BIOLOGY

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

(1) Both of the characters are controlled by more than one gene

(2) The two genes are located on two different chromosomes

(3) Chromosomes failed to separate during meiosis

(4) The two genes are linked and present on the same chromosome

Solution: (1)

If a plant genotype Aa Bb is crossed with aabb then Independent Assortment would result in production of 4 type of offsprings in equal proportion.

Aa Bb – gametes	AB	Ab	aB	ab
Aa bb – Gametes	ab		ab	ab

Offspring according to independent assortment

AaBb	Aabb	aaBb	aabb
1 :	1 :	1 :	1
(Parental)	(Recombinants)		(Parental)

Since parental percentage is more than recombinants it is due to linkage between genes A and B.

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

(1) Anthocyanins

(2) Xanthophylls

(3) Chlorophylls

(4) Carotenoids

Solution: (1)

Anthocyanin is stored in vacuoles.

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

(1) Relaxin - Inhibin

(2) Parathormone - Calcitonin

(3) Insulin - Glucagon

(4) Aldosterone - Atrial Natriuretic Factor

Solution: (1)

Parathormone	→	Increases blood Ca^{+2} level
Calcitonin	→	Decreases blood Ca^{+2} level
Insulin	→	Decreases blood glucose level
Glucagon	→	Increases blood glucose level
Aldosterone	→	Increases B.P.
ANF	→	Decreases B.P.
Relaxin	→	Causes pelvic musculature relaxation
Inhibin	→	Inhibits FSH

4. Mitochondria and chloroplast are:

(i) Semi – autonomous organelles

(ii) Formed by division of pre – existing organelles and they contain DNA but lack protein synthesizing machinery

Which one of the following options is correct?

(1) Both (i) and (ii) are false

(2) Both (i) and (ii) are correct

(3) (ii) is true but (i) is false

(4) (i) is true but (ii) is false

Solution: (4)

Mitochondria and chloroplast are semi-autonomous organelles and they have their own ribosomes with help of which they can synthesize protein.

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

(1) Single – stranded

(2) Independent replication

(3) Circular structure

(4) Transferable

Solution: (1)

Plasmids are extrachromosomal, double stranded circular DNA.

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

(1) Nitrogen fixer

(2) C_3

(3) C_4

(4) CAM

Solution: (3)

C_4 plants have high rate of photosynthesis at higher temperature.

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

(1) Oxidative phosphorylation

(2) Photophosphorylation and non – cyclic electron transport

(3) Two photosystems operating simultaneously

(4) Photophosphorylation and cyclic electron transport

Solution: (3)

Red drop occurs due decreased functioning of PS-II beyond 680 nm and when both PS-I and PS-II are functioning together there is enhancement in quantum yield.

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

(1)

Tissue	Location
Cuboidal epithelium	Lining of stomach

(2)

Tissue	Location
Smooth muscle	Wall of intestine

(3)

Tissue	Location
Areolar tissue	Tendons

(4)

Tissue	Location
Transitional epithelium	Tip of nose

Solution: (2)

Wall of intestine is composed of smooth muscle.

Tendon is a dense regular white fibrous connective tissue and areolar tissue is a loose connective tissue.

Tip of nose is made up of elastic cartilage.

Lining of stomach is composed of columnar epithelium.

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

(1) When death rate is greater than birth rate

(2) When N/K is exactly one

(3) When N nears the carrying capacity of the habitat

(4) When N/K equals zero

Solution: (2)

$$\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right)$$

$$\frac{dN}{dt} = rN(1 - 1) = 0$$

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

(1) Stored pollen in liquid nitrogen can be used in the crop breeding programmes

(2) Tapetum helps in the dehiscence of anther

(3) Exine of pollen grains is made up of sporopollenin

(4) Pollen grains of many species cause severe allegies

Solution: (2)

Dehiscence of anther occurs due to stomium cells of endothecium

11. Which one of the following statements is wrong ?

(1) Phycomycetes are also called algal fungi

(2) Cyanobacteria are also called blue – green algae

(3) Golden algae are also called desmids

(4) Eubacteria are also called false bacteria

Solution: (4)

Eubacteria are called true bacteria.

12. The avena curvature is used for bioassay of:

(1) Ethylene

(2) ABA

(3) GA_3

(4) IAA

Solution: (4)

Avena curvature bioassay is done to test the function of IAA.

13. Which of the following structures is homologus to the wing of a bird ?

(1) Flipper of whale

(2) Dorsal fin of a shark

(3) Wing of a moth

(4) Hind limb of rabbit

Solution: (1)

Flipper of whale is homologous to the wing of a bird.

14. Blood pressure in the pulmonary artery is:

(1) Less than that in the venae cavae

(2) Same as that in the aorta

(3) More than that in the carotid

(4) More than that in the pulmonary vein

Solution: (4)

Blood pressure in different blood vessels:

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

15. Fertilization in humans is practically feasible only if:

(1) The sperms are transported into cervix within 48 hrs of release f ovum in uterus

(2) The sperms are transported into vagina just after the release of ovum in fallopian tube

(3) The ovum and sperms are transported simultaneously to ampullary – isthmic junction of the fallopian tube

(4) The ovum and sperms are transported simultaneously to ampullary – isthmic junction of the cervix

Solution: (3)

Fertilization is practically only feasible if the ovum and sperms are transported simultaneously into the ampulla isthmus region of fallopian tube.

16. In meiosis crossing over is initiated at:

(1) Diplotene

(2) Pachytene

(3) Leptotene

(4) Zygotene

Solution: (2)

In pachytene recombination nodule is formed after which crossing over occurs.

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

(1) Animalia

(2) Monera

(3) Protista

(4) Fungi

Solution: (3)

Protista is a group created by Haeckel which includes all Eukaryotic unicellular organisms.

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

(1) Tonus

(2) Spasm

(3) Fatigue

(4) Tetanus

Solution: (1)

Tonus → low level activity of muscles at rest to maintain posture

Spasm → Sudden involuntary muscle contraction

Fatigue → Decline in muscle activity

Tetanus → Sustained muscle contraction in response to successive stimuli

19. Identify the correct statement or 'inhibin':

(1) Is produced by nurse cells in testes and inhibits the secretion of LH

(2) Inhibits the secretion of LH, FSH and Prolactin

(3) Is produced by granulose cells in ovary and inhibits the secretion of FSH

(4) Is produced by granulose cells in ovary and inhibits the secretion of LH

Solution: (3)

Inhibin is produced by granulosa cells in the ovary and inhibits the secretion of FSH – follicle stimulating hormone.

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

(1) Respiratory alkalosis

(2) Emphysema

(3) Asthma

(4) Respiratory acidosis

Solution: (2)

Emphysema is a chronic respiratory disorder caused due chronic cigarette smoking in which the alveolar walls are damaged due to which the respiratory surface is decreased.

21. Which of the following most appropriately describes hemophilia?

(1) Dominant gene disorder

(2) Recessive gene disorder

(3) X – linked recessive gene disorder

(4) Chromosomal disorder

Solution: (3)

Genes related with hemophilia are always present on X chromosome and it is a recessive gene disorder as it expresses itself in females when it comes a homozygous condition. It causes a defect in the clotting factor formation, thus a simple cut can bleed continuously leading to even death. Thus, it is also known as 'Bleeders' disease or 'Royal Disease' as Queen Victoria is a carrier for this disease.

22. Select the correct statement :

(1) The leaves of gymnosperms are not well adapted to extremes of climate

(2) Gymnosperms are both homosporous and heterosporous

(3) Salvinia, ginkgo and pinus all are gymnosperms

(4) Sequoia is one of the tallest tress

Solution: (4)

Sequoia is one of the tallest tree which is a gymnosperm and it can be 130 – 140 metres tall.

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

(1) Lactose and galactose

(2) Glucose

(3) Galactose

(4) Lactose

Solution: (4)

Lac operon becomes active only after inducing lactose as it is a substrate for the enzyme beta-galactosidase and it also regulates the switching on and off of the operon which cannot be done by glucose and galactose.

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

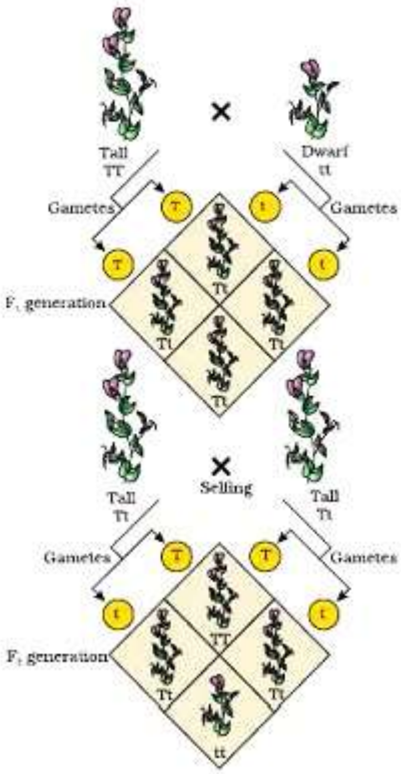
(1) 3 : 1 :: Tall : Dwarf

(2) 3 : 1 :: Dwarf : Tall

(3) 1 : 2 : 1 :: Tall homozygous : Tall heterozygous : Dwarf

(4) 1 : 2 : 1 :: Tall heterozygous : Tall homozygous : Dwarf

Solution: (3)



Phenotypic ratio : tall : dwarf

Genotypic ratio : TT : Tt : tt

1 : 2 : 1

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

(1) Root

(2) Flower

(3) Leaf

(4) Stem

Solution: (1)

Meloidogyne incognita infects the root of tobacco plant.

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

(1) Synapsis

(2) Spindle fibres

(3) Disappearance of nucleolus

(4) Chromosome movement

Solution: (1)

Synapsis is pairing of homologous chromosomes which occurs during meiosis but it is absent in mitosis.

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

(1) Mutations inhibit production of telomerase

(2) Mutations in proto – oncogenes accelerate the cell cycle

(3) Mutations destroy telomerase inhibitor

(4) Mutations inactivate the cell control

Solution: (1)

Cancer will be caused by increased telomerase activity making the cancerous cells immortal and not by inhibition of telomerase production.

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

(1) Hemicellulose

(2) Chitin

(3) Peptidoglycan

(4) Cellulose

Solution: (2)

Peptidoglycan – Bacterial cell wall

Cellulose and Hemicellulose – Plant cell wall

Chitin – Fungal cell wall

29. Cotyledon of maize grain is called:

(1) Scutellum

(2) Plumule

(3) Coleorhiza

(4) Coleoptile

Solution: (1)

In maize grains, the single large shield shaped cotyledon is called scutellum.

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

(1) Green algae

(2) Lichens

(3) Liverworts

(4) Mosses

Solution: (2)

Lichens are pioneer organisms on bare rocks as they corrode the rocks by secreting enzymes and convert it into soil.

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

(1) Progesterone and inhibin

(2) Estrogen and progesterone

(3) Estrogen and inhibin

(4) Progesterone only

Solution: (2)

GnRH pulse frequency in controlled by estrogen and progesterone both after puberty.

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

(1) Attenuated pathogens

(2) Activated pathogens

(3) Harvested antibodies

(4) Gamma globulin

Solution: (1)

OPV is of 2 types:

(i) OPV sabin – Live attenuated vaccine

(ii) OPV salk – Killed vaccine

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

(1) Transducin and Retinene

(2) Guanosine and Retinol

(3) Opsin and Retinal

(4) Opsin and Retinol

Solution: (3)

Rhodopsin which is a photosensitive pigment present in the human eye is made of opsin and retinal.

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

(1) Lenticels

(2) Complementary cells

(3) Subsidiary cells

(4) Bulliform cells

Solution: (3)

As subsidiary cells and guard cells both are modification of epidermal cells in which guard cells have chloroplasts which is absent in surrounding subsidiary cells.

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

(1) Jointed appendages

(2) Chitinous exoskeleton

(3) Metameric segmentation

(4) Parapodia

Solution: (4)

Parapodia is a characteristic of Annelida and it helps in swimming.

36. Reduction in pH of blood will:

(1) Release bicarbonate ions by the liver

(2) Reduce the rate of heart beat

(3) Reduce the blood supply to the brain

(4) Decrease the affinity of hemoglobin with oxygen

Solution: (4)

Reduction in pH of blood decreases the affinity of hemoglobin with oxygen.

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

(1)

3 – chambered heart with one incompletely divided ventricle	Reptilia

(2)

Cartilaginous endoskeleton	Chondrichthyes

(3)

Viviparous	Mammalia

(4)

Possess a mouth with an upper and a lower jaw	Chordata

Solution: (2)

Reptillia has an order crocodilian which shows 4 chambered heart. In mammals, prototheria group shows oviparity while metatheria and eutherian show viviparity. Chordates can be gnathostomata and agnatha (without jaws). Only cartilaginous fishes (chondrichthyes) show cartilaginous endoskeleton without exception.

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

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

(1)

(a)	(b)	(c)	(d)
(iv)	(iii)	(i)	(ii)

(2)

(a)	(b)	(c)	(d)
(ii)	(i)	(iv)	(iii)

(3)

(a)	(b)	(c)	(d)

(ii)	(iii)	(iv)	(i)

(4)

(a)	(b)	(c)	(d)
(iv)	(i)	(ii)	(iii)

Solution: (3)

Dominance – In a heterozygous organism only one allele expresses itself.

Codominance – In a heterozygous organism both alleles express themselves equally.

Pleiotropy – A single gene influences many characters.

Polygenic Inheritance – Many genes govern a single character.

39. A typical fat molecules is made up of:

(1) Three glycerol and three fatty acid molecules

(2) Three glycerol molecules and one fatty acid molecules

(3) One glycerol and three fatty acid molecules

(4) One glycerol and one fatty acid molecule

Solution: (3)

Fat is a triglyceride which is made up of 3 molecules of fatty acids and one molecule of glycerol.

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

(1) Thalamus or petal

(2) Anther

(3) Connective

(4) Placenta

Solution: (1)

Proximal end of the filament of stamen is attached to the thalamus or petal and distal end is attached to anther.

41. Which one of the following statements is wrong?

(1) Glycine is a sulphur containing amino acid

(2) Sucrose is a disaccharide

(3) Cellulose is a polysaccharide

(4) Uracil is a pyrimidine

Solution: (1)

Glycine is the simplest amino acid which is devoid of sulphur content.

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

(1) One process occurs during day time, and the other at night

(2) Both processes cannot happen simultaneously

(3) Both processes can happen together because the diffusion coefficient of water and CO_2 is different

(4) The above processes happen only during night time

Solution: (3)

Water vapour comes out and CO_2 diffuses simultaneously through stomatal opening because diffusion coefficient of water and CO_2 is different and it moves along its concentration gradient.

43. A complex of ribosomes attached to single strand of RNA is known as:

(1) Okazaki fragment

(2) Polysome

(3) Polymer

(4) Polypeptide

Solution: (2)

Many ribosomes are attached to a single strand of mRNA during protein synthesis. This is known as Polysome.

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

(1) Ecological succession

(2) Absence of soil organisms

(3) Least genetic diversity

(4) Absence of weeds

Solution: (3)

Cropland ecosystem has same type of crop plants so it has the least genetic diversity.

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

(1) Co – extinctions

(2) Over – exploitation

(3) Alien species invasion

(4) Habitat loss and fragmentation

Solution: (4)

From the evil quartet, habitat loss and fragmentation due to over population, urbanization and industrialization is the major cause of extinction.

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

(1) Antennae complex

(2) Stroma

(3) Lumen of thylakoids

(4) Inter membrane space

Solution: (3)

Photolysis of water occurs in the lumen of thylakoids which has the highest number of protons.

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

(1) DNA – DNA hybridization

(2) Polymerase chain reaction

(3) Zinc finger analysis

(4) Restriction enzymes

Solution: (3)

Zinc finger analysis does not contribute to DNA fingerprinting.

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

(1) Eubacteria

(2) Halophiles

(3) Thermoacidophiles

(4) Methanogens

Solution: (4)

Archaebacteria are considered as most primitive prokaryote which appeared on earth for the first time as it could survive through the anaerobic harsh environment present that time.

Halophilus, Thermoacidophiles and Methanogens are Archaebacteria.

Methanogens are present in the rumen of cattle that is present in dung as well. It helps in production of methane gas that is a component of biogas.

49. Which of the following features is not present in periplaneta Americana ?

(1) Metamerically segmented body

(2) Schizocoelom as body cavity

(3) Indeterminate and radial cleavage during embryonic development

(4) Exoskeleton composed of N – acetylglucosamine

Solution: (3)

Periplaneta americana shows indeterminate and spiral cleavage.

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

(1) Shifting agriculture

(2) Ley farming

(3) Contour farming

(4) Strip farming

Solution: (2)

Ley agriculture helps to increase soil fertility and improve the physical texture of soil.

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

(1)

Microbe	Product	Application
Clostridium butylicum	Lipase	Removal of oil stains

(2)

Microbe	Product	Application
Trichoderma polysporum	Cyclosporin A	Immunosuppressive drug

(3)

Microbe	Product	Application
Monascus purpureus	Statins	Lowering of blood cholesterol

(4)

Microbe	Product	Application
Streptococcus	Streptokinase	Removal of clot from blood vessel

Solution: (1)

Clostridium butylicum is used for the production of butyric acid. Candida lipolyticum is the source of lipase.

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

(1) Hepatic portal vein

(2) Renal vein

(3) Dorsal aorta

(4) Hepatic vein

Solution: (4)

Urea – Ornithine cycle takes place in liver so the vein leaving liver possesses maximum urea which is hepatic vein.

53. Pick out the correct statements:

(i) Haemophilia is a sex – linked recessive disease

(ii) Down's syndrome is due to aneuploidy

(iii) Phenylketonuria is an autosomal recessive gene disorder

(iv) Sickle cell anaemia is an autosomal recessive gene disorder

(1) (i), (ii) and (iii) are correct

(2) (i) and (iv) are correct

(3) (ii) and (iv) are correct

(4) (i), (iii) and (iv) are correct

Solution: (1)

Hemophilia is a sex – linked recessive disease in which there is a problem in clotting of blood.

Down's syndrome (trisomy 21) is caused due to aneuploidy.

Phenylketonuria is an autosomal recessive gene disorder.

Sickle cell anaemia is autosomal recessive gene disorder.

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

(1) Sphincter of Oddi

(2) Semilunar valve

(3) Ileocaecal valve

(4) Pyloric sphincter

Solution: (1)

The opening of hepatopancreatic duct into the duodenum is guarded by sphincter of Oddi

55. Microtubules are the constituents of:

(1) Centrosome, Nucleosome and Centrioles

(2) Cilia, Flagella and Peroxisomes

(3) Spindle fibres, centrioles and cilia

(4) Centrioles, spindle fibres and chromatin

Solution: (3)

Peroxisomes is a microbody. Chromatin consists of DNA and proteins and it condenses to form chromosomes. Nucleosome is the basic unit of chromatin. Microtubules are structures present in cilia, flagella, centrioles and spindle fibres.

56. The coconut water from tender coconut represents:

(1) Free nuclear endosperm

(2) Endocarp

(3) Fleshy mesocarp

(4) Free nuclear proembryo

Solution: (1)

In tender coconuts, the coconut water represents free nuclear endosperm.

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

(1 Poaceae

(2) Liliaceae

(3) Solanaceae

(4) Fabaceae

Solution: (2)

Liliaceae family is a monocot family characterized by tricarpellary, syncarpous gynoceium with superior, trilocular ovary with two ovules in each loculus and placentation axile.

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

(1) Flattened structures of *Opuntia*

(2) Pitcher of *Nepenthes*

(3) Thorns of citrus

(4) Tendrils of cucumber

Solution: (2)

Pitcher of *Nepenthes* is modification of the leaf.

59. The taq polymerase enzyme is obtained from:

(1) *Pseudomonas putida*

(2) *Thermus aquaticus*

(3) *Thiobacillus ferroxidans*

(4) *Bacillus subtilis*

Solution: (2)

The enzyme taq polymerase is a thermostable enzyme which is obtained from *Thermus aquaticus.*

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

(1) Scales

(2) Cladodes

(3) Phyllodes

(4) Phylloclades

Solution: (4)

Stem modified into flat green organs performing the functions of leaves are known as phylloclade whereas phyllode is modification of petiole.

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

(1) Active immunity

(2) Allergic response

(3) Graft rejection

(4) Auto – immune disease

Solution: (4)

If self and non – self recognition power is lost then immune cells can attack our own body cells and cause an auto immune disease.

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

(1) When written by hand, the names are to be underlined

(2) Biological names can be written in any language

(3) The first words in a biological name represents the genus name, and the second is a specific epithet

(4) The names are written in Latin and are italicized

Solution: (2)

According to the rules of IUCN the original names were taken from Latin or Greek languages. New names are now derived either from Latin language or are Latinized.

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

(1) Water

(2) Wind

(3) Insects

(4) Birds

Solution: (1)

In bryophytes and pteridophytes, the male gametes are motile and it requires water for fertilization.

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

(1) It can be used for detection of Cleft palate

(2) It is usually done when a woman is between 14 – 16 weeks pregnant

(3) It is used for prenatal sex determination

(4) It can be used for detection of Down syndrome

Solution: (1)

Amniocentesis is a medical procedure used in prenatal diagnosis of chromosomal and genetic abnormalities such as Down's syndrome. Turner's syndrome, etc. It also helps in prenatal sex determination, hence there is a statutory ban on it to prevent female foeticide. It is done when woman is between 14 – 16 weeks pregnant and it does not help in detection of cleft palate.

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

(1) Acidic cells

(2) Gastrin secreting cells

(3) Parietal cells

(4) Peptic cells

Solution: (3)

Gastric acid i.e. HCl is secreted by parietal or oxyntic cells.

66. Spindle fibres attach on to:

(1) Kinetosome of the chromosome

(2) Telomere of the chromosome

(3) Kinetochore of the chromosome

(4) Centromere of the chromosome

Solution: (3)

Kinetochore of chromosomes facilitates the attachment of spindle fibre (chromosomal fibre) and the poles.

67. Which is the National Aquatic Animal of India ?

(1) Sea – horse

(2) Gangetic shark

(3) River dolphin

(4) Blue whale

Solution: (1)

River Dolphin represents the purity of the holy Ganga as it can only survive in pure and fresh water.

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

(1) Nuclei

(2) Mitochondria

(3) Chloroplasts

(4) Lysosomes

Solution: (4)

Except lysosomes, all three are bounded by double membrane.

69. The two polypeptides of human insulin are linked together by:

(1) Disulphide bridges

(2) Hydrogen bonds

(3) Phosphodiester bond

(4) Covalent bond

Solution: (1)

The human insulin has two polypeptide chains A and B linked together by disulphide bridges.

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

(1) Nitrogen, nickel, phosphorus

(2) Boron, zinc, manganese

(3) Iron, copper, molybdenum

(4) Molybdenum, magnesium, manganese

Solution: (1)

or bonus Macronutrients are required in greater amount which is 1 mg-gram of plant dry weight. None of the options are correct w.r.t. question statement. However, the option (Nitrogen, nickel, phosphorus) seems to be more appropriate than the rest.

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

(1) Their RNA is of high molecular weight

(2) They lack a protein coat

(3) They are smaller than viruses

(4) They cause infections

Solution: (1)

In viroids, RNA is of low molecular weight.

72. Analogous structures are a result of:

(1) Stabilizing selection

(2) Divergent evolution

(3) Convergent evolution

(4) Shared ancestry

Solution: (3)

Analogous structures are a result of convergent evolution.

73. Select the incorrect statement:

(1) LH triggers secretion of androgens from the Leydig cells

(2) FSH stimulates the sertoli cells which help in spermiogenesis

(3) LH triggers ovulation in ovary

(4) LH and FSH decrease gradually during the follicular phase

Solution: (4)

LH and FSH both increase during follicular phase.

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

(1) Warm blooded nature

(2) Ossified endoskeleton

(3) Breathing using lungs

(4) Viviparity

Solution: (4)

Birds are oviparous while mammals are oviparous (prototherians) and viviparous (metatherians and eutherians).

75. Which of the following statements is not correct?

(1) Some reptiles have also been reported as pollinators in some plant species.

(2) Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style.

(3) Insects that consume pollen or nectar without bringing about pollination are called pollen/nerctar robbers.

(4) Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil.

Solution: (2)

More the one pollen tube of same species can grow into the style. It is frequently found in nature.

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

(1) Apomixis

(2) Sporulation

(3) Budding

(4) Somatic hybridization

Solution: (1)

Apomixis is a special mechanism to produce seeds without fertilization.

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

(1)

Vasectomy	Prevents spermatogenesis

(2)

Barrier methods	Prevent fertilization

(3)

Intra uterine devices	Increase phagocytosis of sperms, suppress sperm motility and fertilizing capacity of sperms

(4)

Hormonal contraceptives	Prevent /retard entry of sperms, prevent ovulation and fertilization

Solution: (1)

Vasectomy causes sterilization by preventing transfer of sperms.

78. The amino acid Tryptophan is the precursor for the synthesis of :

(1) Cortisol and Cortisone

(2) Melatonin and Serotonin

(3) Thyroxine and Triiodothyronine

(4) Estrogen and Progesterone

Solution: (2)

Amino acid tryptophan is the precursor for the synthesis of melatonin and serotonin.

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

(1) Death of fish due to lack of oxygen.

(2) Drying of the river very soon due to algal bloom.

(3) Increased population of aquatic food web organisms.

(4) An increased production of fish due to biodegradable nutrients.

Solution: (1)

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

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

(1) Larger organisms exclude smaller ones through competition

(2) More abundant species will exclude the less abundant species through competition

(3) Competition for the same resources excludes species having different food preferences

(4) No two species can occupy the same niche indefinitely for the same limiting resources

Solution: (4)

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

81. Asthma may be attributed to:

(1) Accumulation of fluid in the lung

(2) Bacterial infection of the lungs

(3) Allergic reaction of the mast cells in the lungs

(4) Inflammation of the trachea

Solution: (3)

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

82. The standard petal of papilionaceous corolla is also called:

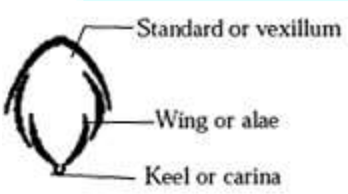
(1) Corona

(2) Carina

(3) Pappus

(4) Vexillum

Solution: (4)



Papillionaceous corolla.

83. Which of the following is a restriction endonuclease?

(1) RNase

(2) Hind II

(3) Protease

(4) DNase I

Solution: (2)

Hind II is a type of restriction endonuclease.

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

(1) The efficiency of muscles in large animals is less than in the small animals

(2) It is easier to carry a small body weight

(3) Smaller animals have a higher metabolic rate

(4) Small animals have a lower O_2 requirement

Solution: (3)

Smaller animals have higher BMR related with sustained energy production and delayed muscle fatigue.

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

(i) The earliest organisms that appeared on the earth were non-green and presumably anaerobes.

(ii) The first autotrophic organisms were the chemoautotrophs that never released oxygen.

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

(1) Both (i) and (ii) are false

(2) (i) is correct but (ii) is false

(3) (ii) is correct but (i) is false

(4) Both (i) and (ii) are correct

Solution: (4)

The first originated organisms were prokaryotic chemoheterotrophs and oxygen was not available on earth at that time so it must be anaerobic too. Even the first autotrophs were dependent on chemicals as oxygen was not released.

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

(1) Polyteny

(2) Aneuploidy

(3) Polyploidy

(4) Somaclonal variation

Solution: (3)

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

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

(1) Methane

(2) Nitrous oxide

(3) Ozone

(4) Ammonia

Solution: (3)

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

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

(1) 1990s

(2) 1960s

(3) 1970s

(4) 1980s

Solution: (4)

Joint Forest Management Concept was introduced to protect forest cover in India in 1988.

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

(1) UAG

(2) AUG

(3) UGA

(4) UAA

Solution: (2)

AUG is start codon that codes for methionine whereas UGA, UAA and UAG are stop codons.

90. The term ecosystem was coined by:

(1) E. Warming

(2) E.P. Odum

(3) A.G. Tansley

(4) E. Haeckel

Solution: (3)

The term ecosystem was coined by A.G. Tansley in 1935.

PHYSICS

91. What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?
    (1) $\sqrt{5gR}$
    (2) $\sqrt{gR}$
    (3) $\sqrt{2gR}$
    (4) $\sqrt{3gR}$

    Solution: (1)

    Minimum velocity required is $v = \sqrt{5gR}$

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

    (1) 180^o
    (2) 0^o
    (3) 90^o
    (4) 45^o

    Solution: (3)

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

    $A^2 + B^2 + 2AB\cos\theta = A^2 + B^2 = 2AB\cos\theta$

    $4AB\cos\theta = 0$

    $\cos\theta = 0$

    $\theta = 90^o$

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

    (1) 2000 km
    (2) 2600 km
    (3) 1600 km
    (4) 1400 km

    Solution: (2)

    $$V = \frac{GM}{R+h} = -5.4 \times 10^7$$

    $$g = \frac{GM}{(R+h)^2} = 6$$

$\therefore \frac{5.4}{6} \times 10^7 = R + h$

$\therefore a \times 10^6 = 6.4 \times 10^6 + h$

$\therefore h = 2600\ km$

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

(1) 1 H
(2) 4 H
(3) 3 H
(4) 2 H

Solution: (1)

$\phi = Li$

$1000 \times 4 \times 10^{-3} = L4$

$1 = L$

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

(1) 0.89 W
(2) 0.51 W
(3) 0.67 W
(4) 0.76 W

Solution: (2)

$wL = 340 \times 20 \times 10^{-3} = 68 \times 10^{-1} = 6.8$

$\frac{1}{wC} = \frac{1}{340 \times 50 \times 10^{-6}} = \frac{10^4}{34 \times 5} = \frac{2}{34} \times 10^3$

$= 0.0588 \times 10^3 = 58.82$

$2 = \sqrt{\left(wL - \frac{1}{wc}\right)^2 + R^2}$

$2 = \sqrt{2704 + 1600} \approx 65.6$

$i = \frac{V}{2}, \frac{10}{65 \times \sqrt{2}} = \frac{10}{65.6\sqrt{2}}$

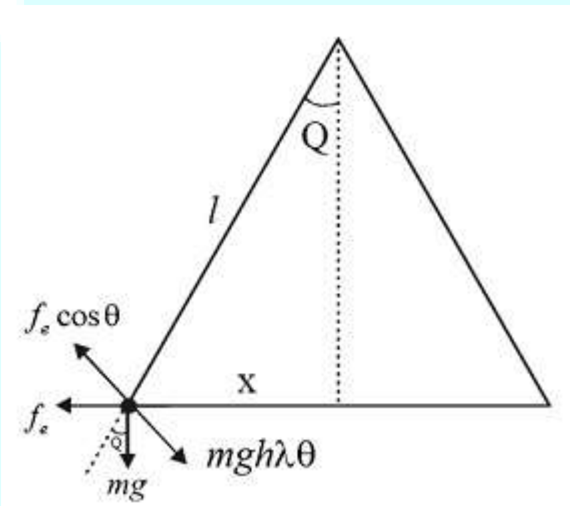
Power $= \frac{100 \times 40}{(65.6)^2 \times 2} = \frac{2000}{(65.6)^2}$

$= 0.51$ w

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

(1) $\upsilon \propto x^{-1}$
(2) $\upsilon \propto x^{\frac{1}{2}}$
(3) $\upsilon \propto x$
(4) $\upsilon \propto x^{-\frac{1}{2}}$

Solution: (4)



$\theta = \frac{x}{2l}$

$f_e \cos\theta = mgh\lambda\theta$

$f_e = mg.\left(\frac{x}{2}\right)$

$\frac{kq^2}{x^2} = \frac{mgx}{2e}$

$kq^2 = \frac{mg}{2l}x^3$

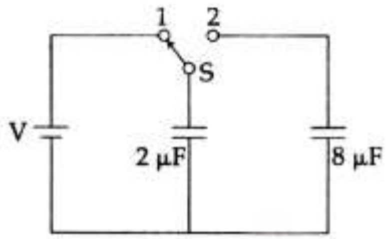
$q \propto x^{\frac{3}{2}}$

$\frac{dq}{dt} \propto \frac{3}{2}\, x^{\frac{1}{2}}.\frac{dx}{dt}$

$\Rightarrow x^{\frac{1}{2}}.v = \text{constant}$

$v \propto x^{-\frac{1}{2}}$

97.



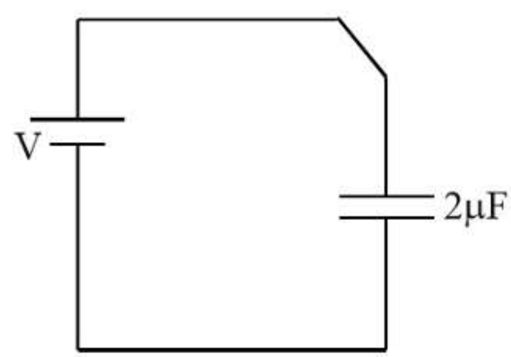
A capacitor of $2\mu F$ is charged as shown in the diagram. When the switch S is turned to position 2, the percentage of its stored energy dissipated is:

(1) 80%
(2) 0%
(3) 20%
(4) 75%

Solution: (1)

$Q = 2V$

$U_i = \frac{1}{2} \times \frac{(2V)^2}{2} = V^2$



$\therefore V_y = \frac{1}{2} \frac{64V^2}{25 \times 8}$

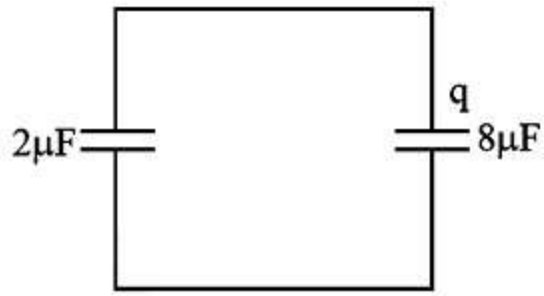
$\frac{2V - q}{2} = \frac{q}{8} + \frac{1}{2} \frac{4V^2}{25 \times 2}$

$\therefore 8V - 4q = q$

$U_f = \frac{5V^2}{25} = \frac{V^2}{5}$

$\therefore q = \frac{8V}{5}$

Energy dissipated $= \frac{4V^2}{5}$



∴ % energy

Dissipated $= \frac{4V^2}{5V^2} \times 100$

$= 80\%$

98. A particle moves so that its position vector is given by $\vec{r} = \cos\omega\, t\, \hat{x} + \sin\omega t\ \hat{y}$. Where ω is a constant. Which of the following is true?

(1) Velocity is perpendicular to $\vec{r}$ and acceleration is directed away from the origin.
(2) Velocity and acceleration both are perpendicular to $\vec{r}$.
(3) Velocity and acceleration both are parallel to $\vec{r}$.
(4) Velocity is perpendicular to $\vec{r}$ and acceleration is directed towards the origin.

Solution: (4)

Position vector is $\vec{r} = \cos\omega + \hat{x} + \sin\omega + \hat{y}$

Velocity of particle is $\vec{v} = \frac{d\vec{r}}{dt}$

$\vec{v} = \sin\omega t.\, \omega\, \hat{x} + \cos\omega t\,.\, \omega\hat{y}$

$\vec{v} = \omega(-\sin\omega t\hat{x} + \cos\omega t\hat{y})$

Acceleration of the particle is

$\vec{a} = \frac{d\vec{v}}{dt}$

$\vec{a} = -\omega^2(\cos\omega t\, \hat{x} + \sin\omega t\hat{y})$

$\vec{a} = -\omega^2\vec{r},$

So direction of $\vec{r}$ and $\vec{a}$ are opposite.

$\vec{v}.\vec{a} = 0 \Rightarrow \vec{v} \perp \vec{a}$

$\vec{v}.\vec{r} = 0 \Rightarrow \vec{v} \perp \vec{r}$

So, ans is (Velocity is perpendicular to $\vec{r}$ and acceleration is directed towards the origin.)

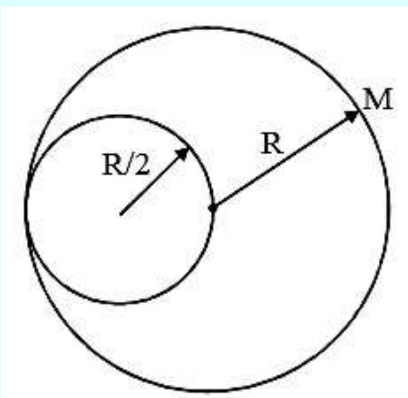
99. From a disc of radius R and mass M, a circular hole of diameter R, whose rim passes through the centre is cut. What is the moment of inertia of the remaining part of the disc about a perpendicular axis, passing through the centre?

(1) $9MR^2/32$
(2) $15\ MR^2/32$
(3) $13MR^2/32$
(4) $11MR\string^32$

Solution: (3)

$$I = \frac{MR^2}{2} - \frac{3\sigma}{2}\pi\left(\frac{R}{2}\right)^2\left(\frac{R}{2}\right)^2$$

Where $\sigma = \frac{M}{\pi R^2}$



$$I = \frac{MR^2}{2} - \frac{3}{32}MR^2$$

$$I = \frac{13}{32}MR^2$$

100. The ratio of escape velocity at earth (υ_e) to the escape velocity at a planet (υ_p) whose radius and mean density are twice as that of earth is:

(1) $1 : \sqrt{2}$
(2) $1 : 2$
(3) $1 : 2\sqrt{2}$
(4) $1 : 4$

Solution: (3)

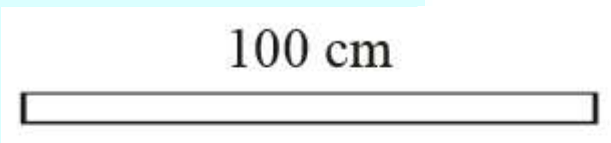
$$\frac{V_e}{V_P} = \frac{\sqrt{2\frac{GM_e}{R_e}}}{\sqrt{2\frac{GM_P}{R_P}}} = \sqrt{\frac{M_R}{M_P}\frac{R_P}{R_e}} = \sqrt{\frac{P_e\frac{4}{3}\pi R_e^3 R_P}{P_P\frac{4}{3}\pi R_P^3 R_e}}$$

$$\frac{V_e}{V_P} = \sqrt{\frac{P_e R_e^2}{P_P R_P^2}} = \sqrt{\frac{1}{2\ 2^2}} = \frac{1}{2\sqrt{2}}$$

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

(1) 3 : 2
(2) 5 : 1
(3) 5 : 4
(4) 3 : 4

Solution: (1)



$$\frac{E_1 + E_2 = \lambda 50}{E_1 - E_2 = \lambda 10}$$

$$E_1 + E_2 = 5E_1 - 5E_2$$

$$6E_2 = 4E_1$$

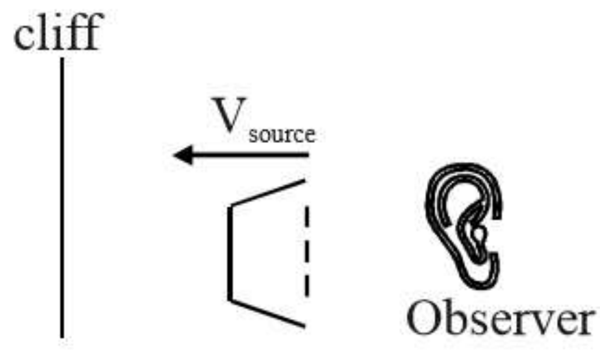
$$\frac{3}{2} = \frac{E_1}{E_2}$$

102. A siren emitting a sound of frequency 800 Hz moves away from an observer towards a cliff at a speed of $15\ \mathrm{ms^{-1}}$. Then, the frequency of sound that the observer hears in the echo reflected from the cliff is :
(Take velocity of sound in air $= 330\ \mathrm{ms^{-1}}$)
(1) 885 Hz
(2) 765 Hz
(3) 800 Hz
(4) 838 Hz

Solution: (4)

$f_0 = 800\mathrm{Hz}$

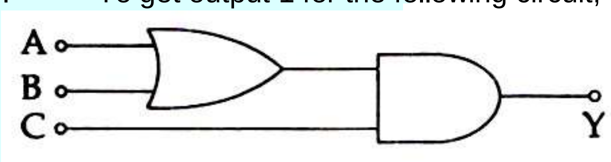
$V_{source} = 15$ m/s



$$f_a = \frac{330}{(330-15)}800 = \frac{330}{315}\times 800$$

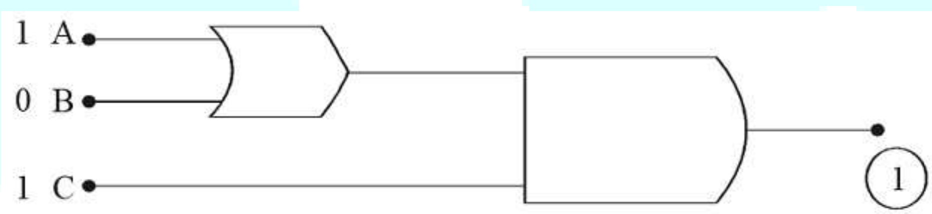
$$f_a = 838\ \text{Hz}$$

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



(1) $A = 1, B = 0, C = 1$
(2) $A = 0, B = 1, C = 0$
(3) $A = 1, B = 0, C = 0$
(4) $A = 1, B = 1, C = 0$

Solution: (1)



104. In a diffraction pattern due to a single slit of width 'a', the first minimum is observed at an angle 30^o when light of wavelength 5000 Å is incident on the slit. The first secondary maximum is observed at an angle of:

(1) $\sin^{-1}\left(\frac{3}{4}\right)$
(2) $\sin^{-1}\left(\frac{1}{4}\right)$
(3) $\sin^{-1}\left(\frac{2}{3}\right)$
(4) $\sin^{-1}\left(\frac{1}{2}\right)$

Solution: (1)

$a\sin 30 = \lambda$

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

$\frac{\sin\theta}{\sin 30} = \frac{3}{2}$

$\sin\theta = \frac{3}{2}\times\frac{1}{2}$

$\sin\theta = \frac{3}{4}$

$\theta = \sin\left(\frac{3}{4}\right)$

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

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

Solution: (1)

In photo electric effects

$eV_0 = 48 - W$

$eV_0 = \frac{hc}{\lambda} - W$

$eV = \frac{hc}{\lambda} - W \qquad \ldots(i)$

$e\frac{V}{4} = \frac{hc}{2\lambda} - W \qquad \ldots.(ii)$

From (i) and (ii)

$\frac{hc}{\lambda} - W = 4\left(\frac{hc}{2\lambda} - W\right)$

$\frac{hc}{\lambda} - W = \frac{2hc}{\lambda} - 4W$

$3W = \frac{hc}{\lambda} \Rightarrow W = \frac{hc}{3\lambda}$

$\frac{hc}{\lambda_{max}} = \frac{hc}{3\lambda} \Rightarrow \lambda_{max} =$ threshold wavelength 3λ

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

(1) m
(2) $\frac{1}{m}$
(3) $\frac{1}{\sqrt{m}}$
(4) $\frac{1}{m^2}$

Solution: (2)

At the distance of lowest approach, total K.E. of α-particle changes to P.E. so

$$\frac{1}{2}mv^2 = \frac{KQ.q}{r} = \frac{K(ze)(2e)}{r}$$

$$r = \frac{4K\,ze^2}{mv^2} \Rightarrow r \propto \frac{1}{m}$$

$$r \propto \frac{1}{m}$$

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

	Column 1		Column 2
(A)	$m = -2$	(a)	Convex mirror
(B)	$m = -\frac{1}{2}$	(b)	Concave mirror
(C)	$m = +2$	(c)	Real image
(D)	$m = +\frac{1}{2}$	(d)	Virtual image

(1) A → c and d; B→ b and d; C→ b and c; D→ a and d
(2) A → b and c; B→ b and c; C→ b and d; D→ a and d
(3) A → a and c; B→ a and d; d→ a and b; D→ c and d
(4) A → a and d; B→ b and c; C→ b and d; D→ b and c

Solution: (2)

$$m = \frac{-V}{u} = \frac{f}{f \times u}$$

$m = -2$ then "V" and "u" same given

$$-2 = \frac{f}{f \times u} - 2f + 2u = f$$

$$= 3f = -2u$$

$$\frac{+3f}{2} = 4$$

For mirror so 4 negative

∴ V has to be negative

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

(1) $0.2 \mathrm{m/s^2}$
(2) $0.1 \mathrm{~m/s^2}$
(3) $0.15 \mathrm{~m/s^2}$
(4) $0.18 \mathrm{~m/s^2}$

Solution: (2)

Tangential acceleration $a_t = r\alpha = \text{constant} = K$

$\alpha = \frac{K}{r}$

At the end of second revoluation angular velocity is w then

$w^2 - w_0^2 = 2 \propto \theta$

$$w^2 - 0^2 = 2\left(\frac{K}{r}\right)(4\pi)$$

$$w^2 = \frac{8\pi K}{r}$$

K.E. of the particle is $= \mathrm{K.E.} = \frac{1}{2}mv^2$

$$\mathrm{K.E.} = \frac{1}{2}mr^2w^2$$

$$\mathrm{K.E.} = \frac{1}{2}m(r^2)\left(\frac{8\pi K}{r}\right)$$

$$8 \times 10^{-4} = \frac{1}{2} \times 10 \times 10^{-3} \times 6.4 \times 10^{-2} \times 3.14 \times K$$

$$K = \frac{2}{6.4 \times 3.14} = 0.1 \frac{m}{ssec^2}$$

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

(1) Current I(t) leads voltage V(t) by 180^o.
(2) Current I(t), legs voltage V(t) by 90^o
(3) Over a full cycle the capacitor C does not consume any energy from the voltage source
(4) Current I(t) is in phase with voltage V(t).

Solution: (3)

In capacitor current leads the voltage. Average power dissipated in capacitor is zero.

110. A disk and a sphere of same radius but different masses roll off on two inclined planes of the same altitude and length. Which one of the two objects gets to the bottom of the plane first?
(1) Depends on their masses
(2) Disk
(3) Sphere
(4) Both reach at the same time

Solution: (3)

Acceleration of the object on rough inclined plane is $a = \frac{g\sin\theta}{1+\frac{I}{mR^2}}$

For sphere $a_1 = \frac{5g\sin\theta}{7}$

For disc $a_2 = \frac{2g\sin\theta}{3}$

$a_1 > a_2$, so sphere will reach bottom first.

111. Coefficient of linear expansion of brass and steel rods are α_1 and α_2. Lengths of brass and steel rods are l_1 and l_2 respectively. If $(l_2 - l_1)$ is maintained same at all temperatures, which one of the following relations holds good?

(1) $\alpha_1 l_1 = \alpha_2 l_2$
(2) $\alpha_1 l_2 = \alpha_2 l_1$
(3) $\alpha_1 l_2^2 = \alpha_2 l_1^2$
(4) $\alpha_1^2 l_2 = \alpha_2^2 l_1$

Solution: (1)

Difference in length are same so increase in length are equal

$\Delta l_1 = \Delta l_2$

$l_1 \alpha_2 \Delta T = l_2 \alpha_2 \Delta T$

$\Rightarrow l_1 \alpha_1 = l_2 \alpha_2$

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

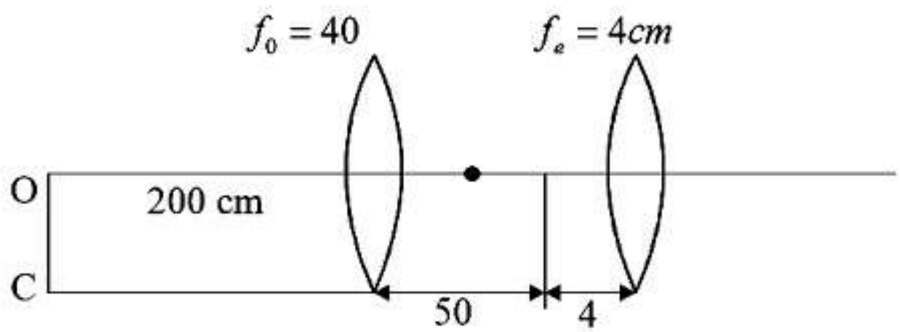
(1) 54.0 cm
(2) 37.3 cm
(3) 46.0 cm
(4) 50. 0 cm

Solution: (1)

$$\frac{1}{V} - \frac{1}{-200} = \frac{1}{40}$$

$\frac{1}{V}=\frac{5}{5}\frac{1}{40}-\frac{1}{200}$

$=\frac{5}{200}-\frac{1}{200}$



$\frac{1}{V}=\frac{4}{200}=\frac{1}{50}$

$V = 50$

$\therefore d = 50 + 4 = 54$ cm

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

(1) 3.0
(2) 8.0
(3) 7.0
(4) 6.0

Solution: (2)

At the end of 2 sec, $w = w_0 + \alpha t$

$w = 0 + 2(2) = 4$ rad/sec

Particle acceleration towards the center is $= a_c = rw^2$

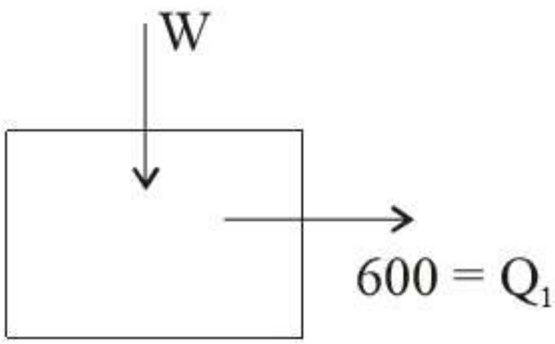
$a_r = \frac{1}{2}(4)^2 = 8$ m/s

114. A refrigerator works between 4^oC and 30^oC. It is required to remove 600 calories of heat every second in order to keep the temperature of the refrigerated space constant. The power required is: (Take 1 cal = 4.2 Joules)

(1) 2365 W
(2) 2.365 W
(3) 23.65 W

(4) 236.5 W

Solution: (4)



$$\frac{600 + w}{600} = \frac{303}{277}$$

$$1 + \frac{w}{600} = 1 + \frac{26}{277}$$

$$w = 600 \times \frac{26}{277} \times 4.2$$

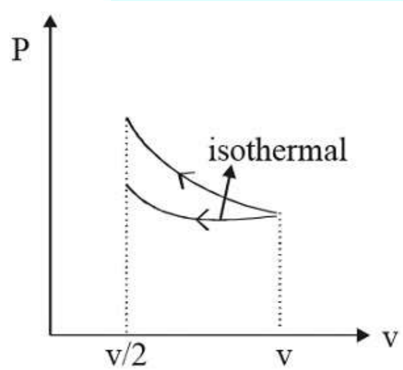
$$w = 236.5$$

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

(1) Which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas.
(2) Compressing the gas isothermally will require more work to be done.
(3) Compressing the gas through adiabatic process will require more work to be done.
(4) Compressing the gas isothermally or adiabatically will require the same amount of work.

Solution: (3)

Solution: (2)



Isothermal curve lie below the adiabatic curve, So in adiabatic process more work to be done.

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

(1) $\frac{I_0}{2}$
(2) I_0
(3) $\frac{I_0}{4}$
(4) $\frac{3}{4}I_0$

Solution: (1)

In YDSE $I_{max} = I_0$

Path difference at a point in front of one of shifts is

$$\Delta x = d\left(\frac{y}{D}\right) = d\left(\frac{\frac{d}{2}}{D}\right) = \frac{d^2}{2D}$$

$$\Delta x = \frac{d^2}{2(10d)} = \frac{d}{20} = \frac{5\lambda}{20} = \frac{\lambda}{4}$$

Path difference is

$$\phi = \frac{2\pi}{\lambda} = (\Delta x) = \frac{2\pi}{\lambda}\left(\frac{\lambda}{4}\right)$$

$$\phi = \frac{\pi}{2}$$

So intensity at that pt is

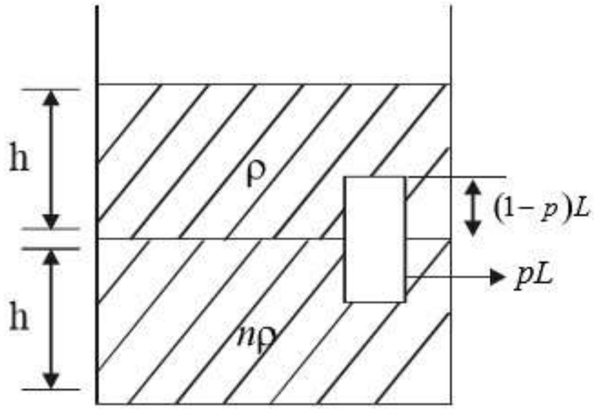
$$I = I_{max}\cos^2\left(\frac{\theta}{2}\right)$$

$$I = I_0\cos^2\left(\frac{\pi}{4}\right) = \frac{I_0}{2}$$

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

(1) $\{1 + (n-1)p\}\rho$
(2) $\{1 + (n+1)p\}\rho$
(3) $\{2 + (n+1)p\}\rho$
(4) $\{2 + (n-1)p\}\rho$

Solution: (1)



$f_0 = mg$

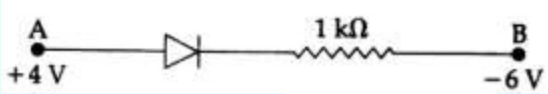
$PA(1 - P)Lg + n\rho ApLg = dALg$

$\rho(1 - p) + n\rho p = d$

$[1 - p + np]\rho = d$

$[1 + (n - 1)p]\rho = d$

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



(1) 10^{-3}A
(2) 0 A
(3) 10^{-2}A
(4) 10^{-1}A

Solution: (3)

$V_A - V_3 = 4 - (-6) = 10$

$\therefore i = \frac{10}{1000} = 10^{-2}$ A

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

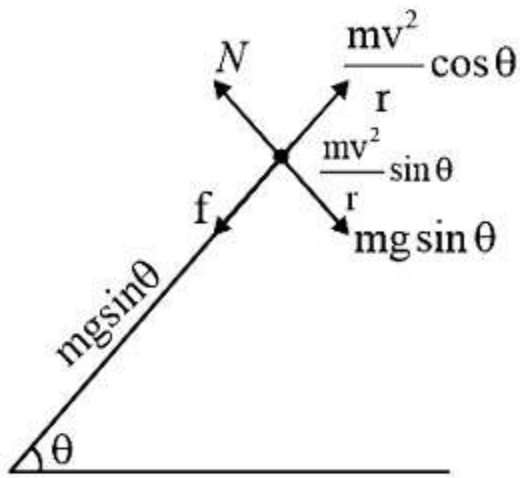
(1) $\sqrt{\frac{g}{R^2}\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

(2) $\sqrt{gR^2\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

(3) $\sqrt{gR\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

(4) $\sqrt{\frac{g}{R}\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

Solution: (3)



$$N = mg\cos\theta + \frac{mv^2}{r}\sin\theta$$

$$f_{max} = \mu mg\cos\theta + \frac{\mu mv^2}{r}\sin\theta$$

$$mg\sin\theta + \mu mg\cos\theta + \frac{\mu mv^2}{r}\sin\theta = \frac{mv^2}{r}\cos\theta$$

$$g\sin\theta + g\cos\theta = \frac{V^2}{r}(\cos\theta - \mu\sin\theta)$$

$$gr\left[\frac{\tan\theta + \mu}{1 + \mu\tan\theta}\right] = V^2$$

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

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

Solution: (4)

$$\frac{\text{Inside the wire}}{\text{By ampere's law}}$$

$$\int \vec{B}.\vec{dl} = \mu_0(i_{enclosed})$$

$$\int B\,.\,dl\cos 0 = \mu_0\left(\frac{I}{\pi a^2}.\pi\left(\frac{a}{2}\right)^2\right)$$

$$B\int dl = \mu_0\frac{I}{4}$$

$$B\left(2\pi\left(\frac{a}{2}\right)\right) = \frac{\mu_0 I}{4}$$

$$B = \frac{\mu_0 I}{4\pi a}$$

Outside the wire,

$$B' = \frac{\mu_0 I}{2\pi r} = \frac{\mu_0 I}{2\pi(2a)} = \frac{\mu_0 I}{4\pi a}$$

So, $\frac{B}{B'} = 1$.

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

(1) $2.5 \times 10^7\ m^{-1}$
(2) $0.025 \times 10^4\ m^{-1}$
(3) $0.5 \times 10^7\ m^{-1}$
(4) $0.25 \times 10^7\ m^{-1}$

Solution: (4)

$$\frac{1}{\lambda} = R = \left(\frac{1}{h_1^2} - \frac{1}{h_2^2}\right)$$

Wavelength $= \frac{1}{\lambda} = R\left[\frac{1}{2^2}\right] = \frac{R}{4} = \frac{10^7}{4} = 0.25 \times 10^7\ m^{-1}$

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

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

Solution: (4)

$$V = At + Bt^2$$

$X = \frac{At^2}{2} + \frac{Bt^3}{3}$

$t = 1$

$X_1 = \frac{A}{2} + \frac{B}{3}$

$t = 2$

$X_2 = 2A + \frac{8B}{3}$

$X_2 - X_1 = \frac{3A}{2} + \frac{7B}{3}$

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

(1) $30^o; \frac{1}{\sqrt{2}}$
(2) $45^o; \frac{1}{\sqrt{2}}$
(3) $30^o; \sqrt{2}$
(4) $45^o; \sqrt{2}$

Solution: (3)

At minimum deviation $\delta_{min} = 2i - A$

$\delta_{min} = 2(45) - 60$

$\delta_{min} = 30^o$

Refractive index of material is

$$\mu = \frac{\sin\left(\frac{\delta_{min} + A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{30+60}{2}\right)}{\sin(30^o)}$$

$$\mu = \frac{\sin 45^o}{\sin 30^o} = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{2}} = \sqrt{2}$$

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

(1) $\frac{100}{3}$
(2) $100\sqrt{2}$
(3) $\frac{400}{\sqrt{3}}$

(4) $\frac{100\sqrt{2}}{3}$

Solution: (3)

Rms speed of molecules is $V_{ms} = \sqrt{\frac{3RT}{M}}$

So it depends only on temperature

$V_{rms} \propto \sqrt{T}$

$$\frac{V_1}{V_2} = \sqrt{\frac{T_1}{T_2}} \Rightarrow \frac{200}{V_2} = \sqrt{\frac{300}{400}}$$

$\frac{200}{V_2} = \frac{\sqrt{3}}{2} \Rightarrow V_2 = \frac{400}{\sqrt{3}}$ m/sec

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

(1) 200 cm
(2) 66.7 cm
(3) 100 cm
(4) 150 cm

Solution: (4)

First minimum resonating length for closed organ pipe $= \frac{\lambda}{4} = 50\ cm$

∴ Next larger length of air column $= \frac{3\lambda}{4} = 150\ cm$

126. The magnetic susceptibility is negative for:
(1) paramagnetic and ferromagnetic materials
(2) diamagnetic material only
(3) paramagnetic material only
(4) ferromagnetic material only

Solution: (2)

Magnetic susceptibility χ_m

is negative for diamagnetic substance only

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

(1) $\frac{1}{c}\left(\frac{2m}{E}\right)^{\frac{1}{2}}$

(2) $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

(3) $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

(4) $c(2mE)^{\frac{1}{2}}$
(c being velocity of light)

Solution: (2)

De-Broglie wavelength is given by

$\lambda_e = \frac{h}{p} = \frac{h}{\sqrt{2m.E}}$ for electron

De-Broglie wavelength of photon is given by

$$\lambda_p = \frac{h}{p} = \frac{h}{\frac{E}{c}} = \frac{hc}{E}$$

$$\frac{\lambda_e}{\lambda_p} = \frac{1}{\sqrt{2mE}}.\frac{E}{c} = \frac{1}{c}\sqrt{\frac{E}{2m}}$$

128. A body of mass 1 kg begins to move under the action of a time dependent force $\vec{F} = (2t\,\hat{i} + 3t^2\,\hat{j})N$, where $\hat{i}$ and $\hat{j}$ are unit vectors along x and y axis. What power will be developed by the force at the time t?

(1) $(2t^3 + 3t^5)W$
(2) $(2t^2 + 3t^3)W$
(3) $(2t^2 + 4t^4)W$
(4) $(2t^3 + 3t^4)W$

Solution: (1)

$\vec{a} = 2t\hat{i} + 3t^2\hat{j}$

$\vec{V} = 2t^2\hat{i} + \frac{3}{3}t^3\hat{j}$

$\vec{F} = 2t\hat{i} + 3t^2\hat{j}$

$P = \vec{F}.\vec{V} = 2t^3 + 3t^5$

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

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

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

Solution: (2)

$Q = at - bt^2$

$\therefore t \epsilon \left[0, \frac{a}{b}\right]$

$i = \frac{dq}{dt} = a - 2bt$

Note: i is +ve $t \in \left(0, \frac{a}{2b}\right)$

And i is – ve $t \in \left(\frac{a}{2b}, \frac{a}{b}\right)$

Positive current means current one direction and negative current means current in opposite direction.

$\therefore dH = i^2 R dt$

$= (a - 2bt)^2 R\, dt$

$$H = \int_0^{\frac{a}{b}} (a - 2bt)^2\, R\, dt$$

$$= \frac{(a - 2bt)^3 R}{3(-2b)}\Bigg|_0^{\frac{a}{b}}$$

$$= \frac{1}{-b}\left[\left(a - 2b\frac{a}{b}\right)^3 - (a)^3\right] R$$

$$= -\frac{1}{6b}[(-a)^3 - a^3]R$$

$$H = \frac{a^3 R}{3b}$$

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

(1) 4, 3.69
(2) 4, 3.84
(3) 3.69, 3.84
(4) 4, 4

Solution: (2)

Voltage gain $= \beta.\left(\frac{R_C}{R_B}\right)$

$$V = 0.96\left(\frac{80}{192}\right)$$

$$V = \frac{96 \times 8}{192} = 4$$

And power gain of the amplifier is

$\beta_{ac}.A_v$

$= 0.96 \times 4$

$= 3.84$

131. A piece of ice falls from a height h so that it melts completely. Only one-quarter of the heat produced is absorbed by the ice and all energy of ice gets converted into heat during its fall. The value of h is: [Latent heat of ice is 3.4×1^5 J/kg and $g = 10$ N/kg]

(1) 68 km
(2) 34 km
(3) 544 km
(4) 136 km

Solution: (4)

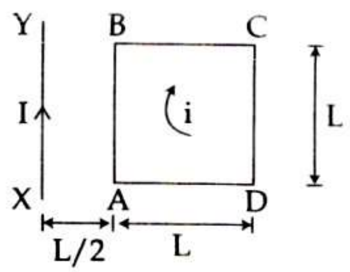
$$\frac{1}{4}mgh = mL$$

$$h = \frac{4L}{g} = \frac{4 \times 3.4 \times 10^5}{10} = 13.6 \times 10^4$$

$= 136 \times 10^3$ km

$= 136$ km

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



(1) $\frac{\mu_0 IiL}{2\pi}$

(2) $\frac{2\mu_0 Ii}{3\pi}$

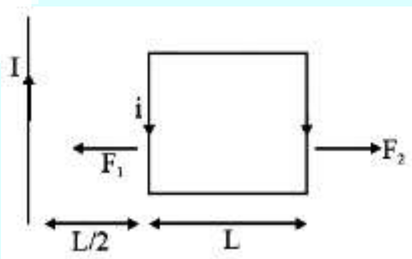
(3) $\frac{\mu_0 Ii}{2\pi}$

(4) $\frac{2\mu_0 IiL}{3\pi}$

Solution: (2)

$$F_1 = \frac{\mu_0 IiL}{2\pi\frac{L}{2}} = \frac{\mu_0 Ii}{\pi}$$

$$2 = \frac{\mu_0 IiL}{2\pi\frac{3L}{2}} = \frac{\mu_0 Ii}{3\pi}$$



$$\therefore F_{net} = F_1 - F_2$$

$$F_{net} = \frac{2}{3}\frac{\mu_0 Ii}{\pi}$$

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

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

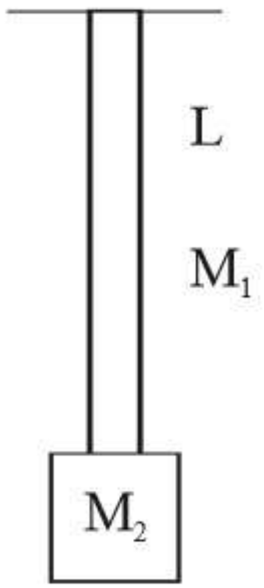
(2) $\sqrt{\frac{m_1}{m_2}}$

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

(4) $\sqrt{\frac{m_2}{m_1}}$

Solution: (3)

At bottom



$$v_1 = \sqrt{\frac{M_2 gL}{M_1}}$$

$$\therefore \lambda_1 = \sqrt{\frac{M_2}{M_1} gL}\,\frac{1}{f}$$

At top.

$$\therefore \frac{\lambda_2}{\lambda_1} = \sqrt{\frac{M_1 + M_2}{M_2}}$$

$$v_1 = \sqrt{\frac{(M_1 + M_2)gL}{M_1}}$$

$$\therefore \lambda_2 = \sqrt{\frac{(M_1 + M_2)gL}{M_1}}\,\frac{1}{f}$$

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

(1) $U_2 > U_1$
(2) $U_1 = 0$
(3) $U_3 = 0$
(4) $U_1 > U_2$

Solution: (4)

$\lambda_{min} T = b$

$\lambda \propto \frac{1}{T}$

$u \propto (T)^4 \propto \frac{1}{(\lambda)^4}$

So

$u_1 > u_2$

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

(1) An accelerating charge
(2) A charge moving at constant velocity
(3) A stationary charge
(4) A chargeless particle

Solution: (1)

An accelerating charge can produce electromagnetic wave.

CHEMISTRY

136. Which one of the following characteristics is associated with adsorption?
(1) ΔG and ΔS are negative but ΔH is positive
(2) ΔG is negative but ΔH and ΔS are positive
(3) $\Delta G, \Delta H$ and ΔS all are negative
(4) ΔG and ΔH are negative but ΔS is positive

Solution: (3) $\Delta H < 0$ Adsorption process is exothermic

$\Delta G < 0$ Adsorption process is Feasible

$\Delta S < 0$ Adsorption process is accompanied of decrease in entropy.

137. The pressure of H_2 required to make the potential of H_2 – electrode zero in pure water at 298 k is:
(1) 10^{-4} atm
(2) 10^{-14} atm
(3) 10^{-12} atm
(4) 10^{-10} atm

Solution: (2) $Pt, \frac{H_{2(g)}}{H^+}$ Hydrogen electrode $E^o_{H_2/H^+} = 0.0\ \text{Volt}$

$H_{2(g)} \rightarrow 2H^+_{(aq)} + 2e^-$

$[H^+] = 10^{-7}\ M$ at 25^oC (for Pure water)

$E = \frac{-0.0591}{2} \log\left(\frac{[H^+]^2}{P_{H_2}}\right)$

$E = 0 = \log\frac{[H^+]}{P_{H_2}} = 0$

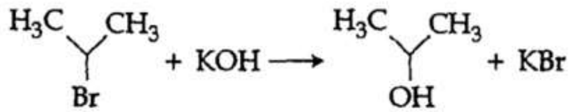
$\therefore [H^+]^2 = P_{H_2}$

$\therefore P_{H_2} = 10^{-14}\ \text{atm}$

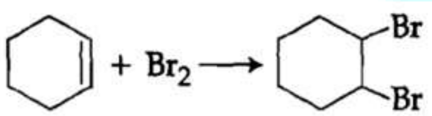
138. The addition of a catalyst during a chemical reaction alters which of the following quantities?
(1) Activation energy
(2) Entropy
(3) Internal energy
(4) Enthalpy

Solution: (1) Catalyst is going to affect the activation energy of a chemical reaction. Activation energy is the minimum energy required to from activated complex or Transition state.

139. For the following reactions:
a. $CH_3CH_2CH_2Br + KOH \rightarrow CH_3CH = CH_2 + KBr + H_2O$
b.



c.

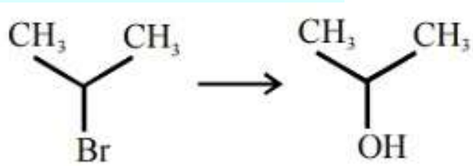


Which of the following statements is correct?

(1) a is substitution, b and c are addition reactions.
(2) a and b are elimination reactions and c is addition reaction.
(3) a is elimination, b is substitution and c is addition reaction.
(4) a is elimination, b and c are substitution reactions.

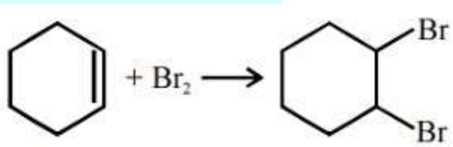
Solution: (3) a] $\underset{\text{(Elimination)}}{CH_3CH_2CH_2Br} + KOH \rightarrow CH_3CH = CH_2 + KBr + H_2O$

b]



(substitution)

c]



(addition)

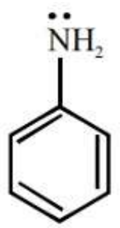
140. The product formed by the reaction of an aldehyde with a primary amine is:
(1) Aromatic acid
(2) Schiff base
(3) Ketone
(4) Carboxylic acid

Solution: (2) $> C = O + R - NH_2 \rightarrow \underset{\text{Schiff base}}{> C = N - R}$

141. The correct statement regarding the basicity of aryl amines is:
(1) Aryl amines are generally more basic than alkyl amines, because the nitrogen atom in aryl amines is sp-hybridized.

(2) Aryl amines are generally less basic than alkyl amines because the nitrogen lone-pair electrons are delocalized by interaction with the aromatic ring π electron system.
(3) Aryl amines are generally more basic than alkyl amines because the nitrogen lone-pair electrons are not delocalized by interaction with the aromatic ring π electron system.
(4) Aryl amines are generally more basic than alkyl amines because of aryl group.

Solution: (2)



Here lone pair is in conjugation with double bond so basic strength decreased

$R - \ddot{N}H_2$ (No conjugation)

142. Equal moles of hydrogen and oxygen gases are placed in a container with a pin-hole through which both can escape. What fraction of the oxygen escape in the time required for one-half of the hydrogen to escape?
(1) $\frac{1}{2}$
(2) $\frac{1}{8}$
(3) $\frac{1}{4}$
(4) $\frac{3}{8}$

Solution: (2) $\frac{\frac{n_1}{t_1}}{\frac{n_2}{t_2}} = \sqrt{\frac{M_2}{M_1}} \Rightarrow n_2 = \frac{1}{2}, n_1 = n'$

$\Rightarrow \frac{2t_2 n'}{t_1 x_1} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{2}{32}} = \sqrt{\frac{1}{16}} = \frac{1}{4}$

Assuming $t_2 = t_1$

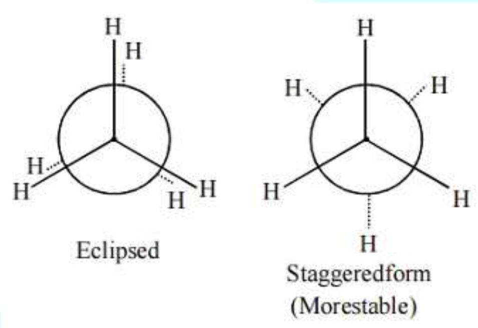
$\frac{2n' t_2}{t_1} = \frac{1}{4}$

$\therefore n' = \frac{1}{8}$

143. The correct statement regarding the comparison of staggered and eclipsed conformations of ethane, is:
(1) The staggered conformation of ethane is more stable than eclipsed conformation, because staggered conformation has no torsional strain.
(2) The staggered conformation of ethane is less stable than eclipsed conformation, because staggered conformation has torsional strain.

(3) The eclipsed conformation of ethane is more stable than staggered conformation, because eclipsed conformation has no torsional strain.
(4) The eclipsed conformation of ethane is more stable than staggered conformation even though the eclipsed conformation has torsional strain.

Solution: (1) $CH_3 - CH_3$



144. In which of the following options the order of arrangement does not agree with the variation of property indicated against it?
(1) $Li < Na < K < Rb$ (increasing metallic radius)
(2) $Al^{3+} < Mg^{2+} < Na^{+} < F^{-}$ (increasing ionic size)
(3) $B < C < N < O$ (increasing first ionization enthalpy)
(4) $I < Br < Cl < F$ (increasing electron gain enthalpy)

Solution: (3,4) N is having $ns^2\ np^3$ (Half filled configuration). Hence has high IP than O which is having $ns^2\ np^4$ electronic configuration.

145. The rate of a first-order reaction is $0.04\ mol\ l^{-1}s^{-1}$ at 10 second and $0.03\ mol\ l^{-1}s^{-1}$ at 20 seconds after initiation of the reaction. The half-life period of the reaction is:
(1) 54.1 s
(2) 24.1 s
(3) 34.1 s
(4) 44.1 s

Solution: (2)

Rate	Time
0.04	10
0.03	20

For first order reaction r ∝ conc.

$\frac{r_1}{r_2} = \frac{C_1}{C_2} = \frac{4}{3}$

$\therefore k = \frac{2.303}{t_2 - t_1} \log \frac{C_1}{C_2}$

$\Rightarrow \frac{0.693}{t_{1/2}} = \frac{2.303}{20-10} \log \frac{4}{3}$

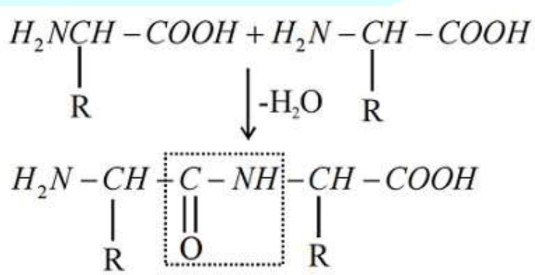
On solving $t_{1/2} = 24.1\ s$

146. When copper is heated with conc. HNO_3 it produces:
(1) $Cu(NO_3)_2$ and N_2O
(2) $Cu(NO_3)_2$ and NO_2
(3) $Cu(NO_3)_2$ and NO
(4) $Cu(NO_3)_2, NO$ and NO_2

Solution: (2) $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + O_2$

147. In a protein molecule various amino acids are linked together by:
(1) Dative bond
(2) α-glycosidic bond
(3) β- glycosidic bond
(4) Peptide bond

Solution: (4)



Peptide bond

148. Fog is a colloidal solution of:
(1) Gas in gas
(2) Liquid in gas
(3) Gas in liquid
(4) Solid in gas

Solution: (2) Fog is a colloidal solution in which liquid droplets are dispersed in gas.

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

	Column I		Column II
(a)	Cyanide process	(i)	Ultrapure Ge
(b)	Froth floatation process	(ii)	Dressing of ZnS
(c)	Electrolytic reduction	(iii)	Extraction of Al
(d)	Zone refining	(iv)	Extraction of Au

		(v)	Purification of Ni

(1) (a) (b) (c) (d)
(iii) (iv) (v) (i)

(2) (a) (b) (c) (d)
(iv) (ii) (iii) (i)

(3) (a) (b) (c) (d)
(ii) (iii) (i) (v)

(4) (a) (b) (c) (d)
(i) (ii) (iii) (iv)

Solution: (2) a] Cyanide process is used to extract and Au in hydrometallurgy.

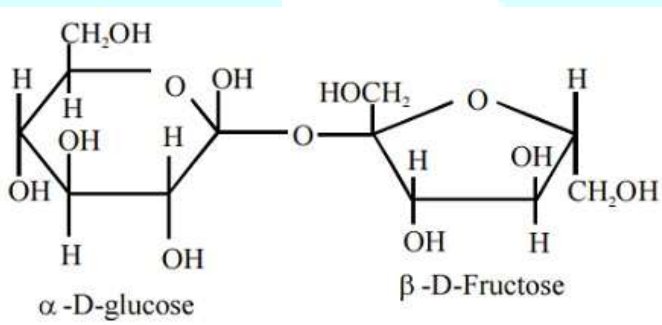
b] Froth foundation process is used for dressing of sulfide ores.

c] Electrolytic reduction is used to extract Al.

d] Zone refinining process is used for obtaining ultrapure Ge.

150. Which one given below is a non-reducing sugar?
(1) Sucrose
(2) Maltose
(3) Lactose
(4) Glucose

Solution: (1)

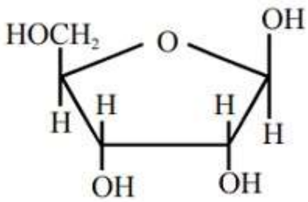


Glycosidic bond involves reducing groups.

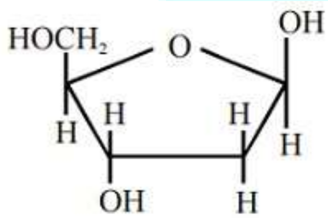
Sucrose (No reducing sugar)

151. The correct statement regarding RNA and DNA, respectively is:
(1) The sugar component in RNA is 2'-deoxyribose and the sugar component in DNA is arabinose.
(2) The sugar component in RNA is arabinose and the sugar component in DNA is 2'-deoxyribose.
(3) The sugar component in RNA is ribose and the sugar component in DNA is 2'-deoxyribose.
(4) The sugar component in RNA is arabinose and the sugar component in DNA is ribose.

Solution: (3)



β -D-ribose
Sugar component of RNA



β -D-2deoxyribose
Sugar component of DNA

152. The correct thermodynamic conditions for the spontaneous reaction at all temperatures is:
(1) $\Delta H < 0$ and $\Delta S < 0$
(2) $\Delta H < 0$ and $\Delta S = 0$
(3) $\Delta H > 0$ and $\Delta S < 0$
(4) $\Delta H < 0$ and $\Delta S > 0$

Solution: (4) $\Delta G = \Delta H - T\Delta S$

Spontaneous at all temperature $\Delta H < 0, \Delta S > 0$

153. Which is the correct statement for the given acids?
(1) Phosphinic acid is a diprotic acid while phosphonic acid is a monoprotic acid.
(2) Phosphinic acid is a monoprotic acid while phosphonic acid is a diprotic acid.
(3) Both are diprotic acids
(4) Both are triprotic acids

Solution: (2) Phosphinic acid is Hypophosphorous acid H_3PO_2 which is Monobasic acid. Phosphonic acid is phosphorous acid H_3PO_3 which is Dibasic acid.

154. MY and NY_3, two nearly insoluble salts, have the same K_{sp} values of 6.2×10^{-13} at room temperature. Which statement would be true in regard to MY and NY_3?
(1) The addition of the salt of KY to solution of MY and NY_3 will have no effect on their solubilities.
(2) The molar solubilities of My and NY_3 in water are identical.
(3) The molar solubility of MY in water is less than that of NY_3.
(4) The salts MY and NY_3 are more soluble in 0.5 M KY than in pure water.

Solution: (3) MY insoluble salt $K_{sp} = s^2$

$MY_{(s)} \rightleftharpoons M^+_{(aq)} + Y^-_{(aq)}$

NY_3 insoluble salt $K_{sp} = 4s^3$

$NY_{3(s)} \rightleftharpoons N^+_{(aq)} + 3Y^-_{(aq)}$

$\therefore S_{(MY)} = \sqrt{6.2 \times 10^{-13}} = 7.8 \times 10^{-7}$

Solubility values

$\therefore S_{(NY_3)} = \left(\frac{6.2\times10^{-13}}{4}\right)^{1/3} = 5.2 \times 10^{-5}$

$\therefore S_{(MY)} < S_{(NY_3)}$

155. Which of the following is an analgesic?
(1) Chloromycetin
(2) Novalgin
(3) Penicillin
(4) Streptomycin

Solution: (2) Novalgin – It is analgesic. Used for treatment of pain.

Pencilin – Antibiotic

Streptomycin – Antibiotic

Chloromycetic – Used for treat infection.

156. The pair of electron in the given carbanion, $CH_3C \equiv C^{\ominus}$ is present in which of the following orbitals?
(1) sp
(2) 2p
(3) sp^3
(4) sp^2

Solution: (1) $CH_3 - C \equiv C^{\ominus}$: In the carbanian the carbon is having 1 sigma bond, 2π bonds and 1 lone pair therefore C is sp hybridized.

157. Among the following, the correct order of acidity is:
(1) $HClO_4 < HClO_2 < HClO < HClO_3$
(2) $HClO_3 < HClO_4 < HClO_2 < HClO$
(3) $HClO < HClO_2 < HClO_3 < HClO_4$
(4) $HClO_2 < HClO < HClO_3 < HClO_4$

Solution: (3) Oxidation state of chlorine ∝ Acidity of Oxo Acid.

$HClO < HClO_2 < HClO_3 < HClO_4$ is the correct increasing order.

158. Which one of the following statements is correct when SO_2 is passed through acidified $K_2Cr_2O_7$ solution?
(1) Green $Cr_2(SO_4)_3$ is formed.
(2) The solution turns blue.
(3) The solution is decolourized.
(4) SO_2 is reduced.

Solution: (1) $$\underset{}{K_2Cr_2O_7 + SO_2 + H_2SO_4} \rightarrow K_2SO_4 + \underset{\text{Green}}{Cr_2(SO_4)_3} + H_2O$$

159. Predict the correct order among the following:
(1) Lone pair – bond pair > bond pair – bond pair > lone pair – lone pair
(2) Lone pair – lone pair > lone pair – bond pair > bond pair – bond pair
(3) Lone pair – lone pair > bond pair – bond pair > lone pair – bond pair
(4) Bond pair – bond pair > lone pair – bond pair > lone pair – lone pair

Solution: (2) As per VSEPR theory, overall order of Repulsion is

$$\underset{\text{(Repulsion)}}{BP - BP} < \underset{\text{(Repulsion)}}{BP - LP} < \underset{\text{(Repulsion)}}{LP - LP}$$

160. Two electrons occupying the same orbital are distinguished by:
(1) Spin quantum number
(2) Principal quantum number
(3) Magnetic quantum number
(4) Azimuthal quantum number

Solution: (1) Electron occupying same orbital have different spin quantum number.

161. The product obtained as a result of a reaction of nitrogen with CaC_2 is:
(1) Ca_2CN
(2) $Ca(CN)_2$
(3) $CaCN$
(4) $CaCN_3$

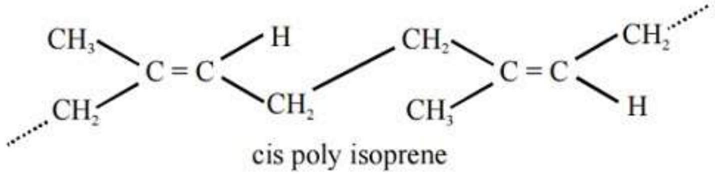
Solution: (Bonus) $$\underset{\substack{\text{Calcium}\\\text{Carbide}}}{CaC_2} + \underset{\substack{\text{Nitrogen}\\\text{Gas}}}{N_2} \rightarrow \underset{\text{Calcium Cyanamide}}{CaCN_2 + C}$$

$CaCN_2$ is not given in the option so it should be bonus.

162. Nutural rubber has:
(1) Random cis – and trans – configuration
(2) All cis – configuration
(3) All trans – configuration

(4) Alternate cis – and trans – configuration

Solution: (2)



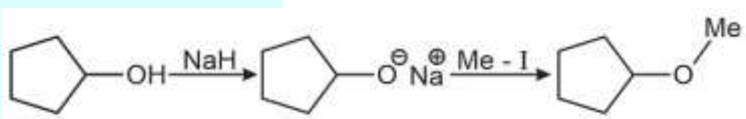
163. Which one of the following orders is correct for the bond dissociation enthalpy of halogen molecules?

(1) $F_2 > Cl_2 > Br_2 > I_2$
(2) $I_2 > Br_2 > Cl_2 > F_2$
(3) $Cl_2 > Br_2 > F_2 > I_2$
(4) $Br_2 > I_2 > F_2 > Cl_2$

Solution: (3) Decreasing order of Bond energy, $Cl_2 > Br_2 > F_2 > I_2$

The reason is anomalous behavior due to large electron – electron repulsion among the lone pairs in F_2 molecule other than Cl_2 and Br_2.

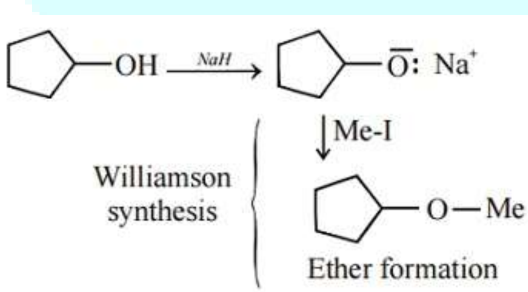
164. The reaction



Can be classified as:

(1) Williamson alcohol synthesis reaction
(2) Williamson ether synthesis reaction
(3) Alcohol formation reaction
(4) Dehydration reaction

Solution: (2)



165. Lithium has a bcc structure. Its density is 530 kg m^{-3} and its atomic mass is 6.94 g mol^{-1}. Calculated the edge length of a unit cell of Lithium metal. $(N_A = 6.02 \times 10^{23} \text{ mol}^{-1})$

(1) 264 pm
(2) 154 pm
(3) 352 pm
(4) 527 pm

Solution: (3) $d = \frac{Z\,M}{N_A\, a^3}$

$a^3 = \frac{6.94\times 2}{6.022\times 10^{23}\times 530\times 10^{-3}} = \frac{6.94\times 200\times 10^{-24}}{5.30\times 6.022}$

$= 3.52\times 10^{-8}$ cm

$= 352$ pm

166. The ionic radii of A^+ and B^- ions are 0.98×10^{-10}m and 1.81×10^{-10} m. The coordination number of each ion in AB is
(1) 2
(2) 6
(3) 4
(4) 8

Solution: (2) Radius ratio of $\left(\frac{A^+}{B^-}\right) = \frac{0.98\times 10^{-10}\text{ m}}{1.81\times 10^{-10}\text{ m}} = \frac{0.98}{1.81} = 0.541$

If the radius ratio is between 0.414 and 0.732 then Co-ordination number is 6.

167. At 100^oC the vapour pressure of a solution of 6.5 g of a solute in 100 g water is 732 mm. If $K_b = 0.52$, the boiling point of this solution will be:
(1) 103^oC
(2) 101^oC
(3) 100^oC
(4) 102^oC

Solution: (2) At 100^oC (boiling point)

Vapour pressure of water $P^o = P_{atm} = 760$ ml

$\therefore \frac{P^o - P_s}{P^o} = X_{solute}$

$\Rightarrow \frac{760-732}{760} = \frac{n_{solute}}{n_{solvent}}$

$\Rightarrow \frac{28}{760} = \frac{6.5/m}{100/18}$

$\Rightarrow m = \frac{6.5\times 18\times 760}{28\times 100} \approx 32$

Now,

$\Delta T_b = K_b$ molality

$= 0.52\times \frac{6.5/32}{0.1}$

$= \frac{0.52\times6.5}{32\times0.1}$

$= 1.05 \approx 1s$

∴ Boiling point of solution $= 100 + 1 = 101^{o}C$

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

(1) $[Xe]4f^7 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 6s^2$
(2) $[Xe]4f^7 6s^2$, $[Xe]4f^8 6s^2$ and $[Xe]4f^8 5d^1 6s^2$
(3) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 6s^2$
(4) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^8 5d^1 6s^2$

Solution: (1) $Eu - [Xe]4f^7, 6s^2$

$Gd - [Xe]4f^7, 5d^1, 6s^2$

$T_6 - [Xe]4f^9, 6s^2$

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

(1) Dihydrogen does not act as a reducing agent.
(2) Hydrogen has three isotopes of which tritium is the most common.
(3) Hydrogen never acts as cation in ionic salts.
(4) Hydronium ion, H_3O^+ exists freely in solution.

Solution: (1,2) Hydrogen is having three isotopes protium, Dentenium and tritium in which tritium is Radioactive and very rare.

170. In the reaction

$$H - C \equiv CH \xrightarrow[(2)\ CH_3\ \ CH_2\ Br]{(1)\ NaNH_2\ \ /liq.\ NH_3} X \xrightarrow[(2)\ CH_3\ CH_2Br]{(1)\ NaNH_2\ \ /liq.\ NH_3} Y$$

X and Y are:

(1) X = 1 – Butyne ; Y = 2 – Hexyne
(2) X = 1 – Butyne ; Y = 3 – Hexyne
(3) X = 2 – Butyne ; Y = 3 – Hexyne
(4) X = 2 – Butyne ; Y = 2 – Hexyne

Solution: (2)

$$H-C\equiv C-H \xrightarrow{NaNH_2/liq.NH_3} H-C\equiv \overline{C}:Na^+ \xrightarrow{CH_3CH_2Br} H-C\equiv C-CH_2CH_3$$

1-Butyne (x)

$$H-C\equiv C-CH_2CH_3 \xrightarrow{NaNH_2/liq.NH_3} Na^+:C\equiv \overline{C}-CH_2CH_3 \xrightarrow{CH_3CH_2Br} CH_3CH_2-C\equiv C-CH_2-CH_3$$

3-Hexyne (y)

171. Consider the following liquid – vapour equilibrium.

$\text{Liquid} \rightleftharpoons \text{Vapour}$

Which of the following relations is correct?

(1) $\frac{d\ln P}{dT} = \frac{\Delta H_\upsilon}{RT^2}$

(2) $\frac{d\ln G}{dT^2} = \frac{\Delta H_\upsilon}{RT^2}$

(3) $\frac{d\ln P}{dT} = \frac{-\Delta H_\upsilon}{RT}$

(4) $\frac{d\ln P}{dT^2} = \frac{-\Delta H_\upsilon}{T^2}$

Solution: (1) $P = Ke^{-\Delta H/RT}$

$\ln P = \ln K - \frac{\Delta H}{RT}$

$\frac{d}{dT}\ln P = \frac{\Delta H_\upsilon}{RT^2}$

$\therefore \frac{d\ln P}{dT} = \frac{\Delta H_\upsilon}{RT^2}$

172. Which of the following statements about the composition of the vapour over an ideal 1 : 1 molar mixture of benzene and toluene is correct? Assume that the temperature is constant at 25^oC. (Given vapour pressure data at 25^oC, benzene = 12.8 kPa, toluene = 3.85 kPa)

(1) Not enough information is given to make a prediction.

(2) The vapour will contain a higher percentage of benzene.

(3) The vapour will contain a higher percentage of toluene.

(4) The vapour will contain equal amounts of benzene and toluene.

Solution: (2) A – benzene, B – Toluene

$P_T = P_A^o X_A + P_B^o X_B$

$= 12.8 \times 0.5 + 3.85 \times 0.5$

$= 6.2 + 1.925$

$= 8.125$

Also, mole fraction of benzene in vapour form

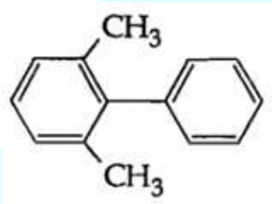
$$Y_A = \frac{P_A^o X_A}{P_T} = \frac{6.2}{8.121} = 0.75$$

And mole fraction of Toluene in vapour form

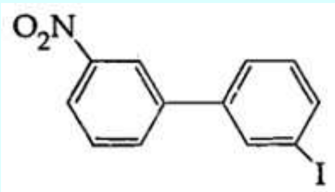
$$Y_B = 1 - 0.75 = 0.25$$

173. Which of the following biphenyls is optically active?

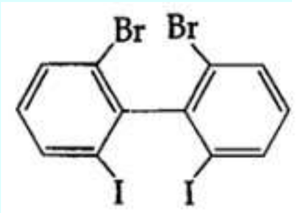
(1)



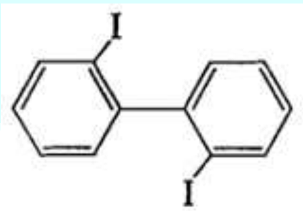
(2)



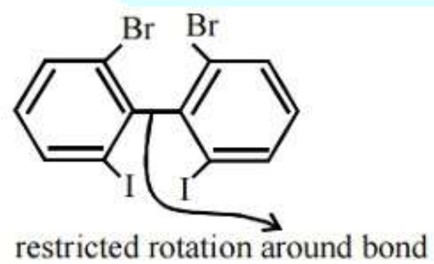
(3)



(4)



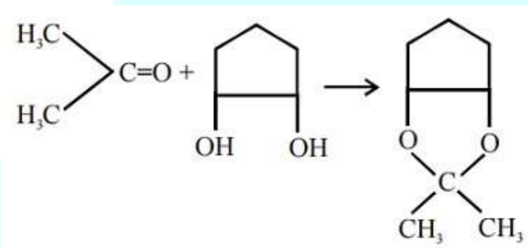
Solution: (3)



Is optically active (Non super imposable on its mirror image)

174. Which of the following reagents would distinguish cis-cyclopenta-1, 2-diol from the trans-isomer?
(1) Aluminium isopropoxide
(2) Acetone
(3) Ozone
(4) MnO_2

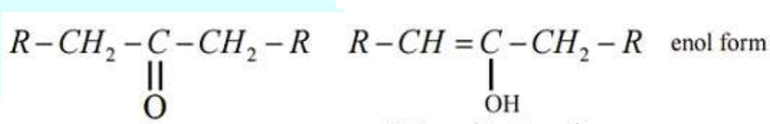
Solution: (2)



Ketal formation

175. The correct statement regarding a carbonyl compound with a hydrogen atom on its alpha carbon, is:
(1) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism.
(2) A carbonyl compound with a hydrogen atom on its alpha-carbon never equilibrates with its corresponding enol.
(3) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as aldehyde-ketone equilibration.
(4) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as carbonylation.

Solution: (1)



Ketoenol tautomerism

176. Consider the molecules CH_4, NH_3 and H_2O. Which of the given statements is false?
(1) The H – C – H bond angle in CH_4 is larger than the H – N – H bond angle in NH_3.
(2) The H – C – H bond angle in CH_4, the H – N – H bond angle in NH_3, and the H – O – H bond angle in H_2O are all greater than 90^o.
(3) The H – O – H bond angle in H_2O is larger than the H – C – H bond angle in CH_4.
(4) The H – O – H bond angle in H_2O is smaller than the H – N – H bond angle in NH_3.

Solution: (3)

Bond Angle	Molecule
104.5^o	H_2O

107^o	NH_3
$109^o28'$	CH_4

All the molecules are sp^3 hybridized and Bond angle of H_2O is smaller than NH_3.

177. Match the compounds given in column I with the hybridization and shape given in column II and mark the correct option.

	Column I		Column II
(a)	XeF_6	(i)	Distorted octahedral
(b)	XeO_3	(ii)	Square planar
(c)	$XeOF_4$	(iii)	Pyramidal
(d)	XeF_4	(iv)	Square pyramidal

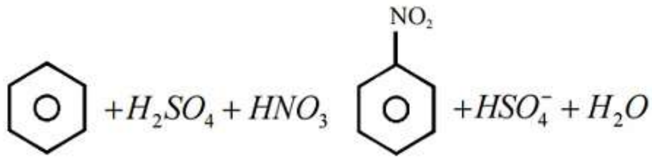
(1) (a) (iv), (b) (i), (c) (ii), (d) (iii)
(2) (a) (i), (b) (iii), (c) (iv), (d) (ii)
(3) (a) (i), (b) (ii), (c) (iv), (d) (iii)
(4) (a) (iv), (b) (iii), (c) (i), (d) (ii)

Solution: (2)

	Molecule	Hybridization	Shape as per VSEPR Theory
1	XeF_6	sp^3d^3	Distored octahedron
2	XeO_3	sp^3	Pyramidal
3	$XeOF_4$	sp^3d^2	Square Pyramidal
4	XeF_4	sp^3d^2	Square planar

178. Consider the nitration of benzene using mixed conc. H_2SO_4 and HNO_3. If a large amount of $KHSO_4$ is added to the mixture, the rate of nitration will be:
(1) Doubled
(2) Faster
(3) Slower
(4) Unchanged

Solution: (3)



If we add $KHSO_4^-$, conc. HSO_4^- increases, equilibrium shifts backward.

179. Which of the following statements is false?
(1) Mg^{2+} ions are important in the green parts of plants.
(2) Mg^{2+} ions form a complex with ATP.
(3) Ca^{2+} ions are important in blood clotting.
(4) Ca^{2+} ions are not important in maintaining the regular beating of the heart.

Solution: (4) Monovalent sodium and potassium ions and divalent magnesium and calcium ions are found in large properties in biological fluids. There ions perform important biological functions such as maintenance of heart and nerve impulse.

180. Which of the following has longest C – O bond length? (Free C – O bond length in CO is 1.128 Å).
(1) $[Mn(CO)_6]^+$
(2) $Ni(CO)_4$
(3) $[Co(CO)_4]^\ominus$
(4) $[Fe(CO)_4]^{2-}$

Solution: (4) Metal carbon bond in metal carbonyls possess both σ and π character. M – C π bond is formed by donation of a pair of electrons from filled orbital of metal into vacant antibonding π orbital of CO. CO bond length increases if M has more tendency to donate lone pair by metal more CO bond length.