

ANGLO-CHINESE JUNIOR COLLEGE
DEPARTMENT OF CHEMISTRY
Preliminary Examination

CHEMISTRY
Higher 2

9729/01

Paper 1 Multiple Choice

16 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, index number and tutorial class 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** 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.

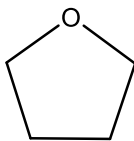
Any rough working should be done in this booklet.

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

This document consists of **15** printed pages and **1** blank page.



- 1 In July 2020, some households in Singapore reported a Pandan smell in their tap water. This was caused by an organic solvent tetrahydrofuran, THF, which has the following structure.



The laboratory found that the concentration of THF in the Pandan smelling water was less than 10 ppb (10 parts per billion) by mass, which was significantly lower than the levels of THF that would cause health concerns.

What is the concentration of 10 ppb of THF in mol dm^{-3} ?

Given:

- 1 billion = 10^9
- density of water = 1.0 g cm^{-3}

- A 1.39×10^{-10}
 B 1.39×10^{-7}
 C 1.56×10^{-7}
 D 6.40×10^{-4}
- 2 *Use of the Data Booklet is relevant to this question.*

The approximate percentage composition of the atmospheres on four planets are given below.

The density of a gas may be defined as the mass of 1 dm^3 of the gas.

Which mixture of gases has the greatest density?

	planet	gases / % by volume
A	Jupiter	H_2 88.8, He 10.2, Ar 1.0
B	Neptune	H_2 80.0, He 19.0, CH_4 1.0
C	Saturn	H_2 92.3, He 7.2, CH_4 0.5
D	Uranus	H_2 82.5, He 15.2, CH_4 2.3

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

An element **E** can exist in a few oxidation states. 0.01 mol of E^{2+} is completely reacted with 0.004 mol of acidified KMnO_4 .

What is the final oxidation state of **E**?

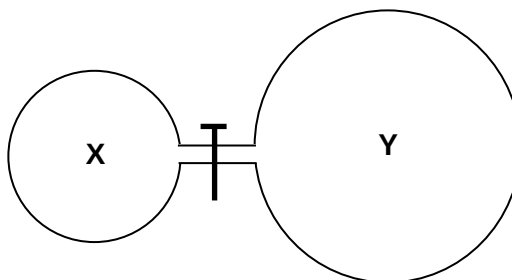
- A +4 B +3 C 0 D -1

- 4 The successive ionisation energies (IE) of two elements, **M** and **N**, are given below.

IE / kJ mol ⁻¹	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th
M	550	1065	4138	5500	6910	8760	10230	11800
N	1140	2103	3470	4560	5760	8550	9940	18600

What is the likely formula of the compound that is formed between **M** and **N**?

- A** **MN** **B** **MN₂** **C** **M₂N** **D** **M₃N₂**
- 5 Which of the following statements best explains why the first ionisation energy of argon is higher than that of sulfur?
- A** Sulfur is more electronegative than argon.
B Argon has a complete octet, while sulfur does not.
C The nuclear charge in argon is greater than that in sulfur.
D The electron removed from sulfur is unpaired, while that removed from argon is paired.
- 6 Two glass bulbs **X** and **Y** are connected by a closed valve.

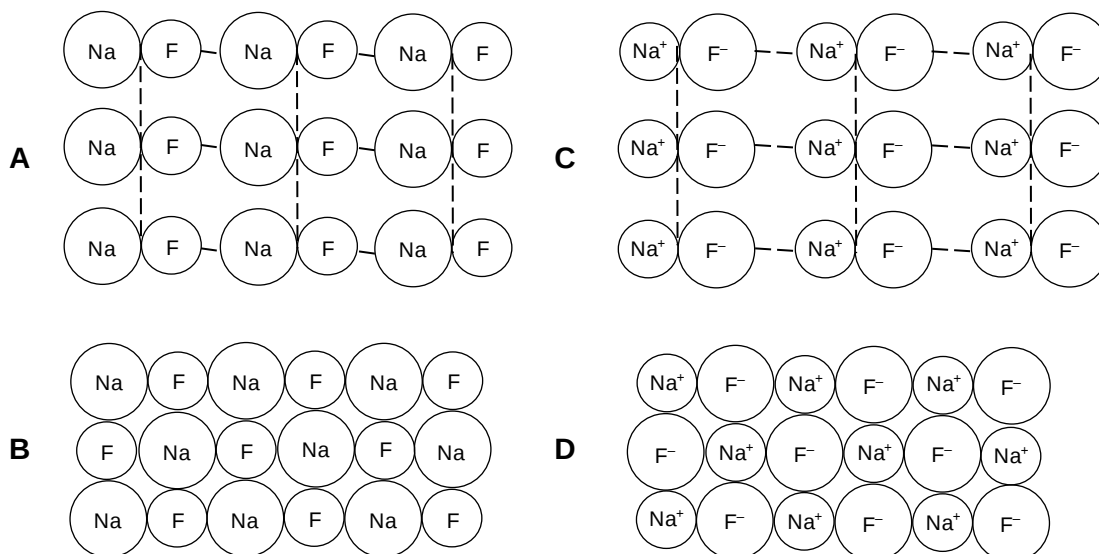


X contains neon at 20 °C at a pressure of 1×10^5 Pa. **Y** is initially empty, and has three times the volume of **X**. In an experiment, the valve is opened and the temperature of the whole apparatus is raised to 100 °C.

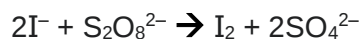
What is the final pressure in the system?

- A** 3.18×10^4 Pa
B 4.24×10^4 Pa
C 1.25×10^5 Pa
D 5.09×10^5 Pa
- 7 Which of the following species is **not** planar?
- A** XeF₄ **B** ICl₃ **C** PCl₄⁺ **D** C₂Cl₄

8 Which diagram best represents the structure of sodium fluoride?



9 An experiment was carried out to investigate the kinetics of reaction between potassium peroxodisulfate, $\text{K}_2\text{S}_2\text{O}_8$, and potassium iodide, KI.



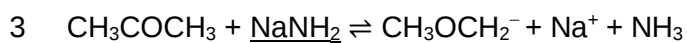
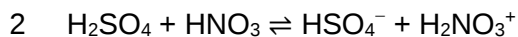
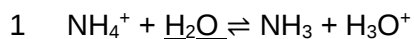
In each experiment, $\text{K}_2\text{S}_2\text{O}_8$ and KI solutions are mixed with fixed volumes of $\text{Na}_2\text{S}_2\text{O}_3$ and starch solutions. The initial concentrations of the $\text{K}_2\text{S}_2\text{O}_8$ and KI solutions in the mixture and the time taken for the mixture to turn dark blue for the various experimental runs are given below.

experiment	initial concentration of $\text{K}_2\text{S}_2\text{O}_8$ / mol dm^{-3}	initial concentration of KI / mol dm^{-3}	time taken to turn dark blue / s
1	0.010	0.020	35
2	0.005	0.020	70
3	0.010	0.004	175
4	0.020	0.040	

What is the time taken (in seconds) for the mixture to turn dark blue in experiment 4?

- A** 8.75 **B** 17.5 **C** 35 **D** 140

10 In which of the following is the underlined species behaving as a Bronsted-Lowry base?



A 1 only

C 3 only

B 1 and 2 only

D 1, 2 and 3 only

11 Which of the following statements best explains why AgCl is soluble in aqueous NH_3 , but AgI is not?

A AgCl forms a complex with NH_3 but AgI does not.

B The solubility product, K_{sp} , of AgCl is greater than that of AgI .

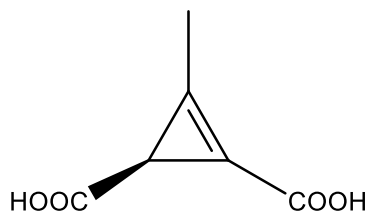
C The M_r of AgI is greater than that of AgCl .

D The ionic bonds between Ag^+ and I^- are stronger than the ionic bonds between Ag^+ and Cl^- .

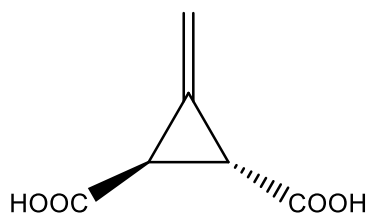
12 In 1893, a new compound Feist's acid was discovered and found to be optically active.

Based on the above information, which of the following could be the structures of Feist's acid?

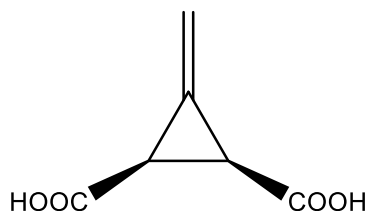
1



2



3



A 1 only

C 1 and 3 only

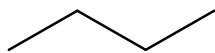
B 1 and 2 only

D 1, 2 and 3

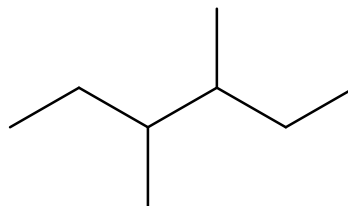
- 13 In the presence of ultraviolet light, ethane and bromine react to give a mixture of products.

Which compound **cannot** be present in the mixture of products?

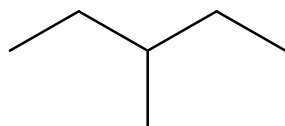
A



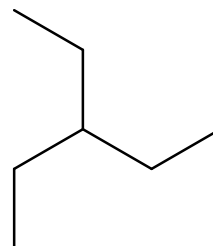
C



B



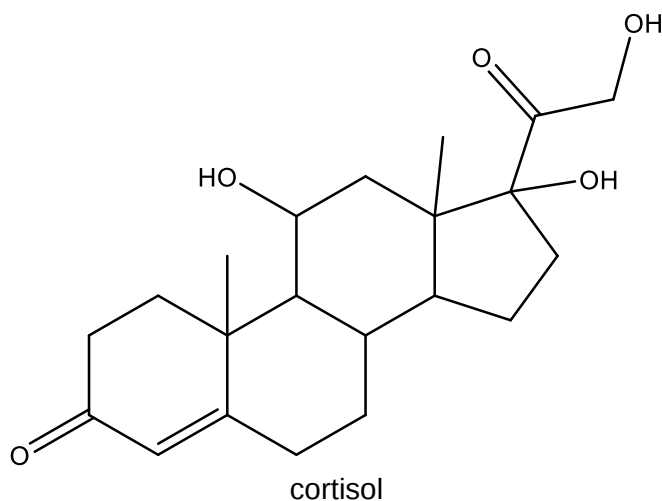
D



- 14 When pent-2-ene is reacted with cold dilute acidified potassium manganate(VII), what will be the major product(s)?

- A $\text{CH}_3\text{CH}_2\text{COCOCH}_3$
 B $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
 C $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_3$
 D $\text{CH}_3\text{CH}_2\text{COOH}$ and CH_3COOH

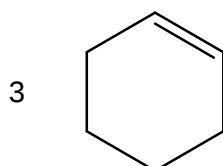
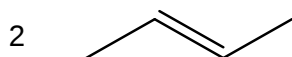
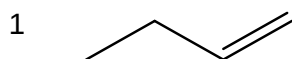
- 15 Cortisol is a hormone involved in the metabolism of fats, proteins and carbohydrates.



How many chiral centres are there in one molecule of cortisol?

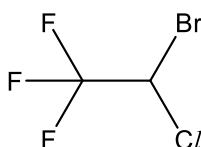
- A 5 B 6 C 7 D 8

- 16** Which alkenes, on reaction with steam at high temperature and pressure in the presence of a phosphoric acid catalyst, could produce an alcohol containing a chiral carbon atom?



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

- 17** Halothane is a general inhalation anesthetic used for the induction and maintenance of general anesthesia.



halothane

Which statement about halothane is correct?

- A** Halothane is highly flammable.
B The molecule has two chiral centres.
C It may cause the depletion of the ozone layer.
D Its IUPAC name is 1-bromo-2-chloro-1,1,1-trifluoroethane.
- 18** When $\text{CH}_3\text{CH}_2\text{CBr}_2\text{CH}_2\text{CH}_3$ is heated with ethanolic KOH, which hydrocarbons could be produced?

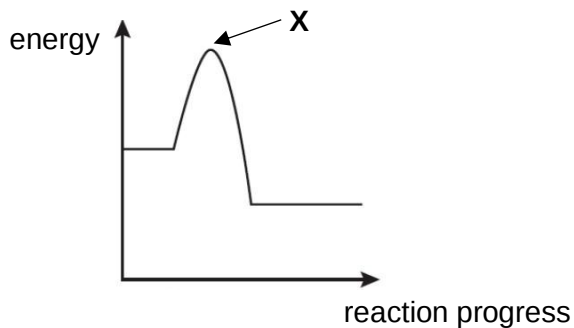
- 1 $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CCH}_3$
 2 $\text{CH}_3\text{CH}=\text{C}=\text{CHCH}_3$
 3 $\text{CH}_3\text{CH}_2\text{CH}=\text{C}=\text{CH}_2$

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

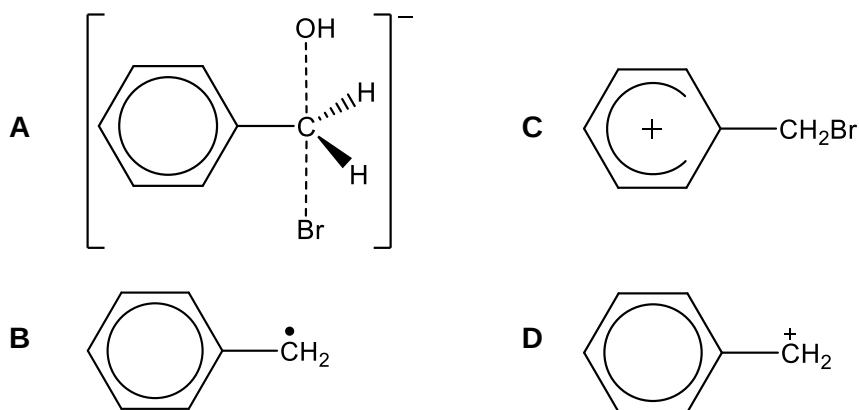
- 19 When (bromomethyl)benzene was heated with NaOH in dimethyl sulfoxide solvent, the following reaction takes place.



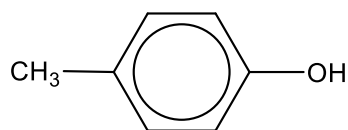
The energy profile diagram for the reaction is shown below.



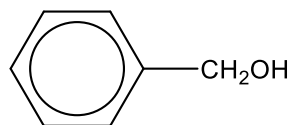
Which of the following represents the species at point X?



- 20 4-methylphenol and phenylmethanol are isomers.



4-methylphenol



phenylmethanol

Which of the following reagents can be used to distinguish between 4-methylphenol and phenylmethanol?

- 1 aqueous bromine
- 2 phosphorus(V) chloride
- 3 neutral iron(III) chloride solution
- 4 hot acidified potassium dichromate(VI)

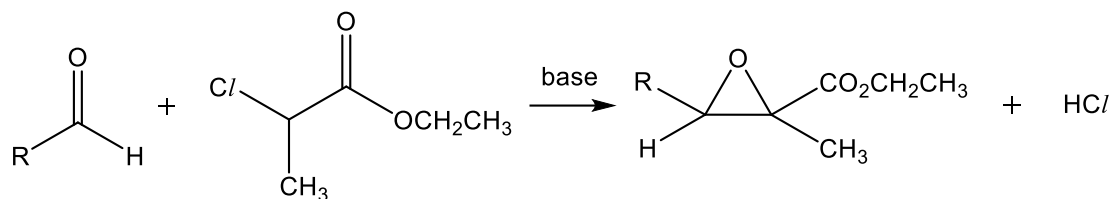
A 1 and 3 only

C 1, 2 and 3 only

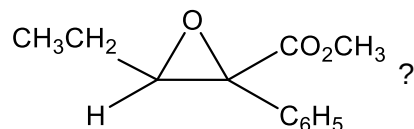
B 3 and 4 only

D 1, 2, 3 and 4

- 21** In the Darzens reaction, an aldehyde can react with an α -haloester in the presence of a base to form a three-membered ether ring known as an epoxide.



Which pair of reactants will react to produce



- A**
- B**
- C**
- D**

22 Given the following information:

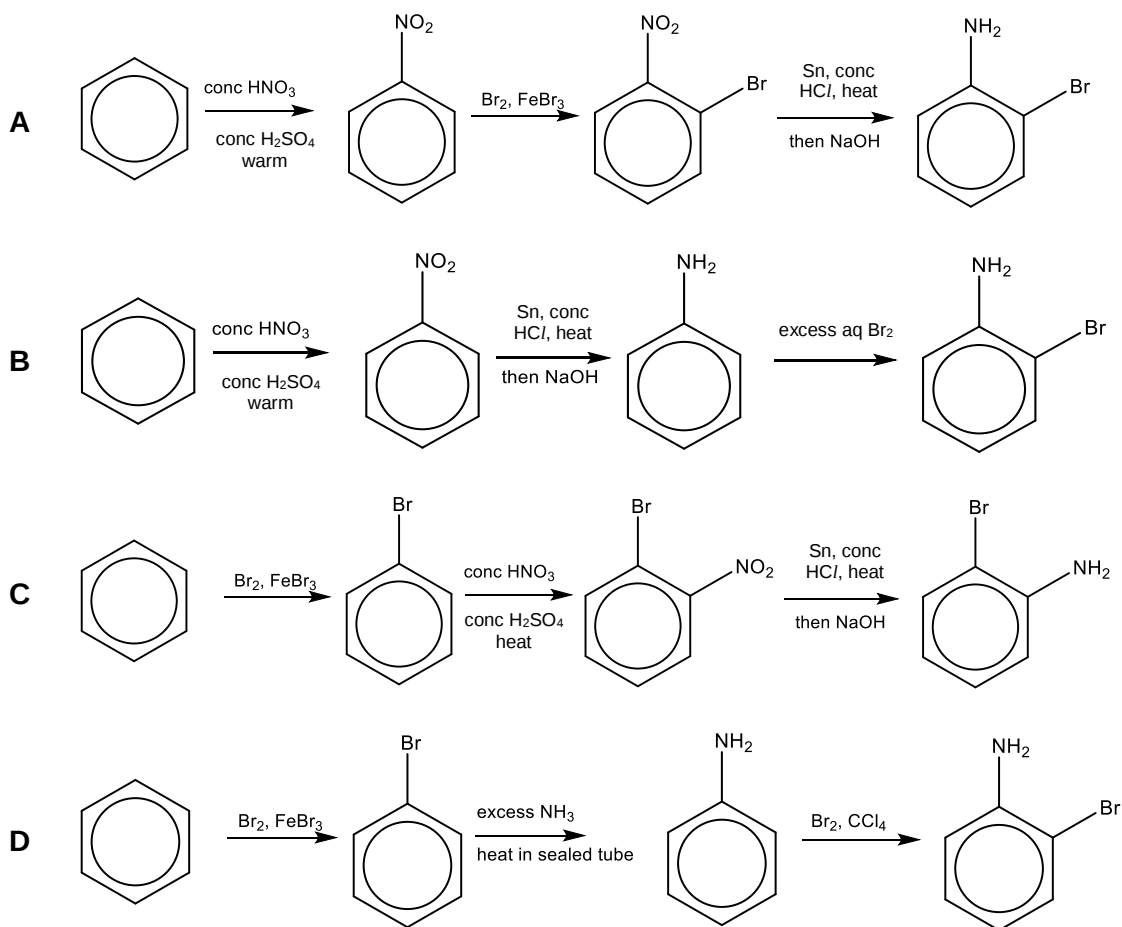
acid	pK_a
HF	3.1
HCl	-6.0
H ₂ O	15.7

Which of the following statements are correct?

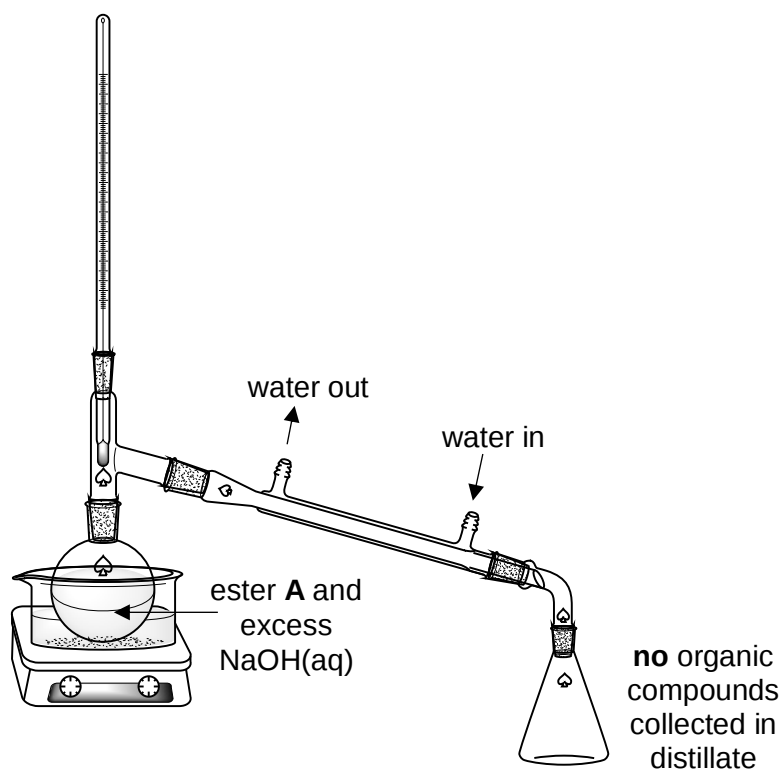
- 1 A solution containing 0.1 mol dm^{-3} of NaF has the same pH as 0.1 mol dm^{-3} of NaCl.
- 2 When excess Na_2CO_3 is added, 20 cm^3 of 0.1 mol dm^{-3} of aqueous HF evolves the same volume of CO_2 gas as 20 cm^3 of 0.1 mol dm^{-3} of aqueous HCl.
- 3 NH_3 ionises to a greater extent in liquid HF than in liquid H_2O .

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

23 Which of the following is the best method to prepare 2-bromophenylamine from benzene?

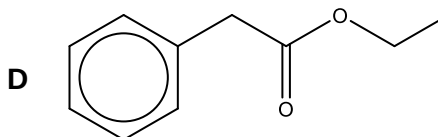
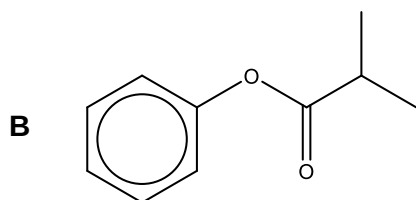
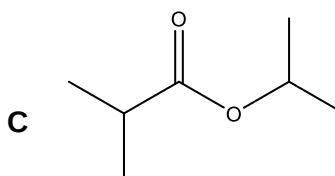
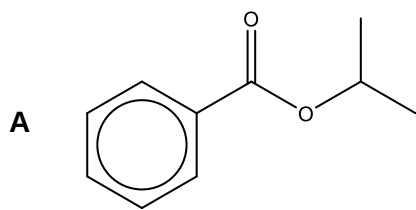


- 24 In this experiment, ester **A** was boiled with NaOH(aq) in the set up shown below. It was found that the distillate did **not** contain any organic compounds.



compound	boiling point / °C	compound	boiling point / °C
<chem>CC(C)O</chem>	83	<chem>CC(C)C(=O)O</chem>	155
<chem>c1ccccc1O</chem>	182	<chem>c1ccccc1C(=O)O</chem>	250
<chem>CCO</chem>	78	<chem>c1ccccc1CC(=O)O</chem>	266

Given the information on **page 11**, which is the correct structure of ester **A**?



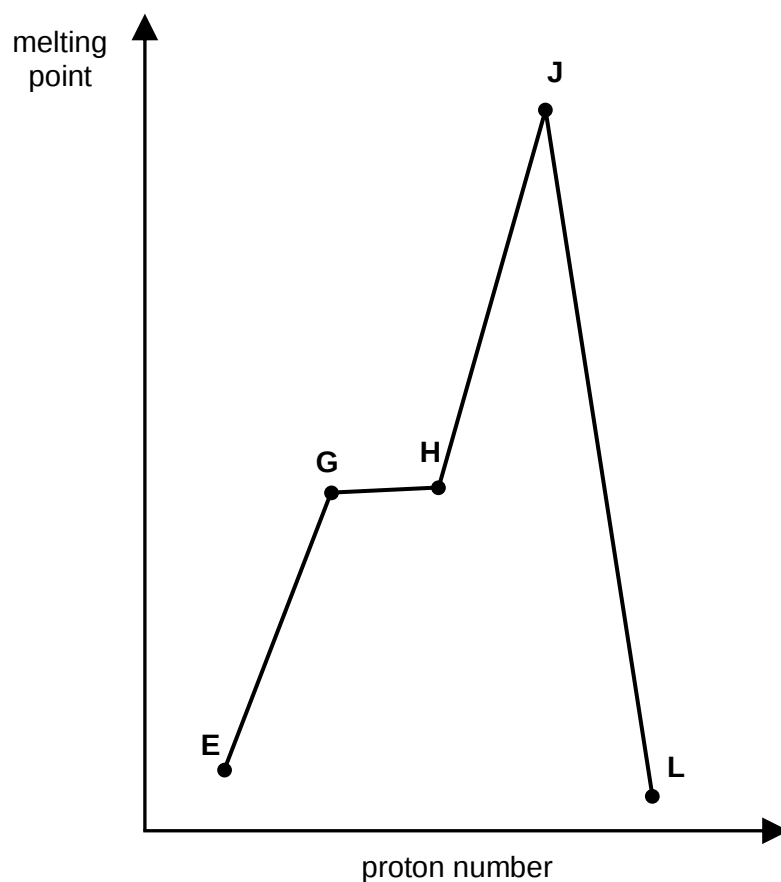
- 25** Which of the following shows the correct arrangement of the compounds according to increasing pH in solution?

- A** CH_3CONH_2 , $\text{CH}_2=\text{CHNH}_2$, $\text{CH}_3\text{CH}_2\text{NH}_2$, $\text{CH}_3\text{CH}_2\text{NH}_3^+\text{Cl}^-$
B $\text{CH}_2=\text{CHNH}_2$, CH_3CONH_2 , $\text{CH}_3\text{CH}_2\text{NH}_3^+\text{Cl}^-$, $\text{CH}_3\text{CH}_2\text{NH}_2$
C $\text{CH}_3\text{CH}_2\text{NH}_3^+\text{Cl}^-$, CH_3CONH_2 , $\text{CH}_2=\text{CHNH}_2$, $\text{CH}_3\text{CH}_2\text{NH}_2$
D $\text{CH}_3\text{CH}_2\text{NH}_3^+\text{Cl}^-$, $\text{CH}_2=\text{CHNH}_2$, $\text{CH}_3\text{CH}_2\text{NH}_2$, CH_3CONH_2

- 26** Which compound dissolves in water to give a solution with the lowest pH?

- A** SO_3 **C** P_4O_{10}
B MgCl_2 **D** Al_2O_3

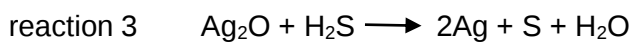
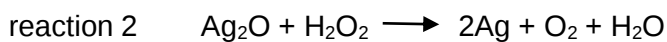
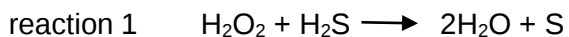
- 27 The melting points of five consecutive elements in Period 3 are represented in the diagram below.



Which option describes the structures of these elements correctly?

	simple molecular	giant metallic lattice	giant molecular
A	E & L	G, H & J	none
B	L	E, G, H & J	none
C	E & L	G & H	J
D	L	E, G & H	J

28 Three reactions involving H_2O_2 , H_2S and Ag_2O are shown below.



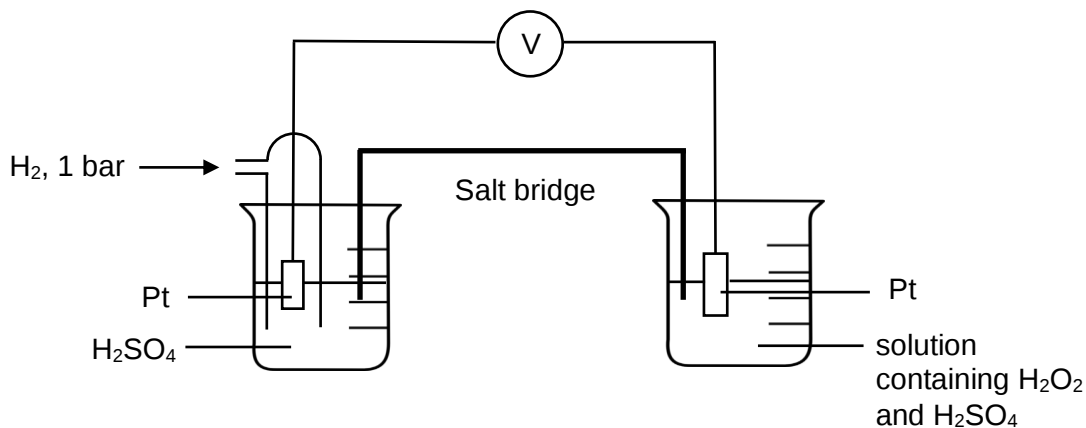
Which statements are correct?

- 1 The oxidation number of oxygen in H_2O_2 is -1 .
- 2 H_2S is the strongest reducing agent of the three species.
- 3 Ag_2O behaves as an oxidising agent in reaction 2.

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

29 Use of the Data Booklet is relevant to this question.

The following apparatus is assembled to measure the standard electrode potential of a half-cell. All measurements are made at 298 K.

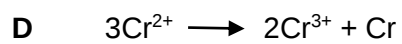
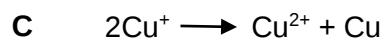
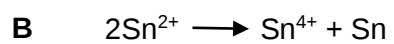
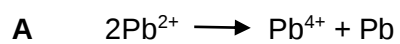


Which row correctly describes the concentration of H_2SO_4 used and the reading on the voltmeter?

	$[\text{H}_2\text{SO}_4] / \text{mol dm}^{-3}$	voltmeter reading / V
A	0.5	+0.68
B	0.5	+1.77
C	1	+0.68
D	1	+1.77

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

Which reaction occurs spontaneously?



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