eduVibrant

ENGINEERING & MEDICAL COACHING

Test Solution

Booster Medical

Test Code : PT0**4**-1617-BM

Biology

1. (A)

Sol.
- Museus have collections of preserved plant and animal specimens for study and reference.
- It often have collections of skeletons of animals too.

2. (A)

Sol. Potato (Solanumtugerosum) and tomato (Lycopersicum esculentum) both belong to family Solanaceae.

3. (B)

Sol.
- Plasmodium falciparus – a protozoan pathogen causing the most serious type of malaria.
- Scientific name of common house lizard is hemidactylus whereas musca domestica is the scientific name of common housefly. Scientific name of common housefly. Scientific name of Indian tiger is panthera tigris.
- Full name of E. coli is Escherichia Coli.

4. (A)

Sol. International code of Botanical Nomenclature.

5. (B)

Sol. Five kingdom system of classification suggested by R.H. whittaker is based on :
– Complexity of cell structure and structural (body) organisation.
– Mode of nutrition
– Ecological life style
– Phyolgenetic relationships

6. (B)

Sol.
- Capsid (the protein coat) is often composed of many identical subunits called capsomeres arranged in helical or polygeom etric forms.
- Tobacco masaic virus is a plant virus which has RNA as a genetic material.
- In plant virus, only TMV shows coiled RNA strand.

7. (A)

Sol. Viruses have either RNA or DNA as genetic material and a protein coat.

8. (D)

Sol.
- Mesosomes may be septal or lateral.
- Septal mesosomes connects nucleoid with plasma membrane and assists in replication.
- Lateral mesosomes contains respiratory enzymes and performs functions similar to eukaryotic mitochondria and hence is also called chondrioid.

9. (D)

Sol.
- Chlamydomonas has flagellated gametes which are similar or dissimilar in size.
- In Volvox and Fucus, non-motile female gametes and motile male gametes are produced (oogamy).
- Spirogyra has gametes that are similar in size (isogamous) and are non-flagellated.

10. (B)

Sol. In majority of algae, external fertilization occurs.

11. (A)

Sol. Funaria lacks independent sporophyte and vascular tissues while independent gameto phyte is absent in Ginkgo.

12. (A)

Sol. Majority of algae (eukaryotes) possess a definite cell wall containing cellulose and other carbohydrates.

13. (D)

Sol.
- Members of ctenophora, cephalochordata and Echinodermata are exclusively marine.
- Cnidarians are the sac – like animals which are aquatic, mostly marine and fresh water, except hydra.

14. (B)

Sol. Sea – fan (Gorgonia)

15. (B)

Sol. Planaria posseses high degree of regeneration.

16. (D)

Sol.
- Reptiles represent the first class of vertebrates fully adapted for life in dry places on land.
- The characters of reptiles are in fact a combination of characters that are found in fish and amphibiam on one hand and birds and animals on the other.
- Reptiles lack external ears and have immovable eyelids.

17. (C)

Sol. ●Tomato is a berry fruit derived from bicarpellary, syncarpous, tetralocular ovary with swollen placentae.
●Berry consists of a membranous skin represented by epicarp.
● Mesocarp is the middle fleshy part.
● Endocarp, septa and placentae are pulpy and edible.

18. (D)

Sol. ●Carrot and sweet potato are root modifications.
●Edible part of groundnut is seed.
●Potato is an edible underground streem.

19. (C)

Sol. ●In china rose the flowers are actinomorphic i.e., it can be divided into 2 equal halves in any radial plane passing through the centre.
●They are hypognous i.e., the gynoecium occupies the highest position.
●They have twisted aestivation i.e., one margin of petal overlaps that of the next one and so on.

20. (D)

Sol. Terminates in a flower.

21. (C)

Sol. ●In stem : Protoxylem lies towards the centre (pith) and the metaxylem lies towards the periphery.
● In root : Protoxylem lies towards periphery and metaxylem lies towards the centre.

22. (B)

Sol. Guard cells are always surrounded by subsidiary cells.

23. (D)

Sol. Xylem fibres.

24. (A)

Sol. ●Companion cell is a type of cell found within the phloem of flowering plants.
●Each companion cell is usually closely associated with a sieve element.
●They remain connected with sieve cells by plasmodesmata.

25. (C)

Sol. ●Tendon is a type of dense connective tissue, adipose tissue is a fat storing loose connective tissue and cartilage is a specialised connective tissue.
●Areolar tissue is the most widely distributed loose connective tissue in the body.

26. (A)

Sol. Both fore wings and hind wings develop.

27. (D)

Sol. Crtilage is a semi – rigid supportive or skeletal connective tissue in which matrix is solid and made of mucoprotein or proteogly can called chondrin.

28. (B)

Sol. The ciliated columnar epithelial cells in humans are present in the nasal passages, oviducts, terminal bronchioles, ventricles of the brain and central canal of the spinal cord of the embryo.

29. (B)

Sol. ●Micotubules are hollow microscopic tubular structures with an external diameter of 24 nm and of variable length.
●Intermediate filaments are the numerous microscopic protein fibres of about 10 nm thickness that form part of the cytoskeleton.
●Microfilaments are 7 – 9 nm in diameter and composed of actin.

30. (B)

Sol. In post translational modification of proteins and glycosylation of lipids.

31. (D)

Sol. ●SER is the site of important metabolic reactions, including phospholipid and fatty – acid synthesis.
●In animal cells lipid – like steroidal bormones are also synthesized.

32. (D)

Sol. Fluid mosaic Model of cell membrane was proposed by singer and Nicolson.

33. (B)

Sol. ●The reduction of activity of succinate dehydrogenase by malonate is an example of competitive inhibition.
●Competitive inhibition is a reversible inhibition where inhibitor competes with the normal substrate for the active site of enzyme.

34. (C)

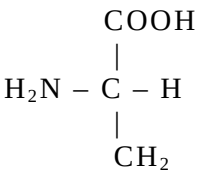
Sol. Nitrogen containing polysaccharide.

35. (C)

Sol. ●Phosphorus is present in plasma membrane in the form of phospholipid bilayer.
●It is an essential component of all nucleic acids not ‘certain’ nucleic acids.
●Moreover, phosphorus is never found in proteins.

36. (A)

Sol. ●Palmitic acid is a saturated fatty acid and contain 16 carbon atoms whereas Alanine is a nonpolar and neutral amino acid having one methyl group and having amino group attached to carbon next to carboxylic group.



Alanine

●Adenylic acid or adenosine monophosphate is a nucleotide formed by union of adenine (nitrogenous base), ribose (pentose sugar) and phosphate.

37. (C)

Sol. ●G_2 phase is second growth phase where DNA content remains 4C.

●DNA replication occurs in S phase.

●G_1 phase have 4C DNA

●In M phase, DNA content either regains 2C level (mitosis) or becomes halves i.e., 1C (in meiosis).

●In Go phase, cell contains DNA as in the same amount as its parent cell.

38. (A)

Sol. ●Pachytene is characterized by the appearance of recombination nodules.

●Nodules contain multienzyme complex called recombinase.

39. (C)

Sol. ●Telophase stage of mitotic cell division.

●The individuals chromosomes are no longer seen and chromatin material tends to collect in a mass at the two poles.

40. (A)

Sol. A kinetochore is a complex protein structure that is analogous to a ring for the microtubule hook; it is the point where microtubules attach themselves to the chromosomes.

41. (D)

Sol. The guard cells contain chloroplasts, so they can manufacture food by photosynthesis (The epidermal cells do not contain chloroplasts.)

42. (D)

Sol. Osmosis

43. (D)

Sol. ●Water molecules remain attached to one another by a strong mutual force of attraction called cohesion force.

●Water column does not further break its connection from the tracheary elements (vessels and tracheids) because of another force called adhesion force between their walls and water molecules.

44. (C)

Sol. ●P – Protein (Phloem proteins) are components found in large amounts in phloem sieve tubes.

●P – Protein bodies are assigned some in the translocation of food material in the sieve tubes but is not universally accepted.

45. (A)

Sol. ●Nitrogen and potassium are mobile elements.

●Deficiency symptoms first appear in old and senescent leaves as the elements are mobilised from senescing regions for supply to young tissues.

46. (D)

Sol. Sulphur is present in two vitamins of B-complex, thiamine and biotin. Biotin is important to hair. It is normally found in protein foods like egg, sprouts etc.

47. (B)

Sol. Leg-haemoglobin facilitate the conversion of atmospheric N_2 to ammonia by playing role of oxygen – scavenger. Nitrogenase (enzyme) which catalyse this conversion is highly sensitive to molecular oxygen and requires anaerobic conditions for its activity.

48. (A)

Sol. Some fungi form symbiotic associations with plants (mycorrhiza). Many members of the genus-Glomus form mycorrhiza. The fungal symbiont in these associations absorbs phosphorous from soil and passes it to the plant.

49. (C)

Sol. Photorespiration is the light dependent process of oxygenation of ribulose biphosphate and release of CO_2 by photosynthetic organs of a plant, that occurs in chloroplast. Persoxisomes and mitochondria are required for completing the process.

50. (B)

Sol. In kranz anatomy, the bundle sheath cells form several layers around the vascular bundles, they are characterised layers around the vascular bundles, they are characterised by having a large no. of chloroplasts, thick walls impervious to gaseous exchange and no in intercellular spaces. \

51. (A)

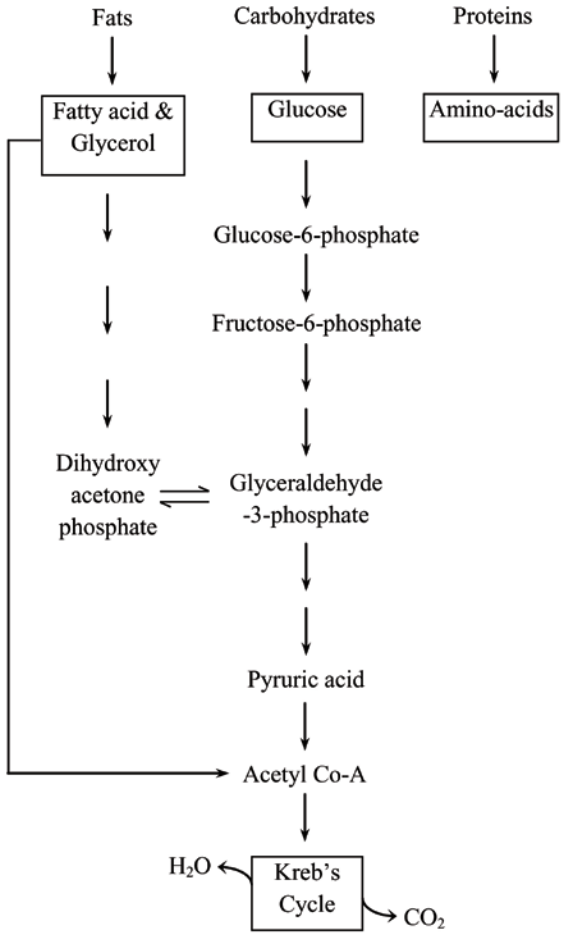
Sol. Mangnese (Mn^{+2}) is used for photolysis of water to produce O_2 and electrons during light reaction of photosynthesis. It acts as an essential co-factor.

52. (C)

Sol. In cyclic photophosphorylation, 2 molecules of ATP are synthesized which are used in dark reaction.

53. (B)

Sol.



54. (B)

Sol. Fermentation is the process of deriving energy from the oxidation of organic compound such as carbohydrates and using an endogenous electron acceptor not external or exogenous.

55. (B)

Sol. Aerobic respiration is called as amphibolic pathway rather than a catabolic pathway as it involves both catabolism of carbohydrates and fatty-acid, and the synthesis of anabolic precursors for anino-acid synthesis, various intermediatory metabolic and secondary metabolites.

56. (D)

Sol. ●In glycolysis, 2ATP molecules are produced from ADP.

●In kreb cycle and conversion of pyruvic acid to acetyl CoA, there is no ATP Production from ADP.

●So, the greatest no. of ATP molecules are produced in the ETC.

57. (A)

Sol. Abscisic acid prepares plants to cope with stress conditions like drought etc by inducing stomatal closure and other reactions. Hence it is named, stress hormone.

58. (B)

Sol. Gibberellins are plant growth substances that promote elongation of stems, and the mobilization of food reserves in germinating seeds and are influential in inducing flowering and fruit development.

59. (C)

Sol. Carrot is a biennial plant requires stimulus of low temperature (vernalization) for flowering. It remains vegetative during warm season and bears flowers and fruits during winter. It can be made to flower in one growing season by providing low temperature treatment.

60. (A)

Sol. Photoperiodism is the response to duration and timings of light and dark period. It was first studied by w. w. Garner and H. A. Allard (1920) in tobacco.

61. (C)

Sol. Renin is secreted by peptic cells present in gastric glands. It converts milk protein-caesin into paracaesin, leading to milk coagulation.

62. (B)

Sol. Fructose and mannose are absorbed through fascilitated diffusion that is by the help of the carrier molecule, along the concentration gradient. (higher concentration to lower concentration).

63. (A)

Sol. Indigestion is the condition in which the food is not properly digested, leading to a feeling of fullness. The cause of indigestion are inadequate enzyme secretion, anxiety, food poisoning, over-eating and spicy-food.

64. (A)

Sol. Carboxy peptidase which contains Zn (11)ions as a metal ion co-factor helps in protein digestion and becomes active in alkaline medium.

65. (A)

Sol. About 70% of CO_2 received by blood from the tissues, enters the RBCs where it reacts with water to form carbonic acid (H_2CO_3)

66. (C)

Sol. Long exposure of the body to dust particles can give rise to inflammation leading to fibrosis (proliferation of fibrous tissues) and thus causing serious lung damage.

67. (A)

68. (A)

Sol. At the tissue site where partial pressure of CO_2 is high due to catabolism, CO_2 diffuses into blood (RBCs and plasma) and forms HCO_2^- and H^+. So, CO_2 trapped as bicarbonate at the tissue level and transported to the alveoli is released out as CO_2.

69. (A)

Sol. Individuals with AB blood grp. have both antigens A and B on their RBCs and no antibodies for either of the antigen in their plasma. So, they can receive blood of A, B or O group.

70. (C)

Sol. In the given diagram, P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria.

71. (C)

Sol. The person having 'O' blood group is universal donor, as it lacks both antigens-A & B. So, there is no agglutination or clumping of blood cells when transfused into person with any of the four blood groups.

72. (B)

Sol. A bundle of nodal fibres, atrioventricular bundle (AV bundle). Continues from the atrioventricular node (AVN) and passes through the atrioventricular septa. It emerges on the top of the inter ventricular septum and immediately divides into right and left bundles.

73. (A)

Sol. Aldosterone is a hormone secreted by the outer layer of the adrenal gland (cortex part). When aldosterone is secreted in the blood, reabsorption of Na^+ in the filterate is increased by the epithelial cells of the collecting duct. Retaining Na^+, osmotic pressure of blood increases, there by reducing water-loss from the body.

74. (C)

Sol. Nearly 99% of the filterate is reabsorbed by renal tubules, where proximal convoluted tubules shows, maximum reabsorption and nearly all the essential nutrients and 70-80% of electrolytes and water are reabsorbed by this segment.

75. (D)

Sol. Excretion of urea is known as ureotelism and the animals which excrete urea are called ureatelic, Eg-Man, other mammals, semi-aquatic amphibians like frogs and toads etc. Urea is less toxic and less soluble in water than ammonia. Hence, it can stay for sometime in the body.

76. (B)

Sol. The medulla of kidney is divided into a number of conical areas, medulla pyramids or renal pyramids. Peritubular capillaries, loop of Henle and collecting ducts lie in the medulla (renal pyramids), while convoluted tubules lie in the cortex of kidney.

77. (D)

78. (A)

Sol. The portion of the muscle plasma membrane (sarcolemma) that lies beneath the nerve endings (axon terminals) is called the motor and plate. The axon terminals and the motor and plate together constitute the neuromuscular junction or neuro motor junction or neuro motor junction.

79. (A)

Sol. During resting state, the edges of thin filaments -(actin) on either side of the thick filaments (myosin) partially overlapp the free ends of the thick filaments, leaving the central part of the thick filaments. This non-overlapped central part of thick filament is called as 'H' zone.

80. (B)

Sol. According to sliding filament theory of muscle contraction, the actin and myosin filaments slide past each other with the help of cross-bridges to reduce the length of sarcomere. As a muscle contracts, the Z-line comes closer together (shortening sarcomere), the width of the I & H –bonds decreases but there is no change in the width of A-bond.

81. (D)

Sol. Hypothalamus is the thermo regulatory centre of the body, which keeps body's temp. at roughly 37°C by means of a complex thermostat system. Any localised injury to hypothalamus will, hence disrupt regulation of body temperature.

82. (C)

Sol. In the given figure

- A → Retina containing rods & cones cells (photoreceptor cells)
- B → Blind spot with no visual cells.
- C → Aqueous humour which nourishes both cornea and lens.
- D → Outer covering-sclera that maintains shape of eyeball.

83. (B)

Sol. K^+ ions predominate in the intracellular fluid whereas Na^+ -ions predominate in the extra cellular fluid.

84. (D)

Sol. When a neuron is not conducting any impulse, i.e., resting, the axonal membrane is comparatively more permeable to K^+ ions & nearly impermeable to Na^+ ions.

85. (C)

Sol. Interstitial cells (or Leydig's cells) secrete androgens in response to stimulation by luteinizing hormone from the anterior pituitary gland. Androgens produce and maintain male characteristics and stimulate germinal epithelium to undergo spermatogenesis.

86. (C)

Sol. Epinephrien (adrenaline) and nor-epinephrine (noradrenaline) are secreted by adrenal medulla during respiration, stress conditions. These hormones increases heartbeat, pupillary dilation, pilocrection (raising of hairs), sweating etc.

87. (A)

Sol. Releasing and inhibiting factors are released by hypothalamus. Neurohypophysis is directly under neural control. Cardiocytes of atria of heart secrete peptide hormone called Atrial Natriuretic factor (ANF), whereas liver produces a hormone called angiotensin.

88. (B)

Sol. Insulin decrease the level of glucose in the blood by increasing the rate of which glucose is transported out of the blood into cells and by stimulating liver cells and muscles cells to take up glucose from blood and convert it into glycogen.

89. (A)

Sol. Enzyme – nitrogenase requires a high input of energy to carry out biological nitrogen fixation.

$$N_2 + 8e^- + 8H^+ + 16\ ATP \xrightarrow{\text{Nitrogenase}} 2NH_3 + H_2 + 16\ ADP + 16\ iP$$

90. (B)

Sol. Deficiency symptoms of some essential elements tends to appear first in young tissues, as these elements are relatively immobile and are not transported out of mature organs. Elements like S and Ca are a part of structural component of the cell and hence are not easily released.

Physics

91. (D)

Sol. $X = M^{-1}L^{3}T^{-2}$

92. (D)

Sol. $R = \frac{V}{I} = \frac{8}{4} = 2\,\Omega$

$$\frac{\Delta R}{R}\times 100 = \frac{\Delta V}{V}\times 100 + \frac{\Delta I}{I}\times 100$$

$$= \frac{0.5}{8}\times 100 + \frac{0.2}{4}\times 100 = 11.25\%$$

$\Rightarrow R = (2 \pm 11.25\,\%)\,\Omega$

93. (D)

Sol. $\frac{A}{B} = m'\ B = \frac{A}{m} = \frac{\text{Force}}{\text{Linear density}} = \frac{MLT^{-2}}{ML^{-1}}$

$\therefore \quad B = [M^{0}L^{2}T^{-2}]$

$\text{Latent heat} = \frac{\text{Heat energy}}{\text{Mass}} = \frac{ML^{2}T^{-2}}{M} = [M^{0}L^{2}T^{-2}]$

Thus, B has same dimensions as that of latent heat.

94. (C)

Sol. We ave $h = \frac{1}{2}gT^{2}$

In T/3 second, distance fallen $= \frac{1}{2}g\left(\frac{T}{3}\right)^{2} = \frac{h}{9}$

So position of the ball from ground is

$$h - \frac{h}{9} = \frac{8h}{9}\,m$$

95. (B)

Sol. $200 = u \times 2 - (1/2)\,a(2)^{2}$

or $\quad u - a = 100$

$200 + 220 = u(2 + 4) - (1/2)\,(2 + 4)^{2}a$

or $\quad u - 3a = 70$

Solving Eqs (i) and (ii), we get a = 15 cms^{-2} and u = 115 cms^{-1}

96. (D)

Sol. At t = 0, velocity is positive and maximum. As the particle goes up, velocity decreases and becomes zero at the highest point. When the particle starts coming down, velocity increases in the negative direction.

97. (B)

Sol. $\frac{R}{T^{2}} = g\frac{\sin 2\theta}{4\sin^{2}\theta} = \frac{g}{2}\cot\theta = 5\cot\theta$

Given $\frac{R}{T^{2}} = 5$; Hence, $5 = 5\cot\theta$ or $\theta = 45^{\circ}$

98. (A)

Sol. $\tan\theta = \frac{u\sin\theta}{u\cos\theta} = \frac{2}{1}$

The desired equation is

$$y = x\tan\theta - \frac{gx^{2}}{2u^{2}\cos^{2}\theta}$$

$$= x\times 2 - \frac{10x^{2}}{2(\sqrt{2^{2}+1^{2}})^{2}\left(\frac{1}{\sqrt{5}}\right)^{2}}$$

or $\quad y = 2x - 5x^{2}$

99. (D)

Sol. $h_{max} = \frac{u^{2}}{2g} = 10$

$u^{2} = 200$

$R_{max} = \frac{u^{2}}{g} = 20\,m$

100. (C)

Sol. Area under the force-time graph is impulse, and impulse is change in momentum.

Area of graph = change in momentum

$\Rightarrow \quad \frac{1}{2}TF_{0} = 2\,mu \quad \Rightarrow \quad F_{0} = \frac{4mu}{T}$

101. (C)

Sol. Let *T* be the tension in the rope and *a* the acceleration of rope.

The absolute acceleration of man is, therefore, $\left(\frac{5g}{4} - a\right)$

Equation of motion for mass man gives :

$$T - 100g = 100a \qquad \text{(i)}$$

$$T - 60g = 60\left(\frac{5g}{4} - a\right) \qquad \text{(ii)}$$

Solving Eqs (i) and (ii), we get $T = \frac{4875}{4}\,N$

102. (C)

Sol. Using conservation of linear momentum, we get $m_1v_1 + m_2v_2 = 0$

103. (A)

Sol. The string is under tension. Hence, there is limiting friction between the block and the plane

$$\sum F_x = 0$$

$\Rightarrow \mu N + 50 \cos 45° = 150 \sin 45°$ (i)

$$\sum F_y = 0$$

$\Rightarrow N = 50 \sin 45° + 150 \cos 45°$ (ii)

Solving Eqs. (i) and (ii), we get $m = 1/2$

104. (C)

Sol. The driving force on the block

$$F_1 - F_2 = 10 - 2 = 8\text{N}$$

As the block is at rest the friction will be static and towards left.

$$f = f_s = 8 \text{ N}$$

If F_1 is removed only $F_2 = 2$ N acting on the block.

If the block is at rest $f = F_2 = 2$ N this value of friction is within static range as in previous case even $f = 8$ N is static case.

105. (A)

Sol. For first half acceleration = $g \sin \phi$

Therefore, velocity after travelling half distance

$$v_2 = 2(g \sin \phi)\, l \qquad \text{(i)}$$

For second half, acceleration

$$= g(\sin \phi - \mu_k \cos \phi)$$

So $0^2 = v^2 + 2g(\sin \phi - \mu_k \cos \phi)\, l$ (ii)

Solving (i) and (ii), we get $\mu_k = 2 \tan \phi$

106. (A)

Sol. In the explosion of a bomb or inelastic collision between two bodies as force is internal, momentum is conserved while KE changes. Hence, the KE of a system can be changed without changing its momentum. Similarly, the reverse is also true, e.g., if a force acts perpendicular to motion, work done will be zero and so KE will remain constant. However, the force will change the direction of motion and so the momentum.

Further, body may have energy (i.e., potential energy) without having momentum.

107. (D)

Sol. $f(\text{x}) = -\dfrac{dU}{d\text{x}}(\text{x})$ or $\text{U}(\text{x}) = -\int F(\text{x})\, dx$

Here $F(\text{x}) = -k\text{x}$, where k is a positive constant.

108. (A)

Sol. $F = ax + bx^2$

$dw = Fdx$

$$W = \int_0^L \left(ax + bx^2\right) dx \qquad W = \frac{aL^2}{2} + \frac{bL^3}{3}$$

109. (B)

Sol. In both CM and ground frame, $K_{\max}$ is there, when x is zero in spring, which accurs simultaneously.

$$v_{\text{CM}} = \frac{m(v_0) + 0}{5m} = \frac{v_0}{5}$$

$$K_{\max \text{CM}} = \frac{1}{2}m\left(\frac{4v_0}{5}\right)^2 + \frac{1}{2}(4m)\left(\frac{v_0}{5}\right)^2 = \frac{2}{5}mv_0^2$$

$$K_{\max \text{ ground}} = \frac{1}{2}mv_0^2$$

$K_{\text{mim CM}} = 0$

$$K_{\min \text{ ground}} = \frac{1}{2}(m + 4m)v_{\text{CM}}^2 = \frac{mv_0^2}{10}$$

$$K_{\max\, m} = \frac{1}{2}mv_0^2 \text{ (ground frame)}$$

$K_{\text{mim } m} = 0$ (ground frame when energy is shared by spring and $4m$ only and m will reverse direction of motion)

110. (D)

Sol. $\Delta p = (p + ep) + (ep + e^2p) + (e^2p + e^3p) + \ldots$

$$= p(1+e)[1+e+e^2+...] = \frac{p(1+e)}{1-e}$$

111. (B)

Sol. $dm = pr^2 \,.\, dy \,.\, r$

$$y_{CM} = \frac{\int y dm}{\int dm} = \frac{\int_0^h \pi r^2 dy \times \rho \times y}{\frac{1}{3}\pi R^2 h\rho} = \frac{3h}{4}$$

112. (C)

Sol. Torque exerted on the disc

$$\tau = TR$$

Now $\tau = I\alpha$

$$\alpha = \frac{\tau}{I} = \frac{TR}{\frac{1}{2}MR^2}$$

$$= \frac{2TR}{MR^2} = \frac{2T}{MR}$$

113. (D)

Sol. Apply conservation of angular momentum about the hinge, we get

$$mvR = \frac{m}{2}R^2\omega + m(R\omega)R$$

$$R\omega = \frac{2v}{3} = \frac{2\times 5}{3} = \frac{10}{3}\text{ m/s}$$

114. (B)

Sol. See the figure. For tilting about A the clockwise torque (due to F) should be greater than the anticlockwise torque about A.

115. (A)

Sol. Total mechanical energy is given by

$$E = K + u = -\frac{GMn}{2a} - \frac{GMm}{a} = -\frac{GMm}{2a}$$

$$\frac{GM}{a} = v^2 \Rightarrow E = -\frac{1}{2}mv^2$$

116. (C)

Sol. During path DAB planet is nearer to sun as comparision with path BCD. So timetaken in travelling DAB is less than that for BCD because velocity of planet will be more in region DAB.

117. (C)

Sol. $$\frac{T_2}{T_1} = \left(\frac{r_2}{r_1}\right)^{3/2} = \left(\frac{4r}{r}\right)^{3/2} = 8$$

$\therefore\ T_2 = 8T_1 = 8 \times 5 = 40$ h

118. (C)

Sol. $$\text{Breaking stress} = \frac{\text{Maximum weight}}{\text{Area of cross section}}$$

$$10^6 = \frac{al\rho g}{a} = l\rho g$$

or $$l = \frac{10^6}{\rho g} = \frac{10^6}{4\times 10^3 \times 10}\text{m} = 25\text{ m}$$

119. (D)

Sol. $$Y = \frac{FL}{Al} = \frac{FdL^2}{Ml}$$

As $M = \text{Volume} \times \text{Density} = A = \times L - d$

$$\Rightarrow A = \frac{M}{Ld}$$

120. (C)

Sol. Here change in length is

$\Delta l = (AC + BC) - 2l$

$= 2(l^2 + x^2)^{1/2} - 2l$

$= 2l\left(1+\frac{x^2}{l^2}\right)^{1/2}$

$= 2l\left(1+\frac{1}{2}\frac{x^2}{l^2}\right) - 2l = \frac{x^2}{l}$

$\therefore$ Strain $= \frac{\Delta l}{2l} = \frac{x^2}{2l^2}$

121. (B)

Sol. At equilibrium, $\sum F = 0$

$kx_0 + \left(\frac{AL}{2}\sigma g\right) - Mg = 0$

$x_0 = Mg\left[1 - \frac{LA\sigma}{2M}\right]$

122. (D)

Sol. $\rho_1 < \rho_2$ because the denser liquid acquires the lowest position in the vessel. $\rho_1 > \rho_2$ because the ball sinks in liquid 1, and $\rho_3 > \rho_2$ because the ball doesn't sink in liquid 2. So $\rho_1 < \rho_3 < \rho_2$

123. (C)

Sol. Soap solution has lower surface tension as compared to pure water, so h is less for soap solution.

124. (B)

Sol. $Q = K\,A\frac{\Delta\theta}{l}t$

$\therefore\ t \propto \frac{l}{A}$ (As Q, K and $\Delta\theta$ are constant)

$\frac{t_1}{t_2} = \frac{l_1}{l_2}\times\frac{A_2}{A_1} = \left(\frac{l_1}{l_1/2}\right)\times\left(\frac{2A_1}{A_1}\right)$

$\frac{t_1}{t_2} = 4 \Rightarrow t_2 = \frac{t_1}{4} = \frac{12}{4} = 3\,\text{s}$

125. (D)

Sol. According to Newton's law of cooling

$$\frac{\theta_1 - \theta_2}{t} \propto \left[\frac{\theta_1 - \theta_2}{2} - \theta\right]$$

For the first condition

$$\frac{80-60}{60} \propto \left[\frac{80+60}{2} - 30\right] \qquad \text{(i)}$$

And for the second condition

$$\frac{60-50}{t} \propto \left[\frac{60+50}{2} - 30\right] \qquad \text{(ii)}$$

By solving Eqs. (i) and (ii), we get t = 48 s

126. (D)

Sol. $E = \left(\frac{1}{2}\right)CV^2$ (i)

The energy stored in the capacitor is lost in the form of heat energy.

$H = ms\Delta T$ (ii)

From (i) and (ii), we have

$ms\Delta T = \left(\frac{1}{2}\right)CV^2$

$\Rightarrow\ V = \sqrt{\frac{2ms\Delta T}{C}}$

127. (A)

Sol. Let t be the temperature of mixture

Heat gained by CO_2 = Heat lost by O_2

$\mu_1 C_{v1}\Delta T_1 = \mu_2 C_{v2}\Delta T_2$

$\Rightarrow\ \frac{22}{44}(3R)(t-27) = \frac{16}{32}\left(\frac{5}{2}R\right)(37-t)$

$\Rightarrow\ 3(t-27) = \frac{5}{2}(37-t)$

By solving we get t = 31.5°C

128. (A)

Sol. AB is isobaric process, BC is isothermal process, CD is isochoric process and DA is isothermal process.

129. (A)

Sol. Change in temperature in process 1 will be greater and in process 3 will be least

130. (B)

Sol. The slope of the length is

$$\frac{F}{x} = -\frac{0.5}{5} = -0.1\ \text{N/cm} = -10\ \text{N/m}$$

But $F = -m\omega^2 x$ or $F/x = -m\omega^2$

so, $-m\omega^2 = -10$ or $m\omega^2 = 10$

or, $\omega^2 = 10/\text{m}$

$$\therefore \quad \omega^2 = \frac{10}{4\times10^{-1}} \Rightarrow \omega = \frac{10}{2} = 5$$

$$\therefore \quad f = \frac{\omega}{2\pi} = \frac{5}{2\pi}/\text{s}$$

131. (D)

Sol. When spring is compressed by $3x_0$. Amplitude, A = $3x_0$. The time taken from extreme compressed position to mean position $t_1 = T/4$.

If time taken (t_2) from mean position to $x = x_0$ is given by

$$x = A\sin\frac{2\pi t_2}{T} \Rightarrow x_0 = 3x_0 \sin\frac{2\pi t_2}{T}$$

$$\sin\frac{2\pi t_2}{T} = \frac{1}{3} \Rightarrow \frac{2\pi t_2}{T} = \frac{\pi}{9} \Rightarrow t_2 = \frac{T}{18}$$

$$t_1 + t_2 = \frac{T}{4} + \frac{T}{18} = \frac{11}{18}T = \frac{11}{18}2\pi\sqrt{\frac{m}{K}} = \frac{11}{9}\pi\sqrt{\frac{m}{K}}$$

132. (D)

Sol. $F = ma = -m\omega^2 x$

$F \propto -x$

133. (D)

Sol. $y = 4\sin\left(4\pi t - \frac{\pi}{16}x\right)$

$\omega = 4\pi$, $k = \pi/16$

$$v = \frac{\omega}{k} = \frac{4\pi}{\pi/16} = 64\ \text{cm/s}$$

in positive x-direction.

134. (A)

Sol. $f = \frac{v}{2\ell}$

Now, it will act like one end opened and other closed.

$$f = \frac{v}{4\ell'} = \frac{v}{4\frac{\ell}{2}} = \frac{v}{2\ell} = f$$

135. (C)

Sol. The equation of a wave is

$y = a\sin(\omega t - kx)$ (i)

Let the equations of another wave be

$y = a\sin(\omega t + kx)$ (ii)

$y = -a\sin(\omega t + kx)$ (iii)

If (i) propagates with (ii), then we get

$y = 2a\cos kx \sin\omega t$ (iv)

If (i) propagates with (iii), then we get

$y = -2a\cos kx \sin\omega t$ (v)

After putting $x = 0$ in (iv) and (v), respectively, we get

$y = 2a\sin\omega t$ and $y = 0$

Hence, (iii) is an equation of the unknown wave.

Chemistry

136. A

Sol. 200 g CO_2 = 0·200 g = $\frac{0\cdot2}{44}$ mol

$= \frac{0\cdot2}{44} \times 6\cdot022 \times 10^{23}$ molecules

$= 2\cdot738 \times 10^{21}$ molecules

After removing; we have

$2\cdot738 \times 10^{21} - 10^{21} = 10^{21}(2\cdot738-1)$

$= 1\cdot2738 \times 10^{21}$ molecules

$= \frac{1\cdot2378\times10^{21}}{6\cdot022\times10^{23}}$ mol.

$= 2\cdot88 \times 10^{-3}$ mol.

137. C

138. A

139. B

Sol. m = ± ℓ (via 0)

140. B

Sol. Let velocity (v) = x

$\Rightarrow \lambda = 100\,x$

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

$100\,x = \frac{h}{mx}$

$x^2 + \frac{1}{100}\frac{h}{m}$

$x = \frac{1}{10}\sqrt{\frac{h}{m}}$

$100x = 10\sqrt{\frac{h}{m}}$

141. A

Sol. $_{24}Cr$:- $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^4$

n = 4, ℓ = 0, m = 0, s = ± ½

142. D

143. D

144. B

Sol. O < N

145. D

146. A

147. C

148. B

149. C

Sol. $u = \sqrt{\frac{3RT}{M}}$

$\frac{uH_2}{uN_2} = \sqrt{\frac{T(H_2)}{M(H_2)} \times \frac{M(N_2)}{T(N_2)}}$

$\sqrt{7} = \sqrt{\frac{T(H_2)}{T(N_2)} \times \frac{28}{2}}$

$7 = \frac{T(H_2)}{T(N_2)} \times 14$

$7\ T(N_2) = 14\ T(H_2)$

$T\ (N_2) = 2\cdot T(H_2)$

$\boxed{T(H_2) < T(N_2)}$

150. C

Sol. Aim

$C + \frac{1}{2}O_2 \rightarrow CO$

eq (i) $-\frac{1}{2}$eq (ii) Gives the desired result

151. D

Sol.  $= -119.5 \text{ kJ mol}^{-1}$

 $= -119.5 \text{ kJ mol}^{-1}$

Actual enthalpy of Hydrogenation

$= -358{\cdot}5 - (-150{\cdot}4)$

$= -208{\cdot}1 \text{ kJ.mol}^{-1}$.

152. C

153. C

Sol. $K = \frac{[HI]^2}{[H_2][I_2]}$

$[H_2] = [I_2] = 1$

$\Rightarrow K = \frac{[HI]^2}{[I]^2}$

$= \frac{[HI]}{[I]} = \sqrt{K} = \sqrt{47{\cdot}6}$

$= [HI] > [I_2]$.

154. D

155. D

Sol. From HCl

$[H^+] = 10^{-8}$ M

From H_2O

$[H^+] = 10^{-7}$M

Total $= 10^{-8} + 10^{-7}$

$= 10-8\ (1 + 10)$

$= 11 \times 10^{-8}$

$pH = -\log [11 \times 10^{-8}]$

$pH = 6{\cdot}96$

156. A

Sol. $[HA] \rightleftharpoons H^+ + A^-$

$[H^+] = c \propto = 10^{-3}$

$0.1 \times \propto = 10^{-3}$

$\propto = 10^{-2}$

$\% \propto = 10\ \%$

157. C

158. C

159. D

Sol. Electron deficient

160. D

161. C

162. A

163. C

164. D

165. A

Sol. $CH \equiv CH + OH \rightarrow CH = CH$ (OH, OH)

166. C

167. D

168. C

169. A

170. A

171. B

172. B

173. D

174. C

175. C

176. C

177. A

178. B

179. D

180. C