OCR
Oxford Cambridge and RSA

A Level Chemistry B (Salters)

H433/02 Scientific literacy in chemistry

Question Set 8

1 Why does human hair turn grey? Studies have shown that this is caused by lower levels of the enzyme catalase in hair follicles. Catalase catalyses the breakdown of hydrogen peroxide as shown in **equation 3.1**.

$$2H_2O_2 \rightarrow 2H_2O + O_2 \qquad \textbf{Equation 3.1}$$

When levels of hydrogen peroxide increase, the melanin (dye) in the hair is bleached.

(a) (i) Catalase has an active site.

Explain how this results in faster decomposition of hydrogen peroxide. **[3]**

(b) Suggest the **type** of reaction by which hydrogen peroxide bleaches melanin. **[1]**

(c)* Some students are given a solution of catalase and solutions of hydrogen peroxide of differentconcentrations. They study the rate of reaction in **equation 3.1**.

They determine the relative initial rates of reaction at the different hydrogen peroxide concentrations, using the volume of oxygen produced.

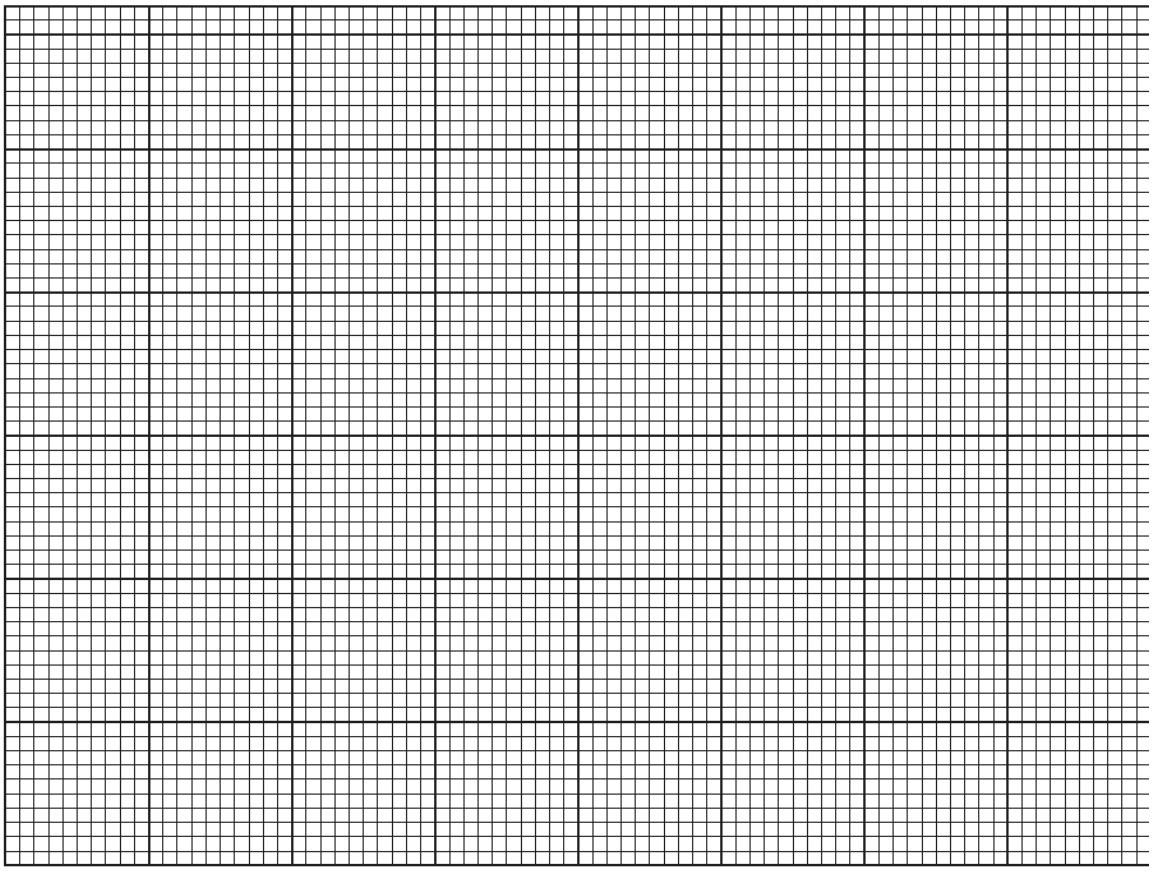
Suggest the procedure they follow, including how the students should process their results.You may include a diagram as part of your answer. **[6]**

(d) (i) The students record their results as shown in the box below.

Concentrations of hydrogen peroxide: 0.05 – 0.35 in 0.05 intervals. Units of concentration mol dm^{-3} Corresponding relative rates of reaction: 1.0; 2.1; 3.0; 3.8; 4.0; 4.1; 4.1 Temperature: 20 °C

Arrange the results in a more appropriate format. **[2]**

(ii) Use the grid below to plot a graph of the results and draw a line of best fit.



[4]

(e) **(i)** A student says that the graph shows that the decomposition of hydrogen peroxide is first order with respect to both the hydrogen peroxide concentration and the catalase concentration.

Write the rate equation that would follow from the student's statement.Give the units of the rate constant.

Rate equation:

Units of rate constant .....

[2]

(ii) Explain why the student is incorrect and give the correct information. **[3]**

(f) Hydrogen peroxide concentration is often measured as 'volume strength'.1 cm^3 of '1 volume' hydrogen peroxide produces 1 cm^3 of oxygen at RTP.

Calculate the 'volume strength' of the 0.35 $mol\,dm^{-3}$ hydrogen peroxide used by the students.

$$2H_2O_2 \rightarrow 2H_2O + O_2 \qquad \textbf{Equation 3.1}$$

Give your answer to an **appropriate** number of significant figures.

[3]

‘volume strength’ = volume

(g) The students have 20.0 cm^3 of 0.35 $mol\,dm^{-3}$ H_2O_2 and wish to make a 0.05 $mol\,dm^{-3}$ solution.

How much water should they add?

volume of water to add = cm^3 **[2]**

Total Marks for Question Set 8: 26

Resource Materials

Question Set No: 8

General Information

Molar gas volume = $24.0\,dm^3\,mol^{-1}$ at RTP

Avogadro constant, $N_A = 6.02 \times 10^{23}\,mol^{-1}$

Specific heat capacity of water, $c = 4.18\,J\,g^{-1}\,K^{-1}$

Planck constant, $h = 6.63 \times 10^{-34}\,J\,Hz^{-1}$

Speed of light in a vacuum, $c = 3.00 \times 10^{8}\,m\,s^{-1}$

Ionic product of water, $K_w = 1.00 \times 10^{-14}\,mol^2\,dm^{-6}$ at 298 K

1 tonne = 10^6 g

Arrhenius equation: $k = Ae^{-E_a/RT}$ or $\ln k = -E_a/RT + \ln A$

Gas constant, $R = 8.314\,J\,mol^{-1}\,K^{-1}$