SH1 Exit Quiz (Reaction Kinetics)

Name: _____ Duration: **20 min**

11

1 Sucrose is a sugar produced in plants such as sugarcane and sugar beet where it is extracted and refined for use as a sweetener in food and beverage.

In sucrose, the bond between the monomers glucose and fructose can be broken via a hydrolysis reaction with water. The hydrolysis is so slow that a solution of sucrose can be stored for a long period of time at room temperature with negligible change.

(a) Enzymes like sucrase have specific activity. When a very small amount of sucrase is added to a solution of sucrose, however, the hydrolysis reaction will proceed rapidly.

(i) Explain what is meant by the term *specific activity* of an enzyme.

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..... [1]

The graph in Fig. 1.1 shows how the initial rate varies with sucrose concentration for the hydrolysis reaction where a very small amount of sucrase was added.

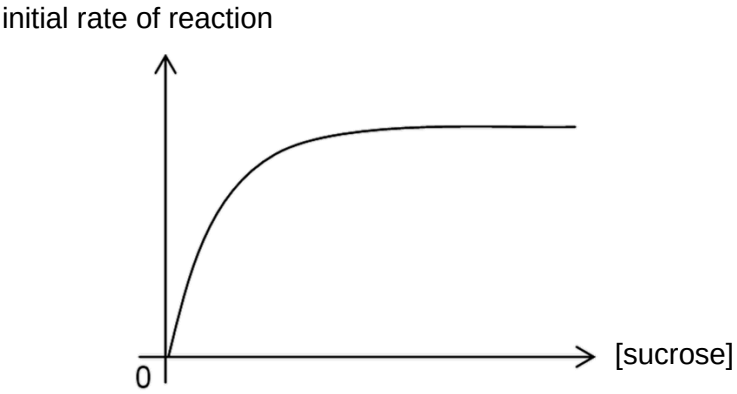

Fig. 1.1

(ii) "At very high concentrations, the order of reaction with respect to [sucrose] is 1."

Comment on the validity of this statement and explain your answer using Fig. 1.1.

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..... [1]

(iii) Using a Boltzmann distribution curve, explain why the addition of sucrase increases the rate of the hydrolysis reaction.

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..... [3]

(b) The hydrolysis reaction of sucrose can also be accelerated with acids such as hydrochloric acid.

The hydrolysis reaction of sucrose with HC*l* was studied at constant temperature via a series of experiments.

experiment	[sucrose] / mol dm^{-3}	[HC*l*] / mol dm^{-3}	rate / mol dm^{-3} min^{-1}
1	0.10	1.0	2.0×10^{-5}
2	0.20	1.0	4.0×10^{-5}
3	0.30	2.0	1.2×10^{-4}

(i) Deduce the order of reaction for sucrose and HC*l*. Hence, give the rate equation for the reaction.

[3]

In each experiment, concentration of HC*l* remained effectively constant throughout the hydrolysis reaction.

(ii) Complete Fig. 1.2 to show how the concentration of sucrose varies with time, at constant temperature for experiment 1 where the initial concentration of sucrose used was 0.100 mol dm^{-3}.

Label any important features on Fig. 1.2.

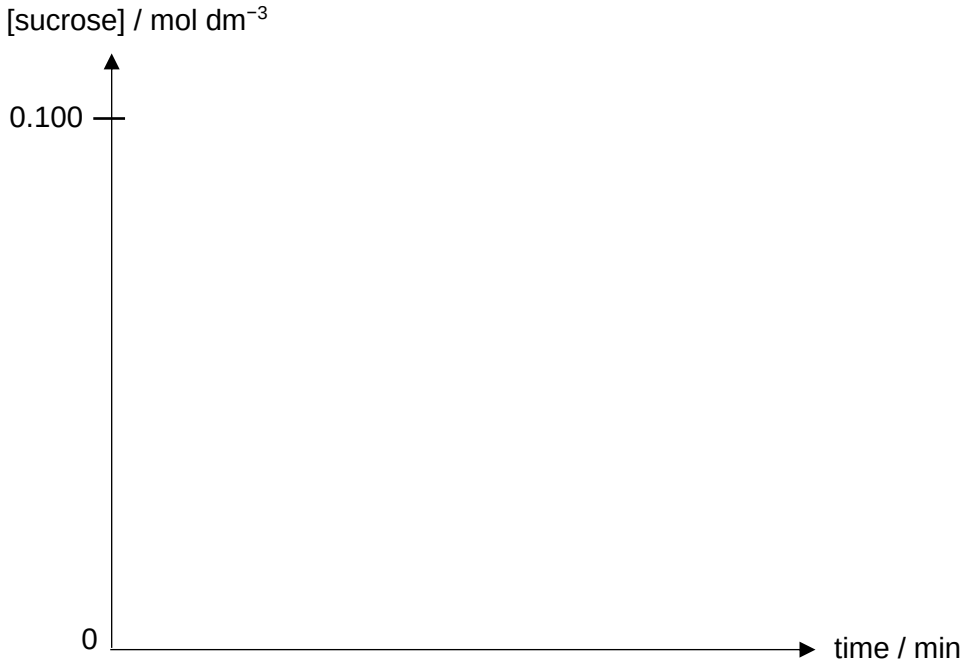

Fig. **1.2**

[2]

2 The age of rock samples can be calculated using Uranium-Lead dating. ^{235}U is an unstable isotope which decays into ^{207}Pb. This nuclear reaction obeys first-order kinetics with a half-life of 710 million years.

The decay can be summarised by the following equation:

$$^{235}U \rightarrow {}^{207}Pb + \text{other decay products}$$

A rock sample has a ^{235}U : ^{207}Pb ratio of 1 : 15.

Assuming that all the ^{207}Pb detected is formed from the decay of ^{235}U, what is the age of the rock sample?

A 710 million years

B 1420 million years

C 2130 million years

D 2840 million years