(PART 1. PHYSICS)

1. The physical quantity which has the dimensional formula M^1T^{-3} is
   (1) Compressibility   (2) Density
   (3) Solar constant   (4) Surface tension

2. A ball is dropped downwards. After 1 second another ball is dropped downwards from the same point. What is the distance between them after 3 seconds
   (1) 20 m   (2) 9.8 m   (3) 25 m   (4) 50 m

3. If a particle of mass m is moving in a horizontal circle of radius r with a centripetal force $(-1/r^2)$, the total energy is
   (1) $-\frac{4}{r}$ (2) $-\frac{2}{r}$
   (3) $-\frac{1}{r}$ (4) $-\frac{1}{2r}$

4. A cubical block of side a is moving with velocity v on a horizontal smooth plane as shown. It hits a ridge at point O. The angular speed of the block after it hits O is
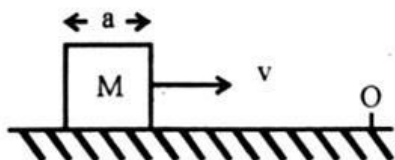
   (1) 3v/2a   (2) $\sqrt{3}v/\sqrt{2}a$
   (3) 3v/4a   (4) Zero

5. A second's pendulum is mounted in a rocket. Its period of oscillation decreases when the rocket
   (1) Moves up with uniform acceleration
   (2) Moves up with a uniform velocity
   (3) Comes down with uniform acceleration
   (4) Moves round the earth in a geostationary orbit.

6. Consider a car moving along a straight horizontal road with a speed of 72 km/h. If the coefficient of static friction between the tyres and the road is 0.5, the shortest distance in which the car can be stopped is $[g = 10 \text{ ms}^{-2}]$
   (1) 20 m   (2) 40 m
   (3) 30 m   (4) 72 m

7. A force acts on a 3.0 gm particle in such a way that the position of the particle as a function of time is given by $x = 3t - 4t^2 + t^3$, where x is in metres and t is in seconds. The work done during the first 4 seconds is
   (1) 530 mJ   (2) 490 mJ
   (3) 450 mJ   (4) 2.28J

8. A body of mass 2 kg collides with a wall with speed 100 m/s and rebounds with same speed. If the time of contact was 1/50 second, the force exerted on the wall is
   (1) 10^4 N   (2) 4N
   (3) 2×10^4 N   (4) 8 N
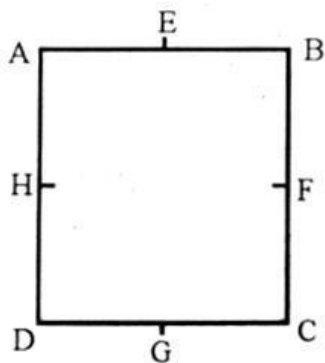
9. If momentum is increased by 20%, then K.E. increases by
   (1) 55%   (2) 77%
   (3) 66%   (4) 44%

10. The decrease in the potential energy of a ball of mass 20 kg which falls from a height of 50 cm is
    (1) 98 J   (2) 968 J
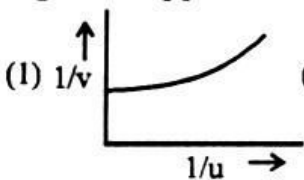   (3) 1980 J   (4) None of these.

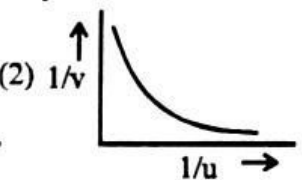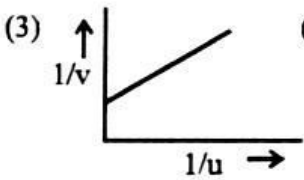11. In a rectangle ABCD (BC = 2AB). The moment of inertia along which axis will be minimum

(1) EG   (2) HF   (3) BD   (4) BC

12. In a carbon monoxide molecule, the carbon and the oxygen atoms are separated by a distance 1.12×10^{-10} m. The distance of the centre of mass from the carbon atom is

(1) 0.64×10^{-10} m   (2) 0.56×10^{-6} m

(3) 0.51×10^{-10} m   (4) 0.48×10^{-10} m

13. For a satellite escape velocity is 11 km/s. If the satellite is launched at an angle of 60° with the vertical, then escape velocity will be

(1) 33 km./s   (2) $\frac{11}{\sqrt{3}}$ km/s

$11\sqrt{3}$ km/s   (4) 11 km/s

14. If the radius of the earth shrinks by 1.5% (mass remaining same) , then the value of acceleration due to gravity changes by

(1) 1%   (2) 3%   (3) 4%   (4) 2%

15. In which case there is maximum tension in the wire, if same force is applied on each wire

(1) L = 400 cm, d = 0.01 mm

(2) L = 300 cm, d = 0.03 mm

(3) L = 200 cm, d = 0.02 mm

(4) L = 500 cm, d = 0.05 mm

16. If the surface tension of water is 0.06 Nm^{-1}, then the capillary rise in a tube of diameter 1 mm is ($\theta = 0°$)

(1) 3.86 cm   (2) 3.12 cm

(3) 2.44 cm   (4) 1.22 cm

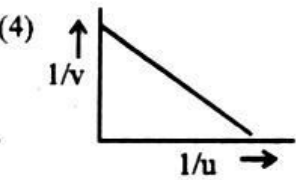17. 1 mole of gas occupies a volume of 100 ml at 50 mm pressure. What is the volume occupied by two moles of gas at 100 mm pressure and at same temperature

(1) 500 ml   (2) 200 ml

(3) 100 ml   (4) 50 ml

18. What is the velocity of wave in monatomic gas having pressure 1 kilo pascal and density 2.6 kg/m³

(1) 8.9×10^3 m/s   (2) 3.6 m/s

(3) Zero   (4) None of these.

19. A gas mixture consists of 2 moles of oxygen and 4 moles of argon at temperature T. Neglecting all vibrational modes , the total internal energy of the system is

(1) 11 RT   (2) 9 RT

(3) 15 RT   (4) 4 RT

20. A diatomic gas initially at 18°C is compressed adiabtically to one - eighth of its original volume. The temperature after compression will be

(1) 144°C   (2) 891°C

(3) 887°C   (4) 18°C

21. The radiant energy from the sun incident normally at the surface of earth is 20 k cal/m² min. What would have been the radiant energy incident normally on the earth, if the sun had a temperature twice of the present one.

(1) 80 kcal/m² min   (2) 320 kcal/m² min

(3) 40 kcal/m² min   (4) 160 kcal/m² min

22. The ratio of energy of emitted radiation of black body at 27°C and 927°C is

(1) 1 : 256   (2) 1 : 64   (3) 1 : 16   (4) 1 : 4

23. Two waves of lengths 50 cm and 51 cm produced 12 beats per second. The velocity of sound is

(1) 360 m/s   (2) 340 m/s

(3) 331 m /s   (4) 306 m/s

24. A whistle giving out 450 Hz approaches a stationary observer at a

22. A monoenergetic electron beam with electron speed of $5.28 \times 10^6\ ms^{-1}$ is subjected to a magnetic field of 2×10^{-4} T normal to the back velocity. What is the radius of the circular path traced by the beam ? Given e/m for electron $= 1.76 \times 10^{11}\ C\ kg^{-1}$.

(1) 20 cm   (2) 15 cm

(3) 10 cm   (4) 5 cm

23. The energy of a photon corresponding to the visible light of maximum wavelength is approximately equal to

(1) 2.0 eV   (2) 2.5 eV

(3) 1.0 eV   (4) 1.5 eV

24. A light signal (photon) cannot escape from the surface of a

(1) neutron star   (2) black hole

(3) red giant   (4) white dwarf

25. On increasing the reverse bias to a large value in a pn junction diode, the current

(1) remains fixed   (2) suddenly increased

(3) decreases slowly   (4) Increased slowly

26. In Boolena algebra $\bar{1} + \bar{1}$ equals

(1) 2   (2) 1

(3) 0   (4) both 0 and 1

27. Which of the following crystals have a hexagonal structure ?

(1) zinc   (2) calcite

(3) quartz .   (4) both (1)&(3)

28. When a β-particle is emitted from a nucleus, the neutron-proton ratio

(1) is increased   (2) is decreased

(3) remains the same

(4) first decreases then increases

29. If the end A of a wire is irradiated with alpha rays and the end B is irradiated with beta rays, then

(1) a current will flow from B to A

(2) a current will flow from A to B

(3) there will be no current in the wire

(4) a current will flow from each end to the mid point of the wire

30. If A, Z and N denote the mass number , the atomic number and the neutron number for a given nucleus, then which of the following statement is incorrect?

(1) isobar have the same A but different Z and N

(2) isotopes have the same Z but different N and A

(3) isotones have the same N but different A and Z

(4) N = Z+A

31. Moving with the same velocity, which of the following has the longest de Broglie wavelength ?

(1) neutron   (2) proton

(3) β - particle   (3) α - particle

32. A concave lens of focal length 20 cm placed in contact with a plane mirror acts as a

(1) concave mirror of focal length 10 cm

(2) concave mirror of focal length 60 cm

(3) concave mirror of focal length 40 cm

(4) convex mirror of focal length 10 cm

33. If a graph is plotted between $1/v$ and $1/u$, which one of the graphs shown in figure is approximately correct ?

34. A particle of mass m and q is released from rest in a uniform electric field E. The kinetic energy attained by the particle, after moving a distance x is

(1) $q^2\ Ex$ (2) $q\ Ex$

(3) $q\ E^2x$ (4) $q\ Ex^2$

35. A proton and an alpha particle enter a uniform magnetic field with the same

(4) A magnetic field is applied normally

(1) 8 Fermi   (2) 11.16 fermi

(3) 6 Fermi   (4) 5 Fermi

38. The wavelength of the first line of Balmer series is 6563 Å. The Rydberg constant for hydrogen is about

(1) 1.09×10^5 per m   (2) 1.09×10^9 per m

(3) 1.09×10^8 per m   (4) 1.09×10^7 per m

39. Radius of $_2^4$He nucleus is 3 Fermi. The radius of $_{82}^{206}$Pb nucleus will be

40. An atom of mass number 15 and atomic number 7 captures an α – particles and then emits a proton. The mass number and atomic number of the resulting product will respectively be

(1) 18 and 8   (2) 16 and 4

(3) 15 and 3   (4) 14 and 2

§ *Directions Q41 to 60 consists of two statements, one labelled the 'Assertion (A)' and the other labelled the 'Reason (R)'. Examine these statements carefully and decide if*

(1) If both assertion and reason are true statements and the reason is a correct explanation of the assertion

(2) If both assertion and reason are true statements but reason is not a correct explanation of the assertion

(3) If the assertion is true but the reason is a false statement

(4) If both assertion and reason are false statements.

41. Assertion (A) : The internal resistance of a cell depends on the concentration of the electrolyte used in the cell.

Reason (R) : Dilution increases the ionisation of the electrolyte.

(1)   (2)   (3)   (4)

42. Assertion (A) : Machine parts are jammed in winter.

Reason (R) : The viscosity of lubricant used in machine parts increases at low temperatures.

(1)   (2)   (3)   (4)

43. Assertion (A) : Brilliant colours are seen in thin layer of oil on the surface.

Reason (R) : White light is composed of several colours.

(1)   (2)   (3)   (4)

44. Assertion (A) : Activity of 10^8 undecayed radioactive nuclei of half life 50 days is equal to that of 1.2×10^8 undecayed nuclei of some other material with half life 60 days.

Reason (R) : Activity is proportional to half life.

(1)   (2)   (3)   (4)

45. Assertion (A) : When two vibrating tuning forks having frequencies 256Hz and 512Hz are held near each other, beats can not be heard.

Reason (R) : The principle of superposition is valid only if the frequencies of the oscillators are nearly equal.

(1)   (2)   (3)   (4)

46. Assertion : (A) : Isotopes of an element can be separated by using a mass spectrometer.

Reason (R) : Separation of isotopes is possible because of the difference in electron numbers of isotopes.

(1)   (2)   (3)   (4)

47. Assertion (A) : A solid floats in a liquid so that it is just submerged. When the liquid is heated the solid sinks to the bottom.

Reason (R) : Weight of the solid increases with the rise in temperature.

(1)   (2)   (3)   (4)

48. **Assertion (A)** : Two systems which are both in thermal equilibrium with a third system are in thermal equilibrium with each other.

(1)   (2)   (3)

Reason (R) : The heat flows spontaneously from a system at a higher temperature to a system at lower temperature.

(4)

49. **Assertion (A)** : Heating engineers use u-values, rather than k-values when calculating heat losses through walls, windows and roofs.

(1)   (2)   (3)

Reason (R) : The u-value of a single brick wall is $1.7 Wm^{-2}K^{-1}$

(4)

50. **Assertion (A)** : Two satellites of mass m_1 & m_2 ($m_1 > m_2$) are going around the earth in orbits of raddi s r_1 and r_2 ($r_1 > r_2$) .

(1)   (2)   (3)

Reason (R) : They will have same velocity.

(4)

51. **Assertion (A)** : If a convex lens of glass is immersed in water its power decreases.

(1)   (2)   (3)

Reason (R) : In water it behaves as a concave lens.

(4)

52. **Assertion (A)** : When light passes from one medium to another of different density the only quantity which is unchanged is its wavelength.

(1)   (2)   (3)

Reason (R) : The wavelength of light is not related to the refractive index of the medium.

(4)

53. **Assertion (A)** : The relative velocity of two photons travelling in opposite directions is C.

(1)   (2)   (3)

Reason (R) : The rest mass of a photon is zero.

(4)

54. **Assertion (A)** : A thin aluminium disc spinning freely about a central pivot is quickly brought to rest when placed between the poles of a strong U-shaped magnet.

(1)   (2)   (3)

Reason (R) : A current induced in a disc rotating in a magnetic field produces a force which tends to oppose the disc's motion.

(4)

55. **Assertion (A)** : If the law of gravitation becomes inverse cube law even then a line joining the sun and the planet sweeps equal areas in equal time intervals.

(1)   (2)   (3)

Reason (R) : A planet moves in an elliptical path.

(4)

56. **Assertion (A)** : A balloon stops rising after attaining a certain maximum height.

(1)   (2)   (3)

Reason (R) : Upthrust due to air decreases with height till it just balances the weight of the balloon.

(4)

57. **Assertion (A)** : A table cloth can be pulled from a table without dislodging the dishes.

(1)   (2)   (3)

Reason (R) : To every action there is an equal but opposite reaction.

(4)

58. **Assertion (A)** : Alpha particles produce more intense ionisation than beta particles.

(1)   (2)   (3)

Reason (R) : Alpha particles are positively charged.

(4)

59. The velocity of sound in air increases due to the presence of moisture.

(1)   (2)   (3)

Reason : (R) : The presence of moisture in air lowers the density of air.

(4)

60. **Assertion (A)** : The positive ray particles are more massive than electrons.

(1)   (2)   (3)

Reason (R) : Positive rays are deflected by a magnetic field to a greater extent than cathode rays.

(4)

ANSWERS WITH HINTS & EXPLANATIONS

1. Ans. (3) Solar constant is energy received per unit area per second

i.e. $\dfrac{ML^2T^{-2}}{L^2T} = M^1T^{-3}$

2. Ans. (3)

$S_{13} - S_{22} = \dfrac{1}{2} \times 10 \times (9) - \dfrac{1}{2} \times 10 \times 14 = 25\,m$

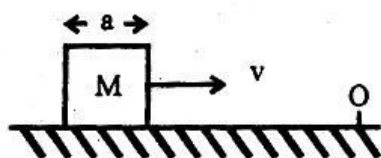3. Ans. (4) $\dfrac{mv^2}{r} = \dfrac{1}{r^2}$ i.e., $mv^2 = \dfrac{1}{r}$

∴ $K.E. = \dfrac{e^2}{2r}$ and $P.E. = \int F\,dtr = -\dfrac{e^2}{r}$

∴ Total energy $= K.E. + P.E. = \dfrac{e^2}{2r} - \dfrac{e^2}{r} = -\dfrac{e^2}{2r}$

4. Ans. (3) Angular momentum with respect O before colliding with $O = Mv\dfrac{a}{2}$

On collision, the block will rotate about the side passing through O.

By law of conservation of angular momentum

$Mv\dfrac{a}{2} = I\omega$

⇒ $Mv\dfrac{a}{2} = \left(\dfrac{Ma^2}{6} + \dfrac{Ma^2}{2}\right)\omega \Rightarrow \omega = \dfrac{3v}{4a}$

Where I is the moment of inertia of the block about the block about the axis perpendicular to the plane passing through O.

5. Ans. (1) $T = 2\pi\sqrt{\dfrac{l}{g}}$

When the rocket accelerates upwards g increases to (g + a)

6. Ans. (2)   Friction $= \mu Mg$

Hence retardation $= \mu g = 0.5 \times 10 = 5\,ms^{-2}$

Using $v^2 - u^2 = 2ax$

Taking $v = 0, u = 20\,ms^{-1}$,

we get x = 40 m

7. Ans. (4) $W = \dfrac{1}{2}m(v_4^2 - v_0^2)$

$v = \dfrac{dx}{dt} = 3 - 8t + 3t^2$

∴ $v_0 = 3\,m/s$ and $v_4 = 19\,m/s$

∴ $W = \dfrac{1}{2} \times 0.03 \times (19^2 - 3^2) = 5.28\,J$

8. Ans. (3) $\Delta p = F\Delta t$

Here $\Delta p = 2 \times (2 \times 100 = 400\,ms^{-1}$

∴ $F = \dfrac{400}{1/50} = 2 \times 10^4\,N$

9. Ans. (4) $K = \dfrac{p^2}{2m}$

∴ $K'' = \dfrac{\left(\dfrac{120}{100}p\right)^2}{2m} = 1.44\dfrac{p^2}{2m} = 1.44\,K$

∴ $\Delta K = K^1 - K = 0.44\,K = 44\%\,K$

10. Ans. (1) $\Delta U_p = mgh = 20 \times 9.8 \times 0.5 = 98\,J$

11. Ans. (1) About EG, the maximum distance from the axis is the least.

12. Ans. (1) $R_{CM} = \dfrac{12 \times 0 + 16 \times 112 \times 10^{-10}}{12 + 16}$

$= \dfrac{16}{28} \times 1.12 \times 10^{-10}\,m$

13. Ans. (4) Escape velocity is same for all angles of projection.

14. Ans. (2) $g = \dfrac{GM}{R^2}$;

$$\therefore \quad \dfrac{\Delta g}{g} = -2\,\dfrac{\Delta R}{R} = -2 \times 1.5 = -3\,\%$$

15. Ans. (1) $Y = \dfrac{F}{A}\,\dfrac{L}{\Delta L}$

$$\Rightarrow \quad \Delta L = \dfrac{f}{A}\,\dfrac{L}{Y} = \dfrac{F}{\pi\,(d^2/4)}\,\dfrac{L}{Y} = \dfrac{4F}{\pi Y}\left(\dfrac{L}{d^2}\right)$$

Here L/d^2 is maximum for wire in option (1)

16. Ans. (3) Use ascent formula for capillary rise.

17. Ans. (3) For 1 mole of gas,

$$50 \times 100 = 1 \times R \times T$$

For 2 moles of gas,

$$V \times 100 = 2 \times R \times T \quad \therefore \quad \dfrac{50 \times 100}{V \times 100} = \dfrac{RT}{2RT}$$

$$\Rightarrow \quad V = 100 \text{ ml}$$

18. Ans. (4) $C = \sqrt{\dfrac{3p}{p}} = \sqrt{\dfrac{3 \times 10^3}{2.6}} = 40 \text{ m/s}$

19. Ans. (1) Oxygen is diatomic gas, hence its energy of two moles

$$= 2 \times \dfrac{5}{2} RT = 5RT$$

Argon is a monatomic gas, hence its internal energy of 4 moles

$$= 4 \times \dfrac{3}{2} RT = 6RT$$

Total Internal energy $= (6 + 5) RT = 11RT$

20. Ans. (2) $T_1 V_1^{r-1} = T_2 V_2^{r-1}$ Here $r = 1.4$.

21. Ans. (2) According to Stefan's law $E \propto T^4$

$$\Rightarrow \quad \dfrac{E_1}{E_2} = \left(\dfrac{T_1}{T_2}\right)^4$$

$$\therefore \quad \dfrac{20}{E_2} = \left(\dfrac{T}{2T}\right)^4 = \dfrac{1}{16}$$

$$\Rightarrow \quad E_2 = 320 \text{ kcal/m}^2 \text{ min}$$

22. Ans. (1) $E \propto T^4$

23. Ans. (4)

24.

$$n_1 = \dfrac{v}{\lambda_1} = \dfrac{v}{0.50} \quad \text{and} \quad n_2 = \dfrac{v}{\lambda_2} = \dfrac{v}{0.51}$$

$$\Delta n = n_1 - n_2 = v\left[\dfrac{1}{0.50} - \dfrac{1}{0.51}\right] = 12$$

$$\therefore \quad v = \dfrac{12 \times 0.51 \times 0.50}{0.01} = 306 \text{ m/s}$$

24. Ans. (1) The apparent frequency heard by the observer is given by

$$n' = \dfrac{v}{v - v_5}\,n$$

Since the source is moving with velocity v_s towards the stationary observer)

$$= \dfrac{330}{330 - 33} \times 450 = \dfrac{330}{297} \times 450 = 500 \text{ Hz}$$

25. Ans. (1) The wave equation is $y = A \sin(\omega t - kx + \phi)$

26. Ans. (3)

$$\dfrac{dy}{dt} = 0.5 \times 10\pi \cos(10\pi t - 5x)$$

$$= 5\pi \cos(10\pi t - 5x)$$

$$\therefore \quad \left(\dfrac{dy}{dt}\right)_{max} = 5\pi \text{ m/sec}$$

27. Ans. (3)

$$d = \dfrac{D\lambda}{\beta} = \dfrac{1 \times 5 \times 10^{-7}}{5 \times 10^{-3}} = 10^{-4} \text{ m} = 0.1 \text{ mm}$$

28. Ans. (1) Since P is ahead of Q by 90° and path difference between P and Q is $\lambda/4$. Therefore at A. phase difference is zero, so intensity is 4I. At C it is zero and at B, the phase difference is 90°, so intensity is 2I

29. Ans. (3) Energy is conserved in the interference of light.

30. Ans. (4)

$$\dfrac{1}{f} = (_1\mu_2 - 1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right)$$

$$= (1.6 - 1)\left(\dfrac{1}{\pm \infty} - \dfrac{1}{-60}\right)$$

$$= \dfrac{0.6}{60} = \dfrac{1}{100} \text{ cm}$$

$$\therefore \qquad f = 100 \text{ cm}$$

$$I = m \left(\frac{a}{2}\right)^2 + m \left(\frac{a}{2}\right) 2 = \frac{ma^2}{2}$$

Hence the correct choices is (2) .

6. Ans. (1) The centripetal force is provided by the gravitational attraction of the earth. Hence the correct choice is (1).

7. Ans. (2) When stones are unloaded into the water in the tank, the volume of water displaced is equal to the volume of the stones. This is less than the volume of water having weight equal to the weight of stones because the density of stones is greater than that of water. Hence the water level falls, which is choice (2)

8. Ans. (1) Mass of water in first tube is
$$m = \pi r^2 h \rho$$
Now, surface tension
$$\sigma = \frac{h\rho g r}{2} = \frac{h\rho g r'}{2}$$
where h' is the height to which water rises in the second tube and r' its radius. Since $r' = 2r$, $h' = h/2$
Therefore, the mass of water in the second capillary tube is
$$m' = \pi r'^2 h' \rho = \pi (2r)^2 \frac{h}{2} \rho$$
$$= 2\pi r^2 h \rho = 2m = 2 \times 5 = 10\,g$$
Hence the correct choice is (1)

9. Ans. (2) Here $l_1 = \dfrac{FL_1}{\pi r_1^2 Y}$

and $\quad l_2 = \dfrac{FL_2}{\pi r_2^2 Y}$

Therefore , $\quad \dfrac{l_1}{l_2} = \dfrac{L_1}{L_2} \times \left(\dfrac{r_2}{r_1}\right)^2$

Given $\quad L_2 = 2L_1$ and $r_2 = \dfrac{r_1}{2}$

Thus, $\quad \dfrac{l_1}{l_2} = \dfrac{1}{2} \times \dfrac{1}{(2)^2} = \dfrac{1}{8}$

10. Ans. (2) The latent heat of vaporization of water is very nearly 540 calories per gram. Therefore heat released in the condensation

of x gram of steam = 540 x calories. The latent heat of fusion of ice is very nearly 80 calories. Therefore, heat required to convert y gram of ice at 0°C to water at
$$100°C = 80 + y + 100\,y$$
$$= 180y \text{ calories}$$
Thus $\quad 180\,y = 540x$
or $\quad \dfrac{y}{x} = 3$
Hence the correct choice is (2)

11. Ans. (3) $PV^\gamma = \text{constant}$

12. Ans. (2) If a force F is applied to a spring of force constant k and the spring extends by an amount x, then $F = kx$

The extension x produced in a spring is proportional to its length. Thus, if the spring is cut into three equal pieces, the same force F will produce an extension x/3 in a piece. If k' is the is the force constant of the piece, we have
$$F = k' x/3$$
Therefore $\quad \dfrac{k'}{3} = k$
or $\quad k' = 3k$

Thus, the force e constant of each piece is 3k. When springs are connected in parallel, the force constant of the combination is equal to the sum of the individual force constants of the springs so connected. Therefore, the force constant of the combination $= 3k + 3k + 3k = 9k$. Hence correct choice is (2).

13. Ans. (4) The speed of sound wave in the rod is
$$v = \sqrt{Y/\rho} = \sqrt{\frac{2 \times 10^{11}}{8000}} = 5000 \text{ ms}^{-1}$$
∴ Time taken is $= 1/5000 = 2 \times 10^{-4}$ s.
Hence the correct answer is (4)

14. Ans. (1) Electric field
$$E = -\frac{dV}{dx} = -\frac{d}{dx}(5 + 4x^2) = -8x$$
Force on charge $(-q) = -qE = +8qx$
At $x = 0.5$ m, force $= 8 \times 2 \times 10^{-6} \times 0.5$
$$= 8 \times 10^{-6}\,N$$

48. (1) Two systems are in thermal equilibrium with a third system implies that all are at the same, temperature. Hence, they will also be in thermal equilibrium.

49. (3) The u-value of a single brick wall is 3.6 $W\,m^{-2}K^{-1}$

50. (3) $\dfrac{GM_eM}{r^2} = \dfrac{mv^2}{r}$

$\Rightarrow \quad v = \sqrt{\dfrac{GM_e}{r}}$

$\therefore \quad \dfrac{v_1}{v_2} = \sqrt{\dfrac{r_2}{r_1}}$ Since $r_1 > r_2$, $v_2 > v_1$

51. (3) When a convex lens of glass ($\mu = 3/2$) is immersed in water ($\mu = 4/3$), its focal length increases. It becomes 4 times. This reduces its power to one-fourth its previous value. But the nature of the lens is not changed in this case. When a lens is immersed in medium whose refractive index is greater than that of the material of the lens, its nature reverses.

52. (4) In the act of refraction it is only the frequency that remains unchanged. Wavelength is related to the refractive index. Thus, both the assertion and the reason are wrong.

53. (2) Very high velocities can not be added directly as in classical mechanics because this would lead to a violation of the postulates of relativity. Such velocities are added in accordance with Lorentz transformations. It can be proved that any velocity added to the velocity of light gives velocity of light.

Relativistic mass of photon –

The relativistic momentum of photon is

$$p = \dfrac{m_0 V}{\sqrt{1 - \left(\dfrac{v^2}{c^2}\right)}}$$

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

$\therefore \quad \dfrac{h}{\lambda} = \dfrac{m_0 V}{\sqrt{1 - \left(\dfrac{v^2}{c^2}\right)}}$

$$m_0 = \dfrac{h}{v\lambda} \sqrt{1 - \left(\dfrac{v^2}{c^2}\right)}$$

For a photon $v = c$, then, $m_0 = 0$

54. (1) This effect is due to the production of 'eddy currents' in the aluminium disc. They are produced due to the motion of disc in magnetic field. According to Lenz's law they oppose this motion (which is the cause of their production) and eventually bring the disc to a stop.

55. (2) Sweeping qual areas in equal time intervals is a consequence of law of conservation of angular momentum. So long as the gravitational force is radial., no torque acts on the planet and the angular momentum is conserved.
It is also true that a planet moves in an elliptical orbit. But this is not the reason of the assertion.

56. (1) Balloon rises till the upthrust of air on it is greater than its weight. As the air becomes thinner with height, at height it is reached where upthrust becomes equal to the weight of the balloon. After this stage the balloon does not rise up further.

57. (2) The reason is law of inertia (Newton's first law of motion) and not law of action and reaction (Newton's third law of motion).

58. (1) The statements given in the assertion and the reason both are correct in themselves but high ionising power of alpha particles is not due to their positive charge. The greater ionisation power of alpha particles is due to their higher energy than beta particles.

59. (1) Velocity of sound in air is given by

$$v = \sqrt{\dfrac{\gamma P}{d}}$$

The density of water vapours is less that of dry air. Hence, the presence of moisture decreases density d of air. This results in increase of velocity of sound.

60. (3) Electrons being much lighter than positive ray particles (ions) are deflected more in a magnetic field.

PART 2. CHEMISTRY

1. 26 ml of CO_2 are passed over hot coke. The maximum volume of CO formed is :
   (1) 32 ml   (2) 52 ml   (3) 15 ml   (4) 10 ml

2. Unsuitability of nucleus is due to :
   (1) Low proton - electron ratio
   (2) High proton - electron ratio
   (3) High proton - neutron ratio
   (4) High neutron - proton ratio

3. Bohr's atomic theory gave the idea of :
   (1) Nucleus
   (2) Shape of sub - levels
   (3) Quantum numbers
   (4) Stationary states.

4. Which has maximum radioactive activity :
   (1) Uranium   (2) Plutonium
   (3) Radium   (4) Thorium

5. Overlapping of 2 hybrid orbitals can lead to the formation of :
   (1) π - bond   (2) σ - bond
   (3) Ionic bond   (4) None

6. NF_3 is :
   (1) Having more dipole moment that NH_3
   (2) Having low value of dipole moment than NH_3
   (3) Electrovalent compound
   (4) Non - polar compound.

7. The compound having highest boiling point :
   (1) CH_4 (2) CH_3OH
   (3) CH_3Br (4) CH_3Cl

8. An element A (at. wt. = 75) and B(at. wt. = 25) combine to form a compound. The compound contains 75% A by weight. The formula of the compound will be
   (1) AB   (2) AB_3 (3) A_3B (4) A_2B

9. The number of milli equivalents in 100 ml of 0.5 N HCl solution is :
   (1) 200   (2) 100
   (3) 50   (4) 25

10. Number of electrons involved in the reduction of $Cr_2O_7^{2-}$ ion in acidic solution to Cr^{3+} is :
    (1) 4   (2) 6   (3) 3   (4) 4

11. Stronger the oxidising agent, greater is the :
    (1) Oxidation potential
    (2) Reduction potential
    (3) Ionic behavior   (4) None

12. In a reaction 4 mole of electrons are transferred to one mole of HNO_3 when it acts as an oxidant. The possible reduction product is :
    (1) 1 mole NH_3 (2) 1 mole of NO_2
    (3) (1/2) mole N_2O (4) (1/2) mole N_2

13. The volume at NTP occupied by 11 g of CO_2 is :
    (1) 11.2 litre   (2) 2.8 litre
    (3) 5.6 litre   (4) 2. 24 litre

14. Which is not correct for catalyst. It : -
    (1) Reduces activation energy of reaction
    (2) Specific in nature
    (3) Enhances the rate of reaction in both directions
    (4) Changes enthalpy of reaction

15. An albumin sol containing sodium chloride as an impurity can best be freed of this impurity by :
    (1) Electrophoresis   (2) Dialysis
    (3) Precipitation   (4) Filtration.

16. Which reaction gives more products as a result of increase in pressure :
    (1) $2HI \xleftarrow{\rightarrow} H_2 + I_2$
    (2) $2SO_2 + O_2 \xleftarrow{\rightarrow} 2SO_3$
    (3) $H_2O + CO \xleftarrow{\rightarrow} H_2 + CO_2$
    (4) $H_2 + Br_2 \xleftarrow{\rightarrow} 2HBr$

17. HCl does not behave as acid in :
    (1) C_6H_6 (2) NH_3 (3) H_2O (4) None

18. The mixed salt among the following is :

(1) $CaCOCl_2$
(2) $NaKSO_4$

(3) $Mg(OH)Cl$
(4) All

19. If s and S are respectively solubility and solubility product of a sparingly soluble binary electrolyte, then :

(1) $s = S^{1/2}$
(2) $s = 1/2S$

(3) $s = S$
(4) $s = S^2$

20. An aqueous solution contains a substance which yields 4×10^{-3} mol litre^{-1} ion of H_3O^+. If log 2 is 0.3010 the pH of the solution is :

(1) 2.398   (2) 1.5   (3) 3.0   (4) 3.4

21. $SOCl_2 + CH_3COOH$

$$\longrightarrow CH_3COCl + HCl + SO_2$$

The reaction is endothermic. A 10 degree centigrade temperature rise will cause the reaction ratio to :

(1) Decrease

(2) Become exactly half+

(3) Remain unchanged

(4) Become nearly double

22. An example of a closed system is :

(1) Hot liquid in closed beaker in equilibrium with its vapour

(2) Hot liquid in an open beaker
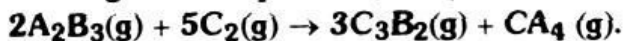
(3) Hot liquid in a sealed insulated beaker

(4) None

23. If

$H_2(g) + I_2(g) \rightarrow 2HI (g); \Delta H = 12.40$ kcal. **The heat information of HI is :**

(1) 12.4 kcal
(2) 6.20 kcal

(3) ~6.20 kcal
(4) − 12.4 kcal

24. If 50 ml of A_2B_3 reacts completely with 200 ml of C_2 in a closed vessel according to the equation ,

$2A_2B_3(g) + 5C_2(g) \rightarrow 3C_3B_2(g) + CA_4$ (g). **The composition of the mixture of gases is :**

(1) 10 ml C_2, 25 ml C_3B_2, 100 ml CA_4

(2) 25 ml C_2, 75 ml C_3B_2, 25ml CA_4

(3) 75 ml C_2, 75 ml C_3B_2, 25 ml CA_4

(4) 100 ml C_2, 50 ml C_3B_2, 50 ml CA_4

25. If the atomic number of an element is 33, it will be placed in the periodic table in the :

(1) 7th group
(2) 5th group

(3) 4th group
(4) 1st group

26. The volume of '10 Vol' of H_2O_2 required to liberate 500 ml O_2 at NTP is :

(1) 125 ml
(2) 100 ml

(3) 25 ml
(4) 50 ml

27. The oxide of which metal is most stable to heat :

(1) Ag
(2) Hg

(3) K
(4) All of these

28. A hydride of nitrogen which is acidic in nature is :

(1) N_3H (2) N_2H_2 (3) N_2H_4 (4) NH_3

29. Which melts in boiling water :

(1) Bell metal
(2) Monel metal

(3) Wood's metal
(4) Gum metal

30. Nitric acid may be kept in a bottle of :

(1) Sn   (2) Al   (3) Pb   (4) Ag

31. When Zn reacts with very dilute nitric acid it produces :

(1) H_2
(2) NO_2

(3) NH_4NO_3
(4) NO

32. Which loses weight on exposure to the atmosphere :

(1) Anhyd. $AlCl_3$

(2) NaOH
(3) Conc. H_2SO_4

(4) Saturated aqueous solution of CO_2

33. The reaction of chlorine with CO in the presence of sunlight gives :

(1) $H_2Cl_2O_2$
(2) HOCl

(3) CO_2Cl_2
(4) $COCl_2$

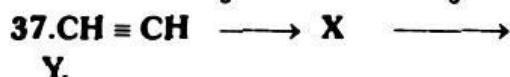**34. The gas used for inflating the tyres of aeroplanes is :**

(1) Ar   (2) He   (3) H_2 (4) N_2

35. d - Block elements are arranged in . . . . . of periodic table :

(1) Six series
(2) Four series

(3) Three series
(4) Two series.

36. Which on mixing gives deep brown colour :

(1) $NO + O_2$ (2) $N_2O + O_2$

(3) $N_2O_3 + O_2$ (4) None

37. $CH \equiv CH \xrightarrow{O_3/NaOH} X \xrightarrow{Zn/CH_3COOH}$ Y.

Y is

(1) CH_3OH (2) CH_3COOH

(3) CH_3CH_2OH (4) $CH_2OH - CH_2OH$

38. Which is expected to react most readily with bromine :

(1) $CH_3 - CH = CH_2$ (2) $CH \equiv CH$

(3) $CH_2 = CH_2$ (4) $CH_3CH_2CH_3$

39. The structural formula of the compound which yields ethylene upon reaction with zinc is :

(1) $CHBr - CHBr$ (2) $CHBr_2 - CHBr_2$

(3) $CH_2Br - CH_2Br$ (4) None

40. Glycerol on treatment with potassium hydrogen sulphate yields

(1) Acraldehyde   (2) Acrylic acid

(3) Propane   (4) Ethanol

§ *Directions Q41 to 60 consists of two statements, one labelled the 'Assertion (A)' and the other labelled the 'Reason (R)'. Examine these statements carefully and decide if*

(1) If both assertion and reason are true statements and the reason is a correct explanation of the assertion

(2) If both assertion and reason are true statements but reason is not a correct explanation of the assertion

(3) If the assertion is true but the reason is a false statement

(4) If both assertion and reason are false statements.

41. **Assertion (A)** : Water is specially effective in screening the electrostatic interactions between the dissolved ions.

(1)   (2)   (3)

Reason (R) : The force of ionic interactions depends upon the dielectric constant (ε) of the solvent.

(4)

42. **Assertion (A)** : The nearly tetrahedral arrangement of the orbitals about the oxygen atom allows each water molecule to form hydrogen bonds with as many as four neighbouring water molecules.

(1)   (2)   (3)

Reason (R) : In ice each water molecule forms four hydrogen bonds as each molecule is fixed in the space.

(4)

43. **Assertion (A)** : Methanoic acid reduces mercuric chloride to mercurous chloride on heating while ethanoic acid does not.

(1)   (2)   (3)

Reason (R) : Methanoic acid is a stronger acid than ethanoic acid.

(4)

44. **Assertion (A)** : Phenol undergoes Kolbe's reaction whereas ethanol does not.

(1)   (2)   (3)

Reason (R) : Phenoxide ion is more basic than ethoxide ion.

(4)

45. **Assertion (A)** : The pressure of a gas is inversely proportional to its volume at constant temperature and n.

(1)   (2)   (3)

Reason (R) : The gas volume is directly proportional to n at constant temperature and pressure.

(4)

46. **Assertion (A)** : The oxidation numbers are artificial, they are useful as a 'book-keeping' device of electrons in reactions.

Reason (R) : The oxidation numbers do not usually represent real charges on atoms, they are simply conventions that indicate what the maximum charge could possibly be on an atom in a molecule.

|(1)|(2)|(3)|(4)|

47. **Assertion (A)** : As mole is the basic chemical unit, the concentration of the dissolved solute is usually specified in terms of number of moles of solute.

Reason (R) : The total number of molecules of reactants involved in a balanced chemical equation is known as molecularity of the reaction.

|(1)|(2)|(3)|(4)|

48. **Assertion (A)** : The atoms of different elements having same mass number but different atomic number are known as isobars.

Reason (R) : The sum of protons and neutrons, in the isobars is always different.

|(1)|(2)|(3)|(4)|

49. **Assertion (A)** : Lead is a metal with a high density. It readily dissolves in moderately concentrated nitric acid giving colourless fumes which turn red in contact with air.

Reason (R) : Nitric oxide (NO) is a colourless oxide of nitrogen while NO_2 is a coloured oxide of nitrogen.

|(1)|(2)|(3)|(4)|

50. **Assertion (A)** : p- nitroaniline is stronger base than p- toluidine.

Reason (R) : The electron withdrawing NO_2 group in the p-nitroaniline makes it a stronger base.

|(1)|(2)|(3)|(4)|

51. **Assertion (A)** : When 20 ml of ethanol is mixed with 20 ml of water, the volume of resulting solution will be less than 40 ml.

Reason (R) : The hydrogen bond between water and alcohol molecules is weaker than hydrogen bond between the like molecules.

|(1)|(2)|(3)|(4)|

52. **Assertion (A)** : Stanous chloride ($SnCl_2$) is a non-linear molecule.

Reason (R) : In ($SnCl_2$) molecule Sn atom is present in sp hybridised state.

|(1)|(2)|(3)|(4)|

53. **Assertion (A)** : During the fermentation of grape juice, a reddish brown coloured crust is formed.

Reason (R) : Impure potassium hydrogen tartrate is of reddish brown colour and it is known as argol

|(1)|(2)|(3)|(4)|

54. **Assertion (A)** : An orbital cannot have more than two electrons, moreover, if an orbital has two electrons they must have opposite spins.

Reason (R) : No two electrons in an atom can have same set of all the four quantum numbers.

|(1)|(2)|(3)|(4)|

55. **Assertion (A)** : A spectral line will be seen for the transition 2px to 2py.

Reason (R) : Energy is released in the form of wave of light when the electron drops from 2px to 2py orbital.

|(1)|(2)|(3)|(4)|

56. **Assertion (1)** : Alkenes and cycloalkanes series of hydrocarbons have same general formula.

Reason (R) ; Either insertion of a double bond or formation of a ring reduce the number of hydrogen atoms of corresponding alkane by 2.

|(1)|(2)|(3)|(4)|

57. **Assertion (A)** : The solubility of n- alcohols in water decreases with increase in molecular weight.

Reason (R): The relative proportion of the hydrocarbon part in alcohols increases with the increase in molecular weight which permits enhanced hydrogen bonding with water.

(1)   (2)   (3)   (4)

58. **Assertion (A)** : The carbonic acid is stronger acid than phenol.

Reason (R) : The hybrid of bicarbonate ion has two equivalent contributing structures, while hybrid of phenoxide ion does not contain such equivalent contributing structures.

(1)   (2)   (3)   (4)

59. **Assertion (A)** : When a concentrated solution is diluted by adding more water, the number of moles of solute in the solution remains unchanged.

Reason (R) : Number of moles of a solute is equal to the product of molarity and volume of solution in litres.

(1)   (2)   (3)   (4)

60. **Assertion (A)** : $_{14}Si^{30}$, $_{15}P^{31}$ and $_{16}S^{32}$ are a group of isotones.

Reason (R) : Isotones are atoms of different elements having different mass numbers and atomic numbers but same number of neutrons in their nuclei.

(1)   (2)   (3)   (4)

ANSWERS WITH HINTS & EXPLANATIONS

1. Ans. (2) $CO_2 + C \rightarrow 2CO$

2. Ans. (4) n/p > 1.5 leads to unstable nucleus.

3. Ans. (4) Stationary states.

4. Ans. (3) Ra is most radioactive element.

5. Ans. (2) Hybrid orbitals always from σ - bond.

6. Ans. (2) Inspite of three polar bond, the lone pair of electron on N atom decreases the dipole moment of NF_3 than NH_3

7. Ans. (2) Due to H- bonding.

8. Ans. (1) g atom of $A = \dfrac{75}{75} = 1$;

   g atoms of B = 25/25;

 ∴ Ratio of g atoms of A & B = 1 : 1

9. Ans. (3) Meq. = $100 \times 0.5 = 50$

10. Ans. (2) $Cr_2^{6+} + 6e \rightarrow 2Cr^{3+}$

11. Ans. (2) More is E_{OP}^0, more is the tendency to get itself oxidised, more is reducing nature.

12. Ans. (3) $4e + N^{5+} \rightarrow N^{1+}$ ∴ possible product is N_2O

13. Ans. (3) 44 g CO_2 occupies 22.4 litre at NTP.

14. Ans. (4) Catalyst does not make the reaction more exothermic or endothermic.

15. Ans. (2) Separation of soluble impurities from sol in followed by dialysis.

16. Ans. (2) An increase in P favours the reaction showing decrease in volume.

17. Ans. (1) C_6H_6 is not capable of accepting proton.

18. Ans. (4) A mixed salt is one which furnishes two types of cations or anions.

19. Ans. (1) $S = s^2$ ∴ $s = \sqrt{S}$ for electrolytes like AgCl, AgBr or AB type.

20. Ans. (1) $[H^+] = 4 \times 10^{-3}$ M

  ∴ pH = $-\log 4 \times 10^{-3} = 2.393$

21. Ans. (4) Rate constant increases twice to thrice for each $10^{\circ}C$ rise in temperature and therefore the rate also changes accordingly.

22. Ans. (1) A closed system can exchange energy from its surroundings.

23. Ans. (2) Heat of formation
$$= \frac{12.40}{2} = 6.20 kcal$$

24. Ans. (3) The mole ratio is $2 : 5 :\ : 3 : 1$
Reaction   Products

25. Ans. (2) The short hand notation for 33 is ,
$[Ar]\, 3d^{10}\, 4s^2\, 4p^3$

26. Ans. (4) 10 vol. H_2O_2 means that 1 ml H_2O_2 gives 10 ml O_2.; Thus 50 ml H_2O_2 will give 500 ml O_2.
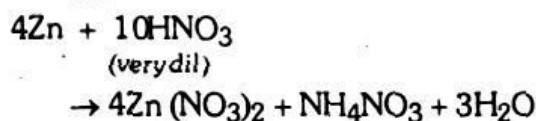
27. Ans. (3) Ag and Hg oxides decompose on heating.

28. Ans. (1) N_3H is called hydrazoic acid.

29. Ans. (3) Wood metal has m.pt. $71^{\circ C}$

30. Ans. (2) Only Al among these does not react with HNO_3.

31. Ans. (3)
$4Zn + 10HNO_3$
(very dil)
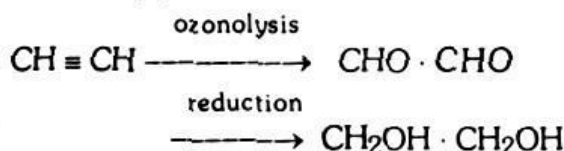$\rightarrow 4Zn\,(NO_3)_2 + NH_4NO_3 + 3H_2O$

32. Ans. (4) CO_2 gets evaporated slowly.

33. Ans. (4) $CO + Cl_2 \rightarrow COCl_2$

34. Ans. (2) He is lightest (after H_2), non inflammable gas.

35. Ans. (2) 3d, 4d and 5d series are complete and 6d series incomplete.

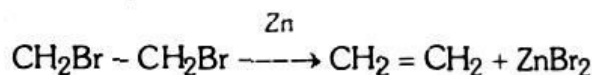36. Ans. (1) $2NO + O_2 \rightarrow 2NO_2$ (brown)

37. Ans. (4)
$$CH \equiv CH \xrightarrow{\text{ozonolysis}} CHO \cdot CHO$$
$$\xrightarrow{\text{reduction}} CH_2OH \cdot CH_2OH$$

38. Ans. (3) Alkenes are more reactive than alkynes towards addition reaction also ethene is most reactive alkene.

39. Ans. (3)
$$CH_2Br - CH_2Br \xrightarrow{Zn} CH_2 = CH_2 + ZnBr_2$$

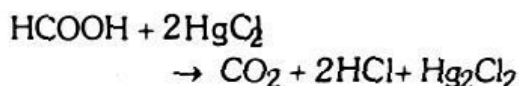40. Ans. (1) $KHSO_4$ is dehydrating agent.

41. (1) The strength of the force (F) of the ionic interaction depends, upon the magnitude of charges (Q), the distance between them and the dielectric constant of solvent as
$$F = \frac{Q_1 Q_2}{\varepsilon\, r^2}$$
Water has high value for ε and thus screens the interactions between ions more effectively.

42. (1) At any given instant in liquid water at room temperature, each water molecule forms hydrogen bonds with an average 3.4 other water molecules. The H_2O molecules are in continuous motion so hydrogen bonds are constantly and rapidly broken and formed. In ice H_2O molecules are, however fixed in the space lattice.
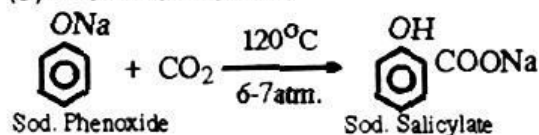
43. (2) Methanoic acid reduces mercuric chloride as :
$HCOOH + 2HgCl_2$
$\rightarrow CO_2 + 2HCl + Hg_2Cl_2$
Ethanoic acid does not react with $HgCl_2$
Since alkyl groups are electron releasing their presence in the molecule will decrease the acidity. Thus methanoic acid (HCOOH) is about 10 times stronger than ethanoic acid (CH_3COOH) .

44. (3) Kolbe's Reaction :

Sod. Phenoxide   Sod. Salicylate

Ethanol does not undergo this reaction.
Phenol is a stronger acid than ethanol. Hence the conjugate base (Phenoxide) will be weaker base than ethoxide ion.

45. (2)   46. (1)

47. (2) The number of moles of a solute present in a litre of solution is known as molarity (M).
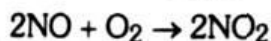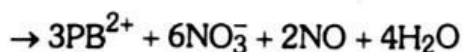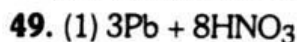The total number of molecules of reactants present in a balanced chemical equation is known as molecularity. For example

$PCl_5 \rightarrow PCl_3 + Cl_2$ **(Unimolecular)**

$2HCl \rightarrow H_2 + I_2$ (Bimolecular)
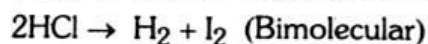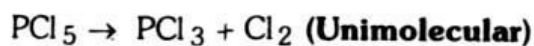
Therefore, molarity and molecularity are used in different sense.

48. (3) Isobars are the atoms of the different elements having same atomic weight or mass number. It means the sum of protons and neutrons will be same. Atomic number of isobars are different.

Hence, (A) is correct and (R) is wrong.

49. (1) $3Pb + 8HNO_3$

$$\rightarrow 3PB^{2+} + 6NO_3^- + 2NO + 4H_2O$$

$$\underset{\text{Colourless}}{2NO} + O_2 \rightarrow \underset{\text{red}}{2NO_2}$$

50. (4) The presence of electron releasing group like - CH_3 at para position increases the basic strength. On the other hand the electron withdrawing - NO_2 group decreases the basic strength. Hence p- nitroaniline is weaker base than p – toluidine.

51. (3) Due to the presence of hydrogen bonding between H_2O and C_2H_5OH the inter molecular attraction increases, therefore after mixing these two compound their volume of mixing decreases from expected volume.

52. (3) The $SnCl_2$ molecule is 'V' shaped and the hybridizaton involved in it is sp^2

53. (1) A reddish brown crust of potassium hydrogen tartrate, known as argol, is deposited during the fermentation of grape juice.

54. (1) According to Pauli's exclusion principle no two electrons in an atom can have same set of all the four quantum numbers. From this it follows that an orbital cannot have more than two electrons. If an orbital has two electrons then they have opposite spins.

55. (4) Spectral line can be seen only when electron jumps from higher energy level to lower energy level. But $2p_x$ and $2p_y$ are the different configuration of same energy level.

56. (1) The general formula of alkene is C_nH_{2n} and the general formula of cycloalkane is also C_nH_{2n}. It is due to the formation of cyclic structure, carbon chain loses hydrogen atom from both end and become cycloalkane. This loss of two hydrogen atom gives the general formula C_nH_{2n}

57. (3) It is true that solubility of alcohols decreases as the molecular weight of alcohol increases. it is due to the fact that bulky alkyl group pumps electron towards electronegative oxygen atom (+ I effect). This increase in electron cloud over oxygen atom, decrease the tendency of formation of hydrogen bond, hence, solubility decreases.

58. (1) The phenoxide ion C_6H_5––O^-, does not have any contributing structure but HCO_3^- ion has two contributing structure, that is why H_2CO_3 is stronger acid than C_6H_5OH

59. (1) It is true that number of solute never changes after dilution because number of moles of solute

$$= \frac{\text{No. of moles of solute} \times \text{volume in (L)}}{\text{volume in (L)}}$$

60. (1)Different atoms when contain same number of neutrons are called isotones.

$_{14}Si^{30}$, $_{15}P^{31}$ and $_{16}S^{32}$ are isotones, because all of these contains 16 neutrons.

since,   Atomic mass = n + p

∴   n = atomic mass – p

For   Si → 30 – 14 = 16

          P → 31 – 15 = 16

          S → 32 – 16 = 16

Part 3. BIOLOGY

1. **The main difference between chlorophyll 'a' and 'b' is**
   (1) Chlorophyll 'a' has no Mg^+ ion in centre of molecule
   (2) Chlorophyll 'a' is linear chain compound and 'b' is brached chain
   (3) In chlorophyll 'a' there is CH_3 group whereas in 'b' it is – CHO group
   (4) All of the above

2. **Loops of lampbrush chromosome are composed of**
   (1) Protein and RNA
   (2) Double helix DNA only
   (3) Double helix DNA, protein and RNA
   (4) Single stranded DNA, protein and RNA

3. **In F_2 generation of monohybrid cross the cause of 1 : 2 : 1 phenotypic ratio is**
   (1) Inhibition
   (2) Epistatics
   (3) Incomplete dominance
   (4) Quantitative inheritance

4. **The evidence that crossing over occurs at four stranded stage and not at two stranded stage of the chromosomes, comes from**
   (1) Studies of meiosis in maize
   (2) Studies on linkage maps of chromosomes in *Drosophila*
   (3) 4 : 4 arrangement of ascospores in *Neurospora*
   (4) 2 : 2 : 2 : 2 arrangement of ascospores in *Neurospora*

5. **Why mycoplasma is pleuomorphic**
   (1) Due to the presence of sterol
   (2) Due to absence of cell wall
   (3) Due to presence of three layered cell membrane
   (4) None of these

6. **Heterotropic nutrition is found in**
   (1) *Pistia*   (2) *Vallisnaria*
   (3) *Drosera*   (4) *Opuntia*

7. **Pteridophytes are also called**
   (1) Ctyptogames   (2) Phanerogames
   (3) Amphibian of plant kingdom
   (4) Vascular cryptogames

8. **Which one of the following normally have cross pollination but are adapted for self pollination**
   (1) Wheat   (2) Sunflower
   (3) China rose   (4) Mustard

9. **Number of nuclei taking part in double fertilization is**
   (1) 5   (2) 4   (3) 3   (4) 2

10. **Secondary was is not formed in**
    (1) Companion cells (2) Collenchyma
    (3) Parenchyma   (4) All the above

11. **Tracheids of angiospems are recognised by the presence of**
    (1) Scalaiform perforation plates
    (2) Scalaiform thickening
    (3) Bordered pits   (4) None of the above

12. **Which of the following is fertilizer**
    (1) Urea   (2) Ammonium chloride
    (3) Calcium citrate (4) Calcium carbonate

13. **The conducting tissues of the plants are**
    (1) Sclerenchyma
    (2) Phloem   (3) Xylem
    (4) Xylem and phloem both

14. **Pollen grains of some of the plants germinate on stigma soon but they burst in water or dilute sugar solution**
    (1) Plasmolysis   (2) Imbibition
    (3) Endosmosis   (4) Exosmosis

15. **Which of the following is responsible for rapid loss of water from plant**
    (1) Water vapour saturation deficit
    (2) Water vapour saturation of air
    (3) More available soil water to the plant
    (4) None of the above

16. **Who invented the enhancement effect on photosynthesis**
    (1) Arnon   (2) Emerson

(3) Calvin   (4) Ruben

17. Who received the Nobel Prize for working out the early carbon pathway of photosynthesis
(1) Watson   (2) Khorana
(3) Krebs   (4) Calvin

18. The number of molecules of pyruvic acid formed from one molecule of glucose at the end of glycolysis is
(1) 4   (2) 3   (3) 1   (4) 2

19. End product of anaerobic respiration is
(1) Pyruvic acid
(2) Glucose
(3) Ethyl alcohol and CO_2
(4) None of the above

20. Acetyl CoA enzyme belongs to
(1) Hydrolase   (2) Desmolase
(3) Isomerase   (4) Synthetase

21. Indicator plants which can be used to indicate atmospheric pollution by SO_2 are:
(1) Climbers like *Cucurbita*
(2) Lichens like *Usnea*
(3) Moss like *Sphagnum*
(4) Grassland like *Deschampsia*

22. Deforestation may reduce the chances of:
(1) erosion of surface soil
(2) frequent landslides
(3) rainfall
(4) frequent cyclones

23. Which of the following show the least constancy of shape?
(1) Leucocytes   (2) Visceral muscle cells
(3) Neurons   (4) Erythrocytes

24. Shivering in cold is a method for:
(1) preventing radiation of heat from the body
(2) production of heat by bringing more blood to the body surface
(3) production of heat by muscluar contractions
(4) none of these

25. Lower jaw of tadpole is formed by:

(1) Coracoid   (2) Meckel's cartilage
(3) Angulo-splenial (4) None of the above

26. Which of the following bone is a favoured site for obtaining haemopoietic tissue?
(1) Radius   (2) Vertebral column
(3) Cranium   (4) Sternum

27. Certain B vitamins act as:
(1) Hormones   (2) Digestive substance
(3) Co-enzymes   (4) Enzymes

28. When partial pressure of CO_2 rises, the oxygen dissociation curve of haemoglobin at $37°C$ will:
(1) remain unchanged
(2) become irregular (3) shift towards left
(4) shift towards right

29. In a normal man, *the amount of blood put out by heart per minute is:*
(1) 3 litres   (2) 1 litre   (3) 5 litres   (4) 4 litres

30. Aquatic animals are mostly ammonotelic because:
(1) these get less light
(2) water contains less nitrogen
(3) excretion of ammonia requires large amount of water which is available to these animals
(4) ammonia helps in checking inflow of water into body

31. Heart beat is regulated by the working of:
(1) Midbrain   (2) Diencephalon
(3) Cerebrum   (4) Medulla oblongata

32. Scala vestibuli and scala media contain respectively:
(1) Perilymph only (2) Endolymph only
(3) Perilymph and endolymph
(4) Endolymph and perilymph

33. Which endocrine gland stores its secretion in the extracellular space before discharging it into the blood?
(1) Testis   (2) Pancreas
(3) Adrenal   (4) Thyroid

34. Testes of rabbit occur:
(1) in scrotal sacs (2) on side of kidney

(3) inside body

(4) on either side of dorsal aorta

35. **During fertilization, the enzyme which facilitates penetration of the egg by the spermatozoan is:**

(1) acetylcholineasterase

(2) alkaline phosphatase

(3) acid phosphatase

(4) hyaluronidase

36. **During regeneration, the following takes place:**

(i) cell division   (ii) dedifferentiation

(iii) cell movement   (iv) tissue differentiation

The correct sequence is:

(1) (ii), (i), (iii), (iv)   (2) (i), (ii), (iii), (iv)

(3) (i), (iii), (ii), (iv)   (4) (iii), (ii), (i), (iv)

37. **Laws of inheritance were given by:**

(1) Mendel   (2) Darwin

(3) Khorana   (4) Lamarck

38. **Chromosomes concerned with sex determination are:**

(1) Oxysomes   (2) B-chromosomes

(3) Autosomes   (4) Heterosomes

39. **Semiconservative DNA replication was first demonstrated by:**

(1) Watson and Crick

(2) Khorana   (3) Meselson and Stahl

(4) Taylor

40. **Which chromosome set is found in male grasshopper?**

(1) XX   (2) YY   (3) X   (4) XY

§ *Directions Q41 to 60 consists of two statements, one labelled the 'Assertion (A)' and the other labelled the 'Reason (R)'. Examine these statements carefully and decide if*

(1) If both assertion and reason are true statements and the reason is a correct explanation of the assertion

(2) If both assertion and reason are true statements but reason is not a correct explanation of the assertion

(3) If the assertion is true but the reason is a false statement

(4) If both assertion and reason are false statements.

41. **Assertion (A)** : The chewing and lapping mouth parts consist of a long tounge which is formed from the glossae of the labium.

Reason (R) : The galeae are much elongated and coiled, each forming a half tube, which makes complete tube when both are locked together.

42. Assertion (A) : Left-handed DNA is known as B-DNA.

Reason (R) : Right-handed DNA is known as Z-DNA.

43. **Assertion (A)** : Translocations involve shifting, not deleting or adding genetic material which can cause chromosomal defects when gametes are formed.

Reason (R) : Translocations involve transfers of genetic material between homologous chromosomes.

44. **Assertion (A)** : They form mutualistic, commensalistic, or parasitic relationships.

Reason (R) : Heterotrophs may not be free living or symbiotic.

45. **Assertion (A)** :The sustaining surface for the gliding in certain animals, is a fold or series of folds of the skin known as patagium.

Reason (R) : The gliding flights are performed by arboreal animals.

46. **Assertion (A)** : Pyramid of energy shows energy accumulation pattern at different trophic levels.

Reason (R) : There is a gradual increase in the energy content at successive trophic level from producer to consumer.

47. **Assertion (A)** : In placental mammals the placenta is connected to the embryo by the umblical cord and has an essential role in the immunological protection of the embryo.

Reason (R) : In mammals foetal components of the placenta derive initially from the chondroblast connected with embryonic derive initially from he chondroblast connected with embryonic blood stream either through its contact with the yolk sac.

48. **Assertion (A)** : The adult gametophyte is the conspicuous leafy green, photosynthetic plant popularly called moss.

Reason (R) : The mosses, like liverworts, do not exhibit alteration of generation.

49. **Assertion (A)** : Histone proteins are synthesized during the S-phase when DNA synthesis occurs.

Reason (R) : Histone proteins form an association with DNA to form nucleosome.

50. **Assertion (A)** : Reduction division, in *Selaginella*, occurs during microspore formation only.

Reason (R) : It has been proved experimentally by Zacharich in 1963.

51. **Assertion (A)** : The conjunctiva is thin, little cornified and richly supplied with free nerve endings.

Reason (R) : Conjunctiva is composed of squamous epithelium and is continuous with the dermis that lines the eyelids.

52. **Assertion (A)** : The water molecules are help together from mesophyll cells to the root hairs because of cohesive force.

Reason (R) : Water does not ascend in the plant because of transpiration pull.

53. **Assertion (A)** : Vitamin A is 11-cis-retinal, the lipid prosthetic group of the protein opsin in visual purple. Its deficiency affects all tissues, but the eyes are most readily affected.

Reason (R) : Youngs lacking a liver store of this vitamin are most affected by deficiency, which causes Xeropthalmia in human infants and young children.

54. **Assertion (A)** : Monocot stem has collateral open vascular bundle.

Reason (R) : If the cambium is absent such vascular bundle is called open type.

55. **Assertion (A)** : Cartilage (protein matrix) ad bone (calcium matrix) are rigid connective tissues.

Reason (R) Blood is connective tissue in which plasma is the matrix.

56. **Assertion (A)** : G_2 phase is mainly concerned with protein synthesis and RNA synthesis.

Reason (R) : Photosystem-1 is situated on the inner surface of thylakoid.

57. **Assertion (A)** : Indentical twins are produced during two births, resulting from the division of a single fertilized egg.

Reason (R) : They are of the different sex and otherwise genetically identical.

58. **Assertion (A)** : If you burn a plant, its nitrogen component is given off as ammonia and other gases.

Reason (R) : Hydroponics does not allow plants to grow well if they are supplied with all the mineral nutrients they need.

59. **Assertion (A)** : In a metabolic reaction with a negative ΔG, the products contain less free energy than the reactants, energy is released and entropy increases.

Reason (R) : Such negative ΔG reaction is spontaneous because it occurs without an input of energy.

60. **Assertion (A)** : A protein that cycles in quantity as the cell cycle progress; combines with and activates the kinases that function to promote the events of the cycle.

Reason (R) : A microtubule structure that brings about chromosomal movement during cell division is called kinetochore.

ANSWERS

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

EXPLANATIONS

1. Chlorophyll 'a' is the most abundant photosynthetic pigment and is the only pigment found in all photosynthetic plants

2. Lampbrush chromosomes were first discovered by Flemming in amphibian oocytes

3. During incomplete dominance the recessive gene dilutes the dominant character and produces an intermediate character e.g.. 4 O' clock plant pink flowers from red and white flowers

4. It was made possible by tetrad analysis

5. Due to absence of cell wall structural rigidity is absent

6. Drosera is insectivorous plant

7. They are called cryptogams because of naked seeds and are called vascular because of differentiation to some extent of vascular tissues

9. Two during syngamy and three during triple fertilization

11. These are characters of vessels

12. Rest are salts

14. By Endosmosis they take the water inside and thus burst

18. Fructose –1, 6 –diphosphate breaks into Di-hydroxyacetone and glyceraldehyde and each yield one molecule of pyruvic acid

20. Because it helps in the synthesis of citric acid during kreb's cycle

22. Because due to deforestation water loss in the atmosphere is reduced as plants are less in number to transpire.

27. FAD and FMN contain Riboflavin (Vit. B_2) as a coenzyme as hydrogen acceptor.

28. Rise in pCO_2 will leads to lowering of pO_2 and thus % saturation of haemoglobin with oxygen will be lesser there by shifting the oxygen dissociation curve of haemoglobin to right

30. Animals consuming less water are urotellic

35. Sperm penetrates the egg by the help of enzymes of hydrolase class which breaks the outer shell of egg

36. Regeneration is the capacity of body to produce the lost part by proliferation of cells

38. Heterosomes are found on the males e.g.. Y chromosomes which are responsible for sex determination .

41. (3) In chewing lapping mouth parts a temporary food channel is formed by proboscis, galeae and labial palps filling together.

42. (4) Left-handed and right-handed DNAs are respectively known as Z-DNA and B-DNA.

43. Translocation of genetic material between non homologous chromosomes. Translocations may take a number of forms; the most common form involves a single break in each of two chromosomes and an exchange of broken pieces.

44. (3) Heterotrophs may be free-living or symbiotic, meaning that they form mutualistic, commensalistic or parasitic relationships.

45. (3) Patagium is concerned with flight or volant adaptations. The gliding flights are performed with the help of patagium by various lizards e.g., flying dragon.

46. (3) There is a gradual decrease in the energy content at successive trophic level from producers to consumers.

47. (3) In mammals foetal components of two placenta derive initially from the trophoblast connected with embryonic blood stream either through its contact with the yolk sac.

48. (3) The mosses, like the liverworts, exhibit a well-defined alternation of generations between gametophyte phase, whose cells contain a single set of chromosomes (n), and a sporophyte phase, whose cells contain a double set of chromosomes (2n).

49. (2) Histones are basic proteins of major importance in packaging of eukaryotic DNA. DNA and histones together comprise chromatin, forming the bulk of the eukaryotic chromosome. Histones are of five major types, H1, H2A and H2B are lysine rich; H3 and H4 arginine-rich, H_1 units link neighbouring nucleosomes while the others are elements of nucleosome structure. Histone proteins are synthesized during the S-phase when DNA synthesis occurs.

50. (4) In *Selaginella*, reduction division occurs during formation of both microspores and megaspores.

51. (3) Conjunctiva is composed of stratified epithelium and in continuous with the epidermis, the lines the eyelids.

52. (3) According to cohesive-adhesive force theory of water molecules, water ascends in the plant because of transpiration pull and column of water remains continuous because of cohesive force of water molecules.

53. (1)

54. (4) Monocot stem has collateral closed vascular bundles. In monocot stem, cambium is absent such vascular bundles are called closed.

55. (2)

56. (4) Proteins and RNAs are synthesised in G_1 phase during interphase. The photosystem-1 is located on the outer surface of the thylakoid.

57. (4) Identical twins are produced during one birth, resulting from the division of a single fertilized egg. They are of the different sex and genetically identical.

58. (3) The preferred method for determining the mineral requirements of a plant is called hydroponics (or water culture). Hydroponics allows plants to grow well if they are supplied with all the mineral nutrients they need.

59. (1)

60. (3) A microtubule structure that brings about chromosomal movement during cell division is called spindle.

PART 4. GENERAL KNOWLEDGE

1. **Who was the first non - Indian to receive the Bharat Ratna?**
   (1) Martin Luther King
   (2) Zubin Mehta
   (3) Mother Teresa
   (4) Khan Abdul Ghaffar Khan

2. **The Satanic Verses' is a book written by**
   (1) Keri Hulme   (2) Salman Rushdie
   (3) Deniel Pipes   (4) Shaul Bakhash

3. **Who among the following got the Nobel Prize for the discovery of neutron?**
   (1) James Chadwick (2) J.J. Thomson
   (3) C.V. Raman   (4) Niel Bohr

4. **Who produced the first automobile?**
   (1) Rudolf Diesel   (2) Carl Benz
   (3) Henry Ford   (4) Gottleib Daimler

5. **Kathakali is a dance of**
   (1) Tamil Nadu   (2) Kerala
   (3) Uttar Pradesh   (4) Manipur

6. **The first Asian Games were help in**
   (1) Seoul   (2) New Delhi

(3) Dhaka   (4) Colombo

7. **Which eminent political personality played an important role in the drafting of the Indian Constitution?**

  (1) B.R. Ambedkar   (2) Dr. Rajendra Prasad

  (3) Sardar Patel   (4) Jawaharlal Nehru

8. **Which country has won the world cup Foot ball 1998?**

  (1) France   (2) Argentina

  (3) Brazil   (4) Italy

9. **The first astronaut to set foot on the moon was**

  (1) Edwin Aldrin   (2) Alan Shepherd

  (3) Niel Armstrong   (4) Yuri Gangarin

10. **Mansoor Ali Khan is well-known in India as**

  (1) an outstanding sportsman

  (2) an Urdu novelist

  (3) a sarod player

  (4) a classical singer

11. **The terms 'Bears' and 'Bulls' refer to those speculators who believe that prices of shares will**

  (1) come down and remain constant respectively

  (2) go up and remain constant respectively

  (3) go up and come down respectively

  (4) come down and go up respectively

12. **The United National Day is observed annually on**

  (1) 14th November   (2) 30th October

  (3) 24th October   (4) 6th June

13. **'March 8' is celebrated as**

  (1) World Health Day

  (2) National Integration Day

  (3) Human Rights Day

  (4) International Women's Day

14. **Which of the following is the indigenously developed multi-barrel rocket system of the Indian Army?**

  (1) Trishul   (2) Pinaka

  (3) Akash   (4) Prithvi

15. **Vilayat Khan is associated with**

  (1) Rudra Veena   (2) Shehnai

  (3) Sitar   (4) Sarod

16. **The author of the famous novel, "Anandamath" is**

  (1) Surendra Nath Banerjee

  (2) Keshav Chandra Sen

  (3) Subhas Chandra Bose

  (4) Bankim Chandra Chatterjee

17. **Which one of the following states leads in the production of Coffee in India?**

  (1) Kerala   (2) Goa

  (3) Karnataka   (4) Tamil Nadu

18. **'Booker Prize' is awarded for which of the following fields?**

  (1) Sports   (2) Social Services

  (3) Literature   (4) None of these

19. **Tripitakas is a sacred book of**

  (1) Hinduism   (2) Sikhism

  (3) Budhism   (4) Jainism

20. **The present decimal system of numbers was the invention of**

  (1) Romans   (2) Indians

  (3) Greeks   (4) Egyptians

ANSWERS

1.(4) 2.(2) 3.(1) 4.(2) 5.(2) 6.(2) 7.(1) 8.(1) 9.(3) 10.(1) 11.(4) 12.(3) 13.(4) 14.(2) 15.(3) 16.(4) 17.(3) 18.(3) 19.(3) 20.(2).