HL Paper 1

Sodium carbonate and hydrochloric acid react according to the equation below.

$$\mathrm{Na_2CO_3(s) + 2HCl(aq) \rightarrow CO_2(g) + 2NaCl(aq) + H_2O(l)}$$

Which conditions will produce the fastest initial rate with 2.0 g of powdered sodium carbonate?

A. $100\ \mathrm{cm^3}$ of $1.0\ \mathrm{mol\,dm^{-3}}$ hydrochloric acid at 323 K

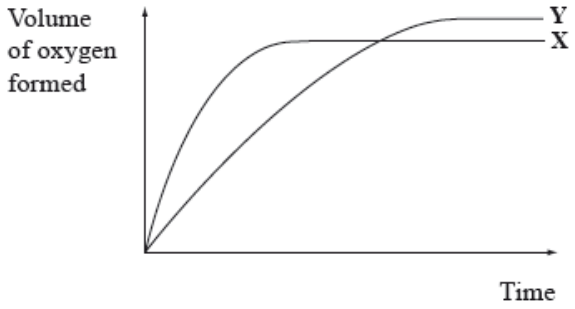
B. $50\ \mathrm{cm^3}$ of $2.0\ \mathrm{mol\,dm^{-3}}$ hydrochloric acid at 323 K

C. $100\ \mathrm{cm^3}$ of $1.0\ \mathrm{mol\,dm^{-3}}$ hydrochloric acid at 348 K

D. $50\ \mathrm{cm^3}$ of $2.0\ \mathrm{mol\,dm^{-3}}$ hydrochloric acid at 348 K

Curve **X** on the graph below shows the volume of oxygen formed during the catalytic decomposition of a $1.0\ \mathrm{mol\,dm^{-3}}$ solution of hydrogen peroxide.

$$\mathrm{2H_2O_2(aq) \rightarrow O_2(g) + 2H_2O(l)}$$



Which change would produce the curve **Y**?

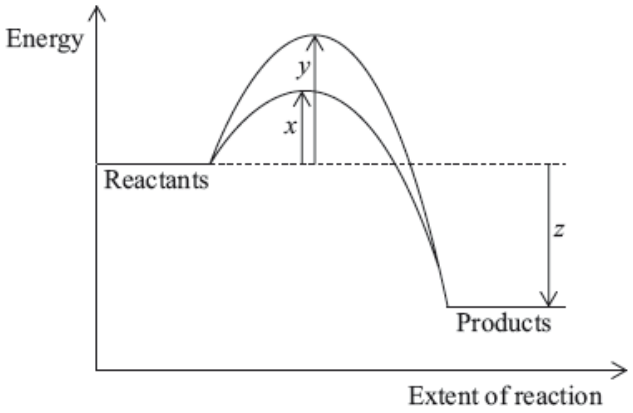
A. Adding water

B. Adding some 0.1 mol dm–3 hydrogen peroxide solution

C. Using a different catalyst

D. Lowering the temperature

The diagram below shows the energy changes for a reaction with and without a catalyst. Which symbols represent the activation energy, E_a, and the enthalpy change, ΔH, for the reaction with a catalyst?



	E_a (with a catalyst)	ΔH
A.	x	z
B.	y	z
C.	z	x
D.	$y-x$	z

Which statements explain why a catalyst is used in the Contact process (shown below)?

$$\mathrm{SO_2(g)} + \frac{1}{2}\mathrm{O_2(g)} \rightleftharpoons \mathrm{SO_3(g)}$$

I. A catalyst lowers the activation energy.

II. A catalyst moves the position of equilibrium towards the product.

III. A catalyst allows the same rate to be achieved at a lower temperature.

A. I and II only

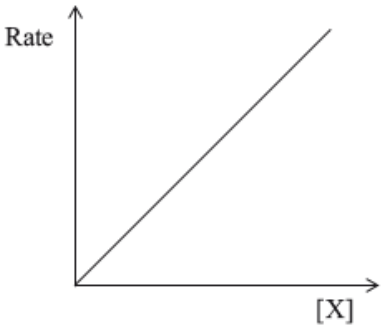
B. I and III only

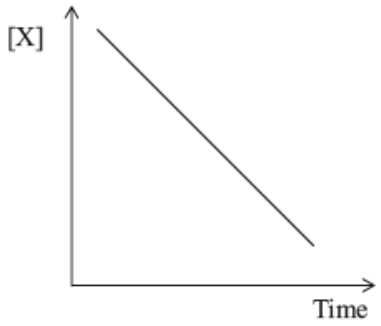
C. II and III only

D. I, II and III

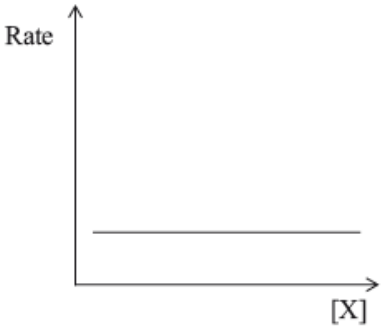
Which pair of graphs shows a decomposition reaction of X that obeys first-order kinetics?

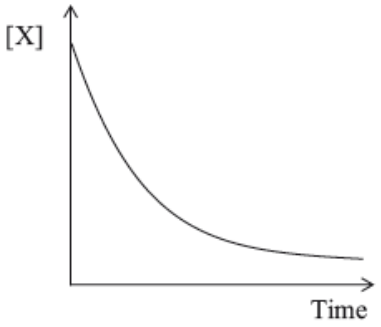
A.



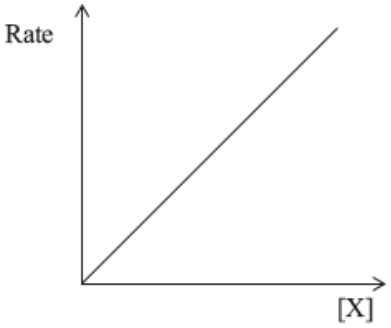


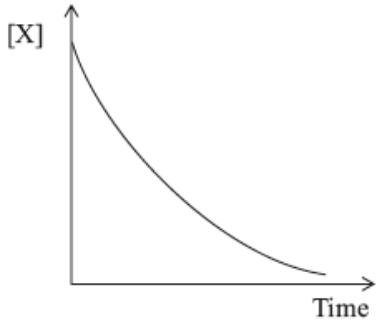
B.





C.





D.