INNOVA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION 2
in preparation for General Certificate of Education Advanced Level
Higher 2

CANDIDATE NAME			
CLASS		INDEX NUMBER	

CHEMISTRY 9746/01

Paper 1 Multiple Choice **24 September 2009**

1 hour

Additional Materials: *Data Booklet*
Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name and class on all the work you hand in.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions on 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 the instructions on the Answer Sheet very carefully.

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 document consists of **16** printed pages.

Section A

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

1 Consider the following half-equation.

$$C_2O_4^{2-} \longrightarrow 2CO_2 + 2e$$

What volume of 0.01 mol dm^{-3} $K_2Cr_2O_7$ is required to oxidise 20 cm^3 of an acidified solution of 0.01 mol dm^{-3} FeC_2O_4?

A 10 cm^3 **C** 30 cm^3

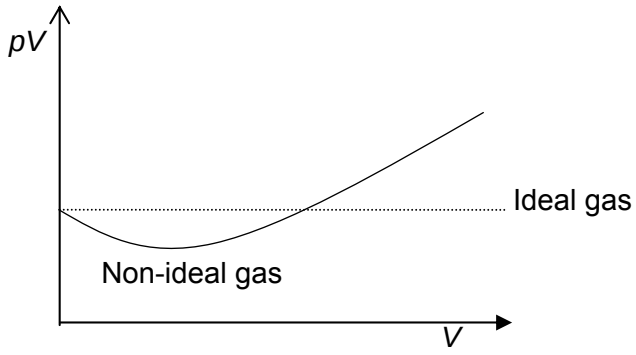
B 20 cm^3 **D** 40 cm^3

2 A sample containing ammonium sulphate (M_r = 132) was warmed with 100 cm^3 of 0.500 mol dm^{-3} sodium hydroxide. When the evolution of ammonia ceased, the excess sodium hydroxide solution was neutralised with 25.00 cm^3 of 0.500 mol dm^{-3} hydrochloric acid. What was the mass of ammonium sulphate in the sample?

A 2.48 g **C** 6.60 g

B 4.95 g **D** 13.20 g

3 The value of *pV* is plotted against *V* for 2 gases, an ideal gas and a non-ideal gas, where *p* is the pressure and *V* is the volume of the gas.



Which of the following gases shows the greatest deviation from ideality?

A hydrogen chloride **C** hydrogen

B nitrogen **D** ammonia

4 The ions P^{3-}, S^{2-} and Cl^- have radii 0.212 nm, 0.184 nm and 0.181 nm respectively. Which one of the following correctly explains the decrease in radius in going from P^{3-} to Cl^-?

A An increase in total number of electrons and in the nuclear charge.

B An increase in total number of electrons with the nuclear charge remaining constant.

C A constant total number of electrons and an increase in the nuclear charge.

D A decrease in the total number of electrons and an increase in the nuclear charge.

5 Three substances, **E**, **F** and **G** have physical properties as shown.

Substance	Melting point / °C	Boiling point / °C	Electrical conductivity in	
			solid state	liquid state
E	801	1413	Poor	Good
F	2852	3600	Poor	Good
G	3550	4827	Good	Not known

What could be the identities of **E**, **F** and **G?**

	E	**F**	**G**
A	NaBr	CaO	SiO_2
B	NaI	Al_2O_3	Diamond
C	NaF	$BeCl_2$	Cu
D	NaCl	MgO	Graphite

6 Which of the following pairs of compounds is the bond angle in particle **I** greater than that in particle **II**?

	I	**II**
A	PH_3	BH_3
B	NO_3^-	ClO_2^-
C	SF_6	ClF_3
D	I_3^-	$BeCl_2$

7 Gas **X** reacts with gas **Y** according to the following equation

$$\mathbf{X}(g) + \mathbf{Y}(g) \longrightarrow \mathbf{XY}(g)$$

The rate equation for the reaction is

$$\text{rate} = k[\mathbf{X}][\mathbf{Y}]^2$$

Which of the following statements is correct at constant temperature?

A Doubling the concentration of **X** and of **Y**, will double the rate of reaction.

B Halving the concentration of **Y**, keeping the concentration of **X** constant, will decrease the rate by a factor of 8.

C Tripling the concentration of both **X** and **Y** will increase the rate by a factor of 27.

D Quadrupling the concentration of **Y**, keeping the concentration of **X** constant, will increase the rate by a factor of 8.

8 Two equilibria are shown below.

Reaction I: $X_2Y(g) \rightleftharpoons X_2(g) + \frac{1}{2} Y_2(s)$

Reaction II: $2X_2(g) + Y_2(s) \rightleftharpoons 2X_2Y(g)$

The numerical value of K_c for reaction I is 2.

Under the same conditions, what is the numerical value of K_c for reaction II?

A $\frac{1}{4}$

B 4

C $\sqrt{\frac{1}{2}}$

D $\frac{1}{2}$

9 A mixture of nitrogen monoxide and carbon dioxide will form an equilibrium mixture as shown by the equation.

$$NO(g) + CO_2(g) \rightleftharpoons NO_2(g) + CO(g)$$

If 2.0 mol of nitrogen monoxide and 2.0 mol of carbon dioxide are allowed to reach equilibrium, 20 % of the resulting mixture is nitrogen dioxide.

What is the value of the equilibrium constant K_c, at the temperature of this experiment?

A $\frac{2}{3}$ **B** $\frac{4}{9}$ **C** $\frac{1}{4}$ **D** $\frac{1}{16}$

10 The solubility product values of silver compounds, at 25°C, are given in table below.

Compound	Solubility products at 25°C
silver carbonate	8×10^{-12} mol^3 dm^{-9}
silver ethanoate	2×10^{-3} mol^2 dm^{-6}

A solution mixture **S** contains 0.05 mol dm^{-3} with respect to carbonate and ethanoate ions.

What will happen when equal volumes of solution **S** and 0.1 mol dm^{-3} aqueous silver nitrate are mixed together?

A Only silver carbonate is precipitated.

B Only silver ethanoate is precipitated.

C Both silver carbonate and silver ethanoate are precipitated.

D No precipitate is formed.

11 The e.m.f. of the cell Pt(s)|H_2(g)|H^+(aq)||Ag^+(aq)|Ag(s) would be increased by

A increasing the concentration of H^+(aq).

B increasing the surface area of the Pt electrode.

C increasing the concentration of Ag^+(aq).

D decreasing the pressure of H_2(g).

12 The radius and charge of each of six ions are shown below:

Ion	A^+	B^+	C^{2+}	X^-	Y^-	Z^{2-}
Radius / nm	0.21	0.27	0.23	0.21	0.27	0.23

The ionic solids AX, BY and CZ are of the same lattice type.

What is the correct order of their lattice energies placing the one with the highest numerical value first?

A CZ > AX > BY

B AX > CZ > BY

C CZ > BY > AX

D AX > BY > CZ

13 The enthalpy change of reaction between zinc and hydrochloric acid can be measured in the laboratory.

$$Zn\ (s) + 2HCl\ (aq) \longrightarrow ZnCl_2\ (aq) + H_2\ (g)$$

What information, other than that obtained in this experiment, is needed to calculate a value for the enthalpy change of formation of aqueous $ZnCl_2$?

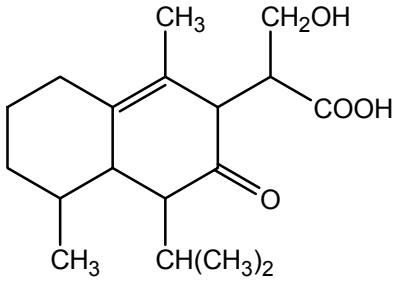
A lattice energy of zinc (II) chloride

B enthalpy change of formation of zinc

C enthalpy change of formation of aqueous H^+ and Cl^- ions.

D first and second ionisation energies of zinc

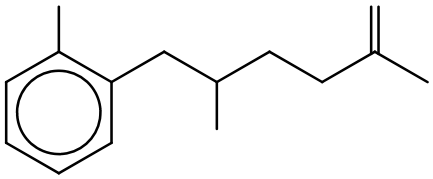
14 When the molecule below is heated with hydrogen gas in the presence of nickel catalyst, how many chiral centres does the product molecule possess?

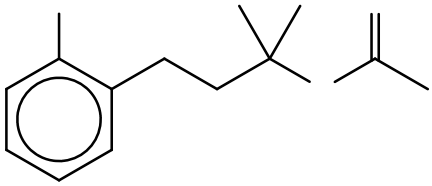


A 5 **C** 6

B 7 **D** 8

15 Which of the following reagents could **not** be used to distinguish between compound **X** and **Y**?





A I_2 in NaOH (aq) **C** Cu^{2+} in alkaline solution

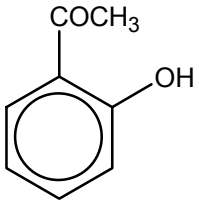
B PCl_5 **D** acidified potassium dichromate

16 Compound **Q** has the following properties.

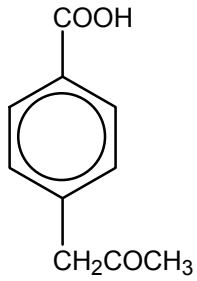
(i) It produces white fumes when PCl_5 is added.
(ii) It does not react with Na_2CO_3 but forms a soluble salt in aqueous NaOH.
(iii) It gives an orange precipitate with 2,4–dinitrophenylhydrazine.

Which one of the following could be **Q**?

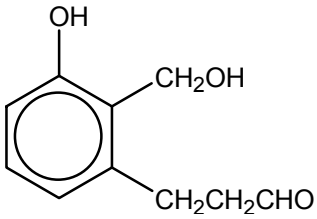
A



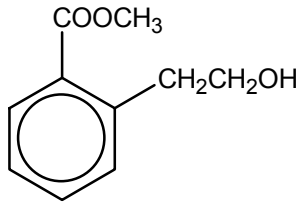
C



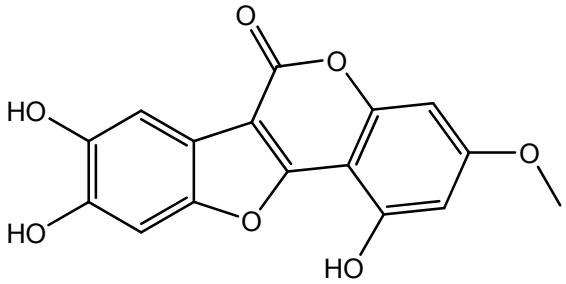
B



D



17 Wedelolactone, the naturally occurring active ingredient of herbal medicine and has been extensively used in South American native medicine as snake anti-venom.



Wedelolactone

Which of the following is true about Wedelolactone?

A It can react with 5 moles of aqueous bromine.

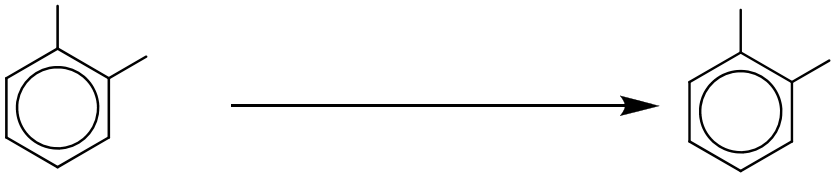
B It gives an orange precipitate with 2,4-dinitrophenylhydrazine.

C It is resistant to hydrolysis in both acidic and alkaline medium.

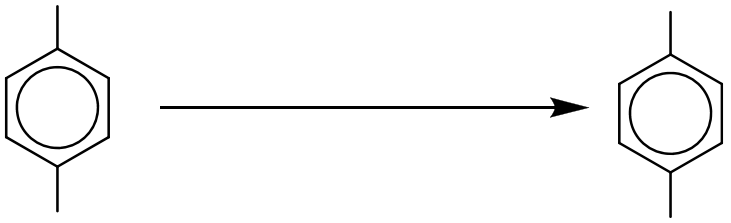
D It results in the formation of green Cr^{3+} ions from an acidified solution of $Cr_2O_7^{2-}$ ions.

18 Which reaction scheme proposed will most likely lead to a successful reaction giving the products given?

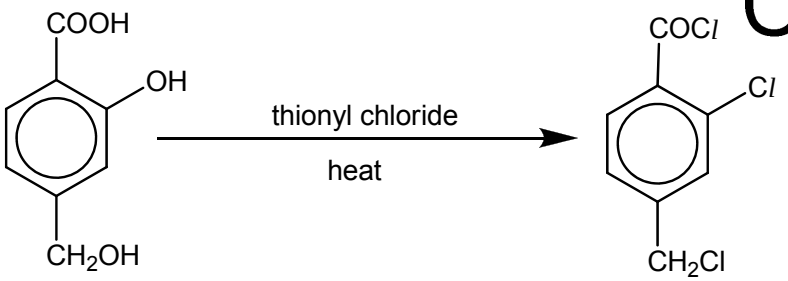
A



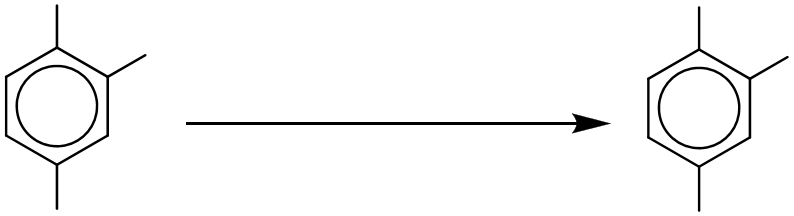
B



C



D



19 Concentrated ammonia was heated in a sealed tube with excess bromoethane, C_2H_5Br. Which of the following products will **not** be formed?

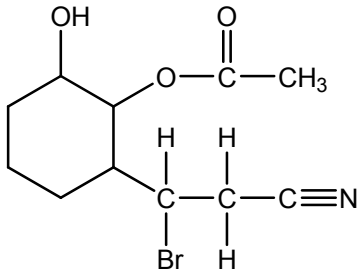
A $C_4H_{11}N$

B $C_5H_{13}N$

C $C_6H_{15}N$

D $C_8H_{20}NBr$

20 0.01 mol of compound **R** is refluxed with 50 cm^3 of 1 mol dm^{-3} aqueous NaOH and all ammonia gas evolved is expelled. The resulting solution is subsequently titrated with 1 mol dm^{-3} H_2SO_4 solution.



Compound **R**

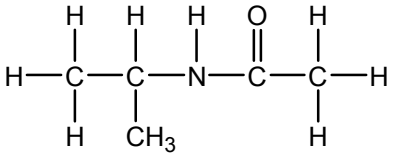
What is the volume of H_2SO_4 required for complete neutralisation of the resulting solution?

A 10 cm^3 **C** 30 cm^3

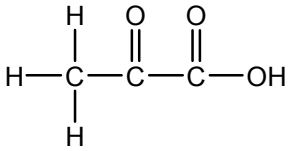
B 20 cm^3 **D** 40 cm^3

21 Which compound can be synthesized from prop-1-ene in less than 3 steps?

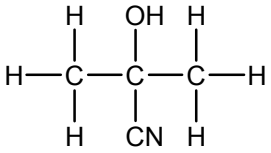
A



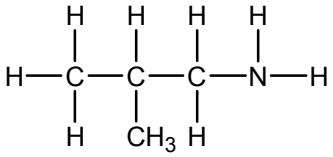
C



B



D



22 In the presence of a base, some aldehyde and ketone undergo a rapid and reversible condensation reaction, where they dimerise to form a hydroxycarbonyl compound (an aldol).

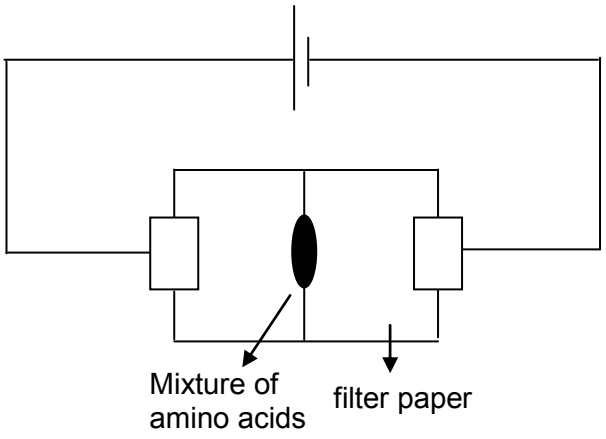
This reaction is initiated by the production of the enolate ion, $RCOCH_2^-$, formed from the reaction between a carbonyl molecule and a base.

What is the mechanism involved in the above reaction?

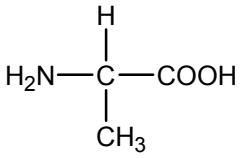
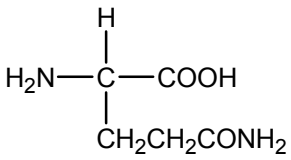
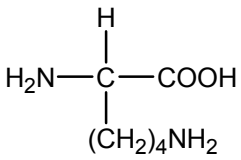
A Electrophilic addition **C** Nucleophilic addition

B Electrophilic substitution **D** Nucleophilic substitution

23 A mixture of amino acids can be separated by electrophoresis.

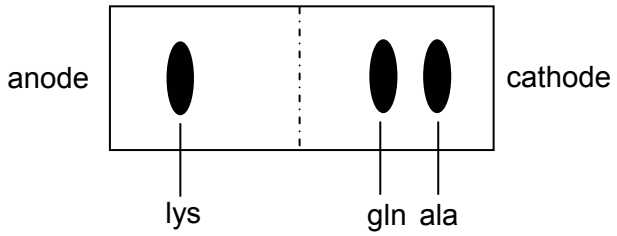


The following information about alanine and two other amino acids are given as below.

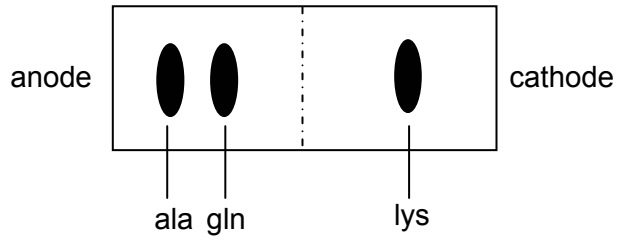
Amino acid	Structure	Isoelectric point
alanine (ala)		6.01
glutamine (gln)		5.65
lysine (lys)		9.74

Which of the following filter papers show a possible result of the separation of the amino acid mixture at pH 8?

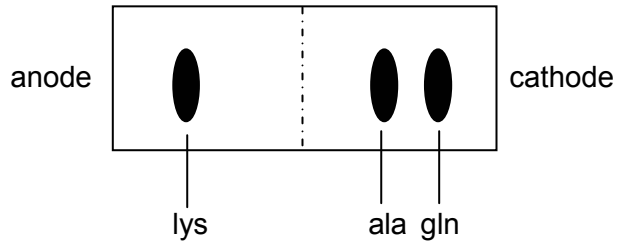
A



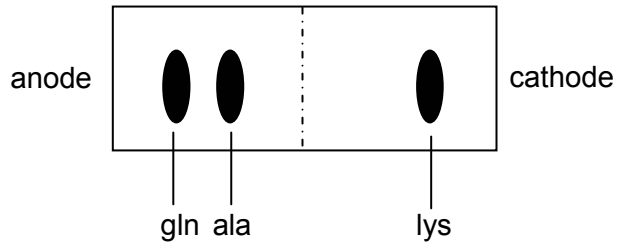
B



C



D



24 In which of the following sequences does the value of pK_a increase continuously?

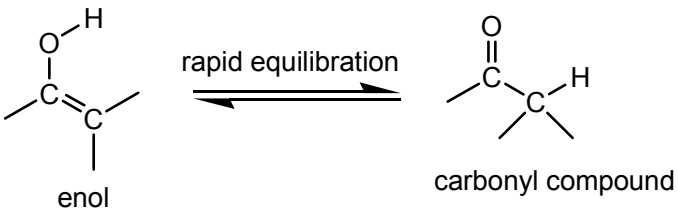
A $CH_3CHClCOOH$, CH_3CH_2COOH, C_6H_5OH

B CH_2ClCH_2COOH, $CH_3CHClCOOH$, CH_3CH_2COOH

C C_6H_5OH, $CH_3CHClCOOH$, $CH_3CHFCOOH$

D CH_3CH_2COOH, $CH_3CHFCOOH$, CH_3CF_2COOH

25 Enols, also known as alkenols, are alkenes with a hydroxyl group affixed to one of the carbon atoms composing the double bond. Enols and carbonyl compounds are rapidly interconvertible via a process called tautomerism.



enol

carbonyl compound

The enol form is usually unstable and difficult to isolate and are present only to a very small extent at equilibrium.

Propane-1,2-diol can undergo dehydration with excess concentrated H_2SO_4 to give enols and a mixture of products. Which of the following is **false** about the resulting solution?

A It decolourises hot acidified potassium manganate (VII) solution with the evolution of a colourless gas.

B It gives a yellow precipitate with aqueous alkaline iodine.

C It gives a grey precipitate with silver diammine complex.

D It reacts with cold alkaline potassium manganate (VII) solution to give an optically active product.

26 Which of the following statements is **false**?

A Denaturation does not affect the primary structure of proteins which implies that there is no breakage of the peptide bonds.

B In an alpha helix, the amide carbonyl oxygen of an amino acid residue *n* is hydrogen bonded to the amide hydrogen of residue *n*+4.

C The formation of the peptide link between amino acids is irreversible.

D The quaternary structure only applies to proteins that contain two or more polypeptide chains.

27 Which one of the following statements is correct?

A $AlCl_3$ has a higher melting point than Al_2O_3.

B The Al_2Cl_6 dimer contains two co-ordinate bonds.

C $AlCl_3$ is pyramidal.

D The $AlCl_3$ catalyst acts as an electron pair donor in the acylation of benzene.

28 Which of the following statements is most likely to be true for astatine, the element below iodine in Group VII of the Periodic Table?

A Silver astatide and concentrated ammonia react to form a solution of a soluble complex.

B Astatine is a dark coloured liquid at room temperature pressure.

C Sodium astatide and hot concentrated sulphuric acid react to form astatine.

D Astatine is a stronger oxidising agent than iodine.

29 Which of the following properties of the Group II elements and their compounds increases down the group?

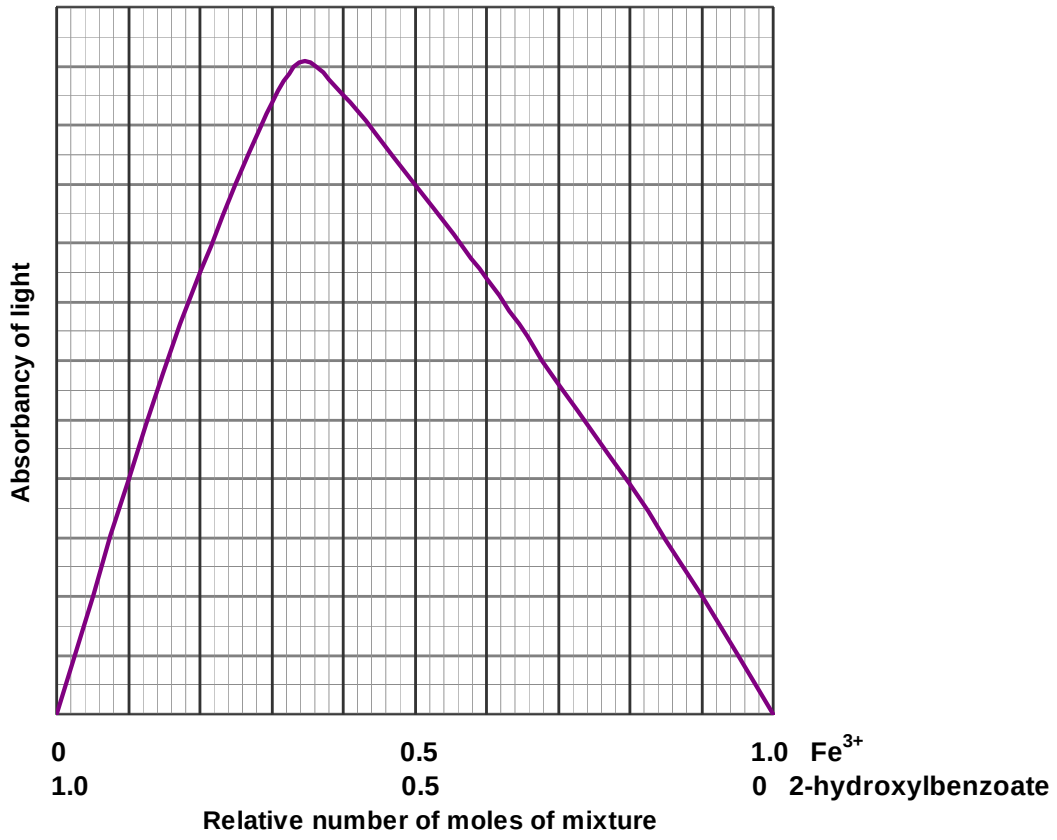
A The magnitude of the enthalpy change of hydration of the metal ion.

B The solubility of the sulphate in water.

C The stability of the carbonate to heat.

D The tendency to form complex ions.

30 When 2-hydroxybenzoate ions are added to Fe^{3+} solution, an iron complex ion is formed. Mixtures of solutions containing Fe^{3+} (aq) and 2-hydroxybenzoate ions show light absorbency measured with colorimeter, as shown in the graph below. The solution with the highest absorbance shows that of the complex ion.



What is the likely overall charge on the complex ion formed?

A –1 **B** 0 **C** +1 **D** +3

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 statements that you consider to be correct).

The responses **A, B, C,** and **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 Which of the following statements are correct?

1 The atomic number of an element is the number of protons in one atom of the element.

2 The nucleon number of an element is the number of neutrons in one atom of the element.

3 The relative mass of an electron is the same as that of a proton.

32 Phosphorus forms phosphorus pentachloride but not phosphorus pentaiodide. Which of the following explains this phenomenon?

1 Steric hinderance due to large iodine atoms.

2 Chlorine is more electronegative than iodine.

3 Iodine has smaller first electron affinity than chlorine.

33 The mechanism for a given reaction is shown below.

$$2\mathbf{A} \rightleftharpoons \mathbf{C} \quad \text{fast}$$

$$\mathbf{C} + \mathbf{B} \longrightarrow \mathbf{D} \quad \text{slow}$$

$$\mathbf{D} + \mathbf{B} \longrightarrow \mathbf{A_2B_2} \quad \text{fast}$$

What conclusions can be drawn from the information given above?

1 Rate = $k[\mathbf{A}]^2[\mathbf{B}]$

2 The overall equation is $2\mathbf{A} + 2\mathbf{B} \longrightarrow \mathbf{A_2B_2}$.

3 The rate of formation of $\mathbf{A_2B_2}$ is proportional to the initial concentration of **B**.

34 The standard enthalpy changes of combustion of element **M** in different allotropic form are as follows:

M (allotrope I) = – 593 kJ mol^{-1}

M (allotrope II) = – 600 kJ mol^{-1}

Which of the following deductions can be made from the data above?

1 **M** (allotrope I) is more stable than **M** (allotrope II).

2 **M** (allotrope I) is formed endothermically from **M** (allotrope II).

3 **M** (allotrope I) has a higher energy content than **M** (allotrope II).

35 *The use of Data Booklet is relevant in this question.*

The relationship between the standard Gibbs free energy change and the standard e.m.f of the cell is given by the equation $\Delta G^o = -nFE^o_{cell}$, where n is the number of moles of electrons exchanged in an electrochemical reaction and F is the Faraday's constant.

For the reaction $4Ag(s) + O_2(g) + 4H^+(aq) \longrightarrow 4Ag^+(aq) + 2H_2O(l)$

Which of the following statements are correct?

1 4 moles of electrons is being exchanged in one mole of the above reaction.

2 The E^o_{cell} for the reaction is 0.43V.

3 The ΔG^o for the reaction is – 340kJ mol^{-1}.

36 Anhydrous compounds of Period 3 elements that react with water to give solutions with a pH value less than 5 include

1 covalent oxides.

2 covalent chlorides.

3 ionic chlorides.

37 Ethyl propanoate, $CH_3CH_2OCOCH_2CH_3$ undergoes acidic hydrolysis in the presence of $H_2{}^{18}O$. Which of the following products are formed?

1 $CH_3CH_2{}^{18}OH$

2 $CH_3CH_2CO^{18}OH$

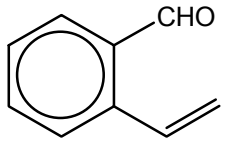
3 CH_3CH_2OH

The responses **A, B, C,** and **D** should be selected on the basis of

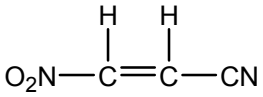
A	B	C	D
1, 2 and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

38 Which of the following molecules are planar?

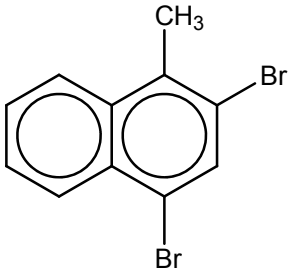
1



2



3



39 In which sequence are the compounds listed in order of increasing ease of hydrolysis?

1 C_6H_5Cl, CH_3CH_2Cl, CH_3COCl

2 CH_3CH_2I, CH_3CH_2Br, CH_3CH_2Cl

3 C_6H_5Cl, CH_3Cl, CH_3CH_2Cl

40 The molecule of benzene, C_6H_6 is a regular hexagon in which the π electrons are described as delocalised.

Which of the following statements support this structure?

1 It prevents benzene from undergoing addition reactions.

2 All C–C bonds lengths in benzene are intermediate between C–C bond in an alkane and C=C bond in an alkene.

3 The enthalpy change of hydrogenation of benzene is less exothermic than that predicted for cyclohexatriene.