ANDERSON SERANGOON JUNIOR COLLEGE

2020 JC 2 PRELIMINARY EXAMINATION

CHEMISTRY **9729/01**

Paper 1 Multiple Choice **23 September 2020**

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.
Write your name and class on the Answer Sheet in the spaces 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 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.

Multiple Choice Answer Sheet

Write your name, class and NRIC / FIN number, **including** the reference letter.

Shade the NRIC / FIN number.

Exam Title: JC2 Preliminary Exam

Exam Details: H2 Chemistry / Paper 1

Date: 23/09/2020

This document consists of **16** printed pages.

1 Beams of charged particles are deflected by an electric field.

In an experiment, protons are deflected by an angle of +15º. In another experiment, under identical conditions, particle **A** is deflected by an angle of –5º.

What could be the composition of particle **A**?

	protons	neutrons	electrons
A	1	2	2
B	3	3	2
C	3	3	4
D	4	5	1

2 50 cm^3 of a 0.10 mol dm^{-3} solution of a metallic salt was found to react exactly with 25.0 cm^3 of 0.10 mol dm^{-3} aqueous sodium sulfite.

In this reaction, the sulfite ion is oxidised as follows.

$$SO_3^{2-}(aq) + H_2O(l) \rightarrow SO_4^{2-}(aq) + 2H^+(aq) + 2e$$

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

3 Which particle would, on losing two electrons, have a half–filled p subshell?

A Ga^-

B Se^-

C Te^+

D As^{2+}

4 The successive ionisation energies (I.E.) of two elements, **B** and **C**, are shown below.

I.E. / kJ mol^{-1}	1st	2nd	3rd	4th	5th	6th	7th	8th
B	1000	2252	3357	4556	7004	8496	27107	31719
C	578	1817	2745	11577	14842	18379	23326	27465

What is the likely formula of the compound formed when **B** and **C** reacts together?

A B_2C_3

B B_3C_2

C BC_3

D B_3C

5 Molecular dimerisation can be described as the process in which two identical molecules combine to give a single product.

Examples of dimers are: Al_2Cl_6, N_2O_4 and $(CH_3CO_2H)_2$.

Which of the following descriptions about the above dimers is **incorrect**?

A Hydrogen bonds hold the CH_3CO_2H molecules together in the dimer.

B Each aluminium atom is surrounded by four chlorine atoms in Al_2Cl_6.

C All the nitrogen–oxygen bonds in N_2O_4 are of equal length.

D Al_2Cl_6 is a planar molecule.

6 Which of the following observations can be explained by intermolecular hydrogen bonding?

1 Ammonia (NH_3) has a higher boiling point than methane (CH_4).

2 Water has a lower density at 0 °C than at 25 °C.

3 Formation of H_3O^+ from water.

A 1, 2 and 3

B 1 and 2 only

C 2 and 3 only

D 1 only

7 Melphalan is a drug used in chemotherapy. When dissolved in blood, the decrease in its concentration has a constant half–life of 90 minutes.

A 100 mg melphalan tablet is dissolved in 4.0 dm^3 blood.

What is the concentration of melphalan in the blood six hours later?

A 1.56 mg dm^{-3}

B 3.13 mg dm^{-3}

C 12.5 mg dm^{-3}

D 25.0 mg dm^{-3}

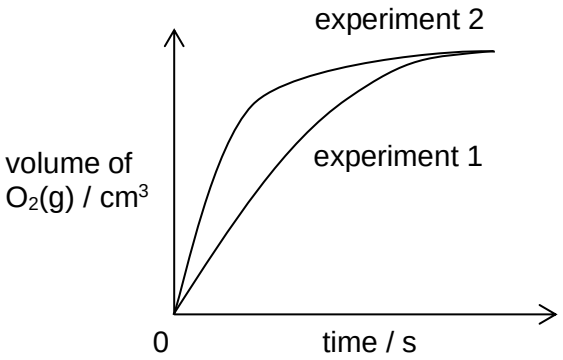
8 Hydrogen peroxide slowly decomposes at room temperature.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Two experiments were performed to study the effects of adding lead(IV) oxide on the decomposition of 1.5 mol dm^{-3} hydrogen peroxide at constant temperature.

Experiment 1: 20 cm^3 of hydrogen peroxide.
Experiment 2: 20 cm^3 of hydrogen peroxide and 1.0 g of lead(IV) oxide.

At the end of the experiment 2 the mixture was filtered and 1.0 g of lead(IV) oxide was recovered.



Which row is correct?

	value of rate constant	activation energy
A	equal in experiment 1 and 2	higher in experiment 1
B	equal in experiment 1 and 2	higher in experiment 2
C	higher in experiment 2	higher in experiment 1
D	higher in experiment 2	higher in experiment 2

9 The values for the standard enthalpy change of combustion of hydrogen and the standard enthalpy change of formation of hydrogen peroxide are –285.8 kJ mol^{-1} and –187.8 kJ mol^{-1} respectively.

What is the standard enthalpy change for this reaction?

$$2H_2O(l) + O_2(g) \rightarrow 2H_2O_2(l)$$

A –98 kJ mol^{-1}

B –196 kJ mol^{-1}

C +98 kJ mol^{-1}

D +196 kJ mol^{-1}

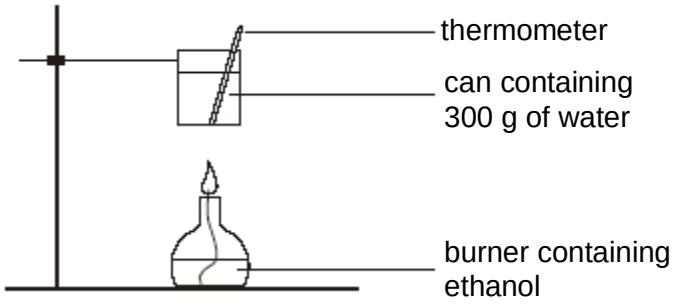
10 In vehicles such as cars, internal combustion engines convert the chemical energy in fuels into kinetic energy. The following reaction takes place in an internal combustion engine.

$$2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$$

What are the signs for ΔH, ΔS and ΔG for the above reaction?

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

11 An experiment was conducted to determine the efficiency of the heating of a can of water using a spirit burner.



The following data were recorded:

mass of ethanol burnt	= m g
change in temperature of water	= ΔT °C

You are also given that:

relative molecular mass of ethanol	= 46.0
enthalpy change of combustion of ethanol	= –1370 kJ mol^{-1}
specific heat capacity of water	= c J g^{-1} K^{-1}

Which expression below gives the efficiency of this heating process?

A $\dfrac{300 \times c \times \Delta T \times 46.0}{m \times 1370 \times 1000} \times 100\%$

B $\dfrac{m \times c \times \Delta T \times 46.0}{300 \times 1370 \times 1000} \times 100\%$

C $\dfrac{300 \times c \times \Delta T \times 46.0}{m \times 1370} \times 100\%$

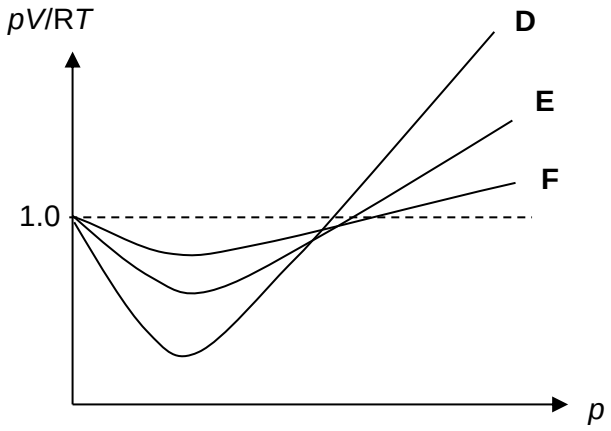
D $\dfrac{m \times 1370 \times 1000}{300 \times c \times \Delta T \times 46.0} \times 100\%$

12 When the temperature of a 2.0 dm^3 sample of a gas was changed from 20 °C to ***k*** °C at constant volume, the pressure of the gas was found to have increased from 1 atm to 2 atm.

What is the value of ***k***?

A 10 **B** 40 **C** 313 **D** 586

13 The value of pV/RT is plotted against p for one mole of each of the three non–ideal gases **D, E** and **F**, where p is the pressure, V is the volume and T is the temperature of the gas.



Which of the following gases could be **D**, **E** and **F**?

	D	**E**	**F**
A	NH_3	H_2O	BF_3
B	H_2O	NH_3	BF_3
C	BF_3	NH_3	H_2O
D	H_2O	BF_3	NH_3

14 The following process is used to convert methane to hydrogen.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H > 0$$

What will increase the yield of the reaction?

1 Adding argon gas to the mixture but keeping the total pressure constant.

2 Increasing the temperature.

3 Increasing the total pressure by decreasing the total volume at constant temperature.

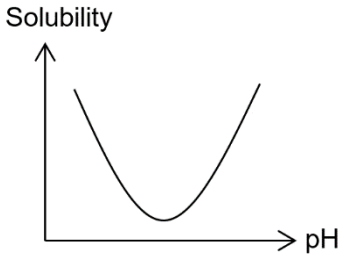
4 Removing CO and H_2 gas as they are formed but keeping the total volume of the mixture the same.

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

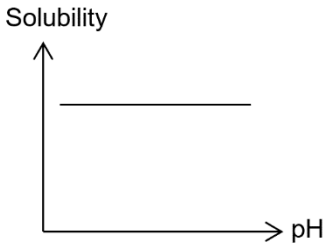
15 CaF_2 is a sparingly soluble salt and is added to a weakly acidic solution of HF. The pH of the solution is adjusted by adding NaOH.

Which diagram shows how the solubility of CaF_2 will vary with the pH of the solution at constant temperature?

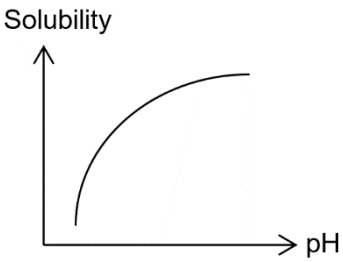
A



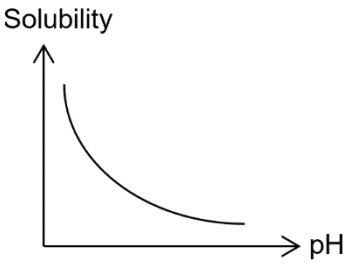
B



C

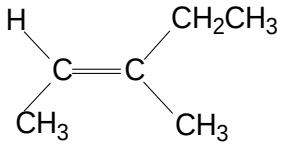


D

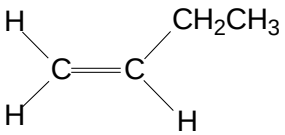


16 Which of the following compounds react with HBr in an addition reaction to form a major product that is chiral?

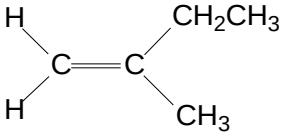
1



2



3



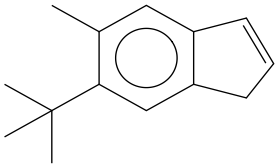
A 1 only

B 2 only

C 1 and 2 only

D 1, 2 and 3

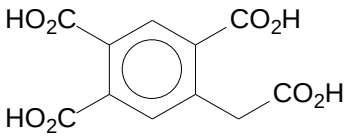
17 Compound **G** reacts with hot acidified $KMnO_4$ under suitable conditions.



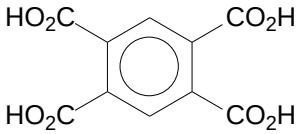
compound **G**

What is the most likely organic products formed from this reaction?

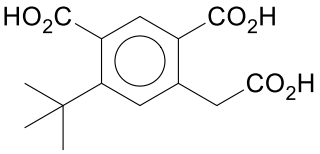
A



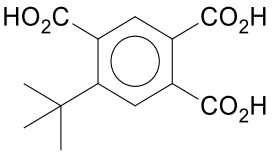
B



C



D



18 An enantiomerically pure bromoalkane, RBr, is reacted with aqueous sodium hydroxide. Results of an investigation into the kinetics of this reaction are given below.

experiment number	[RBr] / mol dm^{-3}	[NaOH] / mol dm^{-3}	relative initial rate
1	0.10	0.20	1.00
2	0.20	0.10	2.00
3	0.30	0.20	3.00

Which of the following statements about the reaction are correct?

1 It produces a racemic mixture.

2 It proceeds via a pentavalent transition state.

3 Sodium hydroxide is involved in the rate–determining step of the mechanism.

A 1 only

B 1 and 3

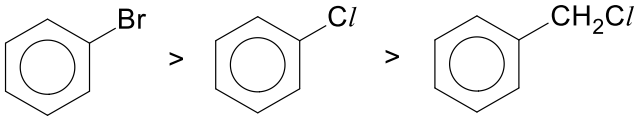
C 2 and 3

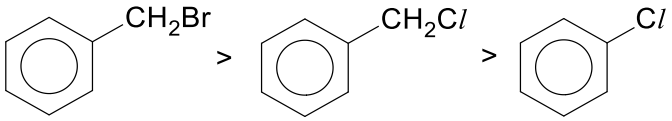
D 1, 2 and 3

19 Which sequence shows the correct order of **decreasing** ease of hydrolysis?

A $CH_3CH_2Cl > CH_3CH_2Br > CH_3CH_2I$

B $(CH_3)_2CHCl > (CH_3)_2CHI > (CH_3)_2CHBr$

C 

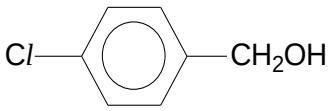
D 

20 An organic compound **H** has the following properties:

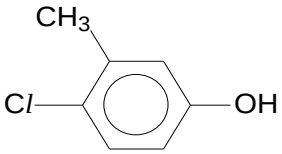
- It has the molecular formula C_7H_7OCl.
- When $Br_2(aq)$ is added to **H**, a white solid, with M_r of 300.3, is formed.
- Warming **H** with $AgNO_3(aq)$ gives a white solid, which is soluble in $NH_3(aq)$.

What is the likely identity of compound **H**?

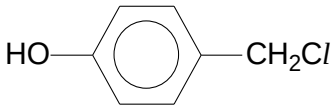
A



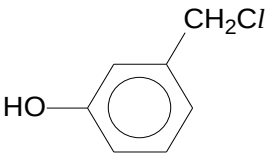
B



C

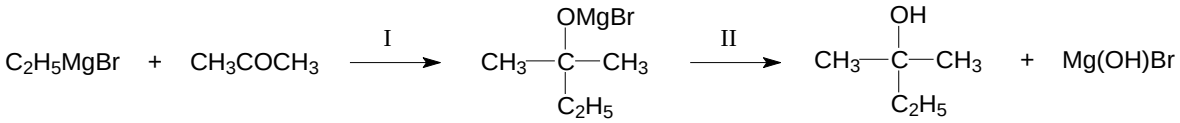


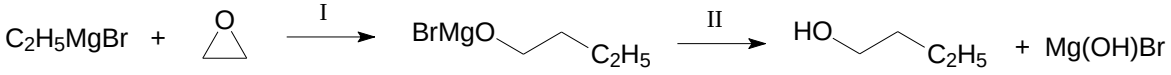
D



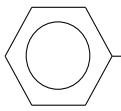
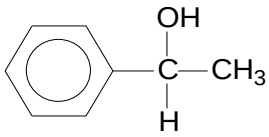
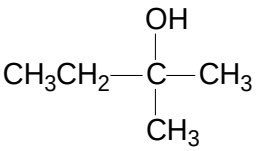
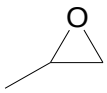
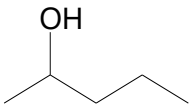
21 Most of the chemistry of magnesium relates to its ionic compounds. However, magnesium does form an important group of covalent compounds which are known as Grignard reagents. Many Grignard reagents, with different alkyl or aryl groups, are widely used in organic syntheses.

The following reaction schemes show two typical examples of the use of a Grignard reagent.





Which of the following sets show the correct reactants and products obtained upon undergoing the same reaction scheme?

	reactants	products
1	 MgBr + CH_3CHO	 + Mg(OH)Br
2	$CH_3CH_2CH_2MgBr$ + CH_3COCH_3	 + Mg(OH)Br
3	CH_3CH_2MgBr + 	 + Mg(OH)Br

A 2 only

B 3 only

C 1 and 2 only

D 1 and 3 only

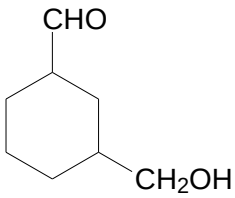
22 When compound **J** is heated with acidified potassium dichromate(VI), a colour change from orange to green is observed.

Three tests are carried out on the organic product of this reaction.

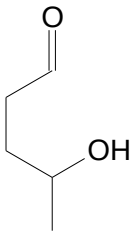
test	observation
Fehling's solution	no observation change
2,4–dinitrophenylhydrazine	orange precipitate formed
magnesium ribbon	effervescence

What could be compound **J**?

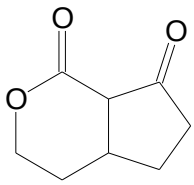
1



2



3



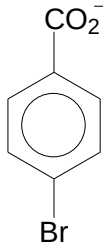
A 1, 2 and 3

B 1 and 2

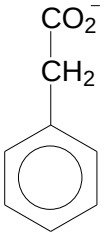
C 2 and 3

D 2 only

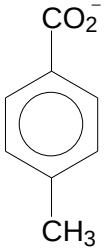
23 Which of the following sequences ranks the given species in order of **decreasing** K_b values?



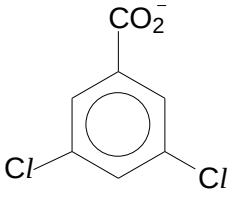
I



II



III



IV

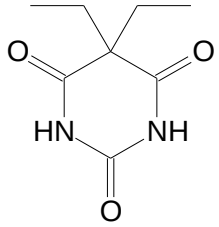
A **III, II, I, IV**

B **II, IV, III, I**

C **II, III, I, IV**

D **IV, I, III, II**

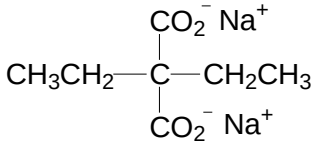
24 5,5–diethylbarbituric acid was used as a sleeping aid from 1903 until the mid–1950s.



5,5–diethylbarbituric acid

Which of the following is not found among the products of the complete hydrolysis of 5,5–diethylbarbituric acid by aqueous sodium hydroxide?

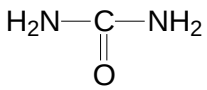
A



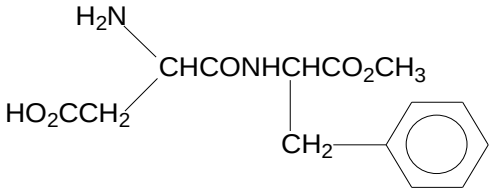
B NH_3

C Na_2CO_3

D



25 Aspartame is widely used as a sweetener in canned drinks.



Aspartame

Which of the following statement is correct?

A Ethanol is formed when aspartame is reacted with hot dilute hydrochloric acid.

B Aspartame reacts with 3 mol of cold aqueous sodium hydroxide.

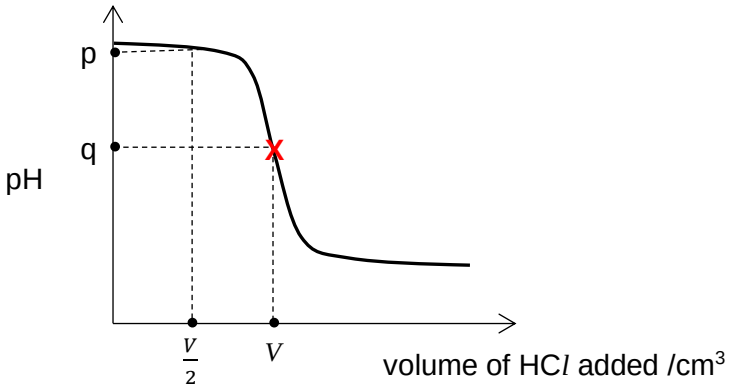
C Aspartame reacts with 2 mol of hot aqueous hydrochloric acid.

D Aspartame give yellow precipitate with alkaline aqueous iodine.

26 Ethylamine, $CH_3CH_2NH_2$, is a weak monoprotic base with the following K_b value.

$K_b = 4.5 \times 10^{-4}$ mol dm^{-3}

25.0 cm^3 of 0.10 mol dm^{-3} aqueous $CH_3CH_2NH_2$ was titrated with 0.20 mol dm^{-3} dilute HC*l*. The titration curve obtained is shown below.

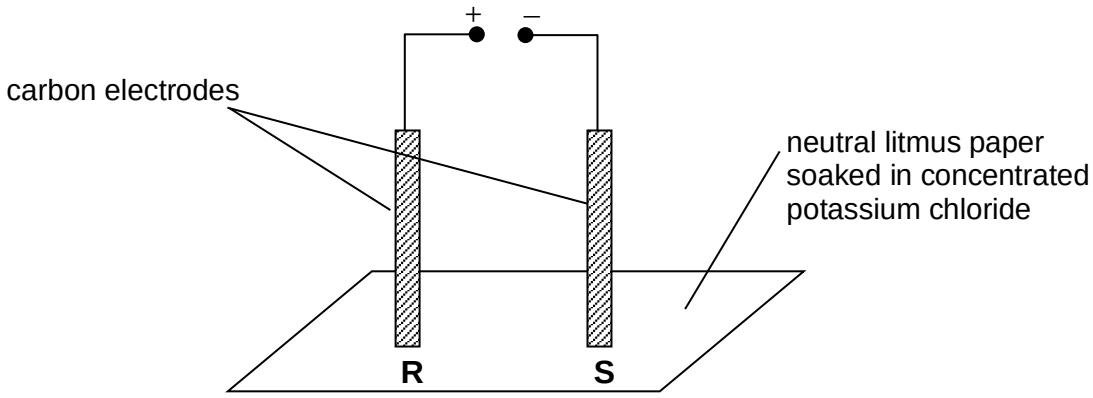


Which of the following sets of values correspond to the points in the diagram?

	V	p	q
A	12.5	10.7	less than 7
B	25.0	10.7	more than 7
C	12.5	3.3	less than 7
D	25.0	3.3	more than 7

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

A direct current is passed through the apparatus shown in the diagram below.



What are the colours observed at positions **R** and **S** after some time?

	R	**S**
A	blue	red
B	red	blue
C	white	blue
D	blue	white

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

An excess of sulfur dioxide, SO_2, is bubbled into a warm solution containing VO_2^+ ions. What will be the final oxidation state of vanadium?

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

29 The enthalpy change of fusion of a solid is defined as the amount of energy, in J or kJ, required to melt one mole of a solid at its melting point.

The table shows the enthalpy change of fusion of four successive elements, *W* to *Z*, in the third period (sodium to argon) of the Periodic Table.

element	*W*	*X*	*Y*	*Z*
enthalpy change of fusion / kJ mol^{-1}	10.8	46.4	0.6	1.4

Which sequence of elements is represented by *W* to *Z*?

	W	*X*	*Y*	*Z*
A	A*l*	Si	P	S
B	Na	Mg	A*l*	Si
C	P	S	C*l*	Ar
D	Si	P	S	C*l*

30 Which of the statements about Group 2 elements is correct?

A The reducing power decreases down the group.

B The ionic radius increases down the group.

C The electronegativity increases down the group.

D The reactivity with water decreases down the group.