SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR MPC | GT-3 | Date: 12-09-20

Time: 09:00 AM to 12:00 Noon | New Model-P1 | Max.Marks: 330

KEY & SOLUTIONS

MATHEMATICS

1	**AB**	2	**AB**	3	**AC**	4	**BD**	5	**ABC**
6	**A-PRS B-P C-P D-QR**	7	**A-S B-PQR C-PQRS D-PQRS**	8	**A-Q B-S C-Q D-R**	9	**A-PQ B-PQRS C-S D-Q**	10	**A-Q B-Q C-P D-S**
11	**2**	12	**2**	13	**7**	14	**5**	15	**6**

PHYSICS

16	**ABCD**	17	**BCD**	18	**AB**	19	**ABC**	20	**ABC**
21	**A-Q B-S C-R D-P**	22	**A-S B-Q C-P D-R**	23	**A-R B-Q C-Q D-P**	24	**A-Q B-PR C-PS D-QS**	25	**A-QR B-P C-QR D-Q**
26	**9**	27	**2**	28	**5**	29	**7**	30	**0**

CHEMISTRY

31	**ABCD**	32	**BC**	33	**CD**	34	**ABCD**	35	**ACD**
36	**A- PS B-Q C-PR D-PR**	37	**A-QS B-R C-QS D-P**	38	**A-P B-Q C-R D-P**	39	**A-QS B-PRS C-PS D-QRS**	40	**A-QR B-R C-PS D-QR**
41	**9**	42	**2**	43	**6**	44	**2**	45	**4**

MATHEMATICS

1. $1440 = 2^5.3^2.5^1 \quad \Rightarrow$ number of divisors $= 6 \times 3 \times 2 = 36$

$P(1440)^{36/2} = (1440)^{18} = \left(2^5.3^2.5^1\right)^{18} = 2^{90}.3^{36}.5^{18} = \left(2^3.3\right)^{30} l$

$= (24)^{30} l$

$\therefore$ x can be 28,30 from options

2. Conceptual

3. $\int_0^2 |2x-a|dx \ge 1 \Rightarrow \left(\frac{(2x-a)|2x-a|}{2}\frac{1}{2}\right)_0^a \ge 1$

$\Rightarrow (4-a)|4-a| + a|a| \ge 4$

$\Rightarrow$ solving we get $a \in [0,\infty)$

4. $\frac{d}{dx}\left(e^{-x}\left(f'(x) - f(x)\right)\right) = 2$

$\Rightarrow e^{-x}\left(f'(x) - f(x)\right) = 2x + c_1$

$\Rightarrow f(x) = \left(x^2 + c_1n + c_2\right)e^x,\ f'(x) = e^x\left(x^2 + (c_1+2)x + c_1 + c_2\right)$

Gives $f'(x) > 0 \Rightarrow x^2(c_1+2)x + c_1 + c_2 > 0 \Rightarrow \Delta < 0$

$\Rightarrow (C_1+2)^2 - 4C_1 - C_2 < 0$

$\Rightarrow C_1^2 - 4_{C_2} + 4 < 0$

$\Rightarrow C_1^2 - 4_{C_2} < -4$

$\Rightarrow C_1^2 - 4_{C_2} < 0$

$\therefore f(x) > 0 \ \forall x \in R$

$\therefore |f(x)| = f(x) \ \forall x \in R$ $\qquad \therefore f(x) > .e^x$

$f(3)$ can be 7

5. $\tan\theta = \left|\frac{-\frac{1}{2}+2}{1+2}\right| = \frac{3}{4}$

$\frac{1}{2}(PC)(PB)\sin\theta = 2 \Rightarrow BD = \frac{20}{3}$

Which rule ΔAPB

$AB = \frac{2}{3}\sqrt{58}$

ΔdPB which rule

$BC = \frac{2}{3}\sqrt{10}$

6. Sum of real pairs $= -\frac{(2018)}{2} = -1009 \Rightarrow$ absolute value=1009

B) $\frac{\sin^{-1}x}{x} > 1 \Rightarrow LHS > 2 \therefore$ number of pairs =0

C) $\cos(\cos x) = \cos\left(\frac{\pi}{2} - \sin x\right) \Rightarrow \cos x + \sin x = 2n\pi + \frac{\pi}{2} \Rightarrow$ number of solutions =0

D) $6(abcdef) = defabc$ =1000def +abc

$\Rightarrow 5999abc = 994def$

$\Rightarrow 857abc = 142\det$

$\begin{matrix} abc = 142 \\ \det = 857 \end{matrix} \Rightarrow N = 142857$

7. A) $\sin\theta = 0 \Rightarrow \theta = n\pi \Rightarrow \theta = 0, \pi, 2\pi, 3\pi \Rightarrow$ number of values = 4

B) $a_0x^n + a_1x^{n-1} + ... + a_n = 0$

$\sum a_i = \pm 1 | \sum a_i a_j = \pm 1 \Rightarrow \sum a_i^2 = 1 \pm 2 = 3$

Where each of $a_1, a_2....a_n$ is non-zero integer $\Rightarrow n \le 3$

C) $|x| = 3 \Rightarrow x = 3, -3 \Rightarrow GE = 0(or) - 1$

$\therefore \sin^{-1}(\sin 2x) = 2\pi - 6(or)6 - 2\pi$

D) det B=0

8. A) GE=I+I = 2I $\Rightarrow K = 2$

B) $GE = -11.2^{2005} \Rightarrow \left.\begin{matrix} a=11 \\ b=2005 \end{matrix}\right\} a + b = 2016$ sum=9

C) $xf(x) = x + \int_1^t f(t)dt \Rightarrow xf'(x) + f(x) = 1 + f(x)$

$\Rightarrow f(x) = \ln|x| + c, f(1) = 1 \Rightarrow f(x) = \ln|x| + 1$

R.A $= 2\left(1 - \frac{1}{e}\right) \Rightarrow K = 2$

D) one root $= \frac{a^4}{-a} = -a^3 \Rightarrow$ replace x by $-\sqrt[3]{x}$

$\therefore P = -3, q = 3 \Rightarrow p + q = 0$

9. A) $(x^2 - 10)(3y^2 + 1) = 507 \Rightarrow 3y^2 + 1 \in \{1, 3, 13, 3.13, 13^2, 3.13^2\}$

Possibilities $\left.\begin{matrix} 3y^2 + 1 = 13 & \text{only} \Rightarrow y = \pm 2 \\ x^2 - 10 = 3.13 & \text{only} \Rightarrow x = \pm 7 \end{matrix}\right\} |x + y| = 9, 5$

B) $x \in [-64, 36]$ number of integers $= |0|$ $f(x) = \begin{cases} -x - 14 & , \quad x \le -12 \\ x + 10 & , \quad -12 < x \le 8 \\ 3x - 6 & , \quad 8 < x \le 10 \\ x + 14 & , \quad x > 10 \end{cases}$

Given $f(x) \le 50$

C) $2x^2yd\left(x^2y\right)+y^2dy-x^2dx=0$

$\Rightarrow \left(x^2y\right)^2+\frac{y^3}{3}-\frac{x^3}{3}=C$

$\Rightarrow l=3, \ln=1 \Rightarrow l+m=4$

D) A,B independent $\therefore P\left(\overline{A}\cup\overline{B}\right)=P\left(\overline{A\cap B}\right)=1-\left(\frac{1}{3}\right)\frac{1}{2}=\frac{5}{6}$

10. $A(0,1),B(-1,3),C(3,3),D(2,1)$

Slope of AD= slope of BC=0

$\therefore$ they are parallel chords

$\therefore$ mid point M (1,1) & N(1,3)

$\therefore$ axis parallel to $\overrightarrow{MN}$ i.e x=1

$\therefore$ axis is parallel to y-axis

$\therefore y=ax^2+bx+c$ is parabola solving $y=\frac{2}{3}x^2-\frac{4}{3}x+1$

Vertex : $\left(1,\frac{1}{3}\right)$

Directrix $y+\frac{1}{24}=0 \Rightarrow 24y+1=0$

$a=1$

$b=\frac{1}{3}$

$l=0$

$m=24$

11. $GI=\int_0^1(e-1)\sqrt{\ln(1+(e-x)x)}.dx+\int_0^1 e^{x^2dx}$ put ln(1+(e-1)x) =t^2

$=\int_0^1 t.e^{t^2}(2t)dt+\int_0^1 e^{x^2}dx$

$=\int_0^1 t.d\left(e^{t^2}\right)+\int_0^1 e^{x^2}dx$

=e $\therefore GE=2$

12. $GI=\int_0^{\frac{\pi}{2}}(\sin x+\cos x)\frac{e^{x/2}}{\sqrt{\sin x}}dx=\int_0^{\frac{\pi}{2}}\sqrt{\sin x}.e^{x/2}dx+\int_0^{\frac{\pi}{2}}\frac{\cos x}{\sqrt{\sin x}}.e^{x/2}dx$

Use by parts for first integrals

$=\left(\sqrt{\sin x}.e^{x/2}.2\right)_0^{\frac{\pi}{2}}=2.e^{\frac{\pi}{4}}$ K=2

13. $\left|\overline{a}-\overline{b}\right|=41,\left|\overline{b}-\overline{c}\right|=36,\left|\overline{c}-\overline{a}\right|=7,\left|\overline{a}\right|=18,\left|\overline{b}\right|=27,\left|\overline{c}\right|=13$

$\therefore GE=\left|\frac{\overline{a}+\overline{b}-\overline{c}}{2}\right|=\frac{1}{4}\left\{\left|\overline{a}\right|^2+\left|\overline{b}\right|^2+\left|\overline{b}\right|^2+2\overline{a}.\overline{b}-2\overline{b}.\overline{c}-2\overline{c}.\overline{a}\right\}$

$=\frac{1}{4}\left\{\left|\overline{a}\right|^2+\left|\overline{b}\right|^2+\left|\overline{c}\right|^2-\left|\overline{a}-\overline{b}\right|^2+\left|\overline{a}-\overline{c}\right|^2+\left|\overline{b}-\overline{c}\right|^2\right\}=137$

14. circle $x^2 + y^2 = 25$

There are 4 points of intersect with given ellipse

These points form square $\Rightarrow$ diamond= $2 \times 5 = 10$

$\therefore$ area $= \dfrac{(10)^2}{2} = 50 \Rightarrow$ sum of digits = 5

15. $b_2 = \dfrac{1}{1 - b_1}$

$$b_3 = \frac{1}{1-b_2} = \frac{1}{1-\frac{1}{1-b_1}} = \frac{b_1 - 1}{b_1}\Big\}$$

$b_2 = b_3 \Rightarrow b_1^2 - b_1 + 1 = 0$

$\Rightarrow b_1 = -\omega, -\omega^2$

$\therefore b_2 = -\omega, -\omega^2$

$b_3 = -\omega, -\omega^2, ...$

$\therefore GE = |-2019| = 2019$

Sum of digits = 12

Half of sum of digits =6

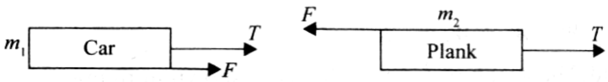
PHYSICS

16. ABCD

Let T = tension in the string.

F = force of friction between C and P.

If the string is under tension, the acceleration of C is the right = acceleration of P to the left = a.



T + F = m_1a F – T = m_2a

$\therefore$ T = $\frac{1}{2}(m_1 - m_2)a$ or T > 0 if $m_1 > m_2$.

If $m_1 < m_2$, T becomes < 0, i.e., it becomes slack.

If $m_1 = m_2$, T = 0

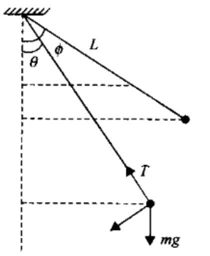
17. Sol. (b) (c) (d)

mg ($l\cos\theta - l\cos\phi$) = 1/2 mv^2

or $mv^2/l = 2mg(\cos\theta - \cos\phi)$

Also, $T - mg\cos\theta = \dfrac{mv^2}{1} = 2mg(\cos\theta - \cos\phi)$

or $T = mg(3\cos\theta - 2\cos\phi)$



18. Effective value of downward force acting on the body

$F = V(d - d_0)g$

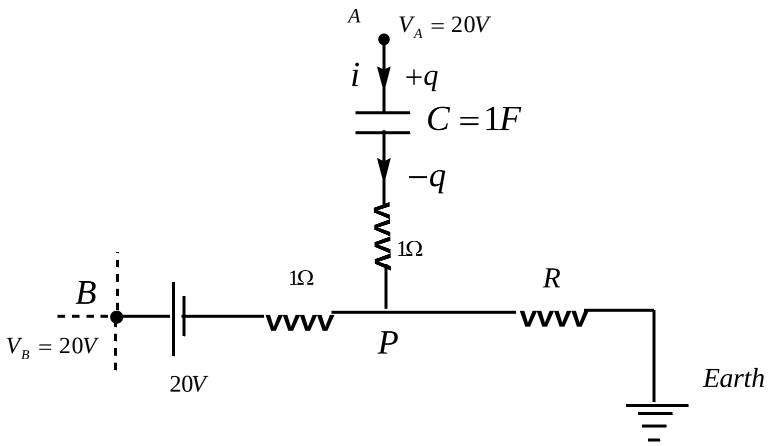
So increase in potential energy in lifting the body through height h in the liquid

= work done against effective downward force

$= V(d - d_0)gh$

It is also evident that potential of water will remain same by raising the body in it. SO options AB are correct

19. At $t = 0$, $q = 3C, i_{Ap} = \frac{dq}{dt} = 3A, V_C = \frac{q}{C} = 3V$



Potential drop across capacitor C=3V

Potential drop across resistor = (1x3) = 3V

$\therefore$ Potential at point $P(V_P) = 20 - (3+3) = 14V$

$\therefore V_P - 0 = 14V$

Now, current through R is given by

$i = \frac{V_P - 0}{R} = \frac{14}{2} = 7A$

20. Distance of the two satellites from the centre of earth are $r_1 = 2R$ and $r_2 = 8R$ respectively . (R = earth's radius). Their potential energies are

$V_1 = \frac{GmM}{r_1}$ and $V_2 = \frac{GmM}{r_2}$

Their ratio is $\frac{V_1}{V_2} = \frac{r_2}{r_1} = \frac{8R}{2R} = 4$

The kinetic energy of a satellite can be obtained from relation $\frac{mv^2}{r} = \frac{GmM}{r^2}$ or

$K = \frac{1}{2}mv^2 = \frac{GmM}{2r}$

The ratio of their kinetic energies is

$\frac{K_1}{K_2} = \frac{r_2}{r_1} = \frac{8R}{2R} = 4$

Their total energies are

$$E_1 = \frac{GmM}{r_1} + \frac{GmM}{2r_1} = -\frac{GmM}{2r_1}$$

$$E_2 = \frac{GmM}{r_2} + \frac{GmM}{2r_2} = -\frac{GmM}{2r_2}$$

Their ratio is

$$\frac{K_1}{K_2} = \frac{r_2}{r_1} = \frac{8R}{2R} = 4$$

$$\frac{E_1}{E_2} = \frac{r_2}{r_1} = \frac{8R}{2R} = 4$$

21. $v_c = \upsilon - \left(\frac{4\upsilon}{3l}\right)\frac{l}{2}$

$= \frac{\upsilon}{3}$

$v_D = \upsilon - \frac{4\upsilon}{3l} \times \frac{3l}{4} = 0$

$L_A = m\frac{\upsilon}{3}.\frac{l}{2} - \frac{ml^2}{12} \times \frac{4\upsilon}{3l} = \frac{1}{18} m\upsilon l$

$L_B = m\frac{\upsilon}{3}.\frac{l}{2} + \frac{ml^2}{12} \times \frac{4\upsilon}{3l} = \frac{5m\upsilon l}{18}$

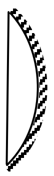
$L_C = I_C.w = \frac{ml^2}{12} \times \frac{4\upsilon}{3l} = \frac{m\upsilon l}{9}$

$L_D = I_D.w = \left[\frac{ml^2}{12} + m\left(\frac{l}{4}\right)^2\right]\frac{4\upsilon}{3l}$

$= \frac{7m\upsilon l}{36}$

22. **(A)** $m = 2 = \frac{v}{u} \Rightarrow \frac{1}{2u} - \frac{1}{u} = \frac{1}{40} \Rightarrow u = -20$ cm

(B) $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$



$\frac{1}{40} = (1.25 - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right)$

$R = 10$ cm

$P = 2P_l + P_m$

$P = \frac{2}{40} + \frac{2}{10} = \frac{1}{4}$

$F_{eq} = -4$ cm

(C) $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} - \frac{1}{8} = \frac{1}{-4}$

$v = -8$ cm

(D) Shift = $\left(1-\frac{1}{\mu}\right)t=\left(1-\frac{1}{1.25}\right)5$ = 1 cm

23. Conceptual
24. Conceptual
25. Conceptual
26. For convex lens forming real image

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

$$m=\frac{15}{5}=\frac{v}{u} \text{ or } 3u=v$$

$$\therefore \frac{1}{3u}+\frac{1}{u}=\frac{1}{f} \text{ or } u=\frac{4f}{3} \text{ and } v=4f$$

In the second position $u^{'}=u+15=\frac{4f}{3}+1.5$

$$m^{'}=\frac{v^{'}}{u^{'}}=\frac{10}{5}$$

$$v^{'}=2u^{'}=2\left(\frac{4f}{3}+1.5\right)=\frac{8f}{3}+3$$

$$\frac{1}{v^{1}}+\frac{1}{u^{'}}=\frac{1}{f^{'}}$$

Or $\frac{1}{\left(\frac{8f}{3}\right)+3}+\frac{1}{\left(\frac{4f}{3}\right)+1.5}=\frac{1}{f}$

$\therefore f=9cm \text{ or } -1.125cm$

Only $f=9cm$ is correct answer. The other value is absurd

27. Let ρ is the charge density and l is the edge length of cube. We know that potential at any point has to be proportional to charge and inversely proportional to side length of cube so

$$V\propto\frac{Q}{l}=\frac{\rho l^{3}}{l}=\rho l^{2}$$

Now, to find potential at centre, the cube of edge length l can be considered as 8 cubes of length $l/2$ so the potential at centre of original can be obtained as sum of potentials due to 8 cubes (of length $l/2$) at the corners

$$V_{centre}\propto 8\times\rho\left(\frac{l}{2}\right)^{2}=\frac{8\rho l^{2}}{4}=2\rho l^{2}$$

$$\therefore \frac{V_{centre}}{V}=\frac{2\rho l^{2}}{\rho l^{2}}=2$$

Hence $\beta=2$

$K\left(\rho\frac{4}{3}\pi\frac{R^3}{8}\right)\left(-j\right)$

28. Given that length of the wire $l=10m$ and its resistance $R=30\Omega$ so, resistance per unit length of the wire

$\lambda=\frac{30}{10}=3\Omega/m$

At balance point, current in the galvanometer coil =0. Let the current in the main wire be I

Hence $2=I\times30$ ir $I=\frac{1}{15}A$

If x be the location of the balance point, then

$3\times\frac{1}{15}\times x=1V=emf\ \ of\ \ battery$

Hence $x=5m$

29. Time constant $=\frac{L}{R}=5ms$

Now, $I=I_0\left[1-e^{-t/t}\right]$

$\frac{I_0}{2}=I_0\left[1-e^{-t/t}\right]$

Or $e^{t/t}=\frac{1}{2}$

So, $t=\tau\ln2=3.5ms=\frac{7\times10^{-3}}{2}\sec$

$\therefore n=7$

30. The Q value of reaction is

$Q=\Delta m\times c^2$

$\Delta m=22.9945-22.9898=0.0047$

$\Delta Q=0.0047\times931.5MeV=4.4MeV$

This released energy is shared between electron (beta particle) and antineutrino

The minimum KE Of $\beta-$particle is 0 and maximum KE of $\beta-$particle is 4.4MEV

CHEMISTRY

31. A) No salt Bridge, both electrodes are present in same solution

B) $\left(\Delta S^\circ\right)_{298K}=+nF\left(\frac{\partial E^o_{cell}}{\partial T}\right)_{P,298K}$

$=(1)(96485)\left[-10^{-4}\right]$

= -9.6485 J/K

C) $\Delta G^\circ_{(298K)}=-nFE^o_{cell}$

= -(1)(96485)[0.01] J/mol

= -0.96485 KJ/mol

D) $\Delta H^\circ = \Delta G^\circ + T\Delta S^\circ$

$$= -0.96485 + \frac{298(-9.6485)}{1000}$$

$$= -[1+2.98]0.96485$$

$$= -[3.98][0.96485]$$

$$= -3.84\,KJ/mol$$

33. II group cations form precipitate.

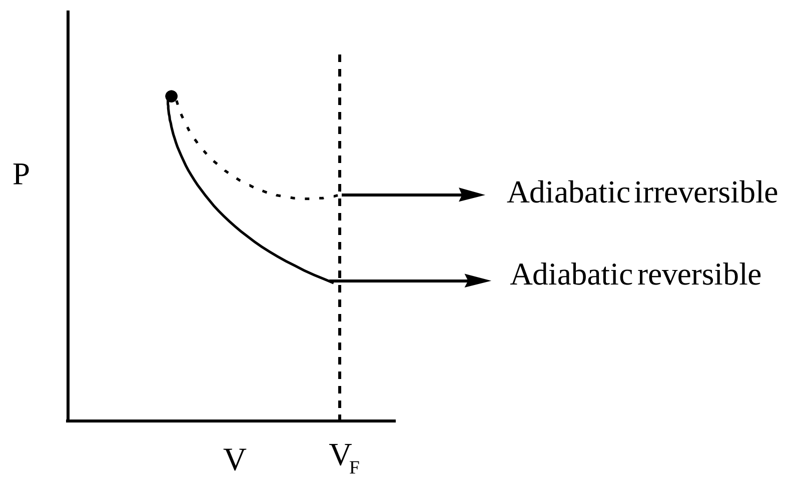
HgS- insoluble in nitric acid

CuS, PbS- black precipitates which dissolve in nitric acid and form sulphur precipitate.

34. free expansion of an ideal gas is

1) Isothermal as well as adiabatic irreversible process q=0 $W^{||} = 0$ $\Delta U = 0$ $\Delta H = 0$

2)



For the same volume change magnitude of work done in reversible expansion is more than irreversible expansion

$|W| > |W^{|}|$

$W < W^{|}$

$\Delta U = W$ for Adiabatic

$\Delta U < \Delta U^{|}$

$\Delta H < \Delta H^{|}$

$P_F = \frac{nRT_F}{V_F}$

$T_2 < T_2^{|} < T_2^{||}$

35. $2Pb(NO_3)_2 \longrightarrow 2PbO + 4NO_2 + O_2$

$P_4 + 20HNO_3 \longrightarrow 4H_3PO_4 + 20NO_2 + 4H_2O$

$3NO_2(g) + H_2O \longrightarrow 2HNO_3 + NO(g)$

36. A) It is Fcc wrt anion and cation is present in O.V

$r_c + r_A = a/2$

% OV occupied = $\frac{4}{4} \times 100$ = 100%

B) It is hcp wrt anion and cation is present in O.V

% of O.V occupied = $\frac{4 \times 100}{6} = 66.67\%$

C) It is Fcc wrt anion and cation is present in T.V

$r_C + r_A = \frac{\sqrt{3}}{4} a$

% T.V occupied = $\frac{8}{8} \times 100 = 100\%$

D) It is FCC wrt cation and anion is present in T.V

$r_C + r_A = \frac{\sqrt{3}}{4} a$

% T.V occupied = $\frac{8}{8} \times 100 = 100\%$

39. $A = [Co(H_2O)_6]^{3+}$ $B = [V(H_2O)_6]^{2+}$ $C = [Fe(NH_3)_6]^{3+}$ $D = [Zn(NH_3)_4]^{2+}$

41. $M_2 = 152\ T_F^o = 450K\ W_2 = 0.5g$

$w_1 = .04g\ T_F = 430\ \Delta_{Fusion}H^\circ = 1.52\,Kcal\,mol^{-1}$

$K_F = \frac{RM_2 (T_F^o)^2}{1000\,\Delta_F H^\circ} = \frac{(2)(152)(450)^2}{1000 \times 1.52 \times 1000}$

$[K_F = 40.5]$

$\Delta T_F = K_F \frac{w_1 \times 1000}{m_1 w_2}$

$20 = 40.5 \times \frac{.04 \times 1000}{.5 \times M_1}$

$M_1 = 40.5 \times 4 = 162$

42. x = 0, y= 2, z = 4

C is NH_2CH_2-COOH and D is $NH_2CH(CH_3)-COOH$

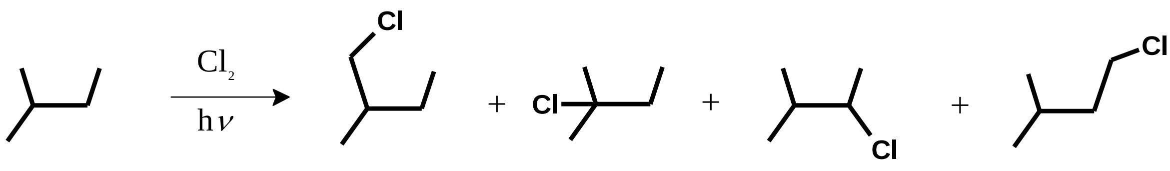
43. (1) (a-a) trans optically inactive-1

(2) (a-b) trans optically active -2

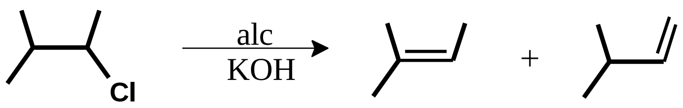
(3) (b-c) trans optically inactive-1

(4) (a-c) trans optically active -2

44.



Major



45.