

Biology

Q 1. In a testcross involving F_1 dihybrid flies, more parental-type offspring were produced than the recombinant-type offspring. This indicates

- (A) Both of the characters are controlled by more than one gene
- (B) The two genes are located on two different chromosomes
- (C) Chromosomes failed to separate during meiosis
- (D) The two genes are linked and present on the same chromosome

Q 2. Water soluble pigments found in plant cell vacuoles are

- (A) Anthocyanins
- (B) Xanthophylls
- (C) Chlorophylls
- (D) Carotenoids

Q 3. Which of the following pairs of hormones are not antagonistic (having opposite effects) to each other?

- (A) Relaxin - Inhibin
- (B) Parathormone - Calcitonin
- (C) Insulin - Glucagon
- (D) Aldosterone - Atrial Natriuretic Factor

Q 4. Mitochondria and chloroplast are

- (1) semi-autonomous organelles
- (2) formed by division of pre-existing organelles and they contain DNA but lack protein synthesizing machinery

Which one of the following options is **correct**?

- (A) Both (1) and (2) are false
- (B) Both (1) and (2) are correct
- (C) (2) is true but (1) is false
- (D) (1) is true but (2) is false

Q 5. Which of the following is not a feature of the plasmids?

- (A) Single-stranded
- (B) Independent replication
- (C) Circular structure
- (D) Transferable

Q 6. A plant in your garden avoids photorespiratory losses, has improved water use efficiency, shows high rates of photosynthesis at high temperatures and has improved efficiency of nitrogen utilization. In which of the following physiological groups would you assign this plant?

- (A) Nitrogen fixer
- (B) C₃
- (C) C₄
- (D) CAM

Q 7. Emerson's enhancement effect and Red drop have been instrumental in the discovery of

- (A) Oxidative phosphorylation
- (B) Photophosphorylation and non-cyclic electron transport
- (C) Two photosystems operating simultaneously
- (D) Photophosphorylation and cyclic electron transport

Q 8. Which type of tissue **correctly** matches with its location?

Tissue	Location
(1) Cuboidal epithelium	Lining of stomach
(2) Smooth muscle	Wall of intestine
(3) Areolar tissue	Tendons
(4) Transitional epithelium	Tip of nose

Q 9. When does the growth rate of a population following the logistic model equal zero? The logistic model is given as $dN/dt = rN(1-N/K)$

- (A) When death rate is greater than birth rate
- (B) When N/K is exactly one
- (C) When N nears the carrying capacity of the habitat
- (D) When N/K equals zero

Q 10. Which one of the following statements is not true?

- (A) Stored pollen in liquid nitrogen can be used in the crop breeding programmes
- (B) Tapetum helps in the dehiscence of anther
- (C) Exine of pollen grains is made up of sporopollenin
- (D) Pollen grains of many species cause severe allergies

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

- (A) Phycomycetes are also called algal fungi
- (B) Cyanobacteria are also called blue-green algae
- (C) Golden algae are also called desmids
- (D) Eubacteria are also called false bacteria

Q12. The avena curvature is used for bioassay of

- (A) Ethylene
- (B) ABA
- (C) GA_3
- (D) IAA

Q13. Which of the following structures is homologous to the wing of a bird?

- (A) Flipper of Whale
- (B) Dorsal fin of a Shark
- (C) Wing of a Moth
- (D) Hind limb of Rabbit

Q 14. Blood pressure in the pulmonary artery is

- (A) Less than that in the venae cavae
- (B) Same as that in the aorta
- (C) More than that in the carotid
- (D) More than that in the pulmonary vein

Q 15. Fertilization in humans is practically feasible only if

- (A) The sperms are transported into cervix within 48 hrs of release of ovum in uterus
- (B) The sperms are transported into vagina just after the release of ovum in fallopian tube
- (C) The ovum and sperms are transported simultaneously to ampullary - isthmic junction of the fallopian tube
- (D) The ovum and sperms are transported simultaneously to ampullary - isthmic junction of the cervix

Q 16. In meiosis crossing over is initiated at

- (A) Diplotene
- (B) Pachytene
- (C) Leptotene
- (D) Zygotene

Q 17. Chrysophytes, Euglenoids, Dinoflagellates and Slime moulds are included in the kingdom

- (A) Animalia
- (B) Monera
- (C) Protista
- (D) Fungi

Q 18. Lack of relaxation between successive stimuli in sustained muscle contraction is known as

- (A) Tonus
- (B) Spasm
- (C) Fatigue
- (D) Tetanus

Q 19. Identify the correct statement on inhibin

- (A) Is produced by nurse cells in testes and inhibits the secretion of LH
- (B) Inhibits the secretion of LH, FSH and Prolactin
- (C) Is produced by granulose cells in ovary and inhibits the secretion of FSH
- (D) Is produced by granulose cells in ovary and inhibits the secretion of LH

Q 20. Name the chronic respiratory disorder caused mainly by cigarette smoking

- (A) Respiratory alkalosis
- (B) Emphysema
- (C) Asthma
- (D) Respiratory acidosis

Q 21. Which of the following most appropriately describes haemophilia?

- (A) Dominant gene disorder
- (B) Recessive gene disorder
- (C) X-linked recessive gene disorder
- (D) Chromosomal disorder

Q 22. Select the correct statement

- (A) The leaves of gymnosperms are not well adapted to extremes of climate
- (B) Gymnosperms are both homosporous and heterosporous
- (C) *Salvinia*, *Ginkgo* and *Pinus* all are gymnosperms
- (D) Sequoia is one of the tallest trees

Q 23. Which of the following is required as inducer(s) for the expression of Lac operon?

- (A) Lactose and Galactose
- (B) Glucose
- (C) Galactose
- (D) Lactose

Q 24. A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the F_1 plants were selfed the resulting genotypes were in the ratio of

- (A) 3 : 1 :: Dwarf : Tall
- (B) 1 : 2 : 1 :: Tall homozygous : Tall heterozygous : Dwarf
- (C) 1 : 2 : 1 :: Tall heterozygous : Tall homozygous : Dwarf
- (D) 3 : 1 :: Tall : Dwarf

Q 25 Which part of the tobacco plant is infected by *Meloidogyne incognita*?

- (A) Root
- (B) Flower
- (C) Leaf
- (D) Stem

Q 26. Which of the following is not a characteristic feature during mitosis in somatic cells?

- (A) Synapsis
- (B) Spindle fibres
- (C) Disappearance of nucleolus
- (D) Chromosome movement

Q 27. Which of the following statements is not true for cancer cells in relation to mutations?

- (A) Mutations inhibit production of telomerase
- (B) Mutations in proto-oncogenes accelerate the cell cycle
- (C) Mutations destroy telomerase inhibitor
- (D) Mutations inactivate the cell control

Q 28. One of the major components of cell wall of most fungi is

- (A) Hemicellulose
- (B) Chitin
- (C) Peptidoglycan
- (D) Cellulose

Q 29. Cotyledon of maize grain is called

- (A) Scutellum
- (B) Plumule
- (C) Coleorhiza
- (D) Coleoptile

Q 30. Which of the following would appear as the pioneer organisms on bare rocks?

- (A) Green algae
- (B) Lichens
- (C) Liverworts
- (D) Mosses

Q 31. Changes in GnRH pulse frequency in females is controlled by circulating levels of

- (A) Progesterone and inhibin
- (B) Estrogen and progesterone
- (C) Estrogen and inhibin
- (D) Progesterone only

Q 32. Antivenom injection contains preformed antibodies while polio drops that are administered into the body contain

- (A) Attenuated pathogens
- (B) Activated pathogens
- (C) Harvested antibodies
- (D) Gamma globulin

Q 33. Photosensitive compound in human eye is made up of

- (A) Transducin and Retinene
- (B) Guanosine and Retinol
- (C) Opsin and Retinal
- (D) Opsin and Retinol

Q 34. Specialized epidermal cells surrounding the guard cells are called

- (A) Lenticels (B) Complementary cells
(C) Subsidiary cells (D) Bulliform cells

Q 35. Which of the following features is not present in the Phylum-Arthropoda?

- (A) Jointed appendages (B) Chitinous exoskeleton
(C) Metameric segmentation (D) Parapodia

Q 36. Reduction in pH of blood will

- (A) Release bicarbonate ions by the liver
(B) Reduce the rate of heart beat
(C) Reduce the blood supply to the brain
(D) Decrease the affinity of hemoglobin with oxygen

Q 37. Which of the following characteristic features always holds true for the corresponding group of animals?

(A)	3-chambered heart with one incompletely divided ventricle	Reptilia
(B)	Cartilaginous endoskeleton	Chondrichthyes
(C)	Viviparous	Mammalia
(D)	Possess a mouth with an upper and a lower jaw	Chordata

Q 38. Match the terms in Column I with their description in Column II and choose the correct option

Column I	Column II
(1) Dominance	(i) Many genes govern a single character
(2) Codominance	(ii) In a heterozygous organism only one allele expresses itself
(3) Pleiotropy	(iii) In a heterozygous organism both alleles express themselves fully
(4) Polygenic inheritance	(iv) A single gene influences many characters

- (A) 1(iv), 2(iii), 3(i), 4(ii) (B) 1(ii), 2(i), 3(iv), 4(iii)
(C) 1(ii), 2(iii), 3(iv), 4(i) (D) 1(iv), 2(i), 3(ii), 4(iii)

Q 39. A typical fat molecule is made up of

- (A) Three glycerol and three fatty acid molecules
- (B) Three glycerol molecules and one fatty acid molecule
- (C) One glycerol and three fatty acid molecules
- (D) One glycerol and one fatty acid molecule

Q 40. Proximal end of the filament of stamen is attached to the

- (A) Thalamus or petal
- (B) Anther
- (C) Connective
- (D) Placenta

Q 41. Which one of the following statements is wrong?

- (A) Glycine is a sulphur containing amino acid
- (B) Sucrose is a disaccharide
- (C) Cellulose is a polysaccharide
- (D) Uracil is a pyrimidine

Q 42. Water vapour comes out from the plant leaf through the stomatal opening. Through the same stomatal opening carbon dioxide diffuses into the plant during photosynthesis. Reason out the above statements using one of following options :

- (A) One process occurs during day time, and the other at night
- (B) Both processes cannot happen simultaneously
- (C) Both processes can happen together because the diffusion coefficient of water and CO₂ is different
- (D) The above processes happen only during night time

Q 43. A complex of ribosomes attached to a single strand of RNA is known

- (A) Okazaki fragment
- (B) Polysome
- (C) Polymer
- (D) Polypeptide

Q 44. Which one of the following is a characteristic feature of cropland ecosystem?

- (A) Ecological succession
- (B) Absence of soil organisms
- (C) Least genetic diversity
- (D) Absence of weeds

Q 45. Which of the following is the most important cause of animals and plants being driven to extinction?

- (A) Co-extinctions
- (B) Over-exploitation
- (C) Alien species invasion
- (D) Habitat loss and fragmentation

Q 46. In a chloroplast the highest number of protons are found in

- (A) Antennae complex
- (B) Stroma
- (C) Lumen of thylakoids
- (D) Inter membrane space

Q 47. Which of the following is not required for any of the techniques of DNA fingerprinting available at present?

- (A) DNA-DNA hybridization
- (B) Polymerase chain reaction
- (C) Zinc finger analysis
- (D) Restriction enzymes

Q 48. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the

- (A) Eubacteria
- (B) Halophiles
- (C) Thermoacidophiles
- (D) Methanogens

Q 49. Which of the following features is not present in *Periplaneta americana*?

- (A) Metamerically segmented body
- (B) Schizocoelom as body cavity
- (C) Indeterminate and radial cleavage during embryonic development
- (D) Exoskeleton composed of N-acetylglucosamine

Q 50. A system of rotating crops with legume or grass pasture to improve soil structure and fertility is called

- (A) Shifting agriculture
- (B) Ley farming
- (C) Contour farming
- (D) Strip farming

Q 51. Which of the following is wrongly matched in the given table?

	Microbe	Product	Application
(A)	<i>Clostridium butylicum</i>	Lipase	Removal of oil stains
(B)	<i>Trichoderma polysporum</i>	Cyclosporin A	immunosuppressive
(C)	<i>Monascus purpureus</i>	Statins	lowering of blood cholesterol
(D)	<i>Streptococcus</i>	Streptokinase	removal of clot from blood vessel

Q 52. In mammals, which blood vessel would normally carry largest amount of urea?

- (A) Hepatic Portal Vein
- (B) Renal Vein
- (C) Dorsal Aorta
- (D) Hepatic Vein

Q 53. Pick out the correct statements :

- (1) Haemophilia is a sex-linked recessive disease.
- (2) Down's syndrome is due to aneuploidy.
- (3) Phenylketonuria is an autosomal recessive gene disorder.
- (4) Sickle cell anaemia is an X-linked recessive gene disorder.

- (A) (1), (2) and (3) are correct
- (B) (1) and (4) are correct
- (C) (2) and (4) are correct
- (D) (1), (3) and (4) are correct

Q.54 Which of the following guards the opening of hepatopancreatic duct into the duodenum?

- (A) Sphincter of Oddi
- (B) Semilunar valve
- (C) Ileocaecal valve
- (D) Pyloric sphincter

Q 55. Microtubules are the constituents of

- (A) Centrosome, Nucleosome and Centrioles
- (B) Cilia, Flagella and Peroxisomes
- (C) Spindle fibres, Centrioles and Cilia
- (D) Centrioles, Spindle fibres and Chromatin

Q 56 The coconut water from tender coconut represents

- (A) Free nuclear endosperm
- (B) Endocarp
- (C) Fleshy mesocarp
- (D) Free nuclear proembryo

Q 57. Tricarpellary, syncarpous gynoecium is found in flowers of

- (A) Poaceae (B) Liliaceae
- (C) Solanaceae (D) Fabaceae

Q 58. Which of the following is not a stem modification

- (A) Flattened structures of *Opuntia*
- (B) Pitcher of *Nepenthes*
- (C) Thorns of citrus
- (D) Tendrils of cucumber

Q 59. The taq polymerase enzyme is obtained from

- (A) *Pseudomonas putida*
- (B) *Thermus aquaticus*
- (C) *Thiobacillus ferrooxidans*
- (D) *Bacillus subtilis*

Q 60. Stems modified into flat green organs performing the functions of leaves are known as

- (A) Scales
- (B) Cladodes
- (C) Phyllodes
- (D) Phylloclades

Q 61. In higher vertebrates, the immune system can distinguish self-cells and non-self. If this property is lost due to genetic abnormality and it attacks self-cells, then it leads to

- (A) Active immunity
- (B) Allergic response
- (C) Graft rejection
- (D) Auto-immune disease

Q 62. Nomenclature is governed by certain universal rules. Which one of the following is contrary to the rules of nomenclature?

- (A) When written by hand, the names are to be underlined
- (B) Biological names can be written in any language
- (C) The first word in a biological name represents the genus name and the second is a specific epithet
- (D) The names are written in Latin and are italicized

Q 63 In bryophytes and pteridophytes, transport of male gametes requires:

- (A) Water
- (B) Wind
- (C) Insects
- (D) Birds

Q 64. In context of amniocentesis, which of the following statement is incorrect?

- (A) It can be used for detection of Cleft palate.
- (B) It is usually done when a woman is between 14 - 16 weeks pregnant.
- (C) It is used for prenatal sex determination.
- (D) It can be used for detection of Down syndrome.

Q 65. In the stomach, gastric acid is secreted by the

- (A) Acidic cells
- (B) Gastrin secreting cells
- (C) Parietal cells
- (D) Peptic cells

Q 66. Spindle fibres attach on to:

- (A) Kinetosome of the chromosome
- (B) Telomere of the chromosome
- (C) Kinetochore of the chromosome
- (D) Centromere of the chromosome

Q 67. Which is the National Aquatic Animal of India?

- (A) Sea-horse
- (B) Gangetic shark
- (C) River dolphin
- (D) Blue whale

Q 68 Which one of the following cell organelles is enclosed by a single membrane?

- (A) Nuclei
- (B) Mitochondria
- (C) Chloroplasts
- (D) Lysosomes

Q 69 The two polypeptides of human insulin are linked together by

- (A) Disulphide bridges
- (B) Hydrogen bonds
- (C) Phosphodiester bond
- (D) Covalent bond

Q 70. In which of the following all three are macronutrients?

- (A) Nitrogen, nickel, phosphorus
- (B) Boron, zinc, manganese
- (C) Iron, copper, molybdenum
- (D) Molybdenum, magnesium, manganese

Q 71. Which of the following statements is wrong for viroids?

- (A) Their RNA is of high molecular weight
- (B) They lack a protein coat
- (C) They are smaller than viruses
- (D) They causes infections

Q 72. Analogous structures are a result of

- (A) Stabilizing selection
- (B) Divergent evolution
- (C) Convergent evolution
- (D) Shared ancestry

Q 73. Select the incorrect statement :

- (A) LH triggers secretion of androgens from the Leydig cells
- (B) FSH stimulates the sertoli cells which help in spermiogenesis
- (C) LH triggers ovulation in ovary
- (D) LH and FSH decrease gradually during the follicular phase

Q 74. Which one of the following characteristics is not shared by birds and mammals?

- (A) Warm blooded nature
- (B) Ossified endoskeleton
- (C) Breathing using lungs
- (D) Viviparity

Q 75. Which of the following statements is not correct?

- (A) Some reptiles have also been reported as pollinators in some plant species
- (B) Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style
- (C) Insects that consume pollen or nectar without bringing about pollination are called pollen/nectar robbers
- (D) Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil

Q 76. Seed formation without fertilization in flowering plants involves the process of

- (A) Apomixis
- (B) Sporulation
- (C) Budding
- (D) Somatic hybridization

Q 77. Which of the following approaches does not give the defined action of contraceptive?

(A)	Vasectomy	Prevents spermatogenesis
(B)	Barrier methods	Prevent fertilization
(C)	Intra uterine devices	Increase phagocytosis of sperms, suppress sperm motility and fertilizing capacity of sperms
(D)	Hormonal contraceptives	sperms, prevent ovulation and fertilization

Q78. The amino acid Tryptophan is the precursor for the synthesis of

- (A) Cortisol and Cortisone
- (B) Melatonin and Serotonin
- (C) Thyroxine and Triiodothyronine
- (D) Estrogen and Progesterone.

Q79. A river with an inflow of domestic sewage rich in organic waste may result in

- (A) Death of fish due to lack of oxygen
- (B) Drying of the river very soon due to algal bloom
- (C) Increased population of aquatic food web organisms
- (D) An increased production of fish due to biodegradable nutrients

Q 80. Gause's principle of competitive exclusion states that

- (A) Larger organisms exclude smaller ones through competition
- (B) More abundant species will exclude the less abundant species through competition
- (C) Competition for the same resources excludes species having different food preferences
- (D) No two species can occupy the same niche indefinitely for the same limiting resources

Q 81. Asthma may be attributed to

- (A) Accumulation of fluid in the lungs
- (B) Bacterial infection of the lungs
- (C) Allergic reaction of the mast cells in the lungs
- (D) Inflammation of the trachea

Q 82. The standard petal of a papilionaceous corolla is also called

- (A) Corona
- (B) Carina
- (C) Pappus
- (D) Vexillum

Q 83. Which of the following is a restriction endonuclease?

- (A) RNase
- (B) Hind II
- (C) Protease
- (D) DNase I

Q 84. It is much easier for a small animal to run uphill than for a large animal, because

- (A) The efficiency of muscles in large animals is less than in the small animals
- (B) It is easier to carry a small body weight
- (C) Smaller animals have a higher metabolic rate
- (D) Small animals have a lower O₂ requirement

Q 85. Following are the two statements regarding the origin of life

- (1) The earliest organisms that appeared on the earth were non-green and presumably anaerobes.
- (2) The first autotrophic organisms were the chemoautotrophs that never released oxygen.

Of the above statements which one of the following options is correct?

- (A) Both (1) & (2) are false
- (B) (1) is correct but (2) is false
- (C) (2) is correct but (1) is false
- (D) Both (1) & (2) are correct

Q 86. A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in

- (A) Polyteny
- (B) Aneuploidy
- (C) Polyploidy
- (D) Somaclonal variation

Q 87. Depletion of which gas in the atmosphere can lead to an increased incidence of skin cancers

- (A) Methane
- (B) Nitrous oxide
- (C) Ozone
- (D) Ammonia

Q 88. Joint Forest Management Concept was introduced in India during

- (A) 1990s
- (B) 1960s
- (C) 1970s
- (D) 1980s

Q 89. Which one of the following is the starter codon?

- (A) UAG
- (B) AUG
- (C) UGA
- (D) UAA

Q 90. The term ecosystem was coined by

- (A) E. Warming
- (B) E.P. Odum
- (C) A.G. Tansley
- (D) E. Haeckel

Physics

Q.91 What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?

(A) $\sqrt{5gR}$

(B) \sqrt{gR}

(C) $\sqrt{2gR}$

(D) $\sqrt{3gR}$

Q.92 If the magnitude of sum of two vectors is equal to the magnitude of difference of the two vectors, the angle between these vectors is

(A) 180°

(B) 0°

(C) 90°

(D) 45°

Q.93 At what height from the surface of earth the gravitation potential and the value of g are $-5.4 \times 10^7 \text{ J kg}^{-2}$ and 6.0 ms^{-2} respectively? Take the radius of earth as 6400 km

(A) 2000 km

(B) 2600 km

(C) 1600 km

(D) 1400 km

Q.94 A long solenoid has 1000 turns. When a current of 4 A flows through it, the magnetic flux linked with each turn of the solenoid is $4 \times 10^{-3} \text{ Wb}$. The self-inductance of the solenoid is

(A) 1 H

(B) 4 H

(C) 3 H

(D) 2 H

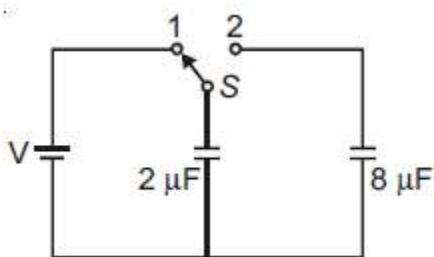
Q.95 An inductor 20 mH , a capacitor $50\text{ }\mu\text{F}$ and a resistor $40\text{ }\Omega$ are connected in series across a source of emf $V = 10 \sin 340t$. The power loss in A.C. circuit is

- (A) 0.89 W
- (B) 0.51 W
- (C) 0.67 W
- (D) 0.76 W

Q.96 Two identical charged spheres suspended from a common point by two massless strings of lengths l , are initially at a distance d ($d \ll l$) apart because of their mutual repulsion. The charges begin to leak from both the spheres at a constant rate. As a result, the spheres approach each other with a velocity v . Then v varies as a function of the distance x between the spheres, as

- (A) $v \propto X^{-1}$
- (B) $v \propto X^{\frac{1}{2}}$
- (C) $v \propto X$
- (D) $v \propto X^{-\frac{1}{2}}$

Q.97 A capacitor of $2\text{ }\mu\text{F}$ is charged as shown in the diagram. When the switch S is turned to position 2, the percentage of its stored energy dissipated is



- (A) 80 %
- (B) 0 %
- (C) 20 %
- (D) 75 %

Q.98 A particle moves so that its position vector is given by $\vec{r} = \cos \omega t \hat{x} + \sin \omega t \hat{y}$, where ω is a constant.

Which of the following is true ?

- (A) Velocity is perpendicular to \vec{r} and acceleration is directed away from the origin
- (B) Velocity and acceleration both are perpendicular to \vec{r}
- (C) Velocity and acceleration both are parallel to \vec{r}
- (D) Velocity is perpendicular to \vec{r} and acceleration is directed towards the origin

Q.99 From a disc of radius R and mass M , a circular hole of diameter R , whose rim passes through the center is cut. What is the moment of inertia of the remaining part of the disc about a perpendicular axis, passing through the center?

- (A) $\frac{9MR^2}{32}$
- (B) $\frac{15MR^2}{32}$
- (C) $\frac{13MR^2}{32}$
- (D) $\frac{11MR^2}{32}$

Q.100 The ratio of escape velocity at earth (V_e) to the escape velocity at a planet (V_p) whose radius and mean density the twice as that of earth is

- (A) $1:\sqrt{2}$
- (B) $1:2$
- (C) $1:2\sqrt{2}$
- (D) $1:4$

Q.101 A potentiometer wire is 100 cm long and a constant potential difference is maintained across it. Two cells are connected in series first to support one another and then in opposite direction. The balance points are obtained at 50 cm and 10 cm from the positive end of the wire in the two cases. The ratio of emf's is

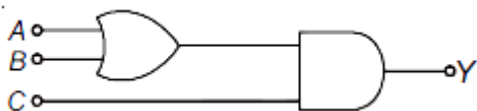
- (A) 3 : 2
- (B) 5 : 1
- (C) 5 : 4
- (D) 3 : 4

Q.102 A siren emitting a sound of frequency 800 Hz moves away from an observer towards a cliff at a speed of 15 ms^{-1} . Then, the frequency of sound that the observer hears in the echo reflected from the cliff is

(Take velocity of sound in air = 330 ms^{-1})

- (A) 885 Hz
- (B) 765 Hz
- (C) 800 Hz
- (D) 838 Hz

Q.103 To get output 1 for the following circuit, the correct choice for the input is



- (A) $A = 1, B = 0, C = 1$
- (B) $A = 0, B = 1, C = 0$
- (C) $A = 1, B = 0, C = 0$
- (D) $A = 1, B = 1, C = 0$

Q.104 In a diffraction pattern due to a single slit of width a , the first minimum is observed at an angle 30° when light of wavelength 5000 \AA is incident on the slit. The first secondary maximum is observed at an angle of

(A) $\sin^{-1}\left(\frac{3}{4}\right)$

(B) $\sin^{-1}\left(\frac{1}{4}\right)$

(C) $\sin^{-1}\left(\frac{2}{3}\right)$

(D) $\sin^{-1}\left(\frac{1}{2}\right)$

Q.105 When a metallic surface is illuminated with radiation of wavelength λ , the stopping potential is V . If the same surface is illuminated with radiation of wavelength 2λ , the stopping potential is $\frac{V}{4}$.

The threshold wavelength for the metallic surface is

(A) 3λ

(B) 4λ

(C) 5λ

(D) $\frac{5}{4}\lambda$

Q.106 When an α -particle of mass m moving with velocity v bombards on a heavy nucleus of charge Ze , its distance of closest approach from the nucleus depends on m as

(A) m

(B) $\frac{1}{m}$

(C) $\frac{1}{\sqrt{m}}$

(D) $\frac{1}{m^2}$

Q.107 Match the corresponding entries of column-1 with column-2. [Where m is the magnification produced by the mirror]

	Column 1		Column 2
(1)	$m = -2$	(i)	Convex mirror
(2)	$m = -\frac{1}{2}$	(ii)	Concave mirror
(3)	$m = +2$	(iii)	Real image
(4)	$m = +\frac{1}{2}$	(iv)	Virtual image

- (A) (1) – (iii) (iv), (2) – (ii) (iv), (3) – (ii) (iii), (4) – (i) (iv)
 (B) (1) – (i) (iii), (2) – (ii) (iii), (3) – (ii) (iv), (4) – (i) (iv)
 (C) (1) – (i) (iii), (2) – (i) (iv), (3) – (i) (ii), (4) – (iii) (iv)
 (D) (1) – (i) (iv), (2) – (ii) (iii), (3) – (ii) (iv), (4) – (ii) (iii)

Q.108 A particle of mass 10 g moves along a circle of radius 6.4 cm with a constant tangential acceleration. What is the magnitude of this acceleration if the kinetic energy of the particle becomes equal to $8 \times 10^{-4}\text{ J}$ by the end of the second revolution after the beginning of the motion?

- (A) 0.2 m/s^2
 (B) 0.1 m/s^2
 (C) 0.15 m/s^2
 (D) 0.18 m/s^2

Q.109 A small signal voltage $V(t) = V_0 \sin \omega t$ is applied across an ideal capacitor C

- (A) Current $I(t)$ leads voltage $V(t)$ by 180°
 (B) Current $I(t)$ lags voltage $V(t)$ by 90°
 (C) Over a full cycle the capacitor C does not consume any energy from the voltage source
 (D) Current $I(t)$ is in phase with voltage $V(t)$

Q.110 A disk and a sphere of same radius but different masses roll off on two inclined planes of the same altitude and length. Which one of the two objects gets to the bottom of the plane first?

- (A) Depends on their masses
- (B) Disk
- (C) Sphere
- (D) Both reach at the same time

Q.111 Coefficient of linear expansion of brass and steel rods are α_1 and α_2 . Lengths of brass and steel rods are I_1 and I_2 respectively. If $(I_2 - I_1)$ is maintained same at all temperatures, which one of the following relations holds good?

- (A) $\alpha_1 I_1 = \alpha_2 I_2$
- (B) $\alpha_1 I_2 = \alpha_2 I_1$
- (C) $\alpha_1 I_2^2 = \alpha_2 I_1^2$
- (D) $\alpha_1^2 I_2 = \alpha_2^2 I_1$

Q.112 An astronomical telescope has objective and eyepiece of focal length 40 cm and 4 cm respectively. To view an object 200 cm away from the objective, the lenses must be separated by a distance

- (A) 54.0 cm
- (B) 37.3 cm
- (C) 46.0 cm
- (D) 50.0 cm

Q.113 A uniform circular disc of radius 50 cm at rest is free to turn about an axis which is perpendicular to its plane and passes through its centre. It is subjected to a torque which produces a constant angular acceleration of 2.0 rad s^{-2} . Its net acceleration in ms^{-2} at the end of 2.0 s is approximately

- (A) 3.0
- (B) 8.0
- (C) 7.0
- (D) 6.0

Q.114 A refrigerator works between $4^{\circ} C$ and $30^{\circ} C$. It is required to remove 600 calories of heat every second in order to keep the temperature of the refrigerated space constant. The power required is [Take 1 cal = 4.2 joules]

- (A) 2365 W
- (B) 2.365 W
- (C) 23.65 W
- (D) 236.5 W

Q.115 A gas is compressed isothermally to half its initial volume. The same gas is compressed separately through an adiabatic process until its volume is again reduced to half. Then

- (A) Which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas
- (B) Compressing the gas isothermally will require more work to be done
- (C) Compressing the gas through adiabatic process will require more work to be done
- (D) Compressing the gas isothermally or adiabatically will require the same amount of work

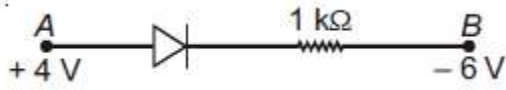
Q.116 The intensity at the maximum in a Young's double slit experiment is I_0 . Distance between two slits is $d = 5\lambda$, where λ is the wavelength of light used in the experiment. What will be the intensity is front of one of the slits on the screen placed at a distance $D = 10d$?

- (A) $\frac{I_0}{2}$
- (B) I_0
- (C) $\frac{I_0}{4}$
- (D) $\frac{3}{4}I_0$

Q.117 Two non-mixing liquids to densities ρ and $n\rho(n > 1)$ are put in a container. The height of each liquid is h . A solid cylinder of length L and density d is put in this container. The cylinder floats with its axis vertical and length $pL(p < 1)$ in the denser liquid. The density d is equal to

- (A) $\{1 + (n - 1)p\}\rho$
- (B) $\{1 + (n + 1)p\}\rho$
- (C) $\{2 + (n + 1)p\}\rho$
- (D) $\{2 + (n - 1)p\}\rho$

Q.118 Consider the junction diode as ideal. The value of current flowing through AB is



- (A) $10^{-3} A$
- (B) $0 A$
- (C) $10^{-2} A$
- (D) $10^{-1} A$

Q.119 A car is negotiating a curved road of radius R . The road is banked at an angle θ . The coefficient of friction between the tyres of the car and the road is μ_s . The maximum safe velocity on this road is

- (A) $\sqrt{\frac{g}{R^2} \frac{\mu_s + \tan \theta}{\tan \theta}}$
- (B) $\sqrt{gR^2 \frac{\mu_s + \tan \theta}{1 - \mu_s \tan \theta}}$
- (C) $\sqrt{gR \frac{\mu_s + \tan \theta}{1 - \mu_s \tan \theta}}$
- (D) $\sqrt{\frac{g}{R} \frac{\mu_s + \tan \theta}{1 - \mu_s \tan \theta}}$

Q.120 A long straight wire of radius a carries a steady current I . The current is uniformly distributed over its cross-section. The ratio of the magnetic fields B and B' at radial distances $\frac{a}{2}$ and $2a$ respectively, from the axis of the wire is

- (A) 4
- (B) $\frac{1}{4}$
- (C) $\frac{1}{2}$
- (D) 1

Q.121 Given the value of Rydberg constant is 10^7 m^{-1} , the wave number of the last line of the Balmer series in hydrogen spectrum will be

- (A) $2.5 \times 10^7 \text{ m}^{-1}$
- (B) $0.025 \times 10^4 \text{ m}^{-1}$
- (C) $0.5 \times 10^7 \text{ m}^{-1}$
- (D) $0.25 \times 10^7 \text{ m}^{-1}$

Q.122 If the velocity of a particle is $v = At + Bt^2$, where A and B are constants, then the distance travelled by it between 1 s and 2 s is

- (A) $\frac{A}{2} + \frac{B}{3}$
- (B) $\frac{3}{2}A + 4B$
- (C) $3A + 7B$
- (D) $\frac{3}{2}A + \frac{7}{3}B$

Q.123 The angle of incidence for a ray of light at a refracting surface of a prism is 45° . The angle of prism is 60° . If the ray suffers minimum deviation through the prism, the angle of minimum deviation and refractive index of the material of the prism respectively, are

- (A) 30° ; $\frac{1}{\sqrt{2}}$
- (B) 45° ; $\frac{1}{\sqrt{2}}$
- (C) 30° ; $\sqrt{2}$
- (D) 45° ; $\sqrt{2}$

Q.124 The molecules of a given mass of a gas have r.m.s velocity of 200 ms^{-1} at 27° C and $1.0 \times 10^5 \text{ Nm}^{-2}$ pressure. When the temperature and pressure of the gas are respectively, 127° C and $0.05 \times 10^5 \text{ Nm}^{-2}$, the r.m.s. velocity of its molecules in ms^{-1} is

- (A) $\frac{100}{3}$ (B) $100\sqrt{2}$
 (C) $\frac{400}{\sqrt{3}}$ (D) $\frac{100\sqrt{2}}{3}$

Q.125 An air column, closed at one end and open at the other, resonates with a tuning fork when the smallest length of the column is 50 cm . The next larger length of the column resonating with the same tuning fork is

- (A) 200 cm (B) 66.7 cm
 (C) 100 cm (D) 150 cm

Q.126 The magnetic susceptibility is negative for

- (A) Paramagnetic and ferromagnetic materials
 (B) Diamagnetic material only
 (C) Paramagnetic material only
 (D) Ferromagnetic material only

Q.127 An electron of mass m and a photon have same energy E . The ratio of de-Broglie wavelengths associated with them is

(c being velocity of light)

- (A) $\frac{1}{c} \sqrt{\left(\frac{2m}{E}\right)}$ (B) $\frac{1}{c} \sqrt{\left(\frac{E}{2m}\right)}$
 (C) $\sqrt{\left(\frac{E}{2m}\right)}$ (D) $c\sqrt{(2mE)}$

Q.128 A body of mass 1 kg begins to move under the action of a time dependent force

$F = (2t\hat{i} + 3t^2\hat{j})N$, where \hat{i} and \hat{j} are unit vectors along x and y axis. What power will be developed by the force at the time t ?

(A) $(2t^3 + 3t^5) W$

(B) $(2t^2 + 3t^2) W$

(C) $(2t^2 + 4t^4) W$

(D) $(2t^3 + 3t^4) W$

Q.129 The charge flowing through a resistance R varies with time t as $Q = at - bt^2$, where a and b are positive constants. The total heat produced in R is

(A) $\frac{a^3 R}{b}$

(B) $\frac{a^3 R}{6b}$

(C) $\frac{a^3 R}{3b}$

(D) $\frac{a^3 R}{2b}$

Q.130 A npn transistor is connected in common emitter configuration in a given amplifier. A load resistance of 800Ω is connected in the collector circuit and the voltage drop across it is $0.8 V$. If the current amplification factor is 0.96 and the input resistance of the circuit is 192Ω , the voltage gain and the power gain of the amplifier will respectively be

(A) $4, 3.69$

(B) $4, 3.84$

(C) $3.69, 3.84$

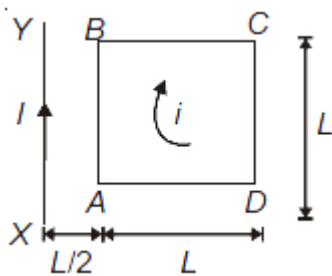
(D) $4, 4$

Q.131 A piece of ice falls from a height h so that it melts completely. Only one-quarter of the heat produced is absorbed by the ice and all energy of ice gets converted into heat during its fall. The value of h is

[Latent heat of ice is $3.4 \times 10^5 \text{ J/kg}$ and $g = 10 \text{ N/kg}$]

- (A) 68 km
- (B) 34 km
- (C) 544 km
- (D) 136 km

Q.132 A square loop ABCD carrying a current i , is placed near and coplanar with a long straight conductor XY carrying a current I , the net force on the loop will be



- (A) $\frac{\mu_0 i I L}{2\pi}$
- (B) $\frac{2\mu_0 i I}{3\pi}$
- (C) $\frac{\mu_0 i I}{2\pi}$
- (D) $\frac{2\mu_0 i I L}{3\pi}$

Q.133 A uniform rope of length L and mass m_1 hangs vertically from a rigid support. A block of mass m_2 is attached to the free end of the rope. A transverse pulse of wavelength λ_1 is produced at the lower end of the rope. The wavelength of the pulse when it reaches the top of the rope is λ_2 . The ratio λ_2 / λ_1 is

- (A) $\sqrt{\frac{m_1 + m_2}{m_1}}$
- (B) $\sqrt{\frac{m_1}{m_2}}$
- (C) $\sqrt{\frac{m_1 + m_2}{m_2}}$
- (D) $\sqrt{\frac{m_2}{m_1}}$

Q.134 A black body is at a temperature of 5760 K . The energy of radiation emitted by the body at wavelength 250 nm is U_1 , at wavelength 500 nm is U_2 and that at 1000 nm is U_3 . Wien's constant, $b = 2.88 \times 10^6\text{ nmK}$. Which of the following is correct?

(A) $U_2 > U_1$

(B) $U_1 = 0$

(C) $U_3 = 0$

(D) $U_1 > U_2$

Q.135 Out of the following options which one can be used to produce a propagating electromagnetic wave?

(A) An accelerating charge

(B) A charge moving at constant velocity

(C) A stationary charge

(D) A chargeless particle

Chemistry

Q.136. Which one of the following characteristics is associated with adsorption?

- (A) ΔG and ΔS are negative but ΔH is positive
- (B) ΔG is negative but ΔH and ΔS are positive
- (C) ΔG , ΔH and ΔS all are negative
- (D) ΔG and ΔH are negative but ΔS is positive

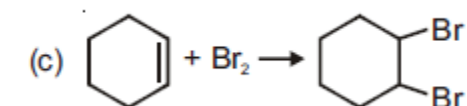
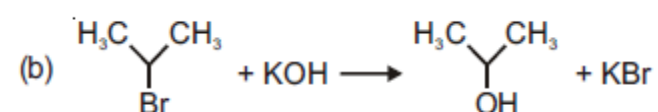
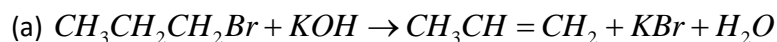
Q.137. The pressure of H_2 required to make the potential of H_2 – electrode zero in pure water at 298 K is

- (A) 10^{-4} atm
- (B) 10^{-14} atm
- (C) 10^{-12} atm
- (D) 10^{-10} atm

Q.138. The addition of a catalyst during a chemical reaction alters which of the following quantities?

- (A) Activation energy
- (B) Entropy
- (C) Internal energy
- (D) Enthalpy

Q.139. For the following reactions :



Which of the following statements is correct?

- (A) (a) is substitution, (b) and (c) are addition reactions
- (B) (a) and (b) are elimination reactions and (c) is addition reaction
- (C) (a) is elimination, (b) is substitution and (c) is addition reaction
- (D) (a) is elimination, (b) and (c) are substitution reactions

Q.140. The product formed by the reaction of an aldehyde with a primary amine is

- (A) Aromatic acid (B) Schiff base
(C) Ketone (D) Carboxylic acid

Q.141. The correct statement regarding the basicity of arylamines is

- (A) Arylamines are generally more basic than alkylamines, because the nitrogen atom in arylamines is sp^2 - hybridized
(B) Arylamines are generally less basic than alkylamines because the nitrogen lone-pair electrons are delocalized by interaction with the aromatic ring π -electron system
(C) Arylamines are generally more basic than alkylamines because the nitrogen lone-pair electrons are not delocalized by interaction with the aromatic ring π -electron system
(D) Arylamines are generally more basic than alkylamines because of aryl group

Q.142. Equal moles of hydrogen and oxygen gases are placed in a container with a pin-hole through which both can escape. What fraction of the oxygen escapes in the time required for one-half of the hydrogen to escape?

- (A) $\frac{1}{2}$ (B) $\frac{1}{8}$ (C) $\frac{1}{4}$ (D) $\frac{3}{8}$

Q.143. The correct statement regarding the comparison of staggered and eclipsed conformations of ethane is

- (A) The staggered conformation of ethane is more stable than eclipsed conformation, because staggered conformation has no torsional strain
(B) The staggered conformation of ethane is less stable than eclipsed conformation, because staggered conformation has torsional strain
(C) The eclipsed conformation of ethane is more stable than staggered conformation, because eclipsed conformation has no torsional strain
(D) The eclipsed conformation of ethane is more stable than staggered conformation even though the eclipsed conformation has torsional strain

Q.144. In which of the following options, the order of arrangement does not agree with the variation of property indicated against it?

- (A) $\text{Li} < \text{Na} < \text{K} < \text{Rb}$ (increasing metallic radius)
- (B) $\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^+ < \text{F}^-$ (increasing ionic size)
- (C) $\text{B} < \text{C} < \text{N} < \text{O}$ (increasing first ionization enthalpy)
- (D) $\text{I} < \text{Br} < \text{Cl} < \text{F}$ (increasing electron gain enthalpy)

Q.145. The rate of a first-order reaction is $0.04 \text{ mol l}^{-1} \text{ s}^{-1}$ at 10 seconds and $0.03 \text{ mol l}^{-1} \text{ s}^{-1}$ at 20 seconds after initiation of the reaction. The half-life period of the reaction is

- (A) 54.1 s
- (B) 24.1 s
- (C) 34.1 s
- (D) 44.1 s

Q.146. When copper is heated with conc. HNO_3 , it produces

- (A) $\text{Cu}(\text{NO}_3)_2$ and N_2O
- (B) $\text{Cu}(\text{NO}_3)_2$ and NO_2
- (C) $\text{Cu}(\text{NO}_3)_2$ and NO
- (D) $\text{Cu}(\text{NO}_3)_2$, NO and NO_2

Q.147. In a protein molecule, various amino acids are linked together by

- (A) Dative bond
- (B) α -glycosidic bond
- (C) β -glycosidic bond
- (D) Peptide bond

Q.148. Fog is a colloidal solution of

- (A) Gas in gas
- (B) Liquid in gas
- (C) Gas in liquid
- (D) Solid in gas

Q.149. Match items of Column I with the items of Column II and assign the correct code :

Column I		Column II	
P	Cyanide process	(i)	Ultrapure Ge
Q	Froth floatation process	(ii)	Dressing of ZnS
S	Electrolytic reduction	(ii)	Extraction of Al
T	Zone refining	(iv)	Extraction of Au
		(v)	Purification of Ni

- (A) P(iii),Q(iv) ,S(v) ,T (i)
(B) P(iv),Q(ii) ,S(iii) ,T (i)
(C) P(ii),Q(iii) ,S(i) ,T (v)
(D) P(i),Q(ii) ,S(iii) ,T (i)

Q.150. Which one given below is a non-reducing sugar?

- (A) Sucrose
(B) Maltose
(C) Lactose
(D) Glucose

Q.151. The correct statement regarding RNA and DNA, respectively is

- (A) The sugar component in RNA is 2'-deoxyribose and the sugar component in DNA is arabinose
(B) The sugar component in RNA is arabinose and the sugar component in DNA is 2'-deoxyribose
(C) The sugar component in RNA is ribose and the sugar component in DNA is 2'-deoxyribose
(D) The sugar component in RNA is arabinose and the sugar component in DNA is ribose

Q.152. The correct thermodynamic conditions for the spontaneous reaction at all temperatures is

- (A) $\Delta H < 0$ and $\Delta S < 0$
(B) $\Delta H < 0$ and $\Delta S = 0$
(C) $\Delta H > 0$ and $\Delta S < 0$
(D) $\Delta H < 0$ and $\Delta S > 0$

Q.153. Which is the correct statement for the given acids?

- (A) Phosphinic acid is a diprotic acid while phosphonic acid is a monoprotic acid
- (B) Phosphinic acid is a monoprotic acid while phosphonic acid is a diprotic acid
- (C) Both are diprotic acids
- (D) Both are triprotic acids

Q.154. MY and NY₃, two nearly insoluble salts, have the same K_{sp} values of 6.2×10^{-13} at room temperature. Which statement would be true in regard to MY and NY₃?

- (A) The addition of the salt of KY to solution of MY and NY₃ will have no effect on their solubilities
- (B) The molar solubilities of MY and NY₃ in water are identical
- (C) The molar solubility of MY in water is less than that of NY₃
- (D) The salts MY and NY₃ are more soluble in 0.5 M KY than in pure water

Q.155. Which of the following is an analgesic?

- (A) Chloromycetin
- (B) Novalgin
- (C) Penicillin
- (D) Streptomycin

Q.156. The pair of electron in the given carbanion, $CH_3C = C^-$ is present in which of the following orbitals?

- (A) sp
- (B) 2p
- (C) sp³
- (D) sp²⁺

Q.157. Among the following, the correct order of acidity is

- (A) HClO₄ < HClO₂ < HClO < HClO₃
- (B) HClO₃ < HClO₄ < HClO₂ < HClO
- (C) HClO < HClO₂ < HClO₃ < HClO₄
- (D) HClO₂ < HClO < HClO₃ < HClO₄

Q.158. Which one of the following statements is corrected when SO_2 is passed through acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution?

- (A) Green $\text{Cr}_2(\text{SO}_4)_3$ is formed
- (B) The solution turns blue
- (C) The solution is decolourized
- (D) SO_2 is reduced

Q.159. Predict the correct order among the following

- (A) lone pair - bond pair > bond pair - bond pair > lone pair - lone pair
- (B) lone pair - lone pair > lone pair - bond pair > bond pair - bond pair
- (C) lone pair - lone pair > bond pair - bond pair > lone pair - bond pair
- (D) bond pair - bond pair > lone pair - bond pair > lone pair - lone pair

Q.160. Two electrons occupying the same orbital are distinguished by

- (A) Spin quantum number
- (B) Principal quantum number
- (C) Magnetic quantum number
- (D) Azimuthal quantum number

Q.161. The product obtained as a result of a reaction of nitrogen with CaC_2 is

- (A) Ca_2CN
- (B) $\text{Ca}(\text{CN})_2$
- (C) CaCN
- (D) CaCN_3

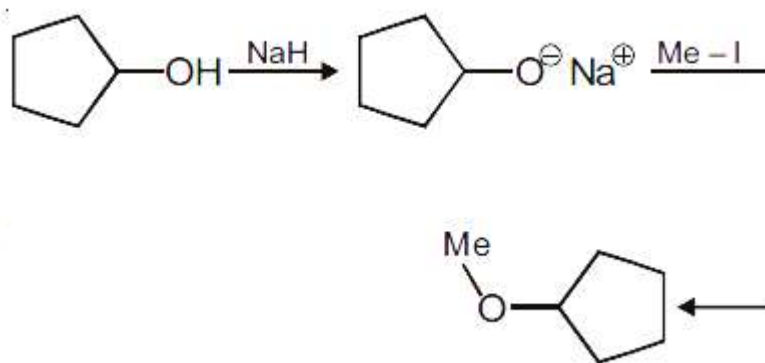
Q.162. Natural rubber has

- (A) Random cis - and trans-configuration
- (B) All cis-configuration
- (C) All trans-configuration
- (D) Alternate cis - and trans-configuration

Q.163. Which one of the following orders is correct for the bond dissociation enthalpy of halogen molecules?

- (1) $F_2 > Cl_2 > Br_2 > I_2$
- (B) $I_2 > Br_2 > Cl_2 > F_2$
- (C) $Cl_2 > Br_2 > F_2 > I_2$
- (D) $Br_2 > I_2 > F_2 > Cl_2$

Q.164. The reaction



can be classified as

- (A) Williamson alcohol synthesis reaction
- (B) Williamson ether synthesis reaction
- (C) Alcohol formation reaction
- (D) Dehydration reaction

Q.165. Lithium has a bcc structure. Its density is 530 kg m^{-3} and its atomic mass is 6.94 g mol^{-1} .

Calculate the edge length of a unit cell of Lithium metal ($N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$)

- (A) 264 pm
- (B) 154 pm
- (C) 352 pm
- (D) 527 pm

Q.166. The ionic radii of A⁺ and B⁻ ions are $0.98 \times 10^{-10} m$ and $1.81 \times 10^{-10} m$. The coordination number of each ion in AB is

- (A) 2
- (B) 6
- (C) 4
- (D) 8

Q.167. At 100° the vapour pressure of a solution of 6.5 g of a solute in 100 g water is 732 mm. If $K_b = 0.52$, the boiling point of this solution will be

- (A) 103° C
- (B) 101° C
- (C) 100° C
- (D) 102° C

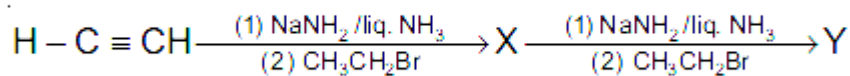
Q.168. The electronic configurations of Eu (Atomic no. 63), Gd (Atomic No. 64) and Tb (Atomic No 65) are

- (A) $[Xe]4f^7 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 6s^2$
- (B) $[Xe]4f^7 6s^2$, $[Xe]4f^8 6s^2$ and $[Xe]4f^8 5d^1 6s^2$
- (C) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5f^1$ and $[Xe]4f^9 6s^2$
- (D) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^8 5d^1 6s^2$

Q.169. Which of the following statements about hydrogen is incorrect?

- (A) Dihydrogen does not act as a reducing agent
- (B) Hydrogen has three isotopes of which tritium is the most common
- (C) Hydrogen never acts as cation in ionic salts
- (D) Hydronium ion, H₃O⁺ exists freely in solution

Q.170. In the reaction



X and Y are

- (A) X = 1-Butyne; Y = 2-Hexyne
 (B) X = 1-Butyne; Y = 3-Hexyne
 (C) X = 2-Butyne; Y = 3-Hexyne
 (D) X = 2-Butyne; Y = 2-Hexyne

Q.171. Consider the following liquid-vapour equilibrium. Consider the following liquid-vapour equilibrium.

Liquid \rightleftharpoons Vapour Which of the following relations is correct?

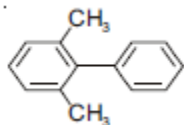
- (A) $\frac{d \ln P}{dT} = \frac{\Delta H_v}{RT^2}$
 (B) $\frac{d \ln G}{dT^2} = \frac{\Delta H_v}{RT^2}$
 (C) $\frac{d \ln P}{dT} = \frac{-\Delta H_v}{RT^2}$
 (D) $\frac{d \ln P}{dT^2} = \frac{-\Delta H_v}{T^2}$

Q.172. Which of the following statements about the composition of the vapour over an ideal 1 : 1 molar mixture of benzene and toluene is correct? Assume that the temperature is constant at 25°C . (Given, Vapour Pressure Data at 25°C , benzene = 12.8 kPa, toluene = 3.85 kPa)

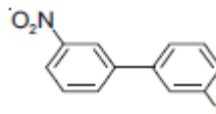
- (A) Not enough information is given to make a prediction
 (B) The vapour will contain a higher percentage of benzene
 (C) The vapour will contain a higher percentage of toluene
 (D) The vapour will contain equal amounts of benzene and toluene

Q.173. Which of the following biphenyl is optically active?

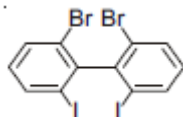
(A)



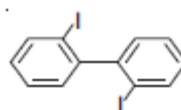
(B)



(C)



(D)



Q.174. Which of the following reagents would distinguish cis-cyclopenta-1, 2-diol from the trans-isomer?

- (A) Aluminium isopropoxide (B) Acetone
(C) Ozone (D) MnO₂

Q.175. The correct statement regarding a carbonyl compound with a hydrogen atom on its alpha-carbon, is

- (A) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism
(B) A carbonyl compound with a hydrogen atom on its alpha-carbon never equilibrates with its corresponding enol
(C) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as aldehyde-ketone equilibration
(D) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as carbonylation

Q.176. Consider the molecules CH₄, NH₃ and H₂O. Which of the given statements is false?

- (A) The H – C – H bond angle in CH₄ is larger than the H – N – H bond angle in NH₃
(B) The H – C – H bond angle in CH₄, the H – N – H bond angle in NH₃, and the H – O – H bond angle in H₂O are all greater than 90°
(C) The H – O – H bond angle in H₂O is larger than the H – C – H bond angle in CH₄
(D) The H – O – H bond angle in H₂O is smaller than the H – N – H bond angle in NH₃

Q.177. Match the compounds given in Column-I with the hybridisation and shape given in Column-II and mark the correct option.

Column-I	Column-II
(P) X ₃ F ₆	(i) Distorted octahedral
(Q) XeO ₃	(ii) Square planar
(R) XeOF ₄	(iii) Pyramidal
(S) XeF ₄	(iv) Square pyramidal

- (A) P(iv), Q(i), R(ii), S(iii) (B) P(i), Q(iii), R(iv), S(ii)
(C) P(i), Q(ii), R(iv), S(iii) (D) P(iv), Q(iii), R(i), S(ii)

Q.178. Consider the nitration of benzene using mixed conc. H_2SO_4 and HNO_3 . If a large amount of KHSO_4 is added to the mixture, the rate of nitration will be

- (1) Doubled
- (B) Faster
- (C) Slower
- (D) Unchanged

Q.179. Which of the following statements is false?

- (A) Mg^{2+} ions are important in the green parts of plants
- (B) Mg^{2+} ions form a complex with ATP
- (C) Ca^{2+} ions are important in blood clotting
- (D) Ca^{2+} ions are not important in maintaining the regular beating of the heart

Q.180. Which of the following has longest C – O bond

length? (Free C – O bond length CO is 1.128 \AA)

- (A) $[\text{Mn}(\text{CO})_6]^+$
- (B) $\text{Ni}(\text{CO})_4$
- (C) $[\text{Co}(\text{CO})_4]^\phi$
- (D) $[\text{Fe}(\text{CO})_4]^{2-}$

SOLUTIONS

Biology

1. (D)

When two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combinations are much higher than the non-parental or recombinant type.

2. (A)

Anthocyanin are water soluble vacuolar pigments that may appear red, purple or blue depending on pH.

Carotenoids, Chlorophylls and Xanthophylls are fat-soluble pigments.

3. (A)

Relaxin relaxes the pubic symphysis during parturition while inhibin decreases the secretion of FSH from anterior pituitary.

Atrial Natriuretic Factor (ANP) has exactly the opposite function of the aldosterone secreted by the zona glomerulosa in regard to its effect on sodium in the kidney – that is, aldosterone stimulates sodium retention and ANP generates sodium loss.

Glucagon works to raise the concentration of glucose in the bloodstream. Its effect is opposite that of insulin, which lowers the glucose.

Calcitonin is involved in helping to regulate levels of calcium and phosphate in the blood, opposing the action of parathyroid hormone. This means that it acts to reduce calcium levels in the blood.

relaxes the pubic symphysis during parturition while inhibin decreases the secretion of FSH from anterior pituitary.

4. (D)

Mitochondria and chloroplast are semi-autonomous organelles which contains DNA, RNA, ribosomes (70s) etc. Hence, statement 1st is true and 2nd is false.

5. (A)

Plasmid is extrachromosomal, double stranded circular DNA.

6. (C)

C₄ plants are special, they tolerate higher temperatures, they lack photorespiration and have greater productivity of biomass.

7. (C)

The **Emerson effect** is the increase in the rate of photosynthesis after chloroplasts are exposed to light of wavelength 670 nm (red light) and 700 nm (far red light). When simultaneously exposed to light of both wavelengths, the rate of photosynthesis is far higher than the sum of the red light and far red light photosynthesis rates (known as enhancement effect). This experiment led to discovery of two photosystems. - PS II and PS I.

8. (B)

Wall of Intestine consists of smooth muscles.

Columnar epithelium is present in the lining of stomach.

Tendon is dense connective tissue and connects muscle to bone.

Tip of nose consists of elastic cartilage.

9. (B)

In logistic growth model population growth equation is described as

$$dN/dt=rN(K-N/K)$$

where N = population density at time t

r = Intrinsic rate of natural increase

K = carrying capacity

when $N/K=1$ then $K-N/K=0$

therefore $dN/dt=0$

10. (B)

Tapetum provides nourishment to developing pollen grain. Rest all statements are true.

11. (D)

Eubacteria are called true bacteria. Rest all statements are true.

12. (D)

Bioassay - It is a quantitative and qualitative test used to determine the nature and function of a biochemical by using living material e.g., Avena curvature test used as bioassay for auxins.

IAA (**indole-3-acetic acid**) is an auxin used for promotion of some aspects of plant growth.

13. (A)

Wings of bird and flipper of whale are modified fore limbs but wings help in flying and flippers help in swimming.

14. (A)

Blood pressure in different blood vessels:

Artery > Arteriole > Capillary > Venule > Vein (Vena cava)

It is observed that it is More than that in the pulmonary vein.

15. (C)

Fertilization in human is practically feasible only if the sperms and ovum are transported simultaneously at ampullary-isthmic junction of the fallopian tube

16. (B)

Leptotene is Condensation of chromatin.

Zygotene is Synapsis of homologous chromosomes

Pachytene is Crossing over.

Diplotene is Dissolution of synaptonemal complex and appearance of chiasmata and Diakinesis is Terminalisation of chiasmata.

17. (C)

All single celled eukaryotes like chrysophytes [diatoms and desmids], Euglenoids [*Euglena*], Dinoflagellates and slime moulds are included in kingdom -Protista.

18. (D)

Sustained muscle contraction due to repeated stimulus is known as tetanus.

Spasm is a sudden involuntary muscular contraction or convulsive movement.

Tonus is the continuous and passive partial contraction of the muscles.

Fatigue can be described as the lack of energy and motivation.

19. (C)

Inhibin is produced by granulosa cells in ovary and has inhibits the secretion of FSH.

20. (B)

Emphysema is characterised by inflation of alveoli which is mainly due to chronic cigarette smoking.

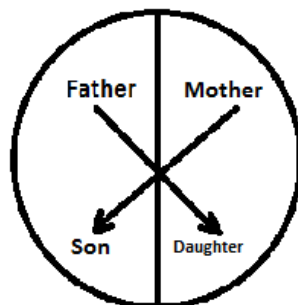
Asthma is a common long-term inflammatory disease of the airways of the lungs in which the airways narrow and swell and produce extra mucus.

Respiratory acidosis is a medical emergency in which decreased ventilation (hypoventilation) increases the concentration of carbon dioxide in the blood and decreases the blood's pH.

Respiratory alkalosis is a disturbance in acid and base balance due to alveolar hyperventilation.

21. (C)

Haemophilia is X-linked recessive gene disorder. It is a blood clotting disorder and shows criss-cross inheritance. Haemophilia is X-linked recessive gene disorder. It is a blood clotting disorder and shows criss-cross inheritance.



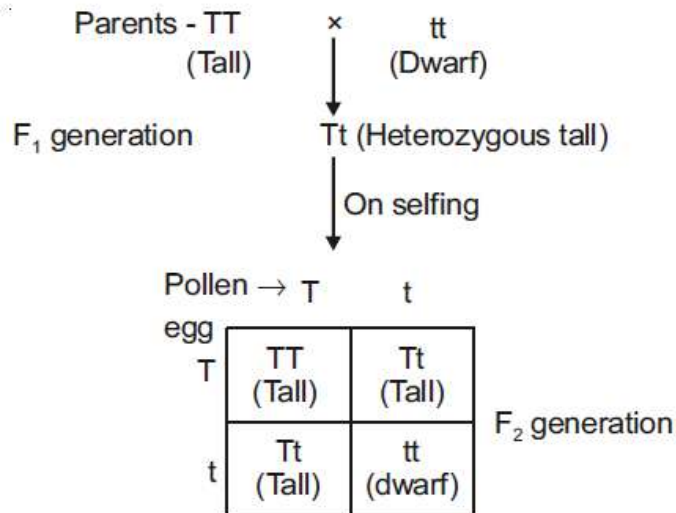
22. (D)

Sequoia is one of the tallest tree species, known as red wood tree.

23. (D)

Lac operon is an inducible operon. Lactose is the substrate for the enzyme beta-galactosidase and it also regulates switching on and off of the operon. Hence, it is termed as inducer.

24. (B)



Phenotypic ratio = 3 : 1 [Tall : Dwarf]

Genotypic ratio ⇒

1 : 2 : 1 [Homozygous tall : Heterozygous tall : Dwarf]

25. (A)

Meloidogyne incognita cause root knot disease in tobacco plant.

26. (A)

Synapsis is pairing of homologous chromosomes. It occurs during zygotene stage of meiosis. Rest all are features during mitosis in somatic cells.

27. (A)

Cancerous cells have high telomerase activity. Telomerase inhibitors are used in cancer treatment.

28. (B)

Cell wall of most fungi is made up of chitin.

Fungi possess **cell walls made** of the glucosamine polymer chitin, and algae typically possess **walls made** of glycoproteins and polysaccharides.

29. (A)

Large, shield-shaped cotyledon of grass family is called scutellum.

Coleorhiza is a sheath protecting the root of a germinating grass or cereal grain.

Coleoptile is a sheath protecting a young shoot tip in a grass or cereal.

Plumule is the rudimentary shoot or stem of an embryo plant.

30. (B)

Pioneer species are the species that invade a bare area.

In primary succession on rocks these are lichens which are able to secrete acids to dissolve rock, helping in weathering and soil formation.

31. (B)

High level of estrogen and progesterone gives negative feedback to hypothalamus for the release of GnRH.

32. (A)

An **attenuated vaccine** is a vaccine created by reducing the virulence of a pathogen, but still keeping it viable (or "live"). Attenuation takes an infectious agent and alters it so that it becomes harmless or less virulent.

Oral polio vaccine consists of attenuated pathogen.

An **inactivated vaccine** (or **killed vaccine**) consists of dead but antigenically active viruses or bacteria i.e, inactivated pathogens which evokes production of protective antibodies without causing disease.

“Salk vaccine” consists of *inactivated* (killed) *poliovirus strains*. It is given as *Injection*.

Gamma globulin injections are usually given in an attempt to temporarily boost a patient's immunity against disease.

33. (C)

Photosensitive pigment rhodopsin in human eye is made up of opsin protein and retinal [aldehyde form of vitamin A (Retinol)].

34. (C)

Few epidermal cells, in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells.

The stomatal aperture, guard cells and the surrounding subsidiary cells are together called **stomatal apparatus**.

The *complementary cells* is a mass of cells in plants, formed from the cork cambium at the position of the lenticels. *Lenticels* are portions of the periderm that have numerous pores or intercellular spaces.

Bulliform cells are large, bubble-shaped epidermal **cells** that occur in groups on the upper surface of the leaves of many grasses. Loss of turgor pressure in these **cells** causes leaves to "roll up" during water stress.

35. (D)

Metameric segmentation, Jointed appendages, Chitinous exoskeleton are features present in the Phylum-Arthropoda.

Parapodia are present in aquatic annelids like Nereis and helps in swimming.

36. (D)

Reduction in pH of blood decrease the affinity of hemoglobin with oxygen and favours the dissociation of oxyhemoglobin.

37. (B)

Cartilaginous endoskeleton - Chondrichthyes is true for the corresponding class given.

Reptiles have 3-chambered heart except crocodiles. Mammals are viviparous except prototherian mammals; chordates have jaws except protochordates and cyclostomes.

38. (C)

The correct match is as follows:

- (1) Dominance - (ii) Expression of only one allele in heterozygous organism.
- (2) Codominance - (iii) Side by side full expression of both alleles. F1 resembles both parents.
- (3) Pleiotropy - (iv) Single gene can exhibit multiple phenotypic expression e.g., Phenyl ketonuria.
- (4) Polygenic inheritance - (i) Many genes govern a single character e.g., Human skin colour.

39. (C)

The fat molecules are called triglycerides (triesters of glycerol). Three chains of fatty acid are bonded to each of the three -OH groups of the glycerol by the reaction of the carboxyl end of the fatty acid (-COOH) with the alcohol. HOH (water) is eliminated and the carbons are linked by an -O- bond through dehydration synthesis. This process is called esterification and fats are therefore esters.

thus in simple terms, A typical fat molecule is triglyceride formed by esterification of one glycerol and three fatty acid molecules.

40. (A)

A typical stamen consist of anther and filament.

The proximal end of filament is attached to thalamus or petal of the flower whereas distal end bears anther.

41. (A)

Glycine is simplest amino acid in which 'R' is replaced by H (Hydrogen), The formula is $\text{NH}_2\text{CH}_2\text{COOH}$.

Methionine, cysteine are sulphur containing amino acids.

42. (C)

Diffusion of water vapour and CO₂ are independent process. Their diffusion depends on the difference in their partial pressure. Thus, Both processes can happen together because the diffusion coefficient of water and CO₂ is different is the correct choice.

43. (B)

In prokaryotes, several ribosomes may attach to single mRNA and forming a chain called polyribosomes or polysomes.

Polypeptide is a chain of amino acids forming a part or whole of protein.

Okazaki fragments are short, newly synthesized DNA **fragments** that are formed on the lagging template strand during DNA replication.

Polymer is a macromolecule containing repeating units.

44. (C)

Cropland ecosystem is largest anthropogenic ecosystem characterised by less diversity and high productivity.

45. (D)

There most important cause driving the animals and plants to extinction is "habitat loss and fragmentation".

46. (C)

Proton concentration is higher in the lumen of thylakoid due to photolysis of water, H⁺ pumping and NADP reductase activity in stroma.

47. (C)

A zinc finger is a small protein structural motif that characterised by the co-ordination of one or more Zn ions in order to stabilise the folds.

48. (D)

Methanogens are obligate anaerobic ancient and primitive bacteria. They are involved in methanogenesis required for the production of biogas from the dung of ruminant animals.

49. (C)

Cockroach has determinate cleavage during embryonic development. Rest all features are present in cockroach.

50. (B)

The growing of grains or legumes in rotation with grain or tilled crops is a soil conservation measure.

51. (A)

Butyric acid is produced by fermentive activity of *Clostridium butylicum*. Rest all applications of the products produced by the microbes are correct.

52. (D)

Urea is synthesized in liver. So maximum amount of urea is present in hepatic vein and minimum in renal vein.

53. (A)

Sickle cell anaemia is autosomal recessive gene disorder.

Haemophilia is a sex-linked recessive disease.

54. (A)

Sphincter of Oddi guards the opening of hepatopancreatic duct into the duodenum.

The *ileocecal valve* is a sphincter muscle valve that separates the small intestine and the large intestine.

The *pyloric sphincter* is a band of smooth muscle at the junction between the *pylorus* of the stomach and the duodenum of the small intestine.

Semilunar valve is each of a pair of valves in the heart, at the bases of the aorta and the pulmonary artery, consisting of three cusps or flaps which prevent the flow of blood back into the heart.

55. (C)

Microtubules are structures present in cilia, flagella, centrioles and spindle fibres.

56. (A)

Coconut has multicellular endosperm (called coconut meal) in the outer part and free nuclear as well as vacuolated endosperm (called coconut milk) in the centre.

hus, Coconut milk represents free nuclear endosperm where the division of PEN is not followed by cytokinesis.

57. (B)

Gynoecium in Liliaceae: Carpels 3 (Tricarpellary), syncarpous, trilocular, two ovules in each locule attached on axile placentation, style simple, stigma trifid, and ovary superior.

58. (B)

Pitcher of *Nepenthes* is modified leaf.

In *Opuntia* stems are modified into fleshy, green flattened or cylindrical branches of unlimited growth.

In cucumber stem gets modified into green thread like leafless structures called tendrils which are meant for climbing.

In citrus stem are modified thorns.

59. (B)

Taq polymerase is thermostable DNA polymerase obtained from *Thermus*

aquaticus. It is frequently used in the polymerase chain reaction (PCR), a method for greatly amplifying the quantity of short segments of DNA.

60. (D)

A phylloclade is a flattened stem of several internodes functioning as a leaf. Hence, Phylloclades are modified stem, e.g., green flat structure as in *Opuntia*.

A phylloclade of one or two internode is called as a cladode.

A phyllode or cladophyll is a flattened leaf like stem arising in the axils of a minute, bract-like, true leaf. It is an aerial branch modification.

Scales are underground stem modification.

61. (D)

In autoimmune diseases, the immune cells are unable to distinguish between self cells and non-self cells and attack self cells.

62. (B)

Biological names originate from latin language and printed in italics. When written by hand, the names are to be underlined. The first word in a biological name represents the genus name and the second is a specific epithet. Hence, only one option remains contrary to the given nomenclature rules.

63. (A)

In several simple plants like algae, bryophytes and pteridophytes, water is the medium through which male gamete transfer takes place. Since the male gametes are motile they need water as medium to swim and fuse with the female gamete.

64. (A)

Amniocentesis is a foetal sex determination test and is banned in India for sex determination to legally check increasing female foeticides whereas Cleft palate is a developmental abnormality and can be detected by sonography.

65. (C)

In stomach, gastric acid (HCl) is secreted by parietal cells of gastric gland.

Peptic cell is a **cell** in the **stomach** that releases pepsinogen and chymosin.

Gastrin secreting cells is a type of *cell* in the stomach and duodenum that *secretes gastrin*.

66. (C)

Spindle fibres attach to kinetochores of chromosomes. Kinetosome of the chromosome.

67. (C)

Gangetic River Dolphin is the national aquatic animal of India.

68. (D)

Nuclei, mitochondria and chloroplasts are double membrane bound organelles. Lysosomes are single membrane bound organelle.

69. (A)

Mature insulin has two polypeptide chains (A and B) which are linked together by disulphide linkages (bridges).

70. (A)

None of the options are accurate with respect to the question statement. The option Nitrogen, nickel, phosphorus seems to be more appropriate.

71. (A)

Viroids have RNA of low molecular weight. Rest all sentences are correct

72. (C)

Analogous structures are a result of convergent evolution.

Analogous structures pertain to the various *structures* in different species having the same appearance, *structure* or function but have evolved separately, thus do not share common ancestor. Thus helping to study how species are related.

73. (D)

In follicular phase of menstrual cycle, LH and FSH increase gradually. Rest all statements are correct.

74. (D)

Mammals are viviparous while birds are oviparous.

75. (B)

Pollen grains of different species are incompatible, so they fail to germinate. Hence, the statement that Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style is incorrect.

76. (A)

Apomixis is a special mechanism to produce seeds without fertilisation. Sporulation and Budding are asexual modes of reproduction.

77. (A)

Vasectomy blocks the gamete transport and does not affect spermatogenesis.

Rest others are the approaches giving the defined action of contraceptive.

78. (B)

Melatonin and serotonin are derivatives of tryptophan amino acid while thyroxine and tri-iodothyronine are tyrosine amino acid derivatives.

79. (A)

A river with an inflow of domestic sewage rich in organic waste will reduce the dissolved oxygen (DO) and may result in death of fish due to lack of oxygen.

80. (D)

Gause's principle of competitive exclusion states that no two species can occupy the same niche indefinitely for the same limiting resources.

It is also stated shortly as "**complete competitors cannot coexist**"

81. (C)

Asthma is an allergic reaction characterised by spasm of bronchi muscles because of effect of histamine released by mast cells.

82. (D)

The standard petal of a papilionaceous corolla is also called vexillum.

83. (B)

Hind II is a restriction endonuclease that always cut DNA molecules at a particular point within a specific sequence of six base pairs.

Proteases refers to a group of enzymes whose catalytic function is to hydrolyze (breakdown) proteins. They are also called *proteolytic* enzymes or systemic enzymes.

Ribonuclease (RNase) is a type of nuclease that catalyzes the degradation of RNA into smaller components.

Deoxyribonuclease I (DNase I), is an endonuclease coded by the human gene **DNASE1**. It is a nuclease that cleaves DNA preferentially at phosphodiester linkages adjacent to a pyrimidine nucleotide.

84. (C)

Basal metabolic rate is inversely proportional to body size. So smaller animals have a higher metabolic rate and so it becomes much easier for a small animal to run uphill than for a large animal.

85. (D)

The earliest organisms that appeared on earth were anaerobic chemoheterotrophs. Chemoautotrophs were the first autotrophic organisms unable to perform photolysis of water and never released oxygen. Hence, both the given statements are correct.

86. (C)

Polyploidy cells have a chromosome number that is more than double the haploid number.

Aneuploidy is the presence of an abnormal number of chromosomes in a cell.

Somaclonal variation is the **variation** seen in plants that have been produced by plant tissue culture.

Polyteny is a special nuclear differentiation reported in larval and adult Diptera, Collembola, Protista and angiosperm ovular nuclei.

87. (C)

Ozone is found in the upper part of the atmosphere called stratosphere and it acts as a shield absorbing ultraviolet radiation from sun and so its depletion can lead to incidence of skin cancers.

88. (D)

Joint Forest Management Concept was introduced in India during 1980s by the Government of India to work closely with the local communities for protecting and managing forests.

89. (B)

AUG is the start codon. UAA, UAG and UGA are stop codons.

90. (C)

The term ecosystem was coined by A.G. Tansley.

Physics

91. (A)

$$V_{\min} = \sqrt{5gR}$$

92. (C)

$$|\bar{A} + \bar{B}| = |\bar{A} - \bar{B}|$$

$$\Rightarrow \cos \theta = 0 \Rightarrow \theta = 90^\circ$$

93. (B)

$$V = -\frac{GM}{(R+h)} \quad g' = \frac{GM}{(R+h)^2}$$

$$\Rightarrow \frac{|V|}{g'} = R+h$$

$$\Rightarrow \frac{5.4 \times 10^7}{6.0} = R+h$$

$$\Rightarrow 9 \times 10^6 = R+h$$

$$\Rightarrow h = (9 - 6.4) \times 10^6 = 2.6 \times 10^6 = 2600 \text{ km}$$

94. (A)

$$N = 1000, I = 4 \text{ A}, \phi = 4 \times 10^{-3}$$

$$L = \frac{\phi N}{I} = \frac{4 \times 10^{-3} \times 1000}{4} = 1 \text{ H}$$

95. (B)

$$L = \frac{20 \text{ mH}}{2} C = 50 \mu\text{F} R = 40 \Omega$$

$$P_{av} = I_v^2 R = \left(\frac{E_v}{Z} \right)^2 R = \left(\frac{10}{\sqrt{2}} \right)^2 R$$

$$40 \times \frac{100}{2} \times \left[\frac{1}{40^2 + \left(340 \times 20 \times 10^{-3} - \frac{1}{340 \times 50 \times 10^{-6}} \right)} \right]$$

$$= \frac{100}{2} \times 40 \times \frac{1}{1600 + [6.8 - 58.8]^2}$$

$$= \frac{2000}{1600 + 2704} \approx 0.46 W = 0.51 W$$

96. (D)

$$\frac{F}{mg} = \tan \theta$$

$$\frac{Kq^2}{x^2 mg} = \frac{\frac{x}{2}}{\sqrt{l^2 - \frac{x^2}{4}}}$$

$$\frac{Kq^2}{x^2 mg} = \frac{x}{2l}$$

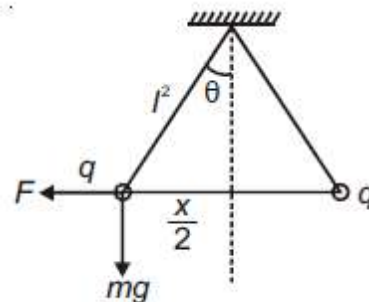
$$q^2 \propto x^3$$

$$\Rightarrow q \propto x^{3/2}$$

$$\Rightarrow \frac{dq}{dt} \propto \frac{d(x^{3/2})}{dx} \frac{dx}{dt}$$

$$\Rightarrow \frac{dq}{dt} \propto x^{1/2} v$$

$$\Rightarrow v \propto \frac{1}{\sqrt{x}}$$



97. (A)

$$\text{Initial energy stored} = \frac{1}{2}(2 \mu F) \times V^2$$

Energy dissipated on connection across $8 \mu F$

$$= \frac{1}{2} \frac{C_1 C_2}{C_1 + C_2} V^2$$

$$= \frac{1}{2} \times \frac{2 \mu F \times 8 \mu F}{10 \mu F} \times V^2$$

$$= \frac{1}{2} \times (1.6 \mu F) V^2$$

$$\% \text{ loss of energy} = \frac{1.6}{2} \times 100 = 80 \%$$

98. (D)

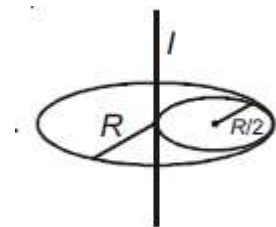
$$\vec{r} = \cos \omega t \hat{x} + \sin \omega t \hat{y}$$

$$\vec{v} = \frac{d\vec{r}}{dt} = -\omega \sin \omega t \hat{x} + \omega \cos \omega t \hat{y}$$

$$\vec{a} = -\omega^2 \cos \omega t \hat{x} - \omega^2 \sin \omega t \hat{y} = -\omega^2 \vec{r}$$

$$\Rightarrow \vec{v} \cdot \vec{r} = 0$$

99. (C)



$$I = I_{\text{remain}} + I_{(R/2)}$$

$$\Rightarrow I_{\text{remain}} = I - I_{(R/2)}$$

$$\begin{aligned}
&= \frac{MR^2}{2} - \left[\frac{\frac{M}{4}(R/2)^2}{2} + \frac{M}{4} \left(\frac{R}{2} \right)^2 \right] \\
&= \frac{MR^2}{2} - \left[\frac{MR^2}{32} + \frac{MR^2}{16} \right] \\
&= \frac{MR^2}{2} - \left[\frac{MR^2 + 2MR^2}{32} \right] \\
&= \frac{MR^2}{2} - \frac{3MR^2}{32} = \frac{16MR^2 - 3MR^2}{32} = \frac{13MR^2}{32}
\end{aligned}$$

100. (C)

$$V_e = \sqrt{2gR} = R\sqrt{\frac{8}{3}\pi G\rho}$$

$$\Rightarrow \frac{V_e}{V_p} = \frac{R\sqrt{\rho}}{R_p\sqrt{\rho}}$$

$$= \frac{1}{2\sqrt{2}}$$

101. (A)

Potentiometer $E \propto I$

$$\Rightarrow \frac{E_1 + E_2}{E_1 - E_2} = \frac{50}{10} = \frac{5}{1}$$

$$\Rightarrow \frac{E_1}{E_2} = \frac{5+1}{5-1} = \frac{6}{4} = \frac{3}{2}$$

102. (D)



$$f' = \left(\frac{V}{V - V_s} \right) f = \left(\frac{330}{330 - 15} \right) 800$$

$$= 838 \text{ Hz}$$

103. (A)



To get $Y = 1$, C should be 1 and either of A or B should be 1.

104. (A)

1st minimum

$$a \sin \theta = n\lambda$$

$$n = 1, a \sin 30^\circ = \lambda$$

$$\Rightarrow a = 2\lambda$$

1st secondary maximum

$$a \sin \theta_1 = \frac{3\lambda}{2}$$

$$\Rightarrow \theta = \sin^{-1} \frac{3\lambda}{2a} = \frac{3}{4}$$

$$\Rightarrow \theta = \sin^{-1} \frac{3}{4}$$

105. (A)

According to Einstein P.E. equation

In Case – I

$$eV = \frac{hc}{\lambda} - \frac{hc}{\lambda_0} \quad \dots(1)$$

In Case – II

$$e \frac{V}{4} = \frac{hc}{2\lambda} - \frac{hc}{\lambda_0}$$

$$\Rightarrow eV = \frac{4hc}{2\lambda} - \frac{4hc}{\lambda_0} \quad \dots(2)$$

Subtracting equation 2 from 1 we get

$$\frac{hc}{\lambda} - \frac{2hc}{\lambda} = -\frac{4hc}{\lambda_0} + \frac{hc}{\lambda_0}$$

$$-\frac{hc}{\lambda} = -\frac{3hc}{\lambda_0}$$

$$\Rightarrow \lambda_0 = 3\lambda$$

106. (B)

Initial kinetic energy = potential energy at closest approach

$$\frac{1}{2}mv^2 = \frac{2Ze^2}{4\pi\epsilon_0 r_0}$$

$$\Rightarrow r_0 \propto \frac{1}{m}$$

107. (B)

(1) – (i) (iii), (2) – (ii) (iii), (3) – (ii) (iv), (4) – (i) (iv)

108. (B)

$$m = 0.01 \text{ kg}$$

$$r = 6.4 \text{ cm}$$

$$\frac{1}{2}mv^2 = 8 \times 10^{-4} \text{ J}$$

$$v^2 = \frac{16 \times 10^{-4}}{0.01} = 16 \times 10^{-2}$$

$$\text{Speed } v^2 = 2a_t s$$

$$v^2 = 2a_t 4\pi r$$

$$\Rightarrow a_t = \frac{v^2}{8\pi r} = \frac{16 \times 10^{-2}}{8 \times 3.14 \times 6.4 \times 10^{-2}}$$

$$= 0.1 \text{ m/s}^2$$

109. (C)

Current leads voltage by phase $\frac{\pi}{2}$ (90°)

Power consumed = 0

110. (C)

$$a_{\text{sphere}} > a_{\text{disc}}$$

Acceleration (a) = $\frac{g \sin \theta}{1 + K^2 / r^2}$, independent of mass and radius.

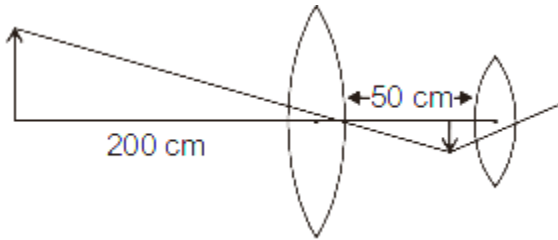
111. (A)

$$I'_2 - I'_1 = I_2 - I_1$$

$$\Rightarrow I_2(1 + \alpha_2 \Delta t) - I_1(1 + \alpha_1 \Delta t) = I_2 - I_1$$

$$I_2 \alpha_2 = I_1 \alpha_1$$

112. (A)



Objective

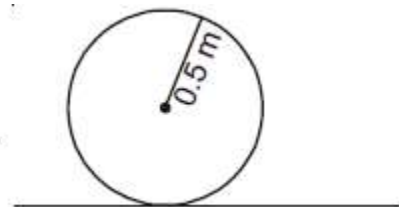
$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{v} - \frac{1}{-200} = \frac{1}{40}$$

$$\frac{1}{v} = \frac{1}{40} - \frac{1}{200} = \frac{5-1}{200} = \frac{1}{50}$$

$$v = 50$$

113. (B)



$$\text{Angular acceleration } \alpha = 2 \text{ rad } s^{-2}$$

$$\text{Angular speed } \omega = \alpha t = 4 \text{ rad } s^{-1}$$

$$a_c = r\omega^2 = 0.5 \times 16 = 8 \text{ m} / s^2$$

$$a_t = \alpha r = 1 \text{ rad} / s$$

$$a = \sqrt{a_c^2 + a_t^2} = \sqrt{8^2 + 1^2} \approx 8 \text{ m} / s^2$$

114. (D)

$$T_2 = 4^\circ \text{C} = 277 \text{ K}$$

$$T_1 = 303 \text{ K}$$

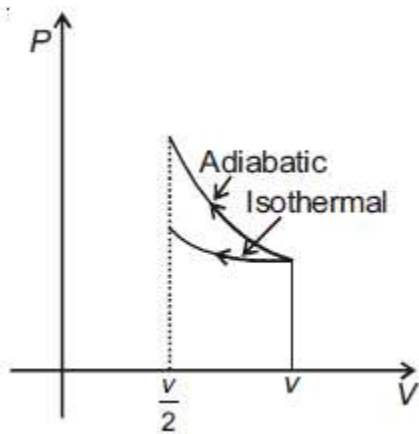
$$Q_2 = 600 \text{ cal}$$

$$\frac{Q_1}{Q_2} = \frac{T_1}{T_2}$$

$$\Rightarrow \frac{Q_2 + W}{Q_2} = \frac{T_1}{T_2}$$

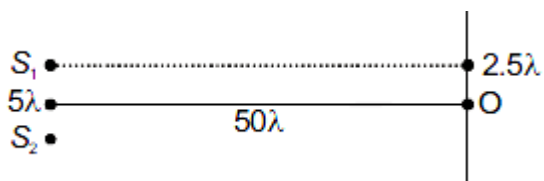
$$W = 236.5 \text{ W}$$

115. (C)



116. (A)

$$I_{\text{max}} = I_0$$

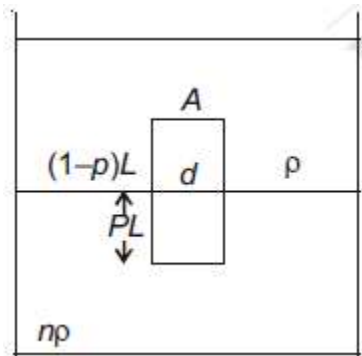


$$\text{Path diff} = \frac{dy_n}{D} = \frac{d \times \frac{d}{2}}{10d} = \frac{d}{20} = \frac{\lambda}{4}$$

$$\text{Phase diff} = 90^\circ$$

$$I = I_0 \cos^2 \frac{\phi}{2} = \frac{I_0}{2}$$

117. (A)



$$\text{Weight of cylinder} = Th_1 + Th_2$$

$$ALdg = (1-P)LA\rho g + (PLA)n\rho g$$

$$\Rightarrow d = (1-P)\rho + Pn\rho$$

$$\Rightarrow \rho - P\rho + nP\rho$$

$$= \rho + (n-1)P\rho$$

$$= \rho\{1 + (n-1)P\}$$

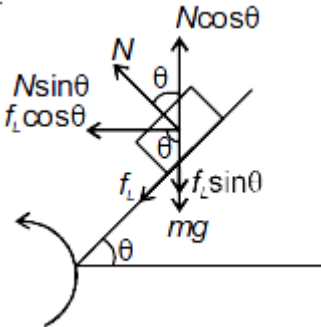
118. (C)

$$V_A - V_B = IR$$

$$\Rightarrow 4 + 6 = 10^3 I$$

$$\Rightarrow I = \frac{10}{10^3} = 10^{-2} \text{ A}$$

119. (C)



Vertical equilibrium

$$N \cos \theta = mg + f_L \sin \theta$$

$$\Rightarrow mg = N \cos \theta - f_L \sin \theta \quad \dots(1)$$

Horizontal equilibrium

$$N \sin \theta + f_L \cos \theta = \frac{mv^2}{R} \quad \dots(2)$$

Dividing the equation (2) by (1) we get

$$\frac{v^2}{Rg} = \frac{\sin \theta + \mu_s \cos \theta}{\cos \theta - \mu_s \sin \theta}$$

$$\Rightarrow v = \sqrt{Rg \frac{\sin \theta + \mu_s \cos \theta}{\cos \theta - \mu_s \sin \theta}}$$

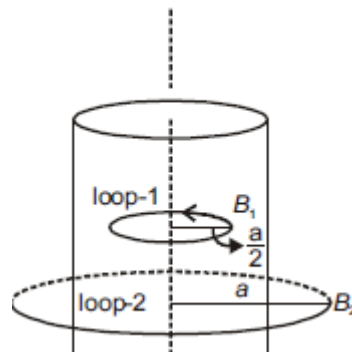
$$= \sqrt{Rg \frac{\tan \theta + \mu_s}{1 - \mu_s \tan \theta}}$$

120. (D)

Using Ampere circuital law

Loop - 1

$$B_1 2\pi \frac{a}{2} = \mu_0 \frac{1}{\pi a^2} \times \frac{\pi a^2}{4}$$



$$B_1 = \frac{\mu_0 I}{4\pi a} \quad \dots(1)$$

Loop - 2

$$B_2 \cdot 2\pi 2a = \mu_0 I$$

$$\Rightarrow B_2 = \frac{\mu_0 I}{4\pi a} \quad \dots(2)$$

$$\frac{B_1}{B_2} = 1$$

121. (D)

$$R_H = 10^7 \text{ m}^{-1}$$

Last line $n_2 = \infty, n_1 = 2$

$$\lambda = \frac{1}{R_H \left(\frac{1}{4} - 0 \right)}$$
$$= \frac{4}{10^7} \text{ m}$$

Thus wave number is $K = \frac{1}{\lambda} = 0.25 \times 10^7 \text{ m}^{-1}$

122. (D)

$$v = At + Bt^2$$

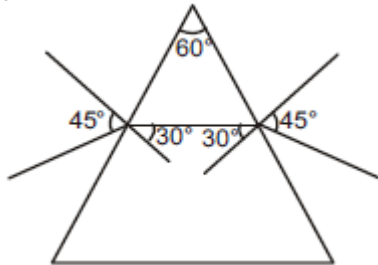
$$\Rightarrow \frac{dx}{dt} = At + Bt^2$$

$$\Rightarrow dx = (At + Bt^2) dt$$

$$\Rightarrow x = \left[\frac{At^2}{2} + \frac{Bt^3}{3} \right]_1^3$$

$$= \frac{A}{2}(4-1) + \frac{B}{3}(8-1) = \frac{3}{2}A + \frac{7}{3}B$$

123. (C)



Ray pass symmetrically through prism

$$\delta_{\min} = (I + e) - A = 30^\circ$$

$$\mu = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin\frac{A}{2}} = \sqrt{2}$$

124. (C)

$$v_{rms} = 200 \text{ ms}^{-1}, T_1 = 300 \text{ K}, P_1 = 10^5 \text{ Nm}^{-2}$$

$$v_{rms} = \sqrt{\frac{3RT}{M}} \quad T_2 = 400 \text{ K}, P_2 = 0.05 \times 10^5 \text{ N/m}^2$$

$$\Rightarrow \frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}}$$

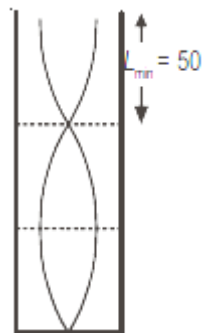
$$\Rightarrow v_2 = \sqrt{\frac{400}{300}} \times 200 \text{ ms}^{-1} = \frac{400}{\sqrt{3}} \text{ ms}^{-1}$$

125. (D)

$$L_{\min} = 50 \text{ cm}$$

So other lengths for resonance are $3L_{\min}, 5L_{\min}, 7L_{\min}, \text{ etc}$

$\Rightarrow 150 \text{ cm}, 250 \text{ cm}, 350 \text{ cm} . \text{ etc.}$



126. (B)

Susceptibility of diamagnetic substance is negative. Susceptibility of para and ferromagnetic substance is Positive

127. (B)

$$\lambda_e = \frac{h}{\sqrt{2mE}}, \lambda_p = \frac{hc}{E}, E = \frac{hc}{\lambda_p}$$

$$\frac{\lambda_e}{\lambda_p} = \frac{h}{\sqrt{2mE}} \frac{E}{hc}$$

$$= \frac{1}{c} \sqrt{\frac{E}{2m}}$$

128. (A)

$$\vec{F} = (2t\hat{i} + 3t^2\hat{j}), \vec{a} = 2t\hat{i} + 3t^2\hat{j}$$

$$v = \int_0^t a dt = t^2\hat{i} + t^3\hat{j}$$

$$P = \vec{F} \cdot \vec{v} = 2t\hat{i}^2 + 3t^2 \cdot t^3$$

$$= 2t^3 + 3t^5$$

129. (B)

$$Q = at - bt^2$$

$$I = \frac{dQ}{dt} = a - 2bt$$

Current will exist till $t = \frac{a}{2b}$

$$P = \int_0^t I^2 R dt = \int_0^{\frac{a}{2b}} (a - 2bt)^2 R dt$$

$$= \int_0^{\frac{a}{2b}} (a^2 + 4b^2 t^2 - 4abt) R dt$$

$$= \left[a^2 t + 4b^2 \frac{t^3}{3} - 4ab \frac{t^2}{2} \right]_0^{\frac{a}{2b}} R = \frac{a^3 R}{6b}$$

130. (B)

$$R_L = 800 \Omega, V_L = 0.8 V \Rightarrow I_C = \frac{V_L}{R_L} = 1 mA$$

$$R_i = 192 \Omega$$

$$\text{Current amplification} = \frac{\text{Output current}}{\text{Input current}} = \frac{I_C}{I_B} = 0.96$$

$$\Rightarrow I_B = \frac{1 mA}{0.96}$$

$$A_v = \frac{V_L}{V_{in}} = \frac{V_L}{I_B R_i} = 4$$

$$A_p = \frac{I_C^2 R_L}{I_B^2 R_i} = 3.84$$

131. (D)

$$\frac{mgh}{4} = mL_f$$

$$\Rightarrow h = \frac{4L_f}{g} = \frac{4 \times 3.4 \times 10^5}{10} = 136 \text{ km}$$

132. (B)

$$F_{\text{Loop}} = F_{BA} - F_{CD}$$

$$= \frac{\mu_0 i I L}{2\pi} \left[\frac{1}{\frac{L}{2}} - \frac{1}{\frac{3L}{2}} \right]$$

$$= \frac{2\mu_0 i I}{3\pi}$$

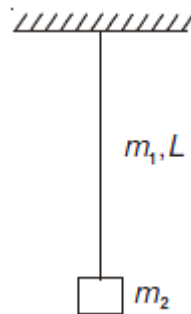
133. (C)

$$\lambda = \frac{V}{f} \left(V = \sqrt{\frac{T}{\mu}} \right)$$

$$\frac{\lambda_2}{\lambda_1} = \frac{V_2}{V_1}$$

$$= \sqrt{\frac{T_2}{T_1}}$$

$$= \sqrt{\frac{(m_1 + m_2)}{m_2}}$$



134. (A)

$$T_1 = 5760 \text{ K}, \text{ and } \lambda_m T = 2.88 \times 10^6 \text{ nmK}$$

$$\Rightarrow \lambda_m = \frac{2.88 \times 10^6 \text{ nmK}}{5760 \text{ K}} = 500 \text{ nm}$$

λ_m = Wavelength corresponding to maximum energy $U_2 > U_1$

135. (A)

Accelerating charge produce electromagnetic wave.

Chemistry

136. (C)

Adsorption is a spontaneous process with release in energy and decreases the randomness of adsorbed substance

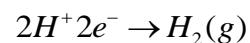
As the process releases energy it is exothermic hence, ΔH is negative.

And there is decrease in the randomness of adsorbed substance hence, ΔS is negative.

Reaction is spontaneous and ΔH and ΔS are also negative so, ΔG is negative

Therefore ΔG , ΔH and ΔS all are negative.

137. (B)



$$E = E^0 - \frac{0.0591}{2} \times \log \frac{P_{H_2}}{[H^+]^2}$$
$$= 0 - \frac{0.0591}{2} \times \log \frac{P_{H_2}}{(10^{-7})^2}$$

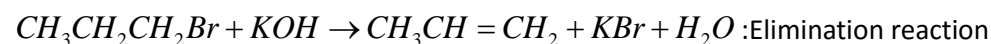
Therefore, For potential of H_2 electrode to be zero, P_{H_2}

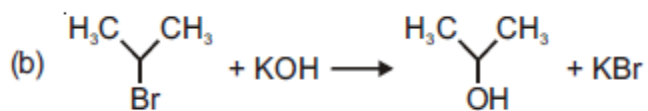
should be 10^{-14} i.e., $\log \frac{10^{-14}}{10^{-14}} = 0$

138. (A)

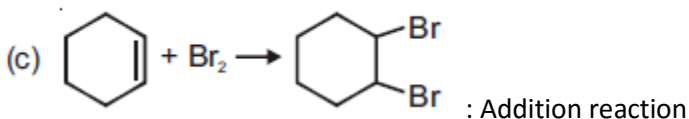
Catalyst decreases the activation energy and thus increases the rate of reaction

139. (C)

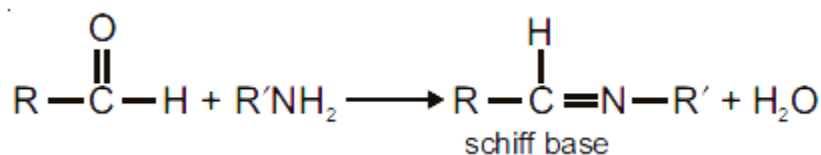




: Substitution reaction

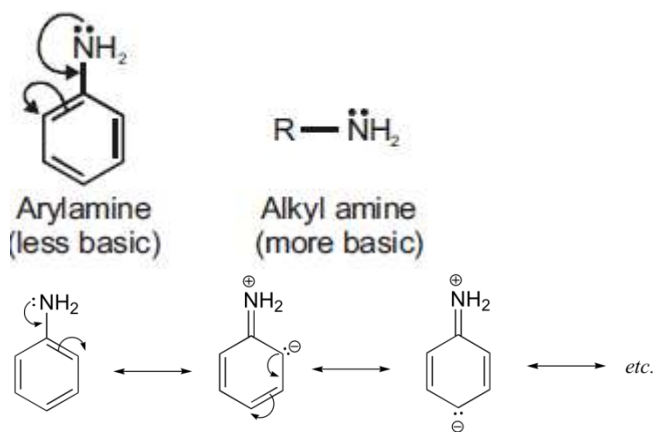


140. (B)



The electrophilic carbon atoms of aldehydes and ketones can be targets of nucleophilic attack by amines. The end result of this reaction is a compound in which the C=O double bond is replaced by a C=N double bond. This type of compound is known as an **imine**, or **Schiff base**

141. (B)



in aniline, the basic lone pair on the nitrogen is to some extent tied up in – and stabilized by – the aromatic p system.

hence the correct statement is that Arylamines are generally less basic than alkylamines because the nitrogen lone-pair electrons are delocalized by interaction with the aromatic ring

π electron system.

142. (B)

$$\frac{n_{O_2}}{n_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}}$$

$$\Rightarrow \frac{n_{O_2}}{0.5} = \sqrt{\frac{2}{32}}$$

$$\text{Therefore } n_{O_2} = \frac{1}{8}$$

143. (A)

The staggered conformation of ethane is more stable than eclipsed conformation, because staggered conformation has no torsional strain.

144. (C)

For option (C) :

The correct order for 1st ionisation energy is

B < C < N < O.

145. (B)

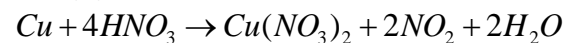
$$K = \frac{2.303}{10} \times \log \frac{0.04}{0.03}$$
$$= \frac{2.303 \times 0.124}{10}$$

$$\text{Therefore } t_{1/2} = \frac{2.303 \times 0.301 \times 10}{2.303 \times 0.124}$$

$$= 24.27 \text{ s}$$

$$\text{Therefore } t_{1/2} \approx 24.1 \text{ s}$$

146. (B)



It is observed that $Cu(NO_3)_2$ and NO_2 are formed when copper is heated with conc. HNO_3 .

147. (D)

In a protein molecule, various amino acids are linked together by Peptide bond.

148. (B)

Fog is a colloidal solution of Liquid in gas

149. (B)

The correct match is

(P) - (iv) Extraction of Au

(Q) - (ii) Dressing of ZnS

(S) - (iii) Extraction of Al

(T) - (i) Ultrapure Ge

150. (A)

In sucrose the glycosidic bond is formed between the reducing ends of both glucose and fructose, and not between the reducing end of one and the nonreducing end of the other. This linkage inhibits further bonding to other saccharide units. Since it contains no anomeric hydroxyl groups, it is classified as a non-reducing sugar.

151. (C)

The correct statement regarding RNA and DNA, is The sugar component in RNA is ribose and the

152. (D)

Because $\Delta G = \Delta H - T\Delta S$

For reaction to be spontaneous, ΔG should be

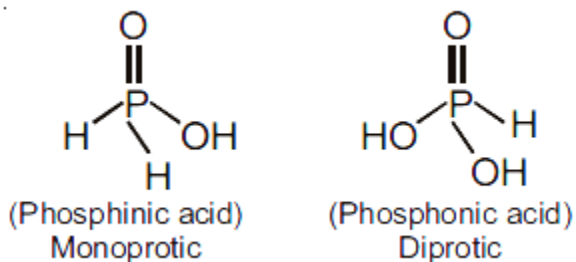
$\Delta H = -ve$ (favourable)

$\Delta S = -ve$ (favourable)

then $\Delta G = -ve$ (favourable)

hence reaction is spontaneous at all temperatures $\Delta H < 0$, $\Delta S > 0$.

153. (B)



Phosphinic acid is a monoprotic acid as it can donate only 1 proton while phosphonic acid is a diprotic acid as it can donate 2 protons.

154. (C)

For MY,

$$K_{sp} = S^2$$

$$\text{Therefore } S = (6.2 \times 10^{-13})^{1/2}$$

For NY₃,

$$K_{sp} = 27S^4$$

$$\text{Therefore } S = \left(\frac{6.2 \times 10^{-13}}{27} \right)^{1/4}$$

so it is observed that The molar solubility of MY in water is less than that of NY₃

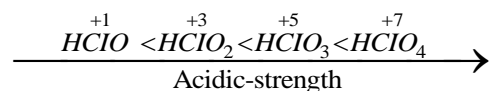
155. (B)

Novalgin is an analgesic, rest all Chloromycetin, Streptomycin, Penicillin are antibiotics.

156. (A)

The pair of electron in the given carbanion $CH_3C=C^-$ is present in which of the following orbitals?

157. (C)



acidity strength increases as the oxidation state increases

158. (A)

.When SO_2 is passed through acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution, Green $\text{Cr}_2(\text{SO}_4)$, is formed

159. (B)

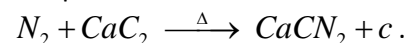
The correct order among the following is lone pair - lone pair > lone pair - bond pair > bond pair - bond pair

160. (A)

Two electrons occupying the same orbital are distinguished by Spin quantum number.

161. (B)

The product obtained as a result of a reaction of nitrogen with CaC_2 is $\text{Ca}(\text{CN})_2$

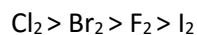


162. (B)

Natural rubber has All cis-configuration.

163. (C)

The correct order for the bond dissociation enthalpy of halogen molecules is



164. (B)

The reaction shown is Williamson ether synthesis reaction.

165. (C)

$$d \text{ (g / cm}^3\text{)} = \frac{Z \times M \text{ (g / mol)}}{a^3 \times N_A}$$

d- density

Z- No. of formula units per unit cell or No. of atoms per unit cell

M- molar mass of the substance or atomic mass of metals

N_A - Avogadro's number

a- edge length of unit cell

$$0.53 \text{ g / cm}^3 = \frac{2 \times 6.94 \text{ (g / mol)}}{a^3 \times 6.02 \times 10^{23} \text{ mol}^{-1}}$$

On solving, a = 352 pm

166. (B)

$$\frac{r_{(+)}}{r_{(-)}} = \frac{0.98 \times 10^{-10}}{1.81 \times 10^{-10}} = 0.54$$

in the table R_x/R_z is the cation to anion radius ratios

Rx/Rz	C.N.	Type
1.0	12	Hexagonal or Cubic Closest Packing
1.0-0.732	8	Cubic
0.732-0.414	6	Octahedral
0.414-0.225	4	Tetrahedral
0.225-0.155	3	Triangular
< 0.155	2	Linear

i.e., Ionic solid has octahedral geometry, thus co-ordination number of each ion in AB is 6.

167. (B)

Because $\frac{P_A^0 - P_S}{P_S} = \frac{n_B}{n_A}$

$$\Rightarrow \frac{760 - 732}{732} = \frac{W_B \times M_A}{M_B \times W_A}$$

$$\Rightarrow \frac{28}{732} = \frac{6.5 \times 18}{M_B \times 100}$$

Therefore $M_B = 30.6$

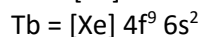
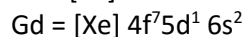
$$\text{Therefore } \Delta T_b = 0.52 \times \frac{6.5 \times 1000}{30.6 \times 100}$$

$$= 1.10$$

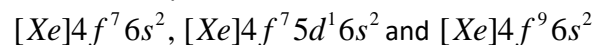
Therefore Boiling point = 100 + 1.1

$$= 101.1^\circ \text{C}$$

$$\approx 101^\circ \text{C}$$

168. (A)

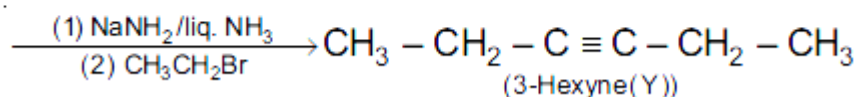
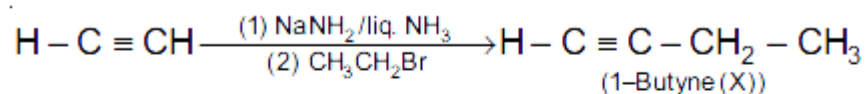
The correct option is



169. (B)

Hydrogen has three isotopes of which protium is the most common.

170. (B)



171. (A)

In liquid-vapour equilibrium $\frac{d \ln P}{dT} = \frac{\Delta H_v}{RT^2}$ In liquid-vapour equilibrium

172. (B)

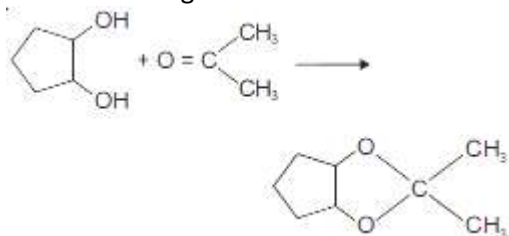
The component having higher vapour pressure will have higher percentage in vapour phase. And by given data benzene has higher vapour pressure hence, The vapour will contain a higher percentage of benzene.

173. (C)

Due to steric hindrance, arising due to presence of bulkier groups at ortho-positions of benzene rings, the biphenyl system becomes non-planar and hence optically active.

174. (B)

cis-cyclopenta-1, 2-diol can form cyclic ketal whereas trans-cyclopenta-1, 2-diol can't form cyclic ketal. Acetone gives ketal with cis isomer and not trans.



175. (A)

A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism

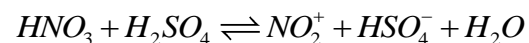
176. (C)

Molecules	Bond angle
CH_4	$\rightarrow 109.5^\circ$
NH_3	$\rightarrow 107.5^\circ$
H_2O	$\rightarrow 104.5^\circ$

Hence it is observed that the statement The H – O – H bond angle in H_2O is larger than the H – C – H bond angle in CH_4 is false.

177. (B)

P-(i), Q-(iii), R-(iv), S-(ii)

178. (C)

Increase in concentration of HSO_4^- retards the formation of the electrophile NO_2^+

Therefore Addition of $KHSO_4$ will decrease the NO_2^+ concentration.

179. (D)

Ca^{2+} ions are important in maintaining the regular beating of the heart. Because it is involved in contraction of cardiac muscles.

180. (D)

Due to increase in –ve charge on metal atom bond length of C – O bond increases.
Hence $[Fe(CO)_4]^{2-}$ has longest C – O bond.