Class Adm No

Candidate Name: _____

2019 Preliminary Exams
Pre-University 3

H2 CHEMISTRY **9729/01**

Paper 1 Multiple Choice **24 Sept 2019**

1 hour

Additional materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Do not turn over this question paper until you are told to do so

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, class and admission number in the spaces provided at the top of this page and on the Multiple Choice Answer Sheet 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 Multiple Choice Answer Sheet provided.

Read the instructions on the Multiple Choice 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 question paper.

The use of an approved scientific calculator is expected, where appropriate.

FOR EXAMINER'S USE	
TOTAL (30 marks)	

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

1 Which of the following contain one mole of the stated particles?

1 H^+ ions in 1 dm^3 of 0.5 mol dm^{-3} $H_2SO_4(aq)$
2 atoms in 6 dm^3 of $SO_3(g)$ at room temperature and pressure
3 electrons in 64.1 g of SO_2
4 neutrons in 1.6 g of $^{32}S_8$

A 1 and 2 only **B** 2 only **C** 1 and 3 only **D** 1, 2, 3 and 4

2 Incomplete combustion of *y* dm^3 of propanol gas yielded a mixture of carbon dioxide and carbon monoxide in the ratio of 2:1, together with water vapour.
What is the volume of oxygen consumed?

A 3.5*y* dm^3 **B** 4*y* dm^3 **C** 4.5*y* dm^3 **D** 5*y* dm^3

3 The redox reaction between potassium manganate(VII) and $MnSO_4$ gives MnO_2 as the only manganese-containing product.
How many moles of $MnSO_4$ react with one mole of potassium manganate(VII) in this reaction?

A 0.5
B 1
C 1.5
D 2

4 The ion $\mathbf{Z}^{2+}$ has 12 electrons and 15 neutrons.

Which of the following statements is true?

A In an electric field, the ion $\mathbf{Z}^{2+}$ will be deflected at a smaller angle than that of Mg^{2+}.

B The first ionisation energy of element **Z** is lower than that of the Group 13 element in the same period as **Z**.

C The chloride of **Z** formed is expected to have a higher melting point than $MgCl_2$.

D Element **Z** is isoelectronic with neon.

5 Consider the following four compounds.

1 $CH_3CH_2CH_2CH_3$

2 $CH_3CH_2CH_2OH$

3 CH_3CH_2Cl

4 $(CH_3)_3CH$

What is the order of increasing boiling point of the compounds?

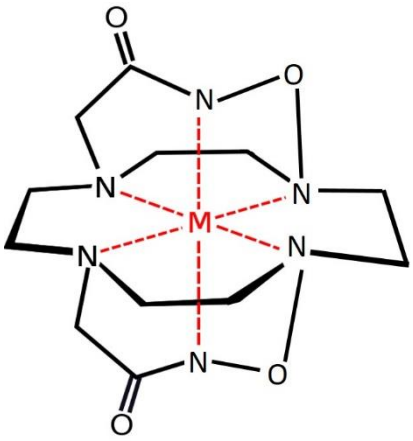
A 1 < 4 < 3 < 2

B 2 < 3 < 4 < 1

C 4 < 1 < 2 < 3

D 4 < 1 < 3 < 2

6 The research on metal complexes have achieved many international breakthrough developments, focusing on their properties and wide range of applications to tackle the challenges in human health and the environment.



Which of the following types of bonding can be found in the complex?

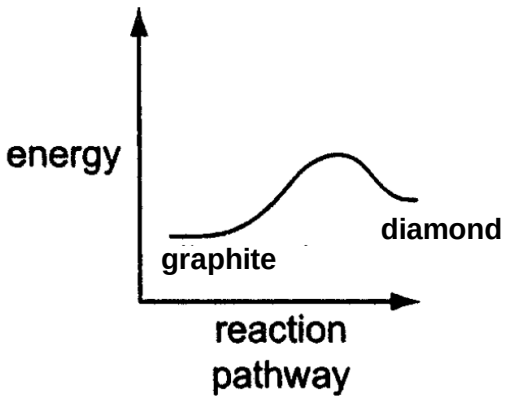
1 ionic bonding
2 dative bonding
3 hydrogen bonding
4 ion-dipole interactions

A 2 only **B** 1 and 2 only **C** 1 and 4 only **D** 2, 3 and 4 only

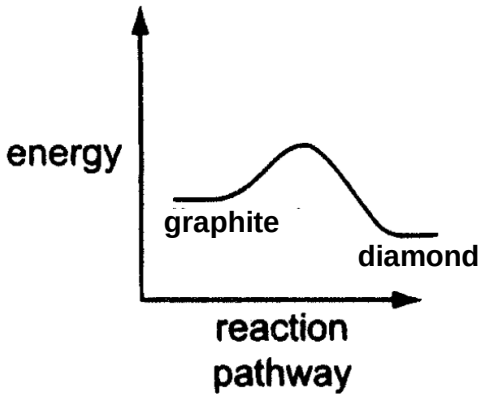
7 The conversion of graphite into diamond is endothermic and this reaction has an extremely small rate constant.

Which reaction pathway correctly represents this conversion?

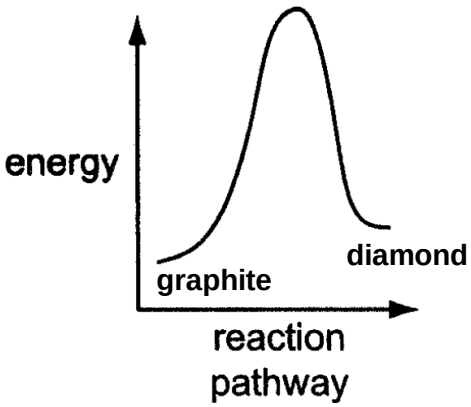
A



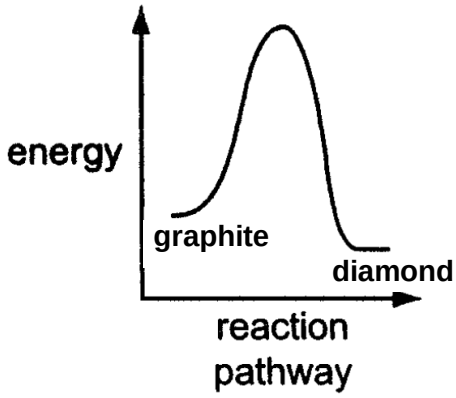
B



C



D



8

Reaction 1	Evaporation of ethanol
Reaction 2	Atomisation of magnesium
Reaction 3	Initiation step for the free radical substitution between chlorine and ethane

Which of the following statements about the reactions are correct?

1 ΔH is positive for all reactions.

2 ΔS is positive for all reactions.

3 ΔG is positive for all reactions.

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

9 When the temperature of a closed vessel containing a gas is increased by 273 °C, the pressure was found to increase by 20%.
What is the initial temperature of the closed vessel?

A 1092 °C **B** 1092 K **C** 1365°C **D** 1365 K

10 Which of the following two species are acting as an acid and a conjugate acid respectively in the following reaction?

$$H_2O + ClO^- \rightleftharpoons HOCl + OH^-$$

A H_2O and $HOCl$

B OH^- and H_2O

C OH^- and ClO^-

D $HOCl$ and ClO^-

11 The reaction for $A + 2B \rightarrow AB_2$ occurs by the following mechanism.

Step 1 $A + B \rightleftharpoons AB$ (fast)

Step 2 $AB + B \rightarrow AB_2$ (slow)

Which of the following represents the correct rate equation?

A Rate = k[A] **B** Rate = k[B] **C** Rate = k[AB][B] **D** Rate = $k[A][B]^2$

12 The following data was obtained during the first-order decomposition of the reaction:

$$2A(g) \rightarrow B(g) + C(s)$$

Time	Total pressure
10 min	300 Pa
After completion	200 Pa

Given that the reaction took place in a sealed container at constant temperature, what is the half-life of the reaction?

A 5 min
B 10 min
C 15 min
D 20 min

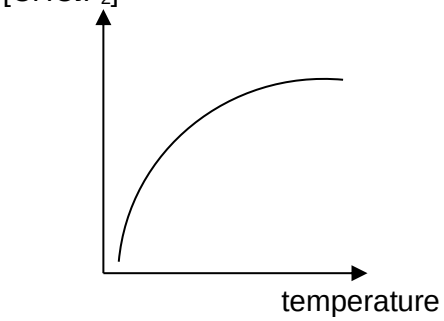
13 Chlorofluorocarbons (CFCs) are nontoxic, nonflammable chemicals containing atoms of carbon, chlorine, and fluorine. They are used in the manufacture of aerosol sprays, blowing agents for foams and packing materials, as solvents, and as refrigerants.

$$2CHCIF_2\,(g) \rightleftharpoons CF_2{=}CF_2\,(g) + 2HCI\,(g)$$

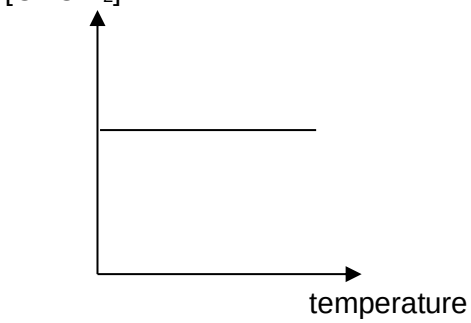
Species	**Standard enthalpy change of formation / kJ mol^{-1}**
$CF_2{=}CF_2(g)$	–658.3
$HCI(g)$	–92.3
$CHCIF_2(g)$	–485.2

Based on the data provided, which of the following describes how would the concentration of $CHCIF_2(g)$ at equilibrium varies with temperature?

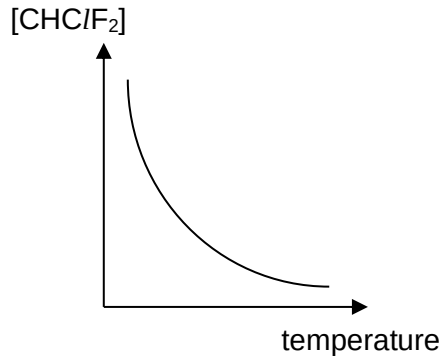
A



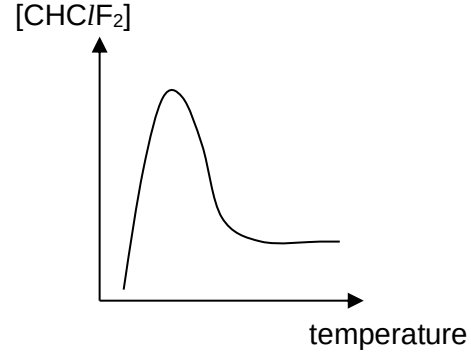
B



C



D



14 Which of the following mixtures will form a solution that resist pH changes when small quantites of acid or base is added?

A 500 cm^3 of 1 mol dm^{-3} aqueous NaC*l* and 500 cm^3 of 1 mol dm^{-3} aqueous HC*l*

B 750 cm^3 of 1 mol dm^{-3} aqueous CH_3COOH and 250 cm^3 of 1 mol dm^{-3} aqueous NaOH

C 600 cm^3 of 1 mol dm^{-3} aqueous NH_3 and 400 cm^3 of 1 mol dm^{-3} aqueous H_2SO_4

D 400 cm^3 of 1 mol dm^{-3} aqueous NaOH and 600cm^3 of 1 mol dm^{-3} aqueous H_2SO_4

15 What is the final pH of the solution formed by mixing equal volumes of two H_2SO_4 solutions, one of pH 2.0 and the other of pH 3.0?

A 1.96 **B** 2.26 **C** 2.50 **D** 2.78

16 **Q**, **R** and **S** are three elements found in Period 3 of the Periodic Table.
Among the elements in Period 3,

- the melting point of the oxide of **R** is the highest.
- the electrical conductivity of **Q** is the highest.
- the melting point of **S** is the lowest.

Which of the following elements is **not** represented by **Q**, **R** or **S**?

A Na **B** Mg **C** A*l* **D** Ar

17 Fluorine has anomalous properties in Group 17.
Which of the following statements is correct?

A HF is a strong acid.

B Fluorine is intensely coloured.

C The melting point of fluorine is high.

D The F–F bond is unusually weak.

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

Each galvanic cell is made up of two half-cells. E_1, E_2 and E_3 are the cell potentials of the three galvanic cells respectively.

Half-cell 1	Half-cell 2	E_{cell}
1 mol dm^{-3} $Zn^{2+}(aq)$ and Zn	0.1 mol dm^{-3} $Cu^{2+}(aq)$ and Cu(s)	E_1
1 mol dm^{-3} $Zn^{2+}(aq)$ and Zn	1 mol dm^{-3} $Cu^{2+}(aq)$and Cu(s)	E_2
0.1 mol dm^{-3} $Zn^{2+}(aq)$ and Zn	1 mol dm^{-3} $Cu^{2+}(aq)$ and Cu(s)	E_3

Which of the following shows the correct sequence of E_{cell} arranged in decreasing order?

A $E_2 > E_3 > E_1$

B $E_3 > E_2 > E_1$

C $E_1 > E_2 > E_3$

D $E_1 > E_3 > E_2$

19 Electrolysis of a dilute aqueous NaC*l* solution was carried out by passing 0.1 A current through it.

What is the time required to liberate 0.01 mol of H_2 gas at the cathode?

A 9.65×10^3 s

B 1.93×10^4 s

C 2.90×10^4 s

D 3.86×10^4 s

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

In research laboratories, the standard calomel reference electrode and the AgC*l* / Ag reference electrodes are often used in place of the standard hydrogen electrode (SHE). Their standard reduction potentials with respect to the SHE are shown below.

Calomel electrode:	$\frac{1}{2}Hg_2Cl_2 + e^- \rightleftharpoons Hg + Cl^-$	$E^\ominus = +0.27$ V
AgC*l* / Ag electrode:	$AgCl + e^- \rightleftharpoons Ag + Cl^-$	$E^\ominus = +0.22$ V

A half–cell containing Au^+/Au has a reduction potential of +1.61 V with respect to AgC*l* / Ag electrode.

Which of the following statements is correct?

A The reduction potential of the Au^+/Au half–cell with respect to the SHE is +1.83 V.
B The reduction potential of the Au^+/Au half–cell with respect to the calomel electrode is +1.88 V.
C Ag is a stronger reducing agent than H_2.
D Hg_2Cl_2 is a weaker oxidising agent than AgC*l*.

21 Which of the following statements is **not** correct?

A Both Fe^{2+} and Fe^{3+} can catalyse the reaction between I^- and $S_2O_8^{2-}$.
B $[Fe(C_2O_4)_3]^{4-}$ has a coordination number of 6.
C $[Fe(H_2O)_6]^{3+}$ has a lower pK_a than $[Fe(H_2O)_6]^{2+}$.
D Aqueous solutions of Fe^{2+} appear green due to the absorption of green light.

22 Which of the following ions does **not** form coloured solutions?

A Co^{3+} **B** Cu^+ **C** Mn^{3+} **D** Ti^{2+}

23 Four different complexes can be obtained by reacting aqueous cobalt(III) chloride with ammonia under various conditions. Different proportions of chloride are precipitated when each complex is treated with aqueous silver nitrate.

	empirical formula	colour of solid	number of moles of AgCl precipitated per mole of complex
I	$CoCl_3(NH_3)_6$	orange	3
II	$CoCl_3(NH_3)_5$	violet	2
III	$CoCl_3(NH_3)_4$	violet	1
IV	$CoCl_3(NH_3)_4$	green	1

Which of the following statements are correct regarding the four different complexes?

1 Complex **I** is the only complex that is made up of only one type of ligand.
2 The cations of the four complexes have the same charge.
3 Complexes **III** and **IV** are stereoisomers.
4 All four complexes have the coordination number of 6.

A 1 and 2 only **B** 3 and 4 only **C** 1, 2 and 4 only **D** 1, 3 and 4 only

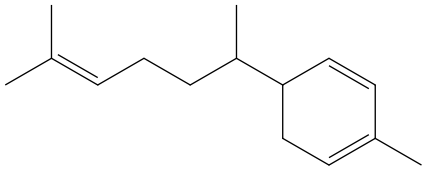
24 Which of the following compounds are arranged in increasing order of their solubility in water?

A $CH_3CH_2CO_2Na$, $CH_3CH_2CH_2OH$, $CH_3CH_2CH_2Cl$
B $CH_3CH_2CH_2Cl$, $CH_3CH_2CH_2OH$, $CH_3CH_2CO_2Na$
C $CH_3CH_2CH_2Cl$, $CH_3CH_2CO_2Na$, $CH_3CH_2CH_2OH$
D $CH_3CH_2CH_2OH$, $CH_3CH_2CO_2Na$, $CH_3CH_2CH_2Cl$

25 How many isomeric esters have the molecular formula $C_4H_8O_2$?

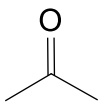
A 2 **B** 3 **C** 4 **D** 5

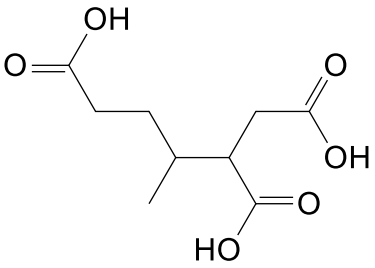
26 The flavour of ginger comes from zingiberene.



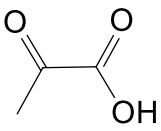
zingiberene

Which of the following compounds are produced from the reaction between zingiberene and hot concentrated acidified $KMnO_4$?

1 

2 

3 CO_2

4 

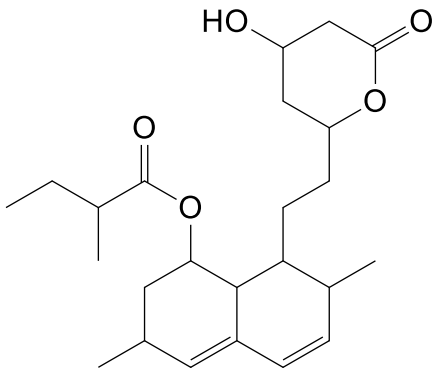
A 1 and 3 only **B** 2 and 4 only **C** 1, 2 and 4 only **D** 1, 3 and 4 only

27 Which of the following reactions would result in the formation of racemic mixture?

1 1-chloropropane ⟶ propan-1-ol
2 ethanal ⟶ cyanoethanol
3 but-2-ene ⟶ 2-chlorobutane

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

28 Statin is a class of lipid-lowering medication which is effective in lowering cholesterol and used for primary prevention in people at high risk of cardiovascular disease.



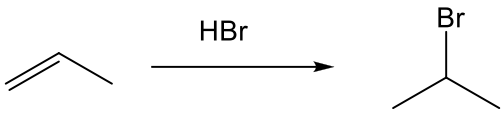
Statin

Which statement about statin is **not** correct?

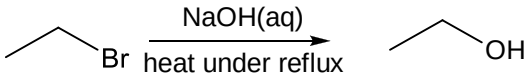
A When statin reacts with aqueous Br_2, the product contains chiral centres.
B When heated with ethanoic acid and concentrated sulfuric acid, statin forms an ester.
C When statin reacts with hot acidified $K_2Cr_2O_7$, one of the products contains three ketone groups.
D When 2,4-dinitrophenylhydrazine is added to statin, an orange precipitate is observed.

29 Which of the following reactions involves an organic intermediate which has a different charge from the other three reactions?

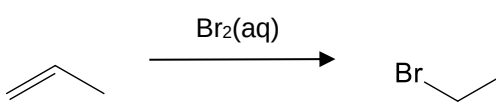
A



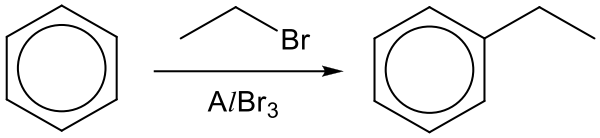
B



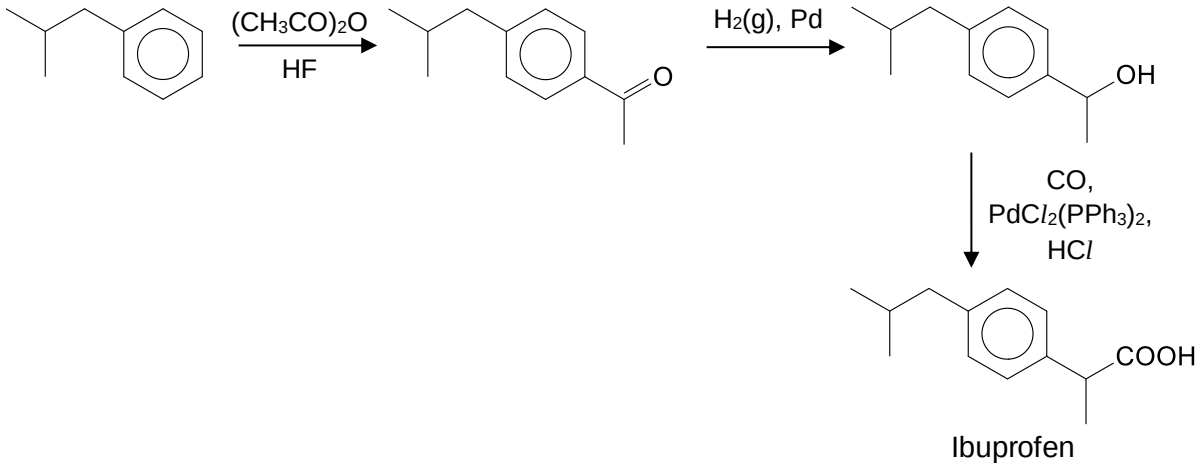
C



D



30 Ibuprofen is used to relieve pain from headache and to reduce fever. The synthesis of ibuprofen is shown below.



Ibuprofen

Which of the following type of reactions can be found in the synthetic route?

1 reduction
2 elimination
3 acidic hydrolysis
4 electrophilic substitution

A 1 only **B** 1 and 4 only **C** 1, 2 and 3 only **D** 1, 2, 3 and 4

END OF PAPER 1

BLANK PAGE