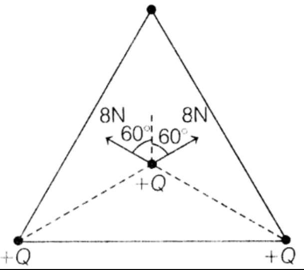
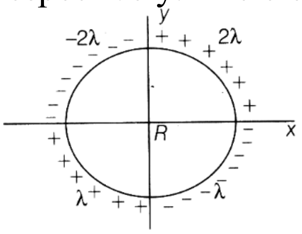
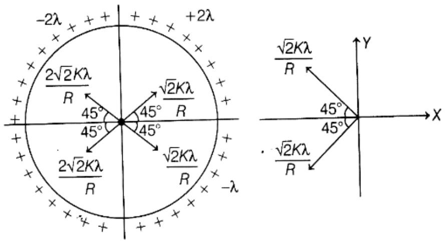
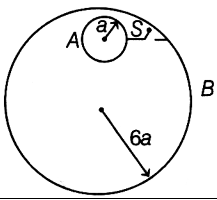
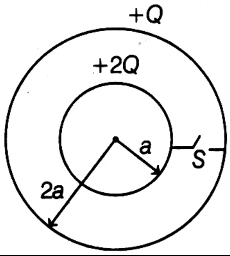
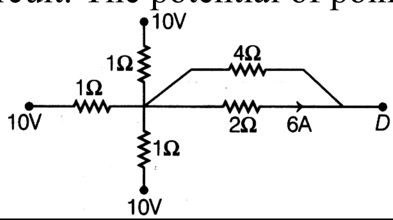
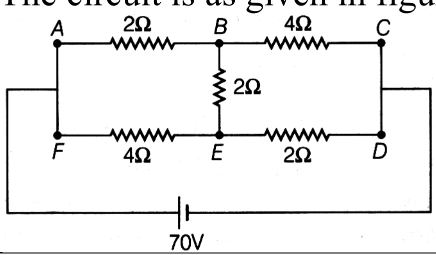
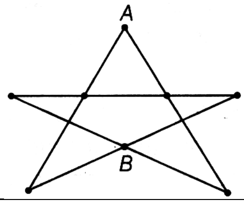
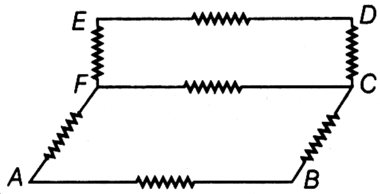
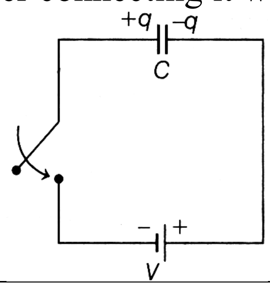
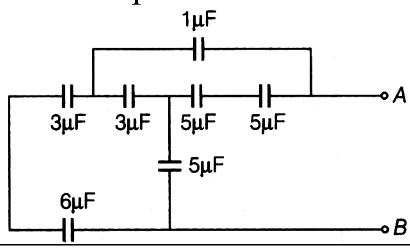
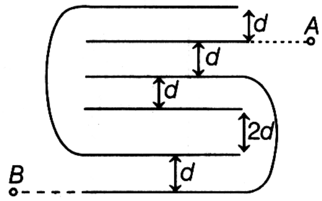
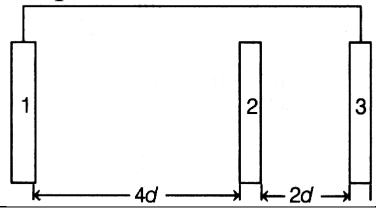
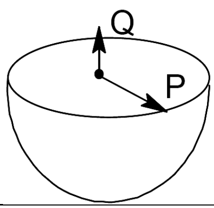
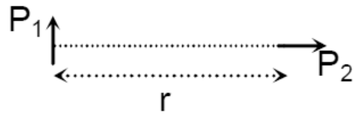
1.	A point charge +Q is placed at the centroid of an equilateral triangle. When a second charge +Q is placed at a vertex of the triangle, the magnitude of the electrostatic force on the central charge is 8N. The magnitude of the net force on the central charge, when a third charge +Q is placed at another vertex of the triangle is	**D**
	Zero	
	4N	
	$4\sqrt{2}N$	
	8N	
Sol.	Net force on the central particle $= 8\cos 60° + 8\cos 60° = 8N$ 	
2.	The charge per unit length of the four quadrant of the ring is 2λ, –2λ, λ, and – λ, respectively. The electric field at the centre is 	**A**
	$-\dfrac{\lambda}{2\pi\varepsilon_0 R}\hat{\imath}$	
	$\dfrac{\lambda}{2\pi\varepsilon_0 R}\hat{\jmath}$	
	$\dfrac{\sqrt{2}\,\lambda}{4\pi\varepsilon_0 R}\hat{\imath}$	
	None of these	
Sol.	Net electric field $= \left(\dfrac{\sqrt{2}K\lambda}{R}\cos 45° \times 2\right)(-\hat{i})$ $= \dfrac{2K\lambda}{R}(-\hat{i}) = \left(\dfrac{\lambda}{2\pi\varepsilon_0 R}\right)(-\hat{i})$	
3.	A small spherical conductor A of radius a is initially charged to a potential V and then placed inside an uncharged spherical conducting shell B of radius 6a as shown in figure. The potential of the spherical conductor A after closing the switch S is 	**D**
	V	

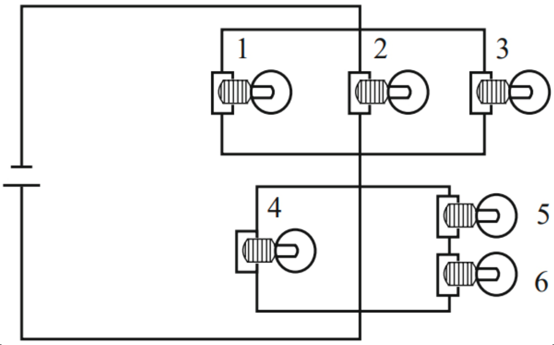
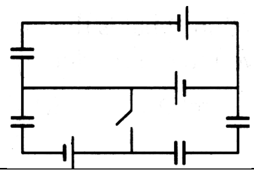
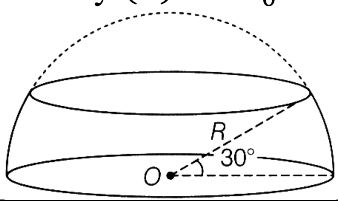
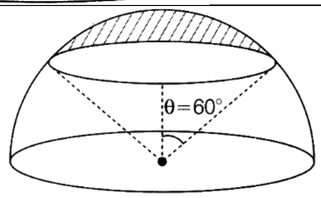
	V/3	
	V/2	
	V/6	
Sol.		
4.	Two concentric spherical conducting shells of radii a and 2a are initially given charges +2Q and +Q respectively as shown in figure. The total heat dissipated after switch S has been closed is (Take $k = \frac{1}{4\pi\varepsilon_0}$) 	**B**
	$\frac{5kQ^2}{4a}$	
	$\frac{kQ^2}{a}$	
	$\frac{kQ^2}{2a}$	
	$\frac{kQ^2}{4a}$	
Sol.		
5.	Figure shows a portion of circuit. The potential of point D is 	**A**
	–5 V	
	–10 V	
	5 V	
	10 V	
Sol.		
6.	The circuit is as given in figure. The current through the branch BE of the circuit is 	**B**
	2A	
	5A	
	7A	
	10A	
Sol.		

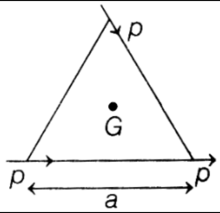
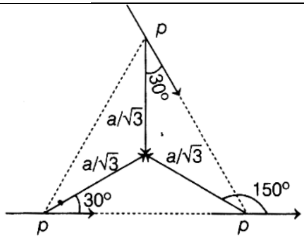
7.	The resistance of all the wires between any two adjacent dots is R. Then, equivalent resistance between A and B as shown in figure is 	**B**
	7/3 R	
	7/6 R	
	14/8 R	
	None of these	
Sol.		
8.	If the potential difference between A and D is V, what will be potential difference between F and C. Each of the resistance is R. 	**C**
	V/3	
	V/5	
	V/7	
	V/8	
Sol.		
9.	A galvanometer has a resistance of $20\,\Omega$ and reads full-scale when 0.2 V is applied across it. To convert it into a 10 A ammeter, the galvanometer coil should have a	**B**
	$0.01\,\Omega$ resistor connected across it	
	$0.02\,\Omega$ resistor connected across it	
	$200\,\Omega$ resistor connected in series with it	
	$2000\,\Omega$ resistor connected in series with it	
Sol.		
10.	A moving coil galvanometer has 150 equal divisions. Its current sensitivity is 10 divisions per milliampere and voltage sensitivity is 2 divisions per milli volt. In order that each division reads 1V, the resistance in ohm needed to be connected in series, with the coil will be	**B**
	99995	
	9995	
	1000	
	10000	
Sol		
11.	The distance between the plates of a circular parallel plate condenser of diameter 40 mm, in order to make its capacity equal to that of a metallic sphere or radius 1m, will be	**A**
	0.1 mm	
	10 mm	
	0.01 mm	
	1 mm	
Sol.		

12.	A capacitor having capacitance C is charged by a battery having emf 2V (battery is disconnected after charging). Now, this charged capacitor is connected to another battery having emf V. The positive plate of capacitor is connected with negative terminal of battery and vice-versa. The amount of heat produced after connecting it with battery 	**A**
	$4.5\ CV^2$	
	$1.5\ CV^2$	
	$4\ CV^2$	
	None of these	
Sol.		
13.	The equivalent capacitance between points A and B is 	**A**
	$\frac{7}{3}\mu F$	
	$\frac{7}{5}\mu F$	
	$\frac{7}{6}\mu F$	
	$\frac{11}{3}\mu F$	
Sol.		
14.	Find equivalent capacitance between A and B. [Assume, each conducting plate is having same dimensions and neglect the thickness of the plate, $\frac{\varepsilon_0 A}{d} = 7\mu F$, where A is area of plates and A > > d] 	**B**
	$7\mu F$	
	$11\mu F$	
	$12\mu F$	
	None of these	
Sol.		

15.	Three identical metal plates of large area A numbered 1,2 and 3 are arranged as shown in the figure. The plates 1 and 3 are connected by a conducting wire. The charge given to plate 2 is 2q and no other plate is given any charge. Find the potential difference between the plates 2 and 3.  	**B**
	$\frac{4}{3}\frac{qd}{A\varepsilon_0}$	
	$\frac{8}{3}\frac{qd}{A\varepsilon_0}$	
	$\frac{12}{3}\frac{qd}{A\varepsilon_0}$	
	$\frac{2}{3}\frac{qd}{A\varepsilon_0}$	
16.	A point charge $q = 50\mu C$ is located in the x – y plane at the point of position vector $\vec{r}_0 = 2\hat{i} + 3\hat{j}$. What is the electric field at the point of position vector $\vec{r} = 8\hat{i} - 5\hat{j}$	**D**
	$1200\frac{v}{m}$	
	$4\times10^{-2}\frac{v}{m}$	
	$900\frac{v}{m}$	
	$4500\frac{v}{m}$	
Sol.	$r = \sqrt{(8-2)^2 + (-5-3)^2} = 10$ $E = \frac{9\times10^9 \times 50\times10^{-6}}{100} = \frac{9}{2}\times10^3 = 4500\,V/m$	
17.	A point charge Q is located just above the centre of the flat face of hemisphere as shown in figure. The electric flux through the flat face and curved face of hemisphere are respectively  	**B**
	$\frac{Q}{2\in_0}, \frac{-Q}{2\in_0}$	
	$\frac{-Q}{2\in_0}, \frac{Q}{2\in_0}$	
	$\frac{Q}{\in_0}, \frac{-Q}{\in_0}$	

	$\frac{-Q}{\in_0},\frac{Q}{\in_0}$	
Sol.	Place another identical hemisphere on given one, so that flat faces of two coincide. The total flux linked with cross- section of bottom half (lower hemisphere) is $\frac{Q}{2\in_0}$ as charge enclosed by given hemisphere is zero. So flux linked with flat face of hemisphere is $\frac{-Q}{2\in_0}$	
18.	A parallel plate capacitor with initial plate distance d_0 is charged upto voltage V_0 and then detached from the charger. Now the distance between the plates is varied periodically according to the law $d = d_0 + d_1 \sin \omega t$. The value of d1 if the potential difference across the capacitor changes according to the law $V = V_0\left(1+\frac{1}{2}\sin \omega t\right)$	**B**
	d_0	
	$\frac{d_0}{2}$	
	$\frac{3d_0}{2}$	
	$2d_0$	
Sol.	As charge on the capacitor is conserved $\Rightarrow C_0V_0 = C'V$ $\Rightarrow \frac{\varepsilon_0 A}{d_0}V_0 = \frac{\varepsilon_0 A}{d}V$ $\Rightarrow \frac{V_0}{d_0} = \frac{V_0}{d}\left(1+\frac{1}{2}\sin\omega t\right)$ After putting the values $d_1 = \frac{d_0}{2}$	
19.	Two point electric dipoles with dipole moments P_1 and P_2 are separated by a large distance 'r' with their dipole axes mutually perpendicular as shown. The electric force between the dipoles is (where $K = \frac{1}{4\pi\varepsilon_0}$) 	**B**
	$\frac{6KP_1P_2}{r^4}$	
	$\frac{3KP_1P_2}{r^4}$	
	$\frac{2KP_1P_2}{r^4}$	
	$\frac{KP_1P_2}{r^4}$	

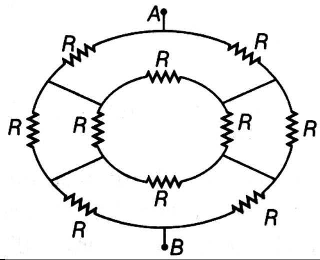
Sol.	$E_1 = \frac{KP_1}{r^3}$ $F = P_2\left\|\frac{dE_1}{dr}\right\| = \frac{3KP_1P_2}{r^4}$	
20.	Six identical light bulbs are connected to a battery to form the circuit shown. Which light bulb (s) glow the brightest? 	**A**
	1, 2 and 3	
	5 and 6	
	1, 2, 3 and 4	
	4 only	
Sol.	No current in bulb 4, 5 and 6.	
21.	In the circuit shown, what charge (in sec) will flow through the switch after it is closed. The switch was initially open since a long time. All capacitors have capacitances = 2μF and all cells have emf = 10 V. 	**10**
Sol.		
22.	Figure shows the part of a hemisphere of radius R = 2 m and surface charge density $(\sigma) = 2\varepsilon_0$ C/m^2. Calculate the electric potential (in volt) at centre O. 	**1**
Sol.	 Solid angle subtended by the shaded part $= 2\pi(1-\cos\theta) = 2\pi(1-\cos 60°) = \pi$ Solid angle subtended by the remaining hemisphere $= 2\pi - \pi = \pi$ $V_{centre} = \frac{kQ}{R} = \frac{k}{R}\left[\sigma\left(\frac{4\pi R^2}{4\pi}\times\pi\right)\right]$ $= \frac{\sigma R}{4\varepsilon_0} = \frac{(2\varepsilon_0)(2)}{4\varepsilon_0} = 1\,V$	
23.	Three small dipoles of dipole moment p, each are placed at the three vertices of an equilateral triangle of side a as shown in figure. If total potential at the centroid G is given by $V = \frac{\sqrt{n}kp}{2a^2}$, Find the value on n. $\left(Take, k = \frac{1}{4\pi\varepsilon_0}\right)$.	**27**

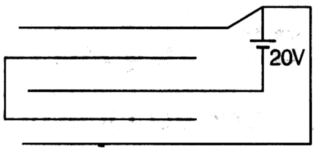
<table>
<tr><td></td><td>
</td><td></td></tr>
<tr><td>Sol.</td><td>

$V = V_1 + V_2 + V_3$

$\Rightarrow \quad V = \dfrac{kp\cos 30^\circ}{(a/\sqrt{3})^2} + \dfrac{kp\cos 150^\circ}{(a/\sqrt{3})^2} + \dfrac{kp\cos 30^\circ}{(a/\sqrt{3})^2}$

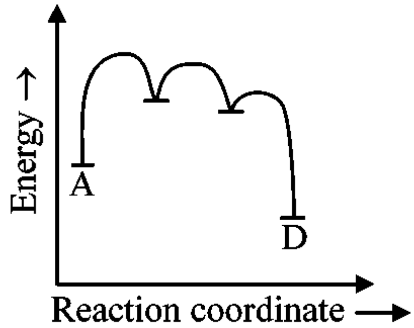
$\Rightarrow \quad V = \dfrac{3\sqrt{3}kp}{2a^2} = \dfrac{\sqrt{27}\,kp}{2a^2}$</td><td></td></tr>
<tr><td>24.</td><td>In the given network of resistors, each resistor has resistance $R = 12\Omega$. Find equivalent resistance (in ohm) across A and B.

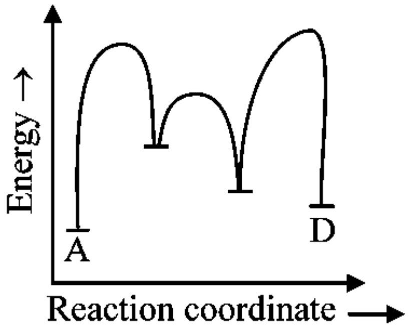

</td><td>15</td></tr>
<tr><td>Sol.</td><td></td><td></td></tr>
<tr><td>25.</td><td>Five plates of dimension 5 cm × 8 m are placed at separation of 8.85 mm from each other. If they are connected through a battery which provides constant potential difference of 20V as shown in figure, find the charge (in nC) flow through the battery

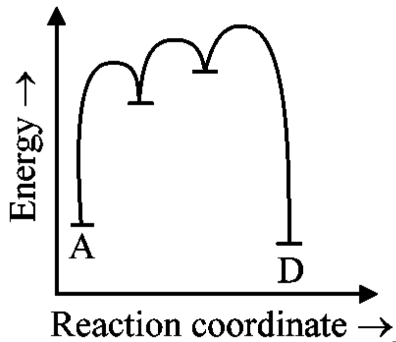

</td><td>8</td></tr>
<tr><td>Sol.</td><td></td><td></td></tr>
<tr><td>26.</td><td>Four successive members of the first row transition elements are listed below with atomic numbers. Which one of them is expected to have to highest $E^{o}_{M^{3+}/M^{2+}}$, value?</td><td>D</td></tr>
<tr><td></td><td>Fe(Z = 26)</td><td></td></tr>
<tr><td></td><td>Mn (Z = 25)</td><td></td></tr>
<tr><td></td><td>Cr (Z = 24)</td><td></td></tr>
<tr><td></td><td>Co(Z = 27)</td><td></td></tr>
</table>

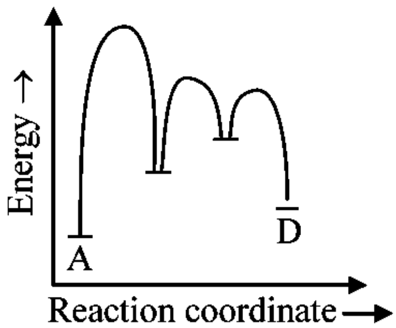
Sol.	$E^o_{Cr^{3+}/Cr^{2+}} = -0.41V; E^o_{Mn^{3+}/Mn^{2+}} = +1.57V;$ $E^o_{Fe^{3+}/Fe^{2+}} = +0.77V;$ $E^o_{Co^{3+}/Co^{2+}} = +1.97V$ Standard reduction potential (SRP) value normally increases from left to right in the period of d-block elements. Some SRP values are exceptionally higher due to stability of the product ion. For e.g., $E^o_{Mn^{3+}/Mn^{2+}} = +1.57V; E^o_{Co^{3+}/Co^{2+}} = +1.97V$	
27.	What will be standard cell potential of galvanic cell with the following reaction? $2Cr(s) + 3Cd^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Cd(s)$ [**Given :** $E^o_{Cr^{3+}/Cr} = -0.74$ V and $E^o_{Cd^{2+}/Cd} = -0.40$ V]	**C**
	0.74 V	
	1.14 V	
	0.34 V	
	– 0.34 V	
Sol.	$E^o_{cell} = E^o_{cathode} - E^o_{anode}$ $E^o_{cell} = E^o_{Cd^{2+}/Cd} - E^o_{Cr^{3+}/Cr}$ $= -0.40 - (0.74) = +0.34$ V	
28.	The conductance of 0.0015M aqueous solution of a weak monobasic acid was determined by using a conductivity cell consisting of platinised Pt electrodes. The distance between the electrodes is 120 cm with an area of cross section of $1cm^2$. The conductance was found to be 5×10^{-7} S. The pH of the solution is 4. The value of limiting molar conductivity (Λ^o_m) of this weak monobasic acid in aq. solution is :	**A**
	600 S cm^2 mol^{-1}	
	400 S cm^2 mol^{-1}	
	300 S cm^2 mol^{-1}	
	500 S cm^2 mol^{-1}	
Sol.	$pH = C\alpha = 10^{-4}$ $\alpha = \frac{10^{-4}}{0.0015} = \frac{1}{15}$ $K = G.\left(\frac{\ell}{A}\right)$ $= 5 \times 10^{-7} \times \frac{120}{1} = 6 \times 10^{-5}\ Scm^{-1}$ $\Lambda_m = \frac{K \times 1000}{C} = \frac{6 \times 10^{-5} \times 1000}{0.0015}$ $\Lambda^0_m = \frac{\Lambda_m}{\alpha} = \frac{6 \times 10^{-5} \times 1000}{0.0015} \times \frac{0.0015}{10^{-4}}$ $= 600\ S\ cm^2\ mol^{-1}$.	
29.	The energy of activation for a reaction is 100 kJ mol^{-1}. Presence of a catalyst lowers the activation energy by 75%. What will be effect on rate of reaction at 20ºC, other things being equal?	**A**

	Increases by a factor of 2.34×10^{13}	
	Increases by a factor of 2.34×10^{10}	
	Increases by a factor of 10^{15}	
	No effect	
Sol.	The Arrhenius equation is $k = Ae^{-E_a/RT}$ In absence of catalyst, $k_1 = Ae^{-100/RT}$ In presence of catalyst, $k_2 = Ae^{-25/RT}$ So $\frac{k_2}{k_1} = e^{-75/RT}$ or $2.303 \log \frac{k_2}{k_1} = \frac{75}{RT}$ or $2.303 \log \frac{k_2}{k_1} = \frac{75}{8.314 \times 10^{-3} \times 293}$ or $\log \frac{k_2}{k_1} = \frac{75}{8.314 \times 10^{-3} \times 293 \times 2.303}$ or $\frac{k_2}{k_1} = 2.34 \times 10^{13}$ As the things being equal in presence or absence of a catalyst, k_2 = rate in presence of catalyst k_1 = rate in absence of catalyst i.e., $\frac{r_2}{r_1} = \frac{k_2}{k_1} = 2.34 \times 10^{13}$	
30.	Consider the following statements related to temperature dependence of rate constants. Identify the **correct** statements, **A.** The Arrhenius equation holds true only for an elementary homogenous reaction. **B.** The unit of A is same as that of k in Arrhenius equation. **C.** At a given temperature, a low activation energy means a fast reaction. **D.** A and Ea as used in Arrhenius equation depend on temperature. **E.** When Ea >> RT. A and Ea become interdependent. Choose the **correct** answer from the options given below :	**C**
	A, C and D Only	
	B, D and E Only	
	B and C Only	
	A and B Only	
Sol.	Arrhenious equation hold true for elementary as well as complex reactions. Unit of A is same as unit of k. Rate of reaction is high if activation energy is low, A and Ea are temperature independent.	
31.	Reactant A converts to product D through the given mechanism (with the net evolution of heat) : $A \rightarrow B$ slow ; $\Delta H = +$ ve $B \rightarrow C$ fast ; $\Delta H = -$ ve $C \rightarrow D$ fast ; $\Delta H = -$ ve Which of the following represents the above reaction mechanism ?	**A**

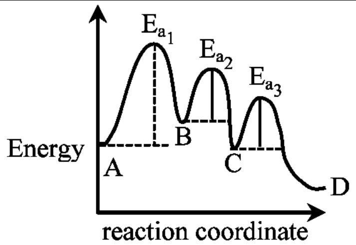








Sol.



$A \rightarrow B$ Slow

$\Delta H = +ve \quad E_{a_1} \rightarrow \text{High}$

$B \rightarrow C$ Fast

$\Delta H = -ve \quad E_{a_2} \rightarrow \text{Low}$

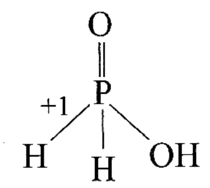
$C \rightarrow D$

$\Delta H = -ve \quad E_{a_3} \rightarrow \text{Low}$

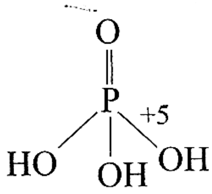
32. Match List-I with List-II **D**

	List-I (Name of oxo acid)		**List-II (Oxidation state of 'P')**
A.	Hypophosphorous	**I.**	+5

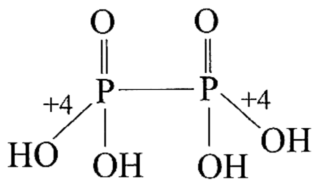
	B. Orthophosphoric acid **II.** +4 **C.** Hypophosphoric acid **III.** +3 **D.** Orthophosphorous acid **IV.** +1 Choose the correct answer from the options given below.	
	A-II, B-I, C-III, D-IV	
	A-II, B-III, C-I, D-IV	
	A-III, B-IV, C-I, D-II	
	A-IV, B-I, C-II, D-III	
Sol.	The correct match is A-IV, B-I, C-II, D-III	



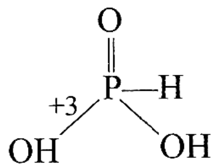
Hypophosphorus acid



Orthophosphoric acid



Hypophosphoric acid



Orthophosphorus acid

33. Match List-I with List-II — **B**

List-I (Electronic configuration of element)		**List-II** (Ionisation enthalpy/kJ mol^{-1})	
A.	$[Xe]6s^2$	I.	374
B.	$[He]2s^2$	II.	520
C.	$[He]2s^1$	III.	503
D.	$[Xe]6s^1$	IV	899

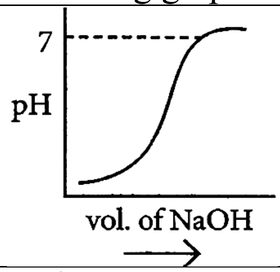
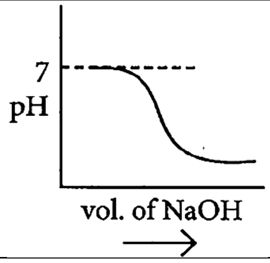
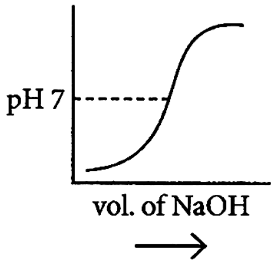
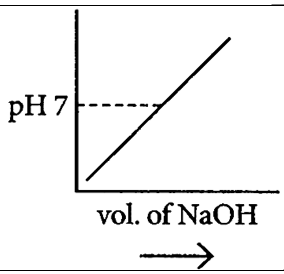
Choose the most appropriate answer from the options given below.

	A-IV, B-II, C-III, D-I	
	A-III, B-IV, C-II, D-I	
	A-II, B-I, C-IV, D-III	
	A-I, B-III, C-IV, D-II	
34.	Which of the following statement is correct regarding following process? **(i)** $Cl \xrightarrow{EA} Cl^-$ **(ii)** $Cl^- \xrightarrow{IE} Cl$ **(iii)** $Cl \xrightarrow{IE} Cl^+$ **(iv)** $Cl \xrightarrow{IE} Cl^{2+}$	**C**
	|IE of process (iv) | = | IE of process (iii)|	
	|IE of process (iii) | = | IE of process (ii)|	
	|IE of process (ii) | = | EA of process (i)|	
	|IE of process (iv) | = | EA of process (i)|	

Sol.	Amount of energy involved in loosing electron from outermost shell is known as IE while amount of energy involved in accepting one extra electron is known as EA and we know that $\|IE\| = \|EA\|$ In process (ii), IE is involved. $Cl^- \longrightarrow \cdot Cl + e^-$ While in process (i), EA is involved. $Cl + e^- \longrightarrow Cl^-$ So, same amount of energy is released when electron is absorbed. So, $\|$IE of process (ii)$\|$ = $\|$EA of process (i)$\|$ **Study Tactics** This problem includes conceptual mixing of IE and EA. It can be solved by knowing the exact concept involved in IE and EA.	
35.	A solution contains Pb^{+2} ion. In order to precipitate Pb^{+2} ions, sodium sulphate solution is required to be added. What is the concentration of sulphate ion required to reduce the concentration of Pb^{+2} to 2×10^{-6} mole per litre? (K_{sp} for $PbSO_4 = 1.8 \times 10^{-8}$)	**C**
	5×10^{-3} M	
	4×10^{-3} M	
	9×10^{-3} M	
	6×10^{-3} M	
Sol.	The cocentration of sulphate ion required to determined as follows $K_{sp} = [Pb^{+2}]\,[SO_4^{-2}]$ $1.8 \times 10^{-8} = 2 \times 10^{-6} \times [SO_4^{-2}]$ $[SO_4^{-2}] = 9 \times 10^{-3}$ M	
36.	Which of the following is the wrong statement?	**D**
	ONCl and ONO^- are not isoelectronic	
	O_3 molecule is bent	
	Ozone is violet-black in solid state	
	Ozone is paramagnetic gas	
Sol.	A. $ONCl = 8 + 7 + 17 = 32e^-$ $ONO^- = 8 + 7 + 8 + 1 = 24e^-$ (correct) B.  central atom O is sp^2 hybridized with 1 lone pair, so bent shape (correct) C. Ozone is voilet-black in solid state. D. O_3 has no unpaired electrons, so diamagnetic (correct)	
37.	$A(g) + 2B(s) \rightleftharpoons 2C(g)$. Initially 2 mol A(g), 4 mole of B(s) and 1 mole of an inert gas are present in a closed container. After equilibrium has established total pressure of container	**A**

	becomes 9 atm. If A(g) is consumed 50% at equilibrium then calculate Kp for above reaction	
	9 atm	
	36/5 atm	
	12 atm	
	6 atm	
38.	The dissociation equilibrium of a gas AB_2 can be represented as, $2AB_2(g) \rightleftharpoons 2AB(g) + B_2(g)$ The degree of dissociation is x and is small as compared to 1. The expression relating the degree of dissociation (x) with equilibrium constant K_P and total pressure P is :	**D**
	$(2K_p / P)^{\frac{1}{2}}$	
	K_p/P	
	$2K_p/P$	
	$(2K_p / P)^{\frac{1}{3}}$	
Sol.	$2AB_2\left(g\right) \rightleftharpoons 2AB\left(g\right) + B_2\left(g\right)$ At equilibrium 2(1 − x) 2x x Total moles = (2 + x) Partial pressures $P_{AB_2} = \frac{2(1-x)}{2+x}p,\ P_{AB} = \left(\frac{2x}{2+x}\right)p,\ P_{B_2} = \left(\frac{x}{2+x}\right)p$ $K_p = \frac{pAB^2 pB_2}{\left(pAB_2\right)^2} = \frac{\left[\left(\frac{2x}{2+x}\right)p\right]^2\left[\frac{xp}{2+x}\right]}{\left[\frac{2(1-x)}{2+x}p\right]^2}$ $K_p = \frac{4x^3P}{4(2+x)(1-x)^2}$ $\left(2+x\right) \rightarrow 2$ (x is small) $\left(1-x\right) \rightarrow 1$ $K_p = \frac{4x^3p}{8} = \frac{x^3p}{2}$ $x = \sqrt[3]{\frac{2kp}{p}}$	
39.	• 0.25 mol of formic acid (HCO_2H) is dissolved in enough water to make one litre of solution. The pH of that solution is 2.19. The K_a of formic acid is	**C**
	• 6.5×10^{-3}	
	• 4.3×10^{-4}	
	• 1.7×10^{-4}	
	• 5.3×10^{-2}	

Sol.	$pH = 2.19 = -\log[H^+]$ $[H^+] = 10^{-2.19}$ = Antilog (-2.19) $= 6.46 \times 10^{-3} M$ $K_a (HCOOH) = \frac{[H^+][HCOO^-]}{[HCOOH]}$ Here $[H^+] = [HCOO^-] = 6.46 \times 10^{-3} M$ $[HCOOH] = 0.25$ mol/1L $= 0.25$ M and $K_a (HCOOH) = ?$ So $K_a \left(HCOOH\right) = \frac{(6.46 \times 10^{-3})^2}{0.25} = 1.7 \times 10^{-4}$ •	
40.	• Which of the following represents the correct order of increasing first ionization enthalpy for Ca, Ba, S, Se and Ar?	**A**
	• Ba < Ca < Sr < S < Ar	
	• Ca < Ba < S < Se < Ar	
	• Ca < S < Ba < Se < Ar	
	• S < Se < Ca < Ba < Ar	
Sol.	Ba < Ca < Sr < S < Ar Ba, Ca belong to gr IIA (Alkaline earth metals) Se and S belong to gr VIA (Chalcogens) and as we go down the group ionaization enthalpy deceases with increasing atomic size. So, Ba < Ca and Se < S Ar has stable completely filled electronic configuration and, therefore, has highest ionization enthalpy. Hence the correct order is **Ba < Ca < Se < S < Ar** • **in KJmol^{-1}** 503 590 941 999 1520	
41.	The electronic configuration of few elements is given below. Mark the statement which is not correct about these elements. (i) $1s^2\ 2s^2\ 2p^6\ 3s^1$ (ii) $1s^2\ 2s^2\ 2p^5$ (iii) $1s^2\ 2s^2\ 2p^6$ (iv) $1s^2\ 2s^2\ 2p^3$	**B**
	(i) is an alkali metal	
	(iii) is a noble metal	
	(i) and (ii) form ionic compounds	
	(iv) has high ionization enthalpy than accepted	
Sol.	As (iii) has $1s^2\ 2s^2\ 2p^6$ type of noble gas configuration so it is an inert gas Neon not a metal.	
42.	Consider the reaction equilibrium: $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g); \Delta H^o = -198$ kJ On the basis of Le-Chatelier's principle, the condition favourable for the forward reaction is	**C**
	• lowering of temperature as well as pressure	

	• Increasing temperature as well as pressure	
	• Lowering the temperature and increasing the pressure	
	• Any value of temperature and pressure.	
43.	• 100 mL of 0.1 M HCl is taken in a beaker and to it 100 mL of 0.1 M NaOH is added in steps of 2 mL and the pH is continuously measured. Which of the following graphs correctly depicts the change in pH?	**C**
	• 	
	• 	
	• 	
	• 	
Sol.	• Steepness Of the slope around the equivalent point is quite large in case of titration of strong acid with strong base.	
44.	A student needs to prepare a buffer solution of propanoic acid and its sodium salt with pH 4. Tie ratio of $\frac{[CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$ required to make buffer is ____________ . • Given : K_a $(CH_3CH_2COOH) = 1.3 \times 10^{-5}$	**B**
	0.03	
	0.13	
	0.23	
	0.33	
Sol.	$K_a (CH_3CH_2COOH) = 1.3 \times 10^{-5}$ $pK_a = -\log K_a$ $pK_a = 5 - \log 1.3$	

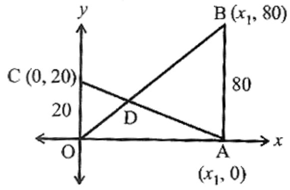
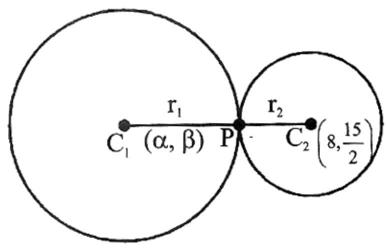
	$pH = pK_a + \log\frac{[CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$ $4 = 5 - \log 1.3 + \log\frac{[CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$ $\log 1.3 - 1 = \log\frac{[CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$ $0.114 - 1 = \log\frac{[CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$ $\frac{[CH_3CH_2COO^-]}{[CH_3CH_2COOH]} = \text{anti}\log(-0.886) = 0.13$	
45.	Match List-I with List-II. <table><tr><th colspan="2">List-I (Molecule)</th><th colspan="2">List-II (Bond order)</th></tr><tr><td>(A)</td><td>Ne_2</td><td>(i)</td><td>1</td></tr><tr><td>(B)</td><td>N_2</td><td>(ii)</td><td>2</td></tr><tr><td>(C)</td><td>F_2</td><td>(iii)</td><td>0</td></tr><tr><td>(D)</td><td>O_2</td><td>(iv)</td><td>3</td></tr></table>Choose the correct answer from the options given below :	**D**
	(A) – (ii), (B) – (i), (C) – (iv), (D) – (iii)	
	(A) – (i), (B) – (ii), (C) – (iii), (D) – (iv)	
	(A) – (iv), (B) – (iii), (C) – (ii), (D) – (i)	
	(A) – (iii), (B) – (iv), (C) – (i), (D) – (ii)	
Sol.	(A) – (iii), (B) – (iv), (C) – (i), (D) – (ii)	
46.	A 1.0 M solution of Cd^{2+} is added to excess iron and the system is allowed to reach equilibrium. What is the concentration in mol of Cd^{2+}? $Cd^{2+}(aq) + Fe(s) \rightarrow Cd(s) + Fe^{2+}(aq)$; $E^o = 0.037$ V Given : log 18 = 1.25 **Report your answer multiply by 100.**	**5**
Sol.	$Cd^{2+}(aq) + Fe(s) \rightleftharpoons Cd(s) + Fe^{2+}(aq)$ At eqm. $1 - x$ – – x At equilibrium, $E^o = \frac{0.0591}{2}\log\left(\frac{Fe^{2+}}{Cd^{2+}}\right)$ $0.037 = \frac{0.0591}{2}\log\left(\frac{x}{1-x}\right)$ $x = \left[Fe^{2+}\right] \Rightarrow 0.947$ M $\therefore \left[Cd^{2+}\right] = 0.053$ M	
47.	Consider the following cell reaction : $2Fe(s) + O_2(g) + 4H^+(aq.) \rightarrow 2Fe^{2+}(aq.) + 2H_2O(l)$ $E^o = 1.67$ V At $[Fe^{2+}] = 10^{-3}$ M, $P(O_2) = 0.1$ bar and pH = 3, the cell potential (in volt) at 25°C is – **(Write Nearest Integer)**	**2**

Sol.	$E = 1.67 - \frac{0.059}{4}\log Q$ $Q = \frac{[Fe^{2+}]^2}{(P_{O_2}(g))[H^+(g)]^4}$ $Q = \frac{[10^{-3}]^2}{(0.1)(10^{-3})^4} = (10)^7$ $E = 1.67 - \frac{0.059}{4}\log(10)^7$ **E = 1.56675 V**	
48.	The decomposition of hydrogen peroxide follows first order kinetics. $2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$ If the volume of O_2 gas liberated at STP in first 20 minutes of the start of decomposition is 25.00 ml, what should be the total volume of O_2 gas (in ml) collected in time, $t >> t_{1/2}$. ($t_{1/2}$ for the decomposition of H_2O_2 is 10 min)	**33**
47.	At 200°C, PCl_5 dissociates as $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$. It was found that the equilibrium vapours are 62 times as heavy as hydrogen. The percentage dissociation of PCl_5 at 200°C is. [Atomic mass : P = 31, Cl = 35.5] **(Write Nearest Integer)**	**68**
Sol.	$\alpha = \frac{M_0 - M}{(n-1).M} = \frac{208.5 - 124}{(2-1).124} = 0.681$	
50.	Total number of species in which atleast one atom have same hybridization as in central atom of azide ion. N_2O, C_2H_2, CO_2, C_3O_2, BeF_2, NO_2, PF_3	**5**
Sol.	N_2O, C_2H_2, CO_2, C_3O_2, BeF_2	
51.	If the locus of the midpoint of the line segment from the point $(-2, 3)$ to a point on the circle $x^2 + y^2 - 2x - 2y - 2 = 0$ is a circle of radius r, then r =	**C**
	2	
	4	
	1	
	3	
Sol.	$A(-2,\ 3), B(1 + 2\cos\theta, 1 + 2\sin\theta)$ $M(x, y) = \left[\frac{-1 + 2\cos\theta}{2}, 2 + \sin\theta\right]$ $\Rightarrow \cos\theta = \frac{2x+1}{2},\ \sin\theta = y - 2$ $\Rightarrow \left(x + \frac{1}{2}\right)^2 + (y-2)^2 = 1$ $\therefore r = 1.$	
52.	The area of the triangle formed by the tangents drawn from a point (2, 3) to the circle $x^2 + y^2 + 4x + 6y + 4 = 0$ and its chord of contact is (in square units) :	**C**
	$\frac{3(42)^{\frac{3}{2}}}{52}$	

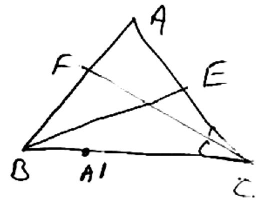
	$\frac{3(43)^{\frac{3}{2}}}{53}$	
	$\frac{3(43)^{\frac{3}{2}}}{52}$	
	9	
Sol.	$\Delta = \frac{r\left(S_{11}\right)^{3/2}}{S_{11}+r^2} = \frac{3\left(43\right)^{3/2}}{52} sq.units$	
53.	If the circles $x^2+y^2+6x+8y+16=0$ and $x^2+y^2+2(3-\sqrt{3})x+2(4-\sqrt{6})y=k+6\sqrt{3}+8\sqrt{6}, k>0$ touch internally at the point $P(\alpha,\beta)$, then $(\alpha+\sqrt{3})^2+(\beta+\sqrt{6})^2$ is :	**A**
	25	
	16	
	49	
	100	
Sol.	$C_1(-3,-4), C_2(-3+\sqrt{3},-4+\sqrt{6}),$ $r_1=3, r_2=\sqrt{34+k}$ $C_1C_2=\lvert r_1-r_2\rvert \Rightarrow k=2$ $\therefore r_2=6$ $\therefore P(\alpha,\beta)=(-3-\sqrt{3},-4-\sqrt{6})$ $\therefore (\alpha+\sqrt{3})^2+(\beta+\sqrt{6})^2=9+16=25.$	
54.	Consider the circle $x^2+y^2=25$ and a point A(1, 2) lying inside it. Consider secants of the circle passing through the point A. It turns out that the midpoint of the secants, lie on another circle of centre (a, b) and radius r, then the value of $a+b+2r^2=$	**D**
	1	
	2	
	3	
	4	

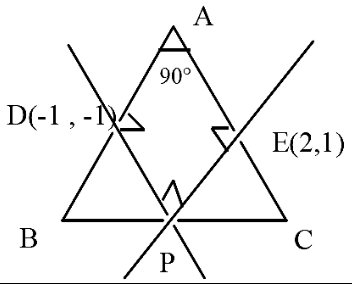
Sol.	Let $P(x_1, y_1)$ be the midpoint of the chord Equation of the chord is $S_1 = S_{11}$ $\Rightarrow xx_1 + yy_1 - 25 = x_1^2 + y_1^2 - 25$ $\Rightarrow x_1^2 + y_1^2 - x_1x - y_1y = 0$ $A(1, 2)$ $\Rightarrow x_1^2 + y_1^2 - x_1 - 2y_1 = 0$ $x^2 + y^2 - x - 2y = 0$ $C\left(\frac{1}{2}, 1\right), r = \frac{\sqrt{5}}{2}$ $a + b + 2r^2 = \frac{1}{2} + 1 + \frac{5}{2} = 4.$	
55.	If a chord of the circle $x^2 + y^2 - 4x - 2y - c = 0$ is trisected at the points $\left(\frac{1}{3}, \frac{1}{3}\right)$ and $\left(\frac{8}{3}, \frac{8}{3}\right)$, then the radius of the circle will be	A
	5	
	7	
	9	
	None of these	
Sol.	$C(2, 1), r$ Chord is $x = y$ $d = \frac{\lvert 2-1 \rvert}{\sqrt{2}} = \frac{1}{\sqrt{2}}$ Length of the chord $= 2\sqrt{r^2 - d^2}$ $\Rightarrow 3\left(\frac{7}{3}\sqrt{2}\right) = 2\sqrt{r^2 - \frac{1}{2}}$ $\Rightarrow 98 = 4\left(r^2 - \frac{1}{2}\right)$ $\Rightarrow r^2 = 25 \Rightarrow r = 5.$	
56.	If $x^2 + y^2 = 16$ and $x^2 + y^2 = 36$ are two circles and P and Q move respectively on these circles such that PQ = 4, then the locus of the midpoint of PQ is a circle of radius is r, then $r^2 =$	**B**
	19	
	22	
	24	
	21	

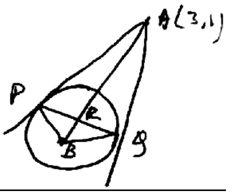
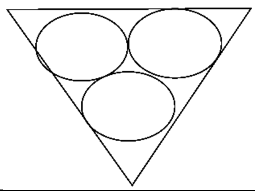
Sol.	**Let** $P(4\cos\alpha,\ 4\sin\alpha), Q(6\cos\beta, 6\sin\beta)$ $PQ = 4 \Rightarrow 16 + 36 - 48\cos(\alpha-\beta) = 16$ $\Rightarrow \cos(\alpha-\beta) = \frac{3}{4}$ $(x, y) = \left(\frac{4\cos\alpha + 6\cos\beta}{2}, \frac{4\sin\alpha + 6\sin\beta}{2}\right)$ $\Rightarrow 2x = 4\cos\alpha + 6\cos\beta$........(1) $\Rightarrow 2y = 4\sin\alpha + 6\sin\beta$..........(2) $(1)^2 + (2)^2 \Rightarrow 4x^2 + 4y^2 = 52 + 48\left(\frac{3}{4}\right)$ $\Rightarrow 4x^2 + 4y^2 = 88$ $\Rightarrow x^2 + y^2 = 22$ $r^2 = 22.$	
57.	If $\frac{1}{\sqrt{1}+\sqrt{2}} + \frac{1}{\sqrt{2}+\sqrt{3}} + \cdots + \frac{1}{\sqrt{99}+\sqrt{100}} = m$ and $\frac{1}{1.2} + \frac{1}{2.3} + \cdots + \frac{1}{99.100} = n$ then the point (m,n) lies on the line	**D**
	$11(x-1) - 100(y-2) = 0$	
	$11(x-2) - 100(y-1) = 0$	
	$11(x-1) - 100y = 0$	
	$11x - 100y = 0$	
Sol.	$\frac{1}{\sqrt{1}+\sqrt{2}} + \frac{1}{\sqrt{2}+\sqrt{3}} + \ldots + \frac{1}{\sqrt{99}+\sqrt{100}} = \mathrm{m}$ On rationalising denominator $\frac{\sqrt{1}-\sqrt{2}}{-1} + \frac{\sqrt{2}-\sqrt{3}}{-1} \ldots \frac{\sqrt{99}-\sqrt{100}}{-1} = \mathrm{m}$ $\sqrt{100} - 1 = \mathrm{m} \Rightarrow \mathrm{m} = 9$ $\frac{1}{1\cdot 2} + \frac{1}{2\cdot 3} + \ldots \frac{1}{99\cdot 100} = \mathrm{n}$ $\frac{1}{1} - \frac{1}{2} + \frac{1}{2} - \frac{1}{3} \ldots \frac{1}{99} - \frac{1}{100} = \mathrm{n}$ $1 - \frac{1}{100} = \mathrm{n} \quad \Rightarrow \frac{99}{100} = \mathrm{n}$ $\therefore (\mathrm{m}, \mathrm{n}) = \left(9, \frac{99}{100}\right)$ $\Rightarrow 11(9) - 100\left(\frac{99}{100}\right) = 99 - 99 = 0$ $\therefore$ option (d) $11x - 100y = 0$ satisfy	
58.	Two vertical poles of height, 20m and 80m stand apart on a horizontal plane. The height (in metres) of the point of intersection of the lines joining the top of each pole to the foot of the other, from this horizontal plane is:	**D**
	15	
	18	
	12	
	16	

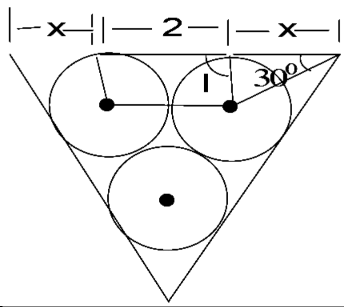
Sol.	Equations of lines OB and AC are respectively $y=\frac{80}{x_1}x$ ...(i)  $\frac{x}{x_1}+\frac{y}{20}=1$ ...(ii) By (i) and (ii) $\frac{y}{80}+\frac{y}{20}=1 \Rightarrow y+4y=80 \Rightarrow y=16$ m Hence, height of intersection point is 16 m.	
59.	Let the circles $C_1: (x-\alpha)^2+(y-\beta)^2=r_1^2$ *and* $C_2: (x-8)^2+\left(y-\frac{15}{2}\right)^2=r_2^2$ touch each other externally at the point (6, 6). If the point (6, 6) divides the line segment joining the centres of the circles C_1 and C_2 internally in the ratio 2 : 1, then $(\alpha+\beta)+4(r_1^2+r_2^2)$ equals.	**B**
	110	
	130	
	125	
	145	
Sol.	**(b)** Given $C_1: (x-\alpha)^2+(y-\beta)^2=r_1^2$ $C_2: (x-8)^2+\left(y-\frac{15}{2}\right)^2=r_2^2$  $P=(6,6)$ $\therefore$ P divides line joint C_1 & C_2 internally in 2 : 1 $\Rightarrow \frac{16+\alpha}{3}=6$ and $\frac{15+\beta}{3}=6$ $\Rightarrow (\alpha,\beta)=(2,3)$ Also, $C_1C_2=r_1+r_2$ $\Rightarrow \sqrt{(2-8)^2+\left(3-\frac{15}{2}\right)^2}=2r_2+r_2$ $\Rightarrow r_2=\frac{5}{2} \Rightarrow r_1=2r_2=5$ Now, $(\alpha+\beta)+4(r_1^2+r_2^2)=5+4\left(\frac{25}{4}+25\right)=130$	
60.	If the incentre of an equilateral triangle is (1, 1) and the equation of its one side is $3x + 4y + 3 = 0$, then the equation of the circumcircle of this triangle is:	**A**
	$x^2+y^2-2x-2y-14=0$	
	$x^2+y^2-2x-2y-2=0$	
	$x^2+y^2-2x-2y+2=0$	
	$x^2+y^2-2x-2y-7=0$	
Sol	**(a)** Let radius of circumcircle be According to the question, $\frac{r}{2}=\frac{10}{5} \Rightarrow r=4$ So equation of required circle is $(x-1)^2+(y-1)^2=16$ $\Rightarrow x^2+y^2-2x-2y-14=0$	

61.	If three distinct points A, B, C are given in the 2–dimensional coordinate plane such that the ratio of the distance of each one of them from the point (1, 0) to the distance from (–1, 0) is equal to $\frac{1}{2}$, then the circumcentre of the triangle ABC is at the point	**A**
	$\left(\frac{5}{3}, 0\right)$	
	(0,0)	
	$\left(\frac{1}{3}, 0\right)$	
	(3, 0)	
Sol	**(a)** Let $P(1,0)$ and $Q(-1,0)$, $A(x,y)$ Given: $\frac{AP}{AQ}=\frac{BP}{BQ}=\frac{CP}{CQ}=\frac{1}{2}$ $\Rightarrow 2AP=AQ \Rightarrow 4(AP)^2=AQ^2$ $\Rightarrow 4[(x-1)^2+y^2]=(x+1)^2+y^2$ $\Rightarrow 4(x^2+1-2x)+4y^2=x^2+1+2x+y^2$ $\Rightarrow 3x^2+3y^2-8x-2x+4-1=0 \Rightarrow 3x^2+3y^2-10x+3=0$ $\Rightarrow x^2+y^2-\frac{10}{3}x+1=0$ ...(i) $\therefore$ A lies on the circle given by (i). As B and C also follow the same condition. $\therefore$ Centre of circumcircle of ΔABC = centre of circle given by (i) = $\left(\frac{5}{3},0\right)$.	
62.	Suppose $ax+by+c=0$, where a,b,c are in A.P. be a normal to a family of circles. The equation of the circle of the family which intersects the circle $x^2+y^2-4x-4y-1=0$ orthogonally is 'S' then radius of 'S' is	**A**
	$\sqrt{8}$	
	$\sqrt{7}$	
	$\sqrt{6}$	
	8	
Sol.	a,b,c are In A.P $\Rightarrow 2b=a+b$ $\quad ax+by+2b-a=0$ $a(x-1)+b(y+2)=0$ represents family of lines passing through the point $(1,-2)$ the equation of circle with $(1,-2)$ and radius r is $(x-1)^2+(y+2)^2=r^2 \rightarrow 1$ Given circle $x^2+y^2-4x-4y+1=0 \rightarrow 2$ 1 and 2 are orthogonally	
63.	The vertex A of ΔABC is (3, -1). Equation of median BE and internal angular bisector CF are $6x+10y-59=0$ and $x-4y+10=0$ respectively. Then the Y –coordinate of B is	**B**
	-8	
	8	
	0	
	4	

Sol.	Let $C=\left(\alpha,\frac{10+\alpha}{4}\right)$ $E=\left(\frac{\alpha+3}{2},\frac{6+\alpha}{8}\right)$ lies on $6x+10y-59=0 \Rightarrow \alpha=10 \quad C=(10,5)$  Also reflection of **A** about **CF** lies on **BC** find equation **BC**, solve BC and **BE**	
64.	The set of all values of a^2 for which the line $x+y=0$ bisects two distinct chords drawn from a point $P\left(\frac{1+a}{2},\frac{1-a}{2}\right)$ on the circle $2x^2+2y^2-(1+a)x-(1-a)y=0$ is equal to	**A**
	$(8,\infty)$	
	$(0, 4)$	
	$(4,\infty)$	
	$(2, 7)$	
Sol	Let $P\left(\frac{1+a}{2},\frac{1-a}{2}\right)=(2h,2k)$ $x^2+y^2-\left(\frac{1+a}{2}\right)x-\left(\frac{1-a}{2}\right)y=0$ Centre $=\left(\frac{1+a}{4},\frac{1-a}{4}\right)=(h,k)$ $x^2+y^2-2hx-2ky=0$ Let $(\alpha,-\alpha)$ be any point on x+y=0 The equation of the chord whose mid point $(\alpha,-\alpha)$ is $S=S_{11}$ $\alpha x-\alpha y-h(x+\alpha)-k(y-\alpha)=\alpha^2+\alpha^2-2hr+2k\alpha$ $2\alpha^2-3(h-k)\alpha+2h^2+2k^2=0$ $\Delta>0$ since these existy two chords $9(h-k)^2-8\left(2k^2+2h^2\right)>0$, $7k^2+7h^2+8hk<0$ $7\left(\frac{1-a}{4}\right)^2+7\left(\frac{1+a}{4}\right)^2+18\left(\frac{1-a^2}{16}\right)<0$, $a^2>8$	
65.	Let sides of an isosceles triangle are $7x-y-4=0$ and $x+y+1=0$ if (1,2) is on the base then the perpendicular distance from origin to the base is	**D**
	2	
	0	
	$3/\sqrt{10}$	
	$5/\sqrt{10}$	
Sol.	Let eq of AB is $7x-y-4=0 \Rightarrow m_1=7$ Let eq of AC is $x+y+1=0 \Rightarrow m_2=-1$ Slope of BC is m $Tan\theta=\left\|\frac{m_1-m}{1+mm_1}\right\|=\left\|\frac{m-m_2}{1+mm_2}\right\| \Rightarrow =1/3,-3$	
66.	The ortho centre of a triangle lies on the variable line $(1+2\lambda)x-(2+\lambda)y=4+5\lambda$ and circum centre lies on $(1+2\mu)x-(2+\mu)y=4\mu+5\ \forall\lambda,\mu\in R$, The centroid of this triangle is (x_1,y_1) then x_1+y_1 is	**A**

	$\frac{-1}{3}$	
	$\frac{1}{3}$	
	0	
	1	
Sol.	Orthocentre is (2,-1) Circumcentre is (1,-2)	
67.	In a $\Delta^{le} ABC,\ x+y+2=0$ is the perpendicular bisector of side AB and it meets AB at (-1, -1). If $x-y-1=0$ is $\perp^{lar}$ bisector of side AC and it meets AC at (2, 1) and P is mid point of BC then distance of P from ortho centre of $\Delta^{le} ABC$ is $\sqrt{k}$ then k is	**C**
	5	
	$\sqrt{8}$	
	13	
	7	
Sol.	Clearly $x+y+2=0$, $x-y-1=0$ are perpendicular to each other $\therefore \angle BAC = 90°$ $\therefore$ A is the ortho centre of $\Delta^{le} ABC$ Mid point of BC = P = circum centre $=\left(\frac{-1}{2}, \frac{-3}{2}\right)$ $\therefore PA^2 = DE^2 = \sqrt{9+4} = \sqrt{13}$ 	
68.	$a = \max\{(x+2)^2 + (y-3)^2\}$ and $b = \min\{(x+2)^2 + (y-3)^2\}$ where (x, y) lies on the circle $x^2 + y^2 + 8x - 10y - 59 = 0$. Then $a + b =$	**B**
	212	
	216	
	215	
	None of these	
Sol.	Sum of the squares of maximum and minimum distances from $(2,3)$ to circle $a+b = (cp+r)^2 + (cp-r)^2 \qquad = \left(9+2\sqrt{2}\right)^2 + \left(9-2\sqrt{2}\right)^2$	
69.	Let B be the centre of the circle $x^2 + y^2 - 2x + 4y + 1 = 0$. Let the tangent at Two points P and Q on the circle intersect at the point A(3, 1). Then $8\left(\frac{\text{Area of } \Delta APQ}{\text{Area of } \Delta BPQ}\right) = \lambda$ then $\frac{\lambda}{9}$ is	**B**
	1	
	2	
	3	
	4	

Sol.	Eq of chord PQ is 2x+3y=0, $AR = \frac{9}{\sqrt{3}}, BR = \frac{4}{\sqrt{13}}$ $8\frac{Area of \Delta APQ}{Area of \Delta BPQ} = 8\frac{AR}{BR} = 18$ 	
70.	The circle passing through the intersection of the circles $x^2 + y^2 - 6x = 0, x^2 + y^2 - 4y = 0$, having its centre on the line $x - y + 1 = 0$, then the radius of the circle is	**D**
	$\frac{\sqrt{72}}{5}$	
	3	
	9	
	$\frac{\sqrt{73}}{5}$	
Sol.	Common chord is $S - S^1 = 0$ $\Rightarrow 6x - 4y = 0$ $\Rightarrow 3x - 2y = 0$ $S + \lambda L = 0 \Rightarrow (x^2 + y^2 - 6x) + \lambda(3x - 2y) = 0$ $\lambda\left(\frac{3\lambda - 6}{-2}, \lambda\right)$, λ lies on the line $x - y + 1 = 0$, $\Rightarrow \frac{3\lambda - 6}{-2} - \lambda + 1 = 0$ $\Rightarrow 3\lambda - 6 + 2\lambda + (-2) = 0$ $\Rightarrow 5\lambda = 8 \Rightarrow \lambda = \frac{8}{5}.$ $5(x^2 + y^2) - 6x - 16y = 0$ $C\left(\frac{3}{5}, \frac{8}{5}\right), r = \sqrt{\frac{9 + 64}{25} - 0} = \frac{\sqrt{73}}{5}.$	
71.	Three coins of unit radius are placed in an equilateral triangle as shown in the following figure. Then, the area of the equilateral triangle is $\alpha + \beta\sqrt{\gamma}$, then $\alpha + \beta + \gamma =$ 	**13**

Sol.	$\tan 30^0 = \frac{1}{x} \Rightarrow x = \sqrt{3}$ $\therefore side = 2 + 2\sqrt{3}$ $\Delta = \frac{\sqrt{3}}{4}\left(2 + 2\sqrt{3}\right)^2$ $= \sqrt{3}\left(1 + \sqrt{3}\right)^2$ $= \sqrt{3}\left(4 + 2\sqrt{3}\right)$ $= 6 + 4\sqrt{3}.$  	
72.	If tangent at (1, 2) to the circle $x^2 + y^2 = 5$ intersects the circle $x^2 + y^2 = 9$ at P and Q and the tangents at P and Q to the second circle meet at the point R (a, b), then 5(a + b) =	**27**
Sol.	Tangent is $\underset{l}{x} + \underset{m}{2y} - \underset{n}{5} = 0$ $R\left(-\frac{lr^2}{n}, -\frac{mr^2}{n}\right) = \left(-\frac{1(9)}{-5}, \frac{-2(9)}{-5}\right) = \left(\frac{9}{5}, \frac{18}{5}\right).$	
73.	If the line 2x + y = k passes through the point which divides the line segment joining the points (1, 1) and (2, 4) in the ratio 3 : 2, then k equals.	**6**
Sol.	$C = \left(\frac{3\times2+2\times1}{3+2}, \frac{3\times4+2\times1}{3+2}\right) = \left(\frac{8}{5}, \frac{14}{5}\right)$ Since Line $2x + y = k$ passes through $C\left(\frac{8}{5}, \frac{14}{5}\right)$ $\Rightarrow \frac{2\times8}{5} + \frac{14}{5} = k \Rightarrow k = 6$	
74.	Let the equation $x^2 + y^2 + px + (1-p)y + 5 = 0$ represent circles of varying radius $r \in (0, 5]$. Then the number of elements in the set $S = \{q : q = p^2 \text{ and } q \text{ is an integer}\} is$________.	**61**
Sol.	**(61)** $r = \sqrt{\frac{p^2}{4} + \frac{(1-p)^2}{4} - 5} = \frac{\sqrt{2p^2 - 2p - 19}}{2}$ Since, $r \in (0, 5] \Rightarrow 0 < 2p^2 - 2p - 19 \le 100$ $\Rightarrow p \in \left[\frac{1-\sqrt{239}}{2}, \frac{1-\sqrt{39}}{2}\right) \cup \left(\frac{1+\sqrt{39}}{2}, \frac{1+\sqrt{239}}{2}\right]$ so, number of integral values of p^2 is 61.	
75.	A straight line cuts off the intercepts OA = a and OB = b on the positive directionof x-axis and y-axis respectively if the perpendicular from origin O to this line makes an angle of $\frac{\pi}{6}$ with positive direction of y-axis and the area of ΔOAB is $\frac{98}{3}\sqrt{3}$. Then $[a^2 - b^2]$ is equal to (where [.] is G.I.F.)	**130**

Sol.

Eq of AB is $x\cos\frac{\pi}{3}+y\sin\frac{\pi}{3}=p$, $\qquad \frac{x}{2}+\frac{y\sqrt{3}}{2}=P$

$A(2P,O),B\left(O,\frac{2}{\sqrt{3}}P\right)$

Area $\Delta OAB=\frac{98}{3}\sqrt{3}$ $\qquad \frac{1}{2}(2P)\frac{2}{\sqrt{3}}P=\frac{98}{3}\sqrt{3}\Rightarrow P^2=49$

$a^2-b^2=4P^2-\frac{4P^2}{3}=\frac{8}{3}P^2=\frac{392}{3}$