TOPIC 10 TEST MS

1. (a) $CaF_2(s) \rightarrow Ca^{2+}(g) + 2F^-(g)$

1

(b) (i) Enthalpy change for formation of 1 mol of substance

Allow heat energy change, NOT energy

1

From its elements

1

Reactants and products/all substances in their standard states

Or normal states at 298 K, 1 bar (100 kPa)

1

(ii) $Ca(s) + F_2(g) \rightarrow CaF_2(s)$

1

(iii) $\Delta H_f(CaF_2) = \Delta H_a(Ca) + 1st\ IE(Ca) + 2^{nd}\ IE(Ca) + BE(F_2) + 2 \times EA(F) - \Delta H_L(CaF_2)$

Or labelled diagram

1

$= 193 + 590 + 1150 + 158 + (2 \times -348) - 2602$

1

$= -1207\ kJ\ mol^{-1}$

Correct answer scores 3
–842 scores 2 (transfer error)
–859 scores 1 only (using one E.A.)
Units not required, wrong units lose 1 mark

1

(c) Electrostatic attraction stronger/ionic bonding stronger/attraction between ions stronger/more energy to separate ions

Molecular attraction/atoms/intermolecular forces CE=0

1

Because fluoride (ion) smaller than chloride

Do not allow F or fluorine

1

(d) (i) $\Delta H = \Delta H_L + \Sigma\Delta H_{hyd} = 2237 - 1650 + (2 \times -364)$

Can be on cycle/diagram

1

$= -141$ kJ mol^{-1}

Correct answer scores 2
Units not required, wrong units lose 1 mark

1

(ii) Decreases

If ans to (d)(i) positive allow increases

1

Reaction exothermic/ΔH –ve

If (d)(i) +ve allow endothermic/ΔH + ve

1

(Equilibrium) shifts to left/backwards
(as temperature rises)/equilibrium
opposes the change

If (d) (i) +ve allow shifts to right/forwards/equilibrium opposes the change

If no answer to (d) (i) assume –ve ΔH used
If effect deduced incorrectly from any ΔH CE = 0 for these 3 marks

1

[15]

2. (a) (i) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

1

(ii) The negative S^- ion

1

repels the added electron

1

(iii) Step B is the atomisation enthalpy of sulphur

1

Step D is the second ionisation enthalpy of calcium

1

(iv) Electrons nearer to the nucleus

1

Electrons removed from a positive species or
more strongly attracted

1

(v) +178 +279 +590 +1145 -200 + 539 + G + 482 = 0

1

G + 3013 = 0 hence G = –3013

1

(b) The model used assumes the ions are spherical and in a lattice

1

The calculated value is smaller than the cycle value or stronger attraction

1

Indicating some covalent character or ions are polarised

1

(c) (i) For a reaction to occur $\Delta G < 0$

1

ΔS is positive and large as a gas is evolved

1

$T\Delta S$ is larger than ΔH and ΔG is negative

1

(ii) ΔS is negative

1

Three moles of gaseous reactant forming two moles of gaseous product

1

At high temperature $T\Delta S$ is larger than ΔH and ΔG is positive

1

[18]

3. (a) $\Delta H = \Sigma\Delta H_f(\text{products}) - \Sigma\Delta H_f(\text{reactants})$

1

$= -201 - 242 - (-394)$

1

$= -49 \text{ kJ mol}^{-1}$

+49 kJ mol^{-1} = 1 mark
units not required, wrong units lose 1 mark

1

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

1

$= 238 + 189 - (214 + 3 \times 131)$

1

$= -180 \text{ J K}^{-1} \text{ mol}^{-1}$

+180 = 1 mark
units not required, wrong units lose 1 mark

1

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

If use G not ΔG penalise M1 but not M2 and M3

1

(ΔS is negative so) at high temp $-T\Delta S$ (is positive and) greater than ΔH/large

Do not award M2 or M3 if positive ΔS value used

1

So $\Delta G > 0$

Independent mark unless positive ΔS value used

1

(Limiting condition $\Delta G = 0$ so) $T = \Delta H/\Delta S$

1

= 272 K

Allow 297-298 if used given values.
Do not award M5 if T –ve or if M4 should give T –ve

1

Reaction is too slow at this temperature/to speed up the reaction

1

(d) $CH_3OH + 3/2O_2 \rightarrow CO_2 + 2H_2O$

Allow multiples.
Ignore state symbols.
Do not allow equation for wrong compound but mark on provided number of moles increases or stays the same.
If no equation or equation that gives a decrease in the number of moles,
CE = 0

1

2.5 mol give 3 mol (gases)

Allow statement 'increase in number of moles/molecules'
If numerical values given, they must match the equation in M1
Ignore the effect of incorrect state symbols on the number of moles of particles unless used correctly

1

Therefore ΔS is positive/entropy increases

If correct deduction from wrong equation is ΔS = 0 or ΔS very small must say H –ve

1

(combustion exothermic so ΔH –ve so $\Delta H - T\Delta S$) and hence ΔG always negative (less than zero)

1

Allow G instead of ΔG
Can score 3 out of 4 marks if equation wrong but leads to increase or no change in number of moles
M4 dependent on M3
Note, if equation wrong AND there is an incorrect deduction about the change in number of moles, CE = 0

[16]

4. A

[1]