OCR
Oxford Cambridge and RSA

A Level Chemistry B (Salters)
H433/01 Fundamentals of chemistry

Practice paper – Set 1
Time allowed: 2 hours 15 minutes

You must have:
• the Data Sheet for Chemistry B (Salters)

You may use:
• a scientific calculator

First name	
Last name	

Centre number		Candidate number	

INSTRUCTIONS
• Use black ink. You may use an HB pencil for graphs and diagrams.
• Complete the boxes above with your name, centre number and candidate number.
• Answer **all** the questions.
• Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
• Do **not** write in the barcodes.

INFORMATION
• The total mark for this paper is **110**.
• The marks for each question are shown in brackets **[ ]**.
• Quality of extended responses will be assessed in questions marked with an asterisk (*).
• This document consists of **32** pages.

SECTION A

You should spend a maximum of 40 minutes on this section.

Write your answer to each question in the box provided.

Answer **all** the questions.

1   Silver nitrate solution reacts with potassium bromide solution.

Which row correctly describes the precipitate formed?

	Colour of precipitate	Solubility in ammonia solution
A	cream	Partially soluble in ammonia
B	white	Soluble in ammonia
C	cream	Insoluble in ammonia
D	white	Insoluble in ammonia

Your answer

[1]

2   What has the longest wavelength?

   A   Ultraviolet radiation

   B   Green light

   C   Red light

   D   Blue light

Your answer

[1]

3   Which formula represents an ester?

   A $C(CH_3)_3OOCCH_2CH_3$

   B $CH(CH_3)_2OCCH_2CH_3$

   C $CH(CH_3)_2OCH_2CH_3$

   D $(CH(CH_3)_2CO)_2O$

Your answer

[1]

4 Which equation represents a termination reaction?

    A $Cl + CH_4 \rightarrow CH_3 + HCl$

    B $CH_3 + Cl_2 \rightarrow Cl + CH_3Cl$

    C $Cl_2 \rightarrow Cl + Cl$

    D $Cl + CH_3 \rightarrow CH_3Cl$

Your answer

[1]

5 Which statement describes an exothermic reaction?

    A   More energy is taken in breaking bonds than is released making bonds.

    B   More energy is taken in making bonds than breaking bonds.

    C   More energy is released making bonds than is taken in breaking bonds.

    D   More energy is released making bonds than breaking bonds.

Your answer

[1]

6 How many structural isomers of C_5H_{10} show *E/Z* isomerism?

    A   1

    B   2

    C   3

    D   4

Your answer

[1]

7 Which change is oxidation?

    A $NO_3^- \rightarrow NH_3$

    B $NO_2^- \rightarrow NO_3^-$

    C $HNO_3 \rightarrow NO_3^-$

    D $NH_4^+ \rightarrow NH_3$

Your answer

[1]

8 What is correct about RNA?

    A   RNA codes for DNA.

    B   RNA has the same bases as DNA.

    C   Triplets in RNA code for amino acids.

    D   RNA contains a deoxyribose-phosphate backbone.

Your answer

[1]

9 Which statement is correct about amines?

    A   They react with organic acids to form amides.

    B   They react with strong acids to form anions.

    C   They have a lone pair of electrons they can donate.

    D   They are neutral in solution.

Your answer

[1]

10 Which row is correct about the ions of copper and iron?

	Element	Ion formed	Colour of aqueous ion
A	copper	3+	green
B	iron	2+	yellow
C	copper	1+	blue
D	iron	3+	orange

Your answer

[1]

11 Which one of the equations is **not** correct?

A $Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$

B $Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$

C $Cu^{2+} + 4NH_3 \rightarrow Cu(NH_3)_4^{2+}$

D $Fe^{2+} + 4NH_3 \rightarrow Fe(NH_3)_4^{2+}$
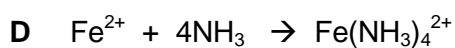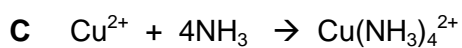
Your answer

[1]

12 Hydrogen is burned as a fuel in a car engine.

Which row shows the possible products?

	Oxides of nitrogen	Sulfur dioxide	Water vapour
A	✓	✓	✓
B			✓
C		✓	✓
D	✓		✓

Your answer

[1]

13 Sodium chloride solution is electrolysed.

Which equation represents the reaction at the cathode?

A $2H_2O\,(l) + 2e^- \rightarrow 2OH^-(aq) + H_2\,(g)$

B $2Cl^-\,(aq_) \rightarrow Cl_2\,(aq) + 2e^-$

C $Na^+\,(aq) + e^- \rightarrow Na\,(s)$

D $2H_2O\,(l) \rightarrow 4H^+(aq) + O_2\,(g) + 4e^-$
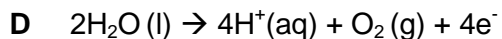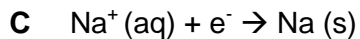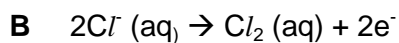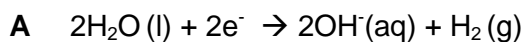
Your answer

[1]

14 What is the systematic name of ClO_3^- ?

A   chlorate(VII)

B   chlorate(VI)

C   chlorate(V)

D   chlorate(III)

Your answer

[1]

15 Which row is correct?

	Species	Electron configuration
A	V^{2+}	[Ar] $3d^3$
B	Fe^{3+}	[Ar] $3d^3\,4s^2$
C	Sc^{3+}	[Ar] $4s^1$
D	Cu	[Ar] $3d^9\,4s^2$

Your answer

[1]

16 CH_3COCl reacts with benzene in a Friedel-Crafts reaction.

What is **not** correct about this reaction?

A The reaction occurs without a catalyst.

B A ketone is formed.

C HCl is formed.

D The reaction is electrophilic substitution.

Your answer

[1]

17 Ethene is reacted with an aqueous solution containing bromine and sodium chloride.

Which row shows possible products of this reaction?

A	CH_2BrCH_2Br	CH_2ClCH_2Cl	CH_2BrCH_2OH
B	CH_2OHCH_2Br	CH_2ClCH_2Br	CH_2BrCH_2Br
C	CH_2BrCH_2Cl	CH_2BrCH_2OH	CH_2ClCH_2OH
D	CH_2ClCH_2Cl	CH_2BrCH_2Br	CH_2ClCH_2OH

Your answer

[1]

18 Sodium thiosulfate reacts with iodine as shown in the equation below.

$$2Na_2S_2O_3 + I_2 \rightarrow 2NaI + Na_2S_4O_6.$$
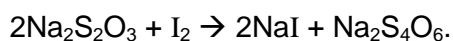
What volume of 0.0300 mol dm^{-3} sodium thiosulfate is needed to react with 25.0 cm^3 of 0.0500 mol dm^{-3} I_2?

A 20.8 cm^3

B 30.0 cm^3

C 41.7 cm^3

D 83.3 cm^3

Your answer

[1]

19 Which one of these reactions represents the standard enthalpy change of combustion of butane?

A $C_4H_{10}(g) + 4O_2(g) \rightarrow 4CO(g) + 4H_2O(l)$

B $C_4H_{10}(g) + 6\frac{1}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l)$

C $2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(l)$

D $C_4H_{10}(g) + 6\frac{1}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$

Your answer

[1]

20 What is the name of the compound $CHCl_2CH_2Br$?

A 1,1-dichloro-2-bromoethane

B 2-bromo-1,1-dichloroethane

C 1-bromo-1,1-dichloroethane

D 1-dichloro-2-bromoethane

Your answer

[1]

21 The equation for the reaction between hydrogen and iodine is shown below.

$$H_2(g) + I_2(g) \leftrightharpoons 2HI(g)$$
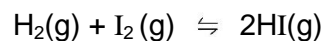
The value of K_c is 46.9 at 760 K.

At equilibrium at 760 K the concentrations of the reactant gases are shown in the table.

What is the concentration of hydrogen iodide?

Gas	Concentration / mol dm^{-3}
I_2	0.00220
H_2	0.00920

A 4.32×10^{-7} mol dm^{-3}

B 6.57×10^{-4} mol dm^{-3}

C 9.49×10^{-4} mol dm^{-3}

D 3.08×10^{-2} mol dm^{-3}

Your answer

[1]

22 In 1800 the concentration of carbon dioxide in the atmosphere was 0.028%.
In 2000 it was 390 ppm.

What is the percentage increase of the carbon dioxide concentration over the 200 years?

A 28%

B 39%

C 72%

D 93%

Your answer

[1]

23 What are the units of the rate constant for a reaction that is third order overall?

A $dm^3 \ mol^{-1} \ s^{-1}$

B $dm^6 \ mol^{-2} \ s^{-2}$

C $dm^6 \ mol^{-2} \ s^{-1}$

D $dm^3 \ mol^{-1} \ s$

Your answer

[1]

24 Some students study the reaction **A + B + C → products**.

Their graph of the concentration of reagent **A** against time is shown below.

concentration of **A**

time
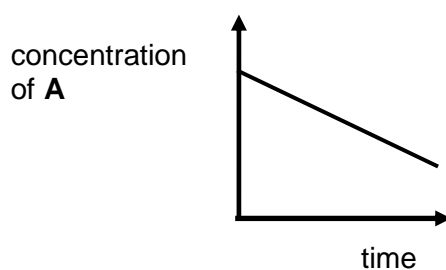
What can be deduced from this graph?

A The reaction is first order with respect to reagent **A.**

B The reaction is zero order with respect to reagent **A.**

C The reaction is first order overall.

D Reagents **B** and **C** are not present in excess.

Your answer

[1]

25 Here are some data for the reaction **W + X →** products.

Reagent	Order with respect to the reagent	Initial concentration/ mol dm^{-3}
W	1	0.015
X	2	0.020

Some students measure the initial rate of reaction as 1.3 x 10^{-4} mol dm^{-3}s^{-1}.

What is the numerical value of the rate constant?

A 0.046

B 0.43

C 2.3

D 22

Your answer

[1]

26 What is correct about the ethanedioate ion?

A it can form two co-ordinate bonds to certain cations

B it has two lone pairs of electrons

C it has a single negative charge

D it contains four sigma bonds

Your answer

[1]

27 Which of the following will react with benzene?

     1: NO_2^+

     2: OH^-

     3: NH_3

  A 1, 2 and 3

  B Only 1 and 2

  C Only 2 and 3

  D Only 1

Your answer ☐

[1]

28 Which of the following is/are correct about the catalytic action of transition metals and their compounds?

  Statement 1: They can act as homogeneous catalysts using their variable oxidation states.

  Statement 2: They provide an alternative route of lower activation enthalpy.

  Statement 3: They do not take part in the reaction.

  A 1, 2 and 3

  B Only 1 and 2

  C Only 2 and 3

  D Only 1

Your answer ☐

[1]

29   Which of the following will react with aldehydes?

   1:   cyanide ions

   2:   acid dichromate(VI)

   3:   Fehlings solution

A   1, 2 and 3

B   Only 1 and 2

C   Only 2 and 3

D   Only 1

Your answer

[1]

30   Which of the following is/are correct?

	Reaction	Description
1	bromination of benzene	electrophilic substitution
2	bromination of alkenes	electrophilic addition
3	bromination of alkanes	nucleophilic substitution

A   1, 2 and 3

B   Only 1 and 2

C   Only 2 and 3

D   Only 1

Your answer

[1]

SECTION B

Answer **all** the questions.

31 In enclosed spaces, such as submarines, it is necessary to remove carbon dioxide from the air. Solid calcium hydroxide, $Ca(OH)_2$, can be used to remove the carbon dioxide.

(a) Suggest the equation for the reaction that takes place.
Include state symbols.

[1]

(b) Air is 0.040% CO_2 by volume.
What mass of calcium hydroxide is needed to absorb the carbon dioxide from 5.0 m^3 of air at 23 ^{o}C and 95 kPa?

mass of calcium hydroxide = ...g **[3]**

(c) Limewater is a saturated solution of calcium hydroxide (a solution that contains as much as will dissolve).

The maximum solubility of calcium hydroxide is 0.113 grams per 100 cm^3 at 298 K.

(i) Calculate the concentration of $Ca(OH)_2$ (in mol dm^{-3}) in limewater at 298 K.

concentration =………………………… mol dm^{-3} **[1]**

(ii) A student wants to make a 0.0100 mol dm^{-3} solution of calcium hydroxide.

What volume of limewater would the student need to dilute to 250 cm^3 at 298 K?

volume = …………………………………..cm^3 **[2]**

(d) Limewater can also be made by reacting calcium with water.

(i) Describe what you would **see** when this reaction occurred.

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....**[2]**

(ii) Magnesium is in the same group as calcium.

What would you **see** when magnesium is reacted with water?

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.... **[1]**

(e) (i) Give the equation for the first ionisation enthalpy of magnesium.

[1]

(ii) How does the difference in ionisation enthalpies of calcium and magnesium account for the difference in the reactions of the elements?

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.... **[2]**

32 In 1869 a green emission line was seen in the Sun during an eclipse. At first this was thought to be caused by a new element. Later it was found to be due to a highly ionised form of iron, Fe^{13+}.

(a)* Describe the appearance and origin of the emission spectrum of the Sun and explain how the lines can be used to identify elements.

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....**[6]**

(b) The wavelength of the green line due to the ionised iron was 530.3 nm.

Calculate the energy given out by the iron (in $kJ\,mol^{-1}$). (1 nm = 1 x 10^{-9} m)
Give your answer to an **appropriate** number of significant figures.

energy = ………………………… $kJ\,mol^{-1}$ **[3]**

(c) Suggest the electronic configuration of the Fe^{13+} ion in terms of sub-shells and atomic orbitals.

....**[1]**

(d) Mass spectrometry can be used to detect the small differences in the abundances of the isotopes of iron in different planets.

A sample of iron is composed of isotopes as shown in the table below.

Isotope	Abundance %
54	5.85
56	91.75
57	2.12
58	0.28

Calculate the relative atomic mass of this sample of iron.
Give your answer to **two** decimal places.

A_r = …………………………………………….... **[2]**

(e) Elements are formed in stars by fusion processes.

Complete the nuclear equations (by writing on the dotted lines) to show the formation of a new element.

$$^{20}_{10}Ne + ^{......}_{......}n \rightarrow ^{21}_{10}Ne$$
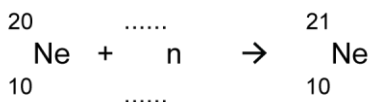
Then

$$^{21}_{10}Ne + ^{4}_{2}He \rightarrow ^{......}_{......} + ^{......}_{......}n$$
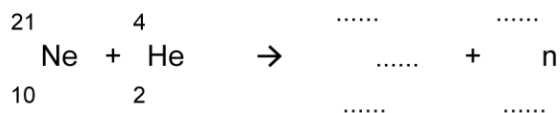
[2]

33 Ammonium nitrate (NH_4NO_3) can be used in cold packs to treat sports injuries.
Ammonium nitrate dissolves in water in an endothermic process.

(a) Some students carry out an experiment to measure the enthalpy change of solution of ammonium nitrate. The students have some powdered ammonium nitrate and normal laboratory equipment.

(i) Describe what the students do and the measurements they make so that they can calculate the enthalpy change of solution.

You do not need to include details of how to carry out the calculation.

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....**[3]**

(ii) The students use a thermometer that can be read to ±0.5°C.

Give the percentage uncertainty in measuring a temperature **change** of 17°C.

percentage uncertainty = ... % **[1]**

(b) Draw an enthalpy level diagram for dissolving ammonium nitrate.

Label the enthalpy levels and use the data below to calculate $\Delta_{\text{hydration}}H$ for the NO_3^- ion.

$\Delta_{\text{hydration}}H$ NH_4^+	-307 kJ mol^{-1}
$\Delta_{LE}H$ NH_4NO_3	-645 kJ mol^{-1}
$\Delta_{\text{solution}}H$ NH_4NO_3	+25.0 kJ mol^{-1}

Enthalpy

$\Delta_{\text{hydration}}H$ for NO_3^- = ...kJ mol^{-1} **[4]**

(c) State and explain how the lattice enthalpy of ammonium chloride would compare with the lattice enthalpy of ammonium nitrate.

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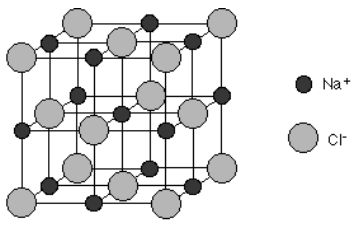
.... **[3]**

(d) (i) Use the diagram of the sodium chloride lattice to draw diagrams of the hydrated ions in aqueous solution.

Sodium chloride lattice	Aqueous ions
Na⁺ Cl⁻	

[2]

(ii) List the types of bonds broken and made during dissolving.

Broken ....

Made..

[2]

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34 Many compounds extracted from coal tar were used as raw materials for the chemical industry in the late 19th century.

One of these compounds was phenol which can be converted to 2-hydroxybenzoic acid.
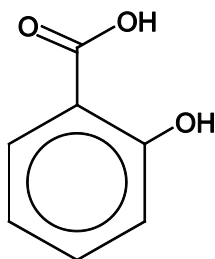
2-hydroxybenzoic acid

(a) Aspirin has the same pain-killing properties as 2-hydroxybenzoic acid but fewer side-effects.

2-hydroxybenzoic acid can be converted to aspirin by esterifying the phenol group with ethanoic anhydride, $(CH_3CO)_2O$.

Give the equation for this reaction, using structural formulae.

[2]

(b) Some students make a sample of aspirin which is contaminated with 2-hydroxybenzoic acid.

The students carry out thin layer chromatography on the contaminated sample of aspirin.

They dissolve the contaminated aspirin, put a spot on a TLC plate and place the plate in a suitable solvent. They wait until the solvent has risen to the top of the plate.

They then made the substances visible using iodine vapour.
Sketch and label the expected result.

	2-hydroxybenzoic acid	aspirin
R_f value	0.32	0.80

[1]

(c) The students then purify the sample by recrystallization.

Suggest **one** factor that influences the choice of solvent for this.

Explain your answer.

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.... **[1]**

(d) The students obtained 29.5 g aspirin (M_r 180) and the yield was 69.5%.

What mass of 2-hydroxybenzoic acid was used in the reaction?

mass of 2-hydroxybenzoic acid = ...g **[2]**

(e) Synthetic dyes can be made from other components of coal tar that have benzene rings.

One such dye is the yellow dye shown below.
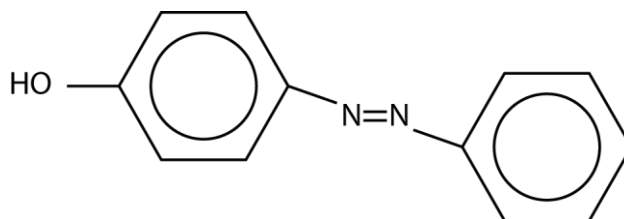
yellow dye

 (i) In a benzene ring, all the C-C bond lengths are equal.

Describe how the bonding in benzene accounts for this.

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....**[2]**

 (ii) Explain, in terms of delocalisation and energy levels, why the dye is yellow and benzene is colourless.

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.... **[5]**

35 Proteins are vital constituents of our bodies. They are made from amino acids.
Two different amino acids are shown below.
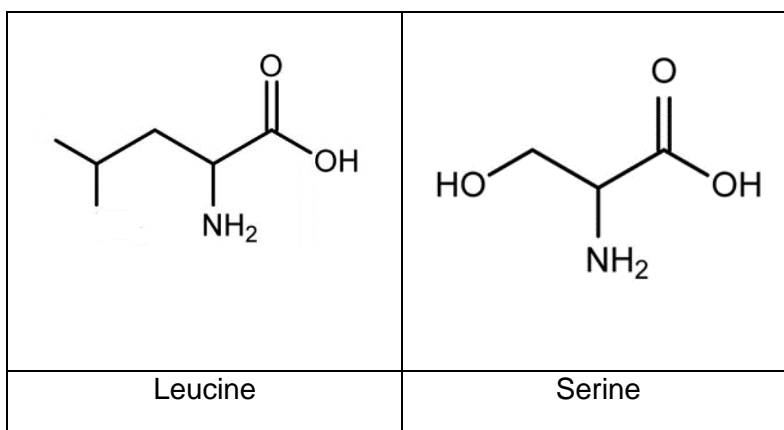
Leucine	Serine

(a) Draw the **skeletal** structures of **two** different dipeptides formed between leucine and serine.

[3]

(b) Both these amino acids exhibit optical isomerism.

Draw the structures of the **two** optical isomers of serine.

[2]

(c) Amino acids can polymerise to proteins, some of which are enzymes.

Describe and explain how the structure of enzymes helps them to catalyse reactions.

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.... **[2]**

(d) Catalase is an enzyme which catalyses the breakdown of toxic hydrogen peroxide in the body.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$
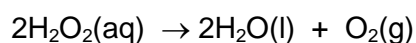
Complete the enthalpy profile to show the reactions with and without the enzyme as catalyst.

enthalpy

$2H_2O_2(aq)$

$2H_2O(l) + O_2(g)$
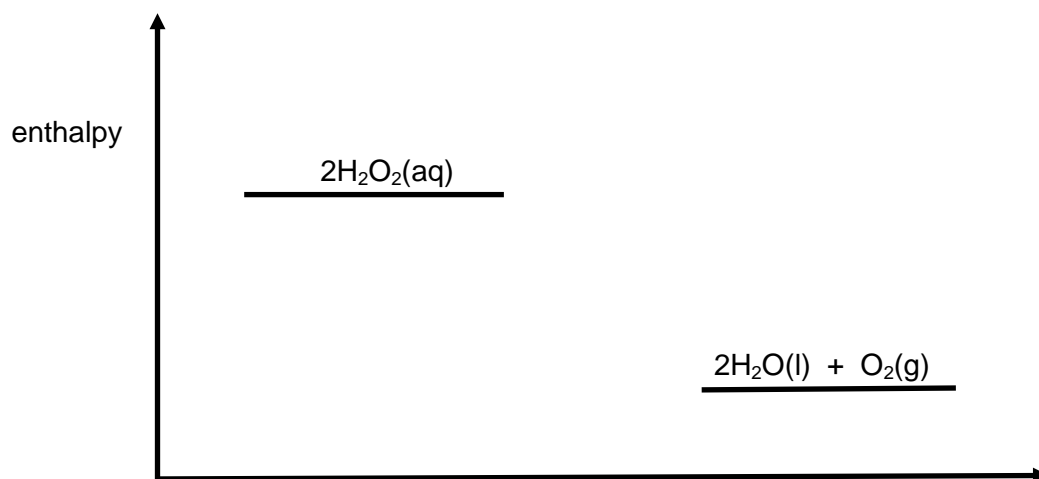
[1]

(e) Some students investigate the decomposition of hydrogen peroxide in the presence of catalase. They measure the volume of oxygen produced at known times as the reaction proceeds.

(i) Describe how they could use these results to find the rate of reaction at a certain time.

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.... **[2]**

(ii) The students are given '20 volume' hydrogen peroxide.

This means $1.0\,cm^3$ of the solution produces $20\,cm^3$ oxygen at room temperature and pressure when it breaks down.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$
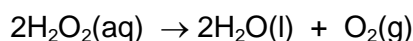
Calculate the concentration of '20 volume' hydrogen peroxide (in mol dm^{-3}).

concentration =……………………….mol dm^{-3} **[2]**

(f) The students carry out a series of experiments with different concentrations of hydrogen peroxide and catalase with a concentration of 1%. They obtain the results shown in the table below.

Concentration of hydrogen peroxide /mol dm⁻³	Rate of reaction /cm³ O₂ s⁻¹
0.08	0.201
0.15	0.552
0.25	0.645
0.33	0.833
0.42	0.900
0.50	0.911

Complete the plot of rate against concentration on the grid below and draw the line of best fit. **[2]**

concentration of hydrogen peroxide/ mol dm⁻³
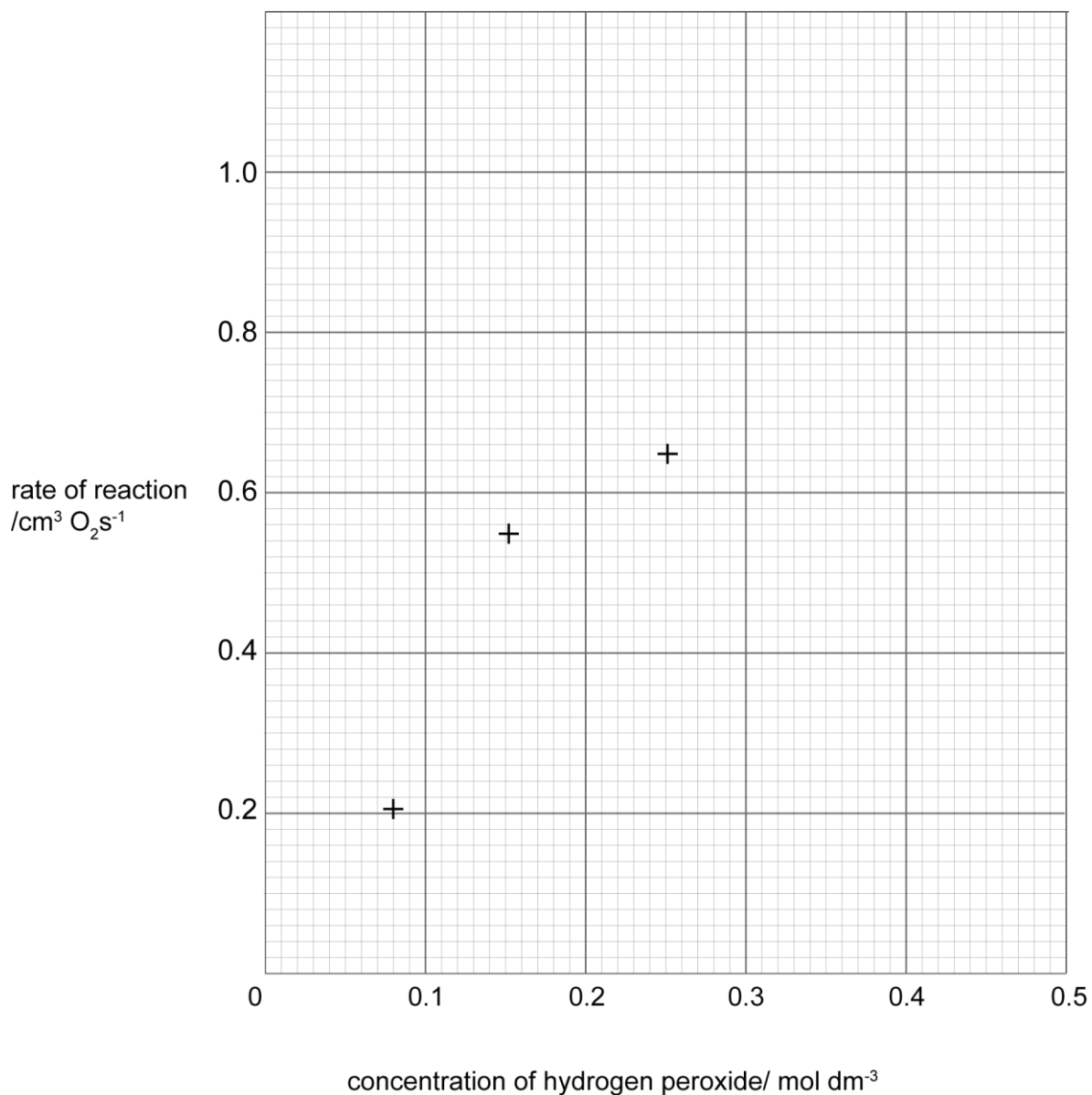
(g)* The students conclude from the graph that the reaction is first order with respect to both enzyme and substrate and that the rate determining step is E + S → products.

Comment on the students' conclusions, using evidence from the graph.
Give the correct chemistry where necessary.

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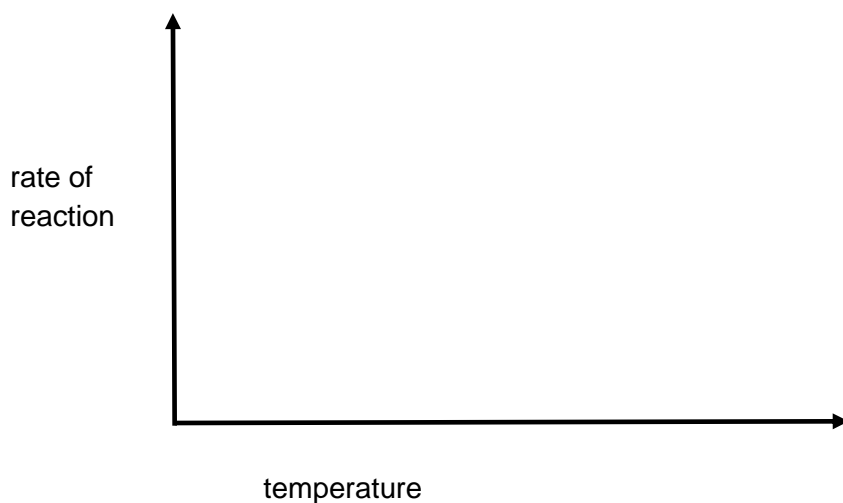
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....**[6]**

(h) The students carry out the reaction at different temperatures and measure the initial rate of reaction.

Sketch the graph of the expected results and explain your answer.

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....**[3]**

(i) Give **one** advantage and **one** disadvantage of using enzymes in industrial processes.

Advantage ....

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Disadvantage ....

....**[2]**

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).