GCE AS/A level

1092/01

CHEMISTRY – CH2

P.M. TUESDAY, 2 June 2015

1 hour 30 minutes plus your additional time allowance

Surname _____

Other Names _____

Centre Number _____

Candidate Number 2 _____

	For Examiner's use only		
	Question	Maximum Mark	Mark Awarded
Section A	1. to 8.	10	
Section B	9.	13	
	10.	12	
	11.	16	
	12.	15	
	13.	14	
	Total	80	

ADDITIONAL MATERIALS

In addition to this examination paper, you will need a: calculator;

DATA SHEET containing a PERIODIC TABLE supplied by WJEC. Refer to it for any RELATIVE ATOMIC MASSES you require.

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball-point pen or your usual method.

Write your name, centre number and candidate number in the spaces provided on the front cover.

SECTION A Answer ALL questions in the spaces provided.

SECTION B Answer ALL questions in the spaces provided.

Candidates are advised to allocate their time appropriately between SECTION A (10 MARKS) and SECTION B (70 MARKS).

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The maximum mark for this paper is 80.

Your answers must be relevant and must make full use of the information given to be awarded full marks for a question.

The QWC label alongside particular part-questions indicates those where the Quality of Written Communication is assessed.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

SECTION A

Answer ALL questions in the spaces provided.

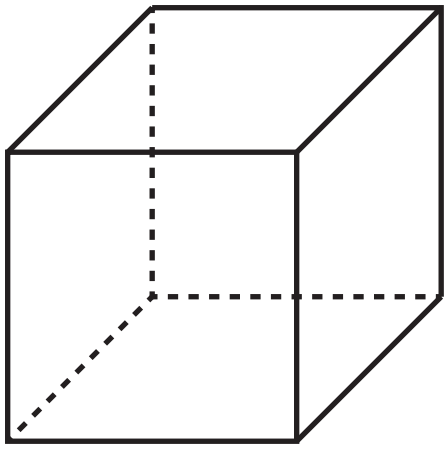
1. **Complete the electronic structure for the oxide ion present in magnesium oxide. [1]**

$1s^2$ _____

2. **Draw a dot and cross diagram to show the bonding in calcium fluoride. You should include outer electrons only and give any charges. [2]**

3. Give the meaning of the term ELECTRONEGATIVITY. [1]

4. Complete and label the diagram to show the positions of the ions present in caesium chloride, CsCl. [1]



5. **State the reagent(s) used and the colour change seen when a primary alcohol is oxidised to give a carboxylic acid. [2]**

Reagent(s) _____

_____

Colour change from _____

to _____

6. **State the systematic name of the compound shown below. [1]**

_____

_____

7. On cracking, one molecule of $C_{20}H_{42}$ can produce one molecule of pentene, one molecule of hexene and one molecule of another product.

Complete the equation for this reaction. [1]

$$C_{20}H_{42} \longrightarrow$$

8. Draw the repeat unit of the polymer formed from the monomer $CH_3CH_2CH{=\!=}CHCH_3$. [1]

TOTAL SECTION A [10]

SECTION B

Answer ALL questions in the spaces provided.

9(a) **Sodium and potassium both react with cold water but their reactivities are different. The first ionisation energy affects the reactivity of Group 1 elements.**

(i) **Give an observation that shows the difference in reactivity with cold water between sodium and potassium. [1]**

_____

_____

_____

_____

9(a) (ii) **Describe the trend in the first ionisation energy of Group 1 elements and explain why this trend occurs. [2]**

(iii) **Explain how this trend affects the reactivity of Group 1 elements. [1]**

9(b) **A GCSE student said that, apart from metallic bonding, bonds were either ionic or covalent. An A level student said that this was not really true and that bonds could be intermediate between ionic and covalent.**

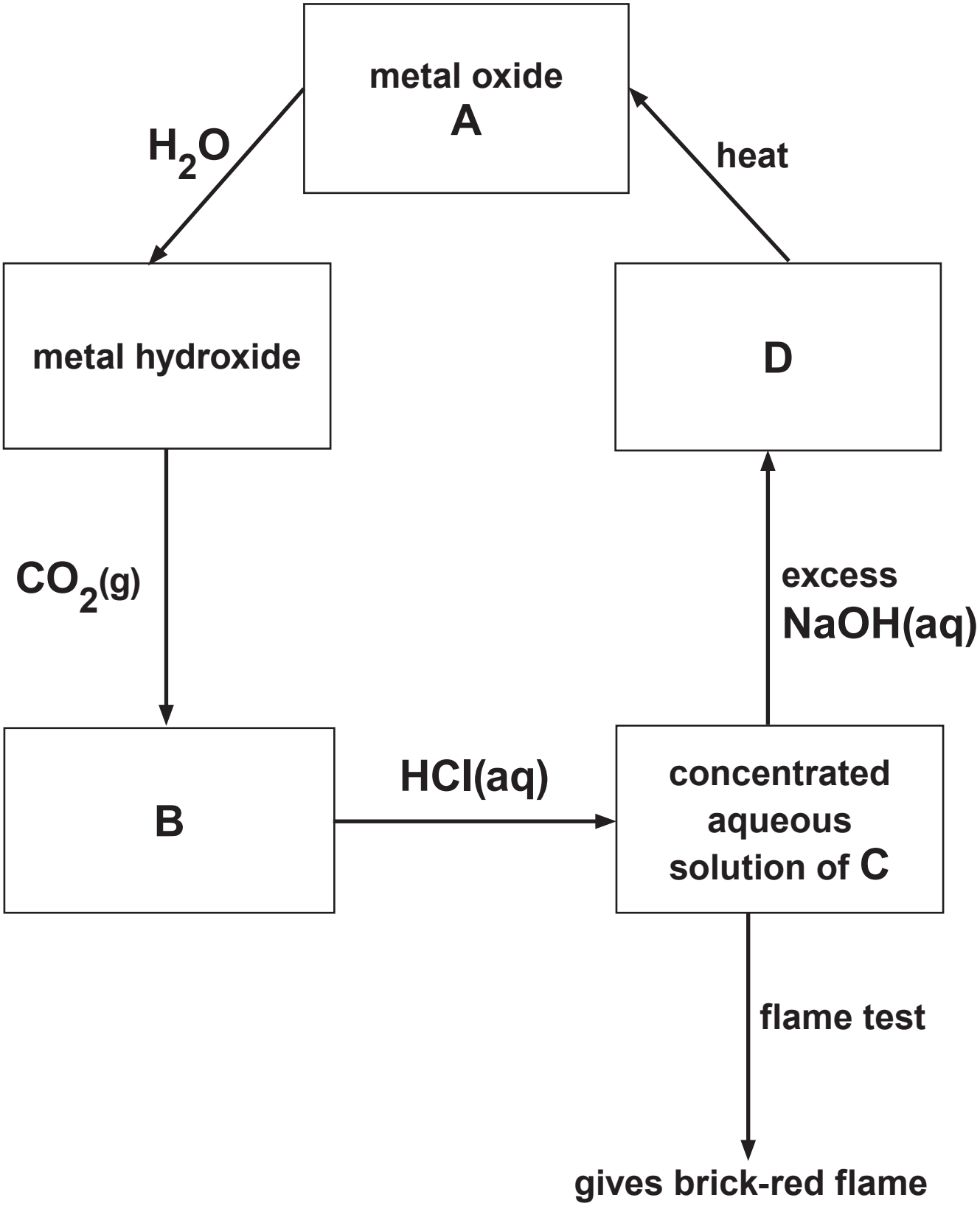
(i) **State ONE factor that governs what type of bond elements form and explain how this leads to different types of bonding. [2]**

9(b) (ii) Describe the electron density in each type of bond. [3]

Ionic

Covalent

Intermediate


metal oxide
A
H_2O
heat
metal hydroxide
D
$CO_2(g)$
excess
NaOH(aq)
B
HCl(aq)
concentrated
aqueous
solution of C
flame test
gives brick-red flame

9(c) **Compound A is the oxide of a metal.**

The diagram opposite shows some reactions of compound A, and associated compounds, that can be carried out in the laboratory.

(i) **What metal is present in compound A? [1]**

(ii) **What compound containing the metal is present in the aqueous solution C? [1]**

(iii) **Describe the appearance of the contents of the test tube with compound D. [1]**

(iv) **Write the IONIC equation for the reaction between solution C and aqueous sodium hydroxide. [1]**

Total [13]

10(a) State why nitrogen is described as a *p*-block element. [1]

(b) (i) Draw a dot and cross diagram to show the electrons in the ammonium ion, NH_4^+. You should include outer electrons only. [1]

10(b) (ii) **State the bond angle in the ammonium ion. Explain why this is the case. [2]**

_____

_____

_____

_____

_____

_____

(iii) **Ammonia reacts with oxygen to give nitrogen(II) oxide and water. Complete the equation for this reaction. [1]**

$$4NH_3 + \_\_\_\_\_\ O_2 \longrightarrow \_\_\_\_\_\ NO + \_\_\_\_\_\ H_2O$$

10(c) When sodium nitrate is heated it decomposes.

$$2NaNO_3(s) \longrightarrow 2NaNO_2(s) + O_2(g)$$

(i) Use oxidation numbers to complete the following.

In this reaction _____ has been reduced because its oxidation state has changed from _____ to _____ . [2]

10(c) (ii) **What volume of oxygen, measured at room temperature and pressure, could be obtained by heating 4.40 g of sodium nitrate? [3]**

[The volume of 1 mol of oxygen is 24.0 dm^3 under these conditions]

Volume of oxygen = _____ dm^3

10(d) A sample of sodium nitrate of mass 65 g was added to 50 g of cold water and the mixture was heated until it all dissolved.

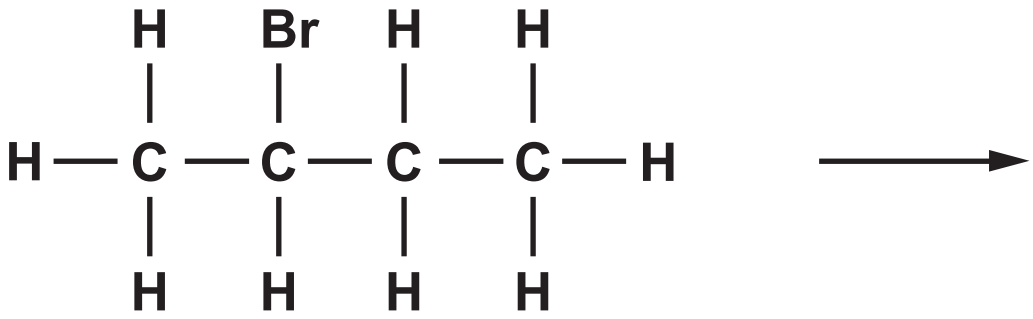
The table gives information about the solubility of sodium nitrate at various temperatures.

Solubility of $NaNO_3$ / g per 100 g water	Temperature / °C
88	20
96	30
103	40
112	50
122	60
133	70

10(d) **Use the data in the table on page 18 to calculate the mass of sodium nitrate that crystallised when the solution was cooled to 30 °C. [2]**

Mass that crystallised = _____ g

Total [12]


H Br H H
H C C C C H
H H H H

11. 2-Bromobutane, C_4H_9Br, is a halogenoalkane that behaves in a similar way to 1-chlorobutane.

(a) (i) Complete the diagram opposite to show the mechanism for the reaction between 2-bromobutane and aqueous sodium hydroxide. You should include relevant charges, dipoles, lone pairs and curly arrows to show the movement of electron pairs. [4]

(ii) What TYPE of mechanism is shown in (a)(i)? [1]

(iii) The reaction involves heterolytic bond fission.

What is meant by HETEROLYTIC BOND FISSION? [1]

11(b) Bromoethane can be converted into ethene.

(i) Name the reagent and solvent needed to convert bromoethane into ethene. [1]

_____

_____

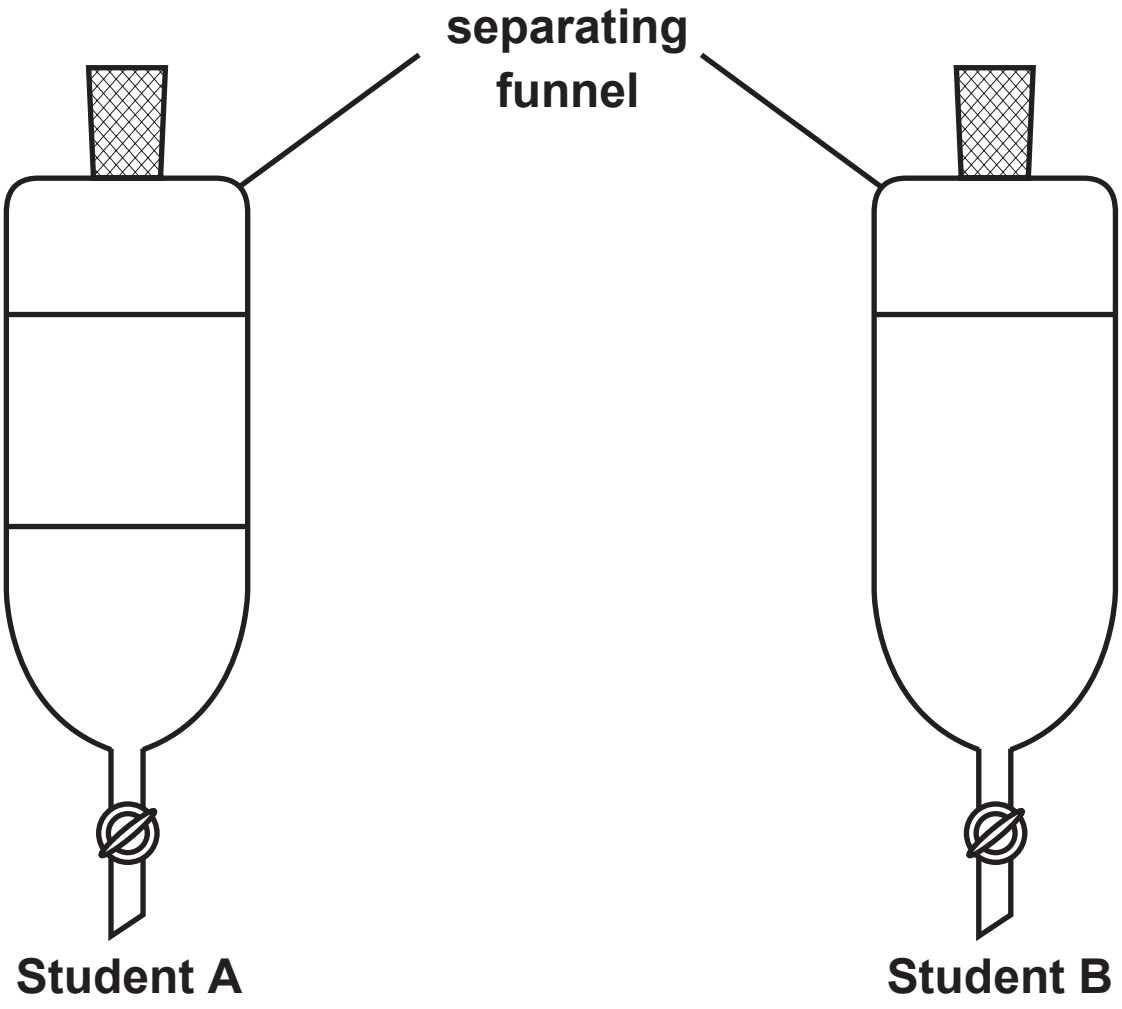
(ii) What TYPE of reaction occurs in (b)(i)? [1]

_____

_____

11(b) (iii) **2-Bromobutane behaves in a similar way to bromoethane in this type of reaction. When 2-bromobutane is reacted as described in (b)(i) two alkenes that are STRUCTURAL isomers are formed.**

Draw the displayed formulae of these two alkenes. [2]


separating
funnel
Student A
Student B

11(c) **Two students were each given a different alcohol. They each added their alcohol to water in a separating funnel, shook the mixture and then left it to stand.**

The diagrams opposite show the results.

What can be deduced about the alcohols given to each student? You should explain why the alcohols behave differently in this experiment. [5]

QWC [1]

Total [16]

12. Explain each of the following observations concerning substances that you have met in your study of Chemistry.

(a) Aluminium has a higher melting temperature than sodium.

You should refer to the nature of the bonding. [3]

QWC [1]

12(b) **The colour of an aqueous solution of potassium iodide changes to brown when chlorine is bubbled through.**

You should include an equation for the reaction that occurs. [3]

12(c) **Ammonia was used as a refrigerant because it is relatively easy to liquefy. Ethane could not be used for this purpose.**

You should refer to intermolecular forces. [4]

12(d) **The reaction between methane and chlorine does not produce a pure sample of chloromethane, CH_3Cl.**

You should include the name of the mechanism of the reaction involved and give an equation to show the formation of a product other than chloromethane. [3] QWC [1]

Total [15]

13(a) An acid F was known to be one of the following.

$CH_3CH_2HC{=}CHCO_2H$ **Acid 1** $M_r = 100$

$HO_2CCH_2CH_2CO_2H$ **Acid 2** $M_r = 118$

A sample of 1.20 g of acid F was burned in excess oxygen. 1.79 g of carbon dioxide was formed.

(i) Calculate the mass of carbon present in the sample of acid F. [1]

Mass of carbon = _____ g

13(a) (ii) **The mass of hydrogen in the sample is 0.061 g. Assuming that the rest of the sample is oxygen, calculate the mass of oxygen in the sample. [1]**

Mass of oxygen = _____ **g**

(iii) **Use your answers to parts (i) and (ii) to find the empirical formula of acid F. [2]**

Empirical formula _____

13(a) (iv) **State the identity of acid F. Show clearly how you reached this conclusion. [1]**

(v) **Describe a chemical test that would distinguish between Acid 1 and Acid 2. You should include the expected results. [1]**

13(a) (vi) **Draw the structural formula of the alcohol that can be oxidised to form Acid 2. [1]**

13(b) Spectra give much information about the structure of organic compounds.

The mass spectrum and infrared spectrum of ethanol, C_2H_5OH, are shown opposite.

(i) What can be deduced by the presence of the peak at m/z 46 in the mass spectrum? [1]

(ii) What can be deduced by the presence of the peak at m/z 15 in the mass spectrum? [1]

(iii) What can be deduced by the presence of an absorption peak at 3100 to 3500 cm^{-1} in the infrared spectrum? [1]

13(c) **Ethene can be converted into ethanol and ethanol can be converted into ethene.**

For each conversion, state the reagent(s) used and the conditions needed. [4]

ethene to ethanol _____

_____

_____

_____

ethanol to ethene _____

_____

_____

_____

Total [14]

TOTAL SECTION B [70]

END OF PAPER

Question number	Additional page, if required. Write the question numbers in the left-hand margin.

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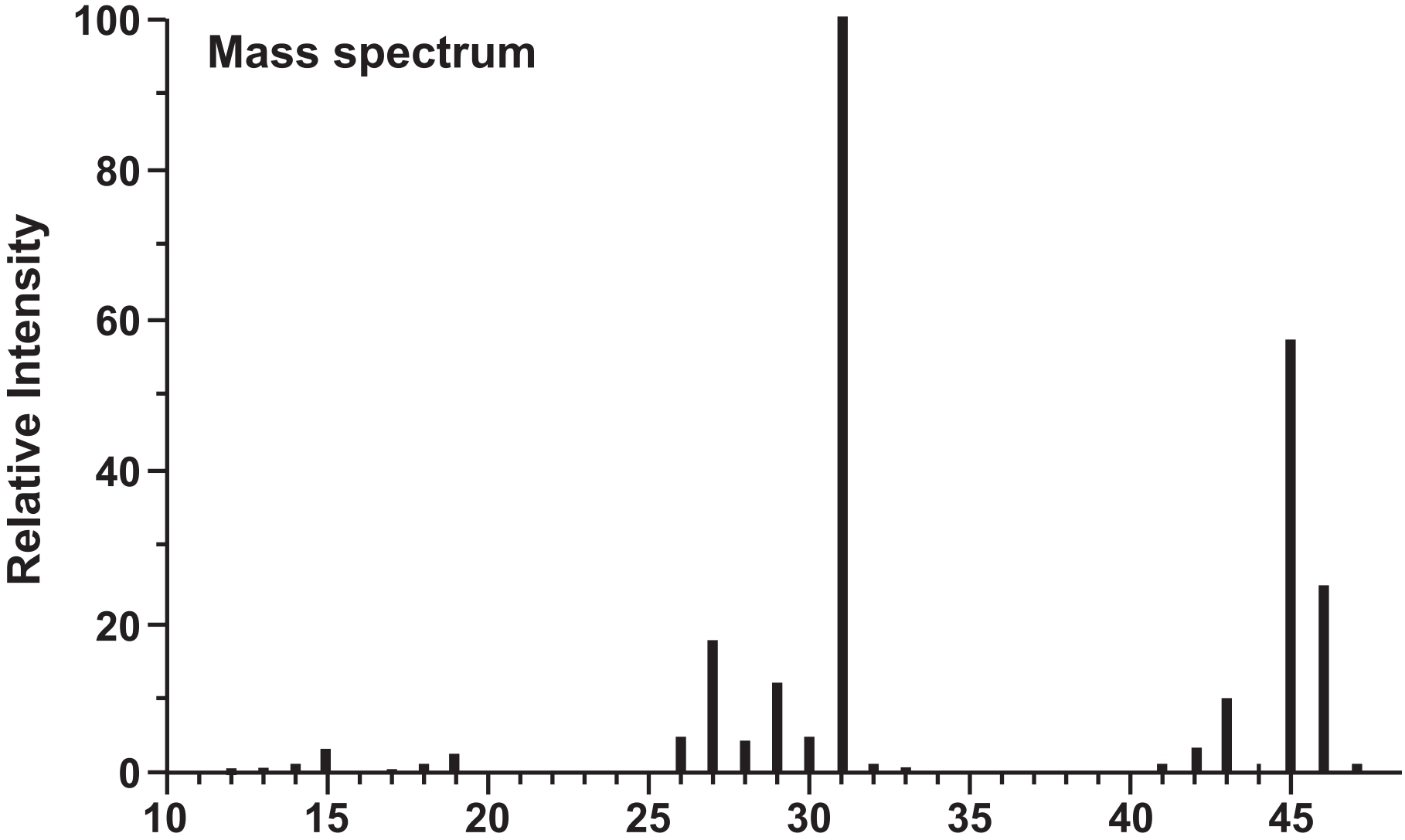
Mass spectrum



Infrared spectrum