EXPLANATIONS

1. Number of mapping from A to B = z^n : f(x) = a and g(x) = b all not surjective.

Hence, surjective mapping = $2^n - 2$.

2. Finding the total arrangement to 4 by taking 3 at a time is, $^4P_3 = 24$.

3. $f(x) = y$

$\therefore \quad 16x - 7 = y$

$\Rightarrow \quad x = \frac{y+7}{10}$

Now, $f(x) = y$

$\Rightarrow \quad f^{-1}(y) = x = \frac{y+7}{10}$

$\therefore \quad f^{-1}(x) = \frac{y+7}{10}$

4. Total number of bijection from set of n elements to itself = n!

5. f(x) = |sin x| – injective in $[0, \frac{\pi}{2}]$ + subjective in [0, 1]

$\therefore$ Invertible if f(x) from $[0, \frac{\pi}{2}]$ to [0,1]

6. Area of triangle = $\frac{1}{2}|z|^2$

$\therefore \quad \frac{1}{2}|z|^2 = 50$

$\Rightarrow \quad a\,|z| = 10.$

7. Area of triangle = $\frac{\sqrt{3}}{4}|z|^2 = 4\sqrt{3}$

8. Let $z = z + y$. Then $\text{Re}\left(\frac{1}{z}\right) = k$

$\Rightarrow \quad \text{Re}\left(\frac{1}{x+iy}\right) = k$

$\Rightarrow \quad x^2 + y^2 - \frac{x}{x} = 0$, which is a circle.

9. Let $z = x + y$, $z^2 = x^2 + y^2 + 2ixy$

$\text{Re}\,(z^2) = x^2 - y^2 = 0 \quad$ or $\quad y = \pm x$

Thus, straight lines pair

10. Let $a = br$ and $c = ar^2$

$\therefore \quad 4b = a + 3c$

$\Rightarrow \quad 4ar = a + 3ar^2$

$\Rightarrow \quad (3r - 1)(r - 1) = 0$

$\therefore \quad r = \frac{1}{3}$

14. $(x - a)(x - 10) + 1 = 0$

$\therefore \quad (x - a)(x - 10) = -1$

$\therefore \quad x - a = 1$

and $\quad x - 10 = -1,$

or $\quad x - a = 1$ and $x - 10 = 1$

$\therefore \quad a = 8$ or $a = 12$

15. D = 0 (since roots are equal)

$\therefore \quad (27 \times 3^{1/p} - 15)^2 - 144 = 0$

$\Rightarrow \quad 27 \times 3^{1/p} = 27$

$\Rightarrow \quad 3^{1/p} = 1$

$\Rightarrow \quad 3^{1/p} = \frac{1}{9}$

$\therefore \quad p = \frac{-1}{2}$

16. $a = 0$ or $a = \frac{1}{2}$, the equation becomes linear

So $\quad a \neq 0, a \neq \frac{1}{2}$

Hence, only answer is, $a = \frac{2}{9}$

17. (m + 1) chooses for each n different books.

Hence, number of choose is $(m + 1)^n$ and 1 choice is of no book selection

$\therefore$ Number of ways = $(m + 1)^n - 1$

18. Number of ways = (10 + 1) (9 + 1) (7 + 1) –1

= 879

19. Number of ways to select 2 elements out of n – 1 elements, hence

required number of subsets = $^{n-1}C_2$

20. $T_{r+1} = {}^{55}C_r\,(y^{1/5})^{55-r}\,(x^{1/10})^r = {}^{55}C_r\,y^{1-r/5}\,x^{r/10}$

Since, $\frac{r}{5}$ and $\frac{r}{10}$ are integers and $0 \le r \le 55$

Hence, 6th term is independent to radicals

21. Sum of coefficient = $(a + b)^n = (2)^n$

$= 4096 = 2^{12}$

$\therefore \quad n = 12$

24. $A(\text{adj } A) = |A|I_n$

Since, A is triangular, therefore |A| = 0

$\therefore$ A (adj) A is null.

25. $A^2 = \begin{bmatrix}1 & 1\\ 1 & 1\end{bmatrix}\begin{bmatrix}1 & 1\\ 1 & 1\end{bmatrix} = \begin{bmatrix}2 & 2\\ 2 & 2\end{bmatrix} = 2A$

Similarly, $A^3 = 2^2 A \therefore A^n = 2^{n-1} A$

26. Degree of the determinant is

$n + (n + 2) + (n + 3) = 3n + 5$

and on R .H.S., degree = 2

$\therefore \quad 3n + 5 = 2$

$\Rightarrow \quad n = -1$

27. ΔOAB is right angled triangleat O. Therefore O (0,0) is orthocentre

28. Line is $\pm \frac{x}{c/a} \pm \frac{y}{c-b} = 1$

$\therefore \quad A\left(\frac{c}{a}, 0\right) B\left(0, \frac{c}{b}\right), C\left(-\frac{c}{a}, 0\right), D\left(0, -\frac{c}{b}\right)$

Hence, it is Rhombus

$\therefore \quad \Delta = \frac{1}{2} AC.\ BD = \frac{1}{2}\left(\frac{2c}{a}\right)\left(\frac{2c}{b}\right) = \frac{2c^2}{ab}$

30. $AL = a \cos 36^\circ = \frac{\sqrt{3}}{2} a$

$\therefore \quad AB = 2AL = \sqrt{3}\, a$

31. Semi-letus rectum $= \frac{2SP.SQ}{SP + SQ} = \frac{12}{5}$

$\therefore$ Letus rectum $= \frac{24}{5}$.

32. $c^2 = a^2m^2 + b^2$

$\therefore \quad c^2 = 64 + 1 = 65$

$\therefore \quad c = \pm \sqrt{65}$

33. $\therefore$ Coeff of x^2 + coeff of $y^2 = 0$ so, the hyperbola is rectangular

Hence eccentricity $= \sqrt{2}$

34. Let $x + 2y = u$ and $x - 2y = v$

$\therefore \quad x = \frac{u+v}{8}, \quad y = \frac{u-v}{4}$

$\therefore \quad f(u, v) = \frac{u^2 - v^2}{8}$

$\Rightarrow \quad f(x, y) = \frac{x^2 - y^2}{8}$

35. $f(x) = \sin^4 x + \cos^2 x = 1 - \frac{1}{2}(\sin 2x)^2$

$= 1 - \frac{1}{2}\left[\frac{-\cos 4x}{2}\right] = \frac{3}{4} + \frac{1}{4}\cos 4x$

Hence, f(x) periodic with $\frac{\pi}{2}$ as cos x is periodic with 2π.

36. $\lim\limits_{x \to 0} \frac{x^2 + 1 - 1}{x^2 + 9 - 9} \times \frac{\sqrt{x^2 + 9} + 3}{\sqrt{x^2 + 1} + 1} = \frac{6}{2} = 3.$

37. $\lim\limits_{x \to 0}\left(1 + \frac{6}{x - 1}\right)^x = e^{\lim\limits_{x \to 0} \frac{6x}{x-1}} = e^6$

40. $f'(x) = \frac{x}{\sqrt{x^2 + 9}}$

Now, $\lim\limits_{x \to 4} \frac{f(x) - f(4)}{x - 4} = f'(4)$

$\therefore \quad$ Required limit $= \frac{4}{\sqrt{4^2 + 9}} = \frac{4}{5}$

41. $\lim\limits_{x \to 9} \frac{\sqrt{f(x)} - 3}{\sqrt{x} - 3} = \lim\limits_{x \to 9} \frac{fx(x) - 9}{x - 9} \times \frac{\sqrt{x} + 3}{\sqrt{f(x)} + 3}$

$= f'(9) \times \frac{3 + 3}{3 + 3} = f'(9) = 4$

42. $f'(x) = \frac{\log x - 1}{(\log x)^2} > 0$

$\Rightarrow \quad \log x - 1 > 0$

$\Rightarrow \quad x > e$

$\therefore \quad x \in (e, 8)$

43. $\int \frac{\cos 2x}{(\sin x + \cos x)^2} dx = \int \frac{\cos x - \sin x}{(\cos x + \sin x)} dx$

$= \log(\sin x + \cos x) + c$

45. Let $x^n + 1 = t$. Therefore $n\, x^{n-1}\, dx = dt$

$\therefore \quad \int \frac{1}{x(x^{n+1})} dx = \frac{1}{n}\int\left(\frac{1}{t-1} - \frac{1}{t}\right) dt$

$= \frac{1}{n} \log\left(\frac{x^n}{x^n + 1}\right) + c$

46. Polarization : It is a phenomenon that occurs only to transverse waves and light undergoes polarization. Therefore, we have an observation that light shows polarising effect. Hence, polarization prove, transverse nature of light.

47. Given, Amplitude of the wave = A

Maximum velocity, $v_{max} = 4v$

(where v is the velocity of wave)

Maximum velocity of wave, $v_{max} = 4v$

or $\quad v_{max} = A\omega = 4v$

$\therefore \quad \omega = \frac{4v}{A}$

Wavelength of the wave,

$\lambda = \frac{\text{velocity of wave (v)}}{\text{frequency of wave (f)}} = \frac{v}{\omega} = \frac{2\pi v}{\omega}$

2π

$= \frac{2\pi v}{4v/A} = \frac{\pi A}{2} \quad \ldots\left(\text{where, } f = \frac{\omega}{2\pi}\right)$

48. Relation between cubical expansion γ and superficial expansion β is

$$\frac{\beta}{2} = \frac{\gamma}{3}$$

or $$\gamma = \frac{3\beta}{2} = 15.\beta$$

$\therefore$ $$x = 1.5$$

49. Weight of the body on earth, $w_e = 700$ N

Given, mass of the planet, $M_p = \frac{M_e}{7}$

where, M_e = mass of the earth

Radius of planet, $R_p = \frac{R_e}{2}$

where, R_e = radius of earth

Acceleration due to gravity,

$$g = \frac{GM}{R^2}$$

$\Rightarrow$ $$g \propto \frac{M}{R^2}$$

$\therefore$ $$\frac{g_e}{g_p} = \frac{M_e}{M_p} \times \frac{R_p^2}{R_e^2} = \frac{M_e}{\frac{1}{7}M_e} \times \frac{\left(\frac{1}{2}R_e\right)^2}{R_e^2} = \frac{7}{4}$$

$\Rightarrow$ $$g_p = g_e \times \frac{7}{4}$$

$\therefore$ Weight of the body on the planet

$$= \frac{4}{7} \times \text{weight of body on earth}$$

$$= \frac{4}{7} \times 700 = 400 \text{ N}$$

50. Time taken for the first echo = 3 sec.

Time taken for the second echo = 5 sec

Velocity of sound, v = 330 m/s

Time taken for the echo to travel from first cliff to the man,

$$t_1 = \frac{3}{2} = 1.5 \text{ sec}$$

Time taken for the echo to travel from the second cliff to the man,

$$t_2 = \frac{5}{2} = 2.5 \text{ sec}$$

$\therefore$ Distance between the man and first cliff,

$$d_1 = \text{time} \times \text{velocity}$$
$$= 1.5 \times 330 = 495 \text{ m}$$

Distance between the man and the second cliff,

$$d_2 = 2.5 \times 330 = 825 \text{ m}$$

Hence, distance between two cliff

$$= d_1 + d_2 = 495 + 825$$
$$= 1320 \text{ m}$$

51. From the formula, $s = ut + \frac{1}{2}at^2$

Since body starts from rest, hence initial velocity u = 0

$\therefore$ $$s = 0 + \frac{1}{2} \times 20 \times 8 \times 8 = 640 \text{ cm}$$

52. Acceleration due to gravity,

$$g = \frac{GM_e}{R_e^2} \text{ and } g' = \frac{\frac{GM_e}{2}}{\left(\frac{R_e}{2}\right)^2}$$

$\therefore$ $$g' = \frac{2GM_e}{R_e^2}$$

So, $$\frac{g}{g} = \frac{2Gm_e}{R_e^2} \times \frac{R_e^2}{GM_e} = 2$$

$\therefore$ $$g' = 2g$$
$$= 2 \times 9.8 \text{ m/s}^2 = 19.6 \text{ m/s}^2$$

53. We know, velocity, $v \propto r^2$

where, r = radius of the ball

If radius becomes $\frac{1}{2}$, then velocity will become one fourth.

$\therefore$ $$\text{Speed} = \frac{20}{4} = 5 \text{ cm/s}$$

54. Velocity of source u_s = velocity of observer $v_0 = 10$ m/s

Apparent frequency of the source, v' =1950 Hz

Given, velocity of sound v = 340m/s

From the Doppler's law,

when observer and source move away from each other, we have

apparent frequency of the source,

$$v' = 1950 = v\left(\frac{v - u_o}{u + u_s}\right)$$
$$= v\left(\frac{340 - 10}{340 + 10}\right) = v\frac{330}{350}$$

where, v is the actual frequency of the source.

$\therefore$ $$v = \frac{350 \times 1950}{330}$$
$$= 206818 \approx 2068 \text{ Hz}$$

55. Ratio of masses of wires, $m_1 : m_2 : m_3 = 1 : 3 : 5$

Ratip of length of wires, $l_1 : l_2 : l_3 = 5 : 3 : 1$

Electrical resistance,

$$R = \rho\frac{l}{A} = \rho\frac{l}{A}\times\frac{l}{l} = \rho\frac{l^2}{V}\times\frac{\rho}{\rho}$$

$$= \rho^2\ \frac{l^2}{m} \propto \frac{l^2}{m}$$

$$\therefore\ R_1 : R_2 : R_3 = \frac{l_1^2}{m_1} : \frac{l_2^2}{m_2} : \frac{l_3^2}{m_3}$$

$$= \frac{(5)^2}{1} : \frac{(3)^2}{3} : \frac{(1)^2}{5} = \frac{25}{1} : \frac{9}{3} : \frac{1}{5}$$

$$= 125 : 15 : 1$$

56. Horizontal component of earth's magnetic field $H = \sqrt{3}\ V$

The angle of dip (δ) at any point is given by

$$\tan\delta = \frac{V}{H} = \frac{V}{V\sqrt{3}} = \frac{1}{\sqrt{3}}$$

or $$\delta = \tan^{-1}\frac{1}{\sqrt{3}} = 30°$$

57. The centre of gravity of the ball is at centre, when the ball is filled with water. As the water starts leaking, its centre of gravity starts lowering down and at last when all the water flows out, it shifts back to the centre of the ball. As because the time period of a pendulum depends upon its length, i.e. distance from the suspension to the centre of gravity, thus time period of this pendulum first increases then decrease.

58. Given: Mass of the moving body $m_1 = a$

Velocity of the body, $v_1 = b$

Mass of the body which is in rest, $m_2 = c$

Now from the law of conservation of momentum, we have

$$m_1v_1 + m_2v_2 = (m_1 + m_2)v$$

where, v velocity of system after collision

$$\therefore\quad a\ .\ b + c\ .0 = (a + c)v$$

Therefore, velocity of the system after collision

$$v = \frac{ab}{a+c}$$

59. Velocity of the boat in still water, $v_b = 5$km/hr

Width of the river, d = 1 km

Time which is taken to cross the river t

$$= 15 \text{ minute} = \frac{1}{4} \text{ hour}$$

Velocity of the boat while crossing the river or resultant velocity of boat

$$(v_b)_r = \frac{d}{t} = \frac{1}{1/4} = 4 \text{ km/hr}$$

Velocity of boat must be perpendicular to the velocity of river while crossing the river in shortest path. Hence, relation for velocity of river water v_w is

$$v_b^2 = (v_b)_r + v_w^2$$

$$\therefore\quad 5^2 = 4^2 + v_w^2$$

Therefore, velocity of river water,

$$v_w = \sqrt{5^2 - 4^2} = 3\text{km/hour}$$

60. Mass, M = 0.4 kg

Radius, r = 100 cm = 1 m

Moment of inertia of the disc

$$= \frac{1}{2}M\,R^2 = \frac{1}{2}\times 0.4 \times 1^2 = 0.2 \text{ kg-m}^2$$

Therefore, moment of inertia of the disc about an axis perpendicular to the plane and passing through its centre is 0.2 kg-m^2.

61. Time period of seconds-hand in a watch

$$T = 60 \text{ sec}$$

Therefore, angular velocity of second's hand in watch,

$$\omega = \frac{2\pi}{T} = \frac{2\times 314}{60} = 0.105 \text{ rad/sec}$$

62. Initial radiated energy, $E_i = 5$ W

Initial temperature, $T_1 = 400$ K

Final temperature, $T_2 = 1200$ K

Now from the Stefan's law, $E \propto T^4$

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

$$\Rightarrow\quad \frac{5}{E_2} = \left(\frac{400}{1200}\right)^4 = \left(\frac{1}{3}\right)^4 = \frac{1}{81}$$

$$E_2 = 5 \times 81 = 405 \text{ W}$$

63. Depth, d = 100km = 10^5 m

Radius, R = 6400km = 64×10^5 m

Gravitation acceleration at a depth

$$g' = g\left(1 - \frac{d}{R}\right)$$

$$= 9.8\left(1 - \frac{10^5}{64\times 10^5}\right) = 9.8\left(1 - \frac{1}{64}\right)$$

$$= 9.65 \text{ m/s}^2$$

64. Given, Mass left after two hours $N = \frac{N_0}{16}$

where, N_0 = original mass

Time taken = 2 hours = 120 min

From the relation of radioactivity $N = N_0\left(\frac{1}{2}\right)^n$

$$\Rightarrow \quad \frac{N}{N_0} = \left(\frac{1}{2}\right)^n$$

where, n = number of half-lives

$$\Rightarrow \quad \frac{N_0}{16}\frac{1}{N_0} = \frac{1}{16} = \left(\frac{1}{2}\right)^n$$

$$\Rightarrow \quad \left(\frac{1}{2}\right)^4 = \left(\frac{1}{2}\right)^n$$

$$\therefore \quad n = 4$$

Hence, half-life period $= \frac{120}{4} = 30$ min.

65. Mass of the body, m = 60 kg

Displacement, s = 0.9 m

Coefficient of friction, $\mu = 0.15$

Work done against friction,

$$W = F.s = \mu Rs = \mu mgs$$
$$= 0.15 \times 60 \times 9.8 \times 0.9 = 79.4 \text{ J}$$

66. Mass of the first substance, $m_1 = 25$g

Mass of the second substance, $m_2 = 81$g

Momentum of the substance, $p = \sqrt{2mK}$

(Since kinetic energes is same)

So $\quad p \propto \sqrt{m}$

$$\therefore \quad \frac{p_1}{p_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{25}{81}} = \frac{5}{9}$$

or $\quad p_1 : p_2 = 5 : 9$

67. Speed of the wave = 650 m/s

Number of waves passing = 4000

Time t = 1.67 min = 100 see

Frequency of the wave,

$$n = \frac{4000}{100} = 40 \text{ second}$$

Hence, wavelength of the wave,

$$\lambda = \frac{v}{n} = \frac{650}{40} = 16.25 \text{ m}$$

68. Acccrding to Bernoulli theorem, sum of pressure energy, potential energy and kinetic energy of an ideal fluid in steady flow per unit mass remains constant. Hence, Bernoulli theorem is related with conservation of energy.

69. Here, acceleration = (g + a) sin θ

From the equation of motion, $s = ut + \frac{1}{2}at^2$

Since u = 0, therefore $\quad s = \frac{1}{2}at^2$

$$\therefore \quad L = \frac{1}{2}(g + a)\sin\theta\, t^2$$

$$\therefore \quad t = \sqrt{\frac{2L}{(g+a)\sin\theta}}$$

70. From the equation of motion,

$$v = u + at \qquad ...(i)$$

Here, u = 5 m/s

From the relation,

$$a = -g[\sin\theta + \mu\cos\theta]$$
$$= -g\,[\sin 30° + \mu\cos 30°]$$
$$= -g\left[\frac{1}{2} + \frac{\mu\sqrt{3}}{2}\right]$$
$$a = \frac{g}{2}[1+\mu\sqrt{3}] \qquad ...(ii)$$

Putting the values of a from equation (ii) in equation (i), we get

$$0 = 5 - \frac{g}{2}(1+\mu\sqrt{3})\frac{1}{2} \qquad \left\{\because t = 0.5 = \frac{1}{2}\right\}$$

$$\Rightarrow \quad \frac{g}{2}(1+\mu\sqrt{3})\frac{1}{2} = 5,$$

If $g = 10$ m/s^2, then $\quad \frac{1+\mu\sqrt{3}}{2} = 1$

$$\Rightarrow \quad \frac{\mu\sqrt{3}}{2} = \frac{1}{2}$$

$$\Rightarrow \quad \mu = \frac{1}{\sqrt{3}} = 0.577 \approx 0.6$$

71. We know from formulac of ellipse

$$r_1 = 0\,(1 + e) \qquad ...(i)$$
$$r_2 = 0\,(1 - e) \qquad ...(ii)$$

Adding equation (i) and (ii), we get

$$r_1 + r_2 = 20$$
$$a = \frac{r_1 + r_2}{2}$$

But from the relation, we get

$$T^2 \propto a^3$$

$$\therefore \quad T \propto a^{3/2}$$

$$\Rightarrow \quad T \propto \left(\frac{r_1 + r_2}{2}\right)^{3/2}$$

$$\Rightarrow \quad T \propto (r_1 + r_2)^{3/2}$$

72. We know, $W = T(8\pi r^2)$ ...(i)

$$V = \frac{4}{3}\pi r^3$$

$$\therefore \quad r = \left(\frac{3V}{4\pi}\right)^{1/3} \quad ...(ii)$$

Putting the value of r from equation (ii) in equation (i), we get

$$W = T8\pi\left(\frac{3V}{4\pi}\right)^{2/3}$$

$$\therefore \quad W \propto V^{2/3}$$

$$\therefore \quad \frac{W_2}{W_1} = \left(\frac{V_2}{V_1}\right)^{2/3} = \left(\frac{2V}{V}\right)^{2/3}$$

But given $V_2 = 2V$

$$\therefore \quad W_2 = 2^{2/3} = 4^{1/3}\,W$$

73. We know, $U = \frac{1}{2}kx^2$

Hence, $$\frac{U_1}{U_2} = \frac{\frac{1}{2}k_1x^2}{\frac{1}{2}k_2x^2} = \frac{k_1}{k_2} = \frac{1500}{3000} = \frac{1}{2}$$

$$\therefore \quad U_1 : U_2 = 1 : 2$$

74. From Wein's displacement law.

$$\lambda_m T = \text{constant}$$

$$\therefore \quad (\lambda_m)_1 T_1 = (\lambda_m)_2 T_2 \quad ...(i)$$

If $(\lambda_m)_2 = 5.5 \times 10^{-5}$, cm and $T_2 = T$

thon for, $(\lambda_m)_1 = 11 \times 10^{-5}$ cm,

and $T_1 = nT$

Now putting the values of $(\lambda_m)_1$, $(\lambda_m)_2$, T_1 and T_2, in equation (i), we get

$$(11 \times 10^{-5}) \times nT = (5.5 \times 10^{-5}) \times T$$

$$n = \frac{1}{2}$$

76. Kinetic energy of n moles of an ideal gas

$$E_1 = n\left(\frac{3}{2}RT_1\right) \quad ...(i)$$

$$E_2 = n\left(\frac{3}{2}RT_2\right) \quad ...(ii)$$

Dividing equation (ii) by equation (i), we get

$$\frac{E_2}{E_1} = \frac{T_2}{T_1} = \frac{273+327}{273+27} = \frac{600}{300} = \frac{2}{1}$$

$$\therefore \quad E_2 = 2E_1$$

77. It is known that the Venus is similar to earth with respect to radius, mass and density. Hence, venus is known as the twin of earth.

78. Mass per unit length, $m = \frac{0.035}{5.5}$

$$= \frac{7}{1100}\frac{kg}{metre}$$

Tension, T = 77 N (given)

Velocity of the wave, $v = \sqrt{\frac{T}{m}} = \sqrt{\frac{77\times1100}{7}}$

$$= 110 \text{ m/s}$$

79. Capacitor is always in the charged condition. It acts as a seat of electro motive force and is discharged when its terminals are touched. Hence, it will effect dangerously due to high voltage.

80. Equivalent capacitance where 4 μF and 6 μF are connected in series

$$\frac{1}{C_s} = \frac{1}{4} + \frac{1}{6} = \frac{5}{12}$$

$$\therefore \quad C_s = \frac{12}{5}\ \mu F$$

Now charge on each capacitor

$$Q = C_sV = \left(\frac{12}{5}\times500\right)\mu C$$

$$= 1200\ \mu C$$

81. Here, $$\left(\frac{E}{2+R}\right)\times2 = 300 \text{ K}$$

and $$\left(\frac{E}{2+R}\right)R = 350 \text{ K}$$

$$\therefore \quad \frac{R}{2} = \frac{350}{300}$$

$$\Rightarrow \quad R = \frac{7}{3}\Omega$$

$$= 2.33\ \Omega$$

82. Energy of a photon E = hv

Here $E = 2$ keV (given)

$$= 2 \times 10^3 \times 1.6 \times 10^{-19}$$

$$= 32 \times 10^{-16}$$

$$\therefore \quad v = \frac{E}{h} = \frac{3.2\times10^{-16}}{6.6\times10^{-34}}$$

$$= 4.84 \times 10^{17} \approx 5 \times 10^{17}$$

83. If r is the angle of refraction, then

$$\theta + r + \frac{\pi}{2} = \pi$$

$$r = \frac{\pi}{2} - \theta$$

$${}_{I}\mu_{II} = \frac{\sin\theta}{\sin r}$$

$$= \frac{\sin\theta}{\sin\left(\frac{\pi}{2} - \theta\right)}$$

$$= \frac{\sin\theta}{\cos\theta} = \tan\theta$$

$${}_{II}\mu_{I} = \tan\theta$$

But we know, $\sin C = \frac{1}{{}_{II}\mu_{I}}$

$\therefore \quad \sin C = \tan\theta$

$\therefore \quad C = \sin^{-1}(\tan\theta)$

84. Let focal lengths of the component lenses are convex and the concave lens be f_1 and f_2. If the focal length of the achromatic combination be F, then

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$F = +60 \text{ cm}$$

$\therefore \quad \frac{1}{60} = \frac{1}{f_1} + \frac{1}{f_2}$ ...(i)

For achromatic combination,

$$\frac{\omega_1}{f_1} + \frac{\omega_2}{f_2} = 0$$

or $\frac{\omega_1}{\omega_2} = -\frac{f_1}{f_2}$ $\left(\text{Here, } \frac{\omega_1}{\omega_2} = \frac{3}{4} \text{ given}\right)$

$$\frac{3}{4} = -\frac{f_1}{f_2}$$

$\therefore \quad f_2 = -\frac{4}{3} f_1$ ...(ii)

Combining equations (i) and (ii), we get

$$\frac{1}{60} = \frac{1}{f_1} - \frac{3}{4f_1} = \frac{1}{4f_1}$$

$\therefore \quad f_1 = +15 \text{ cm}$

and $f_2 = -\frac{4}{3}(15) = -20 \text{ cm}$

Therefore, focal lengths of component lenses are + 15 and – 20 cm.

85. $n = 12 \times 10^6$ Hz, $m = 3.3 \times 10^{-27}$ kg, $q = 1.6 \times 10^{-19}$ C

In a cyclotron,

$$Bqv = \frac{mv^2}{r}$$

$$\frac{v}{r} = \frac{Bq}{m},$$

$\therefore \quad \omega = \frac{Bq}{m}$ ...($\because v = r\omega$)

$$2\pi n = \frac{Bq}{m}$$

$\therefore \quad B = \frac{2\pi nm}{q}$

$$= \frac{2 \times \pi \times (12 \times 10^6)(3.3 \times 10^{-27})}{1.6 \times 10^{-19}}$$

$= 1.55 \text{ tesla} \approx 1.6 \text{ tesla}$

86. Work done $W = {}^{n}C_{u}(T_1 - T_2)$

Here, W = 3 kJ = 3000 J

n = number of moles = 1

T_1 = initial temperature

= 27°C+273= 300K,

$C_v = 20 \text{ kJ}^{-1}$

Putting the values, we get

$$3000 = 1 \times 20(300 - T_2)$$

$$= 6000 - 20T_2$$

$\therefore \quad 20T_2 = 6000 - 20T_2$

$$= 6000 - 3000 = 3000$$

$\therefore \quad T_2 = \frac{3000}{20} = 150 \text{ K}$

87. Water gas and H_2 reacts to produce methanol.

$$\underbrace{CO + H_2}_{\text{water gas}} + H_2 \xrightarrow[300°C]{Cr_2\text{-}ZnO} CH_3OH$$

88. The empirical formula can be calculated as

Element	Percentage	$\frac{\text{Percentage}}{\text{atomic wt.}}$	Ratio
C	40	$\frac{40}{12} = 3.33$	$\frac{3.33}{3.33} = 1$
H	13.33	$\frac{13.33}{1} = 13.33$	$\frac{13.33}{3.33} = 4$
N	46.67	$\frac{46.67}{14} = 3.33$	$\frac{3.33}{3.33} = 1$

$\therefore$ Empirical formula = CH_4N

89. $2NH_3 + NaOCl \longrightarrow NH_2.NH_2 + NaCl + H_2O$

Therefore, the product obtained is hydrazine.

92. We know that the atomic weight of oxygen is 16.

At NTP volume of 16 gm of oxygen is 22.4 litre.

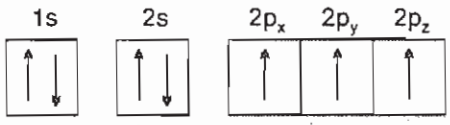
Hence, volume of 1 gm of oxygen at NTP

$$= \frac{22.4}{16} = 1.4 \text{ litre}$$

93. P_2O_5 is an anhydride of HPO_3

$$HPO_3 + HPO_3 \xrightarrow{H_2O} P_2O_5$$

94. $1s^2\ 2s^2\ 2p^3$ can be shown as $\frac{\text{Percentage}}{\text{atomic wt.}}$



Therefore, there are 3 unpaired electrons.

95. We know, normality of solution

$$= \text{Molarity} \times \frac{\text{Molecular wt.}}{\text{Equivalent wt.}}$$

Here, molarity = 0.3 and molecular weight of $H_3PO_4 = 3 + 31 + 64 = 98$

Equivalent weight of H_3PO_4

$$= \frac{\text{molecular weight}}{2}$$

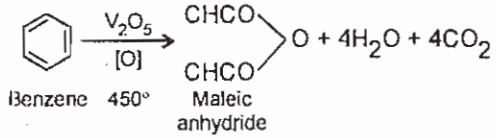
$$= \frac{98}{2} = 49$$

Hence, normality $= 0.3 \times \frac{98}{49} = 0.6$ N

96. Primary amine on heating with CS_2 is presence of excess of $HgCl_2$ produce ethyl isothiocyanate which has smell of mustard oil. Therefore, it is known as Hoffmann's mustard oil reaction.

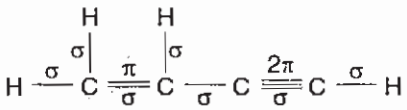
99. On heating the one end of the metal piece the other end becomes hot this is due to the movement of energised electrons from one end to other end.

101. Therefore, maleic anhydride is formed.



103. Cathode have –ve, charge. therefore, during electrolysis cations having + ve, charge migrate to cathode and forms a neutral atom.

104. 1-buten-3-yne has following structure



105. Since $pH = 2$, $[H^+] = 10^{-2}$ M

$pH = 6$, $[H^+] = 10^{-6}$ M

$$\therefore \quad [H^+] \text{ ratio} = \frac{10^{-2}\text{M}}{10^{-6}\text{M}} = 10^4 = 10{,}000$$

106. The most stable carbonium ion is triphenyl methyl carbonium ion because the π-electrons of three benzene rings are delocalized with tb vacant π-orbital of central carbon atom. Therefore, it is stabilized by resonance.

108. The electronic configuration of bromine atom is

$$1s^2,\ 2s^2\ 2p^6,\ 3s^2\ 3p^6\ 3d^{10}, 4s^2\ 4p^5$$

Hence, total number of p-electrons is 17.

111. $2H_2O \xrightarrow{\text{Electrolysis}} 2H_2 + O_2$

2×18 gm = 36gm = 1 mole

$\because$ 36 gm H_2O produce 1 mole of oxygen

$$\therefore \text{ 90 gm } H_2O \text{ produce oxygen} = \frac{90}{36} = 2.5 \text{ moles}$$

112. Since, number of molecules = number of moles

$\therefore$ moles of hydrogen = moles of oxygen

$$\Rightarrow \quad P_{H_2} = P_{O_2}$$

Total pressure = 740 mm

$$\therefore \quad P_{H_2} = P_{O_2} = 370$$

Hence, if oxygen is removed from the system the pressure will behalf due to moles of hydrogen and it becomes half of 740 mm.

114. Flux is used to remove silica and undesirable metal oxide. It is an external material added during smelting to convert infusible impurities into an easily fusible material known as slag.

115. The first law of thermodynamics states that the total energy of the universe is constant.

Hence, $\Delta E = Q + W$.

116. Since, acetic acid is a weak electrolyte, hence

$$[H^+] = \sqrt{K_c} \times C$$
$$= \sqrt{(1.8\times10^{-5})\times 0.1}$$
$$= \sqrt{(1.8\times10^{-6})} \quad \ldots[\because C = 0.1\ M]$$
$$= 1.34 \times 10^{-3}\ M$$

117. Acetaldehyde and acetone both comes under carbonyl group. Both respond to 2, 4-dinitrophenyl hydrazine to produce yellow or orange precipitate. Aldehydes produce colour with Schiff's reagent while ketones do not respond to this test.

118. $_{17}Cl^{35}$ and $_{17}Cl^{37}$ shows that both have same atomic number that is both have same number of protons and same number of electrons. Their atomic masses are different. Atomic mass means number of proton + number of neutron. Therefore, they have different number of neutrons.

119. Weight of benzene = 0.39 gm

Enthalpy of combustion of C_6H_6 = – 3250 kJ

$\because$ 1 mole of C_6H_6 (78 gm) on burning produce heat 3250 kJ.

$\therefore$ 0.39 mole of C_6H_6 on burning produce heat

$$= \frac{3250\times0.39}{78} = 16.25\ kJ.$$

120. $C_6H_6Cl_6 + 3KOH \rightarrow 3KCl + 3H_2O + C_6H_3Cl_3$

Therefore, $C_6H_6Cl_6$ on treatment with KOH produce $C_6H_3Cl_3$.

122. $H_2 + Cl_2 \longrightarrow 2HCl. \qquad \Delta H = -194\ kJ.$

Here, 2 molecules of HCl are formed and the value of ΔH is –194 kJ.

Hence, the change in enthalpy (ΔH) for the formation of one molecule of

$$HCl = \frac{-194}{2} = -97\ kJ$$

123. Lanhanides have different oxidation state because there is only a small difference between the energies of the electrons in the n-s orbital and d orbital. The comon oxidation state is + 3.

124. The dissociation of water is endothermic therefore, Kw increase with increase in temperature. The pH of pure water at 80°C decreases due to rise in temperature and it becomes less than 7 (< 70°C)

125. Producer gas is a mixture of carbon monoxide and nitrogen ($CO + N_2$).

126. Letters at the odd places are coded one letter ahead, and letter at the even places are coded one letter behind in the alphabetical order.

127. ADH and M are the 1st, 4th, 8th and 13th placed alphabet from the left to right in the series of alphabets. Similarly, ZW, Sand N are 1st, 4th, 8th and 13th placed alphabet from the right to left. Therefore, CFJO has same relation with XUQL.

129. As the engineer is directly related to machines similarly doctor is related to diseases.

130. From the above question, it is clear that S is the mother of R (not confirmed R is either male or female). On the other hand N is the daughter of R and sister of M (whose sex is also not known). If R is male then M will be grand daughter/son of S in case of R is female than M will be maternal daughter/son of S. Hence, as per the options data is inadiquate.

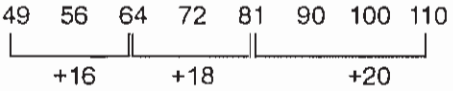
131. Son of woman's mother's mother means the brother of mother. And brother of mother is maternal uncle. Hence, woman is related as niece to the man.

132. Series moves with a difference of 1, 1, 2, 2, 3, 3 and so on. Hence, the missing number is 10.

133. Third number is the sum of first and second, fourth number is the sum of second and third, fifth number is the sum of third and fourth and so on.

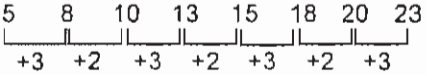
Hence, missing number will be 29 + 47 =76.

134. $(7)^2\ (8)^2\ (9)^2\ (10)^2$



Term at odd places are 7^2, 8^2, 9^2, 10^2 and terms at even places are 56, 72, 90, 110 i.e., with differences of 16, 18 and 20.

135.



Therefore, number 12 is wrong.

136. According to the passage the meaning of the sentence–war is the negation of truth is that wars always spread and give rise to falsehood. Therefore 'd' is correct.

137. According to the author the world's declared love of humanity is considered to be a serious matter because of its false nature. Therefore 'a' is correct.

138. According to the author the achievements of the world are not impressive because these achievements are not based on true grounds of humanity. Therefore 'd' is correct.

139. According to the passage a man should be guided by generous human feelings because one should be a generous and casring to others like as God. Therefore, 'c' is correct.

140. 'Hoard' means to store up or reserve and the 'Store' means accumulation. Therefore, option cd' is correct.

141. 'Mere' means only and 'Empty' means blank. Therefore, option 'a' is correct.

142. 'at' is used always with laugh.

143. 'under' is used to express a thing lying beneath the other thing.

144. 'Stand by' is an idiom that means 'support' .

145. 'Sets in' is an idiom that means 'begins'.

146. The next stop—ON LM—in South wales.

147. Many people—N L O M—that it has received in taxes.

148. Above all—L N M O—into the midst of the reading public.

149. Tough the exact dimension—M L O N—could have not been possible without the connivance of officials at various levels.

150. Inspite of repeated attempts —N O L M—

What is meant?