EXPLANATIONS

1. $\cos x = 2k^2 - 1 = 2\cos^2 20° - 1$
$= \cos 40°$ or $\cos(360° - 40°)$.

2. $32\sin\frac{A}{2}\sin\frac{5A}{2}$
$= 16\{\cos 2A - \cos 3A\}$
$= 16\{2\cos^2 A - 1 - (4\cos^3 A - 3\cos A)\}$.

3. π is an irrational number and $\frac{22}{7}$, a rational number, i.e. $\frac{22}{7} \in Q$ and $\pi \in (R - Q)$.

5. $\sin^2 25° = \sin^2 65°$
$= \sin^2 25° + \sin^2(90° - 25°)$
$= \sin^2 25° + \cos^2 25° = 1$

7. The given product contains the factor $\cos 90° = 0$.

8. $2\sin^2 x - \cos 2x = 4\sin^2 x - 1$ and $0 \le \sin^2 x \le 1$.

9. Since $[x] \in I$ for all $x \in R$, and

$\sin n\pi = 0 \; \forall \; n \in I$,

therefore, $f(x) = \sin([x]\pi) = 0 \; \forall \; x \in R$.

Hence $R_f = \{0\}$.

10. For D_f, we must have $x^2 - 1 \ge 0$ and $x - 1 > 0$
$\Rightarrow x^2 \ge 1$ and $x > 1$
$\Rightarrow |x| \ge 1$ and $x > 1 \Rightarrow x > 1 \Rightarrow x \in (1, \infty)$.
Hence, $D_f = (1, \infty)$.

11. $\cos 2 = \cos 114° 35' 30''$ is surely negative.

12. We know, $\frac{a}{\sin A} = \frac{b}{\sin B}$

$\therefore \quad \sin A = \frac{a\sin B}{b} = \frac{6\sin 60°}{12}$

13. $f'(x) = 2x - 2$
$= 2(x-1) < 0$ if $x < 1$ i.e. $x \in (-\infty, 1)$.
Hence f is strict decreasing in $(-\infty, 1]$

14. For maximum height, $\frac{dx}{dt} = 0$

i.e., $49 - 9.8t = 0$

$\Rightarrow \quad t = \frac{49}{9.8} = 5$

15. The function $\phi(x) = (1 - x^2)\sin x\cos^2 x$ is an odd function, since
$\phi(-x) = (1 - x^2)\sin(-x)\cos^2(-x)$
$= -\phi(x)$.

16. $\underset{x\to 0}{\text{Lt}}\frac{1-\cos x}{x\sin x} = \underset{x\to 0}{\text{Lt}}\frac{1-\cos^2 x}{x\sin x(1+\cos x)}$
$= \underset{x\to 0}{\text{Lt}}\frac{\sin x}{x}\cdot\frac{1}{1+\cos x}$
$= 1\cdot\frac{1}{1+1} = \frac{1}{2}$.

17. $\underset{x\to 0}{\text{Lt}}\frac{\tan x}{\log(1+x)} = \underset{x\to 0}{\text{Lt}}\frac{\tan x}{x}\cdot\frac{x}{\log(1+x)}$
$= \underset{x\to 0}{\text{Lt}}\frac{\tan x}{x}\cdot\underset{x\to 0}{\text{Lt}}\frac{1}{\frac{1}{x}\log(1+x)}$
$= 1\cdot\frac{1}{1} = 1$

18. $\int\frac{\tan^{-1}x}{1+x^2}dx = \int(\tan^{-1}x)\left(\frac{1}{1+x^2}\right)dx$
$= \frac{(\tan^{-1}x)^2}{2}$.

19. We know, $\forall x \in R$, $0 \le -[x] < 1$
$\Rightarrow \quad [x - [x]] = 0 \; \forall \; x \in R$.
This means that $[x - [x]]$ is a constant function on R.
Hence, $\underset{x\to 1}{\text{Lt}}[x - [x]] = 0$.

20. Let $|x| = t$, Then we are required to find
$\frac{d}{dt}(\log t) = \frac{1}{t} = \frac{1}{|x|}$.

21. The two curves must in (0,0) and (1,1).
$\therefore$ Required area lies above the curve $y = x^2$ and below $x = y^2$ is
$= \int_0^1(\sqrt{x} - x^2)\,dx$
$= \left[\frac{2}{3}x^{3/2} - \frac{x^3}{3}\right]_0^1$

22. Substitute $x\,e^{-x} = t$.

23. Let, $y = \log(\log|x|)$ and $z = \log x$,
then $\frac{dy}{dz} = \left(\frac{dy}{dx}\right)/\left(\frac{dz}{dx}\right)$
$= \left(\frac{1}{\log x}\cdot\frac{1}{x}\right)/\left(\frac{1}{x}\right)$
(note that $\frac{d}{dx}(\log|x| = \frac{1}{x})$

24. Here, $\int\frac{-ax}{\sqrt{1-x^2}} = \cos^{-1}x = \frac{\pi}{2} - \sin^{-1}x$

Also, $\int\frac{-1}{\sqrt{1-x^2}}dx = -\int\frac{1}{\sqrt{1-x^2}}dx = -\sin^{-1}x$.

25. $\int_0^1 \frac{\sqrt{1}}{\sqrt{x^2+1}}\,dx = \left[\log\left(x+\sqrt{x^2+1}\right)\right]_0^1$
$= \log(\sqrt{2}+1)$.

26. Given vectors are coplanar if

$$\begin{vmatrix} 2 & -1 & 1 \\ 1 & 2 & -3 \\ 3 & 2b & 5 \end{vmatrix} = 0$$

i.e., if 3(3 – 2) – 2b (–6 –1) + 5 (4 + 1) = 0.

27. $\vec{a}.\vec{a} = 0$
$\Rightarrow |\vec{a}|^2 = 0$
$\rightarrow |\vec{a}| = 0$

28. Required length = $\sqrt{2^2+1^2+4\times1+3} = \sqrt{12}$.

29. The line 3x – 4y = 0 is a normal to the circle $x^2 + y^2 = 25$ as it a passes through the centre of (0, 0) of the circle.

30. $\vec{AB}+\vec{AC} = \vec{AD}+\vec{DB}+\vec{AD}+\vec{DC}$
$= 2\vec{AD}+(\vec{DB}+\vec{DC})$
$= 2\vec{AD}+\vec{0} = 2\vec{AD}$

31. Since, $\hat{v} = \frac{\vec{v}}{|\vec{v}|} = \frac{a_1}{|\vec{v}|}\hat{i} + \frac{a_2}{|\vec{v}|} + \frac{a_3}{|\vec{v}|}\hat{k}$,
therefore , d.c. of $\vec{v}$ are $< \frac{a_1}{|\vec{v}|}, \frac{a_2}{|\vec{v}|}, \frac{a_3}{|\vec{v}|} >$

32. Since $(-1)^2 + 2^2 + 2(-1) - 4(2) + 4 = -1$, therefore, the point (–1, 2) lies inside the circle and hence no tangent to the circle can pass throught the point.

33. Squaring and subtracting, we get
$x^2 - y^2 = \frac{1}{4}[4e^t\ e^{-t}]$
$\Leftrightarrow x^2 - y^2 = 1$, which represents a hyperbola.

34. $|(-5)\vec{a}| = |-5|\,|\vec{a}|$
$= 5 \times 8 = 40$.

35. (1, 0, 0,) . (0, 0, 1) = 1 × 0 + 0 × 0 + 0 × 0
= 0.

36. Here $a^2 = 8$, $b^2 = 6$
$\therefore 6 = 8(1 - e^2)$
$\Rightarrow e^2 = \frac{1}{4}$

37. The vertex of the parabola is (a, 0).

38. Here, $u^2 + v^2 + w^2 - d$
$= (-2)^2 + (3)^2 + (-4)^2 - 29 = 0$.

39. Ends of a diameter are the points with position vector $\vec{a}$ and $\vec{b}$. Hence the position vector of the centre is $\frac{1}{2}(\vec{a}+\vec{b})$.

40. The parabola in rererence is an upward parabola in its standard from, its equation is $x^2 = 4ay$.

41. Each of the given points is at a distance 5 from (0,0,0). So (0,0,0) is the centre of the sphere throught the given points.

42. The point (1, –1, 2) lies on the given line as
$\frac{1+1}{2} = \frac{-1-2}{-3} = \frac{2+2}{4}$ is true.
Hence, the length of perpendicular on the given line = 0.

43. Mean of the given items
$= \frac{22+26+28+20+24+30}{6} = 25$

$\therefore$ Variance $= \frac{(25-22)^2+(25-26)^2+(25-28)^2+(25-20)^2+(25-24)^2+(25-30)^2}{6}$
$= \frac{70}{6} = \frac{35}{3}$

44. $P(x, y) = \frac{\text{cov}(x,y)}{\sigma_x\sigma_y} = \frac{8}{3\times4} = \frac{2}{3}$

45. Two forus of the said type form a couple and do not have a singles force as their resultant.

46. Frequency, $f = \frac{\text{number of vibration}}{\text{time elapsed}} = \frac{2}{0.4} = 5$ Hz

47. Speed of cyclist v = 4.9 m/s
Radius of circular paths = 4m (given)
Centrifugal force acting on the cyclist
$= \frac{mv^2}{r}$ ... (i)
Frictional force = μmg ... (ii)
where, μ = coefficient of friction
Equating these two forces from equations (i) and (ii), we get,
$\mu mg = \frac{mv^2}{r}$
$\therefore \mu = \frac{v^2}{rg} = \frac{(4.9)^2}{4\times9.8} = 0.61$

48. Velocity at the centre is = 0
Velocity at the outer edge = R ω
Now applying Bernoulli's theorem
$P+0 = P' + \frac{1}{2}dv^2$
or $P - P' = \frac{1}{2}dR^2\omega^2$
$\therefore$ Increase in the pressure $= \frac{1}{2}dR^2\omega^2$

49. Momentum of first piece = $\frac{3M}{4}$

Momentum of second piece = $\frac{4M}{4}$

Momentum of third piece = $v\frac{2M}{4}$

where, v = velocity of third piece of mass = $\frac{2M}{4}$

Vector sum of the momentum of the first two pieces is numerically equal but opposite in direction to the momentum of the third piece

$$\therefore \quad v\left(\frac{2M}{4}\right) = \sqrt{\left(\frac{3M}{4}\right)^2 + \left(\frac{4M}{4}\right)^2}$$

$$\Rightarrow \quad 2v = \sqrt{9+16} = 5$$

$$\Rightarrow \quad v = 2.5 \text{ m/sec.}$$

50. Radius of the earth R = 6400 km (given)

We know, distance of geostationary satellite from the centre of the earth = 42000 km

Hence, 42000 = 6400 × R

$$\therefore \quad R = \frac{42000}{6400} = 6.56R \approx 7R$$

51. From the given figure, that the resistances 40 Ω and 60 Ω are connected in parallel combination.

Therefore, their equivalent resistance,

$$R = \frac{60 \times 40}{60+40} = \frac{2400}{100} = 24\ \Omega$$

Now, current in the circuit,

$$i = \frac{E}{R+r} = \frac{6}{24+0} = \frac{6}{24}\text{ A}$$

where, r = resistance of the voltmeter which is equal to zero

∴ Potential difference across voltmeter

$$= i \times R$$

$$= \frac{6}{24} \times 24 = 6.0\text{ V}$$

52. The positive α-particles can be deflected through large angles only. If all of the positive charge is connected in a small space. The fact that only a very small number of particles retrace their path suggested that the positive charge is concentrated in a small space. A heavy particle such as the α-particle can undergo large deflection only, if the entire mass of the atom is concentrated in a small portion of the atom it led Rutherford to conclude that both the mass and the positive charge in an atom are concentrated in a small space whose size is $\frac{1}{10000}$ th of size of atom. It is known as nucleus.

53. Initial time period of simple pendulum, $T_1 = T$,

Initial length of the pendulum, $l_1 = 100$ l.

Final length of the pendulum, $l_2 = 121$ l

Time period of simple pendulum,

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$\Rightarrow \quad T \propto \sqrt{l}$$

$$\text{Hence} \quad \frac{T_2}{T_1} = \sqrt{\frac{l_2}{l_1}} = \sqrt{\frac{121l}{100l}} = 1.1$$

$$\therefore \quad T_2 = 1.1\ T_1$$

∴ Increase in time period

$$= 1.1\ T_1 - T_1 = 0.1\ T_1 = 10\%$$

54. Let initial velocity be v_0 m/s

Then, maximum height attained = $\frac{v_0^2}{2g}$

Velocity at half the height is 10 m/s

We know, $v^2 - u^2 = 2gs$

$$\therefore \quad s = \frac{1}{2}\frac{v^2}{2g} \quad s = \frac{v^2}{4g}$$

$$\Rightarrow \quad 100 - v_0^2 = 2 \times (-g) \times \frac{v_0^2}{4g}$$

$$= -\frac{v_0^2}{2}$$

$$\Rightarrow \quad \frac{v_0^2}{2} = 100$$

$$\Rightarrow \quad v_0 = \sqrt{200}$$

and, maximum height attained

$$= \frac{v_0^2}{2g} = \frac{200}{2 \times 10} = 10\text{m}$$

55. Velocity of projection,

$$v = \sqrt{\frac{gR_e^2}{R_e + h}}$$

Since, $R_e + h = R_e$ = radius of earth

$$\therefore \quad v = \sqrt{gR_e}$$

$$= \sqrt{\frac{GM}{R_e}} \qquad \left[\because g = \frac{GM}{R_e^2}\right]$$

56. Length of wire = 4 m

Resistance, R = 10 Ω

e.m.f., E = 2V

Current in the wire, $i = \frac{E}{R} = \frac{2}{10} = 0.2$ A

∴ Potential difference per unit length of the wire

$$= \frac{iR}{l} = \frac{0.2 \times 10}{4} = 0.5 \text{ V/m}$$

57. Energy released = 200 MeV

$$= 200 \times 10^6 \times 1.6 \times 10^{-19}$$
$$= 32 \times 10^{-11} \text{ J}$$

Since 3.2×100^{-11} J energy is released in one fission.

∴ 1000 watt or J/s energy is released in

$$= \frac{1000}{3.2 \times 10^{-11}} \text{ fission}$$
$$= 3.125 \times 10^{13} \text{ fission}$$

58. First we have found out the number of α-particles, so that

number of α-particles decrease in mass number emitted

$$= \frac{\text{decrease in mass number}}{4}$$
$$= \frac{238 - 222}{4} = 4$$

On this account decrease in atomic number

$$= 90 - 4 \times 2 = 82$$

Since, atomic number of ${}_{83}y^{222}$ is 83.

This is only possible when 1 β-particle is to be emitted. Therefore, one β-particle will be emitted.

59. Radius of first sphere = R

Radius of second sphere = r

Surface density contained by both sphere = σ

Similar charges (q and Q) are contained by both spheres.

Electric potential,

$$U = \frac{1}{4\pi\varepsilon_0}\frac{Q}{R} + \frac{1q}{4\pi\varepsilon_0 r}$$
$$= \frac{1}{\varepsilon_0}\left[\frac{Q \times R}{4\pi R^2} + \frac{q \times r}{4\pi r^2}\right]$$
$$\left[\text{since}, \frac{Q}{4\pi R^2} = \frac{q}{4\pi r^2} = \sigma\right]$$

Hence, $U = \frac{\sigma}{\varepsilon_0}(r + R)$

60. We know $\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}}{1 \times 10}$

$$= 6.626 \times 10^{-35} \text{ m}$$

61. Amplitude of superimposing waves are

$$\frac{A_1}{A_2} = \left(\frac{9}{16}\right)^{1/2} = \frac{3}{4}$$
$$\frac{I_{max}}{I_{min}} = \frac{(A_1 + A_2)^2}{(A_1 - A_2)^2} = \frac{(3+4)^2}{(3-4)^2} = \frac{49}{1}$$

62. Here $q = Q \times C = Q \times 10^{-6}$C

∴ Total flux through six faces of the cube

$$= \frac{q}{\varepsilon_0} = \frac{Q \times 10^{-6}}{\varepsilon_0}$$

Now flux through one face,

$$\phi_s = 1 \times Q \times \frac{1 \times Q \times 10^{-6}}{6\varepsilon_0}$$
$$= \frac{Q \times 10^{-6}}{6\varepsilon_0}\frac{\text{Nm}^2}{\text{C}}$$

63. Here reactance of a coil,

$X_L = 50$ ohms (given)

and frequency of A.C., $v = 50$ c.p.s.

Inductance of the coil,

$$L = \frac{X_L}{\omega} = \frac{X_L}{2\pi v}$$
$$= \frac{50}{2\pi \times 50} = \frac{1}{2 \times 3.14} = 0.16 \text{ Henry}$$

64. Here, potential difference = V_0 as the original charge q_0 is shared by the two capacitors C_1 and C_2.

∴ $q_0 = C_1 V_0$

Also, charge, $q = CV$

From coservation of charge, $C_1 V_0 = C_1 V + C_2 V$

∴ $V = V_0 \frac{C_1}{C_1 + C_2}$

65. From the formula,

$$\frac{K_1 A_1(\theta_1 - \theta)}{l_1} = \frac{K_2 A_2(\theta - \theta_2)}{l_2}$$

∴ $K_1 \Delta\theta_1 = K_2 \Delta\theta_2$

...(since length l and area A are same)

Let temperature of the junction be θ

Then, $K_1 (100° - \theta) = K_2 (\theta - 20°)$

∴ $\frac{K_1}{K_2} = \frac{\theta - 20°}{100° - \theta}$

⇒ $\frac{5}{3} = \frac{\theta - 20°}{100° - \theta}$

⇒ $500 - 5\theta = 3\theta - 60$

⇒ $8\theta = 560$

⇒ $\theta = 70°$

66. Frequency of first overtone of closed end of pipe $P_1 = 3\left(\frac{v}{4l_1}\right)$

Frequency of the third overtone of the open end pipe $P_2 = 4\left(\frac{v}{2l_2}\right)$

Since at resonance the two frequencies are equal, hence

$$\frac{3v}{4l_1} = \frac{4v}{2l_2}$$

$$\therefore \quad \frac{l_1}{l_2} = \frac{3}{8}$$

67. Here, the two springs are connected in parallel.

Equivalent spring constant,

$$k_{eq} = k_1 + k_2$$

and $\omega = \sqrt{\frac{k_{eq}}{m}}$

$$\therefore \quad 2n\pi = \sqrt{\frac{k_1 + k_2}{m}}$$

$$> \quad n = \frac{1}{2\pi}\sqrt{\frac{k_1 + k_2}{m}}$$

68. Given, $y_1 = a \cos \omega t$

$$y_1 = a \sin\left(\omega t + \frac{\pi}{2}\right)$$

and $y_2 = a \sin\omega t$

Phase difference between y_1 and y_2

$$= \left(\omega t + \frac{\pi}{2}\right) - \omega t = \frac{\pi}{2}$$

Hence, phase difference between y_1 and y_2 is $\frac{\pi}{2} = 90°$.

69. Pressure difference $= \frac{2T}{R}$ where, R = radius of the spherical surface and, r = radius of the tube

Then, $\frac{r}{R} = \cos\theta$

$$\therefore \quad R = \frac{r}{\cos\theta}$$

$\therefore$ Pressure difference $= \frac{2T\cos\theta}{r}$

70. For mono atomic gas, $C_v = \frac{3}{2}R$

For diatomic gas, $C_v = \frac{5}{2}R$

Hence, for the mixture, $C_v = \frac{\frac{3}{2}R + \frac{5}{2}R}{2} = 2R$

and $C_p = C_v + R = 3R$

Hence, for the mixture, $\gamma = \frac{C_p}{C_v} = \frac{3}{2} = 1.5$

71. From the law of conservation of energy, we have

$$\frac{1}{2}m \times (3)^2 = \frac{1}{2}mv^2 + mgl(1 - \cos\theta)$$

$$\Rightarrow \quad 9 = v^2 + 2gl(1 - \cos 60°)$$

$$\Rightarrow \quad 9 = v^2 + 2 \times 10 \times 0.5\left(1 - \frac{1}{2}\right)$$

$$\Rightarrow \quad 9 = v^2 + 5$$

$$\Rightarrow \quad v^2 = 4 \text{ m/s}$$

$\Rightarrow$ Therefore, speed of the bob v = 2 m/s

72. Let the final velocity be v.

Now applying conservation of linear momentum, we have

$$40 \times 4 + 60 \times 2 = (40 + 60)v$$

$$\therefore \quad 160 + 120 = 100v$$

$$\Rightarrow \quad 100\,v = 280$$

$$\Rightarrow \quad v = 2.8 \text{ m/s}$$

Now, decrease in kinetic energy

$$= \frac{1}{2}40 \times (4)^2 + \frac{1}{2}60(2)^2 - \frac{1}{2}100(2.8)^2$$

$$= 320 + 120 - 392$$

$$= 48 \text{ Joules}$$

73. While taking a turn with a uniform speed v motorcyclist lean towards an angle θ with the vertical such that

$$\tan\theta = \frac{v^2}{rg}$$

where v = 20m/s, r = 20 m, g = 10m/s

$$\therefore \quad \tan\theta = \frac{(20)^2}{20 \times 10} = 2$$

$$\Rightarrow \quad \theta = \tan^{-1} 2$$

74. Let the resistance of each resistor be R ohm, and

current for maximum power of each resistor be i amp. Then Maximum power for one resistor

$$P_1 = i^2R \qquad \text{...(i)}$$

Now, resistance for combination

$$R_c = \left(R + \frac{R \times R}{R + R}\right) = \left(R + \frac{R}{2}\right) = \frac{3}{2}R$$

and maximum power for the combination of three resistor,

$$P_c = i^2 R_c$$

$$= i^2\left(\frac{3}{2}R\right) \quad ...(ii)$$

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

$$\frac{P_c}{P_I} = \frac{3}{2}$$

Here, $P_1 = 18$ W

∴ maximum power consumed

$$P_c = \frac{3P_1}{2} = \frac{3\times 18}{2} = 27 \text{ watts}$$

75. Magnetic induction due to current i ampere in a long straight conductor at a distance r meter from it,

$$B = \frac{\mu_0}{4\pi}\times\frac{2i}{r}$$

Here, r = 5 cm = 5 × 10^{-2}m

$$\therefore \quad B = 10^{-7}\left(\frac{2i}{5\times10^{-2}}\right) \quad ...\left(\text{since } \frac{\mu_0}{4\pi} = 10^{-7}\right)$$

$$= \frac{2}{5}\times10^{-5}\times i \text{ tesla}$$

$$= 4\times10^{-6}\times i\times10^{4} \text{ gauss}$$

$$= (4i)\ 10^{-2} \text{ gauss}$$

But at the neutral point, the magnetic induction due to earth's horizontal component (0.18 gauss) is equal and opposite to that due to the current in the conductor

Thus, 4 i 10^{-2} =0.18 (here horizontal component of earth magnetic induction is 0.18 gauss)

∴ 4 i = 18,

or i = 4.5 amp.

Therefore, the object will appear 32 cm above surface of the water.

76. Here, optical length of astronomical telescope,

$$f_0 + f_e = 44 \quad ...(i)$$

Also $$m = -\frac{f_0}{f_e}$$

$$\therefore \quad -10 = -\frac{f_0}{f_e}$$

$$f_0 = 10 f_e$$

Putting the value of f_0 in equation (i), we get

$$10f_e + f_e = 44$$

or $f_e = 4$ cm

∴ $f_0 = 10f_e = 10 \times 4 = 40$ cm

Hence, focal length of objective is 40 cm.

77. Energy of ground electronic state of hydrogen atom, E = –13.6 eV

Energy of the first excited state for second orbit (where n = 2) is

$$E_n = \frac{13.6}{n^2} = -\frac{13.6}{4} = -3.4 \text{ eV.}$$

78. Mass of block resting on the horizontal table m_1

Mass of block hanging from the string

$= m_2 = T$

Let tension in the string

and acceleration of the blocks = a

Resultant force acting on the hanging block

$= m_2g - T$

Force acting on the body which causes acceleration = m_2 a

Hence, $m_2g - T = m_2a$ ... (i)

Similarly resultant force on the block resting on the table = T .

Force acting on the block which causes acceleration = m_1a

Therefore, $T = m_1a$ ...(ii)

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

$$a = \frac{m_2 g}{m_1 + m_2}$$

79. Here, Resistance = R, inductance = L

Frequency of the circuit = v

Effective resistance or impedance of the circuit, $Z = \sqrt{R^2 + \omega^2L^2}$

where ω = angular frequency of A.C. = 2π v

∴ impedance, $Z = \sqrt{R^2 + (2\pi v)^2L^2}$

$= \sqrt{R^2 + 4\pi^2L^2v^2}$

80. The given circuit forms a balanced Wheatstone bridge and because the circuit between R and S is inactive so, resistor 7 Ω remains inactive.

Since, resistance in the upper arm make a series combination, hence their equivalent resistance

$$R_{eq} = 3 + 4 = 7\ \Omega$$

Similarly, equivalent resistance of the lower arm

$$R_{eq} = 6 + 8 = 14\ \Omega$$

Now, since the equivalent resistances R_{eq} and R'_{eq} are in parallel combination, hence the resultant resistance between P and Q is

$$R_{PQ} = \frac{R_{eq}\times R_{eq}}{R_{eq}+R_{eq}} = \frac{7\times14}{7+14} = \frac{98}{21} = \frac{14}{3}\Omega$$

81. Given, mass of the water drop = m

weight of water drop, mg

= electrostatic force applied by the field

= qe = eE

∴ electric field required to keep the water to remain suspended, $E = \frac{mg}{e}$

82. Light after passing through a tourmaline crystal, acquires certain one sided property is known as polarisation only transverse waves in which particles of medium vibrate perpendicular to the mean position can exhibit the property of polarisation.

83. Given, maximum height of projectile, H = R

where R = horizontal range

Maximum height attained by projectile is

$$H = \frac{u^2 \sin^2 \theta}{2g}$$

Horizontal range of the projectile,

$$R = \frac{u^2 \sin 2\theta}{g}$$

$$\therefore \quad \frac{u^2 \sin 2\theta}{2g} = \frac{u^2 \sin 2\theta}{g}$$

$$\text{or} \quad \frac{\sin^2 \theta}{2} = 2 \sin \theta \cos \theta$$

$$\text{or} \quad \frac{\sin \theta}{\cos \theta} = 4$$

$$\text{or} \quad \tan \theta = 4$$

$$\text{or} \quad \theta = \tan^{-1} 4 = 75.96° \approx 76°$$

84. Radius of first circular paths $= r_1$

Radius of second circular paths $= r_2$

$$\text{Centripetal force, } F = \frac{mv^2}{r} = \frac{mr^2\omega^2}{r} = mr\omega^2$$

$$\therefore \quad \frac{F_1}{F_2} = \frac{r_1}{r_2}$$

85. In series combination bulb of maximum power has the minimum resistance.

Therefore, 100 W bulb will have the maximum resistance and will also give maximum light.

86. Those substances which have same atomic number but different atomic weight are known as isotopes. The number of protons present in the nucleus of the atom is known as atomic number.

87. On burning 0.5 gm of sulphur the heat liberated

= 4.6 kJ

On burning 32 gm of sulphur the heat liberated

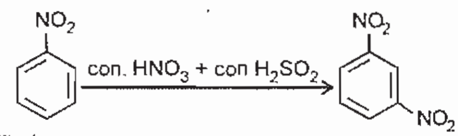
$$= \frac{4.6}{0.5} \times 32 = -294.4 \text{ kJ}$$

Hence, the enthalpy of formation of SO_2

= – 294.4 kJ

88. The pH of neutral solution is 7. The pH below 7 shows acidic and above 7 shows basic solution.

90.



Nitrobenzene m-dinitrobenzene

Therefore, on nitration it produce m-dinitrobenzene.

91. We know, volume of 2 gm H_2 = 22.4 lit

$$\therefore \quad \text{volume of 1 gm } H_2 = \frac{22.4}{2} = 11.2 \text{ lit.}$$

92. For a first order reaction, the specific rate constant always depends upon the concentration of products. It is independent of the concentration of reactants

94. The law of conservation of mass can be best explained by Dalton's law, because according to Dalton's law atoms can neither be created nor destroyed.

96. The linkage present in protein molecules is known as peptide linkage.

97. We know that during expansions of an ideal gas in vacuum. The work done is zero as in vacuum there is no force of attraction or repulsion is taking place.

98. In an aq. solution hydrogen will not reduce Zn^{2+} as its reduction potential is lower than hydrogen.

99. We know, $PV = \frac{w}{M} RT$

Here, $P = 750 \text{ mm} = \frac{750}{760}$ atm,

w = 9.0 gm

M = molecular weight of N_2 = 28, R = 0.082, T = 300K

$$\therefore \quad V = \frac{wRT}{MP}$$

$$= \frac{9 \times 0.082 \times 300 \times 760}{28 \times 750} = 8.0125 \text{ lit.}$$

100. Chromyl chloride oxidise toluene as below

$$C_6H_5CH_3 \xrightarrow[CrO_2Cl_2]{[O]} C_6H_5CHO$$

101. In a period as we move from left to right the number of shells remains the same but as more electrons are added the nuclear charge increases. This results in an increase in the nuclear attraction for the electrons, hence decrease in radius.

102. Entropy change of fusion,

$$\Delta S_f = \frac{\Delta H_f}{T}$$

Here, $\Delta H_f = 60 \times 10^3$ J, T = 273 K

$$\therefore \quad \Delta S_f = \frac{(60 \times 10^3)}{273} = 21.97 \text{ JK}^{-1} \text{ mol}^{-1}$$

104. Secondary amines are obtained by the reduction of isocyanides

$$CH_3NC \xrightarrow[4[H]]{\text{reduction}} CH_3NHCH_3$$

secondary amine

105. Schiff's reagent is a solution of rosaniline hydrochloride used for the detection of aldehyde group.

106. In nuclear reactors moderators are used to slow down the speed of fast moving neutrons. For this purpose D_2O is used.

107. Percentage of sulphur

$$= \frac{32}{233} \times \frac{\text{mass of } BaSO_4}{\text{mass of substance}}$$

$$= \frac{32}{233} \times \frac{0.35}{0.2595}$$

$$= 0.01852 = 18.52\%$$

108. $C_6H_5OH + NH_3 \xrightarrow[300°C]{ZnCl_2} C_6H_5NH_2 + H_2O$

primary amine

Therefore, primary amine is formed.

110. The HCl is a strong acid hence it ionised cent per cent

$$\therefore \quad [H^+] = \frac{1}{10} N = 10^{-1} N \qquad ...(i)$$

$$\because \quad pH = -\log [H^+]$$

By substituting the value of H + ion concentration in equation (i), we get

$$pH = -\log 10^{-1} = 1 \log 10$$

$$\therefore \quad pH = 1$$

111. Suppose the solubility of AgCl is s mol./litre.

$$AgCl \rightleftharpoons Ag^+ + Cl^-$$

s s mol/litre

Solubility product of AgCl

$$K_{sp} = [Ag^+][Cl^-]$$
$$= 1.56 \times 10^{-10}$$

$$\therefore \quad 1.56 \times 10^{-10} = s \times s$$

or $s = 1.249 \times 10^{-5}$ mol/litre

112. The oxides of chromium of higher oxidation states are acidic in nature, while these having lower oxidation are basic and the oxides between higher and lower oxidation states are amphoteric in nature i.e. Cr_2O_3.

115. Slow oxidation of chloroform in air leads to the formation of $COCl_2$ as below

$$CHCl_3 + \frac{1}{2}O_2 \xrightarrow{\text{Sun light}} COCl_2 + HCl$$

chloroform

116. For the manufacture of NH_3 low temperature and high pressure and presence of a catalyst are the favourable condition. This reaction is exothermic and according to Le-Chatelier Braun principle low temperature and high pressure favours the forward reaction.

117. Since 4 gm. of caustic soda is dissolved in 100 cc of solution.

$$\therefore \quad \text{Normality of solution} = \frac{4 \times 1000}{100 \times 40} = 1$$

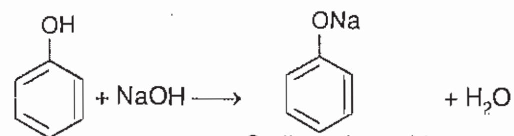
118. The NF_3 molecule is pyramidal and due to this, the bond moments of N–F bonds do not cancel hence it is polar, while BF_3 is planar and bond moments of B–F bonds cancel one another therefore, it is non-polar.

120. $AlCl_3$ reacts with moisture of air to fonn HCl which produce fumes in the air

$$AlCl_3 + 3H_2O \longrightarrow Al(OH)_3 + 3HCl$$

fumes

121. Phenol is more readily soluble in NaOH solution because it immediately react with NaOH to form sodium phenoxide.



Phenol Sodium phenoxide

122. Faraday gives the law of electrolysis according to first law the amount of substance deposited or liberated at the electrode is directly proportional to the quantity of electricity passing through the electrolyte.

$$W = z\,i\,t.$$

123. Since 10 gm. of glucose is dissolved in 150 gm of water

$$\therefore \text{ Mass percentage} = \frac{10}{10+150} \times 100 = 6.25\%$$

126. In front of a mirror the image will be reverse so, that, when watch shows 3:30 in the mirror its actual time is 9:30.

127. We know that the code is obtained by interchanging the first two letters as well as next two and so on. So, ENVELOPE will be coded as NEEVOLEP.

128. In this case the code is obtained by interchanging the first two letter as well as next two letters and so on. Therefore, TEACHER will be coded as ETCAEHR.

129. We know that hoof is the lower portion of horse's leg while foot is the lower portion of man's leg.

130. As per the question. B's motner is the only daughter of A's mother. In other words B is the grandson of A's mother. Hence, A is the uncle of B [assuming being male].

131. 100 97 90 86 76 71 62 56

−3 −7 −4 −10 −5 −9 −6

There are two series in the above pattern. Hence, number 55 is wrong and should be replaced by 56.

132. We know that the difference between IST (Indian Standard Time) and GMT (Green wich Mean Time) is $5\frac{1}{2}$ hours. Therefore, the match would be telecaste on TV. at 3.30 p.m.

133. The code is obtained by moving 1st, 2nd, 3rd, 4th and 5th digit two steps forward, two steps backward one step forward, three steps backward and two steps backward respectively. Therefore, 67284 will be written as 85352.

134. 2^{nd} term = 1^{st} term × 3 + 5 = 3 × 3 + 5 = 14;

3^{rd}term =2^{nd} term × 3 + 5 = 14 × 3 + 5 =47

∴ 4^{th} term =3^{rd} term × 3 + 5 = 47 × 3 + 5 =146.

135. Method used to from the series is

2^{nd} term × 2 + 1 = 2 × 2 + 1 =5;

3^{rd} term = 2^{nd} term × 2 + 1 = 5 × 2 + 1 = 11, and

4^{th} term = 3^{rd} term × 2 + 1 = 11 × 2 + 1 = 23

∴ 5^{th} term = 4^{th} term × 2 + 1 = 23 × 2 + 1 = 47.

136. The central idea of the given passage is "life is an unending struggle".

137. A game could never be interesting, if one already know's about its result before completion. Therefore, option 'b' is correct.

138. The sentence "man can not achieve anything unless he suffers for it" completely elaborate the meaning of the first sentence.

139. The meaning of "foe is worthy of the steel" is that the other fellow is capable of defending himself.

140. 'Shortfall' means deficit and 'shortage' means not available in sufficient amount. Therefore, option 'a' is correct.

141. 'Raise' means to lift something to a higher level and 'uplift' also have same meaning . Therefore, option 'a' is correct.

142. 'Homage' means something is done in regard while the 'insult' means something that is not favourable to somebody. Therefore, option 'c' is correct antonym.

143. 'Density' means the thickness of the matter but 'thinness' means the quality of being thin. Therefore, option 'd' is correct antonym.

147. 'tallest' is used for superlative degree with respect to height.

148. 'few' is used to express very small numbers.

149. 'at' is used for stationary things.

150. 'in' is used with the name of big town or city. 198. 'towards' is used to show the sense of direction.