



HWA CHONG INSTITUTION
C2 Preliminary Examinations
Higher 2

**CANDIDATE
NAME**

CT GROUP

19S

**CENTRE
NUMBER**

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**INDEX
NUMBER**

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CHEMISTRY

9729/01

Paper 1 Multiple Choice

21 September 2020

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.

Complete the information on the Answer Sheet 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**



USE PENCIL ONLY FOR ALL ENTRIES ON THIS SHEET							
0	1	2	3	4	5	6	7
☐	☐	☐	☐	☐	☐	☐	☐

NRIC / FIN											
(S)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(A)	(K)	(U)	
(F)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(B)	(L)	(V)	
(G)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(C)	(M)	(W)	
(T)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(D)	(N)	(X)	

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 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.

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

In which pairs do both species have different number of unpaired p electrons?

- A Al^{2-} and O^+ B N and Cl^{2+} C C and Cl^+ D B^- and S^+

- 2 Four substances have the physical properties shown.

Which substance exists as a simple molecular solid at room temperature?

	melting point/ °C	electrical conductivity	solubility in water
A	-7	does not conduct	slightly soluble
B	46	does not conduct	insoluble
C	420	conducts	insoluble
D	782	does not conduct	soluble

- 3 Which statement about covalent bonds is **incorrect**?

- A The electron density in a σ bond is highest along the axis between the two bonded atoms.
- B Covalent bonds can occur together with ionic bonds in the same compound.
- C A triple bond consists of one π bond and two σ bonds.
- D A π bond restricts rotation about the σ bond axis.

- 4 Which statement about an ideal gas is correct?

- A The density of an ideal gas at constant temperature is inversely proportional to the pressure.
- B One mole of any ideal gas occupies the same volume under the same conditions of temperature and pressure.
- C The volume of a given mass of an ideal gas is doubled if its temperature is raised from 25 °C to 50 °C at constant pressure.
- D Adding an inert gas to an ideal gas at constant volume and temperature will increase the partial pressure of the ideal gas.

- 5 When 10 cm^3 of a gaseous organic compound were completely burnt in an excess of oxygen, 30 cm^3 of carbon dioxide and 5 cm^3 of nitrogen were formed, all volumes being measured at the same temperature and pressure.

Which could be the formula of the organic compound?

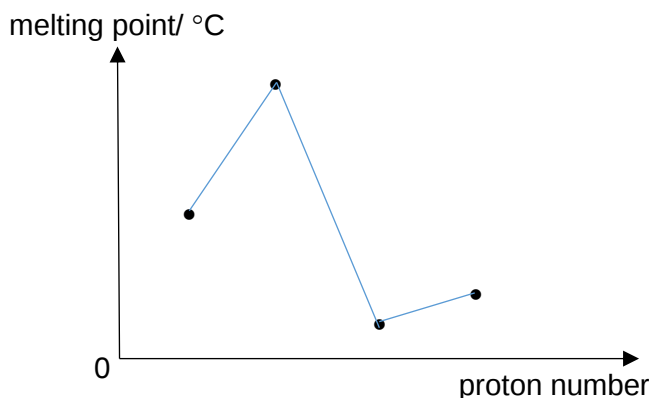
- A $\text{C}_2\text{H}_6\text{N}_2$
 - B $\text{C}_2\text{H}_7\text{NO}$
 - C $\text{C}_3\text{H}_7\text{N}_2$
 - D $\text{C}_3\text{H}_5\text{N}$
- 6 A saturated solution of XeF_2 ($M_r = 169$) contains 25.0 g dm^{-3} of XeF_2 .

In an experiment, 15.20 cm^3 of the XeF_2 solution is required to completely react with 10.0 cm^3 of another solution containing 0.150 mol dm^{-3} of M^{2+} (M is a metal). XeF_2 is converted to Xe.

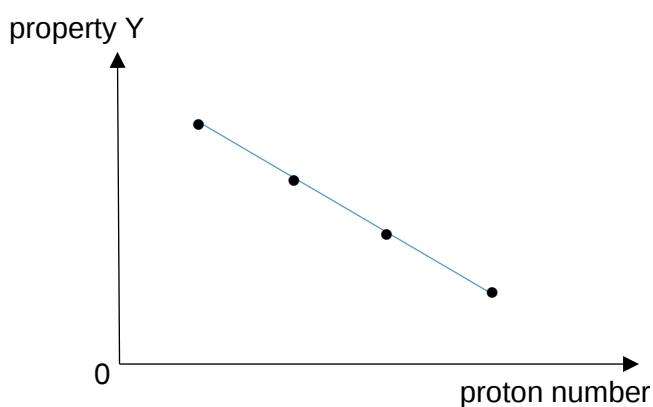
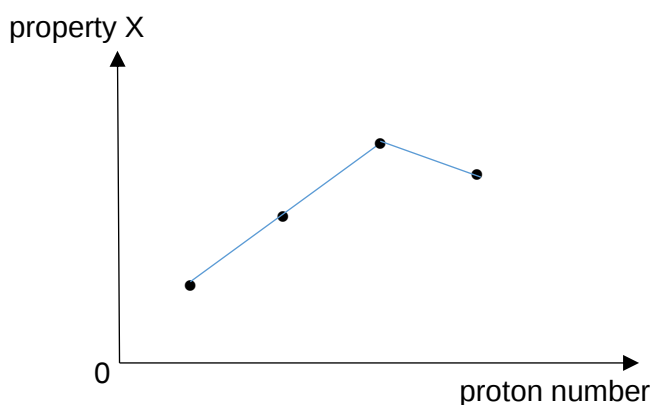
What is the oxidation state of M after the reaction?

- A +3
- B +4
- C +5
- D +6

- 7 The diagram represents the melting points of four consecutive elements in the third period of the Periodic Table.



The sketches below represent another two properties of these elements.



What are properties X and Y?

	property X	property Y
A	electrical conductivity	ionic radius
B	first ionisation energy	atomic radius
C	pH of the chlorides with water	effective nuclear charge
D	pH of the oxides with water	highest oxidation number in oxides

- 8 X and Y are two different Group 2 metals. Some of their applications are described below.

The oxide of X is used as a refractory lining materials in kilns.

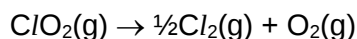
The carbonate of Y is used as a building material. It can be heated to form compound Z. When Z is hydrated, the resulting compound is used agriculturally to treat soils.

Which statement about X and Y is correct?

- A X reacts with cold water more quickly than Y.
 - B The reducing power of X is higher than that of Y.
 - C The nitrate of X decomposes at a lower temperature than the nitrate of Y.
 - D The numerical value of the lattice energy of the oxide of X is smaller than that of the oxide of Y.
- 9 The element astatine lies below iodine in Group 17 of the Periodic Table.

What will be the properties of astatine?

- 1 It forms diatomic molecules which dissociate more readily than chlorine.
 - 2 Hydrogen astatide is less stable to heat than hydrogen iodide.
 - 3 Silver astatide is soluble in aqueous ammonia.
- A 1, 2 and 3
 - B 1 and 2 only
 - C 2 and 3 only
 - D 1 only
- 10 A sample of chlorine dioxide is completely decomposed in a sealed container at constant pressure.



What will cause a decrease in the entropy of the system while keeping the pressure constant?

- A increase the volume of the container
- B increase the temperature of the system
- C add an inert gas into the system at constant temperature
- D remove chlorine from the system at constant temperature

- 11** The following table shows the temperature rise on mixing acids with aqueous sodium hydroxide.

mixture	temperature rise/ °C
25 cm ³ of 1 mol dm ⁻³ HCl(aq) + 25 cm ³ of 1 mol dm ⁻³ NaOH(aq)	w
25 cm ³ of 1 mol dm ⁻³ CH ₃ CO ₂ H(aq) + 25 cm ³ of 1 mol dm ⁻³ NaOH(aq)	x
50 cm ³ of 1 mol dm ⁻³ HCl(aq) + 50 cm ³ of 1 mol dm ⁻³ NaOH(aq)	y
50 cm ³ of 1 mol dm ⁻³ CH ₃ CO ₂ H(aq) + 50 cm ³ of 1 mol dm ⁻³ NaOH(aq)	z

Which are the relative values of temperature rise?

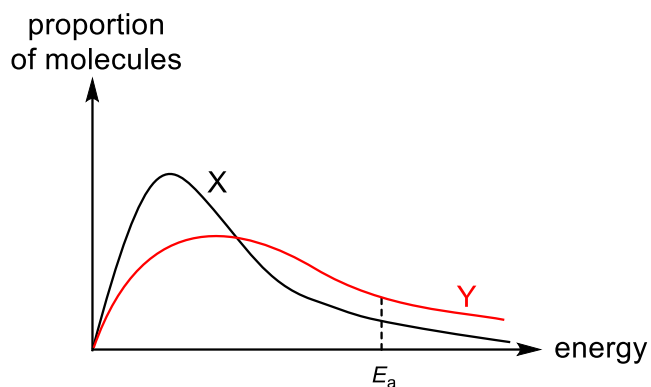
- A** $w = y > x = z$
- B** $w > y > x > z$
- C** $y = z > w = x$
- D** $y > w > z > x$

- 12** Which statement about a first-order reaction is correct?

- A** The reactant concentration decreases linearly with time.
- B** The reactant concentration decreases exponentially with time.
- C** The rate of reaction remains constant as the reaction proceeds.
- D** The rate of reaction increases exponentially as the reaction proceeds.

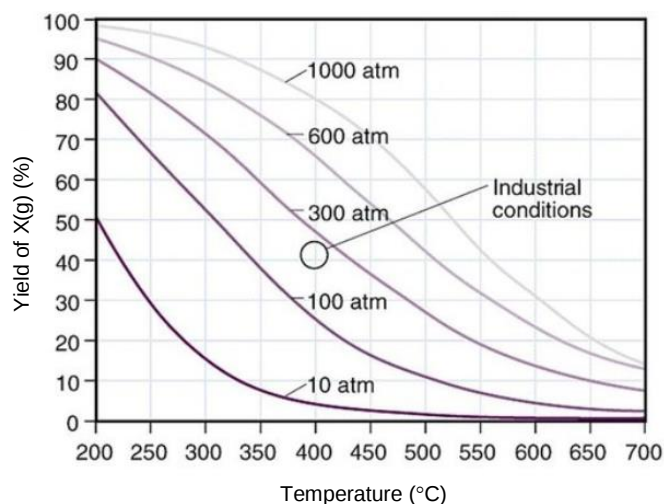
13 Which statements are correct when a catalyst is added to a sample of reacting molecules?

- 1 The rate constant remains the same but the rate of reaction increases.
- 2 The catalyst allows the reacting molecules to react via an alternative pathway with a lower activation energy, hence rate of reaction increases.
- 3 The Boltzmann distribution changes from curve X to Y, resulting in a greater proportion of molecules having energy above the activation energy, E_a , hence rate of reaction increases.



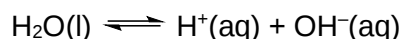
- A** 2 only
- B** 1 and 2 only
- C** 1 and 3 only
- D** 2 and 3 only

- 14 The graph below shows how the yield of an industrially manufactured compound, X, changes with temperature under five different operating pressures. In this reaction, X is the **only** gaseous product formed from gaseous reactants.



What can be inferred from the graph above?

- 1 The forward reaction is exothermic.
 - 2 The balanced equation for the reaction involves a greater number of moles of gaseous reactants than the gaseous product X.
 - 3 The industrial conditions are decided by taking into consideration the rate of the reaction as well as the cost of building the plant.
- A 3 only
 B 1 and 2 only
 C 2 and 3 only
 D 1, 2 and 3
- 15 The forward reaction of this equilibrium is endothermic.



$$K_w = 1.0 \times 10^{-14} \text{ at } 25^\circ\text{C}$$

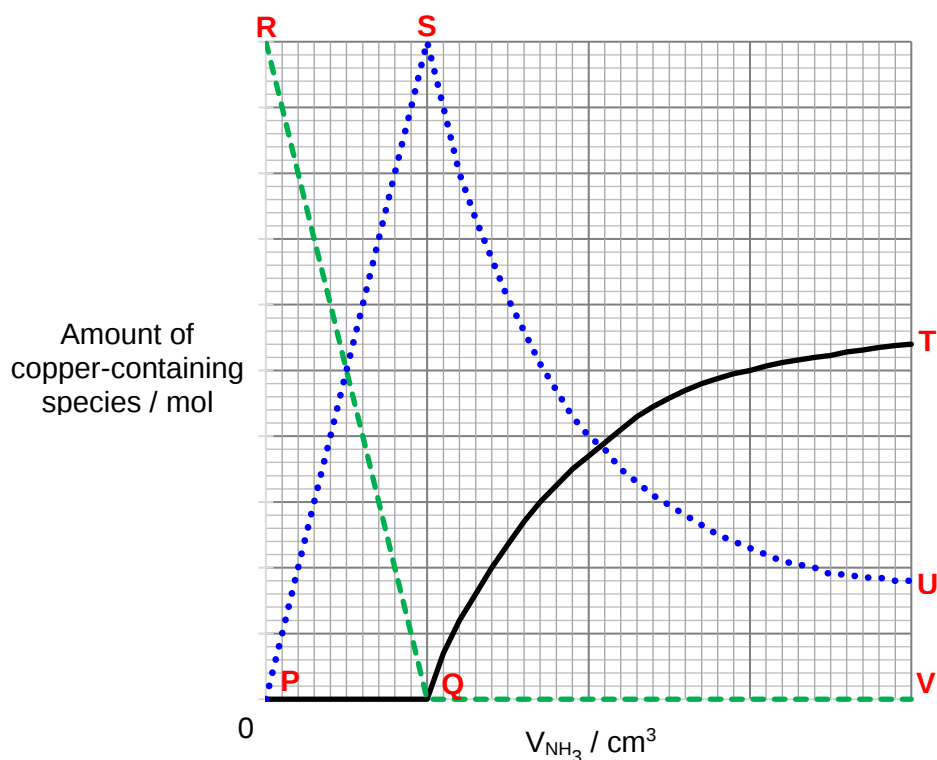
What is correct about water at 70 °C?

- A pH < 7.0
 B pH = 7.0
 C $[\text{H}^+] > [\text{OH}^-]$
 D $[\text{H}^+] < [\text{OH}^-]$

- 16 The indicator bromophenol blue, HIn, changes colour from yellow to blue over a pH range of 3.0 to 4.6.

Which statement is correct?

- A The In^- ions are yellow.
- B The pK_a of bromophenol blue is around 3.8.
- C When bromophenol blue is added to water, $[\text{HIn}] > [\text{In}^-]$.
- D Bromophenol blue would be a suitable indicator for the titration of a strong base and a weak acid.
- 17 An experiment was conducted by adding $\text{NH}_3(\text{aq})$ gradually to $\text{CuSO}_4(\text{aq})$ in a beaker. The amounts of three major copper-containing species were determined and plotted against the volume of $\text{NH}_3(\text{aq})$ added (represented by ---, ... and —). The arrows representing the axes are not shown for clarity.

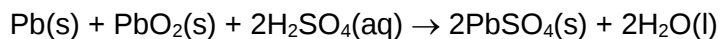


Which portion of the graph best represents each of the processes described?

	precipitation	dissolution	complex formation
A	QT	SU	QT
B	PS	RQ	SU
C	QT	RQ	SU
D	PS	SU	QT

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

One of the reactions in a lead-acid car battery is shown.



Which statements about this reaction are correct?

- 1 Electrons flow from PbO_2 to Pb .
- 2 Pb is oxidised while PbO_2 is reduced.
- 3 The cell e.m.f. is more positive than +1.60 V.
- 4 It is a non-spontaneous reaction driven by electricity.

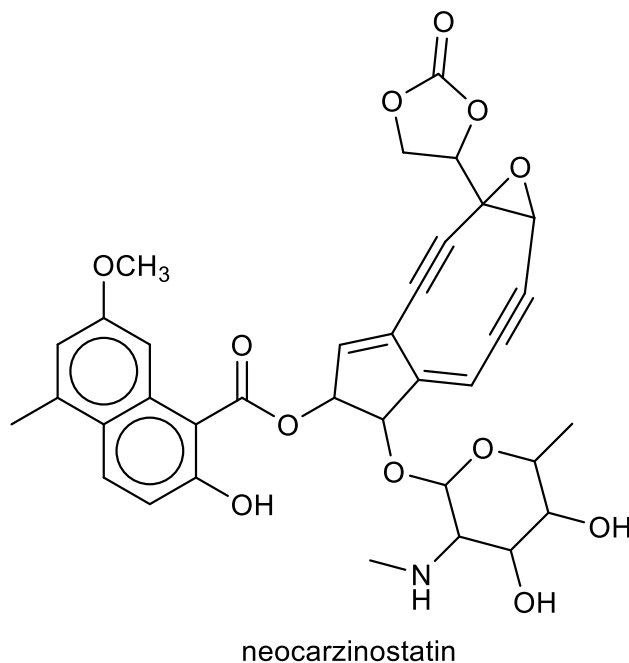
A 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 3 and 4 only

19 Aqueous sulfuric acid is electrolysed using inert electrodes.

What is the volume of gas liberated at the cathode (measured at s.t.p.) when a current of 8 A is passed through the electrolyte for 100 minutes?

A 5.6 dm³ **B** 16.9 dm³ **C** 22.6 dm³ **D** 45.2 dm³

20 Neocarzinostatin is one of the most potent drugs against late stage liver cancer.



Which statements are correct about neocarzinostatin?

- 1 It contains 18 chiral centers.
- 2 It contains 20 sp^2 hybridised carbon atoms.
- 3 Upon hydrolysis with acid, CO_2 is released.

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

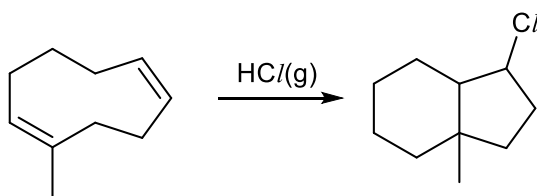
21 How many **non-cyclic** constitutional isomers of C_5H_9Br can exhibit cis-trans isomerism?

A 7 **B** 8 **C** 9 **D** 10

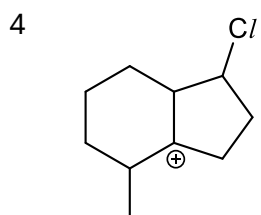
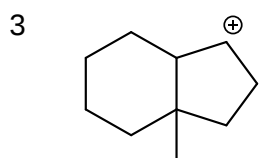
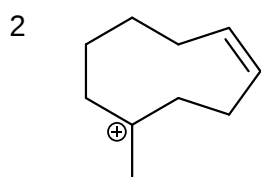
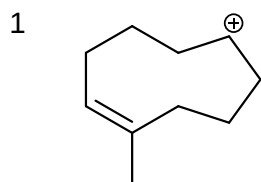
22 Which reaction is a propagation step in the chain reaction between bromine and ethane, in the presence of ultraviolet light?

- A** $CH_3\bullet + Br_2 \rightarrow CH_3Br + Br\bullet$
- B** $Br\bullet + CH_3CH_3 \rightarrow CH_3Br + CH_3\bullet$
- C** $CH_3CHBr\bullet + Br_2 \rightarrow CH_3CHBr_2 + Br\bullet$
- D** $Br\bullet + CH_3CH_2Br \rightarrow CH_3CHBr_2 + H\bullet$

23 The following reaction occurs via **three steps**.



Which are the **two** intermediates most likely produced during the reaction?



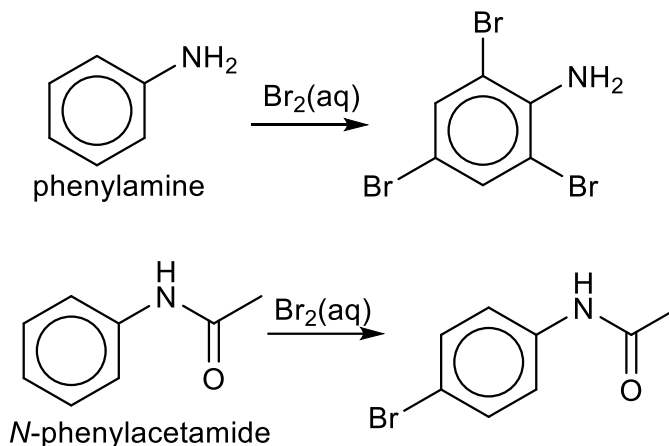
A 1 and 2

B 1 and 4

C 2 and 3

D 3 and 4

- 24 Phenylamine and *N*-phenylacetamide exhibit different reactivities when subjected to aqueous bromine at room temperature.



Which statement best accounts for their reactivities?

- A** The lone pair of electrons on N in *N*-phenylacetamide do not delocalise as much into the phenyl ring as compared to that in phenylamine.
- B** The substituent on *N*-phenylacetamide is considered an electron withdrawing group while that on phenylamine is electron donating.
- C** The larger substituent group on *N*-phenylacetamide imposed greater steric demand on the incoming electrophile.
- D** *N*-phenylacetamide is less soluble in water than phenylamine and hence it affected its reaction with bromine.
- 25 Equal amounts of compounds W, X and Y are added separately to three test-tubes containing equal concentrations of ethanolic silver nitrate solution in a heated water bath.

No precipitate forms in the test-tube containing W.

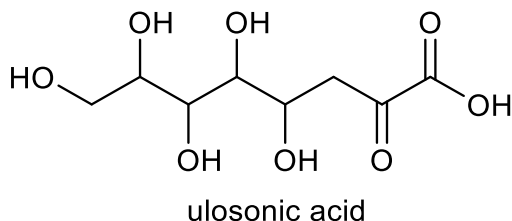
For the other two test-tubes, precipitate is formed faster for Y.

What could be the identities of W, X and Y?

	W	X	Y
1			
2			
3			

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

- 26 Ulosonic acid is used by bacteria to synthesise lipopolysaccharides.



What is the amount (in moles) of hydrogen gas formed when one mole of ulosonic acid is separately reacted with excess sodium metal and with excess aqueous sodium hydroxide?

	sodium metal	sodium hydroxide
A	6.0	1.0
B	6.0	0.0
C	3.0	0.5
D	3.0	0.0

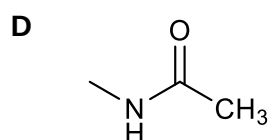
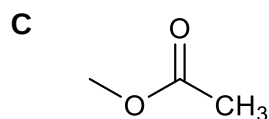
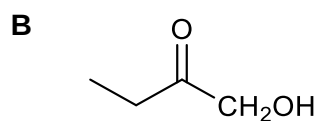
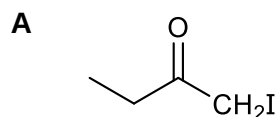
- 27 The pK_a of phenol is measured in different solvents.

The pK_a of phenol in water and in methanol are found to be 10.0 and 14.3 respectively.

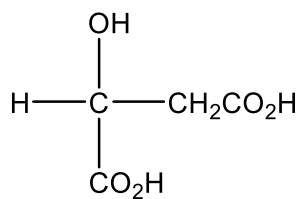
Which row is correct?

	acid strength of phenol in water vs. in methanol	reason
A	stronger	conjugate acid of water is less stable than the conjugate acid of methanol
B	stronger	conjugate base of phenol is more stabilised in water than in methanol
C	weaker	conjugate acid of water is more stable than the conjugate acid of methanol
D	weaker	conjugate base of phenol is less stabilised in water than in methanol

28 Which compound will give a positive iodoform test?



29 Malic acid occurs in apples.



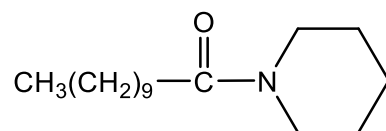
malic acid

Which statements about malic acid are correct?

- 1 It reacts with phenol to form an ester.
- 2 It reacts with CH_3COCl to give white fumes.
- 3 1 mol of malic acid reacts with 1 mol of HBr .
- 4 1 mol of malic acid reacts with 3 mol of NaHCO_3 .

- A 1, 2 and 3 only
- B 2 and 3 only
- C 2 and 4 only
- D 3 and 4 only

30 Compound Q is an acylpiperidine, which is being studied as a mosquito repellent.



Q

Which pair of compounds, when reacted together, would produce Q?

