OCR
Oxford Cambridge and RSA

Wednesday 18 January 2023 – Afternoon

Level 3 Cambridge Technical in Applied Science

05874 Unit 23: Scientific research techniques

Time allowed: 2 hours
C344/2301

C344/2301

You must have:
- your copy of the Pre-release

You can use:
- a scientific or graphical calculator
- an HB pencil

05874

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

Date of birth | D | D | M | M | Y | Y | Y | Y |

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- At the end of the exam, hand in your pre-release notes with your exam paper.
- Use the Pre-release to answer Questions **4** and **5**.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **16** pages.

ADVICE
- Read each question carefully before you start your answer.

Answer **all** the questions.

1 All plants, including plants for human food, absorb metals from the soil.

Some of these metals are toxic to humans so there are legal limits to the amounts of these metals in food.

Amir is a food technologist. His team is developing a range of vegan products that are meat-like in flavour and texture. He must ensure that the process of making these products does not result in excess toxins in the food.

Amir wants to explore the use of different analytical techniques to detect the presence of these toxins in food.

He reads some different pieces of information from a range of secondary sources.

Table 1.1 shows different types of sources.

Table 1.1

Source type	**Letter**
Media	A
Government regulations	B
Published scientific research	C
Trade website	D
Journal (scientific)	E
Scientific website	F
Scientific research institution	G

Use **Table 1.1** to identify which type of source has been used for each piece of information given in **Table 1.2**.

Write **one** source type letter **A**, **B**, **C**, **D**, **E**, **F**, or **G** in each row of **Table 1.2**.

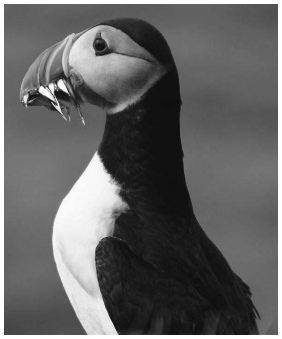
You may use each letter once, more than once, or not at all.

Table 1.2

Information	**Source type letter**
Our laboratory is a leading centre for contaminant analysis serving the food industry. We determine and quantify the presence of metals contained in food using appropriate analytical techniques, such as atomic absorption spectroscopy (AAS) with accredited methods and trained personnel. We have a special introductory offer available for those organisations choosing to use our service during the next 28 days.	.....
Food crops are one of the important parts of our diet, and they may contain a number of essential and toxic metals (Yang et al. 2011; Waqas et al. 2015) depending on growing media characteristics.	.....
The foodstuffs listed shall not be placed on the market where they contain a contaminant listed therein at a level exceeding the maximum level allowed.	.....
The World Health Organization (WHO) has called for data on heavy metals (lead) in cereal-based foods and ready-to-eat meals for infants and young children to be made public.	.....
iCE 3300 AAS Atomic Absorption Spectrometer. A simple, versatile single atomizer AAS with fully automatic gas box. A complete solution for laboratories with a main need to perform flame analysis but with occasional furnace samples.	.....
Atomic absorption spectrophotometers are used in many industries including environmental testing, metal analysis, semiconductor manufacturing, petroleum and chemical production, and in pharmaceuticals, for example. www.labcompare.com	.....
Trace Element Uptake and Distribution in Plants Robin D. Graham, James C. R. Stangoulis Nutrition, Volume 133, Issue 5, May 2003, Pages 1502S–1505S, https://doi.org/10.1093/jn/133.5.1502S	.....

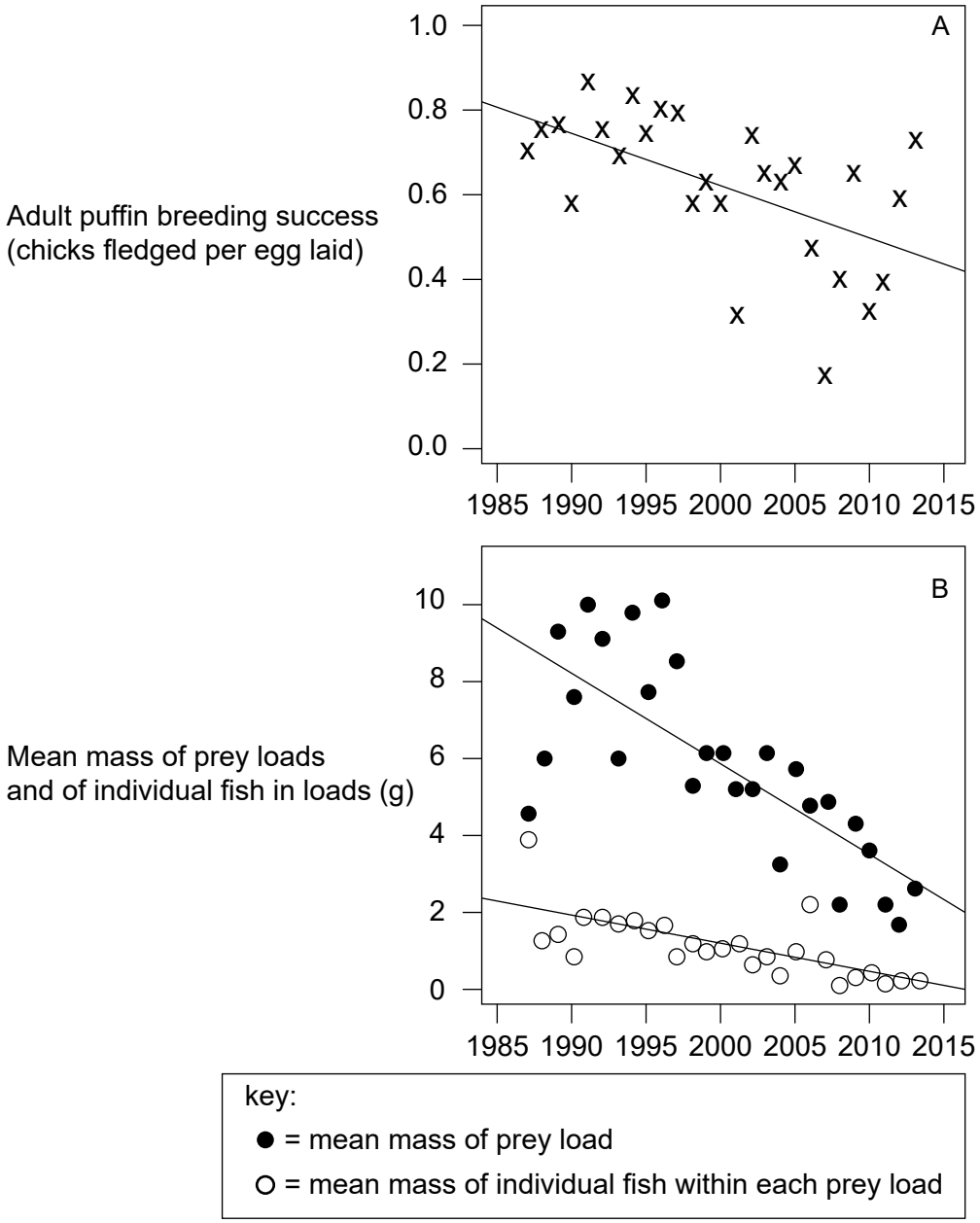
[7]

2 Puffins are seabirds. They feed on small fish such as herring and sand eels and catch the fish using their beaks, as shown below.



The population of puffins in the UK is in steep decline.

A 2015 study, reported in the Public Library of Science (PLOS), contains the graphs shown below.



(a) Graph A shows the change in breeding success of puffins between 1985 and 2015. Graph B shows the change in mass of fish in each catch, known as a prey load, and the change in mass of the individual fish within each prey load, over the same period.

(i) Write **two** hypotheses for the relationships between these changes.

1 .....

.....

2 .....

.....

[2]

(ii) Suggest **three** further pieces of information that would increase confidence in these hypotheses.

1 .....

.....

.....

2 .....

.....

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3 .....

.....

.....

[3]

(b) Describe the key features of the two **graphical techniques** used in graphs A and B.

Scattered data plots .....

.....

Trend lines .....

.....

[2]

3 Ammonia is a gas that only stays in the atmosphere for a few hours after its release.

However, when ammonia mixes with other gases in the atmosphere it can form particles of matter (PM) which can exist for several days and be transported large distances. There are major health concerns linked to exposure to PM concentrations.

The vast majority of ammonia emissions come from agriculture due to the spreading of manures and synthetic fertilisers.

By 2030, the UK is required to have reduced ammonia emissions by 16 per cent compared to those recorded in 2005.

Beth is an ecologist. She uses passive air samplers to monitor ammonia levels in the atmosphere.

- Air diffuses naturally into a collector found in each passive air sampler.
- The air collected is exposed to a filter treated with a chemical that reacts with ammonia.
- The collector is then sent to a laboratory each month so that the filter can be analysed to quantify the amount of ammonia reacted.

(a) Beth evaluates the passive air sampler.

(i) Explain how Beth can ensure that the **data** collected is valid and the **technique** is reliable and repeatable.

valid .....

.....

.....

reliable .....

.....

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repeatable .....

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[3]

(ii) Beth must also evaluate the 'availability' of the sampling technique.

Explain **two** aspects that she must consider.

1 .....

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2 .....

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[2]

(b) There are protocols for the preparation and analysis of the filter samples.

Explain what **protocol** means.

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..... **[1]**

Questions **4** and **5** relate to the pre-release material you have studied and your secondary research.

4 **(a)** Comment on **Sources A** and **B** in relation to their academic rigour.

Source A

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Source B

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[6]

(b) **Source A** concludes that in order to see if body fat loss is occurring, measuring ketosis is a better method than measuring weight.

What **two** pieces of evidence are given in **Source A** to support this conclusion?

1 .....

.....

2 .....

.....

[2]

(c) Design a data recording sheet for the data collected in the study described in **Source B**.

Draw the data recording sheet in the space below.

[7]

(d) Risk assessment is an important part of the management of health and safety.

Suggest how health and safety issues are assessed in **Source A** and in **Source B**.

Source A .....

.....

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Source B .....

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[2]

(e) **Source A** identifies three ways of measuring ketone production to indicate weight loss.

Identify **one** statement in **Source B** which contradicts the idea that measuring ketones is useful to monitor weight loss.

.....

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.....

..... **[1]**

(f) **Source B** describes the use of an enzymatic electrochemical sensor.

The authors conclude that:

'[It] can be used to measure the concentration of propanone in the breath…'

What evidence is given to support this conclusion?

.....

.....

.....

..... **[2]**

5 Write a report on your own research related to the pre-release material, including the following:

- the area of focus you have chosen;
- the findings from your research;
- evaluation of your research with reference to:
  - method(s) chosen
  - evidence generated
  - source material(s) used
- conclusions and implications of your findings;
- areas where further research may be required.

[20]

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END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined pages. The question numbers must be clearly shown in the margins – for example, 3(b) or 5.