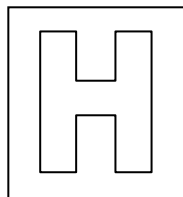


Candidate Name: _____

Class	Adm No



2017 Preliminary Examinations II

Pre-University 3

H2 CHEMISTRY

Paper 1 Multiple Choice

9647/01

20 Sept 2017

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 **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 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.

Section A

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

- 1** Dolomite is a carbonate-containing mineral with formula $\text{MgZ}(\text{CO}_3)_2$ where **Z** is a metal ion. It is insoluble in water but reacts with acids.

When 2.00 g of dolomite was completely dissolved in an excess of hydrochloric acid, 0.759 g of carbon dioxide was given off. What is the identity of the metal **Z**?

- A** Ba **B** Ca **C** Ra **D** Sr

- 2** Sulfur dioxide gas is an irritant to the eyes and respiratory system. The maximum safe toleration level of sulfur dioxide in air is 0.014 mg dm^{-3} .

How many molecules of sulfur dioxide gas are present in 1 dm^3 of air at this toleration level?

- A** $\frac{0.014}{6.02 \times 10^{23}} \times 64.1$ **B** $\frac{0.014}{1000} \times \frac{1}{64.1} \times 6.02 \times 10^{23}$
C $\frac{0.014}{64.1} \times 6.02 \times 10^{23}$ **D** $\frac{0.014}{1000} \times 64.1 \times 6.02 \times 10^{23}$

- 3** The element technetium, Tc (mass number 99; atomic number 43), was discovered in 1937 by two Italian scientists, Segre and Perrier.

Under suitable conditions, technetium reacts with fluorine to form TcF_6 .

Which of the following options shows the correct number of protons, neutrons and electrons in Tc^{6+} ?

	number of protons	number of neutrons	number of electrons
A	43	43	56
B	43	56	37
C	49	43	37
D	43	56	49

4 Which of the following atoms has three unpaired electrons?

- A** Br **B** Co **C** Ga **D** Sc

5 Under standard conditions, water exists in the liquid state but hydrogen sulfide exists in the gaseous state.

Which of the following best explains this phenomenon?

- A** Water has a higher relative molecular mass than hydrogen sulfide.
B The O-H covalent bond in water is stronger than the S-H covalent bond in hydrogen sulfide.
C The hydrogen bonds between water molecules are stronger than the Van der Waals' forces between hydrogen sulfide molecules.
D Hydrogen sulfide has a more spherical structure compared to water.

6 Antimony, Sb, is in Group V of the Periodic Table. It was proposed that antimony is able to form SbF_4^{n-} anion, the structure of which is of square planar shape.

Which of the following shows the correct value of n and the oxidation number of Sb in this anion?

	value of n	oxidation number of Sb
A	1	+3
B	1	+5
C	3	+1
D	3	+3

- 7 **X** and **Y** are ideal gases that do not react with one another. The molar mass of **X** is twice that of **Y**.

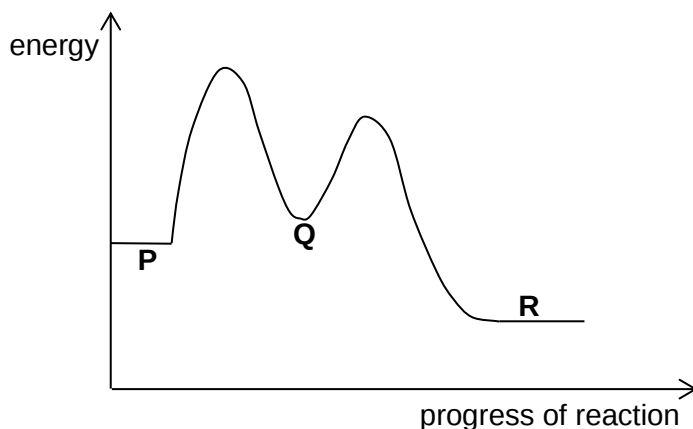
If all measurements are taken at room temperature and pressure, which statement correctly describes **X** and **Y**?

- A** The volume occupied by 2 g of **X** is half that occupied by 2 g of **Y**.
- B** The mass of 5 dm³ of **X** is half that of 5 dm³ of **Y**.
- C** The volume occupied by 2.5 g of **X** is equal to the volume occupied by 5 g of **Y**.
- D** On mixing 1 dm³ of **X** with 1 dm³ of **Y**, the partial pressure of **X** is twice that of **Y**.

- 8 The two steps in the conversion of compound **P** to compound **R** are shown below.



The energy profile of the reaction is shown below.



Which of the following statements about the reaction can be deduced from the information given?

- A** The enthalpy change for the reaction is endothermic.
- B** **Q** acts as a catalyst in the reaction.
- C** Step 1 is the rate determining step.
- D** **R** is thermodynamically less stable than **P**.

- 9 When liquid SOCl_2 is added to $\text{Ba}(\text{OH})_2$, a vigorous reaction occurs and the temperature decreases from 25°C to 5°C .

What are the correct signs of ΔH , ΔS and ΔG for this reaction?

	ΔH	ΔS	ΔG
A	+	+	-
B	+	-	+
C	-	+	-
D	-	-	+

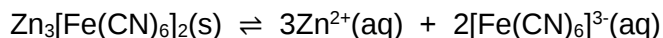
- 10 A sample of finely ground copper was contaminated with zinc powder.
Treatment of the sample with an excess of hydrochloric acid produced 120 cm^3 of hydrogen gas, measured at room temperature and pressure.

The remaining copper was then reacted with acidified potassium manganate(VII). It was found that 0.00424 mol of potassium manganate(VII) was required for complete oxidation of copper to copper(II) ions.

What is the percentage by mass of copper in the sample?

- A** 45.2% **B** 65.8% **C** 67.3% **D** 90.4%

- 11 Zinc(II) reacts with the complex anion hexacyanoferrate(III), $[\text{Fe}(\text{CN})_6]^{3-}$, to give a sparingly soluble salt which dissociates in water according to the following equilibrium.



If the solubility product, K_{sp} , of $\text{Zn}_3[\text{Fe}(\text{CN})_6]_2$ is X , what is the concentration of $\text{Zn}^{2+}(\text{aq})$ at equilibrium?

- A** $\left(\frac{3X}{2}\right)^{\frac{1}{3}}$ **B** $\left(\frac{3X}{2}\right)^{\frac{1}{5}}$ **C** $\left(\frac{9X}{4}\right)^{\frac{1}{3}}$ **D** $\left(\frac{9X}{4}\right)^{\frac{1}{5}}$

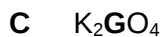
- 12** Which of the following statements about the rate constant, k , of chemical reactions is **not** true?
- A** The rate constant increases when temperature increases.
 - B** The rate constant increases when the concentration of the reactant increases.
 - C** The rate constant decreases when the activation energy increases.
 - D** The units of the rate constant depends on the overall order of reaction.
- 13** A Period 3 element forms an oxide that is soluble in both water and aqueous sodium hydroxide. Which of the following could be the identity of this element?
- A** aluminium **B** silicon **C** sodium **D** sulfur
- 14** In which of the following pairs is the radius of the first species greater than that of the second species?
- A** Mg, Al **B** Ca, Ba **C** Mg^{2+} , Na^+ **D** K^+ , Ar
- 15** Which of the following properties of the Group II elements and their compounds decreases down the group?
- A** Ease of oxidation of the elements
 - B** Electronegativity of the elements
 - C** Reactivity of elements with chlorine
 - D** Thermal stability of nitrates
- 16** With reference to the chemistry of Group VII elements and their compounds, which of the following would be a correct prediction for astatine?
- A** Astatine reacts vigorously with hydrogen at room temperature.
 - B** Astatine exists as a gas at room temperature.
 - C** Astatine reacts with cold aqueous hydroxide to form AtO^- and At^- .
 - D** Molten AlAt_3 can conduct electricity.

17 Which of the following products is **least** likely to act as a ligand?

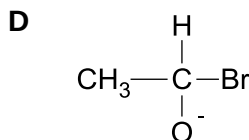
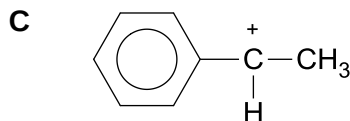
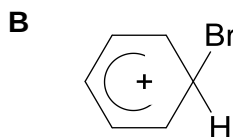
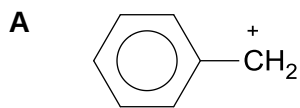


18 The use of *Data Booklet* is relevant to this question.

An element **G** has an atomic number of 23. Which of the following compounds of **G** is **not** likely to exist?



19 Which of the following species could be an intermediate in an electrophilic addition reaction?



20 How many structural isomers with the molecular formula $\text{C}_5\text{H}_{10}\text{O}$ gives an orange precipitate with Brady's reagent and a yellow precipitate with alkaline aqueous iodine?



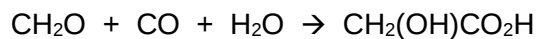
- 21** In an experiment, it was found that during the free radical substitution of alkanes, primary, secondary and tertiary hydrogen atoms were replaced by bromine atoms at different rates, as shown in the table below.

Reaction	Relative Rate
Primary : $\text{RCH}_3 \rightarrow \text{RCH}_2\text{Br}$	1
Secondary : $\text{R}_2\text{CH}_2 \rightarrow \text{R}_2\text{CHBr}$	8
Tertiary : $\text{R}_3\text{CH} \rightarrow \text{R}_3\text{CBr}$	20

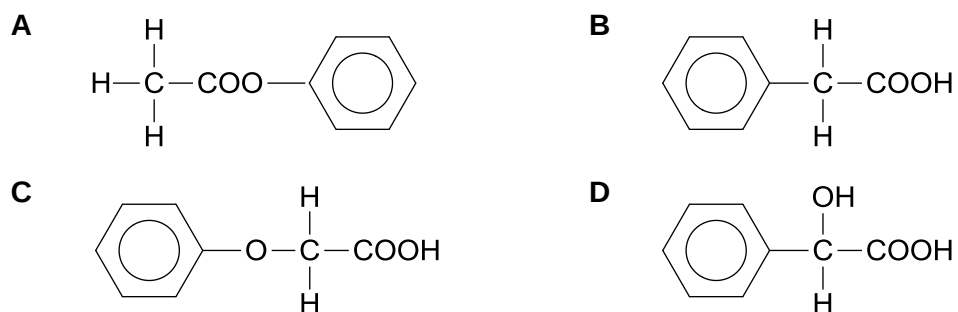
With reference to the information given, which of the following shows the 2 products obtained from the reaction of 2,3-dimethylbutane with bromine gas under UV light and their relative ratio?

- A** $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{CH}_2\text{Br} : (\text{CH}_3)_2\text{CBrCH}(\text{CH}_3)_2 = 3 : 10$
B $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{CH}_2\text{Br} : (\text{CH}_3)_2\text{CBrCH}(\text{CH}_3)_2 = 1 : 20$
C $(\text{CH}_3)_3\text{CCH}_2\text{CH}_2\text{Br} : (\text{CH}_3)_3\text{CCHBrCH}_3 = 3 : 8$
D $(\text{CH}_3)_3\text{CCH}_2\text{CH}_2\text{Br} : (\text{CH}_3)_3\text{CCHBrCH}_3 = 3 : 20$
- 22** Concentrated ammonia was heated in a sealed tube with excess bromoethane. Which of the following products will **not** be formed?
- A** $\text{C}_2\text{H}_7\text{N}$ **B** $\text{C}_3\text{H}_9\text{N}$ **C** $\text{C}_4\text{H}_{11}\text{N}$ **D** $\text{C}_8\text{H}_{20}\text{NBr}$
- 23** Which of the following statements about phenol is **incorrect**?
- A** Acidic hydrolysis of phenylethanoate will give ethanoic acid and phenol.
B Phenol reacts with ethanoic acid to give phenylethanoate.
C Phenol gives violet colouration with neutral FeCl_3 .
D Phenol gives a white precipitate with aqueous bromine.

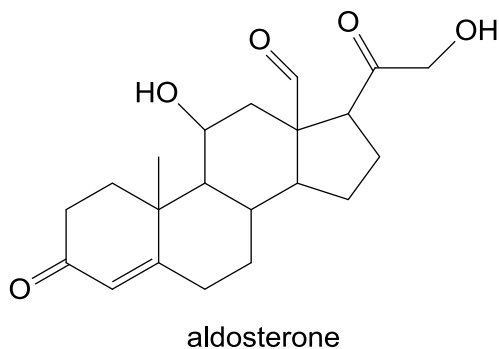
- 24** Several reactions that involve the 'insertion' of carbon monoxide into organic molecules are of industrial importance. One of such reactions is the synthesis of hydroxyethanoic acid from methanal.



Which of the following shows the product formed when benzaldehyde undergoes a similar reaction with carbon monoxide in the presence of water?



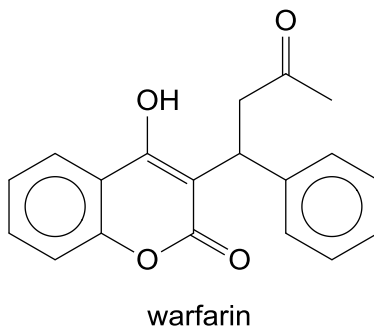
- 25** Aldosterone is a hormone essential for sodium conservation in the kidney, salivary glands and colon.



How many chiral carbons are there in the product of the reaction between aldosterone and LiAlH_4 in dry ether?

- A** 7 **B** 8 **C** 9 **D** 10

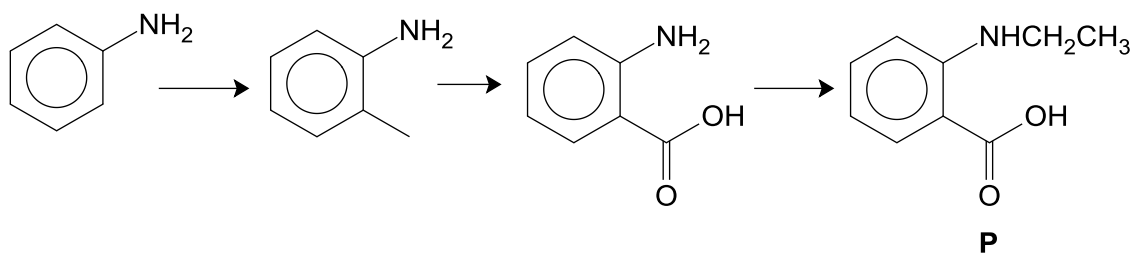
- 26 Warfarin is a drug used as an anticoagulant to prevent stroke in people who have heart disease.



Which of the following statements is true about warfarin?

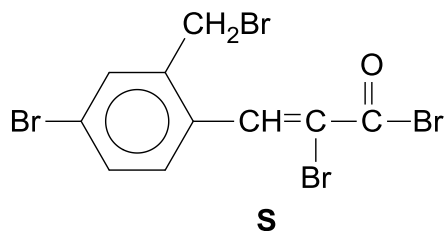
- A** 1 mole of warfarin reacts with 2 moles of 2,4-dinitrophenylhydrazine.
- B** Warfarin can undergo substitution reaction with SOCl_2 .
- C** Warfarin reacts with I_2 and dilute NaOH to give a colourless solution.
- D** There are 16 sp^2 hybridised carbon atoms in 1 molecule of warfarin.
- 27 Which of the following amino acids is **not** involved in the formation of proteins in the body?
- A** $\text{H}_2\text{NCH}(\text{COOH})\text{CH}(\text{CH}_3)_2$ **B** $\text{H}_2\text{NCH}(\text{CH}_3)\text{CH}_2\text{COOH}$
- C** $\text{H}_2\text{NCH}(\text{CH}_2\text{SH})\text{COOH}$ **D** $\text{H}_2\text{NCH}(\text{CH}_2\text{C}_6\text{H}_5)\text{COOH}$
- 28 Why are amides less basic than amines?
- A** Amides form a zwitterion, causing its nitrogen atom to carry a positive charge.
- B** The amide carbonyl group withdraws lone pair of electrons from nitrogen atom, releasing the H atom on NH_2 as proton.
- C** The C-N bond in amides is stronger than that in amines.
- D** The resonance structure of amides causes the movement of a pair of electrons from the nitrogen atom to the oxygen atom.

- 29 The reaction scheme below shows the synthesis of compound **P** from phenylamine.



Which of the following types of reaction is **not** involved in the reaction scheme shown?

- | | | | |
|----------|----------------------------|----------|-----------------------|
| A | electrophilic substitution | B | nucleophilic addition |
| C | nucleophilic substitution | D | oxidation |
- 30 The structure of compound **S** is shown below.



0.01 mol of **S** is reacted with excess hot ethanolic silver nitrate. What is the mass of the silver bromide formed from the reaction?

- | | | | | | | | |
|----------|---------|----------|---------|----------|---------|----------|---------|
| A | 1.878 g | B | 3.758 g | C | 5.634 g | D | 7.512 g |
|----------|---------|----------|---------|----------|---------|----------|---------|

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** 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 Which of the following types of bonding are present in $[\text{Fe}(\text{H}_2\text{O})_5(\text{SCN})]\text{Cl}_2$?

- 1** covalent bonding
- 2** dative bonding
- 3** ionic bonding

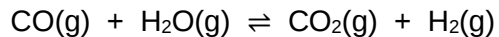
32 Which of the following are **incorrect** assumptions made in the kinetic theory about an ideal gas?

- 1** The gaseous particles are in constant random motion.
- 2** The gaseous particles have constant interactions with one another.
- 3** The volume of the container is negligible.

- 33** When 290 C of electricity are passed through a molten compound of a metal, 0.001 mol of atoms of the metal is deposited at the cathode.

What could the metal be?

- 1** aluminium
 - 2** copper
 - 3** silver
- 34** The following reaction between carbon monoxide and steam occurs in the presence of a suitable catalyst.



The standard enthalpy changes of formation of the compounds involved in the reaction are given below.

Compound	Standard enthalpy change of formation / kJ mol^{-1}
CO(g)	-111
H ₂ O(g)	-242
CO ₂ (g)	-394

Which of the following changes would increase the yield of H₂(g) in the reaction above?

- 1** decrease in temperature
- 2** adding sodium hydroxide into the system
- 3** adding more catalyst into the system

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.

35 Which of the following statements are true for the hydrogen halides HCl, HBr and HI?

- 1** Hydrogen iodide is the strongest acid.
- 2** Hydrogen iodide has the lowest thermal stability.
- 3** Hydrogen chloride has the lowest boiling point.

36 Which of the following properties of copper and calcium are likely to differ?

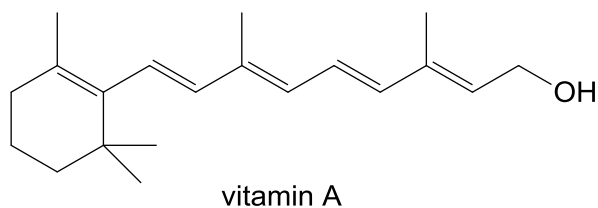
- 1** density
- 2** ability to display variable oxidation states
- 3** reactivity with acid

37 In the catalytic converter in the exhaust system of a car, harmful gases are converted to less harmful ones.

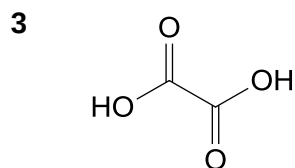
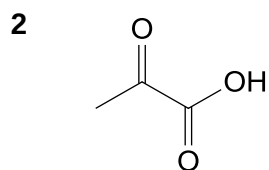
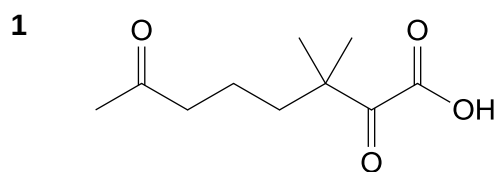
Which of the following processes take place in the catalytic converter?

- 1** hydrocarbons + oxides of nitrogen → carbon dioxide + water + nitrogen
- 2** carbon monoxide + oxides of nitrogen → carbon dioxide + nitrogen
- 3** carbon dioxide + oxides of nitrogen → carbon + nitrogen + water

38 The structure of vitamin A is shown below.



Which of the following are possible products of the reaction of vitamin A with excess hot acidified potassium manganate(VII)?



39 Which compounds reacts with an excess of sodium metal to give one mole of $\text{H}_2(\text{g})$ per mole of the compound?

- 1 $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{COOH}$
- 2 $\text{CH}_3\text{CH}_2\text{COCH}(\text{OH})\text{COOH}$
- 3 $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CHO}$

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.

- 40** Hippuric acid can be produced by adding benzoyl chloride to aminoethanoic acid. Which changes in bonding occur during this synthesis?



hippuric acid

- 1** A carbon-chlorine bond is broken.
- 2** A carbon-nitrogen bond is formed.
- 3** A hydrogen-chlorine bond is formed.

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