Answers & Solutions for NEET (UG) - 2017

Important Instructions:

1. The Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars on Side-1 and Side-2 carefully with blue / black ballpoint pen only.

2. The test is of 3 hours duration and Test Booklet contains 180 questions. Each question carries 4 marks. For each correct response, the candidate will get 4 marks. For each incorrect response, one mark will be deducted from the total scores. The maximum marks are 720.

3. Use Blue / Black Ballpoint Pen only for writing particulars on this page/marking responses.

4. Rough work is to be done on the space provided for this purpose in the Test Booklet only.

5. On completion of the test, the candidate must handover the Answer Sheet to the invigilator before leaving the Room / Hall. The candidates are allowed to take away Test Booklet only with them.

6. The CODE for this Booklet is S. Make sure that the CODE printed on Side-2 of the Answer Sheet is the same as that on this Booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.

7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere except in the specified space in the Test Booklet/Answer Sheet.

8. Use of white fluid for correction is not permissible on the Answer Sheet.

9. Each candidate must show on demand his/her Admission Card to the Invigilator.

10. No candidate, without special permission of the Superintendent or Invigilator, would leave his/her seat.

11. The candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign the Attendance Sheet twice. Cases where a candidate has not signed the Attendance Sheet second time will be deemed not to have handed over the Answer Sheet and dealt with as an unfair means case.

12. Use of Electronic/Manual Calculator is prohibited.

13. The candidates are governed by all Rules and Regulations of the Board with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of the Board.

14. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.

15. The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.
1. The genotypes of a Husband and Wife are \( I^A i \) and \( I^A I^B \).

Among the blood types of their children, how many different genotypes and phenotypes are possible?

(1) 4 genotypes ; 3 phenotypes
(2) 4 genotypes ; 4 phenotypes
(3) 3 genotypes ; 3 phenotypes
(4) 3 genotypes ; 4 phenotypes

Answer (1)

Sol. Husband \( \times \) Wife

\[
\begin{array}{c|c|c}
\text{Husband} & \text{Wife} & \text{Offspring} \\
\hline
I^A & I^A & I^A I^A, I^A i \\
i & i & i i \\
\end{array}
\]

Number of genotypes = 4
Number of phenotypes = 3

\( I^A I^A \) and \( I^A i = A \)

\( I^A I^B = AB \)

\( i i = B \)

2. Adult human RBCs are enucleate. Which of the following statement(s) is/are most appropriate explanation for this feature?

(a) They do not need to reproduce
(b) They are somatic cells
(c) They do not metabolize
(d) All their internal space is available for oxygen transport

(1) (a), (c) and (d)
(2) (b), (c) & (d)
(3) Only (d)
(4) Only (a)

Answer (3)

Sol. In Human RBCs, nucleus degenerates during maturation which provide more space for oxygen carrying pigment (Haemoglobin). It lacks most of the cell organelles including mitochondria so respire anaerobically.

3. An important characteristic that Hemichordates share with Chordates is

(1) Pharynx with gill slits
(2) Pharynx without gill slits
(3) Absence of notochord
(4) Ventral tubular nerve cord

Answer (1)

Sol. Pharyngeal gill slits are present in hemichordates as well as in chordates. Notochord is present in chordates only. Ventral tubular nerve cord is characteristic feature of non-chordates.

4. Good vision depends on adequate intake of carotene rich food

Select the best option from the following statements

(a) Vitamin A derivatives are formed from carotene
(b) The photopigments are embedded in the membrane discs of the inner segment
(c) Retinal is a derivative of vitamin A
(d) Retinal is a light absorbing part of all the visual photopigments

(1) (a) & (c)
(2) (b), (c) & (d)
(3) (a) & (b)
(4) (a), (c) & (d)

Answer (4)

Sol. Carotene is the source of retinal which is involved in formation of rhodopsin of rod cells. Retinal, a derivative of vitamin A, is the light-absorbing part of all visual photopigments.

5. Zygotic meiosis is characteristic of

(1) Funaria
(2) Chlamydomonas
(3) Marchantia
(4) Fucus

Answer (2)

Sol. Chlamydomonas has haplontic life cycle hence showing zygotic meiosis or initial meiosis.

6. A decrease in blood pressure/volume will not cause the release of

(1) Aldosterone
(2) ADH
(3) Renin
(4) Atrial Natriuretic Factor

Answer (4)

Sol. A decrease in blood pressure / volume stimulates the release of renin, aldosterone, and ADH while increase in blood pressure / volume stimulates the release of Atrial Natriuretic Factor (ANF) which cause vasodilation and also inhibits RAAS (Renin Angiotensin Aldosterone System) mechanism that decreases the blood volume/pressure.

7. Lungs are made up of air-filled sacs the alveoli. They do not collapse even after forceful expiration, because of :

(1) Tidal Volume
(2) Expiratory Reserve Volume
(3) Residual Volume
(4) Inspiratory Reserve Volume

Answer (3)

Sol. Volume of air present in lungs after forceful expiration as residual volume which prevents the collapsing of alveoli even after forceful expiration.
8. Which one of the following statements is correct, with reference to enzymes?
   (1) Coenzyme = Apoenzyme + Holoenzyme
   (2) Holoenzyme = Coenzyme + Cofactor
   (3) Apoenzyme = Holoenzyme + Coenzyme
   (4) Holoenzyme = Apoenzyme + Coenzyme
   Answer (4)
   Sol. Holoenzyme is conjugated enzyme in which protein part is apoenzyme while non-protein is cofactor. Coenzyme are also organic compounds but their association with apoenzyme is only transient and serve as cofactors.

9. Mycorrhizae are the example of
   (1) Antibiosis (2) Mutualism
   (3) Fungistasis (4) Amensalism
   Answer (2)
   Sol. Mycorrhizae is a symbiotic association of fungi with roots of higher plants.

10. Which of the following are not polymeric?
    (1) Polysaccharides (2) Lipids
    (3) Nucleic acids (4) Proteins
    Answer (2)
    Sol. – Nucleic acids are polymers of nucleotides
         – Proteins are polymers of amino acids
         – Polysaccharides are polymers of monosaccharides
         – Lipids are the esters of fatty acids and alcohol

11. Which among the following are the smallest living cells, known without a definite cell wall, pathogenic to plants as well as animals and can survive without oxygen?
    (1) Mycoplasma (2) Nostoc
    (3) Bacillus (4) Pseudomonas
    Answer (1)
    Sol. Mycoplasmas are smallest, wall-less prokaryotes, pleomorphic in nature. These are pathogenic on both plants and animals.

12. Asymptote in a logistic growth curve is obtained when
    (1) $K > N$
    (2) $K < N$
    (3) The value of $r'$ approaches zero
    (4) $K = N$
    Answer (4)
    Sol. A population growing in a habitat with limited resources shows logistic growth curve.
    
    For logistic growth
    \[
    \frac{dN}{dt} = rN \left( \frac{K - N}{K} \right)
    \]
    If $K = N$ then \( \frac{K - N}{K} = 0 \)
    
    \[
    \therefore \frac{dN}{dt} = 0,
    \]
    the population reaches asymptote.

13. Plants which produce characteristic pneumatophores and show vivipary belong to
    (1) Psammophytes (2) Hydrophytes
    (3) Mesophytes (4) Halophytes
    Answer (4)
    Sol. Halophytes growing in saline soils show
     (i) Vivipary which is in-situ seed germination
     (ii) Pneumatophores for gaseous exchange

    (1) It conducts water and minerals efficiently
    (2) It comprises dead elements with highly lignified walls
    (3) Organic compounds are deposited in it
    (4) It is highly durable
    Answer (1)
    Sol. Heartwood is physiologically inactive due to deposition of organic compounds and tyloses formation, so this will not conduct water and minerals.

15. With reference to factors affecting the rate of photosynthesis, which of the following statements is not correct?
    (1) \( C_3 \) plants responds to higher temperatures with enhanced photosynthesis while \( C_4 \) plants have much lower temperature optimum
    (2) Tomato is a greenhouse crop which can be grown in \( CO_2 \)- enriched atmosphere for higher yield
    (3) Light saturation for \( CO_2 \) fixation occurs at 10% of full sunlight
    (4) Increasing atmospheric \( CO_2 \) concentration upto 0.05% can enhance \( CO_2 \) fixation rate
    Answer (1)
    Sol. In \( C_3 \) plants photosynthesis is decreased at higher temperature due to increased photorespiration.
Plants have higher temperature optimum because of the presence of pyruvate phosphate dikinase enzyme, which is sensitive to low temperature.

16. Artificial selection to obtain cows yielding higher milk output represents
   (1) Disruptive as it splits the population into two one yielding higher output and the other lower output
   (2) Stabilizing followed by disruptive as it stabilizes the population to produce higher yielding cows
   (3) Stabilizing selection as it stabilizes this character in the population
   (4) Directional as it pushes the mean of the character in one direction

Answer (4)

Sol. Artificial selection to obtain cow yielding higher milk output will shift the peak to one direction, hence, will be an example of Directional selection. In stabilizing selection, the organisms with the mean value of the trait are selected. In disruptive selection, both extremes get selected.

17. Which of the following represents order of 'Horse'?
   (1) Caballus
   (2) Ferus
   (3) Equidae
   (4) Perissodactyla

Answer (3)

Sol. MALT is Mucosa Associated Lymphoid Tissue and it constitutes about 50 percent of the lymphoid tissue in human body.

22. Which of the following is correctly matched for the product produced by them?
   (1) *Penicillium notatum* : Acetic acid
   (2) *Saccharomyces cerevisiae* : Ethanol
   (3) *Acetobacter aceti* : Antibiotics
   (4) *Methanobacterium* : Lactic acid

Answer (2)

Sol. *Saccharomyces cerevisiae* is commonly called Brewer's yeast. It causes fermentation of carbohydrates producing ethanol.

23. Select the correct route for the passage of sperms in male frogs:
   (1) Testes → Vasa efferentia → Bidder's canal → Ureter → Cloaca
   (2) Testes → Vasa efferentia → Kidney → Bidder's canal → Urinogenital duct → Cloaca
   (3) Testes → Bidder's canal → Kidney → Vasa efferentia → Urinogenital duct → Cloaca
   (4) Testes → Vasa efferentia → Kidney → Seminal Vesicle → Urinogenital duct → Cloaca

Answer (2)

Sol. In male frog the sperms will move from Testes → Vasa efferentia → Kidney → Bidder's canal → Urinogenital duct → Cloaca.

19. The DNA fragments separated on an agarose gel can be visualised after staining with
   (1) Aniline blue
   (2) Ethidium bromide
   (3) Bromophenol blue
   (4) Acetocarmine

Answer (2)

Sol. Ethidium bromide is used to stain the DNA fragments and will appear as orange coloured bands under UV light.

20. The hepatic portal vein drains blood to liver from
   (1) Kidneys
   (2) Intestine
   (3) Heart
   (4) Stomach

Answer (2)

Sol. In hepatic portal system, hepatic portal vein carries maximum amount of nutrients from intestine to liver.
3. Inbreeding results in increase in the homozygosity. Therefore, mating of the related individuals of same breed will increase homozygosity.

26. Which one from those given below is the period for Mendel's hybridization experiments?

(1) 1857 - 1869
(2) 1870 - 1877
(3) 1856 - 1863
(4) 1840 - 1850

Answer (3)

Sol. Mendel conducted hybridization experiments on Pea plant for 7 years between 1856 to 1863 and his data was published in 1865 (according to NCERT).

27. Which of the following cell organelles is responsible for extracting energy from carbohydrates to form ATP?

(1) Chloroplast
(2) Mitochondrion
(3) Lysosome
(4) Ribosome

Answer (2)

Sol. Mitochondria are the site of aerobic oxidation of carbohydrates to generate ATP.

28. The final proof for DNA as the genetic material came from the experiments of

(1) Avery, Mcleod and McCarty
(2) Hargobind Khorana
(3) Griffith
(4) Hershey and Chase

Answer (4)

Sol. Hershey and Chase gave unequivocal proof which ended the debate between protein and DNA as genetic material.

29. Select the mismatch:

(1) Salvinia – Heterosporous
(2) Equisetum – Homosporous
(3) Pinus – Dioecious
(4) Cycas – Dioecious

Answer (3)

Sol. Pinus is monoecious plant having both male and female cones on same plant.

30. Transplantation of tissues/organs fails often due to non-acceptance by the patient's body. Which type of immune-response is responsible for such rejections?

(1) Hormonal immune response
(2) Physiological immune response
(3) Autoimmune response
(4) Cell-mediated immune response

Answer (4)

Sol. Non-acceptance or rejection of graft or transplanted tissues/organs is due to cell mediated immune response.

31. Which statement is wrong for Krebs' cycle?

(1) During conversion of succinyl CoA to succinic acid, a molecule of GTP is synthesised
(2) The cycle starts with condensation of acetyl group (acetyl CoA) with pyruvic acid to yield citric acid
(3) There are three points in the cycle where NAD+ is reduced to NADH + H+
(4) There is one point in the cycle where FAD+ is reduced to FADH₂

Answer (2)

Sol. Krebs cycle starts with condensation of acetyl CoA (2C) with oxaloacetic acid (4C) to form citric acid (6C).

32. Which of the following statements is correct?

(1) The ascending limb of loop of Henle is permeable to water
(2) The descending limb of loop of Henle is permeable to electrolytes
(3) The ascending limb of loop of Henle is impermeable to water
(4) The descending limb of loop of Henle is impermeable to water

Answer (3)

Sol. Descending limb of loop of Henle is permeable to water but impermeable to electrolytes while ascending limb is impermeable to water but permeable to electrolytes.

33. In case of poriferans the spongocoel is lined with flagellated cells called:

(1) Choanocytes
(2) Mesenchymal cells
(3) Ostia
(4) Oscula

Answer (1)

Sol. Choanocytes (collar cells) form lining of spongocoel in poriferans (sponges). Flagella in collar cells provide circulation to water in water canal system.

34. Select the mismatch:

(1) Anabaena – Nitrogen fixer
(2) Rhizobium – Alfalfa
(3) Frankia – Alnus
(4) Rhodospirillum – Mycorrhiza

Answer (4)
38. The region of Biosphere Reserve which is legally protected and where no human activity is allowed is known as
   (1) Transition zone   (2) Restoration zone
   (3) Core zone   (4) Buffer zone

Answer (3)
Sol. Biosphere reserve is protected area with multipurpose activities.
   It has three zones
   (a) Core zone – without any human interference
   (b) Buffer zone – with limited human activity
   (c) Transition zone – human settlement, grazing cultivation etc., are allowed.

39. Which of the following is made up of dead cells?
   (1) Phellem   (2) Phloem
   (3) Xylem parenchyma   (4) Collenchyma

Answer (1)
Sol. Cork cambium undergoes periclinal division and cuts off thick walled suberised dead cork cells towards outside and it cuts off thin walled living cells i.e., phelloderm on inner side.

40. The morphological nature of the edible part of coconut is
   (1) Endosperm   (2) Pericarp
   (3) Perisperm   (4) Cotyledon

Answer (1)
Sol. Coconut has double endosperm with liquid endosperm and cellular endosperm.

41. What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis?
   (1) Positively charged fragments move to farther end
   (2) Negatively charged fragments do not move
   (3) The larger the fragment size, the farther it moves
   (4) The smaller the fragment size, the farther it moves

Answer (4)
Sol. During gel electrophoresis, DNA fragments separate (resolve) according to their size through sieving effect provided by agarose gel.

42. Presence of plants arranged into well defined vertical layers depending on their height can be seen best in :
   (1) Grassland
   (2) Temperate Forest
   (3) Tropical Savannah
   (4) Tropical Rain Forest
48. Receptor sites for neurotransmitters are present on
   (1) Tips of axons
   (2) Post-synaptic membrane
   (3) Membranes of synaptic vesicles
   (4) Pre-synaptic membrane

Answer (2)

Sol. Pre-synaptic membrane is involved in the release of
   neurotransmitter in the chemical synapse. The receptors
   sites for neurotransmitters are present on post-synaptic membrane.

49. A dioecious flowering plant prevents both:
   (1) Geitonogamy and xenogamy
   (2) Cleistogamy and xenogamy
   (3) Autogamy and xenogamy
   (4) Autogamy and geitonogamy

Answer (4)

Sol. When unisexual male and female flowers are present
   on different plants the condition is called dioecious
   and it prevents both autogamy and geitonogamy.

50. The pivot joint between atlas and axis is a type of
   (1) Synovial joint
   (2) Saddle joint
   (3) Fibrous joint
   (4) Cartilaginous joint

Answer (1)

Sol. Synovial joints are freely movable joint which allow
   considerable movements. Pivot joint is a type
   of synovial joint which provide rotational movement as
   in between atlas and axis vertebrae of vertebral
   column.

51. The water potential of pure water is
   (1) More than zero but less than one
   (2) More than one
   (3) Zero
   (4) Less than zero

Answer (3)

Sol. By convention, the water potential of pure water at
   standard temperature, which is not under any
   pressure, is taken to be zero.

52. Which ecosystem has the maximum biomass?
   (1) Pond ecosystem
   (2) Lake ecosystem
   (3) Forest ecosystem
   (4) Grassland ecosystem

Answer (3)

Sol. High productive ecosystem are
   – Tropical rain forest
   – Coral reef
   – Estuaries
   – Sugarcane fields
53. GnRH, a hypothalamic hormone, needed in reproduction, acts on
(1) Posterior pituitary gland and stimulates secretion of oxytocin and FSH
(2) Posterior pituitary gland and stimulates secretion of LH and relaxin
(3) Anterior pituitary gland and stimulates secretion of LH and oxytocin
(4) Anterior pituitary gland and stimulates secretion of LH and FSH
Answer (4)
Sol. Hypothalamus secretes GnRH which stimulates anterior pituitary gland for the secretion of gonadotropins (FSH and LH).

54. Alexander Von Humboldt described for the first time
(1) Species area relationships
(2) Population Growth equation
(3) Ecological Biodiversity
(4) Laws of limiting factor
Answer (1)
Sol. Alexander Von Humboldt observed that within a region species richness increases with the increases in area.

55. Fruit and leaf drop at early stages can be prevented by the application of
(1) Auxins
(2) Gibberellic acid
(3) Cytokinins
(4) Ethylene
Answer (1)
Sol. Auxins prevent premature leaf and fruit fall.
NAA prevents fruit drop in tomato; 2,4-D prevents fruit drop in Citrus.

56. Which of the following facilitates opening of stomatal aperture?
(1) Radial orientation of cellulose microfibrils in the cell wall of guard cells
(2) Longitudinal orientation of cellulose microfibrils in the cell wall of guard cells
(3) Contraction of outer wall of guard cells
(4) Decrease in turgidity of guard cells
Answer (1)
Sol. Cellulose microfibrils are oriented radially rather than longitudinally which makes easy for the stoma to open.

57. DNA replication in bacteria occurs
(1) Prior to fission
(2) Just before transcription
(3) During S-phase
(4) Within nucleolus
Answer (1)
Sol. DNA replication in bacteria occurs prior to fission. Prokaryotes do not show well marked S-phase due to their primitive nature.

58. Phosphonol pyruvate (PEP) is the primary CO₂ acceptor in :
(1) C₂ plants
(2) C₃ and C₄ plants
(3) C₃ plants
(4) C₄ plants
Answer (4)
Sol. PEP is 3C compound which serves as primary CO₂ acceptor in the mesophyll cell cytoplasm of C₄ plants like maize, sugarcane, Sorghum etc.

59. Which of the following options best represents the enzyme composition of pancreatic juice?
(1) Peptidase, amylase, pepsin, rennin
(2) Lipase, amylase, trypsinogen, procarboxypeptidase
(3) Amylase, peptidase, trypsinogen, rennin
(4) Amylase, pepsin, trypsinogen, maltase
Answer (2)
Sol. Rennin and Pepsin enzymes are present in the gastric juice. Maltase is present in the intestinal juice.

60. Among the following characters, which one was not considered by Mendel in his experiments on pea?
(1) Seed – Green or Yellow
(2) Pod – Inflated or Constricted
(3) Stem – Tall or Dwarf
(4) Trichomes – Glandular or non-glandular
Answer (4)
Sol. During his experiments Mendel studied seven characters.
Nature of trichomes i.e., glandular or non-glandular was not considered by Mendel.

61. A gene whose expression helps to identify transformed cell is known as
(1) Plasmid
(2) Structural gene
(3) Selectable marker
(4) Vector
Answer (3)
Answer (3)
Sol. In recombinant DNA technology, selectable markers help in identifying and eliminating non-transformants and selectively permitting the growth of the transformants.

62. In case of a couple where the male is having a very low sperm count, which technique will be suitable for fertilisation?
(1) Artificial Insemination
(2) Intracytoplasmic sperm injection
(3) Intrauterine transfer
(4) Gamete intracytoplasmic fallopian transfer

Answer (1)
Sol. Infertility cases due to inability of the male partner to inseminate the female or due to very low sperm count in the ejaculates, could be corrected by artificial insemination (AI).

63. Match the following sexually transmitted diseases (Column - I) with their causative agent (Column - II) and select the correct option.

<table>
<thead>
<tr>
<th>Column - I</th>
<th>Column - II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Gonorrhea</td>
<td>(i) HIV</td>
</tr>
<tr>
<td>(b) Syphilis</td>
<td>(ii) Neisseria</td>
</tr>
<tr>
<td>(c) Genital Warts</td>
<td>(iii) Treponema</td>
</tr>
<tr>
<td>(d) AIDS</td>
<td>(iv) Human Papilloma virus</td>
</tr>
</tbody>
</table>

Options:
(1) (iv) (ii) (iii) (i)
(2) (iv) (iii) (ii) (i)
(3) (ii) (iii) (iv) (i)
(4) (iii) (iv) (i) (ii)

Answer (3)
Sol. Gonorrhea – Neisseria (Bacteria)
Syphilis – Treponema (Bacteria)
Genital Warts – Human papilloma virus (Virus)
AIDS – HIV (Virus)

64. Which among these is the correct combination of aquatic mammals?
(1) Whales, Dolphins, Seals
(2) Trygon, Whales, Seals
(3) Seals, Dolphins, Sharks
(4) Dolphins, Seals, Trygon

Answer (1)
Sol. Sharks and Trygon (sting ray) are the members of chondrichthyes (cartilaginous fish) while whale, Dolphin and Seals are aquatic mammals belong to class mammalia.

65. Flowers which have single ovule in the ovary and are packed into inflorescence are usually pollinated by
(1) Wind
(2) Bat
(3) Water
(4) Bee

Answer (1)
Sol. Wind pollination or anemophily is favoured by flowers having a single ovule in each ovary, and numerous flowers packed in an inflorescence. Wind pollination is a non-directional pollination.

66. Life cycle of Ectocarpus and Fucus respectively are
(1) Haplodiplontic, Diplontic
(2) Haplodiplontic, Haplontic
(3) Haplontic, Diplontic
(4) Diplontic, Haplodiplontic

Answer (1)
Sol. Ectocarpus has haplodiplontic life cycle and Fucus has diplontic life cycle.

67. The association of histone H1 with a nucleosome indicates:
(1) The DNA is condensed into a Chromatin Fibre
(2) The DNA double helix is exposed
(3) Transcription is occurring
(4) DNA replication is occurring

Answer (1)
Sol. The association of H1 protein indicates the complete formation of nucleosome. Therefore the DNA is in condensed form.

68. During DNA replication, Okazaki fragments are used to elongate
(1) The leading strand away from replication fork
(2) The lagging strand away from the replication fork
(3) The leading strand towards replication fork
(4) The lagging strand towards replication fork

Answer (2)
Sol. Two DNA polymerase molecules work simultaneously at the DNA fork, one on the leading strand and the other on the lagging strand.
Each Okazaki fragment is synthesized by DNA polymerase at lagging strand in 5’ → 3’ direction. New Okazaki fragments appear as the replication fork opens further.
As the first Okazaki fragment appears away from the replication fork, the direction of elongation would be away from replication fork.
69. Thalassemia and sickle cell anemia are caused due to a problem in globin molecule synthesis. Select the correct statement.

(1) Thalassemia is due to less synthesis of globin molecules
(2) Sickle cell anemia is due to a quantitative problem of globin molecules
(3) Both are due to a qualitative defect in globin chain synthesis
(4) Both are due to a quantitative defect in globin chain synthesis

Answer (1)

Sol. Thalassemia differs from sickle-cell anaemia in that the former is a quantitative problem of synthesising too few globin molecules while the latter is a qualitative problem of synthesising an incorrectly functioning globin.

70. Coconut fruit is a

(1) Nut
(2) Capsule
(3) Drupe
(4) Berry

Answer (3)

Sol. Coconut fruit is a drupe. A drupe develops from monocarpellary superior ovary and are one seeded.

71. Attractants and rewards are required for

(1) Hydrophily
(2) Cleistogamy
(3) Anemophily
(4) Entomophily

Answer (4)

Sol. Insect pollinated plants provide rewards as edible pollen grain and nectar as usual rewards. While some plants also provide safe place for deposition of eggs.

72. Spliceosomes are not found in cells of

(1) Animals
(2) Bacteria
(3) Plants
(4) Fungi

Answer (2)

Sol. Spliceosomes are used in removal of introns during post-transcriptional processing of hnRNA in eukaryotes only as split genes are absent as prokaryotes.

73. Hypersecretion of Growth Hormone in adults does not cause further increase in height, because

(1) Bones loose their sensitivity to Growth Hormone in adults
(2) Muscle fibres do not grow in size after birth
(3) Growth Hormone becomes inactive in adults
(4) Epiphyseal plates close after adolescence

Answer (4)

Sol. Epiphyseal plate is responsible for the growth of bone which close after adolescence so hypersecretion of growth hormone in adults does not cause further increase in height.

74. Which one of the following statements is not valid for aerosols?

(1) They cause increased agricultural productivity
(2) They have negative impact on agricultural land
(3) They are harmful to human health
(4) They alter rainfall and monsoon patterns

Answer (1)

Sol. Aerosols can cause various problems to agriculture through its direct or indirect effects on plants. However continually increasing air pollution may represent a persistent and largely irreversible threat to agriculture in the future.

75. The vascular cambium normally gives rise to

(1) Secondary xylem
(2) Periderm
(3) Phelloderm
(4) Primary phloem

Answer (1)

Sol. During secondary growth, vascular cambium gives rise to secondary xylem and secondary phloem. Phelloderm is formed by cork cambium.

76. If there are 999 bases in an RNA that codes for a protein with 333 amino acids, and the base at position 901 is deleted such that the length of the RNA becomes 998 bases, how many codons will be altered?

(1) 33
(2) 333
(3) 1
(4) 11

Answer (1)

Sol. If deletion occurs at 901st position the remaining 98 bases specifying for 33 codons of amino acids will be altered.
77. Which of the following are found in extreme saline conditions?
   (1) Cyanobacteria
   (2) Mycobacteria
   (3) Archaebacteria
   (4) Eubacteria

   **Answer (3)**
   **Sol.** Archaebacteria are able to survive in harsh conditions because of branched lipid chain in cell membrane which reduces fluidity of cell membrane. Halophiles are exclusively found in saline habitats.

78. The process of separation and purification of expressed protein before marketing is called
   (1) Bioprocessing
   (2) Postproduction processing
   (3) Upstream processing
   (4) Downstream processing

   **Answer (4)**
   **Sol.** Biosynthetic stage for synthesis of product in recombinant DNA technology is called upstreaming process while after completion of biosynthetic stage, the product has to be subjected through a series of processes which include separation and purification are collectively referred to as downstreaming processing.

79. Capacitation occurs in
   (1) Vas deferens
   (2) Female Reproductive tract
   (3) Rete testis
   (4) Epididymis

   **Answer (2)**
   **Sol.** Capacitation is increase in fertilising capacity of sperms which occurs in female reproductive tract.

80. Functional megaspore in an angiosperm develops into
   (1) Embryo sac
   (2) Embryo
   (3) Ovule
   (4) Endosperm

   **Answer (1)**
   **Sol.** Megaspore is the first cell of female gametophytic generation in angiosperm. It undergoes three successive generations of free nuclear mitosis to form 8-nucleated and 7-celled embryo sac.

81. Anaphase promoting complex (APC) is a protein degradation machinery necessary for proper mitosis of animal cells. If APC is defective in a human cell, which of the following is expected to occur?
   (1) Chromosomes will not segregate
   (2) Recombination of chromosome arms will occur
   (3) Chromosomes will not condense
   (4) Chromosomes will be fragmented

   **Answer (1)**
   **Sol.** Anaphase Promoting Complex (APC) is a protein necessary for separation of daughter chromosomes during anaphase. If APC is defective then the chromosomes will fail to segregate during anaphase.

82. Myelin sheath is produced by
   (1) Oligodendrocytes and Osteoclasts
   (2) Osteoclasts and Astrocytes
   (3) Schwann Cells and Oligodendrocytes
   (4) Astrocytes and Schwann Cells

   **Answer (3)**
   **Sol.** Oligodendrocytes are neuroglial cells which produce myelin sheath in central nervous system while Schwann cell produces myelin sheath in peripheral nervous system.

83. Which of the following options gives the correct sequence of events during mitosis?
   (1) Condensation → crossing over → nuclear membrane disassembly → segregation → telophase
   (2) Condensation → arrangement at equator → centromere division → segregation → telophase
   (3) Condensation → nuclear membrane disassembly → crossing over → segregation → telophase
   (4) Condensation → nuclear membrane disassembly → arrangement at equator → centromere division → segregation → telophase

   **Answer (4)**
   **Sol.** The correct sequence of events during mitosis would be as follows
   (i) Condensation of DNA so that chromosomes become visible occurs during early to mid-prophase.
   (ii) Nuclear membrane disassembly begins at late prophase or transition to metaphase.
   (iii) Arrangement of chromosomes at equator occurs during metaphase, called congression.
(iv) Centromere division or splitting occurs during anaphase forming daughter chromosomes.
(v) Segregation also occurs during anaphase as daughter chromosomes separate and move to opposite poles.
(vi) Telophase leads to formation of two daughter nuclei.

84. A disease caused by an autosomal primary non-disjunction is
(1) Turner's syndrome
(2) Sickle cell anemia
(3) Down's syndrome
(4) Klinefelter's syndrome
Answer (3)
Sol. Down's syndrome is caused by non-disjunction of 21st chromosome.

85. Which one of the following is related to *Ex-situ* conservation of threatened animals and plants?
(1) Amazon rainforest
(2) Himalayan region
(3) Wildlife Safari parks
(4) Biodiversity hot spots
Answer (3)
Sol. *Ex-situ* conservation is offsite strategy for conservation of animals and plants in zoological park and botanical gardens respectively.

86. The function of copper ions in copper releasing IUD's is:
(1) They make uterus unsuitable for implantation
(2) They inhibit ovulation
(3) They suppress sperm motility and fertilising capacity of sperms
(4) They inhibit gametogenesis
Answer (3)
Sol. 

87. Which of the following RNAs should be most abundant in animal cell?
(1) m-RNA
(2) mi-RNA
(3) r-RNA
(4) t-RNA
Answer (4)
Sol. DNA fragments are negatively charged because of phosphate group.
91. A first order reaction has a specific reaction rate of $10^{-2}$ s$^{-1}$. How much time will it take for 20 g of the reactant to reduce to 5 g?

(1) 346.5 second
(2) 693.0 second
(3) 238.6 second
(4) 138.6 second

Answer (4)

Sol. $t_{1/2} = \frac{0.693}{10^{-2}}$ second

For the reduction of 20 g of reactant to 5 g, two $t_{1/2}$ is required.

$\therefore \quad t = 2 \times \frac{0.693}{10^{-2}}$ second

= 138.6 second

92. A gas is allowed to expand in a well insulated container against a constant external pressure of 2.5 atm from an initial volume of 2.50 L to a final volume of 4.50 L. The change in internal energy $\Delta U$ of the gas in joules will be

(1) $-505$ J
(2) $+505$ J
(3) $1136.25$ J
(4) $-500$ J

Answer (1)

Sol. $\Delta U = q + w$

For adiabatic process, $q = 0$

$\therefore \quad \Delta U = w$ $- P \cdot \Delta V$

$= -2.5 \text{ atm} \times (4.5 - 2.5) \text{ L}$

$= -2.5 \times 2 \text{ L-atm}$

$= -5 \times 101.3 \text{ J}$

$= -506.5 \text{ J}$

$= -505 \text{ J}$

93. Which one is the correct order of acidity?

(1) $\text{CH} \equiv \text{CH} > \text{CH}_2 = \text{CH}_2 > \text{CH}_3 - \text{C} \equiv \text{CH} > \text{CH}_3 - \text{CH}_3$
(2) $\text{CH}_3 - \text{CH}_3 > \text{CH}_2 = \text{CH}_2 > \text{CH}_3 - \text{C} \equiv \text{CH} > \text{CH} \equiv \text{CH}$
(3) $\text{CH}_2 = \text{CH}_2 > \text{CH}_3 - \text{C} \equiv \text{CH} = \text{CH}_2 > \text{CH}_3 - \text{C} \equiv \text{CH} > \text{CH} \equiv \text{CH}$
(4) $\text{CH} \equiv \text{CH} > \text{CH}_3 - \text{C} \equiv \text{CH} > \text{CH}_2 = \text{CH}_2 > \text{CH}_3 - \text{CH}_3$

Answer (4)

Sol. Correct order is

$\text{H} \equiv \text{C} \equiv \text{C} - \text{H} > \text{H}_2 \text{C} - \text{C} \equiv \text{CH} > \text{H}_2 \text{C} = \text{CH}_2 > \text{CH}_3 - \text{CH}_3$

94. Which of the following is a sink for CO?

(1) Oceans
(2) Plants
(3) Haemoglobin
(4) Micro-organisms present in the soil

Answer (4)

Sol. Micro-organisms present in the soil is a sink for CO.

95. If molality of the dilute solution is doubled, the value of molal depression constant ($K_f$) will be

(1) Tripled
(2) Unchanged
(3) Doubled
(4) Halved

Answer (2)

Sol. $K_f$ (molal depression constant) is a characteristic of solvent and is independent of molality.

96. With respect to the conformers of ethane, which of the following statements is true?

(1) Both bond angle and bond length change
(2) Both bond angles and bond length remains same
(3) Bond angle remains same but bond length changes
(4) Bond angle changes but bond length remains same

Answer (2)

Sol. There is no change in bond angles and bond lengths in the conformations of ethane. There is only change in dihedral angle.

97. Pick out the correct statement with respect $[\text{Mn(CN)}_6]^{3-}$:

(1) It is $d^5sp^3$ hybridised and octahedral
(2) It is $dsp^2$ hybridised and square planar
(3) It is $sp^3d^2$ hybridised and octahedral
(4) It is $sp^3d^2$ hybridised and tetrahedral
98. Which of the following pairs of compounds is isoelectronic and isostructural?

(1) IBr₂, XeF₂  
(2) IF₃, XeF₂  
(3) BeCl₂, XeF₂  
(4) TeI₂, XeF₂

**Answer (1)**

**Sol.** IBr₂, XeF₂

Total number of valence electrons are equal in both the species and both the species are linear also.

99. Which one of the following statements is not correct?

(1) Enzymes catalyse mainly bio-chemical reactions  
(2) Coenzymes increase the catalytic activity of enzyme  
(3) Catalyst does not initiate any reaction  
(4) The value of equilibrium constant is changed in the presence of a catalyst in the reaction at equilibrium

**Answer (4)**

**Sol.** A catalyst decreases activation energies of both the forward and backward reaction by same amount, therefore, it speeds up both forward and backward reaction by same rate.

Equilibrium constant is therefore not affected by catalyst at a given temperature.

100. Concentration of the Ag⁺ ions in a saturated solution of Ag₂C₂O₄ is 2.2 x 10⁻⁴ mol L⁻¹. Solubility product of Ag₂C₂O₄ is

(1) 4.5 x 10⁻¹¹  
(2) 5.3 x 10⁻¹²  
(3) 2.42 x 10⁻⁶  
(4) 2.66 x 10⁻¹²

**Answer (2)**

**Sol.** Ag₂C₂O₄(s) ⇌ 2Ag⁺(aq) + C₂O₄²⁻(aq)

\[ K_{SP} = [Ag^+]^2 [C_2O_4^{2-}] \]
\[ [Ag^+] = 2.2 \times 10^{-4} \text{ M} \]

\[ \therefore [C_2O_4^{2-}] = \frac{2.2 \times 10^{-4}}{2} \text{ M} = 1.1 \times 10^{-4} \text{ M} \]

\[ \therefore K_{SP} = (2.2 \times 10^{-4})^2 (1.1 \times 10^{-4}) = 5.324 \times 10^{-12} \]

101. The reason for greater range of oxidation states in actinoids is attributed to

(1) 5f, 6d and 7s levels having comparable energies  
(2) 4f and 5d levels being close in energies  
(3) The radioactive nature of actinoids  
(4) Actinoid contraction

**Answer (1)**

**Sol.** It is a fact.

102. In the electrochemical cell

Zn|ZnSO₄(0.01M)||CuSO₄(1.0 M)||Cu, the emf of this Daniel cell is E₁. When the concentration of ZnSO₄ is changed to 1.0 M and that of CuSO₄ changed to 0.01 M, the emf changes to E₂. From the following, which one is the relationship between E₁ and E₂?

(Given, \( \frac{RT}{F} = 0.059 \))

(1) \( E_1 > E_2 \)  
(2) \( E_2 = 0 \neq E_1 \)  
(3) \( E_1 = E_2 \)  
(4) \( E_1 < E_2 \)

**Answer (1)**

**Sol.** Zn|ZnSO₄(0.01 M)||CuSO₄(1.0 M)||Cu

\[ E_1 = E_{cell}^o - \frac{2.303RT}{2F} \times \log \left( \frac{0.01}{1} \right) \]

When concentrations are changed

\[ E_2 = E_{cell}^o - \frac{2.303RT}{2F} \times \log \left( \frac{1}{0.01} \right) \]

i.e., \( E_1 > E_2 \)
103. Identify A and predict the type of reaction

![Chemical structure](image1)

(1) and cine substitution reaction

(2) and cine substitution reaction

(3) and substitution reaction

(4) and elimination addition reaction

**Answer (3)**

**Sol.**

OCH₃

More stable as –ve charge is close to electron withdrawing group

∴ Incoming nucleophile ends on same ‘C’ on which ‘Br’ (Leaving group) was present

∴ **NOT** cine substitution.

104. Which one is the wrong statement?

(1) Half-filled and fully filled orbitals have greater stability due to greater exchange energy, greater symmetry and more balanced arrangement

(2) The energy of 2s orbital is less than the energy of 2p orbital in case of Hydrogen like atoms

(3) de-Broglie’s wavelength is given by \( \lambda = \frac{h}{mv} \), where \( m \) = mass of the particle, \( v \) = group velocity of the particle

(4) The uncertainty principle is \( \Delta E \times \Delta t \geq \frac{h}{4\pi} \)

**Answer (2)**

**Sol.** Energy of 2s-orbital and 2p-orbital in case of hydrogen like atoms is equal.

105. The correct order of the stoichiometries of AgCl formed when AgNO₃ in excess is treated with the complexes: CoCl₃·6NH₃, CoCl₃·5NH₃, CoCl₃·4NH₃ respectively is

(1) 3 AgCl, 2 AgCl, 1 AgCl

(2) 2 AgCl, 3 AgCl, 1 AgCl

(3) 1 AgCl, 3 AgCl, 2 AgCl

(4) 3 AgCl, 1 AgCl, 2 AgCl

**Answer (1)**

**Sol.** Complexes are respectively [Co(NH₃)₆]Cl₃, [Co(NH₃)₅]Cl₂ and [Co(NH₃)₄]Cl₂

106. Name the gas that can readily decolourises acidified KMnO₄ solution:

(1) NO₂

(2) P₂O₅

(3) CO₂

(4) SO₂

**Answer (4)**

**Sol.** SO₂ is readily decolourises acidified KMnO₄.

107. The correct statement regarding electrophile is

(1) Electrophiles are generally neutral species and can form a bond by accepting a pair of electrons from a nucleophile

(2) Electrophile can be either neutral or positively charged species and can form a bond by accepting a pair of electrons from a nucleophile

(3) Electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from a nucleophile

(4) Electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from another electrophile

**Answer (2)**

**Sol.** Fact.
108. The species, having bond angles of 120° is

(1) $\text{NCl}_3$  (2) $\text{BCl}_3$
(3) $\text{PH}_3$  (4) $\text{ClF}_3$

**Answer (2)**

**Sol.**

\[
\begin{array}{c}
\text{Cl} \\
\text{B} \\
\text{Cl}\end{array}
\]

109. Which of the following statements is not correct?

(1) Blood proteins thrombin and fibrinogen are involved in blood clotting
(2) Denaturation makes the proteins more active
(3) Insulin maintains sugar level in the blood of a human body
(4) Ovalbumin is a simple food reserve in egg-white

**Answer (2)**

**Sol.** Due to denaturation of proteins, globules unfold and helix get uncoiled and protein loses its biological activity.

110. Consider the reactions:

\[
\begin{align*}
\text{X} & \quad \text{Cu} / 573 \text{K} \quad \text{Y} \\
\text{(C}_2\text{H}_4\text{O}) & \\
\text{Z} & \\
\end{align*}
\]

Identify A, X, Y and Z

(1) A-Ethanal, X-Ethanol, Y-But-2-enal, Z-Semicarbazone
(2) A-Ethanol, X-Acetaldehyde, Y-Butanone, Z-Hydrazone
(3) A-Methoxymethane, X-Ethanoic acid, Y-Acetate ion, Z-hydrazone
(4) A-Methoxymethane, X-Ethanol, Y-Ethanoic acid, Z-Semicarbazone

**Answer (1)**

**Sol.** Since ‘A’ gives positive silver mirror test therefore, it must be an aldehyde or $\alpha$-Hydroxyketone.

Reaction with semicarbazide indicates that A can be an aldehyde or ketone.

Reaction with OH$^-$ i.e., aldol condensation (by assuming alkali to be dilute) indicates that A is aldehyde as aldol reaction of ketones is reversible and carried out in special apparatus.

These indicates option (1).

\[
\begin{align*}
\text{CH}_3\text{CH}_2\text{OH} & \quad \text{Cu} / 573 \text{K} \quad \text{CH}_2\text{CHO} \\
\text{X} & \quad \text{A} & \quad \text{Y} \\
\text{Z} & \\
\text{CH}_3 - \text{CH} = \text{N} - \text{NH} - \text{C} - \text{NH}_2 & \\
\text{3-Hydroxybutanal} & \\
\text{But-2-enal} & \\
\end{align*}
\]

111. Mechanism of a hypothetical reaction $X_2 + Y_2 \rightarrow 2XY$ is given below:

(i) $X_2 \rightarrow X + X$ (fast)
(ii) $X + Y_2 \rightarrow XY + Y$ (slow)
(iii) $X + Y \rightarrow XY$ (fast)

The overall order of the reaction will be

(1) 0  (2) 1.5  (3) 1  (4) 2

**Answer (2)**

**Sol.** The solution of this question is given by assuming step (i) to be reversible which is not given in question.

Overall rate = Rate of slowest step (ii)

\[
\begin{align*}
\text{Overall rate} & = \frac{\text{Rate of step (ii)}}{k[X][Y]} \\
& = k[X][Y] \\
& \text{(1)}
\end{align*}
\]

$k = \text{rate constant of step (ii)}$

Assuming step (i) to be reversible, its equilibrium constant,

\[
\begin{align*}
\text{k}_{eq} & = \frac{[X]^2}{[X_2]} \Rightarrow [X] = \text{k}_{eq} \frac{1}{2}[X_2] \quad \text{(2)}
\end{align*}
\]

Put (2) in (1)

\[
\begin{align*}
\text{Rate} & = k \frac{1}{2}[X_2] \frac{1}{2}[Y_2] \\
& = 2 \text{k}_{eq} \frac{1}{2}[X_2] \frac{1}{2}[Y_2] \\
& \text{Overall order} = \frac{1}{2} + \frac{1}{2} = \frac{3}{2}
\end{align*}
\]

112. Which of the following reactions is appropriate for converting acetamide to methanamine?

(1) Stephens reaction
(2) Gabriels phthalimide synthesis
(3) Carbylamine reaction
(4) Hoffmann hypobromamide reaction

**Answer (4)**

**Sol.**

\[
\begin{align*}
\text{CH}_3 - \text{C} - \text{NH}_2 + \text{Br}_2 + 4\text{NaOH} & \rightarrow \text{CH}_3 - \text{NH}_3 + \text{2NaBr} + \text{Na}_2\text{CO}_3 + 3\text{H}_2\text{O}
\end{align*}
\]

This is Hoffmann Bromamide reaction.
113. Correct increasing order for the wavelengths of absorption in the visible region for the complexes of Co$^{3+}$ is

(1) [Co(H$_2$O)$_6$]$^{3+}$, [Co(NH$_3$)$_6$]$^{3+}$, [Co(en)$_3$]$^{3+}$
(2) [Co(NH$_3$)$_6$]$^{3+}$, [Co(en)$_3$]$^{3+}$, [Co(H$_2$O)$_6$]$^{3+}$
(3) [Co(en)$_3$]$^{3+}$, [Co(NH$_3$)$_6$]$^{3+}$, [Co(H$_2$O)$_6$]$^{3+}$
(4) [Co(H$_2$O)$_6$]$^{3+}$, [Co(en)$_3$]$^{3+}$, [Co(NH$_3$)$_6$]$^{3+}$

Answer (3)

Sol. The order of the ligand in the spectrochemical series

$\text{H}_2\text{O} < \text{NH}_3 < \text{en}$

Hence, the wavelength of the light observed will be in the order

$[\text{Co(H}_2\text{O)}_6]^{3+} < [\text{Co(NH}_3\text{)}_6]^{3+} < [\text{Co(en)}_3]^{3+}$

Thus, wavelength absorbed will be in the opposite order

i.e., [Co(en)$_3$]$^{3+}$, [Co(NH$_3$)$_6$]$^{3+}$, [Co(H$_2$O)$_6$]$^{3+}$

114. Which is the incorrect statement?

(1) NaCl(s) is insulator, silicon is semiconductor, silver is conductor, quartz is piezo electric crystal
(2) Frenkel defect is favoured in those ionic compounds in which sizes of cation and anions are almost equal
(3) FeO$_{0.98}$ has non stoichiometric metal deficiency defect
(4) Density decreases in case of crystals with Schottky’s defect

Answer (2 & 3)

Sol. Frenkel defect occurs in those ionic compounds in which size of cation and anion is largely different.

Non-stoichiometric ferrous oxide is Fe$_{0.93-0.96}$O$_{1.00}$ and it is due to metal deficiency defect.

115. The equilibrium constants of the following are

$\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 \quad K_1$
$\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO} \quad K_2$
$\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O} \quad K_3$

The equilibrium constant (K) of the reaction

$2\text{NH}_3 + \frac{5}{2}\text{O}_2 \rightleftharpoons 2\text{NO} + 3\text{H}_2\text{O},$ will be

(1) $K_2K_3 / K_1$
(2) $K_3^2K_3 / K_1$
(3) $K_3K_3^3 / K_2$
(4) $K_2K_3^3 / K_1$

Answer (4)

Sol. (i) $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3; K_1 = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$

(ii) $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}; K_2 = \frac{[\text{NO}]^2}{[\text{N}_2][\text{O}_2]}$

(iii) $\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}; K_3 = \frac{[\text{H}_2\text{O}]}{[\text{H}_2][\text{O}_2]^{1/2}}$

$(II + 3 \times III – II)$ will give

$2\text{NH}_3 + \frac{5}{2}\text{O}_2 \rightleftharpoons 2\text{NO} + 3\text{H}_2\text{O};$

$K = K_2 \times K_3^3 / K_1$

116. Extraction of gold and silver involves leaching with CN$^–$ ion. Silver is later recovered by

(1) Zone refining (2) Displacement with Zn
(3) Liquation (4) Distillation

Answer (2)

Sol. Zn being more reactive than Ag and Au, displaces them.

From Native ore,

$4\text{Ag} + 8\text{NaCN} + 2\text{H}_2\text{O} + \text{O}_2 \rightarrow \text{Leaching} \rightarrow 4\text{Na}[\text{Ag(CN)}_2] + 4\text{NaOH}$

$\text{Sodium dicyanoargentate(I)}$

$2\text{Na}[\text{Ag(CN)}_2] + \text{Zn} \rightarrow \text{Displacement} \rightarrow \text{Na}_2[\text{Zn(CN)}_4] + 2\text{Ag}$

117. The most suitable method of separation of 1 : 1 mixture of ortho and para-nitrophenols is

(1) Crystallisation (2) Steam distillation
(3) Sublimation (4) Chromatography

Answer (2)

Sol. Steam distillation is the most suitable method of separation of 1 : 1 mixture of ortho and para nitrophenols as there is intramolecular H-bonds in ortho nitrophenol.

118. It is because of inability of ns$^2$ electrons of the valence shell to participate in bonding that

(1) Sn$^{2+}$ and Pb$^{2+}$ are both oxidising and reducing
(2) Sn$^{4+}$ is reducing while Pb$^{4+}$ is oxidising
(3) Sn$^{2+}$ is reducing while Pb$^{4+}$ is oxidising
(4) Sn$^{2+}$ is oxidising while Pb$^{4+}$ is reducing
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Answer (3)

Sol. Inability of \( ns^2 \) electrons of the valence shell to participate in bonding on moving down the group in heavier p-block elements is called **inert pair effect**

As a result, \( \text{Pb(II)} \) is more stable than \( \text{Pb(IV)} \)

\[ \text{Sn(IV) is more stable than Sn(II)} \]

\[ \therefore \text{Pb(IV) is easily reduced to Pb(II)} \]

\[ \therefore \text{Pb(IV) is oxidising agent} \]

\[ \text{Sn(II) is easily oxidised to Sn(IV)} \]

\[ \therefore \text{Sn(II) is reducing agent} \]

119. An example of a sigma bonded organometallic compound is

(1) Ferrocene (2) Cobaltocene

(3) Ruthenocene (4) Grignard’s reagent

Answer (4)

Sol. Grignard’s reagent \( \text{i.e., RMgX} \) is \( \sigma \)-bonded organometallic compound.

120. For a given reaction, \( \Delta H = 35.5 \text{ kJ mol}^{-1} \) and \( \Delta S = 83.6 \text{ JK}^{-1} \text{ mol}^{-1} \). The reaction is spontaneous at \( T \) (Assume that \( \Delta H \) and \( \Delta S \) do not vary with temperature)

(1) All temperatures (2) \( T > 298 \text{ K} \)

(3) \( T < 425 \text{ K} \) (4) \( T > 425 \text{ K} \)

Answer (4)

Sol. \[ \Delta G = \Delta H - T \Delta S \]

For a reaction to be spontaneous, \( \Delta G = -\text{ve} \)

\( \text{i.e., } \Delta H < T \Delta S \)

\[ T > \frac{\Delta H}{\Delta S} = \frac{35.5 \times 10^3}{83.6} \text{ JK}^{-1} \]

\( \text{i.e., } T > 425 \text{ K} \)

121. Ionic mobility of which of the following alkali metal ions is lowest when aqueous solution of their salts are put under an electric field?

(1) Rb (2) Li

(3) Na (4) K

Answer (2)

Sol. \( \text{Li}^+ \) being smallest, has maximum charge density

\[ \therefore \text{Li}^+ \text{ is most heavily hydrated among all alkali metal ions. Effective size of Li}^+ \text{ in aq solution is therefore, largest.} \]

\[ \therefore \text{Moves slowest under electric field.} \]

122. Which one is the most acidic compound?

(1) \[
\begin{array}{c}
\text{OH} \\
\text{NO}_2 \\
\end{array}
\]

(2) \[
\begin{array}{c}
\text{OH} \\
\text{NO}_2 \\
\end{array}
\]

(3) \[
\begin{array}{c}
\text{OH} \\
\text{CH}_3 \\
\end{array}
\]

(4) \[
\begin{array}{c}
\text{OH} \\
\end{array}
\]

Answer (2)

Sol. \(-\text{NO}_2 \) group has very strong \(-I \) & \(-R \) effects.

123. Mixture of chloroxylenol and terpineol acts as

(1) Antipyretic (2) Antibiotic

(3) Analgesic (4) Antiseptic

Answer (4)

Sol. Mixture of chloroxylenol and terpineol acts as antiseptic.

124. Of the following, which is the product formed when cyclohexanone undergoes aldol condensation followed by heating?

(1) \[
\begin{array}{c}
\text{OH} \\
\end{array}
\]

(2) \[
\begin{array}{c}
\text{O} \\
\text{O} \\
\end{array}
\]

(3) \[
\begin{array}{c}
\text{OH} \\
\text{O} \\
\end{array}
\]

(4) \[
\begin{array}{c}
\text{O} \\
\end{array}
\]

Answer (4)

Sol. \( \text{(i) OH}^{-} \) + (ii) \( \Delta \)
125. The element $Z = 114$ has been discovered recently. It will belong to which of the following family group and electronic configuration?

1. Oxygen family, $[\text{Rn}] 5f^{14}6d^{10}7s^27p^4$
2. Nitrogen family, $[\text{Rn}] 5f^{14}6d^{10}7s^27p^5$
3. Halogen family, $[\text{Rn}] 5f^{14}6d^{10}7s^27p^6$
4. Carbon family, $[\text{Rn}] 5f^{14}6d^{10}7s^27p^2$

Answer (4)

Sol. $Z = 114$ belong to Group 14, carbon family.

Electronic configuration = $[\text{Rn}] 5f^{14}6d^{10}7s^27p^2$

126. The correct increasing order of basic strength for the following compounds is

(I) $\text{NH}_2\text{NH}_2\text{NH}_2$  (II) $\text{NO}_2\text{H}_2\text{O}$  (III) $\text{CH}_3\text{I}$

1. $\text{III} < \text{II} < \text{I}$
2. $\text{II} < \text{I} < \text{III}$
3. $\text{II} < \text{III} < \text{I}$
4. $\text{III} < \text{I} < \text{II}$

Answer (2)

Sol. $–\text{NO}_2$ has strong $–\text{R}$ effect and $–\text{CH}_3$ shows $+\text{R}$ effect.

∴ Order of basic strength is $\text{NH}_2\text{NH}_2\text{NH}_2 < \text{NO}_2\text{H}_2\text{O} < \text{CH}_3\text{I}$

127. Which of the following is dependent on temperature?

1. Mole fraction
2. Weight percentage
3. Molality
4. Molarity

Answer (4)

Sol. Molarity includes volume of solution which can change with change in temperature.

128. The heating of phenyl-methyl ethers with HI produces.

1. Phenol
2. Benzene
3. Ethyl chlorides
4. Iodobenzene

Answer (1)

Sol. $\text{O–CH}_3 \xrightarrow{\text{HI}} \text{OH} + \text{CH}_3\text{I}$

129. Predict the correct intermediate and product in the following reaction

$$\text{H}_3\text{C} = \text{C} = \text{CH} \xrightarrow{\text{H}_2\text{O}, \text{H}_2\text{SO}_4, \text{HgSO}_4} \text{intermediate} \xrightarrow{\text{product}}$$

1. $\text{A}: \text{H}_3\text{C} – \text{C} – \text{CH}_3$  $\text{B}: \text{H}_3\text{C} = \text{C} = \text{CH}$
2. $\text{A}: \text{H}_3\text{C} = \text{C} = \text{CH}_2$  $\text{B}: \text{H}_3\text{C} – \text{C} – \text{CH}_3$
3. $\text{A}: \text{H}_3\text{C} – \text{C} – \text{CH}_2$  $\text{B}: \text{H}_3\text{C} = \text{C} = \text{CH}$
4. $\text{A}: \text{H}_3\text{C} = \text{C} = \text{CH}_2$  $\text{B}: \text{H}_3\text{C} – \text{C} – \text{CH}_2$

Answer (4)

Sol. $\text{O – CH}_3$ $\xrightarrow{\text{HI}}$ $\text{OH}$ $\xrightarrow{\text{Tautomerism}}$

130. In which pair of ions both the species contain $\text{S–S}$ bond?

1. $\text{S}_2\text{O}_7^{2–}, \text{S}_2\text{O}_8^{2–}$
2. $\text{S}_4\text{O}_6^{2–}, \text{S}_2\text{O}_7^{2–}$
3. $\text{S}_2\text{O}_7^{2–}, \text{S}_2\text{O}_3^{2–}$
4. $\text{S}_4\text{O}_6^{2–}, \text{S}_2\text{O}_3^{2–}$

Answer (4)

Sol. $\text{O} \xrightarrow{\text{O}} \text{O} \xrightarrow{\text{O}} \text{O} \xrightarrow{\text{O}} \text{O}$

131. $\text{HgCl}_2$ and $\text{I}_2$ both when dissolved in water containing $\text{I}^–$ ions the pair of species formed is

1. $\text{Hgl}_4^{2–}, \text{I}_3^–$  (2) $\text{Hg}_2\text{I}_2, \text{I}^–$
2. $\text{Hgl}_2^–, \text{I}_3^–$  (4) $\text{Hg}_2\text{I}_2, \text{I}^–$

Answer (1)

Sol. In a solution containing $\text{HgCl}_2$, $\text{I}_2$ and $\text{I}^–$, both $\text{HgCl}_2$ and $\text{I}_2$ compete for $\text{I}^–$.

Since formation constant of $\text{[Hgl}_4^{2–}$ is $1.9 \times 10^{30}$ which is very large as compared with $\text{I}_3^–$ ($K_f = 700$)

∴ $\text{I}^–$ will preferentially combine with $\text{HgCl}_2$.

$\text{HgCl}_2 + 2\text{I}^– \rightarrow \text{Hgl}_2\downarrow + 2\text{Cl}^–$

Red ppt

$\text{Hgl}_2 + 2\text{I}^– \rightarrow \text{[Hgl}_4^{2–}$ soluble
132. A 20 litre container at 400 K contains CO$_2$(g) at pressure 0.4 atm and an excess of SrO (neglect the volume of solid SrO). The volume of the containers is now decreased by moving the movable piston fitted in the container. The maximum volume of the container, when pressure of CO$_2$ attains its maximum value, will be

(Given that : SrCO$_3$(s) $\rightleftharpoons$ SrO(s) + CO$_2$(g). $K_p = 1.6$ atm)

(1) 4 litre  
(2) 2 litre  
(3) 5 litre  
(4) 10 litre

Answer (3)

Sol. Max. pressure of CO$_2$ = Pressure of CO$_2$ at equilibrium

For reaction,

[\ce{SrCO_3(s) <=> SrO(s) + CO_2(g)}]

$K_p = P_{CO_2} = 1.6$ atm = maximum pressure of CO$_2$

Volume of container at this stage,

$V = \frac{nRT}{P}$ ... (i)

Since container is sealed and reaction was not earlier at equilibrium

∴ $n = \text{constant}$

$n = \frac{PV}{RT} = \frac{0.4 \times 20}{RT}$ ... (ii)

Put equation (ii) in equation (i)

$V = \left[\frac{0.4 \times 20}{RT}\right] \frac{RT}{1.6} = 5 \text{ L}$

133. Match the interhalogen compounds of column I with the geometry in column II and assign the correct code

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) XX$'$</td>
<td>(i) T-shape</td>
</tr>
<tr>
<td>(b) XX$'_3$</td>
<td>(ii) Pentagonal bipyramidal</td>
</tr>
<tr>
<td>(c) XX$'_5$</td>
<td>(iii) Linear</td>
</tr>
<tr>
<td>(d) XX$'_7$</td>
<td>(iv) Square-pyramidal</td>
</tr>
<tr>
<td>(v) Tetrahedral</td>
<td></td>
</tr>
</tbody>
</table>

Answer (4)

Sol. XX$'$ $\rightarrow$ Linear

XX$'_3$ $\rightarrow$ Example : ClF$_3$ $\rightarrow$ T-shape

XX$'_5$ $\rightarrow$ Example : BrF$_5$ $\rightarrow$ Square pyramidal

XX$'_7$ $\rightarrow$ Example : IF$_7$ $\rightarrow$ Pentagonal bipyramidal

134. Which one of the following pairs of species have the same bond order?

(1) CN$^-$, CO  
(2) N$_2$, O$_2^-$  
(3) CO, NO  
(4) O$_2$, NO$^+$

Answer (1)

Sol. CN$^-$ and CO have bond order 3 each.

135. The IUPAC name of the compound

HGCOO

is ________.

(1) 5-methyl-4-oxohex-2-en-5-al  
(2) 3-keto-2-methylhex-5-enal  
(3) 3-keto-2-methylhex-4-enal  
(4) 5-formylhex-2-en-3-one

Answer (3)

Sol. HGCOO

Aldehydes get higher priority over ketone and alkene in numbering of principal C-chain.

∴ 3-keto-2-methylhex-4-enal
136. Preeti reached the metro station and found that the escalator was not working. She walked up the stationary escalator in time \( t_1 \). On other days, if she remains stationary on the moving escalator, then the escalator takes her up in time \( t_2 \). The time taken by her to walk up on the moving escalator will be

\[
\begin{align*}
(1) & \quad \frac{t_1 t_2}{t_2 + t_1} \\
(2) & \quad t_1 - t_2 \\
(3) & \quad \frac{t_1 + t_2}{2} \\
(4) & \quad \frac{t_1 t_2}{t_2 - t_1}
\end{align*}
\]

Answer (1)

**Sol.** Velocity of girl w.r.t. elevator \( \frac{d}{t_1} = v_{ge} \)

Velocity of elevator w.r.t. ground \( v_{eg} = \frac{d}{t_2} \) then velocity of girl w.r.t. ground

\[
\vec{v}_{gG} = \vec{v}_{ge} + \vec{v}_{eG}
\]

i.e, \( v_{gG} = v_{ge} + v_{eG} \)

\[
\frac{d}{t} = \frac{d}{t_1} + \frac{d}{t_2}
\]

\[
\frac{1}{t} = \frac{1}{t_1} + \frac{1}{t_2}
\]

\[
t = \frac{t_1 t_2}{t_1 + t_2}
\]

137. An arrangement of three parallel straight wires placed perpendicular to plane of paper carrying same current \( I \) along the same direction is shown in Fig. Magnitude of force per unit length on the middle wire \( 'B' \) is given by

\[
\begin{align*}
(1) & \quad \frac{\sqrt{2} \mu_0 I^2}{\pi d} \\
(2) & \quad \frac{\mu_0 I^2}{\sqrt{2} \pi d} \\
(3) & \quad \frac{\mu_0 I^2}{2 \pi d} \\
(4) & \quad \frac{2 \mu_0 I^2}{\pi d}
\end{align*}
\]

Answer (2)

138. A particle executes linear simple harmonic motion with an amplitude of 3 cm. When the particle is at 2 cm from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then its time period in seconds is

\[
(1) \quad \frac{4 \pi}{\sqrt{5}} \\
(2) \quad \frac{2 \pi}{\sqrt{3}} \\
(3) \quad \sqrt{\frac{5}{\pi}} \\
(4) \quad \frac{\sqrt{5}}{2 \pi}
\]

Answer (1)

**Sol.**

\[
\begin{align*}
F_{BC} = F_{BA} &= \frac{\mu_0 I^2}{2 \pi d} \\
F &= \sqrt{2} F_{BC} \\
&= \sqrt{2} \frac{\mu_0 I^2}{2 \pi d} \\
F &= \frac{\mu_0 I^2}{\sqrt{2} \pi d}
\end{align*}
\]

139. A spherical black body with a radius of 12 cm radiates 450 watt power at 500 K. If the radius were halved and the temperature doubled, the power radiated in watt would be

\[
(1) \quad 1000 \\
(2) \quad 1800 \\
(3) \quad 225 \\
(4) \quad 450
\]

**Sol.** Force between \( BC \) and \( AB \) will be same in magnitude.
Answer (2)
Sol. Rate of power loss
\[ r \propto R^2 T^4 \]
\[ \frac{n}{r} = \frac{R_1^2 T_1^4}{R_2^2 T_2^4} \]
\[ = 4 \times \frac{1}{16} \]
\[ \frac{450}{r} = \frac{1}{4} \]
\[ r = 1800 \text{ watt} \]

140. A long solenoid of diameter 0.1 m has \(2 \times 10^4\) turns per meter. At the centre of the solenoid, a coil of 100 turns and radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0 A from 4 A in 0.05 s. If the resistance of the coil is \(10\pi^2\) Ω, the total charge flowing through the coil during this time is

(1) 32 μC  
(2) 16\pi μC  
(3) 32\pi μC  
(4) 16 μC

Answer (1)
Sol. ε = \(-N\frac{d\phi}{dt}\)
\[ \frac{\epsilon}{R} = \frac{N}{R} \frac{d\phi}{dt} \]
\[ dq = \frac{N}{R} d\phi \]
\[ \Delta Q = \frac{N(\Delta\phi)}{R} \]
\[ \Delta Q = \frac{\Delta\phi_{total}}{R} \]
\[ = \frac{(NBA)}{R} \]
\[ = \frac{\mu m n r^2}{R} \]
Putting values
\[ \Delta Q = 32 \mu C \]

141. Two rods A and B of different materials are welded together as shown in figure. Their thermal conductivities are \(K_1\) and \(K_2\). The thermal conductivity of the composite rod will be

(1) \(K_1 + K_2\)  
(2) \(2(K_1 + K_2)\)  
(3) \(\frac{K_1 + K_2}{2}\)  
(4) \(\frac{3(K_1 + K_2)}{2}\)

Answer (3)
Sol. Thermal current
\[ H = H_1 + H_2 \]
\[ = \frac{K_1 A(T_1 - T_2)}{d} + \frac{K_2 A(T_1 - T_2)}{d} \]
\[ \frac{K_{EQ} 2A(T_1 - T_2)}{d} = \frac{A(T_1 - T_2)}{d} [K_1 + K_2] \]
\[ K_{EQ} = \left[ \frac{K_1 + K_2}{2} \right] \]

142. A Carnot engine having an efficiency of \(\frac{1}{10}\) as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is

(1) 99 J  
(2) 100 J  
(3) 1 J  
(4) 90 J

Answer (4)
Sol. \(\beta = \frac{1 - \eta}{\eta}\)
\[ = \frac{1 - \frac{1}{10}}{\frac{1}{10}} = \frac{9}{10} = \frac{10}{10} \]
\[ \beta = 9 \]
\[ \beta = \frac{Q_2}{W} \]
\[ Q_2 = 9 \times 10 = 90 J \]

143. A spring of force constant \(k\) is cut into lengths of ratio 1 : 2 : 3. They are connected in series and the new force constant is \(k'\). Then they are connected in parallel and force constant is \(k''\). Then \(k : k''\) is

(1) 1 : 11  
(2) 1 : 14  
(3) 1 : 6  
(4) 1 : 9
Answer (1)

Sol. Spring constant $k \propto \frac{1}{l}$

i.e., $k_1 = 6k$

$k_2 = 3k$

$k_3 = 2k$

In series

$$\frac{1}{k'} = \frac{1}{6k} + \frac{1}{3k} + \frac{1}{2k}$$

$$k' = 11k$$

$$\frac{k'}{k''} = \frac{11}{1}$$

i.e., $k':k'' = 1:11$

144. The de-Broglie wavelength of a neutron in thermal equilibrium with heavy water at a temperature $T$ (Kelvin) and mass $m$, is

(1) $\frac{2h}{\sqrt{3mkT}}$

(2) $\frac{2h}{\sqrt{mkT}}$

(3) $\frac{h}{\sqrt{mkT}}$

(4) $\frac{h}{\sqrt{3mkT}}$

Answer (4)

Sol. de-Broglie wavelength

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{h}{\sqrt{2m(KE)}}$$

$$\lambda = \frac{h}{\sqrt{2m\left(\frac{3}{2}kT\right)}}$$

$$\lambda = \frac{h}{\sqrt{3mkT}}$$

145. Radioactive material 'A' has decay constant $8\lambda$, and material 'B' has decay constant $\lambda$. Initially they have same number of nuclei. After what time, the ratio of number of nuclei of material 'B' to that 'A' will be $\frac{1}{e}$?

(1) $\frac{1}{8\lambda}$

(2) $\frac{1}{9\lambda}$

(3) $\frac{1}{\lambda}$

(4) $\frac{1}{7\lambda}$

Answer (4)

Sol. No option is correct

If we take $\frac{N_A}{N_B} = \frac{1}{e}$

Then

$$\frac{N_A}{N_B} = e^{-8\lambda t}$$

$$1 = e^{-7\lambda t}$$

$$-1 = -7\lambda t$$

$$t = \frac{1}{7\lambda}$$

146. Young’s double slit experiment is first performed in air and then in a medium other than air. It is found that 8th bright fringe in the medium lies where 5th dark fringe lies in air. The refractive index of the medium is nearly

(1) 1.69

(2) 1.78

(3) 1.25

(4) 1.59

Answer (2)

Sol. $X_1 = X_{5th \, dark} = \left(2 \times 5 - 1\right) \frac{\lambda D}{2d}$

$X_2 = X_{8th \, bright} = \frac{8\lambda D}{\mu d}$

$X_1 = X_2$

$9 \frac{\lambda D}{2} = \frac{8\lambda D}{\mu}$

$$\mu = \frac{16}{9} = 1.78$$
147. A potentiometer is an accurate and versatile device to make electrical measurements of E.M.F, because the method involves:

(1) A condition of no current flow through the galvanometer
(2) A combination of cells, galvanometer and resistances
(3) Cells
(4) Potential gradients

Answer (1)
Sol. Reading of potentiometer is accurate because during taking reading it does not draw any current from the circuit.

148. The diagrams below show regions of equipotentials.

A positive charge is moved from A to B in each diagram.

(1) Minimum work is required to move q in figure (a).
(2) Maximum work is required to move q in figure (b).
(3) Maximum work is required to move q in figure (c).
(4) In all the four cases the work done is the same.

Answer (4)
Sol. Work done \( w = q\Delta V \)
\( \Delta V \) is same in all the cases so work is done will be same in all the cases.

149. Two cars moving in opposite directions approach each other with speed of 22 m/s and 16.5 m/s respectively. The driver of the first car blows a horn having a frequency 400 Hz. The frequency heard by the driver of the second car is [velocity of sound 340 m/s]

(1) 411 Hz
(2) 448 Hz
(3) 350 Hz
(4) 361 Hz

Answer (2)

Sol. \( f_A = f \left[ \frac{V + V_A}{V - V_A} \right] \)
\( = \frac{340 + 16.5}{340 - 22} \)
\( = 448 \text{ Hz} \)

150. Which one of the following represents forward bias diode?

(1) \(-2 \text{ V} + 2 \text{ V}\)
(2) \(3 \text{ V} - 5 \text{ V}\)
(3) \(-2 \text{ V} - 0 \text{ V}\)
(4) \(-3 \text{ V} - 4 \text{ V}\)

Answer (3)
Sol. In forward bias, \( p \)-type semiconductor is at higher potential w.r.t. \( n \)-type semiconductor.

151. A thin prism having refracting angle 10° is made of glass of refractive index 1.42. This prism is combined with another thin prism of glass of refractive index 1.7. This combination produces dispersion without deviation. The refracting angle of second prism should be

(1) 8°
(2) 10°
(3) 4°
(4) 6°

Answer (4)
Sol. \((\mu - 1)A + (\mu' - 1)A' = 0\)
\(\sqrt{(\mu - 1)A} = \sqrt{(\mu' - 1)A'}\)
\((1.42 - 1) \times 10° = (1.7 - 1)A'\)
\(4.2 = 0.7A'\)
\(A' = 6°\)

152. One end of string of length \( l \) is connected to a particle of mass ‘\( m \)’ and the other end is connected to a small peg on a smooth horizontal table. If the particle moves in circle with speed ‘\( v \)’, the net force on the particle (directed towards center) will be (\( T \) represents the tension in the string)

(1) \( T - \frac{m v^2}{l} \)
(2) Zero
(3) \( T \)
(4) \( T + \frac{m v^2}{l} \)

Answer (3)
Sol. Centripetal force \( \frac{mv^2}{l} \) is provided by tension so the net force will be equal to tension i.e., \( T \).

153. The \( x \) and \( y \) coordinates of the particle at any time are \( x = 5t - 2t^2 \) and \( y = 10t \) respectively, where \( x \) and \( y \) are in meters and \( t \) in seconds. The acceleration of the particle at \( t = 2 \) s is

1. \(-4 \) m/s\(^2\)
2. \(-8 \) m/s\(^2\)
3. 0
4. 5 m/s\(^2\)

**Answer (1)**

Sol. \( x = 5t - 2t^2 \quad y = 10t \)

\[ \frac{dx}{dt} = 5 - 4t \quad \frac{dy}{dt} = 10 \]

\( v_x = 5 - 4t \quad v_y = 10 \)

\[ \frac{dv}{dt} x = -4 \quad \frac{dv}{dt} y = 10 \]

\( a_x = -4 \quad a_y = 0 \)

Acceleration of particle at \( t = 2 \) s is \(-4 \) m/s\(^2\)

154. Suppose the charge of a proton and an electron differ slightly. One of them is \(-e\), the other is \((e + \Delta e)\). If the net of electrostatic force and gravitational force between two hydrogen atoms placed at a distance \( d \) (much greater than atomic size) apart is zero, then \( \Delta e \) is of the order of [Given mass of hydrogen \( m_h = 1.67 \times 10^{-27} \) kg]

1. \(10^{-37} \) C
2. \(10^{-47} \) C
3. \(10^{-20} \) C
4. \(10^{-23} \) C

**Answer (1)**

Sol. \( F_e = F_g \)

\[ \frac{1}{4\pi\varepsilon_0} \frac{\Delta e^2}{d^2} = \frac{Gm^2}{d^2} \]

\[ 9 \times 10^9 (\Delta e^2) = 6.67 \times 10^{-11} \times 1.67 \times 10^{27} \]

\[ \Delta e^2 = \frac{6.67 \times 1.67 \times 1.67 \times 10^{-74}}{9} \]

\[ \Delta e = 10^{-37} \]

155. Which of the following statements are correct?

(a) Centre of mass of a body always coincides with the centre of gravity of the body.
(b) Centre of mass of a body is the point at which the total gravitational torque on the body is zero
(c) A couple on a body produce both translational and rotational motion in a body.
(d) Mechanical advantage greater than one means that small effort can be used to lift a large load.

1. (b) and (c)
2. (c) and (d)
3. (b) and (d)
4. (a) and (b)

**Answer (3)**

Sol. Centre of mass may or may not coincide with centre of gravity.

156. The ratio of wavelengths of the last line of Balmer series and the last line of Lyman series is

1. 4
2. 0.5
3. 2
4. 1

**Answer (1)**

Sol. For last Balmer series

\[ \frac{1}{\lambda_b} = R \left[ \frac{1}{2^2} - \frac{1}{\infty^2} \right] \]

\[ \lambda_b = \frac{4}{R} \]

For last Lyman series

\[ \frac{1}{\lambda_l} = R \left[ \frac{1}{1^2} - \frac{1}{\infty^2} \right] \]

\[ \lambda_l = \frac{1}{R} \]

\[ \frac{\lambda_b}{\lambda_l} = 4 \]

157. Consider a drop of rain water having mass 1 g falling from a height of 1 km. It hits the ground with a speed of 50 m/s. Take \( g \) constant with a value 10 m/s\(^2\). The work done by the (i) gravitational force and the (ii) resistive force of air is

1. (i) 100 J (ii) 8.75 J
2. (i) 10 J (ii) –8.75 J
3. (i) –10 J (ii) –8.25 J
4. (i) 1.25 J (ii) –8.25 J

**Answer** (3)
### Answer (2)

**Sol.** \( w_g + w_a = K_f - K_i \)

\[
mgh + w_a = \frac{1}{2}mv^2 - 0
\]

\[
10^{-3} \times 10 \times 10^3 + w_a = \frac{1}{2} \times 10^{-3} \times (50)^2
\]

\( w_a = -8.75 \text{ J} \) i.e. work done due to air resistance and work done due to gravity = 10 J

158. The two nearest harmonics of a tube closed at one end and open at other end are 220 Hz and 260 Hz. What is the fundamental frequency of the system?

(1) 30 Hz (2) 40 Hz (3) 10 Hz (4) 20 Hz

**Answer (4)**

**Sol.** Two successive frequencies of closed pipe

\[
\frac{n\nu}{4l} = 220 \quad \ldots (i)
\]

\[
\frac{(n+2)\nu}{4l} = 260 \quad \ldots (ii)
\]

Dividing (ii) by (i), we get

\[
\frac{n+2}{n} = \frac{260}{220} = \frac{13}{11}
\]

\( 11n + 22 = 13n \)

\( n = 11 \)

So, \( 11\frac{\nu}{4l} = 220 \)

\( \frac{\nu}{4l} = 20 \)

So fundamental frequency is 20 Hz.

159. Two Polaroids \( P_1 \) and \( P_2 \) are placed with their axis perpendicular to each other. Unpolarised light \( I_0 \) is incident on \( P_1 \). A third polaroid \( P_3 \) is kept in between \( P_1 \) and \( P_2 \) such that its axis makes an angle 45° with that of \( P_1 \). The intensity of transmitted light through \( P_2 \) is

(1) \( \frac{I_0}{8} \) (2) \( \frac{I_0}{16} \) (3) \( \frac{I_0}{2} \) (4) \( \frac{I_0}{4} \)

**Answer (1)**

**Sol.**

\[
I_2 = \frac{I_0 \cos^2 45^\circ}{2}
\]

\[
= \frac{I_0}{2} \times \frac{1}{2}
\]

\[
= \frac{I_0}{4}
\]

\[
I_3 = \frac{I_0 \cos^2 45^\circ}{8}
\]

160. The acceleration due to gravity at a height 1 km above the earth is the same as at a depth \( d \) below the surface of earth. Then

(1) \( d = \frac{3}{2} \text{ km} \) (2) \( d = 2 \text{ km} \) (3) \( d = \frac{1}{2} \text{ km} \) (4) \( d = 1 \text{ km} \)

**Answer (2)**

**Sol.** Above earth surface

\[
g' = g \left( 1 - \frac{2h}{R_e} \right)
\]

\[
\Delta g' = g \frac{2h}{R_e} \quad \ldots (1)
\]

Below earth surface

\[
g' = g \left( 1 - \frac{d}{R_e} \right)
\]

\[
\Delta g = g \frac{d}{R_e} \quad \ldots (2)
\]

From (1) & (2)

\( d = 2h \)

\( d = 2 \times 1 \text{ km} \)

161. The bulk modulus of a spherical object is ‘\( B \)’. If it is subjected to uniform pressure ‘\( p \)’, the fractional decrease in radius is

(1) \( \frac{3p}{B} \) (2) \( \frac{p}{3B} \) (3) \( \frac{p}{B} \) (4) \( \frac{B}{3p} \)
Answer (2)

Sol. \[ B = \frac{p}{\sqrt{\frac{\Delta V}{V}}} \]

\[ \Delta V = \frac{p}{B} \]

\[ 3 \frac{\Delta r}{r} = \frac{p}{B} \]

\[ \frac{\Delta r}{r} = \frac{p}{3B} \]

162. Thermodynamic processes are indicated in the following diagram.

Match the following

<table>
<thead>
<tr>
<th>Column-1</th>
<th>Column-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. Process I</td>
<td>a. Adiabatic</td>
</tr>
<tr>
<td>Q. Process II</td>
<td>b. Isobaric</td>
</tr>
<tr>
<td>R. Process III</td>
<td>c. Isochoric</td>
</tr>
<tr>
<td>S. Process IV</td>
<td>d. Isothermal</td>
</tr>
</tbody>
</table>

(1) P \rightarrow c, Q \rightarrow d, R \rightarrow b, S \rightarrow a
(2) P \rightarrow d, Q \rightarrow b, R \rightarrow a, S \rightarrow c
(3) P \rightarrow a, Q \rightarrow c, R \rightarrow d, S \rightarrow b
(4) P \rightarrow c, Q \rightarrow a, R \rightarrow d, S \rightarrow b

Answer (4)

Sol. Process I = Isochoric

\[ \Pi = \text{Adiabatic} \]

\[ \text{III} = \text{Isothermal} \]

\[ \text{IV} = \text{Isobaric} \]

163. In an electromagnetic wave in free space the root mean square value of the electric field is \( E_{\text{rms}} = 6 \text{ V/m} \). The peak value of the magnetic field is

(1) \( 0.70 \times 10^{-8} \text{ T} \)
(2) \( 4.23 \times 10^{-8} \text{ T} \)
(3) \( 1.41 \times 10^{-8} \text{ T} \)
(4) \( 2.83 \times 10^{-8} \text{ T} \)

Sol. \[ B_{\text{rms}} = \frac{c}{E_{\text{rms}}} \]

\[ B_{\text{rms}} = \frac{6}{3 \times 10^8} \]

\[ B_{\text{rms}} = 2 \times 10^{-8} \]

Answer (4)

B_0 = 2 \times 10^{-8}

164. A rope is wound around a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force of 30 N?

(1) 25 rad/s^2
(2) 5 m/s^2
(3) 25 m/s^2
(4) 0.25 rad/s^2

Answer (1)

Sol.

\[ F = 30 \text{ N} \]

\[ \tau = I \alpha \]

\[ F \times R = M R^2 \alpha \]

\[ 30 \times 0.4 = 3 \times (0.4)^2 \alpha \]

\[ 12 = 3 \times 0.16 \alpha \]

\[ 400 = 16 \alpha \]

\[ \alpha = 25 \text{ rad/s}^2 \]

165. The given electrical network is equivalent to

(1) NOR gate
(2) NOT gate
(3) AND gate
(4) OR gate
Answer (1)
Sol. \( Y = \overline{A + B} \)

166. If \( \theta_1 \) and \( \theta_2 \) be the apparent angles of dip observed in two vertical planes at right angles to each other, then the true angle of dip \( \theta \) is given by

1. \( \cot^2 \theta = \cot^2 \theta_1 - \cot^2 \theta_2 \)
2. \( \tan^2 \theta = \tan^2 \theta_1 - \tan^2 \theta_2 \)
3. \( \cot^2 \theta = \cot^2 \theta_1 + \cot^2 \theta_2 \)
4. \( \tan^2 \theta = \tan^2 \theta_1 + \tan^2 \theta_2 \)

Answer (3)
Sol. \( \cot^2 \theta = \cot^2 \theta_1 + \cot^2 \theta_2 \)

167. Two blocks \( A \) and \( B \) of masses \( 3m \) and \( m \) respectively are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in figure. The magnitudes of acceleration of \( A \) and \( B \) immediately after the string is cut, are respectively

1. \( g, g \)
2. \( \frac{g}{3}, \frac{g}{3} \)
3. \( g, \frac{g}{3} \)
4. \( \frac{g}{3}, g \)

Answer (4)
Sol. \( 3m \)

Before the string is cut

\[ kx = T + 3mg \quad \text{(1)} \]
\[ T = mg \quad \text{(2)} \]

\[ kx = 4mg \]

After the string is cut, \( T = 0 \)

\[ a = \frac{kx - 3mg}{3m} \]
\[ a = \frac{4mg - 3mg}{3m} \]
\[ a = \frac{g}{3} \]

168. Two discs of same moment of inertia rotating about their regular axis passing through centre and perpendicular to the plane of disc with angular velocities \( \omega_1 \) and \( \omega_2 \). They are brought into contact face to face coinciding the axis of rotation. The expression for loss of energy during this process is

1. \( I(\omega_1 - \omega_2)^2 \)
2. \( \frac{1}{8}(\omega_1 - \omega_2)^2 \)
3. \( \frac{1}{2}(\omega_1 + \omega_2)^2 \)
4. \( \frac{1}{4}(\omega_1 - \omega_2)^2 \)

Answer (4)
Sol. \( \Delta KE = \frac{1}{2} \frac{l_1 l_2}{l_1 + l_2} (\omega_1 - \omega_2)^2 \)

\[ = \frac{1}{2} \frac{I^2}{2l} (\omega_1 - \omega_2)^2 \]

\[ = \frac{1}{4} I(\omega_1 - \omega_2)^2 \]

169. A 250-Turn rectangular coil of length 2.1 cm and width 1.25 cm carries a current of 85 \( \mu A \) and subjected to a magnetic field of strength 0.85 T. Work done for rotating the coil by 180° against the torque is

1. \( 2.3 \mu J \)
2. \( 1.15 \mu J \)
3. \( 9.1 \mu J \)
4. \( 4.55 \mu J \)

Answer (3)
Sol. \( W = MB(\cos\theta_1 - \cos\theta_2) \)

When it is rotated by angle 180º then
\[
W = 2MB
\]
\[
= 2 \times 250 \times 85 \times 10^{-6} \times 1.25 \times 2.1 \times 10^{-4} \times 85 \times 10^{-2}
\]
\[
= 9.1 \, \mu J
\]

170. A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system
(1) Remains the same
(2) Increases by a factor of 2
(3) Increases by a factor of 4
(4) Decreases by a factor of 2

Answer (4)

Sol.

\[
\frac{C}{V}
\]

Charge on capacitor
\( q = CV \)
when it is connected with another uncharged capacitor.

\[
\frac{q_1 + q_2}{C_1 + C_2} = \frac{q + 0}{C + C}
\]
\[
V_c = \frac{V}{2}
\]

Initial energy
\( U_i = \frac{1}{2}CV^2 \)

Final energy
\[
U_f = \frac{1}{2}C\left(\frac{V}{2}\right)^2 + \frac{1}{2}C\left(\frac{V}{2}\right)^2
\]
\[
= \frac{CV^2}{4}
\]

\[
\text{Loss of energy} = U_i - U_f
\]
\[
= \frac{CV^2}{4}
\]

\( i.e. \) decreases by a factor (2)

171. Two astronauts are floating in gravitational free space after having lost contact with their spaceship. The two will:
(1) Move away from each other
(2) Will become stationary
(3) Keep floating at the same distance between them
(4) Move towards each other

Answer (4)

Sol. Both the astronauts are in the condition of weightlessness. Gravitational force between them pulls towards each other.

172. A beam of light from a source \( L \) is incident normally on a plane mirror fixed at a certain distance \( x \) from the source. The beam is reflected back as a spot on a scale placed just above the source \( L \). When the mirror is rotated through a small angle \( \theta \), the spot of the light is found to move through a distance \( y \) on the scale. The angle \( \theta \) is given by

(1) \( \frac{x}{2y} \)
(2) \( \frac{y}{x} \)
(3) \( \frac{y}{2x} \)
(4) \( \frac{x}{2y} \)

Answer (3)

Sol. When mirror is rotated by \( \theta \) angle reflected ray will be rotated by \( 2\theta \).
173. In a common emitter transistor amplifier the audio signal voltage across the collector is 3 V. The resistance of collector is 3 kΩ. If current gain is 100 and the base resistance is 2 kΩ, the voltage and power gain of the amplifier is

(1) 150 and 15000
(2) 20 and 2000
(3) 200 and 1000
(4) 15 and 200

Answer (1)

Sol. Current gain ($\beta$) = 100

\[ V_{\text{gain}} = \beta \frac{R_c}{R_b} \]
\[ = 100 \times \frac{3}{2} \]
\[ = 150 \]

Power gain = $V_{\text{gain}} \beta$
\[ = 150 \times 100 \]
\[ = 15000 \]

Note: Not correctly framed but the best option out of given is (1).

174. Figure shows a circuit contains three identical resistors with resistance $R = 9.0 \Omega$ each, two identical inductors with inductance $L = 2.0 \text{ mH}$ each, and an ideal battery with emf $\varepsilon = 18 \text{ V}$. The current $i'$ through the battery just after the switch closed is

(1) 2 A
(2) 0 ampere
(3) 2 mA
(4) 0.2 A

Answer (1*)

Sol. $i' = \frac{\varepsilon}{R_2}$
\[ = \frac{18}{9} \]
\[ = 2 \text{ A} \]

175. A U tube with both ends open to the atmosphere, is partially filled with water. Oil, which is immiscible with water, is poured into one side until it stands at a distance of 10 mm above the water level on the other side. Meanwhile the water rises by 65 mm from its original level (see diagram). The density of the oil is

(1) 800 kg m$^{-3}$
(2) 928 kg m$^{-3}$
(3) 650 kg m$^{-3}$
(4) 425 kg m$^{-3}$

Answer (2)

Sol. $\rho_{\text{oil}} g h_{\text{oil}} = \rho_{\text{water}} g h_{\text{water}}$
\[ 140 \times \rho_{\text{oil}} = 130 \times \rho_{\text{water}} \]
\[ \rho_{\text{oil}} = \frac{13}{14} \times 1000 \text{ kg/m}^3 \]
\[ \rho_{\text{oil}} = 928 \text{ kg m}^{-3} \]

176. The photoelectric threshold wavelength of silver is $3250 \times 10^{-10} \text{ m}$. The velocity of the electron ejected from a silver surface by ultraviolet light of wavelength $2536 \times 10^{-10} \text{ m}$ is

(Given $h = 4.14 \times 10^{-15} \text{ eVs}$ and $c = 3 \times 10^8 \text{ ms}^{-1}$)

(1) $6 \times 10^3 \text{ ms}^{-1}$
(2) $0.3 \times 10^6 \text{ ms}^{-1}$
(3) $6 \times 10^5 \text{ ms}^{-1}$
(4) $0.6 \times 10^6 \text{ ms}^{-1}$
Answer (3 & 4) Both answers are correct.

Sol. \( \lambda_0 = 3250 \times 10^{-10} \text{ m} \)
\( \lambda = 2536 \times 10^{-10} \text{ m} \)
\( \phi = \frac{1242 \text{ eV-nm}}{325 \text{ nm}} = 3.82 \text{ eV} \)
\( h\nu = \frac{1242 \text{ eV-nm}}{253.6 \text{ nm}} = 4.89 \text{ eV} \)
\( KE_{\text{max}} = (4.89 - 3.82) \text{ eV} = 1.077 \text{ eV} \)
\( \frac{1}{2}mv^2 = 1.077 \times 1.6 \times 10^{-19} \text{ J} \)
\( v = \sqrt{\frac{2 \times 1.077 \times 1.6 \times 10^{-19}}{9.1 \times 10^{-31}}} \text{ m/s} \)
\( v = 0.6 \times 10^6 \text{ m/s} \)

177. A physical quantity of the dimensions of length that can be formed out of \( c \), \( G \) and \( \frac{e^2}{4\pi \epsilon_0} \) is \([c \text{ is velocity of light, } G \text{ is universal constant of gravitation and } e \text{ is charge}]\)

178. The ratio of resolving powers of an optical microscope for two wavelengths \( \lambda_1 = 4000 \text{ Å} \) and \( \lambda_2 = 6000 \text{ Å} \) is
(1) 3 : 2
(2) 16 : 81
(3) 8 : 27
(4) 9 : 4

Answer (1)

Sol. Resolving power \( \propto \frac{1}{\lambda} \)
\( \frac{R_1}{R_2} = \frac{\lambda_2}{\lambda_1} \)
\( \frac{6000 \text{ Å}}{4000 \text{ Å}} = \frac{3}{2} \)

179. A gas mixture consists of 2 moles of \( \text{O}_2 \) and 4 moles of \( \text{Ar} \) at temperature \( T \). Neglecting all vibrational modes, the total internal energy of the system is
(1) \( 9RT \)
(2) \( 11RT \)
(3) \( 4RT \)
(4) \( 15RT \)

Answer (2)

Sol. \( U = n_1 \frac{f_1}{2} \text{RT} + n_2 \frac{f_2}{2} \text{RT} \)
\( = 2 \times \frac{5}{2} \text{RT} + 4 \times \frac{3}{2} \text{RT} \)
\( = 5 \text{RT} + 6 \text{RT} \)
\( U = 11 \text{RT} \)

180. The resistance of a wire is \( 'R' \text{ ohm} \). If it is melted and stretched to \( 'n' \text{ times its original length, its new resistance will be} \)
(1) \( n^2R \)
(2) \( \frac{R}{n^2} \)
(3) \( nR \)
(4) \( \frac{R}{n} \)

Answer (1)

Sol. \( \frac{R_2}{R_1} = \frac{\frac{1}{2}}{I_1} = \frac{n^2I_2}{I_1} \)
\( = \frac{n^2I_2}{I_1} \)
\( \frac{R_2}{R_1} = n^2 \)
\( R_2 = n^2R_1 \)