



CHEMISTRY

9729/01

Paper 1 Multiple Choice

15th September 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.

1. Enter your NAME (as in NRIC). _____
2. Enter the SUBJECT TITLE. _____
3. Enter the TEST NAME. _____
4. Enter the CLASS. _____

Write your **name**
and **Civics Group**

Write and shade
your index number

WRITE		SHADE APPROPRIATE BOXES									
I N D E X N U M B E R	0	1	2	3	4	5	6	7	8	9	
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	0	1	2	3	4	5	6	7	8	9	
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
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	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
A	B	C	D	E	F	G	H	I			
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		

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 **13** printed pages.

- 1 The reaction between aluminium powder and anhydrous barium nitrate is used as the propellant in some fireworks. Nitrogen gas is one of the products formed.

Which volume of nitrogen, measured under room conditions, is produced when 1 g of anhydrous barium nitrate reacts with an excess of aluminium?

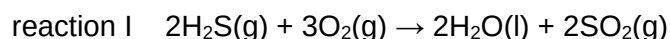
- A 86.9 cm³ B 91.8 cm³ C 174 cm³ D 184 cm³

- 2 Which statements about relative molecular mass are correct?

- 1 It is the mass of one mole of the molecule.
- 2 It is the ratio of the average mass of a molecule to the mass of a ¹²C atom.
- 3 It is the sum of the relative atomic masses of all the atoms within the molecule.

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

- 3 The Claus process recovers sulfur from the gaseous hydrogen sulfide found in raw natural gas and from the crude oil refinery by-product gases.



Which statement about the Claus process is correct?

- A SO₂ is a reducing agent.
B SO₂ behaves as a catalyst.
C H₂S is oxidised in the reaction.
D Reaction II is a disproportionation reaction.

- 4 A stream of gaseous, doubly-charged calcium ions was passed between 2 oppositely charged plates. Analysis of the deflection shows that these ions deflected at an angle of 20.0°.

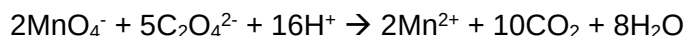
Under the same electric field, an unknown gaseous ion X⁺ is deflected at an angle of 5.08°.

What is the atomic number of X?

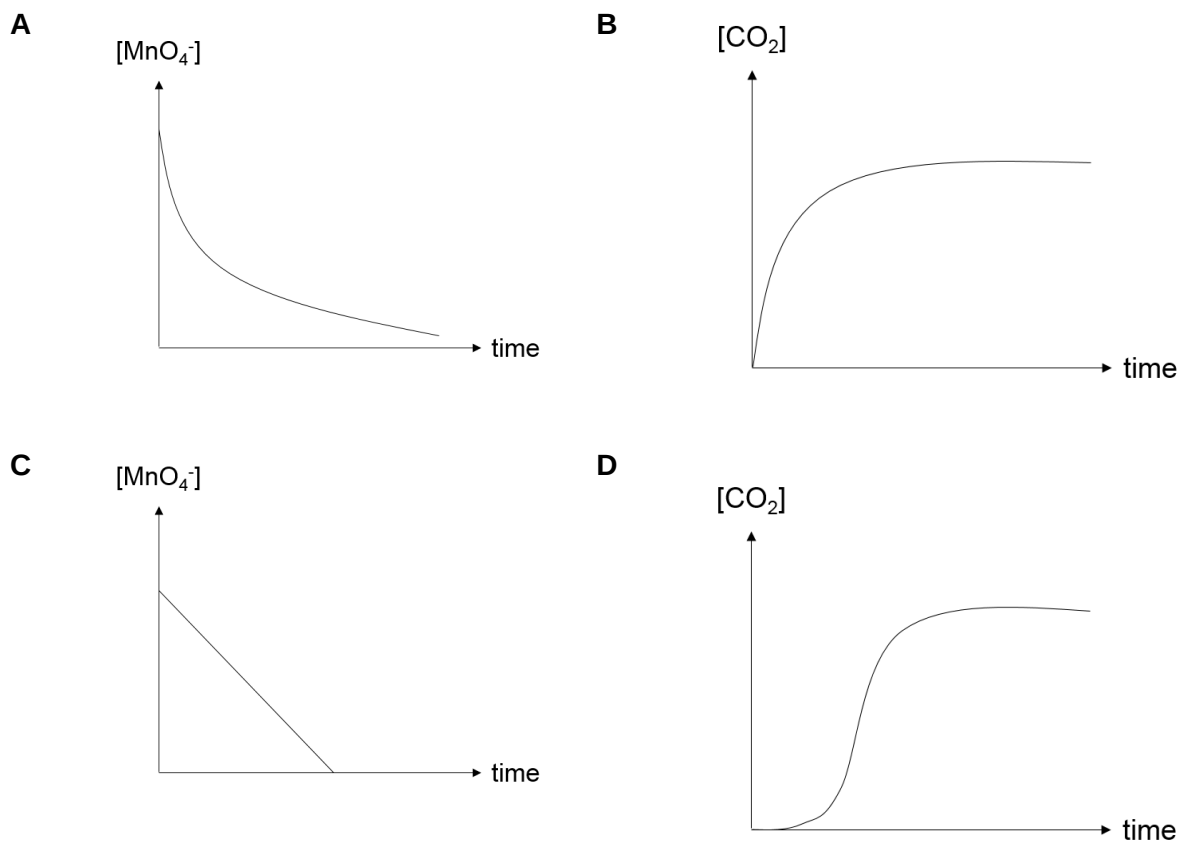
- A 34 B 45 C 46 D 79

- 5 Which of the following species do not have all atoms that lie on the same plane?
- A CH_2CH_2 B I_3^- C XeF_4 D BeCl_4^{2-}
- 6 In which pair of compounds does the first compound have higher boiling point than the second compound?
- A HI , HF
- B MgO , NaCl
- C CH_4 , SiH_4
- D *trans*- $\text{C}_2\text{H}_2\text{Cl}_2$, *cis*- $\text{C}_2\text{H}_2\text{Cl}_2$
- 7 A sample of m g of an organic compound is vaporised in a gas syringe and occupies V cm^3 at T K and p atm.
- What is the relative molecular mass of the compound?
- A $\frac{m \times 24000 \times T}{p \times V \times 293}$
- B $\frac{m \times 24000 \times (T+293)}{p \times V \times 273}$
- C $\frac{m \times 24000 \times 293 \times p}{V \times T}$
- D $\frac{m \times 24000 \times 293 \times p}{V \times (T+273)}$

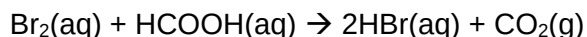
- 8 An autocatalytic reaction is one whereby the products catalyses the reaction. One such reaction is the reaction between ethanedioate and manganate(VII) anions.



Which of the following graphs would be obtained for an autocatalytic reaction?



- 9 Molecular bromine, Br_2 reacts with methanoic acid, HCOOH slowly in an open beaker to produce aqueous hydrogen bromide and carbon dioxide gas.

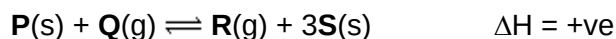


Which of the following methods is **not** suitable for studying the kinetics of this reaction?

- A** Measuring the conductivity of the solution over time.
- B** Measuring the change in pressure of the reaction over time.
- C** Measuring the change in colour intensity of the mixture over time.
- D** Measuring the changes of pH of the solution over time.

- 10** When bromine vapourises at 58.8°C, 30.9 kJ mol⁻¹ of heat was required. What is the entropy change when 32 g of bromine is vapourised?
- A** -18.6 J K⁻¹
B +18.6 J K⁻¹
C -93.1 J K⁻¹
D +93.1 J K⁻¹
- 11** Compound **E** is a hydrocarbon. When 0.47 g of **E** was completely burnt in air, the heat produced raised the temperature of 200 g of water by 26.4 °C. Given that the standard enthalpy change of combustion of **E** is -3290 kJ mol⁻¹, which of the following could be **E**?
- 1** CH₂=CHCH₂CH₃
2 (CH₃)₂C=CHCH₃
3 C₅H₁₀
- A** 1 only
B 3 only
C 1 and 2
D 2 and 3
- 12** Two equilibria are shown below.
reaction I $X_2(g) + \frac{1}{2} Y_2(g) \rightleftharpoons X_2Y(g)$
reaction II $2X_2Y(g) \rightleftharpoons 2X_2(g) + Y_2(g)$
The numerical value of K_c for reaction I is 2.
Under the same conditions, what is the numerical value of K_c for reaction II?
- A** $\frac{1}{2}$ **B** $\frac{1}{\sqrt{2}}$ **C** $\frac{1}{4}$ **D** -2

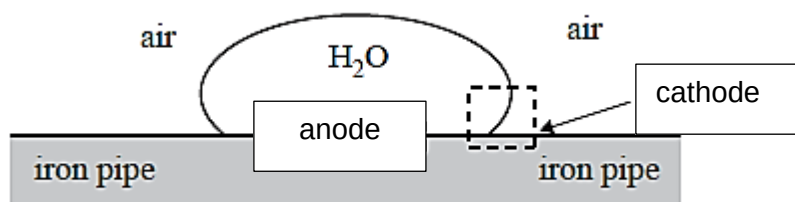
- 13 Consider the following equilibrium system:



0.500 mol each of **P** and **Q** were placed in a 1 dm³ container. At equilibrium, 0.100 mol of **R** was formed.

Which of the following statement is **not** correct?

- A** The value of K_c is 0.25.
- B** K_p increases with increasing temperature.
- C** Increasing the pressure will not affect the equilibrium.
- D** Adding **P** causes the position of equilibrium to shift to the right.
- 14 Which of the following mixtures does not act as a buffer solution?
- A** 10 cm³ of 1 mol dm⁻³ HCl and 5 cm³ of 1 mol dm⁻³ Mg(CH₃CH₂COO)₂
- B** 20 cm³ of 1 mol dm⁻³ Na₂CO₃ and 20 cm³ of 1 mol dm⁻³ NaHCO₃
- C** 20 cm³ of 1 mol dm⁻³ HCl and 20 cm³ of 2 mol dm⁻³ CH₃CH₂NH₂
- D** 10 cm³ of 1 mol dm⁻³ NaOH and 20 cm³ of 1 mol dm⁻³ NH₄Cl
- 15 Iron pipes are used to transport natural gas to cities. Corrosion occurs when water droplets sit on the outer surface of the iron pipes.
- Miniature galvanic cells are created, with regions such as those shown below, that act as anodes and cathodes.



Which of the following is incorrect?

- A** The reaction at the cathode is $\text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^- \rightarrow 4\text{OH}^-$.
- B** The reaction at the anode is $\text{Fe} \rightarrow \text{Fe}^{2+} + 2\text{e}^-$.
- C** The corrosion of iron is inhibited at low pH.
- D** Corrosion can be prevented by connecting it to a magnesium bar buried in the ground.

- 16** Copper minerals often contain magnesium and silver as impurities. An impure copper rod is purified by electrolysis using a constant current. After 1 hour, the mass of one electrode decreased by 19.0 g while the mass of the other electrode increased by 17.8 g.

Which of the following statements is correct?

- 1** The decreased in mass is due to the oxidation of copper, magnesium and silver.
- 2** The increase in mass is due to copper being formed.
- 3** Doubling the mass of the impure copper rod under the same set of operating conditions double the mass of the copper deposited.

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

- 17** Consider the oxides of period 3 elements.

Which factor generally decreases across the period?

- A** Covalent character
- B** Melting point
- C** pH when mixed with water
- D** Solubility in aqueous NaOH

- 18** Which property of the Group 2 elements or their compounds increases with increasing atomic number?

- A** Reducing power of the metal
- B** Magnitude of the enthalpy change of hydration of the metal ion
- C** Acidity of an aqueous solution of the chloride
- D** Tendency to form complex ions

- 19 The table shows the results of experiments in which the halogens X_2 , Y_2 , and Z_2 were added to separate aqueous solutions containing X^- , Y^- and Z^- ions.

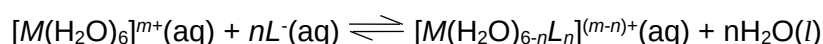
	$X^-(aq)$	$Y^-(aq)$	$Z^-(aq)$
X_2	No reaction	No reaction	No reaction
Y_2	X_2 formed	No reaction	Z_2 formed
Z_2	X_2 formed	No reaction	No reaction

Which set contains the ions X^- , Y^- and Z^- in order of their decreasing strength as a reducing agent?

	Strongest	→	Weakest
A	X^-		Z^-
B	X^-		Y^-
C	Y^-		X^-
D	Z^-		Y^-

- 20 K_{stab} , is an equilibrium constant for the formation of a complex in solution.

Consider the following reaction



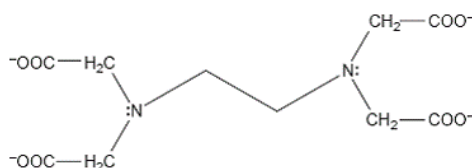
The K_{stab} , of the reaction, taking the concentration of water as being constant, is

$$K_{stab} = \frac{[[M(H_2O)_{6-n}L_n]^{(m-n)+}]}{[[M(H_2O)_6]^{m+}][L^-]^n}$$

The following table shows the colour and the value of K_{stab} of some iron complexes.

complex	colour	K_{stab}
$[Fe(SCN)(H_2O)_5]^{2+}(aq)$	deep red	1×10^2
$[FeF_6]^{3-}(aq)$	colourless	2×10^{15}
$[Fe(CN)_6]^{3-}(aq)$	orange-yellow	1×10^{31}
$[Fe(edta)]^{2-}(aq)$	colourless	2×10^{14}
$[Fe(edta)]^-(aq)$	yellow	1×10^{25}

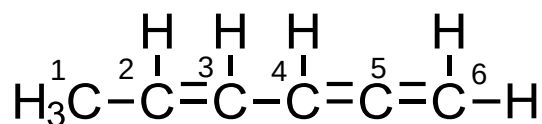
The structure of $edta^{4-}$ is as follows:



Which of the following statements is true?

- A $[Fe(SCN)(H_2O)_5]^{2+}(aq)$ absorbs red light.
- B Addition of $edta^{4-}$ to a solution containing $[FeF_6]^{3-}(aq)$ does not produce any colour change.
- C Addition of $KCN(aq)$ to a solution containing $[Fe(SCN)(H_2O)_5]^{2+}(aq)$ produces an orange-yellow solution.
- D Addition of $Cl_2(aq)$ to a solution of $Fe^{2+}(aq)$ produces a yellow solution which remains yellow when $KF(aq)$ is added.

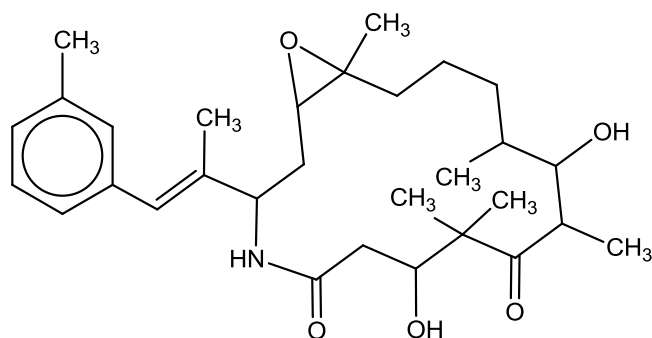
21



Which bond is present in the compound above?

- A** a σ bond formed by sp^3 - sp^3 overlap between C3 and C4
- B** a σ bond formed by sp^2 - sp overlap between C4 and C5
- C** a σ bond formed by sp^2 - sp^2 overlap between C5 and C6
- D** a π bond formed by sp^2 - sp^2 overlap between C2 and C3

- 22** Compound **X** is an analogue of Ixabepilone which is an anticancer agent currently in clinical development.



compound **X**

Compound **X** was reacted with NaBH_4 in methanol.

In this reaction, the  ring remains unaltered.

What is the maximum number of stereoisomers in the product of this reaction?

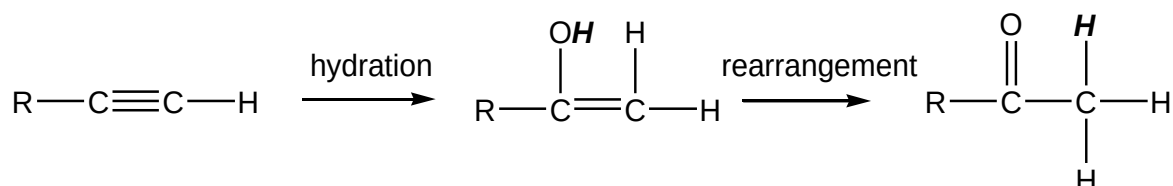
- A** 2^7 **B** 2^8 **C** 2^9 **D** 2^{10}

23 Which of the following reactions will give an optically inactive mixture?

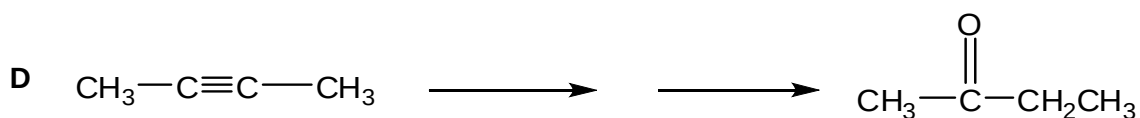
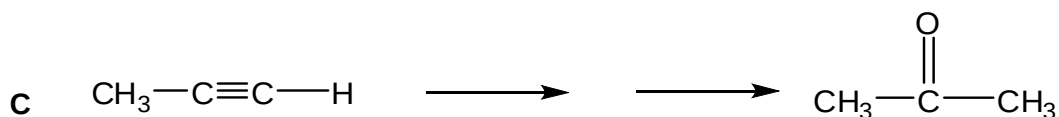
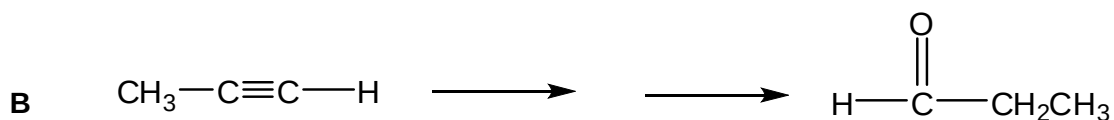
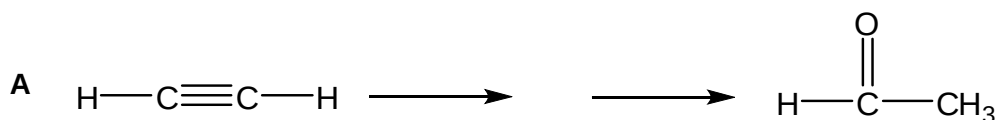
- 1 2-bromo-2-methylbutane heated with aqueous KOH
- 2 3-bromo-3-methylhexane heated with alcoholic NaOH
- 3 But-1-ene reacted with HBr dissolved in organic solvent
- 4 Butanone reacted with HCN, trace amount of NaOH

- A 1 & 3
 B 3 & 4
 C 1, 2 & 3
 D All of the above

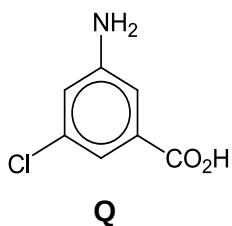
24 An alkyne ($C\equiv C$) undergoes hydration in a similar mechanism as an alkene. However, the formation of enol ($C=C-OH$) is unstable and would undergo rearrangement to form a carbonyl compound.



Which compound will **not** be formed when the following alkynes undergo hydration?

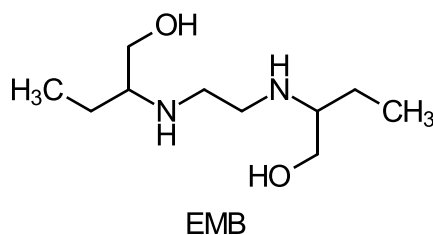


- 25 A student wishes to synthesise compound **Q** from benzene.



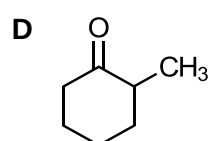
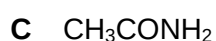
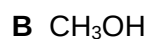
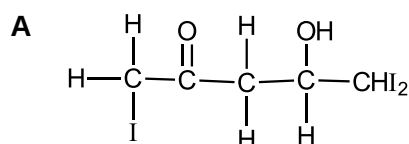
Which of the following routes would give the maximum yield of **Q**?

- A** Alkylation → nitration → chlorination → reduction → oxidation
B Nitration → alkylation → oxidation → chlorination → reduction
C Alkylation → oxidation → nitration → reduction → chlorination
D Chlorination → nitration → reduction → alkylation → oxidation
- 26 Ethambutol (EMB) is commonly used as first line drugs in tuberculosis treating regimes.

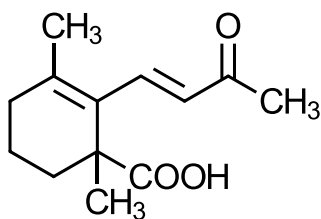


How many moles of hydrogen gas will be produced when one mole of EMB reacts with sodium?

- A** 1.0 **B** 2.0 **C** 3.0 **D** 4.0
- 27 Which of the following compound gives a yellow precipitate with alkaline aqueous iodine?



- 28 Compound Y is a derivative of β -ionone, which is an important contributor of the aroma of roses.

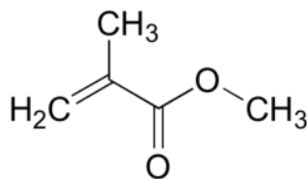


Compound Y

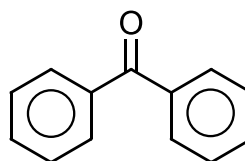
What is the correct number of H atoms incorporated per molecule of Compound Y when Compound Y is reacted with each of the following reducing agents?

	Reducing agent	Number of hydrogen atoms incorporated per molecule of Compound Y
1	H ₂ / Ni	6
2	LiAlH ₄ in dry ether	8
3	NaBH ₄ in ethanol	2

- A 1 is correct only
 B 1 and 3 is correct
 C 2 and 3 is correct
 D 1,2,3 is correct
- 29 Methyl methacrylate and benzophenone are common ingredients found in nail polishes.



Methyl methacrylate

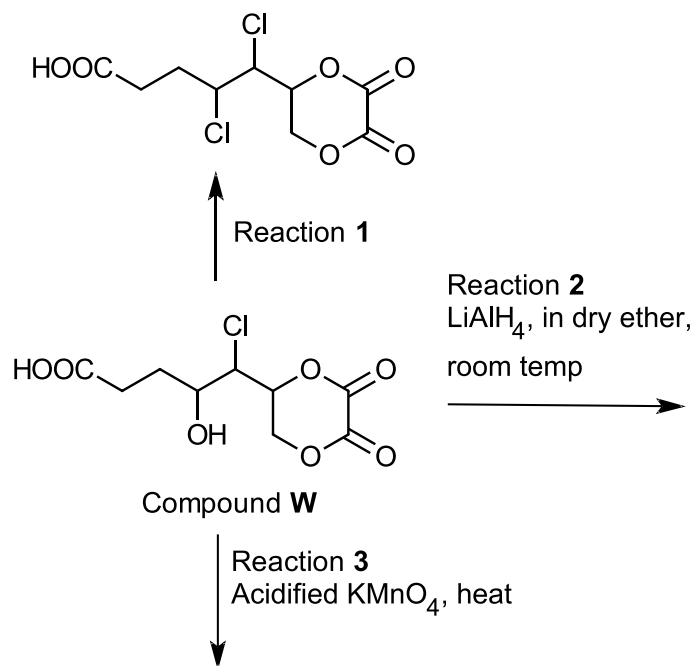


benzophenone

Which of the following reagents cannot be used to distinguish between these two compounds?

- A Acidified K₂Cr₂O₇
 B 2,4-dinitrophenylhydrazine
 C Tollens' Reagent
 D Bromine water

30 The diagram below shows a reaction scheme of compound **W**.



Which of the following shows the correct products of Reactions 2 and 3 and the type of reaction for Reaction 1?

	Reaction 1	Product(s) of Reaction 2	Product of Reaction 3
A	Nucleophilic substitution		
B	Nucleophilic addition		
C	Nucleophilic substitution		
D	Nucleophilic addition		