HWA CHONG INSTITUTION
C2 Preliminary Examinations
Higher 2

CANDIDATE NAME		**CT GROUP**	**21S**
CENTRE NUMBER		**INDEX NUMBER**	

CHEMISTRY **9729/01**

Paper 1 Multiple Choice **19 September 2022**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

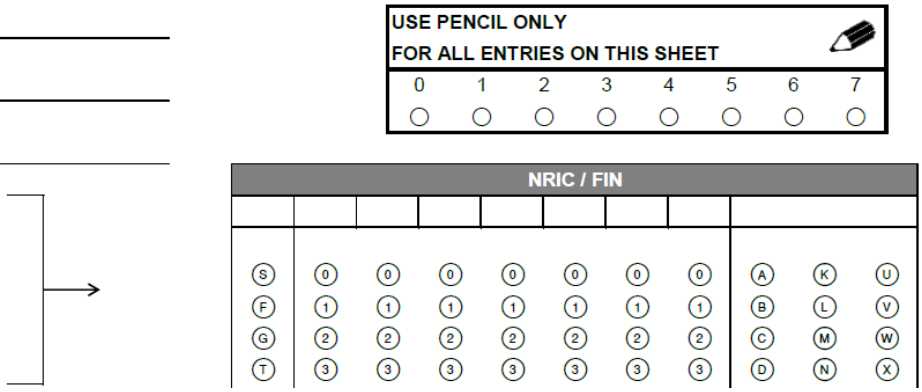
READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Complete the information on the Answer Sheet as shown below.

1. Enter your **NAME** (as in NRIC). _____
2. Enter the **PAPER NUMBER**. _____
3. Enter your **CT GROUP**. _____
4. Enter your **NRIC NUMBER** or **FIN Number**
5. Now **SHADE** the corresponding circles in the grid for **EACH DIGIT** or **LETTER**



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.

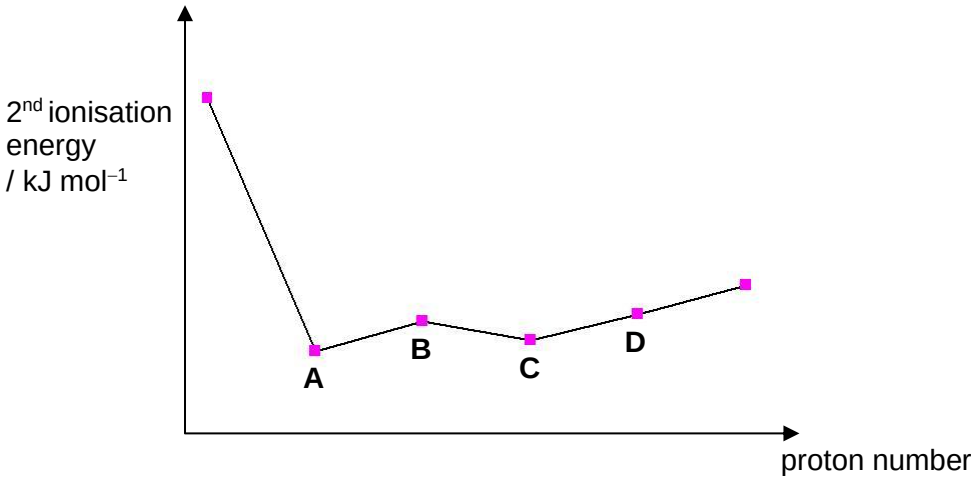
The use of an approved scientific calculator is expected, where appropriate.

1 Which formula represents a particle with the composition of 1 proton, 2 neutrons and 3 electrons? (D represents deuterium, ^2H; and T represents tritium, ^3H)

A H^- **B** D^{2-} **C** T^{2-} **D** He^-

2 The variation in the second ionisation energy of six consecutive elements in the Periodic Table is shown in the graph.

Which element is a Group 13 element?



3 Which observation **cannot** be explained by intermolecular hydrogen bonding?

A Methanol dissolves readily in water.

B The boiling point of HBr is higher than that of HC*l*.

C The boiling point of 4-aminophenol is higher than that of 2-aminophenol.

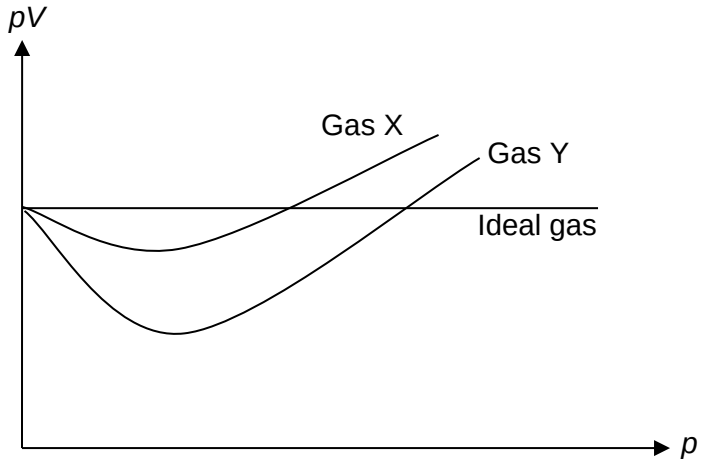
D The relative molecular mass of ethanoic acid when dissolved in hexane is 120.

4 In which pairs of compounds does the first molecule have a smaller bond angle than that in the second molecule?

1	NF_3	CCl_4
2	H_2O	XeF_4
3	SF_6	CS_2

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

5 The following graphs were obtained for three gases for the variation of pV with p, where p is the pressure and V is the volume of the gas.



Which row is correct if gas X is HC*l* at 300 K?

	gas Y	temperature / K
A	HC*l*	400
B	CH_4	400
C	O_2	300
D	HF	300

6 Methyl red ($C_{15}H_{15}N_3O_2$) is an organic compound used as an acid-base indicator. Why does methyl red, which is red in acidic solutions, turn yellow in alkaline solutions?

A It is oxidised by OH^- ions.

B It is reduced by OH^- ions.

C It forms a cation by gain of H^+ ions.

D It forms an anion by loss of H^+ ions.

7 Group 2 nitrates undergo thermal decomposition to give the metal oxide, nitrogen dioxide and oxygen.

0.118 g of a Group 2 nitrate was thermally decomposed and the residue was dissolved in 80.0 cm^3 of 0.0350 mol dm^{-3} HC*l*(aq). The resultant solution required 21.60 cm^3 of 0.0780 mol dm^{-3} NaOH(aq) for complete neutralisation.

What was the Group 2 metal in the nitrate?

A Mg **B** Ca **C** Sr **D** Ba

8 Astatine is below iodine in Group 17 of the Periodic Table.

Which properties are likely correct for astatine and its compounds?

1 Astatine is less volatile than iodine.

2 Silver astatide has less covalent character than silver iodide.

3 When a heated glass rod is inserted into a container of hydrogen astatide, it decomposes into its elements.

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

9 A 0.483 g sample of glycine (M_r = 75) was placed in a bomb calorimeter and then ignited in the presence of excess oxygen. The temperature rose by 0.54 °C.

In a separate experiment using the same calorimeter, the combustion of 0.986 g of benzoic acid (M_r = 122) gave a temperature rise of 2.14 °C. The enthalpy change of combustion of benzoic acid is –3054 kJ mol^{-1}.

What is the enthalpy change of combustion, in kJ mol^{-1}, of glycine?

A –615 **B** –967 **C** –2423 **D** –3812

10 Group 2 hydroxides undergo thermal decomposition in a similar fashion to Group 2 carbonates.

Barium hydroxide undergoes decomposition as shown in the equation below:

$$Ba(OH)_2(s) \rightarrow BaO(s) + H_2O(g) \qquad \Delta H > 0$$

Which statements about this reaction are correct?

1 The Gibbs free energy change can be positive or negative depending on the temperature.

2 The decomposition is spontaneous only at high temperature.

3 The entropy change is negative.

4 Barium hydroxide decomposes at a lower temperature than magnesium hydroxide.

A 1 and 2 only

B 1 and 3 only

C 2 and 4 only

D 1, 2 and 4 only

11 The equation for the bromination of propanone is shown below.

$$CH_3COCH_3 + Br_2 \xrightarrow{H^+} CH_3COCH_2Br + H^+ + Br^-$$

The rate of disappearance of the bromine colour was measured for several different concentrations of CH_3COCH_3, Br_2 and H^+ at a certain temperature.

$[CH_3COCH_3]$/ mol dm^{-3}	$[Br_2]$/ mol dm^{-3}	$[H^+]$/ mol dm^{-3}	rate of disappearance of Br_2 colour/ mol dm^{-3} s^{-1}
0.30	0.05	0.05	5.70×10^{-5}
0.30	0.10	0.05	5.70×10^{-5}
0.30	0.05	0.10	1.14×10^{-4}
0.40	0.05	0.20	3.04×10^{-4}

Which statement about the above reaction is correct?

A The rate equation for the reaction is rate = $k[CH_3COCH_3][Br_2]$.

B The rate constant for the reaction is 3.80×10^{-3} mol^{-1} dm^3 s^{-1}.

C The rate constant of the reaction doubles when $[CH_3COCH_3]$ is doubled.

D The time taken for the concentration of CH_3COCH_3 to decrease to half its initial value is the same for all experiments.

12 Which statement about the Haber process for the manufacture of ammonia is correct?

A At higher temperatures, the yield decreases but the rate of production of ammonia is faster.

B At lower temperatures, the value of K_p decreases.

C At higher pressures, the yield decreases but the rate of production of ammonia is faster.

D In the presence of a catalyst, the yield decreases but the rate of production of ammonia is faster.

13 0.50 moles of CH_3CO_2H and 0.50 moles of CH_3CH_2OH were mixed and an esterification reaction took place. The equilibrium constant for this reaction is 4.0.

What is the amount of CH_3CO_2H (in moles) in the mixture at equilibrium?

A 0.17 **B** 0.25 **C** 0.33 **D** 0.67

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

Water dissociates as shown.

$$H_2O \rightleftharpoons H^+ + OH^-$$

At 25 °C, the equilibrium value of $[H^+]$ is 10^{-7} mol dm^{-3}; $[H_2O]$ = 55.6 mol dm^{-3}.

What is the order of increasing numerical value of pH, pK_a and pK_w for this equilibrium at this temperature?

	smallest		largest
A	pH	pK_a	pK_w
B	pH	pK_w	pK_a
C	pK_a	pK_w	pH
D	pK_w	pK_a	pH

15 Which combination of substances would result in a buffer solution?

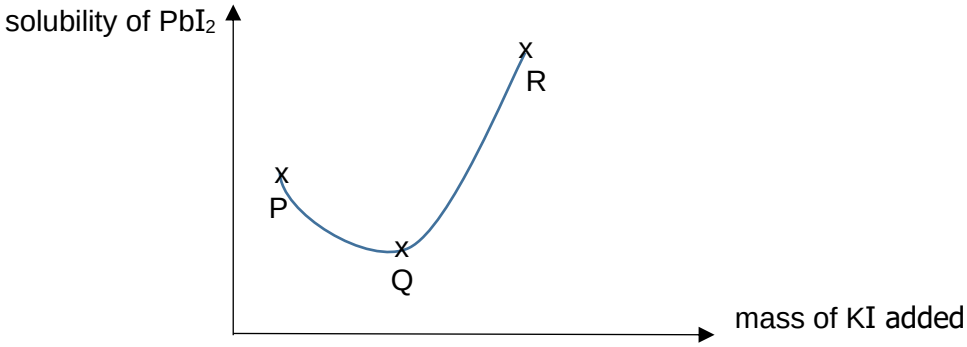
A 25.0 cm^3 of 0.100 mol dm^{-3} HC*l*(aq) and 20.0 cm^3 of 0.100 mol dm^{-3} NaC*l*(aq)

B 25.0 cm^3 of 0.100 mol dm^{-3} HC*l*(aq) and 25.0 cm^3 of 0.200 mol dm^{-3} NH_3(aq)

C 25.0 cm^3 of 0.100 mol dm^{-3} H_2CO_3(aq) and 50.0 cm^3 of 0.100 mol dm^{-3} NaOH(aq)

D 20.0 cm^3 of 0.100 mol dm^{-3} CH_3CO_2H(aq) and 25.0 cm^3 of 0.100 mol dm^{-3} NaOH(aq)

16 The following graph represents how the solubility of a sparingly soluble salt lead(II) iodide, PbI_2, changes upon addition of solid potassium iodide at a fixed temperature.



Which statement about the above graph is **not** correct?

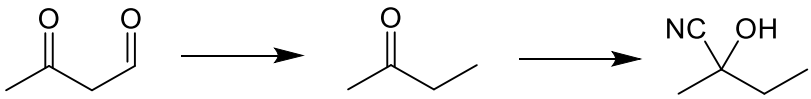
A The change in solubility along PQ is due to common ion effect.

B The change in solubility along QR is due to the formation of a complex between Pb^{2+} and I^-.

C At Q, the molar concentration of I^- ions is twice that of Pb^{2+} ions.

D K_{sp} remains constant along PR.

17 What types of reactions can be found in the following reaction scheme?



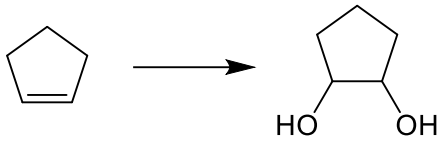
1 substitution

2 reduction

3 addition

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

18 What are the optimal reagents and conditions for the following reaction?



A steam, H_3PO_4 catalyst, high temperature and pressure

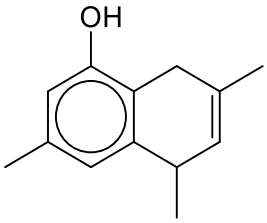
B $K_2Cr_2O_7(aq)$, $H_2SO_4(aq)$, 25°C

C $KMnO_4(aq)$, $H_2SO_4(aq)$, 25°C

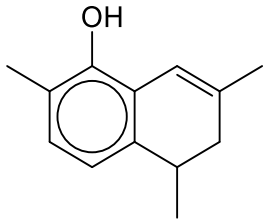
D $KMnO_4(aq)$, KOH(aq), 10°C

19 When mixed with aqueous Br_2, 1 mole of X reacts with 2 moles of Br_2.
What could X be?

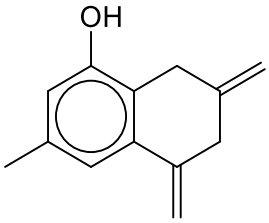
A



B



C



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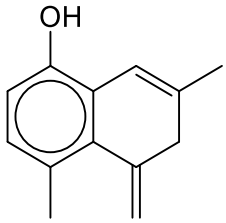
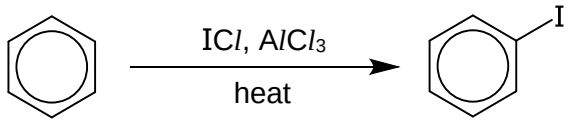
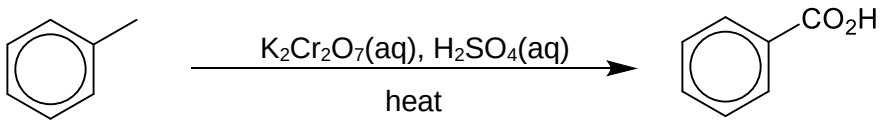


20 Which reaction has the correct reagents and conditions?

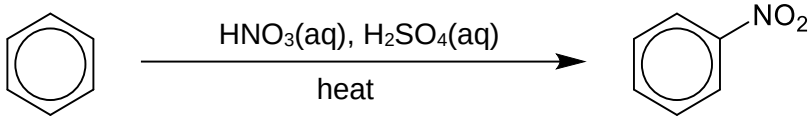
A



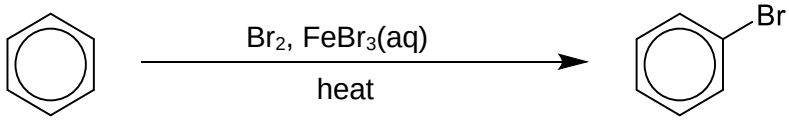
B



C

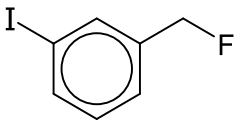


D

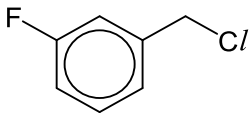


21 1 mole of each of the compounds below was heated with excess aqueous potassium hydroxide followed by acidification. Aqueous silver nitrate was then added to the mixture. Which compound will produce the least silver halide precipitate by mass?

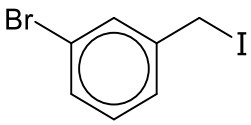
A



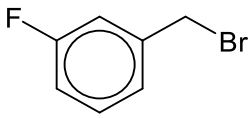
B



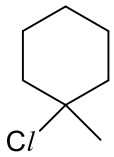
C

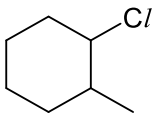


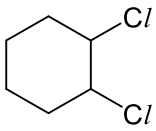
D



22 Which compounds exhibit stereoisomerism?

1 

2 

3 

A 1 only

B 2 only

C 2 and 3 only

D 1, 2 and 3

23 Which statement best explains the difference in reactivity of ethene and ethanal with lithium aluminium hydride?

A Ethanal has an electron deficient reaction centre.

B Ethene does not react as the electrons are delocalised.

C Ethanal adsorbs better onto the lithium aluminum hydride.

D Ethene cannot be reduced any further as it does not have any O atoms.

24 Which statement describes the conversion of a ketone to a cyanohydrin?

A The ketone acts as a nucleophile in the mechanism.

B The second step of the mechanism involves a reduction reaction.

C The hybridisation of the carbonyl carbon remains as sp^2 throughout the reaction.

D The reaction can proceed with KCN added to the ketone, followed by excess aqueous sulfuric acid at room temperature.

25 Which pair of compounds will result in an ester being formed immediately when mixed?

A ethanol and ethanoic acid

B ethanoic acid and ethanoyl chloride

C ethanol and ethanoyl chloride

D sodium phenoxide and ethanoic acid

26 Which reaction will **not** result in the formation of a compound with an amine functional group?

A heating propanamide with aqueous potassium hydroxide

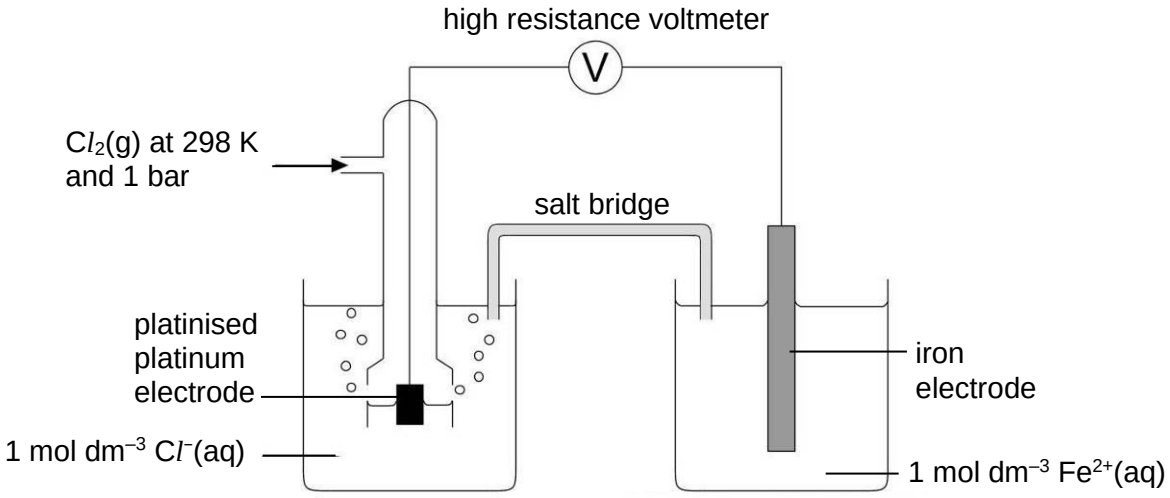
B reacting ethanamide with dry lithium aluminium hydride

C prolonged heating of a tripeptide in aqueous sodium hydroxide

D heating chloroethane with liquid ammonia under reflux

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

Which change to the half-cells will cause the high resistance voltmeter to show a less positive reading?



A using a bigger piece of iron electrode

B adding water to the half-cell on the right

C adding aqueous $AgNO_3$ to the half-cell on the left

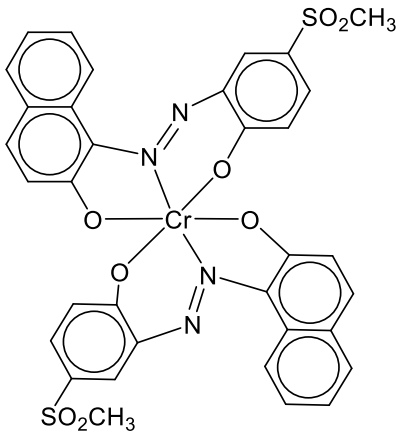
D decreasing the pressure of the chlorine gas

28 Four separate electrolysis experiments were performed as follows, under the same conditions of temperature and pressure.

In which experiment will a gas be produced at only one electrode?

	electrodes used	electrolyte used
A	carbon	dilute sodium chloride solution
B	carbon	concentrated sodium chloride solution
C	copper	copper(II) sulfate solution
D	carbon	copper(II) sulfate solution

29 The following chromium complex, C.I. Acid Violet 78, is used as a dye.



C.I. Acid Violet 78

What is the oxidation number of chromium in the complex above?

A 0

B +2

C +4

D +6

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

The colours of various vanadium-containing ions are given in the table below.

oxidation state	+5	+4	+3	+2
colour	yellow	blue	green	violet

When an excess of W was added to an aqueous solution of acidified ammonium vanadate(V), NH_4VO_3, a green solution was obtained at the end of the experiment.

What could be the identity of W?

1 zinc

2 sulfur dioxide

3 nitrogen dioxide

A 1, 2 and 3

B 1 and 2 only

C 1 and 3 only

D 2 only