Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/12**

Paper 1 Multiple Choice **October/November 2018**

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 **14** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

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 statement about enthalpy changes is correct?

A Enthalpy changes of atomisation are always negative.

B Enthalpy changes of combustion are always positive.

C Enthalpy changes of formation are always positive.

D Enthalpy changes of neutralisation are always negative.

2 Beams of charged particles are deflected by an electrical field. 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 $^{2}H^{-}$ ions are deflected by an angle of Y°.

What is the value of Y?

A –30.0 **B** –7.5 **C** +7.5 **D** +30.0

3 Rubidium and bromine form ions that are isoelectronic. Each ion has 36 electrons.

Which row is correct?

	rubidium radii	bromine / bromide radii
A	atomic < ionic	atomic < ionic
B	atomic < ionic	atomic > ionic
C	atomic > ionic	atomic < ionic
D	atomic > ionic	atomic > ionic

4 In which set do all the molecules have all their atoms arranged in one plane?

A $AlCl_3$, BF_3, PH_3

B $AlCl_3$, CO_2, NH_3

C BF_3, C_2H_4, C_3H_6

D C_2H_4, CO_2, H_2O

5 Flask X contains 5 dm^3 of helium at 12 kPa pressure and flask Y contains 10 dm^3 of neon at 6 kPa pressure.

If the flasks are connected at constant temperature, what is the final pressure?

A 8 kPa **B** 9 kPa **C** 10 kPa **D** 11 kPa

6 Exactly 1.00 g of a metallic element reacts completely with 300 cm^3 of oxygen at 298 K and 1 atm pressure to form an oxide which contains O^{2-} ions.

The volume of one mole of gas at this temperature and pressure is 24.0 dm^3.

What could be the identity of the metal?

A calcium

B magnesium

C potassium

D sodium

7 Ethanol is increasingly being used as a fuel for cars.

The standard enthalpy change of formation of carbon dioxide is –393 kJ mol^{-1}.
The standard enthalpy change of formation of water is –286 kJ mol^{-1}.
The standard enthalpy change of formation of ethanol is –277 kJ mol^{-1}.

What is the standard enthalpy change of combustion of ethanol?

A –1921 kJ mol^{-1}

B –1367 kJ mol^{-1}

C –956 kJ mol^{-1}

D – 402 kJ mol^{-1}

8 Ammonium metavanadate, NH_4VO_3, can be used to make a solution containing VO_2Cl, which contains chloride ions.

What is the **change** in the oxidation number of vanadium in this reaction?

A –1 **B** 0 **C** +1 **D** +2

9 In this question, all pressures are measured in atm.

The equation represents the equilibrium between three gaseous substances X, Y and Z.

$$X + 3Y \rightleftharpoons 2Z$$

At temperature T_1, the numerical value of K_p, the equilibrium constant, is 2.

At a higher temperature T_2, the partial pressures at equilibrium are as shown.

X	Y	Z
2	3	5

Which row is correct?

	the numerical value of K_p at T_2	the forward reaction is
A	54 / 25	endothermic
B	54 / 25	exothermic
C	25 / 54	endothermic
D	25 / 54	exothermic

10 In a chemical system the particles involved have a range of energies. This can be shown on a graph called the Boltzmann distribution.

Which statement correctly explains the effect of a catalyst on the particles in a chemical system?

A A catalyst enables particles with a lower energy to collide successfully.

B A catalyst increases the number of particles with higher energies.

C A catalyst increases the number of particles with the most probable energy value.

D A catalyst increases the value of the most probable particle energy.

11 Nitrogen and hydrogen can react together to form ammonia.

The formation of ammonia is exothermic.

The rate and yield of the reaction can be altered by changing the conditions under which the reaction is carried out.

Which row shows the effects of adding iron to the mixture **and** increasing the temperature?

	adding iron	increasing the temperature
A	has no effect on the equilibrium yield	reduces the equilibrium yield
B	increases the equilibrium yield	increases the equilibrium yield
C	increases the equilibrium yield	increases the rate
D	increases the rate	has no effect on the equilibrium yield

12 The melting points of the Period 3 elements phosphorus to argon are shown in the table.

element	P	S	Cl	Ar
mp / K	317	392	172	84

Which factor explains the changes in melting points from phosphorus to argon?

A the changes in electronegativity from phosphorus to argon

B the changes in first ionisation energy from phosphorus to argon

C the increase in the number of electrons in each atom from phosphorus to argon

D the number of atoms in each molecule of the element from phosphorus to argon

13 Which observations are made when a sample of silicon chloride, SiCl_4, is added to a beaker of water?

A No visible change is observed.

B Steamy fumes and a precipitate are both observed.

C The appearance of a precipitate is the only observation.

D The appearance of steamy fumes is the only observation.

14 A 4.00 g sample of an anhydrous Group 2 metal nitrate is heated strongly until there is no further change. A solid residue of mass 1.37 g is formed.

Which metal is present?

A barium

B calcium

C magnesium

D strontium

15 In which row are all statements comparing magnesium and barium correct?

	fourth ionisation energy		reaction with water	
	magnesium	barium	magnesium	barium
A	higher	lower	faster	slower
B	higher	lower	slower	faster
C	lower	higher	faster	slower
D	lower	higher	slower	faster

16 Which statement about the halogens is correct?

A Iodine cannot behave as an oxidising agent.

B The volatility of the elements increases from chlorine to iodine because of the increase in molecular size down the group.

C When an equimolar mixture of chlorine and hydrogen is exploded, only one product is formed.

D When concentrated sulfuric acid is added to solid sodium bromide, hydrogen sulfide is one of the products.

17 Chlorine reacts with both hot and cold sodium hydroxide to form products containing chlorine.

Cold sodium hydroxide forms sodium chlorate(X) and hot sodium hydroxide forms sodium chlorate(Y). X and Y are oxidation numbers.

Which equation is correct?

A Y = X – 6 **B** Y = X – 4 **C** Y = X + 4 **D** Y = X + 6

18 The product of the Contact process is Z.

Which reaction or process leads to the formation of a gas that can neutralise an aqueous solution of Z?

A atmospheric lightning

B combustion of fuel in an internal combustion engine

C the Haber process

D thermal decomposition of Group 2 nitrates

19 If ammonium cyanate is heated in the absence of air, the only product of the reaction is urea, $CO(NH_2)_2$. No other products are formed in the reaction.

What is the formula of the cyanate ion present in ammonium cyanate?

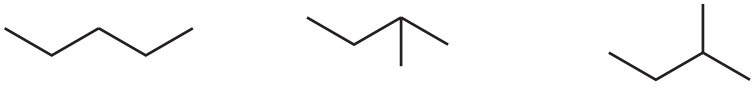
A CON_2^- **B** CON_2^{2-} **C** OCN^- **D** OCN^{2-}

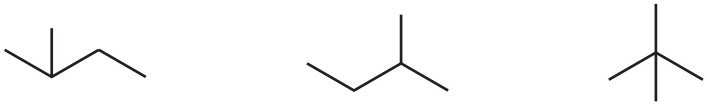
20 There are three structural isomers with the formula C_5H_{12}.

Which formulae correctly represent these three structural isomers?

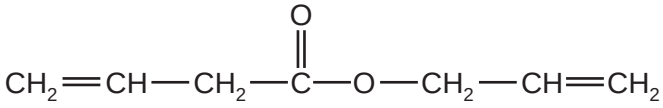
A $CH_3CH_2CH_2CH_2CH_3$ $CH_3CH(CH_3)CH_2CH_3$ $C(CH_3)_4$

B $CH_3CH_2CH_2CH_2CH_3$ $CH_3CH(CH_3)CH_2CH_3$ $CH_3CH_2CH(CH_3)CH_3$

C 

D 

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 Polyethene is made by the polymerisation of ethene.

Which statement is correct?

A The monomer and the polymer have different empirical formulae.

B The monomer can be oxidised without heat whereas the polymer cannot.

C The monomer can be used as a fuel whereas the polymer cannot.

D The monomer has greater van der Waals' forces than the polymer.

23 Compound P reacts separately with KOH(aq) and HBr.

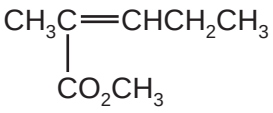
$CH_2CHCH_2CH_2Cl$

compound P

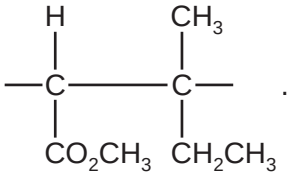
What are the mechanisms of these two reactions?

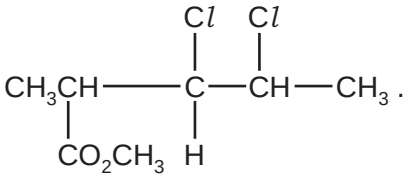
	KOH (aq)	HBr
A	nucleophilic addition	electrophilic addition
B	nucleophilic addition	free radical substitution
C	nucleophilic substitution	electrophilic addition
D	nucleophilic substitution	free radical substitution

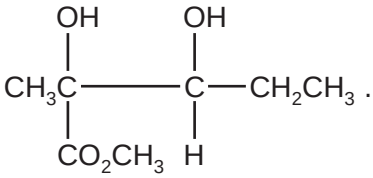
24 Which statement about compound Q is correct?

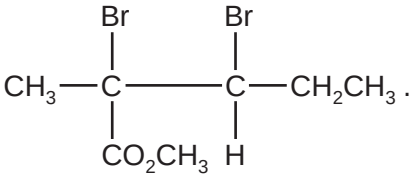


Q

A It could be polymerised to give a polymer with the repeat unit  .

B It reacts with chlorine by a free radical mechanism to give  .

C It reacts with cold, dilute acidified manganate(VII) to give  .

D It reacts with bromine via a free radical mechanism to give  .

25 A halogenoalkane has the molecular formula $C_5H_{11}Br$. The halogenoalkane does **not** form an alkene when treated with ethanolic sodium hydroxide.

What could be the halogenoalkane?

A 1-bromo-2-methylbutane

B 2-bromo-2-methylbutane

C 3-bromopentane

D bromodimethylpropane

26 The reactions of four organic compounds are given in the table.

Which compound could be propan-2-ol?

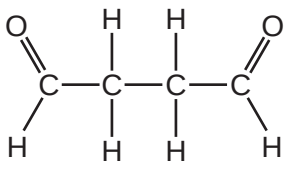
	reagent / observations	
	when oxidised with $Cr_2O_7^{2-}/H^+$, gives an organic product with a boiling point greater than the original compound	when added to ethanoic acid, and a few drops of conc. H_2SO_4, gives a sweet-smelling compound
A	no	no
B	no	yes
C	yes	no
D	yes	yes

27 Compound X has the empirical formula C_2H_3O.

Compound X reacts with 2,4-dinitrophenylhydrazine reagent to give an orange precipitate and also decolourises warmed acidified potassium manganate(VII) solution.

What could be the identity of X?

A



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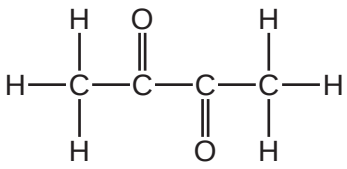

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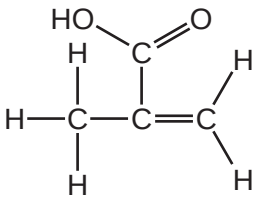
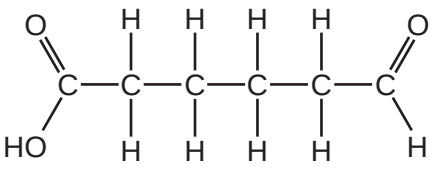


D



28 Compound **Y** gives methanol and sodium ethanoate on treatment with aqueous sodium hydroxide.

What is the structure of **Y**?

A $CH_3CO_2CH_3$

B $HCO_2C_2H_5$

C HO_2CCH_2CHO

D $HOCH_2CH_2COOH$

29 Which compound can be used to make propanoic acid by treatment with a single reagent?

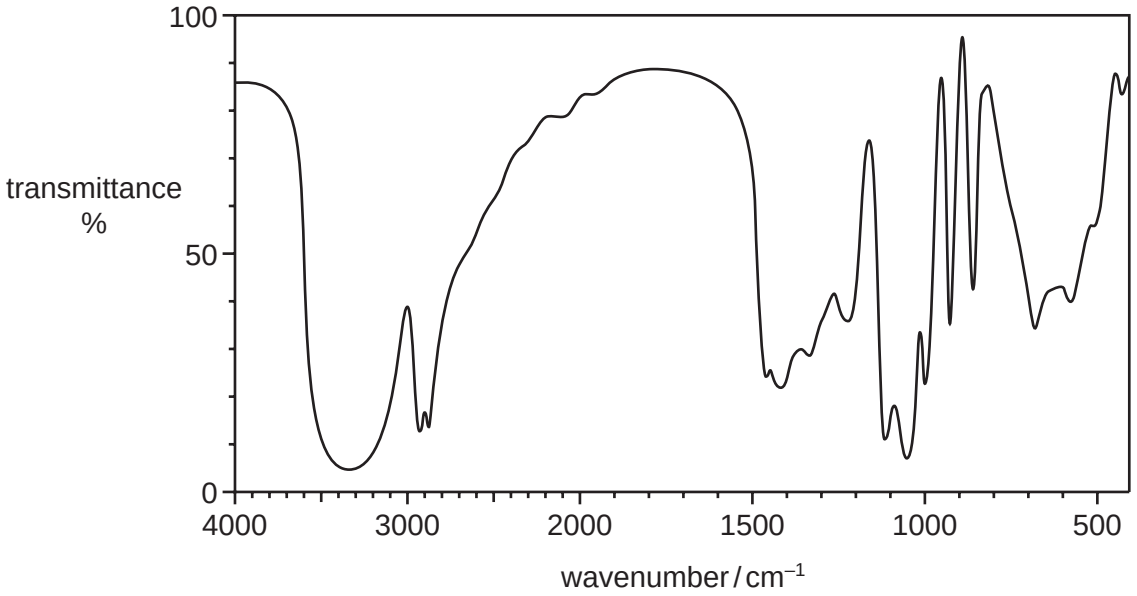
A $CH_2=CHCH_2CH_3$

B $CH_3CH_2CH_2CN$

C $CH_3CH(OH)CN$

D $CH_3CH(OH)CH_3$

30 The infra-red spectrum of compound **L** is shown.



What could be the structure of **L**?

A $HOCH_2COCH_2OH$

B $HOCH_2CH(OH)CHO$

C $HOCH_2CH(OH)CH_2OH$

D $HOCH_2CH_2COOH$

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 Zinc reacts with hydrochloric acid according to the following equation.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

Which statements are correct?

1 A 3.27 g sample of zinc reacts with an excess of hydrochloric acid to give 0.0500 mol of zinc chloride.

2 A 6.54 g sample of zinc reacts completely with exactly 100 cm^3 of 1.00 mol dm^{-3} hydrochloric acid.

3 A 13.08 g sample of zinc reacts with an excess of hydrochloric acid to give 9.60 dm^3 of hydrogen, measured at room conditions.

32 The melting point of chlorine is lower than the melting point of iodine.

Which statements help to explain this difference?

1 Iodine has more electrons than chlorine and so has stronger van der Waals' forces.

2 An iodine molecule is more polar than a chlorine molecule.

3 The covalent bonds between iodine atoms are stronger than the covalent bonds between chlorine atoms.

33 Aqueous iron(II) sulfate can take part in redox reactions.

$$6FeSO_4 + 7H_2SO_4 + Na_2Cr_2O_7 \rightarrow 3Fe_2(SO_4)_3 + Cr_2(SO_4)_3 + Na_2SO_4 + 7H_2O$$

Which redox changes occur during this reaction?

1 Fe(II) is oxidised to Fe(III).

2 Cr(VI) is reduced to Cr(III).

3 Oxygen is reduced to water.

34 The equation represents an equilibrium.

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) \qquad \Delta H = -900\,kJ\,mol^{-1}$$

What would increase the concentration of NO at equilibrium?

1 a reduction in the reaction temperature

2 the use of a suitable catalyst

3 an increase in the total pressure

35 A sample containing *x* mol of Al_2Cl_6 is dissolved in water to give solution W.

In order to precipitate all of the aluminium as its hydroxide, *y* mol of sodium hydroxide are required.

More of the alkali is added to re-dissolve the precipitate, giving solution Z.

Which statements are correct?

1 the initial pH of solution W is below 7

2 $y = 3x$

3 Z contains *x* mol of aluminium

36 Which statements concerning calcium hydroxide are correct?

1 It is less soluble in water than strontium hydroxide.

2 When it is added to water an alkaline solution is formed.

3 It is used in agriculture to lower soil pH.

37 Which bromopropenes would react with cold bromine in the dark to form a product containing a chiral carbon atom?

1 $CHBr{=}CHCH_3$

2 $CH_2{=}CHCH_2Br$

3 $CH_2{=}CBrCH_3$

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 Halogenoalkanes can undergo reaction with hydroxide ions.

$$RBr + OH^- \rightarrow ROH + Br^-$$

The reaction of some halogenoalkanes proceeds by the S_N1 mechanism.

Which statements about the S_N1 mechanism are correct?

1 A carbocation is formed which is stabilised by the inductive effect of the alkyl groups present.

2 Only tertiary halogenoalkanes are hydrolysed in this way.

3 The intermediate formed includes a carbon atom with five bonds attached to it.

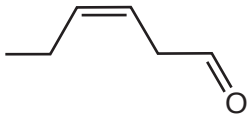
39 Which statements about 2-methylbutan-1-ol are correct?

1 It can give HCl(g) on reaction with PCl_5.

2 It can be oxidised to give an aldehyde.

3 It displays optical isomerism.

40 The compound cis-hex-3-enal is responsible for the characteristic smell of cut grass.



cis-hex-3-enal

Which reagents will react with cis-hex-3-enal?

1 sodium

2 sodium borohydride

3 Fehling's reagent

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