

NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CHEMISTRY

9729/01

Paper 1 Multiple Choice

25 SEP 2017

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, CT and NRIC / FIN on the Answer Sheet in the spaces provided.

There are **thirty** questions in 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** To determine the mass of arsenic present in a sample of pesticide, all the arsenic was first converted to arsenate ion, AsO_4^{3-} . 1.25×10^{-3} mol of AgNO_3 was then added to precipitate AsO_4^{3-} as Ag_3AsO_4 . The excess Ag^+ ions needed 3.64 cm^3 of $0.054 \text{ mol dm}^{-3}$ KSCN to form silver thiocyanate, AgSCN .

Calculate the mass of arsenic ($A_r = 74.9$) present in the sample of pesticide.

A 0.015 g **B** 0.026 g **C** 0.079 g **D** 0.488 g

- 2** How many moles of electrons must be removed from each mole of methylbenzene, $\text{C}_6\text{H}_5\text{CH}_3$, when it is oxidised to benzoic acid, $\text{C}_6\text{H}_5\text{COOH}$?

A 1 **B** 2 **C** 4 **D** 6

- 3** Which elements have the same number of unpaired electrons in its orbitals with principal quantum number 2?

1 Beryllium **2** Carbon **3** Nitrogen **4** Oxygen

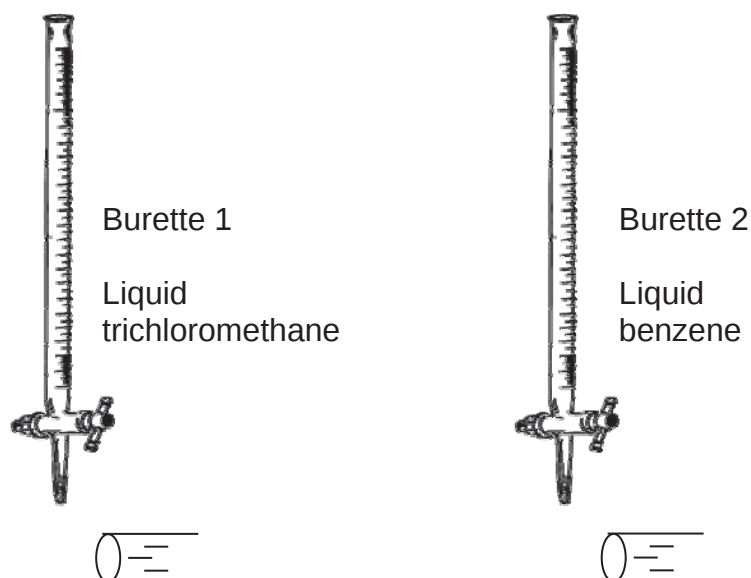
A 1 and 2 only

B 2 and 3 only

C 2 and 4 only

D 3 and 4 only

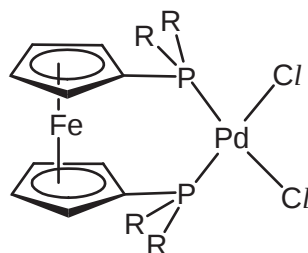
- 4 The diagram below shows liquid trichloromethane and liquid benzene in burettes 1 and 2 respectively.



What would happen to the flow of the liquids trichloromethane and benzene when a negatively-charged rod is brought near to each of them?

	Liquid trichloromethane	Liquid benzene
A	Deflected towards the rod	Deflected towards the rod
B	Undeflected	Deflected towards the rod
C	Deflected towards the rod	Undeflected
D	Undeflected	Undeflected

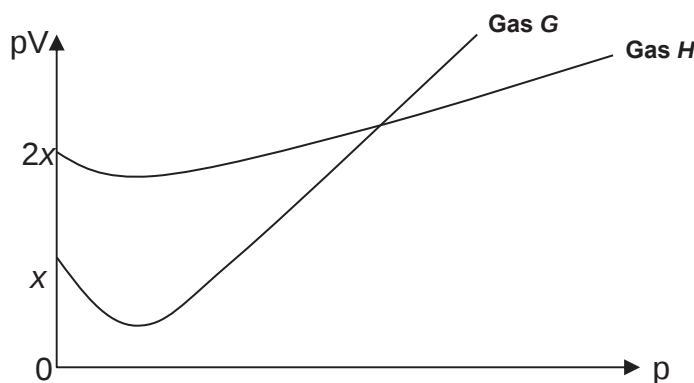
- 5 Palladium compounds are widely used as catalyst in coupling reactions. One such compound is $(\text{dppf})\text{PdCl}_2$ with its structure shown below.



What does the structure of $(\text{dppf})\text{PdCl}_2$ suggest about the nature of the bonding between Pd and the phosphorus atoms, and the oxidation state of Pd?

	Nature of bonding	Oxidation state
A	Covalent	0
B	Ionic	0
C	Covalent	+2
D	ionic	+2

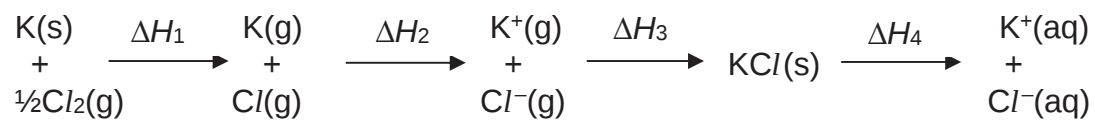
- 6 The value of pV is plotted against p for two gases, G and H, where p is the pressure and V is the volume of the gas.



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

	Gas G	Gas H
A	0.5 mol of H_2 at 25°C	0.5 mol of H_2 at 50°C
B	0.5 mol of H_2 at 25°C	1 mol of SO_2 at 25°C
C	0.5 mol of SO_2 at 25°C	0.5 mol of SO_2 at 50°C
D	0.5 mol of SO_2 at 25°C	1 mol of H_2 at 25°C

- 7 The enthalpy changes involved in the formation of KCl(aq) from K(s) and $\text{Cl}_2(\text{g})$ are as follows:

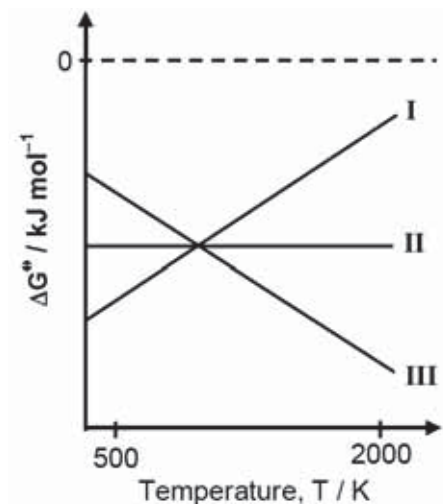


Which statements are correct?

- 1 The lattice energy of potassium chloride is ΔH_3 .
 - 2 The enthalpy change of solution of potassium chloride is $(\Delta H_3 + \Delta H_4)$.
 - 3 The enthalpy change of formation of solid potassium chloride is $(\Delta H_1 + \Delta H_2 + \Delta H_3)$.
- A** 3 only
- B** 1 and 3 only
- C** 2 and 3 only
- D** 1, 2 and 3 only

- 8 In 1944, T. Ellingham published plots of ΔG° against temperature T , for a number of reactions. Today, such plots are called Ellingham diagrams.

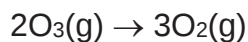
An Ellingham diagram for three reactions involving the oxidation of C and CO is shown below.



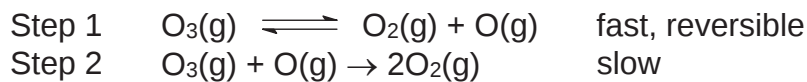
Which of the following shows correctly the three reactions corresponding to **I**, **II** and **III** in the above Ellingham diagram?

	I	II	III
A	$2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$	$2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$
B	$2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$	$2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$
C	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$	$2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$	$2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$
D	$2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$	$2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$

- 9 Ozone in the earth's atmosphere decomposes according to the equation:



This reaction is thought to occur via a two-step mechanism:



With the aid of the K_c expression in Step 1, which rate law is consistent with this mechanism?

A $\text{Rate} = k \frac{[\text{O}_3]^2}{[\text{O}_2]}$

B $\text{Rate} = k \frac{[\text{O}_3]^2}{[\text{O}_2]^3}$

C $\text{Rate} = k[\text{O}_3]$

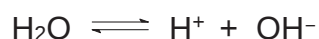
D $\text{Rate} = k[\text{O}_3]^2$

- 10 What does the following pair of values for a reaction system indicate?

	<i>values</i>
ΔG^θ	-50.8
K_c	5.80×10^8

- A** Reaction goes to completion.
- B** ΔH^θ is positive and ΔS^θ is negative.
- C** Rate of the forward reaction is high.
- D** Position of equilibrium lies to the left.

- 11** Water dissociates into H^+ and OH^- as shown.



At 25 °C, the equilibrium $[\text{H}^+]$ is $10^{-7} \text{ mol dm}^{-3}$; $[\text{H}_2\text{O}] = 55.6 \text{ mol dm}^{-3}$.

What is the order of increasing numerical value of pH, $\text{p}K_{\text{a}}$ and $\text{p}K_{\text{w}}$ for this equilibrium at this temperature?

	smallest		largest
A	pH	$\text{p}K_{\text{w}}$	$\text{p}K_{\text{a}}$
B	pH	$\text{p}K_{\text{a}}$	$\text{p}K_{\text{w}}$
C	$\text{p}K_{\text{w}}$	$\text{p}K_{\text{a}}$	pH
D	$\text{p}K_{\text{a}}$	$\text{p}K_{\text{w}}$	pH

- 12** An aqueous solution of sodium carbonate is added very slowly, till excess, to a solution containing 0.2 mol dm^{-3} of zinc nitrate and 0.1 mol dm^{-3} of silver nitrate at 25 °C.

The numerical value of the solubility product of zinc carbonate at 25 °C is 1.4×10^{-11} and that of silver carbonate is 8.1×10^{-12} .

Which statement describes what happens in the solution?

- A** Only zinc carbonate is precipitated.
- B** Only silver carbonate is precipitated.
- C** Zinc carbonate is precipitated first, followed by silver carbonate.
- D** Silver carbonate is precipitated first, followed by zinc carbonate.

- 13** J, K and L are elements in the same period of the Periodic Table. The oxide of J is

amphoteric, the oxide of K is basic and the oxide of L is acidic.

What is the correct order of trend for these elements?

1 Proton number: $K < J < L$

2 Atomic radius: $L < J < K$

3 Melting point: $J < L < K$

A 1 only

B 2 only

C 1 and 2 only

D 1,2 and 3 only

- 14** The table below shows the results of experiments in which the halogens, P_2 , Q_2 and R_2 were added to separate aqueous solutions containing P^- , Q^- and R^- ions.

	P^- (aq)	Q^- (aq)	R^- (aq)
P_2	no reaction	no reaction	R_2 formed
Q_2	P_2 formed	no reaction	R_2 formed
R_2	no reaction	no reaction	no reaction

In which sequence is the solubility of the silver halides in aqueous ammonia arranged in increasing order?

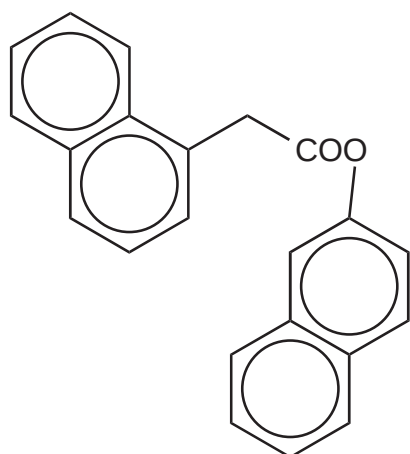
A $AgP < AgQ < AgR$

B $AgQ < AgP < AgR$

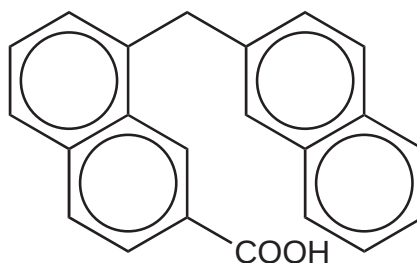
C $AgQ < AgR < AgP$

D $AgR < AgP < AgQ$

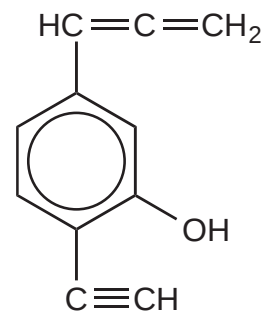
- 15** The three compounds A, B and C have the following structures.



A



B



C

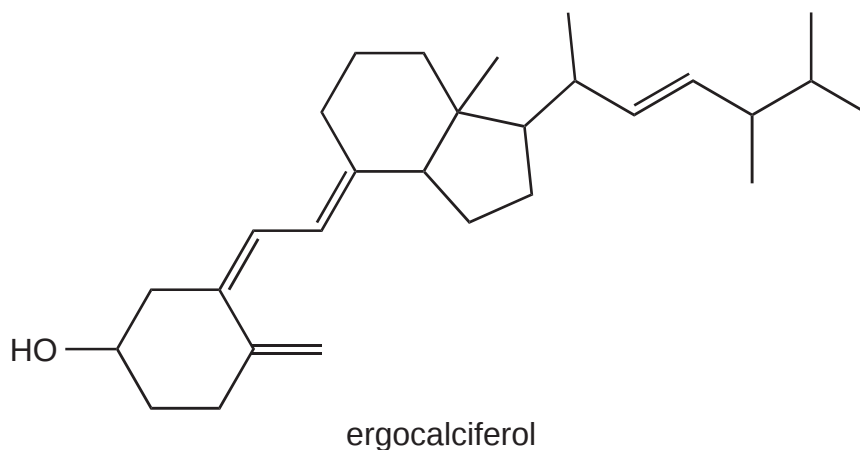
Which of the following statements about A, B and C are correct?

- 1 A and C have the same empirical formula.
- 2 A and B are isomers.
- 3 The M_r of A is twice that of C.

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

16 Vitamin D has a significant role in calcium homeostasis.

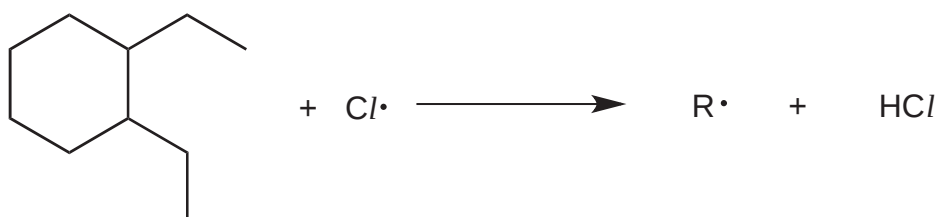
One major form of Vitamin D is ergocalciferol.



How many stereocentres do a molecule of ergocalciferol have?

- A** 6 **B** 7 **C** 8 **D** 9

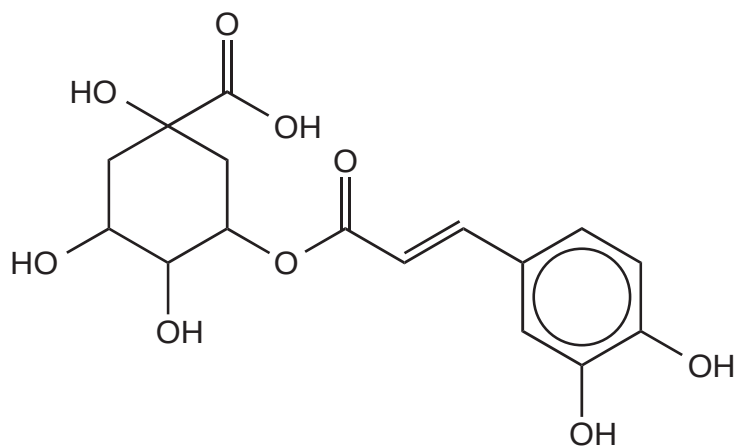
- 17** When heated with chlorine, the following hydrocarbon undergoes free radical substitution. In the propagation step, the free radical $R^\bullet$ is formed from the loss of one hydrogen atom.



How many different forms of $R^\bullet$ are theoretically possible?

- A** 5 **B** 7 **C** 9 **D** 10

- 18** Chlorogenic acid occurs naturally in coffee.



chlorogenic acid

What is the maximum number of bromine atoms that would be incorporated when gaseous hydrogen bromide reacts with chlorogenic acid?

- A** 3
- B** 4
- C** 5
- D** 6

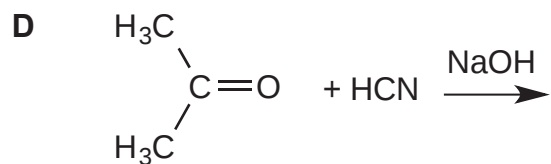
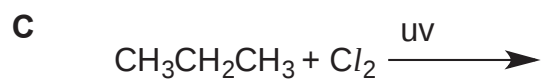
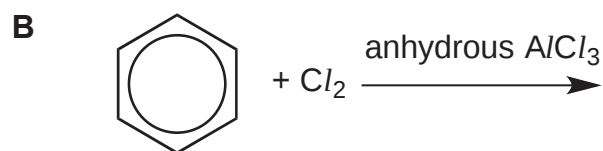
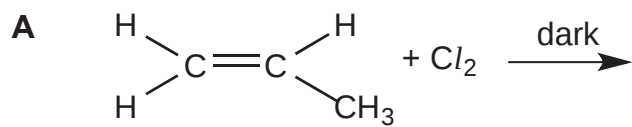
19 Deuterium is an isotope of hydrogen, ^2H .

Which of the following will not yield a carbon-containing species, which contains deuterium?

- A** $\text{CH}_3\text{COCH}_2\text{CH}_3$ with warm I_2 and NaOD in D_2O
- B** $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ with LiAlD_4 in dry ether
- C** $\text{CH}_3\text{CH}_2\text{COCH}_3$ with DCN and trace amounts of NaCN
- D** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ with hot Ag^+ and ND_3 in D_2O

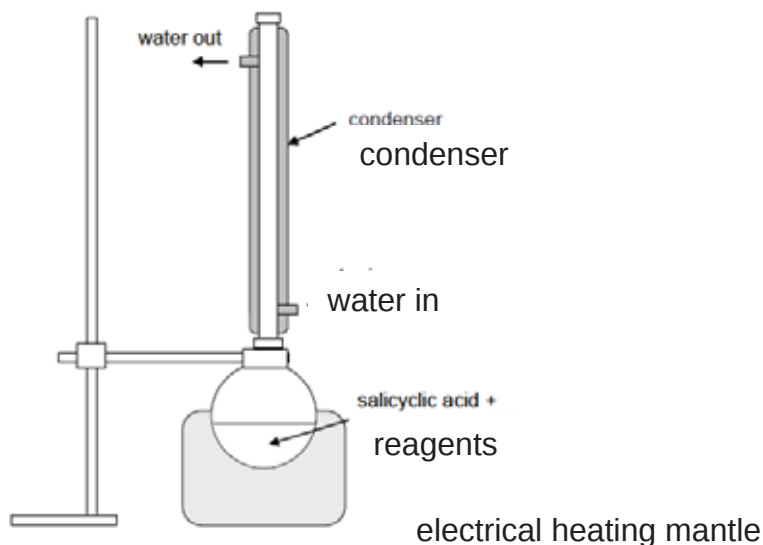
20 In which reaction does a carbon atom change from being sp^3 hybridised in the

intermediate to being sp^2 hybridised in the product?



21 The setup below is commonly used in the synthesis of organic compounds in the

laboratory.



Which of the following reactions requires the above set up for synthesis?

- A** $\text{CH}_3\text{CH}_2\text{NH}_2 + \text{CH}_3\text{COCl} \rightarrow \text{CH}_3\text{CONHCH}_2\text{CH}_3 + \text{HCl}$
- B** $\text{CH}_3\text{COCl} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COOH} + \text{HCl}$
- C** $\text{CH}_3\text{CH}_2\text{OH} + [\text{O}] \rightarrow \text{CH}_3\text{CHO} + \text{H}_2\text{O}$
- D** $\text{CH}_3\text{CONH}_2 + \text{NaOH} \rightarrow \text{CH}_3\text{COO}^-\text{Na}^+ + \text{NH}_3$

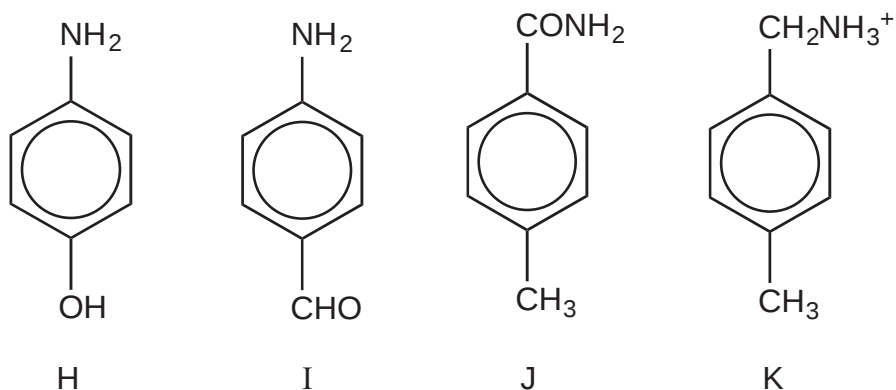
22 A catalytic converter is part of the exhaust system of many modern cars. Which reactions occur in a catalytic converter?

- 1** $2\text{CO} + 2\text{NO} \rightarrow 2\text{CO}_2 + \text{N}_2$
- 2** $2\text{SO}_2 + 2\text{NO} \rightarrow 2\text{SO}_3 + \text{N}_2$
- 3** $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$
- 4** $\text{CO}_2 + \text{NO} \rightarrow \text{CO} + \text{NO}_2$

- A** 1 and 2 only
- B** 1 and 3 only
- C** 2 and 4 only
- D** 3 and 4 only

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

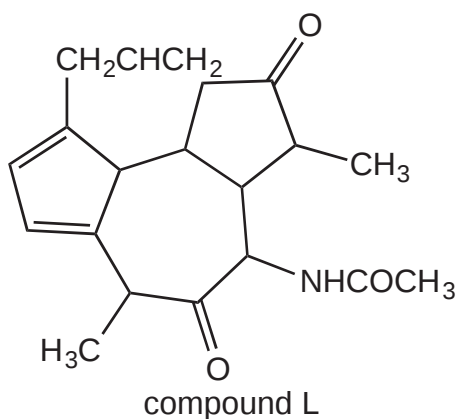
The structures of some nitrogen containing compounds are shown below.



What is the order of increasing basicity, least to most basic, of the nitrogen containing compounds?

	increasing basicity →			
A	K	J	I	H
B	K	J	H	I
C	H	I	J	K
D	J	K	I	H

24 The diagram shows the structure of compound L.

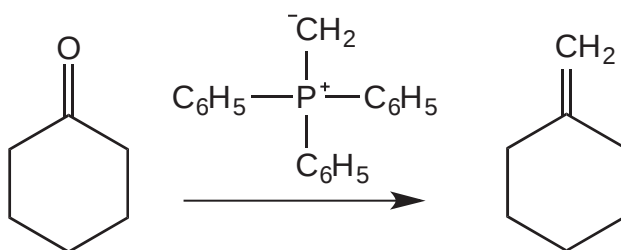
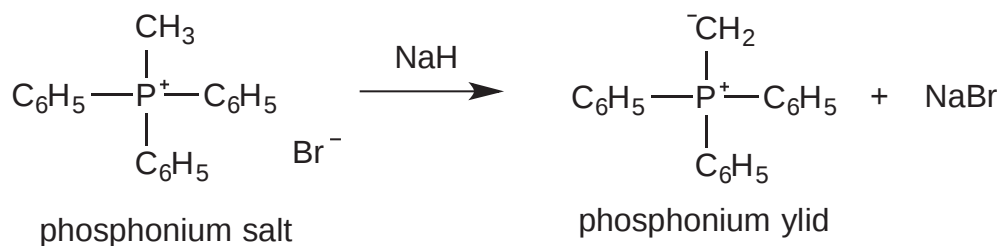


It reacts with LiAlH_4 in dry ether to give a cyclic compound M.

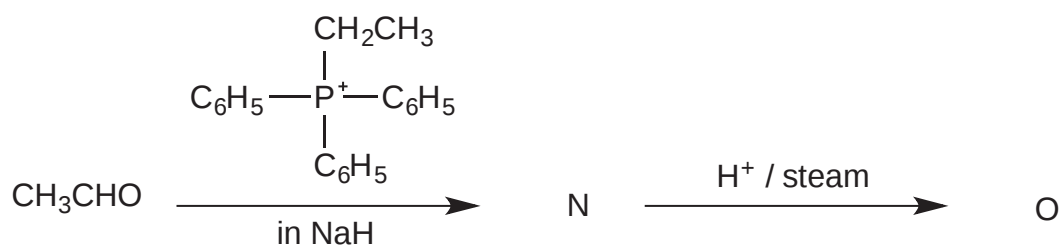
Which of the following statements about compound M is correct?

- A** It reacts with ethanoic acid to form one mole of amide.
- B** It reacts with two moles of 2,4-dinitrophenylhydrazine.
- C** It reacts with sodium metal to produce one mole of hydrogen gas.
- D** It reacts with acidified potassium manganate(VII) to form two moles of carbon dioxide gas.

aldehydes. It involves a reaction between a carbonyl compound and a phosphonium ylid as shown in the following reaction scheme.

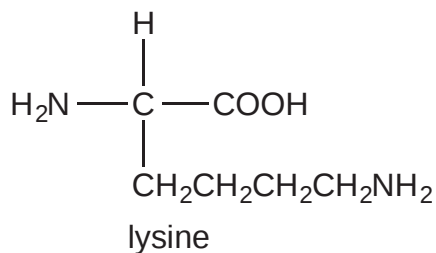


The diagram shows a reaction sequence.

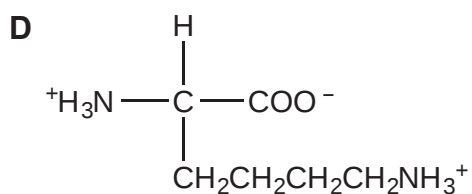
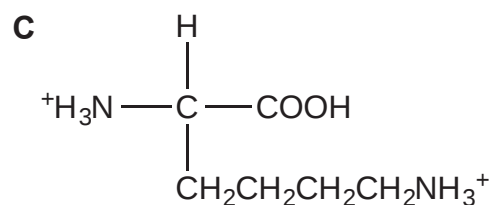
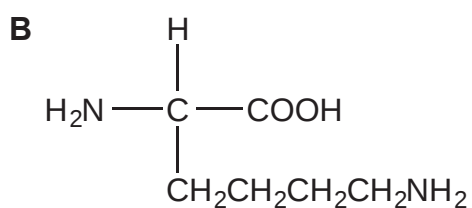
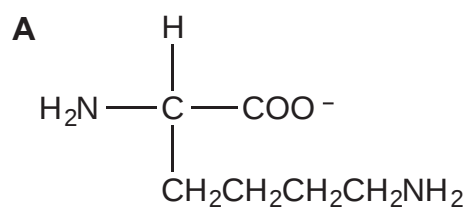


Which of the following will give an observation with O?

- 1 Alkaline aqueous iodine
 - 2 PCl_5
 - 3 2,4-dinitrophenylhydrazine
- A** 1, 2 and 3 only
- B** 1 and 2 only
- C** 2 and 3 only
- D** 1 and 3 only

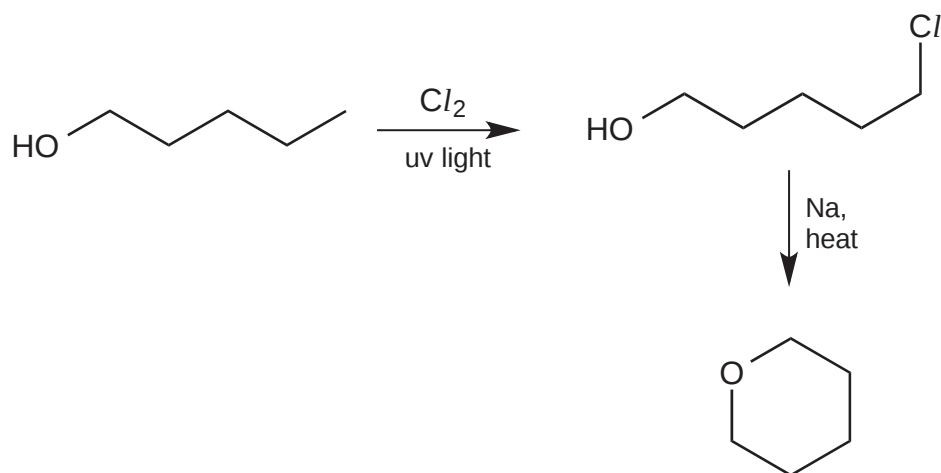


Which structure is predominant when lysine is in aqueous solution at pH = 1?



27 During the synthesis of many organic compounds, by-products are formed.

An ether is produced via the reaction scheme.



What could be the by-products of this reaction?

- 1 $\text{HO}(\text{CH}_2)_{10}\text{OH}$
 - 2 $\text{Cl}(\text{CH}_2)_5\text{O}(\text{CH}_2)_5\text{OH}$
 - 3 HCl
- A** 1, 2 and 3 only
- B** 1 and 2 only
- C** 1 and 3 only
- D** 3 only

- A** Transition elements have partially filled d orbitals.
- B** Transition elements form many coloured compounds.
- C** Transition elements or their compounds are widely used as catalysts.
- D** Transition elements exhibit more than one oxidation state in their compounds.

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

An electrochemical cell is set up using a $\text{Fe}^{2+}(\text{aq})|\text{Fe}(\text{s})$ half-cell and a $\text{VO}_2^+(\text{aq}), \text{VO}^{2+}(\text{aq})|\text{Pt}(\text{s})$ half-cell.

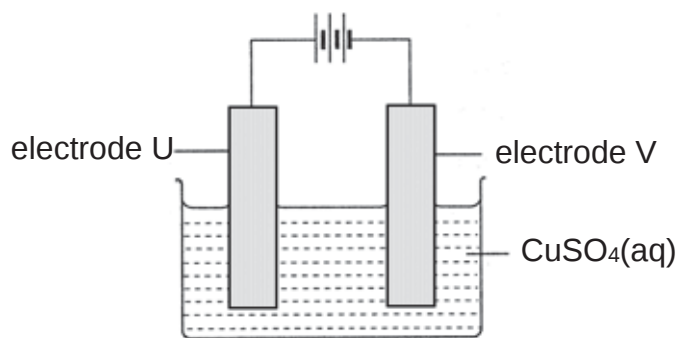
Which of the following gives a correct effect on the $E^\ominus_{\text{cell}}$ and a correct explanation for the effect when each of the changes is made to the cell separately?

	Change	Effect of $E^\ominus_{\text{cell}}$	Explanation
1	Add KCN(aq) to the $\text{Fe}^{2+}(\text{aq}) \text{Fe}(\text{s})$ half-cell	Increases	Concentration of $\text{Fe}^{2+}(\text{aq})$ decreases
2	Add water to the $\text{VO}_2^+(\text{aq}), \text{VO}^{2+}(\text{aq}) \text{Pt}(\text{s})$ half-cell	Decreases	Concentration of water increases
3	Increase temperature of the $\text{Fe}^{2+}(\text{aq}) \text{Fe}(\text{s})$ half-cell	No change	Temperature change does not affect $E^\ominus$

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

30 In an experiment, a cell was set up to obtain pure copper from a copper-silver alloy

as shown below.



When a current of 40.0 A flows through the electrolyte for 26.8 minutes, the mass of the anode changes by 26.47 g.

Which of the following statements is correct?

- A** Electrode U is pure copper and electrode V is the copper-silver alloy.
- B** The mass of the cathode changes by 26.47 g during the experiment.
- C** The concentration of $\text{CuSO}_4(\text{aq})$ decreases during the experiment.
- D** The copper-silver alloy contains 20% silver by mass.