Section A

Answer **all** questions.

Write your answers in the boxes provided at the end of the Section.

1 Which of the following shows the processes used to separate solid potassium nitrate crystals from sand?

A dissolve in water → evaporate the filtrate → crystallise → filter

B dissolve in water → filter → evaporate the filtrate → crystallise

C filter → dissolve in water → evaporate the filtrate → crystallise

D filter → evaporate the filtrate → dissolve in water → crystallise

2 Which of the following shows the correct ionic equation for the reaction between dilute nitric acid and zinc metal?

A $2H^+ + Zn \rightarrow H_2 + Zn^{2+}$

B $H^+ + OH^- \rightarrow H_2O$

C $Zn^{2+} + 2NO_3^- \rightarrow Zn(NO_3)_2$

D $Zn^{2+} + 2H^+ \rightarrow H_2 + Zn$

3 Titration of an acid against a base is a method often used in the preparation of salts.

Which properties of the acid, the base and the salt are required if this method is to be used?

	acid	base	salt
A	insoluble	insoluble	insoluble
B	soluble	insoluble	insoluble
C	soluble	soluble	insoluble
D	soluble	soluble	soluble

4 A mixture of three liquids is separated by fractional distillation.

Which statements are correct?

1 The liquid with the highest boiling point is collected first.

2 The liquid with the lowest boiling point is collected first.

3 The mixture boils at a constant temperature throughout the separation.

4 The temperature at which the mixture boils increases during the separation.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

5 The table below shows information about three indicators.

indicator	colour change	pH at which colour changes
methyl yellow	red to yellow	3
bromocresol green	yellow to blue	5
thymolphthalein	colourless to blue	9

Which one of the following colours would be obtained for each indicator if it were added separately to pure water?

	methyl yellow	**bromocresol green**	**thymolphthalein**
A	red	blue	blue
B	red	yellow	blue
C	yellow	blue	colourless
D	yellow	yellow	colourless

Question	**1**	**2**	**3**	**4**	**5**
Answer					

For Examiner's Use

Section B

Answer **all** questions.
Write your answers in the spaces provided.

6 Choose from the following substances to answer the questions.

Al_2O_3

NaCl

N_2

$Pb(NO_3)_2$

SO_2

Each substance may be used once, more than once or not at all.

Select from the list above,

(a) the amphoteric oxide(s).

……..……..…… [1]

(b) the acidic oxide(s).

……..……..…… [1]

(c) the compound that will react with dilute hydrochloric acid to form a precipitate.

……..……..…… [1]

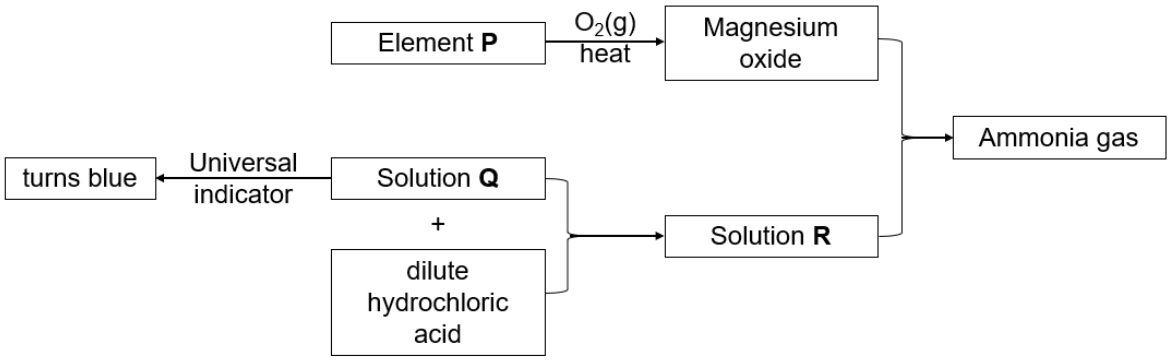
(d) the compound that can be prepared by titration.

……..……..…… [1]

[Total: 4]

For Examiner's Use

7 Study the reaction scheme below.



(a) Write down the identities of **P**, **Q** and **R**.

P : ……...

Q : ……...

R : ……... [3]

(b) Ammonia gas can also be made industrially by reacting nitrogen with hydrogen via the Haber process. The conditions required for this reaction are 450 ^{o}C and 250 atm with finely-divided iron as the catalyst. The reaction is reversible.

(i) Write the chemical equation for the formation of ammonia via the Haber process.

[2]

(ii) State the source of either nitrogen or hydrogen.

……

…… [1]

[Total: 6]

For Examiner's Use

Section C

Answer **all** questions.

Write your answers in the spaces provided.

8 Acids in our daily lives

Acids are an important part of our everyday lives. Our muscles produce lactic acid, the vinegar we use in our cooking is ethanoic acid, and citric acid is found in the citrus fruits we eat.

In addition, the human stomach secretes gastric juice, which contains hydrochloric acid at relatively high concentrations. This strong acid can break down many substances ingested causing them to be absorbed into our blood stream. Although this reaction is important biologically, it has its threats. One example is 'barium poisoning' caused by ingesting these metals or their compounds unknowingly. These compounds react with the gastric juices in our stomach producing aqueous barium ions which are highly poisonous.

Dissociation of acids

***p*K_a** *(*acid dissociation constant*)* is the measure of the extent to which an acid dissociates/ionises. The larger the pK_a value, the less dissociation/ionisation of the molecules occurs in solution and thus the weaker the acid.

The table below shows the pK_a values of some acids, and the volume of carbon dioxide produced after 1 g of calcium carbonate is reacted with the acid for 1 minute.

	***p*K_a**	**volume of CO_2 produced/cm^3**
ethanoic acid	4.7	2.32
citric acid	3.1	4.02
lactic acid	3.9	3.62
carbonic acid	6.3	0.95

Table 8.1

(a) High concentrations of aqueous barium ions found in the stomach can cause 'barium poisoning' because it will affect the nervous system and could result in paralysis. Yet a 'barium meal' containing barium sulfate is often given to patients for consumption before X-ray imaging procedure is carried out.

(i) Use ideas about solubility to explain why a 'barium meal' is not poisonous and can be fed to patients.

……

…… [1]

(ii) Explain why barium carbonate must **not** be substituted for barium sulfate in a 'barium meal'.

……

……

…… [2]

(b) Describe a test and the results to confirm the identity of carbon dioxide gas.

……

…… [2]

(c) **(i)** Explain how the ionisation in a weak acid differs from the ionisation of a strong acid, such as dilute hydrochloric acid.

……

……

……

…… [2]

(ii) A student commented that pH is similar to *pKa* in terms of the way their values change in strong or weak acids.

Using the information from **(c)(i)** and the passage above, **circle** the correct description of *pH* and *pKa* in a solution of a strong and weak acid.

	pH	*pKa*
strong acid	high / low	high / low
weak acid	high / low	high / low

[2]

(d) Using information from the passage and Table 8.1, suggest which acid is the weakest and explain your reasoning.

……

……

……

……

…… [3]

(e) Litmus papers are commonly used to test for the pH of various substances.

Suggest why carbon monoxide has no effect on litmus papers.

…… [1]

[Total: 13]

For Examiner's Use

9 Lavandulol is found in lavender plants. Figure 9.1 shows the formula of a lavandulol molecule.

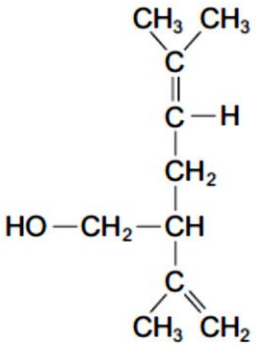


Figure 9.1

Lavandulol can be extracted from lavender flowers using the apparatus shown below. The lavandulol is carried off in small droplets with the steam.

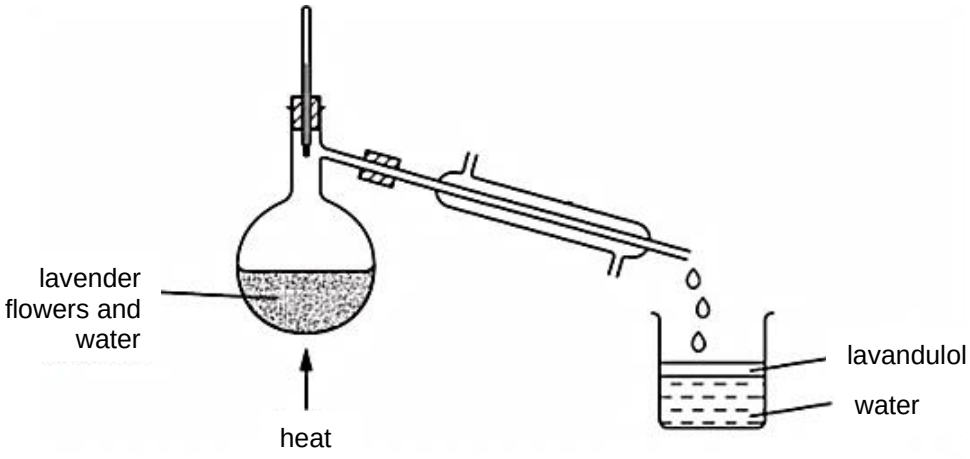


Figure 9.2

(a) Using arrows, indicate and label the 'water in' and 'water out' on the condenser in Figure 9.2. [1]

(b) The lavandulol and water are collected in the beaker.

Suggest how lavandulol can be further separated from the water and explain your reasoning.

……

…… [2]

For Examiner's Use

(b) Lavender flowers contain a variety of different pigments (colourings). A student separated these pigments using a two-way paper chromatography in two different solvents **A** and **B** as shown in Figure 9.3.

Figure 9.3.1 shows the first chromatogram which was the separation of lavender flower with solvent **A** (conventional chromatography).

Figure 9.3.2 shows the second chromatogram which was the separation using the same chromatogram but after it has been rotated anticlockwise 90° in another solvent **B**.

The results are shown in the diagrams below.

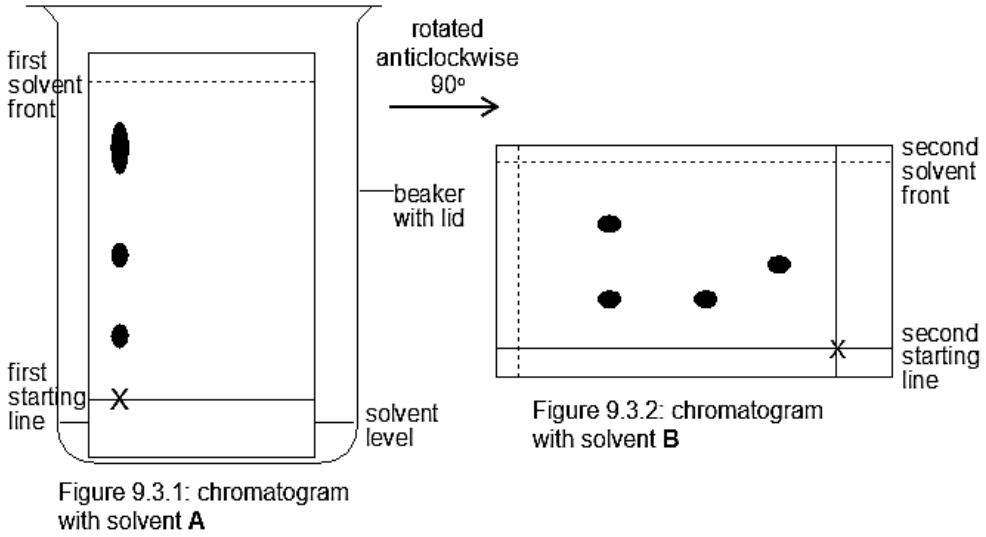


Figure 9.3.1: chromatogram with solvent **A**

Figure 9.3.2: chromatogram with solvent **B**

Figure 9.3

(i) How many different pigments (colourings) are there in the lavender flowers as shown from both the chromatograms?

…….. [1]

(ii) Comment on the advantage of using a two-way chromatography versus the conventional chromatography.

……..……..…

……..……..……

……..……..…… [2]

(iii) Calculate the R_f value of the least soluble pigment (colouring) found in Figure 9.3.1. Give your answer to 2 decimal places.

[1]

[Total: 7]

End of Paper