

Chemistry
Standard level
Paper 1A

Specimen paper

1 hour 30 minutes [Paper 1A and Paper 1B]

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer all questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A calculator is required for this paper.
- A clean copy of the **chemistry data booklet** is required for this paper.
- The maximum mark for paper 1A is **[30 marks]**.
- The maximum mark for paper 1A and paper 1B is **[55 marks]**.

Section A

1. Which technique is used to purify a solid obtained from a chemical reaction?

- A. distillation
- B. evaporation
- C. recrystallization
- D. filtration

2. Ice containing only the isotope ^2H sinks and does not melt when dropped into ordinary distilled water maintained at 3°C .

Which statement is correct?

- A. The isotope ^2H has a high natural abundance.
- B. $^2\text{H}_2\text{O}(\text{s})$ has a higher melting point than normal ice.
- C. $^2\text{H}_2\text{O}(\text{s})$ has a lower density than normal ice-cold water.
- D. $^2\text{H}_2\text{O}$ has different chemical properties from normal water.

3. Which electron transition in the hydrogen atom emits radiation with the highest energy?

- A. $n = 1$ to $n = 2$
- B. $n = 2$ to $n = 3$
- C. $n = 2$ to $n = 1$
- D. $n = 3$ to $n = 2$

4. A container holds 30 g of argon and 60 g of neon.

What is the ratio of number of atoms of argon to number of atoms of neon in the container?

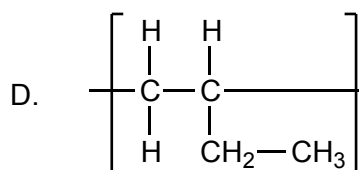
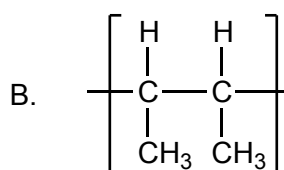
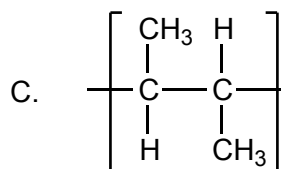
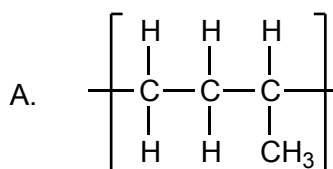
- A. 0.25
- B. 0.50
- C. 2.0
- D. 4.0

5. A gas storage tank of fixed volume V contains N molecules of an ideal gas at 300 K with a pressure of 40 kPa. $\frac{N}{4}$ molecules are removed, and the temperature is changed to 450 K. What is the new pressure of the gas in kPa?
- A. 15
B. 30
C. 45
D. 60
6. What is the formula of the compound formed between magnesium ions and hydrogencarbonate ions?
- A. MgHCO_3
B. $\text{Mg}(\text{HCO}_3)_2$
C. $\text{Mg}(\text{HCO}_3)_3$
D. $\text{Mg}_3(\text{HCO}_3)_2$
7. Which species contains a coordination bond?
- A. CO_2
B. HCN
C. NO_2^+
D. NO_3^-
8. Which properties depend on the movement of the delocalized electrons in a metal?
- I. Electrical conductivity
II. Thermal conductivity
III. Density
- A. I and II only
B. I and III only
C. II and III only
D. I, II and III

9. Which substance, made from two elements with electronegativities E_x and E_y , is an alloy?

	Average electronegativity $\frac{E_x + E_y}{2}$	Electronegativity difference $E_x - E_y$
A.	2.5	2.5
B.	2.5	1.0
C.	3.5	0.2
D.	1.2	0.2

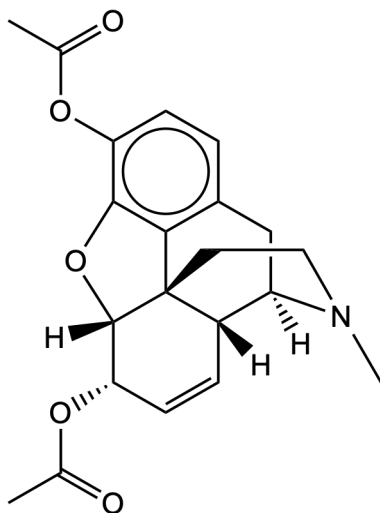
10. Which structure shows the repeating unit of the polymer formed by but-1-ene?



11. What is the explanation for the malleability of metals?

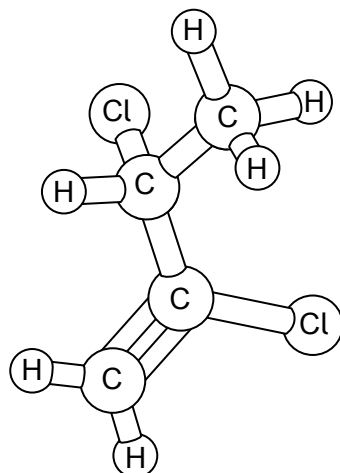
- A. The bonds are strong.
- B. The bonds are weak.
- C. The bonds involve free electrons.
- D. The bonds do not have a specific direction.

12. Which functional groups are present in this molecule?



- A. amino, alkoxy, ester
- B. ether, carboxyl, amino
- C. carboxyl, alkoxy, ester
- D. ester, amino, carboxyl
13. In which block of the periodic table would element 119 be placed, if it is found in the future?
- A. s
- B. p
- C. d
- D. f

14. Which is a correct alternative representation of this molecule?



- A. $\text{C}_3\text{H}_6\text{Cl}_2$
- B.
- C. 2,2-dichlorobut-1-ene
- D. $\text{CH}_3\text{CHClC}(\text{Cl})=\text{CH}_2$
15. The block structure of the periodic table groups elements according to which characteristic?
- A. atomic number
- B. atomic mass
- C. electron configuration
- D. reactivity
16. Which set of conditions describe a reaction in which the reactants are more stable than the products?
- A. endothermic and ΔH negative
- B. endothermic and ΔH positive
- C. exothermic and ΔH negative
- D. exothermic and ΔH positive

17. Which enthalpy changes can be calculated using only bond enthalpy data?

- I. $\text{N}_2(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow \text{N}_2\text{H}_4(\text{g})$
- II. $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
- III. $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{HCl}(\text{g})$

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

18. Which is a renewable energy source?

- A. natural gas
- B. uranium
- C. coal
- D. wood

19. What is the amount, in mol, of H_2O produced for a reaction between 10.0 mol of $\text{C}_2\text{H}_3\text{Cl}$ and 10.0 mol of O_2 if the yield is 90 %?



- A. 3.60
- B. 4.00
- C. 9.00
- D. 10.00

20. The complete combustion of 20.0 cm^3 of a gaseous hydrocarbon, C_xH_y , produces 80.0 cm^3 of gaseous products. This volume reduces to 40.0 cm^3 when the water vapour present condenses. All volumes are measured at the same temperature and pressure.

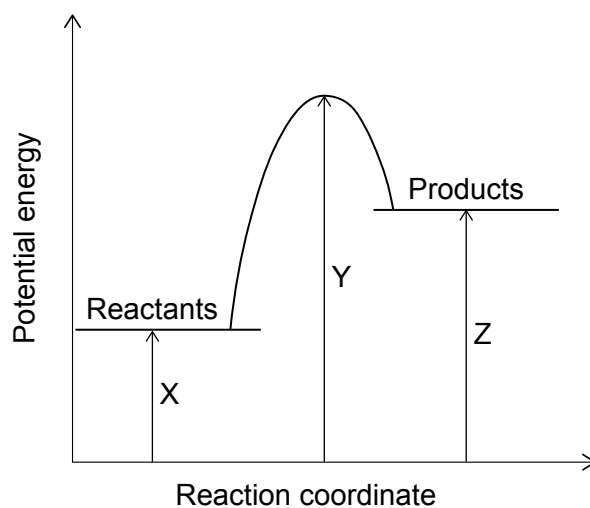
What is the molecular formula of the hydrocarbon?

- A. CH_4
- B. C_2H_2
- C. C_2H_4
- D. C_3H_6

21. Large deposits of methane hydrate, $\text{CH}_4 \cdot 6\text{H}_2\text{O}$ ($M_r = 124$), have been discovered under the ocean floor. What mass of carbon dioxide would be produced by the complete combustion of 12.4 g of the methane hydrate?

- A. 4.40 g
- B. 26.4 g
- C. 34.1 g
- D. 44.0 g

22. The diagram shows the energy profile of a reaction.



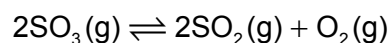
Which combination is correct?

	Activation energy of forward reaction	Activation energy of reverse reaction
A.	X	Z
B.	$Y - X$	$Y - Z$
C.	Y	Y
D.	$Y - X$	$Z - X$

23. What is the main reason for an increase in rate of reaction when the temperature is raised?

- A. A greater proportion of collisions are successful.
- B. Particles collide more frequently.
- C. The bonds in the reactants are weakened.
- D. The activation energy of the reaction decreases.

24. What is the equilibrium constant expression for the following reaction?



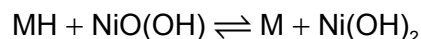
- A. $\frac{[\text{SO}_2]^2[\text{O}_2]}{[\text{SO}_3]^2}$
- B. $\frac{[\text{SO}_2]^2 + [\text{O}_2]}{[\text{SO}_3]^2}$
- C. $\frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$
- D. $\frac{2[\text{SO}_2][\text{O}_2]}{2[\text{SO}_3]}$

25. Which reactions involve the transfer of a proton?

- I. $2\text{HCl}(\text{aq}) + \text{Mg}(\text{s}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{H}_2(\text{g})$
- II. $2\text{HCl}(\text{aq}) + \text{MgO}(\text{s}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- III. $2\text{HCl}(\text{aq}) + \text{MgCO}_3(\text{s}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$

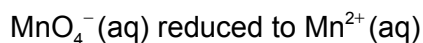
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

26. The overall reaction occurring at the electrodes of a rechargeable metal hydride battery can be summarized as:



Which statement is correct?

- A. The oxidation state of Ni does not change.
 - B. M is oxidized by loss of hydrogen.
 - C. The oxidation state of one H atom changes from -1 to $+1$.
 - D. The oxidation state of one O atom changes from -1 to -2 .
27. In a redox titration, manganate(VII) ions are reduced to manganese(II) ions and iron(II) ions are oxidized to iron(III) ions.



What volume, in cm^3 , of $0.1 \text{ mol dm}^{-3} \text{ MnO}_4^- (\text{aq})$ is required to reach the equivalence point in the titration of 20.00 cm^3 of $0.1 \text{ mol dm}^{-3} \text{ Fe}^{2+} (\text{aq})$?

- A. 2.00
 - B. 4.00
 - C. 20.00
 - D. 100.00
28. What is the organic product of the reaction of 1-chloropentane with aqueous sodium hydroxide?
- A. pentan-1-ol
 - B. 1-chloropentan-1-ol
 - C. 1-chloropent-1-ene
 - D. 1-chloropent-2-ene

29. Which statements explain the following reactions occurring in the upper atmosphere?

	Chlorofluorocarbon (CFC) compounds break down to produce chlorine radicals but usually not fluorine radicals.	A single chlorine radical breaks down many ozone, O₃, molecules.
A.	C–Cl bond is stronger than C–F bond	chain propagation steps produce more radicals
B.	C–F bond is stronger than C–Cl bond	chain termination steps cause chlorine radicals to reform chlorine molecules
C.	C–Cl bond is stronger than C–F bond	chain termination steps cause chlorine radicals to reform chlorine molecules
D.	C–F bond is stronger than C–Cl bond	chain propagation steps produce more radicals

30. Which species can act as an electrophile?

- A. CH₄
 - B. Cl₂
 - C. Cl[–]
 - D. OH[–]
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