

CHEMISTRY

9701/11

Paper 1 Multiple Choice

May/June 2015

1 hour

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

DO NOT WRITE IN ANY BARCODES.

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.

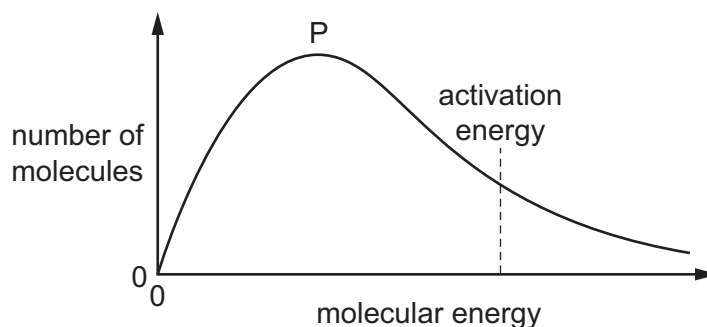
Electronic calculators may be used.

This document consists of **15** printed pages and **1** blank page.

Section A

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

- 1 The diagram shows a Boltzmann distribution of molecular energies for a gaseous mixture. The distribution has a peak, labelled P on the diagram.



What happens when an effective catalyst is added to the mixture?

- A** The height of the peak decreases and the activation energy moves to the right.
 - B** The height of the peak decreases and the activation energy moves to the left.
 - C** The height of the peak remains the same and the activation energy moves to the right.
 - D** The height of the peak remains the same and the activation energy moves to the left.
- 2 Which quantity gives the best indication of the relative strengths of the hydrogen bonds between the molecules in liquid hydrogen halides?
- A** bond dissociation energies
 - B** enthalpy changes of formation
 - C** enthalpy changes of solution
 - D** enthalpy changes of vaporisation
- 3 *Use of the Data Booklet is relevant to this question.*

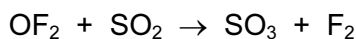
1.00 g of carbon is combusted in a limited supply of pure oxygen. 0.50 g of the carbon combusts to form CO_2 and 0.50 g of the carbon combusts to form CO.

The resultant mixture of CO_2 and CO is passed through excess NaOH(aq) and the remaining gas is then dried and collected.

What is the volume of the remaining gas? (All gas volumes are measured at 25°C and 1 atmosphere pressure.)

- A** 1 dm^3
- B** 1.5 dm^3
- C** 2 dm^3
- D** 3 dm^3

- 4 In oxygen difluoride, OF_2 , fluorine has an oxidation number of -1 . OF_2 will react with sulfur dioxide according to the following equation.



What is oxidised and what is reduced in this reaction?

	fluorine	oxygen in OF_2	sulfur
A	oxidised	oxidised	reduced
B	oxidised	reduced	oxidised
C	reduced	oxidised	reduced
D	reduced	reduced	oxidised

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

The gas laws can be summarised in the ideal gas equation below.

$$pV = nRT$$

0.96 g of oxygen gas is contained in a glass vessel of volume $7.0 \times 10^{-3} \text{ m}^3$ at a temperature of 30°C .

Assume the gas behaves as an ideal gas.

What is the pressure in the vessel?

- A** 1.1 kPa **B** 2.1 kPa **C** 10.8 kPa **D** 21.6 kPa

- 6 One mole of phosphorus(V) chloride, PCl_5 , is heated to 600 K in a sealed flask of volume 1 dm^3 . Equilibrium is established and measurements are taken.



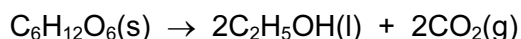
The experiment is repeated with one mole of phosphorus(V) chloride heated to 600 K in a sealed flask of volume 2 dm^3 .

How will the measurements vary?

- A** The equilibrium concentrations of $\text{PCl}_3(\text{g})$ and $\text{Cl}_2(\text{g})$ are higher in the second experiment.
B The equilibrium concentration of $\text{PCl}_5(\text{g})$ is lower in the second experiment.
C The equilibrium concentrations of all three gases are the same in both experiments.
D The value of the equilibrium constant is higher in the second experiment.

- 7 The standard enthalpy changes of combustion of glucose and ethanol are given as -2820 and $-1368 \text{ kJ mol}^{-1}$ respectively.

Glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, can be converted into ethanol.



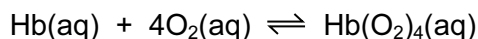
What is the standard enthalpy change for this reaction?

- A $-1452 \text{ kJ mol}^{-1}$
 B -84 kJ mol^{-1}
 C $+84 \text{ kJ mol}^{-1}$
 D $+1452 \text{ kJ mol}^{-1}$

- 8 In which reaction is the underlined substance acting as a base?

- A $\text{HNO}_3 + \underline{\text{H}_2\text{SO}_4} \rightarrow \text{H}_2\text{NO}_3^+ + \text{HSO}_4^-$
 B $\text{HSiO}_3^- + \underline{\text{HCN}} \rightarrow \text{CN}^- + \text{H}_2\text{O} + \text{SiO}_2$
 C $\text{HNO}_2 + \underline{\text{HCO}_3^-} \rightarrow \text{H}_2\text{O} + \text{CO}_2 + \text{NO}_2^-$
 D $\text{C}_6\text{H}_5\text{O}^- + \underline{\text{CH}_2\text{ClCO}_2\text{H}} \rightarrow \text{C}_6\text{H}_5\text{OH} + \text{CH}_2\text{ClCO}_2^-$

- 9 One molecule of haemoglobin, Hb, can bind with four molecules of oxygen according to the following equation.



When the equilibrium concentration of O_2 is $7.6 \times 10^{-6} \text{ mol dm}^{-3}$, the equilibrium concentrations of Hb and $\text{Hb}(\text{O}_2)_4$ are equal.

What is the value of K_c for this equilibrium?

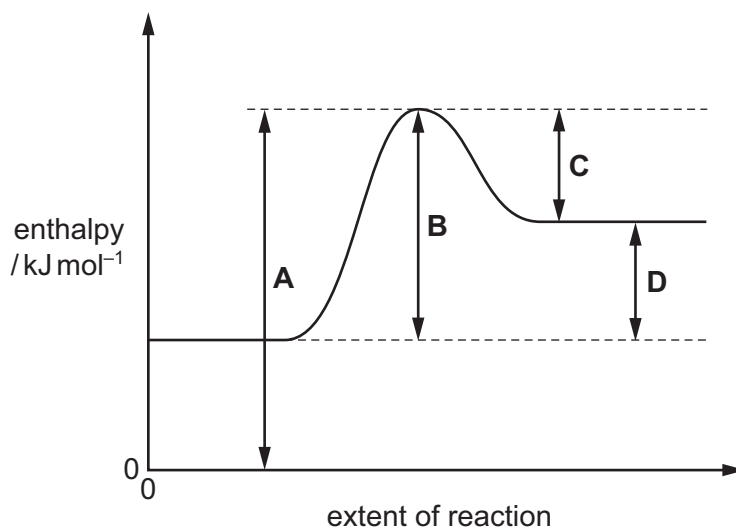
- A 3.0×10^{20} B 1.3×10^5 C 7.6×10^{-6} D 3.3×10^{-21}
- 10 The double bond between the two carbon atoms in an ethene molecule consists of one σ bond and one π bond.

Which orbitals overlap to form each of these bonds?

	σ bond	π bond
A	$\text{sp}^2\text{--sp}^2$	p–p
B	$\text{sp}^2\text{--sp}^2$	$\text{sp}^2\text{--sp}^2$
C	$\text{sp}^3\text{--sp}^3$	p–p
D	$\text{sp}^3\text{--sp}^3$	$\text{sp}^2\text{--sp}^2$

- 11 The diagram shows a reaction pathway for an endothermic reaction.

Which arrow represents the activation energy for the forward reaction?



- 12 In the industrial electrolysis of brine to manufacture chlorine, the diaphragm used is a porous screen which allows the flow of electrolytes but keeps other chemicals separate.

Which substance needs to be kept separate from the chlorine by the diaphragm?

- A** hydrogen
B sodium chloride
C sodium hydroxide
D water
- 13 The three minerals below are obtained from mines around the world. Each one behaves as a mixture of two carbonate compounds. They can be used as fire retardants because they decompose in the heat, producing CO_2 . This gas smothers the fire.

barytocite $\text{BaCa}(\text{CO}_3)_2$

dolomite $\text{CaMg}(\text{CO}_3)_2$

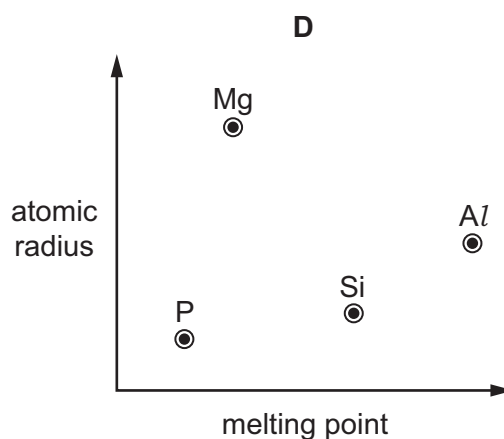
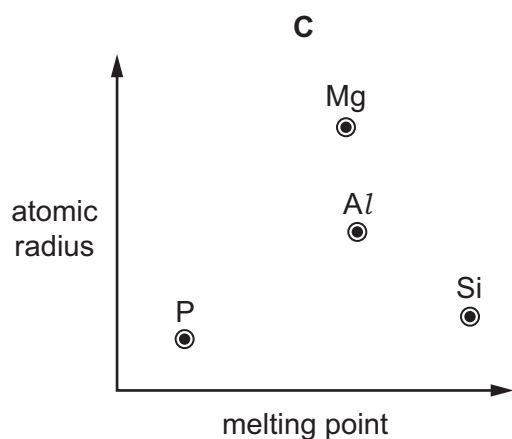
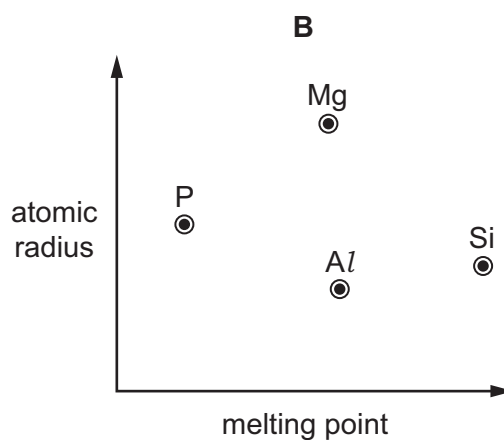
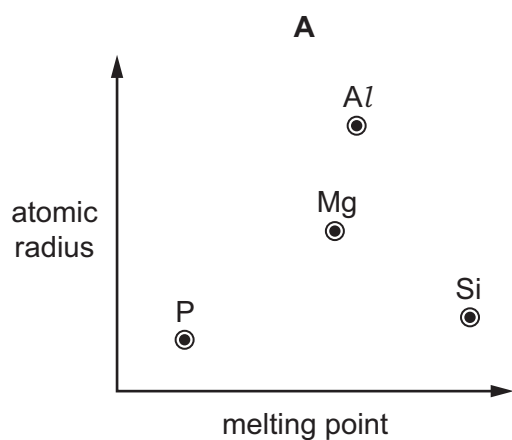
huntite $\text{Mg}_3\text{Ca}(\text{CO}_3)_4$

What is the order of effectiveness as fire retardant, from best to worst?

	best worst		
A	dolomite	barytocite	huntite
B	dolomite	huntite	barytocite
C	huntite	barytocite	dolomite
D	huntite	dolomite	barytocite

- 14 Which observations are made when a sample of silicon chloride, SiCl_4 , is added to a beaker of water?
- A No visible changes are observed.
 - B Steamy fumes and a white precipitate are both observed.
 - C The appearance of a white precipitate is the only observation.
 - D The appearance of steamy fumes is the only observation.
- 15 Use of the Data Booklet is relevant to this question.

Which diagram correctly shows the atomic radii of the elements Mg, Al, Si and P plotted against their melting points?



- 16** Chlorine is widely used in water treatment plants.

Which reaction takes place when chlorine dissolves in water?

- A** $\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HCl} + \text{HClO}$
B $2\text{Cl}_2 + 2\text{H}_2\text{O} \rightarrow 3\text{HCl} + \text{HClO}_2$
C $3\text{Cl}_2 + 3\text{H}_2\text{O} \rightarrow 5\text{HCl} + \text{HClO}_3$
D $4\text{Cl}_2 + 4\text{H}_2\text{O} \rightarrow 7\text{HCl} + \text{HClO}_4$

- 17** Astatine, At, is below iodine in Group VII of the Periodic Table.

Which statement is most likely to be correct?

- A** AgAt(s) reacts with excess dilute aqueous ammonia to form a solution of a soluble complex.
B Astatine and KCl(aq) react to form KAt(aq) and chlorine.
C KAt(aq) and dilute sulfuric acid react to form white fumes of HAt(g) .
D NaAt(s) and concentrated sulfuric acid react to form astatine.

- 18** Mohr's salt is a pale green crystalline solid which is soluble in water. It contains two cations, one of which is Fe^{2+} , and one anion which is SO_4^{2-} .

The identity of the second cation was determined by heating Mohr's salt with aqueous sodium hydroxide. A colourless gas was evolved which readily dissolved in water giving an alkaline solution.

A green precipitate was also formed.

What are the identities of the gas and the precipitate?

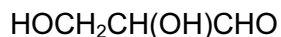
	gas	precipitate
A	NH_3	Fe(OH)_2
B	NH_3	Na_2SO_4
C	SO_2	Fe(OH)_2
D	SO_2	Na_2SO_4

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

Which mass of solid residue will be obtained from the thermal decomposition of 4.10g of anhydrous calcium nitrate?

- A** 0.70g **B** 1.00g **C** 1.40g **D** 2.25g

20 Which reagent will give a different observation with compounds P and Q?



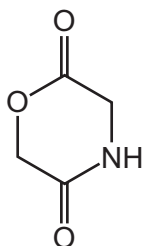
P



Q

- A $\text{Br}_2(\text{aq})$
- B hot acidified KMnO_4
- C silver nitrate in ammonia solution
- D warm acidified $\text{K}_2\text{Cr}_2\text{O}_7$

21 The cyclic compound M is heated with dilute hydrochloric acid.



compound M

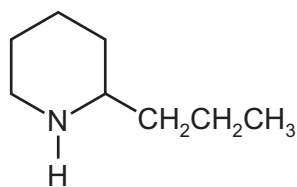
What are the products of the reaction?

- A $\text{HOCH}_2\text{CO}_2\text{H}$ and $\text{H}_2\text{NCH}_2\text{CO}_2\text{H}$
 - B $\text{HO}_2\text{CCH}_2\text{OH}$ and $\text{HO}_2\text{CCH}_2\text{NH}_3^+$
 - C $\text{H}_2\text{NCOCH}_2\text{OH}$ and HOCH_2CHO
 - D $\text{HOCH}_2\text{CONH}_3^+$ and HOCH_2CHO
- 22 Cottonseed oil contains large amounts of polyunsaturated carboxylic acids. When this oil is used to make margarine, the $\text{C}=\text{C}$ double bonds in the unsaturated carboxylic acids are hydrogenated.

What reagents and conditions would be suitable to bring about this hydrogenation reaction?

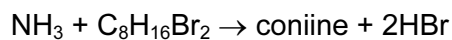
- A H_2 gas, nickel catalyst, 400°C
 - B LiAlH_4 in dry ether
 - C NaBH_4 , aqueous solution
 - D steam, concentrated H_2SO_4 , 300°C and 60 atm pressure
- 23 Which intermediate ion forms in the greatest amount during the addition of HBr to propene?
- A $\text{CH}_3\text{CH}^+\text{CH}_3$
 - B $\text{CH}_3\text{CH}_2\text{CH}_2^+$
 - C $\text{CH}_3\text{CH}^-\text{CH}_2\text{Br}$
 - D $\text{CH}_3\text{CHBrCH}_2^-$

- 24 Coniine is the major constituent of the poison 'oil of hemlock'.



coniine

Coniine can be synthesised by reacting ammonia with a dibromo compound, **X**.



X

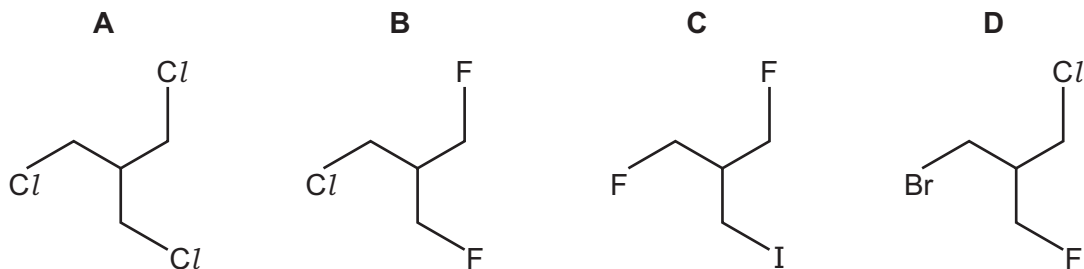
What is the name of compound **X**?

- A 1,1-dibromo-2-propylcyclopentane
 - B 1,2-dibromo-2-propylcyclopentane
 - C 1,4-dibromooctane
 - D 1,5-dibromooctane
- 25 2-bromopropane reacts with a hot concentrated solution of sodium hydroxide in ethanol.

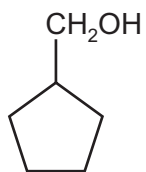
Which substance is the major product of this reaction?

- A propan-1-ol
 - B propan-2-ol
 - C 2-hydroxypropene
 - D propene
- 26 The presence of a halogen in an organic compound may be detected by warming the organic compound with aqueous silver nitrate.

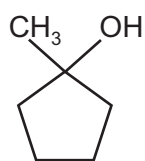
Which compound would be the quickest to produce a precipitate?



27 Which reagent will give a different observation with compounds W and X?



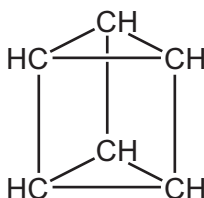
W



X

- A hot SOCl_2
- B hot acidified $\text{K}_2\text{Cr}_2\text{O}_7$
- C NaOH(aq)
- D warm Fehling's reagent

28 In 1869 Ladenburg suggested a structure for benzene, C_6H_6 , in which one hydrogen atom is attached to each carbon atom.



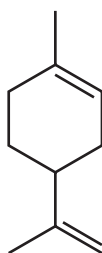
Ladenburg structure

A compound $\text{C}_6\text{H}_4\text{Cl}_2$ could be formed with **the same** carbon skeleton as the Ladenburg structure.

How many **structural** isomers would this compound have?

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

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



limonene

What is the mole ratio of carbon dioxide to water produced when limonene is completely burnt in oxygen?

	number of moles carbon dioxide	number of moles water
A	4	3
B	5	4
C	5	8
D	9	7

- 30 What is the organic product when ethanamide, CH_3CONH_2 , is boiled with excess aqueous sodium hydroxide?

- A** CH_3CN
B $\text{CH}_3\text{CO}_2^-\text{NH}_4^+$
C $\text{CH}_3\text{CONH}^-\text{Na}^+$
D $\text{CH}_3\text{CO}_2^-\text{Na}^+$

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.

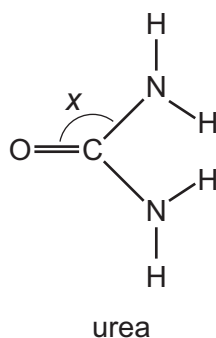
31 *Use of the Data Booklet is relevant to this question.*

The isotope ^{99}Tc is radioactive and has been found in lobsters and seaweed adjacent to nuclear fuel reprocessing plants.

Which statements are correct about an atom of ^{99}Tc ?

- 1** It has 13 more neutrons than protons.
- 2** It has 43 protons.
- 3** It has 99 nucleons.

32 Urea is a product of animal metabolism. It can also be used as a fertiliser.



The diagram shows angle x in this molecule.

Which statements about the structure of urea are correct?

- 1** Angle x is approximately 120° .
- 2** The molecule has two π bonds.
- 3** The molecule has only three lone pairs of electrons.

33 Aluminium is extracted from aluminium oxide by electrolysis.

Which statements are correct?

- 1 Aluminium oxide has an extremely high melting point.
- 2 Bauxite is added to the aluminium oxide to lower its melting point.
- 3 Oxygen produced at the graphite cathode reacts with the graphite to produce CO_2 .

34 Why does raising the pressure of a fixed mass of gaseous reactants at a constant temperature cause an increase in the rate of reaction?

- 1 More collisions occur per second when the pressure is increased.
- 2 More molecules have energy greater than the activation energy at the higher pressure.
- 3 Raising the pressure lowers the activation energy.

35 Which statements about the industrial manufacture of sulfuric acid are correct?

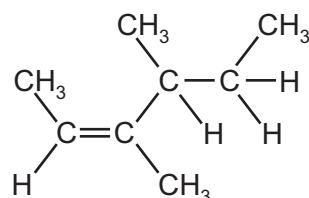
- 1 Sulfur is burned to form sulfur dioxide.
- 2 The stage that forms sulfur trioxide involves a V_2O_5 catalyst.
- 3 The stage that forms sulfur trioxide is non-reversible.

36 **X** is a Group II metal. It forms a sulfate which is more soluble than barium sulfate. It forms a hydroxide which is more soluble than calcium hydroxide.

What could be the identity of **X**?

- 1 strontium
- 2 magnesium
- 3 beryllium

37 The diagram shows the structure of an alkene molecule.



Which statements about this molecule are correct?

- 1 All the carbon atoms are in the same plane.
- 2 It has geometrical isomers.
- 3 It is optically active.

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

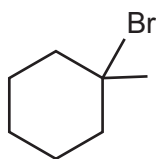
No other combination of statements is used as a correct response.

- 38** An organic compound, **X**, will react with calcium metal to produce a salt with the empirical formula $\text{CaC}_4\text{H}_4\text{O}_4$.

What could be the identity of **X**?

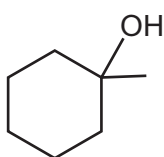
- 1** ethanoic acid
- 2** butanedioic acid
- 3** 2-methylpropanedioic acid

- 39** Which compounds will react with HBr to give the compound **R**?

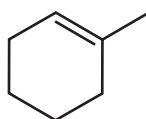


R

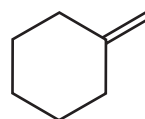
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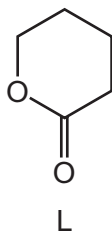
2



3



40 5-hydroxypentanoic acid is readily converted into the cyclic compound L.



Which statements about this reaction are correct?

- 1 Acidified sodium dichromate(VI) is used as a reagent.
- 2 A water molecule is produced in the reaction.
- 3 The reaction is catalysed by concentrated H_2SO_4 .

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9701/12

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May/June 2015

1 hour

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Data Booklet

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Section A

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

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

In which option do all three particles have the same electronic configuration **and** the same number of neutrons?

- A** $^{15}\text{N}^{3-}$ $^{16}\text{O}^{2-}$ $^{19}\text{F}^{-}$
B $^{18}\text{O}^{2-}$ $^{19}\text{F}^{-}$ ^{20}Ne
C $^{19}\text{F}^{-}$ ^{20}Ne $^{23}\text{Na}^{+}$
D ^{22}Ne ^{23}Na $^{24}\text{Mg}^{2+}$

- 2 The shell of a chicken's egg makes up 5% of the mass of an average egg. An average egg has a mass of 50 g.

Assume the egg shell is pure calcium carbonate.

How many complete chicken's egg shells would be needed to neutralise 50 cm^3 of 2.0 mol dm^{-3} ethanoic acid?

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

- 3 Phosphorus forms a compound with hydrogen called phosphine, PH_3 . This compound can react with a hydrogen ion, H^{+} .

Which type of interaction occurs between PH_3 and H^{+} ?

- A** dative covalent bond
B dipole-dipole forces
C hydrogen bond
D ionic bond

- 4 Which solid has a simple molecular lattice?

- A** calcium fluoride
B nickel
C silicon(IV) oxide
D sulfur

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

The gas laws can be summarised in the ideal gas equation below.

$$pV = nRT$$

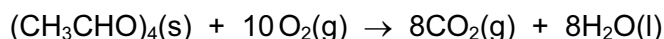
The volume of a sample of methane is measured at a temperature of 60 °C and a pressure of 103 kPa. The volume measured is $5.37 \times 10^{-3} \text{ m}^3$.

Assume the gas behaves as an ideal gas.

What is the mass of the sample of methane, given to two significant figures?

- A** 0.00018 g **B** 0.0032 g **C** 0.18 g **D** 3.2 g

- 6 Metaldehyde, $(\text{CH}_3\text{CHO})_4$, is used as a solid fuel for camping stoves. The equation for the complete combustion of metaldehyde is shown.



$\Delta H_c^\ominus$ = standard enthalpy change of combustion.

Which expression will give a correct value for the enthalpy change of formation of metaldehyde?

- A** $\Delta H_c^\ominus \text{metaldehyde} - (8\Delta H_c^\ominus \text{carbon} + 8\Delta H_c^\ominus \text{hydrogen})$
B $\Delta H_c^\ominus \text{metaldehyde} - (8\Delta H_c^\ominus \text{carbon} + 16\Delta H_c^\ominus \text{hydrogen})$
C $(8\Delta H_c^\ominus \text{carbon} + 8\Delta H_c^\ominus \text{hydrogen}) - \Delta H_c^\ominus \text{metaldehyde}$
D $(8\Delta H_c^\ominus \text{carbon} + 16\Delta H_c^\ominus \text{hydrogen}) - \Delta H_c^\ominus \text{metaldehyde}$

- 7 In industry, copper metal is purified by electrolysis.

Which changes occur to the masses of the electrodes and to the colour of the electrolyte during this process?

	mass of anode	mass of cathode	colour of electrolyte
A	decrease	increase	little or no change occurs
B	decrease	increase	pale blue to blue
C	increase	decrease	little or no change occurs
D	increase	decrease	blue to pale blue

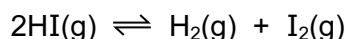
- 8 Nitrogen dioxide, NO_2 , exists in equilibrium with dinitrogen tetroxide, N_2O_4 .



Which conditions give the greatest percentage of $\text{N}_2\text{O}_4(\text{g})$ at equilibrium?

	pressure	temperature
A	high	high
B	high	low
C	low	high
D	low	low

- 9 When a sample of HI is warmed to a particular temperature the equilibrium below is established.



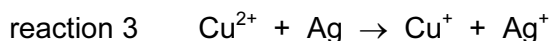
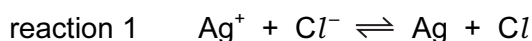
At this temperature, it is found that the partial pressure of HI(g) is 28 times the partial pressure of $\text{H}_2(\text{g})$.

What is the value of K_p at this temperature?

- A** 1.28×10^{-3} **B** 0.035 **C** 28 **D** 784

- 10 Photochromic glass, used for sunglasses, darkens when exposed to bright light and becomes more transparent again when the light is less bright. The darkness of the glass is related to the concentration of silver atoms.

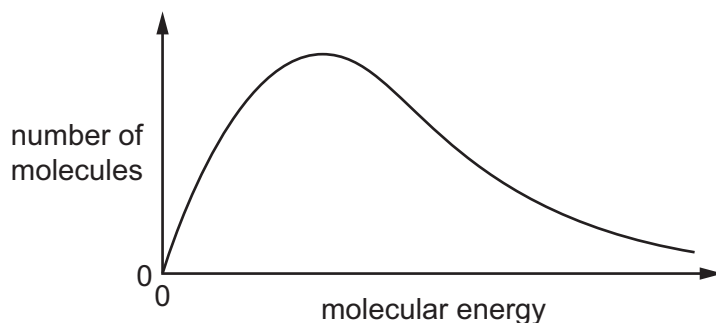
The following reactions are involved.



Which statement about these reactions is correct?

- A** Cu^+ and Cu^{2+} ions act as catalysts.
B Cu^+ ions act as an oxidising agent in reaction 2.
C Reaction 3 increases the darkness of the glass.
D Silver atoms are reduced in reaction 3.

- 11 The Boltzmann distribution below shows the distribution of molecular energies in a sample of a gas at a given temperature.



Which statement correctly describes the change in such a distribution if the temperature is increased?

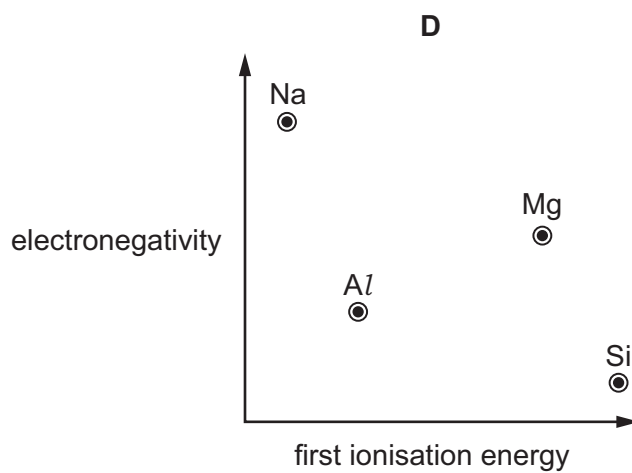
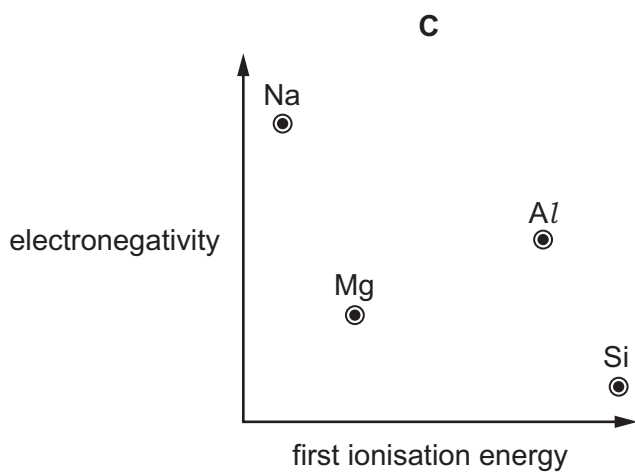
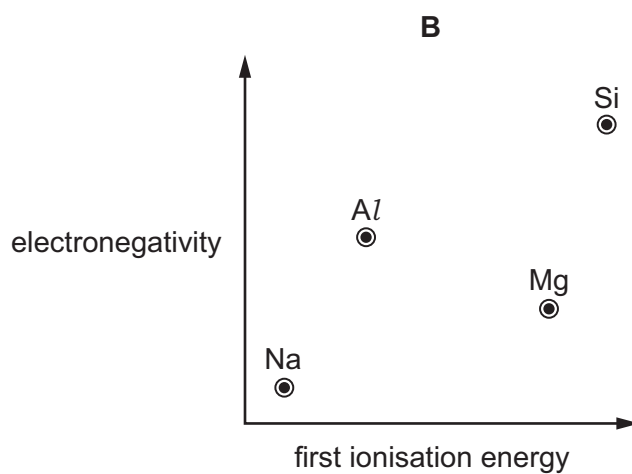
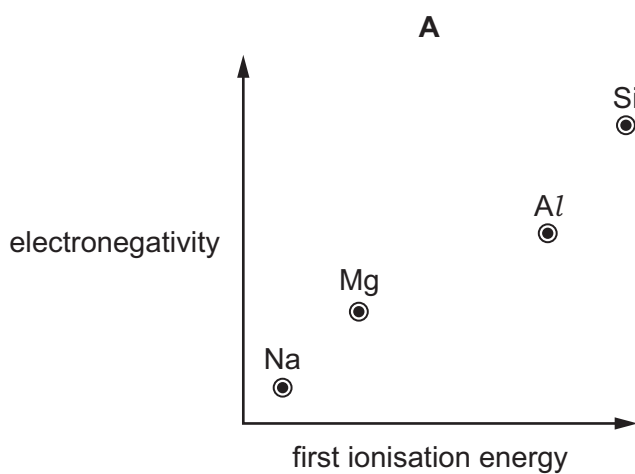
- A Fewer molecules possess the most probable energy value and this value shifts to the left.
 - B Fewer molecules possess the most probable energy value and this value shifts to the right.
 - C More molecules possess the most probable energy value and this value shifts to the left.
 - D The area under the curve of the distribution increases.
- 12 *Use of the Data Booklet is relevant to this question.*
- When 3.00g of an anhydrous nitrate of a Group II metal is decomposed, 1.53g of gas is produced.
- What is the nitrate compound?
- A beryllium nitrate
 - B calcium nitrate
 - C magnesium nitrate
 - D strontium nitrate
- 13 What happens when a piece of magnesium ribbon is placed in cold water?
- A A vigorous effervescence occurs.
 - B Bubbles of gas form slowly on the magnesium.
 - C The magnesium floats on the surface of the water and reacts quickly.
 - D The magnesium glows and a white solid is produced.
- 14 Compound **X** releases carbon dioxide gas and forms a white solid, **Y**, when it is heated. Neither **X** nor **Y** are soluble in water. Compound **Y** is used as a refractory kiln lining.

What is compound **X**?

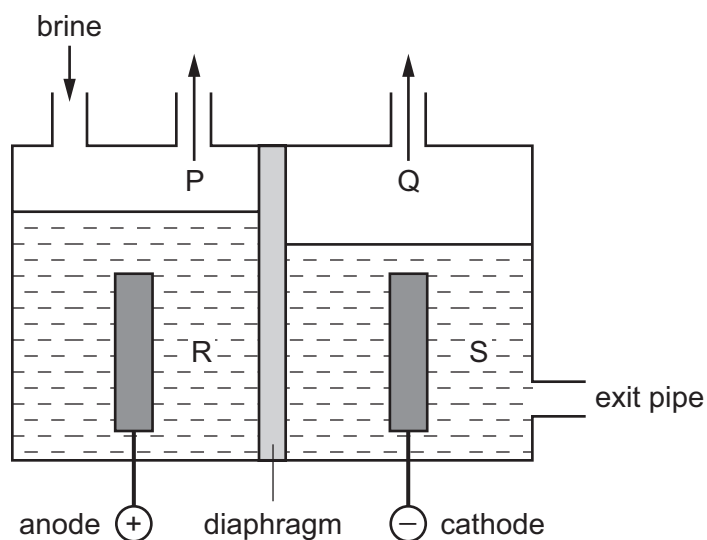
- A CaCO_3
- B CaO
- C MgCO_3
- D MgO

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

Which diagram correctly shows the electronegativity of the elements Na, Mg, Al and Si plotted against their first ionisation energies?



- 16 The diagram shows a diaphragm cell used for the electrolysis of brine. Brine is concentrated aqueous sodium chloride.



A solution of sodium chlorate(I), commonly used as bleach, can be made by mixing which two substances?

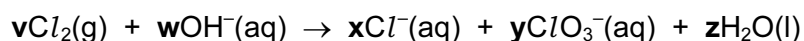
- A** P and R **B** P and S **C** Q and R **D** Q and S
- 17 Which statement about the ammonium ion, NH_4^+ , is correct?
- A** All bond angles are 107° .
B Ammonium ions are formed when ammonia behaves as an acid.
C Ammonium ions are unreactive when heated with $\text{NaOH}(\text{aq})$.
D The bonds are all the same length.
- 18 Carbon monoxide, CO , nitrogen dioxide, NO_2 , and sulfur dioxide, SO_2 , are all atmospheric pollutants.

Which reaction concerning these compounds occurs in the atmosphere?

- A** CO is spontaneously oxidised to CO_2
B NO_2 is reduced to NO by CO
C NO_2 is reduced to NO by SO_2
D SO_2 is oxidised to SO_3 by CO_2

- 19 Chlorate(V) ions, ClO_3^- , are produced in the redox reaction between chlorine and hot aqueous sodium hydroxide. Oxidation numbers can be used to help balance the equation for this reaction.

What will be the values of coefficients **v**, **x** and **y** in the balanced equation?

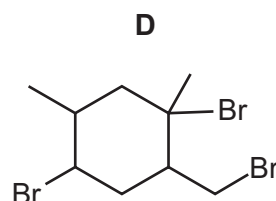
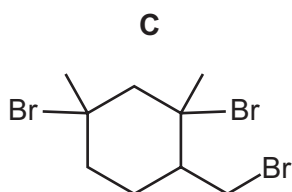
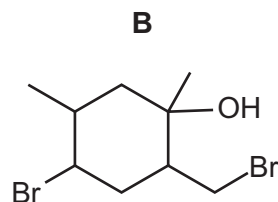
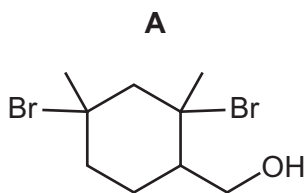
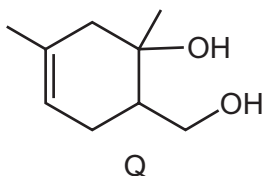


	v	x	y
A	2	3	1
B	3	4	2
C	3	5	1
D	7	12	2

- 20 Which alcohol will react with an acidified solution of potassium dichromate(VI) to produce a ketone containing six carbon atoms?

- A** 2,2-dimethylbutan-1-ol
B 2-methylpentan-3-ol
C 3,3-dimethylpentan-2-ol
D 3-methylpentan-3-ol

- 21 What is the major product formed when compound Q is warmed with excess HBr?



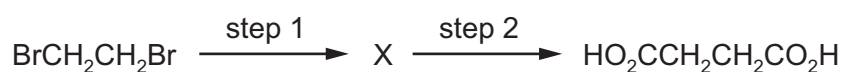
22 Four students, W, X, Y and Z, made the following statements about alkanes and alkenes.

- W 'Bromine reacts with alkanes by electrophilic substitution.'
 X 'Bromine reacts with alkenes by a free-radical addition mechanism.'
 Y 'Alkenes can be oxidised by acidified manganate(VII) ions.'
 Z 'Alkenes are formed from alkanes by cracking.'

Which two students are correct?

- A** W and X **B** W and Z **C** X and Y **D** Y and Z

23 Butanedioic acid may be synthesised in two steps from 1,2-dibromoethane.



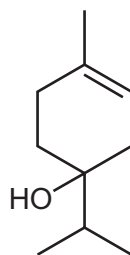
Which reagents could be used for this synthesis?

	step 1	step 2
A	HCN(g)	HCl(aq)
B	HCO ₂ Na(aq)	HCl(aq)
C	KCN(alcoholic)	H ₂ SO ₄ (aq)
D	NaOH(aq)	K ₂ Cr ₂ O ₇ /H ₂ SO ₄ (aq)

24 Which reaction would **not** give propene?

- A** adding excess hot concentrated sulfuric acid to propan-1-ol
B adding warm aqueous sodium hydroxide to 2-bromopropane
C adding warm ethanolic sodium hydroxide to 1-bromopropane
D passing propan-2-ol vapour over heated aluminium oxide

- 25 Terpinen-4-ol is one of the active ingredients in tea tree oil.



terpinen-4-ol

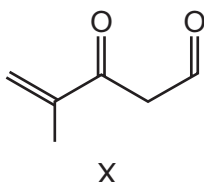
What is the molecular formula of terpinen-4-ol?

- A $C_7H_{11}O$ B $C_{10}H_{16}O$ C $C_{10}H_{17}O$ D $C_{10}H_{18}O$
- 26 Use of the Data Booklet is relevant to this question.

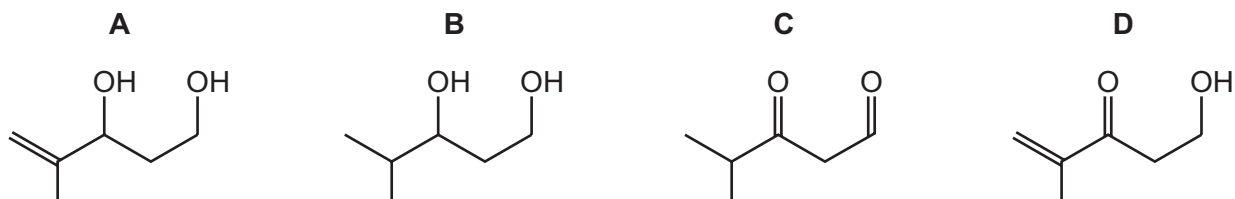
2.40 g of propan-2-ol were mixed with excess acidified potassium dichromate(VI). The reaction mixture was then boiled under reflux for twenty minutes. The organic product was then collected by distillation. The yield of product was 75.0%.

What mass of product was collected?

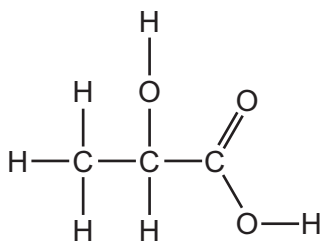
- A 1.74 g B 1.80 g C 2.22 g D 2.32 g
- 27 The diagram shows the structure of compound X.



What is the product of the reaction between compound X and an excess of $NaBH_4$?



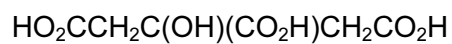
- 28 Lactic acid occurs naturally, for example in sour milk.



lactic acid

What is a property of lactic acid?

- A** It decolourises aqueous bromine rapidly.
 - B** It is insoluble in water.
 - C** It reduces Fehling's reagent.
 - D** Two molecules react with each other in the presence of a strong acid.
- 29 Citric acid is found in lemon juice.

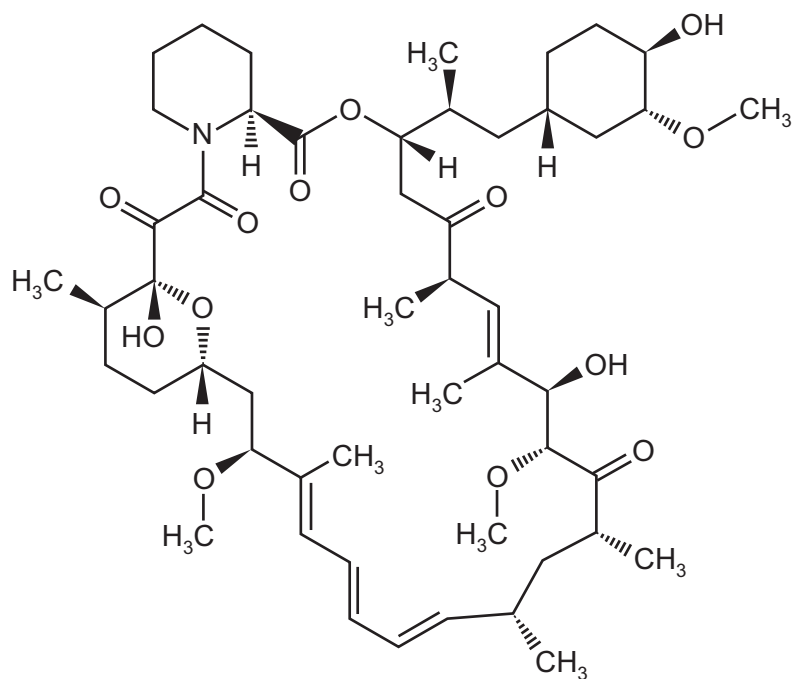


citric acid

What is the volume of 0.4 mol dm^{-3} sodium hydroxide solution required to neutralise a solution containing 0.005 mol of citric acid?

- A** 12.5 cm^3
- B** 25.0 cm^3
- C** 37.5 cm^3
- D** 50.0 cm^3

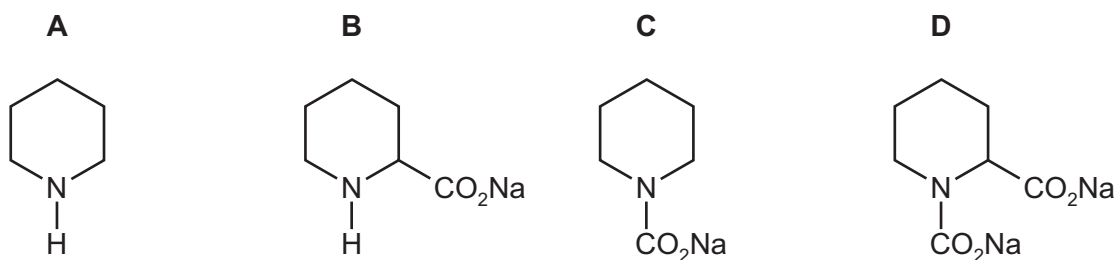
30 The drug *Sirolimus* is used to treat patients after kidney transplants.



Sirolimus

On reaction with hot aqueous sodium hydroxide, *Sirolimus* produces an equimolar mixture of two organic products.

What is the structural formula of the product with the lower relative molecular mass?



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

Which statements about the phosphide ion, $^{31}\text{P}^{3-}$, and the chloride ion, $^{35}\text{Cl}^{-}$, are correct?

- 1** They have the same number of electrons.
- 2** They have the same number of neutrons.
- 3** They have the same number of protons.

32 Why does aluminium chloride, Al_2Cl_6 , sublime at the relatively low temperature of 180°C ?

- 1** The intermolecular forces between the Al_2Cl_6 molecules are weak.
- 2** The co-ordinate bonds between aluminium and chlorine are weak.
- 3** The covalent bonds between aluminium and chlorine are weak.

33 Which statements are correct for **all** exothermic reactions?

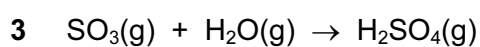
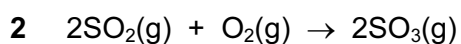
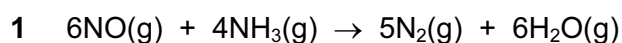
- 1** ΔH for the reaction is negative.
- 2** On a reaction pathway diagram the products are shown lower than the reactants.
- 3** The reaction will happen spontaneously.

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

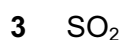
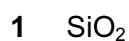
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

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

34 Which of these reactions are redox reactions?



35 When added to water, which oxides will cause a change in the pH of the water?



36 Halogenated hydrocarbons have many uses.

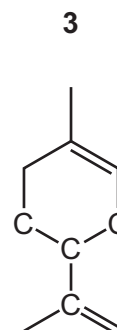
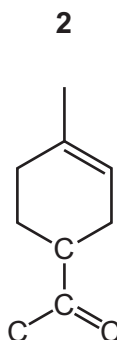
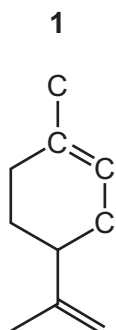
What have halogenated hydrocarbons been used for?

1 solvents

2 refrigerants

3 monomers in polymer manufacture

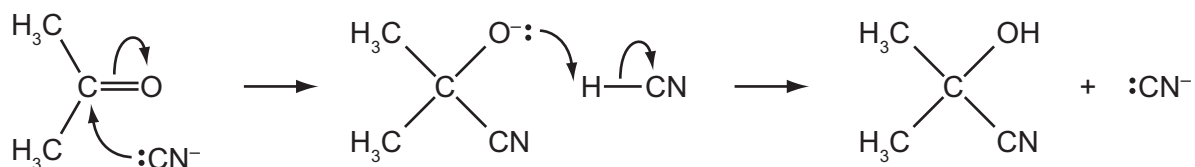
37 In which structures do the four carbon atoms labelled C lie in the same plane?



38 Which statements about 2-methylbutan-1-ol are correct?

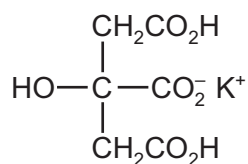
- 1 It can give HCl(g) on reaction with PCl_5 .
- 2 It can be oxidised to give an aldehyde.
- 3 It exists in two optically active forms.

39 Propanone and hydrogen cyanide react together by this mechanism.



Which statements about this mechanism are correct?

- 1 CN^- is an electrophile.
 - 2 It is an addition reaction.
 - 3 Heterolytic bond breaking is involved.
- 40 Monopotassium citrate is used as an emulsifying agent in powdered milk and in powdered soups. It may be represented by the formula shown.



monopotassium citrate

Which statements about monopotassium citrate are correct?

- 1 It does **not** have a chiral carbon atom.
- 2 It can act as a dibasic acid.
- 3 It reacts with NaHCO_3 to give CO_2 .

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CHEMISTRY

9701/13

Paper 1 Multiple Choice

May/June 2015

1 hour

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

DO NOT WRITE IN ANY BARCODES.

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.

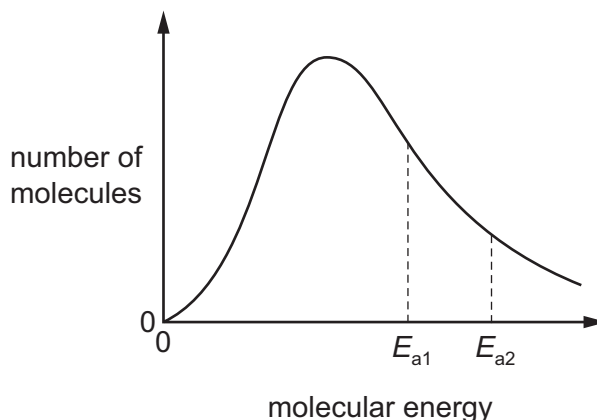
Electronic calculators may be used.

This document consists of **16** 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.

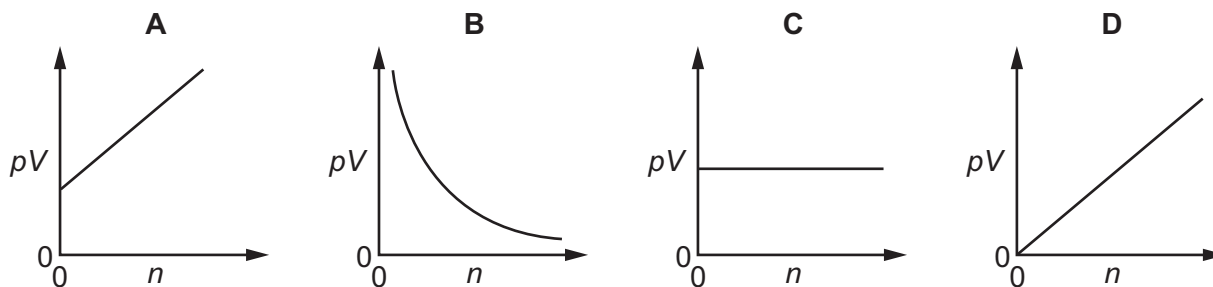
- 1 The diagram shows the Boltzmann energy distribution curve for molecules of a mixture of two gases at a given temperature. For a reaction to occur the molecules must collide together with sufficient energy.



E_a is used to represent the activation energy for the reaction between the gases. Of the two values shown, one is the activation energy for a catalysed reaction, the other for an uncatalysed reaction.

Which statement about E_{a1} is correct?

- A** E_{a1} corresponds to a catalysed reaction with fewer effective collisions than the uncatalysed reaction.
- B** E_{a1} corresponds to an uncatalysed reaction with fewer effective collisions than the catalysed reaction.
- C** E_{a1} corresponds to a catalysed reaction with a greater number of effective collisions than the uncatalysed reaction.
- D** E_{a1} corresponds to an uncatalysed reaction with a greater number of effective collisions than the catalysed reaction.
- 2 Which diagram shows the correct graph of pV against n for an ideal gas at constant temperature?



- 3 A student performed an experiment to measure the enthalpy change of combustion of ethane.

He used the following values for the standard enthalpy changes of combustion of carbon and hydrogen.

$$\Delta H_c^\ominus \text{carbon} = -394 \text{ kJ mol}^{-1}$$

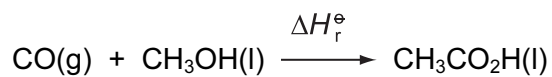
$$\Delta H_c^\ominus \text{hydrogen} = -286 \text{ kJ mol}^{-1}$$

He calculated the enthalpy change of formation of ethane to be -140 kJ mol^{-1} .

What was his experimental value for the standard enthalpy change of combustion of ethane?

- A $-2364 \text{ kJ mol}^{-1}$
B $-1506 \text{ kJ mol}^{-1}$
C $-1112 \text{ kJ mol}^{-1}$
D -540 kJ mol^{-1}
- 4 Which pair has species with different shapes?
- A BeCl_2 and CO_2
B CH_4 and NH_4^+
C NH_3 and BF_3
D SCl_2 and H_2O
- 5 In which reaction does an element have the largest change in oxidation number?
- A $\text{Cr}_2\text{O}_7^{2-} + 6\text{Fe}^{2+} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 6\text{Fe}^{3+} + 7\text{H}_2\text{O}$
B $3\text{OCl}^- \rightarrow \text{ClO}_3^- + 2\text{Cl}^-$
C $5\text{Fe}^{2+} + \text{MnO}_4^- + 8\text{H}^+ \rightarrow 5\text{Fe}^{3+} + \text{Mn}^{2+} + 4\text{H}_2\text{O}$
D $\text{PbO}_2 + \text{Sn}^{2+} + 4\text{H}^+ \rightarrow \text{Sn}^{4+} + \text{Pb}^{2+} + 2\text{H}_2\text{O}$
- 6 Which statement can be explained by intermolecular hydrogen bonding?
- A Ethanol has a higher boiling point than propane.
B Hydrogen chloride has a higher boiling point than silane, SiH_4 .
C Hydrogen iodide forms an acidic solution when dissolved in water.
D Propanone has a higher boiling point than propane.

- 7 Carbon monoxide and methanol can react together to form ethanoic acid.



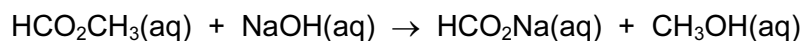
Standard enthalpy changes of combustion are given in the table.

compound	standard enthalpy change of combustion, $\Delta H_c^\ominus$
CO	$-283.0 \text{ kJ mol}^{-1}$
CH ₃ OH	$-726.0 \text{ kJ mol}^{-1}$
CH ₃ CO ₂ H	$-874.1 \text{ kJ mol}^{-1}$

What is the value for $\Delta H_r^\ominus$ for the reaction between carbon monoxide and methanol?

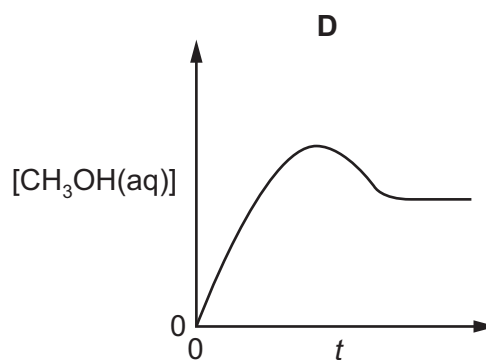
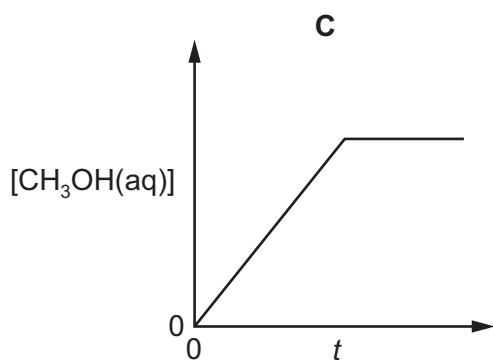
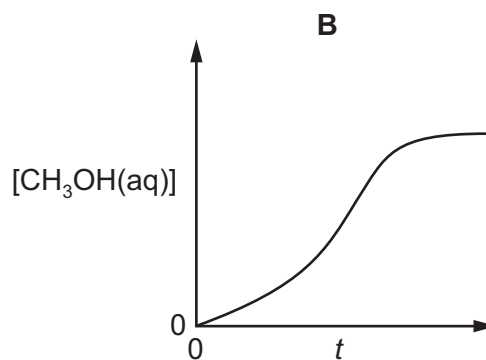
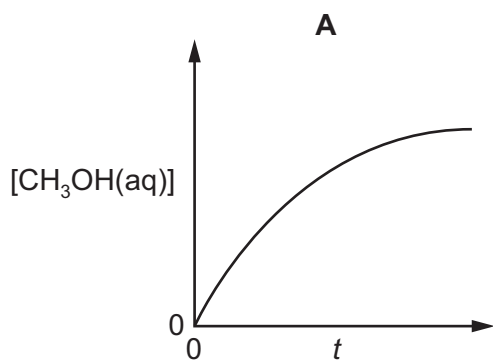
- A** $-1883.1 \text{ kJ mol}^{-1}$
B $-134.9 \text{ kJ mol}^{-1}$
C $+134.9 \text{ kJ mol}^{-1}$
D $+1883.1 \text{ kJ mol}^{-1}$

- 8 The following reaction was carried out.



The concentration of methanol, $[\text{CH}_3\text{OH}(\text{aq})]$, was measured with time, t .

Which graph shows the relationship between $[\text{CH}_3\text{OH}(\text{aq})]$ and t ?



- 9 Brine is concentrated aqueous sodium chloride. Brine is electrolysed in a diaphragm cell.

What is the purpose of the diaphragm?

- A** to prevent Cl_2 reacting with H_2
- B** to prevent HCl reacting with Na
- C** to prevent NaOH reacting with Cl_2
- D** to prevent NaOH reacting with HCl

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

1.00g of a metallic element reacts completely with 300 cm³ of oxygen at 298 K and 1 atm pressure to form an oxide which contains O²⁻ ions.

The volume of one mole of gas at this temperature and pressure is 24.0 dm³.

What could be the identity of the metal?

- A calcium
- B magnesium
- C potassium
- D sodium

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

The gas laws can be summarised in the ideal gas equation below.

$$pV = nRT$$

When an evacuated tube of volume 400 cm³ is filled with gas at 300 K and 101 kPa, the mass of the tube increases by 0.65 g.

Assume the gas behaves as an ideal gas.

What could be the identity of the gas?

- A argon
- B helium
- C krypton
- D neon

12 Which oxide will produce the solution with the highest pH when it is mixed with water?

- A Al₂O₃ B CO₂ C Na₂O D SO₂

13 Barium is a more reactive metal than aluminium.

Which method could be suitable for the extraction of barium?

- A electrolysis of aqueous barium chloride
- B electrolysis of molten barium chloride
- C reducing barium oxide with aluminium
- D reducing barium oxide with carbon

- 14 The compound $(\text{CH}_3)_3\text{NAlCl}_3$ has a simple molecular structure.

Which statement about $(\text{CH}_3)_3\text{NAlCl}_3$ is correct?

- A** $(\text{CH}_3)_3\text{NAlCl}_3$ molecules attract each other by hydrogen bonds.
B The Al atom has an incomplete valence shell of electrons.
C The bonds around the Al atom are planar.
D The molecules contain coordinate and covalent bonding

- 15 The labels had become detached from four bottles in the laboratory. A student realised that the contents of one of them could easily be identified, because on addition of water it would **not** give fumes of hydrogen chloride.

Which did **not** give the HCl fumes?

- A** Al_2Cl_6 **B** MgCl_2 **C** PCl_5 **D** SiCl_4

- 16 Transition elements and their compounds are widely used as catalysts.

What is the identity and what is the oxidation number of the element present in the catalyst used in the Contact process?

	element	oxidation number
A	iron	0
B	iron	+3
C	vanadium	0
D	vanadium	+5

- 17 This question refers to isolated gaseous species.

The species F^- , Ne and Na^+ are isoelectronic. This means they have the same number of electrons.

In which order do their radii increase?

	smallest	→	largest
A	Na^+	F^-	Ne
B	F^-	Ne	Na^+
C	Na^+	Ne	F^-
D	Ne	F^-	Na^+

- 18** Due to their similar ionic radii, the reactions of lithium and magnesium and their corresponding compounds are very similar.

Which statement about the reactions of lithium or its compounds can be predicted from this statement?

- A** Lithium burns very slowly in oxygen.
- B** Lithium carbonate decomposes on heating in a blue Bunsen burner flame, forming lithium oxide and carbon dioxide.
- C** Lithium nitrate decomposes on heating, forming lithium nitrite, LiNO_2 , and oxygen.
- D** Lithium reacts very violently with cold water, liberating hydrogen.

- 19** Two separate tests were carried out on an aqueous solution of a salt which contains only two ions.

In each test, the resulting mixtures were filtered and the filtrate solution was collected.

	reagent	result	filtrate collected
test 1	aqueous silver nitrate acidified with dilute nitric acid	yellow precipitate forms	solution P
test 2	dilute sulfuric acid	white precipitate forms	solution Q

Which ions are present in the filtrates?

	solution P	solution Q
A	$\text{Ba}^{2+}(\text{aq})$	$\text{Cl}^{-}(\text{aq})$
B	$\text{Ba}^{2+}(\text{aq})$	$\text{I}^{-}(\text{aq})$
C	$\text{Mg}^{2+}(\text{aq})$	$\text{Cl}^{-}(\text{aq})$
D	$\text{Mg}^{2+}(\text{aq})$	$\text{I}^{-}(\text{aq})$

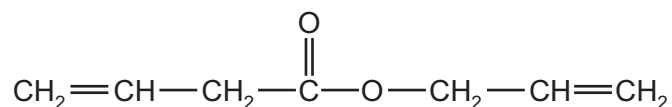
- 20** An organic compound **Z**

- is oxidised by hot acidified potassium manganate(VII),
- reacts with sodium to give hydrogen.

What could be compound **Z**?

- A** $(\text{CH}_3)_3\text{COH}$
- B** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$
- C** $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
- D** $\text{CH}_3\text{CH}_2\text{COCH}_3$

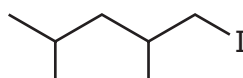
- 21 The diagram shows a molecule that has σ bonds and π bonds.



How many σ bonds are present in this molecule?

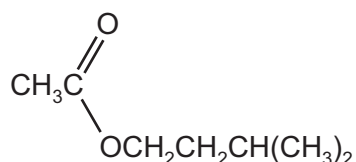
- A 15 B 17 C 18 D 21
- 22 The Finkelstein reaction occurs when NaI in propanone reacts with a chloroalkane or bromoalkane. The halogen is directly replaced by I and the reaction only works for primary halogenoalkanes.

Which halogenoalkane would produce compound X?



compound X

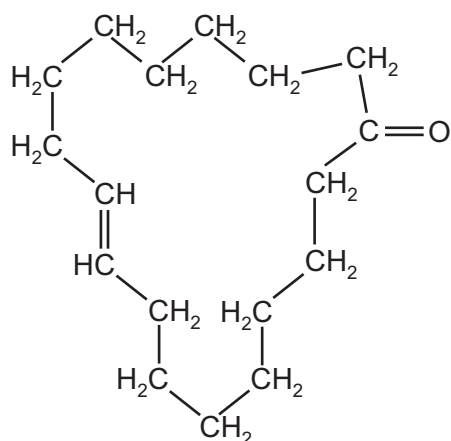
- A $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{Br}$
 B $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{CH}_2\text{Br}$
 C $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{Cl}$
 D $(\text{CH}_3)_2\text{CHCH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{Cl}$
- 23 An ester P with a fruity odour has the following structural formula.



Which compounds are produced when P is hydrolysed using hydrochloric acid?

- A CH_3COCl and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$
 B CH_3CHO and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$
 C $\text{CH}_3\text{CO}_2\text{H}$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CHO}$
 D $\text{CH}_3\text{CO}_2\text{H}$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$

- 24 The naturally-occurring molecule civetone is found in a gland of the African civet cat and has been used in perfumery.



civetone

Which reagent will **not** react with civetone?

- A 2,4-dinitrophenylhydrazine reagent
 - B Fehling's reagent
 - C hydrogen bromide
 - D sodium tetrahydridoborate(III), NaBH_4
- 25 Compound **X**, $\text{C}_5\text{H}_{12}\text{O}$, is oxidised by acidified sodium dichromate(VI) to compound **Y**.

Compound **Y** reacts with butan-2-ol in the presence of a little concentrated sulfuric acid to give liquid **Z**.

What could be the formula of **Z**?

- A $\text{CH}_3(\text{CH}_2)_3\text{CO}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
- B $\text{CH}_3(\text{CH}_2)_3\text{CO}_2(\text{CH}_2)_3\text{CH}_3$
- C $\text{CH}_3(\text{CH}_2)_2\text{CO}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
- D $(\text{CH}_3)_2\text{CHCH}_2\text{CO}_2\text{C}(\text{CH}_3)_3$

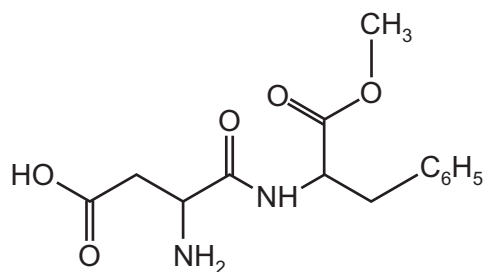
26 Alkane X has molecular formula C_4H_{10} .

X reacts with $Cl_2(g)$ in the presence of sunlight to produce only two different monochloroalkanes, C_4H_9Cl . Both of these monochloroalkanes produce the same alkene Y, and no other organic products, when they are treated with hot ethanolic KOH.

What is produced when Y is treated with hot concentrated acidified $KMnO_4$?

- A CO_2 and $CH_3CH_2CO_2H$
- B CO_2 and CH_3COCH_3
- C HCO_2H and CH_3COCH_3
- D CH_3CO_2H only

27 The compound *aspartame* is widely used as a sweetener in 'diet' soft drinks.



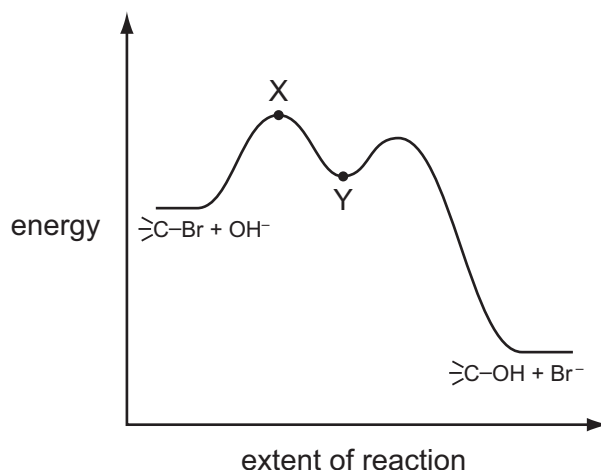
aspartame

Aspartame is chiral. (There are no chiral carbon atoms in C_6H_5 .)

How many chiral carbon atoms are present in a molecule of *aspartame*?

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

- 28 A tertiary bromoalkane, indicated here by >C-Br , reacts with aqueous NaOH. The mechanism has the reaction pathway below.



Which point in the diagram is correctly identified?

A X is >C^+

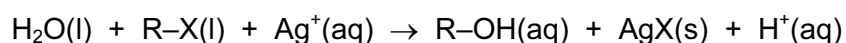
B X is $\left[\text{HO} \cdots \text{C} \cdots \text{Br} \right]^-$

C Y is >C^+

D Y is $\left[\text{HO} \cdots \text{C} \cdots \text{Br} \right]^-$

- 29 Four drops of 1-chlorobutane, 1-bromobutane and 1-iodobutane were put separately into three test-tubes containing 1.0 cm^3 of aqueous silver nitrate at 60°C .

In each case, a hydrolysis reaction occurred. R represents the butane chain C_4H_9 and X the halogen atom.

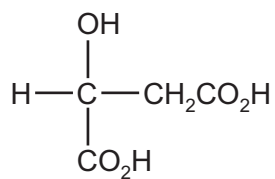


The rate of formation of cloudiness in the test-tubes was in the order $\text{RCl} < \text{RBr} < \text{RI}$.

Why is this?

- A The bond energy of R-X decreases from RCl to RI.
 B The first ionisation energy of the halogen decreases from Cl to I.
 C The solubility of AgX(s) decreases from AgCl to AgI.
 D The R-X bond polarity decreases from RCl to RI.

30 Malic acid occurs in apples.



malic acid

Under suitable conditions, which substance will react with only one of the –OH groups in the malic acid molecule?

- A $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+(\text{aq})$
- B $\text{Na}(\text{s})$
- C $\text{NaOH}(\text{aq})$
- D $\text{PCl}_5(\text{s})$

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** The technetium-99 isotope, ^{99}Tc , is radioactive and has been found in lobsters and seaweed near to nuclear fuel reprocessing plants.

Which statements about an atom of ^{99}Tc are correct?

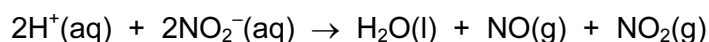
- 1** It has 13 fewer protons than neutrons.
- 2** It forms $^{99}\text{Tc}^{2+}$ which has 45 electrons.
- 3** It has 56 nucleons.

- 32** Nitrogen exists in air as covalently bonded diatomic molecules, N_2 .

Which features are present in one N_2 molecule?

- 1** three π bonds
- 2** three shared pairs of electrons
- 3** two lone pairs of electrons

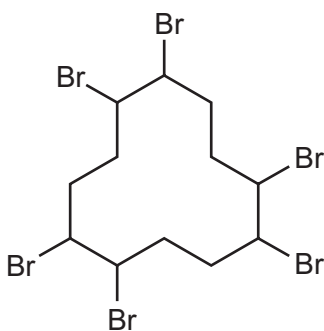
- 33** When dilute acid is added to an aqueous solution containing nitrite ions, NO_2^- , a mixture of gases is produced.



Which statements correctly describe the process?

- 1** Some nitrogen atoms are oxidised and some nitrogen atoms are reduced.
- 2** The $\text{H}^+(\text{aq})$ ion is oxidised by $\text{NO}_2^-(\text{aq})$.
- 3** The $\text{H}^+(\text{aq})$ ion acts as a catalyst.

- 34 Which physical properties are due to hydrogen bonding between water molecules?
- 1 Water has a higher boiling point than H_2S .
 - 2 Ice floats on water.
 - 3 The $\text{H}-\text{O}-\text{H}$ bond angle in water is approximately 104° .
- 35 Under atmospheric conditions, in which transformations is sulfur dioxide involved as either a reagent or a catalyst?
- 1 NO_2 to NO
 - 2 NO to NO_2
 - 3 CO to CO_2
- 36 The element astatine, At, is below iodine in Group VII of the Periodic Table.
- Which statements concerning At can be predicted to be correct?
- 1 At_2 reacts with hydrogen more slowly than I_2 does.
 - 2 At^- ions react with $\text{I}_2(\text{aq})$ to form At_2 molecules.
 - 3 At_2 is a dark coloured solid at room temperature.
- 37 The diagram shows a molecule of a compound used as a flame retardant.



Which statements about this structure are correct?

- 1 Each brominated C atom is chiral.
- 2 The molecular formula is $\text{C}_{12}\text{H}_{20}\text{Br}_6$.
- 3 The $\text{C}-\text{C}-\text{C}$ bond angles are all 120° .

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 Which changes in bonding occur during the reaction of propanal and hydrogen cyanide?

- 1** A carbon-hydrogen bond is broken.
- 2** An oxygen-hydrogen bond is formed.
- 3** A carbon-carbon bond is formed.

39 Which pairs of reagents will react together in a redox reaction?

- 1** CH_3CHO + Fehling's reagent
- 2** C_2H_4 + $\text{Br}_2(\text{aq})$
- 3** CH_4 + $\text{Cl}_2(\text{g})$

40 Which types of reaction are undergone by $\text{CH}_2\text{BrCHCH}_2$?

- 1** hydrolysis
- 2** free radical substitution
- 3** nucleophilic addition

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