridophytes while protonema is haploid stage in bryophytes.	2 marks

11.	Create	Draw labelled diagram and learns relation with scientific concepts.	 Identify A,B and C in the given figure? Explain alternation of generation in bryophytes. a. A-gametophyte, B- zygote ,C-gametophytes b. A- zygote , B- gametophyte, C-Gametogenesis c. A- zygote, B- gametogenesis ,C gametophyte d. A- gametogenesis B- zygote and C- Gametophyte	Ans. b Bryophytes show dominant gametophyte and sporophyte dependent on gametophyte. Hence it is haplodiplontic life cycle of alternation of generations.	5 marks
12.	Analyse	Differentiates and classifies organisms based on scientific characters.	Zygote of pteridophyte a. undergoes reduction division just after formation b. produces multicellular gametophyte c. produces multicellular sporophyte d. remains dormant. Find out correct answer and add a note on life cycle of pteridophytes.	Anzac Pteridophytes show haplodiplontic life cycle in which sporophyte is diploid and dominant while gametophyte is haploid but both of them are independent of each other.	5 ,marks
13.	Analyse	Relates processes	Which of the following are correct about pteridophytes?	Ans. b	5 marks

		like transpiration and guttation	i. the sporophytes bear sporangia that are formed on the sporophylls ii. they are mostly grown a s ornamental. iii. they are the first terrestrial plants to form seeds. iv. vascular tissues are absent in pteridophytes. v. some species flourish well in sandy soil conditions. a. iv and v b. I, ii and iv c. iii, iv and v d. I and ii find correct option and differentiate between guttation and transpiration. Give one example of each.	Definition of guttation Definition of transpiration Example of guttation is Nephrolepis Example of transpiration is hibiscus.	
4. ANIMAL KINGDOM					
1.	Analyse	Classification based on salient features	A previously unknown planktonic animal was discovered from the samples collected on oceanic voyages. a. diploblastic , radially symmetrical body. b. it showed blind sac type of body plan with only tissues and no organs. Which phylum does this animal belong to ?	Phylum Ctenophora	1 mark
2.	Analyse	Classification based on given features	In the laboratory students observed following features in an	Platyhelminthes	1 mark

			animal. a. acoelomate triploblastic body b. incomplete digestive system . Which phylum does the animal belong to?		
3.	Analyse/ evaluate	Applies scientific terminologies	Body cavity is observed between outer body wall and inner alimentary canal. But this cavity is not lined by tissues of mesodermal origin. These observations put the animal in which of the following group. a. acoelomate b. coelomate c. pseudocoelomate d. haemocoel mate	Pseudocoelomate	1 mark
4.	Analyse	Applies scientific terminologies	In the evolutionary history of animal kingdom true coelom appears for the first time in phylum a. Annelida b. Aschelminthes c. Arthropoda d. Platyhelminthes	Annelida	1 mark
5.	Analyse /evaluate	Classification of animals based on observable characteristics	In phylum --------- the larva is bilaterally symmetrical but due to torsion adult animal is asymmetrical. a. Echinodermata b. Arthropoda	Mollusca	1 mark

<table>
<tr><td></td><td></td><td></td><td>c. Annelida
d. Mollusca</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6.</td><td>Analyse/ evaluate</td><td>Applies scientific terminologies for organisms</td><td>An animal was observed basking on the rocks at the river bank. It showed.
a. pentadactyl limbs
b. clawed digits
but it does not show feathers or beak neither external ears
Which animal we are talking about?</td><td>Crocodile</td><td>1 mark</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>7.</td><td>Analyse</td><td>Applies scientific terminologies</td><td>Match the columns based on type of excretory organs
<table>
<tr><td>Column ‘a’</td><td>Column’b’</td></tr>
<tr><td>i. cockroach</td><td>a. nephridia</td></tr>
<tr><td>ii. planaria</td><td>b. kidney</td></tr>
<tr><td>iii. nereis</td><td>c. flame cells</td></tr>
<tr><td>iv. octopus</td><td>d. Malpighian tubules</td></tr>
</table></td><td>Ans. i-d, ii- c, iii-a and iv- b</td><td>2 marks</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>8.</td><td>Analyse</td><td>Applies scientific terminologies</td><td>Give the most appropriate biological terminology for the following
a. free living form of adamsia
b. blood filled body cavity in arthropods
c. stinging cells of jelly fish</td><td>a. medusa
b. haemolymph
c. Cnidoblasts</td><td>3 marks</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>9.</td><td>Analyse /create</td><td>Differentiate and classifies animals</td><td>A group of students in biology lab was given a bunch of fish collected from local fisherfolk. They were asked to classify the fishes on the basis of external morphology and anatomy. How</td><td>Two classes of superclass Pisces are Chondrichthyes and Osteichthyes</td><td>3 or 5 marks</td></tr>
</table>

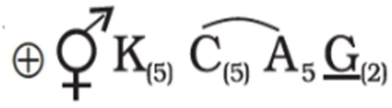
			will you go about this task?	External morphology Scales ---- placoid or cycloid Caudal fins— heterocercal or homocercal Gill slits— exposed or covered Gill arches 7 or 4 Claspers – present or absent Mouth--- ventral or terminal Anatomy Endoskeleton- cartilaginous or bony Swim bladder --- absent or present	
10.	Analyse/ evaluate	Differentiates features	With reason classify the given animals /chordates into classes a.  b.	Pigeon Class aves Feathers and beak are present Bat- Class Mammalia Fur and pinnae are present.	2 marks

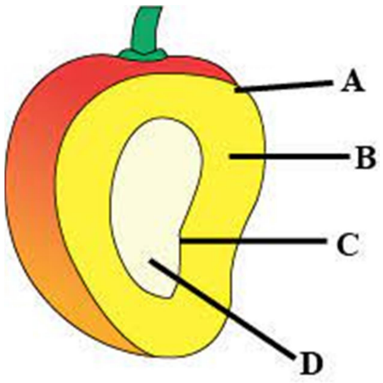
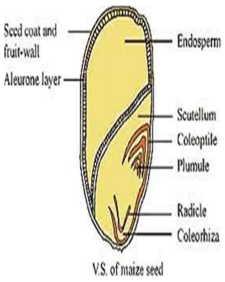
					
11.	Analyse / evaluate	Applies knowledge	Manju visited local fish market with her mother. Although 'Rohu' was available for sale her mother did not bought it. None of them are fresh' was her mother's comment. How did mother come to know of freshness of the fish?	Fish respires via gills. Gills have rich blood supply red gills and fish preserved in ice have faded or colourless gills. Gills can be observed by slightly lifting the operculum which covers the gills.	2 marks
12.	Evaluate /create	Applies knowledge	Justify the statement, " mammals are said to be most successful group of vertebrata which is found in almost all different habitats in the world.'	Types of habitats- Aquatic, terrestrial and aerial Features homeotherms b. kidneys with Henle's loop c. exoskeleton with fur and sweat glands d. blubber and hairless skin in	

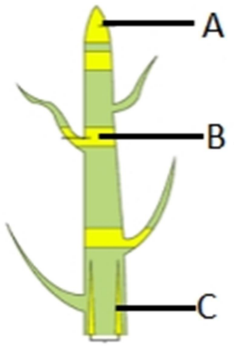
				aquatic habitat.	
5 MORPHOLOGY OF FLOWERING PLANTS					
1.	Analyse	Relates the modifications in different plants	Assertion: Tendrils in watermelon and tendrils in Pisum sativum are not same. Reason: Tendrils in watermelon are the modification of stem and tendrils in Pisum are modified leaflets. a. Both assertion and reason are correct and reason correctly explains the assertion. b. Both assertion and reason are correct but reason does not correctly explain the assertion. c. Assertion is correct reason is wrong d. Both assertion and reason are wrong.	Ans. A	1 mark
2.	Analyse	Recall, relate and conclude	Flowers are not unisexual in ----- and not bisexual in ---. a. dates and papaya b. maize and hibiscus c. china rose and maize d. papaya and mustard	c. china rose and maize.	1 mark
3	Evaluate	Study different concept maps and modifications	Which of the following is /are the correct statements ? 1. stilt roots are grown from lower nodes of the stem in maize. 2. sugarcane develops prop roots for extra support.	b. 1 and 3	1 mark

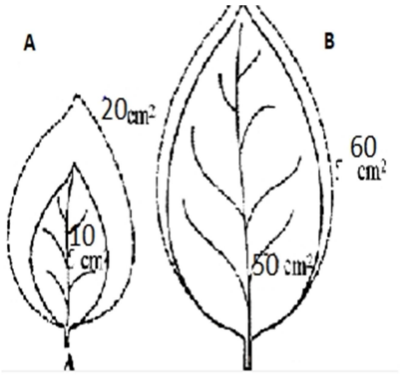
			3. Rhizophora grows in swampy areas with pneumatophores. 4. True roots of sweet potato shows single swollen structures with stored food. a. 1,2 and 4 b. 1 and 3 c. 2 and 4 d. 2,3 and 4		
4.	Evaluate	Study parts of flower with different variations	Choose the incorrect pair/s in description of Androecium from the following i. hibiscus-monoadelphus ii. pea-epipetalous iii. citrus- polyadelphus iv. lily -epiphyllous a. I,ii and iii b. ii only c. iii only d. I and iv	b. ii only	1 mark
5.	Evaluate	Identifies floral formula and diagram	Actinomorphic flowers are seen in a. aloe, colchicum,tulip,datura b. datura,Indigofera,potato, muliathi c. brinjal, colchicum, tobacco , Indigofera d. chilli,potato,tobacco and brinjal	d. chilli, potato, tobacco and brinjal	1 mark

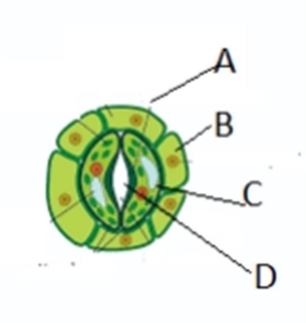
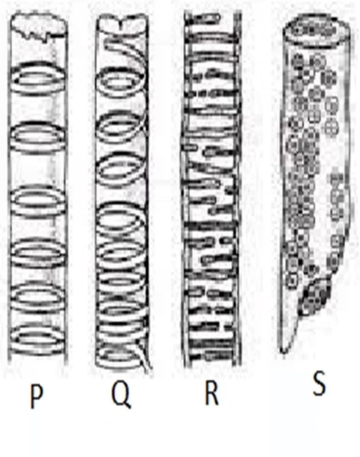
<table>
<tr><td>6.</td><td>Evaluate</td><td>Analyse flower and floral diagram</td><td>Read and choose the incorrect statement from the given and construct it correctly.
1. syncarpus gynoecium is a characteristic feature of family Solanaceae .
2. zygomorphic flower is feature of family Fabaceae.
3. Epipetalous stamens is a character of Solanaceae.
4. Diadelphous condition is seen in family Liliaceae.</td><td>Ans. Statement 4 is wrong
Liliaceae is characterised by epiphyllous , polyandrous stamens.</td><td>2 marks</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>7.</td><td>Evaluate</td><td>Study arrangement of leaves</td><td>Identify the type of phyllotaxy by studying the following statements,
a. more than two leaves arise at each node and form the whorl.
b. only single leaf arises at each node.
c. a pair of leaves arise at each node.</td><td>a. whorled phyllotaxy- Alstonia
b. Alternate phyllotaxy- Mustard
c. opposite phyllotaxy- Calotropis</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>8.</td><td>Analyse</td><td>Modification of roots</td><td>Match the columns<table><tr><td>Column i</td><td>Column ii</td></tr><tr><td>a. maize</td><td>i. prop roots</td></tr><tr><td>b. carrot</td><td>ii. conical root</td></tr><tr><td>c. banyan</td><td>iii. stilt roots</td></tr><tr><td>d. Rhizophora</td><td>iv. climbing roots</td></tr><tr><td></td><td>v. respiratory roots</td></tr></table></td><td>Ans
a. --- iii
b. ---- ii
c. ---- i
d. ---- iv</td><td>2 marks</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>9.</td><td>Evaluate</td><td>Taxonomic study of</td><td>Give the term for each of the given statement</td><td>Ans.</td><td>2 marks</td></tr>
</table>

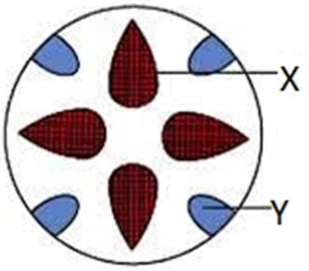
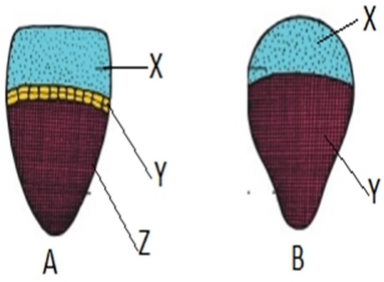
<table>
<tr><td></td><td></td><td>plant</td><td>a. the type of venation where vein and veinlets form a network
b. Slender spirally coiled structures to help weak stemmed plants for climbing on support
c. common axis of a compound leaf on which leaflets are produced.
d. more than one carpel but are free from each other representing gynoecium of flower.</td><td>a. reticulate venation
b. tendrils
c. rachis
d. apocarpus</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>10.</td><td>Create</td><td>Taxonomic study of plants</td><td>Complete the following table:-
<table>
<tr><th>Family</th><th>Plant</th><th>Importance</th></tr>
<tr><td>Fabaceae</td><td>--a---</td><td>dye</td></tr>
<tr><td>----b---</td><td>Sunhemp</td><td>fibres</td></tr>
<tr><td>-----c----</td><td>Ashwagandha</td><td>----d-----</td></tr>
<tr><td>Liliaceae</td><td>------e-----</td><td>Ornamentals</td></tr>
<tr><td>Solanaceae</td><td>-----f----</td><td>Food</td></tr>
</table></td><td>a. Indigofera
b. Fabaceae
c. Solanaceae
d. medicine
e. tulip or gloriosa
f. tomato brinjal potato</td><td>3 marks</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>11.</td><td>Evaluate</td><td>Technical description</td><td>Floral formula
 
Which angiospermic family is represented by the above floral formula?
Explain the accessory whorls of the flower of the same family.
What is the position of ovary in this family?
Which condition exists between</td><td>1. Solanaceae
2. calyx shows five fused sepals and corolla shows five fused petals.
3. The ovary is superior in position.
4. There is epipetalous adhesion in stamens.</td><td>5 marks</td></tr>
</table>

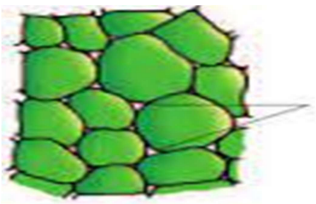
			corolla and androecium in this family?		
12.	Evaluate	Study of plants and fruits.	Given diagram of drupe is labelled as A,B,C and D.  Which part is edible in the given fruit? Is the same part of coconut being edible? Justify. From which type of ovary, the drupe fruit develops?	1. A---- Epicarp B--- Mesocarp C—Endocarp D--- seed 2. The mesocarp of coconut is not edible and is fibrous in nature. 3. Drupe develops from monocarpellary superior ovary.	
13.	Evaluate	Study of floral parts and diagram	Sketch and label monocot seed you have studied. Mention the names of the parts as per the description and give labels to the drawn diagrams a. sheath which enclose plumule b. one large shield shaped cotyledon c. proteinous layer separating endosperm and embryo. d. sheath which is associated with radicle.	a. coleoptile b. scutellum c. aleurone layer d. coleorhiza.  V.S. of maize seed	5 marks

6. ANATOMY OF FLOWERING PLANTS					
1.	Analysis	Interprts diagram	Observe the following diagram and answer the following questions  1.What isn the diagram infer about? 2. What is 'A' in the given diagram.Give its function. 3. What would be the effect if we remove 'A'? 4. Which phytohormone is responsible for it? 5. What is the importance of 'B' and 'C' region.	Ans. 1. Diagram refers to the location of meristematic tissue in plant body. 2. 'A' is apical meristem region signifies linear growth or elongation of plant parts. 3. If 'A' is removed growth of lateral buds will take place. 4. Auxins 5. B- interclary meristem C- Lateral meristem	5 marks
2.	Create and evaluation	Draws conclusion, logical thinking of specific situation	Ashok had collected 5 different leaves from plants. He observed that out of five four had intact and uniform lamina but one leaf showed torn leaves at their margins. What is the reason for this. Write the function and structure of above mentioned tissues.	Banana leaves does not have collenchyma which is preventing tearing of leaves. So banana leaves are torn.	2 marks

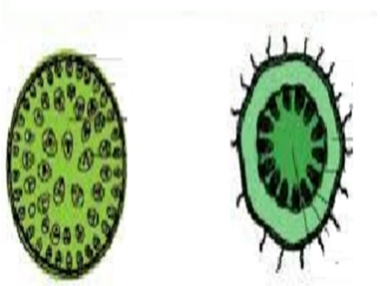
3.	Analyse and create	Draws conclusion, logical thinking of specific situation	 Observe the diagram and answer the following questions 1. What the diagram tell about? 2. Explain the diagram in your own words.	Ans. 1. The diagram is abput the comparison of absolute and relative growth. 2. Measurement and comparison of tota;l growth per unit time is called as absolute growth rate. 3.Growth of the given living system per unit time expressed on common basis is relative growth rate. In the given figure the leaves 'A and B' are different sizes show increase by $10cm^2$ Both of them show same absolute increase in their area in the given unit time. However, leaf 'A' shows more relative growth.	5 marks
4.	Analyse	Analysis and Interprets Graphs	Observe the following diagram and answer the questions	Ans. 1. A- is epidermal cells and B- subsidiary cells 2. C guard cell	5 marks

			 1. What are the labels 'A' and 'B' ? 2. What is the function of 'C'? 3. in which types of plants does it occur? 4. What is the function of this apparatus? 5. Write the difference btween shape of 'C' and the plants belonging to cereals category as per the apparatus.	plays role in opening and closing of stomata. 3. it occurs in dicots. Kidney shaped. 4. stomatal transpiration gaseous exchange are the functions. 5. In cereals, plants belong to monocots they have dumb bell shaped guard cells.	
5.	Analyse and create	Analyses and interprets graphs and figures	 The above diagram show l.s. xylem with different types of thickenings. What is 'P, Q,R and S called. Differentiate xylem and phloem in their structure and functions.	In the above figure P- is annular tghickening Q- spiral thickening R- scalariform thickening S- bordered pits Xylem Dead tissue Water conduction Also called as woo Lignified walls	5 marks

6.	Analyse and evaluate	Draws conclusion, over data collected	 Identify X and Y in the given diagram. Explain the diagram. .Give examples where these structures are found.	Ans. X- xylem and Y- phloem The diagram shows radial vascular bundles in which xylem and phloem are arranged on different radii. They are damaged alternating with each other. These types of bundles are found in roots.	3 marks
7.	Analyse and evaluate	Explain efficiency system relationships processes and phenomenon	Observe the following diagram and answer the questions,  1. What does ‘A’ indicate? 2. What is the difference between A and B. 3. What is the function of Y in the diagram.	Ans. Diagram explains types of vascular bundles. A- conjoint , collateral open B- conjoint collateral closed. Y is the vascular cambium plays an important role in secondary growth of dicot stem.	3 marks

8.	Analyse	Relates processes and phenomenon with cause and effects	 The above diagram shows simple tissue in plants. Which is this tissue? What structure does it show? Describe the structure , occurrence and functions of this tissue.	Ans. The diagram is of parenchyma tissue. The cells are living thin walled with distinct nucleus and vacuolated cytoplasm. The cell wall is made up of cellulose and pectin. The cells are normally loosely arranged with inter-cellular spaces. The adjacent cells remain attached by plasmodesmata. This tissue is present in almost all plants parts. It is also present in pith and as a packing tissue in xylem and phloem. Function:- It provides strength and rigidity At gives aeration and buoyancy. It help in	5 ,marks

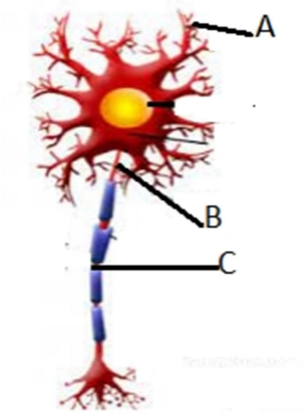
<table>
<tr><td></td><td></td><td></td><td></td><td>photosynthesis.</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>9.</td><td>Analyse</td><td>Differentiates phenomenon based on certain characters</td><td>
<table>
<tr><td>Tracheids</td><td>Vessels</td></tr>
<tr><td>1. Single celled</td><td>1. Multicellular</td></tr>
<tr><td>2. Rounded ends</td><td>2. Narrow ends</td></tr>
<tr><td>3. Narrower than vessels</td><td>3. Broader than trachieds</td></tr>
<tr><td>4. Lumen narrow</td><td>4. Wide lumen</td></tr>
<tr><td></td><td></td></tr>
</table>
Xylem tissue in angiosperms is made of tracheids and vessels. Differentaite between tracheids and vessels.
</td><td>Ans.</td><td>2 marks</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>10.</td><td>Analyse</td><td>Classifies organisms, phenomenon based on certain characters</td><td>Given below are the various types of tissues and their functions. Whjich out of these is not a matching pair and why?
A. collenchyma:- provides mechanical strength to the growing parts of plants
B:- Sclerenchyma :- photsynthesis, storage and secretion
C chlorenchyma- photosynthesis
d. xylem conduction of water and minerals</td><td>Ans b</td><td>1 mark</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>11.</td><td>Analyse and evaluate</td><td>Analyses and interprets data and applies learning to hypothetical situations</td><td>Plam is a monocot plant yet it shows increase in girth.How is it possible? Explain in your own words.</td><td>Being a monocot there should not be secondary growth.
This increase in girth is due to the division of</td><td>2 marks</td></tr>
</table>

				parenchyma cells which are present in ground tissues. It helps in the girth of the stem and it is reffered as secondary growth.	
12.	Analyse and create	Draw conclusions on the basis of data collected.	Following is the diagrammatic view of t.s. dicot stem in dicot and monocot. Write and one point of difference in them with respect to secondary growth. 	Dicot stem shows open vascular bundle with cambium.	1 mark
13.	Evaluate and create	Relates processes and phenomenon with cause and effect	An organized differentiated cellular structure having cytoplasm but no nucleus is --- a. vessels b. xylem parenchyma c. sieve tubes trachieds	Ans. sieve tube	1 mark
14.	Analyse	Analyse and interprets data given	Heartwood differ from sapwood in---- a. presence of rays and fibres b. absence of vessels and parenchyma c. having dead and non conducting elements	Ans. c Having dead and n on conducting	1 mark

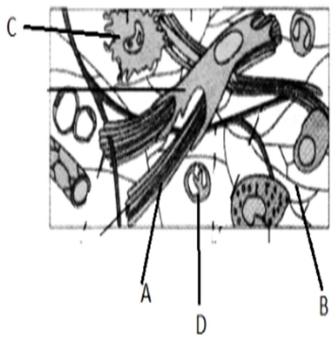
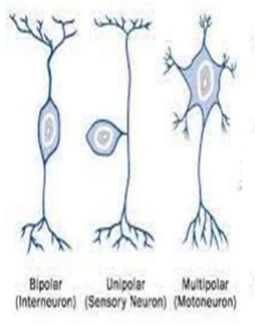
			d. being susceptible to pests and pathogen.		
15	Analyse	Applies scientific terminologies for sec growth	Abnormal anomalous sec. growth occur in a. dracaena b. ginger c. wheat d. cucurbita	Ans. a Dracaena	1 mark
7. STRUCTURAL ORGANISATION IN ANIMALS					
1	Analyse	Differentiates organisms and phenomenon based on certain characters	Choose the correct statements with reference to hyaline cartilage i. It is bluish white translucent and glass like cartilage. ii. Matrix shows collagen fibre and elastic fibres. iii. It is strongest cartilage without perichondrium. iv. It is found at the end of long bones. a. I, ii and iv b. I, iii and iv c. ii and iii d. I and iv	Ans. d	1 mark
2.	Analyse	Applies scientific terminology	Skeletal muscle fibre is synaptical which means it is a.made up off many proteins b. long and slender c. swollen in the middle with tapered ends. d. multinucleated	Ans. d	1 mark

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.</td><td>Analyse</td><td>Explains efficiently system, relationships and mechanism of contraction of muscles.</td><td>Which type of tissue correctly mismatches with its location?<table><tr><td>Tissue</td><td>location</td></tr><tr><td>a. columnar epithelium</td><td>Lining of stomach</td></tr><tr><td>b. cuboidal epithelium</td><td>Tubular parts of nephron</td></tr><tr><td>c. smooth muscles</td><td>Wall of intestine</td></tr><tr><td>d. transitional epithet helium</td><td>Tip of the nose</td></tr></table></td><td>Ans. d</td><td>1 mark</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.</td><td>applicatio n</td><td>Applies scientific terminology</td><td>Statement 1:- thick layer of muscles are present in the wall of alimentary canal.
Statement 2:- These muscles help in the mixing of food material with the enzymes coming from different glands in the alimentary canal.
a. both statements are correct and statement 2 is the correct explanation of statement 1.
b. both statements are correct but 2 is not the correct explanation of 1.
c. statement 1 is correct and statement 2 is wrong
d. statement 1 and 2 are wrong</td><td>Ans. a</td><td>1 mark</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5.</td><td>Analysis</td><td>Relates processes to unknown situations</td><td>While travelling by a bus four persons which are having common age of around 25 years got an accident.</td><td>Ans d.</td><td>1 mark</td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td>The injuries resulting in damage and death of few cells of the following. Which of the cells are least likely to be replaced by new cells?
a. hepatic cells
b. nephron
c. chondrocytes
d. neurons</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6.</td><td>Application</td><td>Applies scientific knowledge</td><td>Complete the following table:<table><tr><td>Cell/tissue/ muscles</td><td>functions</td></tr><tr><td>1.adipocytes</td><td>a----------</td></tr><tr><td>2. ----------</td><td>b. it secrets heparin</td></tr><tr><td>3. transitional epithelium</td><td>c----------</td></tr><tr><td>4. ----------</td><td>It connects bones together.</td></tr></table></td><td>Ans.
A storage fat
2. mast cells
c. distension of organs
4. ligaments</td><td>2 marks</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>7.</td><td>Analyse</td><td>Relates processes to unknown situations</td><td>Ganesh touched the hot plate by mistake and took away his hand quickly. Can you recognize the tissue and its type responsible for this?</td><td>Nervous tissue
Sensory or afferent neurons</td><td>2 marks</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>8.</td><td>Analyse</td><td>Understand diagrams, flow chart and parts with functions</td><td>Observe the structure and identify the marked parts. Also mention their functions.</td><td>Ans. A—collects nerve impulse from different parts and carry it towards the cyto.
B- Axon Carries nerve impulse from Cytons to</td><td></td></tr>
</table>

				different parts. C- node of Ranvier – Rapid conduction of nerve impulse.	
9.	Application	Relates process and scientific terminologies	What are the following and where do you find them in animal body? a. osteocytes b. columnar epithelium c. fibroblasts	Ans. a. Osteocytes- Skeletal connective tissue, living cells of bones and found in bones. b. Columnar epithelium epithelial tissue found in the inner lining of intestine , gall bladder and gastric glands. c. Fibroblasts:- Areolar connective tissue found under the skin, below the muscles , bones around the organs and blood vessels.	3 marks

10.	Analyse	Understand flow chart diagrams and charts	Identify the given diagram and write its structure and functions. 	1. non-striated muscle 2. the smooth muscle fibres taper at both the ends and do not show striations. 3. only one large oval nucleus is present in the centre. 4. they are involuntary in function.	5 marks
11.	Knowledge	Relates processes and phenomenon	What are cell junctions and explain different types of cell junction?	1. the epithelial cells are connected to each other laterally as well as to the basement membrane by junctional complexes called as cell junctions. Types:- a. tight junctions b. gap junctions c. hemidesmosomes d. desmosomes e. adherence junctions	5 marks

12.	Create	Understand diagram, chart and flow charts, relates functions	Given below is the diagram of certain types of connective tissue. Identify the parts labelled and write their functions. 	Ans. a. collagen fibres – tensile strength b. elastic or yellow fibres ---- flexibility c. fibroblast cells---- produces fibres and matrix d. adipocytes---storage of fats	5 marks
13.	Analyse	Understand diagram, chart and flow charts, relates functions	With the help of diagrams describe different types of neurons based upon the number of processes. Write location in animal body where they are present.	1.unipolar neuron- dorsal root ganglion of spinal nerves 2. Bipolar neuron - retina of eyes and olfactory epithelium 3. multipolar neuron- Cytons is star shaped giving rise to more than two processes present everywhere in central nervous system. 	5 marks

8. CELL THE UNIT OF LIFE					
1.	Create	Phenomenon based on in vitro culturing appreciates technological applications	In a tissue culture lab while generating entire organism which will give the best result. a. carrot b. frog c. dog d. human	Carrot	1 mark
2.	Analyse	Understand-ing characters of cells	The streaming movement of cytoplasm is called as a. glycolysis b. cyclosis c. cytosol d. activation	Cyclosis	1 mark
3.	Analyse	Differentiates cells and structure	For the active transport of molecules , ------ ions are required. a. Na/K b.Na/Ca c.K/P d. K/Mg	Na/K	1 mark
4.	Analysis	Relates processes and phenomenon in transport	The transport of different materials from cell to cell through ---- a. Golgi apparatus b. plasmodesmata c. endoplasmic reticulum d. centrioles	plasmodesmata	1 mark

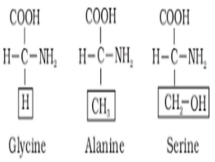
5.	Analysis	Differentiate organisms based on certain characters	Centrioles are present in a. plant cell b. animal cell c. bacterial cell d. virus	Animal cells	1 mark
6.	Create	Appreciates technological applications	Explain why the stem cells are not sufficient to convert into entire organism	Stem cells have the capacity to regenerate only organs not an entire organism	2 marks
7.	Analyse	Characters of living organisms	What is the role of 70S ribosomes in prokaryotic cells ?	As ribosomes are made up of RNA and proteins. They are useful in the protein synthesis and functions as a site of protein synthesis.	2 marks
8.	Create	Phenomenon and process based on certain characters	Explain why the spoonful of cur is added to a bowl of milk the milk curdles but if the process is repeated with spoonful of ghee the result is different. Explain.	Spoon of curd with lactobacillus hence entire milk is converted into curd but if we add ghee it does not convert milk into ghee. Ghee does not show any bacteria whereas curd formation is characterised by multiplication of bacteria.	3 marks

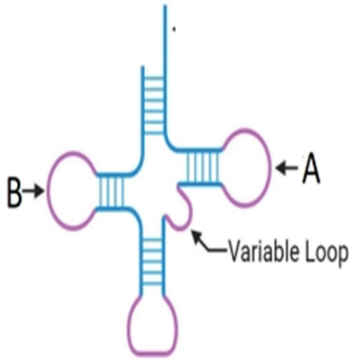
9.	Analyse	Functions of organs are studied	In eukaryotes few mitochondria were damaged. How these will be removed from the cell? Which cell organ play important role in this activity?	The damaged mitochondria are digested by the lysosomes and get cleared by these cells.	2 marks
10.	Create	Characters of cells	Animal cell are devoid of lysosomes. Explain what is the result?	As lysosomes are useful to bring about cellular digestion it helps in maintaining environment of the cell.	2 marks
11.	Analysis	Differentiates cell features	If a prokaryotic and eukaryotic cell are examined in lab which type of organism shows faster rate of reproduction and why?	Reproduction in prokaryotes is faster because of direct cell division. In eukaryotes indirect type of cell division and requires more time.	3 marks
12.	Create	Differentiates cell features	In somatic cells the diploid number of chromosomes is seen. Is there any organism with single chromosome if yes explain the type of chromosome in that organism?	Bacteria shows single chromosome in the form of dsDNA which is circular.	3 marks
13.	Analyse	Identifies phenomenon	How will you differentiate two metabolic processes occurring in prokaryotic and eukaryotic cell?	1. In prokaryotes 70S type of ribosome performs protein synthesis. 2. In eukaryotes	4 marks

				80S type of ribosome performs protein synthesis. 3. In prokaryotic cells nuclei divides directly. 4. In eukaryotes indirect type of division is seen.	
14	Create	Relates processes	Explain why we consider mitochondrion plays partial role in power production in the form of ATP.	If we expect the energy from glucose in the form of ATP the initial step is glycolysis carried out in cytoplast hence mitochondrion does not play role. Hence while converting the glucose into energy or ATP the mechanism occurs partially in cytoplasm and partially in mitochondrion.	4 marks
9. BIOMOLECULES					
1.	Analyse	Study of structure and formula	Statement I :- Sucrose is a non-reducing sugar. Statement II :- Sucrose lacks free aldehyde or ketone group. a. Statement I and II both are correct and II is the explanation of Statement I	a. Statement I and II both are correct and II is the explanation of Statement I	1 mark

			b. Statement I and II are correct but II is not the correct explanation of I c. both the statements are wrong d. Statement I is correct but II is wrong.		
2.	Analyse and evaluate	Uses mathematical base and relates interdisciplin-ary concepts	A DNA molecule measuring 68A^{o} long was inspected. It was found to contain ----- base pairs, ----- sugar phosphate bonds and ----- glycosidic linkages respectively. a. 20,40,38 b. 40,38,20 c. 20,38, 40 d. 20, 40, 40	Ans. c. 20, 38, 40	1 mark
3.	Analyse	Study of structure and formula and commercial role	Identify the incorrect statement from the following with respect to sec. metabolites a. Cellulose is a polymeric substance. b. ricin is a toxin. c. Vinblastine is used as a drug. D. Morphine is a pigment obtained from plant.	Ans. Morphine is a pigment obtained from plant.	1 mark
4.	Analyse and evaluate	Relates processes and effects causes, etc.	Proteins serve various functions in our body. Some of the functions are given below.:- 1. Collagen functions as intercellular ground substance. 2. Insulin enables glucose transport into cells.	d. 1,3 and 4	1 mark

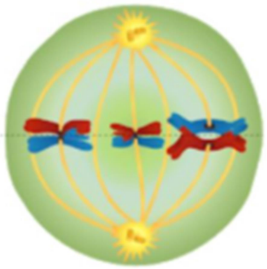
			3. Infectious agents are controlled by antibody. 4. Insulin is hormone. Which of the following set of options contain all correct statements? a. 1 and 2 b. 2 and 4 c. 2, 3 and 4 d. 1,3 and 4		
5.	Analyse	Study of structure and formula and commercial role	Fill in the blanks 1. Based on the nature of --a--- there are 20 amino acids. 2. Based on the number of ---b--- and ----c--- groups there are acidic , basic and neutral amino acids. 3. The R-group in the serine is ---d---. a--- carboxyl , b—amino , c—R-group , d--- hydroxy methyl.	a--- carboxyl , b—amino , c—R-group , d--- hydroxy methyl.	1 mark
6.	Analyse	Study of structure and formula and commercial role	Glycine and alanine are different with respect to one substituent on the a- carbon .What are the other common substituent groups?	The R group in these proteinaceous amino acids could be a hydrogen (glycine) , methyl group (alanine) , hydroxyl methyl (serine) , etc.	2 marks

					
7.	Analyse/ evaluate	Study of structure and formula	How are the prosthetic groups different from co-factors?	Prosthetic group are compounds and are distinguished from other cofactors in that they are tightly bound to the apoenzyme. For example, in peroxidase and catalase which catalyse the breakdown of hydrogen peroxide to water and oxygen, heme is the prosthetic group and it is a part of active site of enzyme. Cofactor may be organic or inorganic.	2 marks
8.	Analyse and apply	Relates metabolic processes	Enzymes are specific in activity. They are sensitive to pH and temperature. Name the enzyme that are active at acidic and alkaline pH. Also mention the name of organ where activity of these enzymes is seen.	At acidic pH-2 pepsin is active in stomach. Trypsin is active at pH-9.5 in duodenum.	2 marks

9.	Analyse and evaluate	Relates processes and phenomenon	Living state is a non-equilibrium steady state to be able to perform work. Justify.	In a biological system, metabolic reaction always remains on and influx and efflux of metabolites takes place constantly. Hence, it can be said that living state is a non - equilibrium steady state that can perform work.	2 marks
10.	Analyse and evaluate	Studies diagram , interprets and corelates	Observe the following figure of tRNA and answer the given questions:-  1. Identify 'A' and 'B' in the given diagram. 2. Name the part which helps in ribosome recognition. 3. Which part helps in amino acid recognition?	Ans 1. A is T-loop and helps in ribosome recognition. 2. 'B' is DHU arm and helps in amino acid recognition.	3 marks
11.	Analyse	Relates processes and phenomenon	Formation of enzyme substrate complex id the first step in catalysed reactions. Can you list other steps till the formation of	1.substrate binds to active site 2. alteration of enzyme shape	5 marks

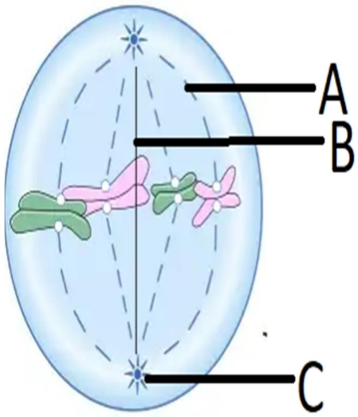
			product?	3. Intimacy of substrate breaks , breaking of bonds 4.enzyme product complex 5. release of product and enzyme joins with another substrate.	
12.	Analyse and evaluate	Analyses and interprets structure , figures	Nucleic acid exhibit secondary structure, justify.	1. wide variety of secondary structures 2. widely accepted B-DNA by Watson and crick 3. double helix, strands are polynucleotide sequences , antiparallel nature. 4. sugar-phosphate backbone , N-base is perpendicular to sugar and phosphate is alternately placed. 5.Specific base pairing i.e. purine pairs with pyrimidine. 6. ladder like structure , each step at 36^0. 7. 10base pairs make one spiral.	5 marks

13.	Analyse	Relates processes and phenomenon	Identify the group of enzymes in the given reactions 1. conversion of alcohol to acetaldehyde 2.synthesis of glucose-6-phosohate from glucose. 3. hydrolytic reaction in sucrose 4. elimination reaction in histidine 5. glucose-6-phosphate to fructose-6-phosphate	1. alcohol dehydrogenase- oxidoreductases 2. enzyme glucokinase – transferases 3. sucrase – hydrolases 4. histidine decarboxylase- lyases 5. phosphoglucoisomerase - isomerase	
10. CELL CYCLE AND CELL DIVISION					
1.	Knowledge and analyse	Relates phenomenon and processes	Select the correct statement in relation to Anaphase-I i. chromosomes with sister chromatids move to opposite pole. ii. Daughter chromosomes more to opposite poles. iii. homologous chromosomes move to same poles iv. homologous chromosomes chromosome move to opposite poles. a. I and iii b. ii and iii c. I and iv d. ii and iv	c. I and iv	1 mark
2.	Knowledge and application	Types of cell division	A teacher has shown various stages of mitosis under the	And c.	1 mark

		and processes	microscope. In which of the stage students can identify whether the source of tissue used to make slide is a plant or animal? a. interkinesis b. cytokinesis c. cytokinesis -1 d. cytokinesis -2		
3.	Evaluate	How daughter cell is formed?	A cell of hibiscus leaf shows 18 chromosomes. Its root cell and pollen grain will show --- and ---- number of chromosomes respectively. a. 18,18 b. 9,9 c. 18,9 d. 9,18	Ans C	1 mark
4.	Application	Stages of cell division	Identify the stage in the given diagram.  a. metaphase b. metaphase -I c. Metaphase -II d. anaphase	b. Metaphase-I	1 mark
5.	Remembe	Study of cell	Spindle fibres are almost	c.prophase	1 mark

	r	cycle	completely formed in ----- while they disappear in telophase. a. G-1 phase b. G-2 phase c. prophase d. metaphase		
6.	Understand	Stages of cell division -meiosis	State the difference between two terms of given pair. 1. anaphase and anaphase -I 2. cytokinesis and interkinesis	Anaphase is separation of centromere and movement of sister chromatids to opposite poles. 1. in anapahsae -I centromere does not separate. Chromosomes move to opposite poles along with sister chromatids. 2. Cytokinesis is a division of cytoplasm at the end of karyokinesis. Interkinesis is a resting phase between M-I and M-ii.	2 marks
7.	Understand	Stages of cell division	Name the processes responsible for given events. 1. each daughter cell receives equal number of chromosomes 2. DNA,RNA and histones are produced in cell.	1. disjunction 2. interphase 3. Apoptosis	3 marks

			3. Our fingers get definite shape in embryonic stage itself.		
8.	Remembe r	Study of interdisciplin-ary concepts	Identify the following structure 1. stage where maternal and paternal characters are exchanged. 2.where two sister chromatids join 3. where chromosomes attach to spindle fibres.	1. chiasmata 2. centromere 3. kinetochore	3 marks
9.	Applicatio n	Study meiosis	A zygote shows 12 chromosomes. How many chromatids will its each cell show at each pole at anaphase-I ? Show the calculations done.	Zygote is diploid and it will not undergo any meiotic division now. Anaphase-I is a stage of meiosis. Zygote will undergo mitosis only.	2 marks
10.	Understand	Study of meiosis	With the help of examples explain the terms heterotypic and homotypic division.	M-I is a heterotypic division. Parent cell (2n) shows meiosis -I and daughter cell will be haploid(n). Genetic constitution is different. Therefore , it is heterotypic. Meiosis-II is homotypic. Each cell produces two	2 marks

				daughter cells with the same number of chromosomes as that of parent cell.	
11.	Applicatio n	Relates diagram and the process	Label A, B and C in the given diagram and state the role A and B in mitosis.  	A-kinetochore fibre B- polar fibre C- centriole Kinetochore fibres contract while polar fibres elongate . This helps to pull away daughter chromosomes at anaphase.	5 marks
12.	Understand	Meiosis stages	What is another name of meiosis? Exactly which stage of meiosis is responsible for giving this name and why? Draw the same stage and label.	Reduction-division is another name of meiosis. Meiosis-i Half number of chromosomes move to opposite poles. Hence, daughter cells receive reduced number of chromosomes. 	5 marks

13.	Application	Stages of importance of synapsis	Rearrange the given stages in sequence. Identify each stage of meiosis-I in which these events occur. 1. desyanapsis 2.crossing over 3. Terminalization 4. synapsis 5. bouquet stage	1. bouquet stage-leptotene 2. synapsis-zygotene 3. crossing over – pachytene 4. desyanapsis – diplotene 5. Terminalization – diakinesis	5 marks
PLANT WATER RELATIONS/TRANSPORT IN PLANTS					
1.	Evaluation	Interprets substrate concentration of a solution	'osmosis is the diffusion of a solution of weaker concentration into a solution of higher concentration, when both are separated by a semipermeable membrane. What is the error in this statement? a. the exact concentrations are not indicated. b. there is no mention of DPD. c. the movement of water m molecule is not specified. d. the behaviour of the semipermeable membrane is not specified.	a. the exact concentrations are not mentioned.	1 mark.
2.	Analyse	Draws conclusion on the basis of elementary investigation	When a cell is kept in 0.5 M solution of sucrose its volume does not alter. If the same cell is placed in a solution of 0.5mNaCl the volume of cell - a. cell is plasmolysed b. no changes are seen	a. cell is plasmolysed	1 mark

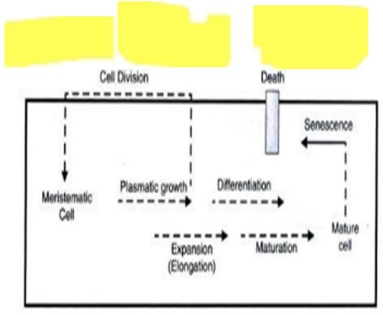
			c. increases d. decreases		
3.	Evaluation	Conclusion on the investigatory project	When beet root cylinders are washed and then placed in cold water anthocyanin does not come out. This indicates that plasma membrane is ------ a. differentially permeable to anthocyanin b. dead in nature c. impermeable to anthocyanin d. permeable to anthocyanin	Ans. impermeable to anthocyanin	1 mark
4.	Analyse	Physiological processes in plants	Which of the following change in the guard cell is responsible for keeping the stomata open during day time? a. decrease in osmotic pressure but increase in turgor pressure b. increase in osmotic pressure but decrease in turgor pressure c. increase in both osmotic and turgor pressure d. decrease in both osmotic and turgor pressure.	a. decrease in osmotic pressure but increase in turgor pressure	1 mark
5.	Analyse	Relates processes and phenomenon with cause and effect	In higher plants, nitrates are absorbed from the soil and converted into ammonia in two steps. In the second step electrons required for reduction are donated by a. nitrate reductase	Ferredoxin	1 mark

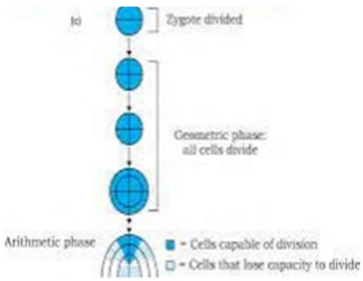
			b. ferredoxin c. nitrite reductase d. cytochrome P450		
6.	Evaluation	Relate process and phenomena	After looking a loaded bike with bags of milk, Shila asked milkman What is this? He replied it is food of plants. Shila is answerless. Will you help Shila in knowing what was that on the bike and for which purpose the milkman was coming?	Bags with food – I mark Purpose – 2 marks	3 marks
7.	Analyse	Relates processes and phenomenon with cause and effects	As an enthusiasm a boy tied a transparent polythene on a potted plant and another polythene bag which is not transparent to another potted plant. He observed both the polythene bags contains water . What do you understand?	Observation – 1 mark Analysis- 2 marks	3 marks
8.	Creation	Plans and conducts experiment.	While explaining the ascent of sap in the clean , a student raised his hand and asked why do plants did such a job to lift water? why not we be able to develop an ability in the plants to draw water from the air / rain directly like some orchid , that may solve/ most of the problems. What do you think	Ascent of sap meaning- 1 mark Role of it in plant – 2 marks Thinking of developing ability in plant to draw water directly like an orchid . – 2 marks	5 marks
9.	Analysis	Experiment to arrive at and verify the facts and	Bring the picture of root hair and stem hair and think if stem hair took the role of root hair. Will	Comparison between stem and root hair – 3 marks	5 marks

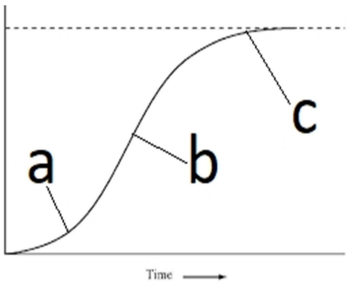
		principles and phenomenon	they succeed. If yes how and not then why?	Yes, how -1 mark No , why – 1 mark	
10.	Analyse	Conclusion on the basis of data collected in activity	Potted plant 'A' was provided with 100 ml of water every day. Another potted plant 'B' is also provided with same amount of water and some urea dissolved in it. What type of reactions both the plants show?	Observation for plant 'A' – 1 mark Observation of plant 'B' 1 mark Effects of urea and water on plant growth * 3 marks	5 marks
11.	Evaluation	Handling of lab experiments	Two potted plants were taken of which one is 'A' which was provide water for a week continuously. The potted plant "B' water is provided intermittently. What will be the effect on plants?	Observation of A- 1 mark Observation for B – 1 mark Conclusion – 1 mark	3 marks
12.	Evaluation	Communicate findings	Geeta after used to observe the act of her mother everyday asked a question to her mom. Is this 'Tulsi' plant drinks water? Why do you give nearly every day? What will her mother answer?	Drinking phenomenon- 1 marks Need of water- 1 mark Transpiration – 1 mark Amount of water sufficient for a day and its conclusion – 1 mark Bushy nature and other characters- 2 marks	5 marks

13.	Analyse	Handle lab experiments and draws conclusion	When a potted plant is cut near the soil, it exudes the water due to root pressure. But, in the forest browsers like goat and wild animals eat plant parts by snatching etc. from the stump.Plants do not show root pressure. Why?	Meaning of root pressure- 2 marks Browsers forest animals eating plant parts- 1 mark Observation – 2 marks	5 marks
PLANT GROWTH AND MINERAL NUTRITION:- BHUPENDRASINGH RAJPUT					
1.	Analyse	Explains systems and relationships and processes.	ABA is known as stress hormone. Justify the statement.	ABA stimulate the closure of stomata in epidermis and increases the tolerance of plant to various kinds of stress.	2 marks
2.	Analyse and create	Draws conclusion on the basis of data collected. Relates processes and phenomenon	What is expected to happen if – a. GA3 is applied to rice seedlings b. dividing cells stop differentiating c. a rotten fruit gets mixed with unripe fruit. d. you forget to add cytokinin to the culture medium e. apical bud is cut from the shoot.	a. inter nodal growth of rice stem , tallness b. may lead to tumour formation c. more ethylene will be diffused from rotten fruit to unripe fruits. d. morphogenesis will not take place. e. Lateral buds will grow and produce bushy appearance to the [plant	5 marks

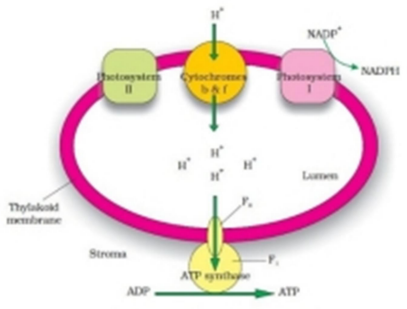
3.	Analyse	Applies learning to hypothetical situation	A gardener wants to give bushy appearance to a plant in our college campus. 1. What should he do to achieve the same 2. Which property of phytohormones he must be aware of	1. He needs to remove apical bud. 2. Apical dominance of auxins , he must be aware of.	2 marks
4.	Analyse and applicatio n	Differentiates phenomenon and processes based on certain characters of tissues	You are given a tissue with its potential for differentiation in an artificial culture. Which of the following pairs of hormones will you add to the medium to secure shoots as well as roots? a. IAA and gibberellins b. Auxins and Cytokinins c. auxin and ABA d. Gibberellins and ABA	b. Auxin and cytokinin	1 mark
5.	Apply and analyse	Relates processes and phenomenon with causes and effects	It is observed that deficiency of a particular element showed its symptoms initially and older ;eaves and then in younger leaves. Does it indicate that the element is actively mobilized or relatively immobile? Name two elements which are highly mobile and two which are relatively immobile. How is the aspect of mobility being important to agriculture and horticulture?	1. This is actively mobilized. 2. Highly mobile elements are Nitrogen and Magnesium. 3. The symptoms of deficiency of mobile elements are first seen in older leaves and symptoms of deficiency of relatively immobile elements appear	5 marks

				first in younger leaves. This information can be used in nurseries.	
6.	Analyse	Relates process and phenomena with cause and effects	There is a biological nitrogen fixation process in nature, analyse the statement.	It is carried out by different organisms belonging to prokaryotes called nitrogen fixers/ obligate diazotrophs.	5 marks
7.	Analyse	Communicates the findings and conclusion effectively	Farmers in particular region were concerned that premature yellowing of leaves of a pulse crop plant might cause decrease in the yield. Which treatments could be most beneficial to obtain maximum yield?	Application Fe and Mg to promote synthesis of chlorophyll.	2 marks
8.	Analyse and evaluate	Writes comments on given flowchart.	Observe the flow chart and give your comment on the steps marked in it.  	Growth of apical meristem in root and shoot apices to show linear growth Once cell division is over cell gets elongated form further development and differentiation.	3 marks

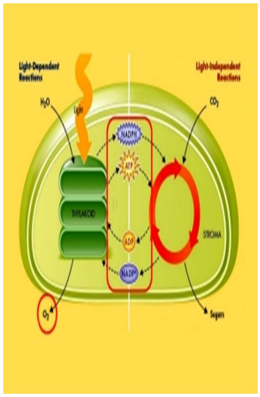
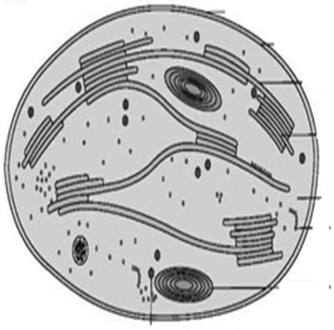
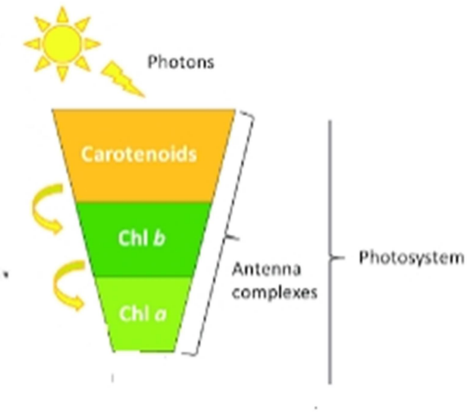
				Ageing of cell or tissue leads to slowing down the rate of metabolism.	
9.	Apply and analyse	Relates processes and phenomena with causes and effects	What is chlorosis, stunted growth and abscission?	1. Chlorosis is the loss of chlorophyll resulting in the yellowing of leaves. 2. The growth is retarded with condensed stem and less leaves. 3. Premature fall of leaves, flowers and fruits.	3 marks
10.	Evaluate	Classifies the data	Classify the given elements into micro and macro elements. Zn, Mg, Cu, Al, P,K.	Zn, Cu and Al are microelements. Mg, P and K are macroelements.	2 marks
11.	Create	Make linkages at the interface of biology with other disciplines	Observe the following diagram showing embryonic development in human embryo.  Which cell in the above diagram shows? 1. Arithmetic growth and why	Zygote shows geometric growth as cells produce undergo division. After 16-celled stage embryo there is arithmetic growth as only few cells undergo division.	5 marks

			2. Geometric growth and why Explain the same in plants also		
12.	Analysis	Graph analysis and interpretation	Observe the given graph and answer the questions given below:-  1. Which phase is represented by 'a'? 2. What is 'b' representing? 3. What is the difference between growth during 'a' and 'b'? 4. Which phase is represented by 'c'?	1. It represents the lag phase or cell division phase. 2. 'b' represents the log phase or exponential phase. 3. In lag phase very little growth is taking place and the time required is more. In log phase maximum growth is taking place in very short time period. 4. 'c' represents the STATIONARY PHASE	5 marks
13.	Create	Thinks logically to derive the mathematical expression of growth	What is efficiency index? Explain the terms AGR and RGR.	Three definitions	3 marks
PHOTOSYNTHESIS IN HIGHER PLANTS					
1.	EVALUATE	Draw labelled diagrams, flow charts , concept learning	How many PGAL molecules are required to regenerate 18 RuBP? a. 30 b. 25 c. 15	a.30	1 mark

			d. 20		
2.	Analyse	Draws conclusion on the basis of data collected.	During dark reaction the carbon atoms in PGA are derived from— a. RuBP only b. CO_2 only c. RuBP and CO_2 d. RuBP+CO_2+PEP	c. RuBP and CO_2	1 mark
3.	Analyse	Draw labelled diagrams, flow charts , concept learning	What is true about compensation point in C3 and C4 plants? a. compensation point in C3 plants is higher b. compensation point in C4 plants is lower c. Both a and b d. none of these	c. both a and b	1 mark
4.	Analyse	Uses scientific conventions and symbols	Photolysis of water molecule yields a. 2 electrons and 4 protons b. 4 electrons and 4 protons c. 4 electrons and 2 protons d. 2 electrons and 2 protons	d. 2 electrons and 2 protons	1 mark
5.	Analyse	Explains system relationship and processes and phenomenon	The evidence that during photosynthesis oxygen is released from water can be explained correctly with— a. photosynthetic bacteria use H_2S and CO_2 to form carbohydrates, water and sulphur. b. isolated illuminated chloroplasts release oxygen if	d. all of above.	1 mark

			provided with potassium ferrocyanide c. isotopic ^{18}O provided experimental proof. d. all of above		
6.	Create and analyse	Compares and relates the phenomenon	Rupa knows that maximum absorption takes place in blue region of visible spectrum. Raghav gives her information that maximum photosynthetic yield is in red region of visible spectrum. Considering the facts known by these two are true. Explain the reason.	In blue wavelength intensity of light is more so the point of saturation reaches earlier. In red region intensity is low that signifies the maximum photosynthetic yield with prolonged saturation.	2 marks
7.	Analyse	Applies learning, relates process and phenomenon with causes and effects.	Observe the given figure and answer the following questions  1. What does above diagram refer? 2. Extract the above process in the form of an equation.	1. photolysis of water 2. $4H_2O$--- $4H^+ +4OH^-$ $4OH^-$ ---- $4OH + 4e^-$ $4OH$--- $2H_2O + O_2$ $4H_2O$----- $2H_2O + O_2 + 4H^+ + 4e^-$	3 MARKS

8.	Analyse	Draw labelled diagrams, flow charts , concept learning	Why does RuBisCO carry out preferentially carboxylation than oxygenation in C_4 plant ? Mention the specific conditions when it will carry out oxygenation.	As it is present in the agranal chloroplast of bundle sheath cells in C4 plant it gets high concentration of metabolic CO2. It is also not directly in contact with the atmosphere. If oxygen concentration is high in the surrounding it will carry out oxygenation.	2 marks
9.	Analyse	Relates processes and phenomenon with cause and effects.	Will the Calvin Cycle run continuously if? 1. availability of RuBP is less 2. Regular supply of ATP . Justify.	1.The cycle will not be carried out continuously as it needs RuBP to accept CO2 for fixation. Continuous energy supply ensures continuity of the cycle.	2 marks
10.	Analyse	Explains system relationships and processes	Dark reaction cannot take place in the absence of light reactions. Justify diagrammatically.	Ans.	3 marks

					
11.	Apply and analyse	Explains system relationships and processes	 Observe the given diagram and answer the questions 1. What are the two main components of this cell organ. 2. Why dark reactions are carried out in ground substance?	1. The two main components of this organ are grana and stroma or the ground substance. 2. The dark reaction is enzyme dependent phase of photosynthesis carried out in stroma as the necessary enzymes are synthesised in stroma using DNA present in it.	3 marks
12.	Evaluate and analyse	Relates processes and phenomenon	 1. Which component acts as core	1. chlorophyll-a acts as reaction centre or core complex. 2. Carotene converts nascent oxygen into molecular oxygen. 3. Inhibition of photosynthesis at very high light	5 marks.

			complex? 2. Name the pigment that converts nascent oxygen into molecular oxygen. 3. What is solarization? 4. How 'LHC' transfers its absorbed energy to core complex? 5. For how much time period state of excitation lasts in chlorophyll-a?	intensities primarily due to photo-oxidation of specific compounds such as chlorophylls. 4. electron spin resonance or ESR is responsible for transfer of energy from LHC to Core complex. 5. It lasts for 10^{-9} seconds.	
13.	Analyse	Relates processes and phenomenon	Define photosynthesis. Is it possible to demonstrate the process of photosynthesis experimentally? Justify your answer with appropriate explanation.	Definition- 1 mark Experiment showing effect of Carbon dioxide concentration or light on process. Diagram required.	5 marks
RESPIRATION IN PLANTS					
1.	Evaluation	Relates processes and phenomenon	Energy is liberated during burning of coal and respiration both. The energy released in later is always in stepwise and controlled manner because— a. enzymatic nature b. hormonal control c. role of oxygen is important d. nature of respiratory substrate	Enzymatic nature	1 mark
2.	Analyse	Interprets the process	Maximum usable energy per mole of glucose metabolised will	c. aerobic respiration by	1 mark

<table>
<tr><td></td><td></td><td></td><td>be generated during
a. fermentation into ethanol by yeast.
b. glycolysis in skeletal muscle
c. aerobic respiration by germinating seeds.
d. production of lactic acid in muscles</td><td>germinating seeds</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.</td><td>Evaluate</td><td>Analyse enzyme activity</td><td>Which on of the following takes place in Krebs cycle?
a. Complete oxidation of acetyl. COA into CO2 and H2O
b. Complete reduction of acetyl. COA into
c. Complete oxidation of acetyl. COA with electron transport
d. complete oxidation of citric acid into water</td><td>c. Complete oxidation of acetyl. COA with electron transport</td><td>1 ,mark</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.</td><td>Analyse</td><td>Relates Findings and conclusion effectively</td><td>Match the biochemical processes given under column I with their respective cellular location,
<table><tr><td>Column-I</td><td>Column-II</td></tr><tr><td>A. Krebs cycle</td><td>I. Stroma</td></tr><tr><td>B. Glycolysis</td><td>J. Grana</td></tr><tr><td>C. Calvin cycle</td><td>K. Mitochondri</td></tr><tr><td></td><td>L. Cytoplasm</td></tr></table></td><td>Ans- A-K, B-L, C-I</td><td>1 mark</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5.</td><td>Analyse</td><td>Communicates the findings and conclusion effectively</td><td>Carbohydrates , fats and proteins give energy during their oxidation. What are these substances called?
a. nitrogenous reserves</td><td>b. respiratory substrates</td><td>1 mark</td></tr>
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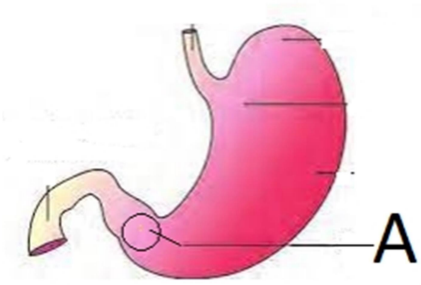
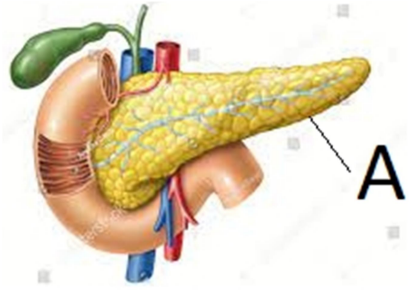
			b. respiratory substrates c. energy releasing substrates d. photosynthetic reserves		
6.	Evaluate	Draw conclusion on the basis of projects	Organisms need suitable conditions and energy for the growth and development. Yeast is a fungus and it is poured into the dough. Will it survive and get energy to grow?	Nature of yeast – 1 mark Activity and mode of respiration-2 marks Conclusion-2 marks	5 marks
7.	Analyse	Analyse and interprets respiration	Although all of us have similar leg muscles the leg muscle of a trained long-distance runner are able to perform much better than an average person. Justify,	Need energy for running- 1 mark Leg muscle type- 1 mark Role of each muscle – 2 marks Effect – 1 mark	5 marks
8.	Evaluation	Draw conclusions on the basis of activity or experiment	Removal of hydrogen is oxidation. Show the difference between respiration and combustion.	Oxidation process- 2 marks Difference -3 marks	5 marks
9.	Evaluation	Analyse and interprets substrate enzyme activity	In the process of glycolysis where do you observe reversible and irreversible reactions?	Meaning of reversible and irreversible reactions – 2 marks Product act as	5 marks

				substrate and vice a versa (example)- 1 mark Reactions- 2 ,marks	
10.	Evaluate	Differentiates organisms , phenomenon and processes based on certain characters	Explain the statement, 'Glycolysis is a biochemical proof of evolution.'	Catabolic activity – 1 mark Common pathway- 1 mark Present in all organ isms- 1 mark Product same- 1 mark Products used in different reactions- 1 mark	5 mark
DIGESTION AND ABSORPTION					
1.	Analyse	Relates processes and phenomenon with causes and effects	Assertion:- Saliva has antibacterial properties. Reason:- lysozyme acts as anti-bacterial agent. a. A is correct and R is incorrect b. A is incorrect and R is correct c. Both A and R are correct d. Both A and R are incorrect	c. Both A and R correct	1 mark
2.	Application	Applies scientific terminologies	Bile contains a. bile pigments, bile salts and enzymes b. phospholipids , cholesterol and enzymes	Ans . phospholipids, bile salts, bile pigments and cholesterol	1 mark

			c. phospholipids , bile salts , bile pigments and cholesterol d. bile salts and bile pigments		
3.	Evaluation and analyse	Applies scientific concept in daily life	Veena consulted a doctor. After certain pathological tests doctor advised her for surgery and removal of major part of intestine. What will be effect on digestion process and why?	The absorption wont takes place as small intestine is mainly involved in absorption of food.	2 marks
4.	Analyse	Explains efficiency of systems	Common bile duct comprises of a. cystic duct and right hepatic duct b. cystic duct and pancreatic duct c. cystic duct + right hepatic duct + left hepatic duct d. cystic duct + common hepatic duct	d. cystic duct + common hepatic duct	1 mark
5.	Understand-ing	Draws conclusion on the basis of data collected	Which of the following is incorrect human dentition? a. adult human has 32 permanent teeth. b. human forms the deciduous type of teeth. c. arrangement of teeth in upper and lower jaw is the same. d. human tooth is embedded in a socket of jaw bone, which is called as diphyodont condition.	. human tooth is embedded in a socket of jaw bone, which is called as diphyodont condition.	1 mark

6.	Evaluate	Relates process and phenomenon with causes and effects	 a. Identify the marked part in the given diagram. b. What is the function of marked part.	1. A is pyloric sphincter 2. opens stomach into duodenum.	2 marks
7.	Analysis	Differentiates processes and phenomenon.	Differentiates between chylomicrons and micells.	Fatty acids and glycerol being insoluble cannot be absorbed into blood, incorporated into small droplets called micells. Micells are reformed into very small protein coated fat globules called as chylomicrons.	2 ,marks
8.	Application	Analysis and interpretation , applies scientific concepts of biology in daily life.	 1. Identify A. 2. Where it is located in human body?	1. A is pancreases 2. It is situated between the limb of the duodenum. 3. Pancreases is a compound gland i.e. Heterocrine gland as it functions as exocrine and endocrine	5 marks.

			3. Comment on the dual nature of the organ shown in diagram. 4. What will happen if there is malfunctioning of endocrine part of the organ?	structure. 4. Endocrine portion secrets hormones insulin and glucagon. If there is malfunctioning of endocrine cells regulation of blood sugar level will be affected.	
9.	Analyse and evaluate	Interprets the processes and phenomenon	Action of pepsin gets stopped after entering into small intestine. Explain.	Pepsin acts in acidic medium as it is active in stomach where pH is 1.8 to 2.0. In small intestine the medium is alkaline and the pH is not suitable for activity of pepsin. It gets denatured in small intestine.	2 marks
10.	Application	Analyse and interprets	Monoglycerides ----A---- fatty acids Dipeptides -----B amino acids Select the correct option for 'A and 'B'.	A is lipase and B is dipeptidases.	1 mark
11.	Evaluate	Explains efficiency of the process and relationship	Lacteals are milky white in appearance. Explain.	Due to storage of fats and lipids lacteals are milky white.	1 ,mark

12.	Analysis	Applies scientific concepts	Complete the chart Food----- mouth----buccal cavity -----A-----bolus----stomach---- chyme----X----- Give the reactions occurring in organ 'X'	Ans. A. starch ----- salivary amylase---- maltose B. Organ is 'X' Small intestine. The reactions Maltose ---- **maltase**--- glucose + glucose Sucrose---- **sucrase**----- glucose + fructose	5 marks
BODY FLUIDS AND CIRCULATION					
1.	Analyse	Relates processes and phenomenon	The correct route through which pulse making impulse travels in the heart is--- a) b) c)SA node --- AV node---- Bundle of HIs Purkinje Fibres---- Heart muscles. d)	Ans c	1 mark
2.	Understand	Analyses and interprets figures and charts	The given figure shows blood circulation humans as A to D. Select the option which gives correct identification of label and its function	d. C- vena cava takes blood from body parts to right auricle	1 mark

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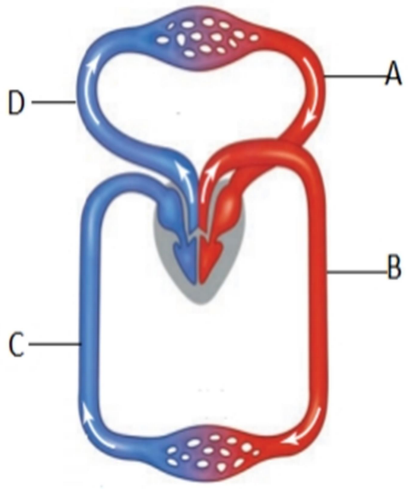
<td> 

a. B- pulmonary artery takes blood from heart to lungs
b. A- pulmonary vein takes impure blood from body parts
c. D- dorsal aorta takes blood from heart to body parts
d. C- vena cava takes blood from body parts to right auricle</td>
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<td>3.</td>
<td>Analyse</td>
<td>Analyses and relates the phenomenon and understand disorders</td>
<td>Match the columns
<table>
<tr><th>Column I</th><th>Column II</th></tr>
<tr><td>A. Heart failure</td><td>1. Sudden damage to heart muscles due to inadequate blood supply</td></tr>
<tr><td>B. Cardiac arrest</td><td>2. Chest pain due to insufficient oxygen supply</td></tr>
<tr><td>C. Heart attack</td><td>3. Atherosclerosis</td></tr>
<tr><td>D. CAD</td><td>4. Heart not pumping blood effectively.</td></tr>
</table></td>
<td>Ans. option a</td>
<td>1 mark</td>
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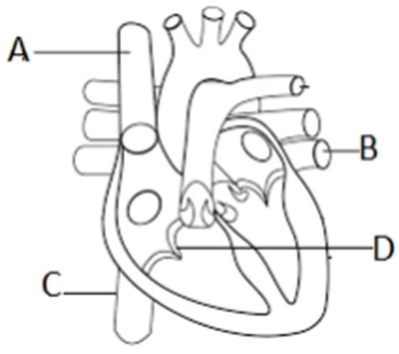
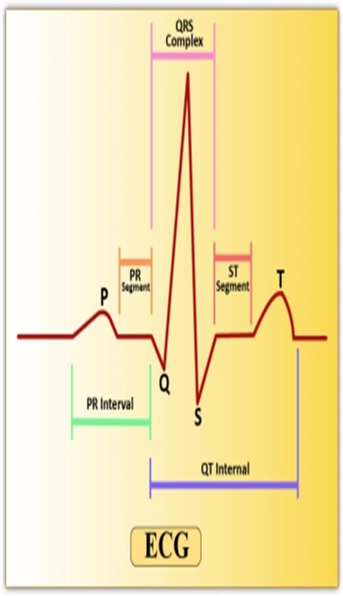
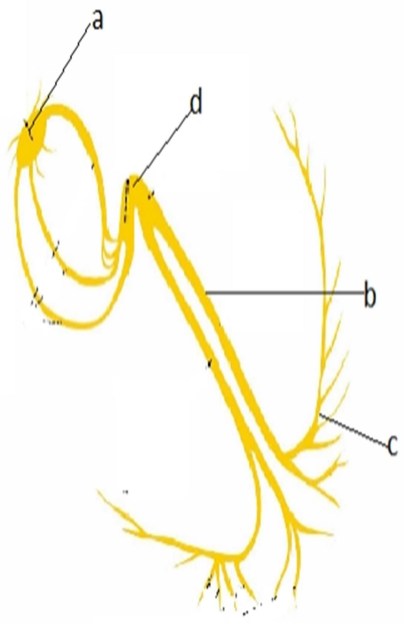
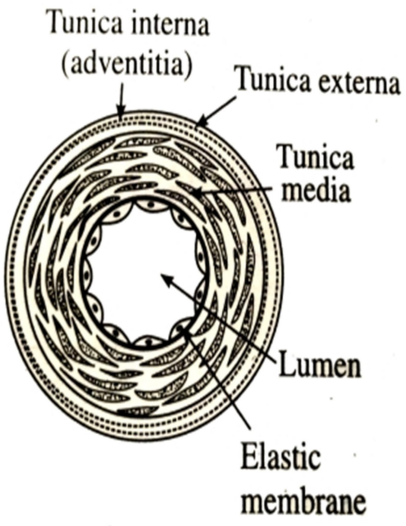
			E. Angina pectoris | 5. Heart stops beating. | | A | B | C | D | | a | 4 | 5 | 1 | 3 | | b | 4 | 5 | 3 | 1 | | c | 4 | 3 | 5 | 2 | | d | 5 | 4 | 2 | 3 |		
4.	Analyse	Applies scientific terminologies	Arteries are best defined as the vessels which a. carry blood away from the heart to different organs b. Break up into capillaries which unite to form vein. c. carry blood from one visceral organ to another d. always supplies oxygenated blood to different organs	Ans a. carry blood away from the heart to different organs	1 mark
5.	Analyse	Applies scientific terminologies	Match the columns based on parts and their respective functions | Column I | Column II | | A. Lymphatic system | i. carries oxygenated blood | | B. Pulmonary veins | ii. immune response | | C. Thrombocytes | iii. to drain back the tissue fluid to circulatory system | | D. Lymphocytes | iv. coagulation of blood |	Ans. b	1 mark
			| | A | B | C | D | | a | Ii | I | Iii | iv |		

			b Iii I Iv Ii c Iii I Ii Iv d Ii I Iii iv		
6.	Analyse	Explains processes , Makes linking,	A person is doing morning exercise felt down , doctor found the pulse rate 85 and his cardiac output 6120 ml. Find out the stroke volume. Explain whether it is normal or not?	Formula Cardiac output = stroke volume X pulse rate 6120= s.v. X 85 s.v. = 6120/85 = 72 ml.	2 marks
7.	Application	Uses knowledge of biology in daily life and unknown situations	A person met with an accident. He lost blood at enormous rate and need to transfuse immediately. No donor was available. A person approached and offered his blood and doctor immediately agreed. What can be the blood group of people? Why doctor agreed to take his blood?	The blood group of that person was 'O'. The person with blood group 'O' produces both types of antibodies and does not show any antigen. Hence doctor readily permitted to take his blood.	3 marks
8.	Analyse and understand	Analyses and interprets diagram and parts for functions	 Observe the diagram and identify the labelled parts. Write function	Ans. 'A' is pre- caval vein. It collects deoxygenated blood from upper parts of the body. 'B' is pulmonary veins. It transports oxygenated blood from lungs to left	5 marks

			of each identified part. Name the valve present between left auricle and left ventricle.	auricle. 'C' is post caval vein. It collects deoxygenated blood from lower parts of the body. 'D' is tricuspid valve. Prevents backflow of blood from right ventricle to right auricle. The valve present between left auricle and left ventricle is mitral valve.	
9.	Apply	Applies scientific terminologies	A blood sample was smeared and examined in a path lab. The smear showed different types of cells with variety of shapes of nuclei. These shapes were multilobed, bilobed and twisted. Can you tell the type of cell with their functions?	1. multilobed nucleus- the cell is neutrophil and its function is phagocytosis. 2. Bilobed nucleus – this is eosinophils and the function are detoxification. 3. Twisted nucleus- It is basophil. It secrets heparin and histamine.	3 marks
10.	Analyse , evaluate and create	Analysis and interpretation of graph , relates	Observe the given figure and answer the questions	Ans. 1. P, R and T waves are positive waves.	5 marks

		process	 1. How many of the waves shown in graph are positive waves? 2. To which waves you will call negative waves and why? 3. Which interval triggers main pumping contraction? 4. What is Significance of ST segment?	2. Q and S waves are negative waves as they are below baseline. 3. QRS complex triggers the main pumping action. 4. ST segment signifies that beginning of ventricular repolarization should be flat.	
11.	Analyse, Evaluate and create	Applies scientific terms, analyse and interpret the information		Ans. 1. AV node and at the base of atria. 2. The delay ensures that your atria are empty of blood before the contraction stops. 3. It is bundle of His. 4. 'c' is purkinje fibres and it is distributed over ventricular wall.	5 marks.

			Observe the given diagram and answer the following questions? 1. The pace setter is denoted by ---- and is present --------. 2. Why structure 'd' delays signal from SA node? 3. The structure denoted as ' b' is ------ 4. The structure denoted as 'c' is located ----- and is responsible for-------.		
12.	Analyse	Applies scientific terms, analyse and interpret the information	Observe the given diagram and answer the following questions:-  1. Which of the layers shown in the diagram is made up of collagen fibres? 2. What if the lumen is deposited with salts? 3. Which type of muscles are present in tunica media? 4. What is vasa vasorum and where you will find it ?	Ans. 1. Tunica externa is made up of collagen fibres. 2. It leads to atherosclerosis. 3. Smooth visceral muscles are present in tunica media. 4. Vasa vasorum is small blood vessel found in outer layer of major blood vessels and it supplies blood to the vessel in which it is found.	5 marks

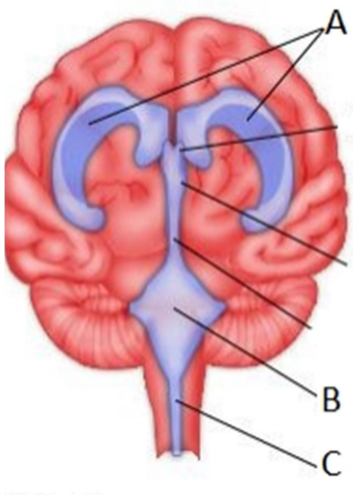
OSMOREGULATION AND EXCRETION					
1.	Analyse	Applies scientific terminologies	Formation of hypertonic urine is due to – a. having small loop of Henle b. eating salt free diet c. counter current mechanism d. increased water intake.	Ans . c- counter current mechanism	1 mark
2.	Analyse	Applies scientific terminologies	A person cannot produce sufficient levels of ADH in diabetes insipidus. ADH increases water permeability of DCT and collecting tubule of nephron. What is produced as a result? a. large volume of concentrated urine. b. small volume of concentrated urine. c. small volume of dilute urine d. large volume of dilute urine.	d. large volume of dilute urine	1 mark
3.	Evaluate	Relates process and phenomenon, applies scientific terminologies	Raju's diet consists of mainly chicken and eggs. He will excrete more amount of a. salts b. glucose c. urea and uric acid d. water	c- urea and uric acid	1 mark
4.	Analyse	Explains system relationship and	Kangaroo rat shows longer loop of Henle than a normal white rat because	d. d. kangaroo rat lives in the desert region where	1 mark

		phenomenon	a. they differ in diet b. kangaroo rat produces more waste material c. kangaroo rat has scarcity of food. d. kangaroo rat lives in the desert region where water is scarce.	water is scarce.	
5.	Evaluate	Applies scientific terminologies	How does the blood leaving the glomerulus of human kidney differ from the blood entering the glomerulus? a. it has lower concentration of crystalloids. b. it has lower concentration of plasm proteins c. it contains fewer corpuscles per litre. d. it has higher concentration of crystalloids.	Ans. a. it has lower concentration of crystalloids	1 mark
6.	Analyse	Differentiates organisms on the basis of processes and phenomenon	The tadpole larva is Ammonotelic while frog is ureotelic. Justify the statement.	Tadpole is Ammonotelic because it has large amount of water in its environment for removal of ammonia as excretory product. Frog excretes urea as less water is available to frog in habitat.	2 marks

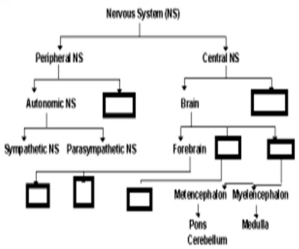
7.	Analyse	Applies scientific concept in daily life	A banker drank coffee many times a day as he was sitting in an AC cabin throughput. He started passing urine many more times than before. What is the reason?	The substances which increase the volume of water to excreted in the urine are called as diuretics. Coffee is a diuretic and since the banker drinks coffee many times his frequency of passing urine is increased.	2 marks
8.	Analyse	Applies scientific concept in daily life	A patient was advised to check blood and urine. Pathologist made a detailed report which was as follows. What is your opinion about these reports? Report A:- blood examination Test- creatinine Result: 2.12 mg /dl Normal values range between:- For males -0.6 to 1.4 mg/dl Female:- 0.6 to 1.2 mg/dl Report B:- – examination of blood Test :- fasting blood sugar Result -225ml/dl Normal values – 70-110ml/dl	Ans. Report A- The creatinine value has increased which may be a sign of poor kidney function. Report B:- High volume of fasting blood sugar indicates that the person is suffering from diabetes.	2 marks
9.	Analyse	Applies scientific terminologies	A 41-year-old man had blood pressure of 100/60 of Hg. He stopped passing urine? What could be the reason for that? What measures can be taken to	The blood requires a certain pressure to pass through the glomerulus of the nephron.	3 marks

			prevent this condition?	If the pressure of blood is less the blood will not pass through the glomerulus , filtration will not occur and urine formation is stopped. Drinking lots of water and maintaining a normal BP is necessary to prevent this.	
10.	Analyse	Applies scientific terminologies	Explain composition of glomerular filtrate is not the same as that of urine.	The volume of the filtrate is much more than that of urine. Most of the Filtrate filtrate is reabsorbed by the renal tubules. Substance like Na ions, glucose is actively absorbed and hence not found in urine.	2 marks
11.	Analyse	Draws and understand flow charts and diagrams	Complete the flow chart. Fill in the blanks at A, B, C, D and E. JG cells release ---- A---- when there is fall in GFR. The released chemical A converts---B--- to angiotensinogen II which	Ans. A. Renin B. Angiotensinogen C. Arterioles D. Aldosterone E. Blood volume	5 marks

			constricts--------C in kidney thereby decreases blood flow and increases blood pressure. Angiotensinogen stimulates adrenal cortex to release -----D---. This causes reabsorption of more sodium ions and water causing increase in ----E----.		
12.	Analyse	Explains system relationship with cause and effects	Vampire bat is nocturnal sanguivorous animal. It feeds on blood of large birds and mammals and can consume blood more than half of its body mass. 1. How does this bat compensates for its heavy weight? 2. How does this bat adapt to high protein diet?	1. To compensate for its heavy weight , while bat is feeding, its kidneys excrete large volume of dilute urine. Thus, the animal can fly easily. 2. As it cannot go to drink water during the day, instead of diluting the nitrogenous waste , the kidneys resort to concentrating the urine in order to conserve water. It changes the osmolarity of urine.	5 marks
13.	Analyse	Relates processes and phenomenon	Give reasons for the following:- 1. birds like albatross manage osmoregulation in spite of never getting access to fresh water. 2. Barnacles are called as euryhaline organisms.	1. They have special salt glands near nostrils capable of secreting salts by active transport and maintaining	5 marks

			3. Marine animals are mostly osmoconfirmer. 4. Composition of blood is determined by what the excretory organs retain and not by what we eat. 5. Infants upto age of 2 years do not have voluntary control over micturition.	osmotic balance. 2. Barnacles are capable of handling wide ranges of salinity. 3. Because their body fluids and external environment are isosmotic in nature. 4. Because excretory organs play an important role in maintaining homeostasis. 5. This is because neural control to the external sphincter muscles are not developed.	
CONTROL AND COORDINATION					
1.	Analyse	Relates diagram charts and processes	 1. Which part is denoted by A?	Ans. 1. Lateral ventricles 2. Ependyma cells 3. Foramen of Monroe 4. Medulla oblongata 5. Cerebrospinal fluid and volume is 120 ml	5 marks

			2. Name the cells that line the cavity of brain. 3.What connects A to B? 4.In which part of brain 'C' cavity is found? 5. Which fluid is found in brain cavity and what is its total volume?		
2.	Analyse / knowledge	Relates diagram and charts with functions	Eye consists of three layers .What are they? Which layer contains rod and cone? Rods and cones are modified a. hair b. unipolar neuron c. bipolar neuron d. multipolar neuron	Ans 1.Sclera , choroid and retina 2. retina 3.bipolar neuron	3 marks
3.	Analyse	Relates processes and structures	Differentiate between cerebrum and cerebellum.	Cerebrum 1. 80-84 % of brain 2. Hemispheres are connected by corpus callosum. 3. controls memory, intelligence and learning 4. Part of forebrain 5. contains more sulci and gyri	5 marks Cerebellum 1. 11% 2. Cerebellar hemispheres by median tube and vermis. 3. controls accura of movement and posture orientatio 4. Part of hindbra 5. Contains less sulci and gyri.
4.	Analyse	Relates processes and	A man feels giddiness as he looks down from a tall building or a	Ans. Semi-circular canal of ear	3 marks

		phenomenon	mountain. Which part of body is affected? Which part register the position of head when it is not moving?	It provides sensory input for experience of rotatory movement. Sacculus and ventriculus	
5.	Knowledge	Relates charts and diagram		1. spinal cord 2. peripheral nervous system 3.Mid brain 4. hind brain 5. olfactory lobes 6. diencephalon 7. cerebrum 8. pons 9. medulla oblongata 10. cerebellum	5 marks
6.	Apply and understand	Identifies parts and relates processes	Which of the following is not the with mid brain ? a. located between thalamus of forebrain a pons of hind brain b. a canal called cerebral aqueduct passes through midbrain. c. ventral portion of mid brain is made up of round bodies d. mid brain and hind brain formed brain stem	Ans d. mid brain and hind brain formed brain stem	1 mark
7.	Understanding	Relates processes and	During propagation of nerve	Ans. d. Na+ ion	1 mark

		phenomenon	impulse e, the action potential results from the movement of a. k+ ions from extracellular fluid to intracellular fluid b. Na+ ion from intracellular to extracellular fluid. c. K+ ion from intracellular to extracellular fluid d. Na+ ion from extracellular to intracellular fluid	from extracellular to intracellular fluid	
8.	Application	Relates processes and phenomenon	Five events in the transmission of nerve impulse across synapse are given. Arrange them in correct sequence. 1. opening of specific ion channels allow entry of ions, a new action potential is generated in post synaptic neuron 2. neurotransmitters bind to receptor on post synaptic membrane 3. Synaptic vesicles fuse with presynaptic membrane , neurotransmitters released in synaptic cleft 4. Depolarization of presynaptic membrane. 5. arrival of action potential at axon terminal.	Ans. b. 5---4—3---2—1	1 mark
9.	Apply	Identified structure	An axon can't have a. synaptic knob with synaptic vesicle b. distal end is branched c. synaptic vesicles have	Ans D Nissl's granules	1 mark

			chemicals called neurotransmitters d. Nissl's granules		
10.	Apply	Relates phenomenon and process	What is sequence of reflex arc? a. sense organ—spinal cord--- motor neuron--- sensory nerve—muscle b. sense organ--- sensory neuron--- motor neuron—spinal cord—muscle c. sense organ—motor neuron--- spinal cord--- sensory neuron—muscle d. sense organ—motor neuron—spinal cord--- sensory neuron—muscle	Ans c	1 mark
11.	Apply	Relates phenomenon and processes	The movement of eyeball has involvement of which of the following cranial nerves? a. optic, Occulomotor, abducens b. Occulomotor, abducens, trochlear c. trochlear, abducens , optic d. abducens, optic , trochlear	Ans. b. Occulomotor, abducens, trochlear	1 mark
12.	Application	Identifies function	Which of the following region of brain is incorrectly paired with its functions and why? a. cerebellum – language comprehension b. corpus callosum- communicates two cerebral hemispheres	Ans. a cerebellum – language comprehension	1 mark

			c. cerebrum- learning memory and music d. medulla oblongata- homeostatic		
HORMONAL CONTROL AND COORDINATION					
1.	Evaluate	Draws conclusion on the basis of data	An office going person sees a black coil on middle of road. When he reaches near, he finds a snake, he immediately gets shocked. His body reactions are – a. pupillary dilation, piloerection, increased heartbeat, sweating. He recovers from shock after sometime as snake passes. 1. which hormone is responsible for body reaction? 2. Which gland secrets this hormone? 3. Which hormone makes him to recover from shock?	Ans. 1. emergency hormone adrenaline by adrenal medulla 2. Adrenal gland 3. Catecholamines	3 marks
2.	Application and analyse	relates processes and phenomenon	On an educational tour to Uttaranchal arti and her friends observed that many local persons have swelling in neck. Please help Arti and her friends to find out solution to following questions. 1. What probable disease are theses local people suffering from? 2. How it is caused? 3. What causes bulging in neck region? 4. What are effects on body?	Ans. 1. Simple goitre 2. Due to deficiency of iodine in food. 3. Size of thyroid gland increased but total output of hormone is less. 4. Low BMR , less alertness , etc. 5. By use iodised salt in diet.	5 marks

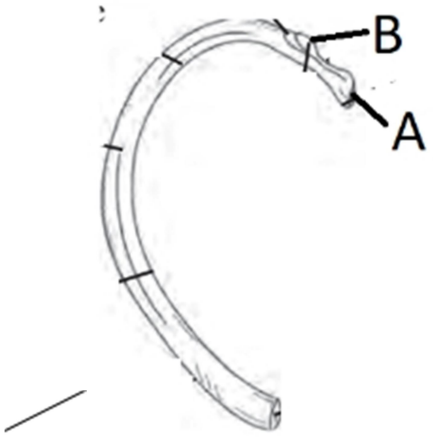
			5. Can it be cured?		
3.	Analyse	Applies scientific terminologies	The hormone that initiates milk ejection , stimulates milk production and promotes ovarian growth are respectively known as a. PRL, OT, LH b. OT, PRL, FSH c. LH, PRL, FSH d. PRL, OT,LH	Ans. b. . OT, PRL, FSH	1 mark
4.	Analyse	Relates processes and phenomenon	A person passes much urine and drinks much water to put his blood glucose level normal. What could cause this condition? a. reduction in insulin secretion from pancreas b. reduction vasopressin c. decrease in glucose concentration in urine d. increased secretion of glycogen	Ans. b. reduction vasopressin	1 mark
5.	Analyse	Explains relationships, system functioning	Which of the following is /are true? a. maximum iodine is stored in thyroid gland b. calcitonin is non-iodine hormone secreted by parafollicular cells c. calcitonin regulates Ca++ level d. calcitonin is hypo calcaemic factor	Ans all are correct	1 mark
6.	Analyse	Explains	A female begins to develop male	Ans. c.	1 mark

		efficiently systems	characters like beard, enlarged clitoris , degeneration of uterus. This may be due to a. overproduction of estrogen and testosterone b. damage to posterior pituitary c. overproduction of adrenal androgen d. surgical removal of mammary glands	overproduction of adrenal androgen	
7.	Analyse	Applies scientific terminologies	Your thymus is a small gland in lymphatic system that produces thymosin. 1. At what age it is most active? 2. How it looks like? 3. Where it is located? 4.What is its function? 5. What are symptoms of enlarged thymus?	Ans. 1. thymus is active during childhood and puberty. 2. Thymus is pinkish ivory. It looks like bilobed mass of lymphoid tissue. 3. It is located behind sternum. 4. Its main function is to produce hormone thymosin. It stimulates maturation of T-cells. 5. Shortness of breath, cough, weight loss and chest pain	
8.	Analyse	Relates processes and phenomenon	What is HCG? How it is secreted ? Give its role.	Ans. During pregnancy	

			What is its role in pregnancy test?	placenta secrets hormone like estrogen, progesterone and HCG. It helps to thicken uterine lining to support growing embryo. Promotes progesterone production. Presence of HCG in urine sample indicates pregnancy.	
LOCOMOTION AND MOVEMENT					
1.	Analyse	Relates processes and phenomenon Applies Scientific concepts of Biology in daily life and solving problems	A Cyclist met with an accident and fractured his coccyx bone. How will he recover? a. only plaster b. only bed rest c. plaster and bed rest both d. traction	b. only bed rest.	1 mark
2.	Application	Makes linkages of Biology with other other discipline	A surgeon performing CABG by traditional method needs to cut which bone? a. first four pairs of ribs b. true ribs c. sternum d. floating ribs	c. sternum	1 mark

3.	Analyse	Classifies organisms phenomenon and processes	Your nose bridge shows specific arrangement of bones. Identify the same. a. square edge b. tapering c. overlapping d. interlocking	a. square edge	1 mark
4.	Analyse	Classifies organisms phenomenon and processes Applies Scientific terminology	Teenager Rohit was in distress when he realised that his doctor told him the name of joint which might have got ossified as a result of which Rohit's height stopped increasing. Identify the joint. a. gomphoses b. synarthrosis c. synchondrosis d. symphysis	synchondrosis	1 mark
5	Understanding	Applies Scientific terminology	Which bone is seen at middorsal position of human pelvic girdle? a. ischium b. iliac crest c. sacrum d. pubic symphysis	c. sacrum	1 mark
6.	Evaluate	Explains systems relationship, processes and phenomenon	Radha said that she developed oxygen debt when she went for a tracking activity. It led to lactic acid accumulation in her muscles. Hence, she is feeling tired and has muscle cramp. Could Radha explain her problem correctly. Justify your answer.	Radha could not explain her problem correctly. She is having muscle cramp and pain after the trek because during	3 marks

				trek her muscles contracted anaerobically. Because of which lactic acid accumulation took place. Oxygen debt is the extra oxygen consumed during recovery of the muscle. It is much more than that consumed in the resting state.	
7	Evaluate	Explains systems relationship, processes and phenomenon	Completely charred bodies of a couple were found in their apartment where there was fire due to short circuit . How could the forensic expert differentiate between the male and the female bodies on the basis of their skeleton.	Female bones are lighter and their pelvic cavities are broader to support child birth whereas male bones are heavier,styrdier and their pelvic cavities are narrower. Thus, male and female can be identified.	2 marks

8.	Evaluate	Differentiates processes and phenomenon	We know that bones act as levers at joints. Identify the levers in the following situations, a. I raise my toes to peep out my window. b. while on a nature trail using binocular, I observed a bird perch on the top of the tree.	a. class 2 lever b. class 1 lever	2 marks
9.	Analyse	Classifies organisms phenomenon and processes	 This is one of the 24 'C' shaped bones present in our body. State functions of 'A' ,'B' and 'C'.	'A' is head of the rib. It articulates with vertebral body. 'B' is the facet of rib that articulates with transverse process of vertebra. 'C' is depression for costal cartilage .	3 marks
10.	Analyse and understanding	Applies Scientific concepts of Biology	Roshni , an eight-year-old has a one and half year-old baby brother, rehan. Roshni is allowed to play with him but warn by her mother that she should take care that rehan should not get injured, especially a head injury. What is the reason behind this worrying?	There are six soft spots called fontanelles in cranial bones. They get ossified only after the age of 2. Thus, in case of head injury there is a	2 marks

<table>
<tr><td></td><td></td><td></td><td></td><td>greater chance of brain damage which why Roshni is warned.</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>11.</td><td>Evaluate</td><td>Explains physiological processes</td><td>Given below are identifying feature of some human bones. Match the columns to identify the bones.<table><tr><th>Column i</th><th>Column ii</th></tr><tr><td>1. Vertebra with kidney shaped centrum</td><td>p. Thoracic vertebra</td></tr><tr><td>2. Bone with head at an angle to shaft.</td><td>Q. Typical cervical vertebra</td></tr><tr><td>3. Vertebra with heart shaped centrum</td><td>R. Lumbar vertebra</td></tr><tr><td>4. Ring like vertebra</td><td>S. Humerus</td></tr><tr><td>5. Vertebra with bifid neural spine</td><td>T. Atlas vertebra</td></tr><tr><td></td><td>U. femur</td></tr></table></td><td>1-R
2- U
3- P
4- T
5- Q</td><td>5 marks</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>12.</td><td>Analyse</td><td>8</td><td>In the above flow chart “E” is the same of the process described. Observe the flow chart and fill in the blanks.</td><td>A- stimulation is terminated
B- Myosin head gets detached from actin filament.
C- Troponin – tropomyosin complex is formed.
D- Muscular relaxation
E- Mechanism of muscle</td><td>5 marks</td></tr>
</table>

				relaxation	
13.	Analyse	4	Given below are few statements about muscle contraction. State whether the statement is true or false. If false correct the statement. A. Deltoid , an adapter muscle is antagonistic muscle for latissimus dorsi and bring body parts towards the body. B. Contraction and relaxation of muscle both are energy consuming processes. C during muscular contraction actin filament pulls myosin filament. D. Rigor mortis takes place because muscle is exhausted of stored ATP. E. All fibres of skeletal muscle do note extend from end to end. F. Bronchialis muscle is synergist muscle.	A. False. It is an abductor muscle which takes body part away. B. True C. False. During contraction process myosin head heads attached to the active site of Actin filament and pulls them inwards. D.True E.True F true	A-1/2 +1 B-1/2 C-1/2+1 D-1/2 E-1/2 F- ½ 5marks

List of Resource Persons

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16. Mr. Vijay Zambare of Fergusson College Pune, Maharashtra.

"Orientation of Teacher Educators in designing questions of different competency level based on Learning Outcomes at Secondary Level (NEP-2020)"

PAC Programme 23.44

Date / Day	Session-I 09.30-10.00 a.m.	Session-II 10.00-11.30 a.m.		Session-III 11.45 a.m. to 01.00 p.m.		Session-IV 02.00-03.30 p.m.		Session-V 03.45-04.45 p.m.	Session-VI 04.45-05.30 p.m.
21/11/2022 (Monday)	***Registration & Inaugural Session***	***Morphology of Flowering Plants*** DP		***Molecular Basis of Inheritance*** HKG		***NEP-2020*** BRB		***Cell cycle and Division*** RB	***Group Work by Participants***
22/11/2022 (Tuesday)	***Tissue Culture*** JM	***Presentation by participants***	**Tea Break - 11.30-11.45 a.m.**	***Principles of Inheritance and Variation*** AB	**Lunch Break - 1.00-2.00 p.m.**	***Reproductive Health*** RB	**Tea Break - 3.30-3.45 p.m.**	***Breathing and exchange of Gases*** AA	***Group Work by Participants***
23/11/2022 (Wednesday)	***Presentation by participants***	***Transport in Plants*** MP		***Neural Control and Coordination*** RI		***Anatomy of Flowering Plants*** MM		***Excretory products and their Elimination*** AA	***Group Work by Participants***
24/11/2022 (Thursday)	***Presentation by participants***	***Human Reproduction*** RI		***Reproduction in Flowering Plants*** MM		***Photosynthesis in Higher Plants*** RS		***Biotechnology: Principles and processes*** SK	***Group Work by Participants***
25/11/2022 (Friday)	***Presentation by participants***	***Digestion and Absorption*** SM		***Biotechnology and its application*** SK		***Respiration in Plants*** RS		***Human Health and Diseases*** MP	***Valedictory Session***

JM: Prof. Jaydip Mandal; AB: Prof. Ajay Bhardwaj; HKG: Prof. H. K. Garg; BRB: Prof. B. Ramesh Babu; RS: Prof. Reeta Sharma;
RI: Dr. Revati Inamdar; MM: Dr. Manisha Mandhare; RB: Dr. Ragini Bhatt DP: Dr. Daksha M. Parmar; SK: Dr. Sabiha Kamal Khan;
AA: Ms. Apeksha Arya; MP: Ms. Manisha Pande; SM: Ms. Srishti Mishra

(Dr. Daksha M.Parmar)
Programme Coordinator

(Prof. Jaydip Mandal)
Principal

Orientation of Teacher Educators in Designing questions of Different competency level based on Learning Outcomes at Secondary level (as per NEP-2020)

Feedback Form

Give your opinion in the points ranging from 1: less likely, 5: very likely.

1. What do you think of the overall training programme?

1 2 3 4 5

2. Do you think the topic and contents covered in the session are relevant?

1 2 3 4 5

3. Were the sessions structured and well organized?

1 2 3 4 5

4. Do you think you can apply the learnt material in your teaching process?

1 2 3 4 5

5. Were the sessions interesting?

1 2 3 4 5

6. Which teaching session did you enjoy the most? And why?

7. Do you wish to attend further such sessions from these resource persons?

8. Are there any scopes for improvement in the session? Kindly share your views.

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