



SERANGOON JUNIOR COLLEGE
General Certificate of Education Advanced Level
Higher 2

Candidate Name

Class

CHEMISTRY

JC2 Preliminary Examination

Paper 1 Multiple Choice

Additional Materials: Data Booklet
 Optical Mark Sheet (OMS)

9647/01

23 September 2016

1 hour

READ THESE INSTRUCTIONS FIRST

On the separate multiple choice OMS given, write your name, subject title and class in the spaces provided.

Shade correctly your FIN/NRIC number.

There are **40** 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 using a **soft pencil** on the separate OMS.

Each correct answer will score one mark.

A mark will not be deducted for a wrong answer.

You are advised to fill in the OMS as you go along; no additional time will be given for the transfer of answers once the examination has ended.

Any rough working should be done in this question paper.

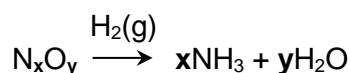
Answer all questions

- 1 The relative abundances of the isotopes of a sample of titanium are shown in the table below.

Relative Isotopic Mass	46	47	48	49	50
Relative Abundance	11.2	10.1	100.0	7.3	7.0

What is the relative atomic mass of titanium in this sample?

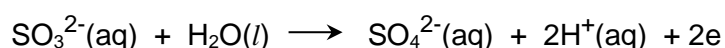
- A 48.00
B 47.92
C 47.90
D 47.89
- 2 To identify an oxide of nitrogen, 0.10 mol of the oxide is mixed with an excess of hydrogen and passed over a catalyst at a suitable temperature.



The water produced weighs 7.20 g. The ammonia produced is neutralised by 200 cm³ of 1.0 mol dm⁻³ HCl.

What is the formula of the oxide of nitrogen?

- A N₂O
B NO
C NO₂
D N₂O₄
- 3 50 cm³ of a 0.10 mol dm⁻³ solution of a metallic salt was found to react exactly with 25.0 cm³ of 0.10 mol dm⁻³ aqueous sodium sulfite. In this reaction, the sulfite ion is oxidised as follows.



What is the new oxidation number of the metal in the salt if its original oxidation number was +3?

- A +1
B +2
C +4
D +5

4 Of the following, which is the strongest oxidising agent?

- A O_2^+
- B O_2
- C O_2^-
- D O_2^{2-}

5 Paramagnetism refers to the magnetic state of an atom with one or more unpaired electrons. The greater the number of unpaired electrons in an atom, the greater the paramagnetism.

Which atom has the greatest paramagnetism?

- A Oxygen
- B Chlorine
- C Scandium
- D Arsenic

6 Which of the following is true of both real and ideal gases?

- A Molecules can be liquefied.
- B Molecules occupy a finite volume.
- C Molecules are in constant random motion.
- D Molecules behave identically at high pressure and low temperature.

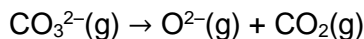
7 The Valence Shell Electron Pair Repulsion Theory (VSEPR) is used to predict the shapes of molecules.

Which shape is correctly predicted by VSEPR?

	number of regions of electron density	number of lone pairs	shape
A	3	1	Tetrahedral
B	3	1	Trigonal pyramidal
C	5	1	See-saw
D	5	1	Square pyramidal

- 8 The magnitude of the lattice energy of calcium oxide and calcium carbonate is 3414 kJ mol^{-1} and 2814 kJ mol^{-1} respectively. The enthalpy change of decomposition of calcium carbonate is $+176 \text{ kJ mol}^{-1}$.

Using the information provided, calculate the enthalpy change of the following reaction.



- A - 424 kJ mol^{-1}
 B + 424 kJ mol^{-1}
 C - 776 kJ mol^{-1}
 D + 776 kJ mol^{-1}
- 9 Primary, secondary and tertiary amine have similarly shaped molecules.

What is the predominant intermolecular force of attraction in methylamine, dimethylamine and trimethylamine?

	methylamine	dimethylamine	trimethylamine
A	hydrogen bonds	hydrogen bonds	hydrogen bonds
B	hydrogen bonds	permanent dipole – permanent dipole	Instantaneous dipole – induced dipole
C	permanent dipole – permanent dipole	permanent dipole – permanent dipole	permanent dipole – permanent dipole
D	hydrogen bonds	hydrogen bonds	permanent dipole – permanent dipole

- 10 The integrated form of first-order rate law is as shown.

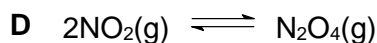
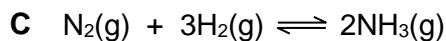
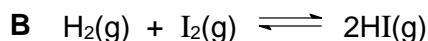
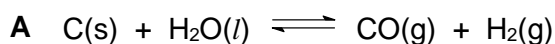
$$\ln A = -kt + \ln A_0$$

where A is the activity at time t,
 A_0 is the initial activity,
 k is the rate constant,
 t is the time taken.

What is the half-life for a first order reaction if 68% of a substance is reacted within 66s?

- A 33 s
 B 40 s
 C 49 s
 D 119 s

11 For which equilibrium is $K_c = K_p$?



12 The ionic product of water, K_w , at two different temperatures is shown below,

$K_w / \text{mol}^2 \text{dm}^{-6}$	Temperature / K
1.00×10^{-14}	298
1.44×10^{-14}	303

Which statement is correct?

A Self-ionisation of water is an exothermic process.

B At 303 K, $[\text{H}^+] = 0.72 \times 10^{-14} \text{ mol dm}^{-3}$

C
$$K_w = \frac{[\text{H}^+][\text{OH}^-]}{[\text{H}_2\text{O}]}$$

D At 303 K, $\text{pH} < 7$

13 Calculate the pH of the resulting solution when 10 cm^3 of potassium hydroxide with concentration at $7.5 \times 10^{-7} \text{ mol dm}^{-3}$ is mixed with an equal volume of hydrogen bromide with concentration at $8.5 \times 10^{-8} \text{ mol dm}^{-3}$.

A 4.18

B 6.36

C 7.64

D 9.82

14 Aqueous hydrochloric acid was electrolysed for ten minutes, 200 cm^3 of gas **A** was collected at the anode.

The same current was then applied to concentrated sodium chloride solution in another experiment and 400 cm^3 of a gas **B** is collected at the cathode.

Which of these statements is correct?

A Gas **B** is pale yellow.

B The time taken for the second electrolysis is also ten minutes.

C Chlorine gas was collected initially in the first electrolysis system.

D Mercury electrodes can be used for the second electrolysis system if gas **B** is to be collected.

- 15 Which of the following properties could be predicted for strontium or its compounds?
- A It does not burn in air.
 - B It forms a soluble sulfate.
 - C It reacts with cold water, liberating hydrogen.
 - D It forms a water-soluble carbonate which does not decompose on heating.

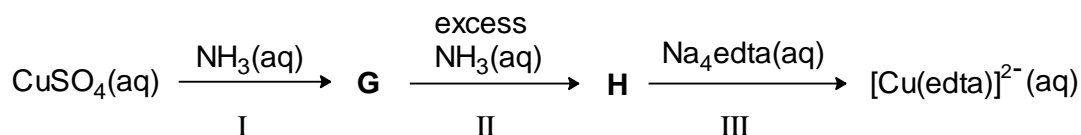
- 16 Equal volumes of chlorine gas were bubbled into hot and cold sodium hydroxide separately until reactions were complete.

Which of the following statements is incorrect about the above reactions?

- A Disproportionation reactions will occur.
 - B Greenish-yellow chlorine gas decolourises in both reactions.
 - C When aqueous silver nitrate is added to the resulting solutions, white precipitate is formed.
 - D Sodium chlorate(VII) and sodium chlorate(I) are formed in the reactions respectively.
- 17 Aqueous chlorine is added to aqueous sodium bromide and the mixture is shaken with an equal volume of trichloromethane.

Which observation will be made?

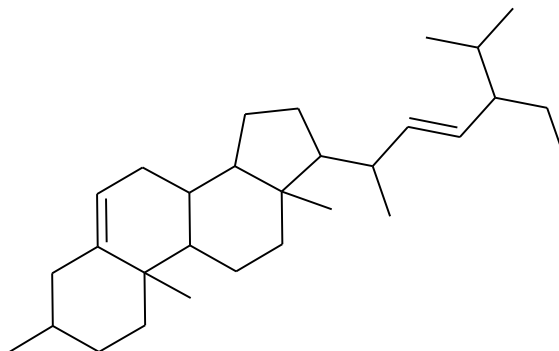
- A The solution in the test-tube turns colourless.
 - B The solution in the test-tube turns orange.
 - C A colourless layer forms on top of a purple layer.
 - D A colourless layer forms on top of an orange layer.
- 18 A reaction scheme starting from aqueous copper(II) sulfate solution is shown below. Both **G** and **H** are copper-containing species.



Which of the following statements is correct?

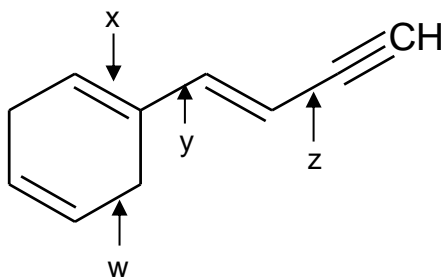
- A Reaction III is a redox reaction.
- B NH_3 acts as a ligand in reaction I.
- C **H** is a deep blue solution containing $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]\text{SO}_4$.
- D The entropy of the system decreases when reaction III occurs.

- 19 Stigmasterol is an unsaturated plant sterol occurring in the plant fats of soybean.



How many stereoisomers does stigmasterol have?

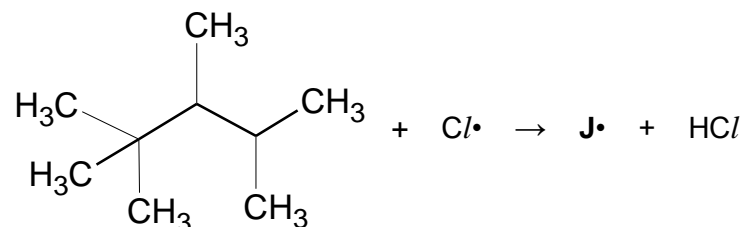
- A 2^9
 - B 2^{10}
 - C 2^{11}
 - D 2^{12}
20. Four carbon-carbon bonds are labelled in the diagram.



Which bonds are made up of a sp^2 - sp^2 overlap?

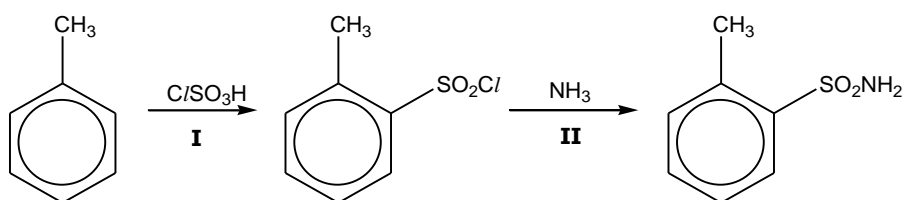
- A x only
- B x and y only
- C w, x and y only
- D w, y and z only

21. When heated with chlorine, the hydrocarbon 2,2,3,4-tetramethylpentane undergoes free radical substitution. In a propagation step, the free radical $\text{J}\cdot$ is formed by the loss of one hydrogen atom.



How many different forms of $\text{J}\cdot$ are theoretically possible?

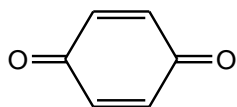
- A 3
B 4
C 5
D 6
22. *Saccharin* was an artificial sweetener used in some soft drinks. It was manufactured from methylbenzene by a series of reactions.



Which of the following shows the correct reaction type for steps **I** and **II**?

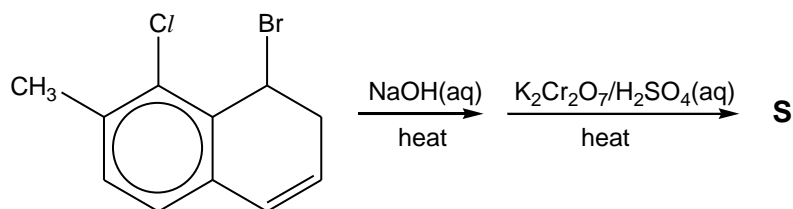
- | I | II |
|------------------------------|----------------------------|
| A Electrophilic substitution | Electrophilic addition |
| B Electrophilic substitution | Nucleophilic substitution |
| C Nucleophilic substitution | Nucleophilic substitution |
| D Nucleophilic substitution | Electrophilic substitution |

23 Which of the following **cannot** be used to distinguish between the following compounds?

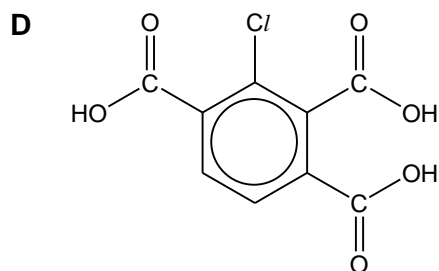
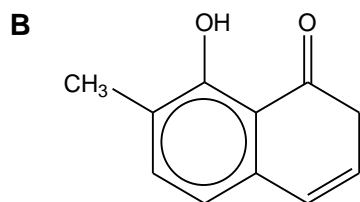
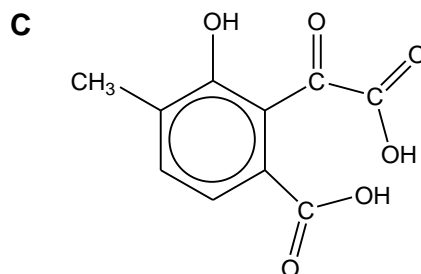
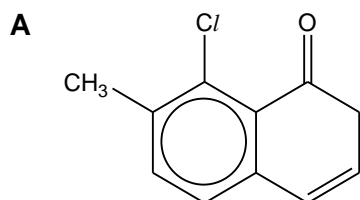


- A Hot acidified $\text{K}_2\text{Cr}_2\text{O}_7$
- B Neutral iron(III) chloride
- C Diammine silver complex
- D Phenylhydrazine

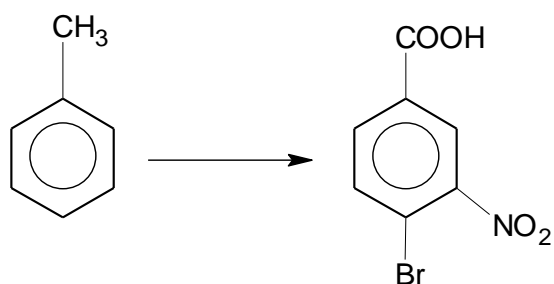
24 The reaction scheme below shows the synthesis of compound **S**.



Which of the following can be **S**?



- 25 The following synthetic route consists of three steps.

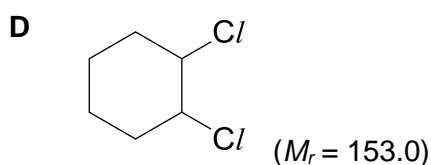
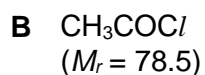
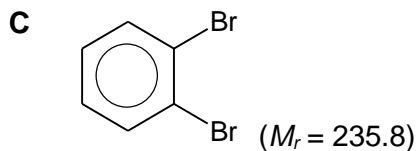
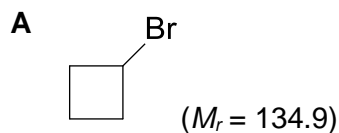


Which sequence of steps would give the highest yield?

	Step 1	Step 2	Step 3
A	KMnO ₄ , H ₂ SO ₄ , heat	conc HNO ₃ , conc H ₂ SO ₄ , heat	Br ₂ , Fe, r.t.p
B	conc HNO ₃ , conc H ₂ SO ₄ , heat	Br ₂ , Fe, r.t.p	KMnO ₄ , H ₂ SO ₄ , heat
C	Br ₂ , Al/Br ₃ , r.t.p	conc HNO ₃ , dilute H ₂ SO ₄ , heat	KMnO ₄ , H ₂ SO ₄ , heat
D	Br ₂ , Fe, r.t.p	KMnO ₄ , H ₂ SO ₄ , heat	conc HNO ₃ , conc H ₂ SO ₄ , heat

- 26 Ten grams of each of the following was heated with NaOH(aq) for a prolonged period of time. Subsequently, dilute HNO₃(aq) and AgNO₃(aq) were added.

Which compound will produce the greatest mass of silver halide precipitate?

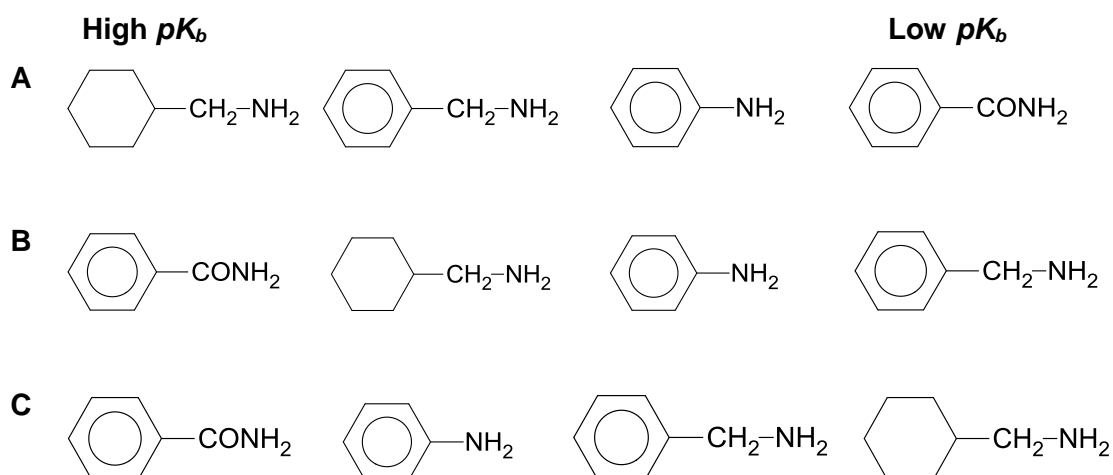


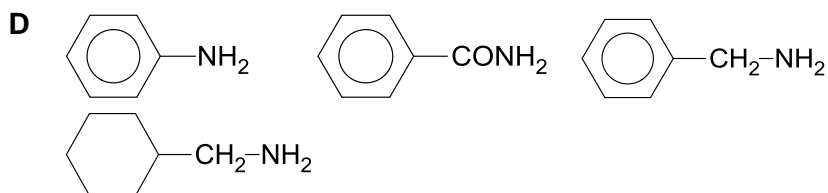
- 27 After the reduction using tin and concentrated acid of nitrobenzene to phenylamine, an excess of sodium hydroxide is added.

What is the purpose of the sodium hydroxide?

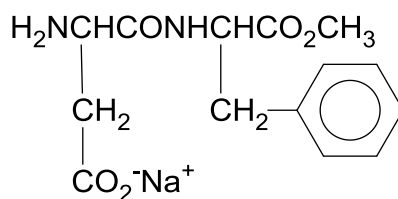
- A** to dry the product
- B** to liberate the phenylamine
- C** to neutralise the excess acid
- D** to lower the boiling point for subsequent distillation

- 28 Which of the following shows the correct order of basicity?

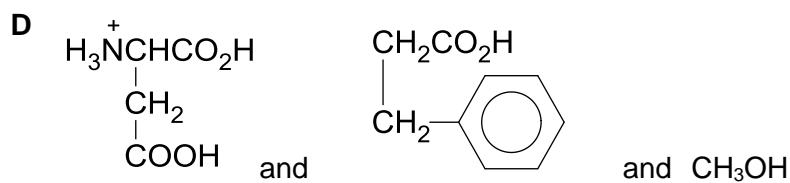
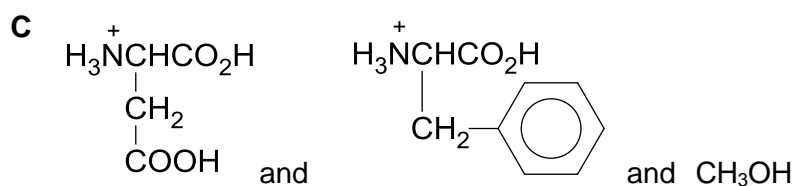
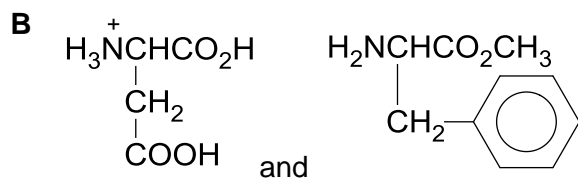
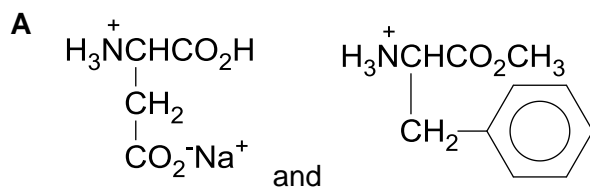




- 29** Aspartame is a dipeptide derivatives used as an artificial sweetener. Its general usefulness is restricted because it loses its sweetness after hydrolysis.

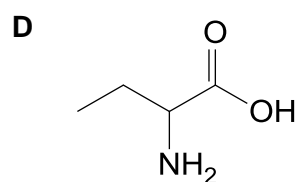
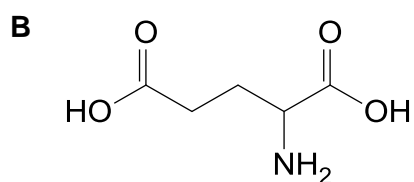
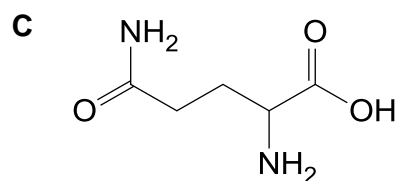
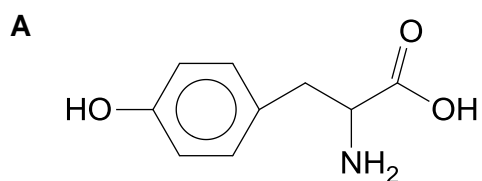


Which product would be formed after prolong acid hydrolysis.



- 30** Electrophoresis is a technique of separating and identifying amino acids. An amino acid is absorbed into paper that is moistened with a buffer stretched between two electrodes. Positively charged species move towards the cathode, negatively charged species towards the anode.

With a buffer at pH 5, which amino acid will move most readily towards the cathode?

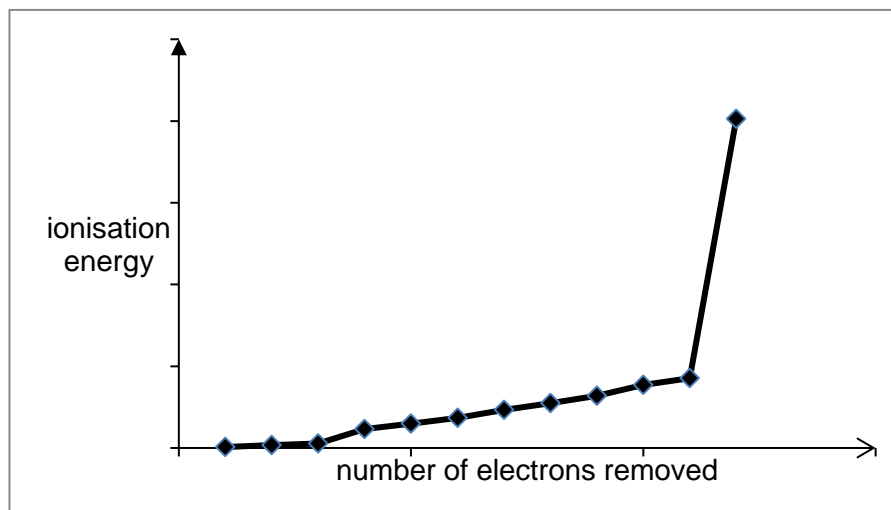


For **questions 31 – 40**, one or more of the numbered statements **1** to **3** may be correct. Decide whether each of the statements is or is not correct. The responses **A** to **D** should be selected on the basis of

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 to be used as correct response.

31 The graph below shows the first twelve ionisation energies for element **T**.



Which of the following statements are true?

- 1** It is in Group I of the Periodic Table.
- 2** It forms an oxide which dissolves readily with acid.
- 3** It is in the third period (Na to Ar) of the Periodic Table.

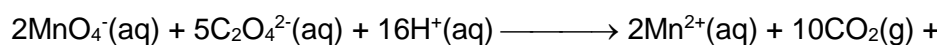
32 The following chemical reactions are listed below.

- Combustion of ethanedioic acid
- Evaporation of water
- Atomisation of magnesium
- Photolysis of chlorine

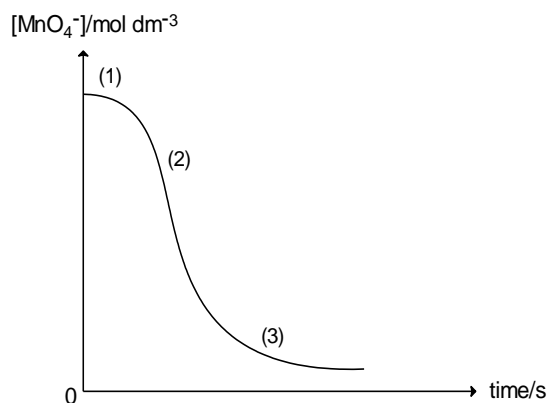
Which of the following statements are correct?

- 1 ΔS is positive for all reactions.
- 2 ΔG is negative for all reactions.
- 3 ΔH is positive for all reactions.

33 A reaction in which a product acts as a catalyst is said to be autocatalytic.

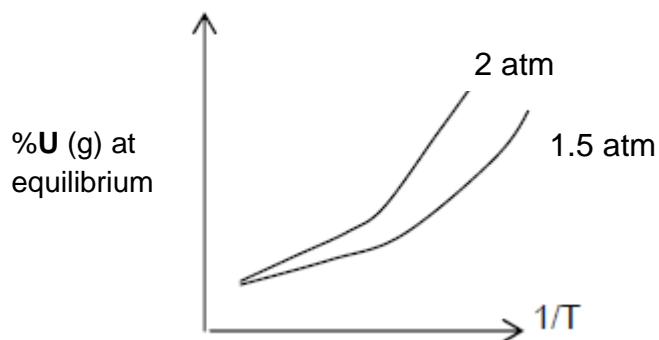


In the oxidation of ethanedioate ions by manganate(VII) ions, the reaction is accelerated by the Mn^{2+} ions produced during the reaction.



Which of the following statements can be deduced from the graph above?

- 1 Initial rate of reaction is the fastest at (1).
 - 2 Reaction rate increases at (2) as Mn^{2+} is generated.
 - 3 Reaction rate decreases at (3) as the concentration of the reactants decrease.
- 34** The graph below shows how the percentage of reactant $\text{U}(\text{g})$ that remained in an equilibrium mixture varies with $1/T$ at pressures of 1.5 atm and 2 atm.

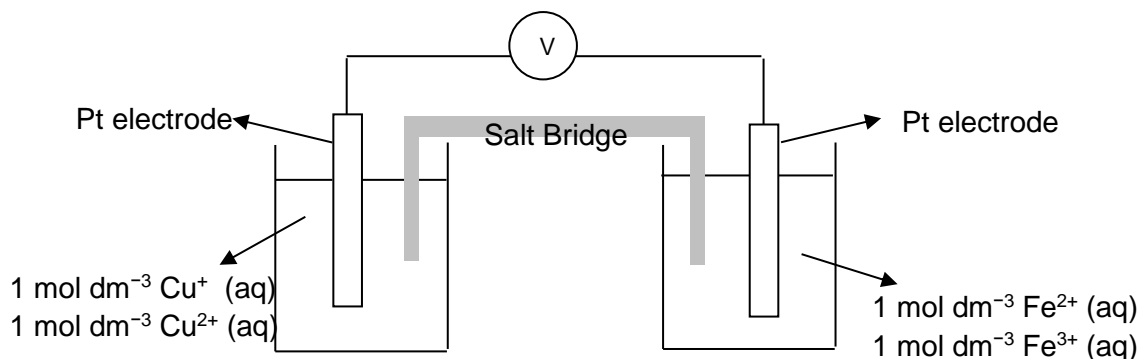


Which of the following statement can be deduced from this information?

- 1 The forward reaction is endothermic.
- 2 The equation for the above reaction could be $\text{U(g)} \rightleftharpoons \text{V(g)} + \text{W(g)}$.
- 3 The equilibrium constant, K_p , increases as pressure increases in the system.

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

- 35 A student was investigating the possibility of an electrochemical cell using $\text{Cu}^{2+}/\text{Cu}^+$ and $\text{Fe}^{3+}/\text{Fe}^{2+}$ half-cells.



Which statements are true of the above set up?

- 1 $E_{\text{cell}}^{\ominus} = +0.62 \text{ V}$.
- 2 Copper and iron electrodes cannot be used instead.
- 3 When excess sodium hydroxide is added to the $\text{Fe}^{2+}/\text{Fe}^{3+}$ half-cell, the polarity of the electrodes are reversed.

- 36 Barium sulfate is less soluble than magnesium sulfate.

Which of these factors are needed to be considered in order to explain this observation?

- 1 ΔH_{hyd} of barium ion and magnesium ion.
- 2 ΔH_f of barium sulfate and magnesium sulfate.
- 3 Atomic radii of barium and magnesium.

37 Which observation about bromine or its compounds is correct?

- 1 When aqueous lead(II) nitrate is added to aqueous sodium bromide, a cream precipitate is observed.
- 2 When sodium bromide is treated with concentrated sulfuric acid, a gas that turns moist blue litmus paper red is evolved.
- 3 Silver bromide is soluble in both dilute and concentrated ammonia solution.

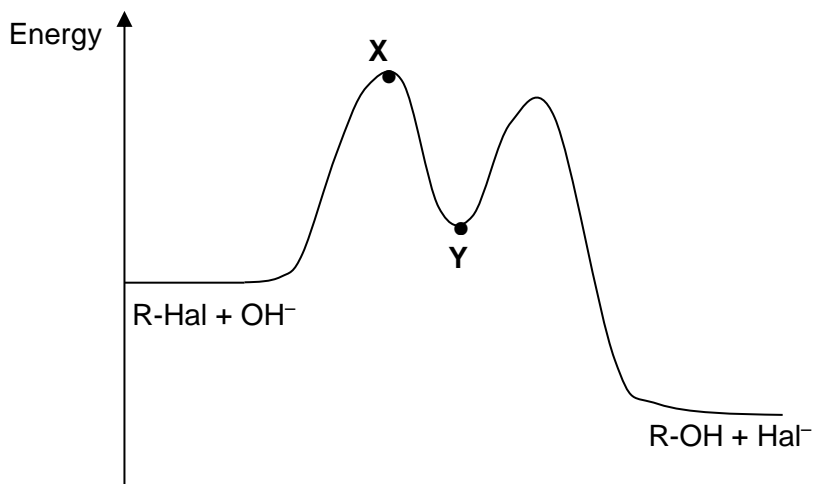
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

38 The catalytic converter is part of the exhaust system of modern cars.

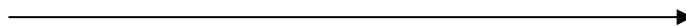
Which reactions occur in the catalytic converter?

- 1 $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$
- 2 $2\text{NO} + \text{CO} \rightarrow \text{N}_2 + 2\text{CO}_2$
- 3 $\text{C}_x\text{H}_y + (2x + \frac{y}{2})\text{NO} \rightarrow x\text{CO}_2 + \frac{y}{2}\text{H}_2\text{O} + (x + \frac{y}{4})\text{N}_2$

39 Halogenoalkanes react with aqueous alkali. One mechanism of this reaction has the reaction pathway diagram shown below.



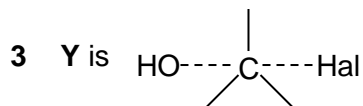
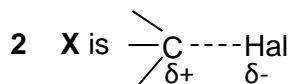
Turn Over]



Reaction Pathway

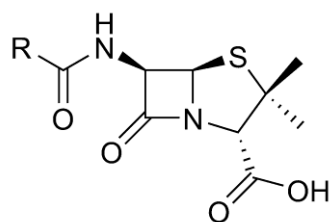
Which statements are true? (---- indicates a partial bond)

1 The reaction is a type of nucleophilic substitution.



40 Which of the following phenomena involves denaturation of proteins?

- 1 Heating of egg white.
- 2 Production of bean-curd from soy milk.
- 3 Dissolving Penicillin in a test tube of hot acid.



Penicillin

END OF PAPER 1