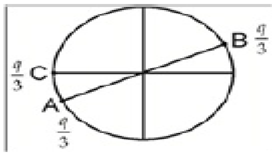
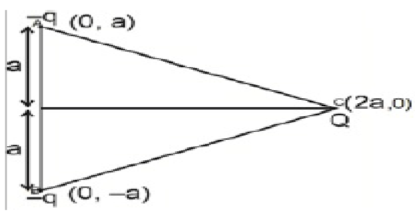
School Name:	**UDAAN**
Test Name:	**Weekly Assessment Class XII Week 1**
Total Questions:	**45**
Marks:	**45**
Duration:	**90 minutes**

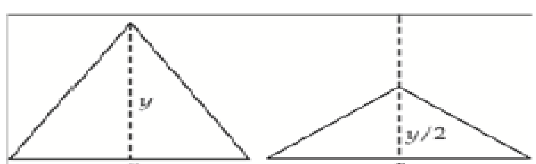
Instructions for Assessment:

- The test is of **1 1/2 hours (90 minutes) duration.**
- The test consists of **45 questions.**
- There are three parts in the question paper **A, B, C consisting of Physics, Chemistry and Mathematics** having 15 questions in each part of equal weightage.
- There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response.
- No candidate is allowed to use any textual material, printed or written, pager, mobile, any electronic device, etc

Section: Physics	
Questions: 15	**Marks: 15**

1.	Three charges are placed at the circumference of a circle of radius R at points A, B & C. The magnitude of force between charges at C & B is:  a. $\frac{Kq^2}{36R^2}$ b. $\frac{Kq^2}{9R^2}$ c. $\frac{Kq^2}{27R^2}$ d. $\frac{4Kq^2}{9R^2}$	**1.0**
2.	Two equal negative charges –q and –q are fixed at (0, a) and (0, –a) any axis. A positive charge Q is released from rest at (2a, o) on x axis. The charge Q will  a. Executive simple Harmonic motion about origin b. Move to infinity c. Move to origin and will remain at rest d. Execute oscillatory but not SHM	**1.0**
3.	The force between two identical metal balls of charges +2Q and –Q separated by distance r is F. The balls are then joined by a conducting wire which is removed afterwards. The force between then will now be: a. $\frac{F}{8}$ b. $\frac{9F}{8}$ c. F d. $\frac{F}{2}$	**1.0**
4.	A proton of mass m_p initially at rest takes time t_1 to move through distance x in an electric field. Now an electron of mass m_e initially at rest is allowed to move through same distance x in time t_2. The ratio of mass of proton to mass of electron is: a. $\left(\frac{t_1}{t_2}\right)^2$ b. Independent of t c. 1 d. $\left(\frac{t_2}{t_1}\right)^2$	**1.0**

5.	Three point charges q_1, q_2 and q_3 are placed at equal distances along a straight line in such a way that q_2 and q_3 have equal magnitude but opposite sign. If the net force on q_3 is zero then the ratio $\frac{q_1}{q_2}$ is: a. -4 b. $+4$ c. $-\frac{1}{4}$ d. $+\frac{1}{4}$	**1.0**
6.	A charge Q is places at each of the opposite corners of a square. A charge q is placed at each of the other two comers. If the net electrical force on Q is zero, then the $\frac{Q}{q}$ a. $-2\sqrt{2}$ b. -1 c. 1 d. $-\frac{1}{\sqrt{2}}$	**1.0**
7.	A charge Q is places at each of the opposite comers of a square. A charge q is placed at each of the other two comers. If the net electrical force on Q is zero, then the $\frac{Q}{q}$ a) $-2\sqrt{2}$ b) -1 c) 1 d) $-\frac{1}{\sqrt{2}}$	**1.0**
8.	The electrostatics potential inside a charged spherical ball is given by $\phi = ar^2 + b$ where r is the distance from the centre; a, b are constants. Then the charge density inside ball is a) $-6a\varepsilon_0$ b) $-24\pi a\varepsilon_0$ c) $-6a\varepsilon_0$ d) $-24\pi a\varepsilon_0 r$	**1.0**
9.	Two point charges are kept at rest at a distance d from each after in a medium of dielectric constant 81. The distance between these two charges in air, to have new force between them as 5F is: a. $\frac{81}{5}d$ b. $\frac{\sqrt{5}}{9}d$ c. $\frac{9}{\sqrt{5}}d$ d. $\frac{d}{\sqrt{5}}$	**1.0**

10.	This question contains Statement 1 and Statement 2. Of the four choices given after the statements, choose the one that best describes the two statements. **Statement 1:** The temperature dependence of resistance is usually given as $R = R_0 (1 + \alpha\Delta t)$. The resistance of a wire changes from 100 Ω to 150 Ω when its temperature is increased form 27°C to 227°C. This implies that α = 2.5×10^{-3}/°C. **Statement 2:** $R = R_i (1 + \alpha\Delta T)$ is valid only when the change in the temperature ΔT is small and $\Delta R = (R - R_0) << R_0$. a) Statement 1 is true, Statement 2 is false b) Statement 1 is true, Statement 2 is true; Statement 2 is the correct explanation of Statement 1. c) Statement 1 is true, Statement 2 is true; Statement 2 is not the correct explanation of Statement 1. d) Statement 1 is false, Statement 2 is true	**1.0**
11.	A hollow metal sphere of radius 2.5cm is charged such chat potential on its surface is 20v. The potential at the centre of sphere is: a) Zero b) same as that on the surface c) different from that on surface d) half of that on surface	**1.0**
12.	A conducting bubble of thickness t less than the radius of bubble has a potential v. If the bubble collapses then the potential of the droplet to which bubble collapses is: a) $\frac{va\frac{4}{3}}{(3t)\frac{1}{b}}$ b) $vt-\frac{1}{3}$ c) $v\left(\frac{a}{3t}\right)\frac{1}{3}$ d) $vt-\frac{1}{2}$	**1.0**
13.	Two pith balls carrying equal charges are suspended from a common point by strings of equal length, the equilibrium separation between them is *r*. Now the strings are rigidly clamped at half the height. The equilibrium separation between the balls now becomes:  a. $\left(\frac{2r}{\sqrt{3}}\right)$ b. $\left(\frac{2r}{3}\right)$ c. $\left(\frac{1}{\sqrt{2}}\right)^2$ d. $\left(\frac{r}{\sqrt{2}}\right)$	**1.0**

14.	Two identical plane metallic plate are kept parallel to each other. The plates are separated by 2cm. First plate is raised to potential of 100v and outer surface of 2nd plate is ear tied as shown. The magnitude and direction of ε. Field between y & z is: a) $5x10^3 \frac{v}{m}$ direction y to z b) $5x10^3 \frac{v}{m}$ direction z to y c) $100 \frac{v}{m}$ direction y to z d) $100 \frac{v}{m}$ direction y to z	**1.0**
15.	A spherical mass, m of an element $^{A}_{Z}X$, has a total of N atoms. The fraction, of electrons present in this mass of the element, that should be removed to give this sphere a charge of $+q\,\mu$ C, equals a. $\frac{qZ}{1.6\ N} \times 10^{-4}$ b. $\left(\frac{6.25\,q}{ZN}\right) \times 10^{-14}$ c. $\left(\frac{6.25}{ZN}\right) \times 10^{-20}$ d. $\left(\frac{qZ}{1.6\ N}\right) \times 10^{-20}$	**1.0**

Section: Chemistry	
Questions: 15	**Marks: 15**

16.	In a reaction, the concentration of a reactant (A) changes from 0.200 mol litre^{-1} to 0.150 mol litre^{-1} in 10 minutes. What is the average rate of a reaction during this interval? a. 0.001 mol L^{-1} min^{-1} b. 0.002 mol L^{-1} min^{-1} c. 0.115 mol L^{-1} min^{-1} d. 0.005 mol L^{-1} min^{-1}	**1.0**
17.	The half time of first order decomposition of nitramide is 2.1 hour at 15°C $NH_2NO_2(ar) \longrightarrow N_2O(g) + H_2O(r)$ If 6.2g of NH_2NO_2 is allowed to decompose, what is the a. Time taken for NH_2NO_2 is decompose 99% b. Volume of dry N_2O produced at this point measured at STP. a. 13.95 hour, 2.217 L b. 19.85 hour, 16.17L c. 31.25 hour, 18.62 L d. 15.62 hour, 3.17L	**1.0**
18.	A first order reaction : $A \to B$ requires activation energy of 89 KJ/mol. When 20% solution of A was kept at 27°C for 40 minutes, 25% decomposition took place. What will be the percent decomposition in the same time in a 30% solution maintained at 37°C? (the activation energy remains constant in this range of temperature) a. 50.0% b. 60.0% c. 70.0% d. 80.0%	**1.0**
19.	In an ore containing Uranium, the ratio of U^{238} to Pb^{206} nuclei is 3. Calculate the age of the ore. assuming that all the lead present in the ore is the final stable product is U^{238}. The half life is of U^{238} is 4.5×10^9 years. a. 0.85×10^{10} years b. 2×10^{5} years c. 1.85×10^{9} years d. 3.45×10^{9} years	**1.0**
20.	The activation energy of reaction: A+B $\longrightarrow$ products is 105.73 KJ/mol. At 40°C, the products are formed at the rate of 0.133 mol L^{-1} min^{-1}. What will be rate of formation of products at 80°C? a. 15.0 mol/L/min b. 13.3 mol/L/min c. 14.0 mol/L/min d. 14.3 mol/L/min	**1.0**

21.	What will be the order of reaction given below? $NH_4CNO \longrightarrow NH_2CONH_2$ The reaction is completed in three steps as : i. $NH_4CNO \rightleftharpoons NH_4NCO$ (fast equilibrium) ii. $NH_4NCO \rightleftharpoons NH_3 + H-N=C=O$ (fast equilibrium) iii. $NH_3 + H-N=C=O \rightarrow NH_2CONH_2$ (slow) a. $\frac{d[urea]}{dt} = K^1[NH_4CNO]^2$ b. $\frac{d[urea]}{dt} = K^1[NH_4CNO]^3$ c. $\frac{d[urea]}{dt} = K^1[NH_4CNO]^3$ d. $\frac{d[urea]}{dt} = K^1[NH_4CNO]$	**1.0**
22.	For the reversible reaction is equilibrium: $A \underset{K_2}{\overset{K_1}{\rightleftharpoons}} B$. The values of K_1 and K_2 are 2×10^{-3} mol L^{-1} sec^{-1} and 3×10^{-3} sec^{-1} respectively. If 0.5 moles of B are added to the equilibrium mixture, initially having 2 moles of A, what will be the time taken for concentration of B to become $\frac{3}{4}$ of the concentration of A at initial equilibrium? (The volume of mixture is 1L and remains constant) a. 89.24 sec b. 83.44 sec c. 94.18 sec d. 98.14 sec	**1.0**
23.	A certain reaction A + B$\longrightarrow$ Products; is first order w.r.t. each reactant with $k = 5\times10^{-3} M^{-1}S^{-1}$. What is the concentration of A remaining after 100s if the initial concentration of A 0.1M and that of B was 6.0M? a. 5×10^{-3} M b. 6×10^{-3} M c. 7×10^{-3} M d. 8×10^{-3} M	**1.0**
24.	The nucleonic ratio of $_1H^3$ to $_1H^1$ in a sample of water is $8.0\times10^{-8}:1$. Tritium undergoes decay with a half life period of 12.0 years. How many tritium atoms would a 10.0 gm of such sample contain 36 years after the original sample is collected? a. 3.66×10^5 atoms b. 5.66×10^5 atoms c. 6.68×10^8 atoms d. 6.66×10^5 atoms	**1.0**
25.	The decomposition of N_2O_5 according to following reactions is first order reactions: $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ After 30 minutes from start of the decomposition in a closed vessel, the total pressure developed is found to be 250 mm of Hg and on complete decomposition, the total pressure is 500mm of Hg. What is the rate constant of the reaction? a. 3.08×10^{-5} min^{-1} b. 6.08×10^{-3} min^{-1} c. 6.01×10^{-7} min^{-1} d. 7.02×10^{-8} min^{-1}	**1.0**

26.	Two second order reactions given below having identical frequency factors: i. A $\rightarrow$ products ii. B $\rightarrow$ products The Ea for first reaction is 10.46 KJ/mol more than that of B. At 100°C, the reaction (i) is 30% completed after 60 minutes when initial concentration of A is 0.1 mol chm^{-3}. How long will it take for reaction (ii) to reach 70% completion at the same temperature if initial concentration of B is 0.05 mol L^{-1}? a. 44.4 min b. 22.22 min c. 66.6 min d. 32.5 min	**1.0**
27.	The activation energy of a non-catalysed reaction at 37°C is 200 KCal/mol and the activation energy of the same reaction when catalysed decreases to only 60.0 Kcal/mol. What is the ratio of rate constants of the two reactions? a. 10^{90} b. 10^{80} c. 10^{98} d. 10^{28}	**1.0**
28.	Activation energy of a reaction is a. The energy released during the reaction. b. the energy evolved when activated complex is formed c. minimum amount of energy needed to form one mole of the product d. minimum amount of energy needed to overcome the potential barrier of reaction	**1.0**
29.	In the reaction $2A \underset{K_2}{\overset{K_1}{\rightleftharpoons}} B$, the rate of disappearance of A is equal to: a. $2\frac{K_1}{K_2}[A]^2$ b. $-2K_1[A]^2 + 2K_2[B]$ c. $+2K_1[A]^2 - 2K_2[B]$ d. $(2K_1 - K_2)[A]$	**1.0**
30.	The decomposition of Cl_2O_7 at 400K in the gas phase to Cl_2 and O_2 is of I order. After 55 sec. at 400K, the pressure of $Cl_2O \longrightarrow$ falls from 0.062 to 0.044 atm. What is the value of a. the rate constant b. pressure of Cl_2O_7, after 100 sec? a. $K = 6.023 \times 10^{-3}\ sec^{-1}, P = 0.033atm$ b. $K = 6.044 \times 10^{-30}\ sec^{-1}, P = 0.044atm$ c. $K = 3.044 \times 10^{-20}\ sec^{-1}, P = 0.144atm$ d. $K = 1.66 \times 10^{-20}\ sec^{-1}, P = 0.144atm$	**1.0**

Section: Mathematics	
Questions: 15	**Marks: 15**

31.	Let a, b, c be such that $b(a+c) \neq 0$. If $\begin{vmatrix} a & a+1 & a-1 \\ -b & b+1 & b-1 \\ c & c-1 & c+1 \end{vmatrix} + \begin{vmatrix} a+1 & b+1 & c-1 \\ a-1 & b-1 & c+1 \\ (-1)^{n+2}a & (-1)^{n+1}b & (-1)^{n}c \end{vmatrix} = 0$ Then the value of 'n' is a. Zero b. any even integer c. any odd integer d. any integer	**1.0**
32.	Let $A = \begin{vmatrix} 5 & 5\alpha & \alpha \\ 0 & \alpha & 5\alpha \\ 0 & 0 & 5 \end{vmatrix}$ If det $(A^2) = 25$, then $\lvert \alpha \rvert$ is Let a. 1 b. $\frac{1}{5}$ c. 5 d. 5^2	**1.0**
33.	I f $A_r = \begin{bmatrix} r & r-1 \\ r-1 & r \end{bmatrix}$ where r is a natural number. Then $\lvert A_1 \rvert + \lvert A_2 \rvert + \dots + \lvert A_{2010} \rvert$ must be equal to a. 2010 b. $(2010)^2$ c. 2011 d. $(2010)^3$	**1.0**
34.	The value of θ lying between $\theta = 0$ and $\theta = \frac{\pi}{2}$ and satisfying the equation $\begin{vmatrix} 1+\sin^2\theta & \cos^2\theta & 4\sin 4\theta \\ \sin^2\theta & 1+\cos^2\theta & 4\sin 4\theta \\ \sin^2\theta & \cos^2\theta & 1+4\sin 4\theta \end{vmatrix} = 0$ is a. $\frac{5\pi}{24}$ b. $\frac{7\pi}{24}$ or $\frac{11\pi}{24}$ c. $\frac{3\pi}{8}$ d. $\frac{\pi}{24}$	**1.0**

35.	If the three linear equations $x + 4ay + ax = 0$, $x + 3by + bz = 0$ and $x+2cy + cz = 0$ have a non trivial solution, then a, b, c are in a. H.P b. G.P c. A.P d. None of these	1.0
36.	If $D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$ and $D' = \begin{vmatrix} a_1 + pb_1 & b_1 + qc_1 & c_1 + ra_1 \\ a_2 + pb_2 & b_2 + qc_2 & c_2 + ra_2 \\ a_3 + pb_3 & b_3 + qc_3 & c_3 + ra_3 \end{vmatrix}$, then a. $D' = D(1+pqr)$ b. $D' = D$ c. $D' = D(1 - pqr)$ d. $D' = D(1 + p + q + r)$	1.0
37.	Consider the system of equations $x - 2y + 3z = -1$ $-x + y - 2z = k$ $x - 3y + 4z = 1$ Statement–1: The system of equations has no solution for $k \neq 3$. and Statement–2: The determinant $\begin{vmatrix} 1 & 3 & -1 \\ -1 & -2 & k \\ 1 & 4 & 1 \end{vmatrix} \neq 0$, for $k \neq 3$. a. Statement–1 is true, Statement–2 is true; Statement-2 is a correct explanation for Statement-1 b. Statement–1 is true, Statement–2 is true; Statement-2 is not correct explanation for Statement-1 c. Statement–1 is true, Statement–2 is false d. None of these	1.0
38.	If $\Delta = \begin{vmatrix} x & 2y - z & -z \\ y & 2x - z & -z \\ y & 2y - z & 2x - 2y - z \end{vmatrix}$, then a. $(x + y)$ is a factor of Δ b. $(x - y)^2$ is a factor of Δ c. $(x + y + z)$ is a factor of Δ d. $(y - z)$ is a factor of Δ	1.0
39.	If $f(x) = \begin{vmatrix} \sin 2x(1 + 2\cos x) & \sin 2x & \sin 3x \\ 3 + 4\sin x & 3 & 4\sin x \\ 1 + \sin x & \sin x & 1 \end{vmatrix}$ then the range of f(x) is a. (0, 1] b. (0, 1) c. [-1, 1] d. (-1, 1)	1.0

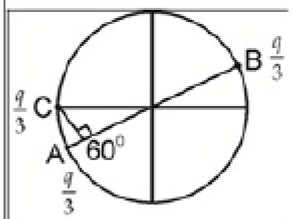
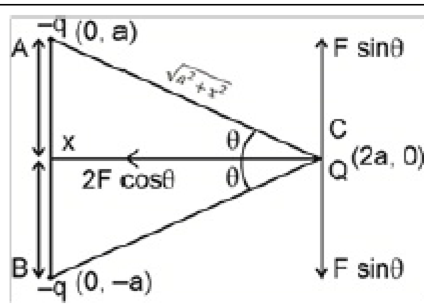
40.	The maximum value of the determinant $\Delta = \begin{vmatrix} 1+\sin^2 x & \cos^2 x & 4\sin 2x \\ \sin^2 x & 1+\cos^2 x & 4\sin 2x \\ \sin^2 x & \cos^2 x & 1+4\sin 2x \end{vmatrix}$ is a. 2 b. 1 c. -2 d. 6	**1.0**
41.	The value of x for which $\begin{vmatrix} x & 2 & 2 \\ 3 & x & 2 \\ 3 & 3 & x \end{vmatrix} + \begin{vmatrix} 1-x & 2 & 4 \\ 2 & 4-x & 8 \\ 4 & 8 & 16-x \end{vmatrix} > 33$ is a. $x \in \left(-\frac{1}{7},\ 1\right)$ b. $x \in \left(-\infty,\ -\frac{1}{7}\right] \cup [1,\ \infty)$ c. $x \in \left(-\infty,\ -\frac{1}{7}\right) \cup (1, \infty)$ d. $x \in \left(-\infty,\ -\frac{1}{7}\right) \cup (1, \infty)$	**1.0**
42.	The determinant $\Delta = \begin{vmatrix} a^2+x & ab & ac \\ ab & b^2+x & bc \\ ac & bc & c^2+x \end{vmatrix}$ is divisible by a. x^2 b. x^3 c. $(a^2+b^2+c^2)$ d. $(a^2+b^2+c^2-x)$	**1.0**
43.	If $f(x) = \begin{vmatrix} a & -1 & 0 \\ ax & a & -1 \\ ax^2 & ax & a \end{vmatrix}$ then $f(2x) - f(x)$ is divisible by a. x^2 b. (a + x) c. $(a+x)^2$ d. (2a + 3x)ax	**1.0**
44.	Vertices of a triangle are given as $[P(P+1), (P+1)]$, $[(P+1)(P+2), P+2]$ and $[(P+2)(P+3), P+3]$. Then area of triangle is a. -1 b. 1 c. 2 d. -2	**1.0**

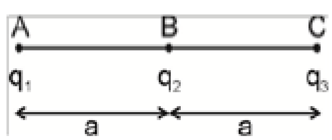
45.	Area of a triangle whose vertices are (0, 0) $(a\tan\theta, b\cot\theta)$, $(a\sin\theta, b\cos\theta)$ is a. $ab(\sin\theta-\cos\theta)$ b. Independent of a c. Independent of b d. $\frac{1}{2}ab(\sin\theta-\cos\theta)$	**1.0**

Key

Question Number	Correct Option	Question Number	Correct Option	Question Number	Correct Option
1.	C	16.	D	31.	C
2.	D	17.	A	32.	B
3.	A	18.	B	33.	B
4.	A	19.	C	34.	B
5.	A	20.	B	35.	A
6.	A	21.	D	36.	A
7.	A	22.	A	37.	A
8.	C	23.	A	38.	B
9.	C	24.	D	39.	C
10.	A	25.	C	40.	D
11.	B	26.	B	41.	C
12.	C	27.	C	42.	A
13.	D	28.	D	43.	C
14.	A	29.	C	44.	B
15.	B	30.	A	45.	D

Explanation

Question Number	Explanation
1.	$\left\|\vec{F}_{CB}\right\| = \dfrac{K\frac{q}{3}\frac{q}{3}}{\left(R\sqrt{3}\right)^2}$  sin 60 $= \dfrac{BC}{AB}$ BC = AB sin 60 $= \cancel{2}\dfrac{R\sqrt{3}}{\cancel{2}}$ $= \dfrac{Kq^2}{37R^2}$
2.	 $F_x = 2F\cos q$ $= 2\dfrac{KqQ}{a^2+x^2}\dfrac{x}{\sqrt{a^2+x^2}}$ $= \dfrac{2KqQx}{\left(a^2+x^2\right)^{3/2}}$ F_x must be proportional to displacement for SHM but this is not being fulfilled. However it will keep moving along CA and CB.

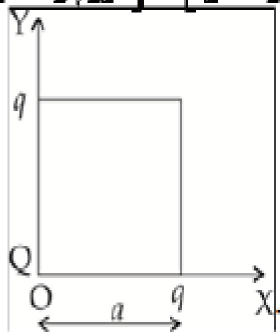
3.	$\left\|\vec{F}\right\| = \frac{2KQ^2}{r^2}$ After redistribution of charge new charge $= \frac{2Q-Q}{2} = \frac{Q}{2}$ $F' = K\frac{\frac{Q}{2}\frac{Q}{2}}{r^2} = \frac{KQ^2}{4r^2}$ $F' = \frac{2KQ^2}{8r^2} = \frac{F}{8}$
4.	$s = ut + \frac{1}{2}at^2$ $a = \frac{F}{m}$ Force due to E is $F = eE$ $a = \frac{eF}{m}$ magnitude of charge on electron and proton is same $x = \frac{1}{2}\frac{eE}{m_p}t_1^2$ $x = \frac{1}{2}\frac{eE}{m_e}t_2^2$ $\frac{et}{m_8}t_1^2 = \frac{eE}{m_e}t_2^2$ $\frac{m_e}{m_p} = \frac{t_2^2}{t_1^2}$ $\frac{m_p}{m_e} = \frac{t_1^2}{t_2^2}$
5.	 $\left\|\overrightarrow{F_{CB}}\right\| = K\frac{q_2q_3}{a^2}$ $\left\|\overrightarrow{F_{CA}}\right\| = K\frac{q_1q_3}{4a^2}$ $F_{CB} + F_{CA} = 0$ $\frac{\cancel{K}q_2\cancel{q_3}}{\cancel{a^2}} = \frac{-\cancel{K}q_1\cancel{q_3}}{4\cancel{a^2}}$ $\frac{q_1}{q_2} = -4$

6.

The total force on the charge Q, taken as the origin, due to the other three charges, is zero.We, therefore, have $\frac{1}{4\pi\varepsilon_0}\frac{Qq}{a^2}(-\hat{i})+\frac{1}{4\pi\varepsilon_0}\frac{Qq}{a^2}(-\hat{j})+$

$$\frac{1}{4\pi\varepsilon_0}\frac{QQ}{[(Q-a)^2+(0-a)^2]^{3/2}}\left[(0-a)\hat{i}+(0-a)\hat{j}\right]=0 \text{Or}$$

$$\left[\frac{Qq}{a^2}+\frac{Q^2}{2\sqrt{2}a^2}\right]\hat{i}+\left[\frac{Qq}{a^2}+\frac{Q^2}{2\sqrt{2}a^2}\right]\hat{j}=0$$



The coefficients of $\hat{i}$ as well as $\hat{j}$ have both to be zero each. These coefficients, being identical, the relevant condition is

$$\frac{Qq}{a^2}+\frac{Q^2}{2\sqrt{2}a^2}=0 \text{ or } q+\frac{Q}{2\sqrt{2}}=0 \Rightarrow \frac{Q}{q}=-2\sqrt{2}$$

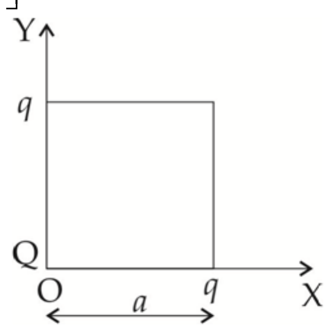
7.

The total force on the charge Q, taken as the origin, due to the other three charges, is zero.
We, therefore, have

$$\frac{1}{4\pi\varepsilon_0}\frac{Qq}{a^2}(-\hat{i})+\frac{1}{4\pi\varepsilon_0}\frac{Qq}{a^2}(-\hat{j})$$

$$+\frac{1}{4\pi\varepsilon_0}\frac{QQ}{[(Q-a)^2+(0-a)^2]^{3/2}}[(0-a)\hat{i}+(0-a)\hat{j}]=0$$

Or $\left[\frac{Qq}{a^2}+\frac{Q^2}{2\sqrt{2}a^2}\right]\hat{i}+\left[\frac{Qq}{a^2}+\frac{Q^2}{2\sqrt{2}a^2}\right]\hat{j}=0$



The coefficients of $\hat{i}$ as well as $\hat{j}$ have both to be zero each. These coefficients, being identical, the relevant condition is

$$\frac{Qq}{a^2}+\frac{Q^2}{2\sqrt{2}a^2}=0 \text{ or } q+\frac{Q}{2\sqrt{2}}=0$$

$$\Rightarrow \frac{Q}{q}=-2\sqrt{2}$$

8.	The electric field, inside the ball, can be obtained by using the relation $E = -\dfrac{\partial \phi}{\partial r}$ In the present case, $E = -\dfrac{\partial}{\partial r}(ar^2 + b) = -2ar$ Thus E increases in direct proportion to a. This implies that the charge density inside to spherical ball is constant, *i.e.*, the sphere is uniformly charged. Let ρ be the uniformly density of charge inside the spherical ball. Using Gauss's theorem, we get $E(r).\ 4\,\varepsilon_0\, r^2 = \dfrac{1}{\varepsilon_0}\left[\rho\left(\dfrac{4\pi}{3}r^3\right)\right]$ $\varepsilon_0 = \dfrac{3E(r).\varepsilon_0}{r} = \dfrac{-6ar\varepsilon_0}{r} = -6a\,\varepsilon_0$.
9.	$F = \dfrac{q_1 q_2}{81 r^2}$ $r^2 = \dfrac{q_1 q_2}{81F}$ $5F = \dfrac{q_1 q_2}{r'^2}$ $r'^2 = \dfrac{q_1 q_2}{5F}$ $\dfrac{r'^2}{r^2} = \dfrac{81}{5}$ $r' = \dfrac{9}{\sqrt{5}} r$
10.	From $R = R_0\,(1 + \alpha t)$, we get $\alpha = \dfrac{R - R_0}{R_0 t} = \dfrac{150 - 100}{100 \times (227 - 27)}$ /°C = 2.5×10^{-3}/°C Hence statement (1) is correct. Statement (2) is, however, false, as it talks about the condition $\Delta R\ (= R - R_0) << R_0$, which is not a valid condition.
11.	The electric potential behaves as if whole charge is concentrated at the centre.
12.	Let a be the radius of bubble $v = \dfrac{kq}{a}$ $q = \dfrac{va}{k}$ (1) Let R be the radius of bubble $\dfrac{4}{3}\pi R^3 = \left(4\pi a^2\right) \times t$ $R^3 = 3a^2t$

<table>
<tr>
<td></td>
<td>
R = $(3a^2t)\ \frac{1}{3}$ (2)
$v' = \frac{kq}{R}$ (3)
Potential of droplet to which bubble collapse
Use 1 & 2 in 3
$v' = \frac{\cancel{k}va}{\cancel{k}\left(3a^2t\right)\frac{1}{3}} = v\left(\frac{a}{3t}\right)^{\frac{1}{3}}$
</td>
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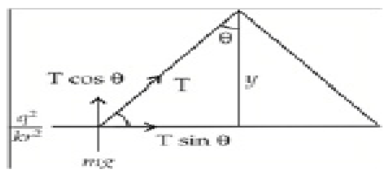
<tr>
<td>13.</td>
<td>
$T\sin\theta = \frac{q^2}{kr^2}, \ T\cos\theta = mg.$


$\tan\theta = \frac{q^2}{kr^2mg} = \frac{\frac{1}{2}}{y} r \propto y^{\frac{1}{3}}.$
Therefore, if $y \to \frac{y}{2}$, then $r \to \frac{r}{\sqrt[3]{2}}$.
</td>
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<tr>
<td>14.</td>
<td>
$E = -\frac{dv}{dt} = \frac{10000}{10^2} = 5x10^3\ \frac{v}{m}$
Direction is from y to z as ε.F points in the direction of decrease of potential.
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<td>15.</td>
<td>
Each (neutral) atom, of the element ${}^{A}_{Z}X$, has Z electrons.∴ Total number of electrons in N atoms = ZN.To give the sphere a positive charge $+q(\mu C)$, the number, n, of electrons that need to be removed
is $\eta = \frac{q \times 10^{-6}}{|\text{charge on the electron}|} = \frac{q \times 10^{-6}}{1.6 \times 10^{-19}} = \left(\frac{q}{1.6}\right) \times 10^{-3}$ ∴ The required fraction is=
$\left(\frac{q}{1.6}\right) \times \frac{10^{-13}}{ZN} = \left[\left(\frac{6.25q}{ZN}\right) \times 10^{-14}\right]$ Hence choice (2) is the correct choice.
</td>
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<tr>
<td>16.</td>
<td>
$[A]_{initial}$ = 0.200 mol L^{-1} (given)
$[A]_{final}$ = 0.150 mol^{-1} (given)
Time = 10 minutes (given)
⇒ [A] = $[A]_{final}$ - $[A]_{initial}$
= [0.150 - 0.200]
= - 0.050 mol L^{-1}
⇒ t = 10 minutes
Average rate of a reaction $= -\frac{\Delta[A]}{\Delta t} = \frac{-(-0.050)}{10}$
$= \frac{0.050}{10} = 0.005 mol L^{-1} min^{-1}$
</td>
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17.	For first order reaction: $t=\frac{2.303}{K}\log\frac{a}{(a-x)}$ If $t=\frac{t}{2},\ x=\frac{a}{2}$ $\therefore t_{1/2}=\frac{2.303}{k}\log\frac{a}{a-\frac{a}{2}}$............(1) If $t=t_{99\%}\quad x=\frac{99a}{100}$ $t_{99\%}=\frac{2.303}{k}\log\frac{a}{a-\frac{aa}{100}a}$...............(ii) For equation (i) and (ii) $t_{99\%}=\frac{\log 100}{\log 2}\times t_{1/2}-\frac{2}{0.3010}\times 2.1=13.95\text{hour}$ Also, mole of N_2O formed $=\frac{99}{100}\times$ mole of NH_2NO_2 taken $=\frac{99}{100}\times\frac{6.2}{62}=0.099$ Volume of N_2O formed at STP $=0.099\times 22.4=2.217\text{L}$
18.	At 27°C, 20% of A decomposes 25% Using first order equation we get, $kt=2.303\log_{10}\frac{C_o}{C_f}$ Where C_o = initial concentration C_f = final concentration $=2.303\log_{10}\frac{1}{1-\alpha}$ $=\ln\frac{1}{1-\alpha}[\alpha=0.25]$ (given) $K(40)=\ln\frac{100}{75}$ $\Rightarrow K(\text{at }300K)=\frac{1}{40}\ln\frac{4}{3}\text{min}^{-1}$ Using Arrhenius equation find K at 310K. $\log_{10}\left(\frac{K_{310}}{K_{300}}\right)=\frac{Ea}{2.303R}\left(\frac{T_2-T_1}{T_1T_2}\right)$ $\log_{10}\frac{K_{310}}{K_{300}}=\frac{89\times 10^3}{2.303\times 8.31}\left(\frac{310-300}{310\times 300}\right)=0.5$ $K(\text{at}310K)=K(\text{at}300K)\times\sqrt{10}$ Now calculate % decomposition at 310K using first order kinetics. $Kt=2.303\log_{10}\frac{C_o}{C_t}$ $K\times 40=\ln\frac{1}{1-\alpha}$ $\ln\frac{1}{1-\alpha}=\left[\left(\frac{1}{40}\ln\frac{4}{3}\right)\times\sqrt{10}\right]\times 40$ = 0.91 $\log 10\frac{1}{1-\alpha}=\frac{0.91}{2.303}=0.40$ $\frac{1}{1-\alpha}=2.5$ $\Rightarrow\alpha=0.6$ $\Rightarrow\alpha=0.6=60.0\%$ decomposition of A at 310K.

19.	$U^{238} \rightarrow Pb^{206}$ $N_0 \equiv x$ 0 $N_t \equiv x-y$ y (initial conc. of product is always 0.) $\Rightarrow \frac{N_0}{N_t} = \frac{x}{x-y}$ Using $\lambda t = 2.303\log_{10}\frac{x}{x-y}$ Given $\frac{x-y}{y} = 3 \Rightarrow \frac{x}{x-y} = \frac{4}{3}$ $\Rightarrow t = \frac{2.303}{0.693}\times 4.5\times 10^9 \log_{10}\frac{4}{3}$ $t = 1.85\times 10^9$ years Note - The radioactive decay follows first order kinetics. Here, we take $N_0 \equiv C_0$, $N_t \equiv C_t$ and $\lambda \equiv K$.
20.	Let the rate law be defined as At $T_1, r_1 = K_1[A]^x[B]^y$ At $T_2 r_2 = K_2[A]^x[B]^y$ $r_2 = r_1\left(\frac{K_2}{K_1}\right)$ Using Arrhenius equation, find K at 40°C. $\log_{10}\frac{K_2}{K_1} = \frac{Ea}{2.03k}\left(\frac{T_2-T_1}{T_1T_2}\right)$ $= \log_{10}\frac{K_2}{K_1} = \frac{105.73\times10^3}{2.303\times8.31}\left(\frac{40}{313\times353}\right)$ $\log_{10}\frac{K_2}{K_1} = 2.0$ $\frac{K_2}{K_1} = 100$ $r_2 = 0.133\times100 = 13.3\,mol L^{-1}\,min^{-1}$
21.	The rate of formation of urea is given by equation $\frac{d[urea]}{dt} = K[NH_3][HNCO]$.....................(a) By step (ii) we have $\frac{[NH_3][HNCO]}{[NH_4NCO]} = Kc_1$...........(b) By step (i) we have, $\frac{[NH_4NCO]}{[NH_4CNO]} = Kc_2$...........(c) By equation (b) and (c) $[NH_3][HNCO] = K_{C_1}.K_{C_2}[NH_4CNO]$............(d) By equation (a) and (d) $\frac{d[urea]}{dt} = K.K_{C_1}.K_{C_2}[NH_4CNO]$ $\frac{d[urea]}{dt} = K^1[NH_4CNO]$

22.	$A \underset{K_2}{\overset{K_1}{\rightleftharpoons}} B$ t = 0 2 mol L^{-1} 0 At. Eq. $(2-X)molL^{-1}$ x $K_1 = 2\times10^{-3} molL^{-1} sec^{-1}$(zero order) $K_2 = 3\times10^{-3} sec^{-1}$(1st order) $\frac{dx}{dt} = K_1[A]^0 - K_2[B]^1$ At equilibrium $= \frac{K_1}{K_2} = \frac{2\times10^{-3}}{3\times10^{-3}} = 0.66 mol\ L^{-1}$ = K_C $A \rightleftharpoons B$ Initial Eq. 1.34 0.66 Moles added at equilibrium 1.34 0.66 + 0.5 = 1.16 Addition of B will bring backward reaction at time t $A \rightleftharpoons B$ $(134+x)$ $(1.16-x)$ $[B] = \frac{3}{4}[A]_{t_{eq.}} = \frac{3}{4}\times1.34 = 1.005$ $(1.16-x) = 1.005$ $\therefore x = 0.155$ Now, $\frac{dx}{dt} = K_1 - K_2[x] = 0.66\ \ K_2 - K_2\ X$ $= K_2[0.66-X]$ $\therefore \frac{dx}{(0.66-x)} = K_2.dt$ OR $-2.303\log(0.66-x) = K_2.t + C$ At t = 0, X = 0 $\therefore C = -2.303\log 0.66$ $\therefore K_2xt = 2.33\log\frac{0.66}{0.66-X}$ $t = \frac{2.303}{3\times10^{-3}}\log\frac{0.66}{0.66-0.155}$ $= 89.24$**sec.**
23.	A + B $\longrightarrow$ Products Given : Rate = K [A] [B] (IInd order reaction) Now, since [B] >> [A], [B] can be assumed to remain constant throughout the reaction. Thus, the rate law for the reaction, becor Rate $\approx K_0[A]$ Where $K_o = K[B] = 5.0\times10^{-3}\times6.05S^{-1} = 3.0\times10^{-2}S^{-1}$. Note : $A + B \xrightarrow{K} Products$ $0.1M\ \ 6.0M$ $0.1-x\ \ 6.0-x$ Using, 2.303 $\log_{10}\frac{C_oA}{C_tA} = K_ot$ $= 2.303\log_{10}\frac{0.1}{C_tA} = K_ot = 3$ $= \log_e\frac{0.1}{C_tA} = 3[\because \log_e x = 2.303\log_{10} x]$ $= C_tA = 10e^{-3} = 5\times10^{-3}M$ Approximation can be checked by $[B]_{change} = x = 0.1 - 5\times10^{-3} = 0.095M$ $\%[B]_{change} = \frac{0.095}{6}\times100\% = 1.58\%$

24.

The ratio of tritium atoms to that of H-atoms will be same as the ratio of moles of T-atoms to that of H-atoms, since 1 mole of T_2O

Calculate the initial number of tritium atoms.

10gm $\equiv$ mass of T_2O + mass of H_2O

$= n_{T_2O} \times 22 + n_{H_2O} \times 18$

$= \left(8 \times 10^{-18} nH_2O\right) \times 22 + n_{H_2O} \times 18$

$\simeq n_{H_2O} \times 18$

$\simeq n_{H_2O} = \frac{10}{18} = \frac{5}{9}$

$\simeq n_{H_2O} = \frac{5}{9} \times 8 \times 10^{-18} = \frac{40}{9} \times 10^{-18}$

$(N_T)_0 = (N_{T_2O}) \times 2 \Rightarrow \left(\frac{40}{9} \times 10^{-18} \times 6 \times 10^{23}\right) \times 2$

$= 5.33 \times 10^6$ atoms

No. of half lines $= \frac{36}{12} = 3$

Use : $N_t = N_o \left(\frac{1}{2}\right)^x = N_o \left(\frac{1}{2}\right)^3$

$= \frac{1}{8} \times 5.33 \times 10^6$ atoms

$= 6.66 \times 10^5$ atoms.

25.

$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$

t =	0	P_o	0	0
t=t	P_o	-2_x	4x	x
t= ∞	-	$2P_o$	$P_o/2$	

Let P_o : initial pressure

P_1 : pressure at 30 min

P_∞: pressure at the end of decomposition

$P_r = P_o + 3x$

$x = \frac{1}{3}(P_t - P_o)$

$P_\infty = 2P_o + \frac{1}{2}P_o = \frac{5}{2}P_o$

$P_o = \frac{2}{5}P_\infty = \frac{2}{5} \times 500 = 200\,\text{mmHg}$

For the first order kinetics

$Kt = 2.303 \log_{10} \frac{C_o}{C_t}$

C_o : initial concentration

C_t : final concentration

Now, $\frac{C_o}{C_t} = \frac{P_o}{P_o - 2x}$

$x = \frac{1}{3}(250 - 200) = \frac{50}{3}$

$\Rightarrow \frac{C_o}{C_t} = \frac{200}{200 - 2 \times \frac{50}{3}} = \frac{6}{5}$

$\Rightarrow K = \frac{1}{30} \times 2.303 \log_{10} \frac{6}{5} = 6.08 \times 10^{-3}\,\text{min}^{-1}$

26.

For I : $K = \frac{1}{t} \frac{x}{a(a-x)}$ (II) order reaction

Given a = 0.1M

	$x = \frac{0.1 \times 30}{100}$ $= 0.03, \quad t = 60\,\text{min}$ $K_1 = \frac{1}{6.0 \times 0.1} \times \frac{0.03}{(0.1 - 0.03)} = 0.07\,\text{min}^{-1}$ Using Arrhenius equation, Also, For I : $K_1 = A\ e^{-Ea/RT}$ For II : $K_2 = A\ e^{-Ea/RT}$ $\frac{K_1}{K_2} = e^{(E_a^1 - E_a)/RT}$ $= e^{-10.46/RT}$ $= e^{-10.46/8.314 \times 10^{-3} \times 3+3}$ OR $K_2 = \frac{K_1}{e^{-10.46/8.314 \times 10^{-3} \times 373}}$ $= \frac{0.07}{0.0374} = 2.10\,\text{min}^{-1}$ Now, for II = $K_2 = \frac{1}{t}\frac{x}{a(a-x)}$ a = 0.05 $x = \frac{0.05 \times 70}{100} = 0.035$ $t = \frac{1}{(2.10 \times 0.05} \times \frac{0.035}{\left(0.05 - \frac{0.05 \times 70}{100}\right)} = 22.22\,\text{min}$
27.	$\log_{10}\frac{K_C}{K} = \frac{1}{2.303RT}(E_a - E_{ac})$ $\log_{10}\frac{K_C}{K} = \frac{1}{2.303 \times 2 \times 310}\left(200 \times 10^3 - 60 \times 10^3\right)$ $\log_{10}\frac{K_C}{K} = 98.0$ $\frac{K_C}{K} = 10^{98}$
28.	Activation energy is the minimum amount of energy by which reactant overcome their forces of attraction and proceeds

29.	$2A \underset{K_2}{\overset{K_1}{\rightleftharpoons}} B$ For $2A \xrightarrow{K_1} B$ Rat of consumption of 'A' = $-2K_1[A]^2$ For $B \xrightarrow{K_2} 2A$ Rate of formation of 'A' = $2K_2[B]$ Net rate of disappearance of 'A' = $2K_1[A]^2 - 2K_2[B]$
30.	Rate constant for reversible reaction can be calculated by $A \underset{K_b}{\overset{K_f}{\rightleftharpoons}} B$ t = 0 $[A]_0$ O t = t $[A]_0 - X$ X t = eq $[A]_0 - X_{eq}$ X_{eq} $t = \frac{2.303}{(K_f + K_b)} \log\left[\frac{X_{eq}}{X_{eq} - X}\right]$ If = [B] = $[B]_0$ at t = 0 then $\frac{t = 2.303}{K_f}\left[\frac{[B]_0 + X_{eq}}{[A]_0 + [B]_0}\right]\log\left[\frac{X_{eq}}{X_{eq} - X}\right]$ Explanation / Answer $Cl_2O_7 \rightarrow Cl_2 + \frac{7}{2}O_2$ Mole at t = 0 a 0 0 Mole at t = 55 sec (a–x) x $\frac{7x}{2}$ a) Since, pressure of Cl_2O_7 is given and therefore, a $\propto$ 0.062 (a – x) $\propto$ 0.044 $K = \frac{2.303}{t}\log 10\frac{a}{a-x}$ $\therefore K = \frac{2.303}{55}\log\frac{0.062}{0.044}$ $K = 6.23 \times 10^{-3}\ sec^{-1}$ b) Let at t = 100 sec, (a – x) $\propto$ P $6.23 \times 10^{-3} = \frac{2.303}{100}\log\frac{0.062}{P}$ $\therefore P = 0.033 atm$
31.	Consider $\begin{vmatrix} a & a+1 & a-1 \\ -b & b+a & b-1 \\ c & c-1 & c+1 \end{vmatrix}$ (1) Consider $(-1)n\begin{vmatrix} a+1 & b+1 & c-1 \\ a-1 & b-1 & c+1 \\ a & -b & c \end{vmatrix}$ $= (-1)^n\begin{vmatrix} a+1 & a-1 & a \\ b+1 & b-1 & -b \\ c-1 & c+1 & c \end{vmatrix}$ (Interchanging rows and columns $\|A\| = \|A^T\|$ $= (-1)^{n+1}\begin{vmatrix} a+1 & a & a-1 \\ b+1 & -b & b-1 \\ c-1 & c & c+1 \end{vmatrix}$ $(C_3 \leftrightarrow C_2 \|A\| = (-1)\|A\|$ when two rows and columns are interchanged) $= (-1)^{n+2}\begin{vmatrix} a & a+1 & a-1 \\ b & b+1 & b-1 \\ c & c-1 & c+1 \end{vmatrix}$ (2) $(C_1 \leftrightarrow C_3)$ Add (1) & (2) If $(-1)^{n+2} = -1$ Then (1) + (2) = 0 $(-1)^{n+2} = -1$ when $n+2$ is odd integer.

32.	det (A^2) = $(\det A)^2$ $A^2 = \begin{vmatrix} 5 & 5\alpha & \alpha \\ 0 & \alpha & 5\alpha \\ 0 & 0 & 5 \end{vmatrix} \begin{bmatrix} 5 & 5\alpha & \alpha \\ 0 & \alpha & 5\alpha \\ 0 & 0 & 5 \end{bmatrix}$ $= \begin{bmatrix} 25 & 25\alpha + 5\alpha^2 & 2\alpha^2 + 25\alpha \\ 0 & \alpha^2 & 5\alpha^2 + 25\alpha \\ 0 & 0 & 25 \end{bmatrix}$ $\det(A^2) = \begin{vmatrix} 25 & 5\alpha(5+\alpha) & 25\alpha^2 + 10\alpha \\ 0 & \alpha^2 & 5\alpha(\alpha+5) \\ 0 & 0 & 25 \end{vmatrix}$ $= (25\alpha)^2$ det $(A^2) = 25$ Þ $(25\alpha)^2 = 25$ or $\alpha^2 = \frac{1}{25}$ or $\lvert \alpha \rvert = \frac{1}{5}$
33.	$\lvert A_r \rvert = \begin{vmatrix} r & r-1 \\ r-1 & r \end{vmatrix} = \left(r^2 - (r-1)^2\right) = 2r - 1$ $\lvert A_1 \rvert = 2(1) - 1$ $\lvert A_2 \rvert = 2(2) - 1$ $\lvert A_{2010} \rvert = 2(2010) - 1$ Add all $\sum \lvert A_n \rvert$ = 2 (1+2+......+ 2010) – 2010 = $2\frac{(2010)(2011)}{2} - 2010$ = 2010^2
34.	Operate $R_1 \to R_1 - R_3$ and $R_2 \to R_2 - R_3$ $\begin{vmatrix} 1 & 0 & -1 \\ 0 & 1 & -1 \\ \sin^2\theta & \cos^2\theta & 1 + 4\sin 4\theta \end{vmatrix} = 0$ $\Rightarrow 1 + 4\sin 4\theta + \cos^2\theta + \sin^2\theta = 0$ $\Rightarrow \sin 4\theta = -1/2$ $\Rightarrow 4\theta = \frac{7\pi}{6}$ or $\frac{11\pi}{6}$
35.	For a non trivial solution $\begin{vmatrix} 1 & 4a & a \\ 1 & 3b & b \\ 1 & 2c & c \end{vmatrix} = 0$ Applying row transformations and solving we get $bc + ab - 2ac = 0$ Hence, a, b, c are in H.P
36.	$D' = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} + pqr \begin{vmatrix} b_1 & c_1 & a_1 \\ b_2 & c_2 & a_2 \\ b_3 & c_3 & a_3 \end{vmatrix}$ (All other determinants will vanish) = D (1 + pqr)

37.

$D=\begin{vmatrix}1 & -2 & 3\\ -1 & 1 & -2\\ 1 & 3 & 4\end{vmatrix}=0$ $D_x=\begin{vmatrix}-1 & -2 & 3\\ k & 1 & -2\\ 1 & 3 & 4\end{vmatrix}=3-k$

$D_y=\begin{vmatrix}1 & -1 & 3\\ -1 & k & -2\\ 1 & 1 & 4\end{vmatrix}=k-3$ $D_z=\begin{vmatrix}1 & -2 & -1\\ -1 & 1 & k\\ 1 & -3 & 1\end{vmatrix}=k-3$ $D_x=0=D_y=D_z$ $k=3$

For no solution: $\frac{D_x}{D}=\frac{D_y}{D}=\frac{D_z}{D}=\frac{d}{0}$ where $d\neq 0$ Here $d=0$ for $k=3$ So for no solution $k\neq 3$ So, statement I is true. For statement II:

$D'=\begin{vmatrix}1 & -1 & 3\\ -1 & k & -2\\ 1 & 1 & 4\end{vmatrix}=-\begin{vmatrix}1 & 3 & -1\\ -1 & -2 & k\\ 1 & 4 & 1\end{vmatrix}=3-k$ $3-k\neq 0$ for $k\neq 3$ So

statement II is true.

38.

$$\Delta=\begin{vmatrix}x & 2y-z & -z\\ y & 2x-z & -z\\ y & 2y-z & 2x-2y-z\end{vmatrix}$$

Applying $R_2\to R_2-R_1$ and $R_3\to R_3-R_1$

$$\Delta=\begin{vmatrix}x & 2y-z & -z\\ y-x & 2(x-y) & 0\\ y-x & 0 & 2(x-y)\end{vmatrix}$$

Taking $(x-y)$ common from R_2 and R_3

$$\Delta=(x-y)^2\begin{vmatrix}x & 2y-z & -z\\ -1 & 2 & 0\\ -1 & 0 & 2\end{vmatrix}$$

Expanding along R_1

$$=(x-y)^2\left[x(4-0)-(2y-z)(-2)-z(0+2)\right]$$

$$=(x-y)^2\left[4x+4y-2z-2z\right]$$

$$=4(x-y)^2(x+y-z)$$

39.

Solving the given determinant

$$f(x)=\begin{vmatrix}\sin 2x(1+2\cos x) & \sin 2x & \sin 3x\\ 3+4\sin x & 3 & 4\sin x\\ 1+\sin x & \sin x & 1\end{vmatrix}$$

Applying $C_1\to C_1-C_2-C_3$

$$=\begin{vmatrix}\cancel{\sin 2x}+2\cos x\sin 2x-\cancel{\sin 2x}-\sin 3x & \sin 2x & \sin 3x\\ 0 & 3 & 4\sin x\\ 0 & \sin x & 1\end{vmatrix}$$

Expanding along C_1 We get

$=(2\cos x\sin 2x-\sin 3x)(3-4\sin^2 x)$

using the formula $\sin 2x=2\sin x\cos x$ and $\sin 3x=3\sin x-4\sin^3 x$

We get

$=\left[2\cos x(2\sin x\cos x)-(3\sin x-4\sin^3 x)\right]\times(3-4\sin^2 x)$

$=(4\sin x\cos^2 x-3\sin x+4\sin^3 x)(3-4\sin^2 x)$

using $\cos^2 x=1-\sin^2 x$

$=(4\sin x(1-\sin^2 x)-3\sin x+4\sin^3 x)(3-4\sin^2 x)$

$=\left(4\sin x-\cancel{4\sin^3 x}-3\sin x+\cancel{4\sin^3 x}\right)(3-4\sin^2 x)$

$=\sin x(3-4\sin^2 x)$

$=3\sin x-4\sin^3 x=\sin 3x$

$f(x)=\sin 3x$

and we know that $-1\le \sin 3x\le 1$

40.

Solving the determinant

$$\Delta = \begin{vmatrix} 1+\sin^2 x & \cos^2 x & 4\sin 2x \\ \sin^2 x & 1+\cos^2 x & 4\sin 2x \\ \sin^2 x & \cos^2 x & 1+4\sin 2x \end{vmatrix}$$

Applying $C_1 \to C_1 + C_2$

$$= \begin{vmatrix} 2 & \cos^2 x & 4\sin 2x \\ 2 & 1+\cos^2 x & 4\sin 2x \\ 1 & \cos^2 x & 1+4\sin 2x \end{vmatrix}$$

Applying $R_2 \to R_2 - R_1$

$R_3 \to R_3 - R_1$

$$= \begin{vmatrix} 2 & \cos^2 x & 4\sin 2x \\ 0 & 1 & 0 \\ -1 & 0 & 1 \end{vmatrix}$$

Expanding along C_1

$= 2(1-0) + (-1)[0 - 4\sin 2x]$

$\Delta = 2 + 4\sin 2x$

Maximum value is $2 + 4 = 6$ option (4) because $-1 \le \sin 2x \le 1$

Solving the determinants separately

$$\begin{vmatrix} x & 2 & 2 \\ 3 & x & 2 \\ 3 & 3 & x \end{vmatrix} = x(x^2-6) - 2(3x-6) + 2(9-3x)$$

$= x^3 - 6x - 6x + 12 + 18 - 6x$

$= x^3 - 18x + 30$ ...(1)

$$\begin{vmatrix} 1-x & 2 & 4 \\ 2 & 4-x & 8 \\ 4 & 8 & 16-x \end{vmatrix}$$

using property

41.

$$\begin{vmatrix} 1 & 2 & 4 \\ 2 & 4-x & 8 \\ 4 & 8 & 16-x \end{vmatrix} + \begin{vmatrix} -x & 2 & 4 \\ 0 & 4-x & 8 \\ 0 & 8 & 16-x \end{vmatrix}$$

Explanation

$C_2 \to C_2 - 2C_1$

$C_3 \to C_3 - 4C_1$

$$\begin{vmatrix} 1 & 0 & 0 \\ 2 & -x & 0 \\ 4 & 0 & -x \end{vmatrix} + \begin{vmatrix} -x & 2 & 4 \\ 0 & 4-x & 8 \\ 0 & 8 & 16-x \end{vmatrix}$$

Expanding along R_1

$1(x^2) + (-x)[(4-x)(16-x) - 64]$

$x^2 - x[\cancel{64} - 4x - 16x + x^2 - \cancel{64}]$

$x^2 + 4x^2 + 16x^2 - x^3$

$21x^2 - x^3$ ...(2)

Adding (1) and (2)

$(\cancel{x^3} - 18x + 30) + (21x^2 - \cancel{x^3}) > 33$

$21x^2 - 18x + 30 > 33$

$21x^2 - 18x - 3 > 0$

$7x^2 - 6x - 1 > 0$

Factorizing

$(7x+1)(x-1) > 0$

So either $x < -\frac{1}{7}, x > 1$

42.	No Solution
43.	No Solution
44.	No Solution
45.	No Solution