Botany - Section A

1. Consider the two statements:
I. Current availability of carbon dioxide levels is limiting to the C_4 plants.
II. C_3 plants have a much lower temperature optimum than C_4 plants.
1. Only I is correct
2. Only II is correct
3. Both I and II are correct
4. Both I and II are incorrect

2. Match the Scientists given in COLUMN I with their contribution in Column II and select the correct match from the codes given:

	COLUMN I		COLUMN II
A	Jan Ingenhousz	P	Provided evidence for production of glucose when plants grow
B	T. W Engelmann	Q	Described the first action spectrum for photosynthesis
C	Julius von Sachs	R	Showed that sunlight is essential for photosynthesis
D	Cornelius van Neil	S	Inferred that oxygen evolved in photosynthesis comes from water and not from carbon dioxide

Codes

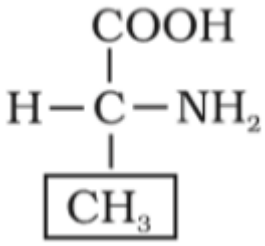
	A	B	C	D
1.	R	Q	P	S
2.	Q	R	S	P
3.	P	S	R	Q
4.	S	P	Q	R

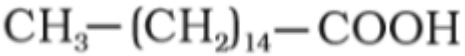
3. Identify the incorrect statement:
1. Viruses are obligate parasites
2. Prions are abnormally folded infectious proteins
3. Viroids are free RNA and lack a protein coat
4. Lichens grow very well in polluted areas

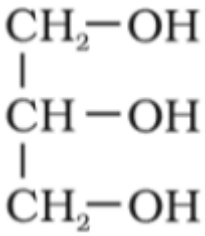
4. The names for Complex III and Complex IV in the mitochondrial electron transport chain respectively are:
1. NADH dehydrogenase and Succinic dehydrogenase
2. NADH dehydrogenase and ATP synthase
3. Cytochrome bc1 and Cytochrome c oxidase
4. Cytochrome bc1 and Cytochrome b6f

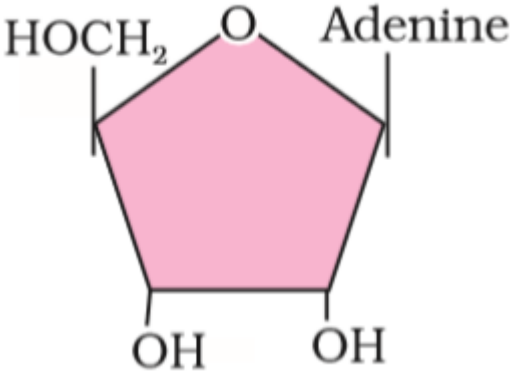
5. You do not expect to see in a plant cell:
1. A tonoplast
2. An elaioplast
3. 80 S ribosomes
4. A centrosome

6. Which of the following organic molecule is not correctly matched with diagrammatic representation of its structure?

1. Alanine 

2. Palmitic acid 

3. Glycerol 

4. Adenylic acid 

7. The ratio of the volume of CO_2 evolved to the volume of O_2 consumed in respiration is called as the respiratory quotient [RQ]. Calculate RQ when albumin is used as a respiratory substrate[see the given equation]:
$C_{77}H_{112}N_2O_{22}S + 77O_2 \rightarrow 63\ CO_2 + 38\ H_2O + SO_2 + 9\ CO(NH_2)_2$
1. 0.70
2. 0.82
3. 0.90
4. 1.00

8. Both Mycoplasma and Euglenoids:
1. can survive without oxygen
2. are unicellular eukaryotes
3. lack cell wall
4. have two flagella

9. In mango and coconut:
1. the fruit is a drupe
2. edible part is the mesocarp
3. the fruit is parthenocarpic
4. thalamus contributes maximum part in the development of fruit

10. Which of the following is/are a surface structure of the bacterial cell but do not play a role in motility?
I. Flagella
II. Pili
III. Fimbriae
1. Only I
2. Only II
3. Only II and III
4. Only III

11. Identify the incorrectly matched pair:

1. Having the sepals united	Gamosepalous
2. Sterile stamen	Staminate
3. Stamens attached to perianth	Epiphyllous
4. Having the carpels of the gynoecium united in a compound ovary	Syncarpous

12. What would be true for both Cycas and Pinus?
1. Cycas is a gymnosperm and Pinus is a pteridophyte
2. The gametophyte is dominant in the life cycle of Cycas and the sporophytes is dominant in the life cycle of Pinus
3. Roots of Pinus have mycorrhiza association and coralloid roots of Cycas are associated with nitrogen-fixing cyanobacteria
4. In Pinus, the male and female cones are borne on different trees and in Cycas on the same tree

13. Identify the correctly matched pair:

1. Isogamy with flagellated gametes	Volvox
2. Isogamy with non-flagellated gametes	Ulothrix
3. Anisogamy	Udorina
4. Oogamy	Spirogyra

14. During oxidation within a cell, all the energy contained in respiratory substrates:
1. is released free into the cell
2. is released in a single step
3. is released in a series of slow step-wise reactions
4. gets converted to usable energy

15. Match the alga with the type of life cycle and select the correct match from the codes given:

Alga	Type of life cycle
A Spirogyra	P Haplontic
B Fucus	Q Diplontic
C Polysiphonia	R Haplo-diplontic

Codes:

	A	B	C
1.	P	Q	R
2.	P	R	Q
3.	Q	P	R
4.	R	Q	P

16. Promotion of flowering process in a plant by exposure to the prolonged cold of winter, or by an artificial equivalent, is called as:
1. Stratification
2. Vernalisation
3. Photoperiodism
4. Scarification

17. Bundle sheath cells, part of Kranz anatomy in a C_4 plant, are not characterized by:
1. May form several layers around the vascular bundle
2. Have large number of chloroplasts
3. Have thick walls impervious to gaseous exchange
4. Large intercellular spaces are seen

18. Two organisms belonging to the same Order may not belong to the same:
1. Class
2. Phylum
3. Family
4. Kingdom

19. Regarding bacteria:
1. The rod shaped are called as coccus
2. Majority are photosynthetic autotrophs
3. As a group show the maximum metabolic diversity
4. All are pathogenic to humans

20. The members of Family Liliaceae have six:
I. Tepals
II. Fused carpels in the ovary
III. Stamens
1. Only I and II
2. Only I and III
3. Only II and III
4. I, II and III

21. In which of the following alga you do not expect to see flagellated structures during their entire life cycle?
1. Porphyra
2. Ectocarpus
3. Ulothrix
4. Laminaria

22. China rose:
1. belongs to Brassicaceae
2. has parietal placentation
3. has monoadelphous stamen
4. has valvate aestivation

23. Genera like Selaginella and Salvinia:
1. do not possess vascular tissues
2. have a dominant gametophyte in their life cycle
3. produce two kinds of spores
4. have macrophylls

24. In glycolysis, which of the following conversions is an energy yielding process?
1. Glucose to Glucose-6-phosphate
2. Fructose-6-phosphate to Fructose 1,6- biphopshate
3. BPGA to 3-phosphoglyceric acid
4. 3-phosphoglyceric acid to 2-phosphoglycerate

25. What is incorrect about CF_0 part of ATP synthase?
1. It is embedded in the thylakoid membrane
2. It forms a transmembrane channel
3. It carries out facilitated diffusion of protons
4. It protrudes on the outer surface of the thylakoid membrane on the side that faces the stroma

26. In the tricarboxylic acid cycle, what are the respective numbers for – decarboxylation steps, substrate level phosphorylation and points at which $FADH_2$ is produced [calculate for oxidation of one molecule of pyruvic acid]?
1. 3, 2 and 1
2. 2, 1 and 1
3. 3, 1 and 2
4. 2, 2 and 2

27. Identify the incorrect statement:
1. Insulin is a polymer of fructose.
2. Cellulose is a homopolymer
3. Starch is a homopolymer
4. Chitin is nitrogen containing complex polysaccharide

28. All the following plants belong to the Family Solanaceae except:
1. Belladonna
2. Tobacco
3. Indigofera
4. Petunia

29. In plant cell division, the formation of the new cell wall begins with the formation of a simple precursor called:
1. the cell plate that represents the middle lamella
2. the cell plate that represents the primary cell wall
3. the cleavage furrow that represents the middle lamella
4. the contractile ring that represents the primary cell wall

30. All the following will be correct regarding mesosome in a bacterial cell except:
1. They are differentiated form of cell membrane
2. They are essentially infoldings of cell membrane
3. They can be in the form of vesicles, tubules and lamellae
4. They contain photosynthetic pigments

31. Consider the given statements:
I. In flowers of guava and cucumber, the flower is epigynous and the ovary is inferior
II. In flowers of mustard, the flower is hypogynous and the ovary is superior
1. Only I is correct
2. Only II is correct
3. Both I and II are correct
4. Both I and II are incorrect

32. RuBP is a:
1. Aldopentose sugar
2. Ketopentose sugar
3. Aldohexose sugar
4. Ketohexose sugar

33. Identify the incorrectly matched pair:

1. Linus Pauling	Discovered the triple helix structure of collagen
2. Rudolf Virchow	Omnis cellula-e-cellula
3. Singer and Nicholson	Fluid mosaic model
4. Georges Palade	First observed ribosome

34. Which PGR promotes flowering in pineapples, induces parthenocarpy in tomatoes and also used as herbicides?
1. Auxins
2. Cytokinins
3. Gibberellins
4. Ethylene

35. In members of Basidiomycetes:
1. Mycelium is unbranched and coenocytic
2. Sex organs are absent and plasmogamy does not take place
3. Asexual spores are not found but vegetative reproduction by fragmentation is common
4. Basidiospores are produced endogenously on the basidium

Botany - Section B

36. Water has some important physical properties. Water molecules are attracted to each other in the liquid phase more than to water in the gas phase. This is called as:
1. Cohesion
2. Adhesion
3. Adnation
4. Surface tension

37. Match each item in Column I with one in Column II and select the correct match from the codes given:

	COLUMN I		COLUMN II
A	Companion cells	P	Absent in most monocots
B	Albuminous cells	Q	Lacking in gymnosperms
C	Phloem parenchyma	R	Generally absent in primary phloem
D	Phloem fibers	S	Parenchyma cell adjacent to the sieve cell in gymnosperm wood

Codes:

	A	B	C	D
1.	Q	S	P	R
2.	S	Q	R	P
3.	P	R	Q	S
4.	R	P	S	Q

38. Single-membrane compartment found in plant cells and mainly functioning in the conversion of fat into sugars are:
1. Peroxisomes
2. Glyoxysomes
3. Lysosomes
4. Ribosomes

39. Regarding the epidermal tissue system of the plant:
1. Cuticle is present in almost all roots.
2. Only guard cells lack chloroplasts.
3. Guard cells are bean-shaped in grasses.
4. Trichomes are usually multicellular.

40. Calcium:
1. is a micronutrient for plants
2. is a constituent of cell membranes
3. is involved in opening and closing of stomata directly
4. is used in synthesis of middle lamella

41. Identify the incorrect statement:
1. Pinus seeds cannot germinate and establish without the presence of mycorrhizae
2. Imbibition is a special type of diffusion
3. Bulk transport can be achieved only through a positive hydrostatic pressure
4. Numerically, osmotic pressure is equivalent to the osmotic potential, but the sign is opposite

42. Which of the following statements regarding meristems in plants is/are incorrect?
I. Intercalary meristem is a primary meristem
II. Fascicular vascular cambium, interfascicular cambium and cork-cambium are responsible for producing secondary tissues
1. Only I
2. Only II
3. Both I and II
4. Neither I nor II

43. To be considered as 'toxic', the mineral ion concentration in plants should reduce the dry weight of tissues by about:
1. 1 %
2. 2 %
3. 5 %
4. 10 %

44. Active transport:
I. is the only means of uphill transport
II. requires ATP energy
1. Only I is true
2. Only II is true
3. Both I and II are true
4. Both I and II are false

45. Plasmolysis:
I. occurs when a plant cell [or tissue] is placed in a hypotonic solution.
II. water is first lost from the cytoplasm and then from the vacuole.
III. is usually reversible
1. Only I and II are correct
2. Only I and III are correct
3. Only II and III are correct
4. I, II and III are correct

46. Match each item in Column I with one in Column II and selct the correct match from the codes given:

	COLUMN I		COLUMN II
A	Dicot stem	P	Vascular bundles are arranged in a ring
B	Monocot stem	Q	Pith is small or inconspicuous
C	Dicot root	R	Vascular bundles are many and scattered in the ground tissue with no definite arrangement.
D	Monocot root	S	Pith is large and well developed

Codes:

	A	B	C	D
1.	Q	S	P	R
2.	S	Q	R	P
3.	P	R	Q	S
4.	R	P	S	Q

47. Organisms that are highly valuable in learning about phloem transport are:
1. Aphids
2. Humming birds
3. Leaf miners
4. Caterpillars

48. Identify the incorrectly matched pair:

1.	Lysosomes	Acid hydrolases
2.	Tonoplast	Membrane of vacuole
3.	Amyloplasts	Store oils and fats
4.	Golgi apparatus	Synthesis of glycoproteins and glycolipids

49. Identify the incorrectly matched pair:

1.	Pneumatophores	Rhizophora
2.	Leaf tendrils	Gourds
3.	Stilt roots	Maize
4.	Palmately compound leaves	Silk cotton

50. Regarding diazotrophs [biological nitrogen fixers]:
1. Frankia produces nitrogen-fixing nodules on the roots of non-leguminous plants
2. Azotobacter and Beijerinckia fix atmospheric nitrogen only as symbionts
3. Rhodospirillum is aerobic
4. No cyanobacteria are diazotrophs

Zoology - Section A

51. In a healthy human adult, what contributes maximum to the total body weight?
1. Muscle
2. Bone
3. Fat
4. Hair

52. Medulla oblongata:
I. is a part of the brain stem
II. is a part of the hind brain
III. is a part of the limbic system
1. Only I and II
2. Only I and III
3. Only II and III
4. I, II and III

53. Identify the incorrectly matched pair:
1. Glycerol Trihydroxy propane
2. Lecithin Phospholipid
3. Glycine Beta amino acid
4. Lysine Basic amino acid

54. Which of the following values will not be normal for a healthy person?
1. 10 gms of haemoglobin per 100 ml of blood
2. 5 million RBC per mm^3
3. 7000 WBC per mm^3
4. 200000 platelets per mm^3

55. Occurrence of which of the following is unlikely?
1. Ciliated epithelium in fallopian tube
2. Cuboidal brush bordered epithelium in PCT
3. Columnar brush bordered epithelium in small intestine
4. Compound epithelium at the diffusion boundaries

56. The relaxation of muscle after contraction is related to:
1. Hydrolysis of ATP by the myosin head
2. binding of calcium ions to Troponin C
3. Pumping of calcium ions back to the sarcoplasmic cisternae
4. Release of acetylcholine at the neuro-muscular junction

57. If we compare percentage weight of elements present in Earth's crust and the Human body, which of the following would be present in the largest percentage in both?
1. Carbon
2. Oxygen
3. Hydrogen
4. Nitrogen

58. Glucose transporter type 4 [GLUT-4]:
1. is widely distributed in fetal tissues.
2. is expressed at highest levels in erythrocytes
3. is expressed mostly in neurons
4. enables glucose transport into cells

59. Match each item in Column I with one in Column II and select the correct match from the codes given:

	Group of protozoans		Example
A	Amoeboid	P	Entamoeba
B	Flagellated	Q	Paramecium
C	Ciliated	R	Trypanosoma
D	Sporozoan	S	Plasmodium

Codes:

	A	B	C	D
1.	Q	S	P	R
2.	S	Q	R	P
3.	P	R	Q	S
4.	R	P	S	Q

60. Which class of vertebrates bears jaw but does not bear limbs?
1. Cyclostomata
2. Chondrichthyes
3. Amphibia
4. Reptilia

61. In a healthy human, under normal physiological conditions the partial pressure of oxygen in systemic [oxygenated blood] circulation is:
1. about 104 mm Hg
2. about 40 mm Hg
3. about 95 mm Hg
4. about 159 mm Hg

62. The muscularis layer in the wall of the GIT normally has:
1. smooth muscles organized into an inner circular and an outer longitudinal layer
2. smooth muscles organized into an outer circular and an inner longitudinal layer
3. skeletal muscles organized into an inner circular and an outer longitudinal layer
4. skeletal muscles organized into an outer circular and an inner longitudinal layer

63. Normally Kwashiokor occurs when:
1. the birth weight of the new born is less than 2 kg and does not increase to 3 kg at six months
2. mother's milk is replaced by high-calorie low protein diet
3. hidden hunger causes vitamin and mineral deficiencies
4. child is exposed to excessive environmental pollution and passive smoking

64. Which bilaterally symmetrical and triploblastic organism doesn't have a coelom of any kind?
1. Planaria
2. Asterias
3. Ascaris
4. Nereis

65. Transport of sodium and potassium ions across axonal membrane:
1. is active through sodium-potassium pump and passive through sodium and potassium channels
2. is active through both sodium-potassium pump through sodium and potassium channels
3. is passive through both sodium-potassium pump through sodium and potassium channels
4. is passive through sodium-potassium pump and active through sodium and potassium channels

66. The stroke volume of left ventricle in a person is 75 ml. His cardiac output is 6000 ml. What will be his heart rate?
1. 72 per minute
2. 75 per minute
3. 80 per minute
4. 100 per minute

67. A notochord, persistent throughout life and present from head to tail region is seen in:
1. Saccoglossus
2. Salpa
3. Branchiostoma
4. Petromyzon

68. Which of the following statements is not correct?
1. Every 100 ml of oxygenated blood can deliver around 5 ml of oxygen to the tissue under normal physiological conditions.
2. Oxygen gas has most potent effect on the central chemoreceptors and plays most vital role in regulation of respiration
3. Nearly 70 percent of carbon dioxide is carried as bicarbonate in the blood.
4. Every 100 ml of deoxygenated blood delivers about 4 ml of carbon dioxide to the alveoli.

69. Identify the incorrect statement:
1. Zinc is a cofactor for caboxypeptidase
2. NADP contains the vitamin cyanocobalamin
3. Malonate is a competitive inhibitor of Succinic dehydrogenase
4. Haem is the prosthetic group in peroxidise

70. If an Rh –ve mother is carrying an Rh +ve foetus, she is likely to be exposed to the Rh antigen:
1. At the time of implantation of the blastocyst
2. At the time when the placenta becomes functional
3. When the first movements of the baby can be felt
4. At the time of delivery

71. An enzyme catalysed reaction is running optimally at $400^{o}C$. If the temperature is reduced to $200^{o}C$, the rate of reaction is expected to:
1. Double
2. Half
3. Increase four time
4. Reduce to a quarter

72. What is correct regarding iodothyronines?
1. They are derivatives of tryptophan amino acid
2. They are peptides
3. They interact with intracellular receptors
4. They act both as hormones neurotransmitters

73. Which of the following is not associated with mitosis?
1. Growth of multicellular living organisms
2. Restoration of effective nuclear/cytoplasmic ratio
3. Cell repair
4. Pairing of homologous chromosomes and crossing over

74. Approximately what amount of carbon dioxide is removed by lungs per hour in a healthy resting individual?
1. 200 ml
2. 12 L
3. 122 L
4. 288 L

75. All the following are Cnidarians except:
1. Sea pen
2. Sea urchin
3. Sea fan
4. Sea anemone

76. Regarding polysaccharides:
I. Cellulose does not contain complex helices.
II. Inulin is a polymer of fructose.
III. Left end of glycogen is the reducing end
1. Only I and II are correct
2. Only I and III are correct
3. Only II and III are correct
4. I, II and III are correct

77. The conducting part of the human respiratory system transports atmospheric air to alveoli and also performs all the following functions except:
1. Clears the inhaled air of foreign particles
2. Humidifies the air
3. Brings the air to body temperature
4. Provides site for diffusion of gases into the blood

78. Under normal physiological conditions:
1. Inspiratory reserve volume is less than expiratory reserve volume
2. Residual volume in a healthy male is about 2500 to 3000 ml
3. Functional residual capacity should be more than expiratory capacity
4. Total lung capacity + residual volume = Vital capacity

79. Which secondary metabolite is used as a drug in the treatment of certain cancers?
1. Abrin
2. Digoxin
3. Concanavalin A
4. Vinblastin

80. Between Telophase I and Prophase II:
1. The nuclear membrane disappears
2. DNA does not replicate
3. A tetrad of cells is formed
4. There is a long duration resting stage

81. Both Molluscs and Echinoderms:
1. exhibit radial symmetry as adults
2. have segmented bodies
3. are diploblastic
4. are coelomates

82. Both hormones and digestive enzymes are secreted by all of the following except:
1. Pancreas
2. Stomach
3. Intestine
4. Liver

83. Neurohypophysis:
1. secretes large number of tropins
2. synthesizes oxytocin and vasopressin
3. merges with pars distalis in humans
4. stores and releases oxytocin and vasopressin

84. Splitting of centromere occurs in:
1. Mitotic anaphase and Anaphase II
2. Mitotic anaphase and Anaphase I
3. Mitotic metaphase and Metaphase II
4. Mitotic metaphase and Metaphase I

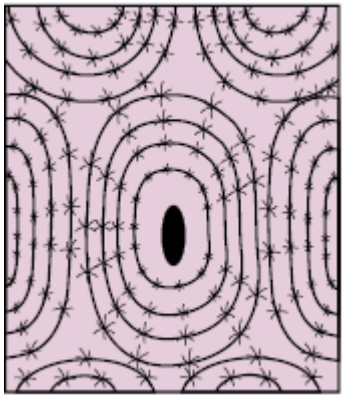
85. What would be true about the role of collecting duct in the concentration of urine by the kidneys?
I. Allows passage of small amounts of urea into the medullary interstitium
II. Large amounts of water could be reabsorbed from this part to produce a concentrated urine.
1. Only I
2. Only II
3. Both I and II
4. Neither I nor II

Zoology - Section B

86. Identify the incorrectly matched pair:

1.	Acromegaly	Excess of growth hormone in adulthood
2.	Diabetes insipidus	Deficiency of insulin
3.	Graves' disease	Hyperthyroidism
4.	Addison's disease	Underproduction of adrenal cortex hormones

87. The diagram shows the chief structural unit of compact (cortical) bone called:

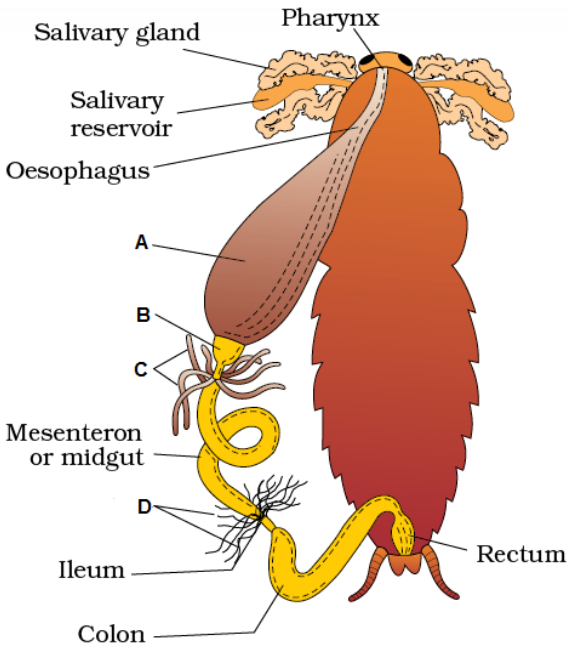


1. Osteocyte
2. Osteoclast
3. Osteon
4. Trabeculae

88. During the ventricular systole:
I. The atria also undergo systole
II. The atrioventricular valves get closed
III. The semilunar valves are forced open
1. Only I and II are correct
2. Only I and III are correct
3. Only II and III are correct
4. I, II and III are correct

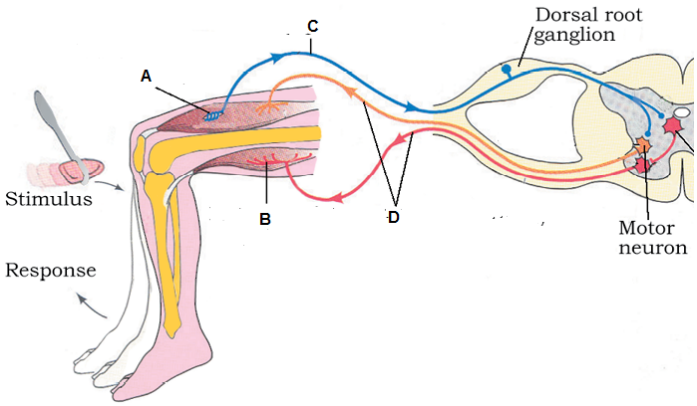
89. Which biomolecule makes up maximum percent of the total cellular mass in an average cell?
1. Proteins
2. Carbohydrates
3. Lipids
4. Nucleic acids

90. Study the given diagram regarding the alimentary canal of cockroach and select the correct statements:



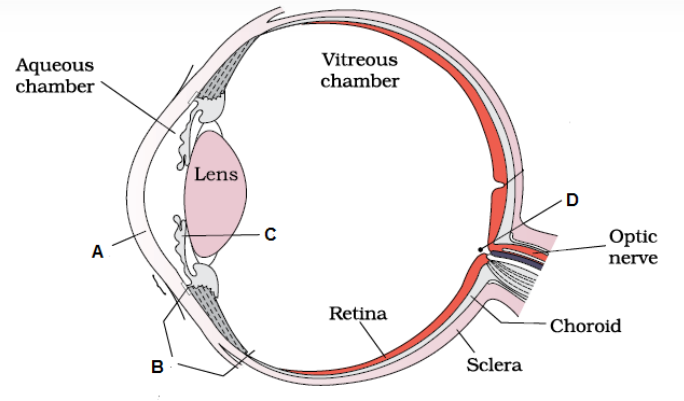
I. A is used for storing food
II. B helps in grinding the food particles
III. C help in osmoregulation
IV. D secretes digestive enzymes
1. Only I and II
2. Only I, III and IV
3. Only II
4. Only III and IV

91. Identify A, B, C and D in the diagrammatic representation of reflex action, showing knee jerk reflex:



	A	B	C	D
1.	Muscle spindle	Motor end plate	Afferent pathway	Efferent pathway
2.	Muscle spindle	Motor end plate	Efferent pathway	Afferent pathway
3	Motor end plate	Muscle spindle	Efferent pathway	Afferent pathway
4.	Motor end plate	Muscle spindle	Afferent pathway	Efferent pathway

92. Regarding the given diagram showing parts of an eye, identify the incorrect match:



1. A Major refractory surface
2. B Accommodation
3. C Regulates diameter of pupil
4. D Point of highest visual acuity

93. Consider the following statements regarding cockroaches:
I. Blood transports respiratory gases
II. Anal styles are absent in females
III. There are 10 [5 pairs] of spiracles
IV. Vision with the help of ommatidia is mosaic vision
V. Development is paurometabolous
The number of correct statements are:
1. 2
2. 3
3. 4
4. 5

94. Identify the gland that is not matched correctly to its location in the body:

1. Thymus	Dorsal side of aorta
2. Parathyroid	Back side of thyroid
3. Pineal	Dorsal side of forebrain
4. Adrenal	Superior pole of kidney

95. Which of the following bones is not a part of human cranium?
1. Sphenoid
2. Maxilla
3. Ethmoid
4. Occipital

96. The total number of bones in the skeleton of girdles in adult humans is:
1. 2
2. 4
3. 6
4. 12

97. Match each item regarding Periplaneta americana in Column I with one in Column II and select the correct match from the codes given:

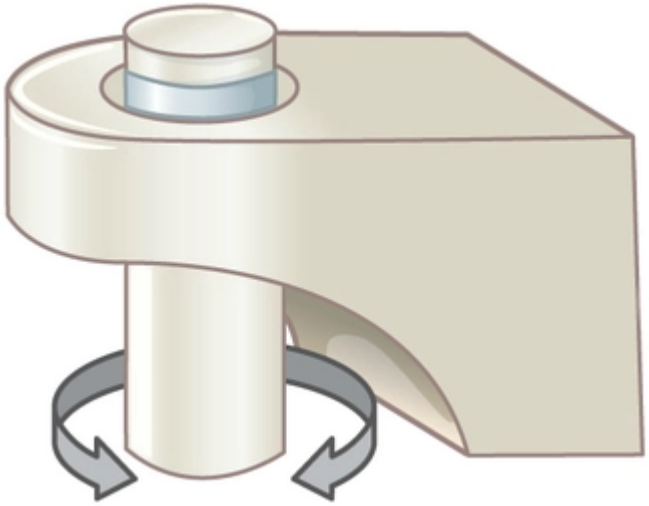
	Morphological feature		Location
A	Sternites	P	Ventral sclerites
B	Tegmina	Q	Dorsal sclerites
C	Tergites	R	Mesothorax
D	Hind wings	S	Metathorax

Codes:

	A	B	C	D
1.	Q	S	P	R
2.	S	Q	R	P
3.	P	R	Q	S
4.	R	P	S	Q

98. Which part of the endomembranous system of a eukaryotic cell is rich in acid hydrolases?
1. Peroxisome
2. Lysosome
3. Vacuole
4. Golgi apparatus

99. The given diagram shows a representation of a synovial joint found between atlas and axis vertebrae. What is this type of synovial joint called?



1. Hinge
2. Ball and socket
3. Pivot
4. Saddle

100. Identify the incorrect statement:
1. Glomerulus is a tuft of capillaries formed by afferent arteriole.
2. Blood from the glomerulus is carried away by an efferent arteriole.
3. Vasa recta is well developed in cortical nephrons.
4. The DCTs of many nephrons open into a straight tube called collecting duct.

Chemistry - Section A

101. The correct statement, amongst the following, is
1. Pressure of an ideal gas is less than the pressure of a real gas
2. Pressure of an ideal gas is more than the pressure of a real gas
3. Pressure of an ideal gas is equal to the pressure of a real gas
4. Pressure of an ideal gas may be more or less than the pressure of a real gas

102. Which of the following alkali metals react with N_2?
1. Li
2. Na
3. K
4. None of the above

103. When 50% H_2SO_4 solution is electrolysed, then H_2O_2 and H_2 will be evolved respectively at
1. cathode and anode
2. cathode and cathode
3. anode and cathode
4. anode and anode

104. When but-2-yne reacts with $Na/Liq.NH_3$, then the product formed is:
1. Butane
2. Cis-but-2-ene
3. Trans-but-2-ene
4. But-1-yne

105. Which element/ion amongst the following has the lowest energy of 1st shell?
1. H
2. He^+
3. Li^{2+}
4. Be^{3+}

106. 3 gm H_2 reacts with 20 gm O_2 to form H_2O. The maximum mass of H_2O formed is:
1. 27 gm
2. 22.5 gm
3. 18 gm
4. 9 gm

107.

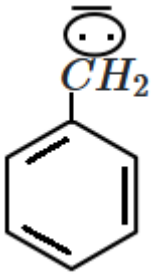
$$N_2(g) + 3H_2(g) \underset{k_2}{\overset{k_1}{\rightleftharpoons}} 2NH_3(g), \quad \Delta H = -ve$$

In the above equilibrium, k_1 and k_2 are the rate constants for forward and backward reactions, and K_C is the equilibrium constant. If the temperature is increases, then:
1. k_1 and k_2 decrease, K_C increases
2. k_1 and k_2 increase, K_C decreases
3. k_1 and K_C decrease, k_2 increases
4. All k_1, k_2, and K_C decrease

108. Assertion (A): PAN (Peroxy Acetyl Nitrate) is a secondary pollutant.
Reason (R): PAN is formed by the interaction of O_3 and NO_2.

1. Both (A) and (R) are true and (R) is the correct explanation of (A).
2. Both (A) and (R) are true but (R) is not the correct explanation of (A).
3. (A) is true but (R) is false.
4. (A) and (R) both are false.

109. The most stable carbanion, amongst the following, is

1. $CH_2 = CH - \overline{C}H_2$
2. 
3. 
4. 

110. Assertion (A): $HCOOH$ is more acidic than C_6H_5COOH.
Reason (R): CH_3COOH is less acidic than C_6H_5COOH.

1. Both (A) and (R) are true and (R) is the correct explanation of (A).
2. Both (A) and (R) are true but (R) is not the correct explanation of (A).
3. (A) is true but (R) is false.
4. (A) and (R) both are false.

111. Which of the following processes is endothermic?
1. $O + e^- \rightarrow O^-$
2. $N + e^- \rightarrow N^-$
3. $Cl + e^- \rightarrow Cl^-$
4. None of the above

112. The formula of inorganic graphite is

1. B_2H_6
2. $B_3N_3H_6$
3. BN
4. B_3N_2

113. Which of the following is not a state function?
1. H (Enthalpy)
2. Q (Heat)
3. S (Entropy)
4. E (Internal Energy)

114. The pKa is highest, for which of the following compounds?
1. CH_3COOH
2. $HCOOH$
3. C_6H_5COOH
4. $(CH_3)_2CHCOOH$

115. If equal volumes of pH=8 and pH=13 solutions are mixed together, then the pH of the resulting solution will be:
1. 8.3
2. 9.3
3. 10.3
4. 12.7

116. For which of the following reaction, $\Delta H < \Delta E$?
1. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
2. $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$
3. $H_2(g) + I_2(g) \rightarrow 2HI(g)$
4. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

117. Consider the reaction given below:

$xMnO_2 + yHCl \longrightarrow xMnCl_2 + ZH_2O + aCl_2$
The value of $[(x + y) - (a + z)]$ will be:

1. 1.5
2. 3
3. 2
4. 1

118. Which of the following solutions acts as a buffer?
1. $HCl + NH_4Cl$
2. $CH_3COONH_4 + H_2O$
3. $NaOH + CH_3COONa$
4. $HNO_3 + NaNO_3$

119. Which of the following molecules has a non-zero dipole moment?
1. PCl_3Br_2
2. PCl_3F_2
3. $PCl_3(CH_3)_2$
4. PCl_5

120. The sum of neutrons and protons in all the isotopes of hydrogen will be

1. 3
2. 4
3. 5
4. 6

121. **Assertion (A):** The oxidation number of chromium in CrO_5 is +6.
Reason (R): CrO_5 has a butterfly structure.

1. Both (A) and (R) are true and (R) is the correct explanation of (A).
2. Both (A) and (R) are true but (R) is not the correct explanation of (A).
3. (A) is true but (R) is false.
4. (A) and (R) both are false.

122. The molarity of 40% $NaOH$ (by mass) is (d = 1.2 g/ml)
1. 10 M
2. 12 M
3. 5 M
4. 6 M

123. When toluene is oxidised with chromyl chloride, then the product formed is:

1. Benzaldehyde
2. Benzoic acid
3. Cumene
4. Benzene

124. In graphite, the hybridized state of carbon and nature of graphite, respectively, are
1. sp^3 and aromatic
2. sp^2 and nonaromatic
3. sp^2 and aromatic
4. sp^3 and nonaromatic

125. In an ideal gas, if the pressure is increased by 10%, then the volume will reduce by
1. 10 %
2. 9.1 %
3. 11 %
4. 20 %

126. The ratio of number of atoms in 1 gm NH_3 and 1 gm N_2 is:
1. $\frac{28}{17}$
2. $\frac{28}{34}$
3. $\frac{56}{17}$
4. $\frac{17}{28}$

127. The total number of structural isomers of molecular formula C_4H_8 are
1. 3
2. 4
3. 5
4. 6

128. In case of hydrogen atom, which of the following transitions has released the maximum energy of radiation?
1. $n_2 = 2 \ to \ n_1 = 1$
2. $n_2 = \infty \ to \ n_1 = 2$
3. $n_2 = 7 \ to \ n_1 = 3$
4. $n_2 = \infty \ to \ n_1 = 3$

129. In Castner Kellner Cell, ion discharged at the cathode for the preparation of $NaOH$,, is
1. H^+
2. Na^+
3. K^+
4. None of the above

130. In ClO_4^-, three π bonds are present. The types of all the three π bonds are
1. $3 \ d\pi - p\pi$
2. $2 \ d\pi - p\pi \ and \ 1 \ p\pi - p\pi$
3. $1 \ d\pi - p\pi \ and \ 2 \ p\pi - p\pi$
4. $3 \ p\pi - p\pi$

131. For the reaction $CO_2(g) \rightleftharpoons CO(g) + \frac{1}{2}O_2(g)$, the value of $\frac{K_P}{K_C}$ will be
1. RT
2. $\sqrt{RT}$
3. $\frac{1}{RT}$
4. $\frac{1}{\sqrt{RT}}$

132. The magnetic moment of Ni^{2+} (Z=28) is
1. 1.732 BM
2. 2.82 BM
3. 3.87 BM
4. 4.89 BM

133. Assertion: In freezing of water, $\Delta H = -ve \ and \ \Delta S = -ve$
Reason: For the spontaneity of freezing of water, $\Delta H < T\Delta S$
1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but the reason is false
4. Both the assertion and the reason are false

134. The most acidic oxide amongst the following is
1. NO
2. N_2O
3. NO_2
4. N_2O_5

135. Which of the following compounds does not act as an oxidising agent?
1. SO_2
2. HCl
3. $KMnO_4$
4. MnO_2

Chemistry - Section B

136. In borax, number of B — O — B bonds will be

1. zero
2. 2
3. 4
4. 5

137. When excess of CH_4 reacts with Cl_2 in presence of sunlight, then the major product formed is
1. CH_3Cl
2. CH_2Cl_2
3. $CHCl_3$
4. CCl_4

138. 1 gram of a mixture of Na_2CO_3 and $NaCl$ has reacted completely with 100 ml $\frac{N}{10}$HCl. The percentage of $NaCl$ in the mixture is
1. 53 %
2. 47 %
3. 37 %
4. 63 %

139. Which of the following species has the highest bond energy ?
1. O_2
2. O_2^-
3. O_2^+
4. O_2^{2+}

140. When fused form of saline hydride is electrolysed, then hydrogen gas is evolved at
1. anode
2. cathode
3. maybe at anode or at cathode
4. hydrogen gas is not formed

141. Which of the following is not regarded as a pollutant?

1. CO_2
2. O_3
3. NO_2
4. Hydrocarbons

142. If the value of m = +3 for an electron, then the electron must be present in
1. s subshell
2. p subshell
3. d subshell
4. f subshell

143. Benzene ring contains
1. 12σ bonds and 3π bonds
2. 9σ bonds and 3π bonds
3. 6σ bonds and 3π bonds
4. 6σ bonds and 6π bonds

144.
The IUPAC name of  is

1. Bicyclo [1,1,0] pentane
2. Bicyclo [2,1,0] pentane
3. Bicyclo [0,1,2] pentane
4. Bicyclo [2,0,1] pentane

145. Which of the following is the main constituent of cement?
1. Dicalcium silicate
2. Tricalcium silicate
3. Tricalcium aluminate
4. Tetracalcium aluminoferrite

146. The correct order of electron affinity is given in
1. O > S > Se
2. S > O > Se
3. Se > O >S
4. S > Se > O

147. The active mass of 5.6 L O_2 gas at NTP is:
1. 0.25 Mol/L
2. $\frac{1}{22.4} Mol/L$
3. 0.175 Mol/L
4. $\frac{1}{5.6}\ Mol/L$

148. In a one-litre container, the pressure of dry N_2 is 600 mm of Hg and the pressure of H_2O vapours is 100 mm of Hg. Now, the volume of the container is increased to two litres. Then, the total pressure in the container will be (assuming temperature remains constant)
1. 700 mm of Hg
2. 350 mm of Hg
3. 400 mm of Hg
4. 300 mm of Hg

149. In which of the following neutralisation reactions, the temperature rise is the minimum?
1. 200 ml 1 M HCl + 100 ml 1M NaOH
2. 50 ml 1 M HCl + 50 ml 1M NaOH
3. 150 ml 1 M HCl + 350 ml 1M NaOH
4. 75 ml 1 M HCl + 125 ml 1M NaOH

150. The oxidation number of N and number of peroxide linkages in HNO_5, respectively, are:
1. +9 and 0
2. +5 and 1
3. +5 and 2
4. +7 and 1

Physics - Section A

151. A uniform solid sphere of mass m rolls with a velocity v on a fixed horizontal surface.
The momentum of the sphere:

1. equals mv, only if it does not slip.
2. equals mv, in all cases.
3. is less than mv, if it slips.
4. is greater than mv, if it slips.

152. The equation of vibration of a taut string, fixed at both ends, is given by:

$$y = (3\text{ mm})\cos\left(\frac{\pi x}{10\text{ cm}}\right)\sin(800\pi\text{ s}^{-1}\text{ t})$$

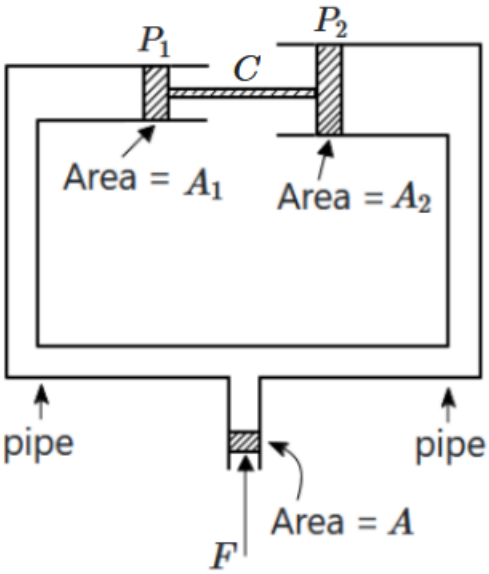
The positions of the nodes are:

1. x = 0 cm, 10 cm, 20 cm,...
2. x = 0 cm, 20 cm, 40 cm,...
3. x = 5 cm, 10 cm, 15 cm,...
4. x = 5 cm, 15 cm, 25 cm,...

153. Wind blows towards north with a speed of 20 m/s. A plane flies in air with a velocity relative to ground of 100 m/s, towards east. Then, the velocity of the plane relative to air is

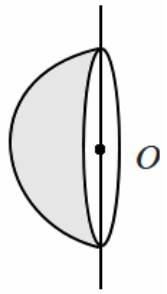
1. 100 m/s towards east and 20 m/s towards north.
2. 100 m/s towards east and 20 m/s towards south.
3. 100 m/s towards west and 20 m/s towards north.
4. 100 m/s towards west and 20 m/s towards south.

154. The arrangement shows two pistons P_1, P_2 with a rigid connecting rod C so that they can slide together with respect to the two fixed cylinders of cross-sectional areas A_1, A_2 respectively. The two cylinders are connected by means of two pipes to a small cylinder (of area A) with a piston at the bottom on which is applied a force F. The interior of the pipes and cylinder is filled with an incompressible oil. Ignore any pressure variations due to gravity. The net force on the two pistons P_1, P_2 is



1. $\frac{F}{A}(A_1 + A_2)$ to right.
2. $\frac{F}{A}(A_1 + A_2)$ to left.
3. $\frac{F}{A}(A_2 - A_1)$ to right.
4. $\frac{F}{A}(A_2 - A_1)$ to left.

155. A uniform solid hemisphere of mass m and radius R is rotated about an axis passing through its center O along a diameter of its flat surface. The moment of inertia of the hemisphere, about this axis, is:



1. $\frac{1}{5}mR^2$
2. $\frac{2}{5}mR^2$
3. $\frac{1}{3}mR^2$
4. $\frac{2}{3}mR^2$

156. A heavy uniform rope PQ is suspended from the ceiling. The lowest end of the rope is given a sharp transverse "shake" (or vibration) so as to cause a pulse. This pulse travels upward. As it travels upward, its speed:

1. increases.
2. decreases.
3. first increases and then decreases.
4. remains constant.

157. The equation of vibration of a taut string, fixed at both ends, is given by:

$$y = (3\text{ mm})\cos\left(\frac{\pi x}{10\text{ cm}}\right)\sin(800\pi\text{ s}^{-1}\text{ t})$$

The speed of waves on the string is:

1. 20 m/s
2. 40 m/s
3. 80 m/s
4. 160 m/s

158. The angular momentum of a planet of mass m, moving around the sun (mass: $M \gg m$) in an orbit of radius r is proportional to

1. mr
2. $\frac{m}{r}$
3. $m\sqrt{r}$
4. $\frac{m}{\sqrt{r}}$

159. Raindrops fall from the sky making an angle of 30° with the vertical. If a man runs at 2 m/s, he finds that the drops fall vertically. If he were to run in the opposite direction with the same speed, the raindrops will fall with a vertical speed of

1. 2 m/s
2. 4 m/s
3. $2\sqrt{3}$ m/s
4. $4\sqrt{3}$ m/s

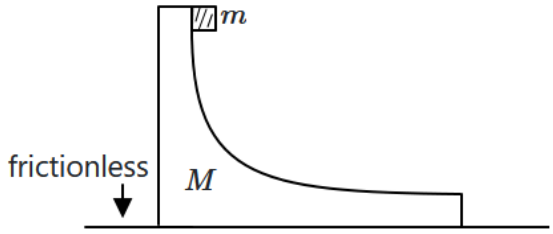
160. A particle undergoes an elastic collision with an identical particle at rest. After the collision, the two particles move with velocities $\vec{v_1}$, $\vec{v_2}$. Final velocities $\vec{v_1}$, $\vec{v_2}$ are in different directions. The angle between $\vec{v_1}$ and $\vec{v_2}$ is:

1. $\frac{\pi}{6}$
2. $\frac{\pi}{3}$
3. $\frac{\pi}{2}$
4. $\frac{2\pi}{3}$

161. **Assertion (A):** When sound waves are emitted by a moving source, their wavelength decreases in the direction of motion of the source compared to when the source is at rest.
Reason (R): This is due to the fact that the speed of sound in the medium changes due to the motion of the source.

1. (A) is true but (R) is false.
2. (A) is false but (R) is true.
3. Both (A) and (R) are true and (R) is the correct explanation of (A).
4. Both (A) and (R) are true but (R) is not the correct explanation of (A).

162. A small block of mass m is released as shown in the figure against the vertical part of the smooth curved surface of a wedge of mass M, initially at rest. When the block reaches the bottom, it travels horizontally with a kinetic energy E_m, while the wedge recoils towards left with a kinetic energy E_M. Then,

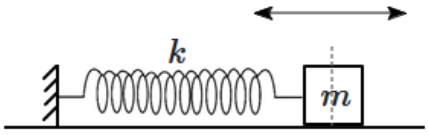


1. $\frac{E_m}{m} = \frac{E_M}{M}$
2. $mE_m = ME_M$
3. $\frac{E_m}{m^2} = \frac{E_M}{M^2}$
4. $m^2E_m = M^2E_M$

163. What is the unit of the quantity represented by: $\frac{\text{(Angular momentum)}}{\text{(electric charge)}^2}$

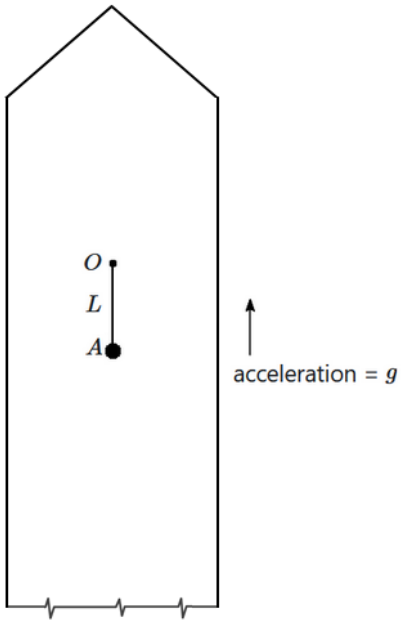
1. Ω (ohm)
2. s/m
3. H (henry)
4. F (farad)

164. A spring-mass system is undergoing horizontal oscillations on a frictionless surface. During the oscillation, the block picks up a particle, when it is at its extreme position. As a result of this,



1. the amplitude increases.
2. the amplitude decreases.
3. the frequency increases.
4. the frequency decreases.

165. A simple pendulum of length L is suspended from a point O in a rocket which is ready to be launched from earth. The rocket takes off with an upward acceleration equal to g. Immediately after take off, the bob of the pendulum is given a horizontal velocity so that it just completes a vertical circle. The bob's speed (relative to the rocket) at its highest point is v_H, where



1. $v_H = \sqrt{gL}$
2. $v_H = \sqrt{2gL}$
3. $v_H = \sqrt{3gL}$
4. $v_H = \sqrt{5gL}$

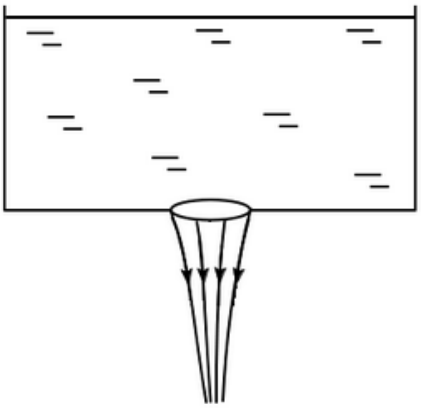
166. A thin spherical shell of radius R, thickness t, made of a metal of density ρ_S, floats half submerged in a vessel containing a liquid of density ρ_L. The ratio $\frac{\rho_S}{\rho_L}$ is equal to:

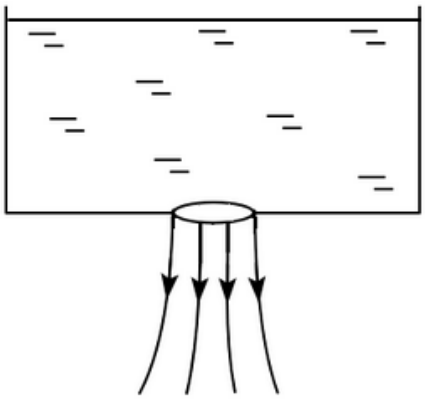
1. $\frac{R}{6t}$
2. $\frac{R}{3t}$
3. $\frac{6t}{R}$
4. $\frac{3t}{R}$

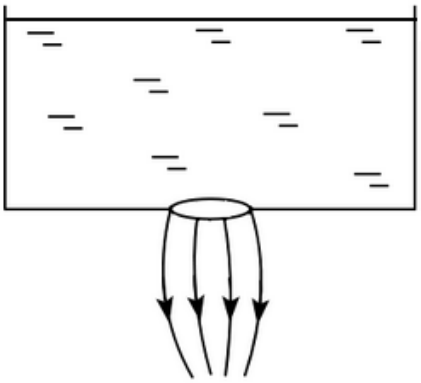
167. A hot body (A) at a temperature of 2000 K radiates like a blackbody, at a rate of 160 W. It is placed in a furnace which is heated to a temperature of 1000 K, the interior of the furnace behaving like a blackbody. At the initial instant, when the hot body A is at 2000 K — the net rate of loss of heat from A due to radiation is:

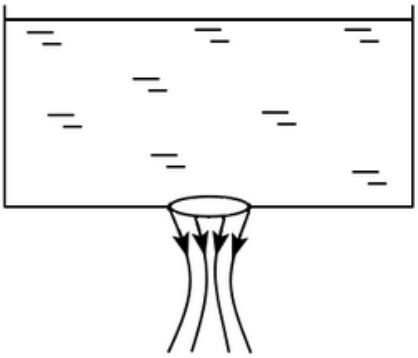
1. 160 W
2. 150 W
3. 60 W
4. 10 W

168. Which of the following diagrams, correctly illustrates the streamline flow of a liquid out of a tank?

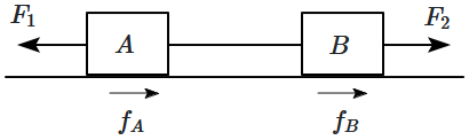
1.


2.


3.


4.


169. The two blocks A, B are connected by an inextensible string, and are lying on a horizontal surface. The blocks move under the action of forces of magnitudes F_1 and F_2, as shown in the figure. The surface exerts non-zero frictional forces f_A, f_B (towards right).



Consider the following situations:

(P) $f_A,\ f_B > 0$ (Q) $f_A,\ f_B < 0$

(R) $f_A > 0,\ f_B < 0$ (S) $f_A < 0,\ f_B > 0$

Which of the above, are possible? Assume that the string is taut.

1. P or Q
2. R or S
3. Any of P, Q, R, S
4. Only P

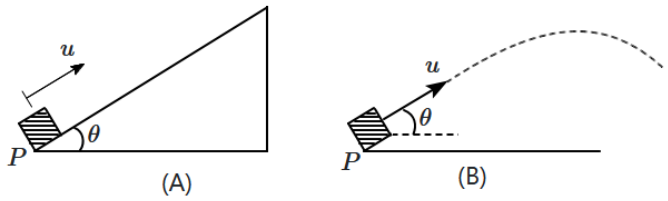
170. Two bodies A, B are maintained at temperatures $\theta_A = 100^\circ$C and $\theta_B = 0^\circ$C. Two thermally conducting rods $(P,\ Q)$ of different conductivities and of different dimensions are connected between A and B. The conductivity of P is twice that of Q. The sides of the rods are insulated. If the mid-points of the two rods are connected to each other by a thin conducting wire (after equilibrium is reached),

1. heat would flow from P to Q.
2. heat would flow from Q to P.
3. no flow of heat occurs between P & Q.
4. flow of heat may occur back and forth between P & Q, varying with time.

171. A boat is rowed across a 400 m wide river so that it can reach the opposite bank in a minimum of 10 minutes. No matter which direction the boat is rowed in, it cannot reach a point exactly opposite on the other bank, unless it is rowed at a slightly higher speed. The speed of flow of the river is:

1. 2.4 km/h
2. 4.8 km/h
3. $2.4\sqrt{2}$ km/h
4. $\frac{2.4}{\sqrt{2}}$ km/h

172.



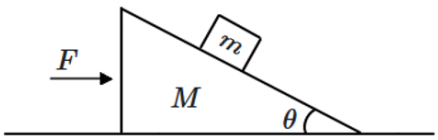
Consider the two situations shown in the figures. In figure (A), the particle P is given a velocity u up a smooth horizontal incline and it reaches a maximum vertical height h_A. In figure (B), the same particle P is projected with a velocity u at an angle θ (parallel to the previous incline) and reaches a maximum height h_B.
Then,

1. $h_A = h_B \sin\theta$
2. $h_A \sin\theta = h_B$
3. $h_A \sin^2\theta = h_B$
4. $\frac{h_A}{\sin^2\theta} = h_B$

173. The moment of inertia of a metallic rod of length L, about an axis passing through its center of mass and perpendicular to the rod, is I_0. When the temperature is raised by $\Delta\theta$, it increases by ΔI_0.
The coefficient of linear expansion of the rod's material is:

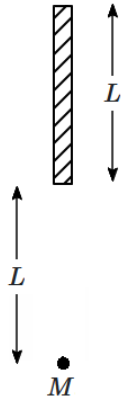
1. $\left(\frac{\Delta I_0}{I_0}\right)\frac{1}{\Delta\theta}$
2. $\frac{1}{2}\left(\frac{\Delta I_0}{I_0}\right)\frac{1}{\Delta\theta}$
3. $\frac{1}{5}\left(\frac{\Delta I_0}{I_0}\right)\frac{1}{\Delta\theta}$
4. $2\left(\frac{\Delta I_0}{I_0}\right)\frac{1}{\Delta\theta}$

174. A small block of mass m lies on a frictionless wedge of mass M, which is pushed horizontally to the right by means of a constant force F. There is no relative motion between block and the wedge. Let the work done by F on M be W_F. The work done by the normal force (between M & m) on m be W_m. Both are measured for the same time interval.



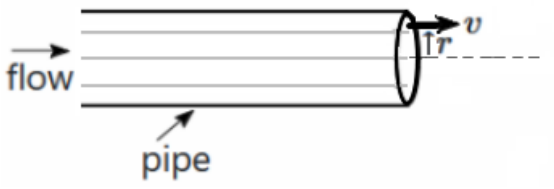
1. $\frac{W_F}{M} = \frac{W_m}{m}$
2. $W_F \cdot M = W_m \cdot m$
3. $\frac{W_F}{M+m} = \frac{W_m}{m}$
4. $\frac{W_F}{M} = \frac{W_m}{m+M}$

175. An extremely long solid rod of length L starts falling longitudinally towards a large point mass M, the near end of the rod being at a distance L from the mass M. The rod experiences

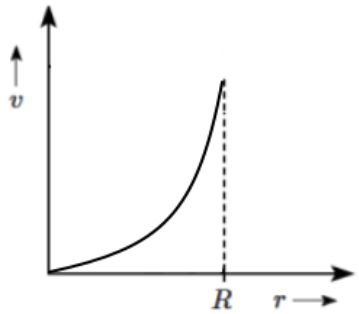


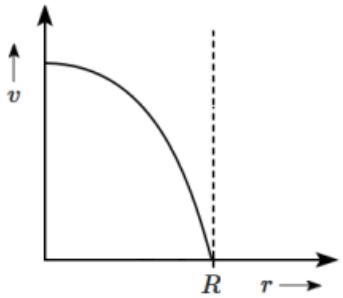
1. no stress.
2. compressive stress.
3. tensile stress.
4. shear stress.

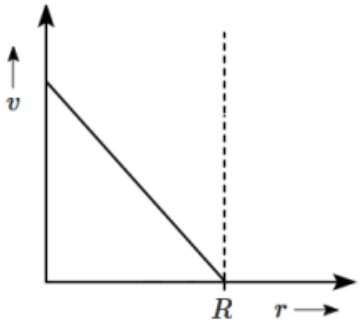
176. A viscous liquid flows slowly through a pipe of cross-sectional radius R. The speed of the particles is a function of the distance from the axis of the pipe.

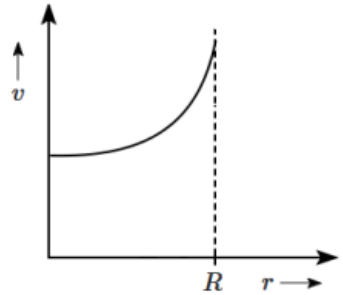


Assume that the flow is smooth. The variation of v vs r is best given by the graph:

1.


2.


3.


4.


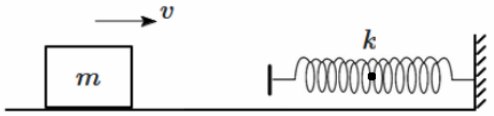
177. An ideal monoatomic gas at a temperature of 300 K and a pressure of 10 atm is suddenly allowed to expand into vacuum so that its volume is doubled. No exchange of heat is allowed to take place between the gas and its surroundings during the process. After equilibrium is reached, the final temperature is:

1. 300 K
2. $\frac{300}{2^{5/3}}$ K
3. $\frac{300}{2^{2/3}}$ K
4. 600 K

178. A block is suspended from a spring and allowed to oscillate vertically, giving a time period T. If the block is suspended from the same spring, the elongation produced will be:

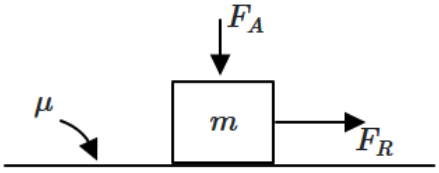
1. $\frac{1}{2}gT^2$
2. $\frac{1}{4}gT^2$
3. $\frac{1}{2\pi}gT^2$
4. $\frac{1}{4\pi^2}gT^2$

179. A block of mass m moving with a speed v meets an unextended spring fixed at one end, and having a spring constant k. During maximum compression, the mid-point of the spring undergoes a rightward displacement x. Then, $v =$



1. $\sqrt{\frac{k}{m}}x$
2. $\sqrt{\frac{m}{k}}x$
3. $\sqrt{\frac{k}{m}}(2x)$
4. $\sqrt{\frac{k}{m}}\left(\frac{x}{2}\right)$

180. A block of mass m is placed on a flat horizontal surface, and the coefficient of friction between the block and the surface is μ. A force F_A is applied to the block from above, and a force F_R is applied to the right. In all situations being considered below, the block remains at rest. Let f be the force of friction on the block.



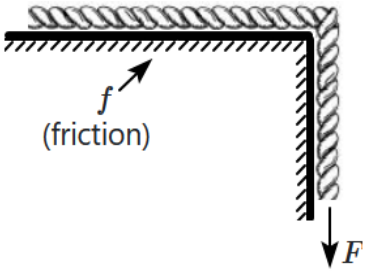
Consider the statements:
(P) f increases if m is increased.
(Q) f increases if F_A is increased.
(R) f increases if F_R is increased.

1. Only P is true.
2. Only Q is true.
3. P, Q are true.
4. Only R is true.

181. A body cools from 52°C to 48°C in 6 minutes. How much time will the same body take to cool from 53°C to 47°C? Assume cooling is linear with time.

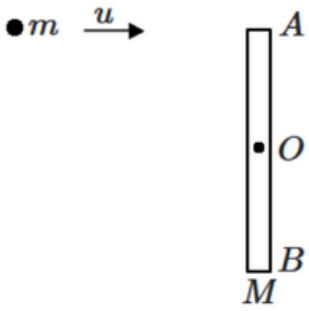
1. 12 minutes
2. 9 minutes
3. 8 minutes
4. 7 minutes

182. A heavy uniform rope of mass m and total length L is slowly pulled down from the edge of a horizontal table, which exerts a frictional force on the rope, against its motion. The work done by pulling force is W_F and the work done against friction is W_f- both during the same time interval. The entire rope remains taut during its displacement. Then,



1. $W_F = W_f$
2. $W_F > W_f$
3. $W_F < W_f$
4. any of the above may be true depending on the coefficient of friction.

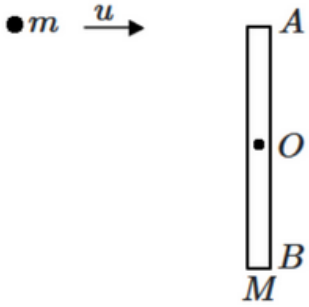
183. A uniform rod of mass M and length L lies at rest on a smooth horizontal plane, as shown in the figure. A particle of mass m, moving with an initial velocity u strikes one end (A) of the rod and stops. The initial velocity u is perpendicular to the length (AB) of the rod.



Consider the following statements:
(P) Momentum of the system is conserved.
(Q) Kinetic energy of the system does not change after the collision.
(R) Angular momentum of the system is conserved.

1. P, Q, R are true.
2. P, R are true.
3. Only R is true.
4. Only P is true.

184. A uniform rod of mass M and length L lies at rest on a smooth horizontal plane, as shown in the figure. A particle of mass m, moving with an initial velocity u strikes one end (A) of the rod and stops. The initial velocity u is perpendicular to the length (AB) of the rod.



The angular momentum of the system, about O, before the collision is:

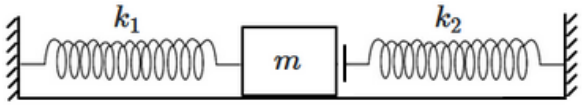
1. zero
2. muL
3. $\frac{muL}{2}$
4. $\frac{muL}{2} + \frac{1}{12}ML^2\left(\frac{u}{L}\right)$

185. Particles are simultaneously projected in all possible directions from a point in space, located in a uniform gravitational field. The initial speed of the particles is u. The maximum separation between any two particles, after a time t, is:

1. ut
2. $2ut$
3. $ut + \frac{1}{2}gt^2$
4. $2ut + gt^2$

Physics - Section B

186. The block of mass m is connected to the spring on the left while resting against the one on the right. There is no friction anywhere. The block undergoes oscillations with a maximum compression of x_1 in the left spring and of x_2 in the right spring.



Then,

1. $k_1x_1 = k_2x_2$
2. $k_1x_1^2 = k_2x_2^2$
3. $k_1x_1^2 = (k_1 + k_2)x_2^2$
4. $k_1x_1^2 = \frac{k_1k_2}{k_1+k_2}x_2^2$

187. A Carnot engine works between two thermal reservoirs maintained at absolute temperatures T_{high} and T_{low}.

Assertion (A): If the efficiency of the engine is $\frac{1}{n}$, then the coefficient of performance of the reversed cycle working as a refrigerator is $n - 1$.

Reason (R): The efficiency of Carnot's cycle is $1 - \frac{T_{\text{low}}}{T_{\text{high}}}$, while the coefficient of performance of the reversed cycle is $\frac{T_{\text{low}}}{T_{\text{high}} - T_{\text{low}}}$.

1. (A) is true but (R) is false.
2. (A) is false but (R) is true.
3. Both (A) and (R) are true and (R) is the correct explanation of (A).
4. Both (A) and (R) are true but (R) is not the correct explanation of (A).

188. Which of the following quantities, have the same dimension?

(A) $\frac{(\text{Magnetic flux})^2}{\text{Electrical resistance}}$ (B) Torque $\times$ time

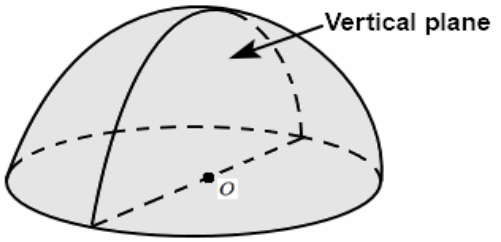
(C) Momentum $\times$ length (D) $\frac{\text{Power}}{\text{time}}$

1. B, C
2. A, B, C
3. B, D
4. A, B, C, D

189. If a simple pendulum be suspended in an elevator which is moving upward, its time period is found to decrease by 2%. The acceleration of the elevator is (in magnitude):

1. 2% of g
2. 1% of g
3. 4% of g
4. 102% of g

190. A thin uniform hemispherical shell (radius: R, center: O) is cut into two symmetric quarter spheres by means of a vertical plane, as shown. The center of mass of a quarter sphere is at a distance d from O. Then d=



1. $\frac{R}{2}$
2. $\frac{R}{\sqrt{2}}$
3. $\frac{R}{4}$
4. $\frac{R}{2\sqrt{2}}$

191. Assume Newton's theory of gravitation to hold true for the following. What should be the mass of a uniform sphere of radius R so that the escape velocity from its surface equals c, the velocity of light in vacuum?

1. $\frac{Rc^2}{G}$
2. $\frac{Rc^2}{2G}$
3. $\frac{2Rc^2}{G}$
4. $\sqrt{2}\frac{Rc^2}{G}$

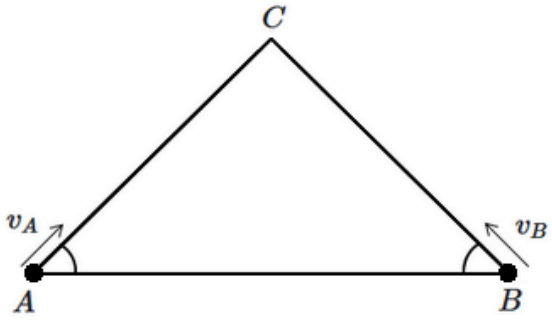
192. A wheel of radius R rolls on a horizontal flat surface, without slipping. The speed of its center is constant and equals v. The acceleration of the point of contact, of the wheel, is

1. zero.
2. $\frac{v^2}{R}$, upward.
3. $\frac{v^2}{R}$, downward.
4. $\frac{v^2}{2R}$, upward.

193. Two liquids flow through a heat exchanger and exchange heat energy.
The first liquid has a mass flow rate $\left(\frac{dm}{dt}\right) = r_1$, and its temperature rises by $\Delta\theta_1$. For the second liquid, the flow rate $\left(\frac{dm}{dt}\right) = r_2$, and the temperature fall is $\Delta\theta_2$. The ratio of their specific heat capacities is:

1. $\frac{\Delta\theta_1}{\Delta\theta_2}$
2. $\frac{r_1}{r_2}$
3. $\frac{r_2\Delta\theta_2}{r_1\Delta\theta_1}$
4. $\frac{r_2\Delta\theta_1}{r_1\Delta\theta_2}$

194. Two particles A, B are projected simultaneously from the base of a triangle ABC. Particle A is projected from vertex A along AC, and particle B is projected from vertex B along BC. Their respective velocities are v_A & v_B and they move with uniform velocities.
For the particles to collide,

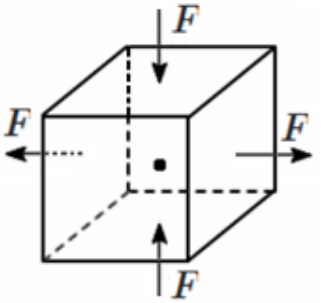


1. $v_A \cos A = v_B \cos B$
2. $v_A \sin A = v_B \sin B$
3. $\frac{v_A}{\sin A} = \frac{v_B}{\sin B}$
4. $v_A \tan A = v_B \tan B$

195. **Assertion (A):** The translational kinetic energy of every molecule of an ideal gas increases by 50% if the absolute temperature is raised by 50%.
Reason (R): The average translational kinetic energy of the molecules of an ideal gas is directly proportional to its absolute temperature.

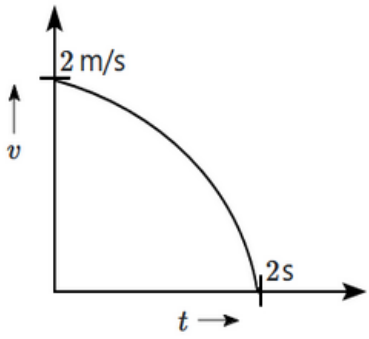
1. (A) is true but (R) is false.
2. (A) is false but (R) is true.
3. Both (A) and (R) are true and (R) is the correct explanation of (A).
4. Both (A) and (R) are true but (R) is not the correct explanation of (A).

196. A cube made of a homogeneous, isotropic elastic solid is acted upon by forces of equal magnitude acting perpendicular to its opposite faces as shown. Forces are applied uniformly over the area of each face. The stress at the center of the cube is:



1. tensile
2. compressive
3. shear
4. zero

197. The velocity-time graph of a particle, moving along a straight time, is shown in the figure. The curve, when plotted, takes the form of a 'circle'. The magnitude of average acceleration of the particle is:



1. 1 m/s^2
2. 2 m/s^2
3. less than 1 m/s^2
4. greater than 2 m/s^2

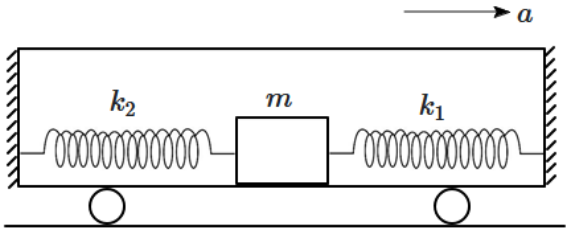
198. A submarine having a fixed volume is floating submerged underwater. Air, at high pressure, is pumped into the submarine using pipes. Due to this, the submarine will

1. rise.
2. sink.
3. float in the same position.
4. either rise or sink depending on the air pressure.

199. The speed of sound in a gas at temperature T is v_s while the rms speed of its molecules is v_r. The ratio of specific heats (C_p/C_v) is equal to

1. $\sqrt{3}\frac{v_s}{v_r}$
2. $\frac{1}{\sqrt{3}}\left(\frac{v_s}{v_r}\right)$
3. $3\left(\frac{v_s}{v_r}\right)^2$
4. $\frac{1}{3}\left(\frac{v_s}{v_r}\right)^2$

200. A block of mass m is placed between two springs connected to the ends of a railroad car. The surface supporting the block is horizontal, and the spring are initially relaxed. The car is given an acceleration a and the mass m finally comes to equilibrium within the car. Let x be the compression (or extension) in the two springs. Assume friction to be negligible. Then,



1. $k_1x - k_2x = ma$
2. $\frac{k_1k_2}{k_1+k_2}x = ma$
3. $k_1x + k_2x = ma$
4. $\frac{k_1k_2}{k_1-k_2} = ma$

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