1. oxygen is not produced during photosynthesis by
(1) Nostoc
(2) Cycas
(3) Green sulphur bacteria
(4) Chara

Sol: (3)
Green and purple sulphur bacteria do not release $\mathrm{O}_{2}$ during photosynthesis. In these organisms, $\mathrm{H}_{2} \mathrm{~S}$ is the hydrogen donor instead of water. The 'oxidation' product is sulphur or sulphate depending on the organism and not $\mathrm{O}_{2}$.
2. which one of the following plants shows a very close relationship with a species of moth, where none of the two can complete its life cycle without the other?
(1) Yucca
(2) Banana
(3) Hydrilla
(4) Viola

Sol: (1)
Association between Yucca and Pronuba moth is an example of mutualism. Both the species i.e. moth and the plant cannot complete their life cycles without each other. The moth deposits its eggs in the locule of the ovary and the flower, in turn, gets pollinated by the moth. The larvae of the moth come out of the eggs as the seeds start developing.
3. In which of the following forms is iron absorbed by plants?
(1) Ferrous
(2) Free element
(3) Ferric
(4) Both ferric and ferrous

Sol: (3)
Plants absorb iron in the form of ferric ions $\left(\mathrm{Fe}^{+3}\right)$.
4. which of the following elements is responsible for maintaining turgor in cells?
(1) Sodium
(2) Potassium
(3) Magnesium
(4) Calcium

Sol: (2)
Potassium is the commonest free ion in cell and is required in the maintenance of the turgidity of cells.
5. Pollen grains can be stored for several years in liquid nitrogen having a temperature of
(1) $-80^{\circ} \mathrm{C}$
(2) $-196^{\circ} \mathrm{C}$
(3) $-120^{\circ} \mathrm{C}$
(4) $-160^{\circ} \mathrm{C}$

Sol: (2)
In vitro conservation in liquid nitrogen at a temperature of $-196^{\circ} \mathrm{C}$ is called cryopreservation, particularly useful for storing pollen grains.
6. double fertilization is
(1) Fusion of one male gamete with two polar nuclei
(2) Fusion of two male gametes with one egg
(3) Fusion of two male gametes of a pollen tube with two different eggs
(4) Syngamy and triple fusion

Sol: (4)
Two types of fusions, syngamy and triple fusion take place in an embryo sac, the phenomenon is termed double fertilisation, an event unique to flowering plants.
7. What is the role of $\mathrm{NAD}^{+}$in cellular respiration?
(1) It functions as an electron carrier.
(2) It is a nucleotide source for ATP synthesis.
(3) It functions as an enzyme
(4) It is the final electron acceptor for anaerobic respiration
Sol: (1)
NAD+ functions as an electron carrier in cellular respiration e.g. two redox-equivalents are removed (in the form of two hydrogen atoms)

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from PGAL and transferred to a molecule of NAD+ in glycolysis.
8. Select the correct match
(1) $\mathrm{F}_{2} \times$ Recessive parent
-Dihybrid cross
(2) T.H. Morgan

- Transduction
(3) Ribozyme
-Nucleic acid
(4) G. Mendel
- Transformation

Sol: (3)
Ribozyme is an RNA (nucleic acid) having autocatalytic activity i.e. works an enzyme.
9. Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes?
(1) Ti plasmid
(2) $\lambda$ Phage
(3) Retrovirus
(4) pBR 322

Sol: (3)
Retroviruses are used as vector for introducing DNA fragment in human lymphocyte for the treating of disease like SCID
10. Use of bioresources by multinational companies and organizations without authorization from the concerned country and its people is called
(1) Biopiracy
(2) Biodegradation
(3) Bio-infringement
(4) Bioexploitation

Sol: (1)
Biopiracy deals with using a product which is patent in the name of some other organization
11. In India, the organization responsible for assessing the safety of introducing genetically modified organisms for public use is
(1) Council for Scientific and Industrial Research (CSIR)
(2) Research Committee on Genetic Manipulaiton
(RCGM)
(3) Indian Council of Medical Research (ICMR)
(4) Genetic Engineering Appraisal Committee (GEAC)
Sol: (4)
Govt of India has developed genetic engineering appraisal committee for assessing the safety of modified organisms for public use
12. The correct order of steps in Polymerase Chain Reaction (PCR) is
(1) Annealing, Extension, Denaturation
(2) Denaturation, Extension, Annealing
(3) Extension, Denaturation, Annealing
(4) Denaturation, Annealing, Extension

Sol: (4)
In denaturation both strand of DNA are separated in annealing primers are added in extension anyone polymerase in used
13. A 'new' variety of rice was patented by a foreign company, though such varieties have been present in India for a long time. This is related to
(1) Sharbati Sonora
(2) Lerma Rojo
(3) Co-667
(4) Basmati

## Sol:(4)

A us company took genes of basmati rice an got it patented in their own name
14. Natality refers to
(1) Birth rate
(2) Number of individuals leaving the habitat
(3) Death rate
(4) Number of individuals entering a habitat

Sol: (1)


Natality is the number of birth in given period in the population i.e. birth rate
15. World Ozone Day is celebrated on
(1) $21^{\text {st }}$ April
(2) $16^{\text {th }}$ September
(3) $5^{\text {th }}$ June
(4) $22^{\text {nd }}$ April

Sol: (2)
World ozone day is celebrated on 16 September.
16. Which of the following is a secondary pollutant?
(1) $\mathrm{CO}_{2}$
(2) $\mathrm{SO}_{2}$
(3) CO
(4) $\mathrm{O}_{3}$

Sol: (4)
Secondary Pollutants are formed in the air as a result of chemical reactions occurring between primary pollutants e.g. ozone which is continuously formed by the action of UV rays on molecular oxygen.
17. Niche is
(1) The physical space where an organism lives
(2) The range of temperature that the organism needs to live
(3) All the biological factors in the organism's environment
(4) The functional role played by the organism where it lives
Sol: (4)
Ecological Niche is the functional role \& position of a species in an ecosystem i.e. what resources it uses, how it interacts with other species, etc.
18. What type of ecological pyramid would be obtained with the following data?
Secondary consumer : 120 g
Primary consumer : 60 g
Primary producer : 10 g
(1) Pyramid of energy
(2) Upright pyramid of numbers
(3) Inverted pyramid of biomass
(4) Upright pyramid of biomass

Sol: (3)
As the biomass is progressively increasing from primary producer to secondary consumer, an inverted pyramid of biomass will have formed.
19. In stratosphere, which of the following elements acts as a catalyst in degradation of ozone and release of molecular oxygen?
(1) CI
(2) Fe
(3) Carbon
(4) Oxygen

Sol: (1)
In stratosphere, UV rays act on ozone depleting substances releasing Cl atoms. Cl degrades ozone releasing molecular oxygen, with these atoms acting merely as catalysts; Cl atoms are not consumed in the reaction.
20. Which of the following pairs is wrongly matched?
(1) ABO type sex : Co-dominance
(2) XO type sex : Grasshopper determination
(3) Starch synthesis in pea : Multiple alleles
(4) T.H. Morgan : Linkage

Sol: (3)
Starch synthesis in pea is an example of pleiotropic gene (not the multiple alleles). Single gene control the expression of Starch synthesis \& Starch grain size in pea seeds.
21. Select the correct statement
(1) Punnett square was developed by a British scientist
(2) Spliceosomes take part in transition.
(3) Franklin Stahl coined the term "linkage"
(4) Transduction was discovered by S. Altman.

Sol: (1)

Punnett Square / Checker Board was developed by a British geneticist, Reginald C. Punnett. Spliceosomes take part in RNA splicing. Thomas Hunt Morgan coined the term Linkage. Transduction was discovered by Zinder and Lederberg.
22. The experimental proof for semiconservative replication of DNA was first shown in a
(1) Bacterium
(2) Plant
(3) Fungus
(4) Virus

Sol: (1)
DNA replicates semi conservatively. It was shown first in Escherichia coli (bacterium) by Mathew Meselson and Franklin Stahl.
23. Select the correct match
(1) Alfred Hershey and Martha Chase - TMV
(2) Matthew Meselson - Pisum sativum and F. Stahl
(3) Alec Jeffreys - Streptococcus pneumoniae
(4) Francois Jacob - Lac operon and Jacques Monod
Sol: (4)
Lac Operon concept was given by two French scientists working at Pasteur Institute, Francois Jacob and Jacques Monod (1961) while studying lactose utilization in mutants of Escherichia coli. Alec Jeffreys (1984) invented the DNA fingerprinting technique. Mathew Meselson and Franklin Stahl proved that DNA replication is semi conservative type. Alfred Hershey and Martha Chase (1952) proved that DNA is the genetic material.
24. Offsets are produced by
(1) Mitotic divisions
(2) Parthenocarpy
(3) Meiotic divisions
(4) Parthenogenesis

Sol: (1)
Offset, an aquatic Runner is a lateral branch with short internodes and each node bearing a rosette of leaves and a tuft of roots as in aquatic plants like Pistia and Eichhornia. These are produced by mitotic divisions.
25. Which of the following flowers only once in its lifetime?
(1) Jackfruit
(2) Mango
(3) Bamboo species
(4) Papaya

Sol: (3)
Bamboo species flower only once in their life time, generally after 50-100 years, produce large number of fruits and die.
26. Which of the following has proved helpful in preserving pollen as fossils?
(1) Cellulosic intine
(2) Oil content
(3) Pollenkitt
(4) Sporopollenin

Sol: (4)
Pollen grains are well preserved as fossils because of the presence of sporopollenin. Exine of pollens exhibits a fascinating array of patterns and designs
27. The two functional groups characteristic sugars are
(1) carbonyl and methyl
(2) carbonyl and phosphate
(3) hydroxyl and methyl
(4) carbonyl and hydroxyl

Sol: (4)

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Sugar contains carbonyl group on one end and hydroxy group on other end
28. Which among the following is not a prokaryote?
(1) Mycobacterium
(2) Nostoc
(3) Saccharomyces
(4) Oscillatoria

Sol: (3)
Saccharomyces is a unicellular fungus (eukaryote) belonging to class ascomycetes.
29. Which of the following is not a product of light reaction of photosynthesis?
(1) NADH
(2) NADPH
(3) ATP
(4) Oxygen

Sol: (1)
Products of light reaction of photosynthesis are ATP, NADPH and $\mathrm{O}_{2}$.
30. Stomatal movement is not affected by
(1) Light
(2) $\mathrm{O}_{2}$ concentration
(3) Temperature
(4) $\mathrm{CO}_{2}$ concentration

Sol: (2)
Factors Affecting stomatal movement or transpiration rate are light, temperature, $\mathrm{CO}_{2}$ concentration.
31. The Golgi complex participates in
(1) Formation of secretory vesicles
(2) Respiration in bacteria
(3) Fatty acid breakdown
(4) Activation of amino acid

Sol: (1)
From the end of Golgi vesicles pinches off secretory vesicles
32. Which of the following is true for nucleolus?
(1) It is a membrane-bound structure
(2) It takes part in spindle formation
(3) Larger nucleoli are present in dividing cells.
(4) It is a site for active ribosomal RNA synthesis

## Sol: (4)

Nucleolus is called factory of ribosome synthesis
33. The stage during which separation of the paired homologous chromosomes begins is
(1) Diplotene
(2) Diakinesis
(3) Pachytene
(4) Zygotene

Sol: (1)
In diplotene stage synaphtenemal complex breaks
34. Stomata in grass leaf are
(1) Kidney shaped
(2) Rectangular
(3) Dumb-bell shaped
(4) Barrel shaped

## Sol: (3)

In grasses, the stomata (guard cells) are dumbbell shaped.
35. Casparian strips occur in
(1) Pericycle
(2) Cortex
(3) Epidermis
(4) Endodermis

Sol: (4)
In roots, endodermis is a well-defined layer with characteristic wall thickenings in the form of Casparian bands.
36. Plants having little or no secondary growth are
(1) Deciduous angiosperms
(2) Conifers
(3) Epidermis
(4) Endodermis

Sol: (3)
Secondary growth is the characteristics feature of gymnosperms and dicotyledons. In monocots (grasses), it is absent.
37. Pneumatophores occur in
(1) Free-floating hydrophytes
(2) Carnivorous plants
(4) Stems are usually unbranched in both Cycas and Cedrus.
(3) Halophytes
(4) Submerged hydrophytes

Sol: (3)
Respiratory Roots / Pneumatophores come out of the ground and grow vertically upwards. Such roots help to get oxygen for respiration e.g. in halophytes like Rhizophora.
38. Sweet potato is a modified
(1) Adventitious root
(2) Top root
(3) Stem
(4) Rhizome

Sol: (1)
In sweet potato adventitious roots get modified, become swollen and store food called Fleshy / Storage Roots.
39. Secondary xylem and phloem in dicot stem are produced by
(1) Vascular cambium
(2) Phellogen
(3) Apical meristems
(4) Axillary meristems

Sol: (1)
In dicot stem, vascular cambium divides; the cells cut off towards pith, mature into secondary xylem and the cells cut off towards periphery mature into secondary phloem.
40. Which of the following statements is correct?
(1) Selaginella is heterosporous, while Salvinia is homosporous
(2) Horsetails are gymnosperms
(3) Ovules are not enclosed by ovary wall in gymnosperms.

## Sol: (3)

In gymnosperms, ovules are naked i.e. not enclosed by ovary wall. Selaginella and Salvinia both are heterosporous. Horsetails are pteridophytes belonging to class sphenopsida. In Cycas, stem is unbranched while in Cedrus, stem is branched.
41. Select the wrong statement:
(1) Mushrooms belong to Basidiomycetes
(2) Pseudopodia are locomotory and feeding structures is Sporozoans.
(3) Cell wall is present in members of Fungi and Plantae
(4) Mitochondria are the powerhouse of the cell in all kingdoms except Monera

## Sol: (2)

Pseudopodia are locomotory and feeding structures in amoeboid protists.
42. Winged pollen grains are present in
(1) Cycas
(2) Mango
(3) Mustard
(4) Pinus

Sol: (4)
In Pinus, pollen grains are winged.
43. After karyogamy followed by meiosis, spores are produced exogenously in
(1) Alternaria
(2) Agaricus
(3) Neurospora
(4) Saccharomyces

Sol: (2)
After karyogamy followed by meiosis, spores (basidiospores) are produced exogenously in members of class basidiomycetes e.g. Agaricus.

## SPACE FOR ROUGH WORK


44. Match the items given in Column I with those in Column II and select the correct option given below:

| Column I |  | Column II |  |
| :---: | :---: | :---: | :---: |
| (A) | Herbariu m | i. | It is a place having a collection of preserved plants and animals. |
| (B) | Key | ii. | A list that enumerates methodically all the species found in an area with brief description. |
| (C) | Museum | iii | Is a place where dried and pressed plant specimens mounted on sheets are kept. |
| (D) | Catalogue | iv. | A booklet containing a list of characters and their alternates which are helpful in identification various taxa. |
| $\begin{array}{lllll} & & \\ \text { (1) } & \text { A } & \text { B } & \text { C } & \text { D } \\ \text { iii } & \text { ii } & \text { i } & \text { iv }\end{array}$ |  |  |  |
|  |  |  |  |
| (2) ii iv iii |  |  |  |
| (3) i iv iii |  |  |  |
| (4) iii iv i ii |  |  |  |
|  |  |  |  |

Sol: (4)
45. Which one is wrongly matched?
(1) Biflagellate zoospores - Brown algae
(2) Gemma cups - Marchantia
(3) Uniflagellate gametes - Polysiphonia
(4) Unicellular organism - Chlorella

Sol: (3)

In the red alga Polysiphonia, non-motile eggs are fertilized by non-motile sperm.
46. Which of these statements is incorrect?
(1) Glycolysis occurs in cytosol.
(2) Glycolysis operates as long as it is supplied with NAD that can pick up hydrogen atoms.
(3) Enzymes of TCA cycle are present in mitochondrial matrix
(4) Oxidative phosphorylation takes place in outer mitochondrial membrane.
Sol: (4)
Oxidative phosphorylation takes place in inner mitochondrial membrane.
47. Nissl bodies are mainly composed of
(1) DNA and RNA
(2) Nucleic acids and SER
(3) Proteins and lipids
(4) Free ribosomes and RER

Sol: (4)
Nissl's bodies are found in cyton of neuron and are composed of free ribosome and RER
48. Select the incorrect match:
(1) Allosomes - Sex Chromosomes
(2) Submetacentric - L-shaped chromosomes
(3) Lampbrush - Diplotene bivalents chromosomes
(4) Polytene - Oocytes of amphibians Chromosomes
Sol: (4)
Polytene chromosomes are commonly found in the salivary glands of insects like dipteran flies when the cells are not dividing.
49. Which of the following events does not occur in rough endoplasmic reticulum?
(1) Protein glycosylation

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(2) Cleavage of signal peptide
(3) Protein folding
(4) Phospholipid synthesis

Sol: (4)
Phospholipid synthesis occurs on smooth endoplasmic reticulum
50. Which of the following terms describe human dentition?
(1) Thecodont, Diphyodont, Heterodont
(2) Pleurodont, Monophyodont, Homodont
(3) Thecodont, Diphyodont, Homodont
(4) Pleurodont, Diphyodont, Heterodont

Sol: (1)
Theocodont are teeth attached in cavity of gums diphyodont teeth appears twice in life Heterodont teeth are of different types
51. Many ribosomes may associate with a single mRNA to form multiple copies of a polypeptide simultaneously. Such strings of ribosomes are termed as
(1) Polyhedral bodies
(2) Plastidome
(3) Polysome
(4) Nucleosome

Sol: (3)
Several ribosomes may attach to a single mRNA and form a chain called polyribosomes or polysomes. The ribosomes of a polysome translate the mRNA into proteins.
52. Which one of these animals is not a homeotherm?
(1) Chelone
(2) Camelus
(3) Macropus
(4) Psittacula

Sol: (1)
Chelone is a reptile and is a cold blooded animal
53. Identify the vertebrate group of animals characterized by crop and gizzard in its digestive system.
(1) Reptilia
(2) Aves
(3) Amphibia
(4) Osteichthyes

Sol: (2)
Birds contains crop and gizzard to crush food
54. Which of the following features is used to identify a male cockroach from a female cockroach?
(1) Presence of caudal styles
(2) Forewings with darker tegmina
(3) Presence of a boat shaped sternum on the $9^{\text {th }}$ abdominal segment
(4) Presence of anal cerci

Sol: (1)
Caudal styles are present on $9^{\text {th }}$ segment of male cockroach
55. Which of the following organisms are known as chief producers in the oceans?
(1) Diatoms
(2) Cyanobacteria
(3) Dinoflagellates
(4) Euglenoids

Sol: (1)
Most of the diatoms are planktonic in nature. They constitute a major part of phytoplankton of the oceans (Chief producer of oceans).
56. Ciliates differ from all other protozoans in
(1) Having a contractile vacuole for removing excess water
(2) Using pseudopodia for capturing prey
(3) Using flagella for locomotion
(4) Having two types of nuclei

Sol: (4)


Ciliates are characterized by the presence of having two types of nuclei i.e. macro and micro nuclei.
57. Which of the following animals does not undergo metamorphosis?
(1) Tunicate
(2) Moth
(3) Earthworm
(4) Starfish

Sol: (3)
Earthworm does not have any larval stale therefore it does not undergo metamorphosis
58. Which of the following options correct represents the lung conditions in asthma and emphysema, respectively?
(1) Increased number of bronchioles; Increase respiratory surface
(2) Increased respiratory surface; Inflammation of bronchioles
(3) Inflammation of bronchioles; Decrease respiratory surface
(4) Decreased respiratory surface; Inflammation of bronchioles
Sol: (3)
Asthma in an allergic condition in which inflammation of bronchi occurs emphysema is common is smokers in which decrease respiratory surface occurs
59. Match the items given in Column I with those: Column II and select the correct option give below:

| Column I |  | Column II |  |  |
| :--- | :--- | :--- | :--- | :--- |
| (A) | Tricuspid valve | i. | Between left <br> atrium and <br> ventricle |  |


| (B) | Bicuspid valve | ii. | Between right ventricle and pulmonary artery |
| :---: | :---: | :---: | :---: |
| (C) | Semilunar valve | iii. | Between right atrium and right ventricle |
| $\begin{array}{ll}\mathrm{A} & \mathrm{B} \\ \mathbf{C}\end{array}$ |  |  |  |
| (1) i iii |  |  |  |
| (2) i ii iii |  |  |  |
| (3) iii |  |  |  |
| (4) ii i iii |  |  |  |
| Sol: (4) |  |  |  |

60. Match the items given in Column I with those in Column II and select the correct option given below:

| Column I |  | Column II |  |
| :--- | :--- | :--- | :--- |
| (A) | Tidal volume | i. | $2500-3000 \mathrm{~mL}$ |
| (B) | Inspiratory <br> Reserve volume | ii. | $1100-1200 \mathrm{~mL}$ |
| (C) | Expiratory <br> Reserve volume | iii. | $500-550 \mathrm{~mL}$ |
| (D) | Residual volume | iv. | $1000-1100 \mathrm{~mL}$ |


| A | B | C |
| :--- | :--- | :--- |
| iii | i | iv |

(2)

(3) iii | ii | i | iv |
| :--- | :--- | :--- | :--- |

(4) iv iii ii i

Sol: (1)
Factual
61. Which of the following is an amino acid derived hormone?
(1) Ecdysone
(2) Estradiol
(3) Epinephrine
(4) Estriol

Sol: (2)

Sol: (3)
Epinephrine is a catch olamine
62. Which of the following structures or regions is incorrectly paired with its function?
(1) Limbic system: consist of fibre tracts that interconnect different regions of brain, controls movement.
(2) Hypothalamus: Production of releasing hormones and regulation of temperature, hunger and thirst.
(3) Medulla oblongata: Controls respiration and cardiovascular reflexes.
(4) Corpus callosum: band of fibres connecting left and right cerebral hemispheres.
Sol: (1)
Limbic system controls emotions
63. The transparent lens in the human eye is held in its place by
(1) ligaments attached to the iris
(2) smooth muscles attached to the iris
(3) ligaments attached to the ciliary body
(4) smooth muscles attached to the ciliary body

Sol: (3)
Suspensory ligaments help in movement of lens
64. Which of the following hormones can play a significant role in osteoporosis?
(1) Progesterone and Aldosterone
(2) Estrogen and Parathyroid hormone
(3) Aldosterone and Prolactin
(4) Parathyroid hormone and Prolactin

Estrogen and parathonomone helps in maintaining calcium in blood
65. Hormone secreted by the placenta to maintain pregnancy are
(1) hCG, hPL, estrogens, relaxin, oxytocin
(2) hCG, hPL, progestogens, estrogens
(3) hCG, hPL, progestogens, prolactin
(4) hCG, progestogens, estrogens, glucocorticoids

Sol: (2)
Factual
66. The contraceptive 'SAHELI'
(1) increases the concentration of estrogen and prevents ovulation in females.
(2) is an IUD.
(3) blocks estrogen receptors in the uterus, preventing eggs from getting implanted.
(4) Is a post - coital contraceptive.

Sol: (3)
Saheli is a non- steroid pill
67. The difference between spermiogenesis and spermiation is
(1) In spermiogenesis spermatozoa are formed, while in spermiation spermatids are formed.
(2) In spermiogenesis spermatozoa from Sertoli cells are released into the cavity of seminiferous tubules, while in spermiation spermatozoa are formed.
(3) In spermiogenesis spermatids are formed, while in spermiation spermatozoa are formed.
(4) In spermiogenesis spermatozoa formed, while

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in spermiation spermatozoa are released from Sertoli cells into the cavity of seminiferous tubules.
Sol: (4)
Factual
68. The amnion of mammalian embryo is derived from
(1) endoderm and mesoderm
(2) mesoderm and trophoblast
(3) ectoderm and mesoderm
(4) ectoderm and endoderm

Sol: (3)
Amnion is a complete membrane around embryo
69. Among the following sets of examples sets of examples for divergent evolution, select the incorrect option:
(1) Heart of bat, man and cheetah
(2) Brain of bat, man and cheetah
(3) Forelimbs of man, bat and cheetah
(4) Eye of octopus, bat and man

Sol: (4)
Factual
70. Which of the following is not autoimmune disease?
(1) Rheumatoid arthritis
(2) Alzheimer's disease
(3) Psoriasis
(4) Vitiligo

Sol: (2)
Alzhemiers disease occurs due to deposition of plaques containing beta amyloid
71. In which diseases does mosquito transmitted pathogen cause chronic inflammation of lymphatic vessels?
(1) Ascariasis
(2) Ringworm disease
(3) Elephantiasis
(4) Amoebiasis

## Sol: (3)

Elephantiasis is also called filariasis occurs due to a nematode
72. Conversion of milk to curd improve its nutritional value by increasing the amount of
(1) Vitamin A
(2) Vitamin $\mathrm{B}_{12}$
(3) Vitamin E
(4) Vitamin E

Sol: (2)
Curd is rich in vit $\mathrm{B}_{12}$
73. The similarity of bone structure in the forelimbs of many vertebrates is an example of
(1) Analogy
(2) Convergent evolution
(3) Homology
(4) Adaptive radiation

Sol: (3)
Factual
74. Which of the following characteristics represent Inheritance of blood groups' in humans?
(a) Dominance
(b) Co - dominance
(c) Multiple allele
(d) Incomplete dominance
(e) Polygenic inheritance
(1) a, b and c
(2) b, d and e
(3) b, c and e
(4) a, c and e

Sol: (1)
Human ABO Blood Group inheritance show dominance ( $I^{A}$ and $I^{B}$ alleles are dominant over i), codominance ( $I^{\mathrm{A}} \& \mathrm{I}^{\mathrm{B}}$ are codominant to each other) and multiple alleles (four blood group phenotypes are determined by three alleles i.e. $I^{\mathrm{A}}$, $\left.I^{B}, i\right)$.

Ex situ (off site) Conservation Strategies include Zoological Park (Zoo) \& Wildlife Safari, Botanical garden, Seed Bank, etc. In situ (on site) Conservation Strategies emphasize protection of total ecosystems e.g. hotspots, protected areas like national parks and wildlife sanctuaries, biosphere reserves and sacred grooves.
78. In a growing population of a country,
(1) reproductive individuals are less than the post - reproductive individuals
(2) reproductive and pre - reproduction individuals are equal in number.
(3) pre - reproductive individuals are more than the reproductive individuals.
(4) pre - reproductive individuals are less than the reproductive individuals.
Sol: (3)
If the number of pre-reproductive individuals are more than number of reproductive individuals, a triangular shaped age pyramid is formed that represents a growing population of a country.
79. Which part of poppy plant is used to obtain the drug "Smack"?
(1) Latex
(2) Roots
(3) Flowers
(4) Leaves

Sol: (1)
80. All of the following are part of an operon except
(1) structural genes
(2) an enhancer
(3) an operator
(4) a promoter

Sol: (2)
An operon consists of one to several structural, an operator gene, a promoter gene, a regulator gene, a repressor and an inducer or corepressor gene.

## SPACE FOR ROUGH WORK


81. A woman has an X - linked condition on one of her $X$ chromosomes. This chromosome can be inherited by:
(1) Only sons
(2) Only grandchildren
(3) Only daughters
(4) Both sons and daughters

Sol: (4)
If a woman has an X-linked condition on one of her X chromosomes i.e. it will be a carrier for an X linked disease. This chromosome can be inherited $50 \%$ by both her sons and daughters.
82. According to Hugo de Vries, the mechanism of evolutions is
(1) Saltation
(2) Phenotypic variations
(3) Multiple step mutations
(4) Minor mutations

Sol: (1)
Hugo de Vries has defined evolution as single step large mutation
83. AGGTATCGCAT is a sequence from the coding strand of a gene. What will be the corresponding sequence of the transcribed mRNA?
(1)UGGTUTCGCAT
(2) ACCUAUGCGAU
(3) AGGUAUCGCAU
(4) UCCAUAGCGUA

Sol: (3)
Transcribed mRNA has the same nucleotide sequence as that of coding strand of the DNA except Thymine (T) in coding stand which is replaced by uracil (U) in transcribed mRNA.
84. Match the items given in Column I with those in Column II and select the correct option given below:

|  | Column I |  | Column II |  |  |
| :--- | :--- | :--- | :--- | :---: | :---: |
| a. | Proliferative <br> phase | i | Breakdown of <br> endometrial lining |  |  |
| b. | Secretory <br> phase | ii | Follicular phase |  |  |
| c. | Secretory <br> phase | iii | Follicular Phase |  |  |
| d. | Menstruation | iv | Luteal Phase |  |  |
| a b |  |  |  |  | c |
| (1) i iii |  |  |  |  |  |
| (2) ii iii | i |  |  |  |  |
| (3) | iii | ii | i |  |  |
| (4) | iii | i | ii |  |  |

Sol: (2)
Factual
85. Match the items given in Column I with those in Column II and select the correct option given below:

|  | Column I |  | Column II |
| :--- | :--- | :--- | :--- |
| a. | Glycosuria | i | Accumulation <br> of uric acid in <br> joints |
| b. | Gout | ii | Mass of <br> crystallised <br> salts within the <br> kidney |
| c. | Renal calculi | iii | Inflammation <br> in glomeruli |

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| d. | Glomerular <br> nephritis | iv | Presences <br> glucose <br> urine | of <br> in |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |


| (1) | a | b | ii | iii | d |
| :--- | :--- | :--- | :--- | :--- | :--- |
| (2) | ii | iii | i | iv |  |
| (3) | iii | ii | iv | i |  |
| $(4)$ | iv | I | ii | iii |  |

Sol: (4)
Factual
86. Match the items given in Column I with those in Column II and select the correct option given below:


Sol: (1)
Factual
87. Which of the following is an occupational respiratory disorder?
(1) Silicosis
(2) Botulism
(3) Anthracis
(4) Emphysema

## Sol: (1)

Persons working in those areas where fine Particles are present in atmosphere
88. Calcium is important in skeletal muscle contraction because it
(1) activates the myosing ATP ase by binding to it.
(2) detaches the myosin head from the actin filament.
(3) binds to troponin to remove the masking of active sites on actin for myosin.
(4) prevents the formation of bonds between the myosin cross bridges and the actin filament.
Sol: (3)
Binding of troponin removes the masking of active site on actin
89. Which of the following gastric cells indirectly help in erythropiesis?
(1) Mucous cells
(2) Goblet cells
(3) Chief cells
(4) Parietal cells

## Sol: (4)

Parental cells releases intrinsic factor of castle which helps in absorption of vit $B_{12}$ which helps in development of RBC
90. Match the items given in Column I with those in Column II and select the correct option given below:

|  | Column I |  | Column II |
| :--- | :--- | :--- | :--- |



| a. | Fibrinogen | i | Osmotic balance |
| :--- | :--- | :---: | :---: |
| b. | Globulin | ii | Blood clotting |
| c. | Albumin | iii | Defence mechanism |
| a |  |  | b |
| (1) | i | ii | c |
| $(2)$ | i | iii | iii |
| $(3)$ | iii | ii | ii |

Sol: (4)
Factual
91. A battery consists of a variable number ' $n$ ' of identical cells (having internal resistance 'r' each) which are connected in series. The terminals of the battery are short-circuited and the current I is measured. Which of the graphs shows the correct relationship between I and $n$ ?
(1)

(2)

(3)
(4)


Sol: (3)
$i=\frac{n E}{n r}=\frac{E}{r}$
Current is independent of $n$.
92. a carbon resistor of $(47 \pm 4.7) \mathrm{k} \Omega$ is to be marked with rings of different colors for its identification. The color code sequence will be
(1) Yellow - Violet - Orange - Silver
(2) Yellow - Green - Violet - Gold
(3) Violet - Yellow - Orange - Silver
(4) Green - Orange - Violet - Gold

Sol: (1)
Concept based
93. A set of ' $n$ ' equal resistors, of value ' $R$ ' each, are connected in series to a battery of emf ' $E$ ' and internal resistance ' $R$ ' the current drawn is I. now, the ' $n$ ' resistors are connected in parallel to the same battery. Then the current drawn from battery becomes 10 I. the value of ' $n$ ' is
(1) 11
(2) 20
(3) 10
(4) 9

Sol: (3)
$I=\frac{E}{(n+1) R}$ and $10 I=\frac{E}{\left(R+\frac{R}{n}\right)}=\frac{n E}{(n+1) R}$
$10 I=n I$
$n=10$
94. An em wave is propagating in a medium with a velocity $\vec{V}=V \hat{\imath}$. The instantaneous oscillating electric filed of this em wave is along $+y$ axis. Then the direction of oscillating magnetic field of the em wave will be along.
(1) $+z$ direction
(2) - y direction
(3) $-z$ direction
(4) - x direction

Sol: (1)
Conceptual
95. The magnetic potential energy stored in a certain inductor is 25 mJ , when the current in the inductor is 60 mA . This inductor is of inductance

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(1) 138.88 H
(2) 1.389 H
(3) 0.138 H
(4) 13.89 H

Sol: (4)
$U=\frac{1}{2} L i^{2}$
$L=\frac{2 U}{i^{2}}=\frac{2 \times 25 \times 10^{-3}}{60 \times 60 \times 10^{-6}}$
$=\frac{50}{36} \times 10=13.89 \mathrm{H}$
96. The refractive index of the material of a prism is $\sqrt{2}$ and the angle of the prism is $30^{\circ}$. One of the two refracting surfaces of the prism is made a mirror inwards, by silver coating. A beam of monochromatic light entering the prism from the other face will retrace its path (after reflection from the silvered surface) if its angle of incidence on the prism is
(1) $45^{\circ}$
(2) $30^{\circ}$
(3) $60^{\circ}$
(4) zero

Sol: (1)

$r_{1}+r_{2}=30^{\circ}$
$r_{2}=0$ So, $r_{1}=30^{\circ}$
$\frac{\sin i}{\sin 30^{\circ}}=\sqrt{2}$
$\sin i=\sqrt{2} \times \frac{1}{2}=\frac{1}{\sqrt{2}}$
$i=45^{\circ}$
97. An object is placed at a distance of 40 cm from a concave mirror of focal length 15 cm . If the object is displaced through a distance of 20 cm towards the mirror, the displacement of the image will be
(1) 36 cm away from the mirror
(2) 30 cm towards the mirror
(3) 30 cm away from the mirror
(4) 36 cm towards the mirror.

Sol: (1)


Before displacement
$\frac{1}{v_{1}}+\frac{1}{u}=\frac{1}{f}$
$\frac{1}{v_{1}}-\frac{1}{40}=\frac{1}{-15}$
$v_{1}=-24 \mathrm{~cm}$
After displacement
$\frac{1}{v_{2}}-\frac{1}{20}=-\frac{1}{15}$
$v_{2}=-60 \mathrm{~cm}$
Displacement of in case $=(60-24)$
$=36$ away from mirror.
98. An electron of mass m with an initial velocity $\vec{V}=$ $V_{0} \hat{\imath} \quad\left(V_{0}>0\right)$ enters an electric filed $\vec{E}=$ $-E_{0} \hat{\imath}\left(E_{0}=\right.$ constant $\left.>0\right)$ at $\mathrm{t}=0$. If $\lambda_{0}$ is its deBroglie wavelength at time $t$ is
(1) $\lambda_{0}\left(1+\frac{e E_{0}}{m V_{0}} t\right)$
(2) $\lambda_{0} t$
(3) $\frac{\lambda_{0}}{\left(1+\frac{e E_{0}}{m V_{0}} t\right)}$
(4) $\lambda_{0}$


Sol: (3)
$\vec{v}=v_{0} \hat{\imath}$
Acceleration of $e^{-}$
$a=\frac{E e}{m}$
$v=u+a t$
$v^{\prime}=v_{0}+\frac{E e}{m} t$
$m v^{\prime}=m v_{0}+E e t$
Also, $\lambda=\frac{h}{m v}$
Or $m v=\frac{h}{\lambda}$
So, $\quad \frac{h}{\lambda^{\prime}}=\frac{h}{\lambda_{0}}+E e t$

$$
\begin{aligned}
& \frac{1}{\lambda^{\prime}}=\frac{1}{\lambda_{0}}+\frac{E e t}{h} \\
& \lambda^{\prime}=\frac{1}{\left(\frac{1}{\lambda_{0}}+\frac{E e t}{h}\right)}
\end{aligned}
$$

Here $h=m v_{0} \lambda_{0}$
So, $\quad \lambda^{\prime}=\frac{1}{\frac{1}{\lambda_{0}}+\frac{E e t}{m v_{0} \lambda}}$
$\lambda^{\prime}=\frac{\lambda_{0}{ }^{\lambda_{0}}}{\left(1+\frac{E e t}{m v_{0}}\right)}$
99. When the light of frequency $2 v_{0}$ (where $v_{0}$ is threshold frequency), is incident on a metal plate, the maximum velocity of electrons emitted is $v_{1}$ when the frequency of the incident radiation is increased to $5 v_{0}$, the maximum velocity of electrons emitted from the same plate is $v_{2}$. The ratio of $v_{1}$ to $v_{2}$ is
(1) $1: 4$
(2) $4: 1$
(3) $1: 2$
(4) $2: 1$

Sol: (3)
$\frac{1}{2} m v_{1}^{2}=h\left(2 v_{0}\right)-h v_{0}$
$\frac{1}{2} m v_{2}^{2}=h\left(5 v_{0}\right)-h v_{0}$
So, $\frac{v_{1}^{2}}{v_{2}^{2}}=\frac{h v_{0}}{4 h v_{0}}=\frac{1}{4}$

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

100. The ratio of kinetic energy to the total energy of an electron in a Bohr orbit of the hydrogen atom, is
(1) $1:-1$
(2) $2:-1$
(3) $1: 1$
(4) $1:-2$
Sol: (1)
$E=-K$
$\frac{K}{E}=-1$
101. for a radioactive material, half-life is 10 minutes. If initially there are 600 number of nuclei, the time taken (in minutes) for the disintegration of 450 nuclei is
(1) 10
(2) 30
(3) 20
(4) 15

Sol: (3)
$N=\frac{N_{0}}{2^{n}}$
$\frac{1}{4}=\left(\frac{1}{2^{n}}\right)$
$n=2$
$t=2 t_{1 / 2}=20 \mathrm{~min}$
102. Unpolarised light is incident from air on a plane surface of a material of refractive index ' $\mu$ '. At a particular angle of incidence ' $I$ '. it is found that the reflected and refracted rays are perpendicular to each other. Which of the

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(1) Reflected light is polarised with its electric vector perpendicular to the plane of incidence
(2) $i=\sin ^{-1}\left(\frac{1}{\mu}\right)$
(3) Reflected light is polarised with its electric vector parallel to the plane of incidence
(4) $i=\tan ^{-1}\left(\frac{1}{\mu}\right)$

Sol: (1)
Concept based from Brewester's law
103. In Young's double slit experiment the separation d between the slits is 2 mm , the wavelength $\lambda$ of the light used is $5896 \AA$ and distance $D$ between the screen and slits is 100 cm . It is found that the angular width of the fringes is $0.20^{\circ}$. To increase the fringe angular width to $0.21^{\circ}$ (with same $\lambda$ and D) the separation between the slits needs to be changed to
(1) 1.9 mm
(2) 2.1 mm
(3) 1.8 mm
(4) 1.7 mm

Sol: (1)
Angular fringe width $\beta \alpha \frac{1}{d}$
$\frac{d_{2}}{d_{1}}=\frac{\beta_{1}}{\beta_{2}}$
$d_{2}=\left(\frac{\beta_{1}}{\beta_{2}}\right) d_{1}$
$=\left(\frac{20}{21}\right) \times 2$
$=1.9 \mathrm{~mm}$
104. An astronomical refracting telescope will have large angular magnification and high angular resolution, when it has an objective lens of
(1) Large focal length and small diameter
(2) Large focal length and large diameter
(3) Small focal length and large diameter
(4) Small focal length and small diameter.

Sol: (2)
Concept based
105. An inductor 20 mH , a capacitor $100 \mu \mathrm{~F}$ and a resistor $50 \Omega$ are connected in series across a source of emf, $\mathrm{V}=10 \sin 314 \mathrm{t}$. The power loss in the circuit is
(1) 0.43 W
(2) 2.74 W
(3) 0.79 W
(4) 1.13 W

Sol: (3)
$L=20 \mathrm{mH}, C=100 \mu \mathrm{~F}$
$R=50 \Omega$
$Z=\sqrt{R^{2}+\left((\omega L)-\frac{1}{(\omega C)}\right)^{2}}$
$=\sqrt{3125}$
$p_{\text {avg. }}=\frac{v_{0} i_{0}}{2} \frac{R}{Z^{2}}=0.79$
106. A metallic rod of mass per unit length $0.5 \mathrm{~kg} \mathrm{~m}^{-1}$ is lying horizontally on a smooth inclined plane which makes an angle of $30^{\circ}$ with the horizontal. The rod is not allowed to slide down by flowing a current through it when a magnetic field of induction 0.25 T is acting on it in the vertical direction. The current flowing is the rod to keep it stationary is
(1) 5.98 A
(2) 14.76 A
(3) 7.14 A
(4) 11.32 A

Sol: (4)

## SPACE FOR ROUGH WORK



$F_{m} \cos 30^{\circ}=m g \sin 30^{\circ}$
$i B l=m g \tan 30^{\circ}$
$i=\frac{m g}{B l} \times\left(\frac{1}{\sqrt{3}}\right)$
$=\frac{0.5 \times 10 \times 100}{0.25} \times \frac{1}{\sqrt{3}}$
$=\frac{20}{1.7}=11.32 \mathrm{~A}$.
107. Current sensitivity of a moving coil galvanometer is $5 \mathrm{div} / \mathrm{mA}$ and its voltage sensitivity (angular deflection per unit voltage applied) is 20 div/V. The resistance of the galvanometer is
(1) $25 \Omega$
(2) $250 \Omega$
(3) $40 \Omega$
(4) $500 \Omega$

Sol: (2)
Let $x$ divisions are there,
So, $i$ for $x$ divisions

$$
=\frac{1}{5} \times 10^{-3} A
$$

and $V$ for $x$ divisions

$$
=\frac{1}{20} V
$$

So, $R=\frac{V}{I}$
$=250 \Omega$
108. A thin diamagnetic rod is placed vertically between the poles of an electromagnet. When the
current in the electromagnet is switched on, then the diamagnetic rod is pushed up, out of the horizontal magnetic field. Hence the rod gains gravitational potential energy. The work required to do this comes from.
(1) The magnetic field
(2) The lattice structure of the material of the rod
(3) The current source
(4) The induced electric field due to the changing magnetic field
Sol: (3)
Concept based
109. A tuning fork is used to produce resonance in a glass tube. The length of the air column in this tube can be adjusted by a variable piston. At room temperature of $27^{\circ} \mathrm{C}$ two successive resonances are produced at 20 cm and 73 cm of column length. If the frequency of the tuning fork is 320 Hz , the velocity of sound in air at $27^{\circ} \mathrm{C}$ is
(1) $339 \mathrm{~m} / \mathrm{s}$
(2) $350 \mathrm{~m} / \mathrm{s}$
(3) $330 \mathrm{~m} / \mathrm{s}$
(4) $300 \mathrm{~m} / \mathrm{s}$

Sol: (1)

$\frac{\lambda}{4}=\ell_{1}$
$\frac{3 \lambda}{4}=\ell_{2}$
$\frac{\lambda}{2}=\left(\ell_{2}-\ell_{1}\right)$
$\lambda=2\left(\ell_{2}-\ell_{1}\right)$

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$\frac{V}{f}=2\left(\ell_{2}-\ell_{1}\right)$
$V=2 f\left(\ell_{2}-\ell_{1}\right)$
$=2 \times 320(53) \times 10^{-2}$
$=339 \mathrm{~m} / \mathrm{s}$
110. An electron falls form rest through a vertical distance $h$ in a uniform and vertically upward directed electric field E. The direction of electric field is now reversed, keeping its magnitude the same. A proton is allowed to fall from rest in it through the same vertical distance h. the time of fall of the electron, in comparison to the time of fall of the proton is
(1) 5 times greater
(2) 10 times greater
(3) Smaller
(4) Equal

Sol: (3)
$a=\frac{E q}{m}$
$h=\frac{1}{2} a t^{2}$
$t=\sqrt{\frac{2 h}{a}}$
$t \propto \frac{1}{\sqrt{a}} \propto \frac{1}{\sqrt{\left(\frac{q}{m}\right)}}$
$t \propto \frac{1}{\sqrt{s}}$
$S$ for $e^{-}=\frac{e}{m_{e}}$
$S$ for proton $=\frac{e}{m_{p}}$

$$
S_{e}>s_{p}
$$

So, $t_{e}<t_{p}$
111. A pendulum is hung from the roof of a sufficiently high building and is moving freely to and fro like a simple harmonic oscillator. The acceleration of the bob of the pendulum is $20 \mathrm{~m} / \mathrm{s}^{2}$ at a distance of 5 m from the mean position. The time period of oscillation is
(1) $\pi \mathrm{s}$
(2) 2 s
(3) $2 \pi \mathrm{~s}$
(4) 1 s

Sol: (1)
$|a|=\omega^{2}|x|$
$\omega=\sqrt{\left|\frac{a}{x}\right|}=\sqrt{\frac{20}{5}}=2$
$T=\frac{2 \pi}{\omega}=\frac{2 \pi}{2}=\pi$
112. The electrostatic force between the metal plates of an isolated parallel plate capacitor C having a charge $Q$ and area $A$, is
(1) Linearly proportional to the distance between the plates
(2) Proportional to the square root of the distance between the plates.
(3) Independent of the distance between the plates
(4) Inversely proportional to the distance between the plates
Sol: (3)
$F=\frac{\sigma^{2}}{2 \varepsilon_{0}} A$
Which is independent of $d$
113.The volume ( V ) of a monatomic gas varies with its temperature (T), as shown in the graph. The ratio of work done by the gas, to the heat absorbed by

it, when it undergoes a change from state $A$ to state B, is

(1) $\frac{2}{3}$
(2) $\frac{1}{3}$
(3) $\frac{2}{5}$
(4) $\frac{2}{7}$

Sol: (3)
Process is isobaric
$\frac{w}{\mathrm{Q}}=\frac{P d V}{n C_{p} d T}=\frac{n R d T}{n C_{p} d T}$
$=\frac{R}{c_{p}}=\frac{2}{5}$
114. The efficiency of an ideal heat engine working between the freezing point and boiling point of water, is
(1) $20 \%$
(2) $6.25 \%$
(3) $26.8 \%$
(4) $12.5 \%$

Sol: (3)
$\eta=\left(1-\frac{T_{2}}{T_{1}}\right) \times 100$
$=\left(1-\frac{273}{373}\right) \times 100$
$=26.8 \%$
115. At what temperature will the rms speed of oxygen molecules become just sufficient for escaping from the Earth's atmosphere?
(Given:
Mass of oxygen molecule (m) $=2.76 \times 10^{-26} \mathrm{~kg}$
Boltzmann's constant $\mathrm{k}_{\mathrm{B}}=1.38 \times 10^{-23} \mathrm{JK}^{-1}$
(1) $8.360 \times 10^{4} \mathrm{~K}$
(2) $5.016 \times 10^{4} \mathrm{~K}$
(3) $2.508 \times 10^{4} \mathrm{~K}$
(4) $1.254 \times 10^{4} \mathrm{~K}$

Sol: (1)
$V_{r m s}=\sqrt{\frac{3 k T}{m}}$
$11 \times 10^{3} \times 11 \times 10^{3}=\frac{3 k T}{m}$
$\mathrm{T}=\frac{121 \times 10^{6} \times 2.76 \times 10^{-26}}{3 \times 1.38 \times 10^{-23}}$
$\mathrm{T}=80.67 \times 10^{3} \mathrm{~K}$
$\mathrm{T}=8.06 \times 10^{4} \mathrm{~K}$
116. The fundamental frequency in an open organ pipe is equal to the third harmonic of a closed organ pipe. If the length of the closed organ pipe is 20 cm , the length of the open organ pipe is
(1) 8 cm
(2) 12.5 cm
(3) 13.2 cm
(4) 16 cm

Sol: (3)
Open
Closed
$n=\frac{v}{2 \ell_{0}}$
$n=3 \frac{v}{4 \ell_{C}}$
$\frac{v}{2 l_{0}}=3 \frac{v}{4 \ell_{c}}$
$\ell_{0}=\frac{2 \ell_{c}}{3}=\frac{2}{5} \times 20=13.2 \mathrm{~cm}$
117. Two wires are made of the same material and have the same volume. The first wire has crosssectional area A and the second wire has crosssectional area 3A. If the length of the first wire is increased by $\Delta \mathrm{l}$ on applying a force F . how much force is needed to stretch the second wire by the same amount?
(1) 6 F
(2) 4 F
(3) 9 F
(4) F

Sol: (3)
$Y=$ constant

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A. $\mathrm{l}=\mathrm{V}=$ constant

1-wire
A. $\ell$,
$A \ell_{1}=3 A l_{2}$
$\frac{\ell_{1}}{\ell_{2}}=3$
$Y=\frac{T / A}{\Delta l / l}=\frac{T}{A} \cdot \frac{\ell}{\Delta l}$
$\mathrm{T}=\frac{Y \cdot A . \Delta l}{l}$
$\mathrm{T} \propto \frac{A}{\ell}$
For wire (1)

$$
\mathrm{F}=\frac{A}{\ell_{1}}
$$

For $2^{\text {nd }}$ wire

$$
\mathrm{F}^{\prime}=\frac{3 A}{\ell_{2}}
$$

$\therefore \quad \frac{F^{\prime}}{F}=\frac{3 A}{\ell_{2}} \times \frac{\ell_{1}}{A}=3 \times 3=9$
$\mathrm{F}^{\prime}=9 \mathrm{~F}$
118. A sample of 0.1 g of water at $100^{\circ} \mathrm{C}$ and normal pressure ( $1.013 \times 10^{5} \mathrm{Nm}^{-2}$ ) requires 54 cal of heat energy to convert to steam at $100^{\circ} \mathrm{C}$. If the volume of the steam produced is 167.1 cc , the change in internal energy of the sample, is
(1) 208.7 J
(2) 42.2 J
(3) 104.3 J
(4) 84.5 J

Sol: (1)

$$
\left[P=\frac{M}{V}\right]
$$

$V_{1}=\frac{0.1}{1}=0.1 \mathrm{cc}$

2-wire
$3 \mathrm{~A} \ell_{2}$
$=226.8 \mathrm{~J}$
$\therefore \quad \Delta \mathrm{Q}=\Delta \mathrm{U}+\Delta \mathrm{W}$
$\Delta \mathrm{U}=\Delta \mathrm{Q}-\Delta \mathrm{W}=208.7 \mathrm{~J}$
119. The power radiated by a black body is $P$ and it radiates maximum energy at wavelength, $\lambda_{0}$. If the temperature of the black body is now changed so that it radiates maximum energy at wavelength $\frac{3}{4}$ $\lambda_{0}$, the power radiated by it becomes nP . The value of $n$ is
(1) $\frac{4}{3}$
(2) $\frac{256}{81}$
(3) $\frac{3}{4}$
(4) $\frac{81}{256}$

Sol: (2)
$\lambda_{0} T=\frac{3}{4} \lambda_{0} T^{\prime}$ (from Wien's law)
$T^{\prime}=\frac{4}{3} T$
$P=\sigma T^{4}$
$n p=\sigma\left(\frac{4}{3}\right)^{4} T^{4}$
$n p=p\left(\frac{4}{3}\right)^{4}$
$n=\frac{256}{81}$
120. A small sphere of radius ' $r$ ' falls from rest in a viscous liquid. As a result, heat is produced due to viscous force. The rate of production of heat when the sphere atains its terminal velocity, is proportional to
(1) $r^{2}$
(2) $r^{5}$
(3) $r^{3}$
(4) $r^{4}$

Sol: (2)
$\mathrm{F} \propto r V_{t}$
$V_{t} \propto r^{2}$


$$
P=F V_{t} \propto r^{5}
$$

121. In the combination of the following gates the output $Y$ can be written in terms of inputs $A$ and $B$ as

(1) $A \cdot \bar{B}+\bar{A} \cdot B$
(2) $\overline{A . B}+A \cdot B$
(3) $\overline{A . B}$
(4) $\overline{A+B}$

Sol: (1)
$Y=A \bar{B}+\bar{A} B$
122. In the circuit shown in the figure, the input voltage $V_{i}$ is $20 V, V_{B E}=0$ and $V_{C E}=0$. The values of $I_{B}, I_{C}$ and $\beta$ are given by

(1) $I_{B}=25 \mu A, I_{C}=5 \mathrm{~mA}, \beta=200$
(2) $I_{B}=20 \mu A, I_{C}=5 \mathrm{~mA}, \beta=250$
(3) $I_{B}=40 \mu A, I_{C}=10 \mathrm{~mA}, \beta=250$
(4) $I_{B}=40 \mu \mathrm{~A}, I_{C}=5 \mathrm{~mA}, \beta=125$

Sol: (4)
$I_{B}=\frac{V_{i}}{R_{B}}=\frac{20}{500 \times 10^{3}}=\frac{2}{5} \times 10^{-4}$
$=0.4 \times 10^{-4}$
$=40 \mu \mathrm{~A}$
$I_{C}=\frac{V_{o}}{R_{C}}=\frac{20}{4 \times 10^{3}}=5 \mathrm{~mA}$
$\beta=\frac{I_{C}}{I_{B}}=\frac{5 \times 10^{-3}}{40 \times 10^{-6}}$
$\beta=\frac{1000}{8}=125$
123. In a p-n junction diode, change in temperature due to heating
(1) affects only forward resistance
(2) does not affect resistance of $p-n$ junction
(3) affects only reverse resistance
(4) affects the overall V-I characteristics of p-n junction
Sol: (4)
Concept based
124. The kinetic energies of a planet in an elliptical orbit about the Sun, at positions A, B and C are $K_{A}, K_{B}$ and $K_{C}$, respectively. AC is the major axis and SB is perpendicular to AC at the position of the Sun $S$ as shown in the figure Then

(1) $K_{A}>K_{B}>K_{C}$
(2) $K_{B}<K_{A}<K_{C}$
(3) $K_{A}<K_{B}<K_{C}$
(4) $K_{B}>K_{A}>K_{C}$

Sol: (1)
$K=\frac{1}{2} m v^{2}$
$K \propto v^{2}$
$v \propto \frac{1}{r}$
$K \propto \frac{1}{r^{2}}$

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$\therefore \quad K_{A}>K_{B}>K_{C}$
125. A solid sphere is in rolling motion. In rolling motion a body possess translational kinetic energy ( $K_{t}$ ) as well as rotational kinetic energy $\left(K_{r}\right)$ simultaneously. The ratio $K_{t}:\left(K_{t}+K_{r}\right)$ for the sphere is
(1) $5: 7$
(2) $10: 7$
(3) $7: 10$
(4) $2: 5$

Sol: (1)
$\frac{2}{5} M R^{2}=M K^{2}$
$\frac{K^{2}}{R^{2}}=\frac{2}{5}$
$K_{t}=\frac{1}{2} M V^{2}$
$K_{T}=\frac{1}{2} M V^{2}\left(1+\frac{K^{2}}{R^{2}}\right)$
$=\frac{1}{2} M V^{2}\left(1+\frac{2}{5}\right)$
$\begin{aligned} & =\frac{7}{5} K_{t} \\ \frac{K_{t}}{K_{T}} & =\frac{5}{7}\end{aligned}$
126. If the mass of the Sun were ten times smaller and the universal gravitational constant were ten times larger in magnitude, which of the following is not correct?
(1) Walking on the ground would become more difficult.
(2) Time period of a simple pendulum on the Earth would decreases.
(3) Raindrops will fall faster.
(4) ' $g$ ' on the Earth will not change.

Sol: (4)
$g=\frac{G M}{R^{2}}, T=2 \pi \sqrt{\frac{e}{g}}$
$g$ increase
$\Rightarrow T$ decrease
$g$ will change
127. A solid sphere is rotating freely about its symmetry axis in free space. The radius of the sphere is increased keeping its mass same. Which of the following physical quantities would remain constant for the sphere?
(1) Moment of inertia
(2) Rotational kinetic energy
(3) Angular velocity
(4) Angular momentum

Sol: (4)
Concept based
128. The moment of the force, $\vec{F}=4 \hat{\imath}+5 \hat{\jmath}-6 \hat{k}$ at $(2,0,-3)$, about the point $(2,-2,-2)$, is given by
(1) $-4 \hat{\imath}-\hat{\jmath}-8 \hat{k}$
(2) $-7 \hat{\imath}-8 \hat{\jmath}-4 \hat{k}$
(3) $-8 \hat{\imath}-4 \hat{\jmath}-7 \hat{k}$
(4) $-7 \hat{\imath}-4 \hat{\jmath}-8 \hat{k}$

Sol: (4)
$O \vec{A}=2 \hat{\imath}-3 \hat{k}, O \vec{B}=\hat{\imath}-2 \hat{\jmath}-2 \hat{k}$
$\vec{r}=\vec{A}+2 \vec{\jmath}-\vec{k}$
$\vec{\imath}=\vec{r} \times \vec{F}=\left|\begin{array}{ccc}i & \hat{\imath} & \hat{k} \\ 0 & +2 & -1 \\ u & 5 & -6\end{array}\right|$
$=\hat{\imath}(-7)-\hat{\jmath}(+4)+\hat{k}(-8)$
$=-(7 \hat{\imath}+4 \hat{\jmath}+8 \hat{k})$
$=-7 \hat{\imath}-4 \hat{\jmath}-8 \hat{k}$
129. A toy car with charge q moves on a frictionless horizontal plane surface under the influence of a uniform electric field $\vec{E}$. Due to the force q $\vec{E}$, its velocity increases from 0 to $6 \mathrm{~m} / \mathrm{s}$ in one second duration. At that instant the direction of the field is reversed. The car continues to move for two

more seconds under the influence this field. The average velocity and the average speed of the toy car between 0 to 3 seconds are respectively
(1) $1 \mathrm{~m} / \mathrm{s}, 3 \mathrm{~m} / \mathrm{s}$
(2) $1 \mathrm{~m} / \mathrm{s}, 3.5 \mathrm{~m} / \mathrm{s}$
(3) $2 \mathrm{~m} / \mathrm{s}, 4 \mathrm{~m} / \mathrm{s}$
(4) $1.5 \mathrm{~m} / \mathrm{s}, 3 \mathrm{~m} / \mathrm{s}$

Sol: (1)

130. A block of mass $m$ is placed on a smooth inclined wedge ABC of inclination $\theta$ as shown in the figure. The wedge is given an acceleration ' $a$ ' towards the right. The relation between a and $\theta$ for the block to remain stationary on the wedge is

(1) $a=\frac{g}{\sin \theta}$
(2) $a=g \cos \theta$
(3) $a=\frac{g}{\operatorname{cosec} \theta}$
(4) $a=g \tan \theta$

Sol: (4)
$m g \sin \theta=m \cos \theta$

$$
a=g \tan \theta
$$

131. A student measured the diameter of a small steel ball using a screw gauge of least count 0.001 cm . the main scale reading is 5 mm and zero of circular scale division coincides with 25 divisions above the reference level. If screw gauge has a zero error -0.004 cm , the correct diameter of the ball is
(1) 0.525 cm
(2) 0.53 cm
(3) 0.521 cm
(4) 0.529 cm

Sol: (4)
132. Three objects, A : (a solid sphere), B : (a thin circular disk) and C : (a circular ring), each have the same mass $M$ and radius. $R$. They all spin with the same angular speed $\omega$ about their own symmetry axes. The amounts of work (W) required to bring them to rest, would satisfy the relation
(1) $W_{A}>W_{B}>W_{C}$
(2) $W_{B}>W_{A}>W_{C}$
(3) $W_{C}>W_{B}>W_{A}$
(4) $W_{A}>W_{C}>W_{B}$

Sol: (3)
$\mathrm{K}=K E_{r}=\frac{1}{2} I \omega^{2}$

$$
\begin{aligned}
& \omega=\text { constant } \\
& K \propto I \\
& I_{\text {Solid }}=\frac{2}{5} M R^{2} \\
& I_{\text {disk }}=\frac{1}{2} M R^{2} \\
& I_{\text {ring }}=M R^{2}
\end{aligned}
$$

$$
\therefore \quad K_{C}>K_{B}>K_{A}
$$

133. A moving block having mass $m$, collides with another stationary block having mass 4 m . The lighter block comes to rest after collision. When

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the initial velocity of the lighter block is $v$, then the value of coefficient of restitution (e) will be
(1) 0.25
(2) 0.8
(3) 0.5
(4) 0.4

Sol: (1)

$$
\begin{aligned}
& \mathbf{m} \rightarrow \mathbf{v} \\
& v_{1}=\left(\frac{m_{1}-m_{2} e}{m_{1}+m_{2}}\right) u_{1}+\left(\frac{(1+e) m_{2}}{m_{1}+m_{2}}\right) u_{2} \\
& 0=\left[\frac{m_{1}-m_{2} e}{m_{1}+m_{2}}\right] v+0\left(u_{2}=0 \text { given }\right) \\
& m_{1}=m_{2} e \\
& m=4 m e \\
& e=\frac{1}{4}=0.25
\end{aligned}
$$

134. A body initially at rest and sliding along a frictionless track from a height $h$ (as shown in the figure) just completes a vertical circle of diameter $\mathrm{AB}=\mathrm{D}$. The height h is equal to

(1) D
(2) $\frac{7}{5} \mathrm{D}$
(3) $\frac{3}{2} \mathrm{D}$
(4) $\frac{5}{4} \mathrm{D}$

Sol: (4)
$h=\frac{5}{2} \cdot \frac{D}{2}$
$h=\frac{5}{4} D$
135. Which one of the following statements is incorrect?
(1) Limiting value of static friction is directly proportional to normal reaction.
(2) Frictional force opposes the relative motion.
(3) Rolling friction is smaller than sliding friction
(4) Coefficient of sliding fraction has dimension of length.
Sol: (4)
Concept based
136. The correct difference between first and second order reactions is that
(1) the half - life of a first - order reaction does not depend on $[A]_{0}$; the half - life of a second - order reaction does depend on $[A]_{0}$
(2) a first - order reaction can be catalyzed; a second - order reaction cannot be catalyzed
(3) the rate of a first - order reaction does not depend on reactant concentration; the rate of a second - order reaction doe depends on reactant concentrations.
(4) the rate of a first - order reaction does depend on reactant concentration; the rate of a second - order reaction does not depend on reactant concentrations
Sol : (1)
Half life of Ist order reaction $=\frac{0.693}{K}$
$t_{1 / 2}$ (second order) $\alpha \frac{1}{\left[A_{0}\right]}$
(2) Both Ist and IInd order reaction can be catalysed.
(3) (4) Rate of both Ist and IInd order reaction depend on concentration

$\because$ (1) option is right Answer
137. Among $\mathrm{CaH}_{2}, \mathrm{BeH}_{2}, \mathrm{BaH}_{2}$, the order of ionic character is
(1) $\mathrm{CaH}_{2}<\mathrm{BeH}_{2}<\mathrm{BaH}_{2}$
(2) $\mathrm{BeH}_{2}<\mathrm{BaH}_{2}<\mathrm{CaH}_{2}$
(3) $\mathrm{BeH}_{2}<\mathrm{CaH}_{2}<\mathrm{BaH}_{2}$
(4) $\mathrm{BaH}_{2}<\mathrm{BeH}_{2}<\mathrm{CaH}_{2}$

Sol: (3)
Ionic character increases downward
138. In which case is the number of molecules of water maximum?
(1) 0.18 g of water
(2) 0.00224 L of water vapours at 1 atm and 273 K
(3) 18 mL of water
(4) $10^{-3} \mathrm{~mol}$ of water

Sol: (3)
(1) No of molecules in 0.18 g water
$=\frac{6.022 \times 10^{2]}}{18} \times 0.18$
$=6.022 \times 10^{21}$
(2) No of molecules in $0.00224 L$ of water
$=\frac{1 \times 0.00224}{8.31 \times 273} \times 6.022 \times 10^{23}$
$=5.95 \times 10^{17}$
(3) No. of molecules in 18 ml of water $=$ $6.022 \times 10^{23}$
(4) No. of molecules in $10^{-]} \mathrm{mol}$ of water $=$ $6.022 \times 10^{2]} \times 10^{-3}$
$=6.022 \times 10^{20}$
139. Consider the change in oxidation state of Bromine corresponding to different emf values as shown in the diagram below:


Then the species undergoing disproportionation is:
(1) $\mathrm{BrO}_{4}^{-}$
(2) $B r_{2}$
(3) $\mathrm{BrO}_{3}^{-}$
(4) HBrO

Sol. (4)
$\mathrm{BrO}_{3}+5 \mathrm{H}^{+}+4 \mathrm{e}^{-} \rightarrow \mathrm{HBrO}+2 \mathrm{H}_{2} \mathrm{O} ; \mathrm{E}^{\circ}=1.50 \mathrm{~V}$
$\mathrm{HOBr}+\mathrm{H}^{+}+\mathrm{e}^{-} \rightarrow 1 / 2 \mathrm{Br}_{2}(l)+\mathrm{H}_{2} \mathrm{O} ; \mathrm{E}^{\circ}=1.595 \mathrm{~V}$
140. In the structure of $\mathrm{ClF}_{3}$. The number of lone pairs of electrons on central atom ' Cl ' is
(1) two
(2) four
(3) one
(4) three

Sol: (1)
Hybridization $=\frac{1}{2}[7+3]=5=s p^{3} d$ $s p^{3} d$ hybridization means $T$ shape with two lone pairs of electrons

141. The correct order of N - compound in its decreasing order of oxidation states is
(1) $\mathrm{HNO}_{3}, \mathrm{NO}, \mathrm{NH}_{4} \mathrm{Cl}, \mathrm{N}_{2}$
(2) $\mathrm{HNO}_{3}, \mathrm{NH}_{4} \mathrm{Cl}, \mathrm{NO}, \mathrm{N}_{2}$
(3) $\mathrm{HNO}_{3}, \mathrm{NO}, \mathrm{N}_{2}, \mathrm{NH}_{4} \mathrm{Cl}$
(4) $\mathrm{NH}_{4} \mathrm{Cl}, \mathrm{N}_{2}, \mathrm{NO}, \mathrm{HNO}_{3}$

Sol : (3)
Oxidation state of N in $\mathrm{HNO}_{3}, \mathrm{NO}, \mathrm{NH}_{4} \mathrm{Cl}$ and $\mathrm{N}_{2}$ is $+5,+2,-3$ and zero respectively.

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142. Which one of the following elements is unable to form $M F_{6}^{3-}$ ion?
(1) Al
(2) B
(3) Ga
(4) In

Sol : (2)
Due to small size and absence of d-orbital boron shows in moles behavior.
143. The correct order of atomic radii in group 13 elements is
(1) $\mathrm{B}<\mathrm{Al}<\mathrm{Ga}<\mathrm{In}<\mathrm{Tl}$
(2) $\mathrm{B}<\mathrm{Ga}<\mathrm{Al}<\mathrm{Tl}<\mathrm{ln}$
(3) $\mathrm{B}<\mathrm{Al}<\mathrm{In}<\mathrm{Ga}<\mathrm{Tl}$
(4) $\mathrm{B}<\mathrm{Ga}<\mathrm{Al}<\ln <\mathrm{Tl}$

Sol: (4)
$\mathrm{B}<\mathrm{Ga}<\mathrm{Al}<\mathrm{In}<\mathrm{Ti}$
The screening effect of these intervening elements being poor \& has less influence to decrease the effective nuclear charge, therefore the electron in Ga experience of more forces of attraction towards nucleus to result in lower size of Ga than Al.
144. Considering Ellingham diagram, which of the following metals can be used to reduce alumina?
(1) Zn
(2) Mg
(3) Fe
(4) Cu

Sol: (2)
Ellingham diagram of varous metal oxides

145. Which of the following statements is not true for halogens?
(1) All are oxidizing agents
(2) All but fluorine show positive oxidation states
(3) All form monobasic oxyacids.
(4) Chlorine has the highest electron - gain Enthalpy.
Sol: (4)
Electron gain enthalpy of the element of the group becomes less negative down the group.
146. Regarding cross - linked or network polymers, which of the following statements is incorrect?
(1) They are formed from bi - and tri - funtctional monomers.
(2) Examples are bakelite and melamine.

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(3) They contain covalent bonds between various linear polymer chains.
(4) They contain strong covalent bonds in them polymer chains.
Sol: (4)
Cross linked or network polymers
These are usually formed from bi-functional and tri-functional monomers and contain strong covalent bonds between various linear polymer chains, eg. Bakelite, melamine, etc. these polymers are depicted as follows:

147. The difference between amylose and amylopectin is:
(1) Amylose have $1 \rightarrow 4 \alpha$ - linkage and $1 \rightarrow 6 \beta$ linkage
(2) Amylopectin have $1 \rightarrow 4 \alpha$ - linkage and $1 \rightarrow 6$ $\beta$ - linkage
(3) Amylopectin have $1 \rightarrow 4 \alpha$ - linkage and $1 \rightarrow 6$ $\alpha$-linkage
(4) Amylose is made up of glucose and galactose

Sol: (3)

148. Nitration of aniline in strong aciding medium also give $m$ - nitroaniline because
(1) In electrophilic substitution reaction amino group is meta directive.
(2) In absence of substitutents nitro group always goes to $m$ - position.
(3) Inspite of substituents nitro group always goes to only m - position.
(4) In acidic (strong) medium aniline is present as anilinium ion.
Sol. (4)


Since nitration involves in strongly acidic medium, so protonation of aniline also takes place $+$ forming anilinium ion $\left(\mathrm{NH}_{3}\right)$ which being meta directing.
149. Which of the following oxides is most acidic in nature?
(1) BeO
(2) BaO

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(3) MgO
(4) CaO

Sol: (1)
BeO is most acidic
Basic nature of oxide increases down the groups.
150. A mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with conc. $\mathrm{H}_{2} \mathrm{SO}_{4}$. The evolved gaseous mixture is passed through KOH pellets. Weight (in g) of the remaining product at STP will be
(1) 3.0
(2) 2.8
(3) 1.4
(4) 4.4

Sol : (2)
$\mathrm{HCOOH} \xrightarrow{\mathrm{H}_{2} \mathrm{SO}_{4}} \mathrm{H}_{2} \mathrm{O}+\mathrm{CO}$
COOH
$\mid \xrightarrow{\mathrm{H}_{2} \mathrm{SO}_{4}} \mathrm{CO}_{2}+\mathrm{CO}+\mathrm{H}_{2} \mathrm{O}$
COOH
$\mathrm{CO}_{2}$ and $\mathrm{H}_{2} \mathrm{O}$ are absorb by KOH and only CO will remain.

$$
\begin{aligned}
& \mathrm{HCOOH} \rightarrow \mathrm{H}_{2} \mathrm{O}+\mathrm{CO} \\
& 46 \mathrm{gm} \quad \underline{28} \mathrm{gm}
\end{aligned}
$$

46 gm HCOOH give $=28 \mathrm{gm} \mathrm{CO}$
2.3 gm HCOOH give $=\frac{28}{46} \times 2.3=1.4 \mathrm{gm}$

90 gm oxalic acid give $=28 \mathrm{gm} \mathrm{CO}$
4.5 gm oxalic acid give $=\frac{28}{90} \times 4.5=1.4 \mathrm{gm}$

Weight (in gm) of remaining product $=1.4+1.4=$ 2.8 gm
151. The compound A on treatment with Na gives B , and with $P C l_{5}$ gives C . B and C react together to give diethyl ether. $\mathrm{A}, \mathrm{B}$ and C are in the order
(1) $\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH}, \mathrm{C}_{2} \mathrm{H}_{5} \mathrm{Cl}, \mathrm{C}_{2} \mathrm{H}_{5} \mathrm{ONA}$
(2) $\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{Cl}, \mathrm{C}_{2} \mathrm{H}_{6}, \mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH}$
(3) $\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH}, \mathrm{C}_{2} \mathrm{H}_{6}, \mathrm{C}_{2} \mathrm{H}_{5} \mathrm{Cl}$
(4) $\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH}, \mathrm{C}_{2} \mathrm{H}_{5} \mathrm{ONa}, \mathrm{C}_{2} \mathrm{H}_{5} \mathrm{Cl}$

Sol : (4)
$\underset{(A)}{\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH} \xrightarrow{\mathrm{PCl}_{5}} \mathrm{C}_{2} \mathrm{H}_{5} \mathrm{Cl}}$
$\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{ONa}+\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{Cl} \rightarrow \mathrm{C}_{2} \mathrm{H}_{5}-\mathrm{O}-\mathrm{C}_{2} \mathrm{H}_{5}$
152.Hydrocarbon (A) reacts with bromine by substitution to form an alkyl bromide which by Wurtz reaction is converted to gaseous hydrocarbon containing less than four carbon atoms. ( A ) is
(1) $\mathrm{CH}_{2}=\mathrm{CH}_{2}$
(2) $\mathrm{CH}_{3}-\mathrm{CH}_{3}$
(3) $\mathrm{CH} \equiv \mathrm{CH}$
(4) $\mathrm{CH}_{4}$

Sol: (4)
$\mathrm{CH}_{4} \xrightarrow{\mathrm{Cl}_{2} / \mathrm{HO}} \mathrm{CH}_{3} \mathrm{Cl}$
$\mathrm{CH}_{3} \mathrm{Cl}+2 \mathrm{Na}+\mathrm{ClCH}_{3} \rightarrow \mathrm{CH}_{3}-\mathrm{CH}_{3}$
153. Which oxide of nitrogen is not a common pollutant introduced into the atmosphere both due to natural and human activity?
(1) $\mathrm{NO}_{2}$
(2) $\mathrm{N}_{2} \mathrm{O}$
(3) $\mathrm{N}_{2} \mathrm{O}_{5}$
(4) NO

Sol: (3)
154. The compound $\mathrm{C}_{7} \mathrm{H}_{8}$ undergoes the following reactions.

$$
C_{7} \mathrm{H}_{8} \xrightarrow{3 \mathrm{Cl}_{2} / \Delta} A \xrightarrow{\mathrm{Br}_{2} / \mathrm{Fe}} B \xrightarrow{\mathrm{Zn/HCI}} C
$$

The product C is
(1) o-bromotoluene
(2) 3-bromo-2,4,6-trichlorotoluene
(3) m-bromotoluene
(4) p-bromotoluene

Sol: (3)


155. Which of the following molecules represents the order of hybridization $s p^{2}, s p^{2}, s p, s p$ from left to right atoms?
(1) $\mathrm{CH}_{2}=\mathrm{CH}-\mathrm{C} \equiv \mathrm{CH}$
(2) $\mathrm{CH}_{2}=\mathrm{CH}-\mathrm{CH}=\mathrm{CH}_{2}$
(3) $\mathrm{HC} \equiv \mathrm{C}-\mathrm{C} \equiv \mathrm{CH}$
(4) $\mathrm{CH}_{3}-\mathrm{CH}=\mathrm{CH}-\mathrm{CH}_{3}$

Sol: (1)

156. Which of the following carbocations is expected to be most stable?
(1)


(2)


(3)

(4)


Sol : (2)


Due to electron drawing nature of $\mathrm{NO}_{2}$ group.
157. Which of the following is correct with respect to -I effect of the substituents? ( $\mathrm{R}=$ alkyl )
(1) $-N R_{2}<-O R<-F$
(2) $-\mathrm{NH}_{2}>-O R>-F$
(3) $-\mathrm{NH}_{2}<-\mathrm{OR}<-F$
(4) $-\mathrm{NH}_{2}<-O R<-F$

Sol: (1)
Fact
158. In the reaction


The electrophile involved is

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## $\oplus$

(1) Formyl cation $(\mathrm{CHO})$
(2) Dichloromethyl anion $\stackrel{\ominus}{\left(\mathrm{CHCl}_{2}\right)}$
(3) Dichloromethyl cation $\underset{(\underset{\mathrm{CHCl}}{2}}{ })$
(4) Dichlorocarbene (: $\mathrm{CCl}_{2}$ )

Sol : (4)
$\mathrm{CHCl}_{3}+\mathrm{NaOH} \rightarrow: \mathrm{CCl}_{2}$


Hence electrophile is: $\mathrm{CCl}_{2}$
159. Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass. It is due to their
(1) Formation of carboxylate ion
(2) More extensive association of carboxylic acid via van der Waals force of attraction
(3) Formation of intramolecular H-bonding
(4) Formation of intermolecular H-bonding

## Sol : (4)

Carboxylic acid higher boiling point then aldehyde, ketone and even alcohol due to formation of inter molecular hydrogen bonding.
160. Compound A, $C_{8} H_{10} O$, is found to react with NaOI (produced by reacting Y with NaOH ) and yields a yellow precipitate with characteristic smell.
$A$ and $Y$ are respectively
(1)

(2)

(3)

(4)


Sol: (2)

(A)
161.Identify the major product $\mathrm{P}, \mathrm{Q}$ and R in the following sequence of reactions:



(2)



Sol: (4)
$\mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{CH}_{2} \mathrm{Cl} \xrightarrow{\mathrm{AlCl}_{3}} \mathrm{CH}_{3}-\mathrm{CH}_{2}-\stackrel{+}{\mathrm{CH}_{2}} \rightarrow \mathrm{CH}_{3}-\stackrel{+}{\mathrm{C}}-\mathrm{CH}_{3}$

162. Which of the following compounds can form a zwitterion?
(1) Acetanilide
(2) Benzoic acid
(3) Aniline
(4) Glycine

Sol: (4)

163. The correction factor ' $a$ ' to the ideal gas equations corresponds to
(1) Volume of the gas molecules
(2) Electric field present between the gas molecules
(3) Density of the gas molecules
(4) Forces of attraction between the gas molecules Sol: (4)
Vandar wall constant ' $a$ ' is responsible for force of attraction.
164. For the redox reaction
$\mathrm{MnO}_{4}^{-}+\mathrm{C}_{2} \mathrm{O}_{4}^{2-}+\mathrm{H}^{+} \rightarrow \mathrm{Mn}^{+2}+\mathrm{CO}_{2}+\mathrm{H}_{2} \mathrm{O}$
The correct coefficients of the reactants for the balanced equation are

| $\quad \mathrm{MNO}_{4}^{-}$ | $\mathrm{C}_{2} \mathrm{O}_{4}^{2-}$ | $\mathrm{H}^{+}$ |
| :--- | :--- | :--- |
| (1) 2 | 5 | 16 |
| (2) 2 | 16 | 5 |
| (3) 16 | 5 | 2 |
| (4) 5 | 16 | 2 |

Sol: (1)
$2 \mathrm{MnO}_{4}^{-}+5 \mathrm{C}_{2} \mathrm{O}_{4}^{2-}+16 \mathrm{H}^{+} \rightarrow 2 \mathrm{Mn}^{+2}+10 \mathrm{CO}_{2}+8 \mathrm{H}_{2} \mathrm{O}$
165. When initial concentration of the reactant is doubled, the half-life period of a zero order reaction
(1) Is doubled
(2) Is tripled
(3) Is halved
(4) Remains unchanged

Sol: (1)
$t_{1 / 2} \propto(a)$
166. The bond dissociation energies of $X_{2}, Y_{2}$ and $X Y$ are in the ratio of $1: 0.5: 1 . \Delta H$ for the formation of $X Y$ is $-200 \mathrm{~kJ} \mathrm{~mol}^{-1}$. The bond dissociation energy of $X_{2}$ will be
(1) $100 \mathrm{~kJ} \mathrm{~mol}^{-1}$
(2) $800 \mathrm{~kJ} \mathrm{~mol}^{-1}$
(3) $200 \mathrm{~kJ} \mathrm{~mol}^{-1}$
(4) $400 \mathrm{~kJ} \mathrm{~mol}^{-1}$

Sol: (2)

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$\frac{1}{2} X_{2}+\frac{1}{2} Y_{2} \rightarrow X Y$
$\Delta H_{r x n}=\frac{1}{2} \mathrm{~B} \cdot E_{X_{2}}+\frac{1}{2} \mathrm{~B} \cdot E_{Y_{2}}-B \cdot E_{X Y}$
$-200=\frac{1}{2} \mathrm{X}+\frac{1}{2} \frac{x}{2}-\mathrm{X}$
$-200=-\frac{1}{4} x$
$\mathrm{X}=800 \mathrm{~kJ} \mathrm{~mol}{ }^{-1}$
167. which one of the following conditions will favour maximum formation of the product in the reaction

$$
A_{2}(g)+B_{2}(g) \rightleftharpoons X_{2}(g) \Delta_{r} H=-X k J ?
$$

(1) Low temperature and low pressure
(2) High temperature and high pressure
(3) Low temperature and high pressure
(4) High temperature and low pressure

Sol: (3)
$A_{2}(g)+B_{2}(g) \rightleftharpoons X_{2}(g), \Delta \mathrm{H}=-x \mathrm{~kJ}$
low temp. and high pressure favour the reaction
168.Iron exhibits bcc structure at room temperature. Above $900^{\circ} \mathrm{C}$, it transforms to fcc structure. The ratio of density of iron at room temperature to that at $900^{\circ} \mathrm{C}$ (assuming molar mass and atomic radii of iron remains constant with temperature) is
(1) $\frac{4 \sqrt{3}}{3 \sqrt{2}}$
(2) $\frac{3 \sqrt{3}}{4 \sqrt{2}}$
(3) $\frac{\sqrt{3}}{\sqrt{2}}$
(4) $\frac{1}{2}$

Sol: (2)
$\frac{d_{b . c . c}}{d_{f . c . c}}=\left[\frac{Z}{a^{3}}\right]_{\text {b.c.c }} \times\left[\frac{a^{3}}{Z}\right]_{\text {f.c.c }}$
$=\frac{2}{\left(\frac{4 r}{\sqrt{3}}\right)^{3}} \times \frac{\left(\frac{4 r}{\sqrt{2}}\right)^{3}}{4}$
$=\frac{3 \sqrt{3}}{4 \sqrt{2}}$
169. Consider the following species:
$C N^{+}, C N^{-}, N O$ and CN
Which one of these will have the highest bond order?
(1) $\mathrm{CN}^{-}$
(2) $C N^{+}$
(3) NO
(4) $C N$

Sol: (1)
$C N^{-}$contain $14 e^{-}$. Bond order three
170. Magnesium reacts with an element ( X ) to form are ionic compound. If the ground state electronic configuration of (X) is $1 s^{2} 2 s^{2} 2 p^{3}$, the simplest formula for this compound is
(1) $M g X_{2}$
(2) $M g_{2} X$
(3) $M g_{2} X_{3}$
(4) $M g_{3} X_{2}$

## Sol :(4)

Mg have valency $=2$
$x$ have 5 valence electron
$\therefore$ valency of $x=3$
$\therefore$ Formula $=M_{g_{3}} x_{2}$
171. Which one is wrong statements?
(1) An orbital is designated by three quantum number while an electron in an atom is designated by four quantum number.
(2) The electronic configuration of N atom is

(3) Total orbital angular momentum of electron in 's' orbital is equal to zero.
(4) The value of $m$ for $d_{z} 2$ is zero.

Sol:(2)
According to Hund's rule of Maximum multiplicity all unpaired electron must have parallel spin.

172. Following solution were prepared by mixing different volumes of NaOH and HCI of different concentrations:
A. $60 \mathrm{~mL} \frac{\mathrm{M}}{10} \mathrm{HCI}+40 \mathrm{~mL} \frac{\mathrm{M}}{10} \mathrm{NaOH}$
B. $55 \mathrm{~mL} \frac{\mathrm{M}}{10} \mathrm{HCI}+45 \mathrm{~mL} \frac{\mathrm{M}}{10} \mathrm{NaOH}$
C. $75 \mathrm{~mL} \frac{\mathrm{M}}{5} \mathrm{HCI}+25 \mathrm{~mL} \frac{\mathrm{M}}{5} \mathrm{NaOH}$
D. $100 \mathrm{~mL} \frac{\mathrm{M}}{10} \mathrm{HCI}+100 \mathrm{~mL} \frac{\mathrm{M}}{10} \mathrm{NaOH}$
pH of which one of them will be equal to 1 ?
(1) $A$
(2) D
(3) $B$
(4) C

Sol:(4)
No of millimoles of HCl left after neutralisation

$$
=\text { Millimoles of } \mathrm{HCl}-\text { Millimoles of } \mathrm{NaOH}
$$

$=75 \times \frac{1}{5}-25 \times \frac{1}{5}$
$=15-5$
$=10$ millimole
Final volume $=75 \mathrm{ml}+25 \mathrm{ml}=100 \mathrm{ml}$
Concentration of HCl in final solution $=$ no of millimoles

$$
=\frac{\begin{array}{c}
\text { volume } \\
10 \text { millimoles }
\end{array}}{100 \mathrm{ml}}
$$

$$
=10^{-1} \mathrm{~m}
$$

$$
\mathrm{pH}=-\log \left[H^{+}\right]=-\log \left[10^{-1}\right]=1
$$

173. On which of the following properties does the coagulating power of an ion depend?
(1) Size of the ion alone
(2) Both magnitude and sign of the charge on the ion
(3) The magnitude of the charge on the ion alone
(4) The sign of charge on the ion alone

Sol: (2)

According to Hardy-Schulze's Rule, "The coagulating power of flocculating ion directly proportional to the valency or charge of ion."
The flocculating ion must have valency opposite to the charge of colloid.
174. Given van der Waals constant for $\mathrm{NH}_{3}, \mathrm{H}_{2}, \mathrm{O}_{2}$ and $\mathrm{CO}_{2}$ are respectively $4.17,0.244,1.36$ and 3.59 which one of the following gases is most easily liquefied?
(1) $\mathrm{H}_{2}$
(2) $\mathrm{O}_{2}$
(3) $\mathrm{NH}_{3}$
(4) $\mathrm{CO}_{2}$

Sol:(3)
Ammonia have highest value of Vanderwal's constant, hence it can be liquefied easily.
175.The solubility of $\mathrm{BaSO}_{4}$ in water is $2.42 \times 10^{-3} \mathrm{gL}^{-1}$ at 298 K . The value of its solubility product ( $K_{s p}$ ) will be
(Given molar mass of $\mathrm{BaSO}_{4}=233 \mathrm{~g} \mathrm{~mol}^{-1}$ )
(1) $1.08 \times 10^{-12} \mathrm{~mol}^{2} \mathrm{~L}^{-2}$
(2) $1.08 \times 10^{-14} \mathrm{~mol}^{2} \mathrm{~L}^{-2}$
(3) $1.08 \times 10^{-10} \mathrm{~mol}^{2} \mathrm{~L}^{-2}$
(4) $1.08 \times 10^{-8} \mathrm{~mol}^{2} \mathrm{~L}^{-2}$

Sol : (3)
$\mathrm{BaSO}_{4} \rightleftharpoons \mathrm{Ba}^{+2}+\mathrm{SO}_{4}^{-2}$
Solubility in $\mathrm{g}^{-1}=2.42 \times 10^{-3} \mathrm{~g} \mathrm{~L}^{-1}$
Solubility in $\mathrm{mol}^{-1}=\frac{2.42 \times 10^{-3}}{233}$ mole $\mathrm{L}^{-1}$
$K_{s p}=\left[\mathrm{Ba}^{+2}\right]\left[\mathrm{SO}_{4}^{-2}\right]$
$=\left[\frac{2.42 \times 10^{-3}}{233}\right]\left[\frac{2.42 \times 10^{-3}}{233}\right]$
$=1.08 \times 10^{-10} \mathrm{~mol}^{2} \mathrm{~L}^{-2}$
176. The type of isomerism shown by the complex $\left|\operatorname{CoCl}_{2}(e n)_{2}\right|$ is
(1) Coordination isomerism

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(2) Ionization isomerism
(3) Geometrical isomerism
(4) Linkage isomerism

Sol:(3)
$\left(\mathrm{CoCl}_{2}(e n)_{2}\right)$ have two monodentate $\&$ two bidentate ligand hence can show geometrical \& optical isomerism.


177. Which one of the following ions exhibits $d-d$ transition and paramagnetic as well?
(1) $\mathrm{Cr}_{2} \mathrm{O}_{7}^{2-}$
(2) $\mathrm{MnO}_{4}^{-}$
(3) $\mathrm{CrO}_{4}^{2-}$
(4) $\mathrm{MnO}_{4}^{2-}$

Sol:(4)
$\mathrm{MnO}_{4}^{2-}$ have Mn in +6 oxidation state. It have $d^{1}$ configuration. Hence can show d-d transition \& paramagnetism.
178. Iron carbonyl, $\mathrm{Fe}(\mathrm{CO})_{5}$ is
(1) Mononuclear
(2) Trinuclear
(3) Tetranuclear
(4) Dinuclear

Sol: (1)

179. Match the metal ions given in Column I with the spin magnetic moments of the ions given in Column II and assign the correct code:

| Column I |  |  | Column II |  |
| :---: | :---: | :---: | :---: | :---: |
| A. | $\mathrm{Co}^{3+}$ |  | i. | $\sqrt{8}$ B. M |
| B. | $\mathrm{Cr}^{3+}$ |  | ii. | $\sqrt{35}$ B.M |
| C. | $F e^{3+}$ |  | iii. | $\sqrt{3}$ B.M |
| D. | $N i^{2+}$ |  | iv. | $\sqrt{24}$ B.M |
|  |  |  | V. | $\sqrt{15}$ B.M |
| A(1) i(2) iv(3) iv(4) iii | B | C | D |  |
|  | ii | iii | iv |  |
|  | i | ii | ii |  |
|  | v | ii | i |  |
|  | v | i | ii |  |

Sol: (3)

| Electronic <br> configurations |  | No. of <br> unpaired <br> electron | $\boldsymbol{\mu}$ <br> $\sqrt{\boldsymbol{n ( n + 2 )}}$ <br> BR |
| :--- | :--- | :--- | :--- |
| $\mathrm{CO}^{+3}$ | $[\mathrm{Ar}] 3 \mathrm{~d}^{6} 4 \mathrm{~s}^{0}$ | 4 | $\sqrt{24}$ |
| $\mathrm{Cr}^{+3}$ | $[\mathrm{Ar}] 3 \mathrm{~d}^{3} 4 \mathrm{~s}^{0}$ | 3 | $\sqrt{15}$ |
| $\mathrm{Fe}^{+3}$ | $[\mathrm{Ar}] 3 \mathrm{~d}^{5} 4 \mathrm{~s}^{0}$ | 5 | $\sqrt{35}$ |
| $\mathrm{Ni}^{+2}$ | $[\mathrm{Ar}] 3 \mathrm{~d}^{8} 4 \mathrm{~s}^{0}$ | 2 | $\sqrt{8}$ |

180. The geometry and magnetic behavior of the complex $\left[\mathrm{Ni}(\mathrm{CO})_{4}\right]$ are
(1) Tetrahedral geometry and diamagnetic
(2) Square planar geometry and paramagnetic

(3) Square planar geometry and diamagnetic (4) Tetrahedral geometry and paramagnetic Sol : (1)
$\mathrm{Ni}(\mathrm{CO})_{4}$ have $\mathrm{sp}^{3}$ hybridization, hence tetrahedral geometry \& diamagnetic complex.
