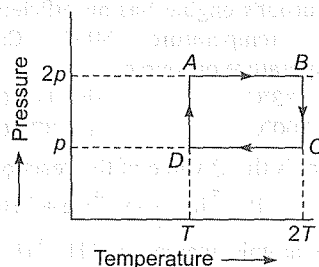ask**IITians**

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Manipal
Medical Entrance Exam
Solved Paper 2012

Physics

1. An ideal monoatomic gas is taken thorough the theromodynamic states $A \to B \to C \to D$ via the paths shown in the figure. If U_A, U_B, U_C and U_D represent the internal energy of the gas in states A, B, C and D respectively, then which of the following is not true?
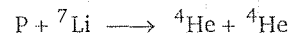

   (a) $U_A = U_D$ (b) $U_B < U_A$
   (c) $U_B = U_C$ (d) $U_C > U_D$

2. The external diameter of a 314 m long copper tube is 1.2 cm and the internal diameter is 1 cm. Calculate its resistance if the specific resistance of copper is 2.2×10^{-8} Ω-m
   (a) $5.0 \times 10^{-2} \Omega$ (b) $4.4 \times 10^{-2} \Omega$
   (c) $3.14 \times 10^{-2} \Omega$ (d) $2.2 \times 10^{-2} \Omega$

3. A voltmeter of range 2 V and resistance 300 Ω cannot be converted into ammeter of range
   (a) 1 A (b) 1 mA
   (c) 100 mA (d) 10 mA

4. If a magnet is suspended at an angle 30° to the magnetic meridian, the dip needle makes angle of 45° with the horizontal. The real dip is
   (a) $\tan^{-1}(\sqrt{3}/2)$ (b) $\tan^{-1}(\sqrt{3})$
   (c) $\tan^{-1}(3/\sqrt{2})$ (d) $\tan^{-1}(2/\sqrt{3})$

5. Which quantity is increased in step-down transformer?
   (a) Current (b) Voltage
   (c) Power (d) Frequency

6. Beyond which frequency, the ionosphere bends any incident electromagnetic radiation but do not reflect it back towards the earth?
   (a) 50 MHz (b) 40 MHz
   (c) 30 MHz (d) 20 MHz

7. In intrinsic semiconductor at room temperature number of electrons and holes are
   (a) equal (b) zero
   (c) unequal (d) infinite

8. What should be the velocity of an electron so that its momentum becomes equal to that of a photon of wavelength 5200 Å?
   (a) 700 m/s (b) 1000 m/s
   (c) 1400 m/s (d) 2800 m/s

9. A radioactive element has half-life period of 600 yr. After 3000 yr, what amount will remain?
   (a) $\frac{1}{2}$ (b) $\frac{1}{16}$
   (c) $\frac{1}{8}$ (d) $\frac{1}{32}$

10. An electric motor runs on DC source of emf 200 V and draws a current of 10 A. If the efficiency be 40%, then the resistance of armature is
   (a) 2 Ω (b) 8 Ω
   (c) 12 Ω (d) 16 Ω

11. A capacitor having capacity of 2.0 μF is charged to 200 V and then the plates of the capacitor are

produced in joule will be
(a) 2×10^{-2} (b) 4×10^{-2}
(c) 4×10^{4} (d) 4×10^{10}

12. In the Wheatstone's network given, $P = 10\,\Omega$, $Q = 20\,\Omega$, $R = 15\,\Omega$, $S = 30\,\Omega$, the current passing through the battery (of negligible internal resistance) is
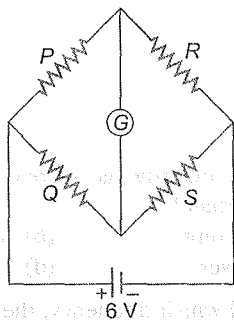
(a) 0.36 A   (b) zero
(c) 0.18 A   (d) 0.72 A

13. Two tangent galvanometers A and B have coils of radii 8 cm and 16 cm respectively and resistance 8 Ω each. They are connected in parallel with a cell of emf 4 V and negligible internal ressistance. The deflections produced in the tangent galvanometers A and B are 30° and 60° respectively. If A has 2 turns, then B must have
(a) 18 turns   (b) 12 turns
(c) 6 turns   (d) 2 turns

14. A current of 5 A is passing through a metallic wire of cross-sectional area 4×10^{-6} m². If the density of charge carriers of the wire is 5×10^{26} m^{-3}, the drift velocity of the electrons will be
(a) 1×10^{2} ms^{-1} (b) 1.56×10^{-2} ms^{-1}
(c) 1.56×10^{-3} ms^{-1} (d) 1×10^{-2} ms^{-1}

15. A single slit Fraunhofer diffraction pattern is formed with white light. For what wavelength of light, the third secondary maximum in the diffraction pattern coincides with the second secondary maximum in the pattern for red light of wavelength 6500 Å?
(a) 4400 Å   (b) 4100 Å
(c) 4642.8 Å   (d) 9100 Å

liquid drops are combined is 20 V. Then, the potential of each single drop was
(a) 10 V   (b) 7.5 V
(c) 5 V   (d) 2.5 V

17. Water rises in plant fibres due to
(a) capillarity   (b) viscosity
(c) fluid pressure   (d) osmosis

18. During an adiabatic process, the cube of the pressure is found to be inversely proportional to the fourth power of the volume. Then, the ratio of specific heats is
(a) 1   (b) 1.33
(c) 1.67   (d) 1.4

19. The volume of a nucleus is directly proportional to
(a) A (b) A^{3}
(c) $\sqrt{A}$ (d) $A^{1/3}$
(where, A = mass number of the nucleus)

20. A Carnot's engine has an efficiency of 50% at sink temperature 50°C. Calculate the temperature of source.
(a) 133°C   (b) 143°C
(c) 100°C   (d) 373°C

21. What is the Q-value of the reaction?
$$P + {}^{7}\text{Li} \longrightarrow {}^{4}\text{He} + {}^{4}\text{He}$$
The atomic masses of ^{1}H, ^{4}He and ^{7}Li are 1.0078254u, 4.0026034u and 7.016004u respectively
(a) 17.35 MeV   (b) 18.06 MeV
(c) 177.35 MeV   (d) 170.35 MeV

22. The water of volume 4 m³ at the height 20 m is pressed by 2×10^{5} N pressure. The work done by motor is
(a) 8×10^{5} J   (b) 16×10^{5} J
(c) 12×10^{5} J   (d) 32×10^{5} J

23. The wavelength of K_{α} line in copper is 1.5 Å. The ionisation energy of K electron in copper is
(a) 11.2×10^{-17} J   (b) 12.9×10^{-16} J
(c) 1.7×10^{-15} J   (d) 10×10^{-16} J

24. A proton is moving in a uniform magnetic field B in a circular path of radius a in a direction perpendicular to Z axis along which field B exists. Calculate the angular momentum. If the radius is a and charge on proton is e.

(a) $\dfrac{Be}{a^2}$ (b) eB^2a

(c) a^2eB (d) aeB

25. Curie-Weiss law is obeyed by iron
    (a) at curie temperature only
    (b) at all temperatures
    (c) below curie temperature
    (d) above curie temperature

26. When light is incidence on a diffraction grating, then the zero order maximum will be
    (a) spectrum of the colours
    (b) white
    (c) one of the component colours
    (d) absent

27. The wavelength of first line of Balmer series is 6563 Å. The wavelength of first line of Lymen series will be
    (a) 1215.4 Å   (b) 2500 Å
    (c) 7500 Å   (d) 600 Å

28. The reactance of inductance at 10^4 Hz is $10^4 \, \Omega$. Its reactance at 2×10^4 Hz will be
    (a) $10^4 \, \Omega$ (b) $2 \times 10^4 \, \Omega$
    (c) $3 \times 10^4 \, \Omega$ (d) $4 \times 10^4 \, \Omega$

29. In adiabatic process, the work done by system is 50 J, then
    (a) the temperature of the system will be increase 50 J
    (b) the temperature of the system will be constant
    (c) the internal energy of the system will be increase 50 J
    (d) the internal energy of the system will be decrease 50 J

30. The ozone layer is important because
    (a) it prevents the cooling of each at night
    (b) it prevents the IR rays coming from the space
    (c) it prevents UV rays from the meteors coming from the space
    (d) it prevents the UV rays and micro rays the coming from the space

31. If resonant frequency is f and capacity become 4 times, then resonant frequency will be
    (a) $\dfrac{f}{2}$ (b) $2f$
    (c) f (d) $\dfrac{f}{4}$

32. If two soap bubbles of different radii are connected by a tube, then
    (a) air flow from bigger bubble to the smaller bubble till sizes become equal
    (b) air flow from bigger bubble to the smaller bubble till sizes are interchanged
    (c) air flow from smaller bubble to bigger
    (d) there is no flow of air

33. The hardness of X-rays by coolidge tube depends upon
    (a) filament current
    (b) air pressure in tube
    (c) material of target
    (d) potential between target and cathode

34. A launching vehicle carrying an artificial satellite of mass m is set for launch on the surface of the earth of mass M and radius R. If the satellite is intended to move in a circular orbit of radius $7R$, the minimum energy required to be spent by the launching vehicle on the satellite is
    (Gravitational constant $= G$)
    (a) $\dfrac{GMm}{R}$ (b) $-\dfrac{13GMm}{14R}$
    (c) $\dfrac{GMm}{7R}$ (d) $\dfrac{GMm}{14R}$

35. The displacements of two particles of same mass executing SHM are represented by the equations
    $$x_1 = 4\sin\left(10t + \dfrac{\pi}{6}\right) \text{ and } x_2 = 5\cos(\omega t).$$
    The value of ω for which the energies of both the particles remain same is
    (a) 16 unit   (b) 6 unit
    (c) 4 unit   (d) 8 unit

36. The excess pressure inside a spherical soap bubble of radius 1 cm is balanced by a column of oil (specific gravity $= 0.8$), 2 mm high, the surface tension of the bubble is
    (a) 3.92 N/m   (b) 0.0392 N/m
    (c) 0.392 N/m   (d) 0.00392 N/m

37. Water from a tap emerges vertically downwards with initial velocity 4 ms^{-1}. The cross-sectional area of the tap is A. The flow is steady and pressure is constant throughout the stream of water. The distance h vertically below the tap,

(a) 0.5 m   (b) 1 m

(c) 1.5 m   (d) 2.2 m

38. The diameter of objective of a telescope is 1m. Its resolving limit for the light of wavelength 4538 Å, will be

(a) 5.54×10^{-7} rad

(b) 2.54×10^{-4} rad

(c) 6.54×10^{-7} rad

(d) None of the above

39. The potential difference between two parallel plates is 10^4 V. If the plates are separated by 0.5 cm, the force on an electron between the plates is

(a) 32×10^{-13} N   (b) 0.32×10^{-13} N

(c) 0.032×10^{-13} N   (d) 3.2×10^{-13} N

40. A body of mass $m_1 = 4$ kg moves at $5\hat{i}$ m/s and another body of mass $m_2 = 2$ kg moves at $10\hat{i}$ m/s. The kinetic energy of centre of mass is

(a) $\dfrac{200}{3}$ J   (b) $\dfrac{500}{3}$ J

(c) $\dfrac{400}{3}$ J   (d) $\dfrac{800}{3}$ J

41. Two block of masses of 1 kg and 2 kg are connected by a metal wire going over a smooth pulley. The breaking stress of metal is $\dfrac{40}{3\pi} \times 10^6$ N/m^2. What should be the minimum radius of wire used if it should not break? ($g = 10$ m/s^2).

(a) 0.5 mm   (b) 1 mm

(c) 1.5 mm   (d) 2 mm

42. In the Young's double slit experiment, intensities of black and bright fringes are 1 and 4 respectively, the ratio of amplitudes of sources will be

(a) 1 : 1   (b) 1 : 2

(c) 3 : 1   (d) 1 : 4

43. If inductance and resistance of chocke coil are X_L and R respectively, then

(a) $X_L = R$ (b) $X_L \gg R$

(c) $X_L \ll R$ (d) $X_L = \infty$

(a) $\dfrac{\lambda}{2}, \dfrac{t}{2}$ and π (b) λ, T and π

(c) $\dfrac{\lambda}{2}, \dfrac{T}{2}$ and $\dfrac{\pi}{2}$ (d) $\dfrac{\lambda}{2}, \dfrac{T}{2}$ and 2π

45. At what speed should a source of sound move so that stationary observer finds the apparent frequency equal to half of the original frequency?

(a) $\dfrac{v}{2}$ (b) $2v$

(c) $\dfrac{v}{4}$ (d) v

46. At inductance 1 H is connected in series with an AC source of 220 V and 50 Hz. The inductive resistance (in ohm) is

(a) 2π (b) 50π

(c) 100π (d) 1000π

47. If the pressure of an ideal gas contained in a closed vessel is increased by 0.4%, the increases in temperature is 1°C. The initial temperature of the gas is

(a) 25°C   (b) 250°C

(c) 250 K   (d) 2500°C

48. If a van der Waal's gas expands freely, then final temperature is

(a) less than the initial temperature

(b) equal to the initial temperature

(c) more than the initial temperature

(d) less or more than the initial temperature depending on the nature of the gas

49. The de-Broglie wavelength of a proton (charge $= 1.6 \times 10^{-19}$ C, mass $= 1.6 \times 10^{-27}$ kg) accelerated through a potential difference of 1 kV is

(a) 600 Å   (b) 0.9×10^{-12} m

(c) 7 Å   (d) 0.9 nm

50. A radioactive element forms its own isotope after 3 consecutive disintegrations. The particles emitted as

(a) 3β-particles

(b) 2β -particles and 1α-particle

(c) 2β-particles and 1γ-particle

(d) 2α-particles and 1β-particle

51. A step-down transformer reduces the voltage of a transmission line from 2200 V to 220 V. The power delivered by it is 880 W and its efficiency is 88%. The input current is
(a) 4.65 mA
(b) 0.045 A
(c) 0.45 A
(d) 4.65 A

52. If λ_1 and λ_2 are the wavelengths of the first members of the Lyman and Paschen series respectively, then $\lambda_1 : \lambda_2$ is
(a) 1 : 3
(b) 1 : 30
(c) 7 : 50
(d) 7 : 108

53. Identify the operation performed by the circuit given below
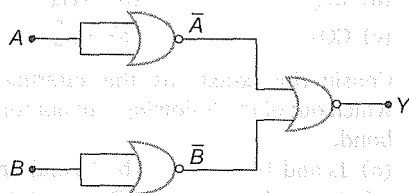
(a) NOT
(b) AND
(c) OR
(d) NAND

54. In a transistor, the collector current is always less than the emitter current because
(a) collector side is reverse biased and the emitter side is forward biased
(b) a few electrons are lost in the base and only remaining ones reach the collector
(c) collector being reverse biased, attracts less electrons
(d) collector side is forward biased and emitter side is reverse biased

55. A rectangular vessel when full of water, takes 10 min to be emptied through an orifice in its bottom. How much time will it take to be emptied when half filled with water?

(a) 9 min
(b) 7 min
(c) 5 min
(d) 3 min

56. The term liquid crystal refers to a state that is intermediate between
(a) crystalline solid and amorphous liquid
(b) crystalline solid and vapour
(c) amorphous liquid and its vapour
(d) a crystal immersed in a liquid

57. A wave travelling in air falls on a glass plate. It is partly reflected and partly refracted. The phase difference between the reflected and refracted waves is
(a) zero
(b) $\dfrac{\pi}{2}$
(c) π
(d) 2π

58. Two coherent monochromatic light beams of intensities I and $4I$ are superposed. The maximum and minimum possible resulting intensities are
(a) $5I$ and 0
(b) $5I$ and $3I$
(c) $9I$ and I
(d) $9I$ and $3I$

59. The light of wavelength 5000 Å falls on a photosensitive plate of work function 1.9 eV. The kinetic energy of the emitted photoelectrons is
(a) 0.58 eV
(b) 2.48 eV
(c) 1.24 eV
(d) 1.18 eV

60. A galvanometer can be converted into a voltmeter by connecting
(a) low resistance in parallel
(b) low resistance in series
(c) high resistance in parallel
(d) high resistance in series

Chemistry

1. Benzaldehyde condenses with *N,N*-dimethyl aniline in the presence of anhydrous $ZnCl_2$ to give
(a) azodye
(b) malachite green
(c) buffer yellow
(d) None of these

2. The general formula $C_nH_{2n}O_2$ could be for open chain

(a) diketones
(b) carboxylic acids
(c) diols
(d) dialdehydes

3. Which of the following is used widely in the manufacture of lead storage battery?
(a) Arsenic
(b) Lithium
(c) Bismuth
(d) Antimony

(a) 9.3   (b) 19.3
(c) 38.3   (d) 39.5

5. Saturated solution of KNO_3 is used to make salt bridge because
   (a) velocity of K^+ is greater than that of NO_3^-
   (b) velocity of NO_3^- is greater than that of K^+
   (c) velocity of both K^+ and NO_3^- are nearly same
   (d) KNO_3 is soluble in water

6. For which order half-life period is independent of initial concentration?
   (a) Zero   (b) First
   (c) Second   (d) Third

7. Sodium phenoxide reacts with CO_2 at 400 K and 4-7 atm pressure to give
   (a) cathechol   (b) salicylaldehyde
   (c) salicylic acid   (d) sodium salicylate

8. The rate constant for the first order reaction is $60 \ s^{-1}$. How much time will it take to reduce the concentration of the reactant to $\frac{1}{16}$th value?
   (a) 4.6×10^{-2} s   (b) 4.6×10^4 s
   (c) 4.6×10^2 s   (d) 4.6×10^{-4} s

9. The rate of reaction
   $CCl_3CHO + NO \longrightarrow CHCl_3 + NO + CO$
   is equal to rate $= k[CCl_3CHO][NO]$. If concentration is expressed in $mol \ L^{-1}$, the unit of k is
   (a) $L \ mol^{-1} s^{-1}$ (b) $mol \ L^{-1} s^{-1}$
   (c) $L^2 \ mol^{-2} s^{-1}$ (d) s^{-1}

10. When phenolic ether is heated with HI it yields
    (a) alkyl halide + aryl halide + water
    (b) alkyl halide + phenol
    (c) alcohol + aryl halide
    (d) None of the above

11. Which of the following is not correct?
    (a) Milk is naturally occurring emulsion
    (b) Gold sol is a lyophilic sol
    (c) Physical adsorption decreases with rise in temperature
    (d) Chemical adsorption is unilayered.

(a) $12 \times 10^{-?}$ (b) $26 \times 10^{-?}$
(c) 34×10^{23} (d) 48×10^{23}

13. Which of the following statement in relation to the hydrogen atom is correct?
    (a) $3s$, $3p$ and $3d$ orbitals all have the same energy.
    (b) $3s$ and $3p$-orbitals are of lower energy than $3d$-orbital.
    (c) $3p$-orbital is lower in energy than $3d$-orbital.
    (d) $3s$-orbital is lower in energy than $3p$-orbital.

14. Which of the following is not tetrahedral?
    (a) BF_4^- (b) NH_4^+
    (c) CO_3^{2-} (d) SO_4^{2-}

15. Considering x-axis as the internuclear axis, which out of the following will not form a sigma bond.
    (a) $1s$ and $1s$ (b) $1s$ and $2p_x$
    (c) $2p_y$ and $2p_y$ (d) $1s$ and $2s$

16. The chlorination of methane is an example of
    (a) addition   (b) elimination
    (c) substitution   (d) chain reaction

17. Reactivity towards nucleophilic addition reaction of (I) HCHO (II) CH_3CHO (III) CH_3COCH_3 is
    (a) II > III > I   (b) III > II > I
    (c) I > II > III   (d) I > II < III

18. Which of the following is active species in sulphonation of benzene?
    (a) SO_3 (b) SO_3^+
    (c) SO_3^- (d) HSO_4^+

19. Which of the following can't be used in Friedel-Craft's reaction?
    (a) $FeCl_3$ (b) $FeBr_2$
    (c) $AlCl_3$ (d) $NaCl$

20. The order of reactivities of methyl halide in the formation of Grignard reagent is
    (a) $CH_3Cl > CH_3Br > CH_3I$
    (b) $CH_3I > CH_3Br > CH_3Cl$
    (c) $CH_3Br > CH_3I > CH_3Cl$
    (d) $CH_3Br > CH_3Cl > CH_3I$

21. The product formed when toluene is heated in light with Cl_2 and in absence of halogen carrier is
    (a) chlorobenzene   (b) gammexene
   (c) benzotrichloride   (d) DDT

22. If the pressure on a NaCl structure is increased, then its coordination number will
(a) increase
(b) decrease
(c) either (a) or (b)
(d) remain the same

23. If the bond dissociation energies of XY, X_2 and Y_2 (all diatomic molecules) are in the ratio of $1 : 1 : 0.5$ and ΔH_f for the formation of XY is -200 kJ mol^{-1}, the bond dissociation energy of X_2 will be
(a) 400 kJ mol^{-1}
(b) 300 kJ mol^{-1}
(c) 200 kJ mol^{-1}
(d) 800 kJ mol^{-1}

24. The enthalpies of all the elements in their standard states are
(a) unity
(b) zero
(c) < 0
(d) different for each element

25. A reaction, $A + B \longrightarrow C + D + q$ is found to have a positive entropy change. The reaction will be
(a) possible at high temperature
(b) possible only at low temperature
(c) not possible at any temperature
(d) possible at any temperature

26. Enthalpy of combustion of carbon to CO_2 is -393.5 kJ mol^{-1}. The heat released upon formation of 35.2 g of CO_2 from carbon and dioxygen gas is (molar mass of $CO_2 = 44$ g mol^{-1})
(a) 3.148 kJ
(b) 31.48 kJ
(c) 314.8 kJ
(d) 3148 kJ

27. Work done during isothermal expansion of one mole of an ideal gas from 10 atm to 1 atm at 300 K is
(a) 4938.8 J
(b) 4138.8 J
(c) 5744.1 J
(d) 6257.2 J

28. Which of the following is not a conjugate acid-base pair?
(a) HPO_4^{2-}, PO_4^{3-}
(b) $H_2PO_4^-$, HPO_4^{2-}
(c) $H_2PO_4^-$, H_3PO_4
(d) $H_2PO_4^-$, PO_4^{3-}

29. Which of the following will not function as a buffer solution?
(i) NaCl and NaOH
(ii) NaOH and NH$_4$OH
(iii) CH$_3$COONH$_4$ and HCl
(iv) Borax and boric acid

30. A litre of solution is saturated with AgCl. To this solution if 1.0×10^{-4} mole of solid NaCl is added, what will be the [Ag$^+$] assuming no volume change?
(a) More
(b) Less
(c) Equal
(d) Zero

31. Aqueous solution of sodium cyanide is
(a) acidic
(b) amphoteric
(c) basic
(d) neutral

32. The equilibrium constant for the reaction
$$SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$$
is $K_c = 4.9 \times 10^{-2}$. The value of K_c for the reaction
$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$
will be
(a) 416
(b) 2.40×10^{-3}
(c) 9.8×10^{-2}
(d) 4.9×10^{-2}

33. In the reaction,
$$Ag_2O + H_2O_2 \longrightarrow 2Ag + H_2O + O_2$$
H_2O_2 acts as
(a) a reducing agent
(b) oxidising agent
(c) bleaching agent
(d) None of these

34. When two ice cubes are pressed over each other they unites to form one cube. Which of the following forces are responsible to hold them together?
(a) Ionic interaction
(b) van der Waal's forces
(c) Covalent interaction
(d) Hydrogen bond formation

35. Red lead is
(a) $PbCO_3$
(b) Pb_3O_4
(c) PbO_2
(d) $PbSO_4$

36. Which gas is liberated when Al_4C_3 is hydrolysed?
(a) CH_4
(b) C_2H_2
(c) C_2H_6
(d) CO_2

37. When zeolite which is hydrated sodium aluminium silicate is treated with hard water, the sodium ions are exchanged with
(a) H$^+$ ions
(b) Ca^{2+} ions

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

(d) both Ca^- and Mg^-

38. A codon has a sequence of **A** and specifies a particular **B** that is to be incorporated in to **C** What are **A, B, C**?

	A	B	C
(a)	3 bases	amino acid	carbohydrate
(b)	3 acids	carbohydrate	protein
(c)	3 bases	protein	amino acid
(d)	3 bases	amino acid	protein

39. Proteins when heated with conc. HNO_3 give a yellow colour. This is
    (a) Hoppe's test   (b) acid base test
    (c) Biuret test   (d) xanthoprotic test

40. Codon is present in
    (a) t-RNA   (b) m-RNA
    (c) fats   (d) r-RNA

41. Amylopectin is a polymer of
    (a) α-D glucose   (b) α-D fructose
    (c) lactose   (d) amylose

42. Which one of the following statements is wrong?
    (a) The repeating monomer units in bakelite are phenol and formaldehyde
    (b) Low density polythene is an example of branched chain polymers
    (c) Homopolymer contains a single type of monomer.
    (d) Vulcanization is the process of heating natural rubber with carbon

43. Parkinson's disease is linked to abnormalities in the levels of dopamine in the body. The structure of dopamine is

(a)

(b)

(c)

(d)
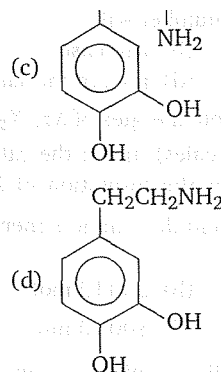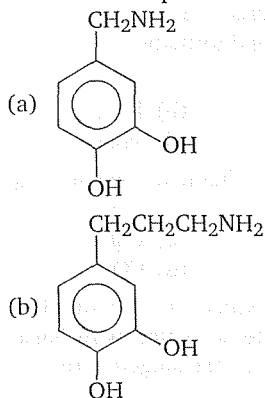
44. Which of the following is a natural dye?
    (a) Alizarin   (b) Malachite green
    (c) Phenolphthalein   (d) Martius yellow

45. Mn^{2+} can be converted into Mn^{7+} by reacting with
    (a) PbO_2 (b) $SnCl_2$
    (c) SO_2 (d) Cl_2

46. Which of the following compounds show optical isomerism ?
    (a) $[Co(CN)_6]^{3-}$ (b) $[Cr(C_2O_4)_3]^{3-}$
    (c) $[ZnCl_4]^{2-}$ (d) $[Cu(NH_3)_4]^{2+}$

47. Which of the following represents a chelating ligand?
    (a) H_2O (b) Cl^-
    (c) OH^- (d) DMG

48. When alkyl halide is heated with dry Ag_2O, it produces
    (a) ester   (b) ether
    (c) ketone   (d) alcohol

49. The best reagent to convert pent-3-en-2-ol into pent-3-en-2-one is
    (a) pyridinium chlorochromate
    (b) chromic anhydride in glacial acetic acid
    (c) acidic dichromate
    (d) acidic permanganate

50. During the process of electrolytic refining of copper, some metals present as impurity settle as "anode mud". These are
    (a) Fe and Ni
    (b) Ag and Au
    (c) Pb and Zn
    (d) Se and Ag

51. Which of the following is not a peroxy acid?
    (a) Perphosphoric acid
    (b) Pernitric acid
    (c) Perdisulphuric acid
    (d) Perchloric acid

52. Chlorine is liberated when we heat
    (a) $KMnO_4$ + NaCl
    (b) $Pb_2(NO_3)_4$ + MnO_2
    (c) $K_2Cr_2O_7$ + MnO_2
    (d) $K_2Cr_2O_7$ + HCl

53. In which case Raoult's law is not applicable?
    (a) 1 M NaCl   (b) 1 M urea
    (c) 1 M glucose   (d) 1 M sucrose

54. Increasing the temperature of an aqueous solution will cause
    (a) decrease in molarity
    (b) decrease in molality
    (c) decrease in mole fraction
    (d) decrease in % w/w

55. To neutralize completely 20 mL of 0.1 M aqueous solution of phosphorus acid (H_3PO_3), the volume of 0.1 M aqueous KOH solution required is
    (a) 20 mL   (b) 30 mL
    (c) 40 mL   (d) 50 mL

56. 138 g of ethyl alcohol is mixed with 72 g of water. The ratio of mole fraction of alcohol to water is

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

57. $CH_3COOH \xrightarrow{\text{LiAlH}_4} A + CH_3COOH$

    $\xrightarrow{H_3O^+} B + H_2O$

    In the above reactions A and B respectively are
    (a) $CH_3COOC_2H_5$, C_2H_5OH
    (b) CH_3CHO, C_2H_5OH
    (c) C_2H_5OH, CH_3CHO
    (d) C_2H_5OH, $CH_3COOC_2H_5$

58. Acetyl bromide reacts with excess of CH_3MgI followed by treatment with a saturated solution of NH_4Cl gives
    (a) acetone
    (b) acetamide
    (c) 2-methyl-2-propanol
    (d) acetyl iodide

59. Reaction of aniline with acetyl chloride in the presence of NaOH gives
    (a) acetanilide
    (b) *p*-chloroaniline
    (c) red dye
    (d) aniline hydrochloride

60. Which of the following is a biodegradable polymer?
    (a) Polythene   (b) Bakelite
    (c) PHBV   (d) PVC

Biology

1. Striped muscles are
   (a) syncytial   (b) uninucleate
   (c) binucleate   (d) anucleate

2. Regarding blood circulation, it may be said that in *Pheretima* the dorsal vessel is a
   (a) collecting vessel in first two segments and distributing vessel in other
   (b) distributing vessel in the first five segments and collecting vessel in other
   (c) collecting vessel in thirteen segments and distributing vessel in intestinal region
   (d) distributing vessel in first thirteen segments and collecting vessel in intestinal region

3. Flatworms excrete through
   (a) kidney
   (b) nephridia

   (c) protonephridia
   (d) Malpighian tubules

4. Which of the following structure is related with vision in rabbits?
   (a) Hippocampus
   (b) Corpus albicans
   (c) Corpus callosum
   (d) Corpora quadrigemina

5. Which of the following cells are useful for feeding in sponges?
   (a) Thesocytes   (b) Collar cells
   (c) Pinacocytes   (d) Sclerocytes

6. The methods of dispersal in *Amoeba* is
   (a) locomotion   (b) sporulation
   (c) encystment   (d) binary fission

(a) Heart beat

(c) Blood pressure

(c) Skeletal muscle contraction

(d) Total cross sectional area of vessel

8. Telomerase is an enzyme, which is a
   (a) repetitive DNA   (b) RNA
   (c) simple protein   (d) ribonucleoprotein

9. Synapsis occur between
   (a) a male and female gamete
   (b) mRNA and ribosomes
   (c) spindle fibres and centromere
   (d) two homologous chromosomes

10. What is not true for genetic code?
    (a) A codon in mRNA is read in a non-contiguous fashion
    (b) It is nearly universal
    (c) It is degenerate
    (d) It is non-ambiguous

11. A sequential expression of set of human gene occurs when steroid molecule binds to the
    (a) transfer RNA   (b) Messenger RNA
    (c) DNA sequence   (d) ribosome

12. Sickle cell anaemia is
    (a) an autosomal linked dominant trait
    (b) caused by substitution of valine by glutamic acid in the β-globin chain of haemoglobin
    (c) caused by a change in base pair of DNA
    (d) characterized by elongated sickle like RBCs with a nucleus

13. A common test to find the genotype of a hybrid is
    (a) crossing of one F_2 progeny with male parent
    (b) crossing of one F_2 progeny with female parent
    (c) studying the sexual behaviour of F_1 progenies
    (d) crossing of one F_1 progeny with recessive parent

14. Phenetic classification is based on
    (a) sexual characteristics
    (b) the ancestral lineage of existing organisms
    (c) observable characteristics of existing organisms
    (d) dendogram based on DNA characteristics

(b) Live in same habitat

(c) Interbreeding

(d) Live in different habitat

16. For retting of jute the fermenting microbe used is
    (a) methophillic bacteria
    (b) butyric acid bacteria
    (c) *Helicobacter pylori*
    (d) *Streptococcus lactis*

17. Which antibiotic inhibits interaction between tRNA and mRNA during bacterial protein synthesis?
    (a) Neomycin
    (b) Streptomycin
    (c) Tetracycline
    (d) Erythromycin

18. Earthworms have no skeleton but during burrowing, the anterior end becomes turgid and acts as a hydraulic skeleton. It is due to
    (a) coelomic fluid   (b) blood
    (c) gut peristalsis   (d) setae

19. Senescence as an active developmental cellular process in the growth and functioning of a flowering plant, is indicated in
    (a) leaf abscission
    (b) annual plants
    (c) floral parts
    (d) All of the above

20. Glycolate induces opening of stomata in
    (a) presence of oxygen
    (b) low CO_2 concentration
    (c) high CO_2 concentration
    (d) absence of CO_2

21. Which one occurs both during cyclic and non-cyclic modes of photophosphorylation?
    (a) Involvement of both PS-I and PS-II
    (b) Formation of ATP
    (c) Release of O_2
    (d) Formation of NADPH

22. The translocation of organic solutes in sieve tube members is supported by
    (a) P-proteins
    (b) mass flow involving a carrier and ATP
    (c) cytoplasmic streaming
    (d) root pressure and transpiration pull

23. The overall goal of glycolysis, Krebs' cycle and the electron transport system is the formation of
    (a) ATP in small stepwise units
    (b) ATP in one large oxidation reaction
    (c) sugars
    (d) nucleic acids

24. Tendons or ligaments are
    (a) connective tissue   (b) vascular tissue
    (c) epithelial tissue   (d) skeletal tissue

25. Darwin's finches represent
    (a) morphological variation
    (b) geographical isolation
    (c) climatic variation
    (d) reproductive isolation

26. Territoriality occurs as a result of
    (a) predation   (b) parasitism
    (c) symbiotism   (d) competition

27. The type of joint between humerus and radius bone is called
    (a) gliding joint   (b) saddle joint
    (c) pivot joint   (d) hinge joint

28. The nucleus is separated from surrounding cytoplasm by a nuclear membrane, which is
    (a) single layered with pores
    (b) single layered without pores
    (c) double layered with pores
    (d) double layered without pores

29. In mammals, histamine is secreted by
    (a) fibroblasts   (b) histiocytes
    (c) lymphocytes   (d) mast cells

30. Species is a
    (a) group immediately below a phylum
    (b) closely related interbreeding population
    (c) taxonomic division of similar genera
    (d) closely related non-breeding population

31. The use of DDT is banned now-a-days because it is
    (a) very costly
    (b) not available
    (c) inflammable
    (d) not degraded easily

32. Which of the following represents Klinefelter's syndrome?
    (a) XX   (b) XO
    (c) XY   (d) XXY

33. In which of the following there is no defect in the sex chromosome?
    (a) Turner's syndrome
    (b) Down's syndrome
    (c) Colour blindness
    (d) Klinefelter's syndrome

34. When a cell is fully turgid, which of the following will be zero?
    (a) Wall pressure
    (b) Osmotic pressure
    (c) Turgor pressure
    (d) Water potential

35. Embryo development from nucellus and integument is known as
    (a) apospory
    (b) apogamy
    (c) apomixis
    (d) adventive embryony

36. Acid rain is due to increase in atmospheric concentration of
    (a) Ozone
    (b) CO_2 and CO
    (c) SO_3 and CO
    (d) SO_2 and nitrogen oxide

37. Which of the given is a long day plant?
    (a) *Glycine max*   (b) Spinach
    (c) *Chrysanthemum*   (d) Tobacco

38. Life span of *Ascaris* is
    (a) 3 to 6 months   (b) 9 to 12 months
    (c) 1 year   (d) 2 to 5 months

39. Which of the following is false fruit?
    (a) Mango   (b) Apple
    (c) Banana   (d) Jack fruit

40. FAD acts as an e^- acceptor in between
    (a) fumaric and malic acid
    (b) succinic and fumaric acid
    (c) malic and oxaloacetic acid
    (d) citric and isocitric acid

41. Pigment iodopsin is contained in
    (a) rod cells
    (b) cone cells
    (c) anacrine cells
    (d) horizontal cells

42. Sexual dimorphism is absent in
    (a) Ascomycetes   (b) Deuteromycetes
    (c) Basidiomycetes   (d) Phycomycetes

(a) *Sphagnum*   (b) *Funaria*
(c) *Anthoceros*   (d) *Polytrichum*

44. The flowers of *Oxalis* open during the day and close at night. Such type of movement is
(a) photonasty   (b) nyctinasty
(c) phototropic   (d) seismonastic

45. Silent valley is tropical evergreen forest located in
(a) Kerala   (b) Karnataka
(c) Maharashtra   (d) Odisha

46. Vitamin-C was first vitamin to be produced by fermentation process using
(a) *Penicillium*
(b) *E. coli*
(c) *Yersenia pestis*
(d) *Acetobactor*

47. The functional unit of DNA molecule that codes for particular gene product is
(a) cistron   (b) exon
(c) intron   (d) gene

48. Total number of biodiversity hot spots in the world are
(a) 24   (b) 12
(c) 34   (d) 52

49. Which of the following is exotic species?
(a) *Parthenium*   (b) *Lantana*
(c) *Eichhornia*   (d) All of these

50. In transgenics, expression of transgene in target tissue is determined by
(a) enhancer
(b) transgene
(c) promotor
(d) reporter gene

51. When CO_2 concentration in blood increases, breathing becomes
(a) shallower and slow
(b) there is no net effect on breathing
(c) slow and deep
(d) faster and deeper

52. Cancer cells can easily be damaged by radiation than normal cells because they are
(a) starved on mutation
(b) undergoing rapid division
(c) different in structure
(d) non-dividing

matched?
(a) *Glossina palpalis* — Sleeping sickness
(b) *Culex* — Filariasis
(c) *Aedes aegypti* — Yellow fever
(d) *Anopheles culifacies* — Leishmaniasis

54. A free living nitrogen fixing cyanobacterium which can also form symbiotic association with the aquatic fern *Azolla* is
(a) *Tolypothrix*   (b) *Chlorella*
(c) *Nostoc*   (d) *Anabaena*

55. Which of the following hormones is not a secretion product of human placenta?
(a) Human chorionic gonadotropin
(b) Prolactin
(c) Oestrogen
(d) Progesterone

56. The fangs of python which pulled out can
(a) not come again
(b) come again with half the length
(c) come again with same length
(d) come again with double length

57. The wings of bat, locust and pigeon are the examples of
(a) vestigial organs
(b) analogous organs
(c) homologous organs
(d) exoskeletal structures

58. Heart lacks sinus venosus in
(a) fishes
(b) mammals
(c) amphibians
(d) echinoderms

59. Krebs' cycle takes place in
(a) cytoplasm
(b) chloroplast
(c) nucleus
(d) mitochondria

60. In which of the following plants, leaf apex changes into tendril?
(a) *Gloriosa*
(b) *smilax*
(c) *Pisum sativum*
(d) Australian *Acacia*

61. The plants having vascular tissue but lacking seeds are placed under
    (a) algae
    (b) bryophytes
    (c) pteridophytes
    (d) gymnosperms

62. The rate of transpiration in plants is dependent upon
    (a) temperature and soil
    (b) light and temperature
    (c) wind, temperature and light
    (d) light, temperature, atmospheric humidity and wind

63. A plant hormone used for inducing morphogenesis in plant tissue culture is
    (a) ethylene   (b) gibberellin
    (c) cytokinin   (d) abscisic acid

64. Which of the following minerals helps in N_2 fixation?
    (a) Copper   (b) Zinc
    (c) Manganese   (d) Molybdenum

65. What is the similarity between fly, mosquitoes and cockroach?
    (a) All have 13 chambered heart
    (b) All have 4 pairs of legs
    (c) All have closed circulatory system
    (d) All belong to class-Insecta

66. Protein present in cartilage is
    (a) chondrin   (b) oesein
    (c) cartilagin   (d) ossein

67. Insectivorous plants usually survive in
    (a) water rich soil
    (b) N_2 deficient soil
    (c) N_2 rich soil
    (d) sugar deficient medium

68. Spore of *Funaria*, on germination gives rise to
    (a) protonema   (b) embryo
    (c) antheridia   (d) archegonia

69. The function of a vessel is
    (a) conduction of food
    (b) conduction of water and minerals
    (c) conduction of hormones
    (d) All of the above

70. Multiplication of DNA is called
    (a) translation
    (b) replication
    (c) duplication
    (d) transcription

71. The pigment sensitive for red and far red light is
    (a) chlorophyll   (b) phytochrome
    (c) cytochrome   (d) carotene

72. Lemon is sour due to the presence of
    (a) acetic acid
    (b) carbonic acid
    (c) citric acid
    (d) sulphuric acid

73. The type of vertebrae in the sub order Ophidia is
    (a) acoelous
    (b) procoelous
    (c) heterocoelous
    (d) amphicoelous

74. Removal of anthers at the time of plant breeding is called
    (a) emasculation
    (b) antherris
    (c) pollination
    (d) fertilization

75. Haemoglobin is a
    (a) protein
    (b) fibrous protein
    (c) globular protein
    (d) enzyme

76. LPP-1 is a
    (a) bacterium   (b) fungus
    (c) bacteriophage   (d) cyanophage

77. Hormogonia are vegetative reproductive structures of
    (a) *Ulothrix*   (b) *Oscillatoria*
    (c) *Spirogyra*   (d) *Chara*

78. Evolutionary history of an organisms is known as
    (a) Phylogeny   (b) Ancestry
    (c) Palaeontology   (d) Ontogeny

79. Sertoli cells are regulated by the pituitary hormone known as
    (a) FSH   (b) GH
    (c) prolactin   (d) LH

80. In which of the following fruits, the edible part is the aril?
    (a) Apple   (b) Pomegranate
    (c) Orange   (d) Litchi

Directions (Q. Nos. 1-5) *In the following questions some of the sentences have errors and some have none. Find out which part of the sentence has an error. The letter of that part is your answer. If there is no error, the answer is (d).*

1. Last night I dream (a)/I was a Sheikh on the 169td floor (b)/of Burj Khalifa. (c)/No error. (d)

2. As soon as (a)/the lion saw the deer (b)/he began to run after it. (c)/No error. (d)

3. The police asked us (a)/about our movements (b)/on a night of the crime. (c)/No error. (d)

4. Did he tell you (a)/why he hasn't (b)/come yesterday? (c)/No error. (d)

5. It was a pleasant (a)/four hours drive (b)/from Pune to Nakhik. (c)/No error. (d)

Directions (Q. Nos. 6-10) *In the following questions sentences are given with blanks to be filled in with an appropriate word(s). Four alternatives are suggested for each question. Choose for correct alternative out of the four.*

6. He travelled all ...... the world when he was eighty years old.
   (a) in   (b) over
   (c) with   (d) of

7. Dr. Sharma concluded his speech ...... stressing on 'Buddha's teachings of the importance of charity.
   (a) by   (b) with
   (c) at   (d) in

8. Shivaji Maharaj fought ...... every kind of aggression.
   (a) against   (b) to
   (c) with   (d) at

9. Don't depend ...... others; you must stand on your own feet.
   (a) upon   (b) on
   (c) to   (d) for

10. Our life promises a lot ...... pleasure and we must learn to enjoy it.
    (a) with   (b) for
    (c) of   (d) at

Directions (Q. Nos. 11-15) *In the following questions out of the four alternatives, choose the one which best expresses the meaning of the given word.*

11. Benevolent
    (a) beneficial   (b) kind
    (c) helpful   (d) supportive

12. Ancestors
    (a) extinct tribes   (b) relatives
    (c) forefathers   (d) old people

13. Embrace
    (a) impress   (b) except
    (c) embarrass   (d) accept

14. Meek
    (a) light hearted   (b) serious
    (c) submissive   (d) begins

15. Sufficient
    (a) full   (b) complete
    (c) enough   (d) less

Direction (Q. Nos. 16-20) *In the following questions choose the word opposite in meaning to the given word.*

16. Gloomy
    (a) radiant   (b) fragrant
    (c) melodious   (d) illusory

17. Bleasing
    (a) dull   (b) curse
    (c) hurt   (d) harsh

18. Accomplish
    (a) fail   (b) improper
    (c) disagreeable   (d) scatter

19. Famous
    (a) obscure   (b) eminent
    (c) lenient   (d) fabulous

20. Orderly
    (a) unclear   (b) valueless
    (c) chaotic   (d) incomplete

Directions (Q. Nos. 21-25) *In the following questions four alternatives are given for the idiom/phrase printed in bold in the sentence. Choose the alternative which best expresses the meaning of the idiom/phrase.*

21. Helena was **over head and ears** in love with Demetrius.
    (a) carefully   (b) completely
    (c) brilliantly   (d) cautiously

22. Gopi work **by fits and starts.**
    (a) consistently   (b) irregularly
    (c) in high spirits   (d) enthusiastically

23. Naresh Goyal had **to stand on his feet** very early in his life.
    (a) to be physically strong
    (b) to be independent

(c) to stand erect

(d) to be successful

24. The possession of Jerusalem is **a bone of contention** between Israrel and Palestine.
    (a) a subject of peace
    (b) a subject of trade
    (c) a subject of dispute
    (d) a subject of exports

25. My friend **turned a deafear** to my tale of loss and refused to help me.
    (a) paid no heed
    (b) went for away
    (c) listened carefully
    (d) turned his ear away

Directions (Q. Nos. 26-30) *In the following questions a part of the sentence is printed in bold. Below are given alternatives to the bold part at (a), (b) and (c) whch may improve the sentence. Choose the correct alternative. In case no improvement is needed your answer is (d).*

26. **The strong breeze** blew his hat away.
    (a) The strong air
    (b) The strong breath
    (c) The strong wind
    (d) No improvement

27. The Japanese are **hardly working people.**
    (a) a hard working people
    (b) a hardly working people
    (c) hard working people
    (d) No improvement

28. The monkey was seated at the **foot** of a tree.
    (a) bottom
    (b) end
    (c) root
    (d) No improvement

29. My father lives **on Delhi.**
    (a) in Delhi
    (b) at Delhi
    (c) inside Delhi
    (d) No improvement

30. He will come **instantaneously.**
    (a) just now
    (b) presently
    (c) instantly
    (d) No improvement

Directions (Q. Nos. 31-35) *In the following questions out of the four alternatives, choose the one which can be substituted for the given words/sentence.*

31. Instruments to measure atmospheric pressure
    (a) metronome
    (b) compass
    (c) pedometer
    (d) barometer

32. One who tends to take a hopeful view of life
    (a) magnate
    (b) creator
    (c) pacifist
    (d) optimist

33. Belonging to all parts of the world
    (a) common
    (b) universal
    (c) worldly
    (d) international

34. To be known for bad acts
    (a) famous
    (b) notorious
    (c) criminal
    (d) terrorist

35. Words of similar meaning
    (a) homonyms
    (b) pseudonyms
    (c) antonyms
    (d) synonyms

Directions (Q. Nos. 36-40) *In the following questions groups of four words are given. In each group, one word is correctly spelt. Find the correctly spelt word.*

36. (a) onvelope
    (b) envelope
    (c) envalope
    (d) envelap

37. (a) character
    (b) charecter
    (c) character
    (d) chaerecter

38. (a) drunkeness
    (b) drunkenness
    (c) durnkness
    (d) drunkennes

39. (a) surprise
    (b) supprise
    (c) suprise
    (d) surprize

40. (a) comitee
    (b) committee
    (c) committie
    (d) commitee

Answers

Physics

1. (b)	2. (*)	3. (b)	4. (d)	5. (a)	6. (a)	7. (a)	8. (c)	9. (d)	10. (c)
11. (b)	12. (a)	13. (b)	14. (b)	15. (c)	16. (a)	17. (a)	18. (b)	19. (a)	20. (d)
21. (a)	22. (b)	23. (b)	24. (c)	25. (d)	26. (b)	27. (a)	28. (b)	29. (d)	30. (d)
31. (a)	32. (c)	33. (d)	34. (b)	35. (d)	36. (b)	37. (b)	38. (a)	39. (d)	40. (c)
41. (c)	42. (b)	43. (b)	44. (a)	45. (d)	46. (c)	47. (b)	48. (a)	49. (b)	50. (b)
51. (c)	52. (d)	53. (b)	54. (b)	55. (b)	56. (a)	57. (c)	58. (c)	59. (a)	60. (d)

*No option is correct.

1. (b)	2. (b)	3. (d)	4. (b)	5. (c)	6. (b)	7. (d)	8. (a)	9. (a)	10. (b)
11. (b)	12. (d)	13. (a)	14. (c)	15. (c)	16. (c)	17. (c)	18. (a)	19. (d)	20. (b)
21. (c)	22. (a)	23. (d)	24. (b)	25. (d)	26. (c)	27. (c)	28. (d)	29. (a)	30. (b)
31. (c)	32. (a)	33. (a)	34. (d)	35. (b)	36. (a)	37. (d)	38. (d)	39. (d)	40. (b)
41. (a)	42. (d)	43. (d)	44. (a)	45. (a)	46. (b)	47. (d)	48. (b)	49. (b)	50. (b)
51. (d)	52. (d)	53. (a)	54. (a)	55. (c)	56. (a)	57. (d)	58. (c)	59. (a)	60. (c)

Biology

1. (a)	2. (d)	3. (c)	4. (d)	5. (b)	6. (c)	7. (d)	8. (d)	9. (d)	10. (a)
11. (c)	12. (b)	13. (d)	14. (c)	15. (c)	16. (b)	17. (c)	18. (a)	19. (d)	20. (b)
21. (b)	22. (b)	23. (a)	24. (a)	25. (b)	26. (d)	27. (d)	28. (c)	29. (d)	30. (b)
31. (d)	32. (d)	33. (b)	34. (c)	35. (d)	36. (d)	37. (b)	38. (b)	39. (b)	40. (b)
41. (b)	42. (b)	43. (a)	44. (a)	45. (a)	46. (d)	47. (a)	48. (c)	49. (d)	50. (d)
51. (d)	52. (b)	53. (d)	54. (d)	55. (b)	56. (c)	57. (b)	58. (b)	59. (d)	60. (a)
61. (c)	62. (d)	63. (c)	64. (d)	65. (d)	66. (a)	67. (b)	68. (a)	69. (b)	70. (b)
71. (b)	72. (c)	73. (b)	74. (a)	75. (c)	76. (d)	77. (b)	78. (a)	79. (a)	80. (d)

English

1. (a)	2. (d)	3. (c)	4. (b)	5. (b)	6. (b)	7. (a)	8. (a)	9. (b)	10. (c)
11. (b)	12. (c)	13. (d)	14. (c)	15. (c)	16. (a)	17. (b)	18. (a)	19. (a)	20. (c)
21. (b)	22. (d)	23. (b)	24. (c)	25. (a)	26. (c)	27. (c)	28. (c)	29. (a)	30. (d)
31. (d)	32. (d)	33. (b)	34. (b)	35. (d)	36. (b)	37. (a)	38. (b)	39. (a)	40. (b)

Hints & Solutions

Physics

1. Internal energy of a gas

$$U = \frac{3}{2} nRT$$

where, R is constant.

Thus, for a given number of moles of the same gas

$$U \propto T$$

From the graphs, we conclude that

$$U_A = U_D$$

$$U_B = U_C$$
$$U_B > U_A$$
$$U_C > U_D$$

2. Given, length $l = 314$ m

Specific resistance $\rho = 2.2 \times 10^{-8}$ Ω-m

External diameter $D_1 = 1.2 \times 10^{-2}$ m

Internal diameter $D_2 = 1 \times 10^{-2}$ m

As resistance of tube $R = \dfrac{\rho l}{A}$

or $\qquad R = \dfrac{\rho l}{\pi[D_1^2 - D_2^2]}$ $\qquad [\because A = \pi r^2]$

or $\qquad R = \dfrac{4 \times 2.2 \times 10^{-8} \times 314}{\pi[(1.2)^2 - (1.0)^2] \times 10^{-4}}$

$\qquad\qquad = 0.2\,\Omega$

3. $\qquad I_g = \dfrac{2}{300}\,A$

$\qquad\qquad = \dfrac{2}{300} \times 1000\,mA$

$\qquad\qquad = \dfrac{20}{3}\,mA$

$\qquad I_g = 6.67\,mA$

As range of ammeter cannot be decreased but can be increased only, therefore, the instrument cannot be converted to measure the range 1 mA.

4. $\qquad \tan \delta' = \dfrac{\tan \delta}{\cos \theta}$

$\qquad\qquad = \dfrac{\tan 45°}{\cos 30°}$

$\qquad \tan \delta' = \dfrac{1}{\sqrt{3}/2}$

$\qquad\qquad = \dfrac{2}{\sqrt{3}}$

$\therefore \qquad \delta' = \tan^{-1}\left(\dfrac{2}{\sqrt{3}}\right)$

5. In step-down transformer, voltage decreases and corresponding current increases.

6. The ionosphere can reflect electromagnetic waves of frequency less than 40 MHz but do not reflect electromagnetic waves of frequency more than 40 MHz.

7. At room temperature, due to thermal vibrations, the few bonds of intrinsic semiconductor are broken and producing equal number of electrons and holes in the semiconductor.

8. Momentum, $p = mv = \dfrac{h}{\lambda}$

or $\qquad v = \dfrac{h}{m\lambda}$

$\therefore \qquad v = \dfrac{6.62 \times 10^{-34}}{9.1 \times 10^{-31} \times 5.2 \times 10^{-7}}$

$\Rightarrow \qquad v = \dfrac{6.62 \times 10^4}{9.1 \times 5.1}$

$\Rightarrow \qquad v = 1400\,m/s$

9. We know that

$\qquad\qquad n = \dfrac{t}{T}$

Given, $t = 3000$ yr, $T = 6000$ yr

$\qquad\qquad n = \dfrac{3000}{600} = 5$

Then, $\qquad \dfrac{N}{N_0} = \left(\dfrac{1}{2}\right)^n$

$\qquad\qquad \dfrac{N}{N_0} = \left(\dfrac{1}{2}\right)^5 = \dfrac{1}{32}$

10. Input power $= VI = 200 \times 10$

$\qquad\qquad = 2000\,W$

Output power $= \dfrac{40}{100} \times 2000 = 800\,W$

Power loss in heating the armature

$\qquad\qquad = 2000 - 800$

$\qquad\qquad = 1200\,W$

$\therefore \qquad I^2 R = 1200$

or $\qquad R = \dfrac{1200}{I^2}$

$\qquad\qquad = \dfrac{1200}{10 \times 10}$

or $\qquad R = 12\,\Omega$

11. Heat produced in a wire is equal to energy stored in capacitor.

$\qquad H = \dfrac{1}{2}CV^2$

$\qquad\quad = \dfrac{1}{2} \times (2 \times 10^{-6}) \times (200)^2$

$\qquad\quad = 10^{-6} \times 200 \times 200$

is
$$\frac{P}{Q} = \frac{R}{S}$$

as is obvious from the given values.

No, current flows through galvanometer is zero.
Now, P and R are in series, so
Resistance, $R_1 = P + R$
$$= 10 + 15 = 25\,\Omega$$

Similarly, Q and S are in series, so
Resistance $R_2 = R + S$
$$= 20 + 30 = 50\,\Omega$$

Net resistance of the network as R_1 and R_2 are in parallel
$$i = \frac{V}{R} = \frac{0.6}{50} = 0.36\,\text{A}$$

13. Current in tangent glavanometer
$$I = \frac{2rH}{\mu_0 N}\tan\theta \qquad \ldots(i)$$
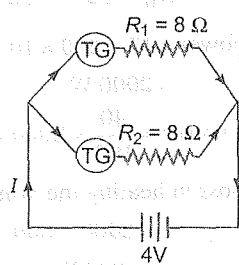
Here, R_1 and R_2 are in parallel
$$\therefore \quad \frac{1}{R_{net}} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$= \frac{R_2 + R_1}{R_1 R_2} = \frac{8+8}{8 \times 8}$$
$$R_{net} = 4\,\Omega$$
Hence, $\quad I = \frac{V}{R} = \frac{4}{4} = 1\,\text{A}$

From Eq. (i), we get
$$\frac{r\tan\theta}{N} = \frac{\mu_0 I}{2H}$$
$$\therefore \quad \frac{r_A \tan\theta_A}{N_A} = \frac{r_B \tan\theta_B}{N_B}$$

$\therefore \qquad N_B = 12\ \text{turns}$

14. Drift velocity, $v_d = \dfrac{I}{neA}$
$$\Rightarrow$$
$$v_d = \frac{5}{(5 \times 10^{26}) \times (1.6 \times 10^{-19}) \times (4 \times 10^{-6})}$$
$$= 1.56 \times 10^{-2}\,\text{ms}^{-1}$$

15. $x = \dfrac{(2n+1)\lambda D}{2a}$

For red light $x = \dfrac{(4+1)D}{2a} \times 6500$

For unknown wavelength of light,
$$x = \frac{(6+1)D}{2a} \times \lambda$$

Accordingly,
$$\therefore \qquad 5 \times 6500 = 7 \times \lambda$$
$$\Rightarrow \qquad \lambda = \frac{5}{7} \times 6500$$
$$= 4642.8\,\text{Å}$$

16. Volume of 8 drops = Volume of big drop
$$\therefore \qquad \left(\frac{4}{3}\pi r^3\right) \times 8 = \frac{4}{3}\pi R^3$$
$$\Rightarrow \qquad 2r = R \qquad \ldots(i)$$
According to charge conservation
$$8q = Q \qquad \ldots(ii)$$
We have
$$V \propto \frac{1}{r}$$
or
$$\frac{V_1}{V_2} = \frac{r_2}{n}$$
$$\Rightarrow \qquad \frac{20}{V_2} = \frac{2r}{r}$$
$$\Rightarrow \qquad V_2 = 10\,\text{V}$$

17. The rise or fall of liquids in vertical capillary tubes is called capillarity. Water in plant fibres rises due to same phenomenon.

18. Equation of an adiabatic process is

$$pV^\gamma = \text{constant} \qquad \ldots(i)$$

Given,

$$p^3 = \frac{k}{V^4}$$

$$p^3 V^4 = k \qquad (\text{constant})$$

$$pV^{4/3} = k \qquad \ldots(ii)$$

Comparing Eqs. (i) and (ii), we get

$$\gamma = \frac{4}{3} = 1.33$$

19. Radius of nucleus $R = R_0 A^{1/3}$

where, $R_0 = 1.2 \times 10^{-15}$ m

Volume of nucleus $(V) = \frac{4}{3}\pi R^3$

$$= \frac{4}{3}\pi [R_0 A^{1/3}]^3$$

$$= \frac{4}{3}\pi R_0^3 A$$

$$V \propto A$$

20. $\eta = \dfrac{\text{Net work done per cycle}}{\text{Total amount of heat absorbed per cycle}}$

or

$$\eta = \frac{W}{Q_1}$$

∴

$$\eta = \frac{Q_1 - Q_2}{Q_1}$$

or

$$\eta = 1 - \frac{Q_2}{Q_1}$$

as

$$\frac{Q_2}{Q_1} = \frac{T_2}{T_1}$$

∴

$$\eta = 1 - \frac{T_2}{T_1} \qquad \ldots(i)$$

where, T_2 is temperature of sink and T_1 is the temperature of the sources.

Here, $\eta = 50\%$

$$T_2 = 50°\text{C} = 273 + 50$$

$$= 323 \text{ K}$$

Putting these values in Eq. (i), we get

$$\frac{50}{100} = 1 - \frac{323}{T_1}$$

$$T = 646 \text{ K} = 373°\text{C}$$

21. The total mass of the initial particles

$$m_i = 1.007825 + 7.016004$$

$$= 8.023829 \text{ u}$$

and the total mass of final particles

$$m_f = 2 \times 4.002603$$

$$= 8.005206 \text{ u}$$

Difference between initial and final mass of particles

$$\Delta m = m_i - m_f$$

$$= 8.023829 - 8.005206$$

$$= 0.018623 \text{ u}$$

The Q-value is given by

$$Q = (\Delta m)c^2$$

$$= 0.018623 \times 931.5$$

$$= 17.35 \text{ MeV}$$

22. Work $W = mgh + \Delta pV$

$$= V\rho gh + \Delta pV$$

$$= 4 \times 10^3 \times 10 \times 20 + (2 \times 10^5) \times 4$$

$$= 16 \times 10^5 \text{ J}$$

23. Required ionisation energy $E = \dfrac{hc}{\lambda}$

$$= \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{1.54 \times 10^{-10}}$$

$$= 12.9 \times 10^{-16} \text{ J}$$

24. Under uniform magnetic field, force evB acts on proton and provides the necessary centripetal force $\dfrac{mv^2}{a}$

$$\frac{mv^2}{a} = evB$$

$$v = \frac{aeB}{m}$$

Now, angular momentum

$$J = r \times p$$

$$= a \times mv$$

$$J = a \times m\left(\frac{aeB}{m}\right)$$

$$J = a^2 eB$$

26. When light is incident on a diffraction grating, then zero order principal maximum will have only white colour.

27. $\dfrac{\lambda_{\text{Lymen}}}{\lambda_{\text{Balmer}}} = \dfrac{\left(\dfrac{1}{2^2} - \dfrac{1}{3^2}\right)}{\left(\dfrac{1}{1^2} - \dfrac{1}{2^2}\right)} = \dfrac{5}{27}$

$$\left[\because \ \frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) \right]$$

$$\lambda_{\text{Lymen}} = \frac{5}{27} \times \lambda_{\text{Balmer}}$$

$$= \frac{5}{27} \times 6563$$

$$= 1215.4\ \text{Å}$$

28. $X_L = \omega L = 2\pi f L$

$X_L \propto f$

If frequency is double, then reactance will be double.

29. From first law of thermodynamics

$$dQ = dU + dW$$

For adiabatic process $dQ = 0$

$\therefore \qquad dU + dW = 0$

$$dU = -50\ \text{J}$$

Therefore, the internal energy of system will decrease.

30. The ozone layer is important because it prevents the UV rays and micro rays coming from the space.

31. Frequency, $f = \dfrac{1}{2\pi\sqrt{LC}}$

When capacitance $= 4C$, then

$$f' = \frac{1}{2\pi\sqrt{4LC}} = \frac{f}{2}$$

32. Air flow from smaller bubble to bigger as the pressure in smaller bubble is higher.

33. The hardness of X-rays depends upon the its wavelength. Which depend upon potential difference between target and cathode.

$$E_1 = -\frac{GMm}{R}$$

When the satellite is intended to move in a circular orbit of radius $7R$, then energy of artificial satellite

$$E_2 = -\frac{1}{2}\frac{GMm}{7R}$$

The minimum energy required

$$E = E_1 - E_2$$

$$= -\frac{GMm}{R} + \frac{1}{2}\left(\frac{GMm}{7R}\right)$$

$$= \frac{-14\,GMm + GMm}{14R}$$

$$= -\frac{13GMm}{14R}$$

35. The equation of displacement

$$x_1 = 4\sin\left(10t + \frac{\pi}{6}\right)$$

The energy of this equation

$$E_1 = \frac{1}{2}m\omega_1^2 a_1^2$$

$$= \frac{1}{2}m \times 10 \times 10 \times 4 \times 4$$

The second equation of displacement

$$x_2 = 5\cos(\omega t)$$

The energy of this equation

$$E_2 = \frac{1}{2}m\omega_2^2 a_2^2$$

$$= \frac{1}{2}m\omega_2^2 \times 5 \times 5$$

According to question

$\because \qquad E_1 = E_2$

$\therefore \quad \dfrac{1}{2}m\omega_2^2 \times 5 \times 5 = \dfrac{1}{2}m \times 10 \times 10 \times 4 \times 4$

$$\omega_2^2 = \frac{10 \times 10 \times 4 \times 4}{5 \times 5}$$

$$\omega_2^2 = 2 \times 2 \times 4 \times 4$$

or $\qquad \omega_2 = \sqrt{2 \times 2 \times 4 \times 4}$

$$= 2 \times 4 = 8\ \text{unit}$$

36. The excess pressure of soap bubble

$$p = \frac{4T}{R}$$

or

$$h\rho g = \frac{4T}{R} \qquad (\because\ p = h\rho g)$$

$$\therefore \qquad T = \frac{Rh\rho g}{4}$$

$$= \frac{1 \times 10^{-2} \times 2 \times 10^{-3} \times 0.8 \times 10^3 \times 9.8}{4}$$

$$= 0.0392\ \text{N/m}$$

37. The equation of continuity

$$A_1 v_1 = A_2 v_2$$

$$A \times 4 = \frac{2}{3} A \times v_2$$

$$v_2 = 6\ \text{ms}^{-1}$$

From Bernoulli's theorem,

$$p + \rho g h_1 + \frac{1}{2}\rho v_1^2 = p + \rho g h_2 + \frac{1}{2}\rho v_2^2$$

or $\quad g(h_1 - h_2) = \frac{1}{2}(v_2^2 - v_1^2)$

$$g \times h = \frac{1}{2}[(6)^2 - (4)^2]\ [\because\ h_1 - h_2 = h]$$

$$10 \times h = \frac{1}{2}[36 - 16]$$

or

$$h = \frac{20}{20}$$

$$= 1\ \text{m}$$

38. Resolving limit

$$d\theta = \frac{1.22\lambda}{a}$$

$$= \frac{1.22 \times 4538 \times 10^{-10}}{1}$$

$$= 5.54 \times 10^{-7}\ \text{rad}$$

39. The force $F = \dfrac{eV}{d}$

$$= \frac{1.6 \times 10^{-19} \times 10^4}{0.5 \times 10^{-2}}$$

$$= 3.2 \times 10^{-13}\ \text{N}$$

40. $v_{\text{CM}} = \dfrac{m_1 \dfrac{dr_1}{dt} + m_2 \dfrac{dr_2}{dt}}{m_1 + m_2}$

$$= \frac{4 \times 5\hat{\mathbf{i}} + 2 \times 10\hat{\mathbf{i}}}{4 + 2}$$

$$v_{\text{CM}} = \frac{40\hat{\mathbf{i}}}{6} = \frac{20}{3}\hat{\mathbf{i}}$$

The kinetic energy

$$K = \frac{1}{2}mv^2$$

$$= \frac{1}{2} \times (4 + 2) \times \frac{20 \times 20}{3 \times 3}$$

$$= \frac{1}{2} \times 6 \times \frac{20 \times 20}{3 \times 3}$$

$$K = \frac{400}{3}\ \text{J}$$

41. Breaking stress $= \dfrac{F}{A}$

$$= \frac{40}{3\pi} \times 10^6\ \text{N/m}^2$$

According to question

$$\frac{40}{3\pi} \times 10^6 = \frac{3 \times 10}{\pi r^2}$$

$$r^2 = \frac{9}{4 \times 10^6}$$

$$r = 1.5 \times 10^{-3}\ \text{m}$$

$$= 1.5\ \text{mm}$$

42. $E = ka^2$

$$\Rightarrow \qquad E \propto a^2$$

or

$$\frac{a_1^2}{a_2^2} = \frac{E_1}{E_2}$$

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

or

$$\frac{a_1}{a_2} = \frac{1}{2}$$

43. Inductance and resistance of choke coil are high and low respectively.

Therefore, $\qquad X_L \gg R$

and $\dfrac{T}{2}$ respectively.

45. Here, frequency $n' = \dfrac{n}{2}$

We have, $\dfrac{n}{2} = n\left(\dfrac{v}{v + v_s}\right)$

or $\dfrac{v + v_s}{v} = 2$

or $v_s = v$

46. Inductive reactance $X_L = \omega L$

$$= 2\pi v L$$
$$= 2\pi \times 50 \times 1$$
$$= 100\,\pi$$

47. We have, $p \propto T$

$$\dfrac{p}{p + \left(\dfrac{0.4}{100}\right)p} = \dfrac{T}{T + 1}$$

$$T = 250°C$$

48. On free expansion of van der Waal's gases, final temperature will be less than initial temperature.

49. According to de-Broglie hypothesis

$$\lambda = \dfrac{h}{p}$$

$$= \dfrac{h}{\sqrt{2mE}} = \dfrac{h}{\sqrt{2mqV}}$$

$$\therefore \quad \lambda = \dfrac{6.6 \times 10^{-34}}{\sqrt{2 \times (1.6 \times 10^{-27})(1.6 \times 10^{-19}) \times 1000}}$$

$$= \dfrac{6.6 \times 10^{-34}}{7.16 \times 10^{-22}}$$

$$= 0.9 \times 10^{-12}\ m$$

50. To form its own isotope atomic number (Z) should remain same.

So, the emission of one α-particle and two β-particles will maintain the Z same.

where, α-particle $= {}_2He^4$; β-particle $= {}_{-1}\beta^0$

$$\eta = \dfrac{\text{output power}}{\text{Input power}}$$

$$\Rightarrow \quad \dfrac{88}{100} = \dfrac{880}{P_i}$$

$$\Rightarrow \quad P_i = 1000\ W$$

Input current, $I_p = \dfrac{P_i}{V_i}$

$$= \dfrac{1000}{2200}$$

$$= 0.45\ A$$

52. For first line of Lyman series,

$n_1 = 1$ and $n_2 = 2$

$$\therefore \quad \dfrac{1}{\lambda_1} = R\left(\dfrac{1}{1^2} - \dfrac{1}{2^2}\right)$$

$$= R\left(1 - \dfrac{1}{4}\right)$$

$$= \dfrac{3R}{4}$$

For first line of Paschen series

$n_1 = 3$ and $n_2 = 4$

$$\therefore \quad \dfrac{1}{\lambda_2} = R\left(\dfrac{1}{3^2} - \dfrac{1}{4^2}\right)$$

$$= R\left(\dfrac{1}{9} - \dfrac{1}{16}\right)$$

$$= \dfrac{7R}{144}$$

$$\therefore \quad \dfrac{\lambda_1}{\lambda_2} = \dfrac{7R}{144} \times \dfrac{4}{3R}$$

$$= \dfrac{7}{108}$$

53. The output of the circuit is,

$$y = \overline{\overline{A} + \overline{B}}$$

$$= \overline{\overline{A}} \cdot \overline{\overline{B}}$$

$$= A \cdot B \quad (\because \overline{\overline{A}} = A \text{ and } \overline{\overline{B}} = B)$$

which is the output of an AND gate.

54. Due to forward bias at the emitter-base junction, the majority charge carrier electrons of emitter get repelled from the negative terminal and move towards base. Some of these electrons

combine with the majority charge carrier holes present in the base and most of the electrons reach the collector, crossing the collector-base junction. This implies that collector current is always less than the emitter current due to the reason (b).

55. If A_0 is the area of orifice at the bottom below the free surface and A that of vessel, time t taken to be empited the tank,

$$t = \frac{A}{A_0}\sqrt{\frac{2H}{g}}$$

$$\therefore \quad \frac{t_1}{t_2} = \sqrt{\frac{H_1}{H_2}}$$

$$\Rightarrow \quad \frac{t}{t_2} = \sqrt{\frac{H_1}{H_1/2}}$$

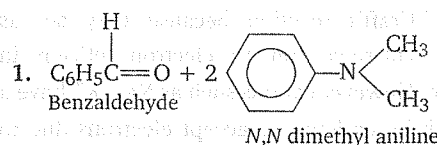$$\Rightarrow \quad \frac{t}{t_2} = \sqrt{2}$$

$$\therefore \quad t_2 = \frac{t}{\sqrt{2}}$$

$$= \frac{10}{\sqrt{2}} = 5\sqrt{2}$$

$$\approx 7 \text{ min}$$

57. The incident wave and reflected wave are always in phase whereas incident wave and refracted wave has phase different of π.

π. Therefore, phase difference between reflected wave and refracted phase is again π.

58. Maximum intensity, $I_{max} = (\sqrt{I_1} + \sqrt{I_2})^2$
$$= (\sqrt{I} + \sqrt{4I})^2$$
$$= 9I$$
Minimum intensity $I_{min} = (\sqrt{I_1} - \sqrt{I_2})^2$
$$= (\sqrt{I} - \sqrt{4I})^2$$
$$= I$$

59. The energy of photon $E = \frac{hc}{\lambda}$
$$= \frac{12375}{\lambda} \text{ eV}$$
$$E = \frac{12375}{5000}$$
$$= 2.48 \text{ eV}$$
The kinetic energy of equation of photoelectric
$$E_k = E - W$$
$$= 0.58 \text{ eV}$$

60. To convert a moving coil galvanometer into a voltmeter a high resistance is connected in series with it.

Chemistry

1.

Benzaldehyde + 2 (N,N dimethyl aniline)

Anhy. ZnCl$_2$ / $-H_2O$ → C$_6$H$_5$CH (Malachite green)

2. $C_nH_{2n}O_2$ is the general formula for open chain carboxylic acid and ester. *e.g.*, if $n = 3 \Rightarrow C_3H_6O_2$
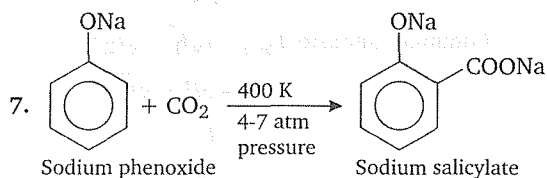
Acid — CH_3CH_2COOH
Ester — CH_3COOCH_3

3. Antimony is used in making lead storage batteries because lead containing antimony is harder and more resistant to the action of acids than ordinary lead.

4. $W_{metal} = \dfrac{Eit}{96500}$
$$= \frac{E \times 3 \times 50 \times 60}{96500}$$
$$E = \frac{96500 \times w}{3 \times 50 \times 60}$$
$$E = \frac{96500 \times 1.8}{3 \times 50 \times 60} = 19.3$$

initial concentration.

$$t_{1/2} = \frac{0.693}{k}$$

7.

Sodium phenoxide $+ CO_2 \xrightarrow[\text{4-7 atm}]{\text{400 K}}$ Sodium salicylate

This reaction is known as Kolbe's reaction.

8. $t = \dfrac{2.303}{k} \log \dfrac{[A]_0}{[A]}$

If $[A]_0 = 1$ then $[A] = \dfrac{1}{16}$

$$t = \frac{2.303}{60} \log 16$$

$$= 4.6 \times 10^{-2} \text{ s}$$

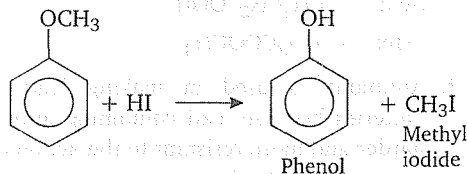**9.** Rate $= \dfrac{dx}{dt} = k[CCl_3CHO][NO]$

$$k = \frac{dx}{dt \times [CCl_3CHO][NO]}$$

$$= \frac{\text{mol L}^{-1}}{\text{s}^{-1} \times \text{mol L}^{-1} \times \text{mol L}^{-1}}$$

$$= \text{L mol}^{-1} \text{ s}^{-1}$$

10. Alkyl halide and phenol is obtained.

+ HI ⟶ Phenol + CH_3I Methyl iodide

11. Gold sol is a lyophobic sol.

12. Sodium ferrocyanide, $Na_4[Fe(CN)_6]$ contains four sodium atoms.

Number of Na atoms = Number of moles × number of atoms per molecule × Avogadro number

13. Hydrogen atom is in $1s^1$ and the $3s$, $3p$ and $3d$-orbitals will have the same energy w.r.t. $1s$ orbital.

14. In CO_3^{2-} ion, the C-atom undergoes sp^2 hybridisation. It has triangular planar structure while BF_4^-, NH_4^+ and SO_4^{2-} have tetrahedral structure.

15. $2p_y$ and $2p_y$ will not form a σ-bond because on taking x-axis as internuclear axis $2p_y$ and $2p_y$ orbitals overlap sideway (lateral overlapping) resulting in the formation of a π-bond.

16. Halogenation of alkanes in the presence of sunlight or heat is an example of free radical substitution.

17. Aldehydes and ketones readily undergo nucleophilic addition reaction. The reactivity decreases as the $+I$ effect of alkyl group increases.
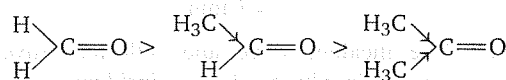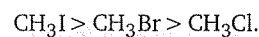

18. Sulphonation of benzene is carried out by SO_3 (electrophile).

19. $FeCl_3$, $FeBr_2$ and $AlCl_3$ are used in Friedel-Craft's reaction because they act as Lewis acid since they are electron deficient in nature. However cations such as Na^+, K^+ have a very little tendency to accept electrons due to inert gas configuration. Therefore, can't be used in Friedel-Craft reaction.

20. Order of electronegativities of halogens are $F > Cl > Br > I$.

Hence, the order of reactivities of methyl halide in the formation of Grignard reagent is

$$CH_3I > CH_3Br > CH_3Cl.$$

21.

Toluene $\xrightarrow[\text{heat}]{+ Cl_2 \; h\nu}$ Benzyl chloride $\xrightarrow[-HCl]{Cl_2}$ Benzal chloride $\xrightarrow[-HCl]{Cl_2}$ Benzotrichloride

22. NaCl structure $\underset{760\,K}{\overset{\text{High }P}{\rightleftharpoons}}$ CsCl structure
6 : 6 coordination number   8 : 8 coordination number

23. $X_2 + Y_2 \longrightarrow 2XY$

$\Delta H = (BE)_{X-X} + (BE)_{Y-Y} - 2(BE)_{X-Y}$

If BE of $(X-Y) = a$

then BE of $(X-X) = a$
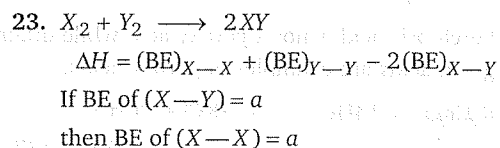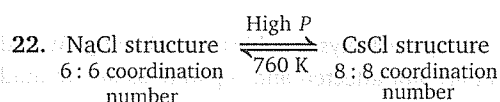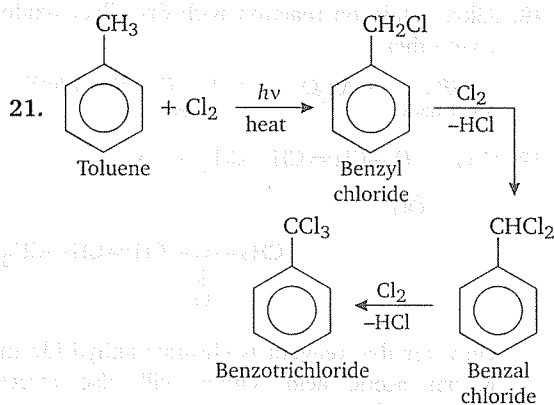
and BE of $(Y-Y) = \dfrac{a}{2}$

$\Delta H_f = (X-Y) = -200\,\text{kJ}$

$\therefore \; -400 \text{ (for 2 moles } XY) = a + \dfrac{a}{2} - 2a$

$$-400 = -\dfrac{a}{2}$$

or $\qquad a = +800\,\text{kJ}$

24. The enthalpies of all elements in their standard states are taken as zero. The standard state of an elementary substance means the most stable form of that substance at 298 K temperature and 1 bar pressure.

25. $\Delta G = \Delta H - T\Delta S$

For the given reaction, $\Delta H = -$ve as it is exothermic, $\Delta S = +$ve then $\Delta G = -$ve. So, the reaction will be spontaneous at all the temperatures.
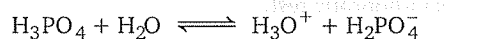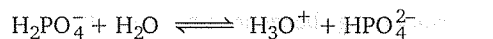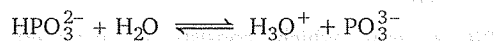
26. $C\,(s) + O_2(g) \longrightarrow CO_2(g);$
$\qquad\qquad\qquad\qquad 44\,g$
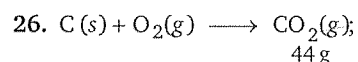
$\Delta H = -393.5\,\text{kJ mol}^{-1}$

Heat released in the formation of
$$44\,\text{g CO}_2 = 393.5\,\text{kJ}$$
$\therefore$ Heat released in the formation of
$$35.2\,\text{g CO}_2 = \dfrac{393.5\,\text{kJ} \times 35.2\,\text{g}}{44\,\text{g}}$$
$$= 314.8\,\text{kJ}$$

27. $W = 2.303\,nRT \; \log \dfrac{p_1}{p_2}$

$= 2.303 \times 1 \times 8.314 \times 300 \times \log 10$

$= 5744.1\,\text{J}$

28. $\text{Acid}_1 + \text{Base}_2 \rightleftharpoons \text{Acid}_2 + \text{Base}_1$

$HPO_3^{2-} + H_2O \rightleftharpoons H_3O^+ + PO_3^{3-}$

$H_2PO_4^- + H_2O \rightleftharpoons H_3O^+ + HPO_4^{2-}$

$H_3PO_4 + H_2O \rightleftharpoons H_3O^+ + H_2PO_4^-$

29. Because buffer solutions are mixture of weak acid or weak base and their salts.

30. $\qquad\qquad AgCl \longrightarrow \underset{X}{Ag^+} + \underset{X}{Cl^-}$
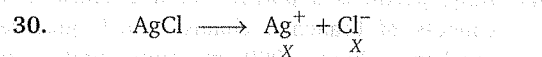
After NaCl is added $\quad -X \quad\; X + 1 \times 10^{-4}$
That's why Ag^+ will be less.

31. Basic, because it is a salt of strong base and weak acid.

32. Equilibrium constant for the reaction,

$$SO_2(g) + \dfrac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$$

$$K_c = \dfrac{1}{4.9 \times 10^{-2}}$$

and for $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

$$K_c = \left(\dfrac{1}{4.9 \times 10^{-2}}\right)^2$$

$$= \dfrac{10^4}{(4.9)^2} = 416.49$$

(Reduction, oxidising agent)

33. $Ag_2O + H_2O_2 \longrightarrow 2Ag + H_2O + O_2$

(Oxidation, reducing agent)

35. Pb_3O_4 is red lead (sindur).

36. Al_4C_3 on treating with water gives methane (CH_4) gas.

37. Zeolite when treated with hard water exchange Ca^{2+} and Mg^{2+} ions (present in hard water) with Na^+ ions.

38. A codon is a specific sequence of 3 adjacent bases on a strand of DNA or RNA that provides genetic code information for a particular amino acid.

39. Proteins which consists of α-amino acid containing benzene ring *e.g.*, tyrosine give xanthoprotic test.

40. Codon is present in *m*RNA. It is responsible for translation.
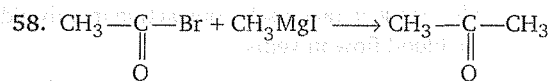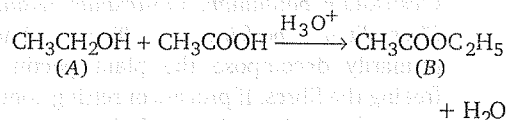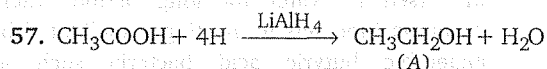
41. Amylopectin is a polymer of α-D glucose. It consists of branched chains of α-D glucose involving about 1000 or more units per molecule.

42. Vulcanization is the process of heating natural rubber with sulphur in order to develop some specific qualities such as abrasion resistance, heat resistance and elasticity.

43. Dopamine is produced in several areas of brain. If the amount of dopamine increases in the brain, the patient may be affected with Parkinson's disease.

44. Alizarin is a natural dye.

45. Strong oxidising agents such as PbO_2 oxidise Mn^{2+} to MnO_4^- or Mn^{+7}.

46. $[Cr(C_2O_4)_3]^{3-}$ shows optical isomerism because its mirror image is not superimposable.

47. DMG is a polydentate ligand which binds the central atom nickel forming a ring like structure.

$$\underset{\text{Alkyl halide}}{2RX} + Ag_2O \longrightarrow \underset{\text{ether}}{R-O-R} + 2AgX$$

49.
$$CH_3-\underset{\underset{OH}{|}}{CH}-CH=CH-CH_3 \longrightarrow$$

$$CH_3-\underset{\underset{O}{\parallel}}{C}-CH=CH-CH_3$$

Only suitable reagent is chromic anhydride in glacial acetic acid. Other will also affect $>C=C<$ bond.

50. During electrolysis, noble metals like Ag, Au and Pt are not affected and separate as anode mud from impure anode.

51. Perchloric acid is not a peroxy acid while other given acids are examples of peroxy acids.

52. $K_2Cr_2O_7 + 14HCl \longrightarrow 2KCl + 2CrCl_3$
$$+ 7H_2O + 3Cl_2$$

53. Raoult's law is not applicable if the total number of particles of solute changes in the solution due to association or dissociation.

54. An increase in temperature increases the volume of the solution and thus, decreases its molarity.

55. H_3PO_3 is a dibasic acid.
$$N_1V_1 \text{ (acid)} = N_2V_2 \text{ (base)}$$
$$0.1 \times 2 \times 20 = 0.1 \times 1 \times V_2$$
$$V_2 = \frac{0.1 \times 2 \times 20}{0.1 \times 1}$$
$$= 40 \text{ mL}$$

56. Number of moles of $C_2H_5OH = \frac{138}{46} = 3$

Number of moles of $H_2O = \frac{72}{18} = 4$

Mole fraction, $x_{C_2H_5OH} = \dfrac{3}{3+4}$

$= \dfrac{3}{7}$

Mole fraction, $x_{H_2O} = \dfrac{4}{3+7} = \dfrac{4}{7}$

$\dfrac{x_{C_2H_5OH}}{x_{H_2O}} = \dfrac{3/7}{4/7} = \dfrac{3}{4}$

57. $CH_3COOH + 4H \xrightarrow{\text{LiAlH}_4} \underset{(A)}{CH_3CH_2OH} + H_2O$

$\underset{(A)}{CH_3CH_2OH} + CH_3COOH \xrightarrow{H_3O^+} \underset{(B)}{CH_3COOC_2H_5}$

$+ H_2O$

58. $\underset{\substack{|| \\ O \\ \text{Acetyl bromide}}}{CH_3-C-Br} + CH_3MgI \longrightarrow \underset{\substack{|| \\ O}}{CH_3-C-CH_3}$

$\xrightarrow{CH_3MgI} \underset{\substack{| \\ CH_3}}{\overset{CH_3}{CH_3-C-OMgI}}$

$\xrightarrow{aq.\ NH_4Cl} \underset{\substack{| \\ CH_3 \\ \text{2-methyl-2-propanol}}}{\overset{CH_3}{CH_3-C-OH}}$

59. $C_6H_5NH_2 + CH_3COCl \xrightarrow[-HCl]{NaOH} \underset{\text{acetanilide}}{C_6H_5NHCOCH_3}$

$+ HCl$

60. PHBV is a biodegradable polymer.

Biology

1. The term 'syncytial tissue' refers to animal tissues formed by fusion of cells, commonly during embryogenesis, to form multinucleate masses of protoplasm. In striated muscle, such syncytium is present in the form of cylinder.

2. Dorsal blood vessel of earthworm is the largest blood vessel. It occurs mid dorsally above the alimentary canal and runs from one end of the body to other. It collects blood from various parts behind the 13th segment, however in the first thirteen segments, it behaves a distributing channel.

3. Protonephridia are probably the earliest type of nephridia and are found in flatworms also. These consist of a network of fine tubles which run along the length of the animal at each side and open to the surface by minute nephridipores.

4. **Corpora quadrigemina,** are two pairs of spherical optic lobes, representing the dorsal part of midbrain. In rabbit, it is associated with vision.
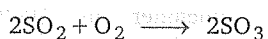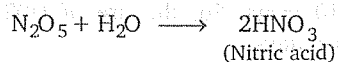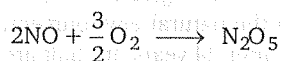
5. The choanocyte (also called collar cells) line the cavity of water canal of sponges. These are ovoid cells with one end embedded in the mesophyll and the other exposed. The exposed end bears a flagellum, surrounded by a collar, which is made up of adjacent microvilli. The microvilli are connected to each other by delicate micro-fibrils, forming the fine filtration device for straining food particles from the water.

6. During unfavourable conditions, *Amoeba* starts forming the cysts, this process is known as **encystment**. During encystment, a number of organelles such as cillia and flagella are reabsorbed and the Golgi apparatus secretes the cyst wall material, which is carried to the surface of *Amoeba* in vesicles. Cyst of *Amoeba* blown far and wide along the wind where *Amoeba* hatch out of these in favourable conditions.

8. Telomerase is an enzyme composed of both RNA and protein, and as such may be an evolutionary link between systems using ribozymes and those using purely protein enzymes.

9. In zygotene of prophase-I, homologous chromosome pair up. This is called synapsis during which one chromosome of the pair comes from male parent and the other from female parent.

10. The general features of genetic code are
    (i) The genetic code is written in **linear** form, using the ribonucleotide bases that compose *m*RNA molecule as letters.
    (ii) Each word of codon consists of three letters, *i.e.,* the codon is **triplet.**
    (iii) The genetic code inside the cell medium is said to be **non-ambiguous.**
    (iv) The code is **degenerate**, *i.e.,* a given amino acid can be specified by more than one codons.
    (v) The codon contains **start** and **stop** signals.
    (vi) The code is said to be **commaless** (continuous).
    (vii) The code is **non-overlapping.**

11. Sequencial expression of gene occurs when steroid binds to DNA. It acts as an inducar. HBE element is present known as hormone binding element.

12. Sickle-cell anaemia is caused by a change in a single base pair of DNA (substitution of valine by glutamic acid in the β-globin chain of haemoglobin). It is a genetic disease reported from negroes. The individuals of sickle-cell anaemia are immune to malaria.

13. Test cross, *i.e.,* crossing of F_1 progeny to the recessive parent is used to find genotype of the progeny.

14. **Phenetics** is also known as **numerical taxonomy.** It dictates taxonomic affinities entirely on the basis of measurable similarities and differences.

offspring.

16. Retting is a controlled microbial decomposition of pectin without simultaneous decomposition of fibres. Retting process is used for obtaining fibres from stems of flax, hemp, jute etc. For this purpose, stems of fibre yielding plants are immersed in water for long period where decomposition sets in. Retting is facilitated by anaerobic butyric acid bacteria such as *Clostridium botulinum, Clostridium tetani* and *Clostridium perfringens.* These bacteria primarily decompose the plant pectin thus, freeing the fibres. If process of retting continues for a long time then cellulose fermenting bacteria develop and destroy the fibres.

17. **Tetracycline** interferes with the attachment of *t*RNA carrying the amino acid to the *m*RNA-ribosome complex preventing the addition of amino acids to the growing polypeptide chain. **Streptomycin** interferes with the initial steps of protein synthesis by changing the shape of 30 S proton of 70 S prokaryotic ribosome.
    Erythromycin reacts with 50 S portion of the 70 S prokaryotic ribosome.

18. The body cavity (coelom) of earthworm is filled with an alkaline, colourless or milky coelomic fluid containing water, salts some proteins and four types of coelomic corpuscles, *i.e.,* phagocytes, mucocytes, circular nucleated cells and chloragogen cells. During burrowing, the coelomic fluid becomes turgid and acts as hydraulic skeleton.

19. Senescence can be defined as "the sum of deteriorative processes, which naturally terminate the functional life of an organisms". Senescence is not confined only to whole plant, it may be limited to a particular plant organ such as leaf and flower or cells such as pholem and xylem. Abscission is natural shedding of leaves, foliage branches, fruits, floral parts etc. According to Leopold (1967) abscission is a senesence phenomenon.

20. Light causes photosynthesis which leads to reduction in CO_2 concentration → synthesis of glycolate → oxidation of glycolate → ATP synthesis → activation of K^+ pump → movement of K^+ in guard cells → movement of water into guard cells → swelling of guard cells → opening of stomata.

21. **Cyclic photophosphorylation** is that type of light energised ATP synthesis in which electron expelled by excited photocentre is returned to it after passing over a chain of electron carriers. **Non-cyclic photophosphorylation** is that type of light energised ATP synthesis in which electron expelled by excited photocentre does not return to them. It involves two Photochemical Systems (PS-I and PS-II) and produces assimilatory power (ATP and NADPH.)

22. According to mass flow hypothesis, the transport of organic solutes takes place from source to sink, this transport also depends on metabolic energy.

23. Glycolysis, Krebs' cycle and electron transport system are meant for ATP synthesis in different steps. ATP is the energy currency of cell.

24. **Tendons** are white fibrous connective tissues, made up of collagen protein and connect bones with skeletal muscles.

    Ligament is a modified elastic connective tissue, which is made up of elastic yellow fibres. Ligaments form connection between bone to bone.

25. There are thirteen types of finches described by Darwin. They are geographically isolated and found in Galapagos Island of South Pacific.

26. The social interaction of competitors result in the establishment of territory or territoriality by the successful competition. The territory distribution depends on feeding, mating, caring of young ones also.

27. The joint between humerus and radius bone is **hinge joint.** The movement in this joint is unidirectional. This joint is also called as gingulum.

28. The nuclear membrane of the nucleus which separates nucleus and cytoplasm is double membrane and porous.

29. Mast cells are special cells found is connective tissue. They secrete three substances heparin-anticogulant, histamine-vasodilator and serotonin-vasoconstrictor.

30. According to the biological concept of sepcies, a species is a group of organisms which can interbreed freely in nature and produce fertile offsprings which rarely breed with organisms of other species in a natural environment.

31. DDT (Dichloro Diphenyl Trichloroethane) either does not degrade or degrade extremely slowly in the natural environment. DDT is still detected after 24 years. It's half life period is up to 10 years. So, the use of DDT is banned now-a-days.

32. Dr. HF Klinefelter in 1942 described **Klinefelter's syndrome.** It occurs in men due to an extra 'X' chromosome thus, having genetic constitution 'XXY'. This is **trisomy** but of **sex chromosome** or **allosome.** It usually results from non-disjunction and is expressed by small penis, absence of body hairs, gynaecomastia etc.

33. **Down's syndrome** (mongolian idiocy) is a congenital disorder caused by trisomy of chromosome 21, often by non-disjunction. It is characterised by mental retardation, simian palm, as mongoloid facial features.

    Turner's syndrome is due to monosomy of sex chromosome, *i.e.,* XO. It was described by **Turner** 1938.

    Colour blindness is a recessive **sex linked** (X) trait in which affected individual can not distinguish red colour from green colour.

    Klinefelter's syndrome is due to an extra X-chromosome to man (male), *i.e.,* **trisomy of sex chromosome.**

34. When a cell becomes turgid, the increase in turgor pressure resists the entry of water into the cell.

    ψ cell – TP cell = – OP cell

    ψ cell = TP cell – OP cell

    At equilibrium

    ψ cell = TP cell – OP cell = zero.

nucellus, integument etc.,) is called **adventive embryony**.

36. Acid rain is caused by large scale emission of nitrogen oxides (NO_x), sulphur oxides (SO_x), volatile organic carbons and HCl from thermal power plants, industries and automobiles. Oxides of nitrogen and sulphur combine with water and oxygen and form nitric acid and sulphuric acid, respectively.

$$2NO + \frac{3}{2}O_2 \longrightarrow N_2O_5$$

$$N_2O_5 + H_2O \longrightarrow 2HNO_3$$
$$\text{(Nitric acid)}$$

$$2SO_2 + O_2 \longrightarrow 2SO_3$$

$$2SO_3 + 2H_2O \longrightarrow 2H_2SO_4$$
$$\text{(Sulphuric acid)}$$

37. Long day plants flower in photoperiod more than critical day length, *e.g., Hyocyamus niger,* radish, *Beta vulgaris, Spinacea* (spinach) lattuce, etc.

38. Lifespan of *Ascaris* in the host is 9 to 12 months.

39. False fruits are developed when some other floral parts participate in the formation of fruits, *e.g.,* in apple, thalamus is modified to form a fruit. Mango is drupe.

40. FAD acts as an e^- acceptor in between succinic and fumaric acid.

41. Cone cells contain the light sensitive pigment iodopsin. It is found in retina of all diurnal vertebrates. Cones are specialised to transmit information about colour and responsible for visual activity of eye.

42. Sexual dimorphism is absent in Deuteromycetes.

43. *Sphagnum* is known as peat mass. The partially decomposed *Sphagnum* accumulates to form compressed mass called peat.

44. **Photonasty** is the response produced by plants in response to availability of light.

46. *Acetobactor* are of commercial importance. They are used in the production of vineger by converting ethanol in wine to acetic acid.

47. The term **cistron** is used to describe the locus responsible for generating a protein. It can also be defined as the segment of DNA that contains all information for production of single polypeptide.

48. A biodiversity hot spot is biogeographic region with a significant reservoir of biodiversity that is threatened with destruction, high levels of species richness and high degree of endemism. Initially, 25 biodiversity hotspots were identified but subsequently nine more have been added to the list, bringing the total number of biodiversity hotspots in the world to 34.

49. All of these are exotic species.

50. **Reporter genes** are used to determine whether a particular DNA construct has been successfully introduced into a cell.

51. When CO_2 concentration is blood increases, breathing becomes faster and deeper. The effect of increased CO_2 is to decrease the affinity of haemoglobin for O_2.

52. Cancer is caused by loss of control over cells reproduction capacity so easily damaged by radiation.

53. Leishamaniasis or kala azar is caused by *Leishmania donovani.* It spreads by sand fly. It is also known as dum-dum fever.

54. *Anabaena* is a free living N_2 fixing cyanobacterium which can form symbiotic association with the quatic fern *Azolla.*

55. Prolactin is secreted by anterior pituitary gland. It stimulates mammary gland development during pregnancy and lactation after child birth.

56. Fangs of python are maxillary teeth located on maxilla. If the fangs are once taken out, they can come out again with the same length.

57. The organs which have different embryonic origin but perform same function are called as **analogous organs**, *e.g.,* wings of bat and insects.

    The organs which have same embryonic origin but adapted to perform different functions are known as **homologous organs**, *e.g.,* wing of bat and forelimb of humans.

58. Sinus venosus refers to the chamber of heart present between veins and right atria. In mammals, it has disappeared as it has been absorbed in right atrium.

59. In aerobic respiration, the pyruvic acid which is produced as a result of glycolysis is further oxidized into CO_2 and water after passing through a series of reactions. This series of reactions takes place in the matrix of mitochondria and is known as **Krebs' cycle**, after the name of it's discoverer.

60. In wild pea (*Lathyrus aphaca*), whole leaf is transformed into tendril. In *Pisum sativum,* terminal leaflet, while in *Gloriosa*, leaf apex is transformed into tendril.

61. Pteridophyta is a group of non-seed forming, vascular cryptogams, *i.e.,* these contain vascular tissues for the conduction of minerals and water but do not produce seeds.

    The main plant body of these plants is diploid called sporophyte which produces spores after meiosis. These spores on germination give rise to gametophytic plant which produces gametes. Fusion between male and female gametes produces a diploid zygote which produces diploid sporophytic stage.

62. Transpiration is a physical as well as physiological process in which water is evaporated in the form of vapour from aerial parts of plants, particularly with the help of structures known as **stomata**. Stomata usually open during day time (*i.e.,* light). Increase in temperature increases the rate of transpiration. High atmospheric humidity reduces the process of transpiration and moving air (wind) increases the rate of transpiration.

63. Cytokinin is also known as cell division hormone as it brings about the process of cell division in plants. The ratio of cytokinin to auxin control the process of **cell differentation.**

    A higher cytokinin to auxin ratio brings about the shoot formation while a higher auxin to cytokinin ratio brings about root development. When both of these are present in relatively equal quantities although the cells divide but fail to differentiate.

64. The enzyme complex nitrogenase has two components, (a) a large Mo–Fe protein consisting of four subunits (enzyme nitrogenase) (b) a smaller Fe protein consisting of two subunits (nitrogenase reductase).

65. Cockroach, housefly, mosquitoes etc., all belong to class Insecta of the phylum- Arthropoda. These contain three pairs of legs (total six) for locomotion.

66. Cartilage is the most important vertebrate connective tissue. The cells of cartilage, called **chondrocytes** are surrounded by an amorphous matrix which is known as **chondrin.** Chondrin contains glycoproteins, basophilic chondroitin and fine collegen fibres.

67. Insectivorous plants can survive in N_2 deficient soil as they trap N_2 from the insects.

68. Spore of *Funaria* on germination, gives rise to protonema.

69. Vessels present in xylem are responsible for conduction of water and minerals from soil to the top of the plant.

70. Multiplication of DNA is called **replication.** Replication means formation of equal and opposite form or carbon copy. Duplication is formation of exactly same type. Transcription is writing the message of DNA in the form of *m*RNA and translation means decoding the message of *m*RNA into proteins.

71. Phytochrome is the pigment of activity of red and far red light. The activity results in photoperiodism.

72. Citric acid present in lemon is responsible for its sourness.

two sub-orders—Sauria (lizards), Ophidia (snakes).

74. Emasculation means removal of anthers or stamens or killing of pollen grains of a flower without affecting in any way, the female reproductive organs. It is done to prevent the self-fertilization pollination means falling of pollen grain on the stigma of flower. Fertilization means fusion of male gamete and female gamete and anthesis means flowering (opening of floral buds).

75. Haemoglobin is a globular protein. It is carrier of oxygen in blood.

76. LPP-1 is the first cyanophage, discovered by Safferman and Morris. It Infects *Lynbya*, *Phromidium* and *Plectonema* (blue-green algae).

77. *Oscillatoria* is a myxophycean alga which reproduces by means of hormogonia. Hormogonia are broken filaments which give rise to new filaments under favourable conditions.

origin and diversification. It is usually represented as diagrammatic phylogenetic tree, *i.e.,* dendrogram.

Palaentology is the study of fossils, ontogeny is the whole course of an individual's development and life history.

79. Sertoli cells are the cells that line the seminiferous tubules in the testis. These cells protect the spermatids and convey nutrients to both the developing and mature spermatozoa. Sertoli cells are regulated by FSH as FSH receptors are confined to Sertoli cells.

80. **Aril** is the edible part in the fruit of litchi. The aril is an accessory seed covering often formed from the outgrowth at base of the ovule.

Fleshy thalamus is the edible part of apple (*Pyrus malus*).

Juicy testa is the edible part of pomegranate (*Punica granatum*).

Endocarpic juicy hairs are the edible part of orange (*Citrus* sp).