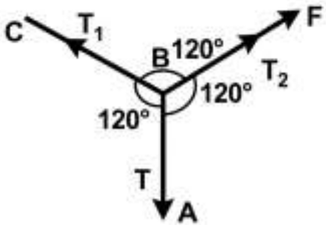
10th CBSE Papers Maths 2017PHYSICS

1. **(c)** The air resistance on an object depends on its area, normal to air flow.
Since, area normal to air flow is maximum in case of dise.
So, air resistance on it is maximum. The air flow in case of cigar shaped is streamlined, so air resistance is minimum.
Hence, the correct order is
$\text{III} < \text{II} < \text{I}$

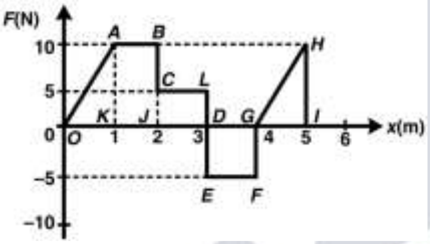
2. **(c)** Let tension in section BC is T and in section BF is T_2, then according to Lami's theorem,



$$\frac{T_1}{\sin 120^\circ} = \frac{T_2}{\sin 120^\circ} = \frac{T}{\sin 120^\circ}$$
$\Rightarrow T_1 = T_2 = T = 10\ \text{N}$

3. **(d)** The velocity of light in vacuum is $3 \times 10^8\ \text{m/s}$, which is a dimensional constant.

4. **(b)** The work done in a $F - x$ graph is calculated by the area under the graph. The given graph can be shown as



$\therefore$ Work done in displacing the object from $x = 1$ m to $x = 5$ m will be
$W =$ area under F-x graph
$=$ area ABJK $+$ areaCLDJ $+$ area DGFE $+$ area CHI
$$= (10 \times 1) + (5 \times 1) + (-5 \times 1) + \left(\frac{1}{2} \times 1 \times 10\right)$$
$= 10 + 5 - 5 + 5 = 15\ \text{J}$

5. **(c)** The first stone move up to some height and then its velocity becomes zero. Now, it move downward and at the level of top of tower, it acquires the same initial velocity u and gravitational acceleration g in downward direction. The second stone is moving with the same speed u and with downward acceleration g. So, both will have same final velocity when they reach the bottom and hit the ground.

6. **(b)** The gravitational acceleration on earth is given by
$$g = \frac{F}{m} = \frac{GMm}{R^2 \times m} = \frac{GM}{R^2}$$
$$\therefore \frac{g}{G} = \frac{M}{R^2}$$

7. **(d)** According to Newton's law, the state of an object can be changed by applying external force on it.
In given case the force applied is internal, so he will not succeed.

8. **(d)** The pressure applied at the bottom of a container
by a liquid column of height h is given by
$p = h\rho g$
Here, in two cases, the liquid used is same (water), so ρ is same. Also, the height of liquid column is same on both. So, the pressure applied at the bottom is same for both

9. **(a)** Young's modulus, $Y = \frac{\text{Stress}}{\text{Strain}}$
Here, strain is a dimensionless quantity and stress is measured in SI unit of Nm^{-2}, dyne cm^{-2} or pascal. So, the Young's modulus has the same unit as stress.
$\therefore \text{Nm}^{-1}$ is not a unit of Young's modulus.

10. (c) When blue glass is heated to a high temperature, it absorbs all radiations of higher wavelength except red. So, when it is taken inside a dimly lit room, it emits all radiations and hence looks brighter red compared to the red piece. This happens according to Kirchhoff's law of radiation.

11. (c) According to Wien's law, the wavelength of radiation emitted by a body is

$$\lambda \propto \frac{1}{T}$$

i.e., it depends on the temperature of the surface.

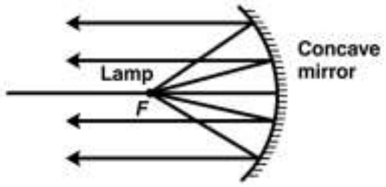
12. (b) Work done in a cyclic process is equal to the area enclosed by the cycle in $p - V$ diagram.

$\therefore$ W = Area ABCD

$= AB \times AD$

$= (2p - p) \times (2V - V) = p \times V = pV$

13. (c) A concave mirror is of converging type as the light parallel to principal axis converges at its focus. So, when a lamp is placed at its focus, the ray of light falling on it becomes parallel beam as shown below.



14. (c) The power of a lens is given by the reciprocal of its focal length,

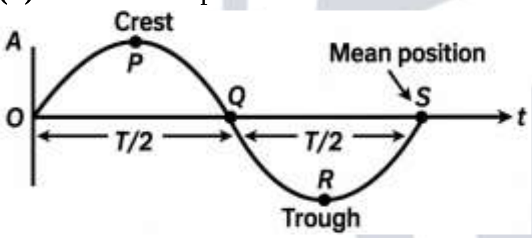
$$P = \frac{1}{f}$$

When f is in metre, then power P is in dioptre. Thus, power depends on the system of unit used to measure f.

15. (a) In first figure, the parallel rays are converging at a point before the retina. So, the person is suffering from near-sightedness.

16. (b) Infrared radiation was discovered in 1800 by William Herschel.

17. (b) As total time period of a wave is T. The wave motion can be shown as



From figure, it can be seen that time taken by the particle to move from trough to its mean position i.e., from R to S is

$$T' = \frac{T/2}{2} = \frac{T}{4}$$

18. (b) The number of waves produced by the dise is equal to number of notes

i.e., $n = 60$

Speed of rotation, $v = 360 \text{rpm}$

$$= \frac{360}{60} = 6 \text{rps}$$

$\therefore$ Frequency $= n \times v = 60 \times 6 = 360$ Hz

19. (c) The velocity of sound in a gas is given by

$$v = \sqrt{\frac{\gamma RT}{M}}$$

At STP, both gases are at same temperature and as they are diatomic, so their specific heat ratio (γ) is also same.

$$\therefore \frac{v_H}{v_O} = \sqrt{\frac{M_O}{M_H}} = \sqrt{\frac{32}{2}} = 4 \text{ or } 4:1$$

20. (b) The wavelength of the sound is proportional to the length of wire. Also, the velocity of sound is same in both cases, so

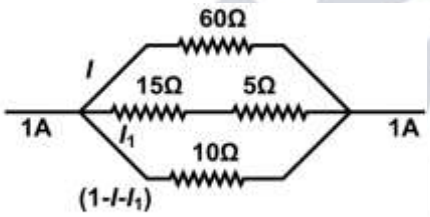
$v_1 = v_2$
$\Rightarrow f_1\lambda_1 = f_2\lambda_2$
$\Rightarrow 256 \times 25 = f_2 \times 16$
$\Rightarrow f_2 = \dfrac{256 \times 25}{16} = 400\ \text{Hz}$

21. **(c)** Let f_s be the frequency of source.
The apparent frequency heard when listener moves towards source is
$f' = f_s\left(\dfrac{v_s + v_o}{v_s}\right)$
$\Rightarrow\ 200 = f_s\left(\frac{v_s+40}{v_s}\right)$ ....(i)
The apparent frequency heard, when listener moves away from source is
$f'' = f_s\left(\dfrac{v_s - v_o}{v_s}\right)$
$\Rightarrow 160 = f_s\left(\frac{v_s-40}{v_s}\right)$ ....(ii)
Dividing Eq. (i) by Eq. (ii), we get
$\dfrac{200}{160} = \dfrac{v_s + 40}{v_s - 40}$
$\Rightarrow \dfrac{5}{4} = \dfrac{v_s + 40}{v_s - 40}$
$\Rightarrow 5v_s - 200 = 4v_s + 160$
$\Rightarrow v_s = 360\ \text{m/s}$

22. **(b)** Christian Huygens believed that the light was made up of waves vibrating up and down perpendicular to the direction of propagation of wave. This is known as Huygens principle.

23. **(c)** If a liquid does not wet glass, it means that the liquid-liquid interaction (cohesion) is more than liquid - solid interaction (adhesion). So, the angle of contact is obtuse.

24. **(a)** Consider the diagram with current distribution as shown below.



As voltage is same in parallel combination, so
$60I = (15 + 5)I_1$
$60I = 20I_1$ or $I_1 = 31$ ....(i)
Similarly, $(15 + 5)I_1 = 10(1 - I - I_1)$
$\Rightarrow 2I_1 = 1 - I - I_1$
$\Rightarrow 3I_1 = 1 - I$
$\Rightarrow 3(3I) = 1 - I$ [Using Eq. (i)]
$\Rightarrow 10I = 1$
or $I = \frac{1}{10} = 0.1\ \text{A}$

25. **(b)** We know that, radius of charge particle of mass m having charge q moving with speed v in magnetic field perpendicular to it,
$r = mv/Bq$ ....(i)
For second case,
$= \dfrac{mv'}{qB'} = \dfrac{m(2v)}{q\left(\frac{B}{2}\right)}\left[\text{Since, } v' = 2v, B' = \dfrac{B}{2}\right]$
$= 4\frac{mv}{qB} = 4r$ [using Eq. (i)]

26. **(c)** Total emf of circuit, $E_T = E + E = 2E$
Total resistance of circuit, $R_T = r_1 + r_2 + R$
Current flowing through the circuit,

$i = \frac{E_T}{R_T} = \frac{2E}{r_1+r_2+R}$ ....(i)

As per question $E = ir_1$

$\Rightarrow\ i = \frac{E}{r_1}$ ....(ii)

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

$\frac{E}{r_1} = \frac{2E}{r_1 + r_2 + R}$

$\Rightarrow r_1 + r_2 + R = 2r_1$

$\Rightarrow R = r_1 - r_2$

27. (b) The maximum and minimum resistances are 16Ω and 3Ω that are obtained by series and parallel combination of resistances. From given option only 4Ω and 12Ω resistors satisfies this condition.

28. (a) According to Fleming's right hand rule, for current in South-North direction, magnetic field in inward direction, the force on the electrons will be to the left or in West side.

29. (b) The deflection in a tangent galvanometer is given by

$\tan\theta = \frac{I}{K}$

where, K = reduction factor

Here, $K = 1\text{ A}, I = 1\text{ A}$

$\therefore\ \tan\theta = \frac{1}{1} = 1 \Rightarrow \theta = 45°$

30. (b) If R be the resistance of voltmeter, then the equivalent resistance of circuit is

$R_{eq} = \frac{R \times 100}{100 + R} + 50$

$= \frac{150R + 5000}{R + 100}$

Total current in circuit,

$i = \frac{V}{R_{eq}} = \frac{10}{\frac{150R + 5000}{(R + 100)}}$

$= \frac{10(R + 100)}{150R + 5000}$

Voltage across 100Ω resistor,

$V = i\left(\frac{R \times 100}{R + 100}\right)$

Given, $V = 5\text{ V}$

$\therefore\ 5 = \frac{10(R + 100)}{150R + 5000} \times \frac{R \times 100}{R + 100}$

$= \frac{1000R}{150R + 5000}$

$\Rightarrow 750R + 25000 = 1000R$

$\Rightarrow\ R = 100\Omega$

31. (c) Force on 25 cm length of wire C due to wire D is

$F_D = \frac{\mu_0}{4\pi}\frac{2I_1I_2}{r} \times l$

$= 10^{-7} \times \frac{30 \times 10 \times 2}{3 \times 10^{-2}} \times 25 \times 10^{-2}$

$= 5 \times 10^{-4}$ N, towards right

Force of 25 cm length of wire C due to wire G is

$F_G = 10^{-7} \times \frac{2 \times 20 \times 10}{2 \times 10^{-2}} \times 25 \times 10^{-2}$

$= 5 \times 10^{-4}$ N, towards left

$\therefore$ Net force on wire $C = F_D - F_G = 0$

32. (a) Given, $I = 5\text{ A}, V = 6\text{ V}, t = 6\text{ min} = 6 \times 60 = 360\text{ s}$

Heat produced in a circuit = Chemical energy reduced in the battery

$\Rightarrow H = Vit$
$= 6 \times 5 \times 360$
$= 10800 = 1.08 \times 10^4$ J

33. **(b)** Given, $I_1 = 5$ A, $R_2 = 2\Omega$, $I_2 = 4$ A
Let initial resistance be R.
As voltage given is same in both cases, so
$V_1 = V_2$
$\Rightarrow I_1R = I_2R' = I_2(R + R_2)$
$\Rightarrow 5 \times R = 4 \times (R + 2) \Rightarrow R = 8\Omega$

34. **(c)** Given, $R_1 = 100\Omega, R_2 = R_3 = 50\Omega, E = 6$ V, $R_4 = 75\Omega$
As R_2, R_3 and R_4 are in parallel combination, so their equivalent resistance be

$$\frac{1}{R'} = \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$$
$$= \frac{1}{50} + \frac{1}{50} + \frac{1}{75} = \frac{3 + 3 + 2}{150} = \frac{8}{150}$$

or $R' = \frac{150}{8}\Omega$
Now, R' is in series with R_1, so

$$R_{net} = R_1 + R' = 100 + \frac{150}{8} = \frac{950}{8} = 118.75\Omega$$

35. **(c)** In first case, at balance point,

$$\frac{P}{Q} = \frac{l}{100 - l} = \frac{20}{100 - 20} = \frac{1}{4} \Rightarrow Q = 4P$$

Let P be the smaller resistance, then in second case at balance point,

$$\frac{P + 15}{Q} = \frac{l'}{100 - l'} = \frac{40}{60} = \frac{2}{3}$$

$\Rightarrow \frac{P+15}{4P} = \frac{2}{3}$ [Using Eq. (i)]
$\Rightarrow 3P + 45 = 8P \Rightarrow P = 9\Omega$

36. **(c)** Given, electric field, $E = 1500$ V/m
Magnetic field, $B = 0.4$ Wb/m^2
Charge on electron, $q = e = 1.6 \times 10^{-19}$C
For minimum uniform speed of electron along a straight line is a region, where electric field E and magnetic field B, both are present is given as

$v = \frac{E}{B}$ $\left[\begin{array}{l} \because qE = Bqv \\ \Rightarrow v = \frac{E}{B} \end{array}\right]$

$$= \frac{1500}{0.4}$$
$= 3750$ m/s
$= 3.75 \times 10^3$ m/s

37. **(b)** If I be the main current, then current passing through galvanometer,

$$I_g = 10\% \text{ of } I = \frac{I}{10}$$

Resistance of galvanometer, $R_g = G$

Shunt resistance, $R_S = \frac{I_gR_g}{I - I_g} = \frac{\frac{I}{10} \times G}{I - \frac{I}{10}} = \frac{G}{9}$

38. **(c)** Magnetic susceptibility of diamagnetic materials is small and negative.
Diamagnetic material do not have permanent magnetic moment because the magnetic moment of individual electrons neutralise each other due randomly oriented.

39. **(b)** The induction coil works on the principle of mutual induction. In the phenomena of mutual induction, an emf is induced across the secondary coil if the magnetic flux due to primary coil linked with the secondary coil changes.

40. **(c)** We know that, in $L - C - R$ series resonant circuit, resonance frequency,

$$f=\frac{1}{2\pi\sqrt{LC}}$$
$$\Rightarrow \sqrt{LC}=\frac{1}{2\pi f}$$
$$\Rightarrow \sqrt{LC}=\frac{1}{\omega}[\omega= \text{ angular frequency }]$$
$$\therefore \text{ Dimension of } \sqrt{LC}=\frac{1}{\text{Dimension of } \omega}$$
$$\Rightarrow [\sqrt{LC}]=\frac{1}{[\omega]}=\frac{1}{[T^{-1}]}=[T]$$
Hence, square root of the product of inductance [L] and capacitance [C] has the dimension of time.

41. **(b)** Given,
$$q_1=-14nC=-14\times10^{-9}C$$
$$q_2=7885nC=78.85\times10^{-9}C$$
$$q_3=-56nC=-56\times10^{-9}C$$
According to Gauss's law

Net electric flux passing through closed surface A, $\phi_A=\frac{1}{\varepsilon_0}$(total charged enclosed by closed surface A)
$$=\frac{1}{\varepsilon_0}(q_1+q_2+q_3)$$
$$=\frac{-14\times10^{-9}+78.85\times10^{-9}-56\times10^{-9}}{8.85\times10^{-12}}$$
$$=\frac{885}{885}\times10^{-9+12}=10^3CN^{-1}\ m^{-2}$$

42. **(a)** In case of spherical metal conductor, the charges quickly spread over its entire surface uniformly because of which charges can stay for longer time on spherical conductor.

While in case of non-spherical surfaces, charge concentration is different at different points due to which the charges do not stay on the surfaces for longer time.

43. **(c)** When we give charge to a conductor, then its potential increases.
$$\text{Potential, } V=\frac{\text{Charge (Q)}}{\text{Capacitance (C)}}$$
$$\Rightarrow V=\frac{Q}{\varepsilon_0\frac{A}{d}}\left[\because C=\frac{\varepsilon_0 A}{d}\right]$$
$$\Rightarrow V=\frac{Qd}{\varepsilon_0 A}$$
Hence, V also depends on d and A. Thus, potential of conductor depends on the amount of charge, area or geometry and size of the conductor.

44. **(d)** According to given situation of charges, electrostatic force works which is conservative in nature i.e., work done depends on initial and final position only. Here, initial and final position coincide, hence work done will be zero.

45. **(d)** Given, capacitance of air filled parallel plate capacitor,
$$C_0=2pF$$
$$\Rightarrow=2\times10^{-12}\text{ F}$$
$$\Rightarrow \varepsilon_0 A=2\times10^{-12}\text{ F} \qquad \ldots(i)$$
When the separation between the plates is doubled

, i.e., $d'=2d$

And wax of dielectric constant k is filled between the plates of capacitor, then,
$$C'=6pF$$
$$\frac{\varepsilon_0 kA}{d'}=6\times10^{-12}\text{ F}$$
$$\Rightarrow \frac{\varepsilon_0 kA}{2d}=6\times10^{-12} \qquad [\because d'=2d]$$
$$\Rightarrow \frac{\varepsilon_0 A}{d}\times\frac{k}{2}=6\times10^{-12}$$

$\Rightarrow 2\times10^{-12}\times\frac{k}{2}=6\times10^{-12}$ [from Eq.(i)]

$\Rightarrow$k=6

46. **(b)** According to Coulomb's law, electrostatic force acts only between two charge particles. Neutron is a neutral particle, therefore Coulomb's law is applicable only for protons.

47. **(c)** Given, In first case, Wavelength of violet light,

$\lambda_1=400$ nm

We know that, width of the diffraction pattern is given as

$\beta=y=\frac{2D\lambda_1}{d}$

$\Rightarrow\ y=\frac{2D\lambda_1}{d}=\frac{2D\times400}{d}$

$y=\frac{800D}{d}$

In the second case,

$\lambda_2=600\text{ nm}, d'=\frac{d}{2}$

$\therefore\ y'=\frac{2D\lambda'}{d'}=\frac{2D\times600}{\frac{d}{2}}$

$=2400\frac{D}{d}=3\times\frac{800D}{d}$

$=3y$ [from Eq. (i)]

48. **(a)** Diameter of objective,

$D_1=1\text{ m}, D_2=254\text{ m}$

Resolving power, $R_F=\frac{D}{1.22\lambda}$

Since, $R_P\propto D$ [For same value of λ]

$\therefore\frac{R_{P_1}}{R_{P_2}}=\frac{D_1}{D_2}=\frac{1}{2.54}$

$\Rightarrow R_{P_2}=2.54\times R_{P_1}$

49. **(a)** According to phenomena of polarisation by reflection, when unpolarised light beam is incident from air onto glass ($n=15$) at the polarising angle (Brewster's angle), then reflected beam is polarised completely i.e. 100%.

50. **(b)** In Huygens principle, the wave theory was established by assuming that the waves were longitudinal. So, option (a) is not correct.

In Maxwell's theory of light, he stated that light is a transverse wave and conducted various experiments to prove so. Hence, option (b) is correct.

Thomas Young conducted his double slit experiment for determining fringe width and tried to prove the wave nature of light by providing that light undergoes interference which is a phenomenon showed by waves. He never proved the type of wave light is, i.e. transverse or longitudinal. Hence, option (c) is not correct.

These statements mostly highlight the wave nature of light.They do not comment on the particle nature of light or the dual nature of light established. Hence, they clearly do not answer the question "what is light" correctly. Hence, option (d) is not correct.

51. **(a)** Given, intensity of two coherent light beams,

$I_1=I$ and $I_2=4I$

After superposition of two light beams,

$\therefore$ Maximum intensity,

$I_{max}=\left(\sqrt{I_1}+\sqrt{I_2}\right)^2$

$=I_1+I_2+2\sqrt{I_1I_2}$

$=I+4I+2\sqrt{I\cdot4I}=9I$

Minimum intensity,

$I_{min}=\left(\sqrt{I_1}-\sqrt{I_2}\right)^2$

$=I_1+I_2-2\sqrt{I_1I_2}$

$= I + 4I - 2\sqrt{I \cdot 4I} = I$

52. **(b)** According to given figure, the graph between stopping potential and frequency is a straight line, therefore stopping potential (V_0) and hence maximum kinetic energy ($K_{max} = eV_0$) of photoelectrons depends linearly on the frequency. Since, threshold frequency for Na is less than that of for Al , therefore work function for Na will be lesser than that of Al. Hence, Na is better photosensitive material than Al .

53. **(b)** Here, for hydrogen atom, $Z = 1$

We know that, time period of electron in nth orbit is given as

$T_n \propto n^3$

$\therefore \frac{T_{n_1}}{T_{n_2}} = \frac{n_1^3}{n_2^3}$

Since, $T_{n_1} = 8T_{n_2}$

$\therefore \frac{8T_{n_2}}{T_{n_2}} = \frac{n_1^3}{n_2^3} \Rightarrow 2^3 = \left(\frac{n_1}{n_2}\right)^3$

$\Rightarrow n_1 = 2n_2$

Hence, this condition satisfies only in option (b). i.e., $n_1 = 4$ and $n_2 = 2$

54. **(b)** When forward voltage in a diode is increased, then it opposes the potential barrier. Due to it, the potential barrier is considerably reduced and hence depletion region decreases.

55. **(b)** Since, nuclear force is independent of charge of the nucleons. Thus, nuclear force is same for any pair of two nucleons which are at same distance apart.

Therefore, $F_1 = F_2 = F_3$

56. **(d)** Given, initial value of de-Broglie wavelength,

$\lambda_1 = 1 \text{ nm} = 1 \times 10^{-9} \text{ m}$

Final value of de-Broglie wavelength,

$\lambda_2 = 0.5 \text{ nm} = 0.5 \times 10^{-9} \text{ m}$

de-Broglie wavelength in terms of energy E is given as

$\lambda = \frac{h}{\sqrt{2mE}}$

$\therefore \lambda \propto \frac{1}{\sqrt{E}}$

$\Rightarrow \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{E_2}{E_1}}$

where, E_1 and E_2 are initial and final energy,

$\Rightarrow \frac{1 \times 10^{-9}}{0.5 \times 10^{-9}} = \sqrt{\frac{E_2}{E_1}}$

$\Rightarrow 2 = \sqrt{\frac{E_2}{E_1}}$

$\Rightarrow E_2 = 4E_1$

$\Rightarrow \therefore$ Addition of energy $= E_2 - E_1 = 4E_1 - E_1 = 3E_1$

$=$ thrice the initial energy

57. **(d)** Given, mean life of radioactive sample,

$\tau = 100 \text{ s} = \frac{100}{60} \text{ min} = \frac{5}{3} \text{ min}$

We know that,

$\tau = 1.44T_{1/2}$

$\Rightarrow T_{1/2} = \frac{\tau}{1.44} = \frac{5/3}{1.44} = \frac{5}{3 \times 1.44} = 1.157 \text{ min}$

$\simeq 1.155 \text{ min}$

58. **(d)** The decay's constant (λ) and half-life period of radioactive nuclei remains constant and independent of time of creation of radioactive nuclei. Hence, the probability of decay during the next time is independent of the time of creation.

59. **(d)** Bohr assumed one of the postulates of Rutherford's atomic model. That is the mass of the nucleus is very large compared to that of the electrons and hence assumed to be infinite. Electrons in quantised orbit does not radiate energy. Mass of electron remains constant.

60. **(a)** A semiconductor acts like an insulator only at absolute temperature i.e. 0°K. It is because the free electrons in the valence band of semiconductor will not carry enough thermal energy to overcome the forbidden energy gap at absolute zero.

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61. **(b)** The correct order in which first ionisation potential (IP) increases is K, Na, Be. On going down the group IP decreases while on going left to right IP increases.

62. **(c)** $V_1 = 10\ cm^3$

$V_2 = 15\ cm^3$

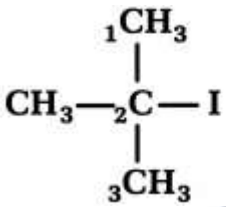
$N_1 = 0.1\ N$

$N_2 = ?$

$N_1V_1 = N_2V_2$

$$N_2 = \frac{0.1 \times 10}{15} = 0.066\ N$$

63. **(d)** Tertiary butyl iodide is



It's IUPAC name is 2-iodo-2-methyl propane.

64. **(c)** $3SO_2 + K_2Cr_2O_7 + H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$

O.N. of S in SO_2 is

$\Rightarrow x + 2(-2) = 0$

$\Rightarrow x = +4$

O.N. of S in K_2SO_4 is

$2(1) + x + 2(-4) = 0$

$x = +6$

$\therefore$ O.N. changes from +4 to +6 .

65. **(c)** Mass of 0.1 mole of methane = molar mass × no. of moles

$= 16 \times 0.1 = 1.6\ g$

66. **(c)** Methoxy methane and ethanol are functional group isomer as one is ether and other is alcohol group.

$CH_3 - O - CH_3$	$CH_3 - CH_2 - OH$
Functional group = ether	Functional group = alcohol
(Methoxy methane)	(Ethanol)

67. **(b)** The azimuthal quantum number has the value of 2 (i.e., $l = 2$) or (d-orbital).

$\therefore$ Magnetic quantum number (m) can be $= 2l + 1$

$= 2 \times 2 + 1 = 5$

68. **(c)** For the following reaction,

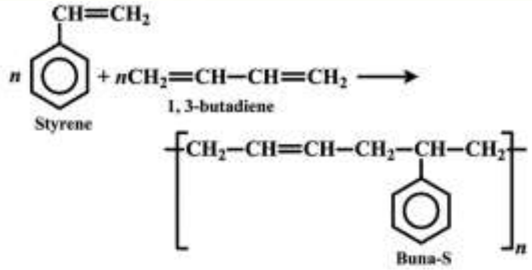
$$\underset{\substack{\text{Ferric oxide}\\ \text{1 mole}}}{Fe_2O_3} + \underset{\substack{\text{Carbon}\\ \text{monoxide}\\ \text{3 moles}}}{3CO} \longrightarrow \underset{\text{Iron}}{2Fe} + \underset{\text{Carbondioxide}}{3CO_2}$$

The volume of carbon monoxide require to reduce one mole of ferric oxide is

$= 3 \times 22.4 dm^3 = 67.2 dm^3$

$\therefore$ Volume of CO required is $67.2 dm^3$.

69. **(c)** The monomers of Buna-S rubber are styrene and butadiene.

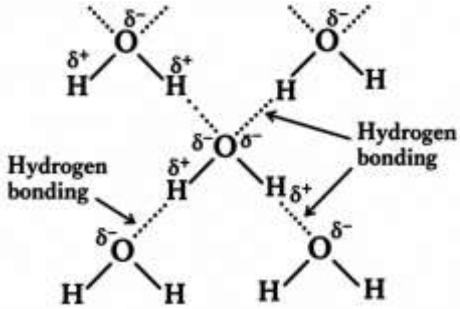


70. (c) Electronic configuration of element (21) is

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$

$\therefore$ It is a transition element as its last electron enters in d-orbital.

71. (d) The maximum number of hydrogen bonds that a molecule can have is 4 .



72. (a) A gas deviates from ideal behaviour at high pressure because its molecules attract one another as their intermolecular distance decreases.

73. (d) The reagent used to convert alkyne to alkene is Pd/H_2.

$$\underset{\text{Ethywe}}{CH \equiv CH} \xrightarrow[\text{Lindlar's catalyst}]{H_2/Pd} \underset{\text{Ethene}}{CH_2 = CH_2}$$

74. (b) ΔG° for the formation of Al_2O_3 is higher than ΔG° for the formation of Cr_2O_3.

75. (c) According to ideal gas equation

$pV = nRT$

$\therefore\ V \propto \dfrac{1}{p}$

76. (b) Catalytic dehydration of a primary alcohol gives aldehyde i.e.,

$$R - \underset{\text{Primary alcohol}}{CH_2} - OH \xrightarrow[-H_2]{Cu, 300^\circ C} R - \underset{\text{Aldehyde}}{CHO}$$

77. (b) Excess of PCl_5 reacts with conc. H_2SO_4 to gives thionyl chloride (SO_2Cl_2), phosphorus oxychloride ($POCl_3$) and HCl .

$H_2SO_4 + 2PCl_5 \longrightarrow SO_2Cl_2 + 2POCl_3 + 2HCl$

78. (c) $\underset{\text{Ammonical}}{NH_3(g)} + \underset{\text{Hydroggen chloride}}{HCl(g)} \longrightarrow \underset{\text{Ammonium chloride}}{NH_4Cl(g)}$

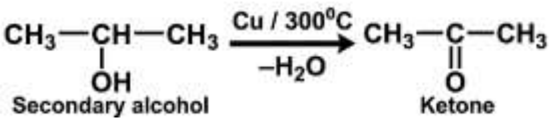
$\Delta n_g = n_P - n_R = 1 - 2 = -1$

Also, $\Delta H = \Delta U + \Delta n_g RT$

$\therefore \Delta H - \Delta U = -ve\ [\because \Delta n_g = -ve]$

$\therefore\ \Delta H < \Delta U$

79. (b) Secondary alcohols gives ketones on dehydrogenation e.g.,

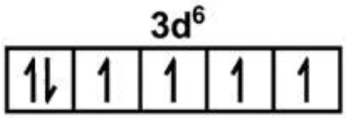


80. (a) Xenon has largest size and thus has high van der Waals' force of attraction. So, it is easily liquefiable rare gas.

81. (a) Mesomeric effect involves delocalisation of π-electrons. It can show +M-effect and -M-effect. The electron donating functional group shows
+M-effect while electron withdrawing functional group shows -M-effect.

82. (b) The electronic configuration of

$Fe(26) = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$
$Fe^{2+} = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^0$



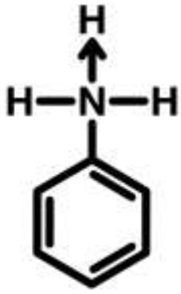
It has four unpaired electrons.

83. **(b)** The order of entropy is

$S_{gas} > S_{liq} > S_{gas}$

∴ One mole of hydrogen gas has the highest entropy.

84. **(b)**$C_6H_5\overset{+}{N}H_3$ does not exert a resonance effect because all the electron pairs of nitrogen are involved in bond formation.



Hence, no lone pair is present on nitrogen for resonance.

85. **(c)** The oxidation number of Ni metal is zero in complex $Ni(CO)_4$. As CO is a neutral ligand i.e.,

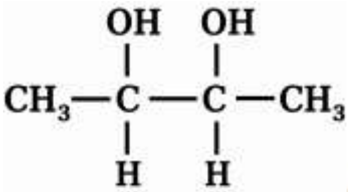
$\Rightarrow Ni(CO)_4$
$x + 4(0) = 0$
$x = 0$

86. **(d)**

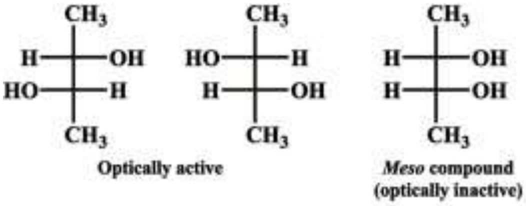
	$PCl_3 +$	$Cl_2 \rightleftharpoons$	PCl_5
Initially	3 moles	2 moles	3moles
At equilibrium	$(3 + 1.5)$ moles		1.5moles

∴ At equilibrium 1.5 moles of PCl_5 is converted into 4.5 moles of PCl_3.
∴ Total moles of PCl_3 at equilibrium is 4.5 .

87. **(b)** The structure of butane-2, 3-diol is



∴ It has three stereoisomers as follows:



∴ It has two optically active isomers.

88. **(c)** An octahedral complex is formed when hybrid orbital of sp^3d^2 (outer orbital) or d^2sp^3 (inner orbital) types are involved.

89. **(a)** For the following reaction,

$2HI(g) \rightleftharpoons H_2(g) + I_2(g); -Q$ kJ
$\Delta n = (n_P)_g - (n_R)_g = (1 + 1) - 2 = 0$
∴ Equilibrium constant (K_C) is independent of pressure and volume.
Heat is given in the reaction ($\Delta H = +ve$)

∴ According to Le-Chatelier's principle, on increasing temperature equilibrium shifts towards left hence, K_C decreases.
Catalyst only speeds up the reaction i.e., it help to achieves equilibrium faster without effecting the equilibrium point.

90. **(d)** The sp^3 hybridised carbon atom have bond angle of $109°28'$ (tetrahedral angle). But in cyclobutane the bond angle is $90°$ due to square shape. Therefore, angle strain $= \frac{1}{2}(109°28' - 90°) = 9°44'$

91. **(a)** The number of nodal planes in σ^*s-antibonding orbital is one. The $\sigma *$ orbital has nodal plane between nuclei and perpendicular to internuclear axis. As most of electron density is located away from the space between the nuclei, as a result of which there is a nodal plane between the nuclei.

92. **(d)** Specific conductance is least for 0.002 N electrolytic solution as it has least number of ions per unit volume of solution.
Specific conductance ∝ concentration of electrolyte.

93. **(c)** In benzene, the hybridisation of each carbon atom is sp^2.
∴ The overlapping in benzene is of $sp^2 - sp^2$ type.

94. **(c)** The electronic configuration of O_2^- is
$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 (\pi 2p_x^2 = \pi 2p_y^2)$
$(\pi^* 2p_x^2 = \pi^* 2p_y^1)$
∴ Bond order $= \frac{10-7}{2} = 1.5$

95. **(a)** Ostwald-Walker's method is used to measure the relative lowering in vapour pressure of the solution.

96. **(b)** n-propyl bromide on treating with alcoholic KOH undergoes elimination reaction to produce propene i.e.,
$$\underset{\text{a-propyl bromide}}{CH_3 - CH_2 - CH_2 - Br} \xrightarrow{\text{Alc. KOH}} \underset{\text{Propene}}{CH_3 - CH = CH_2} + HBr$$

97. **(a)** Mercury is a liquid metal because it has completely filled 6s-orbital. The inner f-orbital poorly screens nuclear charge that stabilise 6s-orbital. Thus, it is not possible to form any bond with other elements.

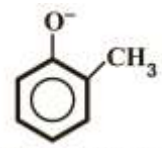
98. **(a)** A occupies comer of unit cell.
∴ Number of A atoms $= 8 \times \frac{1}{8} = 1$
B is at body centre.
∴ Number of B atoms $= 1 \times 1 = 1$
The simplest formula of compound
$A : B$
$1 : 1 = AB$

99. **(b)** Anisole can be prepared by action of methyl iodide on sodium phenate. The reaction is called Williamson's reaction. It is used for preparation of simple or mixed ether.
$$C_6H_5OH + NaOH \xrightarrow[-H_2O]{} \underset{\text{Sodium phenoxide}}{C_6H_5ONa} \xrightarrow{CH_3I} \underset{\text{Anisole (Ether)}}{C_6H_5 - O - CH_3}$$

100. **(c)** Malleability and ductility of metals can be accounted due to capacity of layers of metal ions to slide over the other.

101. **(b)** For tetrahedral structure radius range is 0.225 to 0.414.

102. **(b)** Acidic character of organic compound increases with increase in strength of electron withdrawing group and decreases with electron releasing group. In o-cresol, methyl group show +I-effect. It increase the density of electron on oxygen atom after the release of H^+ ion. Hence, it decrease the acidic strength.

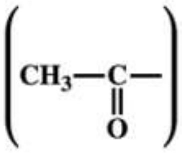


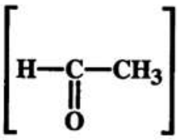
Stability decreases

103. **(c)** A ligand is an atom or group of atom which donates lone pair of electron to central metal ions in coordination compound. Also, Lewis base is the substance that donates a pair of electron. Hence, ligand can also be regarded as Lewis base.

104. **(b)** The colour of sky is due to wavelength of scattered light. This scattering of light take place by particles of much small size.

105. **(c)** Iodoform test is given by compounds having

 functional group.

Acetaldehyde , also contains this group.

It also gives Fehling's test as all aldehydes (- CHO) give Fehling's test.
∴ Ethanal gives both the tests.

106. **(a)** Helium is used in balloons in place of hydrogen, because it is incombustible and inert in nature.

107. **(c)** The basic principle of Cottnell's precipitator is neutralisation of charge on colloidal particle by attracting them towards the wall of oppositively charged precipitator.
Thus, lose their charge and coagulate colloidal particle.

108. **(c)** When, carbon mono-oxide is passed over solid caustic soda heated to $200^{\circ}C$, it forms sodium formate.

$$\underset{\substack{\text{Carbon}\\\text{monoxide}}}{CO} + \underset{\substack{\text{Caustic}\\\text{soda}}}{NaOH} \longrightarrow \underset{\text{Sodium formate}}{HCOONa}$$

109. **(a)** The given reaction, $N_2 + 3H_2 \rightleftharpoons 2NH_3 + \text{Heat}$, is an exothermic reaction.
∴ According to Le-Chatelier's principle, on increase in temperature equilibrium is shifted to the left.

110. **(a)** The order of reactivity of given elements is
$Ag < H < Zn < Sn < Mg$
As, Ag is less reactive than hydrogen, it cannot replace hydrogen from HCl and H_2 gas is not liberated.

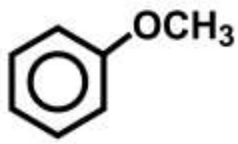
111. **(a)** The ionic compound formed is $M^+X^-(s)$ as the gaseous ions $[M^+(g)$ and $Cl^-(g)]$ combines in the crystal lattice which is in solid state.

112. **(d)** The brown ring is due to the formation of a brown complex between nitric oxide and Fe^{2+} ions.
$NO_3^- + 3Fe^{2+} + 4H^+ \longrightarrow 3Fe^{3+} + NO + 2H_2O$
or $2HNO_3 + 2H_2SO_4 + 6FeSO_4 \longrightarrow [Fe(H_2O)_5NO]SO_4 + H_2O$
Brown colour complex or nitrosofernous sulphate

113. **(b)** Amines behaves as Lewis base as if donates it lone pairs in the chemical reaction.

114. **(b)** Oils reacts with hydrogen in presence of metal catalyst to give saturated glycerides. Thus, vegetable ghee (Dalda) is obtained by hydrogenation (reduction) of oils.

115. **(b)** Anisole is



Its chemical name is methoxy benzene.

116. **(c)** The number of disulphide linkages present in insulin are three. Two linkages are between two polypeptide chains containing 21 and 30 amino acid residues. In addition, the smaller polypeptide chain (21 amino acids) has also an internal disulphide linkage.

117. **(d)** Number of atoms $= \frac{\text{mass}}{\text{molecular mass}} \times N_A$
Number of atoms is oxygen = product of atoms in hydrogen
$\frac{80}{16} \times N_A = \frac{W}{1} \times N_A$
$\therefore\ W = \frac{80}{16} = 5$ g of hydrogen

118. **(d)** Greater the stability of oxide, greater is the chance of its formation. Generally, ionic oxide are more stable, than covalent oxides and among the given metals only Ca form ionic oxide. Hence, Ca has greater tendency to form oxide.

119. **(c)** The reaction, $2Fe_2O_3 + 3C \longrightarrow 4Fe + 3CO_2$, do not occur in blast furnance. This reaction occurs at the end of the process.

120. **(d)** Wax is an ester of fatty acid and an alcohol.

They are formed by combining one fatty acid with one fatty alcohol molecule.

$$\underset{\text{Fatty acid}}{RCOOH} + \underset{\text{Alcohol}}{R'OH} \longrightarrow \underset{\text{Wax (ester)}}{RCOOR'} + H_2O$$

MATHEMATICS

121. **(b)**Let $f(x) = x^2 + \sin^2 x$, then $f(-x) = f(x)$

Therefore, $f(x) = x^2 + \sin^2 x$ is an even functions.

122. **(a)** Here, $A = \{x: x^2 - x + 2 > 0\} = R$

$\left(\begin{matrix} \because x^2-x+2=x^2-x+\frac{1}{4}+\frac{7}{4} \\ =\left(x-\frac{1}{2}\right)^2+\frac{7}{4}\geq\frac{7}{4} \end{matrix}\right)$ and $B = \{x: x^2 - 4x + 3 \leq 0\} = \{x: (x-1)(x-3) \leq 0) = [1,3]$

Hence, $A \cap B = R \cap [1,3] = [1,3]$

123. **(d)** $b \in A$ is said to be an inverse of a w.r.t. operation

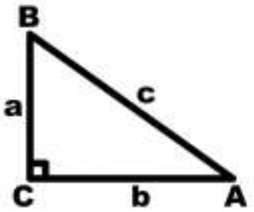
* if $a\,^*b = b^*a = e$.[by definition]

124. **(a)** Given, $\angle C = \frac{\pi}{2} \Rightarrow c^2 = a^2 + b^2$ {by pythagoras}

Now, $\tan^{-1}\left(\frac{a}{b+c}\right) + \tan^{-1}\left(\frac{b}{c+a}\right)$

$$= \tan^{-1}\left[\frac{\frac{a}{b+c} + \frac{b}{c+a}}{1 - \left(\frac{a}{b+c}\right)\left(\frac{b}{c+a}\right)}\right]$$

$$= \tan^{-1}\left(\frac{ac + a^2 + b^2 + bc}{bc + ba + c^2 + ca - ab}\right)$$



$$= \tan^{-1}\left(\frac{ac + c^2 + bc}{bc + c^2 + ca}\right)$$

$$= \tan^{-1}(1) = \frac{\pi}{4}$$

125. **(d)** $\frac{\cos\alpha}{1} = \frac{a}{b+c} \Rightarrow \frac{1}{\cos\alpha} = \frac{b+c}{a}$

By componendo and dividendo,we have

$$\frac{1-\cos\alpha}{1+\cos\alpha} = \frac{b+c-a}{b+c+a}$$

$$\Rightarrow \tan^2\frac{\alpha}{2} = \frac{b+c-a}{3b} \left\{\begin{matrix} \because a, b, c \text{ are in A.P.} \\ \Rightarrow 2b = a + c \end{matrix}\right\}$$

$$\Rightarrow \frac{1-\cos\gamma}{1+\cos\gamma} = \frac{a+b-c}{a+b-c}$$

$$\Rightarrow \tan^2\frac{\gamma}{2} = \frac{a+b-c}{3b}$$

$$\therefore \tan^2\frac{\alpha}{2} + \tan^2\frac{\gamma}{2} = \frac{2b}{3b} = \frac{2}{3}$$

126. **(c)** $\cos(35° + A)\cos(35° - B)$

$+\sin(35° + A)\sin(35° - B)$

$= \cos[(35° + A) - (35° - B)]$

$= \cos(A+B)$

127. **(b)** $2\text{cosec}2x + \text{cosec}x$

$= \frac{2}{\sin 2x} + \frac{1}{\sin x} = \frac{2}{2\sin x \cdot \cos x} + \frac{1}{\sin x}$

$= \frac{1}{\sin x}\left[\frac{1}{\cos x} + 1\right] = \frac{1}{\sin x} \cdot \frac{(1+\cos x)}{\cos x}$

$= \frac{1}{\cos x} \cdot \frac{2\cos^2(x/2)}{2 \cdot \sin(x/2) \cdot \cos(x/2)}$

$= \sec x \cdot \frac{\cos(x/2)}{\sin(x/2)} \left[\because \begin{array}{l} \cos 2x = 2\cos^2 x - 1 \\ \sin 2x = 2\sin x \cos x \end{array}\right]$

$= \sec x \cdot \cot(x/2)$

128. **(d)** We have, $\cot 3x = \cot(2x + x)$

$\Rightarrow \cot 3x = \frac{\cot 2x \cot x - 1}{\cot 2x + \cot x}$

$\left\{\cot(A+B) = \frac{\cot A \cot B - 1}{\cot A + \cot B}\right\}$

$\Rightarrow \cot 3x \cot 2x + \cot 3x \cot x = \cot 2x \cot x - 1$

$\Rightarrow \cot 2x \cot x - \cot 3x \cot 2x - \cot 3x \cot x = 1$

129. **(a)** We have $\cos A \cos B - \sin A \sin B = \cos(A+B) = \cos\left[\left(\frac{\pi}{4} - x\right) + \left(\frac{\pi}{4} - y\right)\right]$

where, $A = \frac{\pi}{4} - x$ and $B = \frac{\pi}{4} - y = \cos\left[\frac{\pi}{2} - (x+y)\right] = \sin(x+y)$

130. **(d)**Let $P(n) = 2 \cdot 4^{2n+1} + 3^{3n+1}$

$P(1) \equiv 128 + 81 = 209$, which is divisible by 11 only.

131. **(c)** $P(1)$: ' $1 \times 1! = (1+1)! - 1$ ' is true.

Let $P(k)$: "$1 \times 1! + 2 \times 2! + 3 \times 3!$

$+ \cdots + k \times k! = (k+1)! - 1$" is true.

Now, $P(k+1)$: $1 \times 1! + 2 \times 2! + \cdots$

$+k + k! + (k+1) \times (k+1)!$

$= (k+1)! - 1 + (k+1)(k+1)!$

$= (k+1)! + (k+1) \times (k+1)! - 1$

$= (k+1)!\,(1 + k + 1) - 1 = (k+2)! - 1$

i.e., $P(k)$ is true $\Rightarrow P(k+1)$ is true

132. **(d)** We have,

$z = re^{i\theta} = r(\cos\theta + i\sin\theta)$

$\therefore\ iz = ir(\cos\theta + i\sin\theta)$

$= ir\cos\theta + i^2 r\sin\theta = -r\sin\theta + ir\cos\theta$

$|e^{iz}| = |e^{(-r\sin\theta + ir\cos\theta)}|$

$= |e^{-r\sin\theta}| \cdot |ir\cos\theta|$

$= e^{-r\sin\theta}\left[\sqrt{\cos^2(r\cos\theta) + \sin^2(r\cos\theta)}\right]$

$= e^{-r\sin\theta} \times 1 = e^{-r\sin\theta}$

133. **(b)** We have, $(\sqrt{5} + \sqrt{3}i)^{33} = 2^{49} z$

Taking modulus on both sides, we get

$2^{49}|z| = |\sqrt{5} + \sqrt{3}i)^{33}$

$\Rightarrow 2^{49}|z| = (\sqrt{5+3})^{33} = (\sqrt{8})^{33} = 2^{33} 2^{33/2}$

$\Rightarrow |z| = \frac{2^{33} 2^{33/2}}{2^{49}} = 2^{\frac{33}{2} - 16} = 2^{1/2} = \sqrt{2}$

134. **(c)** $\left|\frac{1}{1 - \cos\theta + i\sin\theta}\right| = \frac{1}{|1 - \cos\theta + i\sin\theta|}$

$= \frac{1}{\sqrt{(1-\cos\theta)^2 + \sin^2\theta}} = \frac{1}{\sqrt{2 - 2\cos\theta}}$

$= \frac{1}{2|\sin(\theta/2)|} = \frac{1}{2}\left|\text{cosec}\frac{\theta}{2}\right|$

135. **(d)** We have, $a+b\omega+c\omega^2=0$

$$\Rightarrow a+b\left(-\frac{1}{2}+\frac{i\sqrt{3}}{2}\right)+c\left(-\frac{1}{2}-\frac{i\sqrt{3}}{2}\right)=0$$

$$\Rightarrow \left(a-\frac{b}{2}-\frac{c}{2}\right)+i\left(\frac{\sqrt{3}b}{2}-\frac{\sqrt{3}c}{2}\right)=0+0i$$

Real part $\Rightarrow a=\frac{b+c}{2}$.

Imaginary parts $\Rightarrow b=c$

$\therefore\ a=b=c$

136. **(d)** We have,

$(x-1)^3=-8=(-2)^3$

$\therefore x-1=-2-2\omega,-2\omega^2$

$\Rightarrow x=-1,1-2\omega,1-2\omega^2$

137. **(d)** We have, $a^3x^2+abcx+c^3=0$

$$\Rightarrow x^2+\frac{b}{a}\cdot\frac{c}{a}x+\left(\frac{c}{a}\right)^3=0$$

$\Rightarrow x^2-(\alpha+\beta)\alpha\beta x+\alpha^3\beta^3=0$

$\Rightarrow x=\alpha^2\beta,\alpha\beta^2\Rightarrow\alpha^2\beta$ is one of the root.

138. **(a)** There are $4!=24$ numbers. Each digit occurring $3!=6$ times, in the unit's, ten's, hundred's and thousand's places. We note that $(2+4+6+8)=120$. Thus in the over all sum there will be 120 units, 120 tens, 120 hundreds and 120 thousands.

The required sum

$=120(1+10+10^2+10^3)$

$=120\times1111=133320$

139. **(d)** Total number of discs are $4+3+2=9$.

Out of 9 dises, 4 are of the first kind (red) 3 are of the second kind (yellow) and 2 are of the third kind (green). Therefore, the number of arrangements

$$=\frac{9!}{4!\,3!\,2!}=1260$$

140. **(a)** There are 12 face cards and 4 are to be selected, out of these 12 cards. This can be done in ${}^{12}C_4$ ways.

Therefore, the required number of $=\frac{12!}{4!8!}=495$

141. **(a)** $\binom{2n}{3r-1}=\binom{2n}{r+1}$

$$\left\{\begin{matrix}\because\ {}^nC_x={}^nC_y\Rightarrow x+y=n\\ \text{or } n-x=y\end{matrix}\right\}$$

$\Rightarrow\ 2n=3r-1+r+1\Rightarrow n=2r$

142. **(d)** H.M. $=\frac{2ab}{a+b}$; G.M. $=\sqrt{ab}$,

Now, $\frac{\text{H.M.}}{\text{G.M.}}=\frac{2\sqrt{ab}}{a+b}=\frac{4}{5}$

$\Rightarrow 25ab=4(a+b)^2$

$\Rightarrow 4a^2-17ab+4b^2=0$

$\Rightarrow (4a-b)(a-4b)=0$

$\Rightarrow 4a=b\Rightarrow a:b=1:4$

143. **(a)** Let the numbers be a,ar,ar^2,ar^3.

$\Rightarrow a-2,ar-7,ar^2-9$ are in A.P.

$\Rightarrow a-2+ar^2-9=2(ar-7)$

$\Rightarrow a(r^2+1)-11=2ar-14$

$\Rightarrow r^2+1=2r-\frac{3}{a}$ ....(i)

Further, $ar-7+ar^3-5=2(ar^2-9)$

$\Rightarrow ar(r^2+1)-12=2ar^2-18$

$\Rightarrow r^2+1=2r-\frac{6}{ar}$ ....(ii)

Solving Eqs. (i) and (ii), we get $r = 2, a = -3$
The number are $-3, -6 - 12, -24$

144. **(c)** nth term $= \frac{n}{(2n+1)!}$

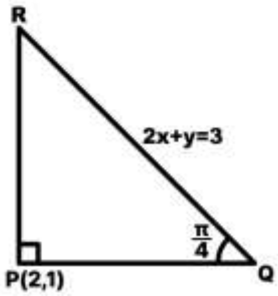
$$= \frac{1}{2}\left[\frac{(2n+1)-1}{(2n+1)!}\right] = \frac{1}{2}\left[\frac{1}{(2n)!} - \frac{1}{(2n+1)!}\right]$$

∴ Sum of the series

$$= \frac{1}{2}\left[\frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} - \frac{1}{5!} + \frac{1}{6!} - \frac{1}{7!} + \cdots\right]$$

$$= \frac{1}{2}e^{-1} = \frac{1}{2e}$$

145. **(b)**Let m be the slope of PQ.



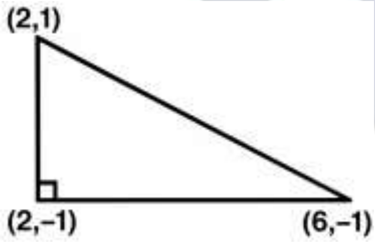
Slope of QR is -2

$$\frac{m+2}{1-2m} = \tan\frac{\pi}{4} = 1$$

$$\Rightarrow m + 2 = \pm(1 - 2m) \Rightarrow m = 3, -\frac{1}{3}$$

The lines PQ and PR are $\frac{y-1}{x-2} = 3, -\frac{1}{3}$
The combined equation is
$(3x - y - 5)(x + 3y - 5) = 0$
or $3x^2 - 3y^2 + 8xy - 20x - 10y + 25 = 0$

146. **(a)** The vertices are $(2, -1), (6, -1), (2,1)$ forming a right angled triangle. Circumcentre is the mid-point of the hypotenuse,



i.e., $\left(\frac{6+2}{2}, \frac{1-1}{2}\right) = (4,0)$

147. **(c)** We have, $a = 3, b = 4$ and $c = \sqrt{a^2 + b^2} = \sqrt{9 + 16} = 5$
Therefore, the coordinates of the foci are $(\pm 5,0)$.
Also, length of latusrectum $= \frac{2b^2}{a} = \frac{32}{3}$

148. **(c)** The line $21x + 5y = 116$ is a tangent to
$7x^2 - 5y^2 = 232$. If $P(x_1, y_1)$ is the point of contact, then $S_1 = 0$.
$\Rightarrow 7x_1x - 5y_1y = 232$ It is same as $21x + 5y = 116$

$$\therefore \frac{7x_1}{21} = -\frac{5y_1}{5} = \frac{232}{116} = 2$$

∴ $x_1 = 6, y_1 = -2$. So, P is $(6, -2)$.

149. **(a)** Let $P(x_1, y_1)$ be the mid-point of a chord of $x^2 + y^2 = r^2$.
Its equation is
$S_1 = S_{11} \Rightarrow x_1x + y_1y = x_1^2 + y_1^2$

or $y = \left(-\frac{x_1}{y_1}\right)x + \frac{x_1^2 + y_1^2}{y_1}$

The line $y = mx + c$ is a tangent to the hyperbola only if

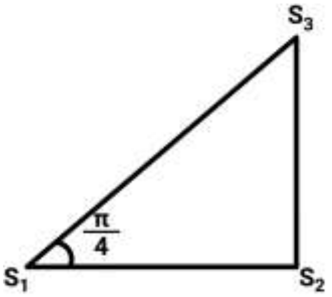
$c^2 = a^2m^2 - b^2$

$\therefore \frac{(x_1^2 + y_1^2)^2}{y_1^2} = \frac{a^2x_1^2}{y_1^2} - b^2$

$\therefore$ The locus of P is

$(x^2 + y^2)^2 = a^2x^2 - b^2y^2$

150. **(b)** $\tan\frac{\pi}{4} = \frac{LS}{S_1S}$



$= \frac{a(e^2 - 1)}{2ae}$

$\Rightarrow 1 = \frac{e^2 - 1}{2e}$

$\Rightarrow e^2 - 2e - 1 = 0$

Solving, $e = \sqrt{2} + 1$

151. **(a)** Tangent with slope m is

$y = mx \pm \sqrt{a^2m^2 - b^2}$

It passes through (0,1).

$\therefore 1 = \sqrt{\frac{m^2}{2} - 1}\ \left[\text{Since, } a^2 = \frac{1}{2}, b^2 = 1\right]$

$\Rightarrow 1 = \frac{m^2}{2} - 1$

$\Rightarrow m = \pm 2$

$\Rightarrow \tan\theta = \left|\frac{2 - (-2)}{1 - 4}\right| = \frac{4}{3}$

152. **(b)** Let $P(3,4,-1)$ and $Q(-1,2,3)$ be the end points of the diameter of a sphere.

$\therefore$ Length of diameter = PQ

$= \sqrt{(-1 - 3)^2 + (2 - 4)^2 + (3 + 1)^2}$

$= \sqrt{16 + 4 + 16} = \sqrt{36} = 6$ units

$\therefore$ Radius $= \frac{6}{2} = 3$ units

153. **(c)** Let $y = \cos^{-1}\left(\frac{1-x}{1+x}\right)$

Put $x = \tan^2\theta$

$\Rightarrow \theta = \tan^{-1}\sqrt{x}$

$\therefore y = \cos^{-1}\left(\frac{1 - \tan^2\theta}{1 + \tan^2\theta}\right)$

$= \cos^{-1}(\cos 2\theta) = 2\theta = 2\tan^{-1}\sqrt{x}$

$\therefore \frac{dy}{dx} = 2\frac{d}{dx}(\tan^{-1}\sqrt{x})$

$= 2 \times \frac{1}{1 + x} \times \frac{1}{2\sqrt{x}} = \frac{1}{\sqrt{x}(1 + x)}$

154. **(b)** $f(x) = \left(\frac{5}{x} + 7\right)$

$\Rightarrow f'(x) = \frac{-5}{x^2} < 0$ for all $x \in R$, where $x \neq 0$.

Hence, $f(x)$ is decreasing for $x \in R - \{0\}$.

155. **(a)**Let $f(x) = x^{1/4}$

$$\Rightarrow f'(x) = \frac{1}{4x^{3/4}}$$

Now, $a + h = 15 = 16 - 1$, where

$a = 16, h = -1$

We know, $f(a + h) = f(a) + hf'(a)$

$\Rightarrow f(15) = f(16) - 1f'(16)$

$$\Rightarrow (15)^{1/4} = (16)^{1/4} - \frac{1}{4(16)^{3/4}} = 2 - \frac{1}{32}$$

$\Rightarrow (15)^{1/4} = 2 - 0.03125 = 1.9688$

156. **(d)** Let the required point be $P(x_1, y_1)$

The given curve is $y = x^2$ ....(i)

Differentiating Eq. (i) w.r.t. x, we get

$$\frac{dy}{dx} = 2x \Rightarrow \text{ Slope of tangent at } P(x_1, y_1) = 2x$$

But the slope of tangent at

$P(x_1, y_1) =$ x-coordinate of P

$\Rightarrow 2x_1 = x_1 \Rightarrow 2x_1 - x_1 = 0$

$\Rightarrow x_1 = 0$

As $P(x_1, y_1)$ lies on the curve, we get

$y_1 = x_1^2 \Rightarrow y_1 = 0$

Hence, the required point is $(0,0)$.

157. **(d)** Given curve, $y = \frac{x^3}{4-x}$ ....(i)

is the given curve

Differentiating Eq. (i) w.r.t. x, we get

$$\frac{dy}{dx} = \frac{(4-x)(3x^2) - x^3(-1)}{(4-x)^2} = \frac{12x^2 - 2x^3}{(4-x)^2}$$

$$\Rightarrow \left(\frac{dy}{dx}\right)_{x=2} = \frac{12(2)^2 - 2(2)^3}{(4-2)^2} = \frac{32}{4} = 8$$

$\Rightarrow$ The slope of tangent at $(2,4)$ is 8 .

$\therefore$ The equation of tangent is

$y - 4 = 8(x - 2)$

$\Rightarrow 8x - y - 12$

$$\Rightarrow = 0 \Rightarrow \text{ slope } = \frac{-8}{-1} = 8$$

Now the slope of normal at $P(2,4)$ is $\frac{-1}{8}$.

$\therefore$ The equation of normal is

$$y - 4 = \frac{-1}{8}(x - 2)$$

$\Rightarrow x + 8y - 34 = 0$

158. **(d)** We have,

$$y = \log_a x + \frac{\log a}{\log x} + 1 + 1 \; [\because \log_x x = 1]$$

$$\Rightarrow \frac{dy}{dx} = \frac{1}{x}\log_a e - \log a\left(\frac{1}{\log x}\right)^2 \frac{1}{x} = \frac{1}{x\log a} - \frac{\log a}{x(\log x)^2}$$

159. **(c)** We have,

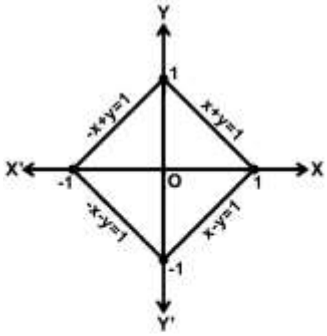
$$\int \frac{1}{\sin x+\sqrt{3}\cos x}dx=\frac{1}{2}\int \frac{dx}{\frac{1}{2}\sin x+\frac{\sqrt{3}}{2}\cos x}$$
$$=\frac{1}{2}\int \frac{1}{\sin\left(x+\frac{\pi}{3}\right)}dx$$
$$=\frac{1}{2}\int \operatorname{cosec}\left(x+\frac{\pi}{3}\right)dx$$
$$=\frac{1}{2}\log\left|\tan\left(\frac{x}{2}+\frac{\pi}{6}\right)\right|+C$$

160. **(a)** $\int e^{2x}(2\sin 3x+3\cos 3x)dx$
$$=2\int e^{2x}\sin 3x dx+3\int e^{2x}\cos 3x dx$$
$$=e^{2x}\sin 3x-3\int e^{2x}\cos 3x dx$$
$$+3\int e^{2x}\cos 3x dx+C$$
$$=e^{2x}\sin 3x+C$$

161. **(a)** $\int_1^2 \frac{dx}{x^2}=\left[\left(\frac{-1}{x}\right)\right]_1^2=\frac{1}{2}$

162. **(a)** We have,
$$I=\int_0^{\pi/2}\frac{\cos x}{\left(\cos\frac{x}{2}+\sin\frac{x}{2}\right)^3}dx=\int_0^{\pi/2}\frac{\cos^2\frac{x}{2}-\sin^2\frac{x}{2}}{\left(\cos\frac{x}{2}+\sin\frac{x}{2}\right)^3}dx$$
$$=\int_0^{\pi/2}\frac{\cos\frac{x}{2}-\sin\frac{x}{2}}{\left(\cos\frac{x}{2}+\sin\frac{x}{2}\right)^2}dx$$
Put $\cos\frac{x}{2}+\sin\frac{x}{2}=t$
$$\Rightarrow \frac{1}{2}\left(-\sin\frac{x}{2}+\cos\frac{x}{2}\right)dx=dt$$
Also, when $x=0\Rightarrow t=1$
When $x=\frac{\pi}{2}\Rightarrow t=\sqrt{2}$
$$\therefore\ I=\int_1^{\sqrt{2}}\frac{2dt}{t^2}$$
$$=2\left[-\frac{1}{t}\right]_1^{\sqrt{2}}=2\left[-\frac{1}{\sqrt{2}}+1\right]=(2-\sqrt{2})$$

163. **(b)** We have,
$x+y=1\forall x,y\geq 0$ ….(i)
$-x+y=1\forall x<0,y\geq 0$ ….(ii)
$-x+y=1\forall x<0,y<0$ ….(iii)
$x+y=1\forall x\geq 0,y<0$ ….(iv)



Required area is the area of shaded region

$= 4\int_0^1 (1-x)dx$

$= 4\left[x-\frac{x^2}{2}\right]_0^1 = 4\times\frac{1}{2} = 2$ sq. units

164. **(c)** Let $I = \int \frac{dx}{\sqrt{x}+\sqrt[3]{x}}$

$x = t^6 \Rightarrow dx = 6t^5 dt$

$\therefore\ I = \int \frac{6t^5}{t^3+t^2}dt = 6\int \frac{t^3}{t+1}dt$

Put $= 6\int\left(t^2-t+1-\frac{1}{t+1}\right)dt$

$= 2t^3 - 3t^2 + 6t - 6\log(t+1) + C$

$= 2\sqrt{x} - 3(\sqrt[3]{x}) + 6(\sqrt[6]{x}) - 6\log(\sqrt[6]{x}+1) + C$

165. **(b)** $\int_a^b \frac{x^n}{x^n+(16-x)^n}dx = 6$ ....(i)

Let $a+b=16$, then

$\int_a^b \frac{(16-x)^n}{(16-x)^n+x^n}dx = 6$ ....(ii)

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

$\int_a^b 1\cdot dx = 12 \Rightarrow b-a = 12$

Solving $a+b=16$ and $b-a=12$, we get

$a = 2, b = 14, n \in R$

166. **(a)** $f(x) = 1+\cos 2x$ and

$f(-x) = 1+\cos(-2x) = 1+\cos 2x = f(x)$

$\Rightarrow\ f(x) = f(-x)$

Hence, $f(x)$ is even function.

$\Rightarrow\ I = 2\int_0^{\pi/4}\frac{dx}{1+\cos 2x}$

$= 2\int_0^{\pi/4}\frac{dx}{2\cos^2 x}$

$= 2\int_0^{\pi/4}\frac{1}{2}\sec^2 x dx$

$= [\tan x]_0^{\pi/4} = \left(\tan\frac{\pi}{4}-\tan 0\right) = 1$

167. **(c)** We have, $y = ae^{bx+c}$ ....(i)

Differentiating Eq. (i) w.r.t. x, we get

$y_1 = a\left(e^{bx+c}\right)b = b\left(ae^{bx+c}\right) = by$ ....(ii)

Again differentiating Eq. (ii) w.r.t. x, we get

$y_2 = by_1$ ....(ii)

From Eq. (ii) and Eq. (i), we have

$\Rightarrow\ y\cdot y_2 = y_1^2$

168. **(a)** Here,$a+3b = \hat{\imath}+\hat{\jmath}+2\hat{k}+3(3\hat{\imath}+2\hat{\jmath}-\hat{k})$

$= 10\hat{\imath}+7\hat{\jmath}-\hat{k}$

and $2a-b = 2(\hat{\imath}+\hat{\jmath}+2\hat{k})-(3\hat{\imath}+2\hat{\jmath}-\hat{k}) = -\hat{\imath}+5\hat{k}$

$(a+3b)\cdot(2a-b) = (10\hat{\imath}+7\hat{\jmath}-\hat{k})\cdot(-\hat{\imath}+5\hat{k})$

$= 10\times(-1)+7\times 0+-1\times 5 = -15$

169. **(a)**$[a-b\ b-c\ c-a] = (a-b)\cdot[(b-c)\times(c-a)]$

$= (a-b)\cdot[b\times c - b\times a - c\times c + c\times a)]$

$= (a-b)\cdot[b\times c - b\times a + c\times a]$

$= a\cdot(b\times c) - a\cdot(b\times a) + a\cdot(c\times a) - b(b\times c)$

$+b\cdot(b\times a) - b(c\times a)$

$= [abc]-[aba]+[aca]-[bbc]+[bba]-[bca]$

$= [abc] - [bca] = 0\ [\because [abc] = [bca] = [cab]]$

170. **(b)** $A = \begin{bmatrix} 2 & -3 \\ 5 & -7 \end{bmatrix}$

$\therefore\ |A| = -14 + 15 = 1 \neq 0$

So, A^{-1} exists.

$\therefore\ \text{adj}A = \begin{bmatrix} -7 & 3 \\ -5 & 2 \end{bmatrix}$

$\Rightarrow\ A^{-1} = \frac{1}{|A|}(\text{adj}A) = \begin{bmatrix} -7 & 3 \\ -5 & 2 \end{bmatrix}$

$\Rightarrow A + A^{-1} = \begin{bmatrix} 2 & -3 \\ 5 & -7 \end{bmatrix} + \begin{bmatrix} -7 & 3 \\ -5 & 2 \end{bmatrix}$

$= \begin{bmatrix} -5 & 0 \\ 0 & -5 \end{bmatrix}$

171. **(d)** We have, $A = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Minor of $a_{32} = \begin{vmatrix} \cos\theta & 0 \\ \sin\theta & 0 \end{vmatrix} = 0 - 0 = 0$ and cofactor of $a_{32} = -$ Minor of $a_{32} = -0 = 0$

172. **(d)** The probability that the place does not hit is $P(\text{ FFFF }) = (1 - 0.4)(1 - 0.3)(1 - 0.2)(1 - 0.1)$

$= (0.6)(0.7)(0.8)(0.9) = 0.3024$

The probability of hitting is $1 - 0.3024 = 0.6976$

173. **(c)** The given statement is

"If I become a teacher, then I will open a school".

Negation of the given statements is

"I will become a teacher and I will not open a school".

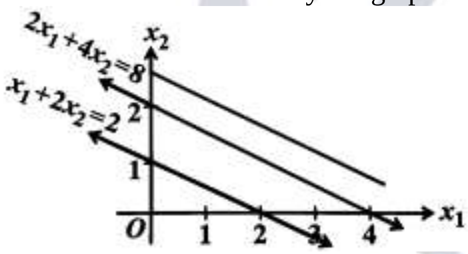
$(\because \sim (p \to q) = (p \wedge \sim q)$, where p is first statement and q is second statement.

174. **(c)** We have,

$x_1 + 2x_2 = 2; 2x_1 + 4x_2 = 8$

i.e., $\frac{x_1}{2} + \frac{x_2}{1} = 1, \frac{x_1}{4} + \frac{x_2}{2} = 1$

The constraint are shown by the graph



From the graph, we conclude that there is no feasible region, i.e. there is no unique solutions satisfying all the constraints.

175. **(c)** Let the coordinates of a point P changes from (x, y) to (x', y') in new coordinates axes where origin has the coordinates $h = 1$,

$k = 1$

Then, $x = x' + 1, y = y' + 1$.

Substituting these values in the given equation of straight line

$(x' + 1)(y' + 1) - (x' + 1) - (y' + 1) + 1 = 0$

$\Rightarrow x'y' + x' + y' + 1 - x' - 1 - y' - 1 + 1 = 0$

$\Rightarrow x'y' = 0$

Therefore, the equation of straight line in the new system is $xy = 0$

176. **(d)** We have, $\log_6 abc = 6 \Rightarrow abc = 6^6$ ….(i)

Let $b = ar, c = ar^2$

Eq. (i), $a^3r^3 = 6^6 \Rightarrow b = ar = 36$

$b - a = 36 - a$ is square for $a = 35,32,27,20,11$

$c = \frac{b^2}{a} = \frac{36^2}{a}$ is an integer for $a = 27$

$\therefore\ a = 27, b = 36, c = 48$

$\Rightarrow\ a+b+c=111$

177. **(c)** $F(x)=P(X<x)$

$F(0)=P(X\le 0)=0.5$

$F(1)=P(X\le 1)=0.5+0.2=0.7$

$F(2)=P(X\le 2)=0.5+0.2+0.18=0.88$

$F(3)=P(X\le 3)=0.5+0.2+0.18+0.12=1$

$\therefore$ The c.d.f. of X is

$X=x$	0	1	2	3
$F(x)$	0.5	0.7	0.88	1

178. **(c)** X can take values 0,1,2.

The probability distribution of X.

Since there are 16 items are perfect and 4 are defective.

Given that two items are drawn randomly.

$\therefore$ P(no defective items are drawn) $=\frac{{}^{16}C_2}{{}^{20}C_2}$

$X=x$	$P(X=x)$
0	$\frac{{}^{16}C_2}{{}^{20}C_2}=\frac{12}{19}$
1	$\frac{{}^{4}C_1\times{}^{16}C_1}{{}^{20}C_2}=\frac{32}{95}$
2	$\frac{{}^{4}C_2}{{}^{20}C_2}=\frac{3}{95}$

179. **(b)** Let sets A and B have m and n elements, respectively.

Then, $2^m-2^n=56\Rightarrow 2^n(2^{m-n}-1)=56$

$\Rightarrow 2^n(2^{m-n}-1)=8\times 7$

$\Rightarrow 2^n(2^{m-n}-1)=2^3\times 7$

One comparing both sides, we get

$2^n=2^3$ and $2^{m-n}-1=7$

$\Rightarrow n=3$ and $2^{m-n}=8$

$\Rightarrow 2^{m-n}=2^3$

$\Rightarrow m-n=3$

$\Rightarrow m-3=3$

$\Rightarrow m=6$

Hence, number of the elements is set A is 6 .

180. **(d)** $\log_4 2+\log_4 4+\log_4 x+\log_4 16=6$

$\log_4(2\times 4\times x\times 16)\ =6$

$128x=4^6$

$\therefore x=\frac{4^3}{2}=32$