

Question 16 (Answer: **C**)

- Only the catalyst differs between the tubes, so compare how fast the foam rises.
- The most effective catalyst gives the fastest decomposition and the tallest foam soonest.
- A tube with no catalyst, or with a substance that is not a catalyst, shows almost no change.

Question 16 (Answer: **A**)

- The rate rises when the particles collide more often or with more energy.
- Raising the concentration or the temperature does exactly that.
- So the yellow sulfur precipitate forms – and hides the cross – sooner.

Question 15 (Answer: **D**)

- Raising the temperature makes the reaction faster, so the 50 °C curve is steeper at the start.
- The acid is the limiting reagent in both, and its amount has not been changed.
- So both curves level off at the *same* final volume of carbon dioxide.

Question 15 (Answer: **B**)

- A catalyst *lowers* the activation energy; it never raises it.
- It does not change the reactants or the products, so the overall enthalpy change is unaffected.
- It works by offering an alternative pathway, not by making collisions more frequent.

Question 15 (Answer: **B**)

- More concentrated acid means more particles in the same volume.
- So collisions happen more often, and the rate rises.
- But the *energy* of the particles is unchanged, so the proportion with enough energy to react stays the same.

2(a)	M1 times are correct for all five experiments (20, 25, 42, 56, 95)
	M2 All times recorded in whole numbers of seconds only
2(b)	M1 y-axis scale is linear and points take up over half of space available
	M2 and M3 All points plotted correctly
	M4 best fit line
2(c)	M1 correct working shown at a concentration of 1.3 on graph
	M2 correct reading from their working shown on graph

2(d)(i)	M1 0.25
	M2 cm / s
2(d)(ii)	Experiment 5
2(e)	to check / verify / compare results / to get concordant results /
2(f)(i)	M1 both temperatures are correct (24.0, 46.5)
	M2 temperature change calculated correctly (22.5) and all temperatures and temperature change given to one dp
2(f)(ii)	a change of temperature will change the rate of reaction
2(f)(iii)	the polystyrene would prevent heat escaping
2(f)(iv)	use a water bath (at room temperature / at starting temperature)

2(a)	M1 volume of aqueous sodium thiosulfate and volume of water correctly recorded for all five experiments and volume of dilute hydrochloric acid shown as 5 cm ³ for all experiments.															
	<table><tr><td>50</td><td>0</td><td>5</td></tr><tr><td>40</td><td>10</td><td>5</td></tr><tr><td>30</td><td>20</td><td>5</td></tr><tr><td>25</td><td>25</td><td>5</td></tr><tr><td>20</td><td>30</td><td>5</td></tr></table>	50	0	5	40	10	5	30	20	5	25	25	5	20	30	5
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	40	10	5													
30	20	5														
25	25	5														
20	30	5														
M2 all five stop clock reading correct																
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30																
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59																
73																
	M3 all times in whole number of seconds only															
2(b)	M1 y-axis linear scale linear and points extend over more than half of the y-axis															
	M2 and M3 all points plotted correctly															
	M4 line of best fit															

2(c)(i)	correct evaluation of $1 \div \text{time}$ for experiment one. expected answer is $1 / 30 = 0.033$
2(c)(ii)	1
2(d)(i)	M1 13
	M2 cm ³
2(d)(ii)	M1 correct working shown at 37 cm ³ on graph to show where value read
	M2 correct reading from their working shown on graph.
2(d)(iii)	so depth of liquid in beaker is the same in all experiments / so concentration of dilute hydrochloric acid in mixture is the same for all experiments
2(e)(i)	a burette is more accurate than a measuring cylinder
2(e)(ii)	Any one from: • volume of aqueous sodium thiosulfate is not 25 cm³ • volume of aqueous sodium thiosulfate is not constant / fixed • volumetric pipettes not available in those sizes
2(f)	M1 (different size beaker would) change depth
	M2 so changes time measured

Question 19 (Answer: **A**)

- Higher temperature means faster particles, so they collide more often – statement 1 is right.
- It also raises their kinetic energy, so more of them exceed the activation energy – statement 3 is right.
- The activation energy belongs to the reaction and does not change, and a fixed volume holds the same number of particles.