



National
Qualifications
2026

X813/77/02

Chemistry
Section 1 — Questions

TUESDAY, 12 MAY

9:00 AM – 12:00 NOON

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X813/77/01.

Record your answers on the answer grid on *page 03* of your question and answer booklet.

You may refer to the Chemistry Data Booklet for Higher and Advanced Higher.

You must leave your answer booklet on your desk; if you do not, you could lose all the marks for this paper.



* X 8 1 3 7 7 0 2 *

SECTION 1 — 25 marks

Attempt ALL questions

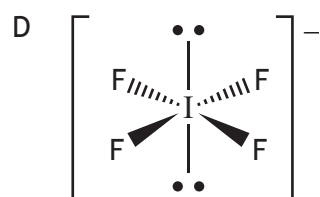
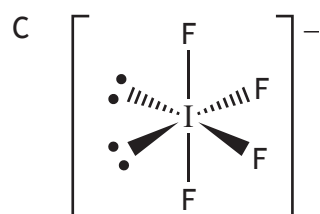
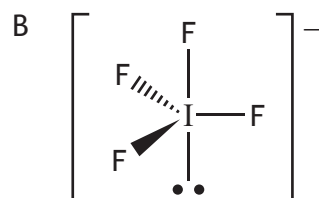
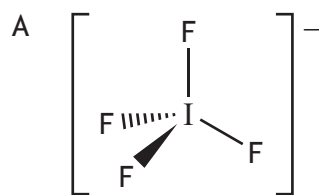
1. Which of the following elements is found in the d-block of the periodic table?
 - A Calcium
 - B Carbon
 - C Chromium
 - D Curium

2. Which of the following statements is true for a Co^{2+} ion in its ground state?
 - A It has 5 unpaired electrons.
 - B It has 8 electrons in s orbitals.
 - C It has 13 electrons in the third main energy level.
 - D Its electrons with the highest energy are in the third main energy level.

3. What is the coordination number of the transition metal in $[\text{Pt}(\text{NH}_3)_2(\text{OH}_2)_2]\text{Cl}_2$?
 - A 2
 - B 3
 - C 4
 - D 6

4. Which diagram best represents the arrangement of atoms in the IF_4^- ion?

A non-bonding pair of electrons is represented by • •

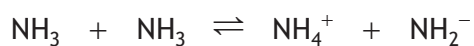


5. What is the pH of a 0.25 mol l^{-1} solution of calcium hydroxide, $\text{Ca}(\text{OH})_2$?

- A 13.7
- B 13.4
- C 0.6
- D 0.3

[Turn over

6.



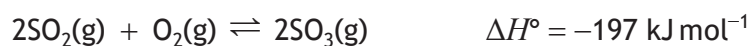
Which line in the table shows the correct conjugate acid and conjugate base in this equilibrium?

	Conjugate acid	Conjugate base
A	NH_3	NH_4^+
B	NH_4^+	NH_3
C	NH_2^-	NH_4^+
D	NH_4^+	NH_2^-

7. Which of the following indicators is the most suitable for the titration of sodium hydroxide with ethanoic acid?

- A *p*-Nitrophenol
- B Thymolphthalein
- C Bromophenol blue
- D Bromothymol blue

Questions 8 and 9 refer to the equilibrium mixture below.



8. The equilibrium mixture was found to contain 0.2 moles of SO_2 , 0.2 moles of O_2 and 16 moles of SO_3 .

Which of the following is correct?

- A $K > 1$ and $\Delta G^\circ > 0$
- B $K > 1$ and $\Delta G^\circ < 0$
- C $K < 1$ and $\Delta G^\circ > 0$
- D $K < 1$ and $\Delta G^\circ < 0$

9. Which of the following changes in reaction conditions will decrease the equilibrium constant for this reaction?

- A Increasing the temperature
- B Decreasing the temperature
- C Increasing the pressure
- D Decreasing the pressure

10.

Substance	K_a
X	1.85×10^{-11}
Y	1.57×10^{-10}
Z	1.61×10^{-5}

Using the information in the table, identify the statement that must be correct.

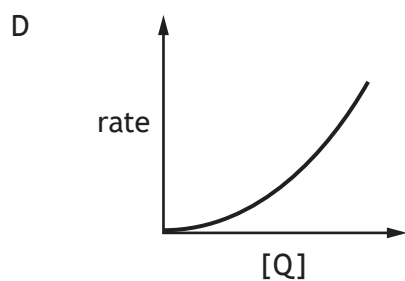
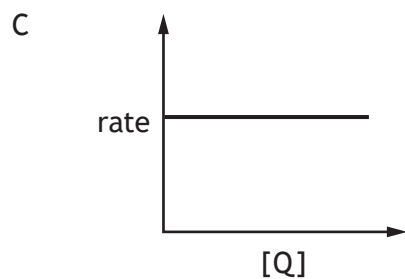
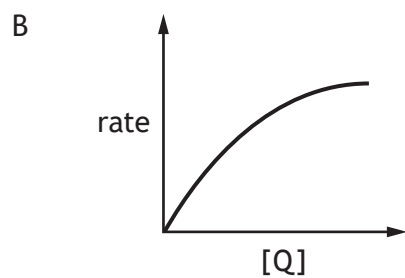
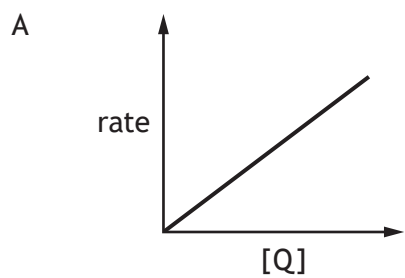
- A X is a stronger acid than Y.
- B X is a weaker base than Z.
- C Y is a weaker acid than Z.
- D Y is a stronger base than X.

11. Which of the following is likely to have the lowest standard entropy at 50 °C?

- A Caesium
- B Calcium
- C Mercury
- D Rubidium

[Turn over

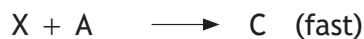
12. Which of the following graphs would be obtained for a reaction that is first order with respect to reactant Q?



13. For the reaction



the mechanism is



Which of the following would be second order?

- A Overall order of the reaction
- B Order of the reaction with respect to A
- C Order of the reaction with respect to B
- D Order of the reaction with respect to X

14. Which of the following has the fewest sigma bonds?

- A Pentane
- B Pent-1-ene
- C Pent-1-yne
- D Cyclopentane

15. Lycopene and vitamin A are coloured organic compounds.

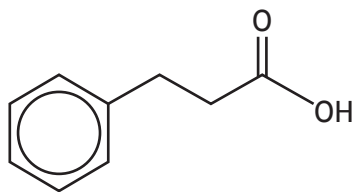
Lycopene is red and vitamin A is yellow.

Which line in the table is correct for lycopene when compared to vitamin A?

	Size of energy gap between HOMO and LUMO	Wavelength of light absorbed
A	larger	longer
B	smaller	longer
C	larger	shorter
D	smaller	shorter

[Turn over

16. Hydrocinnamic acid has the structure shown.



Hydrocinnamic acid will not react with

- A ethanol
 - B bromine solution
 - C sodium hydroxide
 - D concentrated sulfuric acid.
17. Alcohol X does not react with hot copper(II) oxide but produces alkene Y when dehydrated with hot concentrated sulfuric acid.
Alkene Y reacts with bromine solution to form 1,2-dibromo-2-methylpropane.
Which of the following is alcohol X?
- A $(\text{CH}_3)_3\text{COH}$
 - B $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
 - C $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{OH}$
 - D $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$
18. Which line in the table is correct for primary amines as the chain length increases?

	Boiling point	Solubility in water
A	increases	increases
B	decreases	decreases
C	increases	decreases
D	decreases	increases

19.

$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{Cl} \quad \text{H} \end{array} $ 1	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{OH} \quad \text{H} \end{array} $ 2
$ \begin{array}{c} \text{H} \quad \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{O} \quad \text{H} \end{array} $ 3	$ \begin{array}{c} \text{H} \quad \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}=\text{C} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array} $ 4

Which line in the table correctly identifies W, X, Y and Z in the reaction sequence?

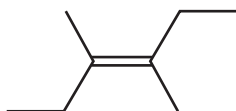


	W	X	Y	Z
A	1	4	2	3
B	2	4	3	1
C	1	4	3	2
D	2	4	1	3

20. The major product in the reaction of HCl with $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)\text{CH}_2$ is

- A 1-chloro-2-methylbutane
- B 2-chloro-2-methylbutane
- C 3-chloro-3-methylbutane
- D 4-chloro-3-methylbutane.

21.

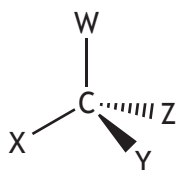


The systematic name of the molecule shown above is

- A *cis*-2,3-diethylbut-2-ene
- B *trans*-2,3-diethylbut-2-ene
- C *cis*-3,4-dimethylhex-3-ene
- D *trans*-3,4-dimethylhex-3-ene.

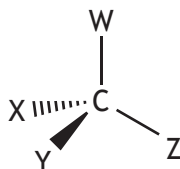
[Turn over

22. The diagram represents one enantiomer of an optically active compound where W, X, Y and Z are four different groups.

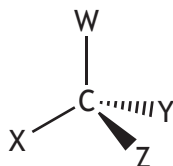


Which of the following represents the other enantiomer of this compound?

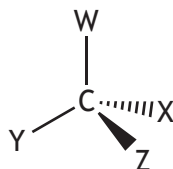
A



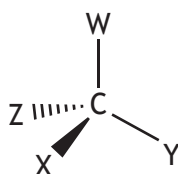
B



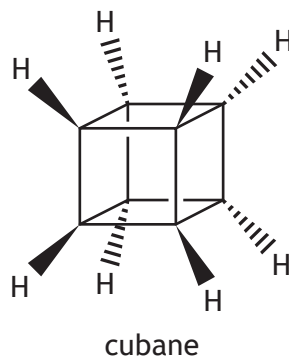
C



D



23. The structure of cubane, C_8H_8 , is shown.



How many peaks would be seen in the low resolution 1H NMR spectrum of cubane?

- A 1
- B 2
- C 4
- D 8

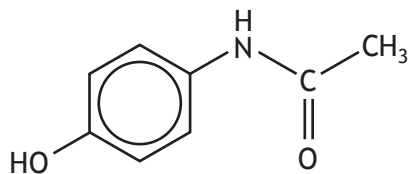
24. 200 cm^3 of water is added to 50 cm^3 of 2 mol l^{-1} sodium hydroxide solution.

The approximate concentration of the diluted sodium hydroxide solution in mol l^{-1} , is

- A 0.1
- B 0.2
- C 0.4
- D 0.5

[Turn over

25. A structural formula for paracetamol is shown.



If one tablet contains 500 mg of paracetamol, how many tablets would be needed to obtain one mole of paracetamol?

- A 294
- B 302
- C 0.294
- D 0.302

[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2 OF
YOUR QUESTION AND ANSWER BOOKLET.]