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.

X8137702

Qualifications Scotland
Teisteanasan Alba

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

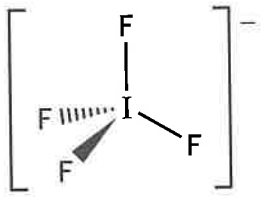
2. Which of the following statements is true for a Co^{2+} ion in its ground state?

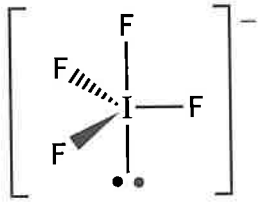
   A It has 5 unpaired electrons.
   B It has 8 electrons in s orbitals.
   C It has 13 electrons in the third main energy level.
   D Its electrons with the highest energy are in the third main energy level.

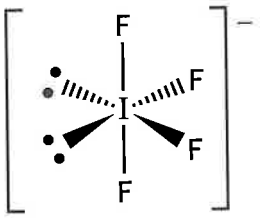
3. What is the coordination number of the transition metal in $[Pt(NH_3)_2(OH_2)_2]Cl_2$?

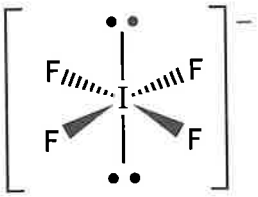
   A 2
   B 3
   C 4
   D 6

4. Which diagram best represents the arrangement of atoms in the IF_4^- ion?
A non-bonding pair of electrons is represented by • •

A 

B 

C 

D 

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

A 13.7
B 13.4
C 0.6
D 0.3

[Turn over

6. $NH_3 + NH_3 \rightleftharpoons NH_4^+ + NH_2^-$

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.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H^\circ = -197 \text{ kJ mol}^{-1}$$

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

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.

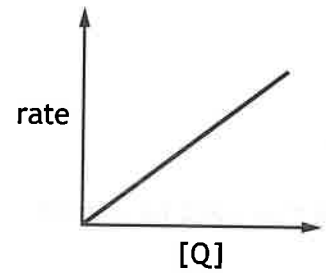
11. Which of the following is likely to have the lowest standard entropy at 50 °C?

A Caesium
B Calcium
C Mercury
D Rubidium

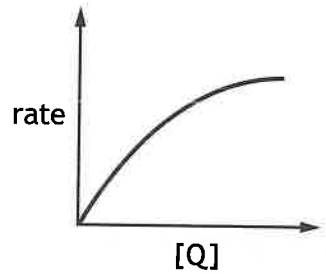
[Turn over

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

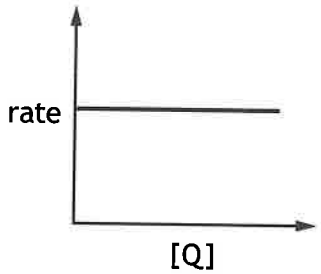
A



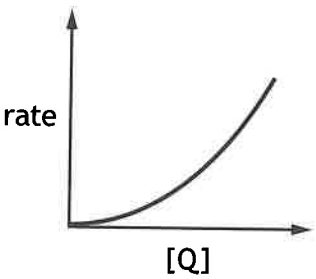
B



C

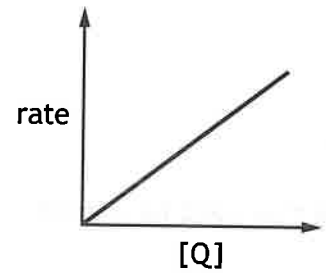


D

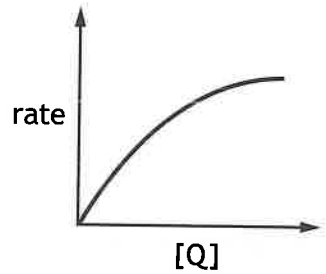


12. Which of the following graphs would be obtained for a reaction that is first order with respect to reactant Q?

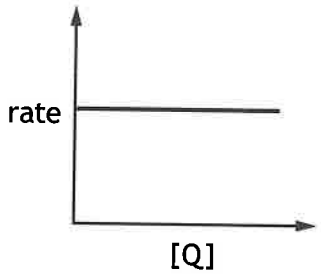
A



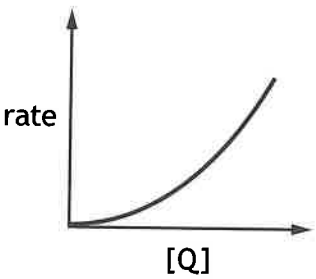
B



C



D



13. For the reaction

$$2A + 2B \longrightarrow C$$

the mechanism is

$$A + 2B \longrightarrow X \quad \text{(slow)}$$

$$X + A \longrightarrow C \quad \text{(fast)}$$

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?

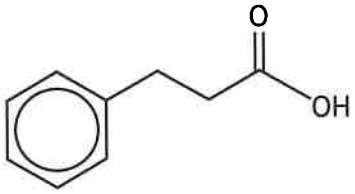
A Pentane
B Pent-1-ene
C Pent-1-yne
D Cyclopentane

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 $(CH_3)_3COH$

B $CH_3CH_2CH(OH)CH_3$

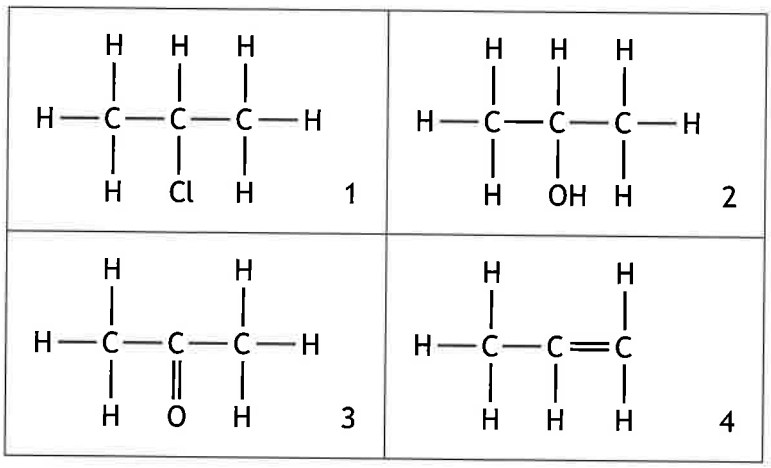
C $CH_3CH_2C(CH_3)_2OH$

D $CH_3CH(CH_3)CH_2OH$

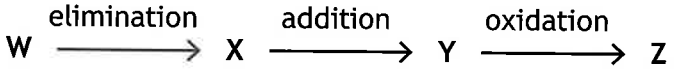
18. Which line in the table is correct for primary amines as the chain length increases?

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

19.



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 $CH_3CH_2C(CH_3)CH_2$ 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

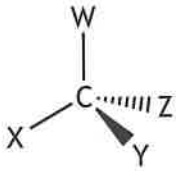
B *trans*-2,3-diethylbut-2-ene

C *cis*-3,4-dimethylhex-3-ene

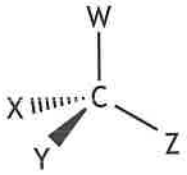
D *trans*-3,4-dimethylhex-3-ene.

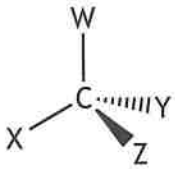
[Turn over

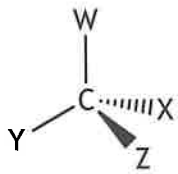
22. The diagram represents one enantiomer of an optically active compound where **W**, **X**, **Y** and **Z** are four different groups.

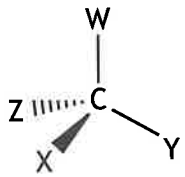


Which of the following represents the other enantiomer of this compound?

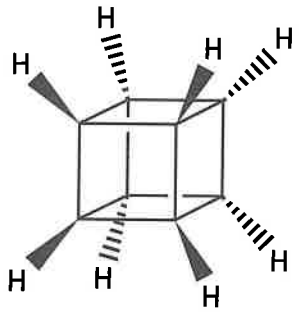
A 

B 

C 

D 

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



cubane

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

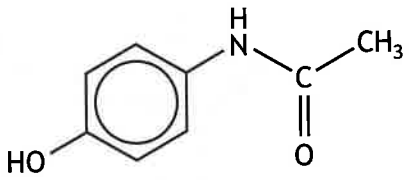
A 1
B 2
C 4
D 8

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.]