

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS
AS LEVEL**

H033/01

**CHEMISTRY B (Salters)
Foundations of chemistry**

**TUESDAY 22 MAY 2018: Morning
TIME ALLOWED: 1 hour 30 minutes
plus your additional time allowance**

MODIFIED ENLARGED 24pt

First name						Last name					
Centre number						Candidate number					

**YOU MUST HAVE:
the Data Sheet for Chemistry B (Salters)**

**YOU MAY USE:
a scientific or graphical calculator**

READ INSTRUCTIONS OVERLEAF



INSTRUCTIONS

Use black ink. HB pencil may be used for graphs and diagrams only.

Complete the boxes on the front page with your name, centre number and candidate number.

Answer ALL the questions.

Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION

The total mark for this paper is 70.

The marks for each question are shown in brackets [].

SECTION A

You are advised to spend no more than 25 minutes on this section.

Answer ALL the questions.

Write your answer to each question in the box provided.

1 What is the correct order of radiation in order of increasing wavelength? [1]

A ultraviolet < visible < infrared

B ultraviolet < infrared < visible

C visible < infrared < ultraviolet

D infrared < visible < ultraviolet

Your answer

2 Which of the following is a cyclic saturated aliphatic compound? [1]

A cyclohexene

B cyclohexane

C benzene

D hexane

Your answer

3 What is NOT a property of hydrogen iodide? [1]

- A It reacts with ammonia.**
- B It is soluble in water.**
- C It is stable to heat.**
- D It reacts with sodium hydroxide.**

Your answer

4 What is the correct order of boiling points with the lowest first? [1]

- A CH_4 CH_3Cl CH_3OH**
- B CH_4 CH_3OH CH_3Cl**
- C CH_3Cl CH_3OH CH_4**
- D CH_3OH CH_3Cl CH_4**

Your answer

5 Which statement about ozone is correct? [1]

- A Ozone is a polluting gas in the stratosphere.**
- B Ozone acts as a sunscreen in the stratosphere.**
- C There is no ozone in the troposphere.**
- D Ozone is an isomer of oxygen.**

Your answer

- 6 A company makes a cleaning product and is looking for a 'greener' method of making the product.**

Which one of the following would the company consider? [1]

- A Finding a reaction with a higher percentage yield.**
- B Finding a reaction with a higher atom economy.**
- C Using more organic solvents.**
- D Using inorganic catalysts rather than enzymes.**

Your answer

- 7 Name the functional group in HCHO. [1]**

- A aldehyde**
- B ketone**
- C alcohol**
- D carboxylic acid**

Your answer

**8 1.0 g of solid carbon dioxide is vaporised.
What volume of gas (in cm³) is produced at RTP? [1]**

A 0.55

B 24

C 550

D 24 000

Your answer

9 What is the percentage of chlorine by mass in magnesium chloride? [1]

A 59%

B 66%

C 74%

D 75%

Your answer

10 Which statement about the reactions of solid halides with concentrated sulfuric acid is correct? [1]

A Chlorides produce HCl as the only gas.

B Bromides produce HBr, Br₂ and H₂S.

C Iodides produce HI, I₂ and SO₂.

D Astatides would be expected to produce HAt only.

Your answer

11 Which statement about electronegativity is correct? [1]

- A Electronegativity is the charge on an element's ion.**
- B If a bond is polar, the two atoms have different electronegativities.**
- C If a molecule has no dipole, all its atoms have the same electronegativity.**
- D Electronegativity increases down a group of the Periodic Table.**

Your answer

☐

12 Which substance does NOT have hydrogen bonding between its molecules? [1]

- A $\text{C}_6\text{H}_5\text{OH}$**
- B CH_3CHO**
- C CH_3COOH**
- D $\text{C}_3\text{H}_7\text{OH}$**

Your answer

☐

13 Which statement about the flame colour of lithium is correct? [1]

A It is yellow.

B It is caused by electrons absorbing visible light.

C It is the result of bright lines in lithium's emission spectrum.

D It follows a pattern of colours in Group 1.

Your answer

14 35 cm^3 of a solution has a concentration of 0.125 mol dm^{-3} . A student calculates the amount (in moles) of solute in this solution.

Which answer is given to the appropriate number of significant figures? [1]

A 4.37×10^{-3}

B 4.375×10^{-3}

C 4.38×10^{-3}

D 4.4×10^{-3}

Your answer

15 Hydrochloric acid reacts with sodium carbonate as shown in the equation.



20 cm³ of 2.0 mol dm⁻³ Na₂CO₃ are added to 20 cm³ 2.0 mol dm⁻³ HCl.

What mass of CO₂ (in g) is produced? [1]

A 0.88

B 1.76

C 22

D 1760

Your answer

16 A sample of gas has a mass of m g and occupies a volume V m³ at a pressure p Pa and temperature T K.

Which expression is correct for the M_r of the gas? [1]

A mRT/pV

B pV/mRT

C pV/RT

D mRT/npV

Your answer

17 Which statement about carboxylic acids is correct? [1]

- A They can be made by oxidising secondary alcohols.**
- B They react with phenols.**
- C They do NOT fizz with sodium carbonate solution.**
- D They form esters when reacted with tertiary alcohols.**

Your answer

☐

18 What is NOT a consequence of hydrogen bonding? [1]

- A Water expands on freezing.**
- B Ethanol is very soluble in water.**
- C Sodium chloride dissolves in water.**
- D H_2O has a higher boiling point than H_2S .**

Your answer

☐

19 Which statement about a lattice of sodium chloride is correct? [1]

- A The ions are the same size.**
- B The attraction between two sodium ions is greater than the repulsion between two chloride ions.**
- C Each sodium ion is surrounded by six chloride ions.**
- D There are more sodium ions than chloride ions.**

Your answer

☐

20 Which row is correct? [1]

	Name	Formula
A	sodium nitride	Na ₃ N
B	aluminium sulfate	AlSO ₄
C	copper(I) oxide	CuO
D	calcium hydroxide	CaOH ₂

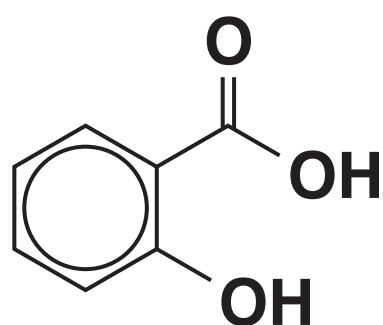
Your answer ☐

SECTION B

Answer ALL the questions.

- 21 Aspirin is a medicine that reduces fever and relieves pain. Some students prepare a sample of aspirin from salicylic acid.

salicylic acid



- (a) Before the students start the preparation, they test the salicylic acid with iron(III) chloride.

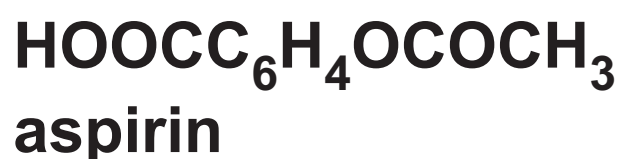
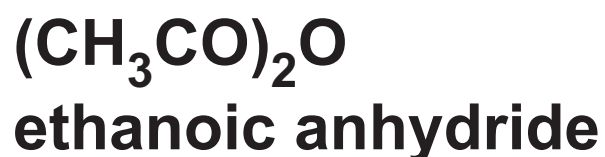
What colour would they see?

_____ [1]

- (b) The students then make aspirin by warming 6.0 g of salicylic acid with 10 cm³ of ethanoic anhydride in the presence of concentrated sulfuric acid.



+



+

.....

- (i) Balance the equation by writing the structural formula of the other product on the dotted line. [1]
- (ii) The density of ethanoic anhydride is 1.1 g cm⁻³.

Calculate the amount (in moles) of ethanoic anhydride used.

amount of ethanoic anhydride = _____ mol [1]

(iii) Which is in excess, the salicylic acid or the ethanoic anhydride? Use the space below. [2]

(c) The students pour their hot solution into water and aspirin crystallises out as the water cools.

The students then look for a suitable solvent to recrystallise the aspirin.

(i) State the properties of a suitable solvent for recrystallisation.

[1]

(ii) Name a method for testing the purity of the aspirin formed.

[1]

(d) After recrystallisation, the students obtained 3.1 g of aspirin.

What value for the percentage yield does this give?

yield = _____ % [2]

(e) Some other students make the liquid ester ethyl ethanoate.

Name the final stage in their purification of the ester.

_____ **[1]**

(f) The students also carry out some tests on phenol, C_6H_5OH .

They find that it is not very soluble in water but fully dissolves when sodium hydroxide solution is added.

A student says that this shows that phenol is acidic and thus it should fizz with sodium carbonate solution.

Comment on the student's statement.

_____ **[2]**

22 In 1875 a French chemist saw two violet lines in an emission spectrum that did not correspond to any known element. He isolated the metal responsible and named it gallium, Ga, after his country.

(a) Explain why each element has a characteristic emission spectrum.

[4]

(b) (i) Complete the electron configuration of gallium, Ga.

$1s^2 2s^2 2p^6 3s^2 3p^6$ _____ [1]

(ii) Describe the shape of an s-orbital. [1]

(iii) Give the charge on the cation of gallium predicted by its position in the Periodic Table. [1]

(c) Gallium forms an anion with chlorine, GaCl_4^- . This is thought to have covalent bonds between a gallium atom and three chlorine atoms and a dative covalent bond from a chloride ion to the gallium atom.

(i) Draw a 'dot-and-cross' diagram of GaCl_4^- . Use the space below. [2]

(ii) Name the shape of GaCl_4^- .

_____ **[1]**

(d) Gallium has two isotopes, ^{69}Ga and ^{71}Ga .
The A_r of gallium is 69.7.

Calculate the relative abundance of ^{69}Ga as a percentage.

relative abundance of ^{69}Ga = _____% [2]

23 Ethene, C_2H_4 , is the simplest alkene and has a wide variety of uses in industry, especially in making polymers.

Ethene is made by the catalytic cracking of longer hydrocarbons, such as those in light naphtha.

(a) Some students are given a supply of liquid light naphtha and they need to obtain some ethene from it. They use aluminium oxide as the catalyst.

(i) Draw a labelled diagram of a suitable apparatus that they could use. Use the space below. [3]

(ii) They test the gas by shaking it with some aqueous bromine.

Describe the colour CHANGE that they would see.

_____ **[1]**

(iii) Draw the mechanism for the reaction of ethene with Br_2 .

Show curly arrows, full charges and the product. Use the space below. [3]

(b) Catalytic cracking uses a heterogeneous catalyst.

(i) State how catalysts work in terms of the activation enthalpy.

_____ [1]

(ii) The students research a simple model of the function of a heterogeneous catalyst.

Name the way the hydrocarbon molecules in light naphtha first attach to the catalyst surface.

_____ [1]

(c) Ethene can be converted to chloroethene, C_2H_3Cl .

(i) Draw the SKELETAL formula for chloroethene. Use the space below. [1]

(ii) A student says that chloroethene shows 'cis-trans' isomerism.

Is the student correct? Explain your answer.

_____ **[1]**

24 Some students research nitrogen oxides as air pollutants.

(a) Name the main polluting effect of NO₂ in the atmosphere.

_____ **[1]**

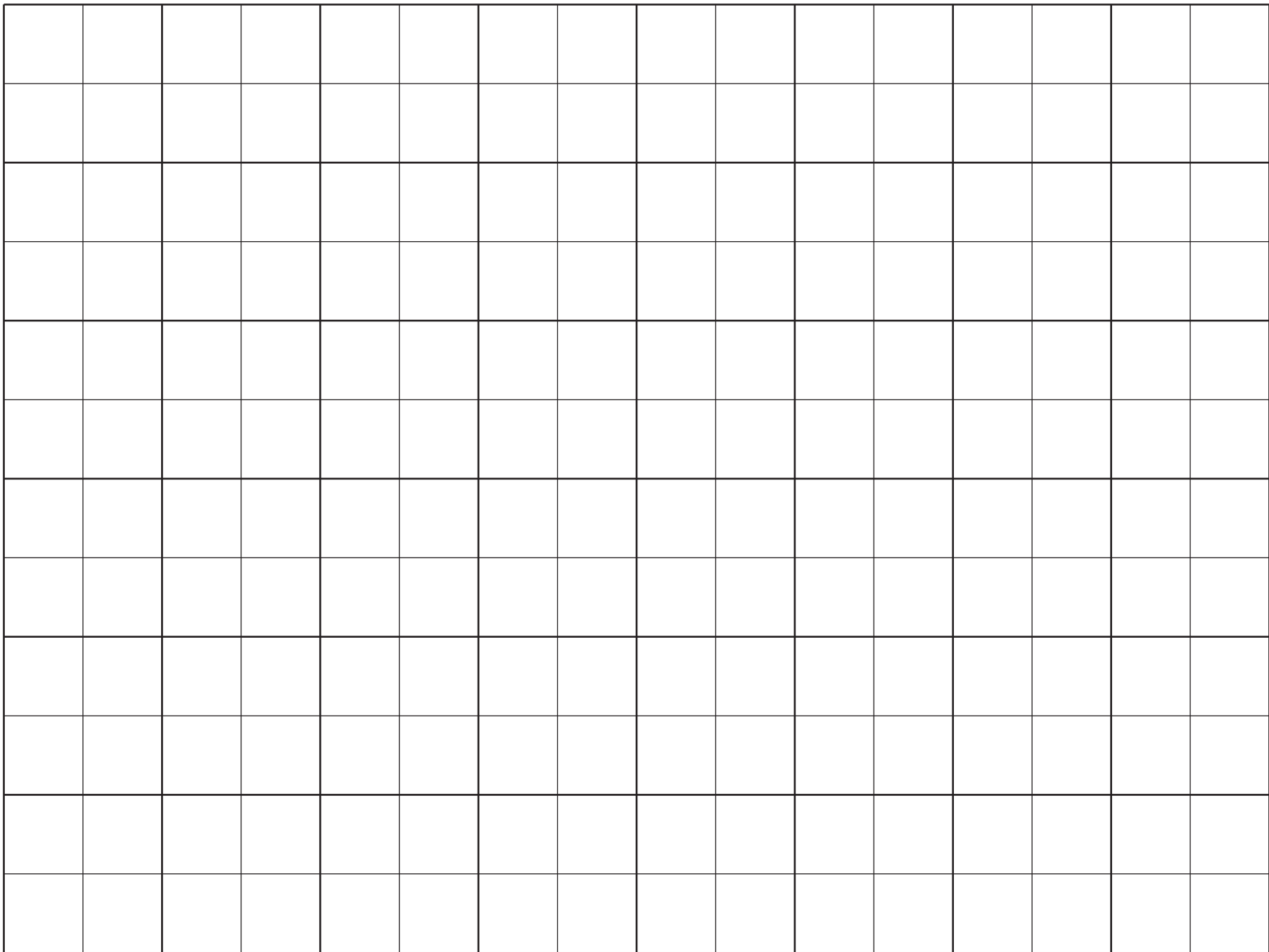
(b) The students look up some data for the experimentally measured rates of the reaction shown below.



Their data are shown in the table below.

<i>T</i>/K	Relative rate
592	1.0
604	1.4
628	3.2
650	8.0
658	10.4

Plot a graph of relative rate against temperature and use it to work out the relative rate when the temperature is 615K.

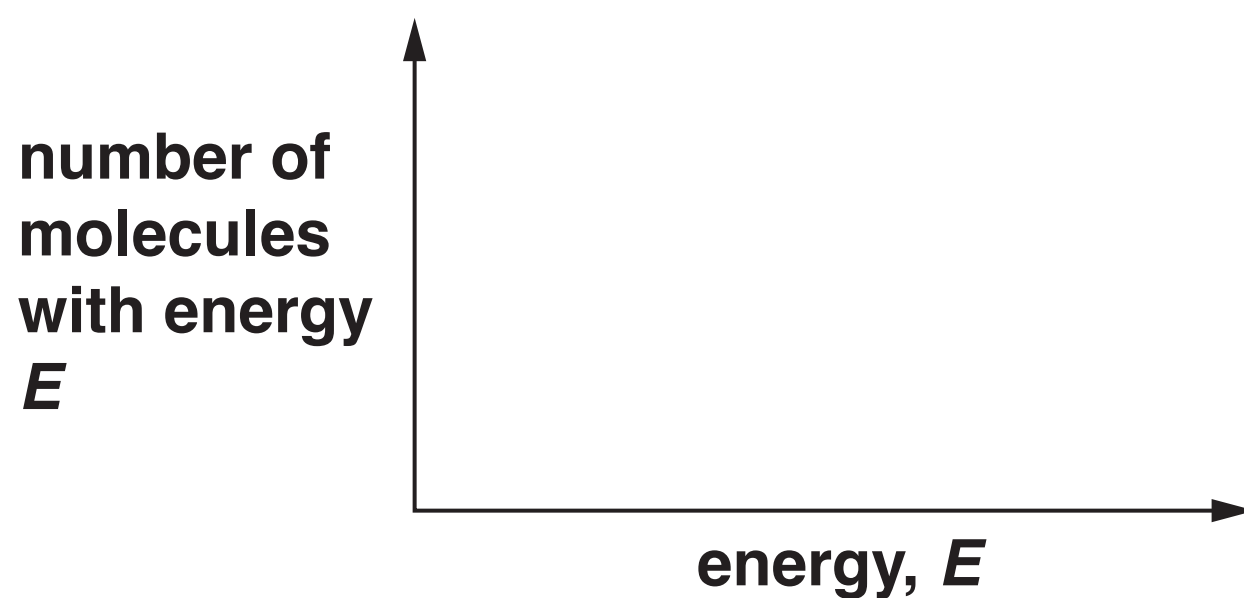


relative rate at 615 K = _____ [3]

(c) Draw two Boltzmann distributions at different temperatures on the axes below.

Use your diagram to explain why the rate of reaction increases with temperature.

Label your diagram.



[3]

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(d) The students then consider the reaction that occurs in lightning flashes:



(i) Complete the expression for the equilibrium constant, K_c , for this reaction. [1]

$K_c =$

(ii) A student says that, when equilibrium is reached in EQUATION 24.1:

the rates of the forward and back reactions are equal

the concentrations of NO, O₂ and NO are equal.

Comment on these statements, giving the correct chemistry where necessary.

[2]

[5]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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