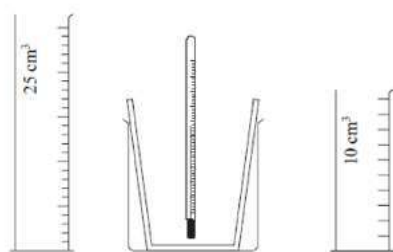


0	1
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The following apparatus is used in an experiment to measure the temperature change when aqueous sodium hydroxide is added to dilute nitric acid.



A student used the following method:

- Using a measuring cylinder, add 25 cm³ aqueous sodium hydroxide to the polystyrene cup and record the temperature.
- Using a different measuring cylinder, add 5 cm³ dilute nitric acid to the cup and stir the mixture.
- Record the temperature of the mixture.
- Add a further 5 cm³ dilute nitric acid, stir the mixture and record the temperature.
- Continue adding 5 cm³ portions of dilute nitric acid until a total of 35 cm³ has been added.

0	1	.	1
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Why is it better to mix the solutions in a polystyrene cup rather than in a glass beaker?

[1 mark]

to prevent / reduce heat loss [1]
 or polystyrene is an insulator [1]
 or glass conducts heat better than polystyrene [1]

The teacher suggested using a burette instead of a measuring cylinder to add the volumes of nitric acid because all of the acid needed can be placed in the burette at the start of the experiment.

0	1	.	2
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Suggest one other advantage of using a burette.

[1 mark]

(more) accurate [1]

A second student used the same method, but followed the teacher's suggestion and added the dilute nitric acid from a burette.

0	1	.	3
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Draw a straight line of best fit through the points that show a temperature increase up to 29.0 °C.

[1 mark]

0	1	.	4
---	---	---	---

Draw a second straight line of best fit through the remaining points. Make sure that the two lines cross each other.

[1 mark]

0	1	.	5
---	---	---	---

Circle on the graph the result that is anomalous.

[1 mark]

0	1	.	6
---	---	---	---

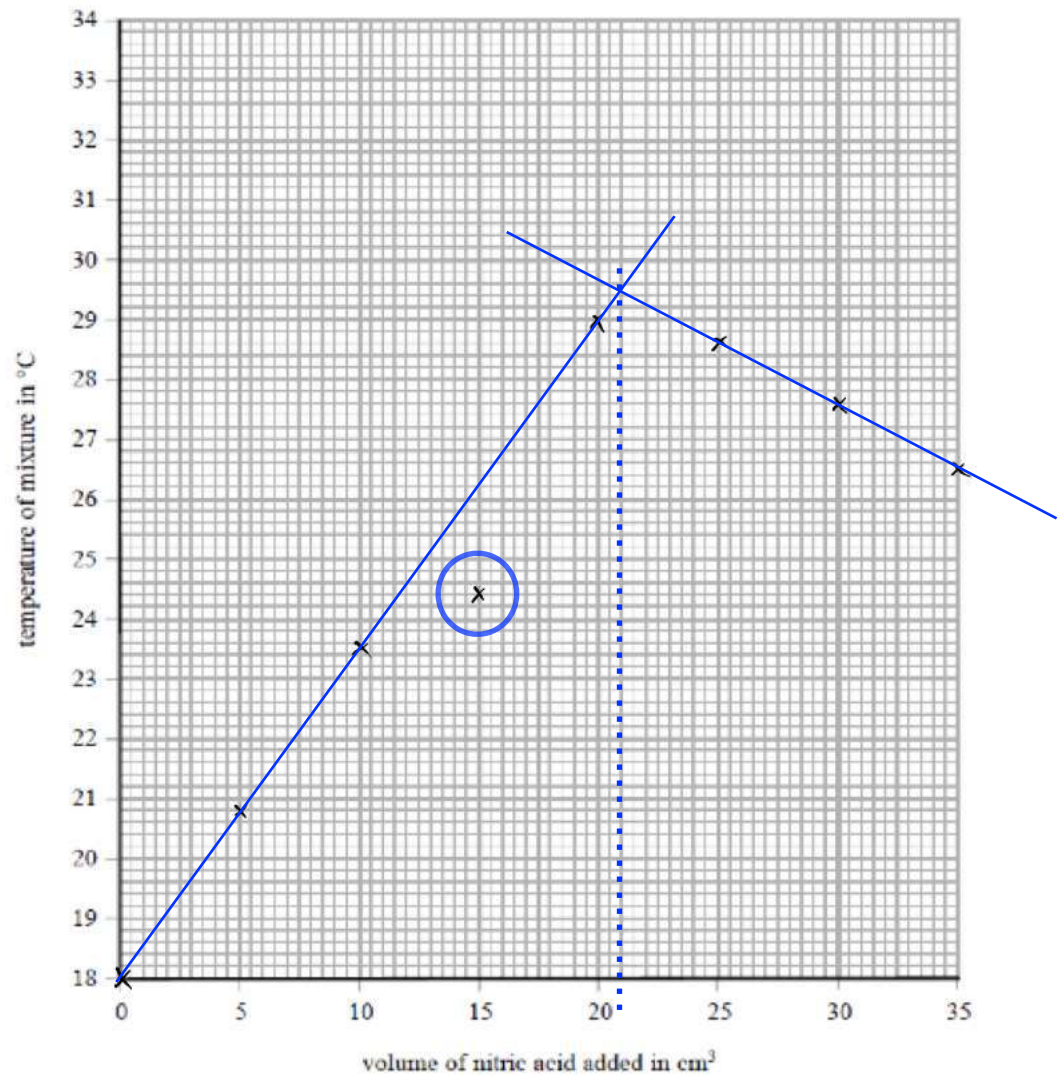
Is this reaction exothermic or endothermic?

[1 mark]

exothermic [1]

WARNING :

The first line of best fit must ignore the anomalous point.



The point where the lines cross indicates the maximum temperature reached during the experiment.

0	1	.	7
---	---	---	---

What is the maximum temperature, in °C, reached during the experiment?

correct line gives 29.4 - 29.5

[1]

[1 mark]

0	1	.	8
---	---	---	---

What volume, in cm³, of dilute nitric acid completely reacts with the 25 cm³ of aqueous sodium hydroxide?

correct line gives 20.5 - 21.0

[1]

[1 mark]

One of the results is anomalous. It shows a temperature lower than it should be.

0	1	.	9
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Suggest a reason for this anomalous result.

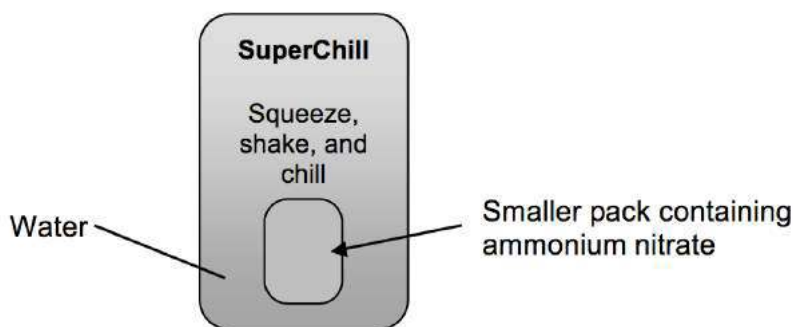
waited too long before adding more acid / reaction cooled in between [1]

or

did not stir enough / reaction had not finished / acid had not been used up [1]

[1 mark]

SuperChill is a type of cooling pack filled with water. Inside the pack is a smaller pack containing solid ammonium nitrate.



The outer pack is squeezed so that the inner pack breaks open. The pack is shaken and quickly gets cold as the ammonium nitrate dissolves in the water. The reaction is not reversible. The packs are made of plastic.

Why does the bag feel cold?

[2 marks]

Takes in heat energy from the surroundings or energy transferred from the surroundings to the pack. [1]

Reaction is endothermic. [1]

TOP TIP :

The reaction of ammonium nitrate with water is a common example of an endothermic reaction. A common point of confusion is that if the reaction takes in heat energy, it should feel hotter. In fact it feels cooler to the touch, because heat energy is being drawn away from your skin, leaving it feeling cooler.

Suggest one disadvantage of using a type of cooling pack such as SuperChill.

[1 mark]

Not reusable/thrown away once used/plastic might be non-biodegradable/uses non-renewable resource/crude oil. [1]

(Total 12 marks)

End