OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

CHEMISTRY B (SALTERS)

Chemistry of Materials

F334

Candidates answer on the question paper.
A calculator may be used for this paper.

OCR supplied materials:
- *Data Sheet for Chemistry B (Salters)* (inserted)

Other materials required:
- Scientific calculator

Friday 24 June 2011
Morning

Duration: 1 hour 30 minutes

OCE/26423

F 3 3 4

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- The insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Answer **all** the questions.
- Do **not** write in the bar codes.

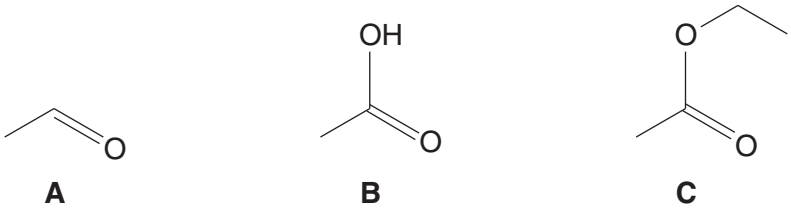
INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.

  This means for example you should:
  - ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
  - organise information clearly and coherently, using specialist vocabulary when appropriate.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry B (Salters)* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **90**.
- This document consists of **20** pages. Any blank pages are indicated.

Answer **all** the questions.

1 Poor processing or storage of wine can lead to the build-up of certain compounds that can spoil the flavour and aroma of the wine. The structures of three such compounds are shown below.



A **B** **C**

(a) (i) Give the systematic name of compound **A**.

..... **[1]**

(ii) A student wanted to make a sample of compound **A** from ethanol in the laboratory.

Give the reagents that would be mixed with ethanol.

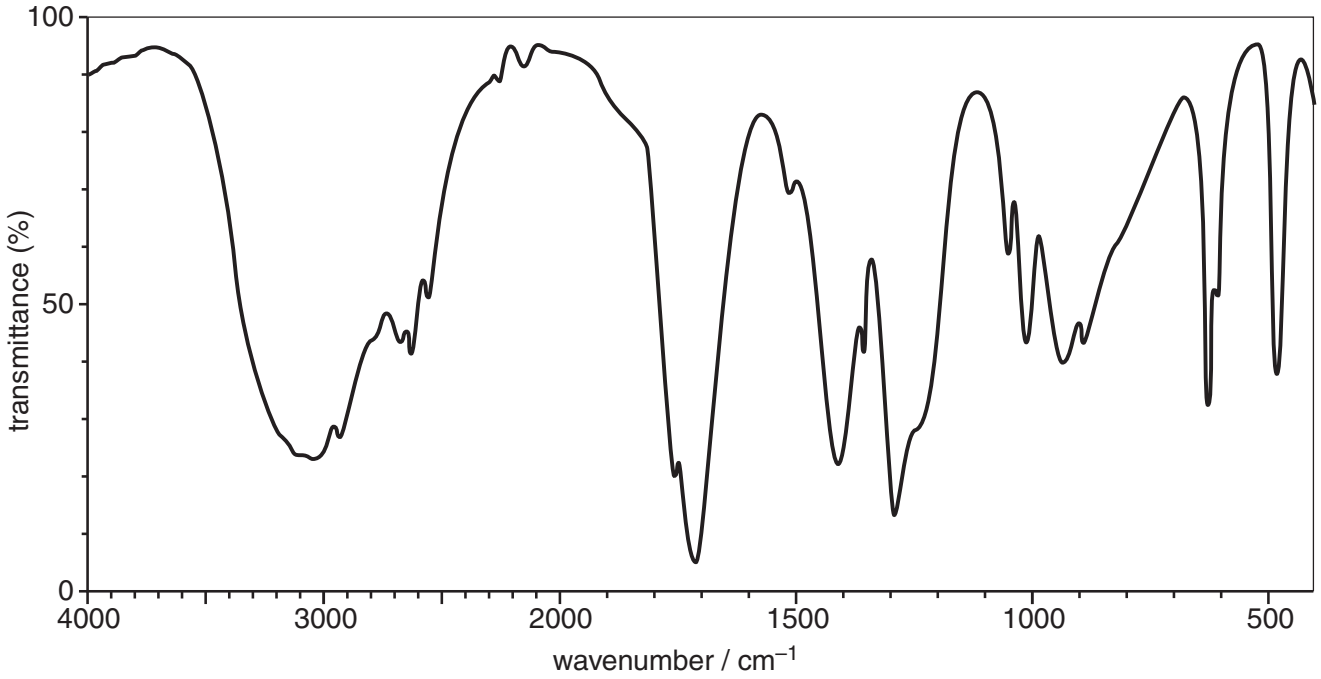
State how compound **A** could be obtained from the reaction mixture.

.....

.....

..... **[3]**

(iii) The infrared spectrum of the purified product, shown below, indicates that the student was **not** successful in converting ethanol to compound **A**.



Give reasons why the spectrum shows that the product was neither unreacted ethanol nor compound **A**.

Use the spectrum to identify the product.

reason product was **not** ethanol .....

.....

reason product was **not** compound **A** .....

.....

product is ..... **[3]**

(iv) Suggest and explain **one** reason why the student did not obtain compound **A**.

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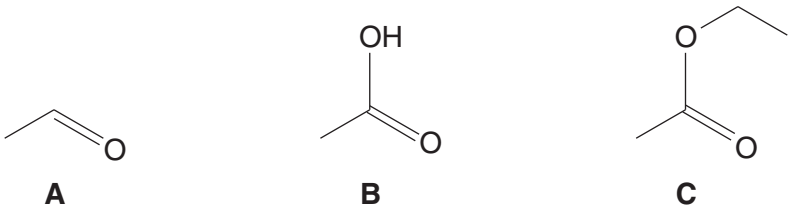
..... **[2]**



A **B** **C**

(b) (i) Name the functional group in compound **C**.

..... **[1]**

(ii) The reaction that takes place in wine to form compound **C** involves enzymes.

Using structural formulae, give the equation for the reaction that takes place in wine in which ethanol forms compound **C**.

$C_2H_5OH \longrightarrow$

[2]

(iii) When the reaction in **(ii)** is carried out in the laboratory, an additional compound is added to the mixture.

Name this compound and suggest **one** reason why it is used.

.....

.....

..... **[2]**

(iv) Suggest **one** advantage of using enzymes over laboratory reagents to prepare organic compounds on an industrial scale.

.....

..... **[1]**

(c) Some people lack an effective enzyme to convert compound **A** to compound **B** in the body. This results in more severe 'hangovers'. The enzyme is less effective as a result of damaged DNA.

One way that DNA can be damaged is by an alteration in the sequence of bases.

Describe and explain how this damage could result in enzymes becoming less effective for a particular reaction.

In your answer you should indicate the importance of the structure of an enzyme to its effectiveness with a particular substrate.

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..... **[6]**

[Total: 21]

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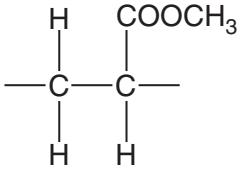
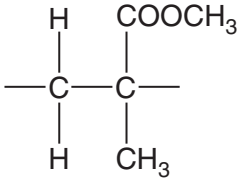
2 Poly(methyl methacrylate) (PMMA) and poly(methyl acrylate) (PMA) are thermoplastic polymers. Some of their properties and their repeating units are shown in the table below.

abbreviation for polymer	property of polymer at room temperature	T_g of polymer /°C	repeating unit of polymer
PMA	white rubbery	9	
PMMA	transparent brittle	114	

(a) (i) Explain how the T_g data indicate that at room temperature PMA is flexible and PMMA is brittle.

.....

.....

..... **[2]**

(ii) Suggest a reason why the extra methyl group in PMMA alters the flexibility of the polymer.

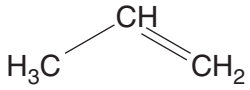
.....

..... **[1]**

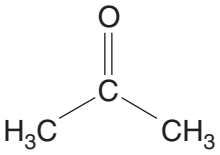
(iii) Give **one** way that PMMA could be modified to make it more flexible.

..... **[1]**

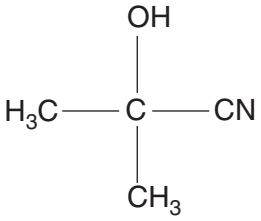
(b) The starting chemical for making the monomer for PMMA is propene. Propene is first converted into propanone which is then converted into compound **D**.



propene



propanone



compound D

(i) At room temperature propene is a gas but propanone is a liquid.

Explain, in terms of intermolecular bonds, the difference in the boiling points of propene and propanone.

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..... **[4]**

(ii) Give the reagent used in the laboratory to convert propanone into compound **D**.

..... **[1]**

(iii) Draw the **two step** mechanism for the formation of compound **D** from propanone, using 'curly arrows' and bond polarities where appropriate.

[4]

(iv) Explain why the CN group in compound **D** is attached to the carbon chain by a C–C bond rather than by a C–N bond.

.....

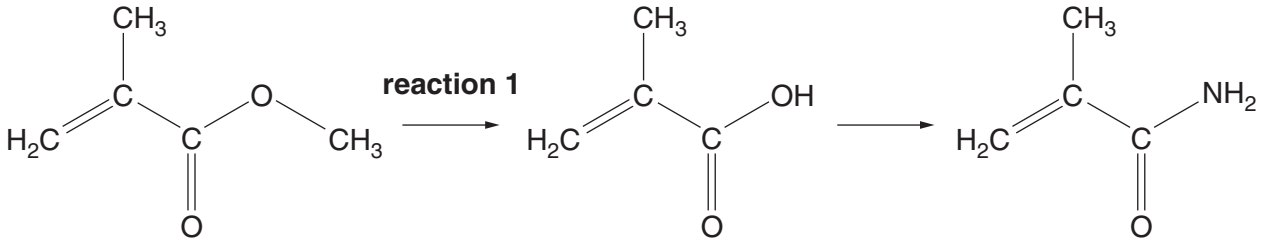
..... **[1]**

(v) The industrial conversion of propanone to compound **D** is an addition reaction.
In what respect are addition reactions environmentally friendly?

.....

..... **[1]**

(c) Another useful polymer similar to PMMA is PMMAA. Its monomer can be made by the reactions shown below.



MMA
(monomer of PMMA)

MMAA
(monomer of PMMAA)

(i) Give the reagent and conditions for **reaction 1**.

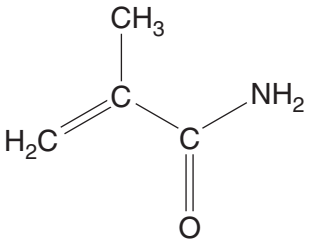
reagent .....

conditions ..... **[2]**

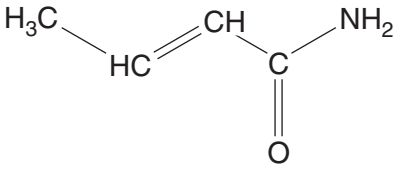
(ii) Name the functional group present in MMAA other than the C=C bond.

..... **[1]**

(iii) Compound **F** is a structural isomer of MMAA.



MMAA



compound F

Will either compound **F** or MMAA or both show *E/Z* isomerism?

Explain your answer.

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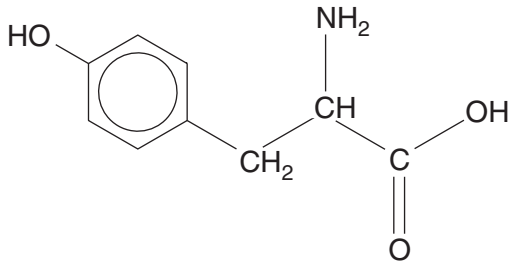
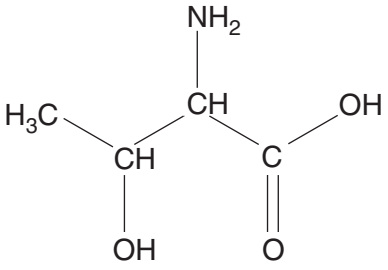
..... **[2]**

[Total: 20]

3 Tyrosine and threonine are two amino acids used in the construction of proteins. Their 'R' groups both contain hydroxyl groups. Their structures are shown below.



tyrosine



threonine

(a) State how the hydroxyl groups are different in tyrosine and threonine and give a chemical test to distinguish between them.

Describe what you would **see** in **each** case.

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..... **[4]**

(b) Tyrosine and threonine are chiral molecules.

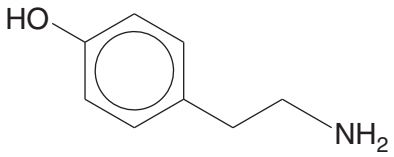
On the diagrams above circle **all** of the chiral carbon atoms in **each** structure. **[2]**

(c) Threonine can form a condensation polymer containing **amine** side chains.

Draw the repeating unit for this polymer and give the name of the link joining the monomer units together.

name of link ..... **[2]**

(d) In foodstuffs such as cheese, tyrosine decays into tyramine. Tyramine is possibly responsible for migraine-type headaches.



tyramine

(i) Complete the table below to show the structures of the products formed when tyramine reacts with the named reagents.

reagent	product(s) formed
hydrochloric acid	
ethanoyl chloride	

[5]

(ii) Although tyramine is not very soluble in water it will 'dissolve' if a little aqueous alkali is added to a mixture of tyramine and water.

Explain why tyramine is able to do this.

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..... **[2]**

[Total: 15]

4 Potassium manganate(VII) can be used as a disinfectant. Over time, the concentration of potassium manganate(VII) in dilute aqueous solution decreases due to a redox reaction taking place in the sealed bottles. Oxygen is also formed in this reaction.

(a) Suggest the reducing agent responsible for the decrease in concentration of potassium manganate(VII) solutions on storage in sealed bottles.

..... **[1]**

(b) Solutions of potassium manganate(VII) can be standardised against a measured volume of a standard solution of sodium ethanedioate, $Na_2C_2O_4$, under acid conditions. The contents of the titration flask have to be warmed to 60 °C before commencing the titration, otherwise the reaction would be too slow.

(i) Describe how you would carry out this titration to get **one** result.

In your answer you should use appropriate technical terms spelled correctly.

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..... **[5]**

(ii) In a titration, a student used a sodium ethanedioate solution with a concentration of $0.0500\,mol\,dm^{-3}$.

Calculate the mass of sodium ethanedioate ($Na_2C_2O_4$) needed to make $250\,cm^3$ of a $0.0500\,mol\,dm^{-3}$ solution.

mass of sodium ethanedioate = ... g **[2]**

(iii) The student found that $10.0\,cm^3$ of the $0.0500\,mol\,dm^{-3}$ sodium ethanedioate solution reacted exactly with $26.0\,cm^3$ of a potassium manganate(VII) solution.

The equation for the reaction is given below.

$$2MnO_4^-(aq) + 5C_2O_4^{2-}(aq) + 16H^+(aq) \rightarrow 2Mn^{2+}(aq) + 10CO_2(g) + 8H_2O(l)$$

Calculate the concentration of the potassium manganate(VII) solution.

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

concentration of potassium manganate(VII) solution = ... $mol\,dm^{-3}$ **[4]**

(c) The student found that the rate of reaction between MnO_4^- and $C_2O_4^{2-}$ ions could be increased at room temperature sufficiently to carry out an accurate titration without warming the solution.

The student did this by adding a few drops of an aqueous solution containing Cu^{2+} ions to the titration flask.

(i) Explain how transition metal ions such as Cu^{2+} are able to increase the rate of a redox reaction.

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..... **[4]**

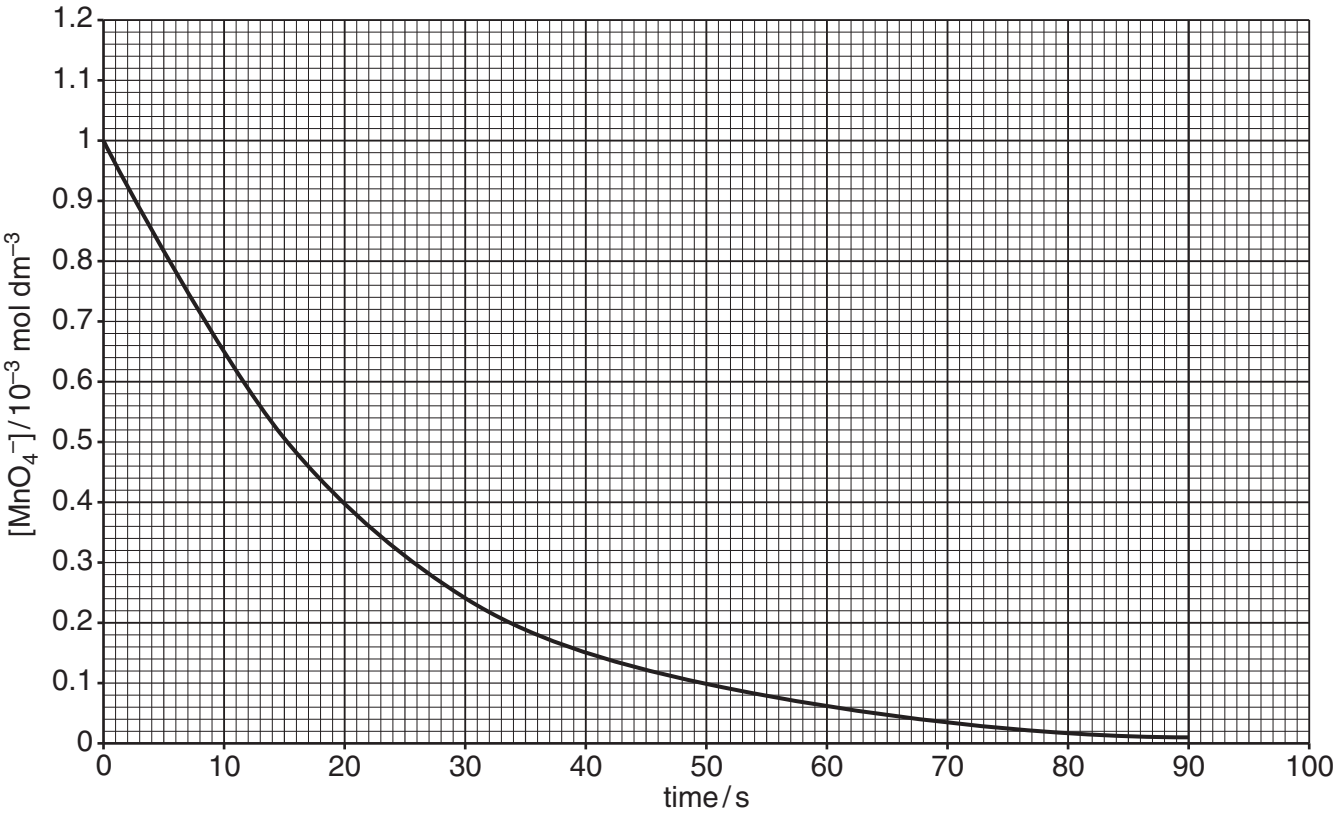
(ii) What name is given to this **type** of catalysis by aqueous transition metal ions?

..... **[1]**

(d) The student investigated the rate of reaction between MnO_4^- and $C_2O_4^{2-}$ ions in aqueous acid, in the presence of a small concentration of Cu^{2+}.

In order to investigate the order of reaction with respect to MnO_4^-, the initial concentrations of $C_2O_4^{2-}$ and H^+ were made much larger than the MnO_4^- concentration.

The results are shown in the graph below.



(i) Why did the student use initial concentrations of $C_2O_4^{2-}$ and H^+ that were much larger than the MnO_4^- concentration?

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..... **[1]**

(ii) Use the graph to show that the reaction is first-order with respect to MnO_4^-.

You should draw any appropriate construction lines on the graph.

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..... **[3]**

(iii) Under the conditions of the reaction, the rate equation can be represented as shown below.

$$\text{rate} = k\,[MnO_4^-]$$

With a concentration of MnO_4^- of $1.20 \times 10^{-3}\,\text{mol dm}^{-3}$, the student found that the rate of reaction was $6.7 \times 10^{-4}\,\text{mol dm}^{-3}\,\text{s}^{-1}$.

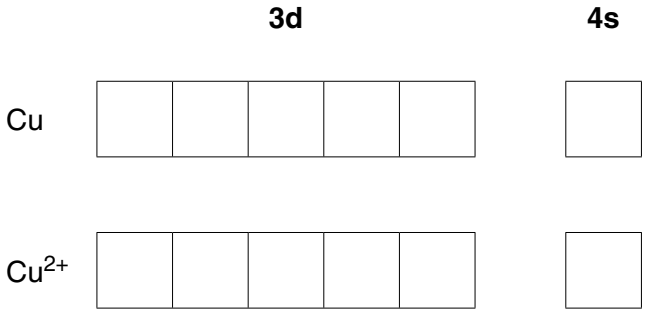
Calculate the value of k for this reaction and give its units.

k = ... units = ...**[3]**

[Total: 24]

5 Early 19th century chemists attempted to protect copper structures from corrosion by strapping blocks of iron to them. This method was especially effective for structures immersed in seawater. The iron would turn into a red–brown solid.

(a) (i) By drawing arrows in the appropriate boxes, complete the outer electron structures for Cu and Cu^{2+}.



[2]

(ii) Use your answer to **(i)** to explain why copper is a transition metal.

.....

..... **[1]**

(b) Some standard electrode potential data are given below.

half-reaction	$E^{\ominus}$/V
$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$	–0.44
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	+0.34
$O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$	+0.40
$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$	+0.77

(i) Use data from the table to explain why copper corrodes in water containing dissolved oxygen.

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..... **[2]**

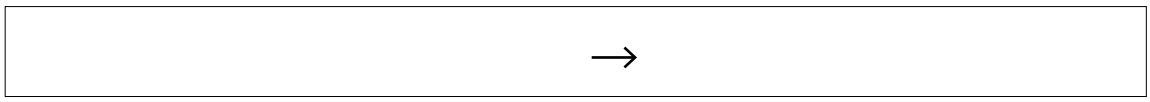
(ii) Use data from the table to explain how the iron prevents the copper from corroding.

.....

..... **[1]**

(c) The reaction of Fe^{3+} ions in solution with excess hydroxide ions produces another red–brown solid. Give the ionic equation for the formation of this red–brown solid.

Include state symbols.



[2]

(d) Describe and explain **one** other method for protecting copper from corrosion.

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..... **[2]**

[Total: 10]

END OF QUESTION PAPER

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