ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

CHEMISTRY

PAPER 3 Multiple Choice **9189/3**

NOVEMBER 2013 SESSION

Additional materials: 1 hour
- Data Booklet
- Mathematical tables and/or calculator
- Multiple Choice answer sheet
- Soft clean eraser
- Soft pencil (type B or HB is recommended)

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your name, Centre number and candidate number on the answer sheet in the spaces provided unless this has already been done for you.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the one you consider correct and record your choice in soft pencil on the separate answer sheet.

Read very carefully the instructions on the answer sheet.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

This question paper consists of 15 printed pages and 1 blank pages.

[Turn over

Section A

*For each question there are four possible answers, **A, B, C** and **D**. Choose the one you consider to be correct.*

1 The first three ionisation energies of an element are 736 $kJmol^{-1}$, 1 450 $kJmol^{-1}$ and 7 740 $kJmol^{-1}$.

How many valence electrons does an atom of this element in the ground state have?

A 1
B 2
C 3
D 4

2 Atoms of elements in the same group of the Periodic Table have similar chemical properties.

This similarity is most closely related to the atoms'

A atomic numbers.
B atomic masses.
C number of valence electrons.
D number of principal energy levels.

3 Complete combustion of 0.400 g of a hydrocarbon with a relative molecular mass of 84 produced 1.257 g of carbon dioxide and 0.514 g of water.

The molecular formula of the hydrocarbon is

A CH_4.
B C_2H_4.
C C_3H_6.
D C_6H_{12}.

4 The equation represents the reaction that takes place when carbon disulphide is burnt in air.

$$CS_2 + 3O_2 \rightarrow CO_2 + 2SO_2$$

What mass of carbon disulphide produces a mixture of carbon dioxide and sulphur dioxide that weighs 34.4 g?

A 7.60 g
B 17.2 g
C 152 g
D 15.2 g

5 The steering rockets in space shuttle use a mixture of N_2O_4 and a derivative of hydrazine, 1, 1 – dimethylhydrazine, $H_2NN(CH_3)_{2(l)}$ as fuel. The mixture ignites when it comes into contact as shown by the equation.

$$H_2NN(CH_3)_{2(l)} + 2N_2O_{4(l)} \rightarrow 3N_{2(g)} + 4H_2O_{(g)} + 2CO_{2(g)}$$

If 4 100 kg of $H_2NN(CH_3)_2$ were used, what mass in kg of N_2O_4 was required for complete reaction?

A 683.025
B 1 266.8
C 12 573.3
D 25 146.5

6 Which statement explains why H – N – H bond angle in ammonia is 107° whereas the H – O – H bond angle in water is 104.5°?

A lone pair lone pair repulsion is greater than lone pair bonded pair
B bonded pair bonded pair repulsion is greater than lone pair lone pair
C bonded pair lone pair repulsion is greater than lone pair lone pair
D bonded pair lone pair repulsion is less than bonded pair bonded pair.

7 Why is Mn^{2+} not readily oxidised to Mn^{3+}?

A The electronic configuration of Mn^{2+} is more stable.
B The electronic configuration of Mn^{2+} is less stable.
C Mn^{2+} does not have any more electrons in its 'd'- orbitals.
D Mn^{2+} cannot accept any more electrons into its 'd' – orbitals.

8 X is a pale green crystalline hydrated salt. An aqueous solution of X decolourises acidified potassium permanganate solution and gives a pale green precipitate with dilute ammonia.

The cation most likely to be present in X is

A Zn^{2+}.
B Cu^{2+}.
C Fe^{3+}.
D Fe^{2+}.

9 In which reaction does hydrogen behave as an oxidising agent?

A $H_2 + Cl_2 \rightarrow 2HCl$
B $C_2H_4 + H_2 \rightarrow C_2H_6$
C $N_2 + 3H_2 \rightarrow 2NH_3$
D $2Na + H_2 \rightarrow 2NaH$

10 Hydrochloric acid was used to titrate a sample of pure sodium carbonate weighing 0.3054 g and it took 35.09 cm^3 to reach the end point.

The exact concentration of the acid was

A 0.00268 $moldm^{-3}$.
B 0.1642 $moldm^{-3}$.
C 0.005762 $moldm^{-3}$.
D 0.2580 $moldm^{-3}$.

11 Which method **cannot** be used to measure the rate of a reaction?

A measuring pressure of gas produced per given time.
B measuring density of the product per given time.
C measuring temperature changes per given time.
D measuring changes in colour intensity per given time.

12 Many biochemical reactions are catalysed by acids. A typical mechanism consistent with experimental results in which HA is the acid and X is the reactant is

step 1	fast reversible	$HA \rightleftharpoons H^+ + A^-$
step 2	fast reversible	$X + H^+ \rightleftharpoons XH^+$
step 3	slow	$XH^+ \rightarrow$ products.

Which rate law is derived from this mechanism?

A $k[XH^+]$
B $k[HA]$
C $k[X][H^+]$
D $k[HA][H^+][A^-]$

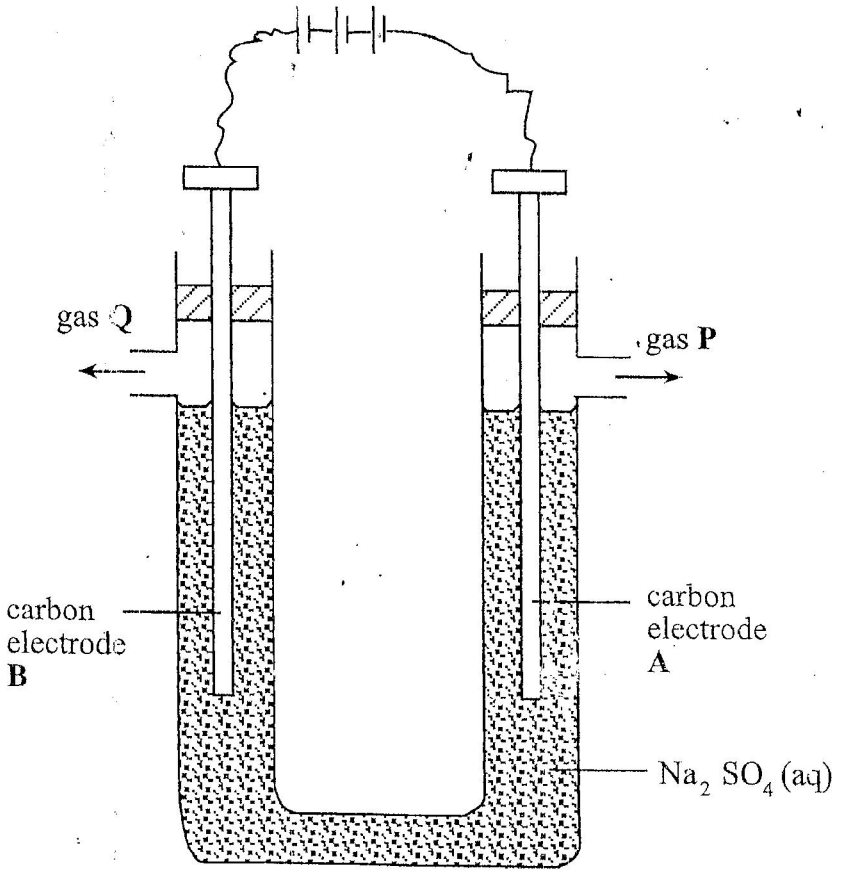
13 For a first order reaction, what fraction of the reactant remains after five half lives have elapsed?

A $\frac{1}{64}$
B $\frac{1}{32}$
C $\frac{1}{16}$
D $\frac{1}{8}$

14 Which statement is true about a reaction whose rate law is $\frac{-d[A]}{dt} = k[A]$.

A The reaction is zero order with respect to [A].
B The reaction is affected by increasing temperature.
C Varying [A] has no effect on the rate of the reaction.
D The reaction is catalysed by a homogeneous catalyst.

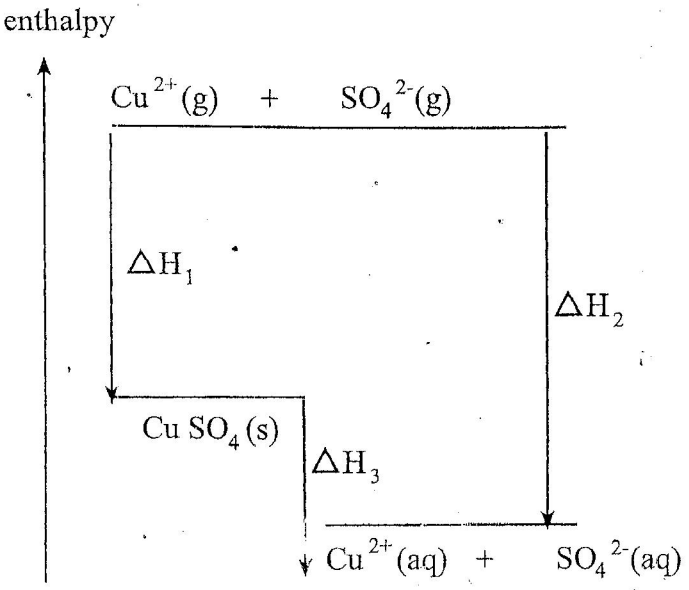
15 An experiment was carried out using the apparatus shown.



What is observed when litmus solution is added to $Na_2SO_{4(aq)}$?

A blue colour around carbon electrode A
B blue colour around carbon electrode B
C white colour around carbon electrode A
D white colour around carbon electrode B

16 An energy level diagram for the dissolving of anhydrous copper (II) sulphate is shown.



Enthalpy changes indicated by ΔH_1 and ΔH_2 are:

	ΔH_1	ΔH_2
A	bond enthalpy	hydration enthalpy
B	enthalpy change of formation	lattice enthalpy
C	lattice enthalpy	hydration enthalpy
D	enthalpy change of solution	lattice enthalpy

17 The oxidation of SO_2 to SO_3 is faster in the presence of nitrogen monoxide, NO. The equations are:

step 1 $2NO + O_2 \rightarrow 2NO_2$

step 2 $2NO_2 + 2SO_2 \rightarrow 2SO_3 + 2NO$

What is the effect of nitrogen monoxide on the kinetics of the reaction?

A nitrogen monoxide provides a route with higher activation energy
B nitrogen monoxide provides a route with lower activation energy
C nitrogen monoxide increases the value of the equilibrium constant
D nitrogen monoxide provides two steps in the reaction

18 A current of 2.40 A was passed through a solution containing Cu^{2+} ions for 30.0 minutes.

What mass of copper in grams is deposited at the cathode?

A 14.2 g
B 1.42 g
C 2.84 g
D 4.32 g

19 Consider the following equilibrium:

$PCl_{5(g)} \rightleftharpoons PCl_{3\,(g)} + Cl_{2\,(g)}$

The equilibrium expressions Kp is

A $\dfrac{p(PCl_5)}{p(PCl_3)p(Cl_2)}$

B $\dfrac{p(PCl_3)^3\,p(PCl_2)^2}{p(PCl_5)^5}$

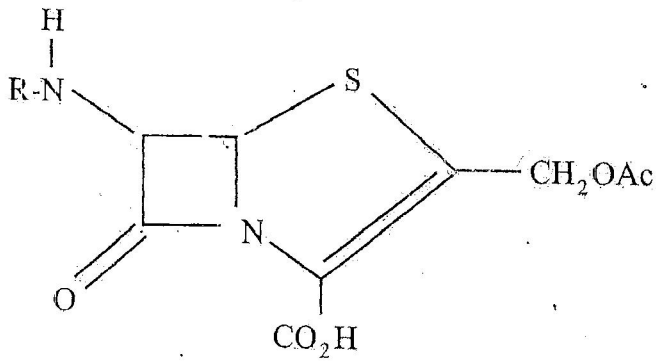
C $\dfrac{p(PCl_3)p(Cl_2)}{p(PCl_5)}$

D $\dfrac{p(PCl_5)p(PCl_3)}{p(Cl_2)}$

20 The oxidation number of the metal in the complex ion, $H_3[CuCl_4]$ is

A +1.
B +2.
C +3.
D +4.

21 Cephalosporin C, an antibiotic, has the structure shown.



Cephalosporin

The number of chiral carbons in cephalosporin C, is / are

A 1.
B 2.
C 3.
D 4.

22 Which molecule shows optical activity?

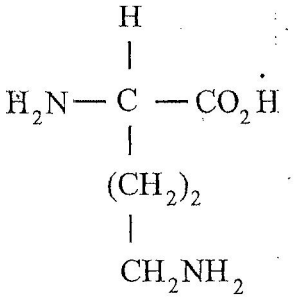
A $HOOCCH = CHCOOH$

B $CH_3CHBrCH_3$

C CH_3COCl

D $CHFClBr$

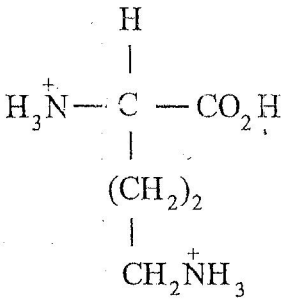
23 Lysine is an amino acid with the following structure.



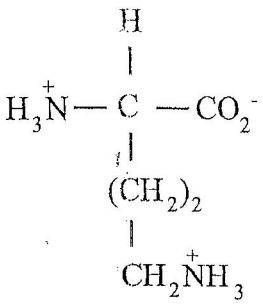
lysine

The structure of lysine at pH 2 is:

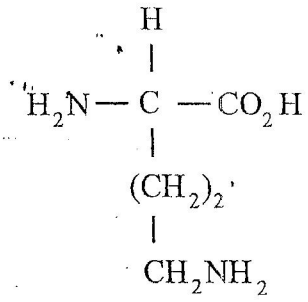
A



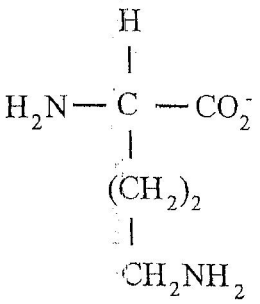
B



C

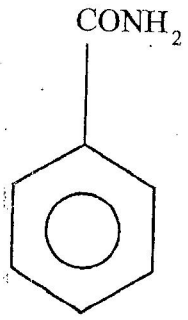


D

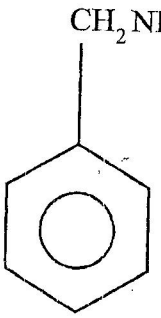


24 Which compound could be used to prepare a diazomium salt on reaction with nitrous acid at 5°C?

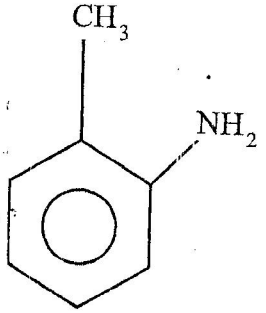
A



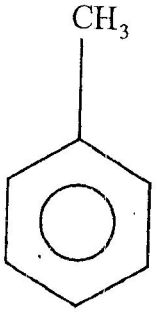
B



C



D



25 In which reaction does the enthalpy change correspond to an enthalpy change of formation?

A $2NO_{(g)} \rightarrow N_{2(g)} + O_{2(g)}$

B $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$

C $Na_{(s)} + Cl_{(g)} \rightarrow NaCl_{(s)}$

D $K_{(s)} + Mn_{(s)} + 2O_{2(g)} \rightarrow KMnO_{4(s)}$

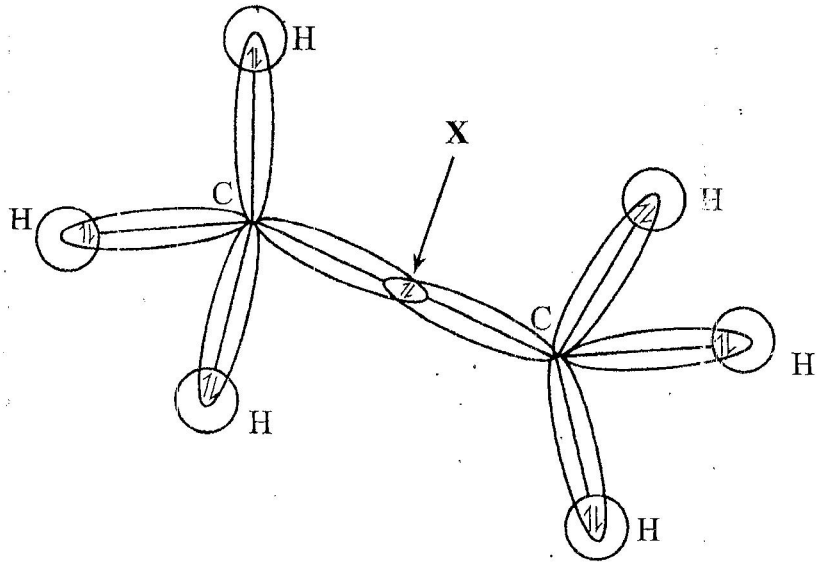
26 Halate ions, react as shown:

$$3ClO^-_{(aq)} \rightarrow 2Cl^-_{(aq)} + ClO^-_{3(aq)}$$

The reaction is an example of

A reduction.
B oxidation.
C disproportination.
D decomposition.

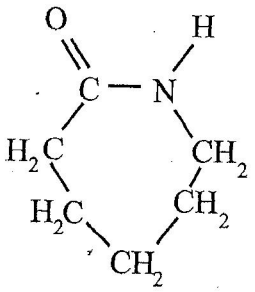
27 The diagram shows bonding in an organic compound.



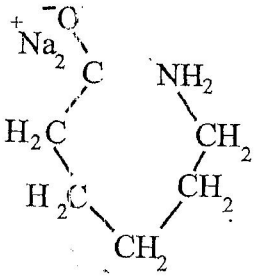
The bond labelled **X** is

A a π bond.
B a coordinate covalent bond.
C a σ bond.
D a double bond.

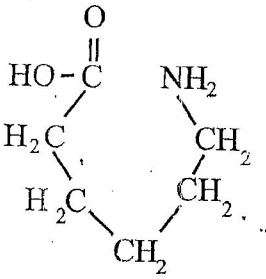
28 Caprolactum has the structure shown.



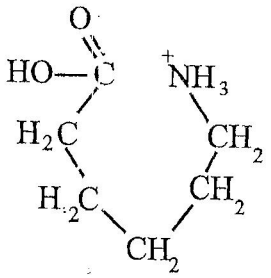
The compound reacts with hot, dilute sodium hydroxide to form.



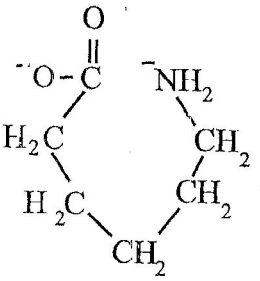
A



B

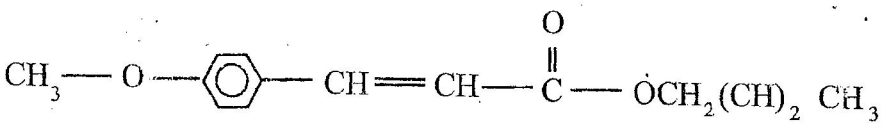


C



D

29 How many functional groups are in the organic compound shown?



A 3
B 4
C 5
D 6

30 Which reagent can be used to show the presence of 4-methylpentan-2-one?

A Fehling's solution
B gaseous iodine
C 2.4 dinitrophenylhydrazine
D alkaline potassium permanganate

Section B

*For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.*

Decide whether each of the statements is or is not correct. (You may find it helpful to put a tick against the statement(s) which you consider to be correct).

*The responses **A** to **D** should be selected on the basis of*

A	B	C	D
1, 2 and 3 are correct	*1 and 2 only are correct*	*2 and 3 only are correct*	*1 only is correct*

No other combination of statements is used as a correct response.

31 The electronic configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8$ could be that of

1. a transition metal ion.
2. an excited group 1 element.
3. a transition metal element in its ground state.

32 Which list(s) includes only species that are isoelectronic with one another?

1. Ca^+, Na^+, Al^+
2. Ca^{2+}, Ar, K^+
3. S^{2-}, Cl^-, P^{3-}

33 Which statement(s) about the reaction

$IO_3^- + 2I^- + 6H^+ + 6Cl^- \rightarrow 3ICl_2^- + 3H_2O$ is / are correct?

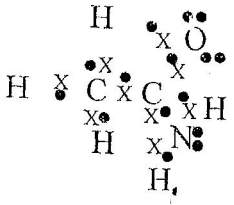
1. the oxidation number of iodine in the iodate ion changes from +5 to +1.
2. the oxidation number of chlorine changes from –1 to –2 .
3. the oxidation number of iodine in the iodide ion changes from –1 to +2.

34 Zinc metal is added to each flask containing 20 cm^3 of 0.100 mol dm^{-3} hydrochloric acid in the following quantities.

In which flask(s) was the zinc in excess?

flask	quantity of zinc added (g)
1	7.00
2	3.27
3	1.31

35 From the dot and cross diagram of ethanamide shown



it may be deduced that ethanamide contains

1. single covalent bonds.
2. double covalent bonds.
3. dative bonds.

36 Substance **X** decomposes into substance **Y** and **Z** according to the following equation

$$2X_{(g)} \rightleftharpoons 2Y_{(g)} + Z_{(g)}$$

In an experiment a quantity of substance **X** was allowed to decompose into **Y** and **Z**. The results of the experiment are shown in the table.

time / s	[X] (mol dm^{-3})	[Y] (mol dm^{-3})	[Z] (mol dm^{-3})
0	1.0	0	0
0.2	0.5	0.5	0.2
0.4	0.3	0.7	0.3
0.6	0.2	0.8	0.4
0.8	0.2	0.8	0.4

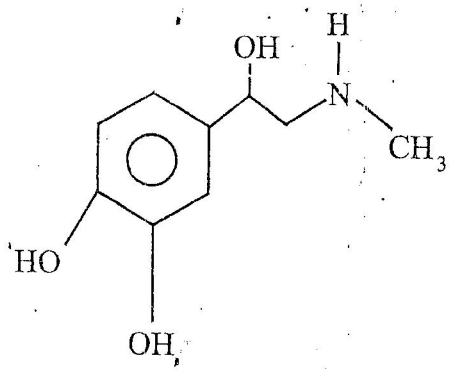
Which statement(s) is/are correct?

1. the reaction reaches equilibrium after 0.8 seconds.
2. concentration of X at equilibrium is 0.2 mol dm^{-3}
3. the K_c value is 6.4 mol dm^{-3}

37 Which reaction(s) can be classified as oxidation reaction(s).

1. Secondary alcohols with acidified dichromate ions.
2. Phenol with acidified dichromate ions.
3. Esters with water in acidic conditions.

38 The molecule of adrenaline is shown.



Which statement(s) about adrenaline is/are true?

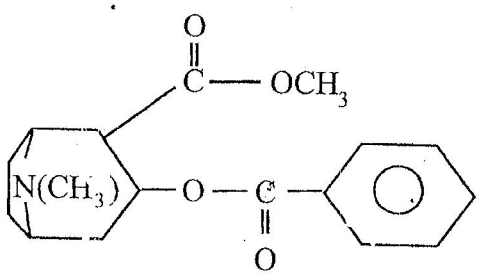
1. It is more soluble in acids than in water.
2. It is more soluble in alkalis than in water.
3. It can be oxidised to an aldehyde.

39 Test for halide ions involves addition of dilute nitric acid followed by a solution of silver nitrate.

What is the role of nitric acid in this test?

1. provides an acidic media
2. prevents precipitation of other silver salts
3. oxidises the halide ion

40 Cocaine, an internationally banned drug, has the structure shown.



Which reactions is/are typical of cocaine?

1. nucleophilic addition
2. acid base reaction
3. hydrolysis