**NATIONAL JUNIOR COLLEGE
SH2 PRELIMINARY EXAMINATION**

Higher 2

CANDIDATE
NAMESUBJECT
CLASSREGISTRATION
NUMBER**CHEMISTRY**

Paper 1 Multiple Choice

9729/01**Thursday 14 Sept 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, highlighters, glue or correction fluid.

Write your name, subject class and registration number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **30** 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 paper consists of **16** printed pages.

Instructions on how to fill in the Optical Mark Sheet

1. Enter your NAME (as in NRIC). <u>TAN AM TECK</u> 2. Enter the SUBJECT TITLE. <u>CHEMISTRY</u> 3. Enter the TEST NAME. <u>SH2 Prelim</u> 4. Enter the CLASS. <u>cm2P</u>	RUB OUT ERRORS THOROUGHLY USE PENCIL ONLY FOR ALL ENTRIES ON THIS SHEET  <table border="1"> <tr> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> <tr> <td>☐</td><td>☐</td><td>☒</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td> </tr> <tr> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> <tr> <td>☐</td><td>☒</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td> </tr> <tr> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> <tr> <td>☒</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td> </tr> </table>	0	1	2	3	4	5	6	☐	☐	☒	☐	☐	☐	☐	0	1	2	3	4	5	6	☐	☒	☐	☐	☐	☐	☐	0	1	2	3	4	5	6	☒	☐	☐	☐	☐	☐	☐
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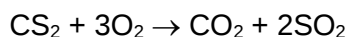
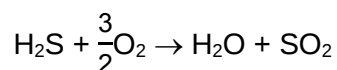
Example:

Shade the index number in a 5 digit format on the optical mark sheet:
2nd digit and the last 4 digits of the Registration Number.

Student	Examples of Registration No.	Shade:
	<u>1605648</u>	65648

For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

- 1 A mixture of two sulfur-containing gases, H_2S and CS_2 , was burned in an excess of oxygen.

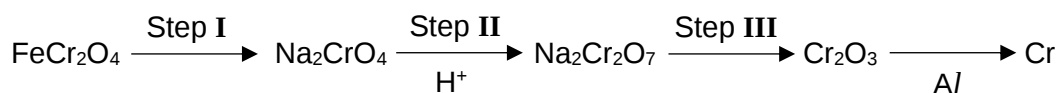


Upon complete combustion followed by cooling back to room temperature, the gaseous mixture was first passed through acidified KMnO_4 . The volume contracted by 10.0 cm^3 .

After which, the resulting gas was passed through aqueous sodium hydroxide, a further contraction of 2.0 cm^3 occurred. All volumes are measured under the same conditions.

What was the mole fraction of H_2S in the mixture?

- A** 0.333
B 0.500
C 0.750
D 0.833
- 2 Chromium has an oxidation state of +3 in its metal ore, chromite, FeCr_2O_4 . Pure chromium is extracted from chromite in several steps show below.



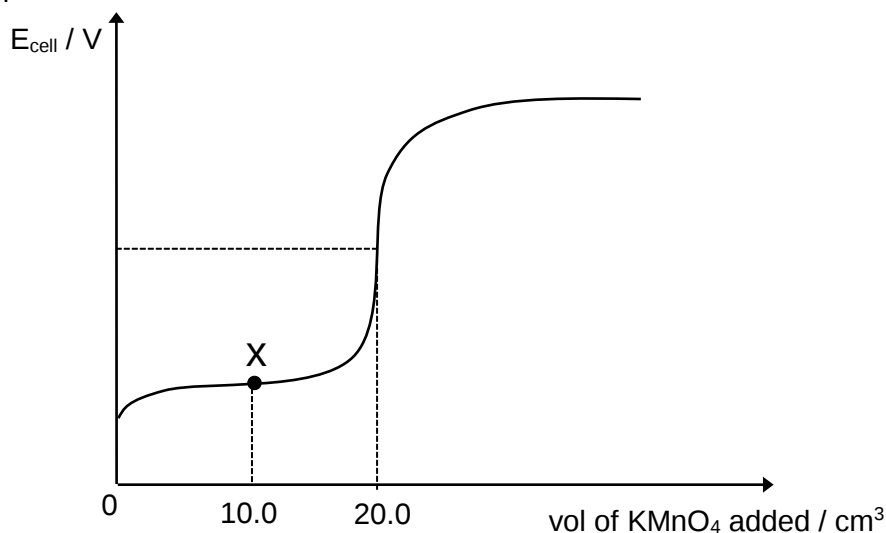
Which shows the correct type of reaction involving chromium in steps **I**, **II** and **III**?

	Step I	Step II	Step III
A	displacement	acid–base	displacement
B	oxidation	oxidation	reduction
C	displacement	oxidation	oxidation
D	oxidation	acid–base	reduction

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

The amount of iron in a pill that contain iron(II) salts can be estimated by titration with $\text{KMnO}_4(\text{aq})$.

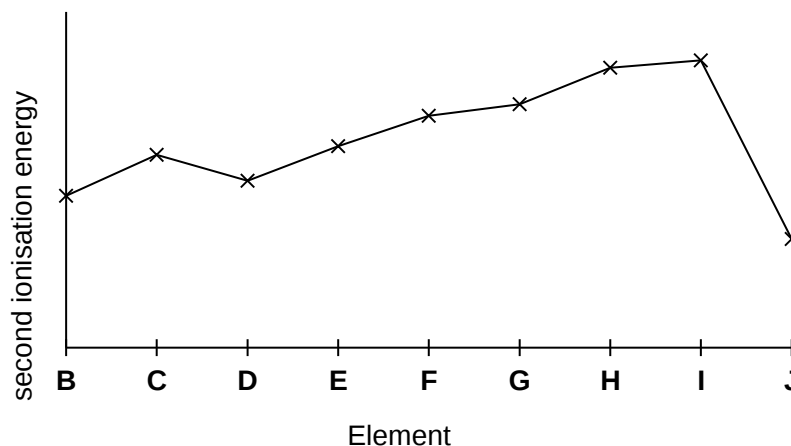
When a pill is dissolved in 10 cm^3 of dilute sulfuric acid and titrated against $0.40\text{ mol dm}^{-3}\text{ KMnO}_4$, the E_{cell} was measured against a standard hydrogen electrode and plotted as shown:



Which statements are correct?

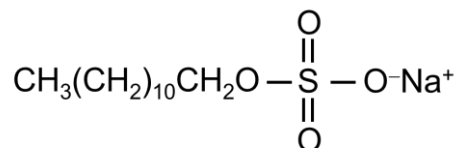
- 1 The number of moles of Fe^{2+} in the pill is $4.0 \times 10^{-2}\text{ mol}$.
 - 2 The value of E_{cell} at point X is 0.77 V.
 - 3 The colour change at end point is from pink to pale green.
- A** 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1 only

- 4 The following graph represents the second ionisation energy trend of 9 consecutive elements in Periods 3 and 4.



Which statement is correct?

- A Element **C** is in Group 3.
- B Element **F** has the lowest boiling point.
- C The ionic radius of ion of **E** is greater than that of ion of **J**.
- D The formula of the compound formed between elements **D** and **G** is D_2G_3 .
- 5 Long-chain alkanes are converted on an industrial scale into alkylsulfates for use as detergents. One example is sodium lauryl sulfate shown below.



Which statements can be deduced from the structure given?

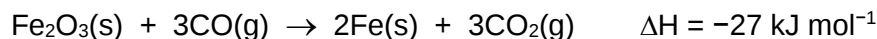
- 1 The compound can dissolve in both polar and non-polar solvents.
- 2 The shape about the sulfur atom is square planar.
- 3 All the C–C–C bond angles are 109.5° .
- A 1, 2 and 3
- B 1 and 2 only
- C 1 and 3 only
- D 2 and 3 only

- 6 Which statement is true for a fixed amount of an ideal gas when temperature increases at constant pressure?

(V = volume, p = pressure and T = temperature in K)

- A V remains constant.
 B $\frac{pV}{T}$ remains constant.
 C Density of the gas remains constant.
 D pV remains constant.

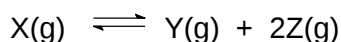
- 7 The reduction of iron ore, Fe_2O_3 , by carbon monoxide is an exothermic reaction which occurs in the upper part of the furnace.



Given that $\Delta H_f^\ominus$ for $\text{CO}_2(\text{g}) = -394 \text{ kJ mol}^{-1}$ and $\Delta H_f^\ominus$ for $\text{CO}(\text{g}) = -110 \text{ kJ mol}^{-1}$, what is the standard enthalpy change of formation of $\text{Fe}_2\text{O}_3(\text{s})$?

- A $+257 \text{ kJ mol}^{-1}$
 B $+825 \text{ kJ mol}^{-1}$
 C -257 kJ mol^{-1}
 D -825 kJ mol^{-1}
- 8 Which value would be required to calculate the lattice energy for the hypothetical ionic compound BaF_3 using Born-Haber cycle?
- A Third electron affinity of fluorine
 B Third ionisation energy of fluorine
 C Ba–F bond energy
 D F–F bond energy

- 9 A sample of $\text{X}(\text{g})$ with initial pressure of p atm is allowed to reach equilibrium at constant pressure.



The equilibrium partial pressure of X is $0.25p$ atm.

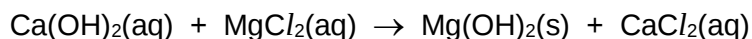
What is the value of K_p ?

- A $0.5p$ B $4.5p$ C $0.25p^2$ D $6.75p^2$

- 10** Which indicator is suitable for use in a titration of $0.1 \text{ mol dm}^{-3} \text{ H}_2\text{SO}_4$ with 0.1 mol dm^{-3} of NH_3 ?
- A** Methyl orange (pH range 3.3 – 4.4)
- B** Bromothymol blue (pH range 6.0 – 7.6)
- C** Phenolphthalein (pH range 8.3 – 10.0)
- D** None of the above

- 11** Magnesium hydroxide is extracted from the seawater as follows.

Aqueous calcium hydroxide is added to seawater. Magnesium hydroxide is then filtered off.



Which statement best explains why magnesium hydroxide is formed in the above reaction?

- A** Magnesium is less electropositive than calcium.
- B** The solubility product for Mg(OH)_2 is lower than that for Ca(OH)_2 .
- C** The enthalpy change of hydration for Mg^{2+} is less exothermic than for Ca^{2+} .
- D** The magnitude of the lattice energy of Mg(OH)_2 is less than that of Ca(OH)_2 .

12 P, Q and R react in aqueous solution according to the following equation:



The kinetics of the above reaction was studied and the experimental results obtained are shown in the table below.

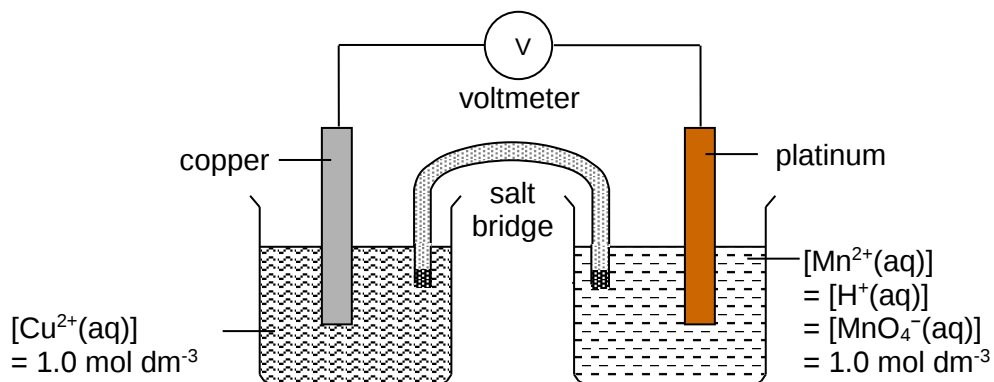
Expt	Volume of P /cm ³	Volume of Q /cm ³	Volume of R /cm ³	Volume of water /cm ³	Relative initial rate
1	10	10	10	20	16
2	10	5	20	15	32
3	5	5	10	30	4
4	10	5	10	25	8

What is the rate equation for the above reaction?

- A Rate = $k[\text{P}][\text{Q}]$
 B Rate = $k[\text{P}][\text{Q}][\text{R}]$
 C Rate = $k[\text{P}][\text{Q}]^2[\text{R}]$
 D Rate = $k[\text{P}][\text{Q}][\text{R}]^2$

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

A cell is set up by connecting a Cu²⁺/Cu half-cell and an acidified MnO₄⁻/Mn²⁺ half-cell.

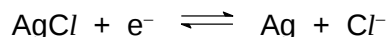


Which change in the set up will cause the corresponding effect on the e.m.f (potential difference) of the cell?

	Change	Effect on e.m.f of cell
A	Addition of excess NH ₃ (aq) into oxidation half-cell	Increases
B	Addition of concentrated H ₂ SO ₄ into reduction half-cell	Decreases
C	Increase the size of the copper electrode	Increases
D	Replace copper with an alloy of copper and zinc	Remains the same

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

The AgCl / Ag reference electrode is based on the following reaction:



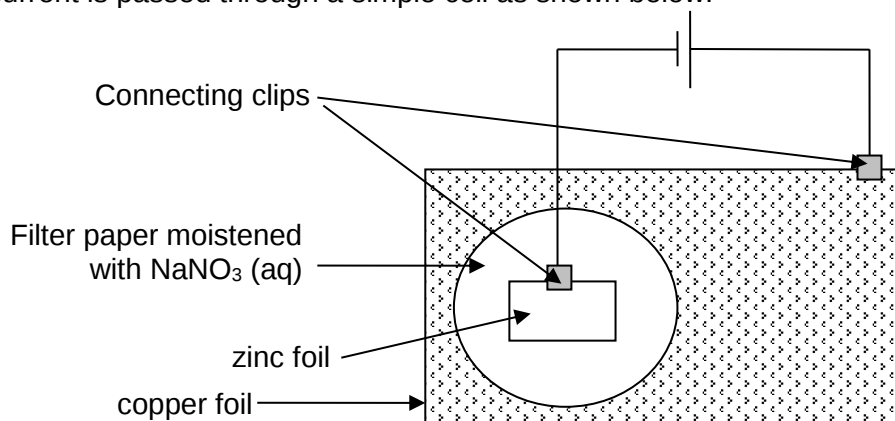
The reduction potential of the $\text{Fe}^{2+} / \text{Fe}$ half-cell was found to be -0.64 V when measured using the AgCl / Ag reference electrode.

What is the reduction potential of the AgCl / Ag electrode with respect to the standard hydrogen electrode?

- A -1.10 V B -0.20 V C $+0.20 \text{ V}$ D $+1.10 \text{ V}$

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

A current is passed through a simple cell as shown below:



What could be an expected observation?

- A Sodium metal was deposited on the filter paper.
 B The size of the zinc foil reduced with time.
 C The filter paper turned blue.
 D A brown gas was observed.
- 16 Consider the sequence of oxides Na_2O , SiO_2 , P_4O_{10} .
 Which factor decreases in the order Na_2O , SiO_2 , P_4O_{10} ?
- A melting point
 B covalent character
 C pH when mixed with water
 D solubility with aqueous alkali

- 17** Anhydrous barium nitrate and anhydrous magnesium nitrate decompose on heating, nitrogen dioxide and oxygen are evolved and an oxide is formed.

Which statements concerning these decompositions are correct?

- 1** Nitrogen dioxide is evolved at a lower temperature from magnesium nitrate than from barium nitrate.
- 2** For both nitrates, the volume of nitrogen dioxide evolved is four times greater than the volume of oxygen.
- 3** The numerical value of the lattice energy of magnesium nitrate is smaller than that of barium nitrate.

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

- 18** Element **Y** forms a chloride, YCl_n , which has a melting point of 3 °C. When treated with an excess of acidified silver nitrate, 0.50 g of the chloride produced 1.20 g of AgCl .

Another 0.50 g sample of the chloride was heated strongly. Chlorine gas was evolved and the residue gave 0.72 g of AgCl when treated with an excess of acidified silver nitrate.

What is the value of n and the identity of element **Y**?

	value of n	identity of element Y
A	5	Sb
B	5	P
C	4	Ge
D	4	Si

19 Which statements are correct for the compounds in the following sequence?

hydrogen chloride, hydrogen bromide, hydrogen iodide

- 1 The thermal stability increases.
- 2 The enthalpy change of formation becomes less exothermic.
- 3 The ease of oxidation increases.

A 1, 2 and 3

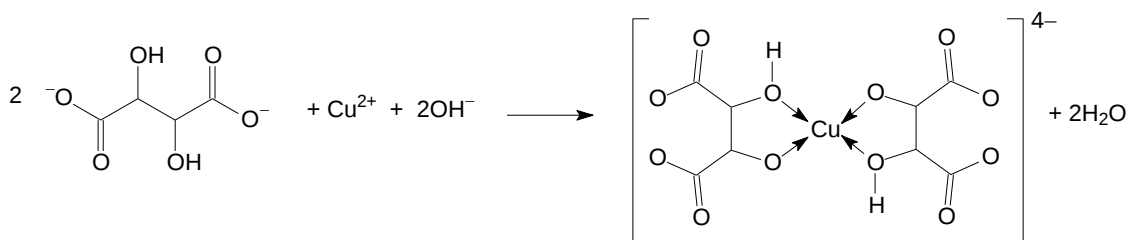
B 1 and 2 only

C 1 and 3 only

D 2 and 3 only

20 Fehling's solution is a common reagent used to identify aldehyde functional group in organic compound. It can be prepared by mixing aqueous copper(II) sulfate with tartrate ions in presence of strong alkalis.

The formation of copper tartrate complex is shown in the following equation.



tartrate ion

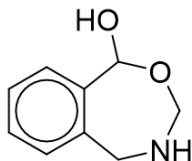
copper tartrate complex

Which statement is correct for the above reaction?

- A The tartrate ion acts as a Lewis acid.
- B The tartrate ion can exist as 3 stereoisomers.
- C The coordination number of the complex ion is 2.
- D The oxidation number of Cu in the complex ion is 0.

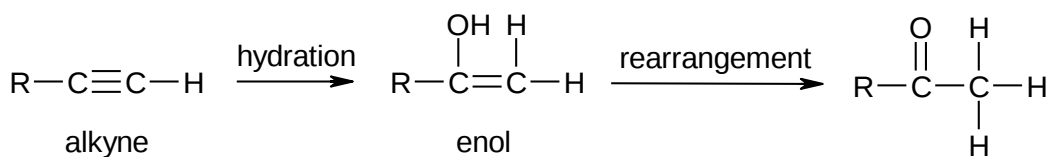
- 21 Hybridisation of orbitals can be observed for central atoms such as C, N and O.

How many atoms in the following molecule are sp^3 hybridised?



- A 3 B 4 C 5 D 6
- 22 An alkyne, a hydrocarbon with $C\equiv C$ bond, undergoes hydration in a similar mechanism as an alkene. However, the formation of an enol is unstable and would undergo rearrangement to form a carbonyl compound.

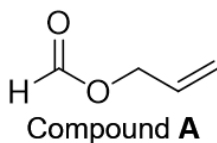
One example of the reaction is shown below.



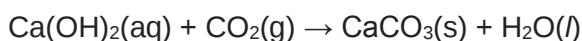
Which product is **not** the major product when the corresponding alkyne undergoes hydration?

	alkyne	product
A	$H-C\equiv C-H$	$H-\overset{\text{O}}{\underset{ }{C}}-CH_3$
B	$H-C\equiv C-CH_3$	$H-\overset{\text{O}}{\underset{ }{C}}-CH_2CH_3$
C	$CH_3-C\equiv C-H$	$CH_3-\overset{\text{O}}{\underset{ }{C}}-CH_3$
D	$CH_3-C\equiv C-CH_3$	$CH_3-\overset{\text{O}}{\underset{ }{C}}-CH_2CH_3$

- 23 When compound **A** was heated with excess acidified KMnO_4 , carbon dioxide gas was produced.

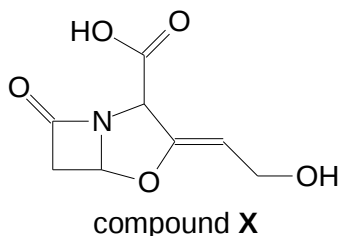


Carbon dioxide gas reacts with excess calcium hydroxide according to the following equation.



What is the mass of calcium carbonate ($M_r = 100.1$) that can be obtained when 1 mole of compound **A** is treated with hot excess acidified KMnO_4 ?

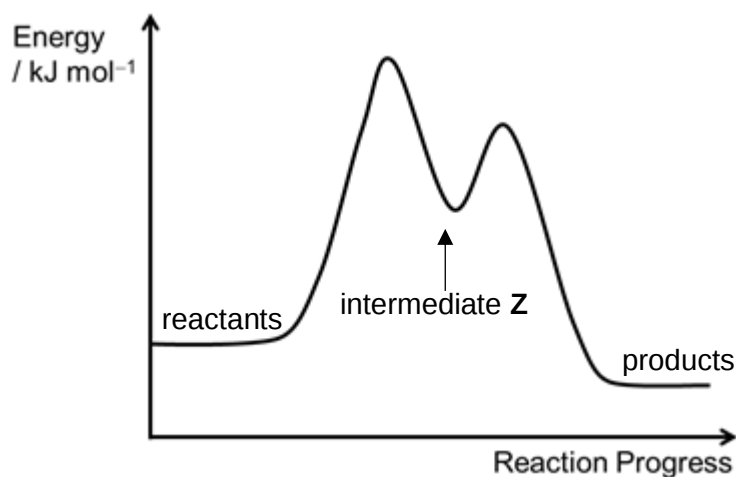
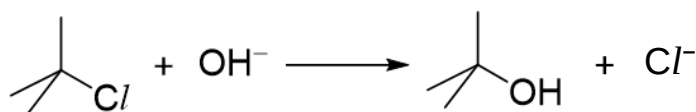
- A** 100.1 g **B** 200.2 g **C** 300.3 g **D** 400.4 g
- 24 Compound **X** has the following structure.



Which statements regarding compound **X** are correct?

- 1 Its molecular formula is $\text{C}_8\text{H}_8\text{NO}_5$.
 - 2 It has 2^3 stereoisomers.
 - 3 2 mol of Br atoms are added when 1 mol of compound **X** reacts with excess $\text{HBr}(\text{g})$.
 - 4 6 mol of H atoms are added when 1 mol of compound **X** reacts with LiAlH_4 in dry ether.
- A** 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 2 and 4 only

- 25 The energy profile diagram for the nucleophilic substitution reaction between hydroxide ions and 2-chloro-2-methylpropane is shown below.



Which statements can be inferred from the information given above?

- 1 The intermediate **Z** is $\left[\text{HO} - \begin{array}{c} | \\ \diagup \text{C} \diagdown \\ | \end{array} - \text{Cl} \right]^-$
- 2 This reaction has an overall order of reaction of 1.
- 3 Removal of 2-methylpropan-2-ol product does not affect the yield of the reaction.
- 4 Increasing the concentration of hydroxide ions reduces the time taken for reaction to complete.
- A 1 and 2 only
- B 1 and 4 only
- C 2 and 3 only
- D 3 and 4 only

26 Which compound will **not** react with NaBH_4 , but react with H_2 when heated with nickel catalyst?

1 $\text{CH}_3\text{CH}_2\text{COOH}$

2 $\text{CH}_3\text{CH}_2\text{CHO}$

3 $\text{CH}_3\text{CH}_2\text{CN}$

4 $\text{CH}_3\text{CH}=\text{CH}_2$

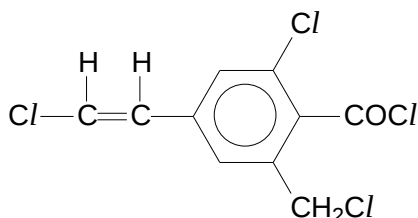
A 1 and 3 only

B 1 and 4 only

C 2 and 3 only

D 3 and 4 only

27



1 mole of the above molecule is treated with NaOH(aq) and warmed, followed by adding excess dilute nitric acid.

How many moles of silver chloride will be formed when excess aqueous silver nitrate is added?

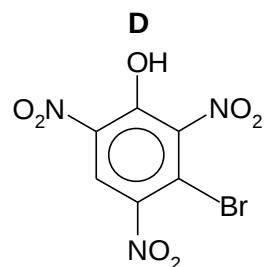
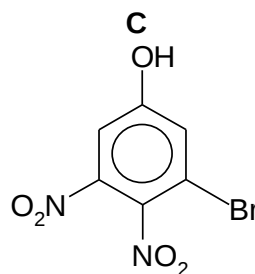
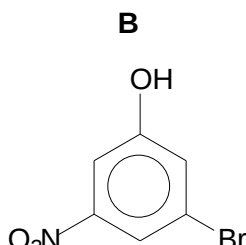
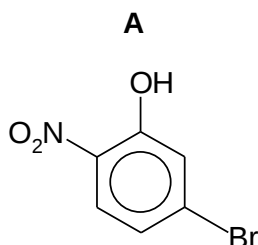
A 1

B 2

C 3

D 4

28 3-bromophenol is a versatile starting material for the synthesis of medicinal compounds. Which compound is likely to be the major product of the reaction between dilute nitric acid and 3-bromophenol?



- 29 Cyanohydrins are useful intermediates in organic syntheses. They can be made by reacting carbonyl compounds with hydrogen cyanide.

Which statements are correct about the reaction of propanone and hydrogen cyanide?

- 1 Propanone reacts with HCN to give a racemic mixture.
 - 2 Propanal reacts with HCN at a faster rate than propanone.
 - 3 The cyanohydrin obtained from the reaction can be distinguished from propanone by warming with NaOH(aq).
- A 1, 2 and 3
 B 1 and 2 only
 C 2 and 3 only
 D 1 only

- 30 Deuterium, D, is an isotope of hydrogen, ${}^2_1\text{H}$.

Which reaction will **not** yield an organic compound containing deuterium, D?

- A $\text{CH}_3\text{CH}_2\text{CN} \xrightarrow[\text{DCI, heat}]{\text{D}_2\text{O}}$
- B $\text{CH}_3\text{COCHI}_2 \xrightarrow[\text{D}_2\text{O, warm}]{\text{I}_2, \text{NaOD}}$
- C $\text{C}_6\text{H}_5\text{COCl} \xrightarrow[\text{KOD}]{\text{D}_2\text{O}}$
- D $\text{CH}_3\text{CH}_2\text{CONHCH}_3 \xrightarrow{\text{LiAlD}_4}$