BIOLOGY

Q. 1. Biological organisation starts with:

   a. Atomic level
   b. Submicroscopic molecular level
   c. Cellular level
   d. Organismic level

Sol. Correct choice: (2)

Q. 2. About 98 percent of the mass of every living organism is composed of just six elements including carbon, hydrogen, nitrogen, oxygen and:

   a. calcium and phosphorous
   b. phosphorus and sulphur
   c. sulphur and magnesium
   d. magnesium and sodium

Sol. Correct choice: (1)

Q. 3. Which one of the following is an example of negative feed back loop in humans?

   a. Secretion of sweat glands and constriction of skin blood vessels when it is too hot.
   b. Constriction of skin blood vessels and contraction of skeletal muscles when it is too cold.
   c. Secretion of tears after falling of sand particles in to the eye
   d. Salivation of mouth at the sight of delicious food.

Sol. When the set point of hypothalamus is disturbed by high temperature, it stimulates vasodilation and sweating while in low temperature there is vasoconstriction and shivering. Correct choice: (2)

Q. 4. What is common to whale, seal and shark?

   a. Homoiothermy
   b. Seasonal migration]

c. Thick subcutaneous fat
d. Convergent evolution

Sol. Shark is poikilothermous. All three species show adaptations for aquatic life while these are not closely related. Correct choice: (4)

Q. 5. Which one of the following is not a constituent of cell membrane?

a. Phospholipids
b. Cholesterol
c. Glycolipids
d. Proline

Sol. Correct choice: (4)

Q. 6. Select the wrong statement from the following:

a. The chloroplasts are generally much larger than mitochondria.
b. Both chloroplasts and mitochondria contain and inner and an outer membrane
c. Both chloroplasts and mitochondria have an internal compartment, the thylakoid space bounded by the thylakoid membrane
d. Both chloroplasts and mitochondria contain DNA.

Sol. Correct choice: (3)

Q. 7. The overall goal of glycolysis, Krebs cycle and the electron transport system is the formation of:

a. Nucleic acids
b. ATP is small stepwise units
c. ATP in one large oxidation reaction
d. Sugars

Sol. Correct choice: (2)

Q. 8. If the mean and the median pertaining to a certain character of a population are of the same value, the following is most likely to occur:

a. a skewed curve
b. a normal distribution
c. a bi-modal distribution
d. a T -shaped curve

Sol. Correct choice: (2)

Q. 9. Which one of the following is a slime mould?

a. Anabaena
b. Rhizopus
c. Physarum
d. Thiobacillus

Sol. Physarum is an acellular slime mould. Correct choice: (3)

Q.10. For a critical study of secondary growth in plants, which one of the following pairs is suitable?

a. Wheat and maiden hair fern
b. Sugarcane and sunflower
c. Teak and pine
d. Deodar and fern

Sol. Secondary growth occurs in gymnosperms and dicots. Correct choice: (3)

Q.11. Which one of the following statements about Mycoplasma is wrong?

a. They cause disease in plants
b. They are also called PPLO
c. They are pleomorphic
d. They are sensitive to penicillin

Sol. Mycoplasma is not sensitive to penicillin due to absence of cell wall. Correct choice: (4)

Q.12. In the prothallus of vascular cryptogam, the antherozoids and eggs mature at different times. As a result:

a. self fertilization is prevented
b. there is no change in success rate of fertilization
c. there is high degree of sterility
d. one can conclude that the plant is apomictic

Sol. In vascular cryptogam i.e. in pteridophytes gametophyte is monoecious but protandrous to avoid self fertilization. Correct choice: (1)

Q.13. Two plants can be conclusively said to belong to the same species if they:

a. have same number of chromosomes
b. can reproduce freely with each other and form seeds
c. have more than 90 per cent similar genes
d. look similar and possess identical secondary metabolities.

Sol. The members of a species are inter-fertile and produce fertile offsprings. Correct choice: (2)

Q.14. If you are asked to classify the various algae into distinct groups, which of the following characters you should choose?

a. Chemical composition of the cell wall
b. Types of pigments present in the cell
c. Nature of stored food materials in the cell
d. Structural organization of thallus.

Sol. The various algae are classified mainly on the types of pigments present in their cells. Correct choice: (2)

Q.15. Flagellated male gametes are present in all the three of which one of the following sets?

a. Riccia, Dryopteris and Cycas
b. Anthoceros, Funaria and Spirogyra
c. Zygnema, Saprolegnia and Hydrilla
d. Fucus, Marsilea and Calotropis

Sol. The male gametes of bryophytes are biflagellete, and those of pteriodophytes are multiflagellate, except Selaginella having biflagellate gametes. The male gametes of gymnosperms are non motile except those of Cycas having multiciliate gametes. Correct choice: (1)

Q.16. In gymnosperms, the pollen chamber represents:

a. the microsporangium in which pollen grains develop
b. a cell in the pollen grain in which the sperms formed
c. a cavity in the ovule in which pollen grains are stored after pollination
d. an opening in the mega gametophyte through which the pollen tube approaches the egg.

Sol. In gymnosperms, below micropylar beak some of the cells of nucellus of ovule disintigerate to form pollen chamber. Correct choice: (3)

Q.17. Spore dissemination in some liverworts is aided by:

a. peristome teeth
b. elaters
c. indusium
d. calyptra

Sol. In some liverworts like Marchantia spore dispersal is due to hydrochasy and is aided by elaters. Correct choice: (2)

Q.18. Which pair of the following belongs to Basidiomycetes?

    a. Morchella and Mushrooms
    b. Birds' nest fungi and Pufballs
    c. Pufballs and Claviceps
    d. Peziza and Stink horns

Sol. Bird's nest fungi – Cyathus, Pufballs – Lycoperdon, Both belong to the class Basidiomycetes. Correct choice: (3)

Q.19. ICBN stands for:

    a. Indian Code of Botanical Nomenclature
    b. Indian Congress of Biological Names
    c. International Code of Botanical Nomenclature
    d. International Congress of Biological Names

Sol. ICBN is one of the codes of nomenclature. It stands for International Code of Botanical Nomenclature. Correct choice: (3)

Q. 20. Ergot of rye is caused by a species of:

    a. Claviceps
    b. Phytophthora
    c. Uncinula
    d. Ustilago

Sol. Ergot of rye is caused by Claviceps purpurea. Correct choice: (1)

Q. 21. When two species of different genealogy come to resemble each other as a result of adaptation, the phenomenon is termed:

    a. Convergent evolution
    b. Divergent evolution
    c. Microevolution
    d. Co-evolution

Sol. Correct choice: (1)

Q. 22. Adaptive radiation refers to:

    a. Power of adaptation in an individual to a variety of environments
    b. Adaptations due to Geographical isolation

c. Evolution of different species from a common ancestor
d. Migration of members of a species to different geographical areas

Sol. Correct choice: (3)

Q. 23. The living organisms can be unexceptionally distinguished from the non-living things on the basis of their ability for:

a. growth the movement
b. responsiveness to touch
c. interaction with the environment and progressive evolution
d. reproduction

Sol. Correct choice: (4)

Q. 24. The Finches of Galapogas islands provide an evidence in favour of:

a. Biogeographical Evolution
b. Special Creation
c. Evolution due to Mutation
d. Retrogressive Evolution

Sol. Correct choice: (1)

Q. 25. One of the important consequences of geographical isolation is:

a. Random creation of new species
b. No change in the isolation faunax
c. Preventing Speciation
d. Speciation through reproductive isolation

Sol. Correct choice: (4)

Q. 26. Industrial melanism as observed in peppered moth proves that:

a. Melanism is a pollution-generated feature
b. The true black melanic forms arise by a recurring random mutation
c. The melanic form of the moth has no selective advantage over lighter form in industrial area
d. The lighter-form moth has no selective advantage either in polluted industrial area or non-polluted area.

Sol. It is an example of directional selection. Correct choice: (2)

Q. 27. The concept of chemical evolution is based on:

a. Possible origin of life by combination of chemicals
b. Crystallization of chemicals under suitable environmental conditions
c. Interaction of water, air and clay under
d. Effect of solar radiation of chemicals

Sol. Correct choice: (1)

Q. 28. Among the human ancestors the brain size was more than 1000 CC in:

a. Homo habilis
b. Homo neanderthalensis
c. Homo erectus
d. Ramapithecus

Sol. Homo habilis had a cranial capacity in the range of 680-720 c.c. & that of
Homo erectus erectus 775-990 c.c,
Homo erectus pekinensis 915-1200 c.c.
Homo neanderthalensis 1300-1600 c.c. Correct choice:

Q. 29. Which of the following pairs are correctly matched?

a. Crocodile   - 4-Chambered heart
b. Sea Urchin   - Parapodia
c. Obelia   – Metagenesis
d. Lemur   – Thecodont

(1) Only A and B
(2) A, C and D
(3) B, C and D
(4) Only A and D

Sol. Correct choice: (2)

Q. 30. Select the correct statement from the following:

a. Mutations are random and directional
b. Darwinian variations are small and directionless
c. Fitness is the end result of the ability to adapt and gets selected by nature
d. All mammals except whales and camels have seven cervical vertebrate.

Sol. It explains natural selection. Correct choice: (3)

Q. 31. Which one of the following is a matching pair of a body feature and the animal possessing it?

a.	Ventral heart	- Scorpion
b.	Post-anal tail	- Octopus
c.	Ventral Central nervous system	– Leech
d.	Pharyngeal gill slits absent in embryo	– Chamaeleon

Sol. Scorpion has dorsal heart. Post-anal tail is found only in chordates. Pharyngeal gill slits are present in the embryo of chameleon. Correct choice: (3)

Q. 32. What is common between parrot, platypus and kangaroo?

a. Ovoparity
b. Homoiothermy
c. Toothless jaws
d. Functional post -anal tail

Sol. Only birds & mammals are homoiothermous. Correct choice: (2)

Q. 33. What is true about Nereis, Scorpion, Cockroach and Silver fish?

a. They all belong to the same phylum
b. They all have jointed paired appendages
c. They all possess dorsal heart
d. None of them is aquatic

Sol. Correct choice: (3)

Q. 34. Which one of the following statement is correct?

a. Ontogeny repeats phylogeny
b. Stem cells are specialized cells
c. There is no evidence of the existence of gills during embryogenesis of mammals
d. All plant and animal cells are totipotent.

Sol. Correct choice: (1)

Q. 35. "Foolish Seedling" disease of rice led to the discovery of:

a. IAA
b. GA
c. ABA
d. 2, 4 – D

Sol. Foolish seeding disease (Bakane disease) of rice is due to a fungus Giberella fujikuroi. Yabuta and Sumuki obtained achemical from the fungus and called gibbrellic acid. Correct choice: (2)

Q. 36. Passage cells are thin- walled cells found in:

    a. central region of style through which the pollen tube grows towards the ovary.
    b. endodermis of roots facilitating rapid transport of water from cortex to pericycle.
    c. phloem elements that serve as entry points for substances for transport to other plant parts.
    d. testa of seed to enable emergence of growing embryonic axis during seed germination.

Sol. Passage cells also called transfusion tissue are found in the endodermis meant for rapid transport of water from cortex to pericycle. Correct choice: (2)

Q. 37. The first acceptor of electrons from an excited chlorophyll molecule of photosystem II is:

    a. Quinone
    b. Cytochrome
    c. Iron-sulphur protein
    d. Ferredoxin.

Sol. The first acceptor of electros from an excited chlorophyll is quinone. Correct choice: (1)

Q. 38. All enzymes of TCA cycle are located in the mitochondrial matrix except one which is located in inner mitochondrial membranes in eukaryotes and in cytosol in prokaryotes. This enzyme is:

    a. succinate dehydrogenase
    b. lactate dehydrogenase
    c. isocitrate dehydrogenase
    d. malate dehydrogenase

Sol. Succinate dehydrogenase is a common enzyme for TCA and ETC. It is located on inner mitochondrial membrane. Rest of the TCA enzymes are present in mitochondrial matrix. Correct choice: (1)

Q. 39. The wavelength of light absorbed by Pr form of phytochrome is:

    a. 620 nm
    b. 640 nm
    c. 680 nm
    d. 720 nm

Sol. The Pr form of phytochrome receives red light (600-680 nm) and changes into Pfr. Correct choice: (3)

Q. 40. Opening of floral buds into flowers, is type of:

  a. Autonomic movement of growth
  b. Autonomic movement of locomotion
  c. Autonomic movement of variation
  d. Paratonic movement of growth.

Sol. Opening of floral bud into flowers, is due to epinasty, a type of autonomic movement of growth. Correct choice: (1)

Q. 41. Which one of the following pairs, is not correctly matched?

  a. IAA - Cell wall elongation
  b. Abscissic Acid - Stomatal closure
  c. Gibberellic Acid - Leaf fall
  d. Cytokinin - Cell division

Sol. Leaf fall is due to interaction of auxin and ethylene. Correct choice: (3)

Q. 42. One gene - one enzyme relationship was established for the first time in:

  a. Diploccus pneumoniae
  b. Neurospora crassa
  c. Salmonella typhimurium
  d. Escherichia Coli

Sol. One gene-one enzyme hypothesis was given by Beadle and Tatum in red mould (Neurospora crassa). Correct choice: (2)

Q. 43. Male gametes in angiosperms are formed by the division of:

  a. Microspore mother cell
  b. Microspore
  c. Generative cell
  d. Vegetative cell

Sol. During the development of male gametophyte first of all two cells – generative cell and tube nucleus are formed from a pollen. This twocelled stage is called pollen grain. Finally the generative cell divides to form 2-male gametes. Correct choice: (3)

Q. 44. Two cells A and B are contiguous. Cell A has osmotic pressure 10 atm, turgor pressure - 7atm and diffusion pressure deficit 3 atm. Cell B has osmotic pressure 8 atm, turgor pressure 3 atm and diffusion pressure deficit 5 atm. The result will be:

a. Movement of water of Cell A to B
b. Movement of water from Cell B to A
c. No movement of water
d. Equilibrium between the two

Sol. The direction of movement of water is from low to high DPD. Correct choice: (1)

Q. 45. In the leaves of C_4 plants, malic acid formation during CO_2 fixation occurs in the cells of:

a. Epidermis
b. Mesophyll
c. Bundle Sheath
d. Phloem

Sol. In C_4 plants, C_4 cycle occurs in mesophyll cells and C_3 cycle in bundle sheath cells. Correct choice: (2)

Q. 46. Which of the following is a flowering plant with nodules containing filamentous nitrogen-fixing microorganism?

a. Cicer arietinum
b. Casuarina equisetifolia
c. Crotalaria juncea
d. Cycas revolute

Sol. The filamentous nitrogen – fixing microorganism like Frankia occurs in root-nodules of non-leguminous plants like Casuarina and Alnus. Correct choice: (2)

Q. 47. Which one of the following is surrounded by a callose wall?

a. Pollen grain
b. Microspore mother cell
c. Male gamete
d. Egg

Sol. The microspore mother cells develops an internal layer of callose which breaks the plasmodesmatal connections among themselves. Correct choice: (2)

Q. 48. Which one of the following elements is not an essential micronutrient for plant growth?

a. Ca
b. Mn
c. Zn
d. Cu

Sol. Calcium is an essential macronutrient for plant growth. Correct choice: (1)

Q. 49. If you suspect major deficiency of antibodies in person, to which of the following would you look for confirmatory evidence?

    a. Haemocytes
    b. Serum albumins
    c. Serum globulins
    d. Fibrinogen in the plasma

Sol. Correct choice: (3)

Q. 50. Which one of the following is a fat -soluble vitamin and its related deficiency disease?

    a. Calciferol – Pellagra
    b. Ascorbic acid – Scurvy
    c. Retinol – Xerophthalmia
    d. Cobalamine – Beri-beri

Sol. Correct choice: (3)

Q. 51. Which one of the following mammalian cells is not capable of metabolising glucose to carbon-dioxide aerobically?

    a. Red blood cells
    b. White blood cells
    c. Unstriated muscle cells
    d. Liver cells

Sol. RBCs do not have mitochondria & thus can respire only anaerobically. Correct choice: (1)

Q. 52. Compared to a bull a bullock is docile because of:

    a. lower levels of adrenalin / noradrenalin in its blood
    b. higher levels of thyroxin
    c. higher levels of cortisone
    d. lower levels of blood testosterone

Sol. The bullock is castrated and therefore secretion of testosterone is not adequate. Correct choice: (4)

Q. 53. In the human female, menstruation can be deferred by the administration of:

    a. FSH only

b. LH only
c. Combination of FSH and LH
d. Combination of estrogen and progesterone

Sol. Correct choice: (4)

Q. 54. In human body, which one of the following is anatomically correct?

a. Cranial nerves   - 10 pairs
b. Floating ribs   - 2 pairs
c. Collar bones   – 3 pairs
d. Salivary glands   –1 pair

Sol. Correct choice: (2)

Q. 55. In which one of the following preparations are you likely to come across cell junctions most frequently?

a. Hyaline cartilage
b. Ciliated epithelium
c. Thrombocytes
d. Tendon

Sol. Correct choice: (2)

Q. 56. A drop of each of the following, is placed separately on four slides. Which of them will not coagulate?

a. Whole blood from pulmonary vein
b. Blood plasma
c. Blood serum
d. Sample from the thoracic duct of lymphatic system

Sol. Blood serum does not contain fibrinogen and few other clotting factors, thus it will not coagulate. Correct choice: (3)

Q. 57. Feeling the tremors of an earthquake a scared resident of seventh floor of a multistoryed building starts climbing down the stairs rapidly. Which hormone initiated this action?

a. Gastrin
b. Thyroxin
c. Adrenaline
d. Glucagon

Sol. Correct choice: (3)

Q. 58. A person who is on a long hunger strike and is surviving only on water, will have:

    a. less urea in his urine
    b. more sodium in his urine
    c. less amino acids in his urine
    d. more glucose in his blood.

Sol. Correct choice: (1)

Q. 59. Which one of the following pairs of structures distinguishes a nerve cell from other types of cell?

    a. Nucleus and mitochondria
    b. Perikaryon and dendrites
    c. Vacuoles and fibers
    d. Flagellum and medullary sheath

Sol. Correct choice: (2)

Q.60. Which part of ovary in mam mals acts as an endocrine gland after evolution?

    a. Vitelline membrane
    b. Graafian follicle
    c. Stroma
    d. Germinal epithelium

Sol. Correct choice: (2)

Q. 61. During the transmission of nerve impulse through a nerve fibre, the potential on the inner side of the plasma membrane has which type of electric charge?

    a. First positive, then negative and again back to positive
    b. First negative, then positive and again back to negative
    c. First positive, then negative and continue to be negative
    d. First negative, then positive and continue to be positive.

Sol. Correct choice: (2)

Q. 62. A person is having problems with calcium and phosphorous metabolism in his body. Which one of the following glands may not be functioning properly?

    a. Thyroid
    b. Parathyroid
    c. Parotid

d. Pancreas

Sol. Correct choice: (2)

Q. 63. Identify the odd combination of the habitat and the particular animal concerned:

a. Rann of Kutch
b. Dachigam National Park
c. Sunderbans
d. Periyar

- Wild Ass
- Snow Leopard
–Bengal Tiger
–Elephant

Sol. Dachigam National Park is for the conservation of Hangul.
Correct choice: (2)

Q. 64. In which one of the following the BOD (Biochemical Oxygen Demand) of sewage (S), distillery effluent (DE), paper mill effluent (PE) and sugar mill effluent (SE) have been arranged in ascending order?

a. $S < DE < PE < SE$
b. $SE < S < PE < DE$
c. $SE < PE < S < DE$
d. $PE < S < SE < DE$

Sol. BOD of distillery effluent is 40,000 mg / l and that of paper mill effluent and sewage is 190 mg/l and 30 mg/l, respectively. Correct choice: (2)

Q. 65. Which one of the following ecosystem types has the highest annual net primary productivity?

a. Temperate deciduous forest
b. Tropical rain forest
c. Tropical deciduous forest
d. Temperate evergreen forest

Sol. Tropical rain forest has highest annual net primary productivity (9000 K cal / m 2 / yr). Correct choice: (2)

Q. 66. Which one of the following is being utilized as a source of biodiesel in the Indian countryside?

a. Pongamia
b. Euphorbia
c. Beetroot
d. Sugarcane

Sol. Pongamia, Jatropa, Euphorbia are petrocrops. However, in the Indian countryside, Pongamia (Kanjar) is being utilized as a source of biodiesel. Correct choice: (1)

Q. 67. In a coal fires power plant electrostatic precipitators are installed to control emission of:

    a. CO
    b. SO_2
    c. NO_X
    d. SPM

Sol. Electrostatic precipitators control emission of suspended particle matter (SPM). Correct choice: (4)

Q. 68. Which one of the following is not a bioindicator of water pollution?

    a. Sewage fungus
    b. Sludge-worms
    c. Blood-worms
    d. Stone flies

Sol. Correct choice: (4)

Q. 69. A high density of elephant population in an area can result in:

    a. Predation on one another
    b. Mutualism
    c. Intra specific competition
    d. Inter specific competition

Sol. Intra-specific competition occurs between the members of the same species. Correct choice: (3)

Q. 70. Geometric representation of age structure is a characteristic of:

    a. Ecosystem
    b. Biotic community
    c. Population
    d. Landscape

Sol. Age structure is one of the characteristics of population. Correct choice: (3)

Q. 71. Which one of the following pairs of organisms are exotic species introduced in India?

a. Nile perch, Ficus religiosa
b. Ficus religiosa, Lantana camara
c. Lantana camara, Water hyacinth
d. Water hyacinth, Prosopis cineraria

Sol. Lantana camara and Eicchornia czassipes (water hyacinth) are exotic species.
Correct choice: (3)

Q. 72. One of endangered species of Indian medicinal plants is that of:

a. Nepenthes
b. Podophyllum
c. Ocimum
d. Garlic

Sol. Podophyllum hexandrum - : (Papri), gives a drug from its rhizome; besides being stimulant and purgative and has destructive action on cancerous tissues. Correct choice: (2)

Q. 73. A genetically engineered micro-organism used successfully in bioremediation of oil spills is a species of:

a. Bacillus
b. Pseudomonas
c. Trichoderma
d. Xanthomonas

Sol. Pseudomonas putida (superbug) developed by genetic engineering by Anand Mohan Chakravorty is used to control oil spills. Correct choice: (2)

Q. 74. A sequential expression of a set of human genes occurs when a steroid molecule binds to the:

a. Ribosome
b. Transfer RNA
c. Messenger RNA
d. DNA sequence

Sol. Correct choice: (4)

Q. 75. The Okazaki fragments in DNA chain growth:

a. polymerize in the

   $5' - to - 3'$ direction and explain $3' - to - 5'$ DNA replication
b. result in transcription
c. polymerize in the $3' - to - 5'$ direction and forms replication fork
d. prove semi-conservative nature of DNA replication

Sol. Replication occurs always in $5'-3'$ direction. Okazaki fragments, synthesized on $3'-5'$ DNA template, join to form lagging strand which grows in $3'-5'$ direction. Correct choice: (1)

Q. 76. In the hexaploid wheat, the haploid (n) and basic (x) numbers of chromosomes are:

    a. n = 21 and x = 7
    b. n = 7 and x = 21
    c. n = 21 and x = 21
    d. n = 21 and x = 14

Sol. The basic number (x) of wheat is 7. Thus the 6x = 2n = 42 and n = 21. Correct choice: (1)

Q. 77. Molecular basis of organ differentiation depends on the modulation in transcription by:

    a. Anticodon
    b. RNA polymerase
    c. Ribosome
    d. Transcription factor

Sol. Correct choice: (4)

Q. 78. Telomere repetitive DNA sequence control the function of eukaryote chromosomes because they:

    a. prevent chromosome loss
    b. act as replicons
    c. are RNA transcription initiator
    d. help chromosome pairing

Sol. Telomerase seal the ends of the chromosomes. Correct choice: (1)

Q. 79. Inheritance of skin colour in humans is an example of:

    a. codominance
    b. chromosomal aberration
    c. point mutation
    d. polygenic inheritance

Sol. Inheritance of skin colour in human is controlled by three genes, A, B and C. Correct choice: (4)

Q. 80. A common test to find the genotype of a hybrid is by:

a. crossing of one F_1progeny with male parent
b. crossing of one F_2 progeny with male parent
c. crossing of one F_2 progeny with female parent
d. studying the sexual behaviour of F1 progenies.

Sol. To find the genotype of hybrid, it is test crossed. Correct choice: (1)

Q. 81. During transcription, RNA polymerase holoenzyme binds to a gene promoter and assumes a saddle - like structure. What is it's DNA-binding sequence?

a. TATA
b. TTAA
c. AATT
d. CACC

Sol. The DNA binding sequence for RNA polymerase is called TATA box. Correct choice: (1)

Q. 82. Two genes R and Y are located very close on the chromosomal linkage map of maize plant. When RRYY and rryy genotypes are hybridized, the F2 segregation will show:

a. Higher number of the parental types.
b. Higher number of the recombinant types.
c. Segregation in the expected 9: 3: 3: 1 ratio.
d. Segregation in 3:1 ratio.

Sol. When the linked genes are situated quite close, the chances of crossing over are highly reduced. Due to this, large number of parental gametes are formed and only few recombinant gametes are formed. This results in higher number of parental types in F_2 generation as compared to recombinants.
Correct choice: (1)

Q. 83. In maize, hybrid vigour is exploited by:

a. Inducing mutations.
b. Bombarding the seeds with DNA.
c. Crossing of two inbred parental lines.
d. Harvesting seeds from the most productive plants.

Sol. Correct choice: (3)

Q. 84. Differentiation of organs and tissues in a developing organism, is associated with:

a. Deletion of genes
b. Developmental mutations

c. Differential expression of genes

d. Lethal mutations

Sol. Correct choice: (3)

Q. 85. In pea plants, yellow seeds are dominant to green. If a heterozygous yellow seeded plant is crossed with a green seeded plant, what ratio of yellow and green seeded plants would you expect in F1 generation?

a. 3 : 1

b. 50 : 50

c. 9 : 1

d. 1 : 3

Sol. This is a monohybrid test cross. Correct choice: (2)

Q. 86. The length of DNA molecule greatly exceeds the dimensions of the nucleus in eukaryotic cells. How is this DNA accommodated?

a. Through elimination of repetitive DNA.

b. Deletion of non-essential genes.

c. Super-coiling in nucleosomes.

d. DNAse digestion.

Sol. The nucleosome model explains the packaging of histone proteins and DNA in the chromatin material which forms the chromosome. Correct choice: (3)

Q. 87. In cloning of cattle a fertilized egg is taken out of the mother's womb and:

a. from this upto eight identical twins can be produced

b. the egg is divided into 4 pairs of cells which are implanted into the womb of others cows

c. in the eight cell stage, cells are separated and cultured until small embryos are formed which are implanted into the womb other cows.

d. in the eight cell stage the individual cells are separated under electrical field for further development in culture media.

Sol. As per the experiment performed by the scientist from Japan. Correct choice: (3)

Q. 88. Which one of the following statements is correct?

a. At present it is not possible to grow maize without chemical fertilizers.

b. Extensive use of chemical fertilizers may lead to eutrophication of nearby water bodies.

c. Both Azotobacter and Rhizobium fix atmospheric nitrogen in root nodules of plants.

d. Cyanobacteria such as Anabaena and Nostoc are important mobilizers of phosphates and potassium for plant nutrition in soil.

Sol. The Agricultural run off contains high concentration of chemical fertilizers. Which is discharge in near by lakes causes nutrient enrichment of lakes called eutrophication. Correct choice: (2)

Q. 89. The population of an insect species shows an explosive increase in numbers during rainy season followed by its disappearance at the end of the season. What does this show?

a. The population of its predators increases enormously.
b. S-shaped or sigmoid growth of this insect.
c. The food plants mature and die at the end of the rainy season.
d. Its population growth curve is of J-type.

Sol. A population which grows exponentially and crashes suddenly exhibits J-type growth curve. Correct choice: (4)

Q. 90. The two polynucleotide chains in DNA are:

a. semiconservative
b. parallel
c. discontinuous
d. antiparallel

Sol. The two chains in a dsDNA run in opposite direction one $5' \rightarrow 3'$ while other $5' \rightarrow 3'$ in opposite direction.

$5' \rightarrow 3'$

$5' \leftarrow 3'$

Correct choice: (4)

Q. 91. A plant requires magnesium for:

a. Cell wall development
b. Holdin g cells together
c. Protein synthesis
d. Chlorophyll synthesis

Q. 92. Probiotics are:

a. Live microbial food supplement
b. Safe antibiotics
c. Cancer inducing microbes

d. New kind of food allergens

Sol. Live microbial food supplements are called probiotics (e.g., curd). Correct choice: (1)

Q. 93. Bowman's glands are located in the:

a. olfactory epithelium of our nose
b. proximal end of uriniferous tubules
c. anterior pituitary
d. female reproductive system of cockroach

Sol. Correct choice: (1)

Q. 94. Increased asthamatic attacks in certain seasons are related to:

a. Low temperature
b. Hot and humid environment
c. Eating fruits preserved in tin containers
d. Inhalation of seasonal pollen

Sol. Correct choice: (4)

Q. 95. A human male produces sperms with genotypes AB, Ab, aB and ab pertaining to two diallelic characters in equal proportions. What is the corresponding genotype of this person?

a. AABB
b. AaBb
c. AaBB
d. AABb

Sol. The formula for gamete formation is $2n$ where n stands for number of heterozygous pairs. AaBb has 2 heterozygous pairs so it will form 4 types of gametes. Correct choice: (2)

Q. 96. Which one of the following pairs is wrongly matched?

a. Coliforms — - Vinegar
b. Methanogens — -Gobar gas
c. Yeast — –Ethanol
d. Streptomycetes — –Antibiotic

Sol. Coliforms are bacteria found in colon e.g. E. coli. For the preparation of vinegar Acetobacter aceti is employed. Correct choice: (1)

Q. 97. Which one of the following pairs is mismatched?

a. Bombyx mori   -silk
b. Pila globosa   -pearl
c. Apis indica   –honey
d. Kenia lacca   –lac

Sol. Pinctada vulgaris is a bivalve from which pearl is obtained. Correct choice: (2)

Q. 98. Which one of the following is viral disease of poultry?

a. Pasteurellosis
b. Salmonellosis
c. Coryza
d. New Castle disease

Sol. Correct choice: (4)

Q. 99. Ultrasound of how much frequency is beamed into human body for sonography?

a. 45 - 70 MHz
b. 30 - 45 MHz
c. 15 - 30 MHz
d. 1 - 15 MHz

Sol. Correct choice: (4)

Q. 100. Lysozyme that is present in perspiration, saliva and tears, destroys:

a. most virus-infected cells
b. certain fungi
c. certain types of bacteria
d. all viruses

Sol. Correct choice: (3)

CHEMISTRY

Q. 1. With which of the following configuration an atom has the lowest ionization enthalpy?

a. $1s^2\ 2s^2\ 2p^6$

b. $1s^2\ 2s^2\ 2p^5$

c. $1s^2\ 2s^2\ 2p^3$

d. $1s^2\ 2s^2\ 2p^5\ 3s^1$

Sol. $1s^2\ 2s^2\ 2p^5\ 3s^1$

$199.96 \approx 200$ Correct choice is: (2)

Q. 3. Concentrated aqueous sulphuric acid is 98% H 2SO 4 by mass and has a density of 1.80 g. mL^{-1} . Volume of acid required to make one litre of 0.1 M H_2SO_4 is,

a. 5.55 mL
b. 11.10 mL
c. 16.65 mL
d. 22.20 mL

Sol. Density = 1.80 g/ml

$\Rightarrow 1\ litre\ has\ 1800g\ H_2SO_4\ (impure)$

$\Rightarrow 1\ litre\ has\ 0.98\ (1800)g\ H_2SO_4\ (pure)$

$\Rightarrow 1\ litre\ has\ \dfrac{1764}{98}\ moles\ H_2SO_4 = 18\ M \Rightarrow Now,\ 18 \times V_1 = 0.1 \times 1\ or,\ V_1 = \dfrac{0.1}{18} \times 1000 = 5.55\ ml$

Correct choice: (1)
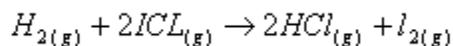
Q.4. Consider the following sets of quantum numbers:

	n	I	M	s
(a)	3	0	0	+ ½
(b)	2	2	1	+ ½
(c)	4	3	-2	- ½

b. $1s^2\, 2s^2\, 2p^5$

c. $1s^2\, 2s^2\, 2p^3$

d. $1s^2\, 2s^2\, 2p^5\, 3s^1$

Sol. $1s^2\, 2s^2\, 2p^5\, 3s^1$ represents the excited state of a Neon atom. The energy needed to knock off an electron from the excited state of neon must be least. Correct choice is: (4)

Q. 2. An element, X has the following isotopic composition; ^{200}X:90% ; ^{199}X:8.0% ; ^{202}X:2.0%

The weighted average atomic mass of the naturally occurring element X is closest to :

a. 199 amu
b. 200 amu
c. 201 amu
d. 202 amu

Sol. The weighted average atomic mass of element (X) = 0.9 (200) + 0.08 (199) + 0.02 (202) = 180 + 15.92 + 4.04 = $199.96 \approx 200$ Correct choice is: (2)

Q. 3. Concentrated aqueous sulphuric acid is 98% H_2SO_4 by mass and has a density of 1.80 g. mL^{-1}. Volume of acid required to make one litre of 0.1 M H_2SO_4 is,

a. 5.55 mL
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d. 22.20 mL

Sol. Density = 1.80 g/ml

$\Rightarrow 1\,litre\ has\ 1800g\ H_2SO_4\ (impure)$

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Correct choice: (1)

Q.4. Consider the following sets of quantum numbers:

	n	I	M	s
(a)	3	0	0	+ ½
(b)	2	2	1	+ ½
(c)	4	3	-2	- ½

c. $\dfrac{\log 2}{K}$
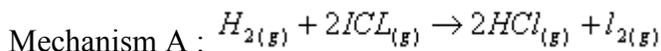
d. $\dfrac{\log\ 2}{K\sqrt{0.5}}$

Sol. $t\ 1/2\ \textit{for a first order reaction} = \dfrac{0.693}{K} = \dfrac{2.303 \log_{10} 2}{K} = \dfrac{\ln 2}{K}$
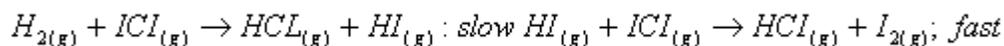
Correct choice: (1)

Q. 7. The reaction of hydrogen and iodine monochloride is given as:

$$H_{2(g)} + 2ICL_{(g)} \rightarrow 2HCl_{(g)} + I_{2(g)}$$

This reaction is of first order with respect to $H_{2(g)}$ and $ICl_{(g)}$, following mechanisms were proposed :

Mechanism A : $H_{2(g)} + 2ICL_{(g)} \rightarrow 2HCl_{(g)} + I_{2(g)}$

Mechanism B :
$H_{2(g)} + ICl_{(g)} \rightarrow HCL_{(g)} + HI_{(g)}$: slow $HI_{(g)} + ICl_{(g)} \rightarrow HCl_{(g)} + I_{2(g)}$; fast

Which of the above mechanism (s) can be consistent with the given information about the reaction

a. A only
b. B only
c. 1 and 2 both
d. Neither 1 nor 2

Sol. The rate law is invariably determined from the slowest step of the mechanism. Therefore mechanism (B) is consistent with the data given for order of reaction. Correct choice: (2)

Q. 8. If 60% of a first order reaction was completed in 60 minutes, 50% of the same reaction would be completed in approximately :

a. 40 minutes
b. 50 minutes
c. 45 minutes
d. 60 minutes

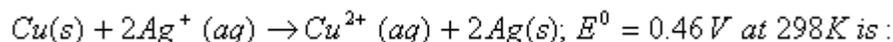$\left(\log 4 = 0.60, \log 5 = 0.69\right)$

Sol.

$$k = \frac{2.303}{60} \log \frac{1}{0.4} = \frac{2.303}{60} \log \frac{10}{4} = \frac{2.303}{60} \log \frac{5}{2} = \frac{2.303}{60} (\log 5 - \log 2) = \frac{2.303}{60} (0.69 - 0.3) = \frac{2.303}{60} \times 0.39$$

$$t \, 1/2 = \frac{2.303 \times 0.3 \times 60}{2.303 \times 0.39} = 46.15 \approx 45 \, min \, utes.$$

Correct choice: (3)

Q. 9. The equilibrium constant of the reaction :

$$Cu(s) + 2Ag^+ (aq) \rightarrow Cu^{2+} (aq) + 2Ag(s); \, E^0 = 0.46 \, V \, at \, 298K \, is :$$

a. 4.0×10^{15}

b. 2.4×10^{10}

c. 2.0×10^{10}

d. 4.0×10^{10}

Sol.
$$\Delta G^0 = -2 \times 96500 \times 0.46 = -88780 \, j$$
$$? G^0 = 2.303 \, RT \log K_c \, or - 88780 = -2.303 \times 8.314 \times 298 \log K_c$$
$$or - 88780 = -5705.84 \log k_c \, or \log k_c = 15.55 \Rightarrow [K_c = 4 \times 10^{15}]$$

Correct choice: (1)

Q. 10. 0.5 molal aqueous solution of a weak acid (HX) is 20% ionized. If Kf for water is 1.86 K kg mol sup-1 , the lowering in freezing point of the solution is

a. -0.56 K
b. -1.12 K
c. 0.56 K
d. 1.12 K

$$\Delta T_f = i \, K_f m = 1.2 \times 1.86 \times 0.5 = 1.12 \, K$$ Correct choice: (4)

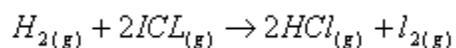**Q. 11.** The efficiency of a fuel cell is given by

a. $\dfrac{\Delta S}{\Delta G}$

b. $\dfrac{\Delta H}{\Delta G}$
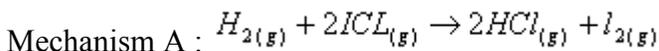
c. $\dfrac{\log 2}{K}$

d. $\dfrac{\log 2}{K \sqrt{0.5}}$

Sol. $t\ 1/2\ for\ a\ first\ order\ reaction = \dfrac{0.693}{K} = \dfrac{2.303 \log_{10} 2}{K} = \dfrac{\ln 2}{K}$
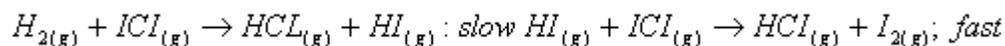
Correct choice: (1)

Q. 7. The reaction of hydrogen and iodine monochloride is given as:

$$H_{2(g)} + 2ICL_{(g)} \rightarrow 2HCl_{(g)} + I_{2(g)}$$

This reaction is of first order with respect to $H_{2(g)}\ and\ ICl_{(g)}$, following mechanisms were proposed :

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Mechanism B :
$H_{2(g)} + ICl_{(g)} \rightarrow HCL_{(g)} + HI_{(g)} : slow\ HI_{(g)} + ICl_{(g)} \rightarrow HCI_{(g)} + I_{2(g)};\ fast$

Which of the above mechanism (s) can be consistent with the given information about the reaction

    a. A only
    b. B only
    c. 1 and 2 both
    d. Neither 1 nor 2

Sol. The rate law is invariably determined from the slowest step of the mechanism. Therefore mechanism (B) is consistent with the data given for order of reaction. Correct choice: (2)

Q. 8. If 60% of a first order reaction was completed in 60 minutes, 50% of the same reaction would be completed in approximately :

    a. 40 minutes
    b. 50 minutes
    c. 45 minutes
    d. 60 minutes

$\left(\log 4 = 0.60, \log 5 = 0.69 \right)$

$H_2 + Cl_2 \rightarrow 2HCl; \left[B.E_{H\_H} + B.E_{Cl-Cl}\right] - \left[2BE_{H-Cl}\right] = \Delta H_R$

$\left[430 + 240\right] - \left[2. BE_{H-Cl}\right] = 180 \ or \ 670 - 2(BE)_{H-Cl} = 850 \ or \ BE_{H-Cl} = 425 \ KJ \ mol^{-1}$

Correct choice: (4)

Q. 14. The Langmuir adsorption isotherm is deduced using the assumption

   a. The adsorbed molecules interact with each other
   b. The adsorption takes place in multilayers
   c. The adsorption sites are equivalent in their ability to adsorb the particles
   d. The heat of adsorption varies with coverage

Sol. angmuir adsorption has the following postulates

   a. The isotherm is devised for adsorption equilibrium i.e., when rate of adsorption = rate of desorption
   b. Adsorption at all sites is equivalent
   c. Adsorption at a site is unaffected by adsorption at neighboring sites.

Correct choice: (3)

Q. 15. The following equilibrium constants are given

$N_2 + 3H_2 \leftrightarrow 2NH_3; K_1$ $\qquad$ $N2 + O_2 \leftrightarrow 2NO; k_2$ $\qquad$ $H_2 + \dfrac{1}{2}O_2 \leftrightarrow H_2O; K_3$
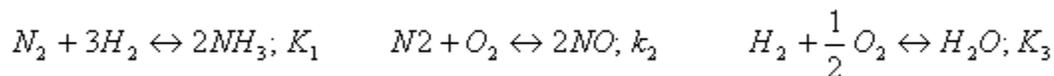
The equilibrium constant for the oxidation of NH$_3$ by oxygen to give NO is

   a. $K_1 K_2 / K_3$
   b. $K_2 K_3^3 / K_1$
   c. $K_{21} K_3^2 / K_1$
   d. $K_2^2 K_3 / K_1$

Sol.

$$2NH_3 \rightarrow N_2 + 3H_2 \qquad \qquad \dfrac{1}{K_1}$$

$$3H_2 + \dfrac{3}{2}O_2 \rightarrow 3H_2O \qquad \qquad K_3{}^3$$

$$N_2 + O_2 \rightarrow 2NO \qquad \qquad K_2$$

_____

$$2NH_3 + \dfrac{5}{2}O_2 \rightarrow 2NO + 3H_2O \qquad \left[K^* = K_2K_3{}^3 / K_1\right]$$
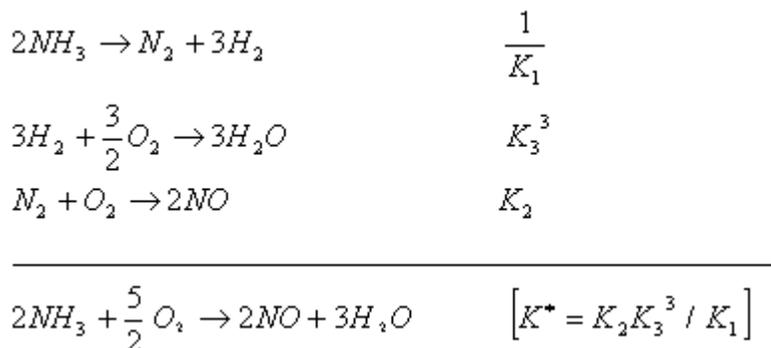
Correct choice: (2)

Q. 16. Caulate the pOH of a solution at 25^0C that contains

1×10^{-10} M of hydronium ions, i.e. H_3O^+ :

    a. 1.000
    b. 7.000
    c. 4.000
    d. 9.000

Sol. $\left|OH^-\right| = 10^{-4}$ mol / 1; $P^{OH} = 4$ Correct choice : (3)

Q. 17. A weak acid, HA has a K_a of 1.00×10^{-5}. If 0.100 mol of this acid is dissolved in one litre of water, the percentage of acid dissociated at equilibrium is closest to

    a. 0.100%
    b. 99.0%
    c. 1.00%
    d. 99.9%

Sol. We know that, $K_a = C\alpha^2$ or $\alpha = \sqrt{\dfrac{K_a}{C}} = \sqrt{\dfrac{10^{-5}}{10^{-1}}} = 10^{-2}$ Correct choice: (3)

Q. 18. The fraction of total volume occupied by the atoms present in a simple cube is

    a. $\dfrac{\pi}{4}$

    b. $\dfrac{\pi}{6}$

    c. $\dfrac{\pi}{3\sqrt{2}}$

d. $\dfrac{\pi}{4\sqrt{2}}$

Sol. Packing fraction for a simple cube $=\dfrac{\dfrac{4}{3}\left(\dfrac{a}{2}\right)^3}{a^3}=\dfrac{\pi}{6}$ Correct choice: (2)

Q. 19. Identify the correct order of the size of the following:

a. $Ca^{2+} < Ar < K^+ < Cl^- < S^{2-}$

b. $Ca^{2+} + K^+ < Ar < S^{2-} < Cl^-$

c. $Ca^{2+} + < K^+ < Ar < Cl^- < S^{2-}$

d. $Ar < Ca^{2+} < K^+ < Cl^- < S^{2-}$

Sol. Anions have the largest sizes followed by neutral atoms and then cations for a respective period. So, the correct order should be $Ca^{2+} + < K^+ < Ar < Cl^- < S^{2-}$
Correct choice: (3)

Q.20. In which of the following pairs, the two species are iso-structural?

a. BrO_3^- and XeO_3

b. SF_4 and XeF_4

c. SO_3^{2-} and NO_3^-

d. BF_3 and NF_3

Sol. Both -

BrO_3^- and XeO_3 have the central atom in SP^3. both these species are pyramidal.

Q. 21. The correct order of $C-O)$ bond length among CO, CO_3^{-2}, CO_2 is :

a. $CO < CO_2 < CO_3^{2-}$

b. $CO_2 < CO_3^{2-} < CO$

c. $CO < CO_3^{2-} < CO_2$

d. $< CO_3^{2-} < CO_2 < CO$

Sol. The correct order of $C-O$ bond length will be $CO < CO_2 < CO_3^{2-}$

Correct choice: (1)

Q. 22. Which one of the following ionic species has the greatest proton affinity to form stable compound?

    a. I-
    b. HS-
    c. NH_2^-
    d. E-

Sol. Strongest base would have the highest proton affinity i.e, NH_2^- Correct choice: (3)

Q. 23. In which of the following the hydration energy is higher than the lattice energy?

    a. $SrSO_4$
    b. $BaSO_4$
    c. $MgSO_4$
    d. $RaSO_4$

Sol. $MgSO_4$ is the most soluble out of the given alkaline earth metal sulphates. Correct choice: (3)

Q. 24. Which of the following statements, about the advantage of roasting sulphide ore before reduction is not true?

    a. Roasting of the sulphide to the oxide is thermodynamically feasible.
    b. Carbon and hydrogen are suitable reducing agents for metal sulphides.
    c. The $\Delta_f G^{\theta}$ of the sulphide is greater than those for CS_2 andH_2S
    d. The $\Delta_f G^{\theta}$ is negative for roasting of sulphide ore to oxide

Sol. Carbon and hydrogen are not suitable for reduction of sulphides directly. Correct choice: (2)

Q. 25. The correct order of increasing thermal stability of

$K_2CO_3, MgCO_3, CaCO_3 \text{ and } BeCO_3 \text{ is}:$

    a. $K_2CO_3 < MgCO_3 < CaCO_3 < BeCO_3$
    b. $BeCO_3 < MgCO_3 < K_2CO_3 < CaCO_3$
    c. $BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$
    d. $MgCO_3 < BeCO_3 < < CaCO_3 < K_2CO_3$

Sol. The correct order is $BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$

Correct choice: (3)

Q. 26. Sulphides ores of metals are usually concentrated by Froth Flotation process. Which one of the following sulphides oresoffers an exception and is concentrated by chemical leaching?

    a. Sphalerite
    b. Argentite
    c. Galena
    d. Copper pyrite

Sol. Argentite ore is leached with NaCN during extraction of silver in the Mc Arthur Forrest Cyanide process. Correct choice: (2)

Q. 27. Which one of the following anions is present in the chain structure of silicates?

    a. SiO_4^{4-}
    b. $Si_2O_7^{6-}$
    c. $\left(SiO_3^{2-}\right)_n$
    d. $\left(Si_2O_5^{2-}\right)_n$

Sol. Chain silicates have the general formula $\left(SiO_3^{2-}\right)_n$ Correct choice: (4)

Q. 28. Which one of the following orders correctly represents the increasing acid strengths of the given acids?

    a. $HOClO_3 < HOClO_2 < HOClO < HOCl$
    b. $HOClO_3 < HOClO < HOClO_2 < HOClO_3$
    c. $HOClO_3 < HOCl < HOClO_3 < HOClO_2$
    d. $HOClO_2 < HOClO_3 < HOClO < HOCl$

Sol. The correct order is $HOClO_3 < HOClO < HOClO_2 < HOClO_3$

Correct choice: (2)

Q. 29. Which of the following oxidation states are the most characteristic for lead and tin respectively?

    a. $+2, +2$
    b. $+4, +2$
    c. $+2, +4$
    d. $+4, +4$

Sol. Among common characteristic states for Pb and Sn, we find +2 and +4 respectively. Correct choice: (3)

Q. 30. Identify the incorrect statement among the following:

a. Shielding power of 4f electrons is quite weak
b. There is a decrease in the radii of the atoms or ions as one proceeds from La to Lu
c. Lanthanoid contraction is the accumulation of successive shrinkages
d. As a result of lanthanoid contraction, the properties of 4d series of the transition elements have no similarities with the 5d series of elements

Sol. The atomic radii of 4d and 5d elements down the group become quite similar due to lanthanidecontraction. Correct choice: (4)

Q. 31. Which one of the following ions is the most stable in aqueous solution?

a. Mn^{3+}
b. Cr^{3+}
c. V^{3+}
d. Ti^{3+}

(Atomic number. Ti = 22, V = 23, Cr = 24, Mn = 25)

Sol . Cr^{3+} is the most stable ion in aqueous medium. Correct choice: (2)

Q. 32. The d electron configurations of Cr . Which one of the following aqua complexes will exhibit the minimum paramagnetic behaviour?

a. $[Cr(H_2O_6)]^{2+}$
b. $[Mn(H_2O_6)]^{2+}$
c. $[Fe(H_2O_6)]^{2+}$
d. $[Ni(H_2O_6)]^{2+}$

(Atomic number. Cr + 24, Mn = 25, Fe = 26, Ni = 28)

Sol. AsH_2O ia a weak field ligand, $[Ni(H_2O_6)]^{+2}$ will have two unpaired electrons and will show least paramagnetic character. Correct choice: (4)

Q. 33. Which of the following will give a pair of enantiomorphs?

a. $[Pt(NH_3)_4][PtCl_6]$
b. $[Co(NH_3)_4 Cl_2]NO_2$

c. $[Cr(NH_3)_6][Co(CN)_6]$

d. $[Co(en)_2 Cl_2]Cl$ $\qquad$ $(en = NH_2CH_2CH_2NH_2)$

Sol . The complex ion $[Co(en)_2 Cl_2]^+$ can show optical isomerism in its cis-isomer, and will form a pair of enantiomorphs. Its trans-form will be optically inactive (meso).
Correct choice: (4)

Q. 34. If NaCl is doped with
10^{-4} *mol % $SrCl_2$, the concentration of cation vacancies will be* $\left(N_A = 6.02 \times 10^{23} \ mol^{-1}\right)$

a. $6.02 \times 10^{14} \ mol^{-1}$

b. $6.02 \times 10^{15} \ mol^{-1}$

c. $6.02 \times 10^{16} \ mol^{-1}$

d. $6.02 \times 10^{17} \ mol^{-1}$

Sol. Number of moles of cationic vacancies

$\dfrac{10^{-4}}{10^2} = 10^{-6} \ mole$

$\Rightarrow$ *Number of cationic vacancies* $= 10^{-6} \times 6.02 \times 10^{23} = 6.02 \times 10^{17}$ Correct choice: (4)

Q. 35. Which of the following presents the correct order of the acidity in the given compounds?

a. $FCH_2COOH > ClCH_2COOH > BrCH_2COOH > CH_3COOH$

b. $CH_3COOH > BrCH_2COOH > ClCH_2COOH > FCH_2COOH$

c. $FCH_2COOH > CH_3COOH > BrCH_2COOH > ClCH_2COOH$

d. $BrCH_2COOH > ClCH_2COOH > FCH_2COOH > CH_3COOH$

Sol. $FCH_2COOH > ClCH_2COOH > BrCH_2COOH > CH_3COOH$ Correct choice: (1)

Q. 36. The product formed in Aldol condensation is

a. an alpha, beta unsaturated ester
b. a beta-hydroxy acid
c. a beta-hydroxy aldehyde or a beta-hydroxy ketone
d. an alpha-hydroxy aldehyde or ketone

Sol. Aldol condensation leads to formation of
*β – hydroxy aldehyde or a β – hydroxy Ketone.*

Correct choice: (3)

Q. 37. Reduction of aldehydes and ketones into hydrocarbons using zinc amalgam and conc.HCl is called

    a. Wolf-Kishner Reduction
    b. Clemmensen Reduction
    c. Cope Reduction
    d. Dow Reduction

Sol. This is Clemmensen's reduction. Correct choice: (2)

Q. 38. Consider the following compounds

    a. C_6H_5COCl

    b. O_2N—⬡—$COCl$

    c. H_3C—⬡—$COCl$

    d. OHC—⬡—$COCl$
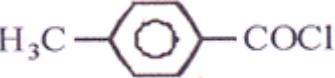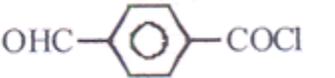
The correct decreasing order of their reactivity towards hydrolysis is

    a. (b) > (d) > (a) > (c)
    b. (b) > (d) > (c) > (a)
    c. (a) > (b) > (c) > (d)
    d. (d) > (b) > (a) > (c)

Sol. The attack of the nucleophile onto the carbonyl carbon is the rate-determining step. So, order must be (b) > (d) > (a) > (c) Correct choice: (1)

Q. 39. Which one of the following on treatment with 50% aqueous sodium

$$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3$$

    a. CH_3-C-CH_3
    b. $C_6H_5CH_2CHO$
    c. C_6H_5CHO
    d. $CH_3CH_2CH_2CHO$

Sol. Benzaldehyde has no $\alpha-$hydrogen atom, so it can undergo Cannizaro reaction. Correct choice: (3)

Q. 40. Which one of the following on reduction with lithium aluminium hydride yields a secondary amine?

    a. Methyl Cyanide
    b. Nitroethane
    c. Methylisocyanide
    d. Acetamide

Sol. Methyl isocyanide on reduction with LiAlH $_4$ will give dimethylamine. Correct choice: (3)
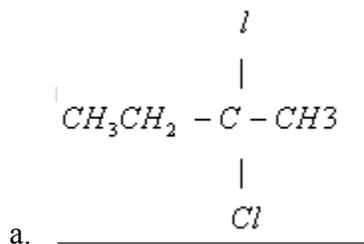
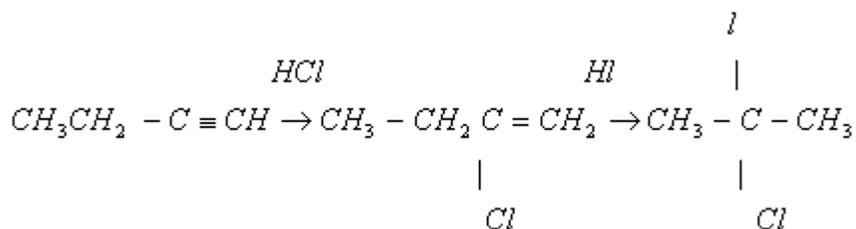**Q. 41.** The order of decreasing reactivity towards an electrophilic reagent, for the following:

    a. Benzene
    b. Toluene
    c. Chlorobenzene
    d. Phenol would be

    a. d > b > a > c
    b. a > b > c > d
    c. b > d > a > c
    d. d > c > b > a

Sol. The correct order is d > b > a > c. Correct choice: (1)

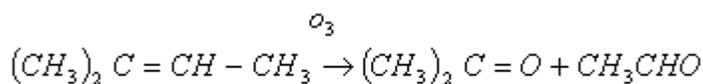**Q. 42.** Predict the product C obtained in the following reaction of

$$CH3CH2 - C \equiv CH\ CH + HCl \xrightarrow{Hl} B \rightarrow C$$

a.
$$CH_3CH_2 - \overset{\overset{\displaystyle l}{\displaystyle |}}{\underset{\underset{\displaystyle Cl}{\displaystyle |}}{C}} - CH3$$

b.
$$CH_3 - \overset{}{\underset{\underset{\displaystyle Cl}{\displaystyle |}}{CH}} - CH_2CH_2l$$

$$CH_3 - CH_2 - CH_2 - \overset{\overset{\displaystyle l}{\displaystyle |}}{\underset{\underset{\displaystyle Cl}{\displaystyle |}}{C}} - H$$

c.

$$CH_3 - CH_2 - \overset{\overset{\displaystyle l}{\displaystyle |}}{CH} - CH_2Cl$$

d.

$$CH_3CH_2 - C \equiv CH \xrightarrow{HCl} CH_3 - CH_2 \underset{\underset{\displaystyle Cl}{\displaystyle |}}{C} = CH_2 \xrightarrow{HI} CH_3 - \overset{\overset{\displaystyle l}{\displaystyle |}}{\underset{\underset{\displaystyle Cl}{\displaystyle |}}{C}} - CH_3$$
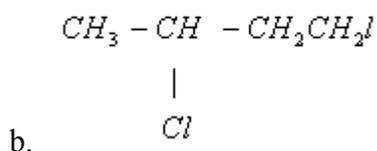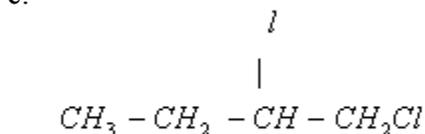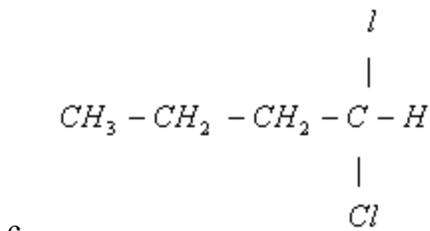
Sol.
Correct choice: (1)

Q. 43. Which of the compounds with molecular formulaC5H10 yields acetone on ozonolysis?

   a. 2 – Methyl – 1 – butene
   b. 2 – Methyl – 2 – butane
   c. 3 – Methyl – 1 – butane
   d. Cyclopentane

$$(CH_3)_2 C = CH - CH_3 \xrightarrow{O_3} (CH_3)_2 C = O + CH_3CHO$$

Sol. $2 - methyl\ 2 - butene\quad Zn\ /\ H_2O$

Correct choice: (2)

Q. 44. If there is no rotation of plane polarized light by a compound in a specific solvent, thought to be chiral, it may mean that

   a. the compound may be a racemic mixture
   b. the compound is certainly a chiral
   c. the compound is certainly meso
   d. there is no compound in the solvent

Sol. The given compound was thought to be chiral because of a chiral carbon/s. If there is no optical activity, it means the compound must certainly be meso. Correct choice: (3)

Q. 45. For the following

   a. I–
   b. Cl –
   c. Br-
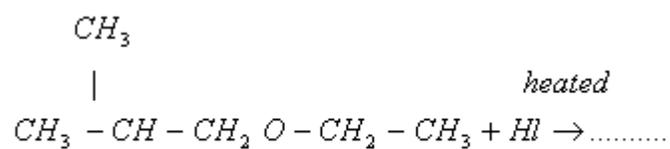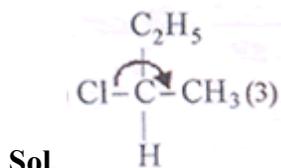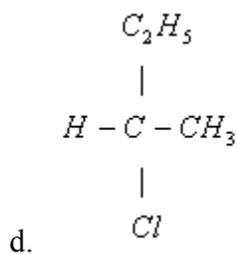
the increasing order of nucleophilicity would be:

   a. $Br^- < Cl^- < I^-$

   b. $I^- < Br^- < Cl^-$

   c. $Cl^- < Br^- < I^-$

   d. $I^- < Cl^- < Br^-$

Sol. The order of nucleophilicities of halides ions in water (default solvent) will be
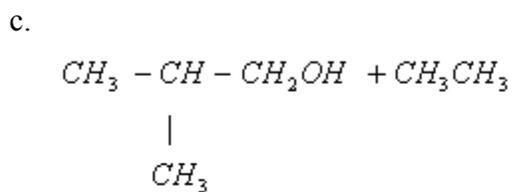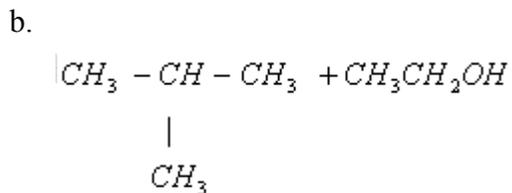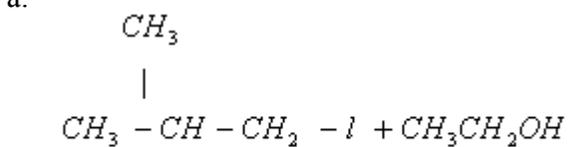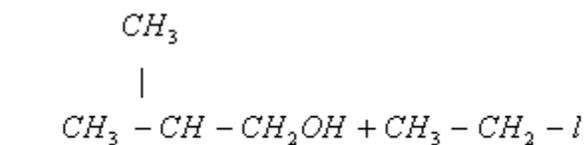$Cl^- < Br^- < I^-$ Correct choice: (3)

Q. 46. $CH_3 - CHCl - CH_2 - CH_3$ has a chiral centre. Which one of the following represents its R configuration?

a.
$$CH_3$$
$$|$$
$$H - C - Cl$$
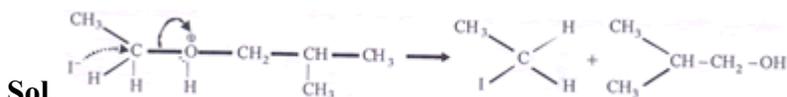$$|$$
$$C_2H_5$$

b.
$$C_2H_5$$
$$|$$
$$H_3C - C - Cl$$
$$|$$
$$Cl$$

c.
$$C_2H_5$$
$$|$$
$$H - C - CH_3$$
$$|$$
$$Cl$$

d.

$$C_2H_5$$
$$|$$
$$H-C-CH_3$$
$$|$$
$$Cl$$

Sol.

$$C_2H_5$$
$$Cl\overset{\curvearrowright}{-}C\overset{}{-}CH_3\,(3)$$
$$H$$

$$
CH_3
$$
$$
|
$$
$$
CH_3 - CH - CH_2\,O - CH_2 - CH_3 + Hl \xrightarrow{\text{heated}} ....
$$

Q. 47. In the reaction

Which of the following compounds will be formed?

a.

$$CH_3$$
$$|$$
$$CH_3 - CH - CH_2OH + CH_3 - CH_2 - l$$

b.

$$CH_3$$
$$|$$
$$CH_3 - CH - CH_2 - l + CH_3CH_2OH$$

c.

$$CH_3 - CH - CH_3 + CH_3CH_2OH$$
$$|$$
$$CH_3$$

d.

$$CH_3 - CH - CH_2OH + CH_3CH_3$$
$$|$$
$$CH_3$$

Sol.
Correct choice: (1)

Q. 48. Which one of the following vitamins is water-soluble?

a. Vitamin A
b. Vitamin B
c. Vitamin E
d. Vitam in K

Sol. Vitamin (B) and vitamin (C) are water soluble, while Vitamin (A), (D), (E) and (K) are fat soluble. Correct choice: (2)

Q. 49. RNA and DNA are chiral molecules, their chirality is due to

a. D – sugar component
b. L – sugar component
c. Chiral bases
d. Chiral phosphate ester units

Sol. Deoxyribose and ribose sugars are D -chiral sugars in DNA and RNA. Correct choice: (1)

Q. 50. Which one of the following polymers is prepared by condensation polymerization?

a. Styrene]
b. Nylon – 66
c. Teflon
d. Rubber

Sol. Nylon-66 is a condensation polymer of hexamethylene diamine and adipic acid. \Correct choice: (2)

PHYSICS

Q. 1. Dimensions of resistance in an electrical circuit, in terms of dimension of mass M, of length L, of time T and of current I, would be

a. $\left[ML^2T^{-3}I^{-2}\right]$
b. $\left[ML^2T^{-3}I^{-1}\right]$

c. $\left[ML^2T^{-2}\right]$

d. $\left[ML^2T^{-1}I^{-1}\right]$

Sol. $P = I^2 R,\ R = PI^{-2} = \left[ML^2T^{-3}I^{-1}\right]$ Correct choice: (1)

Q. 2. A particle moving along x-axis has acceleration f, at time t, given

$f = f_0\left(1 - \dfrac{t}{T}\right)$, where f_o and T are constant. The particle at t = 0 has zero velocity. In the time interval between t = 0 and the instant when f = 0 , the particle's velocity (v_x) is

a. $\dfrac{1}{2} f_o T$

b. $f_o T$

c. $\dfrac{1}{2} f_o T^2$

d. $f_o T^2$

Sol.

$\int_0^v dv = \int_0^t f dt \Rightarrow v = f_o\left(t - \dfrac{t}{2T}\right),\ \int_0^s ds = \int_0^T v dt \Rightarrow s = \dfrac{f_o T^3}{3}\quad v_{av} = \dfrac{s}{T} = \dfrac{f_o T}{3}\ \therefore\ No\ alternative\ matches$

If they have asked instantaneous velocity when $f = o\ then\ v = \dfrac{f_0 T}{2}$ Correct choice: (1)

Q. 3. A car moves from X to Y with a uniform speed vu and returns to Y with a uniform speed vd .The average speed for this round trip is

a. $\dfrac{v_u + v_d}{2}$

b. $\dfrac{2 v_u + v_d}{v_d + v_u}$

c. $\sqrt{v_u v_d}$

d. $\dfrac{v_d + v_u}{v_d + v_u}$

Sol. In question it must be car moves from X to Y and returns to X.

$t_1 = $ *time taken from X to Y* $= \dfrac{S}{v_u}$; $t_2 = $ *time taken from Y to X* $= \dfrac{S}{v_d}$; *average speed* $= \dfrac{2S}{t_1 + t_2} = \dfrac{2\,v_u v_d}{v_u + v_d}$
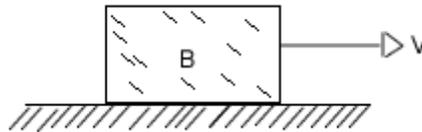
Correct choice: (2)

Q. 4. A particle starting from the origin (0, 0) moves in a straight line in the (x, y) plane. Its co-ordinates at a later time are $\left(\sqrt{3},\, 3\right)$. The path of the particle makes with the x-axis an angle of

   a. 0^0
   b. 30^0
   c. 45^0
   d. 60^0

Sol. $\tan\theta = \dfrac{3}{\sqrt{3}}$; $\theta = 60^0$ Correct choice: (4)

Q. 5. A block B is pushed momentarily along a horizontal surface with an initial velocity V. If μ is the coefficient of sliding friction between B and the surface, block B will come to rest after a time

   a. V/g
   b. $V/(g\,\mu)$
   c. $(g\,\mu)V/$
   d. g/V

Sol. $u = V$; $a = -\mu g$; $v = 0$; $v = u + at$; $0 = V - \mu g t$; $t = V/\mu g$ Correct choice: (2)

Q. 6. A vertical spring with force constant K is fixed on a table. A ball of mass m at a height h above the free upper end of the spring falls vertically on the spring so that the spring is compressed by a distance d . The net work done in the process is

   a. $mg\left(h - d\right) + \dfrac{1}{2}Kd^2$

   b. $mg\left(h + d\right) + \dfrac{1}{2}Kd^2$

c. $mg\left(h+d\right)-\dfrac{1}{2}Kd^{2}$

d. $mg\left(h-d\right)-\dfrac{1}{2}Kd^{2}$

Sol. $W_{net}=$ *work done by gravity* + *work done by spring* $\Rightarrow W_{net}=mg\left(h+d\right)-\dfrac{1}{2}Kd^{2}$

Correct choice: (3)

Q. 7. A wheel has angular acceleration of 3.0 rad/sec2 and an initial angular speed of 2.00 rad / sec. In a time of 2 sec it has rotated through an angle (in radian) of

   a. 4
   b. 6
   c. 10
   d. 12

Sol. $\alpha=3\;rad\,/\,sec^{2};\;\varpi_{0}=2\;rad\,/\,s;\;t=2\;sec;\;\theta=\varpi_{0}t+\dfrac{1}{2}\alpha t^{2}=10\;rad$ Correct choice: (3)

Q. 8.

$\vec{A}$ *and* $\vec{B}$ *are two vectors and* θ *is the angle between them, if* $\left|\vec{A}\times\vec{B}\right|=\sqrt{3}\left(\vec{A}\cdot\vec{B}\right)$ *the value of* θ *is*

   a. 90^{0}
   b. 60^{0}
   c. 45^{0}
   d. 30^{0}

Sol.

$\left|\vec{A}\times\vec{B}\right|=\sqrt{3}\left(\vec{A}\cdot\vec{B}\right),\;\left|\vec{A}\right|\left|\vec{B}\right|\sin\theta=\sqrt{3}\left|\vec{A}\right|\left|\vec{B}\right|\cos\theta\Rightarrow\tan\theta=\sqrt{3}\Rightarrow\theta=60^{0}$ Correct choice: (2)

Q. 9. The position x of a particle with respect to time t along x -axis is given by $x=9t^{2}-t^{3}$ where x is in metres and t in second. What will be the position of this particle when it achieves maximum speed along the $+_{x}$ direction?

   a. 24 m
   b. 32 m
   c. 54 m

d. 81 m

Sol.

$$v = \frac{dx}{dt} = 18t - 3t^2; \frac{dv}{dt} = 18 - 6t. \text{ Velocity is maximum when } \frac{dv}{dt} \; 0 \Rightarrow t = 3 \sec, x = 54 \, m$$
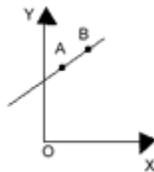
Correct choice: (3)

Q. 10. A mass of 2.0 kg is put on a flat pan attached to a vertical spring fixed on the ground as shown in the figure. The mass of the spring and the pan is negligible. When pressed slightly and released the mass executes a simple harmonic motion. The spring constant is 200 N/m. What should be the minimum amplitude of the motion so that the mass gets detached from the pan? $[\text{Take } g = 10 \, m/s^2]$
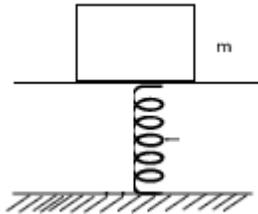
a. 4.0 cm
b. 8.0 cm
c. 10.0 cm
d. any value less than 12.0 cm

Sol. $m \, \omega^2 A = mg; \; \omega = \sqrt{\frac{K}{m}} = 10 \Rightarrow A = \frac{g}{\omega^2} = \frac{10}{10^2} = 0.1m = 10.0 \, cm$

Correct choice: (3)

Q. 11. A particle of mass m moves in the XY plane with a velocity V along the straight line AB. If the angular momentum of the particle with respect to origin O is L_A when it is at A and L_B when it is at B, then


a. $L_A < L_B$
b. $L_A > L_B$
c. $L_A = L_B$
d. The relationship between L_A and L_B depends upon the slope of the line AB

Sol. $L = mVd$ $(d = perpendicular\ dis\tan ce) \Rightarrow L_A = L_B$ Correct choice: (3)

Q. 12. A uniform rod AB of length l and mass m is free to rotate about point A. The rod is released from rest in the horizontal position. Given that the moment of inertia of the rod about A is $\dfrac{ml^2}{3}$, the initial angular acceleration of the rod will be
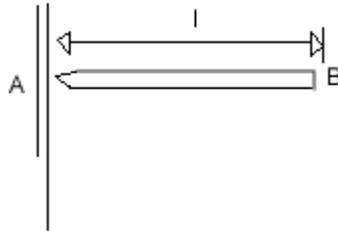
a. $\dfrac{3g}{2l}$

b. $\dfrac{2g}{3l}$

c. $mg\dfrac{1}{2}$

d. $\dfrac{3}{2}gl$

Sol. $mg\dfrac{1}{2} = \dfrac{ml^2}{3}\alpha \Rightarrow \alpha = \dfrac{3g}{2l}$

is four times the mass of $S_1\ and\ S_2$ hoice: (1) are moving in the same orbit. The mass of S_1 S_2. Which one of the following statements is true?

Q. 13. Two satellites of earth,

  a. The kinetic energies of the two satellites are equal.
  b. The time period of is S_1 four times that of S_2.
  c. The potential energies of earth and satellite in the two cases are equal.
  d. $S_1\ and\ S_2$ are moving with the same speed.

Sol . As orbital velocity $v = \sqrt{\dfrac{GM}{R}}$ it is independent of mass of satellite Correct choice: (4)

Q. 14. Assuming the sun to have a spherical outer surface of radius r , radiating like a black body at temperature t^0C , the power received by a unit surface, (normal to the

incident rays) at a distance R from the center of the sun is (where σ is the Stefan's constant).

a. $r^2 \sigma (t + 273)^4 / R$

b. $4 \pi r^2 \sigma t^4 / R^2$

c. $r^2 \sigma (t + 273)^4 / 4 \pi R^2$

d. $16 \pi^2 r^2 \sigma t^4 / R^2$

Sol. Power radiated

$$P = \sigma 4 \pi r^2 (t + 273)^4; \frac{Power received}{Area} = \frac{P}{4\pi R^2} = \frac{\sigma r^2}{R^2}(t + 273)^4 \quad \text{Correct choice: (1)}$$

Q. 15. An engine has an efficiency of 1/6. When the temperature of sink is reduced by 62^0C, its efficiency is doubled. Temperature of the source is

a. $99^0 C$

b. $124^0 C$

c. $37^0 C$

d. $62^0 C$

Sol. $\eta = 1 - \frac{T_2}{T_1}; \frac{1}{6} = 1 - \frac{T_2}{T_1} \dots (i) \ \frac{1}{3} = 1 - \frac{T_2 - 62}{T1} \dots (ii), \ from \ (i) \ and \ (ii) \Rightarrow T_1 = 99^0 C$

Correct choice: (1)

Q. 16. A black body is at $727^0 C$. It emits energy at a rate which is proportional to

a. $(727)^4$

b. $(727)^2$

c. $(1000)^4$

d. $(1000)^2$

Sol. $P \propto T^4$ Correct choice: (3)

Q. 17. The frequency of a light wave in a material is $2 \times 10^{14} \ HZ$ and wavelength is 5000Å. The refractive index of material will be

a. 1.33

b. 1.40

c. 1.50

d. 3.00

Sol. $n = 2 \times 10^{14}$ HZ; $\lambda = 5000 \times 10^{-10} m$; $v = n\lambda = 10^8$ m/s; $\mu = \dfrac{c}{v} = 3$

Correct choice: (4)

Q. 18. The phase difference between the instantaneous velocity and acceleration of a particle executing simple harmonic motion is

a. (1) zero
b. 0.5π
c. π
d. 0.707π

Sol.

$x = A\sin(\omega t + \phi)$, $v = A\omega\cos(\omega t + \phi)$, $a = -A\omega^2\sin(\omega t + \phi)$ ∴ Phase difference $= \dfrac{\pi}{2}$

Correct choice: (2)

Q. 19. The particle executing simple harmonic motion has a kinetic energy $K_0\cos^2\omega t$. The maximum values of the potential energy and the total energy are respectively

a. K_0 and K_0
b. 0 and $2K_0$
c. $\dfrac{K_0}{2}$ and K_0
d. K_0 and $2K_0$

Sol. $P \cdot E_{max} = K \cdot E_{max} = K_0$ Correct choice: (1)

Q. 20. A particle executes simple harmonic oscillation with an amplitude a . The period of oscillation is T. The minimum time taken by the particle to travel half of the amplitude from the equilibrium position is

a. T / 2
b. T / 4
c. T / 8
d. T / 12

Sol. $x = A\sin\omega t$; $\omega = \dfrac{2\pi}{T}$; x $A/2$ when $t = T/12$
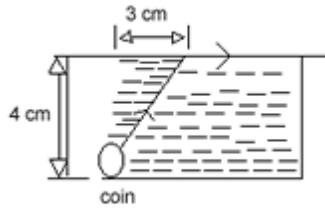
Correct choice: (4)

Q. 21. The electric and magnetic field of an electromagnetic wave are

   a. in phase and perpendicular to each other
   b. in phase and parallel to each other
   c. in opposite phase and perpendicular to each other
   d. in opposite phase and parallel to each other

Sol. $E_y(x,t) = E_o \sin(wt - kx),\ B_z(x,t) = B_o \sin(wt - kx)$
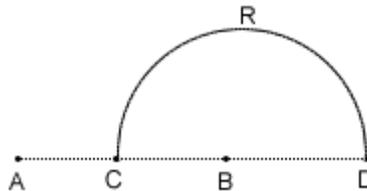
Correct choice: (1)

Q. 22. A small coin is resting on the bottom of a beaker filled with a liquid. A ray of light from the coin travels upto the surface of the liquid and moves along its surface (see figure). How fast is the light traveling in the liquid?

   a. $1.2 \times 10^8\ m/s$
   b. $1.8 \times 10^8\ m/s$
   c. $1.2 \times 10^8\ m/s$
   d. $3.0 \times 10^8\ m/s$

Sol . $\mu \sin \theta = cons \tan t \Rightarrow \mu \times \dfrac{3}{5} = 1 \times \sin 90;\ \mu = \dfrac{5}{3};\ v = c/\mu = 1.8 \times 10^8\ m/s$ Correct choice: (2)

Q. 23. Charges +q and -q are placed at points A and B respectively which are a distance 2L apart, C is the midpoint between A and B. The work done in moving a charge +Q along the semicircle CRD is
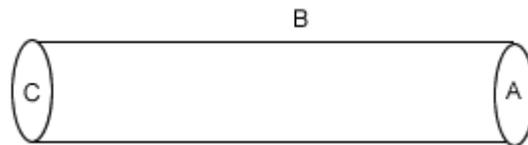

   a. $-\dfrac{qQ}{6\pi \varepsilon_o L}$

b.
$$-\frac{qQ}{4\pi\varepsilon_o L}$$

c.

d.
$$-\frac{qQ}{2\pi\varepsilon_o L}$$

Sol. At C potential

$$V_1 = 0; \; At\; D\; potential\; V_2 = \frac{kq}{3L} - \frac{kq}{L} = -\frac{2\,kq}{3L}; \; W_{external} = Q\left(V_2 - V_1\right) = -\frac{Qq}{6\pi\varepsilon_o L}$$

Correct choice: (1)

Q. 24. A hollow cylinder has a charge q coulomb within it. If f is the electric flux in units of volt × meter associated with the curved surface B, the flux linked with the plane surface A in units of volt × meter will be


a.
$$\frac{\frac{q}{\varepsilon_o} - \phi}{\varepsilon_o}$$

b.
$$\frac{1}{2}\left(\frac{q}{\varepsilon_o} - \phi\right)$$

c.
$$\frac{q}{2\varepsilon_o}$$

Sol.
$$\phi_{curved} + 2\,\phi_{plane} = \frac{q}{\varepsilon_0} \Rightarrow \phi_{plane} = \frac{q}{2\varepsilon_o} - \frac{\phi}{2}$$ Correct choice: (2)

Q. 25. Three point charges +q, - 2q and +q are placed at points (x = 0, y = a, z = 0), (x = 0, y = 0, z = 0) and (x = a, y = 0, z = 0) respectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are
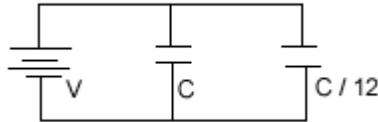
a. $\sqrt{2}\; qa\; along + x\; direction$

b. $\sqrt{2}\; qa\; along + y\; direction$

c. $\sqrt{2}\; qa\; along\; the\; line\; joining\; point\; s\,(x=0,y=0,z=0)\,and\,(x=a,y=a,z=0)$

d. $qa\; along\; the\,line\; joining\; point\; s\,(x=0,y=0,z=0)\,and\,(x=a,y=a,z=0)$
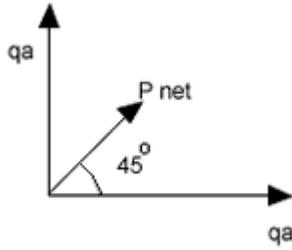
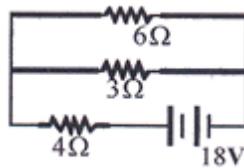**Sol .** qa $P_{net} = \sqrt{2}\, qa$ Correct choice: (3)

Q. 26. Two condensers, one of capacity C and the other of capacity C/2, are connected to a V-volt battery, as shown. The work done in charging fully both the condensers is

a. $\dfrac{1}{2} CV^2$

b. $2CV^2$

c. $\dfrac{1}{4} CV^2$

d. $\dfrac{3}{4} CV^2$

Sol. $U_i = 0; U_f = \dfrac{1}{2} \cdot \dfrac{3}{2} CV^2; W = \dfrac{3}{4} CV^2$ Correct choice: (4)

Q. 27. The total power dissipated in Watts in the circuit shown here is

a. 4
b. 16
c. 40
d. 54

Sol $R_{eq} = 6\,\Omega; p = \dfrac{V^2}{R_{eq}} = \dfrac{18 \times 18}{6} = 54\,W$ Correct choice: (4)

Q. 28. A steady current of 1.5 amp flows through a copper voltameter for 10 minute. If the electrochemical equivalent of copper is $30'10^{-5}$ gm coulomb^{-1} , the mass of copper deposited on the electrode will be

    a. 0.27 gm
    b. 0.40 gm
    c. 0.50 gm
    d. 0.67 gm

Sol . m = Zit; m = 0.27gm Correct choice: (1)

Q. 29. If the cold junction of a thermo-couple is kept at 0^0C and the hot junction is kept at T^0C, then the relation between neutral temperature (Tn) and temperature of inversion (Ti) is
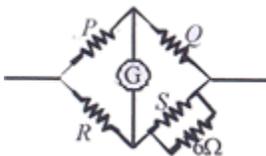
    a. $T_n = T_i + T$
    b. $T_n = T_i + T/2$
    c. $T_n = 2T_i$
    d. $T_n = T_i - T$

Sol . $T_n = \dfrac{T_i}{2}$ Correct choice: (2)

Q. 30. Three resistances P, Q, R each of 2Ω and an unknown resistance S form the four arms of a Wheatstone bridge circuit. When a resistance of 6Ω is connected in parallel to S the bridge gets balanced. What is the value of S?

    a. 1Ω
    b. 2Ω
    c. 3Ω
    d. 6Ω

Sol .

$$\frac{P}{Q} = \frac{R}{S6/(S+6)}; P = Q = R = 2\Omega, \Rightarrow S = 3\Omega$$

Correct choice: (3)

Q. 31. The resistance of an ammeter is 13Ω and its scale is graduated for a current upto 100 Amps. After an additional shunt has been connected to this ammeter it becomes possible to measure currents upto 750 Amperes by this meter. The value of shunt-resistance is

    a. $2\,K\Omega$
    b. $20\,\Omega$
    c. $2\,\Omega$
    d. $0.2\,\Omega$

Sol. $I_{max} = I_{gmax}\left(\dfrac{G+S}{S}\right); I_{max} = 750\,A, I_{gmax} = 100\,A; G = 13\Omega \Rightarrow S = 2\Omega$

Correct choice: (3)

Q. 32. Under the influence of a uniform magnetic field a charge-particle is moving in a circle of radius R with constant speed V. The time period of the motion

    a.   depends on R and not on V
    b.   depends on V and not on R
    c.   depends on both R and V
    d.   is independent of both R and V

Sol. $T = \dfrac{2\pi m}{Bq}$ Correct choice: (4)

Q. 33. A charged particle (charge q) is moving in a circle of radius R with uniform speed v . The associated magnetic moment μ is given by

    a.   qvR
    b.   qv R / 2
    c.   qv R^2
    d.   qvR^2 / 2

Sol. $\mu = IA;\ I = \dfrac{q}{2\pi R/v},\ A = \pi R^2 \Rightarrow \mu = \dfrac{qvR}{2}$ Correct choice: (2)

Q. 33. A beam of electrons passes undeflected through mutually perpendicular electric and magnetic fields. If the electric field is switched off, and the same magnetic field is maintained, the electrons move

    a.   along a straight line

b. in an elliptical orbit
c. in a circular orbit
d. along a parabolic path

Sol. As velocity, magnetic field and electric field are mutually perpendicular. Correct choice: (3)

Q. 34. A beam of electrons passes undeflected through mutually perpendicular electric and magnetic fields. If the electric field is switched off, and the same magnetic field is maintained, the electrons move

a. along a straight line
b. in an elliptical orbit
c. in a circular orbit
d. along a parabolic path

Sol. As velocity, magnetic field and electric field are mutually perpendicular. Correct choice: (3)

Q. 35. The primary and secondary coils of a transformer have 50 and 1500 turns respectively. If the magnetic flu σ f linked with the primary coil is given by $\phi = \phi_o + 4t, where \phi is in webers, t is time in \sec onds and \phi_o$ is a constant, the output voltage across the secondary coil is

a. 30 volts
b. 90 volts
c. 120 volts
d. 220 volts

Sol. $e_p = -\dfrac{d\phi_p}{dt} = 4 Volt, N_p e_p = N_s e_s, \Rightarrow e_s = 120 Volts$ 　　　Correct choice: (3)

Q. 36. What is the value of inductance L for which the current is a maximum in a series LCR circuit with $C = 10\mu F\, and\, \omega = 1000 \sec^{-1}$?

a. 10 mH
b. 100 mH
c. 1 mH
d. cannot be calculated unless R is known

Sol.
$\omega = \dfrac{1}{\sqrt{LC}} \Rightarrow L = \dfrac{1}{\omega^2 C} = 100 mH \left(Although\, \omega is\, written\, 1000\, \sec^{-1}\, it\, must\, be\, 1000\, rad\, /\sec.\right)$
Correct choice: (2)

Q. 37. A transformer is used to light a 100W and 110V lamp from a 220V mains. If the main current is 0.5A, the efficiency of the transformer is approximately

    a. 10%
    b. 30%
    c. 50%
    d. 90%

Sol. $\eta = \dfrac{out\,put}{input} \times 100; \eta = \dfrac{100}{0.5 \times 220} 100 = 90.9\%$ Correct choice: (4)

Q. 38. Nickel shows ferromagnetic property at room temperature. If the temperature is increased beyond Curie temperature then it will show

    a. diamagnetism
    b. paramagnetism
    c. anti ferromagnetism
    d. no magnetic property

Sol . Fact based Correct choice: (2)

Q. 39. A 5 watt source emits monochromatic light of wavelength $5000 \overset{0}{A}$. When placed 0.5 m away, it liberates photoelectrons from a photosensitive metallic surface. When the source is moved to a distance of 1.0 m, the number of photoelectrons liberated will

    a. be reduced by a factor of 2
    b. be reduced by a factor of 4
    c. be reduced by a factor of 8
    d. be reduced by a factor of 16

Q. 40. Monochromatic light of frequency is $6.0 \times 10^{14}\ HZ$ produced by a laser. The power emitted is $2 \times 10^{-3}\ W$. The number of photons emitted, on the average, by the source per second is

    a. 5×10^{14}
    b. 5×10^{15}
    c. 5×10^{16}
    d. 5×10^{17}

Sol . $nhv = 2 \times 10^{-3}; n = 5 \times 10^{15}$ Correct choice: (2)

Q. 41. In a mass spectrometer used for measuring the masses of ions, the ions are initially accelerated by an electric potential V and then made to describe semicircular paths of radius R using a magnetic field B. If V and B are kept constant, the ratio

$$\left(\frac{ch\arg eon\ the\ ion}{mass\ of\ the\ ion}\right)$$ will be proportional to

   a. R
   b. 1/R
   c. $1/R^2$
   d. R^2

Sol . Radius of path

$$R = \frac{mv}{qB} = \sqrt{\frac{2m\,(K\cdot E)}{qB}}, \text{where, } K\cdot E = qV \Rightarrow R = \frac{\sqrt{2mqV}}{qB} \Rightarrow \frac{q}{m} = \frac{2V}{B^2R^2}$$ Correct

choice: (3)

Q. 42. If the nucleus $^{27}_{13}13$ has a nuclear radius of about 3.6 fm, then $^{125}_{52}$ Te would have its radius approximately as

   a. 4.8 fm
   b. 6.0 fm
   c. 9.6 fm
   d. 12.0 fm

Sol. $\dfrac{R_2}{R_1}\left(\dfrac{A_2}{A_1}\right)^{1/3}$; $R_2 = R_1\left(\dfrac{125}{27}\right)^{1/3} = 3.6\times\dfrac{5}{3} = 6.0\ fm$ Correct choice: (2)

Q. 43. In radioactive decay process, the negatively charged emitted β^- particles are

   a. the electrons orbiting around the nucleus
   b. the electrons present inside the nucleus
   c. the electrons produced as a result of the decay of neutrons inside the nucleus
   d. the electrons produced as a result of collisions between atoms

Sol . When neutron decays as given $_0n^1 = {}_1H^1 + {}_{-1}e^0 + \bar{\nu}$ Correct choice: (3)

Q. 44. A nucleus ^A_ZX has nucleus A X
Z has mass represented by M (A, Z). If M_p and M_n denote the mass of proton and neutron respectively and B.E the binding energy in Me V then

a. $B.E = M\,(A,z) - ZM_p - (A-Z)\,M_n$

b. $B.E = \left[M\,(A,z) - ZM_p - (A-Z)\,M_n\right]c^2$

c. $B.E = \left[ZM_p + (A,z)M_n - M\,(A,Z)\right]c^2$

d. $B.E = \left[ZM_p + AM_n - M\,(A,Z)\right]c^2$

Sol. $B.E = \left[ZM_p + (A,z)M_n - M\,(A,Z)\right]c^2$ Correct choice: (3)

Q. 45. Two radioactive substances A and B have decay constants $5\lambda \; and \; \lambda$ respectively. At t = 0 they have the same number of nuclei. The ratio of number of nuclei of A to those of B will be $(1/e)^2$ after a time interval

a. $\dfrac{1}{2\lambda}$

b. $\dfrac{1}{4\lambda}$

c. 4λ

d. 2λ

Sol. $\dfrac{N_A}{N_B} = \dfrac{N_0 e^{-\lambda_1 t}}{N_0 e^{-\lambda_2 t}} \; Where \; \dfrac{N_A}{N_B} = \dfrac{1}{e^2}; \lambda_1 = 5\,\lambda, = \lambda_2 = \lambda \; So, \; \dfrac{1}{e^2} = \dfrac{e^{-5\lambda t}}{e^{-\lambda t}} \Rightarrow t = \dfrac{1}{2\,\lambda}$

Correct choice: (1)

Q. 46. The total energy of electron in the ground state of hydrogen atom is –13.6 eV. The kinetic energy of an electron in the firstm excited state is
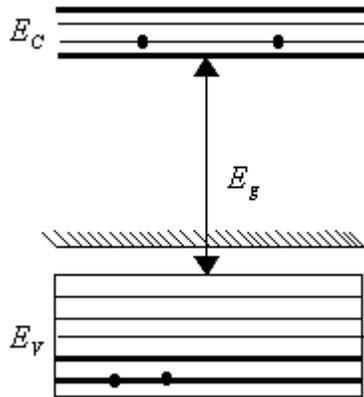
a. 1.7 eV
b. 3.4 eV
c. 6.8 eV
d. 13.6 eV

Sol. Total energy in 1st excited state

$= -\dfrac{13.6}{4} = -3.4eV \; and \; K.E = -(total \; energy) = 3.4eV$

Correct choice: (2)

Q. 47. In the energy band diagram of a material shown below, the open circles and filled circles denote holes and electrons respectively. The material is

    a. an n-type semiconductor
    b. a p-type semiconductor
    c. an insulator
    d. a metal

Sol. In diagram acceptor level is near valance band which will happen in p-type semiconductor. Correct choice: (2)

Q. 48. A common emitter amplifier has a voltage gain of 50, an input impedance of $100\,\Omega$ and an output impedance of $200\,\Omega$. The power gain of the amplifier is
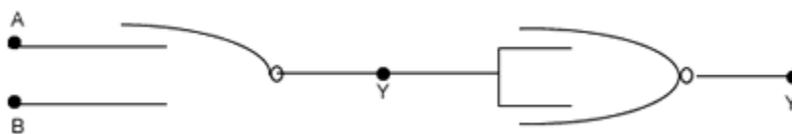
    a. 100
    b. 500
    c. 1000
    d. 1250

Sol.
Voltage gain, $A_v = 50$; input impedance, $Ri = 100\Omega$; output impedance $R_o = 200\Omega$. the

$$power\ gain\ of\ the = (A_v)^2 \times \frac{R_i}{R_0} = 1250$$

Correct choice: (4)

Q. 49. In the following circuit, the output Y for all possible inputs A and B is expressed by the truth table

(i)   A   B   Y

0	0	0
0	1	1
1	1	1

(ii)

A	B	Y
0	1	0
1	0	0
1	1	1

(iii)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

(iv)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

Q. 50. For a cubic crystal structure which one of the following relations indicating the cell characteristics is correct?

a. $a = b = c$ and $\alpha = \beta = \gamma = 90^0$

b. $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90^0$

c. $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^0$

d. $a = b = c$ and $\alpha \neq \beta \neq \gamma = 90^0$

Sol. the cubic system is the most symmetric out of all seven crystal systems. All edges for the unit cell are same i.e., a = b = c and all angles are right angles i.e., $\alpha = \beta = \gamma = 90^0$

Correct choice: (1)