TEMASEK
JUNIOR COLLEGE

CHEMISTRY **8872/01**

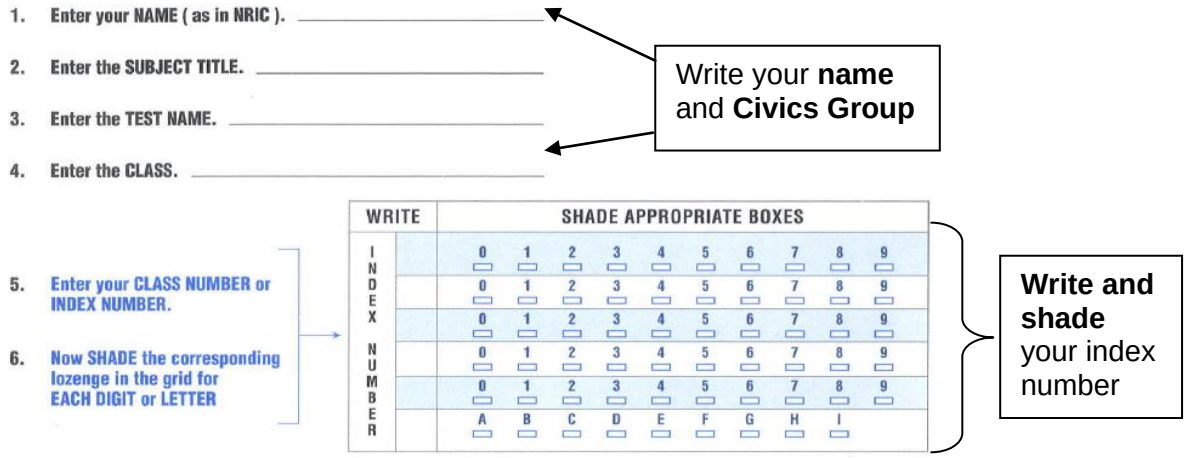
Paper 1 Multiple Choice **18th September 2015**

50 minutes

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.



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 **15** printed pages.

Section A

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

1 Incomplete combustion of y dm^3 of butane, C_4H_{10}, yielded a mixture of carbon dioxide and carbon monoxide in the ratio of 3:1, together with water vapour.

What is the volume of oxygen consumed?

A $5y$ dm^3

B $6y$ dm^3

C $9y$ dm^3

D $12y$ dm^3

2 0.005 mol of a metal oxide, $\mathbf{Y}_2O_x$, reacted exactly with 0.006 mol of acidified potassium manganate(VII) solution. The half-equation for the reduction of MnO_4^- is shown below.

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$

Given that the oxidation state of **Y** in the product is +6, what is the value of x?

A 1

B 2

C 3

D 4

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

Significant contributions to carbon dioxide levels in the atmosphere comes from the thermal decomposition of limestone (calcium carbonate) and the manufacture of cement and lime (calcium oxide).

Cement works roast 1000 million tonnes of limestone per year and a further 200 million tonnes is roasted in kilns to make lime.

What is the total annual mass output of carbon dioxide (in million tonnes) from these two processes?

A 440

B 528

C 660

D 880

4 Which of the following species has three unpaired electrons?

A A*l* **B** Ti^{3+} **C** Zn^{2+} **D** Cr^{3+}

5 Which of the following describes a phenomenon which **cannot** be explained by hydrogen bonding?

A Ethanoic acid molecules form a dimer when dissolved in benzene.

B Ice has a lower density than water at 0^oC.

C The boiling point of alcohol increases with increasing molecular mass.

D 2-nitrophenol has a lower boiling point than 4-nitrophenol.

6 In the presence of hydrochloric acid, potassium iodate(V), KIO_3, reacts with iodine, I_2, to form $IC\mathit{l}_2^-$.

What is the ratio of IO_3^- to I_2 in the balanced chemical equation for the overall reaction?

A 2 : 1

B 1 : 4

C 1 : 1

D 1 : 2

7 Dicarbon monoxide, C_2O, is found in dust clouds in space. Analysis of it shows that the sequence of atoms in this molecule is C – C – O. All bonds are double bonds and there are no unpaired electrons.

How many lone pairs of electrons are present in a molecule of C_2O?

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

8 *Use of Data Booklet is relevant to this question.*

An industrial method for manufacturing ethanol involves passing ethanol vapour and air over a heated copper catalyst.

$$CH_3CH_2OH + ½\ O_2 \xrightarrow{Cu\ at\ 300^oC} CH_3CHO + H_2O$$

What will be the enthalpy change for this reaction?

A - 430 kJ mol^{-1}

B - 344 kJ mol^{-1}

C - 182 kJ mol^{-1}

D + 278 kJ mol^{-1}

9 *Use of Data Booklet is relevant to this question.*

Propane burns exothermically in air as follows.

$$CH_3CH_2CH_3(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l) \qquad \Delta H = -2200\ kJ\ mol^{-1}$$

0.05 moles of propane from the burner was used to heat 0.9 dm^3 of water. It was found that the temperature of the water increased to 40 ^oC after three minutes at room conditions.

What is the rate of heat loss to the surroundings in kJ min^{-1}?

A 17.9 kJ min^{-1}

B 36.7 kJ min^{-1}

C 53.6 kJ min^{-1}

D 103 kJ min^{-1}

10 The equilibrium, $A_2(g) + 4B(g) \rightleftharpoons 2AB_2(g)$, has an equilibrium constant K_c of 3.60. What will be the numerical value of the equilibrium constant of the following reaction at the same temperature?

$$AB_2(g) \rightleftharpoons ½\ A_2(g) + 2B(g)$$

A 0.14

B 0.53

C 0.28

D 3.60

11 Sulfur dioxide is converted to sulfur trioxide in the Contact process as shown by the equation below.

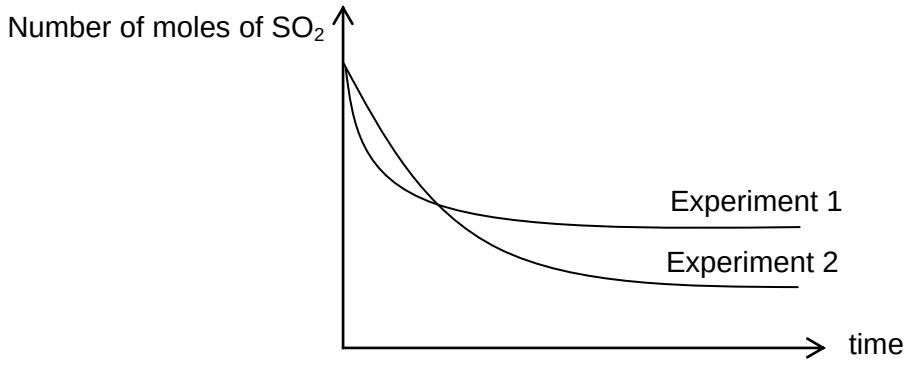
$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

To investigate the reaction, two experiments were conducted.

Experiment 1: Quantities of SO_2 and O_2 were placed in a sealed vessel and the reaction was allowed to proceed at a constant temperature.

Experiment 2: The experiment was repeated at a different temperature using quantities of reactants same as experiment 1.

The graph below shows the amount of SO_2 present in the mixture.



These results show that experiment 2 was conducted at a

A higher temperature and the forward reaction is endothermic.

B lower temperature and the forward reaction is endothermic.

C higher temperature and the forward reaction is exothermic.

D lower temperature and the forward reaction is exothermic.

12 Steam reforming process is the most common method for industrial production of hydrogen.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$$

The value of K_c is found to be 5.27 for this reaction when 0.65 mol of methane is mixed with 0.30 mol of steam in a 1 dm^3 vessel.

How many moles of steam must be added to the mixture to raise the equilibrium amount of hydrogen gas to 0.84 mol at the same temperature?

A 0.030

B 0.065

C 0.085

D 0.090

13 Which of the following mixtures gives a buffer solution?

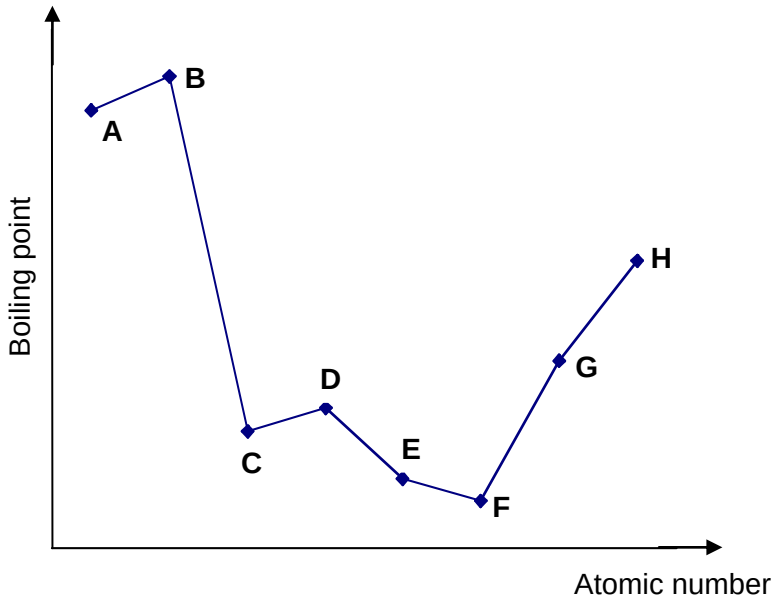
A 10 cm^3 of 0.1 mol dm^{-3} HC*l* and 10 cm^3 of 0.2 mol dm^{-3} $CH_3CO_2^-Na^+$

B 10 cm^3 of 0.1 mol dm^{-3} HC*l* and 10 cm^3 of 0.2 mol dm^{-3} NaOH

C 20 cm^3 of 0.1 mol dm^{-3} HC*l* and 10 cm^3 of 0.2 mol dm^{-3} NH_3

D 20 cm^3 of 0.1 mol dm^{-3} NaOH and 10 cm^3 of 0.1 mol dm^{-3} NH_3

14 The graph below shows the variation in the boiling points for eight consecutive elements in the Periodic Table, all with atomic number between 10 and 20.



Which of the following statements is true?

A Element **A** and barium are in the same group.

B Element **G** has a smaller atomic radius than element **H**.

C Element **D** has a lower first ionisation energy than element **C**.

D The oxide of **G** dissolves in water to give an acidic solution.

15 **X**, **Y** and **Z** are elements in Period 3 of the Periodic Table.

A mixture containing the oxides of **X**, **Y** and **Z** was dissolved in excess dilute sulfuric acid and filtered. The oxide of **Z** was collected as a residue. When excess dilute sodium hydroxide was added to the filtrate, only a white precipitate of the hydroxide of **Y** was formed.

What are the possible identities of **X**, **Y** and **Z**?

	X	**Y**	**Z**
A	Mg	A*l*	P
B	A*l*	Mg	P
C	Mg	A*l*	Si
D	A*l*	Mg	Si

16 A student conducted an experiment which involved burning a small sample of sodium metal in air. What is the colour of the flame observed?

A white

B yellow

C blue

D red

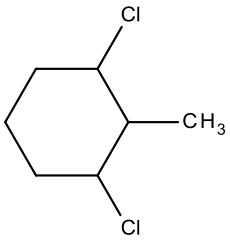
17 Methylcyclohexane and Cl_2 are mixed together and irradiated with light.

Which of the following compound **cannot** be formed?

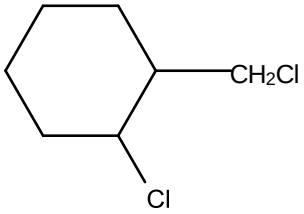
A H_2

B HC*l*

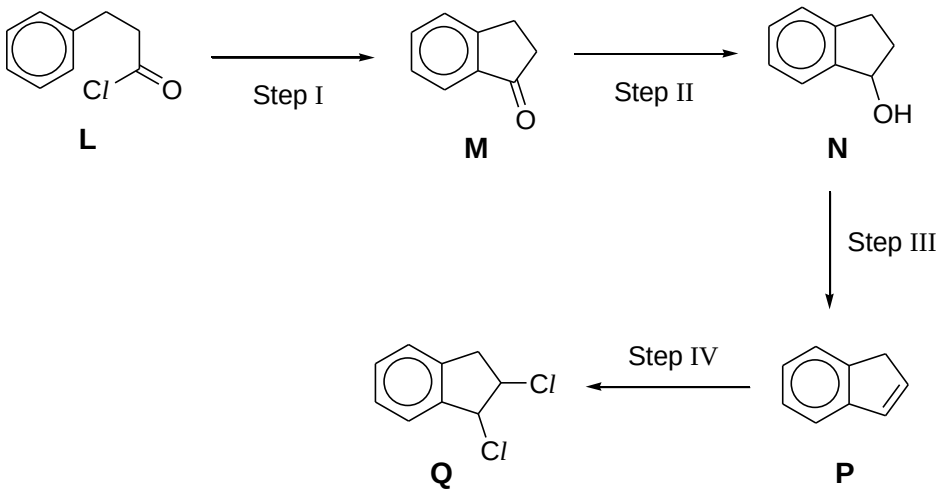
C



D



18 Consider the following reaction scheme.



Which of the following statements about the above reaction scheme is correct?

A Step **I** does not require a catalyst.

B Compound **M** is a planar molecule.

C Step **III** is an elimination reaction.

D Step **IV** is a substitution reaction.

19 Deuterium, D, is an isotope of hydrogen.

Which reaction will **not** yield organic product(s) containing deuterium?

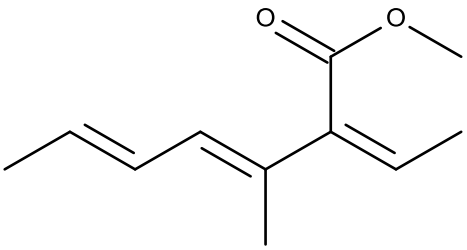
A $CH_3CH_2CH_2OH \xrightarrow[\text{heat}]{CD_3CO_2D,\ \text{concentrated } D_2SO_4,}$

B $CH_3CH{=}CHCH_3 \xrightarrow{DBr}$

C $CH_3CH_2COCH_2I \xrightarrow{NaOI,\ D_2O\ \text{heat}}$

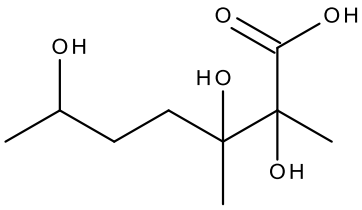
D $CH_3CH_2CH_2CN \xrightarrow{NaOD,\ D_2O,\ \text{heat}}$

20 Part of the structure of a fungicide, strobilurin, is shown.

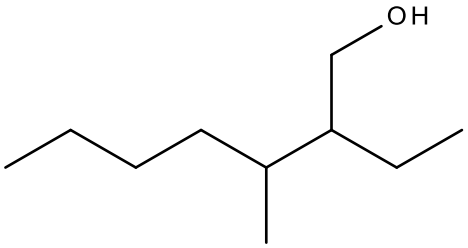


If strobilurin is first warmed with aqueous sulfuric acid, and its product then treated with hydrogen in the presence of a palladium catalyst, what could be the structure of the final product?

A



B



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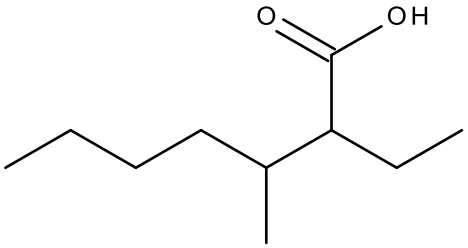

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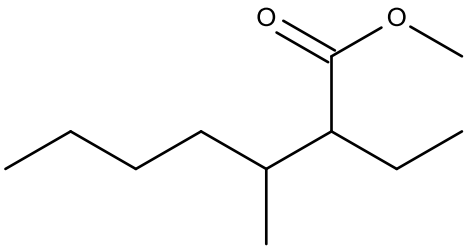


21 An organic compound **R** has the following properties:

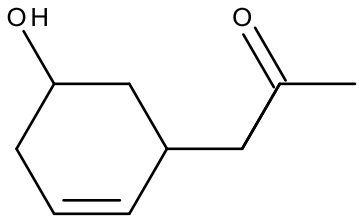
(i) It reacts with PCl_5(s).

(ii) It decolourises Br_2(aq).

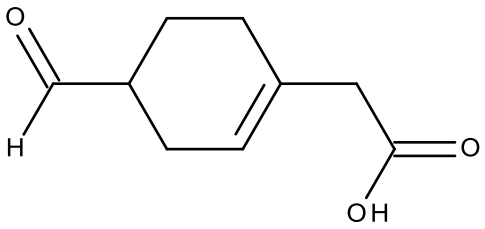
(iii) It gives a brick-red precipitate with an alkaline solution of complexed Cu^{2+}(aq).

Which of the following is the likely identity of compound **R**?

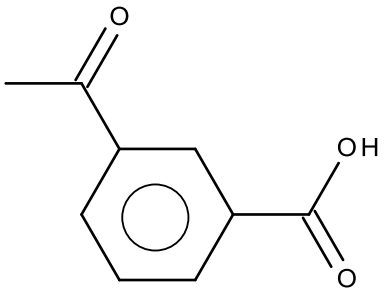
A



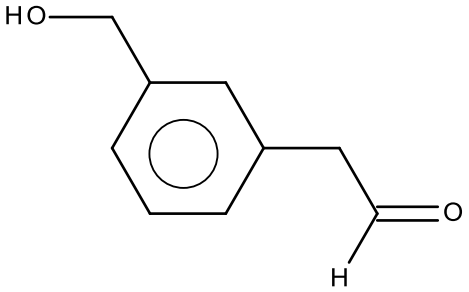
B



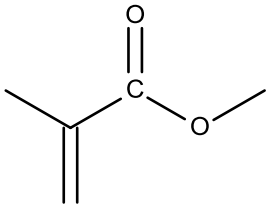
C



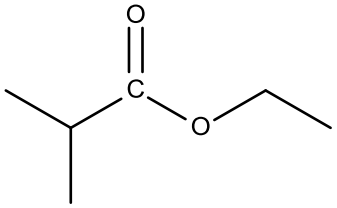
D



22 Perspex is a clear, colourless polymer used for optical applications. It is made of the monomer, methyl methacrylate.



Methyl methacrylate



Compound **Z**

Which of the following reagents and conditions can be used to distinguish methyl methacrylate and compound **Z**?

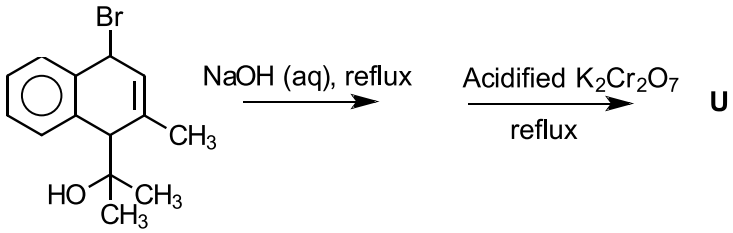
A 2,4-DNPH, room temperature

B NaOH(aq), heat

C HBr(g)

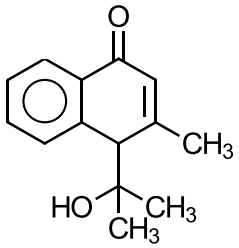
D Aqueous alkaline iodine, heat

23 The reaction scheme below shows the synthesis of compound **U**.

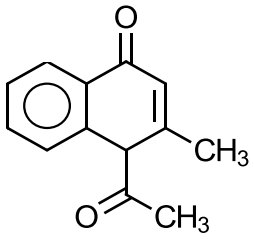


Which of the following can be **U**?

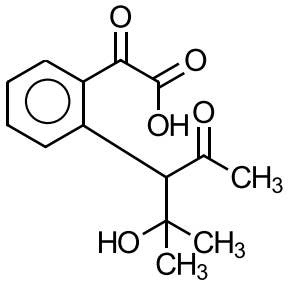
A



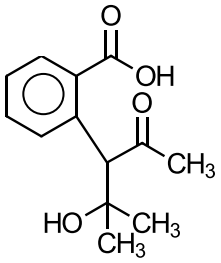
B



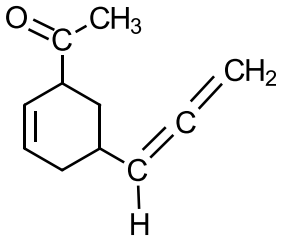
C



D



24 Which of the following statements are true regarding compound **Z**?



Compound **Z**

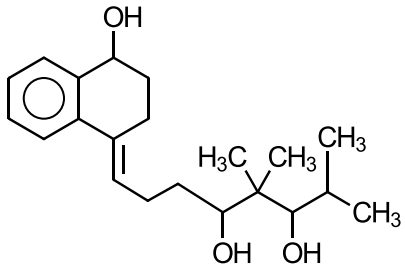
A There is only one *sp* hybridised carbon atom in a molecule of **Z**.

B A molecule of **Z** contains three π bonds.

C After **Z** reacts with $LiAlH_4$, all the carbon atoms in the product formed are sp^3 hybridised.

D **Z** is a planar molecule.

25 Compound **P** reacts with concentrated H_2SO_4 at 180ºC to form Compound **Q**. Compound **P** has the following structure.



Compound **P**

What is the total number of geometric isomers of Compound **Q**?

A 2 **B** 4 **C** 8 **D** 16

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 which 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.

26 Which of following statements are **incorrect**?

1 A covalent compound that contains both hydrogen and oxygen can form hydrogen bonds between its molecules.

2 Ionic compounds can be distinguished from metals by their electrical conductivity in the liquid states.

3 All substances with covalent bonding have poor electrical conductivity.

27 The table below shows the experimental results for the reaction of bromate(V) and bromide in the presence of acid.

$$BrO_3^- + 5Br^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$$

Expt	$[BrO_3^-]$	$[Br^-]$	$[H^+]$	relative rate
1	0.10	0.15	0.40	1
2	0.20	0.15	0.40	2
3	0.10	0.30	0.40	2
4	0.30	0.10	0.20	0.5
5	0.01	0.60	0.80	x

Which of the following statements are correct for this reaction?

1 The value of x is 1.6.

2 The overall order of reaction is 4.

3 The units of rate constant are $mol^{-3}\ dm^9\ s^{-1}$.

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.

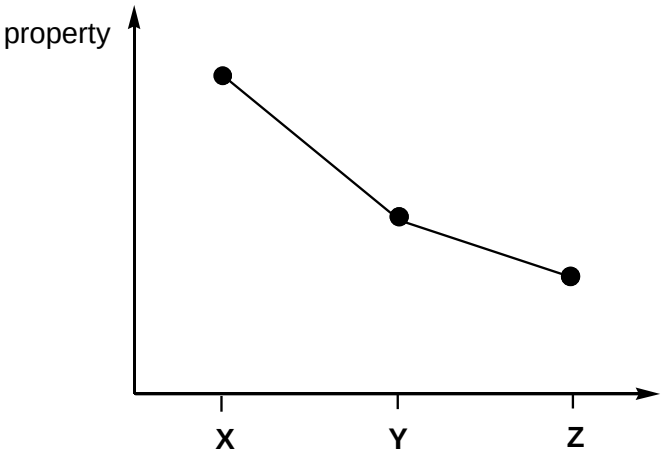
28 At 50 °C, pure water is found to have a pH value of 6.6. Which of the following statements are true?

1 The concentration of hydrogen ion in water is higher at 50 °C compared to at 25°C.

2 A solution of 0.1 mol dm^{-3} NaOH has a pH of 12.2 at 50 °C.

3 Water is acidic at 50 °C.

29 Which property about **X**, **Y** and **Z** will give the trend shown below?



	Property	**X**	**Y**	**Z**
1	pH of the resultant solution when added to water	$MgCl_2$	$AlCl_3$	$SiCl_4$
2	atomic radius	S	Cl	Ar
3	boiling point	HCl	HBr	HI

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

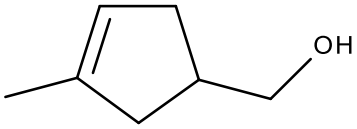
A	B	C	D
1,**2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

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

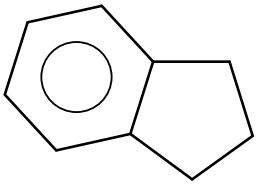
30 An organic compound **L** was subjected to prolonged heating with excess acidified potassium manganate(VII). A dicarboxylic acid was amongst the products found.

Which of the following is a possible structure of compound **L**?

1



2



3 $CH_2=C(CH_3)CH_2CH_2CH=CH_2$