

Wednesday 19 January 2022 – Afternoon

Level 3 Cambridge Technical in Applied Science

05874 Unit 23: Scientific research techniques

Time allowed: 2 hours

C344/2201



You must have:

- your copy of the Pre-release (C348)
- a ruler (cm/mm)

You can use:

- a scientific or graphical calculator
- an HB pencil



Please write clearly in black ink.

Centre number

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Candidate number

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First name(s)

Last name

Date of birth

D	D	M	M	Y	Y	Y	Y
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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.

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.

FOR EXAMINER USE ONLY	
Question No	Mark
1	/9
2	/5
3	/6
4	/20
5	/20
Total	/60

Answer **all** the questions.

- 1 A team of scientists is analysing data obtained from their research study in Bangladesh. They are comparing it with data obtained in an earlier study in The Gambia, West Africa.

The scientists write a research paper for a medical journal.

The research paper includes the following abstract.

ABSTRACT

Analysis of data from rural Gambia has previously shown that being born during the annual hungry season strongly influences susceptibility to mortality from infectious disease in young adulthood, possibly through an influence on immune function. In rural Bangladesh pregnancies are exposed to similar seasonality. The current paper uses data from a large demographic survey in the Matlab region of Bangladesh to retest the Gambian-derived hypothesis that early life exposures correlated with season of birth predict later patterns of mortality.

S. Moore, A. Fulford, P. Streatfield, L. Persson and A. Prentice

International Journal of Epidemiology, Volume 33, Issue 1, 1 February 2004,
Pages 137 - 143

<https://doi.org/10.1093/ije/dyh007>

- (a) State the scope of the research study.

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

- (b) (i) Suggest a hypothesis for the study in Bangladesh.

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

- (ii) State the outcome if your hypothesis **cannot** be proved.

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

(c) The statements listed are about outcomes that answer the research brief described in the abstract. Only **two** statements are correct.

Which **two** statements are correct?

Tick (✓) **two** boxes.

Data from large demographic surveys are/are not more reliable.

Infectious disease is/is not the main cause of death in rural areas.

Lack of food does/does not affect immune function.

Exposure to infectious disease in rural Gambia and the Matlab are/are not similar.

The season of birth does/does not affect mortality.

[2]

(d) (i) State **one** way in which the research study aims to ensure the reliability of data.

Justify your answer with a quotation from the abstract.

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

(ii) Describe **one** way in which the researchers ensure that their study can be repeated by others.

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

(iii) Suggest why the reference to the research paper was added to the abstract.

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

- 2 Some R&D (research and development) scientists are investigating new materials that could be used to make tennis balls.

Ball **A** and ball **B** were made from two different materials.

The diagram compares the highest points reached when ball **A** and ball **B** were bounced vertically from the same test surface.



- (a) Suggest a protocol for using the diagram to determine the difference between the vertical heights reached by ball **A** and ball **B**.

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

- (b) (i) Use the diagram to determine an accurate value for the difference between the vertical heights reached by ball **A** and ball **B**, and state the uncertainty in your measurement reading.

Vertical height difference =units

Uncertainty =
[2]

(ii) Describe **one** source of error in determining the value for the vertical height difference in (b)(i).

.....

..... [1]

3 In 1960, the physicist Freeman Dyson proposed an idea about alien civilisations.

He envisioned that the growing demand for energy from the rising alien populations would drive them to dismantle planets, and use the debris to construct massive solar collectors around their stars.

Such structures, known as Dyson Spheres, could theoretically be detected by the wavelength of radiation they would emit in a narrow temperature range.

The Infrared Astronomical Satellite (IRAS), launched in 1983, made a survey of the sky mapping different wavelengths of infrared radiation. Out of 250 000 observations, 17 were identified as possible “Spheres”, only four of which were considered promising.

Mia is a research astronomer. She is developing a research plan and needs to use secondary sources.

(a) (i) State **one** reliable source that Mia should use.

..... [1]

(ii) Suggest how Mia should make the most **effective** use of her time investigating secondary sources.

.....
.....
.....
.....
.....
..... [3]

- (b) Part of Mia's research plan is to assess the method that was used to **identify** the possible Dyson Spheres.

Which **two** pieces of information does Mia need to make a confident assessment of the method?

Tick (✓) **two** boxes.

The different wavelengths of infrared that were observed by IRAS.

The duration of the IRAS mission.

The equation that shows the relationship between wavelength and temperature.

The percentage of infrared absorbed by the Earth's atmosphere.

The percentage of the night sky that was mapped by IRAS.

[2]

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

4 (a) Refer to **Source A**.

(i) State the role of GW1516.

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

(ii) State the function of the PPARD gene.

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

(iii) Explain the evidence to support the conclusion that the pill “boosts athletic endurance **by 70 percent**”.

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

(b) **Source A** defines exhaustion as occurring when “blood glucose decreased to around **70 mg/dL**”.

(i) Suggest why exhaustion is defined using this particular value.

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

(ii) Explain why using a specific value to define exhaustion improves data quality.

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

(c) Suggest how the information in paragraphs 5 and 6 of source A may be contradictory.

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

(d) Compare sources A and B in relation to **innovation, bias** and **regulation**.

Use information from the source material to justify your answers.

Innovation
.....
.....
.....

Bias
.....
.....
.....

Regulation
.....
.....
.....

[5]

- (e) Researchers at the Salk Institute may seek permission to carry out an investigation to analyse the effects of GW1516 in human volunteers.

They write an investigation plan to present to their colleagues at the Institute.

List **five** factors to be considered within the investigation plan, in the table.

	Factors to be considered
1	
2	
3	
4	
5	

[5]

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:
 - o method(s) chosen
 - o evidence generated
 - o source material(s) used
- conclusions and implications of your findings;
- areas where further research may be required.

[20]

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A series of horizontal dotted lines for writing, consisting of 25 lines spaced evenly down the page.

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, 1(a) or 2(b).

A vertical line on the left side of the page is followed by 25 horizontal dotted lines, providing a ruled area for writing answers.



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