

LEVEL 3 CAMBRIDGE TECHNICAL IN APPLIED SCIENCE

05848/05849/05874

Unit 3: Scientific analysis and reporting

Time allowed: 2 hours plus your additional time allowance

You must have:

a ruler

a copy of The Periodic Table

You may use:

a scientific or graphical calculator

Modified Enlarged 18 pt

Please write clearly in black ink.

**Centre
number**

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

**Candidate
number**

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

First name(s)

Last name _____

Date of Birth

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| D | D | M | M | Y | Y | Y | Y |
|---|---|---|---|---|---|---|---|

INSTRUCTIONS

Use black ink.

Answer ALL the questions.

If additional answer space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

The Periodic Table is provided separately.

INFORMATION

The total mark for this paper is 100.

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

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

Answer ALL the questions.

1 A group of patients are anaemic.

They have regular blood tests to monitor the number of platelets in their blood.

The results of the blood tests are shown in TABLE 1.1.

TABLE 1.1

| PATIENT | PLATELET COUNT |
|----------------|-----------------------|
| 1 | 105 |
| 2 | 92 |
| 3 | 81 |
| 4 | 86 |
| 5 | 110 |
| 6 | 98 |
| 7 | 101 |
| 8 | 92 |
| 9 | 92 |
| 10 | 83 |
| 11 | 102 |

(a) Identify the mode of the platelet count in TABLE 1.1.

_____ [1]

(b) Calculate the median of the platelet count in TABLE 1.1.

_____ [1]

(c) Calculate the mean of the platelet count in TABLE 1.1.

Give your answer to 2 significant figures.

Show your working.

mean = _____ [2]

- (d) The formula below can be used to calculate the standard deviation of the platelet count data in TABLE 1.1.

$$\text{standard deviation } s = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (x_i - \bar{x})^2}$$

N is the number of blood tests to measure the platelet count

x_i is the platelet count

\bar{x} is the mean platelet count calculated in (c).

Use the formula above to calculate the standard deviation for the data in TABLE 1.1.

Give your answer to 1 decimal place.

Show your working.

standard deviation $s =$ _____ [6]

- (e) (i) Calculate $\bar{x} + s$.

$\bar{x} + s =$ _____ [1]

(ii) Calculate $\bar{x} - s$.

$$\bar{x} - s = \underline{\hspace{4cm}} \quad [1]$$

(iii) Use your answers to (e)(i) and (e)(ii) to determine the percentage of platelet counts that are within one standard deviation of the mean.

Show your working.

percentage of platelet counts within one
standard deviation = $\underline{\hspace{4cm}}$ % [2]

(f) The platelet count in TABLE 1.1 is in an abbreviated form.

A true platelet count is the number of platelets per microlitre of blood.

A normal platelet count is 300 000 platelets per microlitre of blood.

Calculate the number of platelets in one litre of normal blood.

1 microlitre = 0.000001 litres

Give your answer in standard form.

number of platelets in one litre of normal blood = _____ [2]

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

- 2 The concentration of sugar in the leaves of cereal plants varies with the time of day.**

TABLE 2.1 shows results from an experiment analysing sugar concentration in leaves.

TABLE 2.1

| Time of day (h) | 04:00 | 08:00 | 12:00 | 16:00 | 20:00 |
|--|--------------|--------------|--------------|--------------|--------------|
| Sugar concentration (percentage of dry leaf mass) | 0.44 | 0.70 | 1.75 | 2.00 | 1.40 |

- (a) Plot a graph of the results in TABLE 2.1 and draw a curve of best fit. [4]**



- (b) Use your graph to estimate the sugar concentration at 10:00.

sugar concentration = _____
percentage of dry leaf mass [1]

- (c) Use your graph to predict the sugar concentration at 22:00.

sugar concentration = _____
percentage of dry leaf mass [1]

- (d) (i) Calculate the gradient of the graph at 08:00.

Give the units.

Show your working.

gradient = _____ units = _____ [4]

- (ii) Describe how the gradient of the graph changes between 04:00 and 10:00.

_____ [1]

- (iii) Describe how the gradient of the graph changes between 12:00 and 16:00.

_____ [1]

3 Keys can be used for the identification of living organisms.

TABLE 3.1 shows some characteristics of native British plants.

TABLE 3.1

| Plant species | Form of reproduction | Presence of roots | Plant height (cm) | Other features |
|-------------------------------|-----------------------------|--------------------------|--------------------------|------------------------------------|
| Selaginella kraussiana | Spore | No | 15 | Scale-like leaves |
| Equisetum telmateia | Spore | Yes | 40 | Fine grooves in stems |
| Equisetum palustre | Spore | Yes | 60 | Deep grooves in stems |
| Marchantia polymorpha | Spore | No | 10 | No true leaves |
| Lolium perenne | Seed | Yes | 90 | Hollow seeds, rounded stems |
| Agropyron repens | Seed | Yes | 120 | Hollow seeds, rounded stems |
| Carex capillaris | Seed | Yes | 20 | Solid seeds, 3-sided stems |
| Carex hirta | Seed | Yes | 70 | Solid seeds, 3-sided stems |

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

- (a) FIG. 3.1 opposite shows a key to identify the different plant species in TABLE 3.1.

Use the data in TABLE 3.1 to complete the blank spaces in the key.

Some of the key has already been completed. [7]

(b) Plants are often known by their common names.

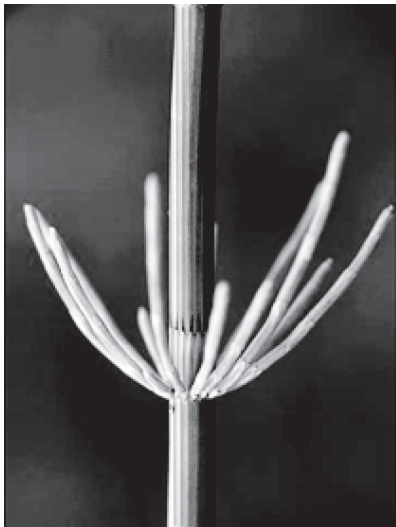
Horsetails, liverworts and mosses are the common names for three types of plant.

They produce spores during reproduction.

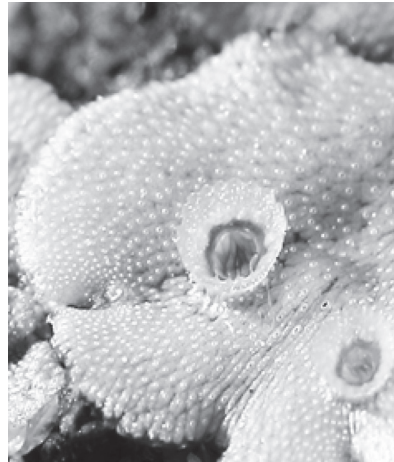
An example of each plant is shown in the photographs in FIG. 3.2.

FIG. 3.2

Horsetail



Liverwort



Moss



- (i) Draw a line from the Latin name to the common name to identify the plants.

Use the information in TABLE 3.1, FIG. 3.1 and FIG. 3.2 to help you. [2]

| LATIN NAME | COMMON NAME |
|---------------------------|-------------|
| Equisetum palustre | Horsetail |
| Marchantia polymorpha | Moss |
| Selaginella kraussiana | Liverwort |

- (ii) FIG. 3.2 shows one type of primary data.

State another source of primary data to be used in the classification of plants.

[1]

(c) (i) Define the term BINOMIAL NOMENCLATURE.

[2]

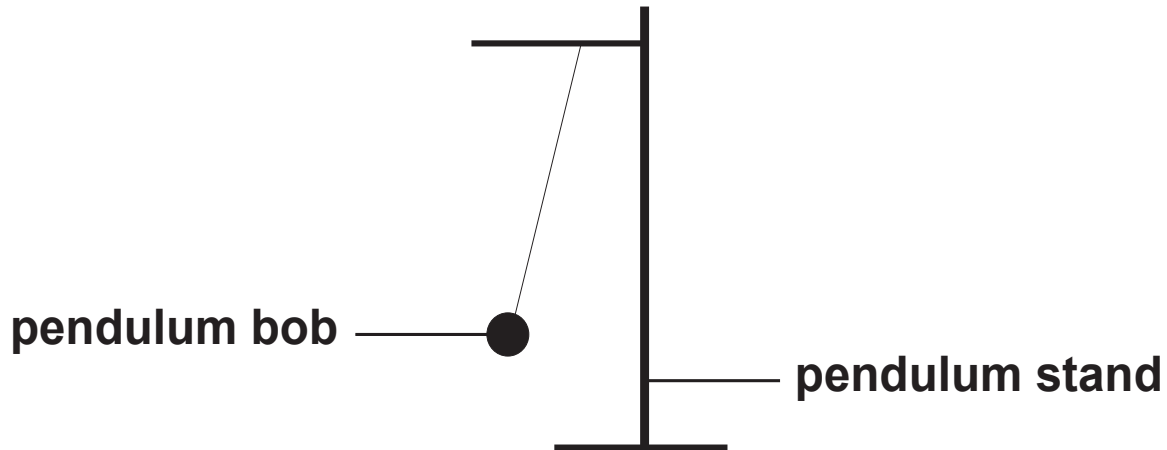
(ii) Suggest why binomial nomenclature is used in the classification of plants.

[4]

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

4 Beth is investigating the time period for a simple pendulum (FIG. 4.1) to swing from left to right.

FIG. 4.1



She records the time taken for the heavy pendulum bob to swing from a set point.

She repeats the swing four times for each of four experiments, A, B, C and D.

The results of her four experiments are shown in TABLE 4.1.

TABLE 4.1

| Experiment | Time period (s) for a simple pendulum | | | |
|------------|---------------------------------------|-------------|-------------|-------------|
| | Repeat | | | |
| | 1 | 2 | 3 | 4 |
| A | 48.5 | 53.0 | 49.5 | 51.0 |
| B | 45.6 | 47.0 | 45.0 | 46.5 |
| C | 45.5 | 46.2 | 54.5 | 48.5 |
| D | 50.5 | 51.0 | 50.0 | 49.5 |

(a) The **TRUE VALUE** of the period of the pendulum is **50.5 s**.

(i) Which experiment, A, B, C or D, is precise and accurate? [1]

(ii) Which experiment, A, B, C or D, is precise but **NOT** accurate? [1]

(iii) Which experiment, A, B, C or D, is accurate but **NOT** precise? [1]

(iv) Which experiment, A, B, C or D, is **NOT** precise or accurate? [1]

(b) Determine the range of the times recorded in Experiment C.

Show your working.

range = _____ s [2]

(c) Suggest what Beth should specify to make her investigation **REPEATABLE**.

[2]

(d) Time was measured in this investigation.
Beth started and stopped a stopwatch.
This introduced a source of error.

(i) Describe the **CAUSE** of this error.

[1]

(ii) What type of error is caused when a person starts and stops a stopwatch?

Tick (✓) **ONE** box. [1]

Measurement error

☐

Random error

☐

Systematic error

☐

(iii) Explain your answer to d(ii).

[1]

- (e) The reading on a stopwatch lies between a minimum time value and a maximum time value.

The manufacturer states that the stopwatch has an accuracy of 0.3%.

The stopwatch shows a reading of 1000.0 s.

- (i) Calculate the minimum and maximum time values.

minimum = _____ s

maximum = _____ s
[3]

- (ii) What TYPE of error is due to the accuracy of the stopwatch?

Tick (✓) ONE box. [1]

Measurement error

☐

Random error

☐

Systematic error

☐

- 5 Amir is carrying out an investigation using voice recognition software to display sounds as wave forms on a computer screen.**

He asks two of his friends to say a single-syllable word into a microphone.

Each wave form is recorded as a trace on the computer screen.

FIG. 5.1 opposite shows the trace recorded for each of Amir's friends.

- (a) The horizontal axis of each trace shows the time taken to speak the single-syllable word.**

Amir concludes that the same word was spoken by both of his friends.

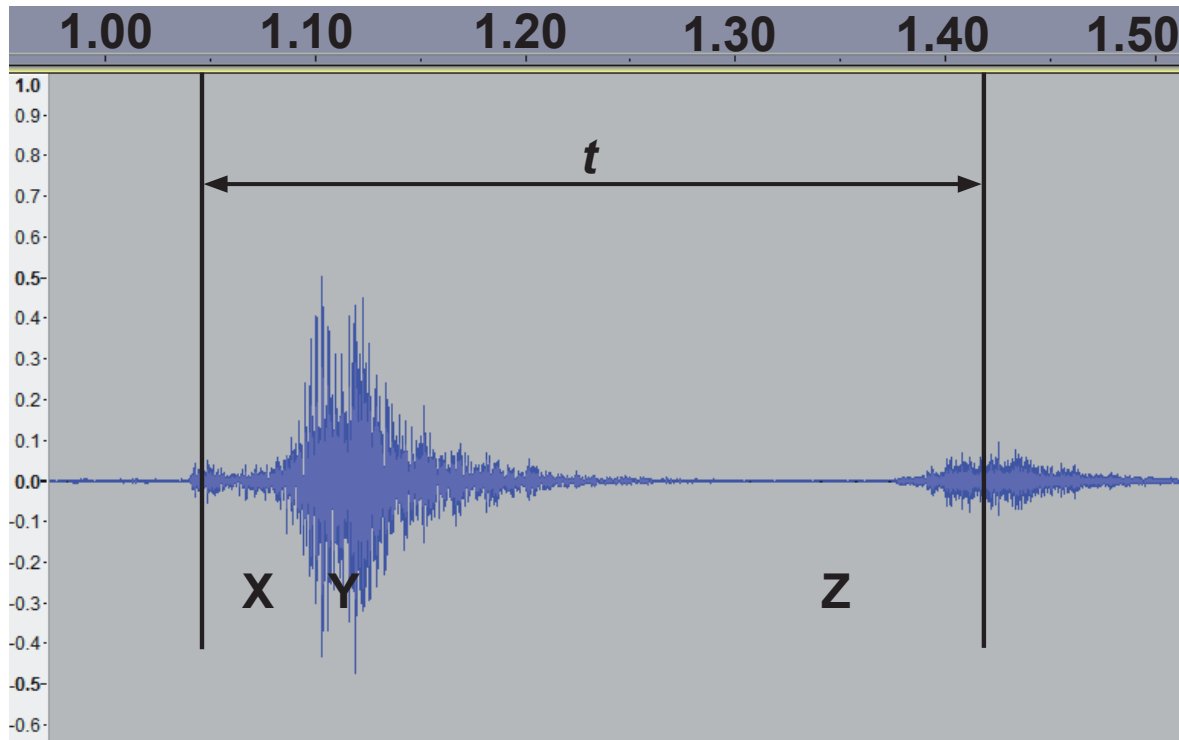
Do you agree with Amir's conclusion?

Use TRACES 1 and 2 to explain your answer.

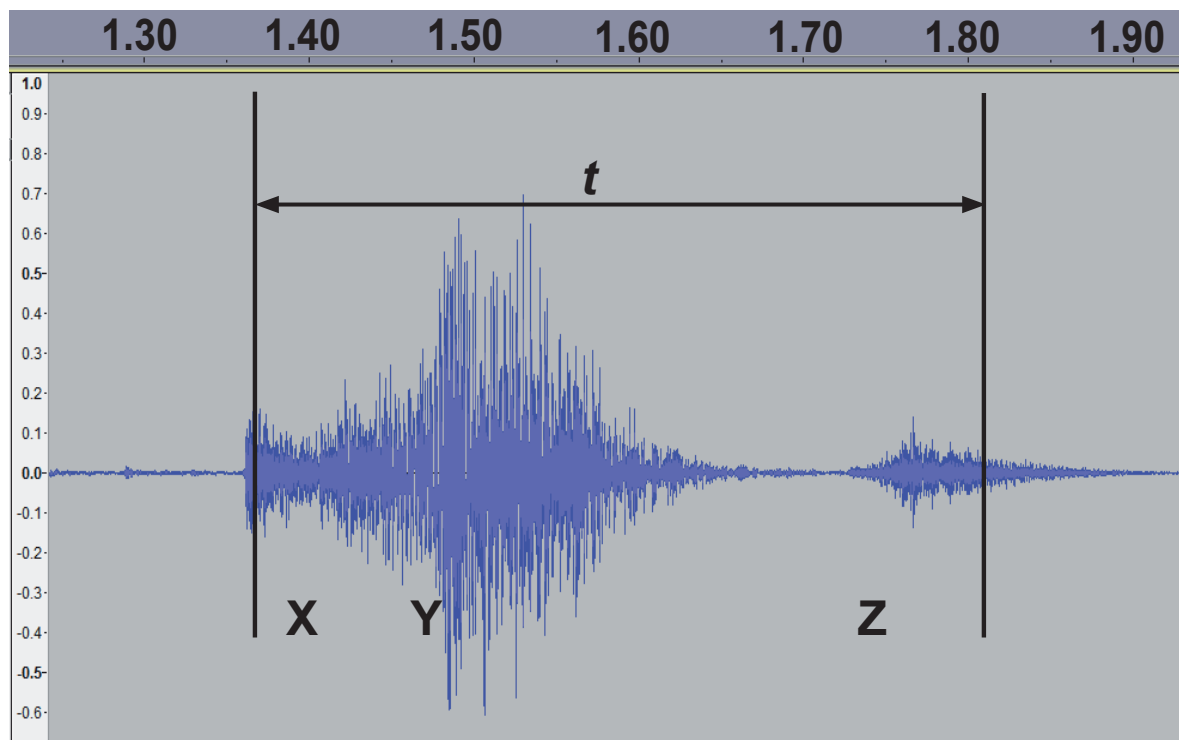
[2]

FIG. 5.1

TRACE 1



TRACE 2



- (b) The voice recognition software used by Amir also gives a frequency analysis of each trace.**

Frequency, in Hertz (Hz), is plotted against the loudness of the sound, in decibels (dB).

Amir recorded the frequency of the sounds produced by three different friends on a computer screen when they said the same word.

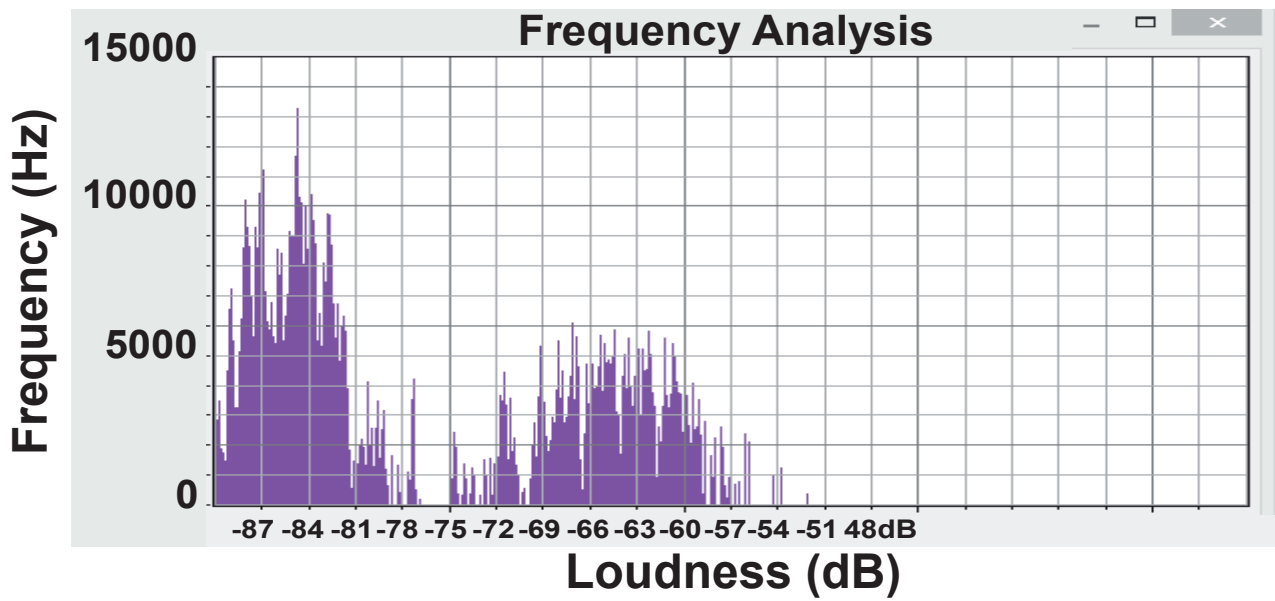
The results of the frequency analysis are shown as three traces in FIG. 5.2 opposite.

Compare the three traces in FIG. 5.2 to describe how they confirm that the same word was spoken and describe why the traces are not identical.

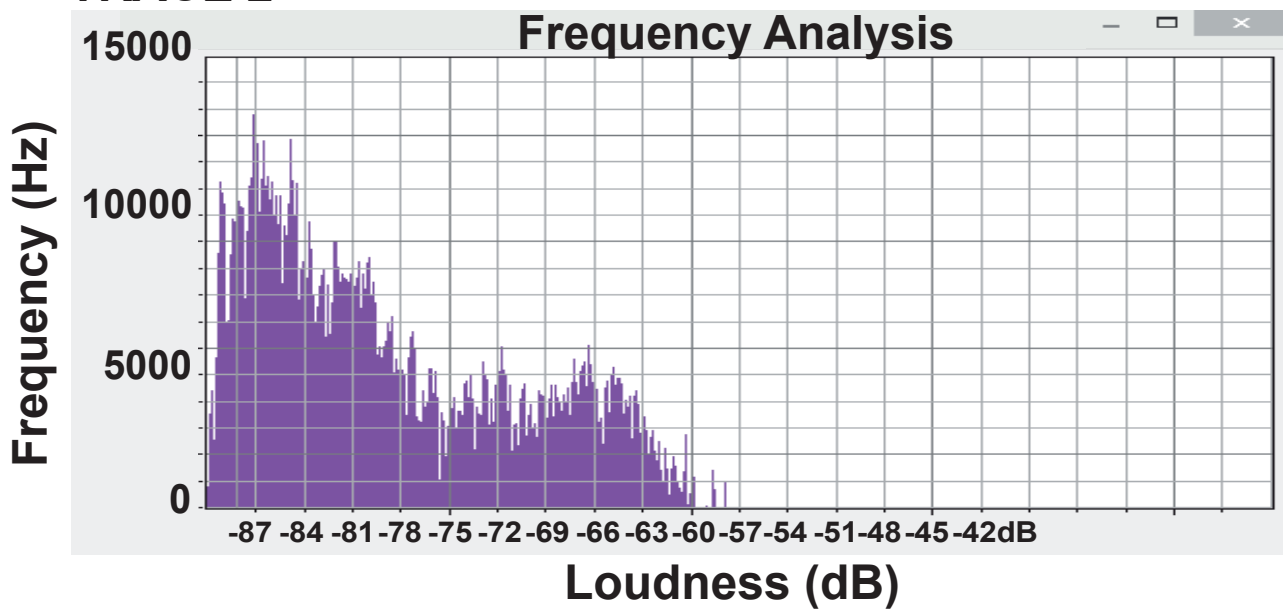
[6]

FIG. 5.2

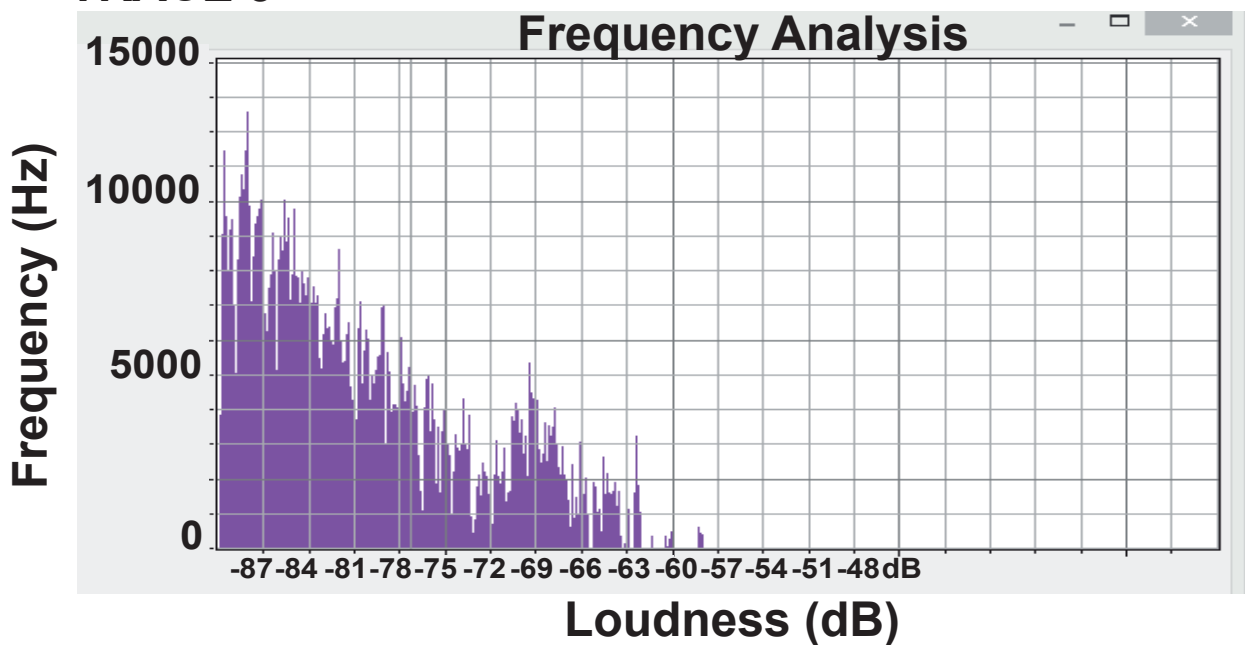
TRACE 1



TRACE 2



TRACE 3



(c) The data shown in FIG. 5.1 and FIG. 5.2 are primary data.

(i) Describe ONE feature of primary and secondary data.

Primary data _____

Secondary data _____

_____ [2]

(ii) Suggest THREE advantages of using secondary data.

1 _____

2 _____

3 _____

[3]

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

6 Scientific findings are shared with a wide range of people.

Scientific authors can be either public information scientists or scientific journalists.

- (a) For each type of author in TABLE 6.1 put a tick (✓) in the correct box to indicate if they are public information scientists or scientific journalists. [7]

TABLE 6.1

| Type of author | Public information scientist | Scientific journalist |
|--------------------------------|------------------------------|-----------------------|
| University scientist | | |
| Scientific book authors | | |
| Government scientific agencies | | |
| Newspaper article authors | | |
| Scientific companies | | |
| TV programme producers | | |
| Blog author | | |

- (b) When writing a scientific report it is important to consider the audience that the report is written for. Suggest **THREE** different audiences that scientific reports can be written for.

1 _____

2 _____

3 _____

[3]

- 7 Iron tablets are used to treat people with a low level of iron in their blood.**

The active ingredient in iron tablets is iron(II) sulfate, FeSO_4 .



- (a) Susan carries out a titration to check the mass of iron in an iron tablet.**

She follows three key steps.

STEP 1 - The iron tablet is ground to a fine powder using a pestle and mortar and transferred to a conical flask.

STEP 2 - 100 cm^3 of dilute sulfuric acid is added to the powder, and then the flask is shaken until the iron tablet dissolves.

STEP 3 - A few drops of indicator are added and the solution is titrated with $0.010 \text{ mol dm}^{-3}$ potassium dichromate.

Susan records the initial and final burette readings as part of the titration, and calculates the volume needed to reach the end-point.

She obtains the results shown in TABLE 7.1.

TABLE 7.1

| | |
|--|--------------|
| Initial burette reading (cm³) | 0.10 |
| Final burette reading (cm³) | 19.00 |
| Volume of 0.010 mol dm⁻³ potassium dichromate added (cm³) | 18.90 |

- (i) Calculate the number of moles of potassium dichromate required to react with the iron in the tablet.

Use the equation:

$$\text{number of moles} = \frac{\text{concentration (mol dm}^{-3}\text{)} \times \text{volume (cm}^3\text{)}}{1000}$$

number of moles = _____ [2]

- (ii) In the titration, 6 moles of iron(II) ions react with 1 mole of dichromate ions.

Calculate the number of moles of iron in the tablet.

Use your answer from (a)(i).

number of moles = _____ [1]

- (iii) The relative atomic mass of iron is 55.8.

Calculate the mass, in mg, of iron in the tablet.

Use the equation:

mass (g) = number of moles \times relative atomic mass

Use your answer from (a)(ii).

Give your answer to 3 significant figures.

mass of iron = _____ mg [4]

- (iv) The bottle of iron tablets states that EACH tablet contains 65 mg.

Calculate the error in Susan's value from a(iii) as a percentage of the value shown on the bottle.

percentage error = _____ % [2]

- (v) Susan considers using a spectrophotometer to determine the mass of iron in the tablet.

Suggest ONE advantage and ONE disadvantage of using a spectrophotometer rather than completing a titration.

Advantage _____

Disadvantage _____

[2]

(b) Chromatography can be used to purify (prepare) a chemical for further use or to quantify the amount of a chemical present.

(i) Complete the sentences below using words from this list.

Each word may be used once, more than once or not at all. [3]

elution protonometry scraping
radiology nephrology

Preparative samples can be obtained from column chromatography by

_____ .

Preparative samples from thin layer chromatography (TLC) can be obtained by

_____ or

_____ .

- (ii) **Densitometry** can be used to quantify the amount of substance separated on a TLC plate.

Complete the sentences below using words from this list.

Each word may be used once, more than once or not at all. [4]

scanned

intensities

less

protracted

cyclons

greater

calibration

wavelengths

similar

A beam of light is _____
across the TLC plate.

Different chemicals absorb specific
_____ of light.

The more substance present, the
_____ the amount of light
absorbed. The amount of substance present can be
estimated by comparing the absorption of the spot
with a _____ graph.

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s) – for example 1(a) or 2(b).

[illegible]



Copyright Information:

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, OCR (Oxford Cambridge and RSA Examinations), The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.

OCR is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.