Botany - Section A

1. Though their main body is sporophyte, yet, free-living photosynthetic gametophyte can be seen in:
1. Bryophytes
2. Pteridophytes
3. Gymnosperms
4. Angiosperms

2. Consider the two statements:
I. Most of the water flow in the roots occurs via the apoplast.
II. The movement of water through the root layers is ultimately symplastic in the endodermis.
1. Only I is correct
2. Only II is correct
3. Both I and II are correct
4. Both I and II are incorrect

3. The number of ATP and NADPH molecules required to make one molecule of glucose through the Calvin pathway respectively is:
1. 6 and 6
2. 6 and 9
3. 12 and 15
4. 18 and 12

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

	COLUMN I [Mineral]		COLUMN II [Role in plant]
A	Boron	P	Structure of chlorophyll
B	Manganese	Q	Synthesis of auxin
C	Magnesium	R	Pollen germination
D	Zinc	S	Splitting of water in photosynthesis

Codes:

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

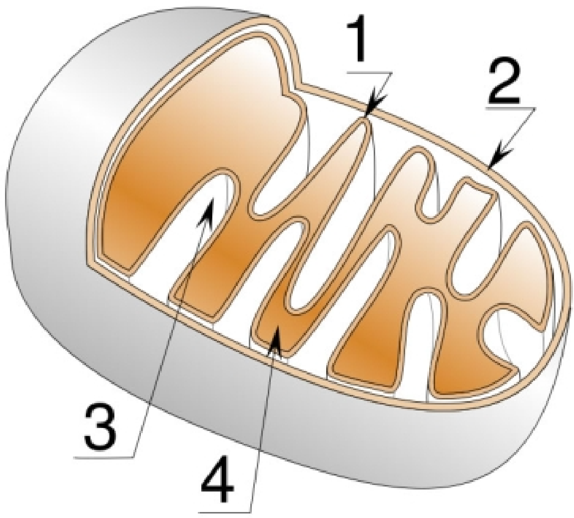
5. For each molecule of glucose, the number of molecules of Acetyl CoA entering the Citric Acid Cycle is:
1. 1
2. 2
3. 3
4. 4

6. Both Dinoflagellates and Euglenoids:
1. have stiff cellulosic cell wall
2. have two flagella
3. can behave as heterotrophy when deprived of sunlight
4. are mostly marine and photosynthetic

7. In Dianthus and Primrose, the ovules:
1. are borne on a ridge along the ventral suture of the ovary
2. are attached to axial placenta in a multilocular ovary
3. are borne on central axis and septa are absent
4. is single and attached to placenta at the base of the ovary

8. Periderm and secondary phloem constitute:
1. bark
2. cork
3. heart wood
4. sap wood

9. Krebs cycle takes place in the part labeled:



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

10. Gynoecium is situated in the centre and other parts of the flower are located on the rim of the thalamus almost at the same level in:
1. Mustard
2. China rose
3. Plum
4. Guava

11. Consider the two statements:
I. The water-splitting complex is located on the inner side of the thylakoid membrane
II. The NADP reductase enzyme is located on the stromal side of the thylakoid membrane
1. Only I is correct
2. Only II is correct
3. Both I and II are correct
4. Both I and II are incorrect

12. Nostoc:
1. is a green alga
2. is unicellular eukaryote capable of forming filamentous colonies
3. can fix atmospheric nitrogen
4. carry out anoxygenic photosynthesis

13. The PGR ethylene does not:
1. promote senescence and abscission of plant organs
2. affect fruit ripening
3. stimulate closure of stomata in times of water stress
4. help in initiating flowering in pineapple

14. During complete aerobic respiration of one molecule of glucose, there can be a net gain of:
1. 24 ATP
2. 28 ATP
3. 33 ATP
4. 38 ATP

15. Identify the incorrect statement regarding photosynthetic pigments in higher plants:
1. Chlorophyll a is the chief pigment associated with photosynthesis.
2. In the chromatogram, carotenoids appear bright or blue green.
3. Accessory pigments protect chlorophyll a from photo-oxidation.
4. The maximum absorption of chlorophyll a is in blue and green wavelength region of light.

16. At the root tip, some of the epidermal cells form very fine and delicate, thread-like structures called root hairs in the region of:
1. Root cap
2. Meristematic activity
3. Elongation
4. Maturation

17. Mycelium branched and septate, asexual spores conidia produced exogenously and sexual spores produced endogenously are the features of fungi belonging to:
1. Phycomycetes
2. Ascomycetes
3. Basidiomycetes
4. Deuteromycetes

18. Nitrogen-fixing bacterium that lives in symbiosis with actinorhizal plants in the genus Alnus is:
1. Rhizobium
2. Frankia
3. Azotobacter
4. Azospirillum

19. The relationship between incident light and carbon dioxide fixation by photosynthetic plants, at low light intensities, is a:
1. Straight line relationship
2. Hyperbola relationship
3. Parabola relationship
4. Ellipse relationship

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

	COLUMN I [Family]		COLUMN II [Floral character]
A	Brassicaceae	P	Tetradynamous stamen
B	Fabaceae	Q	Obliquely placed ovary
C	Solanaceae	R	Epitepalous stamen
D	Liliaceae	S	Vexillary aestivation

Codes:

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

21. Identify the incorrect statement:
1. Gymnosperms lack vessels in their xylem.
2. In roots, the arrangement of primary xylem is endarch.
3. Gymnosperms lack sieve tubes and companion cells.
4. Phloem parenchyma is absent in most of the monocotyledons.

22. The initial carboxylation reaction:
1. occurs in mesophyll cells in C_3 plants and in bundle sheath cells in C_4 plants
2. occurs in bundle sheath cells in C_3 plants and in mesophyll cells in C_4 plants
3. occurs in mesophyll cells in both C_3 plants and in C_4 plants
4. occurs in bundle sheath cells in both C_3 plants and in C_4 plants

23. Column I shows characteristics of members of Red algae. Match each item in Column I with the one in Column II and select the correct match from the codes given:

	COLUMN I		COLUMN II
A	Pigment	P	Fucoxanthin
B	Stored food	Q	Phycoerythrin
C	Cell wall	R	Floridean starch
D	Flagella	S	Laminarin
		T	Polysulfate esters
		U	Algin
		V	2-8. equal, apical
		W	Absent

Codes:

	A	B	C	D
1.	Q	R	T	W
2.	P	S	U	V
3.	Q	R	U	W
4.	P	S	T	V

24. What is not common to facilitated transport and active transport?
1. Requirement of special membrane proteins
2. Highly selective nature
3. Saturation of transport
4. Uphill transport

25. An example of a chemical used to remove the effect of inhibitory chemicals, present in seeds and causing dormancy, is:
1. Abscisic acid
2. Gibberellic acid
3. Para-ascorbic acid
4. Phenolic acid

26. How is a prion different from viroids, viruses, bacteria, fungi, and parasites?
1. It is non-infectious
2. It is obligate intracellular parasite
3. It is devoid of nucleic acids
4. It is a low molecular weight RNA molecule

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

	COLUMN I [PGR]		COLUMN II [Discovered by]
A	Auxin	P	F. W. Went
B	Gibberellic acid	Q	E. Kurosawa
C	Kinetin	R	Miller et al.
D	Ethylene	S	H. H, Cousins

Codes:

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

28. Which of the following is an activator of carboxylases and alcohol dehydrogenase?
1. Magnesium
2. Molybdenum
3. Zinc
4. Iron

29. In Australian acacia:
1. The leaves are converted into spine for defence
2. The leaves are converted into tendrils for climbing
3. The petiole expands, becomes green, and photosynthesizes food
4. The leaves become fleshy and store food

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

	COLUMN I [Kingdom]		COLUMN II [Cell wall]
A	Monera	P	Absent
B	Fungi	Q	Chitinous
C	Plantae	R	Polysaccharide + amino acid
D	Animalia	S	Cellulosic

Codes:

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

31. In Electron Transport System in mitochondria, UQH_2 passes electrons to:
1. FMN
2. Cytochrome b
3. Fe-S
4. FAD

32. Match each item in Column I with the one in Column II regarding C4 plants and select the correct match from the codes given:

	COLUMN I		COLUMN II
A	Primary acceptor of carbon dioxide	P	RuBP
B	Cells in which Calvin cycle takes place	Q	PEP
C	Primary carbon dioxide fixation product	R	Bundle sheath
D	Example	S	Mesophyll
		T	PGA
		U	OAA
		V	Sorghum
		W	Wheat

Codes:

	A	B	C	D
1.	Q	S	U	V
2.	P	S	T	W
3.	Q	R	U	V
4.	P	R	T	W

33. A modification of stem where a lateral branch with short internodes and each node bearing a rosette of leaves and a tuft of roots is found in:
1. Mint and Jasmine
2. Pistia and Eicchornia
3. Banana and Pineapple
4. Chrysanthemum and Strawberry

34. Which of the following is not an anatomical feature of a dicot stem?
1. Hypodermis of collenchyma
2. Endodermis, also called the starch sheath
3. Pericycle semilunar patches of parenchyma
4. Vascular bundle – conjoint and closed

35. 2, 4 – D, widely used to kill dicotyledonous weeds, is a derivative of:
1. Auxin
2. Cytokinin
3. Gibberellin
4. Abscisic acid

Botany - Section B

36. Assertion: The spread of living pteridophytes is limited and restricted to narrow geographical regions.
Reason: Evolutionarily, pteridophytes are the first terrestrial plants to possess vascular tissue – xylem and phloem.
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 reason is false
4. Both assertion and reason are false

37. Assertion: Some infections with gram-negative bacteria can lead to life-threatening septic shock.
Reason: Lipopolysaccharide layer in gram-negative bacteria can trigger an innate immune response.
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 reason is false
4. Both assertion and reason are false

38. Assertion: Alternaria, Colletotrichum and Trichoderma are kept in the fungal class- Deuteromycetes.
Reason: Asexual and vegetative phases in the life cycle of these fungi are not known.
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 reason is false
4. Both assertion and reason are false

39. Assertion: The respiratory pathway is an amphibolic pathway.
Reason: The respiratory pathway is involved in both anabolism and catabolism.
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 reason is false
4. Both assertion and reason are false

40. Assertion: Spraying sugarcane crops with gibberellins increase the yield by as much as 20 tonnes per acre.
Reason: Sugarcane stores carbohydrates such as sugar in their stems.
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 reason is false
4. Both assertion and reason are false

41. Assertion: Shoot apices modify themselves into flowering apices prior to flowering.
Reason: Shoot apices are the site of perception of light/dark in plants.
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 reason is false
4. Both assertion and reason are false

42. Assertion: The reaction centres in both photosystems in plants is the same.
Reason: The reaction centres of both photosystems are formed by chlorophyll b molecules.
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 reason is false
4. Both assertion and reason are false

43. Assertion: Growth, at a cellular level, is measured by a variety of parameters such as increase in fresh weight, dry weight, length, area, volume and cell number.
Reason: Such parameters are more or less proportional to the increase in protoplasm which is primarily responsible for growth at cellular level.
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 reason is false
4. Both assertion and reason are false

44. Assertion: Water is often the limiting factor for plant growth and productivity in both agricultural and natural environments.
Reason: Plants have very high demands for water.
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 reason is false
4. Both assertion and reason are false

45. Assertion: The maximum concentration of alcohol in beverages that are naturally fermented with yeast is about 13%.
Reason: In alcohol fermentation, yeast converts pyruvic acid to ethanol and carbon dioxide.
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 reason is false
4. Both assertion and reason are false

46. Assertion: During secondary growth in a dicot stem, the amount of secondary phloem produced is more than secondary xylem.
Reason: The cambium is more active on the outer than on the inner side.
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 reason is false
4. Both assertion and reason are false

47. Assertion: Cyclic photophosphorylation results in the synthesis of ATP but not of NADPH + H+.
Reason: The excited electron does not pass on to NADP+ but is cycled back to the PS I complex through the electron transport chain.
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 reason is false
4. Both assertion and reason are false

48. Assertion: Growth cannot be taken as a defining property of living organisms.
Reason: A multicellular organism grows by cell division.
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 reason is false
4. Both assertion and reason are false

49. Assertion: The membranes of chloroplasts and mitochondria are not included in the endomembrane system of a eukaryotic cell.
Reason: The presence of chloroplasts and mitochondria in eukaryotic cells is explained by endosymbiosis.
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 reason is false
4. Both assertion and reason are false

50. Assertion: Excess of manganese may induce deficiency of calcium.
Reason: Manganese competes with calcium for uptake.
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 reason is false
4. Both assertion and reason are false

Zoology - Section A

51. Which of the following stages of Meiosis is not correctly matched with event of cell division?

1.	Metaphase I	Bivalent align on the equatorial plate
2.	Anaphase I	Splitting of centromere
3.	Prophase II	Nuclear membrane disappears by the end
4.	Metaphase II	Microtubules from the opposite poles of the spindle get attached to the kinetochores of sister chromatids

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

	Column I		Column II
A	Cephalochordata	P	Swim bladder
B	Cyclostomata	Q	Notochord – head to tail
C	Chondrichthyes	R	Males bear claspers on pelvic fins
D	Osteichthyes	S	Marine but migrate to freshwater for spawning

Codes:

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

53. Specific receptors of the vestibular apparatus responsible for maintenance of balance of the body and posture are called:
1. Utricle and Saccule
2. Crista and Macula
3. Macula and Fovea
4. Organ of Corti and Sterocilia

54. Aldosterone acts mainly at renal tubules and stimulates the:
1. Reabsorption of Na^+ and K^+
2. Excretion of Na^+ and K^+
3. Excretion of K^+ and phosphate ions
4. Reabsorption of Na^+ and phosphate ions

55. The thick filaments in the 'A' band are also held together in the middle of this band by a thin fibrous membrane called:
1. I-band
2. Z-line
3. M-line

56. Consider the given statements regarding Sponges.
I. They have a cellular level of organisation
II. Digestion is intracellular
III. Fertilization is external and development is direct

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

57. Consider the given two statements:
I. When a neuron is not conducting any impulse, i.e., resting, the axonal membrane is comparatively more permeable to potassium ions (K+) and nearly impermeable to sodium ions (Na+).
II. Similarly, the membrane is permeable to negatively charged proteins present in the axoplasm.

1. Only I is correct
2. Only II is correct
3. Both I and II are correct
4. Both I and II are incorrect

58. In Cardiac muscle tissue:
I: Cell junctions fuse the plasma membranes of cardiac muscle cells
II. Communication junctions allow the cell to contract as a unit
1. Only I is correct
2. Only II is correct
3. Both I and II are correct
4. Both I and II are incorrect

59. At 40 mm Hg partial pressure of oxygen, the percentage saturation of haemoglobin with oxygen is expected to be about:
1. 50 %
2. 75 %
3. 95 %
4. 99 %

60. What can act as a competitive inhibitor of enzyme Succinic dehydrogenase?
1. ATP
2. $FADH_2$
3. Malonate
4. Pyruvate

61. Identify the incorrect statement:
1. Arrangement of axonemal microtubules in cilia and flagella is described as 9 + 2
2. Arrangement of microtubules in centriole is described as 9 + 0
3. Centrosome is involved in spindle formation in plant cell division
4. Centrioles form the basal body of cilia and flagella

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

	Column I		Column II
A	Pivot joint	P	Between carpal and metacarpal of thumb
B.	Saddle joint	Q	Between atlas and axis vertebrae
C	Gliding joint	R	Between carpal bones
D	Hinge joint	S	Humero-ulnar joint

Codes

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

63. The medulla oblongata contains centres which control all the following except:
1. respiration
2. cardiovascular reflexes
3. gastric secretions
4. body temperature

64. Which of the following glands do not secrete a protein hormone?
1. Pancreas
2. Thyroid
3. Adenohypophysis
4. Gonads

65. A person has the following values of respiratory volumes:

Tidal Volume	400 ml
Expiratory reserve volume	1000 ml
Inspiratory reserve volume	2500 ml
Residual volume	1000 ml

His functional residual capacity and vital capacity respectively are:
1. 2000 ml and 3900 ml
2. 2000 ml and 4900 ml
3. 1400 ml and 3900 ml
4. 1400 ml and 4900 ml

66. In Chordates
I. Heart is dorsal
II. Central nervous system is ventral
III. A post-anal tail is present
1. Only I and II are correct
2. Only III is correct
3. Only II is correct
4. Only I and III are correct

67. What feature on ECG represents the return of ventricles from excited to normal state?
1. P wave
2. R wave
3. S wave
4. T wave

68. At a place where a ‘diffusion boundary’ is present in the human body, you are most likely to find
1. Simple squamous epithelium
2. Cuboidal brush bordered epithelium
3. Columnar ciliated epithelium
4. Compound epithelium

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

	Column I		Column II
A	Plasma	P	45 % of blood
B.	Formed elements	Q	55 % of blood
C	Neutrophils	R	60-65 % of total WBCs
D	Lymphocytes	S	20-25 % of total WBCs

Codes

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

70. A diploid cell has a chromosome number of 8 and DNA content as 8 units. At the end of the S phase, the number of chromosomes and the DNA content respectively will be:
1. 8 and 8
2. 16 and 8
3. 8 and 16
4. 16 and 16

71. The bile released into the second part of the duodenum does not contain:
1. Bile slats
2. Bile pigments
3. Cholesterol
4. Lipases

72. Sphincter of Oddi guards the opening of:
1. Small intestine into the caecun
2. Common hepato-pancreatic duct into duodenum
3. Lower end of oesophagus into stomach
4. Pylorus into the first part of duodenum

73. What is correct regarding the atrial natriuretic factor?
1. It causes vasodilation and reduces blood pressure
2. It acts on the atrial wall of our heart and reduces cardiac output
3. It stimulates angiotensin leading to vasoconstriction
4. It acts on the distal tubule and lead to diuresis.

74. Identify the incorrect statement regarding human eye:
1. The diameter of the pupil is regulated by the muscle fibres of iris.
2. The choroid layer is thin over the posterior two-thirds of the eye ball, but it becomes thick in the anterior part to form the ciliary body.
3. Retina contains three layers of neural cells – from outside to inside – ganglion cells, bipolar cells and photoreceptor cells.
4. The fovea is a thinned-out portion of the retina where only the cones are densely packed and where the visual acuity (resolution) is the greatest.

75. Which of the following is not a feature of animals belonging to Phylum Annelida?
1. Metameric segmentation
2. An open circulatory system
3. Nephridia for osmoregulation and excretion
4. Bilateral symmetry

76. Which of the following is not a function of adrenaline and noradrenaline?
1. Piloerection
2. Pupilary constriction
3. Increase in strength of heart contraction
4. Breakdown of glycogen, lipids, and proteins.

77. Graves' disease is not characterized by:
1. Enlargement of the thyroid gland
2. Protrusion of eyeballs
3. Increased BMR and weight loss
4. Metal retardation

78. To maintain the pH and ionic balance of the body fluids, the proximal convoluted tubule selectively secretes all the following into the filtrate except:
1. Hydrogen ion
2. Potassium ion
3. Ammonia
4. Bicarbonate ion

79. Platyhelminthes, rotifers and lancelets:
1. are pseudocoelomates
2. have protonephridia as excretory structure
3. do not reproduce by sexual method
4. possess remarkable powers of true regeneration

80. In cockroach:
I. 100 – 150 hepatic cecae are present at the junction of foregut and midgut
II. 6 – 8 malpighian tubules are present at the junction of midgut and hindgut
1. Only I is correct
2. Only II is correct
3. Both I and II are correct
4. Both I and II are incorrect

81. Head of Periplaneta americana is formed by the fusion of:
1. 3 segments
2. 4 segments
3. 6 segments
4. 10 segments

82. To increase renal medullary interstitial osmolality, NaCl passes to the interstitium from:
1. The thick segment of ascending limb of the loop of Henle
2. The collecting tubule
3. Descending limb of vasa recta
4. The Proximal Convoluted Tubule

83. Which of the following animals is not matched to its correct scientific name?
1. Penguin: Aptenodytes
2. Tortoise: Testudo
3. Platypus: Macropus
4. Angel fish: Pterophyllum

84. Identify the incorrectly matched pair:
1. Radula – Molluscs
2. Malpighian tubules– Insects
3. Choanocytes– Sponges
4. Cnidocytes – Ctenophora

85. All the following are functions of lymph in the human body except:
1. Helps in digestion of fats
2. Returns proteins and excess interstitial fluid to the bloodstream
3. Transports nutrients and hormones
4. Helps in immunity against disease-causing agents

Zoology - Section B

86. Assertion: Post-menopausal women are at higher risk to develop osteoporosis.
Reason: Levels of oestrogen in post-menopausal women are decreased.
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 reason is false
4. Both assertion and reason are false

87. Assertion: Rh incompatibility related complication does not arise in first pregnancy even if an Rh negative mother is carrying an Rh positive foetus.
Reason: Rh antigens are proteins.
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 reason is false
4. Both assertion and reason are false

88. Assertion: Oxytocin helps in parturition and causes milk ejection from the mammary glands.
Reason: Oxytocin acts on the smooth muscles of our body and stimulates their contraction.
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 reason is false
4. Both assertion and reason are false

89. Assertion: Lipids are macromolecules.
Reason: They have a molecular weight range of ten thousand Daltons and above.
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 reason is false
4. Both assertion and reason are false

90. Assertion: The filtrate gets concentrated as it moves down the descending limb of loop of Henle in the human nephron.
Reason: The descending limb of loop of Henle is impermeable to water but allows transport of electrolytes actively or passively.
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 reason is false
4. Both assertion and reason are false

91. Assertion: Hemichordates are not chordates.
Reason: They do not have a notochord.
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 reason is false
4. Both assertion and reason are false

92. Assertion: Fatty acids and glycerol cannot be absorbed into the blood.
Reason: They are transported into the lymph vessels in the villi.
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 reason is false
4. Both assertion and reason are false

93. Assertion: Damage to parietal or oxyntic cells in gastric mucosa can cause anaemia.
Reason: Parietal or oxyntic cells in gastric mucosa secrete HCl.
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 reason is false
4. Both assertion and reason are false

94. Assertion: Meiosis conserves specific chromosome number of each species across generations in sexually reproducing organisms.
Reason: Meiosis, per se, results in reduction of chromosome number by half.
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 reason is false
4. Both assertion and reason are false

95. Assertion: The sino-atrial node is normally the pacemaker of the human heart.
Reason: It is the only autoexcitable part of the nodal tissue of the human heart.
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 reason is false
4. Both assertion and reason are false

96. Assertion: Living state is a non-equilibrium steady state.
Reason: Living organisms work continuously.
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 reason is false
4. Both assertion and reason are false

97. Assertion: Dietary proteins are the source of essential amino acids.
Reason: All essential amino acids are aromatic.
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 reason is false
4. Both assertion and reason are false

98. Assertion: The amount of carbon dioxide that can diffuse through the diffusion membrane per unit difference in partial pressure is much higher compared to that of oxygen.
Reason: The solubility of carbon dioxide is 20 – 25 times lower than that of oxygen.
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 reason is false
4. Both assertion and reason are false

99. Assertion: Vertebrochondral ribs are called as true ribs.
Reason: Vertebraochondral ribs are attached to the thoracic vertebrae dorsally and are ventrally connected to the sternum.
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 reason is false
4. Both assertion and reason are false

100. Assertion: Low temperature destroys enzymatic activity.
Reason: Proteins are denatured when exposed to low temperatures.
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 reason is false
4. Both assertion and reason are false

Chemistry - Section A

101. In a nitrating mixture (HNO_3 + H_2SO_4), H_2SO_4 can act as
1. Acid
2. Base
3. Neither acid nor base
4. Both acid as well as base

102. The heats of combustion of C, H_2 and C_2H_6 are -94 Kcal, -68 Kcal and -372 Kcal, respectively. The enthalpy of formation of C_2H_6 will be
1. +20 K cal
2. -40 K cal
3. -20 K cal
4. +40 K cal

103. The most stable free radical, amongst the following, is
1. Allyl
2. Benzyl
3. Vinyl
4. Phenyl

104. An organic compound contains C=40%, H=6.66%, and rest oxygen. The vapour density of this compound is 30. The molecular formula of this compound is
1. CH_2O
2. $C_2H_4O_2$
3. C_3H_8O
4. CO_3

105. The formal charge on nitrogen in NO_3^- is
1. -1
2. +1
3. +5
4. -3

106. The correct representation for the formation of CH_4(g) is-
1. $\mathrm{C}(diamand) + 2\mathrm{H}_2(g) \longrightarrow \mathrm{CH}_4(g)$
2. $C(graphite) + 4\mathrm{H}(g) \longrightarrow \mathrm{CH}_4(g)$
3. $\mathrm{C}(graphite) + 2\mathrm{H}_2(g) \longrightarrow \mathrm{CH}_4(g)$
4. $C(diamand\ ) + 4\mathrm{H(g)} \rightarrow \mathrm{CH}_4(g)$

107. Which, of the following, compounds has the highest lattice energy?
1. LiCl
2. BeO
3. LiF
4. MgO

108. The bond order of B_2 is one. The type of bond and magnetic behavior of B_2, respectively, are
1. σ and diamagnetic
2. π and diamagnetic
3. σ and paramagnetic
4. π and paramagnetic

109. For which of the following equations, $\Delta H > \Delta E$?
1. $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$
2. $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l)$
3. $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$
4. $H_2(g) + I_2(g) \rightarrow 2HI(g)$

110. The electrophile used in the sulphonation of benzene is
1. $^{+}SO_3H$
2. SO_3
3. SO_2
4. $^{+}SO_3$

111. For a particular real gas, highest and lowest temperature, respectively, is
1. Boyle temperature and Critical temperature
2. Inversion temperature and Boyle temperature
3. Critical temperature and inversion temperature
4. Inversion temperature and Critical temperature

112. Clean water has Biochemical oxygen Demand (BOD) value of
1. 10 ppm
2. less than 5ppm
3. 17 ppm
4. 14 ppm

113. 1-Butyne and 2-Butyne can be distinguished by the use of
1. Na/NH_3
2. Ammoniacal silver nitrate
3. Cl_2
4. H_2 and Lindlar's catalyst

114. Which, of the following, elements can form a hydride?
1. Cr
2. Mn
3. Fe
4. Co

115. Which, of the following, has greatest number of atoms at NTP?
1. 1 ml N_2
2. 1 ml CH_4
3. 1 ml H_2O
4. 1 ml NH_3

116. The IUPAC name of 'Ekamercury' is
1. Ununquadium
2. Ununbiium
3. Unniloctium
4. Unnilquadium

117. On adding inert gas at constant volume, which, of the following, equilibrium shifts in forward direction?
1. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
2. $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$
3. $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
4. $None\ of\ these$

118. How many peroxide linkages are present in HNO_5?
1. zero
2. 1
3. 2
4. 3

119. Equal volumes of pH=4 and pH =6 solutions are mixed together. The pH of the resulting solution will be
1. 4.3
2. 4.7
3. 5.3
4. 5.7

120. The molecular formula $C_4H_{10}O$ can show
1. Chain isomerism
2. Position isomerism
3. Metamerism
4. All of these

121. But-1-en-3-yne contains
1. 6σ and 3π bonds
2. 7σ and 2π bonds
3. 7σ and 3π bonds
4. 5σ and 3π bonds

122. When gypsum is heated at 200°C then the product formed is
1. Plaster of paris
2. Burnt Plaster
3. $CaSO_4.H_2O$
4. $CaSO_4.\frac{1}{2}H_2O$

123. 2-Butyne is hydrogenated in presence of Lindlar's catalyst, The major product formed will be
1. Cis-but-2-ene
2. Trans-but-2-ene
3. 1-Butyne
4. Butane

124. **Assertion:** The boiling point of neopentane is less than isopentane
Reason: Higher is the branching, the lesser will be the boiling point of a compound.
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 reason is false
4. Both assertion and reason are false.

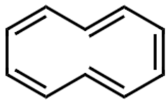
125. When borax is red heated then a transparent glassy solid is formed. The composition of this glassy solid is
1. B_2O_3
2. $NaBO_2 + B_2O_3$
3. $Na_2B_4O_7$
4. $NaBO_2$

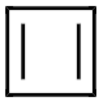
126. The correct relation for the work done in isothermal expansion will be
1. $w_{reversible} < w_{irreversible}$
2. $w_{reversible} > w_{irreversible}$
3. $w_{reversible} = w_{irreversible}$
4. All of the above

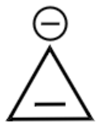
127. $\psi_{3,2,0}$ is the representation of the orbital
1. $3p_x$
2. $3d_{xy}$
3. $3d_{z^2}$
4. $3d_{x^2-y^2}$

128. The nonaromatic species, amongst the following, is

1. 

2. 

3. 

4. 

129.
$$x\mathrm{Cl_2} + y\,\mathrm{NaOH} \longrightarrow \mathrm{zNaCl} + a\,\mathrm{NaClO_3} + bH_2O$$
The ratio of $\frac{x+y}{z+a+b}$ will be
1. 1
2. 2
3. 2.5
4. 3

130. The solubility of AgCl is minimum in
1. 0.01 M NaCl
2. 0.02 M $CaCl_2$
3. 0.05 M $AgNO_3$
4. 0.01 M NH_4OH

131. For the following compound, IUPAC name is
CH_2 - CH - CH_2
| | |
COOH COOH COOH
1. 3- Carboxypentan-1,5-dioic acid
2. 1,2,3-tricarboxypropane
3. Propane-1,2,3-tricarboxylic acid
4. All of these

132. In P_4O_{10}, the number of P-O and P=O bonds, respectively, are
1. 8, 4
2. 10, 4
3. 12, 4
4. 16, 0

133. The aqueous solution of $NaHCO_3$ is
1. Acidic
2. Alkaline
3. Slightly alkaline
4. Slightly acidic

134. Which, of the following, ions has the highest ionisation potential?

1. F^-
2. Cl^-
3. Br^-
4. I^-

135. When diborane is heated with NH_3, a crystalline compound is formed. On red heating this crystalline compound, $B_3N_3H_6$ (inorganic benzene) is formed. In $B_3N_3H_6$, the hybridized state of B and N, respectively, are
1. sp^2 and sp^2
2. sp^2 and sp^3
3. sp^3 and sp^2
4. sp^3 and sp^3

Chemistry - Section B

136. The number of unpaired electrons in Ni and Ni^{2+}, respectively, are (Z of Ni = 28)
1. 2, 2
2. 2, 4
3. 2, 0
4. 4, 2

137. Volume of N/5 NaOH required to neutralise CH_3COOH which is produced from hydrolysis of 4.4 gm $CH_3COOC_2H_5$ is
1. 125 ml
2. 250 ml
3. 500 ml
4. 1000 ml

138. The specific heats of a gas at constant pressure and at constant volume, respectively, are 0.125 cal/g and 0.075 cal/g. The molecular weight of the gas is 40. The atomicity of the gas will be
1. 1
2. 2
3. 3
4. 4

139. Classical smog and photochemical smog behave, respectively, as
1. Oxidizing agent and reducing agent
2. Oxidizing agent and oxidizing agent
3. Reducing agent and oxidizing agent
4. Reducing agent and reducing agent

140. The volume strength of 1.5 M H_2O_2 will be
1. 33.6
2. 22.4
3. 16.8
4. 8.4

141. At high temperature, the Van der Waal's gas equation for one mole of gas is

1. $1-\frac{a}{RTV}$
2. $1+\frac{Pb}{RT}$
3. $1+\frac{a}{RTV}$
4. $1-\frac{Pb}{RT}$

142. Which element does not react with nitrogen to form a nitride?
1. Mg
2. Na
3. Li
4. Ba

143. The strongest conjugate base is

1. CH_3COO^-
2. Cl^-
3. NO_3^-
4. HSO_4^-

144. ClO_4^- contains three π bonds. The type of these π bonds are
1. 3dπ-pπ
2. 2dπ-pπ and 1pπ-pπ
3. 1dπ-pπ and 2pπ-pπ
4. 3pπ-pπ

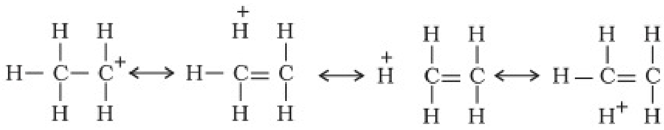
145.
$$CH_2=CH-C\equiv CH+HBr\rightarrow A(Major),$$
$$(1Mole)$$
The compound 'A', in the above reaction, is

1.
$$CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-C\equiv CH$$
2.
$$CH_2=CH-\underset{\displaystyle Br}{\underset{|}{C}}=CH_2$$
3. $CH_2=CH-CH=CH-Br$
4.
$$\underset{\displaystyle Br}{\underset{|}{CH_2}}-CH_2-C\equiv CH$$

146. The number of geometrical isomers of CH_3-CH =CH-CH=CH-CH_3 are
1. 2
2. 3
3. 4
4. Zero

147. **Assertion:** PCl_3Br_2 has zero dipole moment.
Reason: Br atom occupies axial position while Cl atom occupy equatorial position.
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 reason is false
4. Both assertion and reason are false

148. The hyperconjugation effect is a permanent effect in which localization of σ electrons of the C-H bond of an alkyl group directly attached to an atom of the unsaturated system or to an atom with an unshared p orbital takes place.
Hydrogen attaches to alpha carbon in an allylic compound and alpha carbon of carbon-containing positive charge show hyperconjugation. The orbital diagram showing hyperconjugation in ethyl cation is as follows:



In general, greater the number of alkyl groups attached to a positively charged carbon atom, greater is the hyperconjugation interaction and stabilization of the cation. More the hyperconjugation in the structure, more is the stability.

The most stable carbocation is

1. $CH_3-\overset{\oplus}{C}H-CH_3$
2. $CH_3-\overset{\oplus}{C}H-CH_2-CH_3$
3. $CH_3-CH_2-\overset{\oplus}{C}H-CH_2-CH_3$
4. $CH_3-\overset{\oplus}{C}H-CH_2-CH_2-CH_3$

149. Based on the hyperconjugation effect described above:

In which of the following compounds is the double bond longest?
1. CH_3- CH = CH - CH_3
2. $(CH_3)_3$ C-CH = CH_2
3. CH_3-CH = CH-CH$(CH_3)_2$
4. CH_2 = CH- CH_2 -CH_3

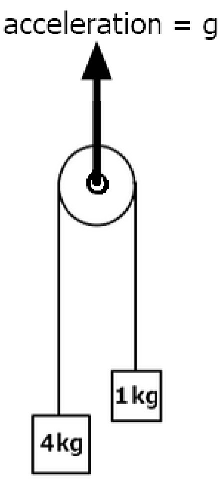
150. Based on the hyperconjugation effect described above:

Which of the following alkenes has the smallest heat of hydrogenation?
1. But-1-ene
2. 2,3-dimethyl but-2-ene
3. But-2-ene
4. Pent-2-ene

Physics - Section A

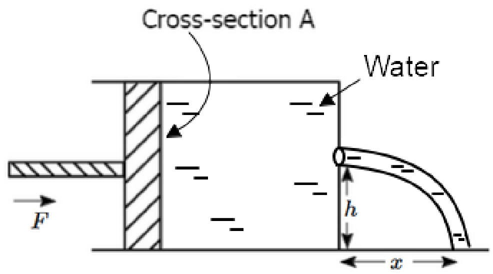
151. When the logarithm of the temperature difference between a body and its surroundings is plotted as a function of time, the graph is a
1. straight line with positive slope.
2. straight line with negative slope.
3. exponentially decaying curve.
4. parabola.

152. The acceleration of the 4 kg block is:



1. $\frac{3\text{ g}}{5}$ down.
2. $\frac{6g}{5}$ down.
3. $\frac{g}{5}$ down.
4. $\frac{11\text{ g}}{5}$ down.

153. A liquid of density ρ is forced out through a small hole by means of a piston of cross-section 'A', on which a force F is applied. The flow is streamline. The liquid stream strikes the ground at a distance 'x' in front of the hole. The hole is in the middle of the right face and its height is 'h' above the ground. The expression for x^2 is:



1. $\frac{4Fh}{A\rho g}$
2. $\frac{2Fh}{A\rho g}$
3. $\frac{Fh}{A\rho g}$
4. $\frac{Fh}{2A\rho g}$

154. The average momentum of the molecules in a sample of H_2 - gas at temperature 300 K has a magnitude p_1 and that for He-gas at the same temperature has the magnitude p_2. Then,
1. $p_1 > p_2$
2. $p_2 > p_1$
3. $p_1 = p_2$
4. the relationship between p_1 and p_2 depends on pressure.

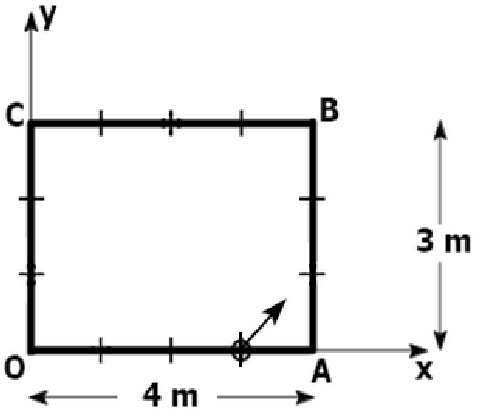
Hint: Momentum is a vector.

155. If the absolute temperature increases by 1%, the frequency of an organ pipe will:
1. increase by 1%.
2. decrease by 1%.
3. increase by 0.5%.
4. decrease by 0.5%.

156. A particle is projected with a speed u so that it has the maximum horizontal range under gravity. The speed is increased to v (without changing the direction of its projection), so that, after projection, it passes above its previous point of impact but at a height which is equal to its previous maximum height. Then,
1. $2u = v$
2. $3u = 2v$
3. $2u = \sqrt{3}v$
4. $3u = \sqrt{2}v$

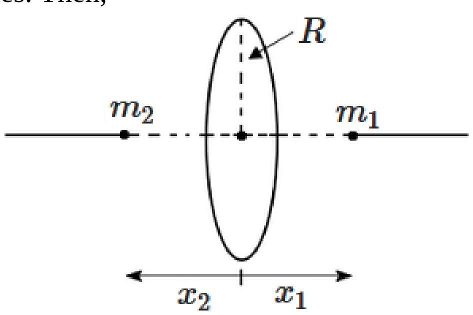
157. A 100 cm wire of mass 40 g is fixed at both ends. A tuning fork, vibrating at a frequency of 50 Hz, sets the wire into resonance in its fundamental mode. Then, the tension in the wire is:
1. 400 N
2. 100 N
3. 25 N
4. 1600 N

158. A ball is released with a velocity $(2\hat{\imath}+2\hat{\jmath})\ \mathrm{m/s}$ on the rectangular pool table from the point $(3,0)$ m. All the collisions of the ball are elastic.



After 4 seconds of being released, the location of the ball will be:
1. $(2,2)$ m
2. $(0,1)$ m
3. $(2,1)$ m
4. $(3,2)$ m

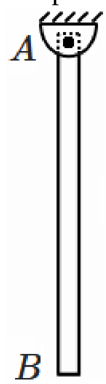
159. Two particles of masses m_1, m_2 are placed on the axis of a uniform circular ring of mass M and radius R, on opposite sides of the center of the ring. The distances of m_1, m_2 from the center of the ring are x_1, x_2 respectively, and $x_1\ x_2 \ll R$. The net force on the ring vanishes. Then,



1. $\frac{m_1}{x_1}=\frac{m_2}{x_2}$
2. $\frac{m_1}{x_1^2}=\frac{m_2}{x_2^2}$
3. $\frac{m_1}{x_1^3}=\frac{m_2}{x_2^3}$
4. $m_1x_1=m_2x_2$

160. The dimension of which group of quantities is the same?
h : Planck's constant, K : kinetic energy, ω : angular speed/frequency, F: force, L : inductance, i : current, q : charge, t : time, x: distance
1. $h,\ Ftx,\ Liq$
2. $K, h\omega, \omega Li$
3. $Fx,\ Li^2,\ K\omega$
4. $\frac{Fx}{t},\ Kx,\ ht$

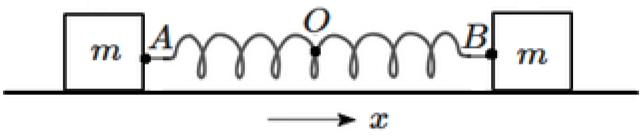
161. A uniform rod is pivoted at one of its ends, so that it can rotate freely in a vertical plane. Initially, it hangs vertically as shown in the figure. A sharp impulse is delivered to the rod at its lowest end B, towards the right. An impulse is exerted by the pivot at A, due to the constraint. The impulse at A acts



1. to the right.
2. to the left.
3. upward.
4. downward.

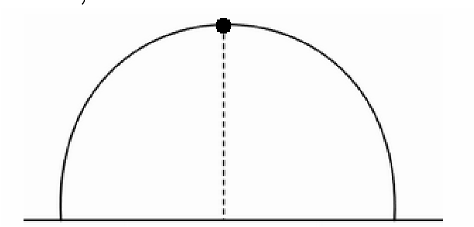
162. A glass vessel of volume V_0 contains a liquid which fills 20% of its volume. When the temperature of the system is raised by 10°C, the volume of the unfilled portion is found to remain constant. If the coefficient of linear expansion of glass is α , the coefficient of expansion of the liquid is
1. 5α
2. $\frac{3\alpha}{5}$
3. $\frac{5\alpha}{3}$
4. 15α

163. Two identical blocks are connected by an ideal spring and the system is allowed to oscillate, when undergoing horizontal displacements in opposite directions, with the centre-of-mass at rest. O is the mid-point of the spring, A is left end point, B is the right end-point. The motion of A is described by: $x_A = A_0 sin\,\omega t$ (displacement is taken to be positive rightward).
Then, motion of the point B is described by:



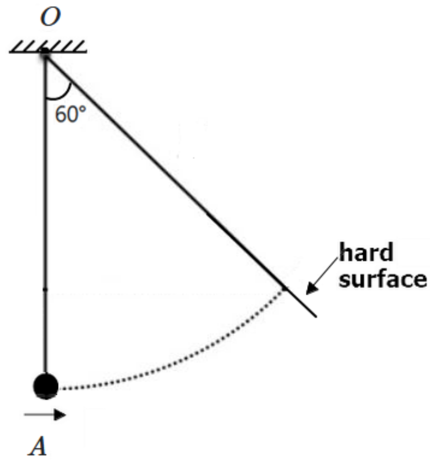
1. $x_B = A_0 \sin \omega t$
2. $x_B = A_0 \cos \omega t$
3. $x_B = A_0 \sin(\omega t + \pi)$
4. $x_B = A_0 \cos(\omega t + \pi)$

164. A particle is released from the top of a smooth hemisphere of radius R, and it slides down along its surface. After it slides down a height $\frac{R}{5}$, its acceleration will be a, where



1. $a < \frac{2g}{5}$
2. $\frac{2g}{5} < a < \frac{3g}{5}$
3. $\frac{3g}{5} < a < g$
4. $a = g$

165. The pendulum OA has a length L. The bob A is given an initial velocity towards right when it is at its lowest position. Thereafter it moves in a circular path and collides with the hard surface (at 60°) losing 50% of the kinetic energy it had just before the collision. The pendulum rebounds and it reaches a height of $\frac{3L}{4}$ above its lowest point A. In the absence of the hard surface, it would have risen to a height of



1. $\frac{3L}{2}$
2. $\frac{5L}{2}$
3. $2L$
4. L

166. **Assertion (A):**
If two particles move with uniform accelerations in different directions, then their relative velocity changes in direction.

Reason (R):
Since the acceleration are in different directions, there is a relative acceleration and hence the relative velocity changes.

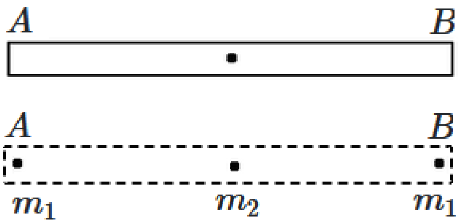
1. (A) is true but (R) is false.

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).

167. A uniform rod AB of mass m and length L is replaced by three particles – two particles of masses m_1 each at the ends and another particle of mass m_2 at its centre. The new system of particles has the same total mass, the same center-of-mass and the same moment of inertia about an axis through its C.M. and perpendicular to AB.
If the moment of inertia of the new system of particles is measured about an axis passing through the end A, and perpendicular to AB then it is found to be I_2. For the rod, the same quantity is found to be I_1. Then



1. $I_1 = 2I_2$
2. $I_2 = 2I_1$
3. $I_1 = I_2$
4. $I_1 = 3I_2$

168. A particle is projected vertically upwards with a speed u and moves under the force of gravity. The distance travelled by the particle during its entire motion (until it returns) is d_1. If the force of gravity were to be switched off, and the particle travelled for the same length of time, then the distance travelled is d_2. Then,
1. $d_2 = d_1$
2. $d_2 = 2d_1$
3. $d_2 = 3d_1$
4. $d_2 = 4d_1$

169. A uniform rod of mass m, having cross-section A is pushed along its length (L) by means of a force of magnitude, F. There is no friction anywhere. Ignore the weight of the rod. The longitudinal stress in the rod, at a distance $\frac{L}{3}$ from the left end, is:

1. Tensile, $\frac{F}{3A}$
2. Compressive, $\frac{F}{3A}$
3. Tensile, $\frac{2F}{3A}$
4. Compressive, $\frac{2F}{3A}$

170. **Assertion (A):**
The center-of-mass of an isolated system of particles remains at rest if it is initially at rest.

Reason (R):
Internal forces, acting within a system, cannot change the velocity of the center of mass; which is proportional to the total momentum of the system.

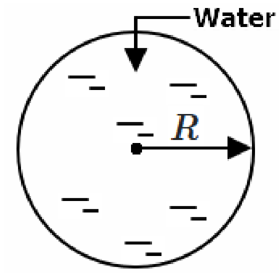
1. (A) is true but (R) is false.

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).

171. A thin spherical metallic vessel of radius R contains water, the mass of water being equal to the mass of the vessel that contains it. A hole is made in the bottom so that the water begins to flow out. When the vessel is half-empty the centre of mass is at a distance d from the centre of the vessel



1. $d = \frac{3R}{16}$
2. $d = \frac{R}{2}$
3. $d = \frac{R}{4}$
4. $d = \frac{R}{8}$

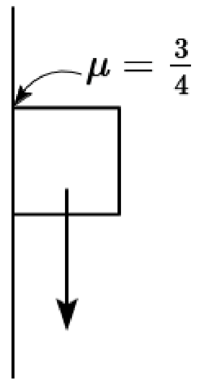
172. The current passing through a certain device doubles when the temperature rises by 10°C, in the temperature range from 0°C to 500°C. This effect is used to measure the temperature of a sample. The current is measured to be 5 mA at 15°C and then the next measurement shows a current of 50 mA. The temperature of the new measurement is nearly (take $log_{10}2 \simeq 0.3$, if required)
1. 150°C
2. 50°C
3. 450°C
4. 25°C

173. A block of ice floats in water, in a beaker at 0°C, nearly. The ice melts slowly until the beaker is full of water. As a result, the pressure at the bottom
1. increases slowly.
2. decreases slowly.
3. first increases and then decreases.
4. remains constant.

174. A wooden block floats submerged at the interface of two liquids, the upper one of specific gravity 0.4 and the lower one being water (density: 1 g/cc) It is observed that the block has $\frac{1}{3}$ of its volume in water and $\frac{2}{3}$ of it in the upper liquid. The density of the block is:
1. 0.5
2. 0.6
3. 0.8
4. 0.9

175. If the ends of the meter stick are maintained at θ_1°C and θ_2°C, the temperatures measured at the 25 cm and 80 cm marks are observed to be 35°C and 68°C respectively. Then the temperatures of the left end (θ_1°C) and the right end (θ_2°C) are:
1. $\theta_1 = 0,\ \theta_2 = 90$
2. $\theta_1 = 10,\ \theta_2 = 85$
3. $\theta_1 = 20,\ \theta_2 = 80$
4. $\theta_1 = 30,\ \theta_2 = 100$

176. A 3 kg-block is pressed against a vertical wall with a coefficient of friction, $\mu = \frac{3}{4}$. What minimum force should be applied to the block in order to prevent it from falling down? Take $g = 10$ m/s^2



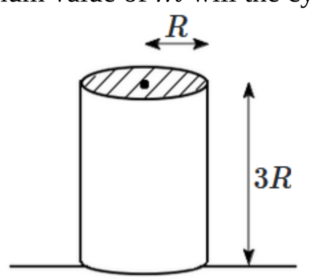
1. $\frac{3}{4} \times 30$ N
2. $\frac{4}{3} \times 30$ N
3. $\frac{3}{5} \times 30$ N
4. $\frac{4}{5} \times 30$ N

177. A Carnot engine having an efficiency of 25% is driven in reverse, so to act as a refrigerator. The coefficient of performance of the refrigerator is
1. 3
2. 4
3. 5
4. 8

178. A block is suspended from a spring and causes an extension of 2 cm. It is now imparted a kinetic energy E so that the block rises up by exactly 2 cm. If the block were to be given the same kinetic energy upward, without being attached to a spring, it would rise up by
1. 1 cm
2. 2 cm
3. 4 cm
4. 8 cm

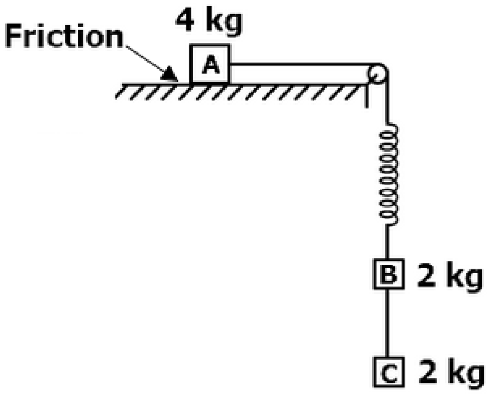
179. When the temperature difference between a body and its surroundings is 20°C, it loses heat to the surroundings at a rate of 40 W. If the temperature difference increases to 25°C, the rate of loss of heat is
1. 45 W
2. 50 W
3. 60 W
4. 80 W

180. A uniform cylinder of mass M, radius R and height $3R$ is placed upright on a horizontal surface. A particle of mass m is placed on the top of the cylinder at its edge. For what minimum value of m will the cylinder topple?



1. $m = 3M$
2. $m = \frac{M}{3}$
3. $m = \frac{3M}{2}$
4. No value of m will cause the cylinder to topple.

181. The system is at rest initially, due to the force of friction acting on A. If the string connecting the lower blocks is cut, the accelerations of the blocks A, B, C will be, respectively,



1. $\frac{g}{3}$ to left, g upward, g downward.
2. zero, zero, g downward.
3. zero, g upward, g downward.
4. g to right, zero, g downward.

182. A particle starts to move along a straight line under a force that delivers constant power P, starting from rest. The velocity of the particle, v varies with time t, as:
1. $v \propto t$
2. $v \propto \frac{1}{t}$
3. $v \propto \sqrt{t}$
4. $v \propto \frac{1}{\sqrt{t}}$

183. Two identical springs are joined end-to-end to form a single spring and a block is suspended from the combination. The time period of oscillation is T_1. Alternatively, if the springs were joined in parallel, the time period is T_2. Then
1. $T_1 = T_2$
2. $T_1 = 2T_2$
3. $T_2 = 2T_1$
4. none of the above is true.

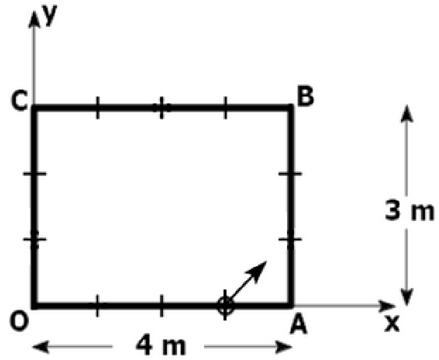
184. A block of mass 1 kg moving with a velocity of 4 m/s strikes a second block of mass 2 kg at rest. The first block is brought to rest by the collision. The coefficient of restitution is:
1. $\frac{1}{2}$
2. $\frac{1}{3}$
3. $\frac{2}{3}$
4. $\frac{1}{4}$

185. Suppose that the average kinetic energy (translational & rotational) of random molecular motion of helium (He) at temperature T_{He} is equal to that of hydrogen (H_2) at temperature T_{H_2}. Then,
1. $T_{H_2} = T_{He}$
2. $\frac{T_{H_2}}{2} = \frac{T_{He}}{4}$
3. $5T_{H_2} = 3T_{He}$
4. $\frac{T_{H_2}}{5} = \frac{T_{\mathrm{He}}}{3}$

Physics - Section B

186. A source of sound moves with a constant velocity. An observer standing close to the line of motion finds the frequency of sound to be 1100 Hz when the source is approaching and 900 Hz when it is receding from him. The frequency of the source is:
1. 1000 Hz
2. 950 Hz
3. 990 Hz
4. 1010 Hz

187. A ball is released with a velocity $(2\hat{\imath} + 2\hat{\jmath})\ \mathrm{m/s}$ on the rectangular pool table from the point $(3, 0)$ m. All the collisions of the ball are elastic.



After the 4th collision with the edges of the board, the location and velocity of the ball will be:
1. $(3, 0)$ m and $(2\hat{\imath} + 2\hat{\jmath})\ \mathrm{m/s}$
2. $(0, 2)$ m and $(2\hat{\imath} - 2\hat{\jmath})\ \mathrm{m/s}$
3. $(1, 0)$ m and $(2\hat{\imath} + 2\hat{\jmath})\ \mathrm{m/s}$
4. $(2, 2)$ m and $(-2\hat{\imath} - 2\hat{\jmath})\ \mathrm{m/s}$

188. A simple pendulum is made with a thin wire (length: l, area: A, Young's modulus: Y) attached to a heavy bob of mass M. The pendulum is released from the rest with the bob at the same level as the point of suspension and swings down in a circular arc. The elongation in the wire when the bob reaches the lowest point is:

1. $\frac{3Mgl}{AY}$
2. $\frac{2Mgl}{AY}$
3. $\frac{3Mgl}{2AY}$
4. $\frac{Mgl}{AY}$

189. The quantity "Action" (S) is defined by the equation:

$S = \int_0^t (K - U)dt$

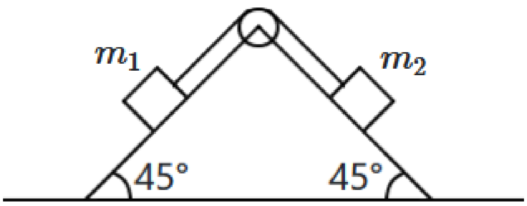
where K is the kinetic energy, U is the potential energy and the integral is over the time, t during the motion.
The proper unit of action will be

1. kg - m/s
2. kg-m^2
3. kg-m^2-s
4. kg-m^2/s

190. The gravitational potential energy of a particle of mass m increases by mgh, when it is raised through a height h in a uniform gravitational field "g". If a particle of mass m is raised through a height h in the earth's gravitational field (g: the field on the earth's surface) then the increase in gravitational potential energy is U. Then,

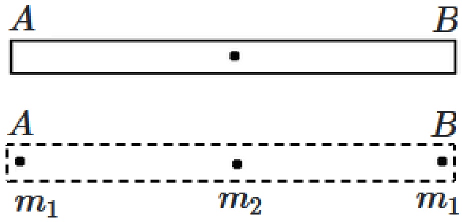
1. $U > mgh$
2. $U < mgh$
3. $U = mgh$
4. any of the above may be true depending on the value of h, considered relative to the radius of the earth.

191. There is no friction anywhere, and the string and the pulley are ideal. Assume that $m_1 < m_2$.The acceleration of m_2 down the plane is a. Then,



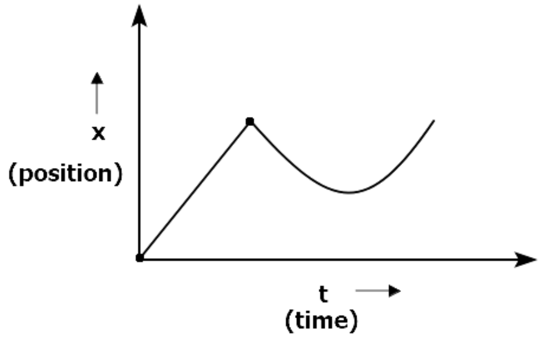
1. as $\frac{m_1}{m_2} \to 1, a \to 0.$
2. as $\frac{m_1}{m_2} \to 0, a \to g.$
3. a varies linearly with $\frac{m_1}{m_2}$.
4. all the above are true.

192. A uniform rod AB of mass m and length L is replaced by three particles – two particles of masses m_1 each at the ends and another particle of mass m_2 at its centre. The new system of particles has the same total mass, the same center-of-mass and the same moment of inertia about an axis through its C.M. and perpendicular to AB.
Which of the following is true?



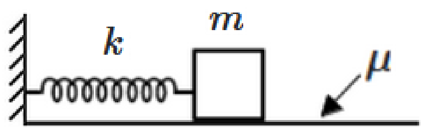
1. $m_1 = \frac{m}{3}, m_2 = \frac{m}{3}$
2. $m_1 = \frac{m}{4}, m_2 = \frac{m}{2}$
3. $m_1 = \frac{m}{6}, m_2 = \frac{2m}{3}$
4. $m_1 = \frac{m}{5}, m_2 = \frac{3m}{5}$

193. Which of the following statements is true about the motion depicted in the diagram?



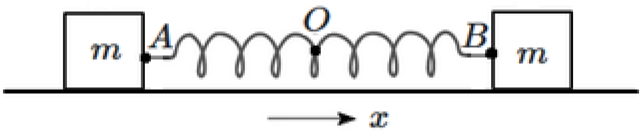
1. The acceleration is constant and non-zero.
2. The velocity changes suddenly during the motion.
3. The velocity is positive throughout.
4. All of the above are true.

194. In the figure, the coefficient of friction between the block (mass m) and the horizontal surface is μ. The block is given an initial velocity to the left compressing the spring by x_1. The block 'rebounds' and then the spring gets extended - the maximum extension being x_2.



1. $x_1 + x_2 = \frac{\mu mg}{k}$
2. $x_1 - x_2 = \frac{\mu mg}{k}$
3. $x_1 + x_2 = \frac{2\mu mg}{k}$
4. $x_1 - x_2 = \frac{2\mu mg}{k}$

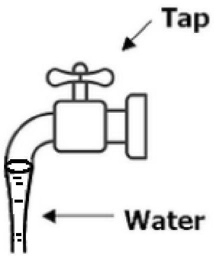
195. Two identical blocks are connected by an ideal spring and the system is allowed to oscillate, when undergoing horizontal displacements in opposite directions, with the centre-of-mass at rest. O is the mid-point of the spring, A is left end point, B is the right end-point. The motion of A is described by: $x_A = A_0 sin\,\omega t$ (displacement is taken to be positive rightward).
Call the mid-point of O and B as C and its x-coordinate as x_C. Then, the motion of point C of the spring is described by:



1. $x_C = A_0 \sin\left(\omega t + \frac{\pi}{2}\right)$
2. $x_C = \frac{A_0}{2} \sin \omega t$
3. $x_C = \frac{A_0}{2} \sin\left(\omega t + \frac{\pi}{2}\right)$
4. $x_C = \frac{A_0}{2} \sin(\omega t + \pi)$

196. A piece of alloy of mass 250 g (specific heat capacity = 0.1 × that of water) is placed in a furnace and then put into a calorimeter containing 240 g of water at 20°C. The water equivalent of the calorimeter is 10 g. The final temperature of the mixture is 50°C. The temperature of the furnace is (nearly)
1. 250°C
2. 350°C
3. 600°C
4. 800°C

197. As water flows out slowly from a tap, under gravity, it is observed that the cross-section of the stream decreases as it falls down (figure). This effect is due to



1. viscosity of water.
2. surface tension of water.
3. incompressibility and Bernoulli's principle.
4. increase in atmospheric pressure at lower levels.

198. The moment of inertia of a uniform solid cube of mass M and edge L, about an axis passing through one of its edges is
1. $\frac{ML^2}{6}$
2. $\frac{ML^2}{3}$
3. $\frac{ML^2}{2}$
4. $\frac{2ML^2}{3}$

199. During an experiment, an ideal gas is observed to obey the law: $pV^3 = constant$, as the process is conducted. If the volume of the gas doubles during this process, the absolute temperature of the gas changes from T to
1. $2T$
2. $\frac{T}{2}$
3. $4T$
4. $\frac{T}{4}$

200. A uniform hollow cylindrical shell has an outer radius R_1 and inner radius R_2. If its mass be m then its rotational inertia about its axis is equal to
1. $\frac{1}{2}m\left(R_2^2 - R_1^2\right)$
2. $\frac{1}{2}m\left(R_2^2 + R_1^2\right)$
3. $\frac{1}{2}m\,\frac{R_2^3 - R_1^3}{R_2 - R_1}$
4. $\frac{1}{2}m\,\frac{R_2^5 - R_1^5}{R_2^3 - R_1^3}$

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