Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Mark Schemes

Q1.

(a) The enthalpy change / ΔH when one mole of a (solid) ionic compound

Ignore *standard states / conditions*
Allow *heat change at constant pressure when...*
Ignore *heat change (alone) / energy change*

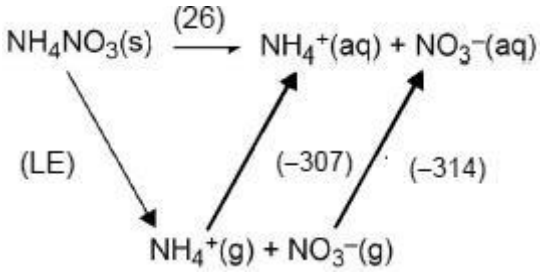
1

dissociates (fully) into gaseous ions

M2 Allow *suitable equation with state symbols for ions*
Not *one mole of gaseous ions*

1

(b)



Allow *+ water or +aq*
M1 = cycle (3 'corners' with formulae and state symbols and suitable arrows)
Allow *equivalent Born-Haber style energy cycle*
Not *ecf to M2 and M3 from incorrect cycle*

1

LE = 26 + 307 + 314

M2 = working e.g. 26 = LE − 307 − 314

= (+)647

1

M3 = answer (+)647 gets 3/3 if M1 given or 2/3 if not
−647 = 2/3 if M1 given or 1/3 if not
+595 / −595 = 2/3 if M1 given or 1/3 if not
−621/+621 = 1/3 if M1 given
Not *ecf for M3 from incorrect expression in M2*

1

(c) ($q = mc\Delta T$ =) 25.0 × 4.18 × (20.2 − 12.2) **OR** 25.0 × 4.18 × 8
(= 836 (J) or 0.836 (kJ))

Not *if m = 29*

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Ignore *sign of q*

1

4.00 g NH_4NO_3 = 4.00/80 **OR** 0.0500 mol

1

$\Delta H^{\⦵}$soln = 836/0.05 = 16720 = (+)16.7(2) kJ mol^{-1}

Allow *ecf from M1 and/or from M2*

–16.7(2) = 2/3

+19.4 = 2/3 (using m = 29 in M1)

−19.4 = 1/3

+2.68 = 2/3

−2.68 = 1/3

+587 or +588 = 2/3

−587 or −588 = 1/3

Allow *2 sig figs or more*

1

(d) (2 × 0.1/8) × 100 = 2.5%

Allow *ecf from* ΔT *in (c)*

1

(e) use a larger mass/amount of NH_4NO_3 / solid

Marking points are independent

Allow *smaller volume of water / less water*

Allow *use more* NH_4NO_3

Not *larger volume of water*

Ignore *higher concentration (of* NH_4NO_3*)*

Ignore *any references to changing apparatus e.g. insulation*

1

so temperature change/decrease is greater
OR final temperature is lower

Allow *temperature increase is greater*

Not *final temperature is higherr*

1

(f) heat gain (from the surroundings) / incomplete dissolvingg

Allow *incomplete reaction*

Allow *thermal energy gain*

Not *heat loss*

Ignore *energy gain*

Ignore *references to mistakes in method*

1

(g) ΔS = (113 + 146) − 151 = +108 (J K^{-1} mol^{-1})

1

$\Delta G = \Delta H - T\Delta S$ **OR** 26 − (298 × 108 × 10^{-3})

Allow *ecf 26 − (298 × M1 ×* 10^{-3}*)*

Allow *ecf 26 − (298 × M1)*

Allow M2 *for 26000 − (298 × 108)*

Allow M2 *for 26 − (298 × 108)*

1

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ΔG = −6.184 / −6.18 / −6.2

−32158 = ***M1*** *and* ***M2***

−32.2 = ***M1*** *and* ***M2***

−6184 = ***M1*** *and* ***M2***

(+)58.2 = ***M2*** *and* ***M3*** *(ecf if −108 for M1)*

1

negative value for ΔG indicates reaction is feasible/spontaneous

Allow *positive value for* ΔG *indicates reaction is NOT feasible/spontaneous*

Allow *< 0 or > 0 as appropriate*

M4 *is standalone*

1

(h) Converting ΔH into J **OR** ΔS into kJ

1

($T = \Delta H/\Delta S$ = 123/144 × 10^{-3} **OR** 123000/144) = 854(.1666666) (K)

0.854 (K) = 1/2

0.00117 (K) = 1/2 (calculation upside down)

2SF minimum

1

[18]

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