

Question 14 (Answer: **B**)

- An endothermic reaction takes energy in, so the mixture gets colder.
- An exothermic reaction gives energy out, so the mixture gets hotter.
- So the neutralisation cools down and the displacement warms up.

Question 15 (Answer: **A**)

- Activation energy is measured from the reactant level up to the peak.
- The enthalpy change is measured from the reactant level to the *product* level.
- So they start from the same place but end at different ones – do not confuse the two arrows.

Question 14 (Answer: **A**)

- Bonds broken: the four N–H bonds and the N–N bond of the hydrazine, plus the O=O of the oxygen.
- Bonds formed: the N≡N triple bond of nitrogen and four O–H bonds in the two waters.
- ΔH = energy in – energy out; the very strong N≡N is what makes this so exothermic.

Question 15 (Answer: **A**)

- Endothermic means the change takes energy *in* from its surroundings.
- The surroundings here are the water and the beaker.
- So they lose energy and the temperature of the mixture falls.

2(a)	M1 all initial temperatures correct (21.0, 21.5, 21.5, 22.0, 22.0) M2 all readings for temperature after one minute correct (29.0, 36.5, 33.5, 38.5, 46.0) M3 temperature changes correct (8.0, 15.0, 12.0, 16.5, 24.0) M4 all temperatures and temperature changes recorded to 1 decimal place
2(b)	M1 y-axis scale is linear, and points extend above halfway up the scale M2 and M3 all points plotted correctly M4 best fit curve correctly drawn
2(c)	M1 the larger the volume of acid, the lower the temperature (increase/change) M2 same amount of heat energy given out (as same length of magnesium and acid is in excess)
2(d)	M1 extrapolation shown on graph, this must be a smooth continuation of line M2 correct reading from their working shown on graph M3 °C
2(e)	sketched line is below plotted line for all volumes of acid and does not drop to or below zero
2(f)(i)	(burette is more) accurate (than a measuring cylinder)
2(f)(ii)	to mix them / to evenly distribute acid/heat energy
2(g)	M1 change: insulate the boiling tube M2 explanation: reduce/no heat loss

Question 13 (Answer: **C**)

- The mixture gets hot, so energy is released – the reaction is exothermic.
- On a reaction pathway diagram the products must therefore sit *below* the reactants.
- ΔH is negative.

Question 14 (Answer: **A**)

- Forming a bond *releases* energy, so the enthalpy change must be negative.
- Methane contains four C–H bonds.
- $4 \times 413 = 1652$, so $\Delta H = -1652$ kJ.

Question 13 (Answer: **D**)

- Exothermic means energy is given out to the surroundings.
- So the surroundings get warmer.
- Energy leaving the reacting system makes ΔH negative.

Question 17 (Answer: **B**)

- Bonds broken: $4 \times \text{C–H} + 2 \times \text{O=O} = 1640 + 992 = 2632$ kJ.
- Bonds formed: $2 \times \text{C=O} + 4 \times \text{O–H} = 1610 + 1840 = 3450$ kJ.
- $\Delta H = 2632 - 3450 = -818$ kJ/mol – negative, because more is released than absorbed.