Diploma Programme
Programme du diplôme
Programa del Diploma

Chemistry
Standard level
Paper 1A

16 May 2025

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

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]**.

2225 – 6222

11 pages

Section A

1. How many oxygen atoms are present in 0.0200 mol $CuSO_4 \cdot 5H_2O$?

A. 1.20×10^{22}

B. 1.08×10^{22}

C. 6.02×10^{23}

D. 1.08×10^{23}

2. What is a possible empirical formula for a substance with $M_r = 58$?

I. C_2H_5

II. C_4H_{10}

III. C_3H_6O

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

3. Which volume of butane gas, in cm^3, will produce 40 cm^3 of carbon dioxide gas when it is completely combusted in oxygen?

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g)$$

A. 5

B. 10

C. 20

D. 40

4. Which row shows the number of subatomic particles in $^{57}Fe^{3+}$?

	Protons	Neutrons	Electrons
A.	26	31	29
B.	26	31	23
C.	23	57	23
D.	57	57	26

5. What is the maximum number of electrons that can occupy the fourth main energy level of an atom?

A. 8

B. 18

C. 32

D. 64

6. What is the formula of the compound formed by aluminium ions and sulfate(VI) ions?

A. $AlSO_3$

B. $Al_2(SO_3)_3$

C. $AlSO_4$

D. $Al_2(SO_4)_3$

7. A substance has the following properties:

Melting point (°C)	Electrical conductivity	
	When solid	**When molten**
714	poor	good

What is the most probable structure of this substance?

A. Simple molecular

B. Ionic lattice

C. Covalent network

D. Metallic lattice

8. Which forces of attraction cause the boiling point of ammonia, NH_3, to be significantly higher than that of phosphine, PH_3?

A. Covalent bonds

B. Dipole–dipole forces

C. London (dispersion) forces

D. Hydrogen bonds

9. Which answer shows the correct order of metallic bond strength from strongest to weakest?

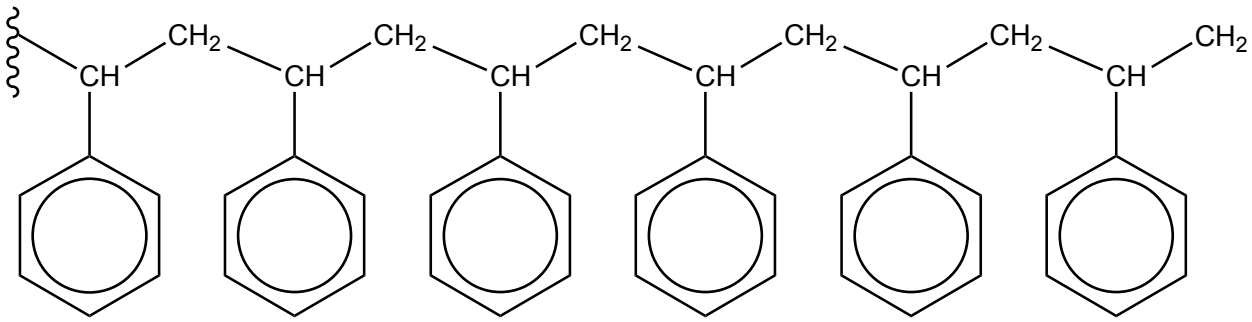
A. Al > Mg > Na > K

B. Al > Mg > K > Na

C. Na > K > Mg > Al

D. K > Na > Mg > Al

10. Which monomer could produce this polymer?



A. $C_6H_6CH_2CH_2$

B. $C_6H_6CHCH_2$

C. $C_6H_5CHCH_2$

D. $C_6H_5CH_2CH_2$

11. Which of these elements is in the f-block of the periodic table?

A. Ra

B. Lu

C. Rf

D. Nh

12. What is the electron configuration of an atom of Cu?

A. $[Ar]3d^9$

B. $[Ar]4s^23d^9$

C. $[Ar]4s^24d^9$

D. $[Ar]4s^13d^{10}$

13. Which pair of elements would react with each other the least vigorously?

A. Lithium and fluorine

B. Lithium and iodine

C. Caesium and fluorine

D. Caesium and iodine

14. Which compounds contain an atom in a +3 oxidation state?

I. NO_2^-

II. $FeCl_3$

III. BrF_3

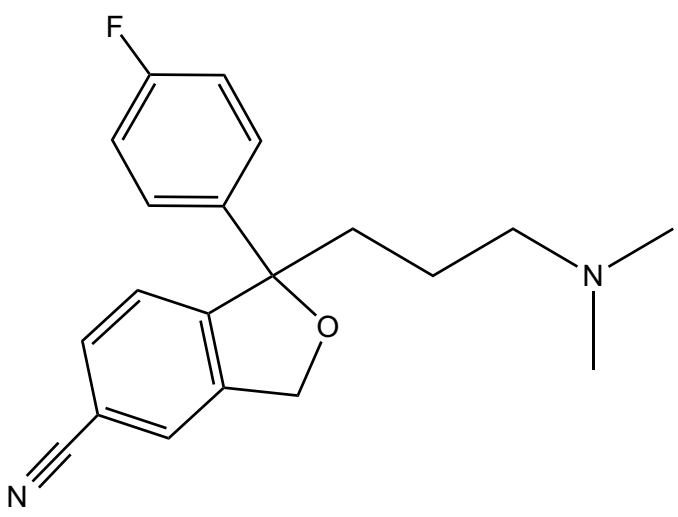
A. I and II only

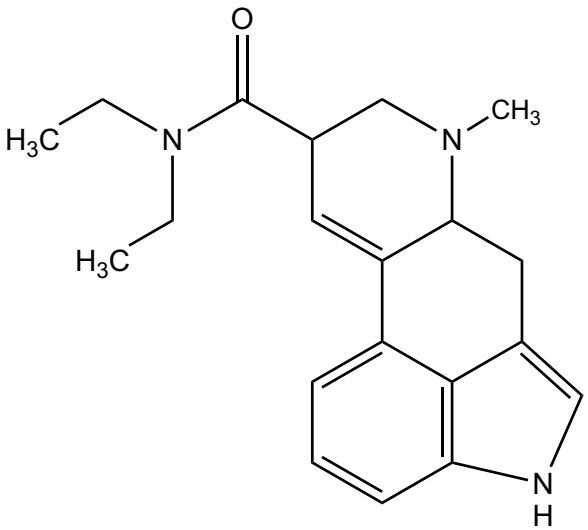
B. I and III only

C. II and III only

D. I, II and III

15. Which functional groups are present in both of these molecules?





A. Amino and amido

B. Amino and alkoxy

C. Amino and carbonyl

D. Amino and a benzene ring

16. Which statement about an exothermic reaction is correct?

A. Temperature decreases and the products have higher enthalpy than the reactants.

B. Temperature decreases and the products have lower enthalpy than the reactants.

C. Temperature increases and the products have higher enthalpy than the reactants.

D. Temperature increases and the products have lower enthalpy than the reactants.

17. The energy from burning 0.321 g of methanol causes the temperature of 200 cm^3 of water to rise by 5.00 K. What is the enthalpy of combustion of the methanol in $kJ\,mol^{-1}$?

Specific heat capacity of water: $4.18\,J\,g^{-1}\,K^{-1}$, M_r methanol $= 32.05\,g\,mol^{-1}$

$$Q = mc\Delta T$$

A. –417

B. –579

C. –23 200

D. –417 000

18. Which process to produce ethanol has an atom economy of 100?

A. $C_2H_4 + H_2O \rightarrow C_2H_5OH$

B. $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

C. $CH_3COOC_2H_5 + NaOH \rightarrow C_2H_5OH + CH_3COONa$

D. $CH_3COOC_2H_5 + H_2O \rightleftharpoons C_2H_5OH + CH_3COOH$

19. Which apparatus can be used to monitor the progress of this reaction?

$$NaHCO_3(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l) + CO_2(g)$$

I. A pH meter

II. A gas syringe

III. A colorimeter

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

20. Which statement about this equilibrium reaction is correct?

$$CH_3CH_2OH(aq) + HCOOH(aq) \rightleftharpoons CH_3CH_2OOCH(aq) + H_2O(l)$$

A. Removing water from the reaction mixture has no effect on the position of equilibrium.

B. Adding ethanol to the reaction mixture moves the position of equilibrium to the left.

C. Removing ethanol from the reaction mixture moves the position of equilibrium to the left.

D. Adding water to the reaction mixture moves the position of equilibrium to the right.

21. How many moles of oxygen are needed for the complete combustion of 11.5 g of $C_3H_8(g)$?

M_r propane $= 44.1\,g\,mol^{-1}$

A. 10.4

B. 5.20

C. 2.60

D. 1.30

22. Which molecule has the shortest carbon to oxygen bond?

A. CH_3OH

B. H_2CO

C. CO

D. CO_2

23. What are the electron domain geometries around the carbon and nitrogen atoms, shown in bold, in glycine $H_2\mathbf{NC}H_2COOH$?

	Carbon	**Nitrogen**
A.	tetrahedral	tetrahedral
B.	trigonal pyramidal	trigonal pyramidal
C.	trigonal planar	tetrahedral
D.	trigonal planar	trigonal pyramidal

24. What is the pH of $0.0010\,\text{mol}\,\text{dm}^{-3}$ HCl (aq)?

A. 2.0

B. 2.5

C. 3.0

D. 3.5

25. Which solution is acidic at 25 °C?

A. $[H^+] = 1.0 \times 10^{-9}\,\text{mol}\,\text{dm}^{-3}$

B. $[OH^-] = 1.0 \times 10^{-13}\,\text{mol}\,\text{dm}^{-3}$

C. $[OH^-] = 1.0 \times 10^{-6}\,\text{mol}\,\text{dm}^{-3}$

D. $[H_3O^+] = 1.0 \times 10^{-13}\,\text{mol}\,\text{dm}^{-3}$

26. Which equation correctly describes a chemical reaction?

A. $2HCl + Na_2CO_3 \rightarrow 2NaCl + CO_2 + H_2O$

B. $Cu + 2HCl \rightarrow CuCl_2 + H_2$

C. $NaOH + HCl \rightarrow NaCl + H_2$

D. $2HCl + Ca(HCO_3)_2 \rightarrow CaCl_2 + 2H_2O$

27. The following occurs when tin is added to separate solutions of lead(II) nitrate, $Pb(NO_3)_2$, and manganese(II) nitrate, $Mn(NO_3)_2$.

$$Sn\,(s) + Pb(NO_3)_2\,(aq) \rightarrow Sn(NO_3)_2\,(aq) + Pb\,(s)$$

$$Sn\,(s) + Mn(NO_3)_2\,(aq) \rightarrow \text{no reaction}$$

What is the order of decreasing reactivity of the metals?

A. Sn > Pb > Mn

B. Sn > Mn > Pb

C. Mn > Sn > Pb

D. Pb > Sn > Mn

28. What are the products of the electrolysis of molten aluminium oxide, $Al_2O_3(l)$?

	Product at anode	**Product at cathode**
A.	O_2	Al
B.	O_3	Al
C.	Al	O_2
D.	Al	O_3

29. Which compound can be reduced to produce butanal?

A. Butanoic acid

B. Butan-1-ol

C. Butanone

D. Butan-2-ol

30. Which is a conjugate acid–base pair?

A. H_3PO_4 / HPO_4^{2-}

B. H_3O^+ / OH^-

C. H_2O / OH^-

D. NH_4^+ / NH_2^-