1. Two identical samples of zinc were added to an excess of two solutions of sulphuric acid, concentrations 2 mol l^{-1} and 1 mol l^{-1} respectively.
   Which of the following would have been the same for the two samples?
    A. The total mass lost
    B. The total time for the reaction
    C. The initial rate of the reaction
    D. The average rate of evolution of gas

2. Which of the following is not a correct statement about the effect of a catalyst?
    The catalyst
    A. provides an alternative route to the products
    B. lowers the energy which molecules need for successful collisions
    C. provides energy so that more molecules have successful collisions
    D. form bonds with reacting molecules

3. Which of the following graphs of rate of reaction against temperature would apply to the neutralisation of dilute hydrochloric acid with zinc?

A.

Rate

Temperature

B.

Rate

Temperature

C.

Rate

Temperature

D.
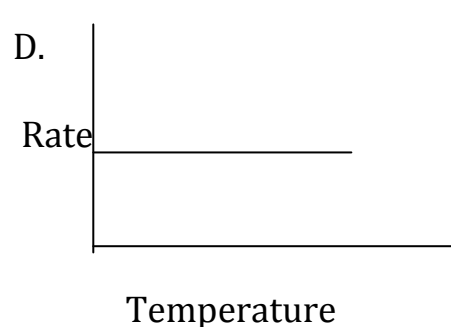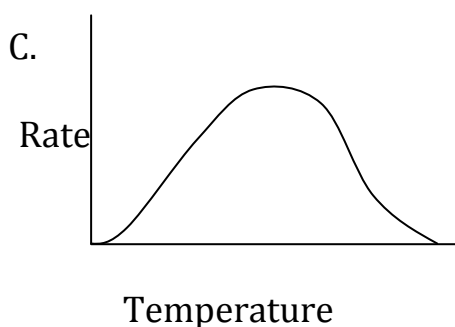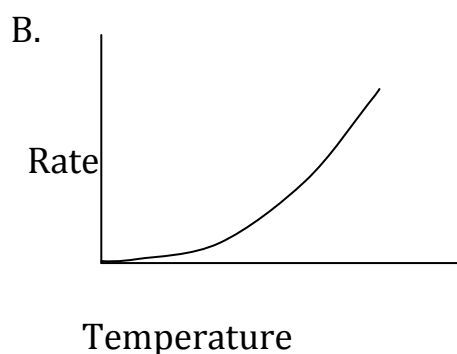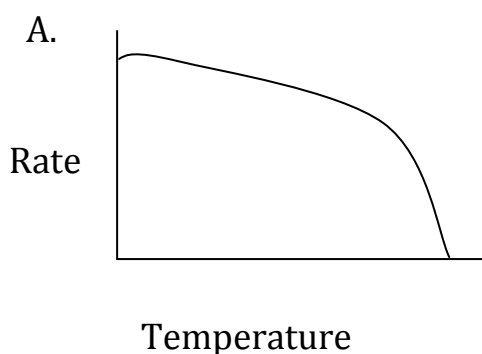
Rate

Temperature

4. A small increase in temperature results in a large increase in rate of reaction.
    The **main** reason for this is that
    A. more collisions are taking place
    B. the enthalpy change is lowered
    C. the activation energy is lowered
   D. many more particles have energy greater than the activation
    energy

5.   The following results were obtained in the reaction between marble chips
     and dilute hydrochloric acid.

Time (minutes)	0	2	4	6	8	10
Total volume of carbon dioxide production/cm³	0	52	68	78	82	84

What is the average rate of production of carbon dioxide, in cm^3 min^{-1},
between 2 and 8 minutes?

A. 5
B. 26
C. 30
D. 41

6.
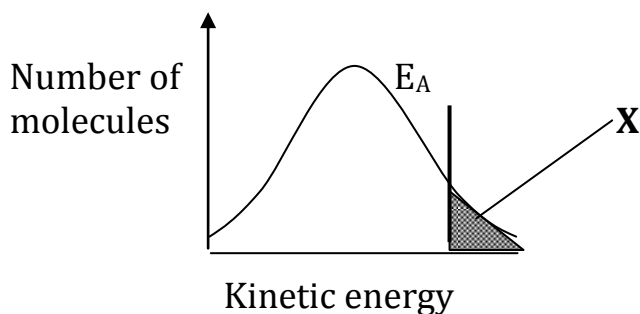
In area **X**
A. molecules always form an activated complex
B. no molecules have the energy to form an activated complex
C. collisions between molecules are always successful in forming
products
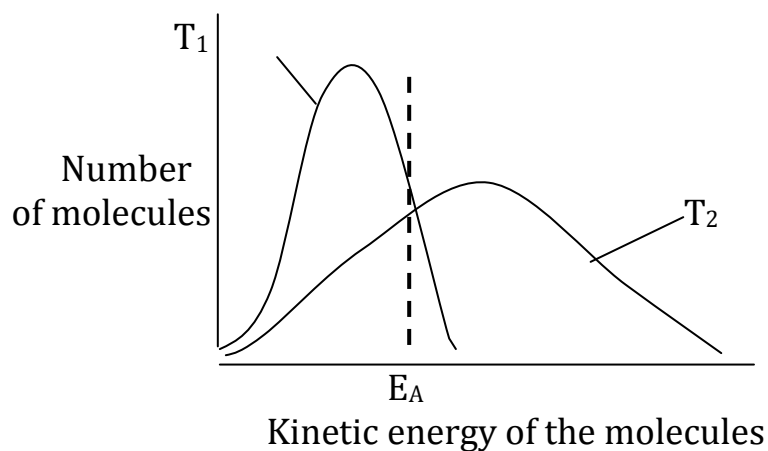D. all molecules have the energy to form an activated complex

7. The graph below shows the variation of concentration of a reactant with time as a reaction proceeds.
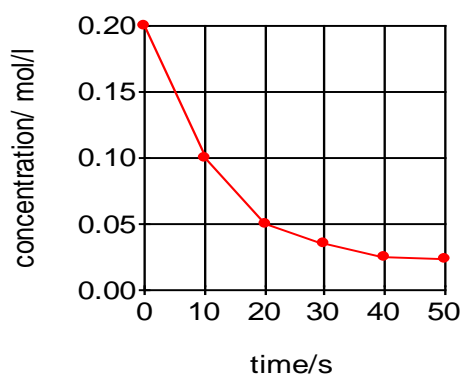
What is the average rate during the first 20s?

        A. 0.0025 mol $l^{-1}s^{-1}$
        B. 0.0036 mol $l^{-1}s^{-1}$
        C. 0.0075 mol $l^{-1}s^{-1}$
        D. 0.0090 mol $l^{-1}s^{-1}$

8.

Which of the following is the correct interpretation of the above energy distribution diagram for a reaction as the temperature **decreases** from T_2 to T_1 ?

	Activation energy (E_A)	Number of successful collisions
A	remains the same	increases
B	decreases	decreases
C	decreases	increases
D	remains the same	decreases

9. The continuous use of large extractor fans greatly reduces the possibility of an explosion in a flour mill. This is mainly because
    A. a build up in the concentration of oxygen is prevented
    B. local temperature rises are prevented by the movement of the air
    C. particles of flour suspended in the air are removed
    D. the slow accumulation of carbon monoxide is prevented

10.   When copper carbonate reacts with excess acid, carbon dioxide is produced. The curves shown were obtained under two different conditions.
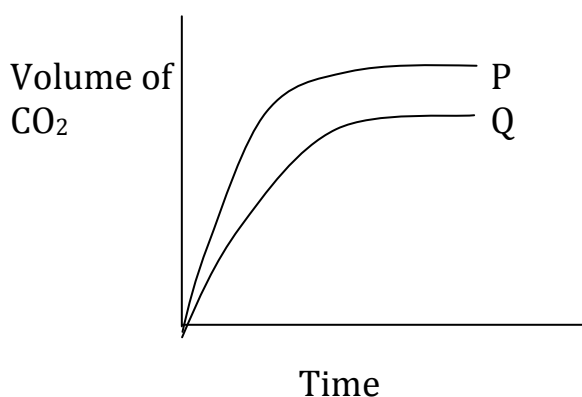
The change from **P** to **Q** could be brought about by
    A. increasing the concentration of the acid
    B. decreasing the mass of copper carbonate
    C. decreasing the particle size of the copper carbonate
    D. adding a catalyst

11. A student carried out the some practical work to find the effect of concentration on the rate of the reaction between hydrogen peroxide solution and an acidified solution of iodide ions.

$$H_2O_2(aq) + 2H^+(aq) + 2I^-(aq)   \rightarrow   2H_2O(l) + I_2(aq)$$
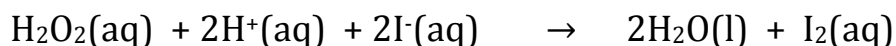
During the investigation, only the concentration of the iodide ions was changed.
Part of the student's results sheet for the experiment is shown.

Results

Experiment	Volume of KI(aq) (cm³)	Volume of H₂O(aq) (cm³)	Volume of H₂O₂(aq) (cm³)	Volume of H₂SO₄(aq) (cm³)	Volume of Na₂S₂O₃(aq) (cm³)	Rate (s⁻¹)
1	25	0	5	10	10	0.043
2						
3						

a) Describe how the concentration of the potassium iodide solution could be changed during this series of experiments.

b) Calculate the reaction time, in seconds, for the first experiment.

12. Nitrogen dioxide gas can be prepared in different ways.
It is manufactured industrially as part of the Ostwald process. In the first stage of the process, nitrogen monoxide is produced by passing ammonia and oxygen over a platinum catalyst.

$$NH_3(g) \ + \ O_2(g) \quad \rightarrow \quad NO(g) + H_2O(g)$$
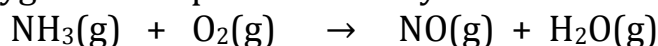
a)   Balance the above equation.
b)   Platinum metal is a heterogeneous catalyst for this reaction.
    What is meant by a **heterogeneous** catalyst?

13. Catalytic converters in car exhaust systems convert poisonous gases into less harmful gases.

    a. Two less harmful gases are formed when nitrogen monoxide reacts with carbon monoxide.
   Name the **two** gases produced.

    b.   The catalyst is made up of the metals platinum, palladium and rhodium.
        Explain what happens to molecules in the exhaust gas during their conversion to less harmful gases.
        You may wish to draw a labelled diagram.

14. The rate of carbon dioxide production was measured in three laboratory experiments carried out at the same temperature and using excess calcium carbonate.

Experiment	Acid	Calcium carbonate
A	40cm³ of 0.10 mol l⁻¹ sulphuric acid	1g lumps
B	40cm³ of 0.10 mol l⁻¹ sulphuric acid	1g powder
C	40cm³ of 0.10 mol l⁻¹ hydrochloric acid	1g lumps

The curve obtained for Experiment **A** is shown.
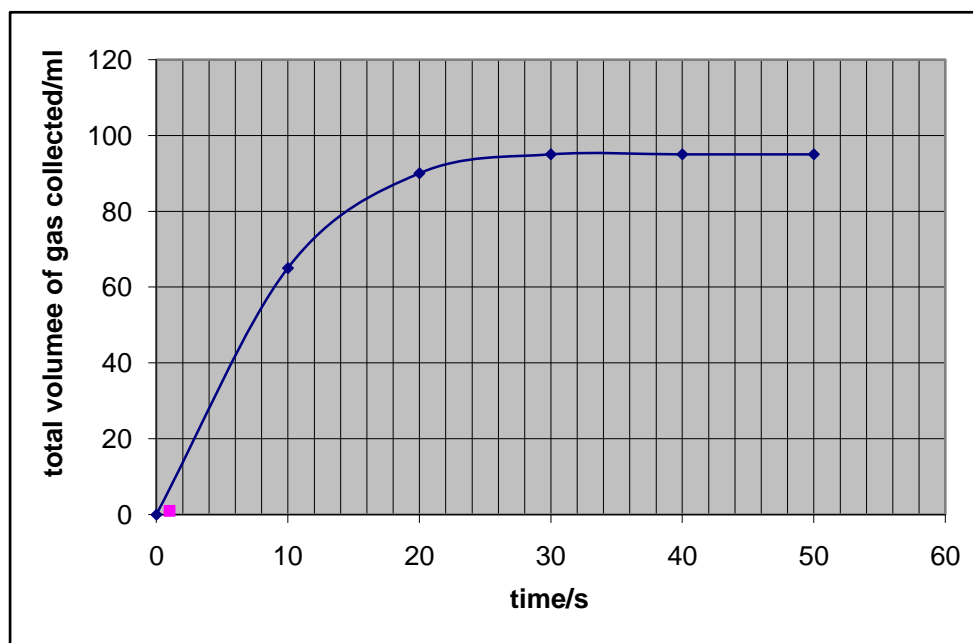
a. Use the graph to calculate the average reaction rate in ml s⁻¹, between 10 and 20s.

b. Make a rough copy of the graph in your jotter.
Draw curves on the graph to show the results that could be obtained for experiments **B** and **C**.
Label each curve clearly.

c. Draw a labelled diagram of the assembled apparatus which could be used to carry out this experiment.