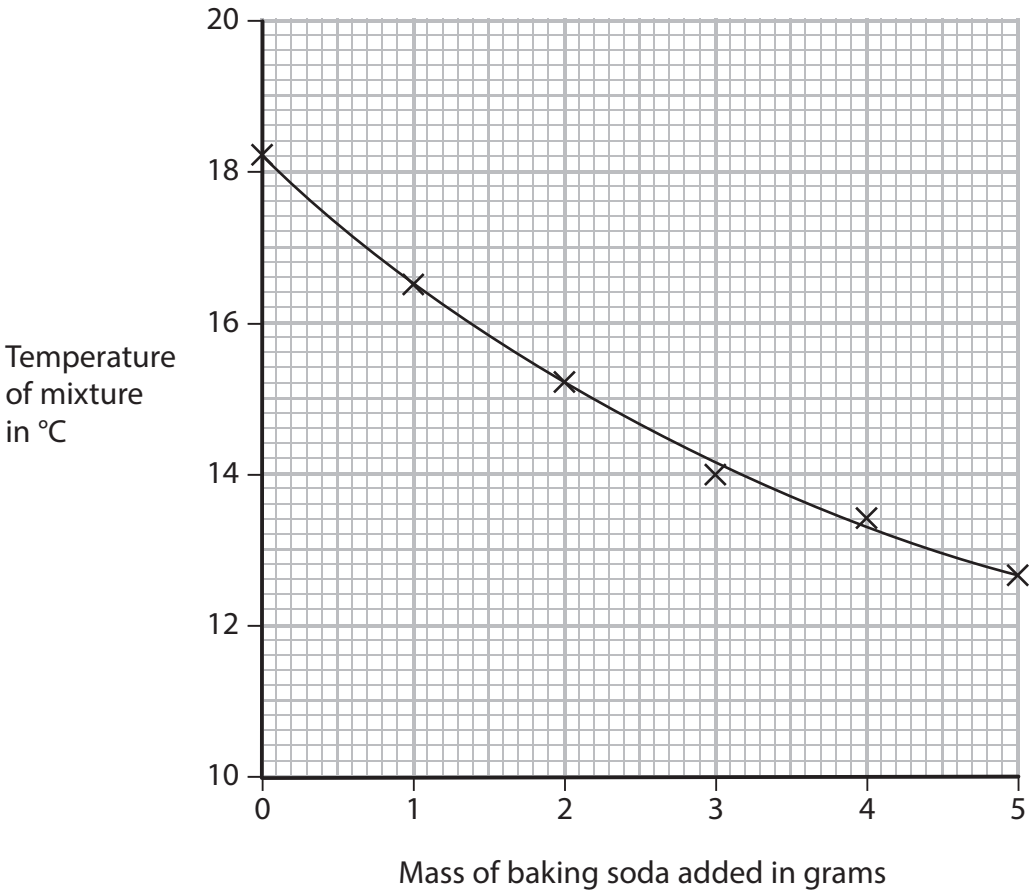
1 A teacher asked her students to suggest some experiments that could be done using chemicals found in the home. One student planned an experiment to measure the temperature change when baking soda is added to vinegar.

She wrote this plan.

- pour 100 cm^3 of vinegar into a polystyrene cup
- weigh out five separate 1 g portions of baking soda
- measure the temperature of the vinegar
- add 1 g of baking soda to the vinegar and stir
- record the new temperature
- add the other portions of baking soda, stirring and recording the temperature after each portion is added

The graph shows her results.



(a) The student said that the reaction in her experiment was not complete.

How does the graph support her statement?

(1)

.....

.....

(b) The student used a polystyrene cup rather than a glass beaker.

Why is it better to use a polystyrene cup?

(1)

.....

.....

(c) Vinegar contains ethanoic acid. Baking soda contains sodium hydrogencarbonate.

The student found this equation for the reaction:

$$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$$

(i) There is no colour change during this reaction.

Suggest one observation, other than the change in temperature, that could be made during the reaction.

(1)

.....

.....

(ii) The compound CH_3COOH is an acid and the compound CH_3COONa is a salt.

The graph shows that the temperature goes down during the reaction.

Use this information to state the two types of reaction occurring.

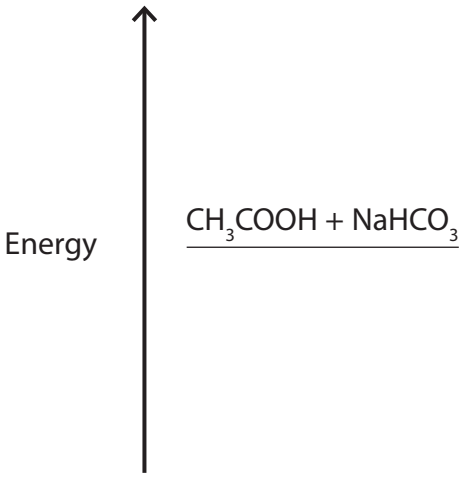
(2)

1 .....

2 .....

(d) (i) Complete the energy level diagram by showing the products of the reaction.

(1)



(ii) Label the diagram to show the energy change, ΔH, for the reaction.

(1)

(e) The student repeated the experiment using the same method with a different sample of vinegar. She recorded these results.

Volume of vinegar = 100 cm^3

Mass of baking soda = 5.0 g

Temperature at start = 18.7 °C

Temperature at end = 13.2 °C

(i) Calculate the heat energy change in this experiment using the expression

heat energy change = volume of vinegar × 4.2 × temperature change

(2)

Heat energy change = ... J

(ii) The student wanted to calculate the amount, in moles, of ethanoic acid in the vinegar.

Apart from the volume of vinegar, what other information would she need to be able to calculate the amount of ethanoic acid?

(1)

.....

.....

(Total for Question 1 = 10 marks)