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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.

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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.

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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.

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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.

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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.

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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

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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)

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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.

50	0	5
40	10	5
30	20	5
25	25	5
20	30	5

M2 all five stop clock reading correct

30
37
49
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 ÷ 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 cm^3 • 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.