Name:		Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examinations 2016
Year 6

H2 CHEMISTRY 9647/01

Paper 1 Multiple Choice **27 September 2016**

1 hour

Additional Materials: Optical Mark Sheet
Data Booklet

INSTRUCTIONS TO CANDIDATES

1 Write your **name** and **class** on this question paper.

2 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 separate Optical Mark Sheet.

3 Each correct answer will score one mark. A mark will not be deducted for wrong answer.

4 Any rough working should be done in this booklet.

5 You may use a calculator.

[Turn over

Section A

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

1 Ferrous sulfate ($FeSO_4$) tablets are commonly prescribed by doctors as 350 mg tablets and serve as a dietary supplement for pregnant women. However, it was found that these tablets may cause poisoning in young children if accidentally consumed. The lethal dosage for a 12.0 kg child is 590 mg of Fe^{2+}.

What is the minimum number of tablets that would constitute a lethal dose to a 12.0 kg child?

A 1

B 2

C 4

D 5

2 25.0 cm^3 of a solution of 0.0518 mol dm^{-3} hydroxylammonium chloride, $NH_3OH^+Cl^-$ was added to a solution containing an excess of acidified Fe^{3+} ions and the mixture boiled. The Fe^{2+} ions in the resultant solution was titrated with 25.90 cm^3 of 0.02 mol dm^{-3} potassium manganate (VII) solution.

Given the mole ratio $MnO_4^- \equiv 5Fe^{2+}$, which of the following nitrogen–containing species is formed in the reaction?

A NH_4^+

B N_2O

C NO_2

D NO_3^-

3 Two elements, **Y** and **Z**, have the following properties.

Property 1: **Y** and **Z** form ionic compounds Na_3**Y** and Na_3**Z** respectively.
Property 2: Element **Z** forms **Z**Cl_5 molecule whereas **Y** is unable to form **Y**Cl_5.

Which pair of electronic configurations of **Y** and **Z** is correct?

	Y	**Z**
A	[He] $2s^2$ $2p^2$	[Ne] $3s^2$ $3p^3$
B	[He] $2s^2$ $2p^3$	[Ne] $3s^2$ $3p^3$
C	[He] $2s^2$ $2p^2$	[He] $2s^2$ $2p^3$
D	[Ne] $3s^2$ $3p^2$	[Ne] $3s^2$ $3p^3$

4 For one mole of an ideal gas, which plot produces a straight line graph passing through the origin?

	Y–axis	X–axis	
A	PV	P	at constant T (K)
B	P	V	at constant T (K)
C	P/ρ	T (°C)	at constant V
D	P	1/V	at constant T (K)

5 Use of *Data Booklet* is relevant to this question.
Which substance is considered to have the largest covalent character?

A AlF_3 **B** Al_2O_3 **C** Be_3N_2 **D** BeO

6 Which substance does **not** contain an atom that has an unpaired electron?

A ClO_2 **B** NO **C** NO_2 **D** N_2O

7 Ammonia is made via the Haber Process. The reactants are nitrogen and hydrogen.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92 \text{ kJ mol}^{-1}$$

What will increase the rate of the forward reaction?

A Adding argon to the mixture but keeping the total volume constant.

B Decreasing the temperature.

C Increasing the total pressure by reducing the total volume at constant temperature.

D Removing nitrogen from the mixture but keeping the total volume of the mixture the same.

8 How much water must be added to a 10 cm^3 solution of 0.05 mol dm^{-3} sulfuric acid in order to increase its pH to 2.0?

A 10 cm^3

B 50 cm^3

C 90 cm^3

D 100 cm^3

9 Given that the K_{sp} for magnesium hydroxide, $Mg(OH)_2$, is 1.80×10^{-11} mol^3 dm^{-9} at 298 K, calculate the pH of a saturated solution of $Mg(OH)_2$.

A 3.48

B 3.78

C 10.2

D 10.5

10 The reaction of nitrogen monoxide and hydrogen gas

$$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$$

is hypothesised to involve the following steps:

I $NO + NO \rightleftharpoons N_2O_2$ (fast)

II $N_2O_2 + H_2 \rightarrow H_2O + N_2O$ (slow)

III $N_2O + H_2 \rightarrow N_2 + H_2O$ (fast)

Which of the following is true about the reaction?

A H_2 acts as a catalyst in this reaction.

B The overall order of the reaction is 2.

C There are 2 intermediates present in the reaction mechanism.

D Increasing the concentration of NO will increase the rate constant.

11 The radius and charge of each of the six ions are shown in the table.

ion	J^+	L^+	M^{2+}	X^-	Y^-	Z^{2-}
radius / nm	0.14	0.18	0.15	0.14	0.18	0.15

Which of the following pair shows the first compound having a smaller magnitude of lattice energy than the second?

A JX, MZ

B JX, LX

C JY, LX

D MZ, LY

12 The common rubber band has very interesting thermodynamic properties due to its randomly coiled long polymeric molecular structure. When the rubber band is stretched, a slight warming effect is felt.

What are the correct signs of ΔS, ΔH and ΔG if the stretched rubber band is released quickly?

	ΔS	ΔH	ΔG
A	+	+	–
B	+	–	+
C	–	–	+
D	–	+	–

13 The nickel–cadmium cell is a rechargeable battery which contains an alkaline electrolyte such as aqueous KOH.

During the discharging process, Cd is oxidised to solid $Cd(OH)_2$ while NiO(OH) is reduced to solid $Ni(OH)_2$.

Which statement is true about this rechargeable battery?

A Water is produced in the discharging process.

B The mass of cadmium remains unchanged.

C The alkaline electrolyte can be replaced by an acid.

D The concentration of the alkaline electrolyte remains unchanged in the discharging process.

14 Which statement regarding the oxides across Period 3 is true?

A The covalent character decreases from Na to S.

B The oxides of the elements changes from basic to neutral then to acidic from Na to S.

C The oxides formed are increasing soluble in water from Na to S.

D The standard entropy change of formation of the oxides becomes more negative from Na to A*l*.

15 The following information is about a Period 3 element **L**.

The oxide of **L** is a solid at room temperature.
The oxide of **L**, when added to water, gives a non-acidic solution.
The aqueous chloride of **L** gives a white precipitate with aqueous sodium hydroxide.

In which Group of the Periodic Table could **L** be found?

A V only

B I and III only

C II and III only

D II, III and IV only

16 Which property shows an increasing trend down Group II from Mg to Ba?

A Polarising power of metal cation

B Second ionisation energy

C Reducing strength

D Melting point

17 Which statement regarding the halogens or their hydrides is correct?

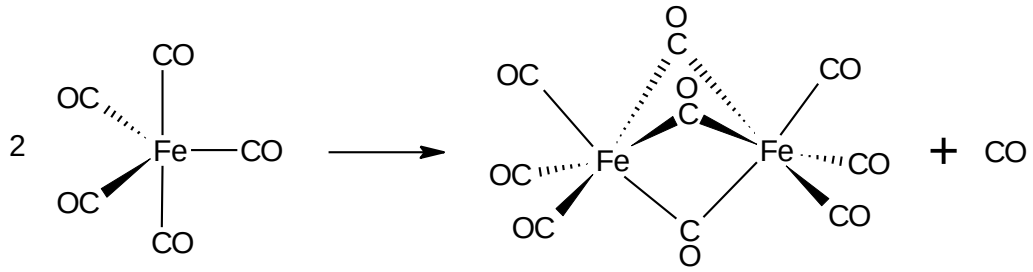
A HC*l* has a higher melting point than HF due to its larger electron cloud.

B Iodine, when dissolved in hexane, gives a colour that is similar to its vapour.

C The halogens become less volatile from fluorine to iodine due to the weaker covalent bonds.

D HF is less thermally stable than HI because of the larger electronegativity difference between the H and F atoms.

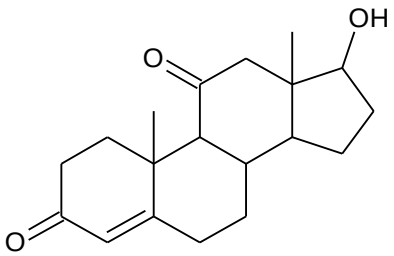
18 Photolysis of a solution of $Fe(CO)_5$ in ethanoic acid produces $Fe_2(CO)_9$ according to the following equation.



What is the oxidation state of Fe in $Fe(CO)_5$ and the coordination number of Fe in $Fe_2(CO)_9$?

	oxidation state of Fe in $Fe(CO)_5$	coordination number of Fe in $Fe_2(CO)_9$
A	+5	9
B	+5	6
C	0	9
D	0	6

19 The structure of 11-ketotestosterone, a sex hormone in fish, is shown below.



Which statement about 11-ketotestosterone is correct?

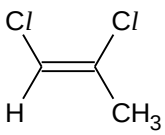
A Its molecular formula is $C_{19}H_{26}O_3$.

B It has a total of 2^7 stereoisomers.

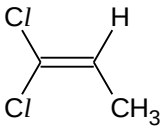
C It has six sp^2-hybridised carbon atoms.

D It has a tertiary alcohol functional group.

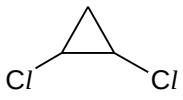
20 The following compounds have the same molecular formula.



X



Y



Z

Which of the following best describes the isomeric relationships between the compounds?

	X and **Y**	**Y** and **Z**
A	chain	optical
B	positional	functional group
C	cis–trans	positional
D	positional	chain

21 Which of the following is a **non**-greenhouse gas that could be released from the catalytic converter of a car exhaust?

A CO_2

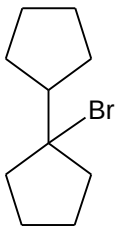
B H_2O

C CH_4

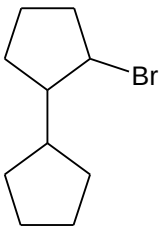
D N_2

22 Which compound is **not** possibly formed when cyclopentane is reacted with excess bromine gas in the presence of ultraviolet light?

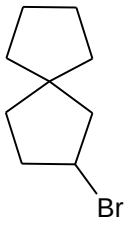
A



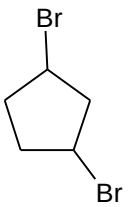
B



C



D



23 Carbonyl groups in aldehydes and ketones, C=O, undergo nucleophilic addition while alkene groups, C=C, undergo electrophilic addition.

Which statement explains the above reactions?

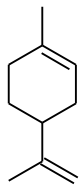
A Oxygen is more reactive than carbon.

B The different lengths of the double bonds.

C The different strengths of the double bonds.

D The electronegativity difference between the carbon and oxygen atoms in the carbonyl group.

24 The citrus flavour of lemons is due to the compound limonene, present in both the peel and the juice.



limonene

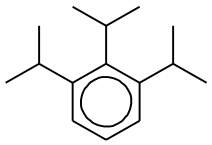
Limonene is separately treated with

- cold, dilute acidified $KMnO_4$,
- hot, concentrated acidified $KMnO_4$.

What is the change in the **number** of chiral carbon atoms in the molecule during each reaction?

	cold, dilute acidified $KMnO_4$	hot, concentrated acidified $KMnO_4$
A	+3	0
B	+3	–1
C	+4	0
D	+4	–1

25 The diagram shows the structure of a derivative of propofol.



When reacted with a dilute solution of Cl_2, a chlorine atom may substitute a hydrogen atom on the benzene ring but **not** for a hydrogen atom on the alkyl branches.

Given that any number of the benzene hydrogen atoms may be substituted, how many possible products of the reaction are there?

A 3

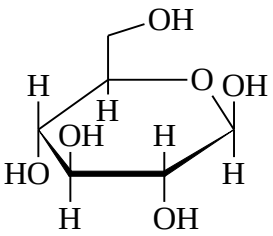
B 4

C 5

D 6

26 In the body, cellular respiration produces energy from the oxidation of glucose.

The diagram shows the structure of glucose.



A new artificial sweetener has been produced by replacing all of the hydroxyl groups attached directly to the ring carbon atoms in glucose with chlorine atoms.

What is the empirical formula of this chlorinated glucose?

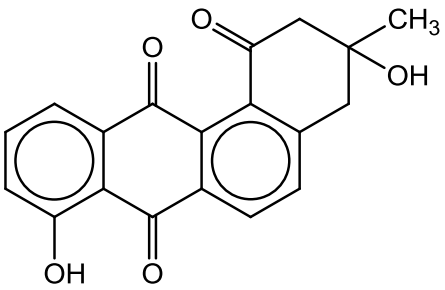
A CH_2Cl

B $C_3H_4Cl_2O$

C $C_6H_7Cl_5O$

D $C_6H_8Cl_4O_2$

27 *Tetrangomycin* is one of the first member of the class of antibiotics under the angucycline group. What is the maximum number of optical isomers that can be obtained when 1 mole of *tetrangomycin* fully reacts with $NaBH_4$?



Tetrangomycin

A 2

B 8

C 16

D 32

28 The small hive beetle, which invades colonies of the honeybee, identifies these colonies by detecting the bees' own alarm signal, the pheromone 3-methylbutyl ethanoate.

How may this ester be made in the laboratory?

A $CH_3COCl + (CH_3)_2CHCH_2CH_2OH \rightarrow \text{ester} + HCl$

B $CH_3COCl + CH_3CH_2CH(CH_3)CH_2OH \rightarrow \text{ester} + HCl$

C $(CH_3)_2CHCH_2CO_2H + CH_3CH_2OH \xrightarrow[\text{heat}]{\text{conc. } H_2SO_4} \text{ester} + H_2O$

D $(CH_3)_2CHCH_2CH_2CO_2H + CH_3CH_2OH \xrightarrow[\text{heat}]{\text{conc. } H_2SO_4} \text{ester} + H_2O$

29 Why are amides, $RCONH_2$, less basic than amines, RNH_2?

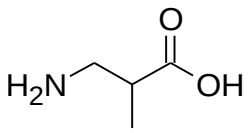
A Amides form a zwitterion in which the nitrogen atom carries a positive charge.

B Amides have a resonance structure involving the movement of a pair of electrons from the nitrogen atom to the oxygen atom.

C Electrons on the nitrogen atom of amides move on the C-N bond giving it some double bond character so that it is more difficult to break.

D The amide carbonyl group withdraws electrons from the $-NH_2$ group to make the hydrogen atoms acidic.

30 3-aminoisobutyric acid was shown to prevent diet induced diabetes in mouse. It has the structure shown below.



Which statement about 3-aminoisobutyric acid is **not** true?

A It migrates to the cathode at pH 10.

B It exists predominately as a zwitterion at pH 7.

C It reacts with ethanoyl chloride to form an amide.

D It exists as a crystalline solid at room temperature.

Section B

For each question, one or more of the three numbered statements **1** to **3** may be correct.

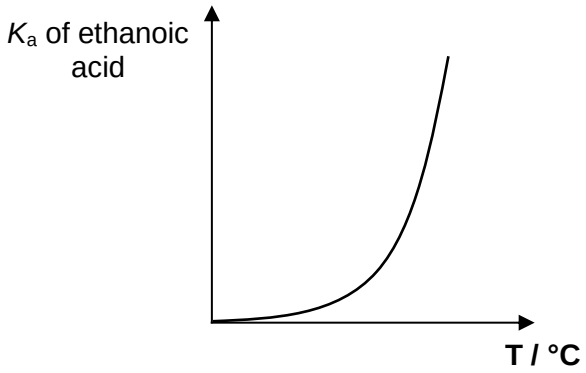
Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements which you consider to be correct).

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.

31 Which statement about ethanoic acid can be deduced from the sketch below?



1 The ionic dissociation of ethanoic acid is an endothermic process.

2 The pH of the ethanoic acid decreases with increasing temperature.

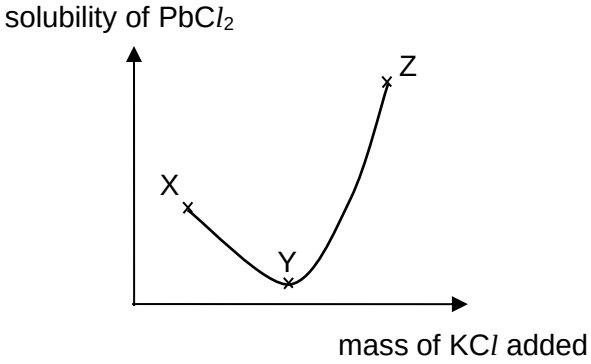
3 At T = 40 °C, pH of ethanoic acid = 14 – pOH

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.

32 The following graph represents how the solubility of a sparingly soluble salt lead(II) chloride, $PbCl_2$, changes upon addition of solid potassium chloride.



Which statement is correct?

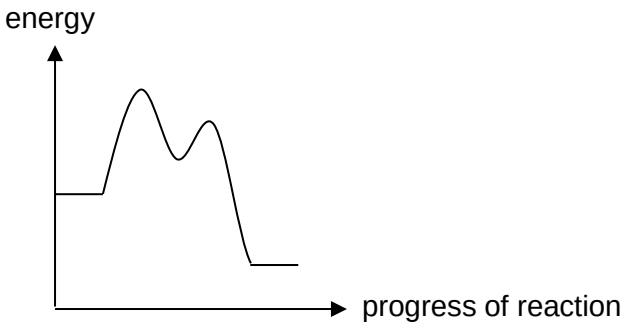
1 The K_{sp} value decreases along XY and then increases along YZ.

2 The change in solubility along XY is caused by common ion effect.

3 The change in solubility along YZ is caused by the formation of a complex between Pb^{2+} and Cl^- ions.

33 In a chemical reaction, **P** reacts with **Q** to form **R**. The rate equation is found to be rate = k [**P**] [**Q**].

The energy profile diagram for the reaction is as shown.



Which is the likely overall equation of the above reaction?

1 $2\mathbf{P} + \mathbf{Q} \rightarrow \mathbf{R}$

2 $\mathbf{P} + 2\mathbf{Q} \rightarrow \mathbf{R}$

3 $\mathbf{P} + \mathbf{Q} \rightarrow \mathbf{R}$

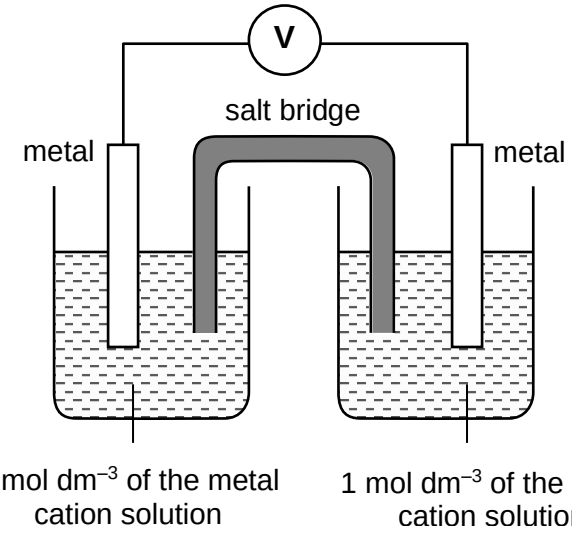
The responses **A** to **D** should be selected on the basis of

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.*

The half-cells for four metals: Mg, **X**, **Y** and **Z** were in turn connected in pairs and the potential difference was recorded at room temperature.



The results obtained are as shown in the table below.

positive electrode	negative electrode	$E^{\ominus}$ / V
X	Mg	+2.10
Y	Mg	+2.72
Mg	**Z**	+0.33

Which of the following statements is true?

1 **Y** is likely to be copper metal.

2 **X** is stronger than **Y** in terms of reducing power.

3 Ease of oxidation of metals: **Z** < **X** < **Y**.

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 Solid **P** dissolves in aqueous chlorine to give a solution **Q** which gives precipitate **R** on adding excess aqueous sodium thiosulfate followed by aqueous lead(II) nitrate.

Which combination could agree with the procedure above?

	Identity of **P**	Colour of **Q**	Colour of **R**
1	NaI	brown	mixture of white and bright yellow
2	NaBr	orange	white only
3	NaC*l*	colourless	white only

36 Consider the two reactions of $Cu^{2+}(aq)$ below.

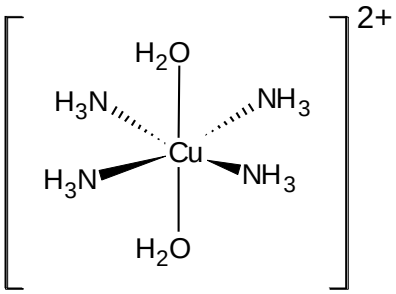
$$[Cu(H_2O)_6]^{2+} + EDTA^{4-} \rightleftharpoons [Cu(EDTA)]^{2-} + 6H_2O \quad \text{(equilibrium 1)}$$

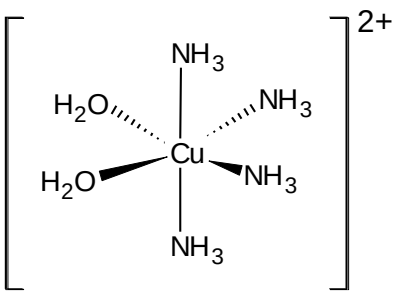
$$[Cu(H_2O)_6]^{2+} + 4NH_3 \rightleftharpoons [Cu(NH_3)_4(H_2O)_2]^{2+} + 4H_2O \quad \text{(equilibrium 2)}$$

What can you deduce from the equilibria above?

1 The entropy change of equilibrium 1 is more positive than that of equilibrium 2.

2 $[Cu(NH_3)_4(H_2O)_2]^{2+}$ in equilibrium 2 has two possible isomers:





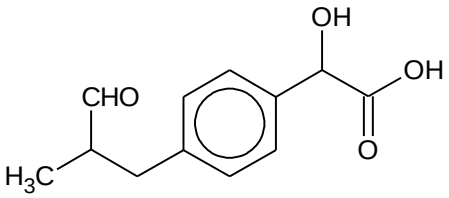
3 $EDTA^{4-}$ is a stronger ligand than NH_3.

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

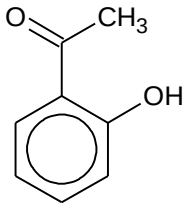
A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

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

37 Compounds **L** and **M** are precursors to the synthesis of some analgesic drugs.



L



M

Which statement is true?

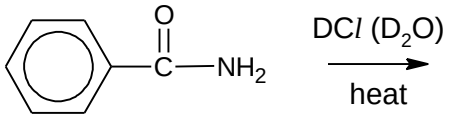
1 Only **L** reacts with KBr in concentrated H_2SO_4 to give a bromine-based compound under heat.

2 Both **L** and **M** react with HCN to form a product with at least one chiral carbon atom.

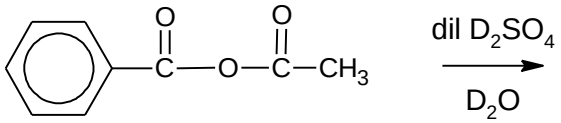
3 **L** is expected to be more acidic than **M**.

38 Which of the following will yield an organic compound containing deuterium? (D = ^2H)

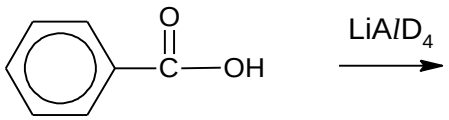
1



2



3

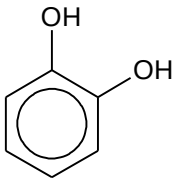


The responses **A** to **D** should be selected on the basis of

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 reagent can be used to distinguish catechol from benzene –1,2 – dicarboxylic acid?



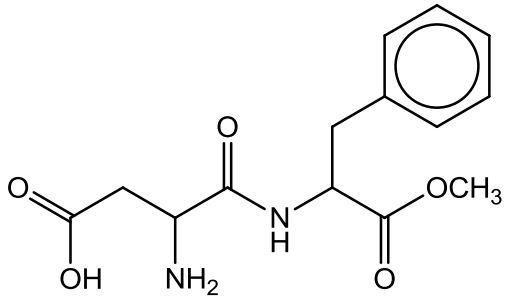
catechol

1 Sodium bicarbonate solution

2 Neutral iron(III) chloride solution

3 Aqueous bromine solution

40 Aspartame is an artificial sweetener used as a sugar substitute in some foods and beverages. The structure is shown below:



Which deduction about the reactions of aspartame can be made from this structure?

1 It undergoes hydrolysis to form two α-amino acids.

2 It reacts with 2,4-dinitrophenylhydrazine to give an orange precipitate.

3 The solution remains orange when heated with acidified potassium dichromate(VI).