



ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

CHEMISTRY

9189/1

PAPER 1

NOVEMBER 2013 SESSION

2 hours

Additional materials:

Answer paper

Data Booklet

Mathematical tables and/or electronic calculator

TIME: 2 hours

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer **six** questions.

Answer **two** questions from Section A, **one** question from Section B, **two** questions from Section C and **one** other question chosen from any section.

Write your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.

You are reminded of the need for good English and clear presentation in your answers.

This question paper consists of 10 printed pages and 2 blank pages.

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Section A

Answer at least *two* questions from this section.

- 1 (a) Fig. 1.1 shows the mass spectrum of copper.

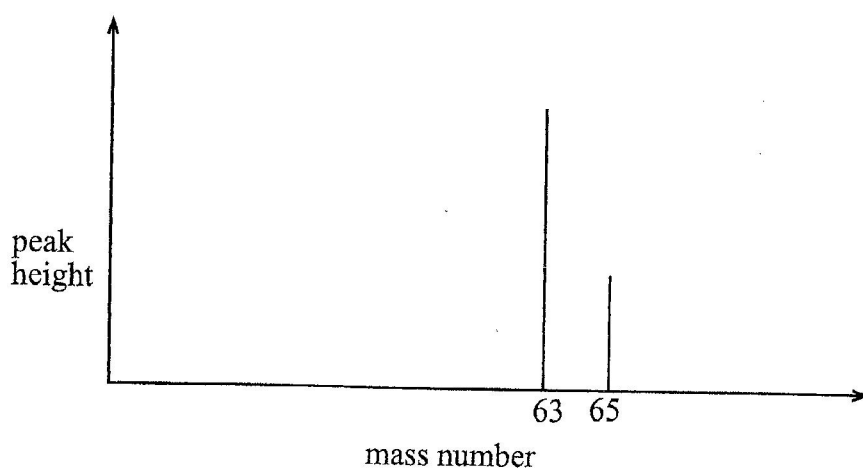


Fig. 1.1

- (i) Determine the relative atomic mass of copper.
- (ii) Draw a sketch of the mass spectrum of hydrogen peroxide, H_2O_2 .

[4]

- (b) Fig. 1.2 shows the formula of nitroglycerine, an explosive that gives a smokeless explosion. On explosion, it gives nitrogen, carbon monoxide, steam and oxygen.

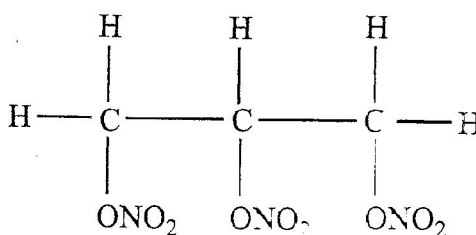


Fig. 1.2

- (i) Name the acid that reacts with glycerine, $\text{CH}_2(\text{OH})\text{CH}(\text{OH})\text{CH}_2\text{OH}$, to give this explosive.
- (ii) Write a balanced equation for the explosion.
- (iii) Explain why the explosion is described as smokeless.
- (iv) Calculate the number of moles of gas produced by the decomposition of 1.0 g of nitroglycerine.
- (v) Calculate the volume of gas produced by 1.0 g of nitroglycerine if at the temperature generated during explosion, one mole of gas has a volume of 55.0 dm^3 .

- (vi) Suggest **one** major problem of using nitroglycerine for controlled blasting in underground mining? [8]
[Total: 12]

- 2 (a) (i) State the **three** main ideas of the electron pair repulsion theory.
(ii) Use the theory to predict the shapes of
1. CO_3^{2-} and
2. PO_4^{3-} . [5]
- (b) Describe, in general, the lattice structures of the following types of solids:
(i) simple molecular
(ii) ionic
(iii) metallic [3]
- (c) Differentiate between ionic solids and simple molecular solids in terms of solubility in water and electrical conductivity. [2]
- (d) Suggest explanations for the following physical properties:
(i) ionic solids are brittle
(ii) metals are malleable [2]
[Total: 12]

- 3 (a) Define *oxidation* and *reduction* in terms of:
(i) changes in oxidation states
(ii) electron transfer [2]
- (b) Hydroxylamine, NH_2OH , can be reduced to ammonia under alkaline conditions or oxidised to nitric acid under acidic conditions.
(i) Deduce half equations for the **two** reactions.
(ii) Suppose the E^\ominus value for the reduction reaction is positive, draw a diagram to show how this value can be determined.
(iii) Show, on your diagram, the direction of flow of electrons. [8]

- (c) (i) Use information from the Data-Booklet and the half equation you deduced in **b(i)** to write an equation for the oxidation of hydroxylamine by potassium dichromate.
- (ii) Hydroxylamine also disproportionates to N_2O and NH_3 .

Deduce a balanced equation for the disproportionation process.

[2]

[Total: 12]

Section B

Answer at least *one* question from this section.

- 4 (a) (i) Draw sketches of graphs to show variations for the following physical properties of Period three elements.
1. melting points
 2. electrical conductivity
 3. first ionisation energies
- (ii) Explain the variation in the melting points of the elements. [6]
- (b) Construct balanced equations for each of the reactions described below.
- (i) When magnesium nitrate is heated strongly red brown fumes that relight a glowing splint are observed.
 - (ii) Solid AgCl dissolves in aqueous NH₃.
 - (iii) Al₂O₃ gives Na[Al(OH)₄] with aqueous NaOH.
 - (iv) When concentrated H₂SO₄ is added to solid KI, a purple vapour is seen and H₂S is given off.
 - (v) S₂O₃²⁻ ions give SO₄²⁻ ions with Br₂.
 - (vi) Nitric acid oxidises copper metal to copper (II) nitrate and nitrogen monoxide is given off. [6]
- [Total: 12]
- 5 (a) Explain how the melting points of group (II) elements vary down the group. [2]
- (b) State one use of each of the following magnesium compounds.
- (i) Mg(OH)₂
 - (ii) MgSO₄ · 7H₂O
 - (iii) MgO [3]

- (c) Anhydrous MgSO_4 paste with ethanol is used as a treatment for inflammations of the skin.

Suggest

- (i) the effect of MgSO_4 on the inflammations,
(ii) the role of ethanol.

[2]

- (d) Given a sample of a group (II) metal which is known to be either magnesium or calcium, describe a simple test, including observations made, that can be carried out to identify it.

Write an equation for any reaction taking place.

[3]

- (e) Explain why beryllium, unlike other group (II) elements, largely forms covalent compounds.

[2]

[Total: 12]

Section C

Answer at least **two** questions from this section.

- 6 (a) Define the term *functional group*. [1]
- (b) Describe how the presence of **each** of the following functional groups affect the reactivity of benzene:
- (i) $-\text{NH}_2$
- (ii) $-\text{CHO}$

[4]

- (c) Fig. 2 shows the structure of compound A.

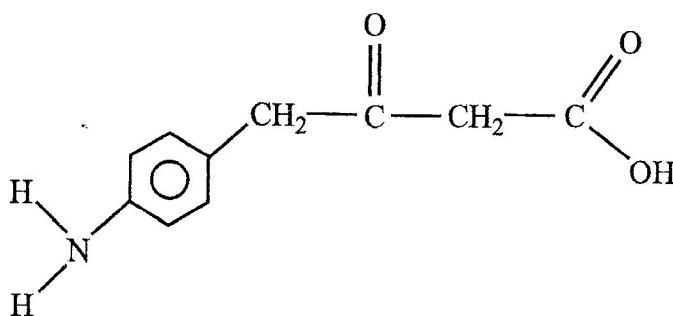


Fig. 2

Describe simple one-step tests to show the presence of **three** functional groups in A.

For each test, state the reagents and conditions used and the observations made.

[7]

[Total: 12]

- 7 Perspex is a hard transparent thermoplastic polymer, made from the monomer whose structure is shown in Fig. 3.1.

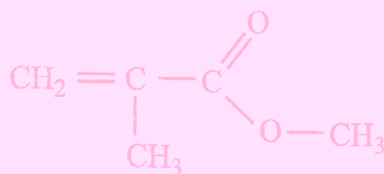


Fig. 3.1

- (a) (i) Name the monomer.
- (ii) What type of polymer is perspex?
- (iii) Give a section of perspex showing **two** repeat units. [3]

- (b) The monomer of perspex can be made from propanone in four steps as shown in Fig. 3.2.

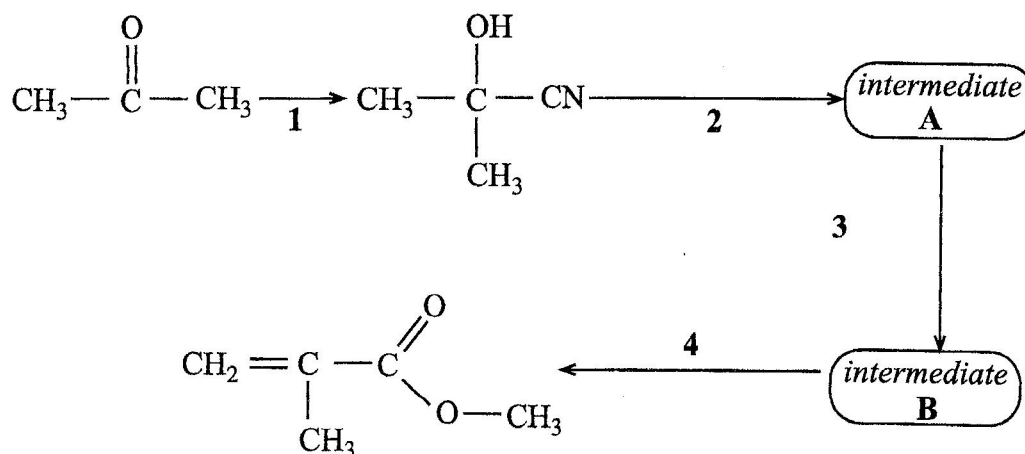


Fig. 3.2

Intermediate **B** decolourises aqueous bromine but **A** does not.

- Identify intermediates **A** and **B**.
- Suggest reagents and conditions for steps 1, 2, 3 and 4.
- Draw a displayed formula of the organic product of the reaction of **B** with KMnO_4 .
- Explain why the monomer of perspex does not exhibit isomerism? [9]

[Total: 12]

8 Study the reaction scheme shown in Fig. 4.

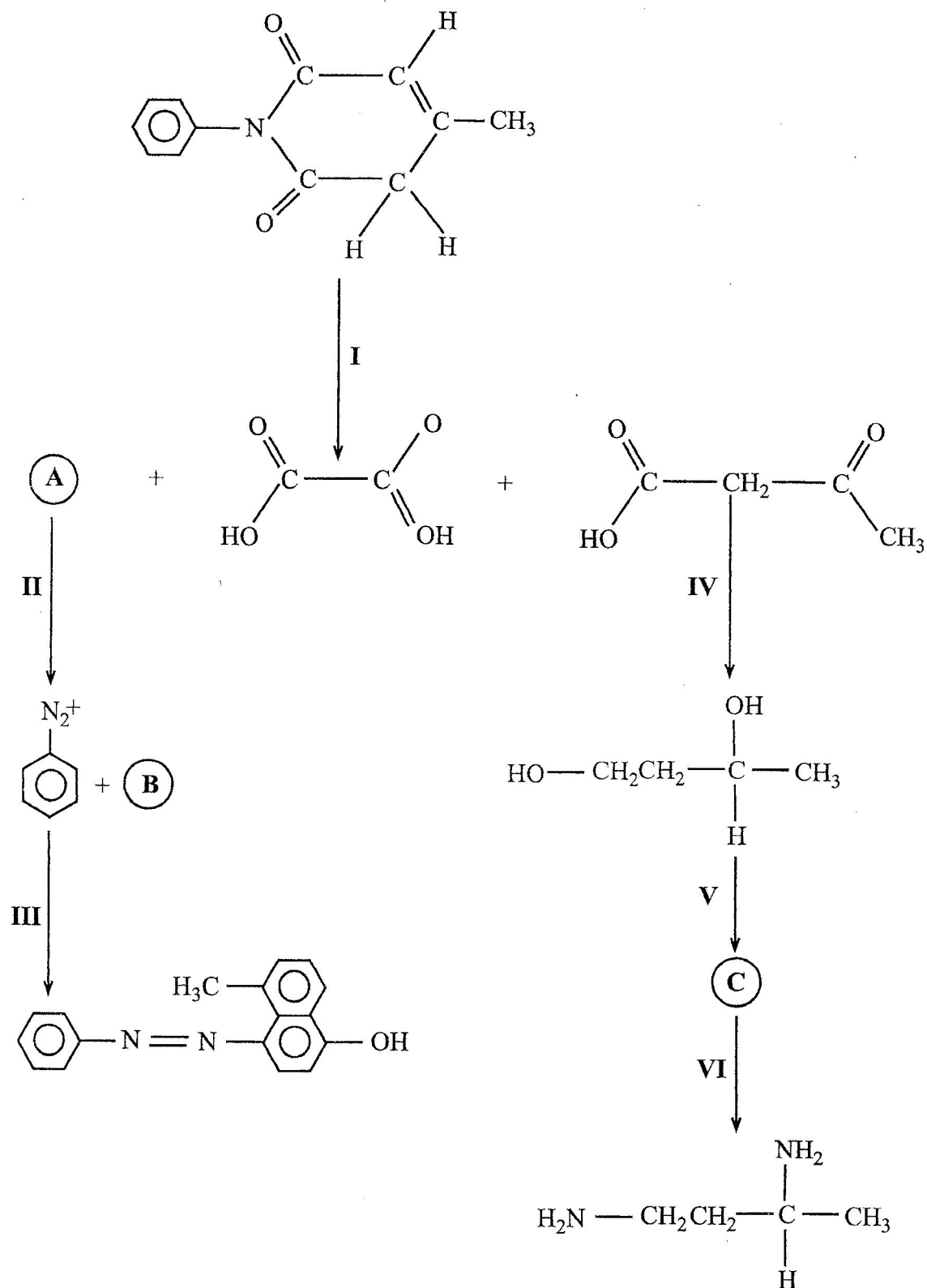


Fig. 4

- (a) Give the structural formulae of the compounds A, B and C. [3]
- (b) Suggest reagents and conditions for steps I, III and VI. [3]
- (c) Name the reactions occurring in I, II and V. [4]

- (d) The reaction in step **III** is a typical electrophilic substitution reaction, similar to the nitration of benzene.

Suggest a mechanism for the reaction.

[2]
[Total: 12]