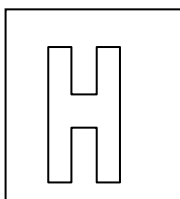


Candidate Name: _____

Class Adm No

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2020 Preliminary Examination Pre-University 3

H2 CHEMISTRY

9729/01

Paper 1 Multiple Choice

22 Sep 2020

1h

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.

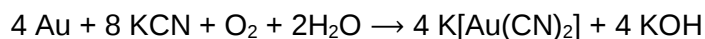
FOR EXAMINER'S USE	
TOTAL (30 marks)	

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

1 Which statement about a 36.0 g sample of $^{18}\text{O}_2$ is correct?

- A** There are 6.02×10^{23} ^{18}O atoms in the sample.
- B** The number of atoms is the same as the number of atoms in a 32.0 g sample of $^{16}\text{O}_2$.
- C** The number of moles in the sample is the same as the number of moles in a 40.0 g sample of H_2^{18}O .
- D** The number of molecules is the same as the number of atoms in a 20.0 g sample of H_2^{18}O .

2 In gold mining, potassium cyanide is used to dissolve gold in order for easier extraction. The equation, commonly known as the Elsner equation, is given below.



What is the minimum volume of oxygen required to dissolve 1 kg of gold, assuming room temperature and pressure?

- A** 28.8 dm³
- B** 30.5 dm³
- C** 461 dm³
- D** 487 dm³

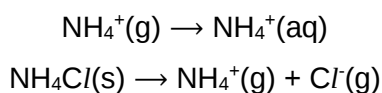
3 Which of the following experiences the greatest deflection in the same electric field?

- A** $^3\text{H}^+$
- B** $^9\text{F}^-$
- C** $^{12}\text{Mg}^{2+}$
- D** $^{32}\text{S}^{2-}$

4 Which of the following pairs have the same molecular shape?

- A** BCl_3 and ICl_3
- B** HCN and H_2O
- C** CF_4 and SF_4
- D** SCl_2 and H_2S

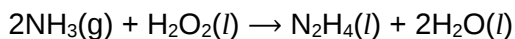
- 5 Which of the following pairs contains a compound held together by permanent dipole-permanent dipole interactions and a compound containing ionic bonds?
- A ClO_2 , AlCl_3
B HCl , AlCl_3
C NH_4Cl , NaCl
D HCl , NaCl
- 6 Which of the following molecules will not form hydrogen bonds with another of its own molecule?
- A** CH_3OCH_3
B CH_3COOH
C $(\text{CH}_3)_3\text{CNH}_2$
D $(\text{CH}_3)_2\text{CHOH}$
- 7 To determine the enthalpy change of solution of $\text{NH}_4\text{Cl}(\text{s})$, the enthalpy changes of the following reactions are determined.



Which of the following enthalpy changes is needed in order to determine the enthalpy change of solution of $\text{NH}_4\text{Cl}(\text{s})$?

- A The first electron affinity of chlorine atom
B The enthalpy change of atomisation of gaseous chlorine molecule
C The enthalpy change of hydration of gaseous chloride ion
D The enthalpy change of formation of solid ammonium chloride

- 8 Hydrazine, N_2H_4 , is used as a propellant in spacecraft propulsion. Hydrazine can be manufactured from ammonia using the following reaction.



Using the following information, what is the standard enthalpy change of reaction of this reaction in kJ mol^{-1} ?

Compound	$\Delta H_f^\circ / \text{kJ mol}^{-1}$
$\text{NH}_3(\text{g})$	-80.8
$\text{H}_2\text{O}_2(\text{l})$	-187.3
$\text{N}_2\text{H}_4(\text{l})$	+97.4
$\text{H}_2\text{O}(\text{l})$	-285.8

- A -79.7 **B** -125.3 C +79.7 D +125.3

- 9 Under which set of conditions will **any** reaction be spontaneous at all temperatures?

	ΔH	ΔS
A	positive	negative
B	positive	positive
C	negative	positive
D	negative	negative

- 10 An ideal gas is described as a theoretical gas that obeys the ideal gas equation.

Which of the following correctly explains why a real gas deviates from ideal gas behaviour?

- 1 Real gas molecules travel in a non-random manner.
- 2 Real gas molecules have a definite volume.
- 3 Real gas molecules have forces of attraction between them.

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

11 Which species can act as a Lewis acid?

- A** BF_3
- B** OH^-
- C** H_2O
- D** NH_3

12 In which reaction does ammonia function as a base?

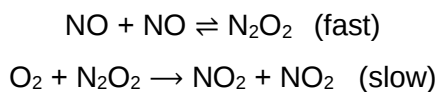
- 1 $2\text{NH}_3(l) + 2\text{Na}(s) \rightarrow 2\text{NaNH}_2(s) + \text{H}_2(g)$
- 2 $\text{NH}_3(g) + \text{H}_2\text{O}(l) \rightarrow \text{NH}_4^+(aq) + \text{OH}^-(aq)$
- 3 $\text{NH}_3(g) + \text{H}_2\text{S}(g) \rightarrow \text{NH}_4^+(g) + \text{HS}^-(g)$

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

13 The reaction $\text{X}(g) + 2\text{Y}(g) \rightarrow \text{Z}(g)$ is found to have the rate equation $\text{rate} = k[\text{X}]$ and a rate constant of $1.155 \times 10^{-3} \text{ s}^{-1}$. If the initial concentration of **X** is $2.50 \times 10^{-3} \text{ mol dm}^{-3}$, what is the concentration of **X** in mol dm^{-3} after 30 minutes?

- A** 3.13×10^{-4}
- B** 6.25×10^{-4}
- C** 1.25×10^{-3}
- D** 2.00×10^{-3}

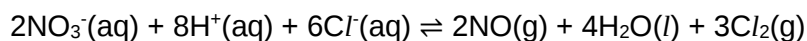
- 14 The mechanism for the reaction between nitrogen monoxide and oxygen is believed to be as follows.



Which of the following rate equation is consistent with the mechanism?

- A rate = $k[\text{O}_2][\text{N}_2\text{O}_2]$
- B rate = $k[\text{NO}]^2$
- C** rate = $k[\text{NO}]^2[\text{O}_2]$
- D rate = $k[\text{NO}][\text{O}_2]$

- 15 The following reaction is non-spontaneous under standard conditions.

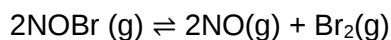


Which of the following conditions can help to aid the reaction to happen?

- 1 Adding H_2SO_4
- 2 Adding NaNO_3
- 3 Adding NaOH

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

- 16 Nitrosyl bromide gas is placed in a vessel of constant volume and an equilibrium is set up.



The total equilibrium pressure is larger than the initial pressure of nitrosyl bromide by 25%.
What is the mole fraction, x , of bromine in this equilibrium mixture?

- A** 0.200
- B 0.250
- C 0.333
- D 0.500

- 17 Methanol is produced industrially through the reaction between carbon dioxide and hydrogen, over a copper/zinc-oxide mixture as a catalyst. The reaction is carried out at 50-100 atm and 250 °C.

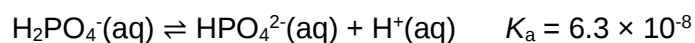
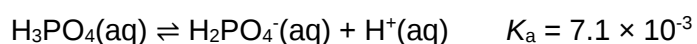


Which of the following explains the choice of these conditions?

- A At lower pressures, the catalyst works more efficiently.
 - B At lower pressures, the rate of formation increases.
 - C At lower temperatures, the rate of formation of methanol increases.
 - D** At lower temperatures, the yield of methanol increases.
- 18 The $\text{p}K_{\text{b}}$ value for aqueous ammonia at 25 °C is 4.80. What is the pH of a solution containing 50 cm³ of 0.80 mol dm⁻³ of aqueous ammonia and 50 cm³ of 0.50 mol dm⁻³ of nitric acid?

- A 3.31
- B 5.02
- C** 8.98
- D 10.7

- 19 Phosphoric acid is a weak acid that is sometimes found in soft drinks. It dissociates in water in the manner below:



Which of the following describes the concentrations of the species present in equilibrium?

- A** $[\text{H}_3\text{PO}_4] > [\text{H}_2\text{PO}_4^-] > [\text{HPO}_4^{2-}]$
- B $[\text{HPO}_4^{2-}] > [\text{H}_2\text{PO}_4^-] > [\text{H}_3\text{PO}_4]$
- C $[\text{H}_3\text{PO}_4] > [\text{HPO}_4^{2-}] = [\text{H}_2\text{PO}_4^-]$
- D $[\text{H}_3\text{PO}_4] = [\text{H}_2\text{PO}_4^-] > [\text{HPO}_4^{2-}]$

- 20** Two solutions of 20 cm^3 of CH_3COOH and HCl with the same concentration were respectively titrated against NaOH solution.

Which of the following will be the same for both reactions?

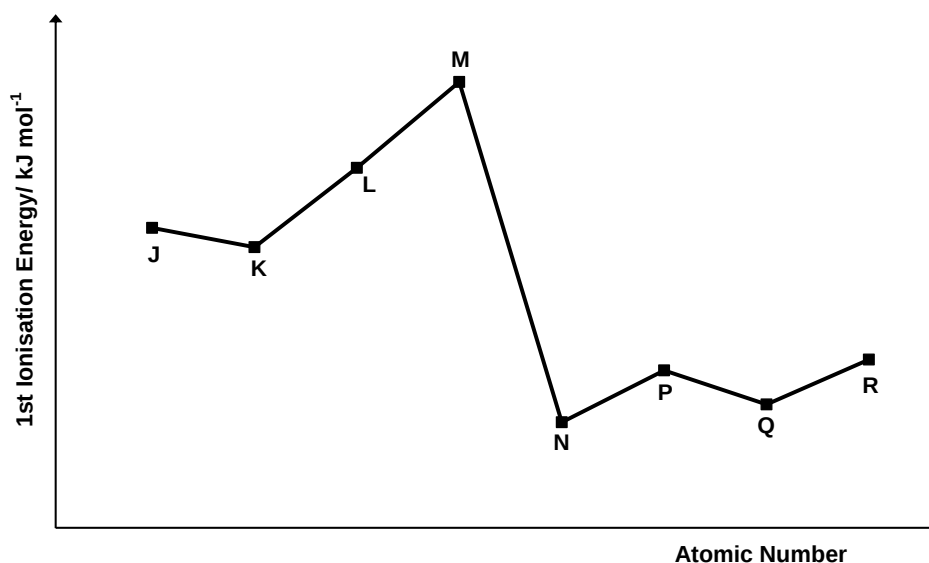
- 1 Initial pH
- 2 Volume of NaOH required to reach equivalence point
- 3 pH at equivalence point

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

- 21** Magnesium phosphate, $\text{Mg}_3(\text{PO}_4)_2$ is a sparingly soluble salt. If the solubility product of $\text{Mg}_3(\text{PO}_4)_2$ is given as $\mathbf{M}$, what is the concentration of PO_4^{3-} at equilibrium?

- | | | | |
|----------|---|----------|---|
| A | $\left[\frac{\mathbf{M}}{108}\right]^{1/5}$ | B | $\left[\frac{\mathbf{M}}{36}\right]^{1/5}$ |
| C | $\left[\frac{4\mathbf{M}}{9}\right]^{1/5}$ | D | $\left[\frac{8\mathbf{M}}{27}\right]^{1/5}$ |

- 22 The following graph shows the first ionisation energies of eight consecutive elements **J** to **R**, which have atomic numbers between 3 to 20 in the Periodic Table.



Which one of the following statements about the elements is true?

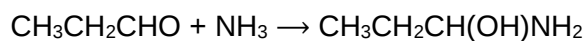
- A Atomic radius of **J** is smaller than **K**.
 - B **M** exists as discrete molecules.
 - C** The chloride of **Q** reacts with water to form an acidic solution.
 - D Oxides of **R** can react with acids.
- 23 *Use of the Data Booklet is relevant to this question.*

Electroplating is a common process to prevent corrosion. Numerous objects can be electroplated, including keys. A metal key is dipped into a CuSO_4 solution where it acts as an electrode of an electroplating setup.

Which of the following statements is correct?

- 1 The key acts as a cathode in the electrolytic cell.
 - 2 0.0987 g of copper will be deposited on the key in 30s if a 10A current is used.
 - 3 The electrolyte will turn universal indicator green at the end of the electroplating process.
- A 1 only
 - B 3 only
 - C** 1 and 2 only
 - D 2 and 3 only

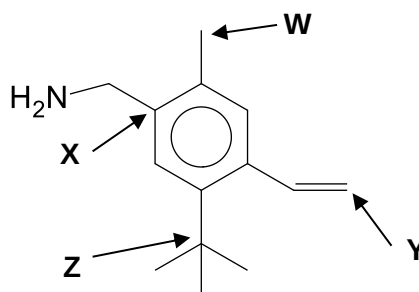
- 24 Propanal can react with ammonia as shown.



Which type of reaction is this?

- A** Nucleophilic addition
- B Elimination
- C Electrophilic substitution
- D Addition-elimination

- 25 Which of the carbon atoms in the molecule below is sp^2 hybridised?



- A W and Z only
- B** X and Y only
- C X only
- D Z only

- 26 Which of the statements are true about 2-chloroethanoic acid and 2-bromoethanoic acid?

- 1 2-chloroethanoic acid can precipitate faster than 2-bromoethanoic acid when both are reacted with ethanolic AgNO_3 .
- 2 2-chloroethanoic acid is a stronger acid than 2-bromoethanoic acid.
- 3 2-chloroethanoic acid contains a stronger electron-withdrawing group than 2-bromoethanoic acid.

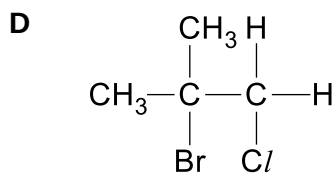
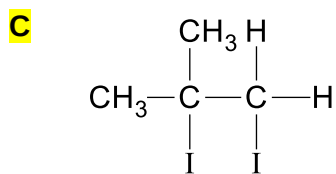
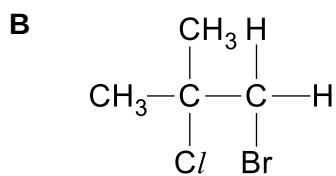
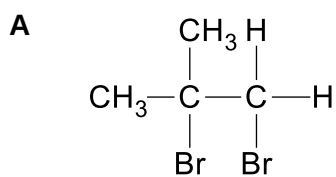
- A 1, 2 and 3 only
- B 2 only
- C 1 and 3 only
- D** 2 and 3 only

27 Which of the following pairs of reagents will react together to give a water-soluble organic product?

- 1 $\text{CH}_3\text{CH}_2\text{COOH}$ and LiAlH_4
- 2 $\text{CH}_3\text{CH}_2\text{COOH}$ and $\text{CH}_3\text{CH}_2\text{NH}_2$
- 3 $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$ and NaOH

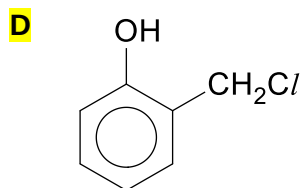
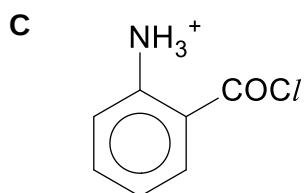
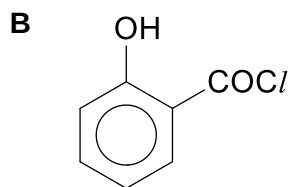
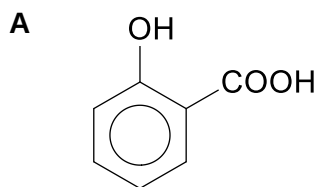
- A** 1, 2 and 3
B 1 and 3 only
C 2 and 3 only
D 1 and 2 only

28 Which of the following is **not** a possible product when 2-methylpropene is reacted with a mixture containing Br_2 and ICl ?

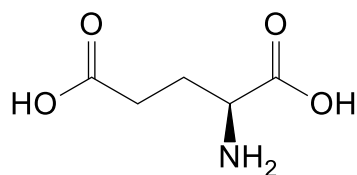


- 29 Compound **X** reacts with 1 mol of sodium hydroxide at room temperature and 2 mol of sodium hydroxide when heated.

Which of the following could be a possible structure of compound **X**?



- 30 Glutamic acid is one of the neurotransmitters present in the nervous system.



Which of the following statements is **false** about glutamic acid?

- A** It exists as a crystalline solid at room temperature.
- B** It exists as a zwitterion at pH 7.
- C** The two carboxylic groups have different pK_a .
- D** There is only 1 chiral centre in glutamic acid

END OF PAPER 1

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