Practice Question Set For A-Level
Subject : Chemistry
Paper-1 Topic: Physical 1_Thermodynamics

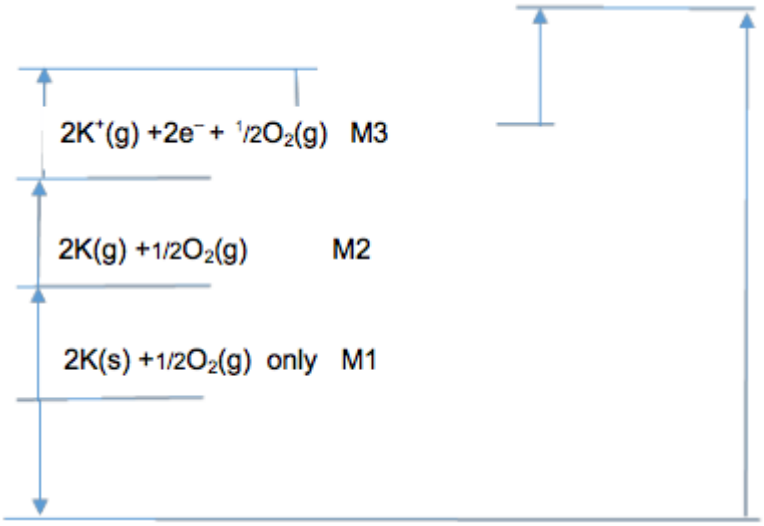
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Name of the Student:_____
Max. Marks : 28 Marks **Time : 28 Minutes**

Mark Schemes

Q1.

(a) (i)



Mark each line independently, but follow one route only
Must have state symbols, but ignore s.s. on electrons
Penalise lack of state symbols each time
Alternative answers
2K(g) + O(g) M3
2K(g) +½O_2(g) M2
2K(s) +½O_2(g) only M1
or
2K(g) + O(g) M3
2K(s) +O(g) M2
2K(s) +½O_2(g) only M1

1
1
1

(ii) (2 × 90) + 248 + (2 × 418) – 142 + 844 = – 362 + Lattice enthalpy of dissociation

Enthalpy of lattice dissociation = (+) 2328 ($kJmol^{-1}$)

M1 for (2 × 90) and (2 × 418)
M2 for a correct expression (either in numbers or with words/formulae)
M3 for answer
2328 $kJmol^{-1}$ scores 3 marks
Allow answers given to 3sf
Answer of 1820, scores zero marks as two errors in calculation.

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Answers of 2238, 1910, 2204 max = 1 mark only since one chemical error in calculation (incorrect/missing factor of 2)

Allow 1 mark for answer of -2328 ($kJmol^{-1}$)

Penalise incorrect units by one mark

3

(b) K^+ (ion)/K ion is bigger (than Na^+ ion)

K^+ has lower charge density / Na^+ has higher charge density

Ignore K atom is bigger

1

(Electrostatic) attraction between (oppositely charged) ions is weaker

If attraction is between incorrect ions, then lose M2

Attraction between molecules/atoms or mention of intermolecular forces CE=0/2

Allow converse for Na_2O if explicit

1

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Q2.

(a) $MgCl_2(s) \longrightarrow Mg^{2+}(aq) + 2Cl^-(aq)$

State symbols essential

Do not allow this equation with H_2O on the LHS

Ignore + aq on the LHS

Allow H_2O written over the arrow / allow equation written as an equilibrium

Allow correct equations to form $[Mg(H_2O)_6]^{2+}$ ions

1

(b) $\Delta H_{soln}\ MgCl_2 = LE + (\Delta H_{hyd}Mg^{2+}) + 2(\Delta H_{hyd}Cl^-)$

$\Delta H_{soln}\ MgCl_2 = 2493 - 1920 + (2 \times -364)$

$= -155$ (kJ mol-1)

M1 for expression in words or with correct numbers

Ignore units, but penalise incorrect units

1
1

(c) M1: Solubility decreases (as temp increases)

M2: the enthalpy of solution is exothermic / reaction is exothermic / backwards reaction is endothermic

M3: (According to Le Chatelier) the equilibrium moves to absorb heat/reduce temperature/oppose the increase in temperature (in the endothermic direction)

If M1 is incorrect then CE=0/3

If answer to (b) is a +ve value, allow:

M1: Solubility increases (as temp increases)

M2: Enthalpy of solution is endothermic etc

M3: (According to Le Chatelier) the equilibrium moves to absorb heat/reduce the temperature/oppose the increase in temperature (in the endothermic direction)

1
1
1

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Q3.

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

1

or $(2 \times -395) - (2 \times -297)$

$= -196$ (kJ mol^{-1})

Penalise incorrect units, ignore missing units

1

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

1

$= (2 \times 256) - 205 - (2 \times 248)$

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

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

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

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

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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