Mark schemes

Q1.

(a) displacement

1

(b)

(percentage =)

$$\frac{63.5}{159.5} \times 100$$

1

= 39.81191 (%)

1

= 39.8 %

allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses both the values in the question

1

(c) volume of copper sulfate solution

1

(d) 0.8(0) g

1

(e) (maximum temperature change) = 47 – 22 (ºC)

1

= 25 (ºC)

allow correct use of incorrectly determined value(s) from the graph

1

(f) (conversion 25 cm^3 =) 0.025 dm^3

1

(concentration =) $\frac{6.75}{0.025}$ (g/dm^3)

allow correct use of an incorrectly determined or unconverted volume

1

= 270 (g/dm^3)

1

(g) line of best fit using the first five points

*max **1** mark if the lines do not intersect*

1

line of best fit using the last four points

1

(h) energy is **taken in from** the surroundings so the reaction is **endothermic**

1

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Q2.

(a) (independent variable)
mass (of ammonium nitrate)

1

(dependent variable)
(lowest) temperature (reached by solution)

allow change in temperature (of solution)

1

(b) all 6 points plotted correctly

allow a tolerance of ± ½ a small square

2

*allow **1** mark for 4 or 5 points plotted correctly*

line of best fit

1

(c) line extrapolated to *y*-axis

1

(initial temperature)
value for temperature where extrapolated line meets *y*-axis

allow a tolerance of ± ½ a small square

1

(d) temperature decreased

ignore correct references to energy transfer

1

(e) (0.3 °C) is the uncertainty

1

(because 0.3 °C) is the range about the mean value

allow values are (a maximum of) 0.3 (°C) either side of the mean

allow (because)

16.8 = 16.5 + 0.3

and

16.2 = 16.5 - 0.3

1

(f) random error

1

[11]

Q3.

(a) **Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- **measure volume of (hydrochloric) acid**
- with a measuring cylinder

- pour (hydrochloric) **acid into a suitable container** eg polystyrene cup
- measure the initial temperature (of hydrochloric acid)
- with a thermometer

- **add a known mass of sodium carbonate**
- measured with a balance
- stir

- **measure the highest temperature reached**

- **repeat with different masses of sodium carbonate**
  or
  add successive masses of sodium carbonate to the same mixture

- repeat the whole investigation

- use the same starting temperature
- use the same volume of (hydrochloric) acid each time
- use the same concentration of (hydrochloric) acid each time

(b) **View with Figure 1**

change in highest temperature

allow a tolerance of ± ½ a small square

1

corresponding change in mass

allow a tolerance of ± ½ a small square

1

(gradient =) $\frac{\text{change in highest temperature}}{\text{change in mass}}$

allow correct use of an incorrectly determined change in highest temperature and / or change in mass

1

(gradient =) 1.6

1

°C/g

allow °C/gram(s)

1

(c) **View with Figure 1**

extrapolates line to the y-axis

1

20.6 (°C)

allow a tolerance of ± ½ a small square

allow a correctly determined value from an incorrectly extrapolated line

1

alternative approach:

(highest temperature at 1.0 g − change in highest temperature per gram =)
22.2 − 1.6 (1)

*allow correct use of value determined for gradient in part **(b)***

= 20.6 (°C) (1)

(d) **C**

1

(e) (**X**) energy

1

(**Y**) (overall) energy change

1

(f) (level of) products is below (level of) reactants

allow the energy decreases (overall)

allow energy is transferred to the surroundings

ignore references to bond making / breaking

1

[17]