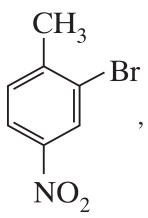
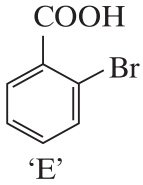
Answers to RCH–DS1/Set-3

1. (*b*) $E_4 = \dfrac{2.20 \times 3 + 0.77 \times 1}{4} = 1.84$ [Using $\Delta G = -nE°F$]

2. (*a*)  , 

'A' 'E'

3. (*b*)

4. (*a*) $CH_3—\overset{\overset{O}{\|}}{C}—CH_2—CH_2—\overset{\overset{O}{\|}}{C}—H$ ∵ it has both aldehyde and $CH_3—\overset{\overset{O}{\|}}{C}—$group.

5. (*b*) Phosgene, $COCl_2$

6. (*b*) Ni^{2+} is green, Sc^{3+} is colourless, Fe^{3+} is yellow.

7. (*d*) degree of dissociation $= 1 - e^{-kt}$

8. (*c*) $H_3C—NH—(CH_2)_4—COOH$

9. (*b*) II < III < I

10. (*d*) Both (*a*) and (*b*) ∵ $—OCH_3$ is *o* and *p*-directing.

11. (*a*) goes on increasing due to decrease in atomic size and increase in atomic mass.

12. (*a*) P and Q only ∵ reaction is exothermic, $H_p < H_R$.

13. (*b*) Both A and R are true but R is not the correct explanation of A.

14. (*c*) A is true but R is false.

15. (*c*) A is true but R is false.

16. (*c*) A is true but R is false.

17. No. of moles of glucose $= \dfrac{10.8}{40}$

∵ (1 moles of glucose contains $\dfrac{72}{180} \times 100 = 40\%$ of C)

$M = \text{No. of moles} \times \dfrac{1000}{\text{vol. of solution in mL}} = \dfrac{10.8}{40} \times \dfrac{1000}{250} = \dfrac{10.8}{10} = 1.08$ M.

18.

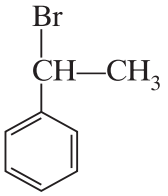
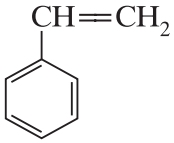
	$A(g)$	$\longrightarrow$	$2B(g)$	+	$C(g)$
Initial	800		0		0
After 10 min	$800 - p$		$2p$		p

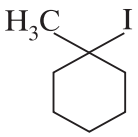
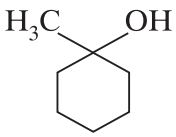
$p_{total} = 800 + 2p \Rightarrow 1600 = 800 + 2p \Rightarrow p = 400$ mm

It means $t_{1/2}$ = 10 min, 30 min = $3t_{1/2}$ i.e., $\frac{1}{8}$th of reactant will remain and $\frac{7}{8}$th will change into products.

p after 30 min = $\frac{7}{8} \times 800 = 700$ mm Hg

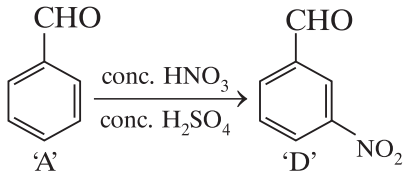
p_T for 30 min = $(800 - p) + 2p + p = (800 - 700) + 2 \times 700 + 700 = 2200$ mm Hg

19. (*a*) 'A' is  'B' is 

(*b*) 'A' is  'B' is 

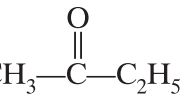
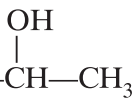
20. 'A' is $2C_6H_5CHO \xrightarrow{\text{conc. NaOH}} C_6H_5CH_2OH + C_6H_5COONa$

'B' 'C'

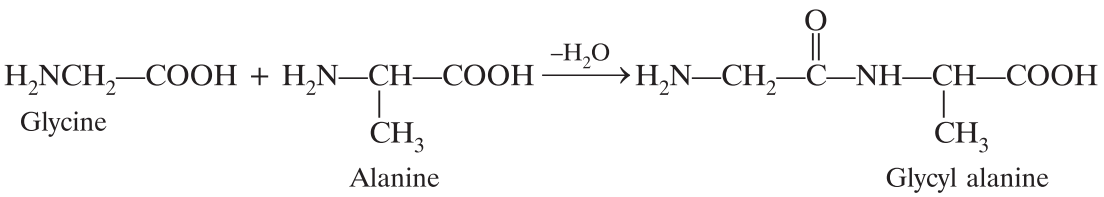


'A' 'D'

Or

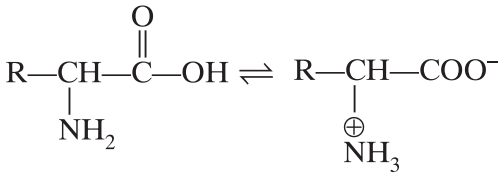
(*a*) 'X' is  (*b*) 'X' is 

21. (*a*)



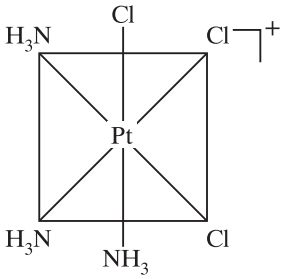
Glycine Alanine Glycyl alanine

(*b*) It is because they have acidic as well as basic group present in the same molecule.

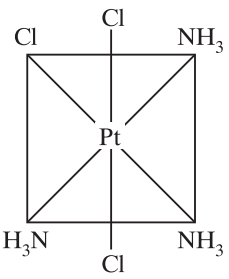


22. (*a*) 1 : 1 $\because$ CN^- cannot cause pairing of electrons in this complex although it is strong field ligand. $\because$ Both have equal number of unpaired electrons.

(*b*)



facial



meridional

(*c*) Tris-(ethane 1, 2 – diamine) platinum (IV)

23. $2Al(s) + 3Ni^{2+}(aq) \rightarrow 2Al^{3+}(aq) + 3Ni(s)$

$$E_{cell} = (E^\circ_{Ni^{2+}/Ni} - E^\circ_{Al^{3+}|Al}) - \frac{0.0591}{6} \log \frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$$

$$= [-0.25V - (-1.66V)] - \frac{0.0591}{6} \log \frac{(10^{-3})^2}{(0.50)^3}$$

$$= 1.41V - \frac{0.0591}{6} \log 8 \times 10^{-6}$$

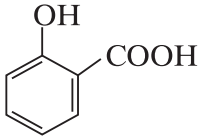
$$= 1.41V - \frac{0.0591}{6} [\log 8 + \log 10^{-6}]$$

$$= 1.41V - \frac{0.0591}{6} [0.9031 - 6.000]$$

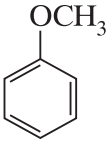
$$= 1.41V - \frac{0.0591}{6} \times -5.0969 = 1.41 \text{ V} + 0.05 \text{ V}$$

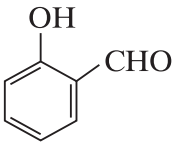
$$= 1.46V$$

24. (*a*) Kolbe's Reaction—

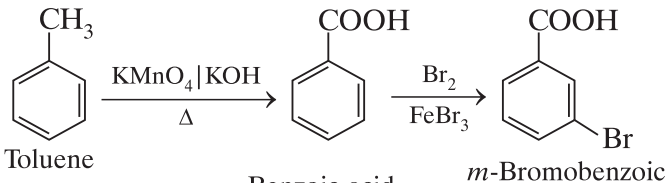


(2-hydroxy benzoic acid)

(*b*) Williamson Synthesis—  (Methoxy benzene)

(*c*) Reimer Tiemann Reaction,  (2-hydroxy benzaldehyde)

25. (*a*) 3, 5 – Dimethyl phenyl ethanoate

(*b*) 

Toluene — Benzoic acid — *m*-Bromobenzoic acid

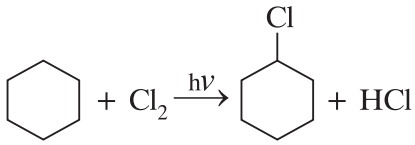
(*c*) FCH_2COO^- is more stable than $ClCH_2COO^-$ as F is more electronegative than Cl and stronger electron withdrawing.

26. $\log k_2 - \log k_1 = \frac{E_a}{19.15}\left(\frac{1}{200} - \frac{1}{300}\right)$

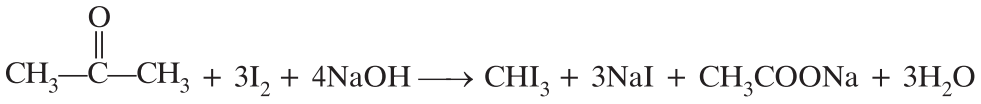
$\log k_2 - \log 3 \times 10^{-2} = \frac{2.55 \times 1000 \times 100}{19.150 \times 60000} = \frac{25.5}{19.15 \times 6} = \frac{25.5}{114.90} = 0.2219$

$\log k_2 + 2.000 - 0.4771 = 0.2219$

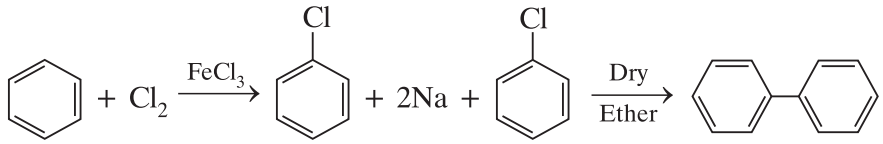
$\log k_2 = 0.6990 - 2.000 = -1.3010$

27. (*a*) 

Cyclohexane 'X' — 1-Chlorocyclo hexane

(*b*) (*i*) 

Acetone — Iodoform

(*ii*) 

Benzene — Diphenyl

28. $CH_3—\underset{\displaystyle CH_3}{\underset{|}{CH}}—N=N—\underset{\displaystyle CH_3}{\underset{|}{CH}}—CH_3(g) \xrightarrow{\text{heat}} C_6H_{14}(g) + N_2(g)$

Initial *p*ressure	p_i	0	0
Final *p*ressure	$p_i - x$	x	x

$$p_t = p_i - x + x + x = p_i + x$$

$$p_t - p_i = x \Rightarrow 54 - 35 = x$$

$$\Rightarrow \quad x = 19 \text{ after 360 seconds.}$$

$$k = \frac{2.303}{t} \log \frac{p_i}{p_i - x}$$

$$k_{360} = \frac{2.303}{360} \log \frac{35}{35 - 19}$$

$$k = \frac{2.303}{360} (\log 35 - \log 16)$$

$$k = \frac{2.303}{360} (1.5441 - 1.2041)$$

$$k = \frac{2.303}{360} \times 0.3400$$

$$k = \frac{0.7830}{360} = 2.175 \times 10^{-3} s^{-1}$$

$$x = p_t - p_i = 63 - 35 = 28, \text{ after 720 s}$$

$$k_{720} = \frac{2.303}{t} \log \frac{p_i}{p_i - x}$$

$$= \frac{2.303}{720} \log \frac{35}{35 - 28} = \frac{2.303}{720} \log 5$$

$$= \frac{2.303}{720} \times 0.6990 = 2.235 \times 10^{-3} \text{ s}^{-1}.$$

Average rate constant $= \dfrac{(2.175 + 2.235) \times 10^{-3}}{2} = 2.205 \times 10^{-3} \text{ s}^{-1}$

29. (*a*) It is because CN^- is stronger ligand than NH_3, Crystal Field Splitting Energy is high.

(*b*) $[Cd(NH_3)_4]^{2+}$ is least stable due to bigger size of Cd^{2+} ions.

(*c*) (*i*) It is because Fe^{3+} has higher charge and smaller size than Fe^{2+}.

(*ii*) It is because Ag^{+} is bigger in size than Cu^{2+}.

Or

(*c*) $k = \frac{1}{\beta_4} = \frac{1}{2.0 \times 10^{13}} = 5 \times 10^{-14}$

30. (*a*) The total volume will be less than 20 mL $\because$ force of attraction between ethanol-water < ethanol-ethanol and water-water.

Or

$\Delta H = 0$, $\Delta V = 0$ for ideal solution $\because$ force of attraction A–B = A–A or B–B

(*b*) Give the person concentrated solution of common salt (Hypertonic). The person will have vomiting and poison is most likely to come out then take the person to hospital.

(*c*) $\Delta T_f = i \times K_f \times \frac{W_2}{M_2} \times \frac{1000}{W_1}$ [$\because$ $i = 3$ for $MgBr_2(aq) \longrightarrow Mg^{2+}(aq) + 2Br^{-}(aq)$]

$$= 3 \times 1.86 \times \frac{18.4}{184} \times \frac{1000}{200} = \frac{3 \times 1.86}{2} = \frac{5.58}{2} = 2.29 \text{ K}$$

Freezing point of solution = 273.15 K – 2.29 K = 270.86 K

31. (*a*) $2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$

(*b*) $Fe^{3+}(3d^5)$ is more stable than $Fe^{2+}(3d^6)$ due to half filled *d*-orbitals.

(*c*) Zn^{2+} does not have unpaired electron $\therefore$ cannot undergo *d-d* transition.

(*d*) Transition metals have similar atomic size, can replace each other in metallic bond.

(*e*) La is bigger in size, most electropositive as compared to Lu (smallest in size).

(*f*) U–235 is used in nuclear reactor.

(*g*) $2KMnO_4 \xrightarrow{\text{heat}} K_2MnO_4 + MnO_2 + O_2$

32. (*a*) It is because it can be recharged $\therefore$ it is regarded as secondary cell.

(*b*) (*i*) H_2 (*ii*) CH_4 (*iii*) CH_3OH (*Any two*)

(*c*) $H_2(g) \longrightarrow 2H^{+} + 2e^{-}$ (At anode)

$Cu^{2+} + 2e^{-} \longrightarrow Cu(s)$ (At cathode)

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{2} \log \frac{[H^+]^2}{[Cu^{2+}]}$$

$$= 0.34V - \frac{0.0591}{2} \log \frac{(0.1)^2}{(10^{-3})}$$

$$= 0.34V - \frac{0.0591}{2} \log 10$$

$$= 0.34V - 0.0295$$

$$= 0.3105 \text{ V}$$

Or

(*a*) $2Cr(s) \longrightarrow 2Cr^{3+} + 6e^-$ (At anode)

$6e^- + 3Fe^{2+}(aq) \longrightarrow 3Fe(s)$ (At cathode)

$$E_{cell} = (E^\circ_{Fe^{2+}/Fe} - E^\circ_{Cr^{3+}/Cr}) - \frac{0.0591}{6} \log \frac{[Cr^{3+}]^2}{[Fe^{2+}]^3}$$

$$= [-0.44 \text{ V} - (-0.74 \text{ V})] - \frac{0.0591}{6} \log \frac{(10^{-1})^2}{(10^{-2})^3}$$

$$= +0.30V - \frac{0.0591}{6} \log 10^4$$

$$E_{cell} = 0.30 \text{ V} - \frac{0.0591}{6} \times 4 = 0.30 \text{ V} - \frac{0.2364}{6} = 0.30 \text{ V} - 0.0394 = 0.2606 \text{ V}$$

$$\Delta G = -nEF = \frac{-6 \times 0.2606 \times 96500}{1000} = -150.887 \text{ kJ mol}^{-1}$$

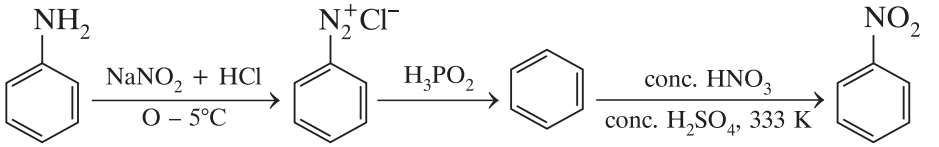
(*b*) $m = Z \times I \times t$

$$1.2 = \frac{24}{2 \times 96500} \times I \times 60 \times 60 \quad [\because 1 \text{ hour} = 60 \times 60 \text{ s}]$$

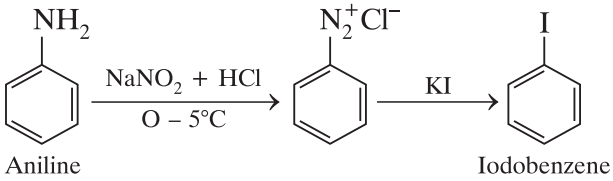
$$I = \frac{9650}{3600} = 2.68 \text{ A}$$

33. (*a*) But –3–en–1–amine

(*b*) (*i*)



Aniline — Benzene diazonium chloride — Benzene — Nitrobenzene

(*ii*) 

(*c*) $(CH_3)_3N < (CH_3)_2NH < CH_3NH_2$

(*d*) It is because C_6H_5 directly attached to $-NH_2$ in Aniline which is electron withdrawing reduces electron density on N more than in $C_6H_5CH_2NH_2$.

Or