Name of the Student:_____
Max. Marks : 16 Marks **Time : 16 Minutes**

Mark Schemes

Q1.

(a) **M1** Temperature on the y-axis and uses sensible scales (i.e. minimum 20 little squares for each °C on y-axis)

Lose mark if temperature scale starts at 0°C

*This mark scores if all points fit on the grid. Do not penalise M1 if extrapolation to 4 mins goes off the grid – this is penalised in **M3**.*

1

M2 Plots all the points correctly (± half a small square)

Lose mark if the points go off the grid Ignore a plotted point at 4 mins used to work out ΔT

1

M3 Draws two best fit lines (0-3 mins) and (6-12 mins)

Both lines must be straight and through all points except 5th minute; lose mark if the lines are kinked/doubled. Any line through 5th minute loses mark

*"S-shaped curve" through points loses **M3** and **M4***

1

M4 Extrapolates both lines to at least the 4th minute

Lose mark if the extrapolation goes off the grid.

1

M5 21.9 – 19.8 = 2.1 (°C)

Allow calculation of ΔT from S-shaped curve as: Value at 4th minute – 19.8 but not if 0 (°C)

ΔT value ecf from incorrect lines/extrapolation

ΔT must be to at least 1dp

If value of ΔT = 2.1, then award M5

1

(b) 0.2 / 2.1 × 100 = 9.5 %

Conseq on (a)

Ignore no of sfs.

1

(c) Replace the glass beaker with a polystyrene cup / insulate the glass beaker / use a lid

Ignore use more dilute solutions

Ignore suggested materials for insulation

Do not allow copper calorimeter / bomb calorimeter

1

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(d) Increase magnitude of temperature change

Ignore references to volume changes

1

by increasing the <u>concentration</u> of the acid/alkali

Mark independently

1

(e) **M1** $HOOCCOOH + 2KOH \rightarrow K_2(OOCCOO) + 2H_2O$

***M1** – equation (allow ionic KOH / $_2C_2O_4$)*

$H_2C_2O_4 + 2KOH \rightarrow K_2C_2O_4 + 2H_2O$

ignore state symbols

allow multiples

Mark independently

M2 q (= mc∆T) = 100 × 4.2 × 3.2 = 1344 J

***M2** – process*

(ignore sign here)

(allow calculations involving 4.18 which leads to 1338 J)

1

M3 n HOOCCOOH = 25 × 0.800 / 1000 = <u>0.020</u>

n KOH = 75 × 0.6 / 1000 = <u>0.045</u>

M3 – calculations of amounts, in moles, of both the ethanedioic acid and potassium hydroxide (both calculations needed)

1

M4 Moles of water = <u>0.040</u> moles

***M4** – answer (stated or used in calculation of ∆H)*

1

M5 ∆H = –1.344/0.04

= – 33.6 (kJ mol^{-1})

M5** – ecf on **M2** and **M4

Answer must be negative and to at least 2sf

*∆H = – **M2** (in kJ) / M4*

*–32.5 - –34 scores 4/4 (**M2**-**M5** + equation)*

*+32.5 - +34 scores 3/4 (**M2**, **M3**, **M4** + equation)*

–65 - –68 scores 3/4 (+ equation)

+65 - +68 scores 2/4 (+ equation)

–52 - –54 scores 3/4 (+ equation)

+52 - +54 scores 2/4 (+ equation)

2

(f) HOOCCOOH is a weak acid / not fully dissociated

H_2SO_4 is a strong(er)acid / fully dissociated / dissociates more

1

(more) <u>energy</u> needed to break bonds/complete dissociation / dissociation is endothermic

So less energy is needed for dissociation of sulfuric acid

Ignore references to heat loss

1

[16]

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