HWA CHONG INSTITUTION
C2 Preliminary Examinations
Higher 2

CANDIDATE NAME		**CT GROUP**	**14S**
CENTRE NUMBER		**INDEX NUMBER**	

CHEMISTRY

9647/01

Paper 1 Multiple Choice

18 September 2015

1 hour

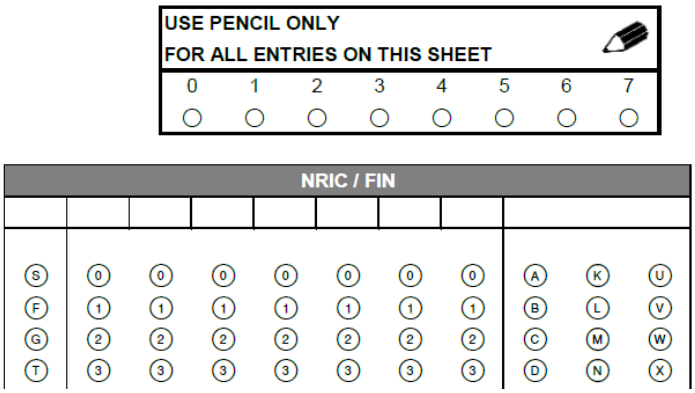
Additional Materials: Optical Mark Sheet (OMS)

Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Complete the information on the optical mark sheet (OMS) as shown below.

1. Enter your **NAME** (as in NRIC). _____
2. Enter the **PAPER NUMBER.** _____
3. Enter your **CT GROUP.** _____
4. Enter your **NRIC NUMBER** or **FIN Number**
5. Now **SHADE** the corresponding circles in the grid for **EACH DIGIT** or **LETTER**



There are **forty** 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 OMS.

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.

SECTION A

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

1 10 cm^3 of a hydrocarbon was mixed with 50 cm^3 of oxygen and combusted completely. After the resulting gas mixture was cooled and passed through aqueous sodium hydroxide, the volume of the residual gas mixture was found to be ¼ the volume of the original gas mixture before combustion. All volumes were measured at room temperature and pressure.

What is the formula of the hydrocarbon?

A C_2H_4
B C_2H_6
C C_3H_6
D C_3H_8

2 Equal volumes of 1 mol dm^{-3} hydrogen sulfide and sulfur dioxide (each containing a different isotope of sulfur) are mixed to precipitate sulfur according to the equations shown below:

$$H_2{}^{32}S(aq) \rightarrow {}^{32}S(s) + 2H^+(aq) + 2e^-$$

$${}^{34}SO_2(aq) + 4H^+(aq) + 4e^- \rightarrow {}^{34}S(s) + 2H_2O(l)$$

What is the relative atomic mass of the sulfur precipitated?

A 32.1
B 32.7
C 33.0
D 33.3

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

Which particle would, on losing an electron, have a half-filled set of d orbitals?

A Cr **B** Mn^{2+} **C** Fe^{3+} **D** Cr^{2+}

4 Which of the following pairs of liquids are immiscible?

A $(CH_3)_2CO$ and H_2O
B CH_2Cl_2 and $(CH_3)_2CO$
C CCl_4 and H_2O
D CCl_4 and CH_3CHO

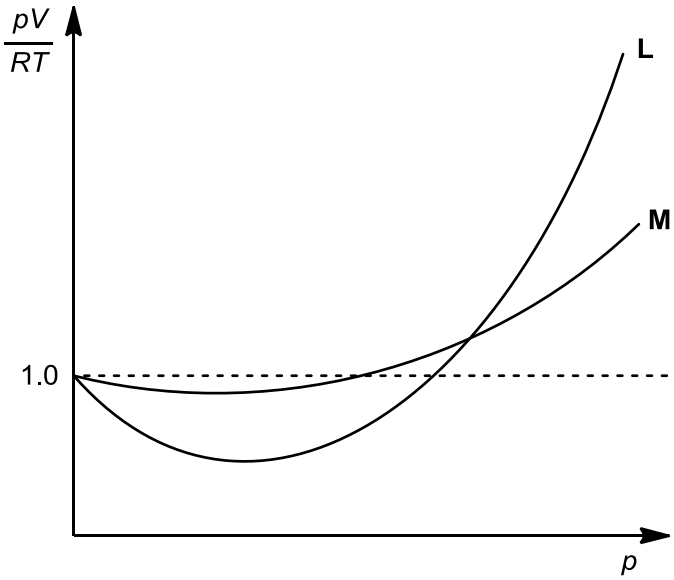
5 A solid **E** has the following physical properties.

- It is insoluble in non-polar solvents.
- It melts at 1290 ^oC.
- It conducts electricity in both aqueous and molten states.

What is the likely structure of **E**?

A a giant ionic structure
B a simple covalent structure
C a giant covalent structure
D a metallic structure

6 The value of pV/RT is plotted against p for one mole of each of the two non-ideal gases **L** and **M**, where p is the pressure, V is the volume and T is the temperature of the gas.



Which of the following pairs of gases could be **L** and **M**?

	L	**M**
A	HCl	F_2
B	CH_4	C_2H_6
C	$CH_3CH_2CH_3$	CH_3Cl
D	N_2	O_2

7 Which of the following is involved in determining the enthalpy change of a chemical reaction?

A The number of steps involved in the chemical reaction
B The mechanism of the reaction
C The initial and final states of the reacting system
D The activation energy of the reaction

8 For which process is the enthalpy change always negative?

A Dissolving a compound in water
B Forming an ion from an atom
C Synthesizing a compound from its elements
D Burning an element in oxygen

9 The rate for the reaction $2\boldsymbol{X}O(g) + O_2(g) \rightarrow 2\boldsymbol{X}O_2(g)$ was investigated by varying the partial pressures of ***X***O and O_2. The results are shown in the table below.

partial pressure of ***X***O/ atm	1.00	1.00	0.25	***p***
partial pressure of O_2/ atm	1.00	0.50	1.00	0.50
relative rate	1.00	0.50	0.25	0.125

What is the value of ***p*** in the table?

A 0.125 **B** 0.25 **C** 0.50 **D** 1.00

10 The age of a rock sample may be determined by rubidium-strontium dating, in which rubidium-87 decays to strontium-87. This radioactive decay is a first-order reaction with a half-life of 4.88×10^{10} years.

Assuming the rock sample contained no strontium-87 initially, what is the age of the rock sample if the molar ratio of rubidium-87 to strontium-87 in the sample is now 1:7?

A 6.97×10^9 years
B 1.63×10^{10} years
C 1.46×10^{11} years
D 3.42×10^{11} years

11 Which of the following statements involving the Haber process is correct?

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g); \ \Delta H < 0$$

A At equilibrium, the rate constants of the forward reaction and backward reaction are the same.
B The equilibrium yield of NH_3 can be improved by using powdered iron.
C The activation energy of the forward reaction is greater than that of the backward reaction.
D The equilibrium constant decreases with increasing temperature.

12 The numerical values of the solubility products at 25 °C for AgC*l* and AgI are 1.6×10^{-10} and 8.0×10^{-17} respectively.

What is the equilibrium constant for the reaction below?

$$AgCl(s) + I^-(aq) \rightleftharpoons AgI(s) + Cl^-(aq)$$

A 1.3×10^{-26}
B 5.0×10^{-7}
C 1400
D 2.0×10^{6}

13 Which of the following solutions will form an alkaline buffer?

A 50 cm^3 of 0.10 mol dm^{-3} NaOH added to 25 cm^3 0.10 mol dm^{-3} $CH_3CO_2^-Na^+$.
B 25 cm^3 of 0.10 mol dm^{-3} NaOH added to 50 cm^3 0.10 mol dm^{-3} CH_3CO_2H.
C 25 cm^3 of 0.10 mol dm^{-3} NaOH added to 50 cm^3 0.10 mol dm^{-3} $CH_3NH_3^+Cl^-$.
D 50 cm^3 of 0.10 mol dm^{-3} NaOH added to 50 cm^3 0.10 mol dm^{-3} $CH_3NH_3^+Cl^-$.

14 Two sodium chloride solutions of different concentrations were electrolyzed at 1 atm and 298 K. Which of the following correctly describes the colour of the litmus paper when placed at the respective electrodes of each solution?

	[NaC*l*(aq)] = 0.001 mol dm^{-3}		[NaC*l*(aq)] = 5.0 mol dm^{-3}	
	cathode	anode	cathode	anode
A	blue	red	blue	white
B	blue	white	blue	red
C	red	blue	white	blue
D	red	blue	red	blue

15 The oxide and chloride of an element **F** are separately mixed with water. The two resulting solutions have the same effect on litmus.

What is element **F**?

A aluminium
B magnesium
C phosphorus
D silicon

16 A solid metal chloride with the formula, **M**Cl_2, was analysed to yield the following results.

- The solid is soluble in water.
- Precipitation did not occur when NaOH(aq) is added.
- White precipitate observed when H_2SO_4(aq) is added.

What is the identity of the cation?

A Mg^{2+} **B** Pb^{2+} **C** Zn^{2+} **D** Ba^{2+}

17 When a white solid **G** reacts with concentrated H_2SO_4, the products include pungent-smelling gases and a dark brown solution containing a yellow solid. When aqueous sodium thiosulfate is added, the solid remains but the dark brown colour disappears.

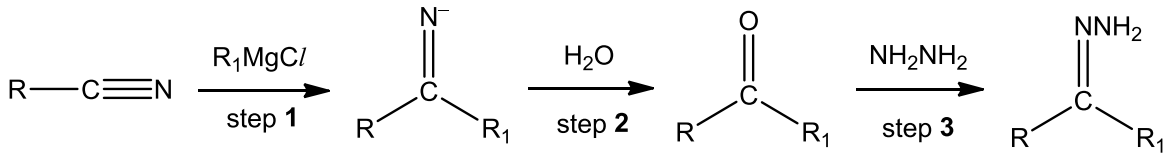
What is **G**?

A $AgNO_3$
B $CaCO_3$
C NaBr
D KI

18 Which statement correctly **defines** a transition element?

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

19 A reaction scheme is shown below.



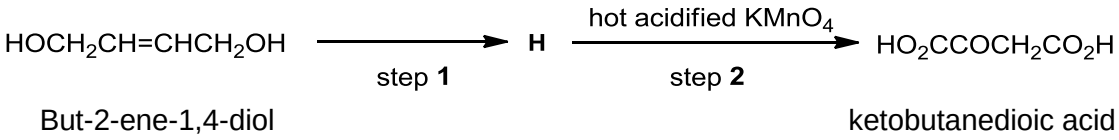
How can the three steps be classified?

	step **1**	step **2**	step **3**
A	addition	hydrolysis	condensation
B	addition	oxidation	substitution
C	substitution	oxidation	substitution
D	reduction	hydrolysis	condensation

20 Which of the following compounds could be formed when dichloromethane is reacted with excess chlorine in the presence of sunlight?

A $CHCl_3$ and H_2
B $CHCl_3$ and CH_2ClCCl_3
C $CHCl_3$ and CCl_3CHCl_2
D CCl_3CHCl_2 and CH_2ClCCl_3

21 But-2-ene-1,4-diol is converted in two steps through an intermediate **H** into ketobutanedioic acid.

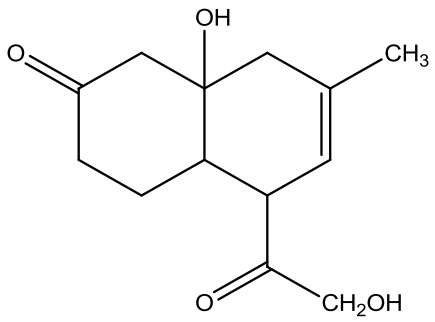


But-2-ene-1,4-diol ketobutanedioic acid

What could be the reagent for step **1** and the intermediate **H**?

	reagent for step **1**	**H**
A	steam and concentrated H_2SO_4	$HOCH_2CH_2CH(OH)CH_2OH$
B	hot acidified $K_2Cr_2O_7$	$HO_2CCH(OH)CH_2CO_2H$
C	cold acidified $KMnO_4$	$HOCH_2CH(OH)CH(OH)CH_2OH$
D	warm acidified $K_2Cr_2O_7$	$HO_2CCH=CHCO_2H$

22 Compound **K** is first reduced with hydrogen in the presence of a platinum catalyst, and the product is oxidized by warming with acidified $KMnO_4$.



compound **K**

How many moles of sodium hydroxide will react with one mole of the final product?

A 0 **B** 1 **C** 2 **D** 3

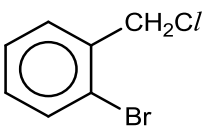
23 Which of the following reagents and conditions can be used to distinguish between benzene and cyclohexene?

A Oxygen gas, heat
B Acidified potassium dichromate, heat
C Aqueous bromine, absence of uv light
D Hydrogen bromide, room temperature

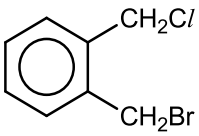
24 Equal mass of each of the following compounds was heated with NaOH(aq), and then excess dilute HNO_3(aq) and $AgNO_3$(aq) were added. The precipitate was collected and shaken with aqueous ammonia.

Which compound will produce the largest mass of precipitate after shaken with excess aqueous ammonia?

A



B



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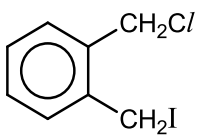
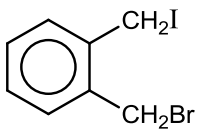


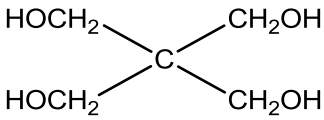
D



25 Which of the following best describes nitrogen oxides (NO and NO_2) as atmospheric pollutants?

A NO converts carbon monoxide and unburnt hydrocarbons into harmless products in the catalytic converter.
B NO_2 is a greenhouse gas which would cause global warming.
C NO_2 catalyses the formation of acid rain from atmospheric sulfur dioxide.
D NO_2 undergoes an acid-base reaction in water to produce HNO_2 and HNO_3, which results in acid rain.

26 Pentaerythritol is used as an intermediate in the manufacture of paint.



pentaerythritol

Which statement about pentaerythritol is **incorrect**?

A It can be dehydrated by concentrated sulfuric acid to form alkene.
B Its empirical formula and molecular formula are same.
C One mole of pentaerythritol gives two moles of hydrogen gas on reaction with excess sodium.
D It reacts with sodium bromide and concentrated sulfuric acid to form $C(CH_2Br)_4$.

27 Which compound has the highest pK_a value?

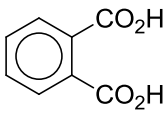
A HCO_2H
B CH_3CO_2H
C $BrCH_2CO_2H$
D $ClCH_2CO_2H$

28 Compound **N**, has the following features:

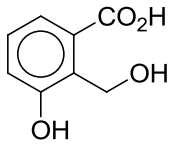
- Its molecular formula is $C_8H_6O_4$
- 1 mole of **N** reacts completely with 2 moles of PCl_5 to give misty fumes
- **N** reacts with hot concentrated H_2SO_4 to form a compound, $C_8H_4O_3$

Which of the following could be **N**?

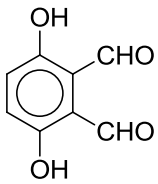
A



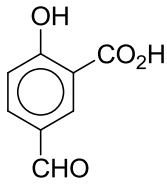
C



B



D



29 A mixture contains the following compounds:

X $CH_3CH_2CH{=}CHCH_2CO_2H$

Y $CH_3CH_2CH{=}CHCH_2COCH_3$

Z $CH_3CH_2CH_2CH{=}CHCH{=}CHCHO$

If these compounds are all present in the ratio **X** : **Y** : **Z** = 2 : 2 : 1, and all are reduced by an excess of $LiAlH_4$, how many hydrogen atoms would be incorporated on average per molecule?

A 1.2
B 2.0
C 3.2
D 4.4

30 The earliest use of chemicals to “perm” hair was in 1938. In modern use, two different compounds are used to “perm” hair. First, compound **P** is used as a “relaxer” to break the disulfide linkages within and between the polypeptide chains in the hair proteins:

R−S−S−R → R−SH + HS−R

When the desired amount of curl is achieved in the hair, compound **Q** is used as a “restorer” to reform the disulfide linkages:

R−SH + HS−R → R−S−S−R

Which of the following shows the roles of compounds **P** and **Q**?

	P	**Q**
A	acid	base
B	base	acid
C	oxidising agent	reducing agent
D	reducing agent	oxidising agent

SECTION B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

31 In which of the following reactions is the named element undergoing a disproportionation reaction?

	Element	Reaction
1	carbon	$H_2C_2O_4 \rightarrow H_2O + CO + CO_2$
2	copper	$2Na(CuCl_2) \rightarrow Cu + CuCl_2 + 2NaCl$
3	sulfur	$2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$

32 In which of the following pairs does the second species have a larger bond angle than the first?

1 NH_3 and BCl_3
2 SCl_2 and $BeCl_2$
3 SF_6 and XeF_4

33 The use of chlorine as a water disinfectant in swimming pools is now widely banned and the weak acid trichloroisocyanuric acid is used instead.

$$\text{trichloroisocyanuric acid} + OH^- \rightleftharpoons ClO^- + \text{cyanuric acid}$$

The ClO^- ion is the effective disinfectant.

Why is it necessary to maintain the pH of the water at 7.5?

1 At a pH of 7.5, the concentration of ClO^- is at a maximum.
2 The concentration of ClO^- ion depends on the pH.
3 The concentration of H^+ is too low for the following reaction to occur:
$2H^+(aq) + ClO^-(aq) + Cl^-(aq) \rightarrow H_2O(l) + Cl_2(g)$

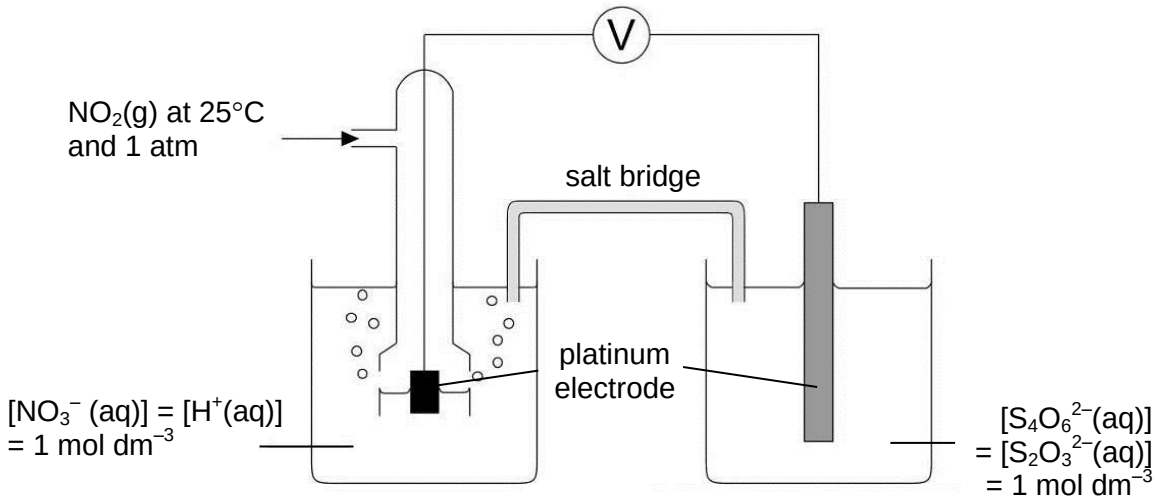
The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

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

A cell is set up as shown below.



Which of the following changes would decrease the cell potential?

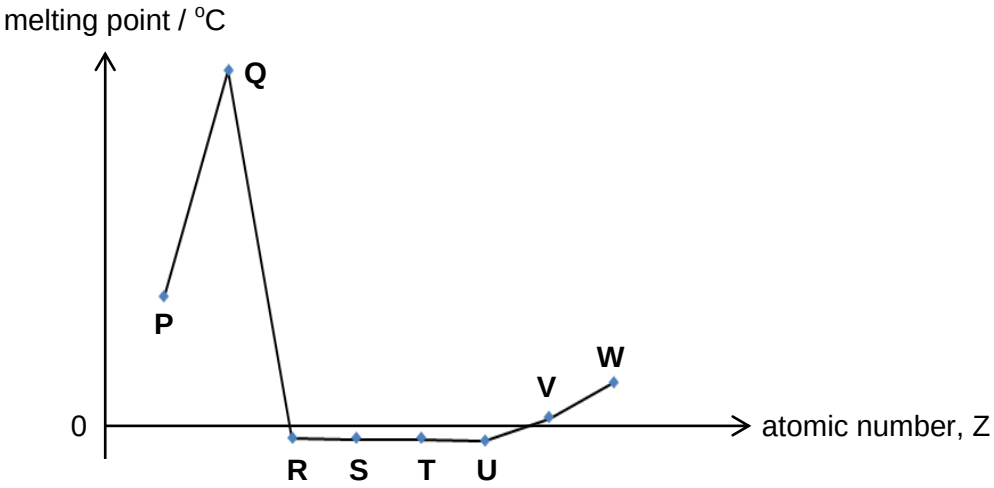
1 Adding sodium hydroxide to the $NO_3^-(aq)$ / $NO_2(g)$ half cell
2 Adding water to the $S_4O_6^{2-}(aq)$ / $S_2O_3^{2-}(aq)$ half cell
3 Adding iodine crystals to the $S_4O_6^{2-}(aq)$ / $S_2O_3^{2-}(aq)$ half cell

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

35 The graph below shows the variation in the melting points of eight consecutive elements in Period 2 and 3 of the Periodic Table.



Which statements are correct?

1 **P** and **Q** tend to form covalent compounds.
2 When 2 mol of dilute HC*l* is added to 1 mol of the oxide of **W**, the resulting solution is slightly acidic.
3 The ionic radius of **V** is larger than that of **S.**

36 When zinc powder was added to aqueous iron(III) chloride, effervescence was observed and the solution gradually changed colour from yellow to pale green.

Which of the following statements are correct about the reaction?

1 Fe^{3+} is a stronger oxidising agent than Zn^{2+}.
2 Effervescence was observed as an acid-base reaction has taken place.
3 The solution is coloured as d→d transitions occur in Zn^{2+}.

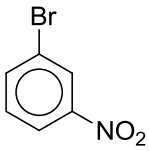
The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

37 Given that benzene undergoes bromination followed by nitration, which of the following are the major products?

1



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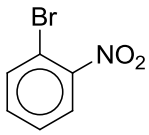


3

38 An account in a student's notebook read:

"An excess of aqueous bromine was added to aqueous phenol in a test-tube. 2,4,6–tribromophenol was produced as a creamy-white precipitate suspended in a yellow alkaline solution."

Which statements in this account are correct?

1 2,4,6–tribromophenol was produced as a creamy-white precipitate.
2 The resultant solution is yellow.
3 The resultant solution is alkaline.

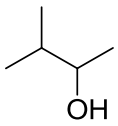
The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

39 Which of the following compounds will give a yellow precipitate with alkaline aqueous iodine?

1



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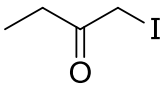

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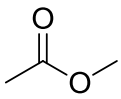
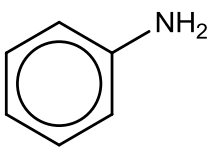


40 An organic compound **Z** is sparingly soluble in water, but readily dissolves in cold dilute sulfuric acid. Evaporation of this solution formed yields a crystalline solid.

Which of the following compounds could **Z** be?

1



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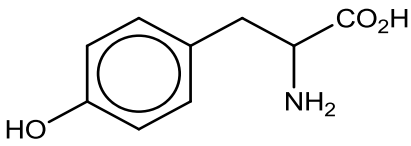
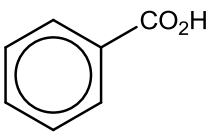


3



The End