Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/11**

Paper 1 Multiple Choice **May/June 2017**

1 hour

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

3509307748

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.

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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.

Use of the Data Booklet may be appropriate for some questions.

1 Which molecule contains six bonding electrons?

A C_2H_4 **B** H_2S **C** NCl_3 **D** SF_6

2 The mass spectrum of a sample of lithium shows that it contains two isotopes, ^6Li and ^7Li.

The isotopic abundances are shown in the table.

isotope	isotopic abundance
^6Li	7.42%
^7Li	92.58%

What is the relative atomic mass of this sample of lithium, given to three significant figures?

A 6.07 **B** 6.50 **C** 6.90 **D** 6.93

3 A sports medal has a total surface area of 150 cm^2. It was evenly coated with silver by electrolysis. Its mass increased by 0.216 g.

How many atoms of silver were deposited per cm^2 on the surface of the medal?

A 8.0×10^{18} **B** 1.8×10^{19} **C** 8.7×10^{20} **D** 1.2×10^{21}

4 Which property of an atom does **not** affect its first ionisation energy?

A the atomic radius

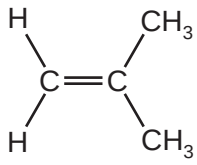
B the number of electron shells

C the number of neutrons

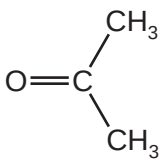
D the number of protons

5 Which molecule has the largest overall dipole?

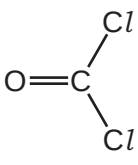
A



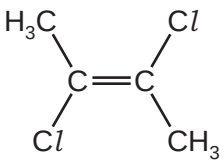
B



C



D



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6 The complete combustion of 2 moles of a straight chain alkane produces 400 dm^3 of carbon dioxide measured at 301 K and 1×10^5 Pa. Carbon dioxide can be assumed to behave as an ideal gas under these conditions.

What is the formula of the straight chain alkane?

A C_8H_{18} **B** $C_{16}H_{34}$ **C** $C_{20}H_{42}$ **D** $C_{40}H_{82}$

7 Which expression gives the standard enthalpy change of combustion of methane?

A $\Delta H_f^\ominus(CH_4) + \Delta H_f^\ominus(CO_2) - 2\Delta H_f^\ominus(H_2O)$

B $\Delta H_f^\ominus(CO_2) + 2\Delta H_f^\ominus(H_2O) + \Delta H_f^\ominus(CH_4)$

C $\Delta H_f^\ominus(CH_4) + 2\Delta H_f^\ominus(H_2O) - \Delta H_f^\ominus(CO_2)$

D $\Delta H_f^\ominus(CO_2) + 2\Delta H_f^\ominus(H_2O) - \Delta H_f^\ominus(CH_4)$

8 Solutions containing chlorate(I) ions are used as household bleaches and disinfectants. These solutions decompose on heating as shown.

$$3ClO^- \rightarrow ClO_3^- + 2Cl^-$$

Which oxidation state is shown by chlorine in each of these three ions?

	ClO^-	ClO_3^-	Cl^-
A	+1	+3	–1
B	–1	+3	+1
C	+1	+5	–1
D	–1	+5	+1

9 When K_2MnO_4 is dissolved in water, the following reaction occurs.

$$a\,MnO_4^{2-}(aq) + b\,H_2O(l) \rightarrow c\,MnO_4^-(aq) + d\,MnO_2(s) + e\,OH^-(aq)$$

What are the values of *a* and *c* in the balanced chemical equation?

	a	*c*
A	2	1
B	3	2
C	4	3
D	5	4

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10 Methanol can be produced from hydrogen and carbon monoxide.

$$2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g)$$

What is the expression for K_p for this reaction?

A $K_p = \dfrac{(2p_{H_2})^2 \times p_{CO}}{p_{CH_3OH}}$

B $K_p = \dfrac{(p_{H_2})^2 \times p_{CO}}{p_{CH_3OH}}$

C $K_p = \dfrac{p_{CH_3OH}}{(p_{H_2})^2 \times p_{CO}}$

D $K_p = \dfrac{p_{CH_3OH}}{p_{CO} \times (2p_{H_2})^2}$

11 When 4 g of powdered calcium carbonate, $M_r = 100$, were added to 100 cm^3 of 0.10 $mol\,dm^{-3}$ hydrochloric acid the volume of carbon dioxide produced was recorded.

time / s	30	60	90	120	150	180	210	240
total volume of carbon dioxide given off / cm^3	40	70	88	101	110	116	120	120

Which row gives the correct explanations about these results?

	why the rate of the reaction changes with time	why the reaction stops
A	fewer collisions between reacting molecules occur	the calcium carbonate is used up
B	fewer collisions between reacting molecules occur	the hydrochloric acid is used up
C	more collisions between reacting molecules occur	the calcium carbonate is used up
D	more collisions between reacting molecules occur	the hydrochloric acid is used up

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12 Why is the second ionisation energy of sodium larger than the second ionisation energy of magnesium?

A The attraction between the nucleus and the outer electron is greater in Na^+ than in Mg^+.

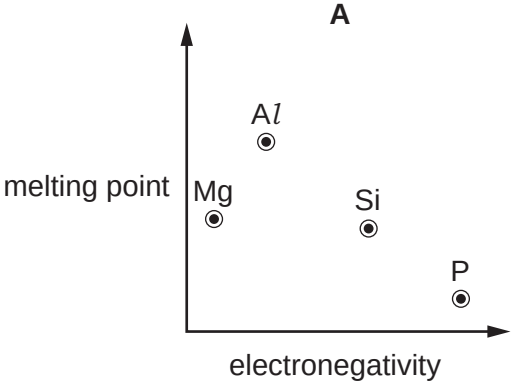
B The nuclear charge of Na^+ is greater than that of Mg^+.

C The outer electron of Na^+ is more shielded than the outer electron of Mg^+.

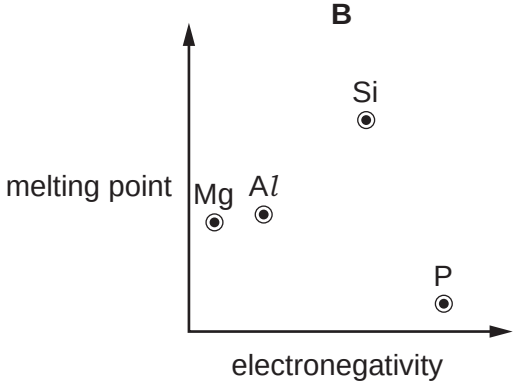
D The outer electron of Na is in the same orbital as the outer electron of Mg.

13 Which graph correctly shows the relative melting points of the elements Mg, A*l*, Si and P plotted against their relative electronegativities?

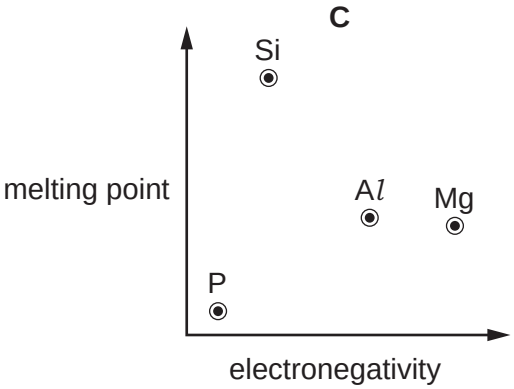
A



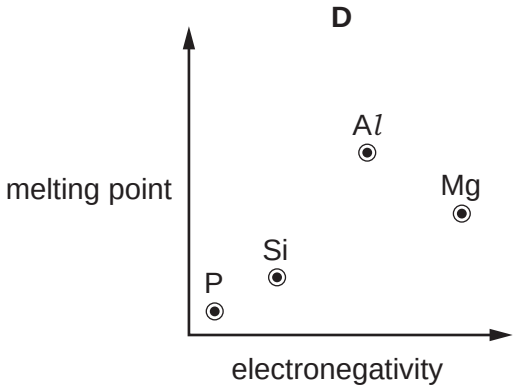
B



C



D



14 An excess of MgO is shaken with water. The resulting mixture is filtered into test-tube X.

An excess of BaO is shaken with water. The resulting mixture is filtered into test-tube Y.

Which oxide reacts more readily with water and which filtrate has the **lower** pH?

	oxide reacts more readily with water	test-tube with filtrate of **lower** pH
A	barium oxide	X
B	barium oxide	Y
C	magnesium oxide	X
D	magnesium oxide	Y

15 Samples of magnesium carbonate, $MgCO_3$, are placed in crucibles R and S. The sample in crucible R is heated until there is no further loss in mass, and then allowed to cool. The sample in crucible S is left unheated.

Dilute hydrochloric acid is then added to both crucibles.

On adding the dilute hydrochloric acid, which observations are correct?

	R	S
A	gas produced	gas produced
B	gas produced	no gas produced
C	no gas produced	gas produced
D	no gas produced	no gas produced

16 Which statement about nitrogen or its compounds is correct?

A In the Haber process the temperature is kept high to give a good equilibrium yield of ammonia.

B Nitrogen gas is unreactive because of the strong nitrogen-nitrogen double bond.

C Nitrogen monoxide will react with carbon monoxide under suitable conditions.

D The formula of ammonium sulfate is NH_4SO_4.

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17 When concentrated sulfuric acid reacts with sodium iodide the products include sulfur, iodine, hydrogen sulfide and sulfur dioxide.

Which statement is correct?

A Hydrogen sulfide is the product of a reduction reaction.

B Iodide ions are stronger oxidising agents than sulfate ions.

C Sulfur atoms from the sulfuric acid are both oxidised and reduced.

D Sulfur atoms from the sulfuric acid are oxidised to make sulfur dioxide.

18 A solution of sodium hydroxide reacts with 3 mol of chlorine under certain conditions. The reaction produces 5 mol of sodium chloride and 1 mol of **X**, the only other chlorine-containing product.

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

A $NaCl O$ **B** $NaClO_2$ **C** $NaClO_3$ **D** $NaClO_4$

19 Redox reactions are common in the chemistry of Group 17.

Which statement is correct?

A Br^- ions will reduce Cl_2 but not I_2.

B Cl_2 will oxidise Br^- ions but not I^- ions.

C F_2 is the weakest oxidising agent out of F_2, Cl_2, Br_2 and I_2.

D I^- ions are the weakest reducing agent out of F^-, Cl^-, Br^- and I^-.

20 Structural isomerism and stereoisomerism should be considered when answering this question.

Each of the following carbonyl compounds is reacted with $NaBH_4$. The product of each reaction is heated with Al_2O_3 at 600 °C, generating one product or a mixture of isomers.

Which carbonyl compound will produce the most isomers?

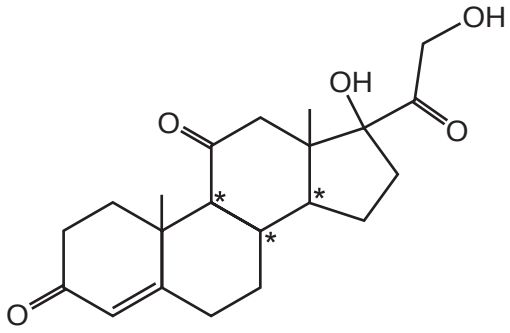
A butanal

B butanone

C pentan-3-one

D propanone

21 The drug cortisone has the formula shown.



In addition to those chiral centres marked by an asterisk (*), how many **other** chiral centres are present in the cortisone molecule?

A 0 **B** 1 **C** 2 **D** 3

22 An alkene is reacted with acidified manganate(VII) ions, MnO_4^-. The desired organic product has a relative molecular mass greater than that of the alkene by 34.

What conditions should be used?

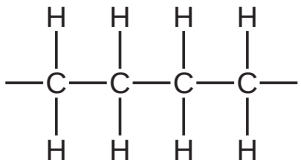
A cold, concentrated MnO_4^-

B cold, dilute MnO_4^-

C hot, concentrated MnO_4^-

D hot, dilute MnO_4^-

23 The diagram shows a short length of an addition polymer chain.



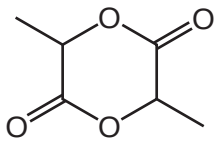
The polymer has a relative molecular mass of approximately 10 000.

Approximately how many monomer units are joined together in each polymer molecule?

A 180 **B** 360 **C** 625 **D** 710

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24 Lactide is an intermediate in the manufacture of a synthetic fibre.



lactide

Which compound, on heating with an acid catalyst, can produce lactide?

A hydroxyethanoic acid

B 2-hydroxybutanoic acid

C 2-hydroxypropanoic acid

D 3-hydroxypropanoic acid

25 Diols in which both hydroxy groups are bonded to the same carbon atom spontaneously eliminate a molecule of water to produce a carbonyl compound.

Which compound is hydrolysed to form a product that gives a positive reaction with 2,4-dinitrophenylhydrazine but **not** with Fehling's reagent?

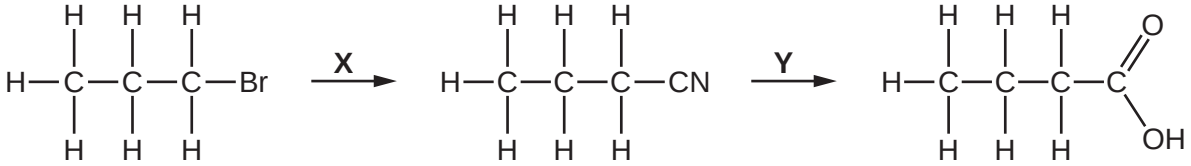
A 1,1-dibromopropane

B 1,2-dibromopropane

C 1,3-dibromopropane

D 2,2-dibromopropane

26 **X** and **Y** are the reagents required to convert 1-bromopropane into butanoic acid.



What are the correct identities of **X** and **Y**?

	X	**Y**
A	NH_3	HCl(aq)
B	KCN in C_2H_5OH	NaOH(aq)
C	KCN in C_2H_5OH	HCl(aq)
D	HCN	NaOH(aq)

27 **Q** is a compound with the molecular formula $C_4H_{10}O$. **Q** can be oxidised with acidified potassium dichromate(VI). **Q cannot** be made by reducing a carboxylic acid with $LiAlH_4$.

What is the structure of **Q**?

A $CH_3CH(OH)CH_2CH_3$

B $CH_3CH_2CH_2CH_2OH$

C $(CH_3)_3COH$

D $(CH_3)_2CHCH_2OH$

28 A sample of 2.30 g of ethanol was mixed with an excess of aqueous acidified potassium dichromate(VI). The reaction mixture was then boiled under reflux for one hour. The required organic product was then collected by distillation. The yield of product was 60.0%.

Which mass of product was collected?

A 1.32 g **B** 1.38 g **C** 1.80 g **D** 3.00 g

29 Which compound gives a positive test with alkaline aqueous iodine and does **not** show optical isomerism?

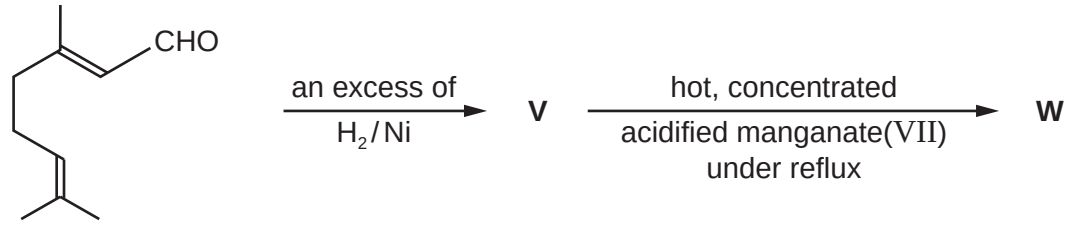
A $CH_3COCH_2CH_2OH$

B $CH_3CH_2CH(OH)CHO$

C $CH_3COCH(OH)CH_3$

D $(CH_3)_2C(OH)CHO$

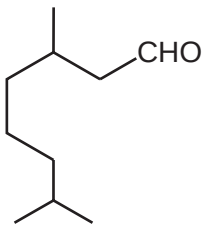
30 Citral is found in lemongrass oil. It can react to give compound **W**.



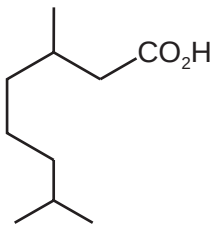
citral

What could compound **W** be?

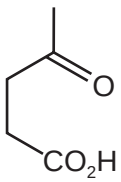
A



B



C



D



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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.

Use of the Data Booklet may be appropriate for some questions.

31 Beams of charged particles are deflected by an electric field. In identical conditions the angle of deflection of a particle is proportional to its charge / mass ratio.

In an experiment, protons are deflected by an angle of +15°. In another experiment under identical conditions, particle Y is deflected by an angle of –5°.

What could be the composition of particle Y?

	protons	neutrons	electrons
1	1	2	2
2	3	3	5
3	4	5	1

32 Graphene, graphite and the fullerene C_{60} are allotropes of carbon.

Which statements are correct for all three of these allotropes of carbon?

1 Delocalised electrons are present in the structure.

2 All bond angles are 120°.

3 It has a giant molecular crystalline lattice structure.

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 A reaction between carbon and oxygen is shown.

$$C(s) + \tfrac{1}{2}O_2(g) \rightarrow CO(g)$$

How can the enthalpy change of this reaction be described correctly?

1 enthalpy change of formation

2 enthalpy change of combustion

3 enthalpy change of atomisation

34 Which changes can be used to measure the rates of chemical reactions?

1 the decrease in concentration of a reactant per unit time

2 the rate of appearance of a product

3 the increase in total volume per unit time at constant pressure

35 Which statements describe a trend in Period 3 between **every pair** of adjacent elements from sodium to chlorine?

1 The atomic radius decreases.

2 The 1st ionisation energy decreases.

3 The melting point decreases.

36 X is either nitrogen or sulfur and forms pollutant oxide Y in a car engine.

Further oxidation of Y to Z occurs in the atmosphere. In this further oxidation, 1 mol of Y reacts with 0.5 mol of gaseous oxygen molecules.

Which statements about X, Y and Z can be correct?

1 The oxidation number of X increases by two from Y to Z.

2 Y has an unpaired electron in its molecule.

3 Y is a polar molecule.

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37 P and Q are a pair of cis-trans isomers.

What **must** be the same for P and Q?

1 their empirical formula

2 their functional groups

3 their skeletal formula

38 The following statements are about the reaction of NaOH(aq) with the three chloroalkanes shown.

$CH_3CH_2CHClCH_3$ $(CH_3)_2CHCH_2Cl$ $(CH_3)_3CCl$

Which statements are correct?

1 $(CH_3)_2CHCH_2Cl$ reacts with NaOH(aq) by an S_N2 mechanism.

2 The tertiary chloroalkane reacts more quickly than the others because the carbon atom bonded to the Cl atom is more positive in this molecule.

3 The Cl atoms in the three chloroalkanes are attacked by OH^-.

39 For which reactions are the colour changes described correctly?

	reagents	colour change
1	pentanal + hot, acidified potassium dichromate(VI)	orange to green
2	pentan-2-one + warm Fehling's reagent	no change
3	cyclohexane + cold, acidified potassium manganate(VII)	purple to colourless

40 Which statements about ethanol and ethanoic acid are correct?

1 Both react with a suitable reagent to form an ester.

2 Both react with sodium.

3 Both are soluble in water.

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