Name of the Student:_____
Max. Marks : 26 Marks **Time : 26 Minutes**

Mark Schemes

Q1.

(a) $\Delta H^{\ominus} = \Sigma \Delta H_f^{\ominus}$ products - $\Sigma \Delta H_f^{\ominus}$ reactants **1**

or (2 × –395) – (2 × –297)

= –196 (kJ mol^{-1})

Penalise incorrect units, ignore missing units **1**

(b) $\Delta S^{\ominus} = \Sigma S^{\ominus}$ products - $\Sigma S^{\ominus}$ reactants **1**

= (2 × 256) – 205 – (2 × 248)

= –189 $\underline{JK^{-1}\ mol^{-1}}$

Allow -0.189 kJ K^{-1} mol^{-1}

Units must be given and must match value **1**

(c) Causes an increase in order / a decrease in disorder

Allow products more ordered / products less disordered

If answer to (b) is +ve, allow products are less ordered / causes an increase in disorder / causes a decrease in order **1**

(d) $\Delta G^{\ominus} = \Delta H^{\ominus} - T\Delta S^{\ominus}$

Do not insist on standard state symbol **1**

= –196 – 323 (–189/1000)

If conversion of T or ΔS incorrect, then can only score M1 **1**

= –134.9 kJ mol^{-1}

Must have correct units

Allow answers in J mol^{-1}

–135 kJ mol^{-1}

If both alternative values used then -169(.3) kJ mol^{-1}

Allow alternative ΔH and/or alternative ΔS in calculation **1**

(e) Feasible because ΔG is negative

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Allow mark if a correct deduction from answer to (d)
Both a reference to feasibility and to ΔG needed

1

(f) (i) (The catalyst is in) a different state or phase (from the reactants)

1

(ii) $SO_2 + V_2O_5 \longrightarrow SO_3 + V_2O_4$

Allow $2VO_2$ instead of V_2O_4
Allow multiples

1

$$\frac{1}{2}O_2 + V_2O_4 \rightarrow V_2O_5$$

Must have equations in this order

1

(iii) Surface area is increased

1

(iv) So that the catalyst is not poisoned

Allow correct reference to the blocking active sites

1

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Q2.

(a) [Ar] $4s^2$ $3d^7$ or $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^7$

Allow 4s and 3d in either order

1

[Ar] $3d^7$ or $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7$

1

Any 3

Variable oxidation state

Act as catalysts

Form complexes

Form coloured ions/compounds

3

(b) Two atoms that each donate a lone pair (of electrons) / coordinate bonds from two atoms

1

Formula of ethane-1,2- diamine: $NH_2CH_2CH_2NH_2$

M2 gained from equation or structure

1

$[Co(H_2O)_6]^{2+} + 3NH_2CH_2CH_2NH_2 \longrightarrow [Co(NH_2CH_2CH_2NH_2)_3]^{2+} + 6H_2O$

Equation must be balanced inc charges

Allow en or $C_2H_8N_2$ in equation for ethane-1,2-diamine

1

There is an increase in the number of particles / the reaction goes from 4 moles to 7 moles

Allow increase number of molecules/moles. Allow numbers that match an incorrect equation

1

Disorder/entropy increases / ΔS is positive

1

ΔG negative

1

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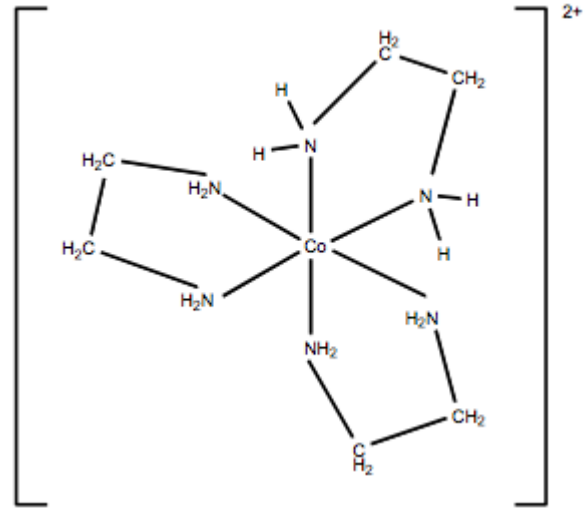
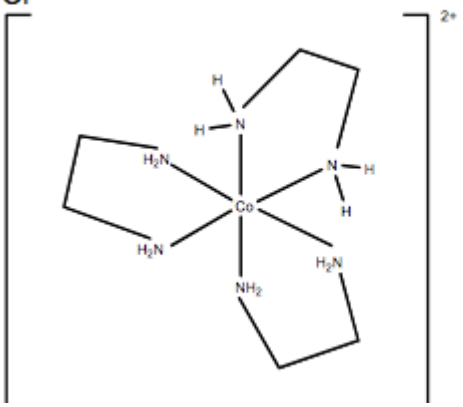


Or



Mark for correct structure (ignore charges -even if wrong)

NH_2 can be shown in either way – see structure

1

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