EUNOIA JUNIOR COLLEGE
JC2 Preliminary Examination 2021
General Certificate of Education Advanced Level
Higher 2

CHEMISTRY

Paper 1 Multiple Choice

9729/01

23 September 2021

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, civics group and registration number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** 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 question paper.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **10** printed pages.

1 Which electronic configuration represents an atom of an element, at ground state, that forms a stable ion with a charge of +3?

A $1s^2\ 2s^2\ 2p^3$

B $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

C $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

D $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^1$

2 Which particle has more protons than electrons and more protons than neutrons?
$\left(D = {}^{2}_{1}H\right)$

A H_3O^+ **B** D_3O^+ **C** D_2O **D** OH^-

3 Gaseous particle **R** has a proton number *n* and forms a stable monoatomic ion of charge –1.

Gaseous particle **S** has a proton number of (*n*+2) and it forms a stable monoatomic ion which is isoelectronic with the ion of **R**.

Which of the following statement is correct?

A Ion of **S** has a smaller ionic radius than ion of **R**.

B Ion of **R** releases more energy than ion of **S** when an electron is added to each particle.

C **R** has a larger atomic radius than **S**.

D Ion of **S** requires less energy than ion of **R** when an electron is removed from each particle.

4 In a single covalent bond, one pair of electrons is shared by two atoms. Which of the following statement is true for **all** single covalent bonds?

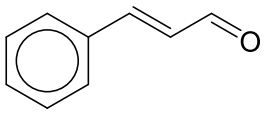
A Covalent bonds are formed when bonding electrons are shared equally between two atoms.

B Covalent bonds allow the atoms involved to complete their outer electron shell configuration**.**

C Covalent bonds formed between atoms of different electronegativities are stronger.

D Covalent C−H bonds formed between sp^3 hybridised C and H atoms are weaker than that formed between sp^2 hybridised C and H atoms**.**

5 Cinnamaldehyde occurs naturally in cinnamon oil.



Which of the following statements are true about the structure?

1 Hydrogen bonds can be formed between cinnamaldehyde molecules.

2 Cinnamaldehyde dissolves in organic solvents readily via instantaneous dipole−induced dipole interactions.

3 The bond angles about all carbon atoms in cinnamaldehyde are the same.

A 1, 2 and 3 **B** 2 and 3 **C** 3 only **D** none of the above

6 Which of the following statements about Group 17 elements is true?

A I_2 can reduce $S_2O_3^{2-}$ to $S_4O_6^{2-}$.

B When $Br_2(g)$ is bubbled into NaC*l*(aq), an orange solution is produced.

C Cl_2 is soluble in water as it can form favourable hydrogen bonds with water.

D F_2 is more volatile than Br_2 as the F−F bonds are weaker than the Br−Br bonds.

7 Which of the following pairs of reactants **cannot** undergo an acid-base reaction together?

A NH_3 and H_2O

B NH_3 and BH_3

C A*l*Cl_3 and Cl_2

D A*l*Cl_3 and BH_3

8 Which of the following quantities is equal to the Avogadro constant?

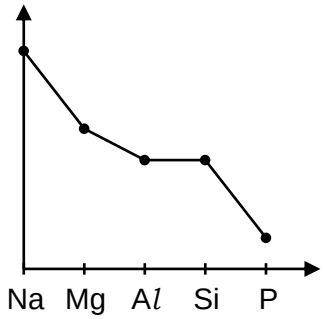
A The number of atoms in 24 dm^3 of oxygen under room temperature and pressure.

B The number of molecules in 1 dm^3 of chlorine at 273 K and 1.5 atm.

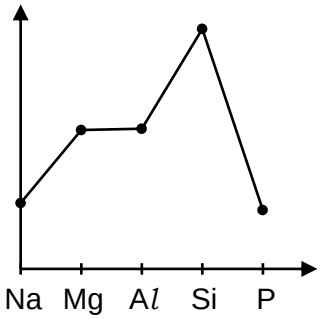
C The number of ions in 68.05 g of $CaSO_4$.

D The number of carbon atoms in 22.7 dm^3 of ethane gas under standard temperature and pressure.

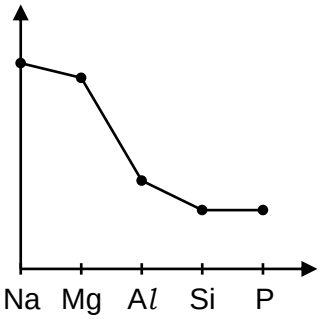
9 The following graphs show the variation of three properties of consecutive Period 3 elements.



Graph 1



Graph 2

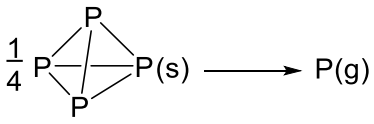


Graph 3

What properties are shown by the three graphs?

	Graph 1	Graph 2	Graph 3
A	pH of chloride	pH of oxide	melting point of element
B	pH of chloride	melting point of element	pH of oxide
C	pH of oxide	melting point of element	pH of chloride
D	pH of oxide	pH of chloride	melting point of element

10 The conversion of white phosphorus to phosphorus atoms is shown.



ΔH_r

Which expression will give a correct value for the ΔH_r indicated above?

A bond energy of P–P

B enthalpy change of atomisation of phosphorus

C enthalpy change of formation of phosphorus

D enthalpy change of vaporisation of phosphorus

11 The conversion of graphite into diamond is non-spontaneous at 298 K.

$$\text{C(graphite)} \rightarrow \text{C(diamond)} \qquad \Delta G = +3.08 \text{ kJ mol}^{-1}, \quad \Delta S = -3.3 \text{ J mol}^{-1} \text{ K}^{-1}$$

Assuming ΔH and ΔS are constant with temperature, which of the following statements are correct?

1 The enthalpy change of combustion of diamond is more exothermic than that of graphite.

2 The bond energies of the C–C bonds in graphite and diamond are the same.

3 The reaction is more spontaneous with increasing temperature.

A 1 only **B** 1 and 2 **C** 1 and 3 **D** 2 and 3

12 The reaction A + B $\rightarrow$ C + D has the rate equation, rate = k[A][B].

An experiment was conducted by reacting 0.001 mol dm^{-3} of A with 1.0 mol dm^{-3} of B. The half-life for this experiment was found to be 5 min.

A second experiment was conducted with twice the concentrations of both A and B. What will be the half-life of the second experiment?

A 1.25 min **B** 2.5 min **C** 5 min **D** 10 min

13 Which of the following statements about enzyme-catalysed reactions are true?

1 Enzymes lower the activation energy of the reaction.

2 When the concentration of substrate is low, rate is directly proportional to the concentration of substrate.

3 Rate will always increase when the concentration of substrate is increased.

A 1, 2 and 3 **B** 1 and 2 **C** 2 and 3 **D** 1 only

14 The equilibrium constant of the reaction $2\text{A} + \text{B} \rightleftharpoons 2\text{C}$ at T ºC is x.

What is the equilibrium constant of the reaction $\text{C} \rightleftharpoons \text{A} + \frac{1}{2}\text{B}$ at the same temperature?

A $-\frac{x}{2}$ **B** $\frac{1}{2x}$ **C** $\frac{1}{\sqrt{x}}$ **D** x

15 Consider a system comprising hydrogen, nitrogen and ammonia gas at equilibrium.

$$3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g)$$

Which of the following statements about the system are true?

1 Decreasing the volume at constant temperature will increase the rates of both the forward and backward reactions.

2 Addition of a noble gas at constant pressure will not affect the position of equilibrium.

3 Addition of finely divided iron as catalyst increases the equilibrium constant of the reaction.

A 1, 2 and 3 **B** 1 and 2 **C** 2 and 3 **D** 1 only

16 Calculate the pH of the resultant solution when 20 cm^3 of sodium hydroxide with concentration at 0.500 mol dm^{-3} are mixed with 20 cm^3 of ethanoic acid with concentration of 1.00 mol dm^{-3}.
(K_a of ethanoic acid = 1.8×10^{-5} mol dm^{-3})

A 2.37 **B** 2.61 **C** 4.74 **D** 9.13

17 The solubilities of AgC*l* and AgBr are *x* and *y* mol dm^{-3} respectively at 298 K.

Which of the following statements are correct about a solution saturated with both AgC*l* and AgBr?

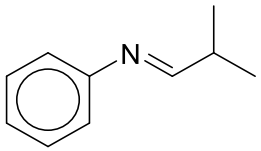
1 $[Ag^+] = x + y$

2 $[Br^-] < y$

3 $[Ag^+] = [Br^-] + [Cl^-]$

A 1, 2 and 3 **B** 1 and 2 **C** 1 and 3 **D** 2 and 3

18 The structure of 2-methyl-*N*-phenylpropan-1-imine is shown.



Which statement about 2-methyl-*N*-phenylpropan-1-imine is correct?

A 2-methyl-*N*-phenylpropan-1-imine is optically active.

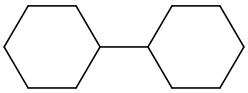
B The C–N π bond is formed from an overlap between sp^2 hybrid orbitals of C and N.

C The nitrogen atom in 2-methyl-*N*-phenylpropan-1-imine is sp hybridised.

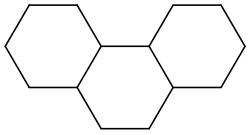
D 2-methyl-*N*-phenylpropan-1-imine is less basic than ammonia.

19 Which compound is not possibly formed when cyclohexane is reacted with excess bromine gas in the presence of ultraviolet light?

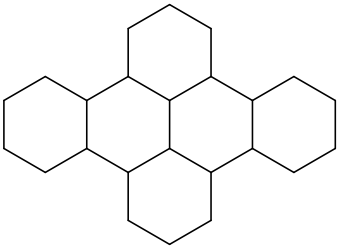
A



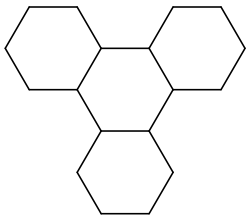
B



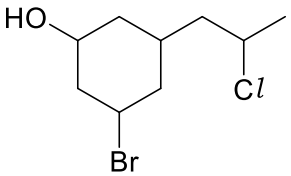
C



D



20 Compound **K** has the following structure.

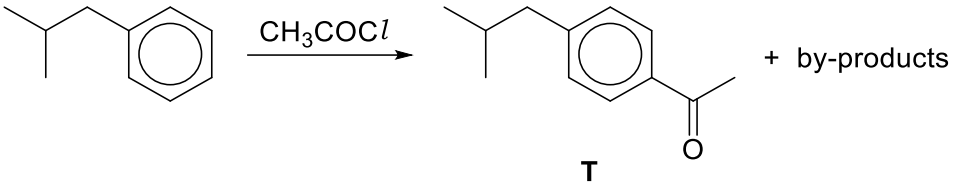


What is the total number of products, including stereoisomers, that can be formed from the reaction of compound **K** with excess concentrated sulfuric acid at 170 ºC?

A 2 **B** 4 **C** 8 **D** 16

21 Ibuprofen is a pain killer.

The first step in the synthesis of ibuprofen involves the synthesis of compound **T** via a Friedel–Crafts acylation, which is similar to the Friedel–Crafts alkylation in terms of conditions required and the mechanism involved.



T

Which statement is **false** about the reaction above?

A The reaction will proceed at a faster rate if benzene was used instead.

B $FeCl_3$ can be used to catalyse the reaction.

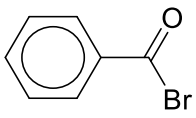
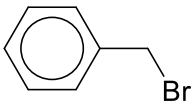
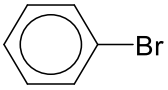
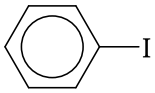
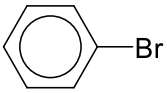
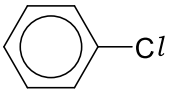
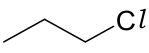
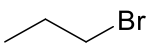
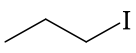
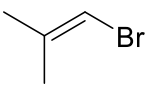
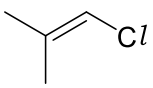
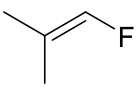
C The major product is 1,4-substituted due to steric hindrance.

D HCl is produced as a by-product.

22 Equal amounts of compounds **X**, **Y** and **Z** were heated with ethanolic silver nitrate in three separate test-tubes. After some time, the precipitate formed in each test-tube, if any, was filtered, dried and weighed.

Compound **X** produced the largest amount of precipitate, while compound **Z** did not produce any precipitate.

Which of the following could be the identities of **X**, **Y** and **Z**?

	X	**Y**	**Z**
A			
B			
C			
D			

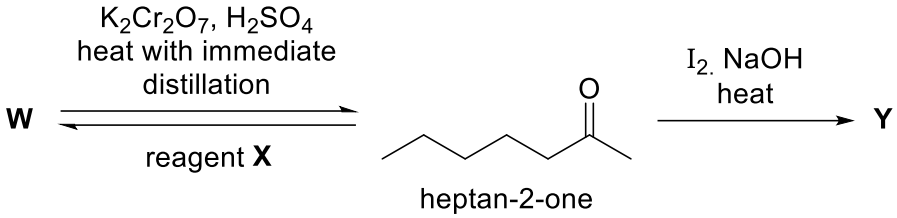
23 The following shows a series of reactions.

$$CH_3CHO \xrightarrow{1} C_2H_5OH \xrightarrow{2} C_2H_4 \xrightarrow{3} C_2H_6 \xrightarrow{4} CO_2$$

Which conversion shows an increase in bond angle and an increase in oxidation number in at least one of the reacting carbon atom(s)?

A 2 only **B** 2 and 4 **C** 3 and 4 **D** 1, 2 and 4

24 The diagram shows reactions involving heptan-2-one.



Which row correctly identifies compound **W**, reagent **X** and compound **Y**?

	W	reagent **X**	**Y**
A	heptane	$NaBH_4$	heptanoic acid
B	heptan-1-ol	H_2	heptanoic acid
C	heptanal	$KMnO_4$	hexanoic acid
D	heptan-2-ol	$LiAlH_4$	hexanoic acid

25 Which of the following compounds cannot be turned into a carboxylic acid in a single reaction?

A C_6H_5COCl **B** $CH_2=CHCH(CH_3)_2$

C $(CH_3)_2CHCl$ **D** CH_3CH_2CN

26 Compound **Z**, $(CH_3)_2NCO(CH_2)_9CH_3$, is being studied as a mosquito repellent.

Which pair of compounds would produce **Z** when reacted together?

A $(CH_3)_2NH$ and $CH_3(CH_2)_9COCl$ **B** $(CH_3)_2NH$ and $CH_3(CH_2)_9CO_2H$

C $(CH_3)_2NCl$ and $CH_3(CH_2)_9CO_2H$ **D** $(CH_3)_2COCl$ and $CH_3(CH_2)_9NH_2$

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

A galvanic cell is made up of an Ag^+/Ag half-cell and a Fe^{3+}/Fe^{2+} half-cell.

Which of the following statements are correct?

1 Addition of solid potassium iodide to the Ag^+/Ag half-cell results in a more positive value for the reduction potential of Ag^+/Ag half-cell.

2 Addition of water to the Ag^+/Ag half-cell has no effect on the cell e.m.f.

3 Addition of water to the Fe^{3+}/Fe^{2+} half-cell has no effect on the cell e.m.f.

A 1 and 2 **B** 1 and 3 **C** 3 only **D** 1, 2 and 3

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

A current of 15.0 A flow through a saturated solution of sodium chloride for 30 minutes. Which of these statements describe the reaction at the anode during this time?

A 1.12×10^{-3} mol of oxygen gas is produced.

B 6.99×10^{-2} mol of oxygen gas is produced.

C 5.60×10^{-3} mol of chlorine gas is produced.

D 1.40×10^{-1} mol of chlorine gas is produced.

29 Which statement correctly defines a transition element?

A Transition elements exhibit more than one oxidation state in their compounds.

B Transition elements form many coloured compounds.

C Transition elements have partially filled d orbitals.

D Transition elements or their compounds are widely used as catalysts.

30 When copper(II) sulfate is dissolved in water it gives a blue solution. When this solution is treated with an excess of concentrated hydrochloric acid, it turns yellow.
What are the formulae of the copper species in the blue and yellow solutions?

	blue	yellow
A	$CuSO_4$	$CuCl_2$
B	$CuSO_4(H_2O)_4$	$[CuCl_6]^{4-}$
C	$[Cu(H_2O)_6]^{2+}$	$[CuCl_4]^{2-}$
D	Cu^{2+}	$[CuCl_5]^{3-}$