

Name of the Student: _____

Max. Marks : 25 Marks

Time : 25 Minutes

Mark Schemes

Q1.

- (a) (i) (Enthalpy change for formation of) 1 mol (of CaF_2) from its ions

allow heat energy change

do not allow energy or wrong formula for CaF_2

penalise 1 mol of ions

CE=0 if atoms or elements or molecules mentioned

ignore conditions

1

ions in the gaseous state

ions can be mentioned in M1 to score in M2

allow fluorine ions

$\text{Ca}^{2+}(\text{g}) + 2\text{F}^{-}(\text{g}) \rightarrow \text{CaF}_2$ scores M1 and M2

1

- (ii) (enthalpy change when) 1 mol of gaseous (fluoride) ions (is converted) into aqueous ions / an aqueous solution

allow $\text{F}^{-}(\text{g}) \rightarrow \text{F}^{-}(\text{aq})$ (ignore + aq)

do not penalise energy instead of enthalpy

allow fluorine ions

do not allow F^{-} ions surrounded by water

1

- (b) water is polar / H on water is δ^{+} / is electron deficient / is unshielded

1

penalise H^{+} on water 1 mark

(F^{-} ions) attract water / δ^{+} on H / hydrogen

allow H on water forms H-bonds with F^{-}

allow fluorine ions

penalise co-ordinate bonds for M2

penalise attraction to O for M2

1

- (c) $\Delta H = -(-2611) - 1650 + 2x - 506$

ignore cycles

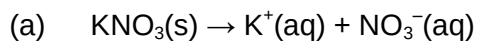
M1 is for numbers and signs correct in expression

1

$= -51 \text{ (kJ mol}^{-1}\text{)}$

correct answer scores 2

Q2.



do not allow equations with H_2O

allow aq and the word 'water' in equation

1

- (b) increase in disorder because solid $\rightarrow$ solution / increase in number of particles / 1 mol (solid) gives 2 mol (ions/particles) / particles are more mobile

allow random or chaos instead of disorder

penalise if molecules/atoms stated instead of ions

allow any reference to increase in number of particles even if number of particles wrong

1

(c) $\Delta G = \Delta H - T\Delta S$ / $T = \Delta H/\Delta S$

1

$T = \Delta H/\Delta S = (34.9 \times 1000)/117$

also scores M1

1

$= 298 \text{ K}$

correct answer scores 3, units essential

0.298 scores M1 only

1

- (d) (i) positive / increases / $\Delta G > 0$

Allow more positive

1

- (ii) if ans to (d) (i) positive, dissolving is no longer spontaneous / no longer feasible / potassium nitrate does not dissolve / less soluble

if ans to (d) (i) negative, dissolving is spontaneous / feasible / potassium nitrate dissolves / more soluble

If no mention of change to ΔG in (d)(i),

Mark = 0 for (d)(ii)

1

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Q3.

(a) (i) $\Delta H = \Sigma \text{ bonds broken} - \Sigma \text{ bonds formed}$

1

$$= 944/2 + 3/2 \times 436 - 3 \times 388$$

1

$$= -38 \text{ (kJ mol}^{-1}\text{)}$$

ignore units even if incorrect

correct answer scores 3

-76 scores 2/3

+38 scores 1/3

1

- (ii) mean / average bond enthalpies are from a range of compounds
or
mean / average bond enthalpies differ from those in a single compound / ammonia

1

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

1

$$= 193 - (192/2 + 131 \times 3/2)$$

1

$$= -99.5 \text{ J K}^{-1} \text{ mol}^{-1}$$

units essential for M3

correct answer with units scores 3

-199 J K⁻¹ mol⁻¹ & -99.5 score 2/3

-199 and + 99.5 J K⁻¹ mol⁻¹ score 1/3

1

(c) (i) $\Delta G = \Delta H - T\Delta S = -46 + 800 \times 99.5/1000$
mark is for putting in numbers with 1000
if factor of 1000 used incorrectly CE = 0

1

$$= 33.6 \text{ or } 33600$$

allow 33 to 34 (or 33000 to 34000)

1

kJ mol^{-1} with J mol^{-1}

correct units for answer essential

if answer to part (b) is wrong or if -112 used, mark consequentially e.g.

• -199 gives 113 to 114 kJ mol⁻¹ (scores 3/3)

• -112 gives 43 to 44 kJ mol⁻¹ (scores 3/3)

1

- (ii) If answer to (c) (i) is positive: not feasible / not spontaneous

If answer to (c) (i) is negative: feasible / spontaneous

if no answer to (c) (i) award zero marks

1

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