

PART A: CLASS XI

PHYSICS

Q1

There are two balls. One has a mass of 2 kg and the other one has a mass of 4 kg. Both of them have been dropped from a tower whose height is 60 feet. When they cover one half of this distance downwards, the ratio of their kinetic energies is:

(a) $\frac{1}{4}$

(b) $\frac{1}{2}$

(c) $\frac{3}{2}$

(d) $\frac{2}{3}$

Q2

One mole of an ideal gas at an initial temperature T (in K) performs $6R$ joules of work in an adiabatic process. If the ratio of specific heat at constant pressure and specific heat at constant volume is $5:3$, what is the final temperature of the gas?

(a) $T_f = (T - 6)k$

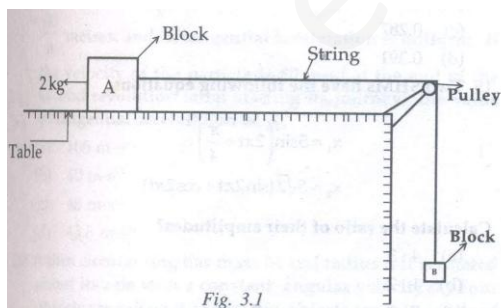
(b) $T_f = \left(\frac{T-6}{2}\right)k$

(c) $T_f = (T - 4)k$

(d) cannot be determined

Q3

Look at Fig.3.1 shown below. We have two blocks – A and B. The mass of A is 2kg. The co-efficient of static friction between A and the table is μ and the value of μ is 0.2. What is the maximum value of the mass of B so that two blocks do not move? Assume that the string and pulley are smooth. They do not have any mass either. The value of g is 10 m-s^{-2} .



(a) 0.4kg

(b) 2.4 kg

(c) 1.4 kg

(d) 4.0 kg

Q4

A particle is in SHM. Its speed v and its acceleration is a . Which one of the following is true?

- (a) When the value of v is 0, the value of a is maximum
- (b) When the value of v is maximum, the value of a is minimum.
- (c) When the value of v is maximum, the value of a is zero
- (d) Cannot be determined

Q5

We have two springs whose constants are k_1 and k_2 , respectively. The spring constant of this combination is:

- (a) $k_1 k_2 (k_1 + k_2)$
- (b) $\frac{k_1 k_2}{(k_1 + k_2)}$
- (c) $\frac{k_1 + k_2}{k_1 k_2}$
- (d) $k_1 + k_2$

Q6

There are two waves. They are represented as y_1 and y_2 , where

$$y_1 = 10^{-6} \sin \left[100t + \left(\frac{x}{50} \right) + 0.5 \right] m$$

$$y_2 = 10^{-6} \cos \left[100t + \left(\frac{x}{50} \right) \right] m$$

What is the phase difference between these two waves?

Assume that X is in metres and t is in seconds.

- (a) $\Delta\Phi = 0.07$ rad
- (b) $\Delta\Phi = 2.07$ rad
- (c) $\Delta\Phi = 3.07$ rad
- (d) $\Delta\Phi = 1.07$ rad

Q7

A wheel has a moment of inertia of 2 kg-m^2 about its vertical axis. Its speed is 60 rpm (about its axis). What is the value of torque that will stop this wheel in 60 seconds?

- (a) $15\pi \text{ N-m}$
- (b) $\frac{15}{\pi} \text{ N-m}$
- (c) $\frac{\pi}{15} \text{ N-m}$
- (d) 15 N-m

Q8

Why is the reading of a mercury barometer always less than actual pressure?

- (a) Liquid metal: Hg is liquid metal, hence its reading of pressure is less
- (b) Surface Tension: the Hg content in the barometer tube is depressed or squeezed
- (c) Viscosity: Hg is highly viscous
- (d) Angle of contact: θ is high for Hg

Q9

A wind-powered generator converts wind energy into electrical energy. The generator uses up a small fraction of wind energy to do so. The wind speed is $V \text{ m-s}^{-1}$. The electrical power output will be proportional to:

- (a) V^3
- (b) $V^{1/2}$
- (c) $3V$
- (d) $\frac{V}{3}$

Q10

Which one of the following is incorrect w. r. t. Bernoulli's Principle?

- (a) $P + \frac{1}{2} \rho v^2 = \text{Constant}$
- (b) $\frac{P}{\rho g} + \frac{1}{2} \frac{v^2}{g} + h = \text{Constant}$
- (c) This Theorem is applicable to compressible liquids only
- (d) The sum of pressure head, velocity head and gravitational head remains constant in a streamlined flow

Q11

Refer Fig.3.2 shown here.

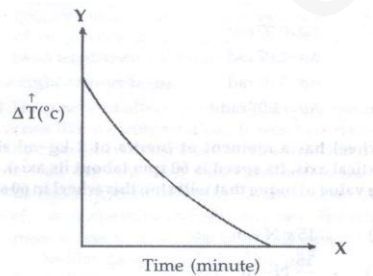


Fig 3.2

What does this curve indicate w. r. t. the cooling of a body?

- (a) The body cools at a constant rate.
- (b) The rate of cooling of the body is higher to begin with.
- (c) The rate of cooling of the body depends upon the mass the body
- (d) None of these

Q12

What is escape velocity of a body from a planet which is exactly similar to the earth in terms of shape and composition but whose radius is one fourth of that of the earth?

- (a) 9.6 m-s^{-1}
- (b) 7.8 m-s^{-1}
- (c) 5.6 m-s^{-1}
- (d) 2.8 m-s^{-1}

Q13

The moment of Inertia (MI) of a disc about an axis passing through its centre and perpendicular to its plane is equal to $\frac{MR^2}{2}$. Then, what is the MI of the same disc about a tangent that is parallel to its diameter?

- (a) $\frac{5}{4}MR^2$
- (b) $\frac{4}{5}MR^3$
- (c) $\frac{5}{4}MR$
- (d) $\frac{1}{4}MR^3$

Q14

The time taken by a simple pendulum at Srinagar is 2 minutes. The time taken by the same pendulum at New Delhi is 1 minute and 15 seconds. Calculate the ratio the accelerations due to gravity at these two places:

- (a) 0.29
- (b) 0.3
- (c) 0.287
- (d) 0.391

Q15

Two SHMs have the following equations:

$$x_1 = 5 \sin \left(2\pi t + \frac{\pi}{4} \right)$$

$$x_2 = 5\sqrt{2}(\sin 2\pi t + \cos 2\pi t).$$

Calculate the ratio of their amplitudes?

- (a) 4:3
- (b) 1:2
- (c) 2:1
- (d) 3:4

Q16

Poiseuille's Equation is as follows:

$$V = \frac{\pi pr^4}{8 \eta l}$$

What are the dimensions of V?

- (a) LT
- (b) L^3T^3
- (c) L^3T^{-1}
- (d) $L^{-1}T^3$

Q17

A body has mass m . It falls from a height h and collides with another body of mass m . The two bodies become one after this collision. They travel for some distance. This united body comes to the state of rest. What was the work done against the resistance offered?

- (a) $\frac{1}{2}mg(h + 4d)$
- (b) $\frac{mg}{4d}$
- (c) $\frac{1}{2}g(m + 4d)$
- (d) $2g(h + 4d)$

Q18

A man weighs 80kg. He is standing on a weighing machine. The weighing machine is inside an elevator. This elevator is moving upwards in a skyscraper at a uniform acceleration of 5 m-s^{-2} . The value of g is 10 m-s^{-2} . What is the reading of the weighing machine?

- (a) 1020 N
- (b) 1800 N
- (c) 1205 N
- (d) 1200 N

Q19

A particle is in a circular motion along a circle of radius $\frac{20}{\pi}$ metres. And its tangential acceleration is uniform. If the velocity of the particle is 80 m-s^{-1} at the end of the second revolution (after starting its journey), the value of tangential acceleration is:

- (a) 105 m-s^{-2}
- (b) 40 m-s^{-2}
- (c) 48 m-s^{-2}
- (d) 43.5 m-s^{-2}

Q20

A thin circular ring has mass M and radius r . It is rotated about its axis with a constant angular velocity ω . Four objects are put on its so that two objects are at the two ends of the other diameter. The two diameters are at an angle of 90° with respect to each other. What is the value of the angular velocity of this ring?

- (a) $\frac{M\omega}{M+m}$
- (b) $\frac{M\omega}{4M}$
- (c) $4M\omega(m + M)$
- (d) $\frac{M\omega}{M+4m}$

Q21

A ball is thrown vertically upwards with a speed u . What is the distance covered by it during the last t seconds?

- (a) $\frac{1}{2}t^2$
- (b) $\frac{1}{2}gt^2$
- (c) $2gt^2$
- (d) $2gt$

Q22

The vector sum of two forces is perpendicular to their vector difference. Hence the forces:

- (a) are not equal to each other
- (b) are equal to each other (in terms of magnitude)
- (c) are in the same direction
- (d) Cannot be determined

Q23

The coefficient of static friction is equal to

- (a) the sine value of the angle of friction
- (b) zero in any case
- (c) the tangent value of the angle of friction
- (d) unity in any case

Q24

A man throws a ball upwards, one ball after the other. He sends the following ball 2 seconds after the previous one. What should be his throwing velocity (upwards) so that he may be able to throw more than two balls upwards at any point of time? Take the value of g as 9.8m-s^{-2} .

- (a) $u = 19.4 \text{ m-s}^{-1}$
- (b) $u < 19.6 \text{ m-s}^{-1}$
- (c) $u > 19.6 \text{ m-s}^{-1}$
- (d) $u > 19.4 \text{ m-s}^{-1}$

Q25

A particle is in one- dimensional motion. Then, which two out of the following statements are correct?

- (a) If it is at zero speed, it may have non-zero velocity.
- (b) If it has zero speed at an instant, it may have non-zero acceleration at that very instant
- (c) When it reaches a height, its initial velocity is zero.
- (d) If it has a constant speed, it means it must have zero acceleration

Q26

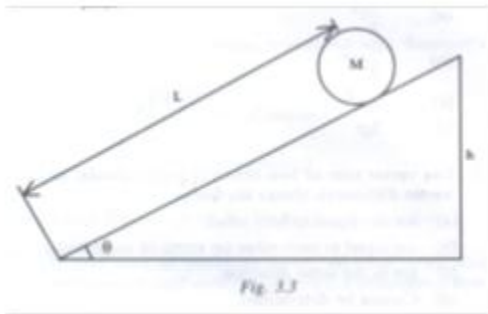
In the event of forced vibration, the resonance wave will become pretty sharp if the:

- (a) applied periodic force is little
- (b) damping force is small
- (c) quality factor is little
- (d) None of these

Q27

Refer Fig. 3.3. A solid cylinder has mass M and radius R . It rolls down an inclined surface. The length of the inclined surface is L and its height is h . Calculate the speed of the centre of mass of this cylinder when it reaches the bottom.

- (a) $12 g h$
- (b) $3 g h$
- (c) $3 g h$
- (d) $\sqrt{\frac{4gh}{3}}$



Q28

A stationary particle is broken by a blast into two particles of masses m_1 and m_2 , respectively. Now, they move in opposite directions with velocities v_1 and v_2 , respectively. The ratio of their kinetic energies will be:

- (a) $m_2 : m_1$
- (b) $m_1 : m_2$
- (c) $\frac{1}{2}$
- (d) None of these

Q29

A gas engine is working on an ideal gas. It is operating between the temperature range of 227 degrees Celsius and 127 degrees Celsius in the carnot cycle. It takes in 6.0 kcal. The amount of heat converted into work is:

- (a) 2.2 kcal
- (b) 2.1 kcal
- (c) 3.9 kcal
- (d) 1.2 kcal

Q34

The time of ascent for a body thrown upwards is equal to:

- (a) $\frac{u^2}{2g}$ (b) $\frac{u}{3g}$
(c) $\frac{u}{g}$ (d) $\frac{2u}{g}$

Q35

A block of mass m is pulled along a horizontal surface by a rope of mass m . A force F is applied at the free end of the rope. Also, a force F is applied by rope on the block. If the surface is sans friction, what is the value of F ?

- (a) $\frac{m+m_1}{F}$ (b) $F \frac{(m+m_1)}{2}$
(c) $\frac{m.F}{m+m_1}$ (d) $(m + m_1)F$

Q36

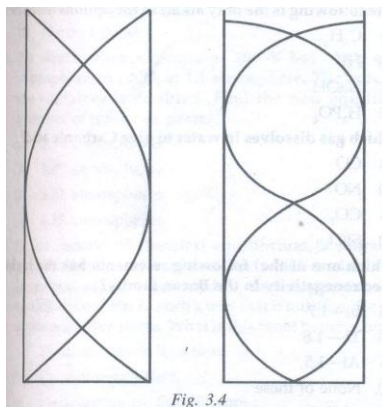
Two trains are moving at velocities of 40 km-hr^{-1} and 70 km-hr^{-1} in the same direction. The net relative velocity between them is:

- (a) 110 Km-hr^{-1} in the direction of the fast train (b) 30 Km-hr^{-1} in the direction of the fast train
(c) 70 Km-hr^{-1} in the direction of the slow train (d) 30 Km-hr^{-1} in the direction of the slow train

Q37

Fig.3.4 shows the vibrating modes of an air column. What is the ratio of frequencies of the two modes?

- (a) 5:3 (b) 1:3
(c) 3:1 (d) 3:5



Q38

If the value of Re (Reynold's Number) is 3120, the flow of the liquid in question is:

- (a) turbulent
- (b) laminar
- (c) unstable
- (d) Cannot be determined

Directions (Valid for Q. Nos.39 to 45):

In the questions that follow, an Assertion has been given for each question. This Assertion is followed by a Reason. You have to mark the correct choice as:

- (a) if both the Assertion and Reason are true and the Reason is the correct explanation of the Assertion;
- (b) if both the Assertion and Reason are true but the Reason is not the correct explanation of the Assertion;
- (c) if the Assertion is true but the Reason is false; and
- (d) if both the Assertion and Reason are false.

Q39

Assertion: The RMS and most probable speed of the molecules of a gas are the same.

Reason: The Maxwell Distribution for the speed of molecules in a gas is symmetrical.

Q40

Assertion: Air pressure in a car tyre increases during driving.

Reason: Absolute Zero temperature is not the zero-energy temperature.

Q41

Assertion: The average kinetic energy per molecules per degree of freedom is $KE = \frac{1}{2} k_B T$.

Reason: A diatomic molecule has 7 degrees of freedom if it vibrates.

Q42

Assertion: The ratio $\frac{c_p}{c_v}$ for a diatomic gas is more than that for a monoatomic gas.

Reason: The molecules of a monotomic gas have more degrees of freedom than those of a diatomic gas.

Q43

Assertion: For an ideal gas, the internal energy can only be the translational kinetic energy.

Reason: Gravity does not make any impact on the molecules of an ideal gas.

Q44

Assertion: The RMS speed and energy speed of the molecule of a gas are the same.

Reason: $V_{\text{RMS}} = \sqrt{V_1^2 + V_2^2 + V_3^2} = \bar{V}$

Q45

Assertion: The mean free path of the molecules of a gas is inversely proportional to the square of the molecular diameter.

Reason: $\bar{\lambda} = \frac{K_B T}{\sqrt{2} \pi d^2 p}$

PART B: CLASS XI**CHEMISTRY****Q46**

Which one of the following is not an assumption of Nell Bohr's theory?

- (a) Electrons revolve around the nucleus in stable circular orbits or shells.
- (b) The centripetal force needed for the circular motion of electrons is provided by the electrostatic attraction between the negatively charged electrons and positively charged nucleus
- (c) An electron can revolve in any arbitrary orbit around the nucleus
- (d) If an electron is revolving in a stationary orbit, it cannot radiate energy. The energy release will take place only if the electron jumps to a lower orbit and $\Delta E = E_1 - E_2 = h\nu$

Q47

The presence of spaces in frozen ice is a result of the phenomenon of :

- (a) covalent bonding
- (b) ionic bonding
- (c) hydrogen bonding
- (d) None of these

Q48

When do gases act as ideal ones?

- (a) When P is high and T is Low
- (b) When both P and T are high
- (c) When both P and T are Low
- (d) When P is Low and T is high

Q49

The algebraic sum of the oxidation numbers of all atoms in a compound is equal to:

- (a) 1
- (b) 0
- (c) 10
- (d) 1/10

Q50

Which one of the following is not a balanced reaction?

- (a) $\text{Cr}_2\text{O}_7^{2-} + 14 \text{H}^+ + 6\text{Cl}^- \rightarrow 2 \text{Cr}^{3+} + 3\text{Cl}_2 + 7\text{H}_2\text{O}$
- (b) $\text{IO}_3^- + \text{Cl}_2 + 2\text{OH}^- \rightarrow \text{IO}_4^- + 2\text{Cl}^- + \text{H}_2\text{O}$
- (c) $\text{NO}_3 + \text{S}^2 \rightarrow \text{NO} + \text{S}$
- (d) $4\text{P} + 3\text{OH}^- + 3\text{H}_2\text{O} \rightarrow 3\text{H}_2\text{PO}_2^- + \text{PH}_3$

Q51

The total KE of 1 mol of a gas is given by:

- (a) $\frac{3R}{2T}$
- (b) $\frac{3}{2}RT$
- (c) $\frac{2}{3}RT$
- (d) $3RT^2$

Q52

The total number of electrons in 1.6 grams of CH_4 is equal to:

- (a) 6.023×10^{20}
- (b) 6.023×10^{10}
- (c) 6.023×10^{23}
- (d) 6.023×10^{22}

Q53

When one of the following is the correct reaction for preparing NH_3 from H_2 ?

- (a) $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$
- (b) $\text{N}_2 + 3\text{H} \rightarrow 2\text{NH}_3$
- (c) $\text{N}_2 + \text{H}_2 \xrightarrow{\text{Fe-Mo}} \text{NH}_3$
- (d) $\text{N}_2 + 3\text{H}_2 \xrightarrow[200-900\text{atm}]{\text{Fe-Mo}} 2\text{NH}_3$

Q54

What is Clark's Method?

- (a) It is a method for determining the pH value of water
- (b) This method removes permanent hardness of water
- (c) This method uses slaked lime for removing the temporary hardness of water
- (d) None of these

Q55

How can we obtain Boron from B_2O_3 ?

- (a) By heating it
- (b) By treating it with Mg
- (c) By oxidizing it
- (d) None of these

Q56

The following is the only alkali in the options listed here,

- (a) C_6H_6
- (b) HF
- (c) NaOH
- (d) H_3PO_4

Q57

Which gas dissolves in water to give carbonic acid?

- (a) CO
- (b) NO
- (c) CO_2
- (d) $SiCl_4$

Q58

Which one of the following elements has the highest electronegativity in the Boron family?

- (a) In-1.7
- (b) Tl- 1.8
- (c) Al-1.5
- (d) None of these

Q59

Na and H_2O meet in a vigorous reaction to produce:

- (a) Oxygen
- (b) Hydrogen
- (c) Na_2O
- (d) H_2O

Q60

What is the chemical formula for Epsom salt?

- (a) MgCO_3
- (b) MgSO_4
- (c) $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
- (d) $\text{CaSiO}_3 \cdot 3\text{Mg SiO}_3$

Q61

Which one of the following is not true about Potassium?

- (a) It is an an alkaline earth metal
- (b) It is used in photoelectric
- (c) It is used for making Na-K alloy that has applications in special thermometers for measuring high temperature
- (d) It is a black metal that is header than Na.

Q62

What would happen if we heat limestone?

- (a) We get quick lime
- (b) We get carbon (black particles)
- (c) We got CO
- (d) This reaction is not feasible

Q63

What are the uses of slaked lime?

- (a) For the preparation of coal gas
- (b) In the recovery of NH_3 in the solvay process
- (c) For the production of bleaching powder
- (d) All of these

Q64

The stability of free radicals has the following order.

- (a) Primary < Secondary < Tertiary
- (b) Tertiary > Secondary > Primary
- (c) Secondary > Primary > tertiary
- (d) None of these

Q65

An equilibrium mixture at 300 K has N_2O_4 at 0.28 atmosphere and NO_2 at 1.1 atmosphere. The volume of the container is doubled. Find the new equilibrium pressure of these two gases.

- (a) 2.34 atmospheres
- (b) 4.39 atmospheres
- (c) 3.32 atmospheres
- (d) 4.32 atmospheres

Q66

In the context of chemical equilibrium, if a system at equilibrium is subjected to stress (which can be change in pressure, concentration or temperature), the equilibrium shifts in such a way that it nullifies the effects of the causative stress. What is this tenet better known as?

- (a) Zimmermann's Reaction
- (b) Electromeric Effect
- (c) Heterogeneous Equilibrium
- (d) Le Chatelier's principle

Q67

Read the following reaction: $\text{A}_2(\text{g}) + \text{B}_2(\text{g}) \rightleftharpoons 2\text{AB}(\text{g})$

The temperature of the reaction is 100 degrees Celsius. The equilibrium constant of this reaction is 50. A flask having the capacity of 1 litre and containing 1 mole of a gas A_2 is connected to another flask having a capacity of 2 litre and containing 2 moles of a gas B_2 . How many moles of AB will be formed at 373 K?

- (a) 1.780
- (b) 1.870
- (c) 2.870
- (d) 0.870

Q68

Nitrogen and Oxygen react to form Nitric oxide (NO). The value of $H = +21.5$ kcal. The formation of NO is favoured by a/an:

- (a) decrease in temperature
- (b) increase in N_2 concentration
- (c) increase in pressure
- (d) All of these

Q69

The heat of formation of a substance is the:

- (a) input heat
- (b) enthalpy of the substance
- (c) heat generated in the reaction
- (d) None of these

Q70

Bond energy is the average amount of energy needed to dissociate:

- (a) 1.0 kg of bonds
- (b) 1.0 mole of solid bonds
- (c) 1.0 mole of bonds present in different gaseous compounds in gaseous atoms
- (d) None of these

Q71

For an isochoric process:

- (a) $\Delta V = 0$
- (b) $\Delta H = 0$
- (c) $\Delta T = 0$
- (d) None of these

Q72.

The following elements are causing the maximum harm to our environment by helping in the production of acid rain.

- (a) Ca and Mg
- (b) S and Ca
- (c) N and H
- (d) S and N

Q73

When one of the following is not an electrophile?

- (a) NO_2^+
- (b) SO_3
- (c) R_3C
- (d) HSO_3^-

Q74

When one of the following is not a nucleophile?

- (a) OH^-
- (b) OR^-
- (c) Cl^+
- (d) Br^-

Q75

The union of two or more molecules of the same substance or of different substance to give rise to a single large molecule is called:

- (a) Saturation
- (b) Electrophilic Addition
- (c) Free Radical Substitution
- (d) Polymerisation

Q76

How does H_2O_2 protect old oil painting?

- (a) It produces PbS
- (b) It removes PbS
- (c) It removes $2 \text{PbCO}_3, \text{Pb}(\text{OH})_2$
- (d) None of these

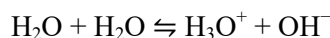
Q77

Phenol is an acid, yet it does not react with sodium bicarbonate, a base. Why is that so?

- (a) Phenol is a strong acid
- (b) Sodium bicarbonate is inert towards all phenols
- (c) Phenol is a weak acid
- (d) None of these

Q78

In the reaction shown ahead, identify the acid and its conjugate base.



- (a) There is no acid in it
- (b) Acid – H_2O , Base – H_2O
- (c) Acid – H_2O , Base – OH^-
- (d) None of these

Q79

Why do the salts of strong acids and bases not undergo hydrolysis?

- (a) Their structure does not allow them to react
- (b) Their solutions are highly acidic or basic
- (c) Their solutions cannot be formed
- (d) It is difficult to break up their radicals.

Q80

- (a) $\text{Cl} > \text{Br} > \text{F}$
- (b) $\text{F} > \text{Br} > \text{Cl}$
- (c) $\text{Cl} > \text{F} > \text{Br}$
- (d) None of these

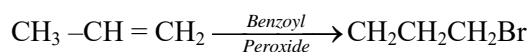
Q81

Why is H_2O_2 a better oxidizing agent than H_2O ?

- (a) It is more reactive
- (b) It gives O_2 easily upon decomposition
- (c) Water is neutral but H_2O_2 is not
- (d) All of these

Q82

Read this reaction:



What type of reaction is this?

- (a) Elimination
- (b) Electrophilic
- (c) Nucleophilic
- (d) Free Radical

Q83

If the value of ΔH is negative, the reaction is:

- (a) endothermic
- (b) exothermic
- (c) neutral
- (d) no reaction at all

Q84

The first law of thermodynamics states that:

- (a) $E = \frac{q}{w}$
- (b) $\Delta E = \Delta q \cdot \Delta w$
- (c) $\Delta E = \frac{1}{2}(\Delta q \cdot \Delta w)^2$
- (d) $\Delta E = q + w$

Q85

Which activity would lead to the reduction of pollutants in major water bodies of world?

- (a) Removal of leather processing units from river banks
- (b) Creation of separate sewage disposal tanks for urban areas
- (c) Dredging of lakes and river beds
- (d) All of these

Q86

It is possible to cool a gas below absolute zero?

- (a) No
- (b) Yes
- (c) Need to create conditions for this cooling
- (d) None of these

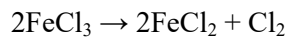
Q87

A reducing agent is a compound or ion in which there is a /an:

- (a) decrease in the oxidation state of one of its constituent elements
- (b) constant state in the oxidation state of one of its constituent elements
- (c) increase in the oxidation state of one of the constituent elements
- (d) None of these

Q88

Note this reaction:

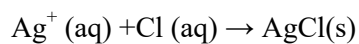


In this reaction, ferric chloride is being:

- (a) reduced
- (b) oxidation
- (c) nether oxidation nor reduced
- (d) both oxidation and reduced

Q89

Read this reaction

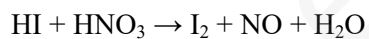


Were Ag^+ ions oxidation or reduced in this reaction?

- (a) Oxidized
- (b) Reduced
- (c) Neither oxidation nor reduced
- (d) Cannot be determined

Q90

Balance this equation through the oxidation state method.



- (a) $\text{HI} + \text{HNO}_3 \rightarrow 3\text{I}_2 + 2\text{NO} + 4\text{H}_2\text{O}$
- (c) $6\text{HI} + \text{HNO}_3 \rightarrow \text{I}_2 + 3\text{NO} + 2\text{H}_2\text{O}$
- (d) None of these

PART C: CLASS XI

BOTANY

Q91

Which one of these represents the zone of differentiation?

- (a) Zone of elongation
- (b) Root hair zone
- (c) Zone of mature cells
- (d) Region of elongation.

Q92

The stems of Maize and Sugarcane have supporting roots coming out of the lower nodes of the stem. So, they are called:

- (a) Stilt Roots
- (b) Prop Roots
- (c) Pneumatophores
- (d) Adventitious

Q93

Phloem is made up of:

- (a) Sieve tubes
- (b) companion cells
- (c) phloem parenchyma
- (d) All of these

Q94

Kranz Anatomy is found in

- (a) wheat leaf
- (b) sugarcane leaf
- (c) maize leaf
- (d) hydrilla leaf

Q95

Osmotic pressure is measured by:

- (a) Ganong's photometer
- (b) photometer
- (c) auxonometer
- (d) osmometer

Q96

Water potential of pure water and its solution are:

- (a) 0 and 1
- (b) 0 and 0
- (c) 0 and more than one
- (d) 0 and less than 0

Q97

Hydroponics refers to growing plants in:

- (a) tissue culture medium
- (b) water
- (c) solution of mineral nutrients
- (d) soil culture

Q98

Succulents carry out photosynthesis:

- (a) CAM pathway
- (b) C-4 pathway
- (c) C-3 pathway
- (d) C-2 pathway

Q99

The value of RQ is more than 1.0 in case the substrate is a/an:

- (a) fat
- (b) glucose
- (c) protein
- (d) organic acid

Q100

Which one of the following is cytokinin?

- (a) Phytochrome
- (b) Leucine
- (c) Ethylene
- (d) Zeatin

Q101

Which one of the following is not a short-day plant?

- (a) Spinach
- (b) Aster
- (c) Chrysanthemum
- (d) Xanthium

Q102

Oxidative phosphorylation is the:

- (a) anaerobic production of ATP
- (b) citric acid production of ATP
- (c) production of ATP by chemiosmosis
- (d) alcoholic fermentation

Q103

Thread –like branches of Mycelium are called:

- (a) Filaments
- (b) Hyphae
- (c) Sporangiphores
- (d) Haustoria

Q104

Bread mould is:

- (a) Saccharomyces
- (b) Rhizopus
- (c) Clostridium
- (d) Erysiphe

Q105

Upon germination, moss spores produce:

- (a) Annulus
- (b) Theca
- (c) Peristome
- (d) Protonema

Q106

The kidney-shaped covering of sorus in Dryopteris is:

- (a) Indusium
- (b) Ramentum
- (c) Placenta
- (d) Sporophy II

Q107

A plant that produces seeds but lacks flowers is:

- (a) Gymnosperm
- (b) Bryophyte
- (c) Angiosperm
- (d) Pteridophyte

Q108

Which one of the following is monocarpic?

- (a) Annual plants
- (b) Biennial Plants
- (c) Perennial plants
- (d) All of these

Q109

Pit canals are found in:

- (a) Collenchyma
- (b) Sclerenchyma fibres
- (c) Sclereids
- (d) Paraenchyma

Q110

Lacunate collenchyma occurs in the stem of:

- (a) Leucas
- (b) Cucurbita
- (c) Sunflower
- (d) Sambucus

Q111

Quiescent centre is found in a plant at its:

- (a) root tip (b) shoot tip
(c) cambium (d) leaf tip

Q112

The right order for the instrument used for measuring:

- (i) transpiration;
(ii) stomatal size;
(iii) atmospheric pressure; and
(iv) osmosis

Is as follows:

- (a) Potometer, porometer, manometer and osmometer
(b) Porometer, manometer, Potometer and osmometer
(c) Potometer, manometer, porometer and osmometer
(d) Manometer, potometer, porometer and osmometer

Q113

Denitrification is carried out by:

- (a) pseudomonas and Nitrosomonas
(b) Nitrosomonas and Nitrobacter
(c) Nitrosomonas and Nitrococcus
(d) Pseudomonas and Thiobacillus

Q114

The function of leg-haemoglobin during the course of biological nitrogen fixation in root nodules of legumes is the:

- (a) conversion of N_2 into NH_3 (b) conversion of ammonia into nitrite
(c) transpiration of oxygen for thenitro-genase activity (d) protection of nitrogenase from oxygen

Q115

Hill used a dye for his famous Hill reaction. It was

- (a) Sulphur green
- (b) Eosine
- (c) Methylene blue
- (d) Dichlorophenol indophenol

Q116

Photosynthesis is continuous under:

- (a) Green Light
- (b) red light
- (c) continuous light
- (d) very high light

Q117

Cell respiration is carried out by:

- (a) Mitochondria
- (b) Golgi bodies
- (c) ribosomes
- (d) continuous

Q118

Which one of the following acts as an energy currency of cell?

- (a) AMP
- (b) ADP
- (c) ATP
- (d) NAD

Q119

A hormone that breaks the dormancy of seeds and vegetative organs is:

- (a) ABA
- (b) Gibberellin
- (c) IAA
- (d) Indole and lactic acid

Q120

Which one of the following is also called stress hormone?

- (a) ABA
- (b) Gibberellin
- (c) IAA
- (d) Indole and lactic acid

Q121

Black rust of wheat is caused by:

- (a) Pucciniagraminis
- (b) Ustilagonuda
- (c) Alternariasolani
- (d) Xanthomonasoryzae

Q122

Red rot of sugarcane is caused by:

- (a) Colletorichum
- (b) Fusarium
- (c) Pythium
- (d) Albugo candida

Q123

Archegoniophore occurs in:

- (a) Chara
- (b) Funaria
- (c) Adiantum
- (d) Marchantia

Q124

The phloem of angiosperms differs from those of other vascular plants due to the presence of:

- (a) Tylosoides
- (b) Secretion cells
- (c) Companion cells
- (d) Albuminous cells

Q125

Which ones of the following are also called Humus Plants?

- (a) Saprophytes
- (b) Holoparasites
- (c) Hemiparasites
- (d) Insectivores

Q126

Which one of the following has whorled phyllotaxy?

- (a) Shoe flower
- (b) Quisqualis
- (c) Zinnia
- (d) Nerium

Q127

Casparian thickenings occur in the cells of:

- (a) Pericycle of stem
- (b) endodermis of stem
- (c) pericycle of root
- (d) endodermis of root

Q128

Motor cells take part in the process of:

- (a) guttation
- (b) transpiration
- (c) inrolling
- (d) All of these

Q129

The Cohesion Tension theory is related to the:

- (a) respiration
- (b) ascent of sap
- (c) transpiration
- (d) photosynthesis

Q130

The oozing of water drops from an injured leaf's edges is referred to as:

- (a) Bleeding
- (b) Guttation
- (c) Transpiration
- (d) Oozation

Q131

Its deficiency produces leaf Necrosis and stunted growth in rice. It is:

- (a) Silicon
- (b) Sodium
- (c) Zinc
- (d) Aluminium

Q132

The most abundant element found in plants is:

- (a) Carbon
- (b) Nitrogen
- (c) Iron
- (d) Manganese

Q133

Pigments of PS1 occur in the

- (a) appressed part of granal thylakoids
- (b) stromal thylakoids and non-appressed parts of granal thylakoids
- (c) both appressed and non-appressed parts of granal thylakoids
- (d) stroma

Q134

Carbon dioxide is fixed in a/an:

- (a) Light reaction
- (b) dark reaction
- (c) aerobic respiration
- (d) anaerobic respiration

Q135

Fermentation is a/an:

- (a) anaerobic respiration
- (b) incomplete oxidation
- (c) excretory process
- (d) None of these

PART D: CLASS XI**ZOOLOGY****Q136**

Which one of the following is not true about kingdom Monera?

- (a) The Kingdom comprises prokaryotic organisms
- (b) The organisms of this Kingdom are unicellular, colonial, mycelial and filamentous
- (c) The cell size of this Kingdom Varies from 10 to 100 μm
- (d) None of these is true.

Q137

The incubation period of Plasmodium vivax is:

- (a) 14 days
- (b) 20 days
- (c) 30 days
- (d) 45 days

Q138

In Amoeba, the contractile vacuole is present:

- (a) near the trailing end
- (b) near the advancing end
- (c) at the middle of the body
- (d) anywhere inside the body

Q139

Tooth-shaped scales are:

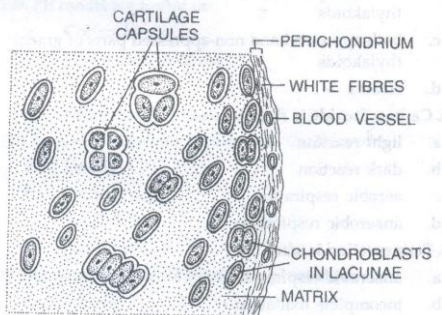
- (a) Cycloids
- (b) Ctenoids
- (c) Ganoids
- (d) Placoids

Q140

Column I contains Larval Stages and Column II contains the groups to which they belongs. Match them correctly and choose the right from the options given below:

Column I	Column II
A. Planula	1. Annelida
B. Tornaria	2. Mollusca
C. Trochophore	3. Arthropoda
D. Bipinnaria	4. Hemichordata
E. Glochidium	5. Echinodermata
	6. Coelenterata

- (a) A-6, B-4, C-1, D-5, E-2
- (b) A-2, B-5, C-1, D-4, E-6
- (c) A-5, B-4, C-3, D-2, E-6
- (d) A-4, B-3, C-2, D-1, E-5

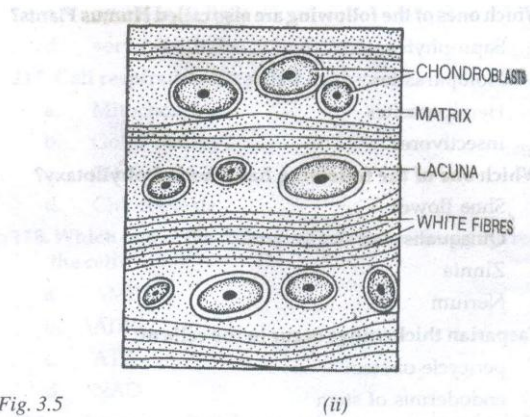


- (a) phagocytosis of pathogens
- (b) cell mediated and antibody immunity
- (c) inhibition of allergic reactions
- (d) heparin secretion for preventing thrombosis

Q141

Refer Fig. 3.5. This is the diagram of a section of hyaline cartilage. The different parts have been indicated by alphabets. Choose the correct match.

- (a) a- cartilage, b-white fibers, c- lacuna, d- capsular matrix, e-perichondrium
- (b) a- chondrin, b- lacuna, c- chondrocyte, d- capsular matrix, e-chondrin
- (c) a- perichondrium, b- chondrocyte, c- lacuna, d- capsular matrix, e- chondrin
- (d) a- capsular matrix, b- chondrocyte, c- lacuna, d- perichondrium, e- chondrin



Q143

The 9th pair of cranial nerve in the frog is:

- (a) Hypoglossal
- (b) Glossopharyngeal
- (c) Vagus
- (d) Trigeminal

Q144

In pheretima, gizzard, buccal cavity, pharynx, oesophagus, pharyngealnephridia receive the blood from this blood vessel:

- (a) Supra oesophageal
- (b) Lateral oesophageal
- (c) Dorsal blood
- (d) Subneural

Q145

Which technique was successfully demonstrated by Wilmut and Campbell when they cloned the first mammal (sheep), Dolly?

- (a) Totipotency
- (b) Morphogenesis
- (c) Embryoids
- (d) De-differentiation

Q146

Lysosomes are produced by:

- (a) Mitochondria
- (b) Endoplasmic reticulum
- (c) Golgi bodies
- (d) Both (b) and (c)

Q147

Chitin occurs in the cell wall of:

- (a) bacteria
- (b) algae
- (c) fungi
- (d) yeast

Q148

Benedict's Solution is used for detecting:

- (a) sucrose
- (b) glucose
- (c) fat
- (d) starch

Q149

The main digestive function of Enterokinase is the:

- (a) conversion of casein into paraeasein
- (b) conversion of pepsinogen into pepsin
- (c) conversion of trypsinogen into trypsin
- (d) conversion of trypsin into trypsinogen

Q150

Pernicious anaemia results due to the deficiency of:

- (a) Vitamin B
- (b) Vitamin A
- (c) Vitamin B₁₂
- (d) Iron

Q151

Emphysema is a:

- (a) cardiovascular disease
- (b) disease of alveolar sacs
- (c) neural disease
- (d) renal disease

Q152

The condition characterized by the ill-effect of hypoxia (shortage of oxygen) in tissues at high attitudes is called:

- (a) Mountain Sickness
- (b) Bronchitis
- (c) Asthma
- (d) Emphysema

Q153

In a standard ECG, which one of the following alphabets is the correct representation of the respective activity of the human heart?

- (a) S-Start of systole
- (b) T-end of diastole
- (c) P-depolarisation of the atria
- (d) R- repolarization of ventricles

Q154

Mitral valve is present between the:

- (a) right atrium and right ventricle
- (b) left atrium and left ventricle
- (c) right ventricle and left ventricle
- (d) left ventricle and aorta

Q155

A person with an unknown blood group under ABO system has suffered much blood loss in an accident. He needs immediate blood transfusion. His friend, who has a valid certificate of his own blood type, offers to donate blood without delay. What could have been the type of blood group of the donor friend?

- (a) Type B
- (b) Type AB
- (c) Type O
- (d) Type A

Q156

The animals that excrete urea are called:

- (a) Ammonotelic
- (b) Ureotelic
- (c) Uricotelic
- (d) Aminotelic

Q157

It is the pressure exerted by plasma proteins in the glomeruli. It is called:

- (a) Glomerular Hydrostatic Pressure
- (b) Blood Colloidal Osmotic Pressure
- (c) Capsular Hydrostatic Pressure
- (d) Effective Filtration Pressure

Q158

A deltoid ridge occurs in:

- (a) radius
- (b) ulna
- (c) femur
- (d) humerus

Q159

Acetabulum is present in the :

- (a) hip joint
- (b) knee joint
- (c) elbow joint
- (d) shoulder joint

Q160

Which one of the following options shows the correct matching pair?

- (a) Man-ureotelic
- (b) Bird-ammonotelic
- (c) Fish- uricotelic
- (d) Frog-uricotelic

Q161

This muscle pulls a limb away from the mid- line of the body.

- (a) Adductor
- (b) Abductor
- (c) Supinator
- (d) Sphincter

Q162

Which neural system comprises brain and spinal cord?

- (a) Central neural system
- (b) Peripheral neural system
- (c) Somatic neural system
- (d) Automatic neural system

Q163

The cytoplasm of neuron has the following.

- (a) Neurofibrils
- (b) Neurotubles
- (c) Nissl's granules
- (d) All of these.

Q164

Which neuron's body has only one axon?

- (a) Non-polar neuron
- (b) Uniplar neuron
- (c) Pseudounipolar neurons
- (d) Bipolar neurons

Q165

Which one of the following is not a function of cerebrospinal fluid?

- (a) Protection of the brain and spinal cord
- (b) Buoyancy to the brain
- (c) Digestion
- (d) Endocrine medium for the brain

Q166

Meissner's Corpuscles occur in the:

- (a) brain
- (b) nerve cells
- (c) skin
- (d) tongue

Q167

The following disorder is caused due to the deficiency of the thyroid hormone in infants.

- (a) Cretinism
- (b) Gull's Disease
- (c) Simple Goitre
- (d) Hashimoto's Disease

Q168

This is the outer zone that lies just below the capsule in the adrenal cortex.

- (a) Zone glomerulosa
- (b) Zone fasciculate
- (c) Zone reticularis
- (d) None of these

Q169

The correct sequence in the Linnaean hierarchy is:

- (a) Species, genus, family, order, class
- (b) Species, genus, phylum, family, class
- (c) Class, family, Species, genus, order
- (d) Phylum, class, family, species, order

Q170

The Adipose tissue is a:

- (a) fat-storing connective tissue
- (b) dense connective tissue
- (c) specialised connective tissue
- (d) None of these

Q171

Which one of the following does not possess nucleic acid?

- (a) Prion
- (b) Viroid
- (c) Virus
- (d) Mycoplasma

Q172

The shape of staphylococcus bacteria is:

- (a) Oval
- (b) curved rod
- (c) elongated
- (d) cubical

Q173

Spirulina belongs to the following kingdom.

- (a) Plantae
- (b) Monera
- (c) Protista
- (d) Fungi

Q174

Phylum protozoa has been classified on the basis of:

- (a) mode of reproduction
- (b) locomotory organelles
- (c) mode of nutrition
- (d) None of these

Q175

From the option given below, identify the alga known for a biological activity, called Bioluminescence.

- (a) Chlorella
- (b) Spirogyra
- (c) Cyclotella
- (d) Noctiluca

Q176

In the life cycle of plasmodium, man is a:

- (a) primary host
- (b) secondary host
- (c) tertiary host
- (d) None of these

Q177

The phenomenon of torsion occurs in:

- (a) Gastropoda
- (b) Pelecypoda
- (c) Cephalopoda
- (d) Amphineura

Q178

Which one of the following is multinucleated?

- (a) Non-striated muscle
- (b) Striated muscle
- (c) Renal tissue
- (d) Nervous tissue

Q179

In the earthworm:

- (a) integumentary and pharyngeal nephridia are exonephric
- (b) pharyngeal and septalnephridia are enteronephric
- (c) pharyngeal and septalnephridia are exonephric
- (d) integumentary and septalnephridia are enteronephric

Q180

The stink gland is found in the:

- (a) 4th and 5th terga of cockroach
- (b) 5th and 6th terga of cockroach
- (c) 5th and 6th sterna of cockroach
- (d) 4th and 5th sterna of cockroach

ANSWER WITH EXPLANATIONS

PART A: PHYSICS

Sol.1 (b)

In a free fall, two balls of different mass will acquire the same velocity after falling through some height. Now $v_1 = v_2 = v$ at 30 feet from the falling point.

$$\text{Here, } m_1 = 4 \text{ kg Thus, } \frac{K_1}{K_2} = \frac{\frac{1}{2}m_1v^2}{\frac{1}{2}m_2v^2} = \frac{m_1}{m_2} = \frac{2}{4} = \frac{1}{2}$$

The right option is (b).

Sol.2 (c)

In an adiabatic process, heat transfer into or out of a system $= Q = 0$.

From the first Law of Thermodynamics we have:

$$A = -\Delta U$$

$$-nC_v\Delta T$$

$$-\left(\frac{R}{\gamma - 1}\right)(T_f - T_i)$$

$$\frac{nR}{\gamma - 1}(T_i - T_f)$$

Here: $W = 6R\text{J}$, $n = 1 \text{ mol}$,

$$R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$$

$$\gamma = \frac{5}{3}, T_i = T\text{K}$$

Put these values in eqn.(i):

$$\therefore 6R = \frac{R}{\left(\frac{5}{3}-1\right)}(T - T_f)$$

$$\Rightarrow 6R = \frac{3R}{2}(T - T_f)$$

$$\Rightarrow T - T_f = 4$$

$$\therefore T_f = (T - 4)\text{K}$$

The right choice is (c).

Sol.3 (a)

The tension in the string is equal to static frictional force between the block and the surface. Refer Fig. 3.6.
Let the mass of the block B be M.

At equilibrium:

$$T - Mg = 0$$

$$T = Mg \dots (i)$$

If blocks do not move:

$$T = f_s = \text{Frictional force}$$

$$f_s = \mu_s R = \mu_s mg$$

$$T = \mu_s mg \dots (ii)$$

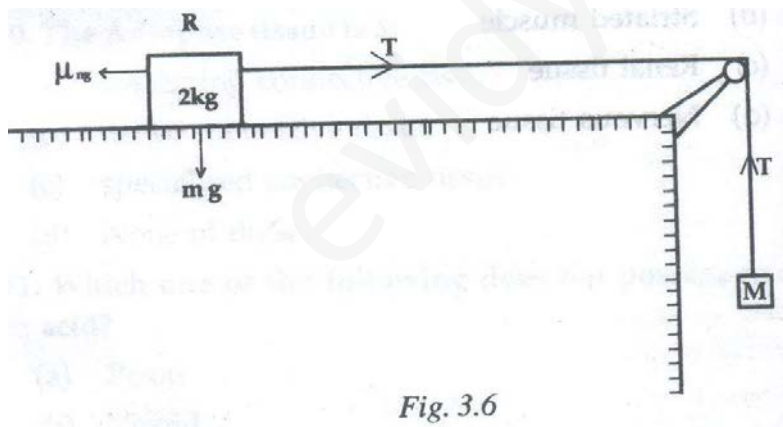
From Eqns. (i) and (ii), we get

$$Mg = \mu mg$$

$$M = \mu m$$

$$M = 0.2 \times 2.0 = 0.4 \text{ kg}$$

The right option is (a).



Sol4. (b)

In simple harmonic motion, the displacement equation is $y=A \sin \omega t$, where A is amplitude of the motion.

$$\text{Velocity, } v = \frac{dy}{dt} = A\omega \cos \omega t$$

$$v = A\omega\sqrt{1 - \sin^2 \omega t}$$

$$v = \omega\sqrt{A^2 - y^2} \quad \text{Acceleration, } a \propto \frac{dv}{dt} = \frac{d}{dt}(A\omega \cos \omega t)$$

$$a = -A\omega^2 \sin \omega t$$

$$a = -\omega^2 y \dots \text{(ii) When } y = 0; v = A\omega = v_{\max}$$

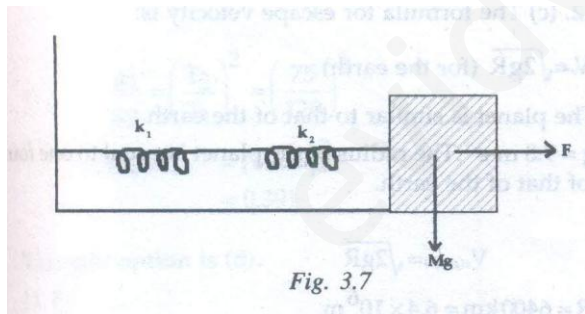
$$a = 0 = a_{\min} \quad \text{When } y = A, v = 0 = v_{\min}$$

$$a = -\omega^2 A = a_{\max}$$

When v is maximum, a is minimum (zero). The vice versa of this statement is also true. The right choice is (b).

Sol.5 (b)

Let us consider two springs of spring constants k_1 and k_2 , respectively, joined in series as shown in Fig-3.7.



Under a force F, they will stretch by y_1 and y_2

$$\text{So, } y = y_1 + y_2 \quad \text{Or } \frac{F}{k} = \frac{F_1}{k_1} = \frac{F_2}{k_2}$$

The springs are massless. Therefore, the force on them must be the same.

$$\text{Thus, } F_1 = F_2 = F$$

$$\text{So, } \frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2} \quad \text{or, } k = \frac{k_1 k_2}{k_1 + k_2}$$

The right option is (b).

Sol.6 (d)

The waves are:

$$y_1 = 10^{-6} \sin \left[100t + \left(\frac{x}{50} \right) 0.5 \right] \text{ m}$$

$$y_2 = 10^{-6} \cos \left[100t + \left(\frac{x}{50} \right) \right] \text{ m}$$

$$y_2 = 10^{-6} \sin \left[100t + \left(\frac{x}{50} \right) + \frac{\pi}{2} \right]$$

That is because $\sin(90^\circ + A) = \sin A$

$$\begin{aligned} \text{Phase different} &= \Delta\Phi = \left(\frac{\pi}{2} - 0.5 \right) \\ &= \left(\frac{22}{7 \times 2} - 0.5 \right) \\ &= \left(\frac{\pi}{7} - 0.5 \right) = 1.566 - 0.5 \\ &= 1.066 \\ &= 1.01 \text{ rad} \end{aligned}$$

The right answer is (d).

Sol.7 (c)

$$I = 2 \text{ kg} - \text{m}^2$$

$$\omega_0 = \frac{60}{60} \cdot 2\pi \text{ rad} - \text{s}^{-1}$$

$$\omega = 0$$

$t = 60\text{s}$ The torque needed to stop the wheel = τ

$$\tau = I\alpha$$

$$\tau = I \left[\frac{\omega_0 - \omega}{t} \right]$$

Sol.8 (b)

Due to the surface tension of Hg, this metal (liquid) gets depressed in the barometer tube. So, the observed height of Hg in the barometer tube is less than its actual height. So, the reading of an Hg barometer is always less than the actual pressure.

The right option is (b)

Sol. 9 (a)

$$\text{Force} = V \frac{dm}{dt} = V \frac{d}{dt}(\text{Volume} \times \text{Density}) = V \frac{d}{dt}(A \times \rho) = VA_p \frac{dx}{dt}$$

$$= A_p V^2$$

$$\text{Power} = \text{Force} \times \text{Velocity} = A_p V^2 \cdot V$$

$$A_p V^3$$

Thus, power is proportional to V^3 **The right option is (a).**

Sol.10

David Bernoulli, a Swiss physicist, derived a relationship between the height and speed of a fluid. His principle (propounded in 1738) states that the some of pressure energy, kinetic energy and potential energy per unit volume of an incompressible non-viscous fluid in an irrotational flow remains constant along a streamline. Thus, we have:

$$P + \frac{1}{2} \rho v^2 + \rho gh = \text{Constant} \dots (i)$$

Refer Fig.3.8 which was used for deriving this equation:

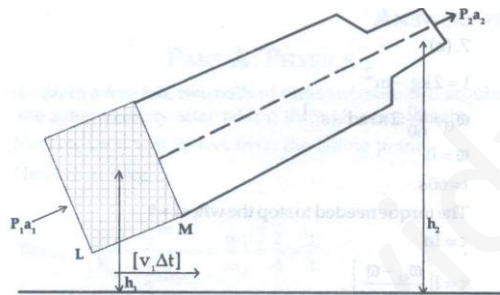


Fig. 3.8

Bernoulli also proved that energy per unit volume remains constant. Hence Eqn. (i) can be written as follows:

$$\frac{P}{\rho g} + \frac{1}{2} \frac{v^2}{g} + h = \text{Constant} \dots (ii)$$

Where the terms have their usual meanings. So, the sum of pressure head, velocity head and gravitational head is constant. This theorem is applicable only to incompressible liquids, for it does not take into account the elastic energy of fluids. Further, it is applicable only if the fluid flow is streamlined. It is redundant when the fluid flow is turbulent. It also does not consider the angular momentum of the fluid. So, it does not apply to fluids that traverse curved paths. All other options are correct.

The right option is (c).

Sol. 11 (b)

Newton's law of cooling states that the cooling rate of a body is directly proportional to the temperature difference between the body and its surroundings, provided the temperature difference is small. Thus, we have:

$$T = T_0 + Ce^{-kt}$$

Where, C= constant of integration = e^c

C=specific heat of the body,

M= mass of body

T= temperature of surroundings and

$$k = \frac{k}{mc} = \text{constant}$$

Clearly, $\Delta T = T - T_0$ (degree Celsius)

Time is in minutes. These two variables were plotted to deliver the curve shown in Fig.3. The figure clearly shows that the rate of cooling is high to begin with since the value of ΔT is high. As ΔT is reduced gradually, the body loses comparatively less heat to its surrounding.

The right option is (b).

Sol.12 (c)

The formula for escape velocity is:

$$V_e = \sqrt{2gR} \text{ (for the earth)}$$

The planet is similar to that of the earth.

$G = 9.8 \text{ m-s}^{-2}$. The radius of the planet is equal to one fourth of that of the earth.

$$V_{e(\text{Planet})} = \sqrt{2gR}$$

$$R = 6400 \text{ km} = 6.4 \times 10^6 \text{ m}$$

$$V. (\text{planet}) = \sqrt{2 \times 9.8 \times \frac{6.4 \times 10^6}{4}}$$

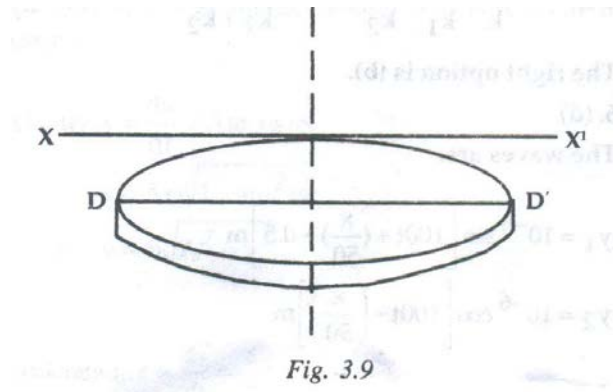
$$= 5.6 \text{ km s}^{-1}$$

Thus the right option is (c).

Sol.13 (a)

The MI of the disc about a tangent parallel to its diameter is given by the following equation (refer Fig. 3.9).

$$\text{MI about } XX' = \frac{5}{4} MR^2$$



The right option is (a)

Sol.14 (d)

Time at Srinagar = 2 minutes

$$T_1 = 120 \text{ seconds}$$

Time at New Delhi = 1 hour 15 minutes

$$\Rightarrow T_2 = 75 \text{ seconds}$$

$$\frac{T_2}{T_1} = \left(\sqrt{\frac{g_1}{g_2}} \right)^2$$

$$\Rightarrow \left(\frac{T_2}{T_1} \right)^2 = \left(\sqrt{\frac{g_1}{g_2}} \right)^2 \Rightarrow \left(\frac{T_2}{T_1} \right)^2 = \frac{g_1}{g_2}$$

$$\Rightarrow \frac{g_1}{g_2} = \left(\frac{T_2}{T_1} \right)^2 = \left(\frac{75}{120} \right)^2$$

$$= (0.625)^2$$

$$= 0.391$$

The right option is (d).

Sol.15 (b)

$$X_1 = 5 \sin \left(2\pi t + \frac{\pi}{4} \right)$$

$$\Rightarrow A_1 = 5$$

$$X_2 = 5\sqrt{2}(\sin 2\pi t + \cos 2\pi t)$$

$$= 10 \sin \left(\sin 2\pi t \cos \frac{\pi}{4} + \cos 2\pi t \sin \frac{\pi}{4} \right)$$

$$= 10 \sin \left(2\pi t + \frac{\pi}{4} \right)$$

$$\Rightarrow A_2 = 10$$

$$\Rightarrow \frac{A_1}{A_2} = \frac{5}{10} = \frac{1}{2} = 1:2$$

The right choice is (b).

Sol.16 (c)

We have:

$$V = \frac{\pi Pr^4}{8 \eta l}$$

Put the dimensions of physical quantities:

$$\text{Dimensions of } V = \frac{ML^{-1}T^{-2}L^4}{ML^{-1}T^{-1}L} = L^3T^{-1}$$

The right choice is (c).

Sol.17 (a)

Final velocity of the first having mass m and falling through a height h is given by: $v^2 = 0 + 2gh$

$$\Rightarrow v = \sqrt{2gh}$$

Let us apply the law of conservation of momentum. Initial Momentum = Final momentum

$$mv + 0 = (m + m)v' \quad m\sqrt{2gh} = 2mv' \Rightarrow v' = \frac{\sqrt{2gh}}{2} = \sqrt{\frac{gh}{2}} \quad W = \left(\frac{1}{2} \times 2mv'^2 \right) + (2mgd)$$

Now d is the distance through which the total mass moves on the ground. Also, v' is the velocity of this single body.

$$\text{Work done} = m \left(\frac{gh}{2} \right) + 2mgd = \frac{1}{2} mg(h + 4d)$$

The right option is (a).

Sol.18 (d)

When the lift moves up, it weighs more than the actual weight of man. The multiplication factor in this case is (ma). Refer Fig. 3.10.

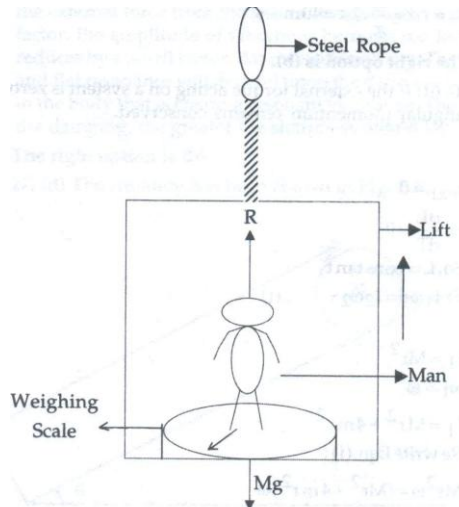


Fig. 3.10: Man in a lift

Mass of man = $M=80$ kg, Acceleration of lift = $a =5$, $m\text{-s}^{-2}$

When the lift moves up, the reading of the weighing scale is R . Thus, we have:

$$R - M \cdot g = M \cdot a \quad \text{Or, } R = M \cdot g + M \cdot a = M (G + a) = 80 (10 + 5) = 1200 \text{ N}$$

The right option is (d).

Sol.19 (b)

Tangential acceleration in a circular path = (Radius of circular path) \times (Angular acceleration).

$$a_T = r\alpha \dots (i)$$

$$\omega = \omega_0^2 + 2\alpha\theta$$

$$\omega_0 = 0$$

$$\omega = \frac{v}{r} = \frac{80}{20/\pi} = 4\pi \text{ rad} - \text{s}^{-1}$$

$$\theta = 2.2\pi \text{ radius}$$

$$\alpha = \frac{\omega^2}{2\theta} = \frac{(4\pi)^2}{2 \cdot (2.2\pi)} = 2\pi \text{ From Eqn. (i), we get:}$$

$$a_T = r\alpha = \frac{20}{\pi} = 40 \text{ m} - \text{s}^{-2}$$

The right option is (b).

Sol.20 (d)

If the external torque acting on a system is zero, the angular momentum remains conserved.

$$\tau_{\text{ext}} = 0 \Rightarrow \frac{dL}{dt} = 0$$

So, $L = \text{const} \Rightarrow I_1 \omega_1 = I_2 \omega_2 \dots (i)$

$$I_1 = Mr^2$$

$$\omega_1 = \omega$$

$$I_1 = Mr^2 + 4mr^2 \text{ Rewrite Eqn. (i):}$$

$$Mr^2 \omega = (Mr^2 + 4mr^2) \omega \Rightarrow \omega_2 = \frac{M\omega}{(M+4m)}$$

The right option is (d).

Sol. 21(b)

Assume that the ball takes T seconds to reach a maximum height H. Refer Fig. 3.11. Here, B is the point of maximum height.

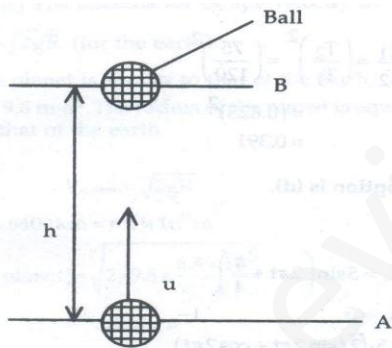


Fig. 3.11: At the maximum height, $v = 0$

$v = u - gT$ Now, $v=0$ when the ball is at height H So, $u=0-gT$ In (T-t) seconds, the velocity attained by the ball is:

$$v' = u - g(T - t) = u - gT + gT = u - g\frac{u}{g} + gT = u - u + gT = gT$$

Thus, the distance travelled in last t seconds:

$$CB = v't - \frac{1}{2}gt^2 = (gt) \cdot t - \frac{1}{2}gt^2 = gt^2 - \frac{1}{2}gt^2$$

$$= \frac{1}{2}gt^2$$

The right option is (b).

Sol.22 (b)

If the dot product of two vectors is zero, they must be perpendicular to each other.

$$\vec{F}_1 = \vec{A} + \vec{B} \dots\dots (i)$$

$$\vec{F}_2 = \vec{A} - \vec{B} \dots\dots(ii)$$

The sum of two forces is perpendicular to their difference.

Thus, we have:

$$\vec{F}_1 \cdot \vec{F}_2 = 0$$

$$(\vec{A} + \vec{B}) \cdot (\vec{A} - \vec{B}) = 0$$

$$A^2 - \vec{A} \cdot \vec{B} + \vec{B} \cdot \vec{A} - B^2 = 0$$

Hence, $A^2 = B^2$

Hence, $|\vec{A}| = |\vec{B}|$

So, the forces are equal in terms of magnitude.

The right option is (b).

Sol.23 (c)

The co- effective of static friction is equal to the tangent of the angle of friction.

$$\frac{f_s \max}{R} = \mu_s$$

$\mu_s =$ Co-efficient of static friction. $= \tan \theta$

The right option is (c).

Sol. 24 (c)

We have the formula (for gravitation):

$$v = u - gT \text{ (ball is going up)}$$

When the ball reaches the maximum height during its upward journey, its final velocity becomes zero.

$$\text{So, } v=0$$

$$\text{So, } 0 = u - gT$$

$$\text{Thus, } u = gT$$

If $T = 2 \text{ s}$ and $g = 9.8 \text{ m-s}^{-2}$, we have

$$U = 9.8 \cdot 2 = 19.6 \text{ m-s}^{-1}$$

The man is throwing a ball; it would reach its maximum height in 2 seconds. Now, he throws the second ball. At that point the first ball has already reached the maximum height and is stationary for a precise time frame. When he throws the third ball, the first one comes to the ground (time taken = 2 seconds). The second one would reach the maximum height by this time (time taken = 2 seconds). Thus, only two balls remain in the air. If the man wants to throw more than two balls in the air, he would have to throw the balls with a speed greater than 19.6 m-s^{-1} .

The right option is (c).

Sol.25 (b) and (d)

- (a) If the particle is at zero speed, its velocity is zero. Speed is the magnitude of velocity. If the magnitude is zero, velocity is also zero. The magnitude of non-zero velocity is non-zero. Hence, option (a) is incorrect.
- (b) If the particle has zero speed at an instant, it may have non-zero acceleration at that very instant. Take an example. A body is falling freely. The value of $g = 9.8 \text{ m-s}^{-2}$. So, its speed is zero. However, its acceleration is non-zero. Hence, option (b) is correct.
- (c) When it reaches a height, its final velocity is zero, not initial velocity. When a ball goes up, it becomes stationary at one particular instant due to the pull of the gravity. The initial velocity (While throwing it up) was non-zero but final velocity is zero (at the maximum height). Hence, option (c) is incorrect.
- (d) If the particle has a constant speed, it must have zero acceleration. The speed (magnitude) should remain the same. The direction should also remain the same. Hence, option (d) is correct.

Hence, option (b) and (d) are correct.

Sol.26 (b)

In resonant vibrations of a body, the frequency of external force applied on the body is equal to its natural frequency. If we increase and decrease the frequency of the external force from the natural frequency by a certain factor, the amplitude of vibrations becomes too less. If it reduces by a small factor, flat resonance occurs. The sharp and flat resonance will depend upon the damping present in the body that is creating resonant vibrations. The lower the damping, the greater the sharpness would be.

The right option is (b).

Sol.27 (d)

The situation has been shown in Fig. 3.12.

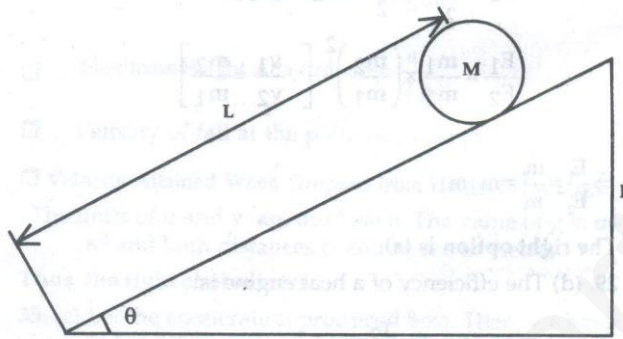


Fig. 3.12

The potential energy of the cylinder at the top will be converted into rotational kinetic energy and translational kinetic energy when it would start rolling down the inclined slope. Thus, energy remains conserved.

$$Mgh = \frac{1}{2}Mv^2 + \frac{1}{2}I\omega^2 = \frac{1}{2}Mv^2 + \frac{1}{2} \frac{MR^2}{2} \frac{v^2}{R^2} \left(\because I_{\text{cylinder}} = \frac{MR^2}{2} \right)$$

$$\text{So, } Mgh = \frac{1}{2}Mv^2 + \frac{1}{4}Mv^2$$

$$Mgh = \frac{3}{4}Mv^2$$

$$v^2 = \frac{4}{3}gh$$

$$v = \sqrt{\frac{4gh}{3}}$$

The right option is (d).

Sol.28 (a)

For a body, its linear momentum is conserved. From the law of conservation of linear momentum, we have:

$$P_{\text{initial}} = P_{\text{final}}$$

$$\text{Or } 0 = m_1 v_1 - m_2 v_2$$

$$\text{So, } m_1 v_1 = m_2 v_2$$

$$\text{Or } \frac{v_1}{v_2} = \frac{m_2}{m_1} \dots (i)$$

The ratio of their kinetic energies is as follows:

$$\frac{E_1}{E_2} = \frac{\frac{1}{2} m_1 v_1^2}{\frac{1}{2} m_2 v_2^2} = \frac{m_1}{m_2} \times \left(\frac{v_1}{v_2} \right)^2$$

$$\frac{E_1}{E_2} = \frac{m_1}{m_2} \times \left(\frac{m_2}{m_1} \right)^2 \left[\because \frac{v_1}{v_2} = \frac{m_2}{m_1} \right]$$

$$\Rightarrow \frac{E_1}{E_2} = \frac{m_2}{m_1} = m_2 : m_1$$

The right option is (a).

Sol.29 (d)

The efficiency of a heat engine is:

$$\eta = 1 - \frac{T_2}{T_1}$$

$$\Rightarrow \frac{W}{Q_1} = 1 - \frac{T_2}{T_1}$$

Q_1 = Heat absorbed from heat source = 6 kcal

T_1 = Temperature of sink K = 127+273=400K

Put these values in Eqn. (i):

$$\frac{W}{6} = 1 - \frac{400}{500}$$

$$\Rightarrow \frac{W}{6} = \frac{100}{500}$$

$$\Rightarrow W = 1.2 \text{ Kcal}$$

The right option is (d).

Sol. 30 (d)

The potential energy in a stretched spring is given by:

$$E = \frac{1}{2} kx^2$$

$$\Rightarrow \frac{E_1}{E_2} = \left(\frac{x_1}{x_2}\right)^2$$

$$x_1 = 2\text{cm} = 0.02\text{m}$$

$$x_2 = 10\text{cm} = 0.1\text{m}$$

$$\frac{E_1}{E_2} = \left(\frac{0.02}{0.1}\right)^2 = \left(\frac{1}{5}\right)^2 = \frac{1}{25}$$

$$\frac{E_1}{E_2} = \frac{1}{25}$$

Cross – multiplying, we get:

$$25E_1 = E_2$$

$$E_2 = 25E_1$$

Here, $E_1 = E$

$$\Rightarrow E_2 = 25 E$$

The right option is (d).

Sol.31 (c)

Young's Modulus is as follows: $y = \frac{Mgl}{\pi r^2 \Delta l} = \frac{Mgl}{\pi \left(\frac{D}{2}\right)^2 \Delta l} = \frac{4Mgl}{\pi D^2 \Delta l}$

$D =$ Diameter of wire $\text{Elongation} = \Delta l = \frac{4Mgl}{\pi D^2 y} \Rightarrow \Delta l \propto \frac{1}{D^2}$

For new cable, $\Delta l \propto \frac{1}{D^2}$

So, elongation will become one fourth of that for the new cable.

$\text{Load} = Mg = \frac{\pi D^2 \Delta l y}{4l} \Rightarrow Mg \propto D^2$

For new cable, $Mg \propto 4D^2$

So, if the diameter is doubled, the (new) cable can support four times the load that the old cable could.

The right answer is (c).

Sol. 32 (b)

All other conditions are true for Stoke's Law, except the condition given in option (b). The body must be perfectly rigid and smooth if Stoke's Law is to be applied to it. As per this law, the backward viscous flow acting on a small spherical body of radius moving a velocity v through a fluid having a viscosity η is given by:

$$F = k\eta r v$$

For small spheres, we have:

$$K = 6\pi$$

$$\Rightarrow F = 6\pi \eta r v$$

Hence, the right choice is (b).

Sol. 33 (c)

We have:

$$F = p\sqrt{x} + qt^2$$

$$[p\sqrt{x}] = [F]$$

$$[P] = \frac{[F]}{[\sqrt{x}]}$$

$$= \frac{MLT^{-2}}{L^{\frac{1}{2}}}$$

$$= ML^{1-\frac{1}{2}}T^{-2}$$

$$= ML^{\frac{1}{2}}T^{-2}$$

$$[qt^2] = [F]$$

$$q = \frac{[F]}{t^2} = \frac{MLT^{-2}}{T^2} = MLT^{-2-2} = MLT^{-4}$$

$$\Rightarrow \left[\frac{p}{q}\right] = \frac{ML^{\frac{1}{2}}T^{-2}}{MLT^{-4}}$$

$$= L^{\frac{1}{2}-1}T^{-2+4}$$

$$= L^{-\frac{1}{2}}T^2$$

Hence, the right option is (c).

Sol. 34 (c)

Some important equations must be kept in mind. They are as follows. For a body that is thrown vertically upwards, we have the following standard equations:

- Time of Flight = $\frac{2u}{g}$
- Time of Ascent = $\frac{u}{g}$
- Time of Descent = $\frac{u}{g}$
- Maximum Height Attained = $h = \frac{u^2}{2g}$
- Velocity of fall at ten point of projection = u
- Velocity Attained when Dropped from Height (h) = $2\sqrt{gh}$

The units of u and v are $m\text{-s}^{-1}$ each. The value of g is $m\text{-s}^{-2}$ and both distances (s and h) are in metres.

Thus, the right choice is (c).

Sol. 35 (c)

Let the acceleration produced be a . then, we have: $F = (m + m_1)a$

$$\Rightarrow a = \frac{F}{m+m_1} \text{ So, the force exerted by the rope on the block} = F'$$

$$F' = ma = m \frac{F}{(m+m_1)} = \frac{mF}{(m+m_1)}$$

Thus, the right option is (c).

Sol. 36 (b)

If the trains are moving in the same direction, the slow speed will be subtracted from the high speed and the net relative velocity will be in the direction of the fast train. Refer **Fig.3.13**

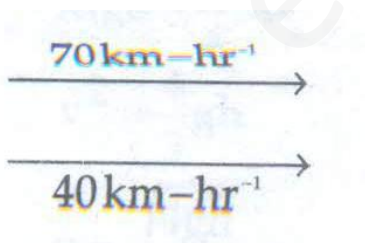


Fig. 3.13

$$\text{Relative velocity} = 70 - 40 = 30 \text{ km} - \text{hr}^{-1}$$

It is in the direction of the first train.

Thus, the right choice is (b).

Sol. 37 (d)

Refer Fig.3.14

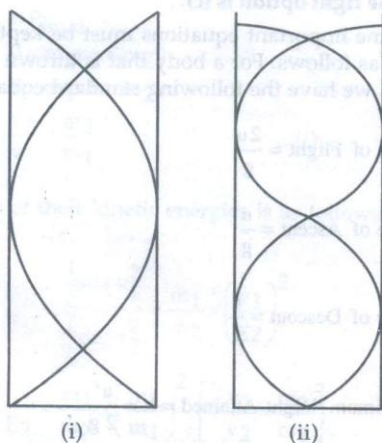


Fig. 3.14

Let the length of air columns be 1 each. Thus, we have

For mode (i) ↔ Part (i) of figure:

$$1 = 3$$

$$\lambda = \frac{41}{3} \dots (i)$$

$$\text{Frequency} = v_1 = \frac{v}{\lambda} = \frac{3v}{41}$$

For mode (ii) ↔ Part (ii) of figure:

$$L = \frac{5\lambda}{4}$$

$$\Rightarrow \lambda = \frac{41}{5}$$

$$\text{Frequency} = v_2 = \frac{v}{\lambda} \Rightarrow v_2 = \frac{5v}{41}$$

$$\frac{v_1}{v_2} = \frac{\frac{3v}{41}}{\frac{5v}{41}}$$

$$= \frac{3v}{41} \times \frac{41}{5v}$$

$$= \frac{3}{5}$$

$$\Rightarrow v_1 : v_2 :: 3 : 5$$

The right option is (d).

Sol.38 (a)

Reynolds's number is dimensionless. It determines the nature of the flow of liquid. The formula is as follows:

$$R_e = \frac{\rho v D}{\eta},$$

Where, R_e = Renold's Number,

ρ = density of fluid,

D = diameter of pipe and

η = Viscosity of liquid.

If $R_e < 2000 \Rightarrow$ la min ar flow

If $R_e > 3000 \Rightarrow$ turbulent flow

If $2000 < R_e < 3000 \Rightarrow$ unstable flow

The flow may change from laminar to turbulent and vice-versa. Also note that:

$$R_e = \frac{\text{Inertialforce per unit area}}{\text{Viscous force per unit area}}$$

Given, $R_e = 3120$ Hence, the flow of the liquid is turbulent. Thus, the right choice is (a).

Sol. 39 (d)

The **Assertion** is false. The RMS speed and average speed of molecules are different from each other. The Reason is false. The Maxwell distribution for the speed of molecules in a gas is asymmetrical.

The right option is (d).

Sol. 40 (b)

The **Assertion** is true. When a car moves ahead, its tyres face the frictional force exacted by the road. This friction causes the heating of tyres. A part of this heat goes inside the tyres and heats up the inner air, albeit only partially. The fast – moving air outside the tyres keeps cooling them. But a small part of heat does reach the air trapped inside the radial tyre and rubber tube. The air pressure inside each tyre increases due to this small heating effect. Continuous driving can increase the pressure further, for the tyre does not get many an opportunity to lose its heat.

The reason is not a correct explanation of the Assertion. This reason is not, in any way, contributing to tyre heating during the course of driving.

The right option is (b).

Sol.41 (b)

The Assertion is true. The average kinetic energy per molecule per degree of freedom is $\frac{1}{2} K_n T$.

This result was given by Boltzmann. It is also known as Law of Equipartition of Energy.

The Reason is true but it is not a correct explanation of the Assertion. A diatomic gas has 7 degrees of freedom.

The right option is (b)

Sol.42 (b)

The Assertion is true.

For a monatomic gas (say Helium), we have $\gamma = \frac{C_p}{C_v} = \frac{3}{5}$

For a diatomic gas (say Hydrogen), we have $\gamma = \frac{C_p}{C_v} = \frac{3}{5}$

The Reason is true. But this fact does not affect the Assertion; nor does it give any explanation for proving the supremacy of Assertion.

The right choice is (b).

Sol.43 (c)

The Assertion is true. For an ideal gas, the molecular forces among them. There can neither be internal PE nor internal energy due to their rotation or vibration. Thus, the molecules of an ideal gas can have translational KE.

The Reason is false. Gravity affects all gases. An ideal gas, which does not exist Prima Facie, would also be deemed under the influence of gravity.

The right choice is (c).

Sol.44 (d)

The Assertion is false. The RMS speed of the molecules of a gas is the square root of the mean of squared velocities of gas molecules in questions:

$$V_{\text{RMS}} = \sqrt{\frac{v_1^2 + v_2^2 + v_3^2}{3}}$$

The average speed of gas molecules is a different concept. Thus we have: $\bar{v} = \frac{v_1 + v_2 + v_3}{3}$

It is evident that $V_{\text{RMS}} \neq \bar{v}$. In actual practice, the formulae of both these speeds are different. Therefore, the Reason is also false. The formula states that $V_{\text{RMS}} = \bar{v}$. In actual practice, the formulae for both these speeds are different. So, the Reason is false. **The right option is**

Sol.45 (a)

The Assertion is true. The mean free path ($\bar{\lambda}$) is inversely proportional to the square of molecular diameter.

$$\Rightarrow (\bar{\lambda}) \propto \frac{1}{d^2}$$

The Reason is true and a correct explanation of the Assertion. We have: $\Rightarrow (\bar{\lambda}) \propto \frac{k_B T}{\sqrt{2} \pi d^2 \rho}$

We conclude that:

- (a) $\bar{\lambda} \propto m$ (mass of gas molecules)
- (b) $\bar{\lambda} \propto \frac{1}{\rho}$ (density of gas)
- (c) $\bar{\lambda} \propto \frac{1}{d^2}$ (square of molecule diameter)
- (d) $\bar{\lambda} \propto T$ (absolute temperature of gas) and
- (e) $\bar{\lambda} \propto \frac{1}{p}$ (pressure of gas)

Thus, the mean free path is inversely proportional to the square of molecule diameter.

The right option is (a).

PART B: CHEMISTRY

Sol. 46 (c)

All assumptions are correct, except (c). An electron cannot revolve around the nucleus in any arbitrary orbit. Rather, it can revolve only in an orbit in which its total angular momentum is equal to an integral multiple of $\frac{h}{2\pi}$. Here, h is Planck's constant. These orbits are stationary.

Refer Fig. 3.15

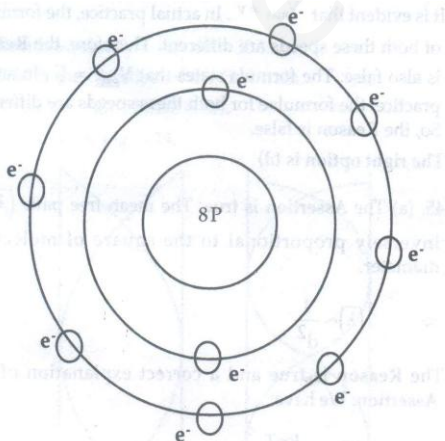


Fig. 3.15 Atoms are stable only if elements revolve in stationary orbits

The right option is (c).

Sol.47 (c)

Water molecules form weak hydrogen bonds. Refer Fig.3.16. The strong oxygen atom gets a slightly negative charge (δ^-) and hydrogen gets a slight positive charge (δ^+). That is because oxygen atom exerts more pull over electrons than hydrogen. Due to these polarities, the molecules form weak hydrogen bonds. Thus, spaces are trapped when water is frozen to form ice. When ice melts, the hydrogen bonds break. The space between molecules is eliminated and the volume of water becomes less than that ice had. That is why water or beer bottles are not kept in deep freezers. The empty spaces between molecules of water exert pressure. The ice blocks so formed may even explode.

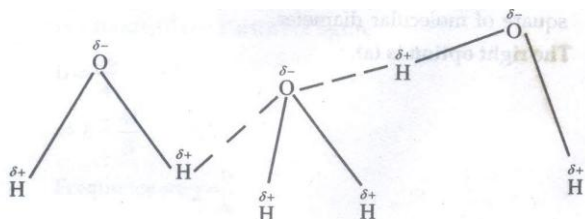


Fig. 3.16: Hydrogen bonding in water molecules

The right option is (c).

Sol. 48 (d)

A gas that obeys gas laws at all temperatures and pressures is called Ideal Gas. At very low pressure and very high temperature, gases have known to be obeying gas laws and thus we can assume that they act like ideal gases under such conditions.

The right option is (d).

Sol. 49 (b)

The algebraic sum of the oxidation numbers of all atoms in a compound is equal to zero. Let us take the example of H_2SO_4 (Sulphuric acid).

$$\text{Oxidation number of 2 H} = 2 \times (+1) = +2$$

$$\text{Oxidation number S} = +6$$

$$\text{Oxidation number of 4 O} = 4 \times (-2) = -8$$

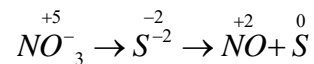
$$\text{Sum of oxidation numbers} = +2 + 6 - 8 = 0$$

The right option is (b).

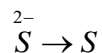
Sol. 50 (c)

Only reaction (c) has not been properly balanced. Let us balanced it.

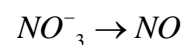
Step 1:



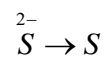
Step 2: Oxidation



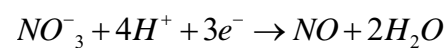
Step 3: Reduction



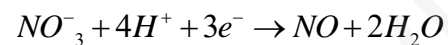
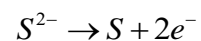
Step 4:



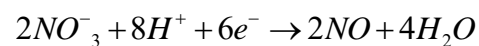
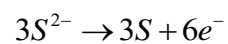
Step 5:



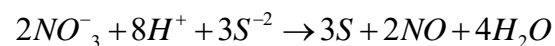
Step 6:



Step 7:



Step 8:



This right option is (c).

Sol. 51 (b)

The total KE of 1 mol of a gas is given by:

$$KE = \frac{3}{2}RT$$

Also note that KE per molecule is:

$$= \frac{3}{2}KT$$

$$\text{Boltzmann Constant} = K = \frac{R}{N}$$

And R = Gas constant

N = Avogadro 's number

$$= 6.02 \times 10^{23} \text{ atoms}$$

The mean KE of a gas is independent of the nature of the gas and directly proportional to the temperature of the gas.

The right choice is (b).

Sol. 52 (c)

The total number of elements in 1.6 grams of CH₄ can be calculated as follows.

$$\text{No. of mol of CH}_4 = \frac{1.6\text{g}}{10\text{g-mol}^{-1}}$$

$$= 0.1 \text{ mol}$$

1 mol of CH₄ has = 6.023 × 10²³ molecules

$$0.1 \text{ mol of CH}_4 \text{ has} = 6.023 \times 10^{23} \times 0.1$$

$$= 6.023 \times 10^{22} \text{ molecules}$$

No. of electrons in 1 molecules = 6+4=10

(Six from carbon, four from hydrogen)

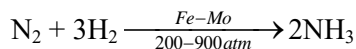
No. of electrons in 0.1 mol = 6.23 × 10²² × 10 or 1.6 f of CH₄

$$= 6.023 \times 10^{23}$$

The right option is (c).

Sol. 53 (d)

Nitrogen and hydrogen combine to form ammonia at high temperature and pressure. The Fe-Mo catalyst is present. Thus, we have:



The right option is (d).

Sol. 54 (c)

Clark's method uses slaked lime for removing the temporary hardness of water. In this reaction, insoluble carbonate is precipitated. Thus, we have: $\text{Ca}(\text{HCO}_3)_2 + \text{Ca}(\text{OH})_2 \rightarrow 2\text{CaCO}_3 + 2\text{H}_2\text{O}$

The right option is (c).

Sol. 55 (b)

Boron can be obtained by reducing B_2O_3 with Mg at high temperatures: $\text{B}_2\text{O}_3 + 3\text{Mg} \xrightarrow{\text{High}\Delta} 2\text{B} + 3\text{MgO}$

The right choice is (b).

Sol. 56 (c)

NaOH is an alkali in the choice (c). It is widely used in industry. Upon mixing it with water, it gives Na^+ ions and OH^- ions.

The right option is (c).

Sol. 57 (c)

Carbon dioxide dissolves in water to give Carbonic acid. However, this is not a stable compound. Thus, we have: $\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3$

The right option is (c).

Sol. 58 (c)

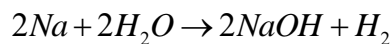
Boron has the highest electronegativity in the boron family. The data has been shown in Table 3-I.

S. No.	Element	Electronegativity
1.	B	2.0
2.	Al	1.5
3.	Ga	1.6
4.	In	1.7
5.	Tl	1.8

The right option is (d).

Sol. 59 (b)

This is very violent reaction. Hydrogen gas is produced in this reaction.



The right option is (b).

Sol. 60 (c)

The correct formula for Epsom salt is Epsom Salt: $MgSO_4 \cdot 7H_2O$

It is a salt of MG which is an s-block element. The atomic number of Mg is 12 and its electronegativity is 1.2. It has two electrons in its 3 s orbit.

The right option is (c).

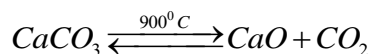
Sol.61 (d)

Potassium is a silvery white metal. It is softer than sodium. All other properties regarding potassium are true.

The right option is (d).

Sol.62 (a)

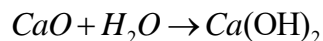
Lime stone, when heated at high temperature, yields CaO or Quick Lime.



The right option is (a).

Sol. 63 (d)

Water can be added to quick lime for preparing slaked lime. Thus, we have:



Slaked lime [$Ca(OH)_2$] has all the uses mentioned in the question statement.

The right option is (d).

Sol. 64 (b)

A free radical has one unpaired electron. It is paramagnetic in nature. The stability of free radical follows this order:

Tertiary > Secondary > Primary

The right option is (b).

Sol. 65 (d)

We have:



At the point equilibrium, we have:

$$PN_2O_4 = 0.28 \text{ atm (given)}$$

$$PNO_2 = 1.1 \text{ atm (given)}$$

$$Kp = \frac{(PNO_2)^2}{PN_2O_4} = \frac{(1.1)^2}{0.28} = 4.32 \text{ atm}$$

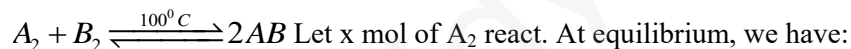
The right option is (d).

Sol.66 (d)

If a system at equilibrium is subjected to stress, its equilibrium shifts in such a way that it mollifies the effects of the stress causing it. the stress can be a change in pressure, concentration or temperature. This is the renowned **Le Chatelier's Principle**.

The right option is (d).

Sol. 67 (b)



$$A_2 = \frac{(1-x)}{3} \quad B_2 = \frac{(2-x)}{3} \quad AB = \frac{2x}{3}$$

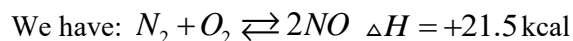
$$K = \frac{[AB]^2}{[A_2][B_2]} = \frac{(2x/3)^2}{\left[\frac{1-x}{3}\right]\left[\frac{2-x}{3}\right]}$$

But $k=50$, Solve for x , we get $x=0.935$

Hence, number of mol of AB formed in the reaction $=2 \times 0.935=1.870$

The right option is (d)

Sol. 68 (b)

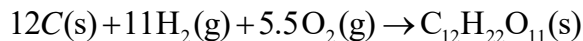


If the concentration of N_2 is increased in this reaction, NO is formed easily and at a faster rate.

The right option is (b).

Sol. 69 (b)

Let us take the example of cane sugar to explain the concept. The heat of formation of cane sugar is the heat of the following reaction.



The heat of formation is the change in enthalpy when one mole of a substance is formed from its elements. But the enthalpies of substances in their chemical state are assumed to be zero. At all temperatures, the heat of formation is given by:

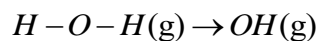
$$\Delta H_f = H_2 - H_1 = H_2 - 0 = H_2$$

Hence, the heat of formation of a substance is the enthalpy of that substance.

The right choice is (b).

Sol.70 (c)

Bond energy of H₂O can be discussed as an example. The energy needed to break each O-H bond in water is different.



$$\Rightarrow \Delta H_1 = 500kJ$$



$$\Rightarrow \Delta H_2 = +428kJ$$

Bond Energy of O-H Bond in H₂O:

$$= \frac{\Delta H_1 + \Delta H_2}{2}$$

$$= \frac{500 + 428}{2}$$

$$= \frac{928}{2} = 464J$$

The right option is (c).

Sol.71 (a)

For an isochoric process, the value of ΔV is zero.

The right choice is (a).

Sol. 72 (d)

In the recent times, Environmental Chemistry has become a key branch of the chemical sciences in the wake of growing threats to our environment. Chemical engineers and chemists devoted to environmental protection aver that sulphur (S) and nitrogen (N) are the chief culprits that contribute towards the production of acid rain. Sulphur finally yields H_2SO_4 . Nitrogen finally yields HNO_3 . Both these acids fall on the earth in the form of acid rain. They destroy crops, soil fertility, building edifices, marble statues and micro-organisms present in soil.

The right option is (d).

Sol. 73 (d)

An electron-loving species is called Electrophile.

E.g: Br^+ , Cl^+ , NO_2^+ , NO^+ , SO_3 , R_3C , BF_3 , AlCl_3 , ZnCl_2 , etc.

The right option is (d)

Sol.74 (c)

A nucleus-loving species is called Nucleophile.

E.g: Cl^- , Br^- , OH^- , SH^- , OR^- , HSO_3^- , $\text{RC}\equiv\text{C}^-$, $\text{CH}_3\text{COCH}_2^-$

The right option is (c).

Sol. 75 (d)

Inpolymerisation simple molecules that take part in the reaction are called Monomers.

Polymerisation can be of two types – Addition Polymerisation and Condensation Polymerisation.

The right option is (d).

Sol.76 (b)

Oil paintings contain a white pigment which is $2\text{PbCO}_3\text{Pb(OH)}_2$. In the earth's atmosphere, H_2S (g) is present in small traces. It reacts with this white pigment and forms PbS . The white pigment is discoloured due to this reaction. When restoration experts use H_2O_2 on these paintings, H_2O_2 oxidizes PbS into PbSO_4 which is white in terms of colour. Thus, the original colours and white shades of the painting in question are restored.

The right option is (b).

Sol. 77 (c)

Phenol is a weak acid and it is weaker than carbonic acid.

The right option is (c).

Sol.78 (c)

In this reaction, H₂O acts as an acid and OH acts as a base.

The right option is (c).

Sol.79 (b)

The salts of strong acids and strong bases, when dissolved in H₂O, gave strong acids and bases, respectively. The presence of high ionic concentration does not allow them to undergo hydrolysis.

The right option is (c)

Sol. 80 (c)

The decreasing order of electron affinity is:

Cl > F > Br

The right option is (c).

Sol.81 (b)

When H₂O₂ is decomposed, it easily gives nascent oxygen. Thus, H₂O₂ acts as a better oxidizing agent than H₂O because it is not easy to decompose H₂O through simple physical means.

The right option is (b).

Sol.82 (d)

This is a free radical reaction. It is known as free Radical Reaction because in this reaction, the free radical attacks first. It is catalyzed by light or high temperature. Non-polar solvents are used too.

The right option is (d).

Sol. 83 (b)

$\Delta H = H_{Products} - H_{Reactants}$ if ΔH is negative, heat will be evolved during the course of reaction. Such a reaction is called Exothermic Reaction.

The right option is (b).

Sol.84 (d)

The first law of thermodynamics states that $\Delta E = q + w$

So, the entire energy is to be accounted for by heat (q) or work (w) in case an interaction takes place between a system and its surroundings.

The right option is (d).

Sol.85 (d)

The water bodies of the world have high levels of Hg, As, Cr, Sr, Cu and Pb. All these metals can harm marine life as well as humans. The steps mentioned in options (a), (b) and (c) are correct suggestions.

The right choice is (d).

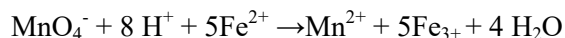
Sol.86 (a)

At absolute zero, the molecular motion comes to a standstill. The KE of molecules is zero at this stage. So, it is impossible to cool a gas below a temperature of absolute zero. That is because there is no heat left in the gas that could be removed.

The right choice is (a).

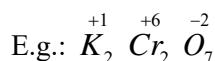
Sol.87 (c)

We can take an example here:



Fe^{2+} is oxidized to Fe^{3+} because its oxidation number increases from +2 to +3. MnO_4^- is reduced to Mn^{2+} because its oxidation number decreases from +7 to +2. So, MnO_4^- is an oxidizing agent in this reaction. Further Fe^{2+} is acting as a reducing agent in this reaction.

Note that the concept of oxidation number is used for identifying the species that have undergone oxidation or reduction in a Redox reaction.



Here, oxidation number of K = +1

Oxidation number of Cr = +6

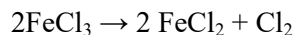
Oxidation number of O = -2

These numbers have been written above their respective elements.

The right choice is (c).

Sol. 88 (a)

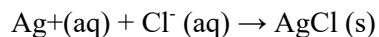
Note that FeCl_3 is being reduced in this reaction. It has faced a reduction in its oxidation state.



The right option is (a).

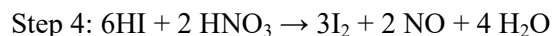
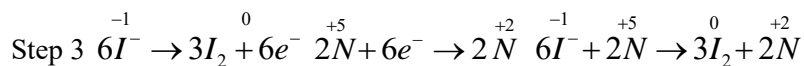
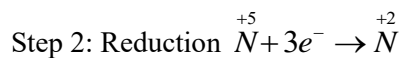
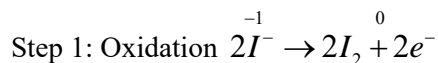
Sol.89 (c)

Ag⁺ ions were neither oxidized nor reduced in this reaction.



The right option is (c).

Sol. 90 (b)



The right option is (b).

PART C: BOTONY

Sol.91 (b)

The root hair zone also represents the zone of differentiation or maturation because different types of primary tissues differentiate or mature in this region (Viz. xylem, phloem, pericycle, endoderm's, cortex, epiblema, etc.) Refer Fig.3.17

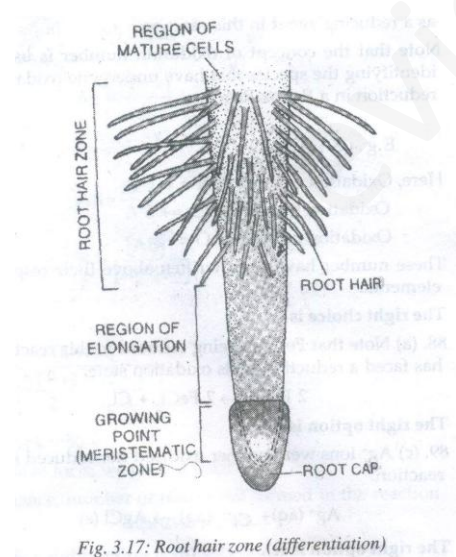
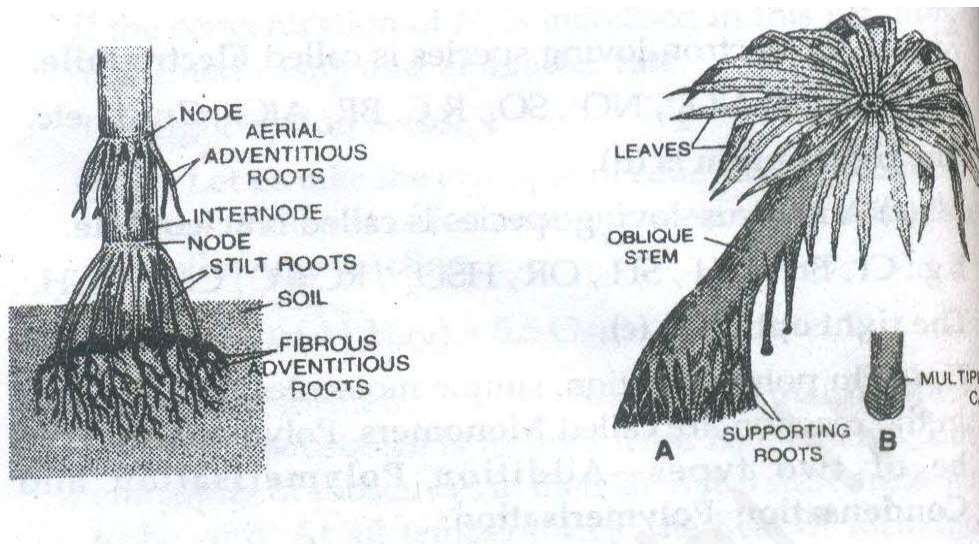


Fig. 3.17: Root hair zone (differentiation)

The right option is (b).

Sol.92 (a)

Stilt roots are short but thick supporting roots which develop obliquely from the basal nodes of the stem.
Refer Fig. 3.18



The right answer is (a)

Sol. 93 (d)

Phloem is made up of sieve tubes, companion cells and phloem parenchyma. Sieve tubes conduct organic food. Phloem parenchyma cells store food and help in the lateral conduction of food. Companion cells are supposed to control the function of sieve tubes.

The right answer is (d).

Sol. 94 (c)

In Maize leaf the undifferentiated mesophyll occurs in concentric layers around vascular bundles having large centrifugal chloroplasts in its large bundle sheath cells. Such an arrangement is called **Kranz Anatomy**.

The right answer is (c).

Sol.95 (d)

Osmotic pressure can be defined as the pressure required to completely stop the entry of water into an osmotically active solution across a semi-permeable membrane. It is numerically equal to osmotic potential (=solute potential, ψ). Osmotic potential has a negative value but osmotic pressure (T_i , P_i) has a positive value ($P = -T_i$). The instrument used for measuring osmotic pressure is called Osmometer.

The right answer is (d).

Sol. 96 (d)

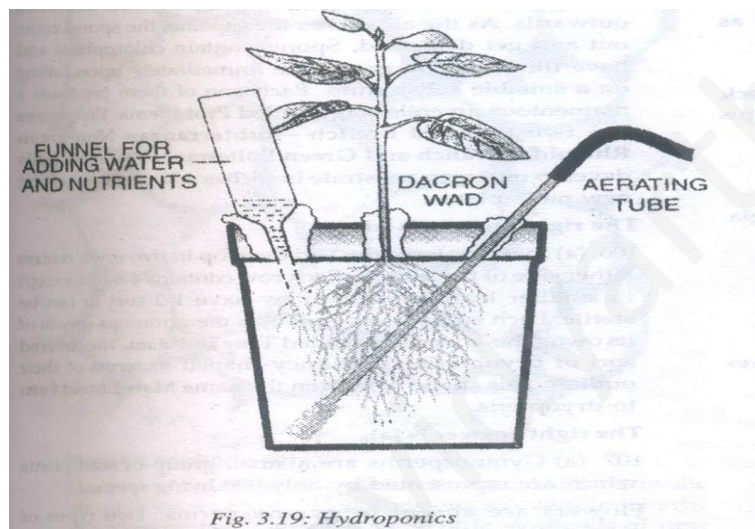
The chemical potential of pure water at normal temperature and pressure is zero. In solutions, the value of water potential is always negative (less than zero).

The right answer is (d).

Sol. 97 (c)

Solution culture is being used for raising flowers and vegetables at home. This production of plants sans soil is called Hydroponics. Plants are raised in small tanks of concrete or metal. The upper covering has support for plants. Narrow tanks are filled up with nutrient solutions. A pump circulates air as well as nutrient solutions. Roots of the plants are, therefore, regularly supplied aerated nutrient solutions, Hydroponics is useful in areas having thin, infertile and dry soil. They conserve water.

Additionally hydroponics can regulate pH for a particular crop, control soil-borne pathogens, avoid problems of weeding and obtain consistently better yield. **Refer Fig. 3.19**



The right answer is (c)

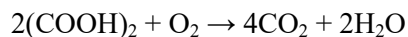
Sol. 98 (a)

Crassulacean acid Metabolism (CAM) is a mechanism of photosynthesis involving the double fixation of CO_2 which occurs in succulents belonging to crassulaceae, cacti, euphorbias and some other plants of dry habitats. In these habitats, stomata remain closed during the day and open only at night.

The right answer is (a).

Sol.99 (d)

A value of slightly more than unity is found in RQ when organic acids are broken down as respiratory substrates under aerobic conditions. Read this reaction; here, Oxalic acid is being treated with oxygen:



$$\text{RQ} = \frac{4\text{CO}_2}{\text{O}_2} = 4.0$$

The right answer is (d).

Sol.100 (d)

The first natural cytokinin was obtained from unripe maize grains or kernels by Lethamet. Al (1964). It is known as Zeatin (6- hydroxyl 3-methyl trans 2-butenyl amino-purine). It is also found in coconut milk.

Refer Fig.320.

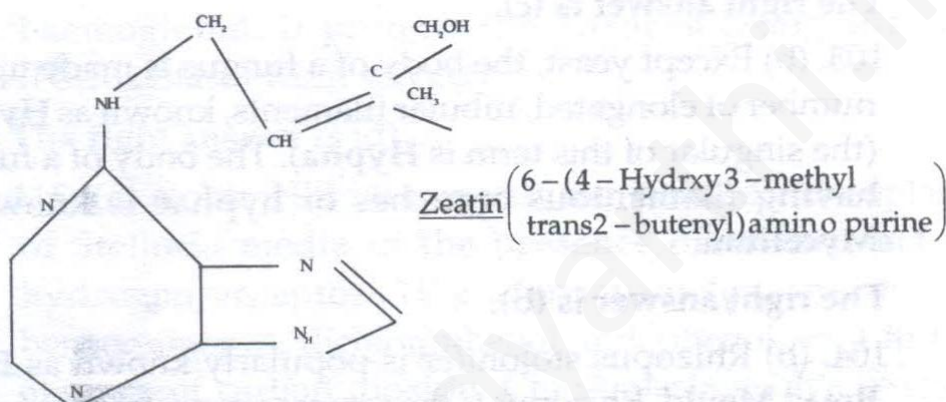


Fig. 3.20: Zeatin

The right answer is (d).

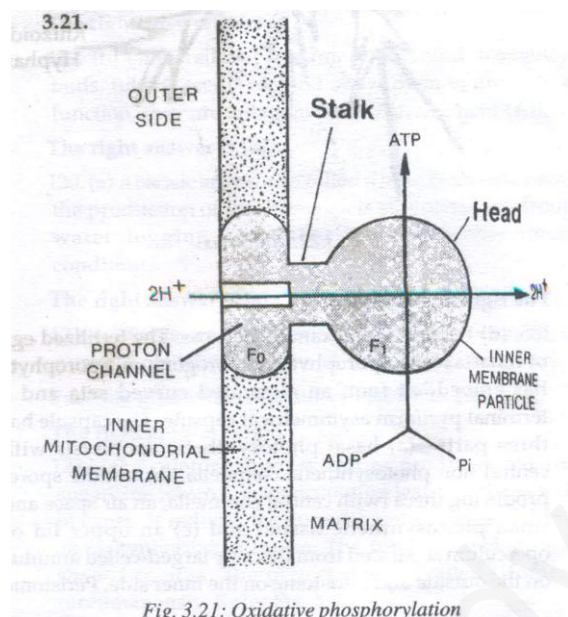
Sol. 101 (a)

Short- day plants flower when the photo period or day length is below a critical period. Most of winter flowering plants to this category. E. g: Xanthium, Chrysanthemum, Cosmos bipinnatus, Aster, Dahila, Rice and sugarcane.

The right answer is (a).

Sol. 102 (c)

Oxidative phosphorylation is the synthesis of energy-rich ATP molecules with the help of energy liberated during the oxidation of reduced co-enzymes (NADH, FADH₂) produced in the respiration process. The enzyme required for this synthesis is called ATP synthase. It is considered to be the fifth complex of electron transport chain. ATP synthase is located in F₁ or head –piece of F₀-F₁ or elementary particles. These particles are present in the inner mitochondrial membrane. ATP synthase becomes active in ATP formation only where there is a proton gradient having higher concentration of H⁺ ions or protons on the F₀ side as compared to F₁ side (Chemiosmotic Hypothesis of Peter Mitchell). Refer Fig. 3.21



The right answer is (c).

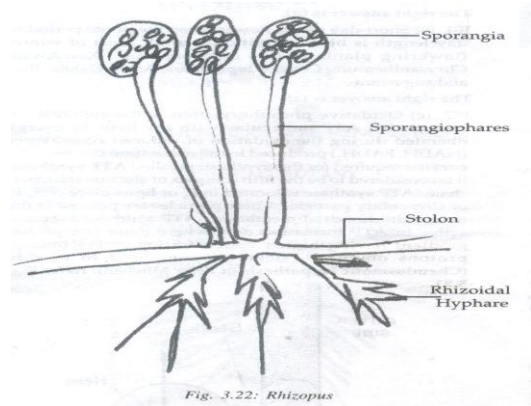
Sol.103 (b)

Except yeast, the body of a fungus is made up of a number of elongated, tubular filaments, known as Hyphae (the singular of this term is **Hypha**). The body of a fungus having filamentous branches or hyphae is known as **Mycelium**.

The right answer is (b).

Sol.104 (b)

Rhizopusstolonifer is popularly known as **Black Bread Mould**. Rhizopus is the common saprotrophic fungus that attacks a variety of food items. **Refer Fig. 3.22**



The right answer is (b).

Sol. 105 (d)

Funaria is an example of moss. The fertilized egg of funaria forms sporophyte or sporogonium. Sporophyte has embedded foot, an elongated curved seta and a terminal pyriform asymmetrical capsule. The capsule has three parts – (a) basal photosynthetic apophysis with central non photosynthetic columella, (b) middle sporeproducing theca (with central columella, an air space and small photosynthetic tissue) and (c) an upper lid or operculum separated from theca by large-celled annulus on the outside and peristome on the inner side. Peristome consists of 32 acellular teeth that are arranged in two whorls – an outer hygrosocopic and an inner non- hygrosocopic. As spores become mature, annulus shrivels and operculum falls down. The outer peristome teeth bend outwards. As the air shakes the capsule, the spores come out and get dispersed. Spores contain chloroplasts and have the ability to germinate immediately upon falling on a suitable substratum. Each one of them produces a filamentous juvenile stage, called **Protonema**. Protonema has two types of branch - **subterranean Non-green** Rhizoidal Branch and Green Epiterranean Branch. Buds develop on green prostrate branches which grow to form new moss plants.

The right answer is (d).

Sol. 106 (a)

In dryopteris, the sori develop in two rows, one on either side of the midrib. Each row contains 4-6 sori, except in smaller leaflets which may have 1-2 sori or can be sterile. Each sorus is covered by a membranous sheath of its own. This covering is called True Indusium. The covered sori of dryopteris are kidney-shaped in terms of their outline. This shape has given the name Male Shield Fern to dryopteris.

The right answer is (a).

Sol.107 (a)

Gymnosperms are a small group of seed plants which are represented by only 900 living species.

Flowers are absent in gymnosperms. Two types of sporophyll – **microsporophyll** and mega sporophyll – are usually aggregated to form distinct cones or strobili. The pollen cones are male cones and seed cones are female cones. Seeds do not occur inside a fruit. They are naked.

The right answer is (a).

Sol. 108 (c)

The flowers and fruits are found only once after a vegetative growth of several years in monocarpic plants. Thus, perennial plants are monocarpic.

The right answer is (c).

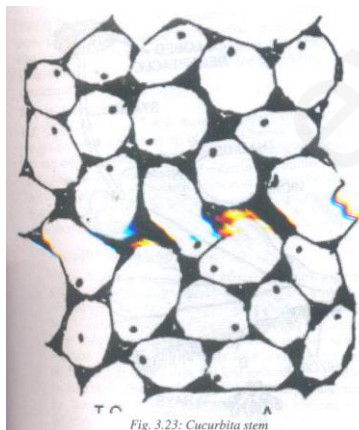
Sol. 109 (c)

Sclereids are highly thickened dead sclerenchyma cells with very narrow cavities. Sclereids are broader as compared to fibres, being isodiametric polyhedral, spherical, oval short or cylindrical. They may also be branched. The thick cell walls have branched or unbranched simple pits. Since they are elongated, the pits of sclereids are also known as **Pit Canals**.

The right answer is (c).

Sol. 110 (b)

The thickenings are found on the walls bordering intercellular spaces (lanceolate thickenings) are called **Lacunate Collenchymas**. Example: Cucurbita stem has been shown here. **Refer Fig. 3.23**



The right answer is (b).

Sol. 111 (a)

In many cases, a quiescent centre is found in the centre of the root apex. Cell divisions are very few in the quiescent centre as there is very little synthesis of new proteins, RNA and DNA. The quiescent centre may function as a reserve meristem. Due to the presence of a quiescent centre, the root apical meristem appears cup- shaped or hemispherical.

The right answer is (a).

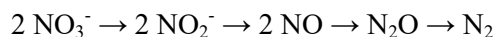
Sol. 112 (a)

Transpiration is measured with the help of the photometer. The size of stomata is measured with the help of the porometer. Atmospheric pressure is measured with the help of the manometer. Finally, osmotic pressure is measured with the help of the osmometer.

The right answer is (a).

Sol. 113 (d)

Under anaerobic conditions, some micro- organisms use nitrate and other oxidized ions as sources of oxygen. In this process, nitrate are reduced to gaseous compounds of nitrogen. The latter escape from the soil. The common bacteria that cause denitrification of soil are *Pseudomonas denitrificans* and *Thiobacillusdenitrificans*.



The right answer is (d).

Sol. 114 (d)

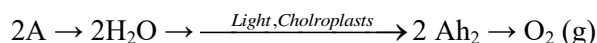
In an infected cell, bacterioids occur in groups surrounded by a host membrane. The host cell

Develops a pinkish pigment, called **Leg haemoglobin (Lb)**. It is an oxygen scavenger and is related to blood pigment, haemoglobin. It protects the nitrogen – fixing enzyme (Nitrogenase) from oxygen.

The right answer is (d).

Sol. 115 (d)

Robin Hill illuminated the isolated chloroplasts of *Stellaria media* in the presence of leaf extract or hydrogen acceptors (E.g :ferricyanicles, chromates, benzoquinones, dichlorphenol, indophenol, etc.) in the absence of carbon dioxide. Chloroplasts evolve oxygen gas.



Here, A is a nitrogen acceptor.

The right answer is (d).

Sol. 116 (c)

Continuous photosynthesis can occur in continuous illumination without any harm to the plant through the root of photosynthesis may slightly decline after six days.

The right answer is (c).

Sol. 117 (a)

Food reaches every cell of an organism so that respiration may take place. It is called Cellular Respiration. During the course of cellular respiration, food substances are oxidized. This phenomenon occurs in cytoplasm and mitochondria.

The right answer is (a).

Sol. 118 (c)

ATP is broken down to release energy whenever and whenever energy is to be utilized. This energy (stored in ATP) is utilized for carrying out different cellular activities, thus, ATP acts as the energy currency of the cell.

The right answer is (c).

Sol. 119 (b)

Gibberellins overcome the natural dormancy of buds, tubers, seeds etc. and allow them to grow. In this function, they are antagonistic to Abscisic acid (ABA)

The right answer is (b).

Sol. 120 (a)

Abscisic acid is also called Stress Hormone because the production of this hormone is stimulated by drought, water logging and after adverse environmental conditions.

The right answer is (a).

Sol. 121 (a)

Rusts are characterized by the formation of rusty pustules containing spores. A basidiocarp is absent. Pucciniagraministritici causes black rust in wheat.

Sol. 122 (c)

Colletotrichum falcatum produces red rot of sugarcane which is conspicuous on leaf midribs as well as in canes. It reduces the juice content of canes and brings about withering of leaves. The fungus develops sickle shaped conidia. The perfect stage is called **Glomerellatuccumanensis**. Refer Fig. 3.24

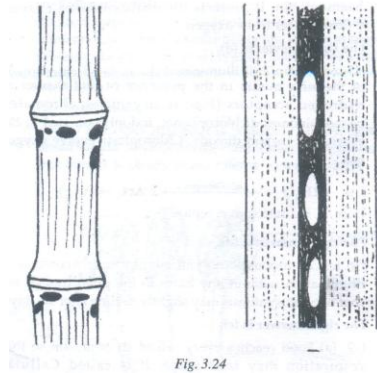


Fig. 3.24

The right answer is (a).

Sol. 123(d)

Sexually, *Marchantia* is dioecious with sex organs borne on stalked upright receptacles or gametophores. The gametophore of female thallus is called Archegoinophore. Its receptacle has nine cylindrical processes or rays. The upper surface of the female receptacle is convex and bears only air chambers. Each lobe of the receptacle has a patch of hanging archegonia on the under surface, with younger archegonia towards the stalk and older archegonia towards the periphery. A two-lipped hanging membrous covering or perichetium occurs around each archegonial patch. Refer Fig. 3.25.

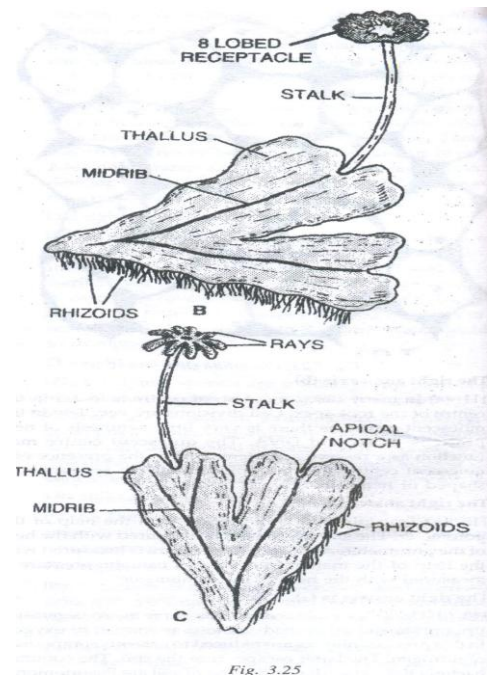
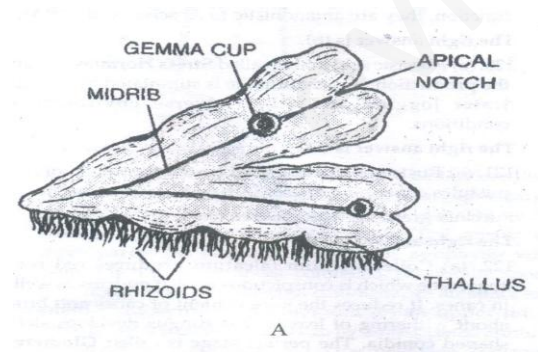


Fig. 3.25

The right answer is (d).

Sol. 124 (c)

The phloem of angiosperms possesses sieve tubes and companion cells.

The right answer is (c).

Sol. 125 (a)

Saprophytes obtain their nourishment from dead decaying organic matter. They are also called **Humus Plants**. E. g: Monotropa and Neottia.

The right answer is (a).

Sol. 126 (d)

Three leaves (as in Nerium and Vernonia) or more than three leaves (as in Alstonia) develop from a single node. The leaves of one whorl generally alternate with those of the adjacent whorls for providing the maximum exposure.

The right answer is (d).

Sol. 127 (d)

Endodermis or the inner boundary of Cortex is single-layered. It is made up of barrel-shaped cells which do not enclose intercellular spaces. The young endoderm cells possess an internal strip of suberin and lignin which is known as **Casparian Strip**. However, it soon becomes indistinguishable due to the additional thickening of the endodermal cells.

The right answer is (d).

Sol. 128 (c)

At places, the upper or adaxial epidermis contains groups of larger thin-walled protruding and turgid cells over the region of veins. They are called **Bulliform** or **Motor Cells**. These cells are highly vacuolated and can store water if it is available. However, in case of water deficiency, the bulliform cells lose water and become flaccid. As a result of this, the leaf gets rolled up so as to reduce the exposed surface. Bulliform cells are also useful for the unrolling of leaf during the course of its development.

The right answer is (c).

Sol. 129 (b)

Cohesion-Tension and Transpiration Pull Theory was put forward by Dixon and Jolly (1894). It was further improved by Dixon (1914). Therefore, this theory has named after him as Dixon's theory of Ascent of Sap. Today, most scientists believe in this theory.

The right answer is (b).

Sol. 130 (a)

Bleeding is the exudation of sap or watery solution from the cut or injured parts of a plant. E.g: Agave, Acer, Vitis, toddy palm, etc. it occurs due to root pressure, phloem pressure, local pressure in xylem (stem pressure) and latex or resin. **The right answer is (a).**

Sol. 131 (a)

Silicon is required by most grasses and cereals. Its deficiency produces **Leaf necrosis** and stunted growth in rice.

The right answer is (a).

Sol.132 (a)

The essential elements derived from soil are termed as **Mineral Elements**. Essential elements obtained from air or water are known as Non-mineral Elements. E.g: Carbon, Hydrogen and Oxygen. They are the building blocks of macromolecules that form the bulk of plant body. Carbon is the most abundant element in plants.

The right answer is (a).

Sol.133 (b)

Photosystem I is a photosynthetic pigment system along with some electron carriers. It is located on both the non-appraised part of Grana thylakoids and stroma thylakoids. PS 1 has more of chlorophyll b and carotenoids are comparatively less.

The right answer is (b).

Sol.134 (b)

Carbon dioxide can be fixed in the dark. The biosynthetic phase or dark reaction catalyses the assimilation of CO₂ to form carbohydrates. These reactions are called Carbon Reactions. They occur in stroma or matrix of chloroplasts. These reactions do not require light. Instead, an assimilatory power (ATP and NADPH) produced during the photochemical phase is used up in the processes of fixation and reduction of carbon dioxide. All enzymes required for the process are present in the matrix or stroma of the chloroplast.

The right answer is (b).

Sol. 135 (a)

In micro-organism, the term fermentation is more commonly used where anaerobic respiration is known after the name of the product like alcoholic fermentation, lactic acid fermentation, etc. Carbon dioxide is evolved in some cases. It gives a frothy appearance (Latin – Fermentum means “to boil”) to the medium. Buchner (1897) was the first to find that fermentation can be caused without the living yeast cells by grinding them under pressure and mixing the extract was named as Zymase. Fermentation can be defined as the anaerobic breakdown of carbohydrates and other organic compounds into alcohols, organic acids, gases, etc. with the help of micro-organism or their enzymes.

The right answer is (a).

PART D: ZOOLOGY

Sol. 136 (c)

The cell size of kingdom Monera varies from 0.1 to 5 μm . Thus, option (c) is incorrect in the context of Kingdom Monera.

The correct answer is (c).

Sol.137 (a)

The interval between the entry of the sporozoite into the human blood and first appearance of fever is called **Incubation Period**. It is about 14 days in the case of Plasmodium vivax. During this period, parasites multiply to increase their number so that they are able to produce enough toxins to cause malaria.

The correct answer is (a).

Sol. 138 (a)

A contractile vacuole is present for osmoe- regulation. The excess of water is passed out by one or more contractive vacuoles. Refer Fig. 3.26.

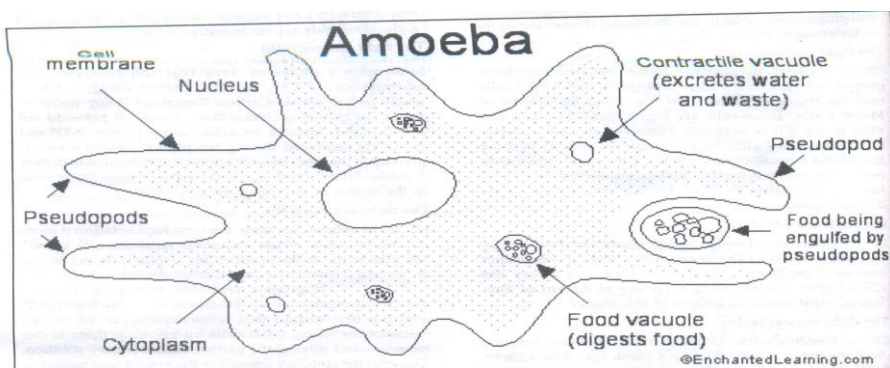


Fig. 3.26

The correct answer is (a).

Sol. 139 (d)

Numerous dermal placoid scales are embedded in the skin of cartilaginous fish and form the exoskeleton of the fish.

The correct answer is (d).

Sol. 140 (a)

The correct answer is (a).

Sol.141 (a)

The hyaline cartilage contains clear and large amounts of translucent slightly elastic matrix with less fibres. The matrix often has very fine white fibres which are difficult to observe. It is the most prevalent cartilage.

The correct answer is (a).

Sol. 142 (d)

The nucleus of basophils is usually three-lobed. They have less number of coarse granules. Their granules take basic starch (like methylene blue) strongly. Both mast cells and basophils liberate Histamine and Heparin as well as smaller quantities of Bradykinin and Serotonin. They are probably like the mast cells of connective tissues.

The correct answer is (d).

Sol. 143 (b)

The glossopharyngeal nerve supplies the taste buds of tongue and muscles of the pharynx. Some fibres carry impulses from tongue, while the other fibres are responsible for pharynx movement as they are concerned with the swallowing reflex. Thus, both sensory and motor nerve fibres are present in this nerve. The nature of this nerve is mixed.

The correct answer is (b).

Sol. 144 (b)

Lateral oesophageal blood vessels is a pair of blood vessels lying one on either ventrolateral side of the alimentary canal in the first fourteen segments. Both these lateral oesophageal vessels collect blood from the buccal cavity, pharynx, oesophagus and the body wall through oesophageo- tegumentaries and carry this blood to the supraoesophageal vessel through two pairs of anterior loops situated in the 10th and 11th segments.

The correct answer is (b).

Sol. 145 (a)

Totipotancy or cellular totipotency is the ability of a living somatic nucleated cell to form a complete organism.

The correct answer is (a).

Sol. 146 (d)

Lysosomes are believed to be formed through the joint activity of endoplasmic reticulum endosomes and the golgi complex (GERL system). The precursors of hydrolytic enzymes are mostly synthesized at the rough endoplasmic reticulum. The latter transfers them to the forming face of the golgi complex either directly or from the smooth endoplasmic reticulum through its vesicles. In the golgi complex, the precursors are changed into enzymes. The enzymes are then packed in larger vesicles which are pinched off from the maturing face. Golgian vesicles are joined by endosomes for producing lysosomes.

The right answer is (d).

Sol. 147 (c)

Chitin is a complex carbohydrate of heteropolysaccharide type which is found as the structural component of fungal walls, chitin is often known as **Fungus Cellulose**.

The right answer is (c).

Sol. 148 (b)

Some disaccharides possess the reducing groups. The reaction is used for detecting glucose in urine. Benedict's solution comprises a blue – coloured alkaline solution of copper (cupric) sulphate. The reducing sugar changes into insoluble reddish cuprous oxide upon gentle heating. Cuprous oxide separates as a precipitate. The final precipitate may appear green, yellowish, Orange to brick red, depending upon the amount of reducing sugar.

The right answer is (b).

Sol. 149 (c)

Trypsinogen $\xrightarrow[\text{of Intestinal Juice}]{\text{Enterokinase}}$ Trypsin (Proenzyme)

The right answer is (c).

Sol.150 (c)

Vitamin B₁₂ (cyanocobalamin, cobalamin) causes Pernicious anaemia. It is reported in spirulina (anolga).

The right answer is (c).

Sol.151 (b)

Emphysema is an inflation or abnormal distension of the bronchioles or alveolar sacs of lungs.

The right answer is (b).

Sol.152 (a)

Mountain sickness is commonly developed in persons who visit high- altitude places for the very first time. In case of mountain sickness, symptoms occur mostly in the digestive and nervous system of the human body.

The right answer is (a).

Sol.153 (c)

A normal Electro Cardio Gram (ECG) is composed of a P-wave, a QRS wave (complex) and a T-wave. The letters are arbitrarily selected and do not stand for any particular words.

The P wave is a small upward wave that represents electrical excitation or atrial depolarization which leads to contraction of both the atria (atrial contraction). It is caused by the activation of S node. The impulses of contraction start from the SA node and spread throughout the atria.

The QRS wave (complex) begins after a fraction of second of the P-wave. It begins as a small downward deflection (Q) and continues as large upright (R) and triangular wave, ending as a downward wave (S) at its base. It represents ventricular depolarization (ventricular contraction). It is caused by the impulses of contraction from the AV node through the bundle of His and Purkinje fibres and the contraction of ventricular muscles. Thus, this wave is due to the spread of electrical impulses through ventricles.

The T- Wave is dome-shaped which represents ventricular repolarization (ventricular relaxation). The potential generated by the recovery of the ventricular from the depolarization state is called Repolarisation Wave.

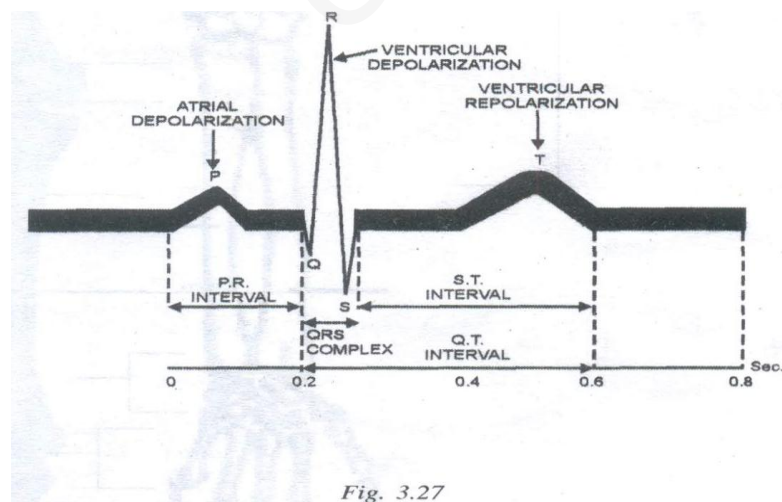


Fig. 3.27

The right answer is (c).

Sol.154 (b)

The atrioventricular opening between the left atrium and the left ventricle is guarded by the bicuspid valve, also called **Mitral Valve**. It has two flaps.

The right answer is (b).

Sol.155 (c)

Individuals with blood group O can donate blood to anyone. This is the most important blood group for transfusion.

The right answer is (c).

Sol. 156 (b)

The excretion of urea is known as **Ureotelism** and the animals which excrete urea are called **Ureotelic Animals**.

The right answer is (b).

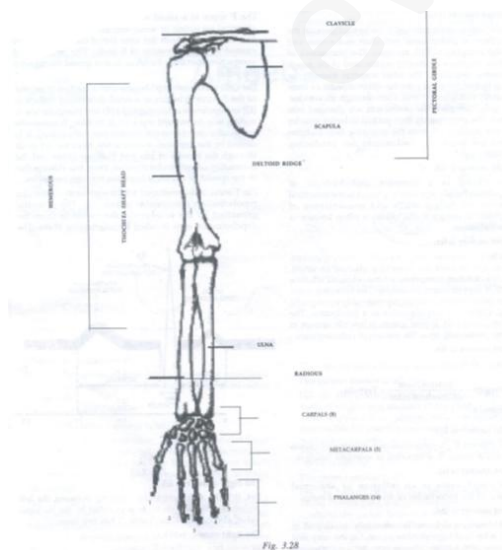
Sol. 157 (b)

Plasma proteins are not filtered through the glomerular capillaries. Blood Colloidal Osmotic Pressure (BCOP) opposes filtration. It is about 32 mm of Hg.

The right answer is (b).

Sol.158 (d)

The shaft of the humerus has a V-shaped deltoid ridge at about its middle. **Refer Fig. 3.28.**



The right answer is (d).

Sol. 159 (a)

The pelvis or pelvic girdle is formed by two innominate bones (hip bones). The sacrum and coccyx also take part in the formation of the pelvis. Each innominate bone comprises three separate bones – **Ilium**, **Ischium** and **Pubis**. On its outer surface, it has a deep depression, called **Acetabulum** to which the head of femur is articulated thus forming the hip joint. The acetabulum is formed by Ilium, Ischium and Pubis. Refer Fig. 3.29.

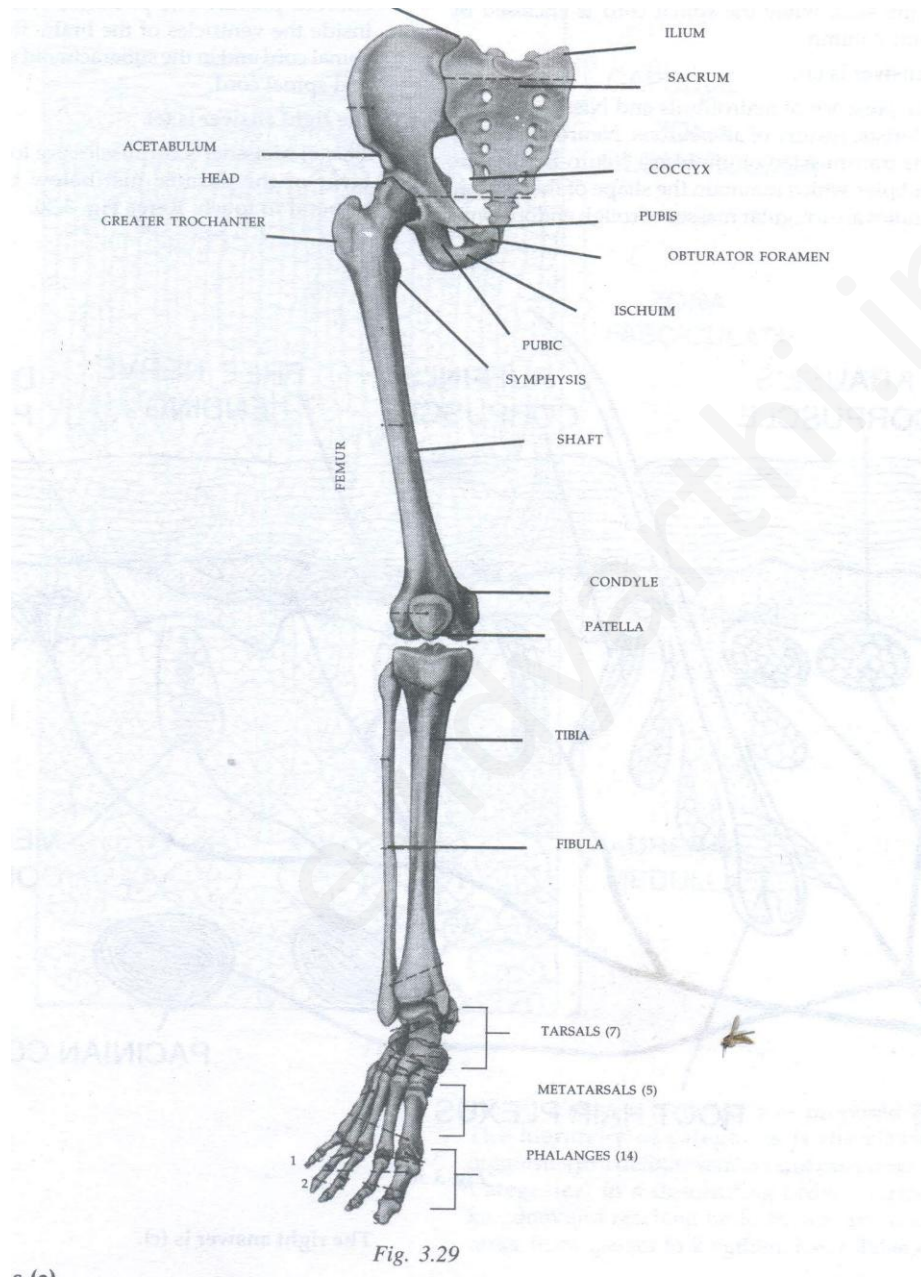


Fig. 3.29

The right answer is (a).

Sol.160 (a)

Man is ureotelic. It releases urea through his urine.

The right answer is (a).

Sol.162 (b)

The central neural system is a hollow, dorsally placed structure lining along the mid-dorsal axis of the body. It comprises brain and spinal cord. The brain is lodged in the skull while the spinal cord is enclosed by the vertebral column.

The right answer is (a).

Sol. 163 (d)

The presence of neurofibrils and Nissl's granules is a characteristics feature of all neurons. Neurofibrils play a role in the transmission of impulses. Neuro- tubules are the microtubules which maintain the shape of the neuron. Nissl's granules are irregular masses of rough endoplasmic reticulam, with numerous attached and free ribosomes and polysomes. Nissl's granules probably synthesise proteins for the cell.

The right answer is (d).

Sol. 164 (b)

Unipolar neurons are found usually in the embryonic stage.

The right answer is (b).

Sol.165 (c)

The cerebrospinal fluid is secreted by anterior choroid plexus. The posterior choroid plexus is found inside the ventricles of the brain, the central canal of the spinal cord and in the subarachnoid space around the brain and spinal cord.

The right answer is (c).

Sol.166 (c)

Meissner's corpuscles are located in the papillary layer of the dermis, just below the epidermis which respond to touch. Refer Fig. 3.30.

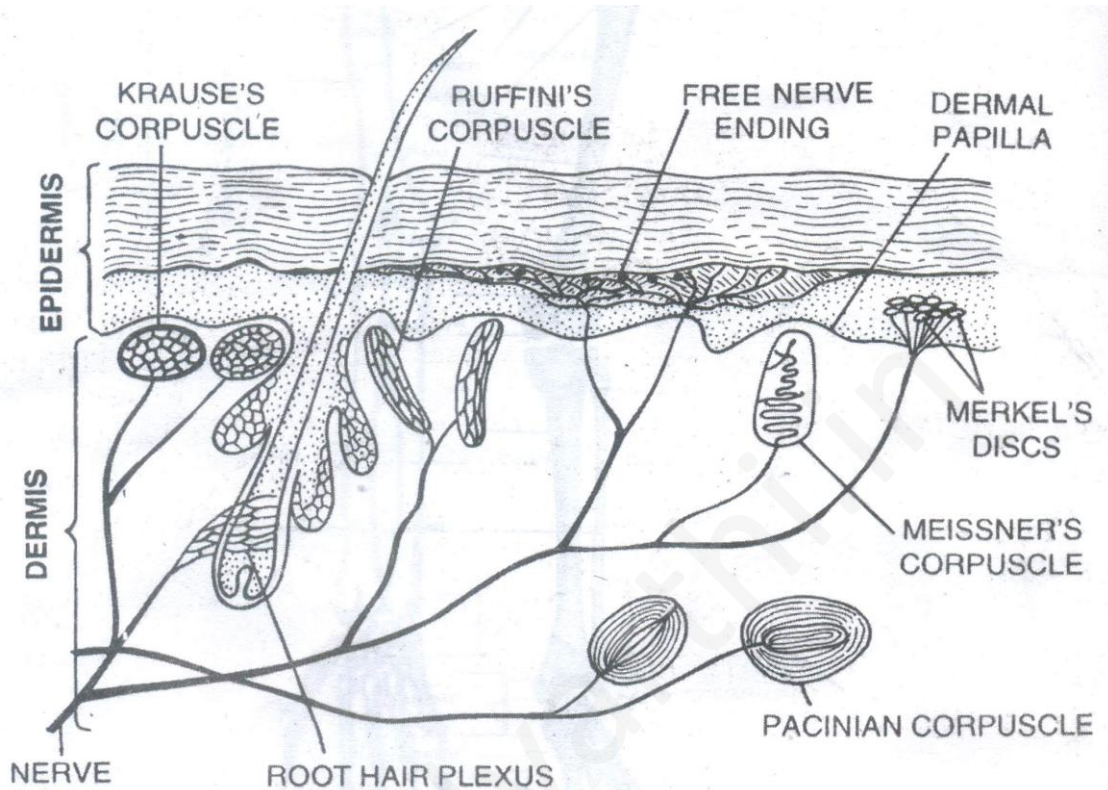


Fig. 3.30

Sol.167 (a)

An infant has slow body growth and mental development of reduced metabolic rate. This disease can be treated by an early administration of thyroid hormones.

The right answer is (a).

Sol. 168 (a)

Zonaglomerulosa constitutes about 15 percent of the gland. Its cells are closely packed and arranged in spherical clusters and arched columns secrete hormones called mineralo corticoids because they effect mineral homeostasis. Refer Fig. 3.31.

The right answer is (a).

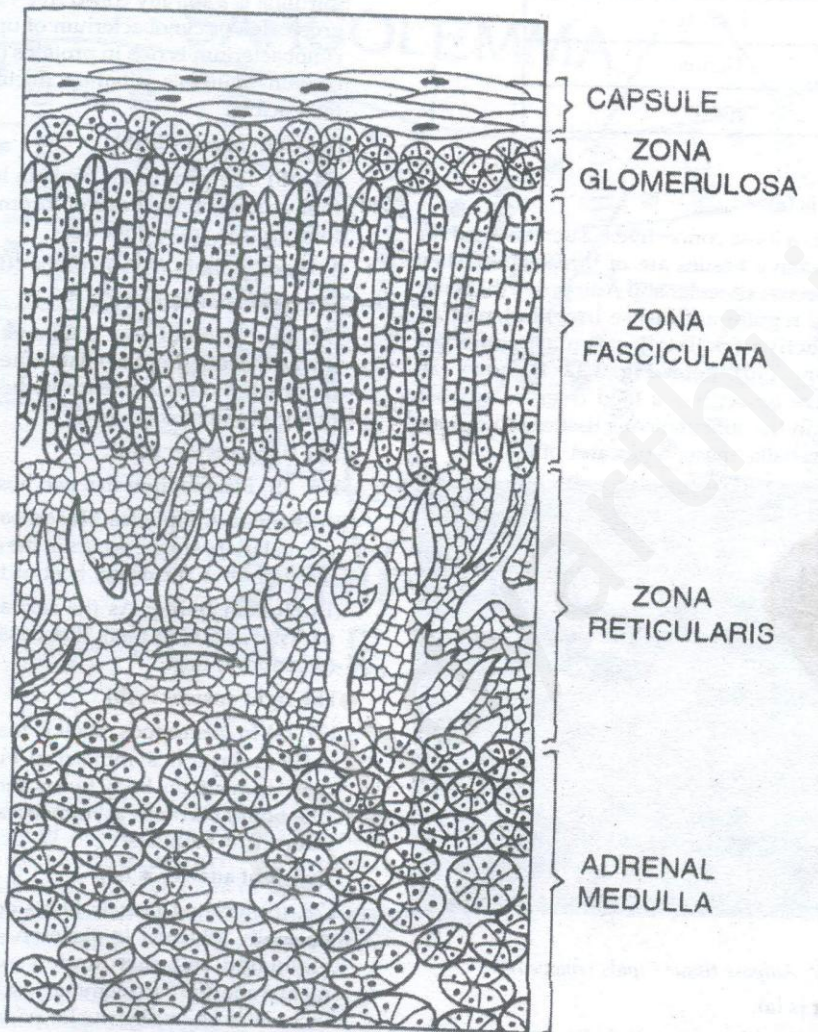


Fig. 3.31

Sol.169 (a)

Linnaean hierarchy was proposed by Linnaeus. The hierarchy of categories is the classified of organisms in a definite sequence of categories (**Taxonomic Categories**) in a descending order, starting from the kingdom and reaching up to the species in an ascending order from species to kingdom. Refer **Table 6-II**

Table 6-II

Kingdom
Phylum or Division
Class
Order
Family
Genus
Species

The right answer is (a).

Sol. 170 (a)

Adipose is a loose connective tissues. It is used for storing fat. Connective tissues are of three types. They are: (a) loose connective (Areolar and Adipose); (b) dense connective (dense regular and dense irregular); and (c) specialised connective (skeletal, vascular, reticular, pigmented and mucoid). Refer Fig. 3.32. it shows the Adipose connective tissues. It is a food reserve. Adipose tissues are found in the subcutaneous tissues around the heart, kidneys, eyeballs, mesenteries and omenta.



Fig 3.32: Adipose tissue (lipids removed)

The right answer is (a).

Sol. 171 (a)

Prions are highly resistant glycoprotein particles which function as infectious agents. They are formed due to mutation in gene PRNP. Prions can also act as catalysts to convert normal protein into the prion state. Prions are not affected by proteases, nucleases, temperature of up to 800⁰C, ultraviolet radiation and Formaldehyde. Prions accumulate in the nervous tissue and bring about its degeneration. Some common diseases caused by them are – scrapie of sheep, mad cow diseases, CruetzfeldtJakob Disease (CJD) and Kuru.

The right answer is (a).

Sol. 172 (a)

Coccus bacteria are spherical or ovoid in terms of their outline. Staphylococcus are irregular grape- like clusters. Their shape can be termed oval.

The right answer is (a).

Sol. 173 (b)

Spirulina is a common cyanobacteria which comes under Kingdom Monera.

Spirulina is a spirally coiled free- floating filamentous blue green alga or cyanobacterium of upto 0.5mm length. This cyanobacterium is rich in proteins (55 to 68 percent). It also contains minerals, vitamins (including B₁₂) and essential fatty acids.

The right answer is (b).

Sol. 174 (b)

The protozoan protists have been divided into four groups on the basis of locomotory organelles. These four groups are as follows:

(I) Mastigophora (II) Sarcodina (III) Sporozoa (IV) Ciliate

The right answer is (b).

Sol. 175 (d)

Noctiluca alga is famous for bioluminescence as it was the first dinoflagellate where bioluminescence was reported. Bioluminescence is the production of light by living organisms.

The right answer is (d).

Sol.176 (b)

Plasmodium has two hosts, as follows:

(A) **Female Anopheles Mosquito:** as the sexual phase of the malarial parasite occurs in the mosquito it is considered the definitive (primary) host of the malarial parasite.

(B) **Human Beings:** As the sexual phase of the malarial parasite occurs in man, it is considered the intermediate (secondary) host.

The right answer is (b).

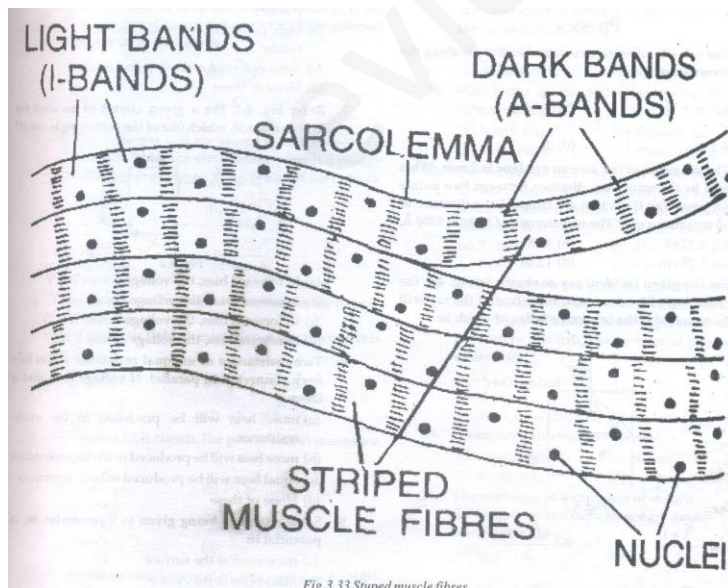
Sol. 177 (b)

In gastropods, shell is made up of one piece. The early embryo is symmetrical but during the course of development, the body twists and shows torsion so that it (the body) becomes asymmetrical. It includes the largest number of molluscs.

The right answer is (a).

Sol. 178 (b)

Striated muscle fibres occur in bundles and are normally attached to skeleton. Each muscle fibre is an elongated cell surrounded externally by a delicate membrane, the Sarcolemma. Just beneath the Sarcolemma, in each fibre, many nuclei occur at irregular intervals. Thus, these fibres are multi-nucleated or cyncytial in nature. The cytoplasm of each fibre (sacroplasm) has a large number of myofibrils which are tightly packed. Each myofibril shows dark bands (A-bands) and light bands (I-bands) of strips alternating with each other. That is why they have been named striped Muscle Fibres. **Refer Fig. 3.33**



The right answer is (b).

Sol. 179(b)

The septalnephridia discharge their excretory matter into the lumen of the alimentary canal / enteron. Hence, they are called **Enteronephric Nephridia**. Pharyngeal nephridia occur in three pairs of bunches in the 4th, 5th and 6th segments. Lying on each side of the alimentary canal, the ducts carry excretory matter from pharyngeal nephridia into the gut (buccal cavity / pharynx). Thus, like septalnephridia, pharyngeal nephridia are also enteronephric nephridia.

The right answer is (b).

Sol.180. (b)

A pair of stink glands is present between the fifth and sixth abdominal terga. These glands produce a secretion that gives a characteristic stinky (foul) smell.

The right answer is (b).