



TEMASEK
JUNIOR COLLEGE

CHEMISTRY

9647/01

Paper 1 Multiple Choice

19th September 2016

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.

1. Enter your NAME (as in NRIC). _____
2. Enter the SUBJECT TITLE. _____
3. Enter the TEST NAME. _____
4. Enter the CLASS. _____

Write your **name**
and **Civics Group**

Write and shade
your CG number
followed by
last 3 digits of NRIC

WRITE		SHADE APPROPRIATE BOXES									
I N D E X N U M B E R	0	1	2	3	4	5	6	7	8	9	
	0	1	2	3	4	5	6	7	8	9	
	0	1	2	3	4	5	6	7	8	9	
	0	1	2	3	4	5	6	7	8	9	
	0	1	2	3	4	5	6	7	8	9	
	0	1	2	3	4	5	6	7	8	9	
A	B	C	D	E	F	G	H	I			

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 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.

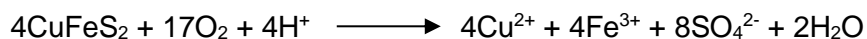
This document consists of **18** printed pages.

Section A

Part 1

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

- 1 During the bacterial leaching of low grade copper ores, acidified water is sprayed onto the ore chalcopryrite, CuFeS_2 . Bacteria then convert the insoluble ore into a solution according to the equation shown below:



No change occurs in the oxidation state of copper.

What changes in oxidation state occur for the iron and the sulfur in this reaction?

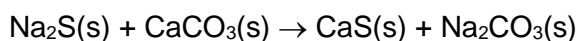
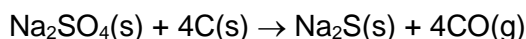
Change in oxidation state

	Fe	S
A	+1	+8
B	+1	-8
C	-1	+6
D	-1	-6

- 2 When cobalt metal is reacted with a solution containing cobalt(III) ions, only cobalt(II) ions are formed. How many moles of Co and $\text{Co}^{3+}(\text{aq})$ would result in a mixture containing both cobalt(II) and cobalt(III) ions in the mole ratio of 3:1 after the reaction had taken place?

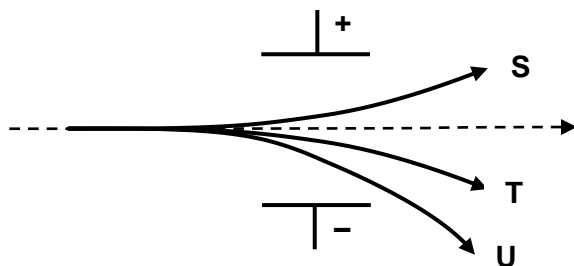
	Moles of Co	Moles of Co^{3+}
A	1	2
B	1	3
C	1	5
D	2	3

- 3 Sodium hydrogen carbonate, NaHCO_3 , can be prepared from sodium sulfate by a three-step process.



What is the mass of sodium hydrogen carbonate ($M_r = 84.0$), to the nearest kg, that could be formed from 100 kg of the sodium sulfate ($M_r = 142.1$), assuming a 90 % yield in each step?

- A** 43 **B** 86 **C** 106 **D** 118 kg



	S	T	U
A	$^{15}\text{O}^+$	$^{14}\text{C}^+$	$^{14}\text{N}^+$
B	$^{15}\text{O}^-$	$^{14}\text{C}^+$	$^{28}\text{Si}^+$
C	$^{14}\text{N}^-$	$^{16}\text{O}^{2+}$	$^{28}\text{Si}^{2+}$
D	$^{14}\text{N}^-$	$^{14}\text{C}^+$	$^{28}\text{Si}^{4+}$

- CC[N+](C)(C)OP(=O)([O-])O[C@H](COP(=O)([O-])OC(=O)R)[C@@H](COP(=O)([O-])OC(=O)R)O

where R = long hydrophobic carbon chains

A It can form van der Waals' forces with other non-polar molecules.

B It has a low boiling point.

C It cannot rotate plane of polarised light.

D It can form hydrogen bonds between its own molecules.

- What could be the other gas in this mixture? [Density of argon = 1.78 g dm^{-3} at s.t.p.]

- A** neon
- B** oxygen
- C** fluorine
- D** carbon dioxide

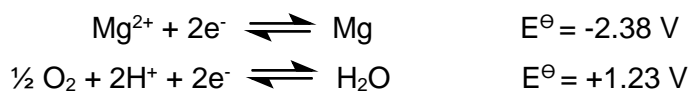
- 7 Which line in the table gives the signs of ΔH , ΔS and ΔG for the melting of ice at room temperature and pressure?

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

- 8 Which reaction represents standard enthalpy change at 298 K?

- A** $\text{P}_4(\text{l}) \rightarrow 4\text{P}(\text{g})$
B $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$
C $\text{HF}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaF}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
D $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$

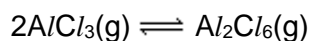
- 9 In the construction of heart ‘pacemakers’, it is possible to use a tiny magnesium electrode which creates an electrical cell with the inhaled oxygen. The relevant half-cells are as follows:



Under standard conditions, the cell e.m.f. would be +3.61 V, but in the body a potential of +3.25 V is more usual.

What is the best explanation for this lower e.m.f.?

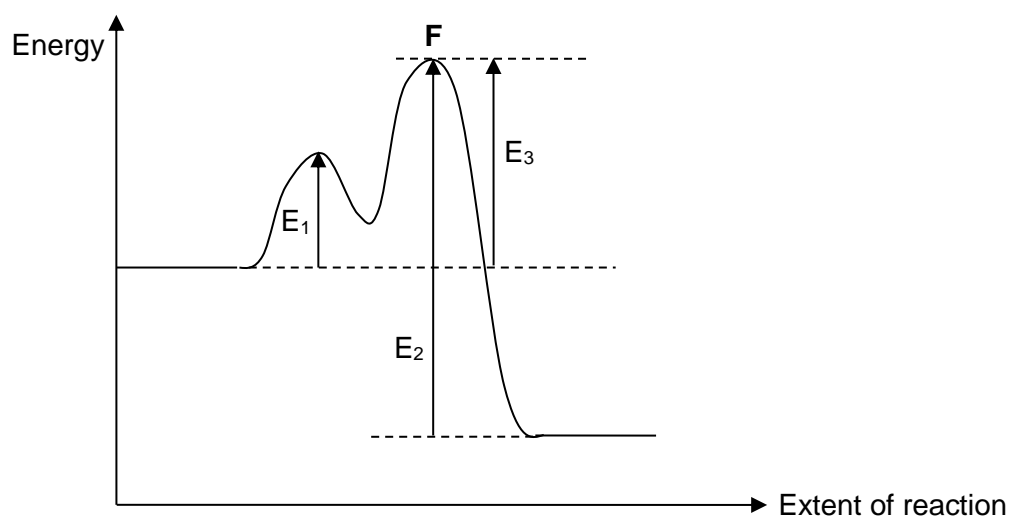
- A** the low concentration of Mg^{2+} ions surrounding the magnesium electrode
B the pH of between 7 and 8 of the body fluid surrounding the electrodes
C the high resistance of the body fluids surrounding the electrodes
D the small size of the magnesium electrode
- 10 Consider the following equilibrium system:



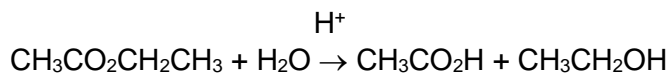
Which of the following statements will cause the position of the above equilibrium to shift to the left?

- A** decreasing the volume of the vessel
B increasing the temperature
C pumping inert gas into the vessel at constant volume
D pumping AlCl_3 gas into the vessel

- 11 Which of the following statements is true about the following energy profile for a catalysed reaction?



- A **F** is the intermediate formed.
 B The enthalpy change of the reaction is $E_2 - E_3$.
 C The reaction is catalysed by a heterogenous catalyst.
 D The second step of the reaction is the rate determining step.
- 12 Ethyl ethanoate undergoes a slow acid-catalysed hydrolysis in water where the concentration of acid in the solution remains constant.



The rate equation is found to be

$$\text{rate} = k[\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3][\text{H}^+]$$

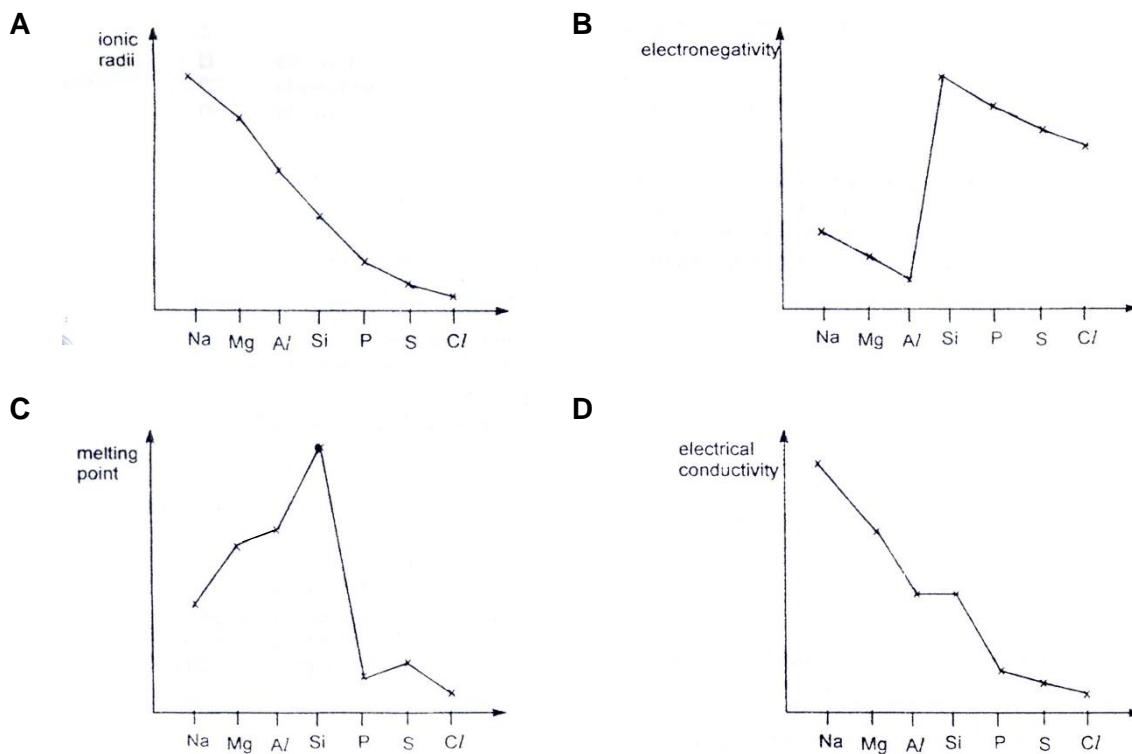
In an experiment, when $1.0 \text{ mol dm}^{-3} \text{ HCl}$ was reacted with 0.10 mol dm^{-3} ethyl ethanoate, the half-life was found to be 42 min.

In a second experiment, $2.0 \text{ mol dm}^{-3} \text{ HCl}$ was reacted with 0.20 mol dm^{-3} ethyl ethanoate. What is the half-life of the second experiment?

- A 10.5 min B 21 min C 42 min D 63 min
- 13 Ethanol has a pK_a of 15.5 at room temperature. Sodium ethoxide can be produced by reacting ethanol with sodium metal, and Solution **P** is 0.1 mol dm^{-3} sodium ethoxide.
- Which of the following statements is **incorrect**?

- A Ethanol is a weak acid.
 B Ethoxide is a strong base.
 C The pH of Solution **P** is 13.
 D The type of reaction between ethanol and sodium is acid-base

- 14 Which of the following graphs shows the correct trend in the physical property of the period 3 elements?



- 15 Which of the following elements has an oxide with a giant structure and a chloride which is readily hydrolysed?

- | | |
|------------------|---------------------|
| A sodium | B carbon |
| C silicon | D phosphorus |

- 16 Two experiments are carried out with anhydrous potassium chloride and observations **1** and **2** are made at the end of each experiment.

Experiment 1: Concentrated sulfuric acid is added to potassium chloride and the fumes produced are bubbled into aqueous potassium bromide solution – observation **1**.

Experiment 2: Potassium chloride is dissolved in concentrated aqueous ammonia and the resulting solution is then added to aqueous silver nitrate – observation **2**.

What are the observations **1** and **2**?

- | | observation 1 | observation 2 |
|----------|----------------------|----------------------|
| A | colourless solution | colourless solution |
| B | colourless solution | white precipitate |
| C | brown solution | colourless solution |
| D | brown solution | white precipitate |

- 17 Which property of the Group II elements (magnesium to barium) and their compounds increases with increasing proton number?

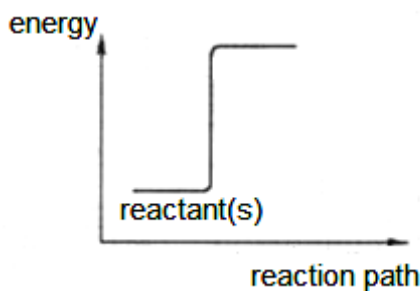
A the magnitude of the enthalpy change of hydration of the metal ion
 B the solubility of the sulfate
 C the stability of the carbonate to heat
 D the tendency to form complex ions

- 18 Letters written on paper using aqueous ammonium thiocyanate are invisible until turned blood red by brushing the paper with aqueous iron(III) chloride. If the ammonium thiocyanate is first made alkaline, the letters turned orange brown and are less clear.

Which of the following substances, when formed on the paper in these reactions, best explains these observations?

	with aqueous ammonium thiocyanate	with alkaline aqueous ammonium thiocyanate
A	$[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$	$\text{Fe}(\text{OH})_3$
B	$[\text{Fe}(\text{H}_2\text{O})_5(\text{SCN})]^{2+}$	$[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
C	$[\text{Fe}(\text{H}_2\text{O})_5(\text{SCN})]^{2+}$	$\text{Fe}(\text{OH})_3$
D	$[\text{Fe}(\text{H}_2\text{O})_5(\text{SCN})]^{2+}$	$[\text{Fe}(\text{OH})_4]^-$

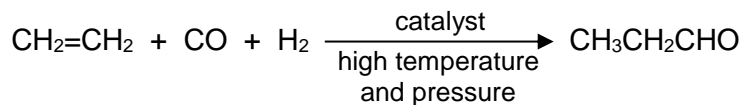
- 19 An energy profile diagram for a single reaction step is shown below.



To which of the following steps in the reaction of ethane with bromine in the presence of light does this diagram apply?

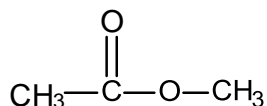
- A $\text{CH}_3\text{CH}_2\cdot + \text{CH}_3\text{CH}_2\cdot \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
 B $\text{CH}_3\text{CH}_2\cdot + \text{Br}_2 \rightarrow \text{CH}_3\text{CH}_2\text{Br} + \text{Br}\cdot$
 C $\text{CH}_3\text{CH}_2\cdot + \text{Br}\cdot \rightarrow \text{CH}_3\text{CH}_2\text{Br}$
 D $\text{Br}_2 \rightarrow \text{Br}\cdot + \text{Br}\cdot$

- 20 The oxo reaction is an important industrial process in which an alkene combines directly with carbon monoxide and hydrogen under suitable conditions. The reaction with ethene is shown below.

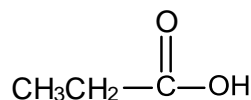


Which of the following structural formulae correctly represents the product of the oxo reaction starting with but-2-ene?

- A $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CHO}$
 B $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$
 C $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$
 D $(\text{CH}_3)_2\text{CHCH}_2\text{CHO}$
- 21 Compounds **X** and **Y** are isomers with the molecular formula $\text{C}_3\text{H}_6\text{O}_2$.



Compound **X**



Compound **Y**

Which reagent can be used to distinguish between **X** and **Y**?

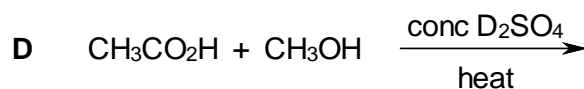
- A sodium metal
 B 2,4-dinitrophenylhydrazine
 C aqueous alkaline iodine
 D aqueous sodium hydroxide
- 22 The compound hex-3-en-1-ol has a strong 'leafy' smell of newly cut grass and is used in perfumery.



hex-3-en-1-ol

What are the organic products when hex-3-en-1-ol is treated with hot acidic $\text{K}_2\text{Cr}_2\text{O}_7$, followed by hydrogen gas in the presence of platinum?

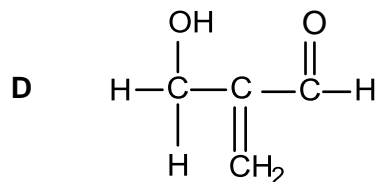
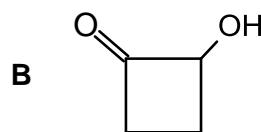
- A $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
 B $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ and $\text{HO}_2\text{CCH}_2\text{CO}_2\text{H}$
 C $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ and $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{OH}$
 D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$



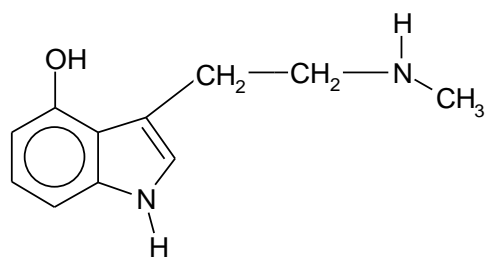
24 Compound **Z**, $\text{C}_4\text{H}_6\text{O}_2$, undergoes the following reactions.

- It gives a red precipitate with Fehling's solution.
- It gives white fumes with PCl_5 .
- Upon reaction with hydrogen gas and nickel catalyst, an optically active product is obtained.

What is compound **Z**?



- 25 Psilocin is the pharmacologically active agent in the body after ingestion of some species of psychedelic mushrooms.

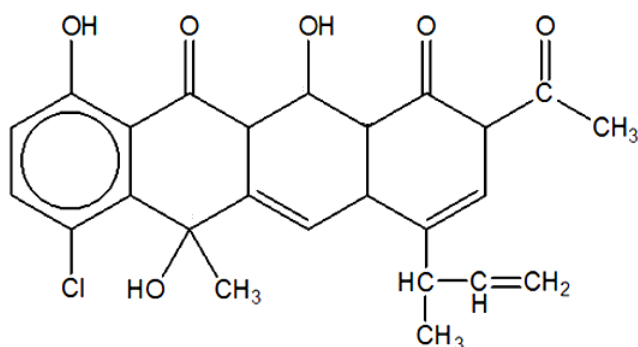


psilocin

Which σ bond formed by the following orbitals overlap is **not** present in psilocin?

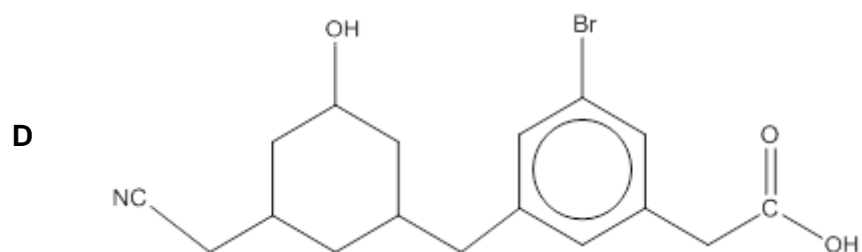
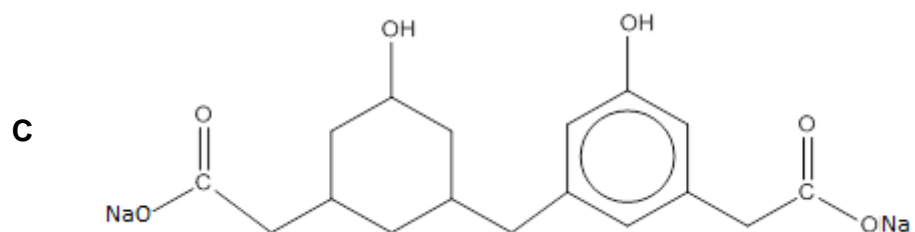
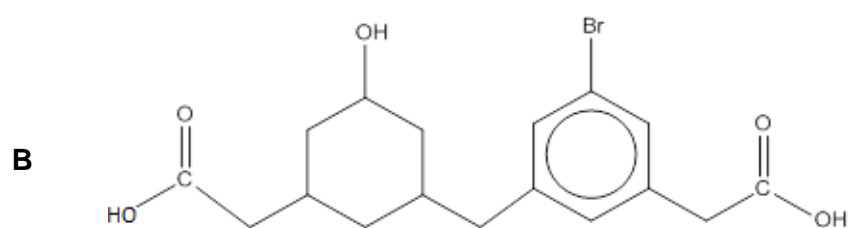
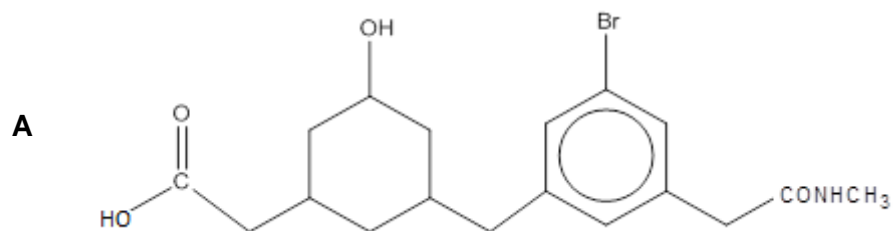
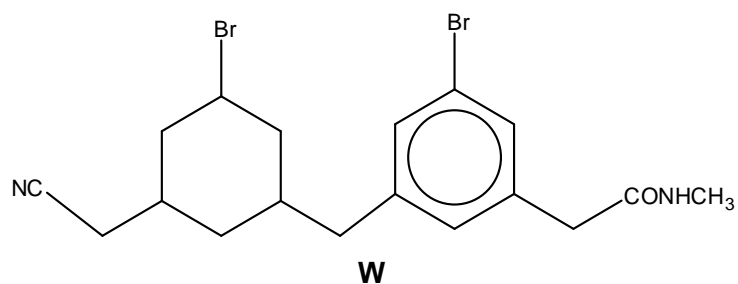
- A sp^3-sp^3 overlap between two C atoms
- B sp^2-sp^2 overlap between two C atoms
- C sp^3-sp^2 overlap between C and N atoms respectively
- D sp^3-sp^3 overlap between C and N atoms respectively

- 26 How many stereoisomers are possible for the following compound?

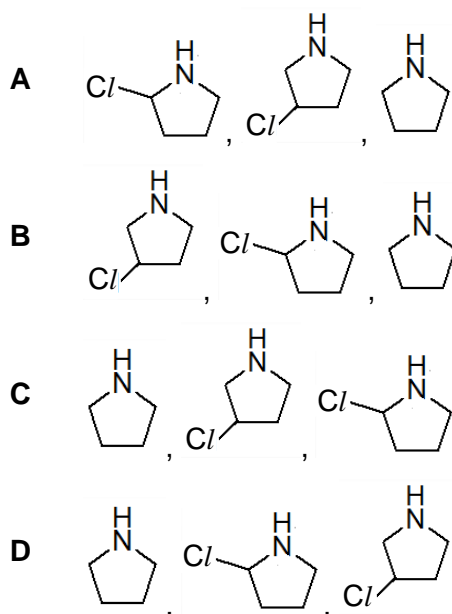


- | | | | |
|---|-------|---|----------|
| A | 2^3 | B | 2^7 |
| C | 2^8 | D | 2^{10} |

- 27 What is the structure of the compound formed when compound **W** was heated with aqueous sodium hydroxide, followed by acidification?



- 28 Which one of the following shows the given molecules arranged in order of decreasing pK_b values?



- 29 A polypeptide is subjected to hydrolysis.

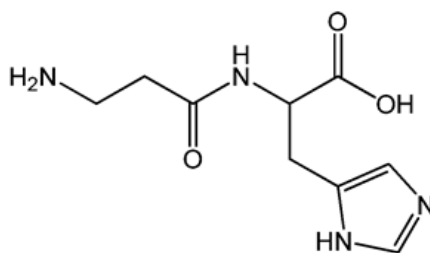
The following was found:

- The enzyme trypsin hydrolyses a peptide bond at the carboxylic end of arginine (arg) to give 2 tripeptides and gly
- The enzyme chymotrypsin hydrolyses a peptide bond at the carboxylic end of tyrosine (tyr) to give 2 dipeptides and a tripeptide
- The chemical cyanogen bromide cleaves the peptide bond at the carboxylic end of methionine (met) to give a tetrapeptide and a tripeptide

What is the primary structure of the polypeptide?

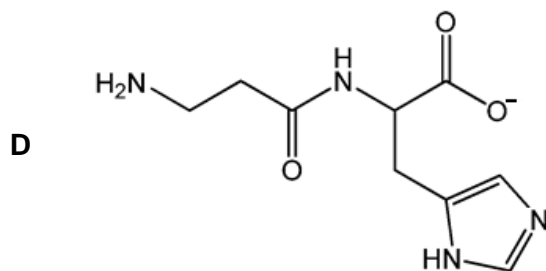
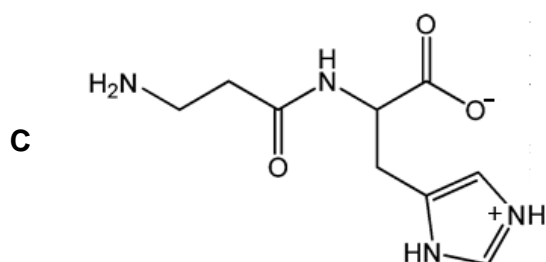
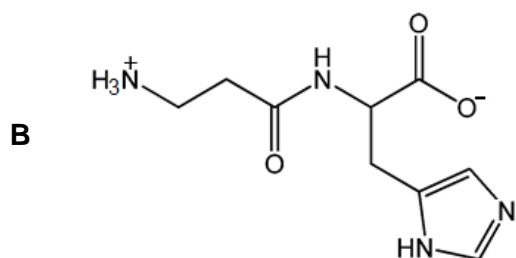
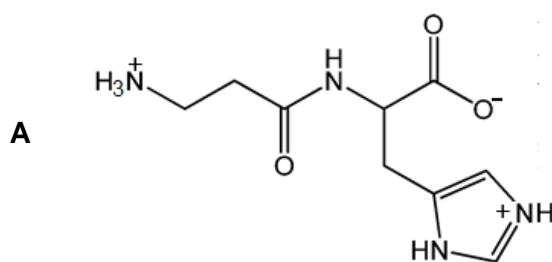
- A** pro–tyr–arg–met–tyr–arg–gly
B gly–arg–tyr–met–arg–tyr–pro
C pro–tyr–arg–tyr–met–arg–gly
D gly–arg–met–tyr–arg–tyr–pro

- 30 Carnosine is a dipeptide formed from β -alanine and histidine, and has been documented in recent research as having the ability to prevent many of the detrimental effects of aging.



carnosine

The isoelectric point of carnosine is 6.83. Which of the following is the predominant species present in an aqueous solution at physiological pH 7.4?



Part 2

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

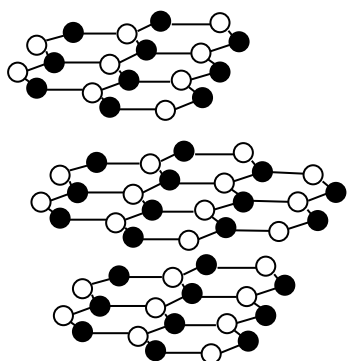
Decide whether each of the statements is or is not correct. (You may find it helpful to put a tick against the statements which you consider to be correct.)

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

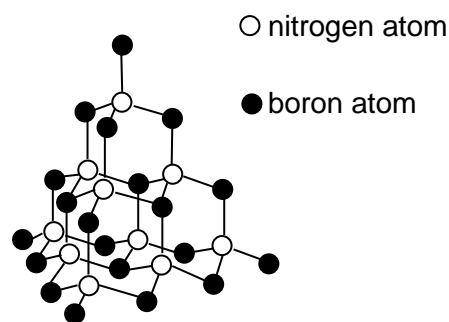
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

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

- 31** Boron nitride, BN, exists in two possible forms, hexagonal boron nitride and cubic boron nitride. The structure of hexagonal boron nitride and cubic boron nitride are similar to graphite and diamond respectively.



hexagonal boron nitride



cubic boron nitride

Which of the following statements are correct?

- 1 There is dative bonding in cubic boron nitride.
 - 2 The layers in hexagonal boron nitride are held together by van der Waals' forces.
 - 3 The boron-nitrogen bond in cubic boron nitride is shorter than that in hexagonal boron nitride.
- 32** The standard enthalpy changes of combustion of carbon are as follows:

$$\text{C}(\text{graphite}) = -393.1 \text{ kJ mol}^{-1}$$

$$\text{C}(\text{diamond}) = -395.0 \text{ kJ mol}^{-1}$$

Which of the following deductions can be made from the data above?

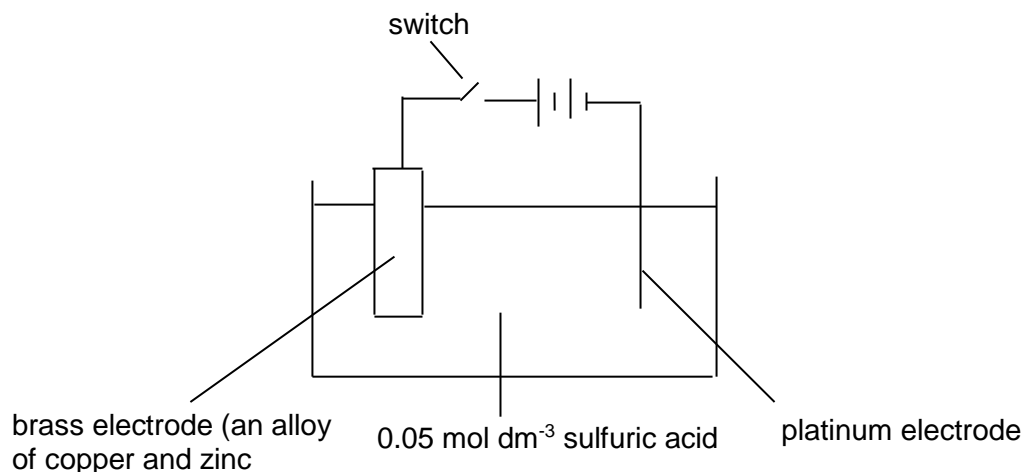
- 1 Graphite is less stable than diamond.
- 2 Graphite has a lower energy content than diamond.
- 3 The conversion of diamond to graphite is exothermic.

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.

33 The circuit shown in the diagram was set up.

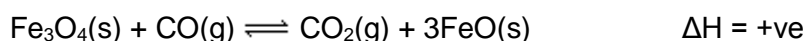


A steady current of 1.00 A was passes through the electrolyte for 10 minutes at room conditions.

Which statements regarding the electrolysis are correct?

- 1** Zinc dissolves preferentially at the anode.
- 2** Effervescence is observed at the cathode.
- 3** pH of the solution increases.

34 Consider the following equilibrium system:



Which of the following statements are correct?

- 1** Increasing the temperature causes the position of equilibrium to shift to the right.
- 2** The equilibrium constant, K_c , for this reaction has no units.
- 3** Adding FeO causes the position of equilibrium to shift to the left.

35 Which of the following shows a general decrease for Period 3 chlorides from MgCl_2 to PCl_5 ?

- 1** pH of the resulting solution when dissolve in water
- 2** maximum oxidation states of the elements in the chlorides
- 3** electrical conductivity in solid state

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

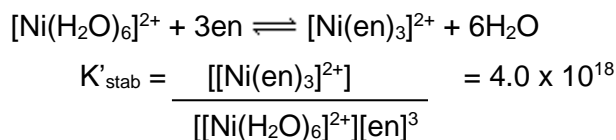
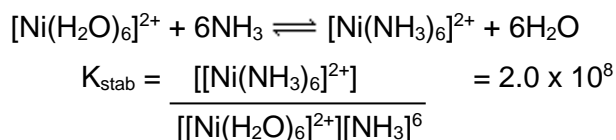
No other combination of statements is used as a correct response.

- 36** The following data refer to copper as a typical transition element and to calcium as an s-block element.

For which property are the data under the correct element?

	property	copper	calcium
1	density/g cm ⁻³	8.92	1.54
2	melting point/° C	1085	842
3	electrical conductivity/ relative units	9.6	85

- 37** Consider the following equilibria shown together with the magnitude of their respective equilibrium constants:



where en represents ethylenediamine, a bidentate ligand.

Which of the following statements are correct?

- 1** Ammonia is a stronger ligand than water.
- 2** Ethylenediamine is a stronger ligand than ammonia.
- 3** The equilibrium constant, K''_{stab} , for the following reaction is equal to $K'_{\text{stab}} / K_{\text{stab}}$:

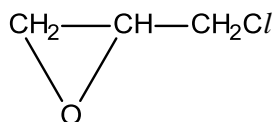
$$[\text{Ni}(\text{NH}_3)_6]^{2+} + 3\text{en} \rightleftharpoons [\text{Ni}(\text{en})_3]^{2+} + 6\text{NH}_3$$

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

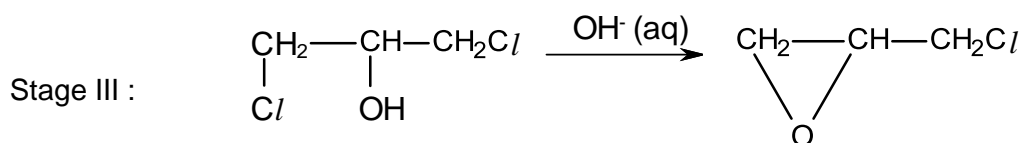
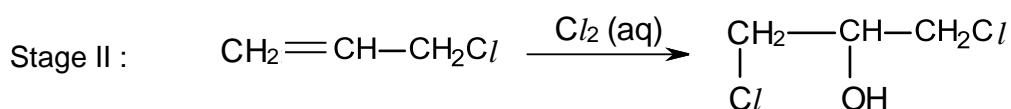
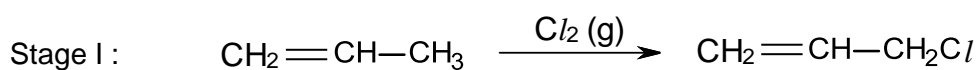
A	B	C	D
1,2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

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

- 38** Epoxy resins are polymers which are used in adhesives. One monomer used in their manufacture has the following structure:



This monomer is manufactured from propene in three stages:



Which statements are correct for the above synthesis?

- 1** Stage I involves free radical substitution.
- 2** Stage II involves electrophilic addition.
- 3** Stage III involves nucleophilic addition.

- 39** Ovalbumin is the predominant protein in egg white.

A perfect poached egg, with firm white surrounding a velvety yolk, can be made by the addition of vinegar into boiling water, before tipping the egg in and leaving it to cook for 1-2 minutes.

The addition of vinegar allows the egg white to coagulate faster around the yolk, instead of dispersing in the water. Which of the following explains this observation?

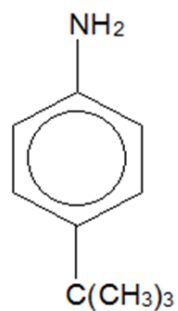
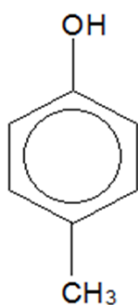
- 1** H^+ in vinegar denatures ovalbumin by protonating the R groups of amino acid residues.
- 2** H^+ in vinegar denatures ovalbumin by protonating the N atom of the peptide linkages.
- 3** H^+ in vinegar denatures ovalbumin by breaking it down to its constituent amino acids.

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.

- 40** Which of the following reagents can be used to distinguish between the two compounds shown below?



- 1** aqueous bromine
- 2** acidified KMnO_4 , reflux
- 3** CH_3Br with heating, followed by the addition of AgNO_3