NAME _____ CLASS **18S**

JURONG PIONEER JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION 2019

CHEMISTRY **9729/01**

Higher 2 **26 September 2019**

Paper 1 Multiple Choice **1 hour**

Candidates answer on separate paper.

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, class and exam index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** or **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.

This document consists of **12** printed pages.

1 In which of the following pairs do the molecules have similar shapes?

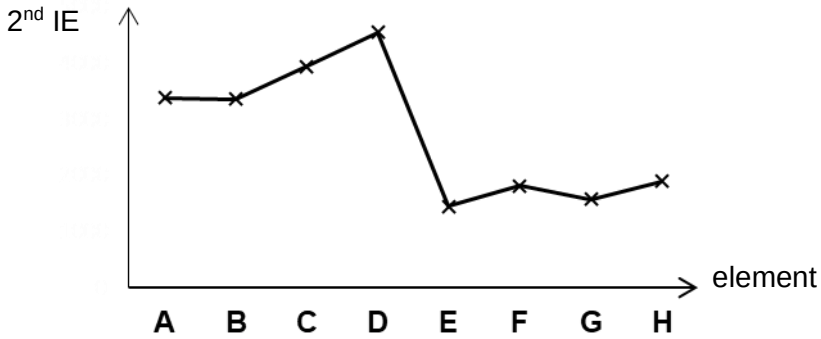
A CO_2 and SO_2

B BF_3 and NH_3

C H_2O and ClO_2^-

D NO_2^+ and ClO_2

2 **A** to **H** are consecutive elements with atomic numbers less than 20. The graph below shows their second ionisation energies (2^{nd} IE).



Which of the following statements is **incorrect**?

A Element **E** is from Group 2.

B **H** exists as tetratomic molecules.

C The compound formed between **A** and **G** is a gas at room temperature.

D The 2^{nd} IE of **B** is lower than that of **A** due to inter–electronic repulsion between its paired p electrons.

3 After an oil spillage at sea, a liquid hydrocarbon layer floats on the surface of the water.

Which statements help to explain this observation?

1 Hydrocarbon molecules are not solvated by water.

2 There are only instantaneous dipole–induced dipole interactions between hydrocarbon molecules.

3 Hydrogen bonding between water molecules causes water molecules to be packed closely together.

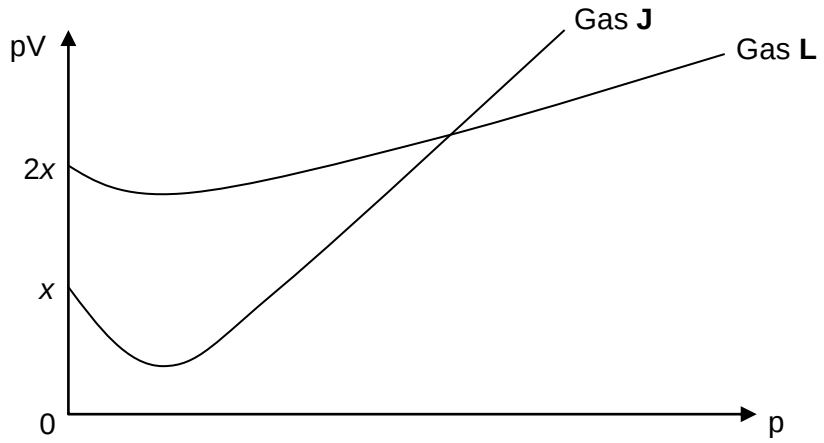
A 2 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3

4 The value of pV is plotted against p for two gases, **J** and **L**, where p is the pressure and V is the volume of the gas.



Which of the following could be the identities of the gases?

	Gas **J**	Gas **L**
1	0.5 mol of H_2O at 25 °C	0.5 mol of H_2 at 50 °C
2	0.5 mol of NH_3 at 25 °C	1 mol of CH_4 at 25 °C
3	0.25 mol of SO_2 at 25 °C	0.5 mol of H_2 at 25 °C

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

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

Which statement about 28.0 g of nitrogen gas is correct?

A It contains the same number of atoms as one mole of neon gas.
B It contains the same number of molecules as 71.0 g of chlorine gas.
C It has the same mass as one mole of carbon dioxide gas.
D The gas occupies a volume of 24 dm^3 at standard temperature and pressure.

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

An element **M** can exist in a few oxidation states.

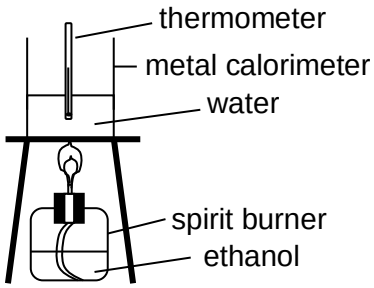
15.00 cm^3 of an aqueous solution of 0.100 mol dm^{-3} of $\mathbf{M}^{n+}$ required 20.00 cm^3 of 0.0250 mol dm^{-3} of acidifed $K_2Cr_2O_7$ solution for a complete reaction.

What is the change in oxidation state of **M**?

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

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

A student carried out an experiment under laboratory conditions and the following results were obtained.



initial temperature of the water	28.0 °C
final temperature of the water	50.4 °C
mass of ethanol burner before burning	259.400 g
mass of ethanol burner after burning	259.286 g
mass of water used	30.000 g

Given that the enthalpy change of combustion of ethanol is –1367 kJ mol^{-1}, what is the efficiency of heat transfer in the above experiment?

A 60.7% **B** 81.1% **C** 82.9% **D** 83.2%

8 Hydrogen can be made from steam as shown.

$$H_2O(g) + C(s) \rightarrow H_2(g) + CO(g)$$

The Gibbs free energy change of the reaction is +78 kJ mol^{-1} at 378K.

Which statement about the reaction is not correct?

A The entropy change is positive.

B The products are energetically less stable than the reactants

C The E_{cell} value of the reaction is positive.

D The reverse reaction is spontaneous.

9 The table below gives data for the reaction between **N** and **Q** at constant temperature.

Experiment	[**N**] / mol dm^{-3}	[**Q**] / mol dm^{-3}	Initial rate / mol dm^{-3} min^{-1}
1	0.003	0.2	4.0×10^{-4}
2	0.006	0.4	1.6×10^{-3}
3	0.006	0.8	6.4×10^{-3}

Which statement about the reaction is not correct?

A The reaction is elementary.

B The rate constant *k* has the units of mol^{-1} dm^3 min^{-1}.

C The half–life of **N** is not constant.

D The order of reaction with respect to [**Q**] is 2.

10 Poly(tetrafluoroethene) is a polymer used as a coating in non–stick kitchen utensils and for replacement of bone joints. One of the stages in the manufacture of the polymer is

$$2CHClF_2(g) \rightleftharpoons C_2F_4(g) + 2HCl(g) \qquad \Delta H_c = +128 \text{ kJ mol}^{-1}$$

Which statement correctly describes the effect of the change applied?

A The equilibrium position will shift to the left when the reaction vessel is expanded.

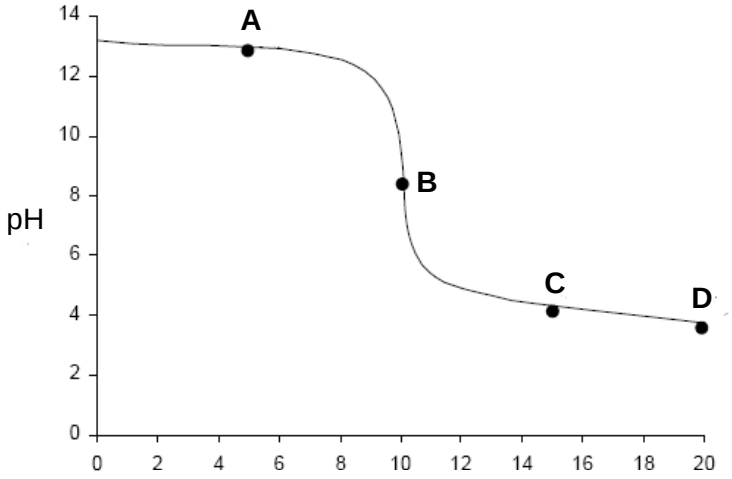
B The equilibrium concentration of $CHClF_2$ decreases when the reaction vessel is cooled.

C The addition of a catalyst will increase the equilibrium concentration of C_2F_4.

D The equilibrium constant, K_c, increases when the reaction vessel is heated.

11 The diagram below shows the change of pH produced by gradually adding 0.100 mol dm^{-3} aqueous ethanoic acid to 10.0 cm^3 of 0.100 mol dm^{-3} aqueous sodium hydroxide.

At which point on the graph does pH = pK_a, where K_a is the acid dissociation constant of ethanoic acid?



12 The following tests were performed on an aqueous solution to identify the unknown ions it contains.

Step	Test	Observations
1	Add $AgNO_3(aq)$ followed by excess dilute $NH_3(aq)$. Swirl and filter the mixture.	Yellow residue and colourless filtrate obtained.
2	Add $Cl_2(aq)$ to filtrate.	Orange solution formed.

Which statements are correct?

1 I^- ion is present in the mixture as the yellow AgI residue was obtained due to the low K_{sp} of AgI.

2 Br^- ion is present in the mixture as it undergoes disproportionation reaction with $Cl_2(aq)$.

3 Br^- ion and $[Ag(NH_3)_2]^+$ ion are present in the filtrate.

A 1, 2 and 3

B 1 and 3 only

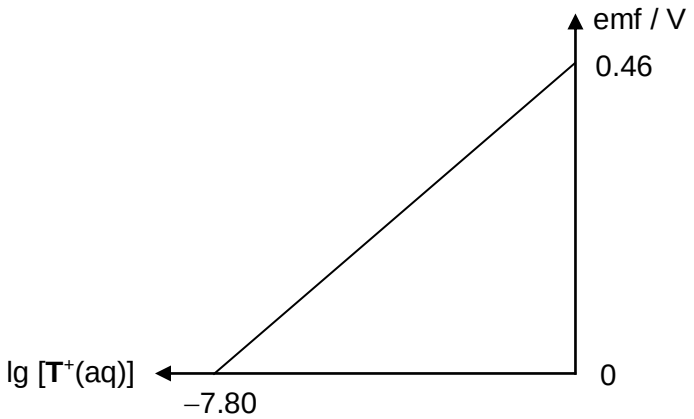
C 2 and 3 only

D 1 only

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

The graph below shows the variation in electromotive force (emf) of the following electrochemical cell with lg [$\mathbf{T}^+(aq)$] at 298 K.

$$Cu(s) \mid Cu^{2+}(aq, 1\ mol\ dm^{-3}) \parallel \mathbf{T}^+(aq) \mid \mathbf{T}(s)$$



Which statement is not correct?

A **T**(s) is the positive electrode.

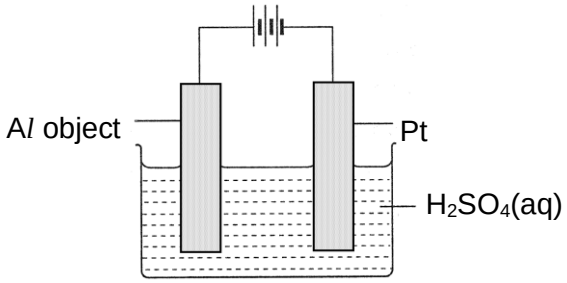
B The direction of electron flow in the external circuit will be reversed when the concentration of $\mathbf{T}^+(aq)$ is 1.00×10^{-5} mol dm^{-3}.

C The emf of the given cell under standard conditions will be +0.46 V.

D The standard electrode potential of the $\mathbf{T}^+(aq) \mid \mathbf{T}(s)$ half−cell is +0.80 V.

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

A piece of aluminium object was placed in dilute sulfuric acid and anodised with a direct current of 1.5 A. After *t* minutes, the mass of the oxide layer formed is 3.7 g.



What is the time taken, *t*, for this anodisation process?

A 38.9 **B** 58.3 **C** 117 **D** 233

15 Consider the following sequence of compounds:

NaF MgO AlN SiC

What conclusions can be drawn about this sequence of compounds from left to right?

1 The electronegativity difference between the elements in each compound increases.
2 These compounds are isoelectronic.
3 The bonding becomes increasingly covalent.

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

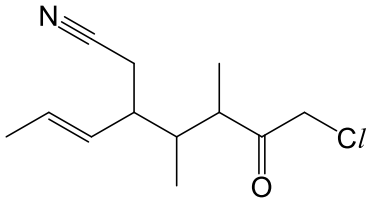
16 A student carried out two experiments involving copper(II) sulfate.

Experiment 1: Addition of aqueous ammonia causes a pale blue precipitate to form which dissolves in excess ammonia to give a deep-blue solution.
Experiment 2: Addition of aqueous potassium iodide produces a white precipitate and a brown solution.

What can be deduced from the experiments?

A The pale blue precipitate dissolves in excess ammonia due to the formation of a complex ion in experiment 1.
B There is a redox reaction occurring in experiment 1.
C The white precipitate formed in experiment 2 is CuI_2.
D The brown solution in experiment 2 decolourises upon addition of sodium thiosulfate due to a ligand exchange reaction.

17 Which of the following options about the structure below is correct?



	Number of *sp* hybridised C	Number of sp^2 hybridised C	Number of sp^3 hybridised C
A	1	3	8
B	1	3	6
C	0	4	8
D	0	4	6

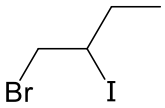
18 3–methylpentane can undergo reaction with chlorine to form monosubstituted compounds that are optically active.

How many possible stereoisomers can be formed in the reaction?

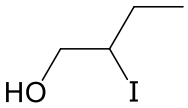
A 4 **B** 5 **C** 6 **D** 8

19 Which of the following is not the product formed when but–1–ene reacts with IBr(aq)?

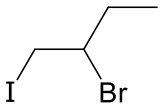
A



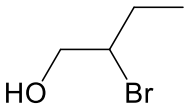
B



C



D



20 Fly paper is used as a non–toxic method of trapping houseflies. To increase its effectiveness and attractiveness, Muscalure, which is a fly sex pheromone, is added to the paper during its manufacture. Mascalure has the following structure:

$$CH_3(CH_2)_7CH{=}CH(CH_2)_{12}CH_3$$

Which of the following statements about Muscalure is not correct?

A In the presence of excess bromine and UV light, it undergoes free radical substitution.

B It exists as a pair of cis–trans isomers.

C It gives a diol with cold dilute acidified potassium dichromate(VI).

D It can be extracted from the fly paper by soaking the paper in benzene.

21 In which of the following reactions do benzene and methylbenzene behave differently?

1 Reacting with hot aqueous alkaline potassium manganate(VII)
2 Reacting with bromine in the presence of an iron catalyst
3 Reacting with bromine in the presence of light

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

22 A sample of bromoethane was warmed with ethanolic silver nitrate, and a cream precipitate was observed after about 4 minutes.

Under similar reaction conditions, which of the following compounds will result in precipitate formation only after 8 minutes?

A iodoethane
B ethanoyl bromide
C bromobenzene
D chloroethane

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

Which of the following statements are likely to be true for the reaction:

$$(CH_3)_3SiCl + C_2H_5O^- \rightarrow (CH_3)_3SiOC_2H_5 + Cl^-$$

1 It is likely to undergo a S_N1 mechanism.
2 $C_2H_5O^-$ plays the role of the nucleophile.
3 Reaction proceeds faster if $(CH_3)_3CCl$ is used instead.

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

24 Geraniol is found in rose oil and is used for the preparation of artificial scents.

Upon controlled oxidation, geraniol yields CH_3COCH_3, $CH_3COCH_2CH_2COOH$ and $(CO_2H)_2$.

A possible structure of geraniol is:

A $CH_3CH=C(CH_3)CH_2CH_2C(CH_3)=CHCH_2OH$

B $(CH_3)_2C=CHCH_2CH_2C(CH_3)=CHCH_2OH$

C $(CH_3)_2C=C(CH_3)CH_2C(CH_3)=CHCH_2OH$

D $(CH_3)_2C=CHCH_2CH_2C(CH_2OH)=CHCH_3$

25 The table below shows the relative rates of reaction for the addition of hydrogen cyanide to ketones under different conditions.

condition	*relative rate*
In water	slow
With small amount of acid	virtually zero
With small amount of base	very rapid

Which of the following statement can explain the above observations?

A H_2O is involved in the rate–determining step.

B The small amount of base added acts as a catalyst.

C Reaction in water is slow due to the low concentration of CN^-.

D H^+ is not a nucleophile.

26 Which of the following compounds react with both $NaBH_4$ and Tollens' reagent?

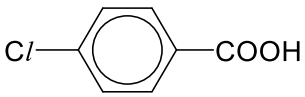
A Both aldehydes and ketones

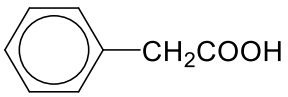
B Aldehydes only

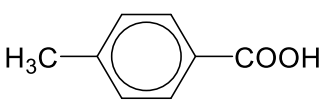
C Ketones only

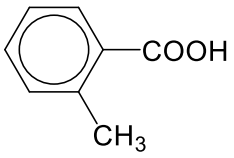
D Neither aldehydes nor ketones

27 Which of the following compounds has the lowest pK_a value?

A 

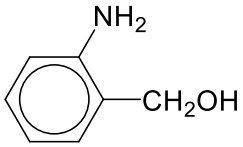
B 

C 

D 

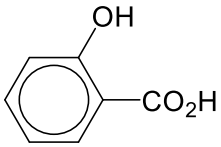
28 A compound **U** releases carbon dioxide from aqueous sodium hydrogencarbonate, and it readily decolourises aqueous bromine.

Which of the following could be **U**?

A 

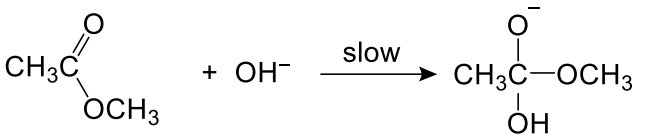
B $HOCH_2CO_2H$

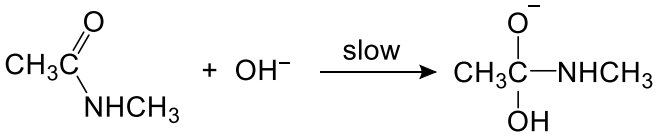
C $CH_2{=}CHCH_2CO_2Na$

D 

29 1 mol of an ester ($CH_3CO_2CH_3$) and an amide ($CH_3CONHCH_3$) underwent base hydrolysis separately and the initial rate of reaction was measured. It was found that the ester undergoes hydrolysis approximately three times faster than the amide.

The slow step of the base hydrolysis of the ester and amide is the same and shown below.





Which statements help to explain the faster rate of base hydrolysis of the ester?

1 Oxygen is more electronegative then nitrogen.

2 The lone pair of electrons on the nitrogen atom in the amide interacts more with the carbonyl group.

3 There are two lone pairs of electrons on the oxygen atom in the ester and only one lone pair of electron on the nitrogen atom in the amide.

A 1, 2 and 3

B 1 and 2 only

C 1 and 3 only

D 2 and 3 only

30 **X** is synthetic nonapeptide that is resynthesised from the amino acids found in honey bee venom. To investigate the sequence of amino acids in **X**, the nonapeptide was first hydrolysed by two enzymes. The protein fragments were then separated and their sequence determined.

The following protein fragments were obtained from the first enzyme which hydrolysed the peptide chain at the carboxylic end of the amino acid isoleucine, Ile.

Arg–Ile
Ser–Lys–Trp–Ile
Lys–Leu–Arg

The second enzyme, which hydrolysed the peptide chain at the carboxylic end of the amino acid lysine, Lys, yielded the following fragments

Arg–Ile–Ser–Lys
Trp–Ile–Lys
Leu–Arg

Which of the following is the correct primary structure of the nonapeptide **X**?

A Lys–Leu–Arg–Ile–Ser–Lys–Trp–Ile–Lys

B Trp–Ile–Lys–Leu–Arg–Ile–Ser–Lys–Trp

C Arg–Ile–Ser–Lys–Trp–Ile–Lys–Leu–Arg

D Arg–Ile–Ser–Lys–Leu–Arg–Trp–Ile–Lys