TAMPINES MERIDIAN JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATION

H2 CHEMISTRY **9729/01**

Paper 1 Multiple Choice **26 September 2019**

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, class and 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** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

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 **18** printed pages.

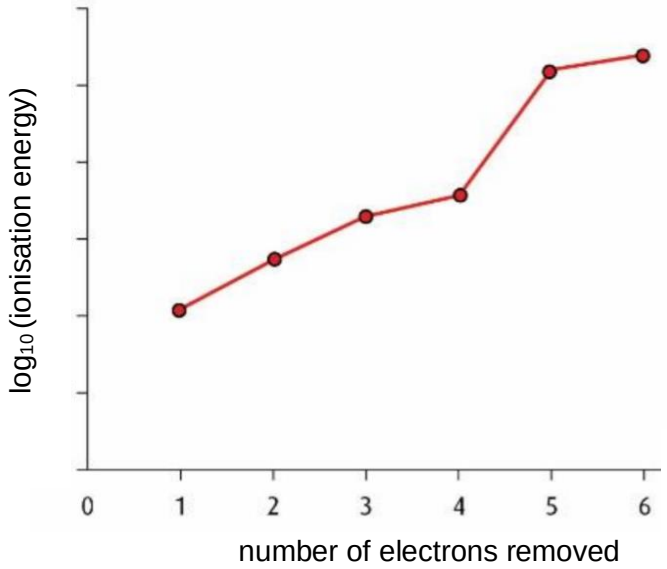
1 Some data of the ions of four unknown elements are given in the table below.

	A^+	B^-	D^{2-}	E^{3-}
mass number	21	20	20	21
number of protons	–	11	9	–
number of electrons	9	–	–	12

Which of the following correctly shows pairs of isotopic and isoelectronic species?

	isotopic	isoelectronic
A	D^{2-}, E^{3-}	B^-, E^{3-}
B	B^-, D^{2-}	A^+, B^-
C	B^-, D^{2-}	B^-, E^{3-}
D	D^{2-}, E^{3-}	A^+, B^-

2 The first six ionisation energies of element **G** are plotted in the graph below**.**



Which of the following can be deduced from the graph?

A There are 2 quantum shells in element **G**.

B Element **G** is from Group 2 in the Periodic Table.

C The fifth and sixth electrons are removed from the same subshell.

D The identity of element **G** is carbon.

3 For which of the following pairs does the first molecule have a higher polarity than the second molecule?

1 CH_3OH, CH_3I

2 CF_4, CCl_4

3 *cis*-CHF=CHF, *trans*-CHF=CHF

A 1 only

B 1 and 3

C 2 and 3

D 1, 2 and 3

4 Three substances **H**, **I** and **J** have physical properties shown in the table below.

substance	melting point/ °C	boiling point/ °C	electrical conductivity	
			of solid	of liquid
H	801	1413	poor	good
I	2852	3600	poor	good
J	3500 at very high pressure	unable to determine	poor	unable to determine

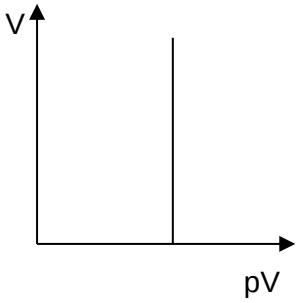
What are the possible identities for substances **H**, **I** and **J**?

	H	**I**	**J**
A	NaCl	$AlCl_3$	C (diamond)
B	MgO	$AlCl_3$	C (graphite)
C	NaCl	MgO	C (graphite)
D	NaCl	MgO	C (diamond)

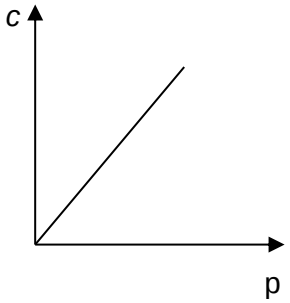
5 Which of the following diagrams correctly describe the behaviour of a fixed mass of an ideal gas at constant temperature?

[*c* is concentration]

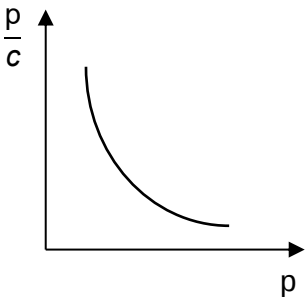
graph 1



graph 2



graph 3



A 2 only

B 1 and 2

C 2 and 3

D 1, 2 and 3

6 In which of the following reactions is the underlined reactant acting as a Lewis acid?

A $\underline{BF_3} + F^- \longrightarrow BF_4^-$

B $AlCl_3 + \underline{Cl_2} \longrightarrow AlCl_4^- + Cl^+$

C $Ag^+ + 2\underline{NH_3} \longrightarrow [Ag(NH_3)_2]^+$

D $H_2O + \underline{HSO_3^-} \longrightarrow H_2SO_3 + OH^-$

7 Which of the following statements is true of the Period 3 chlorides, $NaCl$ to PCl_5?

A The melting points of the chlorides show a continuously decreasing trend.

B The pH of the solutions formed when the chlorides are added to water range from alkaline to acidic.

C Three of the chlorides have simple molecular structures.

D The only chlorides which undergo hydrolysis in water are $AlCl_3$ and $MgCl_2$.

8 The relative abundances of the isotopes of a sample of titanium are shown in the table below.

relative isotopic mass	46	47	48
relative abundance	11.2	10.1	*z*

Given that the relative atomic mass of the sample is 47.862, what is the value of *z*?

A 214.2 **B** 79.1 **C** 78.7 **D** 26.6

9 A metallic salt was found to react exactly with sulfite ions in a 2 : 1 ratio.

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

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

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

10 The enthalpy changes for the following reactions are given:

$2Cr(s) + \frac{3}{2}O_2(g) \rightarrow Cr_2O_3(s)$ $\quad \Delta H_f(Cr_2O_3(s)) = -1120$ kJ mol^{-1}

$C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g)$ $\quad \Delta H_f(CO(g)) = -110$ kJ mol^{-1}

What is the enthalpy change of reaction for the following reaction, in terms of kJ mol^{-1}?

$$3C(s) + Cr_2O_3(s) \rightarrow 2Cr(s) + 3CO(g)$$

A – 940 **B** – 870 **C** + 590 **D** + 790

11 An experiment was conducted by reacting propyne with hydrogen gas in a shock tube.

$$CH_3C{\equiv}CH(g) + 2H_2(g) \rightarrow CH_3CH_2CH_3(g)$$

The value of ΔG for the reaction is found to be negative at low temperature.

What is the sign of ΔH and ΔS for the above reaction?

	ΔH	ΔS
A	–	–
B	+	–
C	–	+
D	+	+

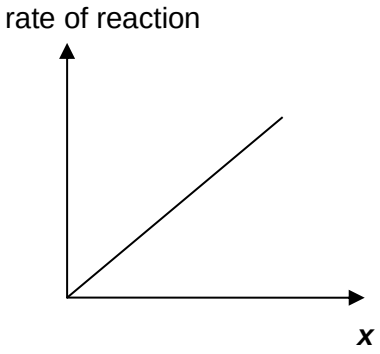
12 The kinetics of the reaction between hydrogen peroxide and acidified iodide ions were investigated.

$$H_2O_2(aq) + 2H^+(aq) + 2I^-(aq) \rightarrow I_2(aq) + 2H_2O(l)$$

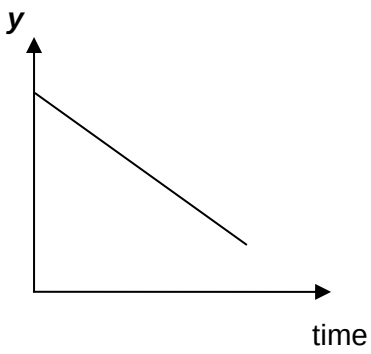
The rate equation was found to be: rate = $k[H_2O_2][I^-]$

Which of the following shows the correct labelling of the ***x***-axis for **Graph I** and ***y***-axis for **Graph II**?

Graph I



Graph II



	x-axis for **Graph I**	***y***-axis for **Graph II**
A	$[I^-]$	$[H_2O_2][I^-]$
B	$[H^+]$	$[I_2]$
C	$[H_2O_2][I^-]$	$[H^+]$
D	$[H_2O_2][H^+]$	$[I^-]$

13 The reaction between HBr and O_2 is thought to occur via a multi-step mechanism:

$HBr + O_2 \rightarrow HO_2Br$ (slow)

$HO_2Br + HBr \rightarrow 2HOBr$ (fast)

$HOBr + HBr \rightarrow Br_2 + H_2O$ (fast)

The overall reaction is given to be $4HBr + O_2 \rightarrow 2Br_2 + 2H_2O$.

Which of the following statements are true?

1 The overall order of reaction is 2.

2 HO_2Br is the only intermediate in the reaction.

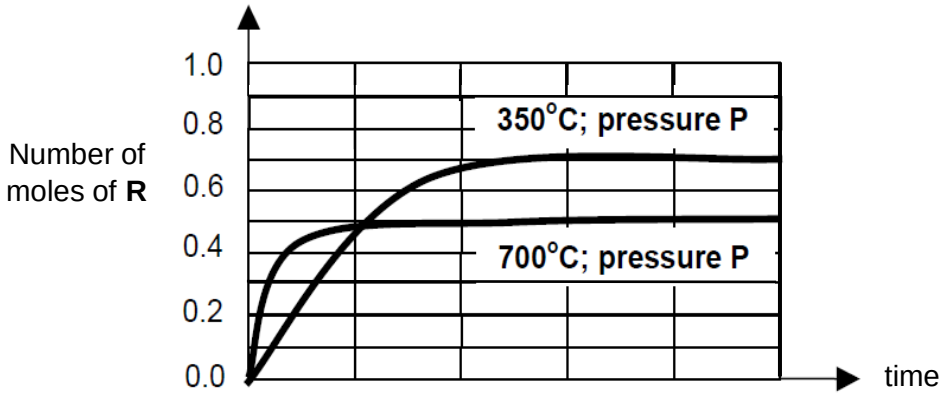
3 HOBr acts as a catalyst in the reaction.

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

14 **L** and **M** can react together to reach equilibrium in the reaction below.

$$\mathbf{L}(g) + \mathbf{M}(g) \rightleftharpoons \mathbf{Q}(g) + \mathbf{R}(g)$$

In an experiment, 1.0 mole each of **L** and **M** were reacted at constant pressure P and temperature 350 ºC. The amount of **R** present in the mixture at intervals of time was recorded. The experiment was repeated at the same pressure P, but at a temperature of 700 ºC. The results for both experiments are shown below.



Which one of the following information **cannot** be deduced from the graph?

A The value of K_c decreases with an increase in temperature.

B The equilibrium is achieved at a faster rate at higher temperatures.

C The enthalpy change for the forward reaction is negative.

D The activation energy of the forward reaction is high.

15 The dissociation constants, K_w, for the ionisation of water at different temperatures are given below.

$$H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq)$$

temperature / °C	K_w / mol^2 dm^{-6}
0	1.15×10^{-15}
25	1.00×10^{-14}
50	5.50×10^{-14}

What can be deduced from this information?

A Only at 25 °C are $[H^+]$ and $[OH^-]$ equal.

B K_w is not affected by changes in temperature.

C The forward reaction is exothermic.

D The pH of water decreases as temperature increases.

16 The following tests were performed on an aqueous solution containing chloride and iodide ions.

step	test	observations
1	Add excess $AgNO_3(aq)$.	Mixture of white and yellow precipitates is formed.
2	To the mixture from step 1, add excess $NH_3(aq)$.	White precipitate dissolves to form a colourless solution. Yellow precipitate is insoluble.
3	Filter the mixture from step 2.	Filtrate was a colourless solution. Residue was a yellow solid.

Which of the following statements are correct?

1 The K_{sp} for AgC*l* is lower than that for AgI.

2 There are no $Ag^+(aq)$ and C*l*$^-$(aq) present in the filtrate formed in Step 3.

3 In step 2, the addition of $NH_3(aq)$ results in the formation of $[Ag(NH_3)]_2^+$ that momentarily decreases the ionic product of AgC*l*.

A 3 only

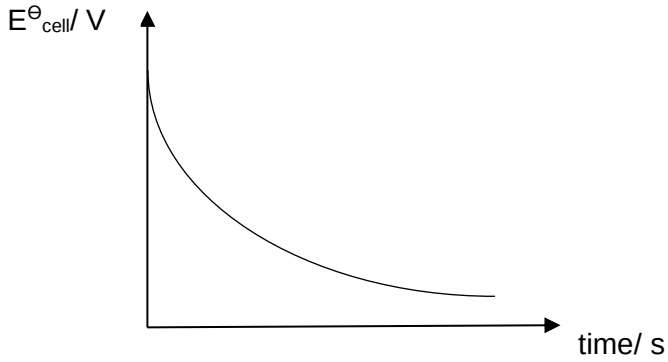
B 1 and 2

C 2 and 3

D 1, 2 and 3

17 An experiment is carried out between the Fe^{2+}/Fe and Co^{2+}/Co half cells.

The following graph of cell potential against time was obtained when a change was continuously made to the half-cell.



What continuous change could produce this graph?

A add aqueous cobalt(II) ions to the cobalt half-cell

B add aqueous ammonia to the cobalt half-cell

C add water to the iron half-cell

D increase the mass of solid iron immersed in the solution

18 Which of the following statements about octahedral complexes is correct?

A The ratio of hexadentate ligands to the central metal ion is 6:1.

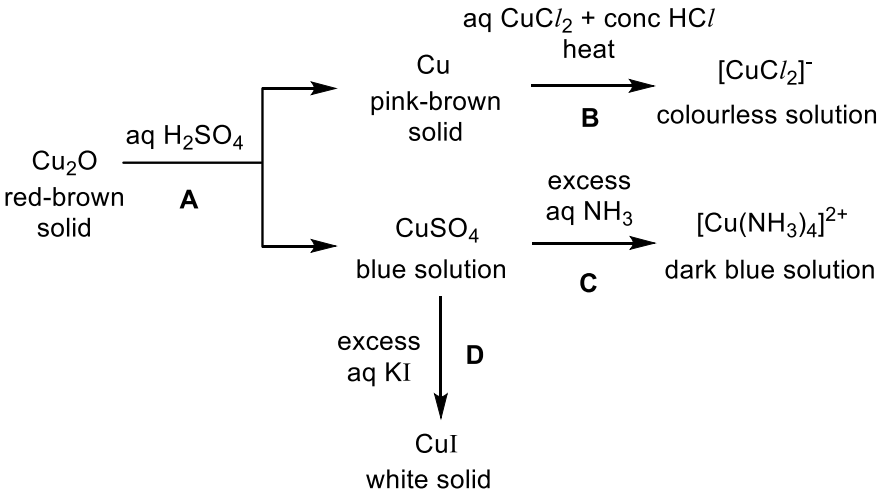
B The d_{xz}, d_{yz} and d_{xy} orbitals are higher in energy than the $d_{x^2-y^2}$ and d_{z^2} orbitals.

C The d orbitals are split into different energy levels due to different orientation of the orbitals to the ligands.

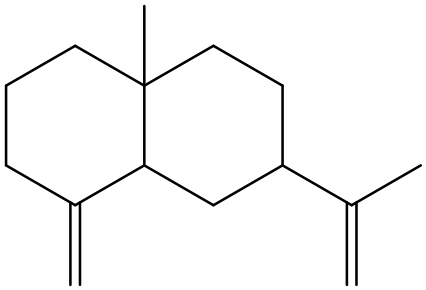
D The same transition metal with different oxidation states displays the same colour with the same ligands.

19 The diagram below shows some reactions involving copper and its compounds.

Which reaction involves ligand exchange only?



20 β-selinene is a molecule that can be isolated from plants. It has the following structural formula.



β-selinene

Which of the following statements about this molecule is correct?

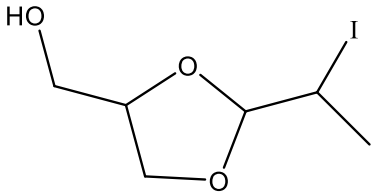
A It has a plane of symmetry.

B It does not contain any sp hybridised carbon.

C It has one chiral centre.

D It exhibits cis-trans isomerism.

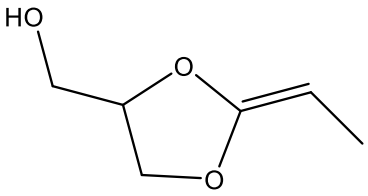
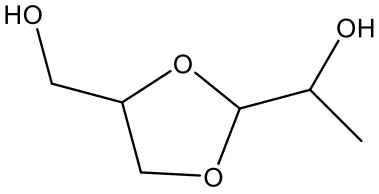
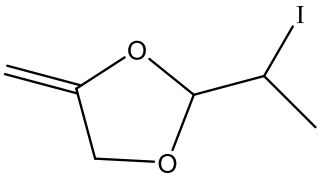
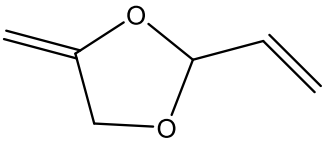
21 Iodinated glycerol is used in the symptomatic treatment of patients with chronic obstructive pulmonary disease.



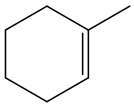
iodinated glycerol

Which of the following correctly shows the product formed when iodinated glycerol is reacted with the given reagents and conditions?

[The C–O–C bond in the structure is inert to the reagents.]

	reagent & conditions	*product*
A	alcoholic KOH, heat	
B	alcoholic KOH, heat	
C	aqueous KOH, heat	
D	concentrated H_2SO_4, heat	

22 Which of the following compounds react with HBr in an addition reaction to give a major chiral product?

1 

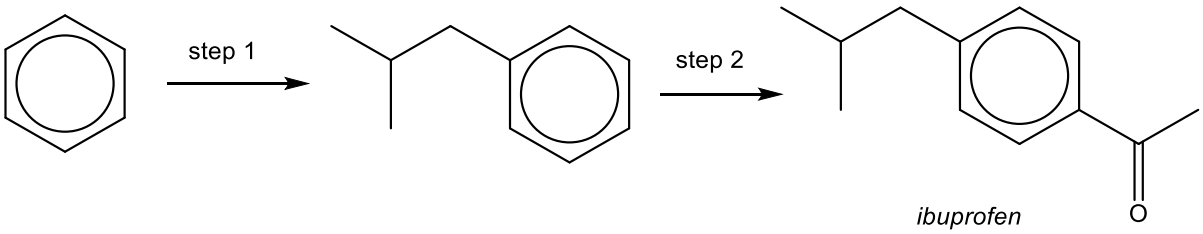
2 $CH(Br)=CH_2$

3 $CH_3CH=C(CH_3)CH_2CH_3$

4 $CH_2=CHCH_2CH_3$

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

23 Two of the steps in the manufacture of the pain-relief drug, *ibuprofen* are shown below.



ibuprofen

Which statement is correct?

A Both steps involve the use of catalyst.

B The sequence of the steps are interchangeable.

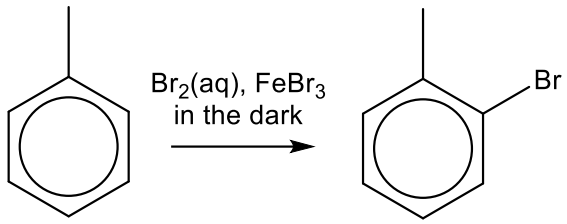
C Both steps involve different types of reaction.

D Only step 2 involves the use of a halogen-containing reagent.

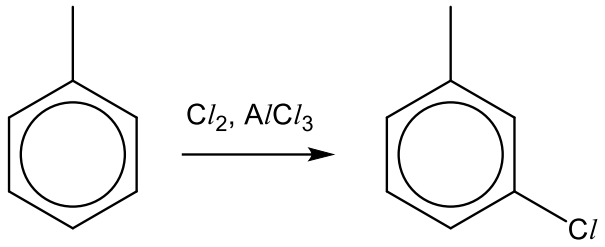
24 The reaction conditions for four electrophilic substitution reactions are given below.

Which reaction would yield the product stated?

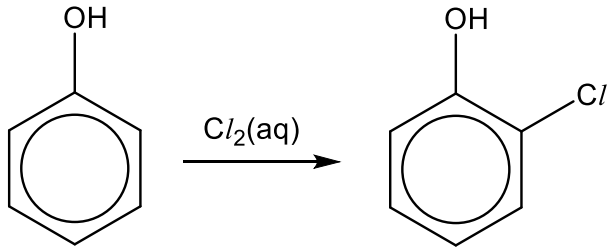
A



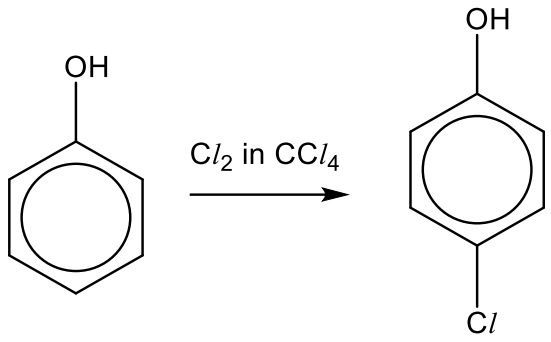
B



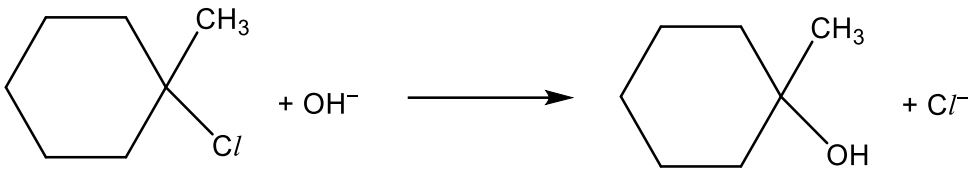
C



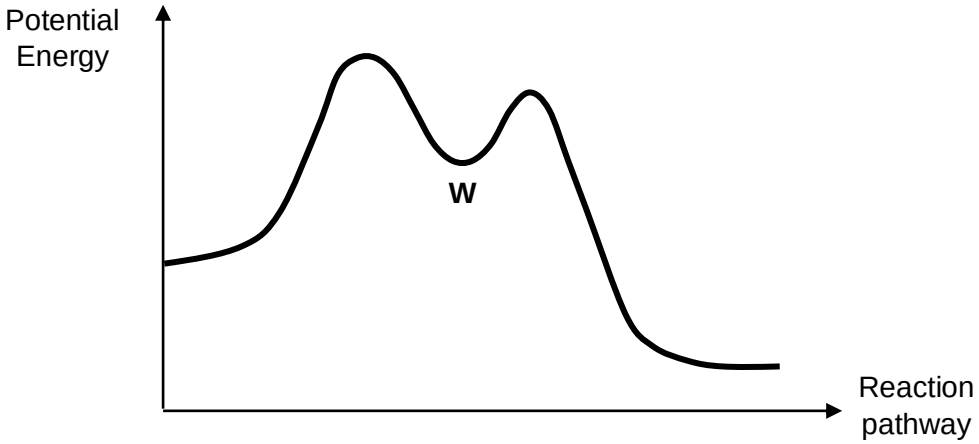
D



25 1-chloro-1-methylcyclohexane is hydrolysed by heating with NaOH(aq).



The energy profile diagram for this reaction is shown below.



Which statements regarding this reaction are correct?

1 The species at point **W** bears a positive charge.

2 The reaction proceeds via S_N2 mechanism since it is a two-step mechanism.

3 The same energy profile diagram would be obtained if chloromethane undergoes the same reaction.

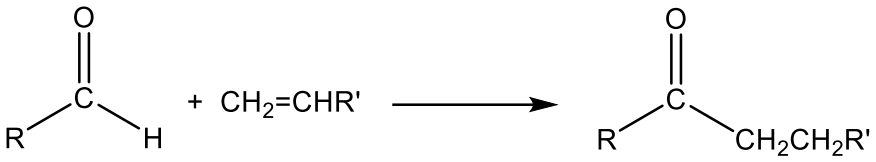
A 1 only

B 1 and 2

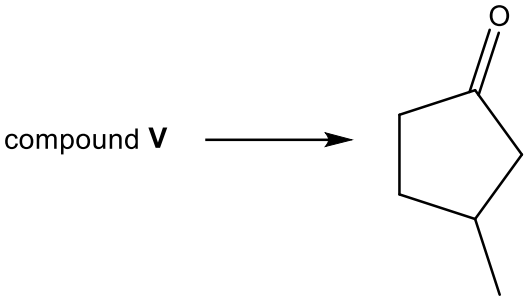
C 2 and 3

D 1, 2 and 3

26 Hydroacylation is a reaction in which an alkene is 'inserted' into the C–H bond of an aldehyde to form a ketone.



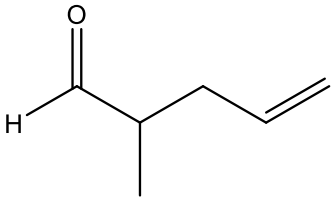
Compound **V** could be converted to 3-methylcyclopentanone using the above reaction.



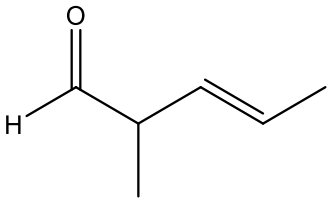
3-methylcyclopentanone

What could compound **V** be?

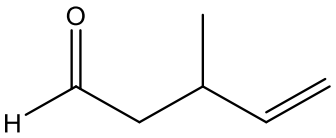
A



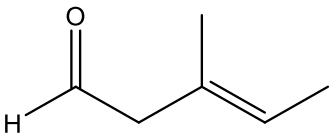
B



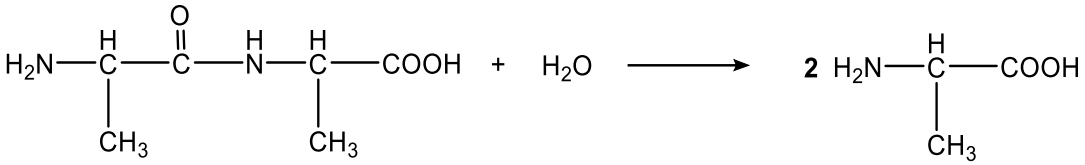
C



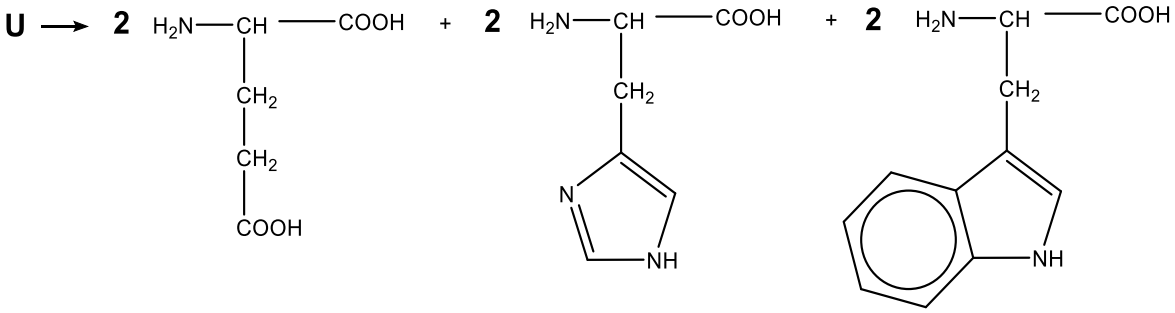
D



27 Peptidases are enzymes that hydrolyse the peptide bonds that bind amino acids together in the polypeptide chain of a protein.



Partial hydrolysis of a small peptide, **U**, by a peptidase, produces the following amino acids.



glutamic acid
M_r = 147

histidine
M_r = 155

tryptophan
M_r = 204

What is the M_r of the peptide **U**?

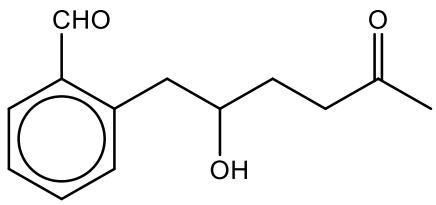
A 904

B 922

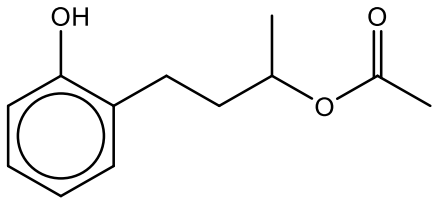
C 1012

D 1102

28 Which of the following reagents could be used to distinguish between compounds **S** and **T**?



Compound **S**



Compound **T**

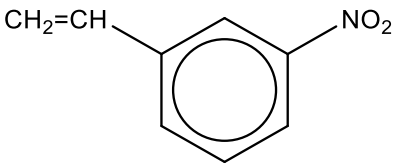
A I_2 in aqueous NaOH

B Cu^{2+} in alkaline solution

C aqueous NH_3 with $AgNO_3$

D acidified potassium dichromate

29 3-nitrostyrene is an aromatic organic compound.



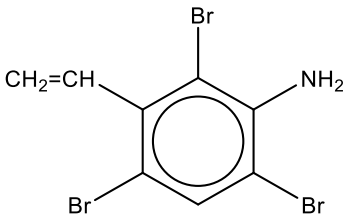
3-nitrostyrene

It is subjected to the following reactions:

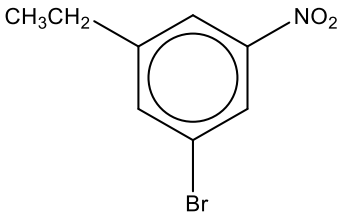
- heat with Sn in concentrated HC*l* followed by careful addition of cold NaOH(aq)
- then the addition of Br_2(aq)

What is the product obtained after the above reactions?

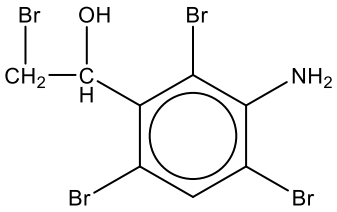
A



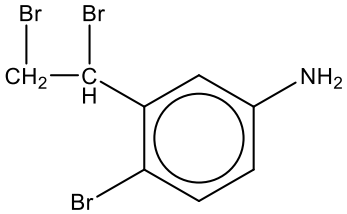
B



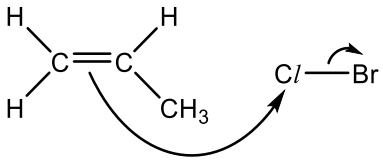
C

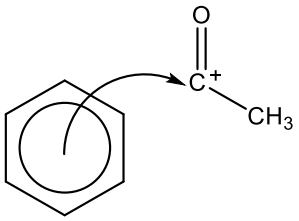


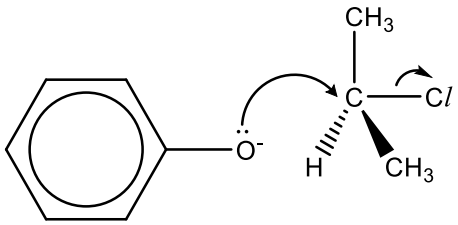
D



30 Which of the following show a correct mechanistic step in the reaction between the reagents?

1 

2 

3 

A 3 only

B 1 and 2

C 2 and 3

D 1, 2 and 3

End of Paper 1