Catholic Junior College

JC 2 Preliminary Examinations

Higher 2

CANDIDATE NAME	
CLASS	**2T**

CHEMISTRY 9729/01

Paper 1 Multiple Choice **15 September 2022**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and NRIC/FIN number on the Answer Sheet in the spaces provided.

There are **thirty** 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.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **14** printed pages.

1 Which statement about 27 g of A*l* is always correct?

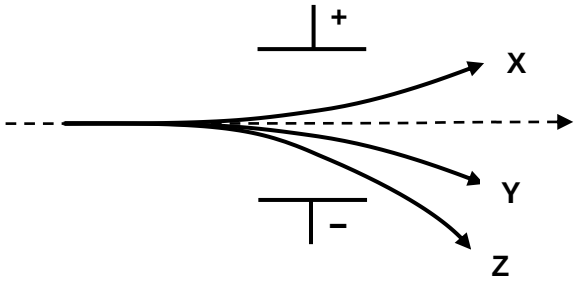
A It contains the same number of atoms as $\frac{1}{12}$ g of ^{12}C.

B It contains the same number of atoms as 24 dm^3 of krypton gas at room temperature and pressure.

C It contains the same number of hydrogen ions as 1 dm^3 of 1 mol dm^{-3} aqueous sulfuric acid.

D It contains the same number of atoms as 28 g of nitrogen gas.

2 The following are flight paths of charged particles as they pass through an electric field at the same speed.



Which of the following correctly identifies **X**, **Y** and **Z**?

	X	**Y**	**Z**
A	$^{14}N^-$	$^{16}O^{2+}$	$^{28}Si^{2+}$
B	$^{14}N^-$	$^{14}C^+$	$^{28}Si^{4+}$
C	$^{15}O^+$	$^{14}C^+$	$^{14}N^+$
D	$^{15}O^-$	$^{14}C^+$	$^{28}Si^+$

3 *Use of the Data Booklet is relevant to this question.*

Species containing one or more unpaired electrons can be attracted by an external magnetic field and are said to be paramagnetic.

Which of the following species is paramagnetic?

1 Cr^{3+}
2 Cu^+
3 Ni^{2+}

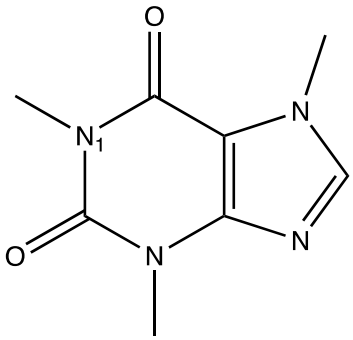
A 3 **B** 1 and 2

C 1 and 3 **D** 1, 2 and 3

4 In which of the following sequences are the species quoted in order of decreasing boiling points?

A RbC*l*, KC*l*
B HF, HC*l*
C K, Ca
D CO, CO_2

5 People drink beverages containing caffeine to relieve or prevent drowsiness and to improve cognitive performance.



Caffeine

Which statement about caffeine is true?

A Caffeine molecule has a planar structure.
B The π bond in C=C is formed by sideways overlap of 2p orbitals.
C The nitrogen atom in caffeine, N_1 is basic.
D There are 16 sigma bonds in a caffeine molecule.

6 Which of the following substances conduct electricity due to delocalised electrons?

1 Graphite
2 Solid magnesium
3 Molten sodium chloride

A 1 only
B 1 and 2 only
C 2 and 3 only
D 1, 2 and 3

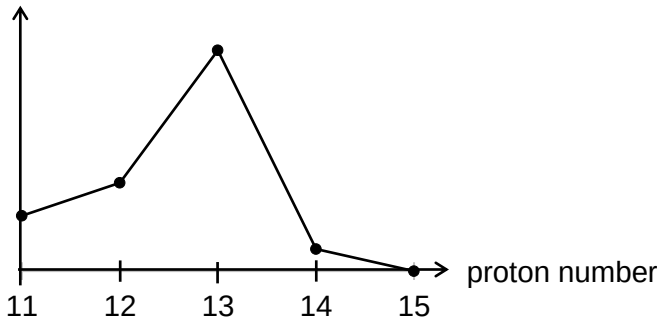
7 Which of the following statements is **incorrect**?

A When methane gas is subjected to low pressure, it liquefies.
B Tyre pressure readings are higher on a hot day.
C The boiling point of water is lower than 100ºC at a higher altitude.
D The density of an ideal gas at constant pressure is inversely proportional to the temperature.

8 For the oxides of Period 3 elements (Na to P), which property decreases from Na_2O to P_4O_{10}?

A melting point
B covalent character
C pH when mixed with water
D solubility in aqueous alkali

9 The following graph shows how a property of the elements in Period 3, from Na to P, or their compounds, varies with proton number.



What property is shown by the graph?

A ionisation energies of elements
B melting point of element
C pH of aqueous chloride
D electrical conductivity of element

10 *Use of Data Booklet is relevant to this question.*

The $\Delta G^{\ominus}_{solution}$ and $\Delta S^{\ominus}_{solution}$ for silver chloride, AgC*l* are +55.6 kJ mol^{-1} and +33.2 J mol^{-1} K^{-1} respectively.

What is the standard enthalpy change ($\Delta H^{\ominus}$) when 287 g of AgC*l* is precipitated under the same conditions?

A +65.5 kJ **B** −65.5 kJ **C** +131 kJ **D** −131 kJ

11 The rate equation for a reaction between **A** and **B** is given by: rate = k[**A**]
Which of the following statements about the reaction is true?

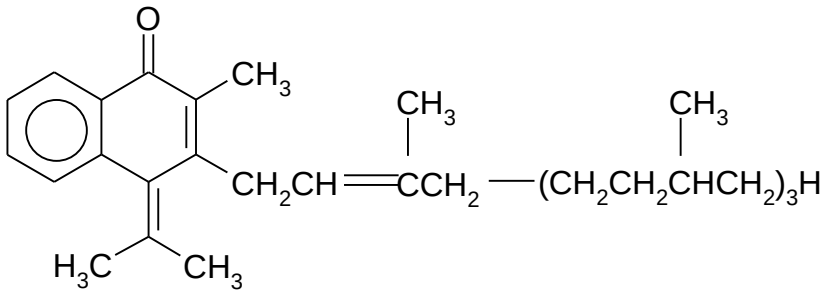
1 **A** is involved in the rate−determining step in the reaction mechanism.
2 The rate constant, k, increases with increasing concentration of **A**.
3 A graph of rate against [**A**] gives a straight line that passes through the origin.

A 1,2 and 3 **B** 1 and 3 only **C** 2 only **D** 1 only

12 What is the pH of the final solution when V cm^3 of dilute nitric acid of pH 2.0 is mixed with V cm^3 of dilute nitric acid of pH 4.0 followed by the addition of 2V cm^3 of water?

A 2.3 **B** 2.6 **C** 3.0 **D** 3.6

13 Compound **K** is a yellow viscous oil found in plants. It has the following structure.



What is the total number of stereoisomers for compound **K**?

A 4 **B** 8 **C** 16 **D** 32

14 In the free radical substitution reaction of methane, CH_4, one of the side-products formed is ethane, CH_3CH_3, which is formed when two $\bullet CH_3$ radicals combine.
Upon careful heating, a sample of butane, $CH_3CH_2CH_2CH_3$, reacted with chlorine gas in a free radical substitution reaction to give only mono-substituted products.

How many possible organic side-products would be obtained in this reaction when the radicals produced combine with each other?

A 2 **B** 3 **C** 4 **D** 5

15 The reaction between carbon dioxide and potassium hydroxide is exothermic. The proposed two–step mechanism of the reaction is shown below:

Step 1: $CO_2(aq) + KOH(aq) \rightarrow KHCO_3(aq)$

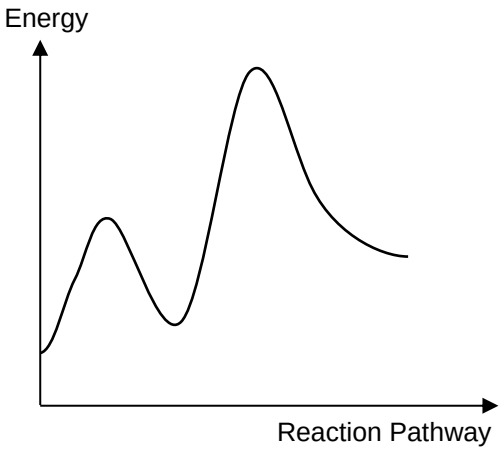
Step 2: $KHCO_3(aq) + KOH(aq) \rightarrow K_2CO_3(aq) + H_2O(l)$

Experiments were carried out to study the rate of the reaction above.

Experiment Number	Initial concentration of CO_2 / mol dm^{-3}	Initial concentration of KOH / mol dm^{-3}	Initial reaction rate / mol dm^{-3} s^{-1}
1	0.2	0.2	0.0034
2	0.4	0.2	0.0068
3	0.2	0.1	0.0017

Which of the following graphs most likely describes the energy profile of the reaction above?

A



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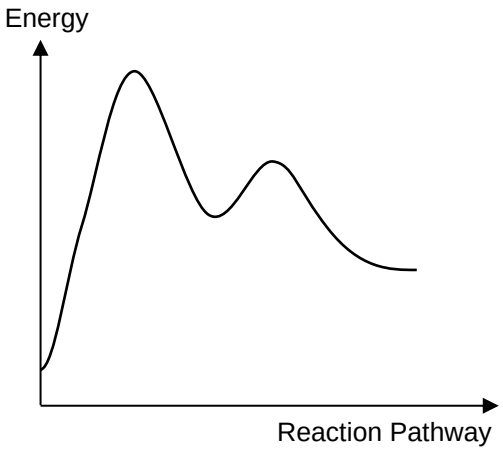
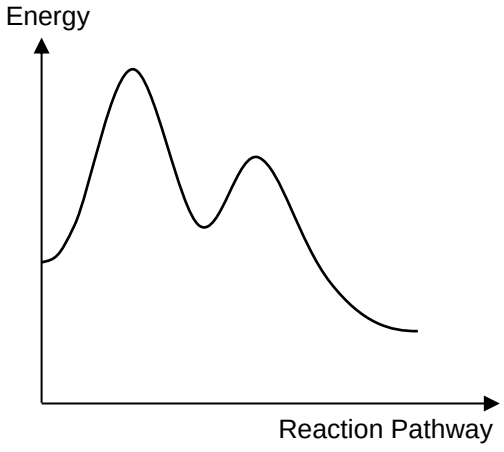
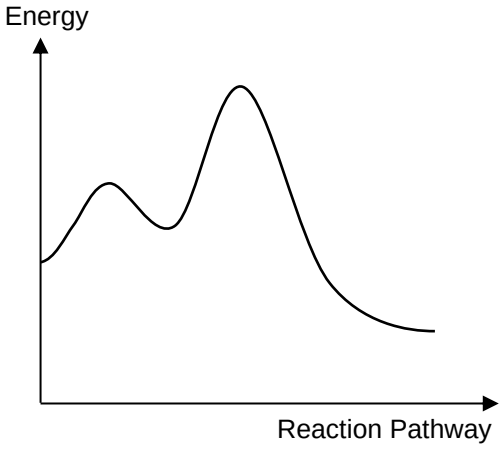


C



D

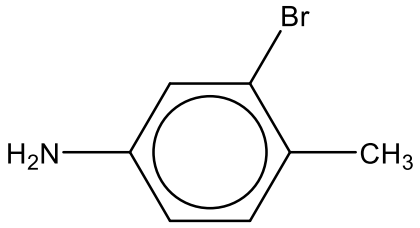


16 Aqueous bromine can react with propene in the presence of concentrated potassium nitrate solution.

Which of the following is the major product formed in the reaction?

A $CH_3CHBrCH_2ONO_2$
B $CH_3CHBrCH_2Br$
C $CH_3CHBrCH_2OH$
D $CH_3CH(ONO_2)CH_2Br$

17 Which synthetic route is most likely to lead to the most successful synthesis of the following product from benzene?



A nitration, bromination, alkylation, reduction
B nitration, bromination, reduction, alkylation
C nitration, alkylation, reduction, bromination
D alkylation, bromination, nitration, reduction

18 A few drops of 1–chlorobutane, 1–bromobutane, 1–iodobutane were placed separately into three test–tubes each, containing 1.0 cm^3 of aqueous silver nitrate at 60 ^oC.

A hydrolysis reaction occurred. (X is the halogen atom)

$H_2O + CH_3CH_2CH_2CH_2X + Ag^+ \rightarrow CH_3CH_2CH_2CH_2OH + AgX + H^+$

Which of the following would be the best explanation for the rate of the reaction?

A The bond energy of C–X bond decreases from C–C*l* to C–I.
B The bond polarity of C–X bond decreases from C–C*l* to C–I.
C The electron deficiency of the carbon atom bonded to X decreases from C–C*l* to C–I.
D The solubility of AgX decreases from AgC*l* to AgI.

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

A $C_4H_{10}N$
B $C_4H_{11}N$
C $C_6H_{15}N$
D $C_8H_{20}NBr$

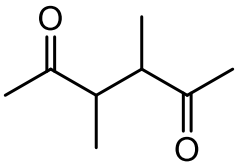
20 An alcohol **A** with molecular formula $C_4H_{10}O$ is oxidised by acidified potassium dichromate(VI) under certain conditions to give **B**. The following shows some properties of **B**:

1 **B** does not produce a yellow precipitate with aqueous alkaline iodine.
2 **B** gives a brick – red precipitate when reacted with Fehling's solution.

How many isomers of alcohol **A** could result in the observations for **B**?

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

21 Compound **Z** shown below is an intermediate used to generate pyrroles which are essential to the production of many different chemicals in the pharmaceutical industry.

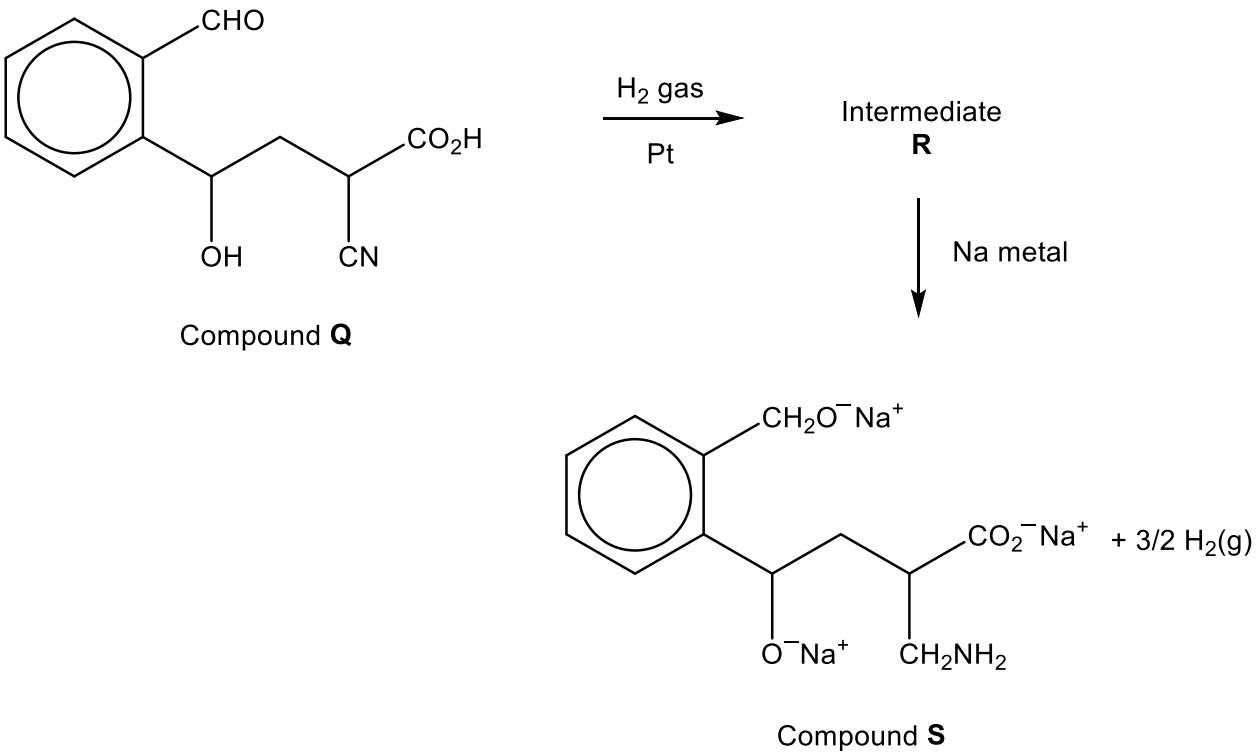


compound **Z**

Which sentence is correct for compound **Z**?

A It produces a silver mirror with Tollens' reagent.
B It decolourises acidified potassium manganate(VII).
C It produces a yellow precipitate with aqueous alkaline iodine.
D It does not produce an orange precipitate with 2,4-dinitrophenylhydrazine.

22 Compound **S** can be obtained via the following 2-step synthesis from compound **Q**.



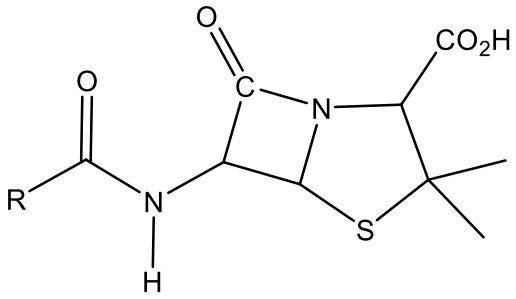
Compound **Q**

Compound **S**

If 96 dm^3 of hydrogen gas was reacted with **one mole** of compound **Q**, followed by the addition of sodium metal at room temperature and pressure, what is the final gas volume when the reaction was completed? (Given V_m = 24 dm^3 mol^{-1} at r.t.p.)

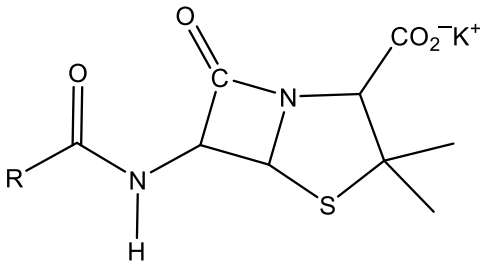
A Gas volume decreases by 36 dm^3.
B Gas volume decreases by 60 dm^3.
C Gas volume increases by 36 dm^3.
D No change in gas volume.

23 Penicillin is an antibiotic commonly used to treat a number of bacterial infections. The general structure of a penicillin molecule is given below.

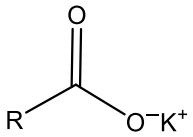


What are the products formed when penicillin is boiled with excess aqueous potassium hydroxide?

A



B



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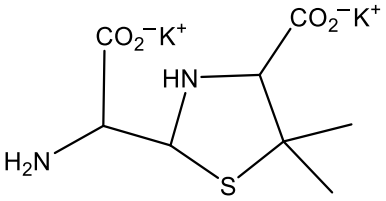
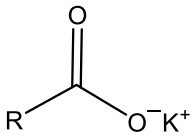


C



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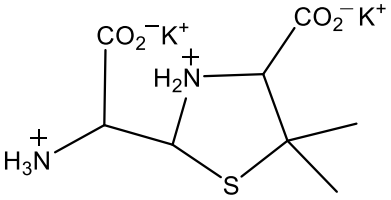

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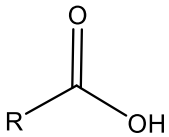

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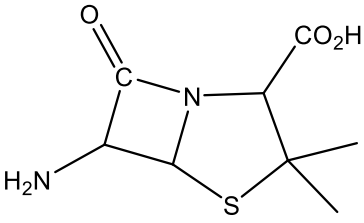
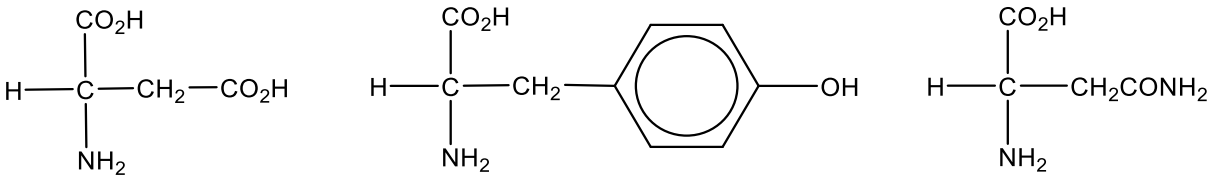
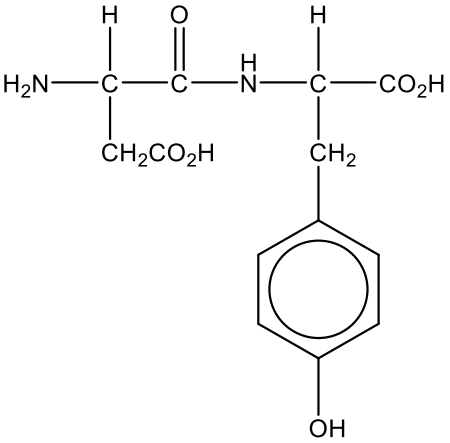


24 The following shows the structures of three amino acids.



Which of the following represent the dipeptides formed from these amino acids?

1



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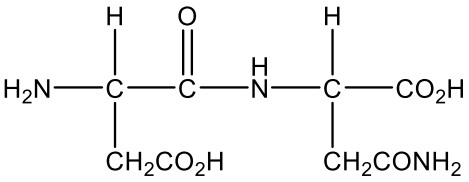

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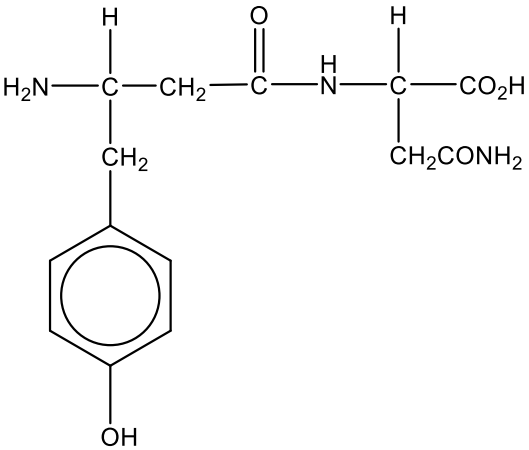


A 1, 2 and 3
B 1 and 2
C 1 and 3
D 2 only

25 Two electrode potentials are given.

$$Fe^{3+} + e^- \rightleftharpoons Fe^{2+} \qquad E^{\ominus} = +0.77\ V$$
$$Cl_2 + 2e^- \rightleftharpoons 2Cl^- \qquad E^{\ominus} = +1.36\ V$$

Which species is the strongest reducing agent?

A Fe^{3+} **B** Fe^{2+} **C** Cl_2 **D** Cl^-

26 *Use of the Data Booklet is relevant to this question.*

An electrochemical cell is set up using a $Fe^{2+}(aq)|Fe(s)$ half–cell and a $VO_2^+(aq),VO^{2+}(aq)|Pt(s)$ half–cell.

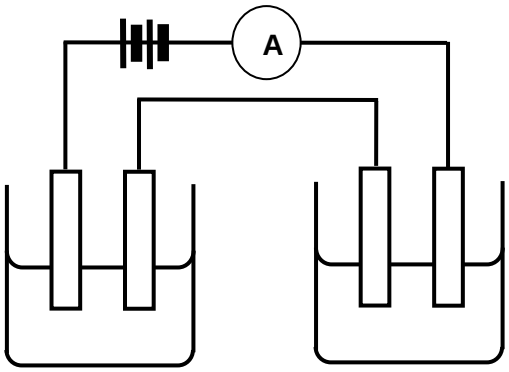
Which of the following gives a correct effect on the E_{cell} and a correct explanation for the effect when each of the changes is made to the cell separately?

	change	effect on E_{cell}	explanation
1	add KCN(aq) to the $Fe^{2+}(aq)|Fe(s)$ half–cell	increases	concentration of $Fe^{2+}(aq)$ decreases
2	add water to the $VO_2^+(aq),VO^{2+}(aq)|Pt(s)$ half–cell	decreases	concentration of water increases
3	increase temperature of the $Fe^{2+}(aq)|Fe(s)$ half–cell	no change	temperature change does not affect E_{cell}

A 1, 2 and 3 **B** 1 and 2 **C** 2 and 3 **D** 1 only

27 *Use of the Data Booklet is relevant to this question.*

Using inert electrodes, a current was passed through two beakers containing aqueous silver sulfate and aqueous copper(II) nitrate, connected in series under standard conditions.



What is the ratio of the mass of silver to copper deposited after the current was passed for *t* minutes?

A 0.59 **B** 0.85

C 1.70 **D** 3.40

28 A current of 10 A is passed for 150 minutes through molten aluminium oxide using inert electrodes.

What will be the approximate volume of gas liberated, measured at s.t.p.?

A 0.089 dm^3 **B** 5.3 dm^3 **C** 5.6 dm^3 **D** 11.2 dm^3

29 $EDTA^{4-}(aq)$ solution is added dropwise until in excess to a solution of $[CrCl_2(H_2O)_4]^+$. The equlibrium constant for this reaction is greater than 1 and the equation for the reaction is as shown below.

$$[CrCl_2(H_2O)_4]^+(aq) + EDTA^{4-}(aq) \rightleftharpoons [Cr(EDTA)]^-(aq) + 2Cl^-(aq) + 4H_2O(l)$$

Which one of the following statements about the above reaction is correct?

A There is no change in colour of the solution after addition of $EDTA^{4-}$.

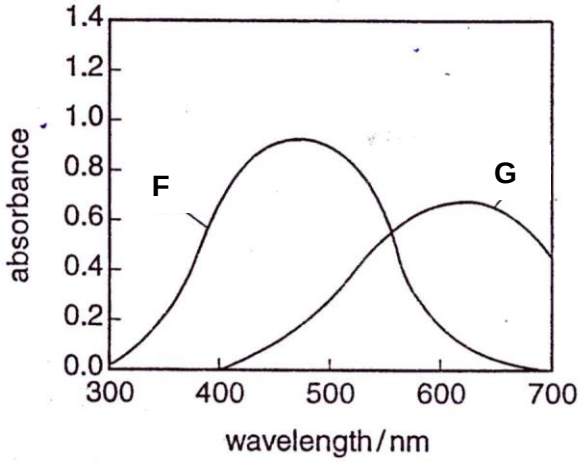
B $[Cr(EDTA)]^-$ is a less stable complex ion than $[CrCl_2(H_2O)_4]^+$.

C Both $[Cr(EDTA)]^-$ and $[CrCl_2(H_2O)_4]^+$ are octahedral complexes.

D The above is a redox reaction.

30 The absorbance of a solution at a particular wavelength is proportional to the concentration of ion responsible for the absorption.

The visible spectra of solutions of two transition metal complexes **F** and **G** are shown in the diagram below. Both complexes contain the same transition metal ion.



Given that energy is inversely proportional to wavelength and the visible region of the electromagnetic spectrum is as follows:

violet	blue	green	yellow	orange	red
400		500		600	700

Wavelength (nm)

Which of following statements can be deduced from the spectra?

1 Complex **F** is likely to be red while complex **G** is likely to be blue.

2 The energy gap in complex **F** is greater than that in complex **G.**

3 The K_c value for the formation of complex **F** is higher than the K_c value for formation of complex **G**.

A 1, 2 and 3 are correct

B 1 and 2 only are correct

C 2 and 3 only are correct

D 1 only is correct

END OF PAPER