A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

Level 3 Certificate/Extended Certificate

APPLIED SCIENCE

Unit 3 Science in the Modern World

ASC3

Time allowed: 1 hour 30 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

For this paper you must have:

- **a clean copy of the pre-release SOURCES A, B, C and D**
- **a calculator.**

INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Answer ALL questions.**
- **You must answer the questions in the spaces provided. Do NOT write on blank pages.**
- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**
- **Do all rough work in this book. Cross through any work you do NOT want to be marked.**

INFORMATION

- **You will be provided with copies of the pre-release SOURCES A, B, C and D.**
- **There are two sections in this paper – SECTION A and SECTION B.**
- **You should answer all questions in each section. You should spend approximately 1 hour on SECTION A and 30 minutes on SECTION B.**
- **The marks for questions are shown in brackets.**
- **The maximum mark for this paper is 60.**

ADVICE

Read each question carefully.

DO NOT TURN OVER UNTIL TOLD TO DO SO

SECTION A

This section is based on SOURCES A, B, C and D.

Answer ALL questions in this section.

0 1

SOURCE A is an article from the 'New Scientist' that refers to the fictional detective, Sherlock Holmes.

0 1 . 1

Give ONE reason why SOURCE A could be described as a VALID source of information. [1 mark]

0 1 . 2

Give ONE reason why SOURCE A could be described as an UNRELIABLE source of information. [1 mark]

0 1 . 3

Suggest TWO reasons why the author refers to the fictional detective, Sherlock Holmes in the article. [2 marks]

1

2

0 2

Fingerprinting techniques have been used in forensic science for over 100 years.

Use SOURCE A to answer Question 02.

0 2 . 1

Describe the difference between a FINGERMARK and a FINGERPRINT in forensic science. [2 marks]

0 2 . 2

Describe how FINGERMARKS and FINGERPRINTS can be used together to solve a crime. [2 marks]

0 2 . 3

Give ONE limitation of using fingerprinting techniques. [1 mark]

0 3

DNA collected from a crime scene can be analysed by scientists to predict what a person looks like.

Use SOURCE A to answer Question 03.

0 3 . 1

What name is given to the process of analysing DNA to predict what a person looks like? [1 mark]

Tick (✓) ONE box.

- ☐ **DNA phenotyping**
- ☐ **DNA profiling**
- ☐ **DNA screening**
- ☐ **DNA sequencing**

0 3 . 2

Eye colour is an example of a physical trait that scientists can predict by analysing a person's DNA.

Give TWO OTHER examples of physical traits that scientists might be able to predict by analysing a person's DNA.
[2 marks]

1 _____

_____

2 _____

_____

0 3 . 3

The process of analysing DNA to predict a person's eye colour is not completely accurate.

How many people could have their eye colour predicted INCORRECTLY if the DNA from 1000 people is analysed?

Use data in SOURCE A. [1 mark]

Tick (✓) ONE box.

- ☐ **100**
- ☐ **200**
- ☐ **500**
- ☐ **1000**

4

0 4

The language used in newspaper articles is often sensationalised.

A student suggested the language used in SOURCE B could be described as sensationalised.

0 4 . 1

Give ONE reason why you would NOT expect sensationalised language to be used in SOURCE B. [1 mark]

0 4 . 2

Give ONE reason why an author would use sensationalised language. [1 mark]

_____

_____

2

[Turn over]

0 5

SOURCE B describes different types of forensic evidence examined by scientists.

0 5 . 1

What information CANNOT be determined by scientists examining maggots from a crime scene? [1 mark]

Tick (✓) ONE box.

☐ **When a crime was committed**

☐ **Where a crime was committed**

☐ **Who committed a crime**

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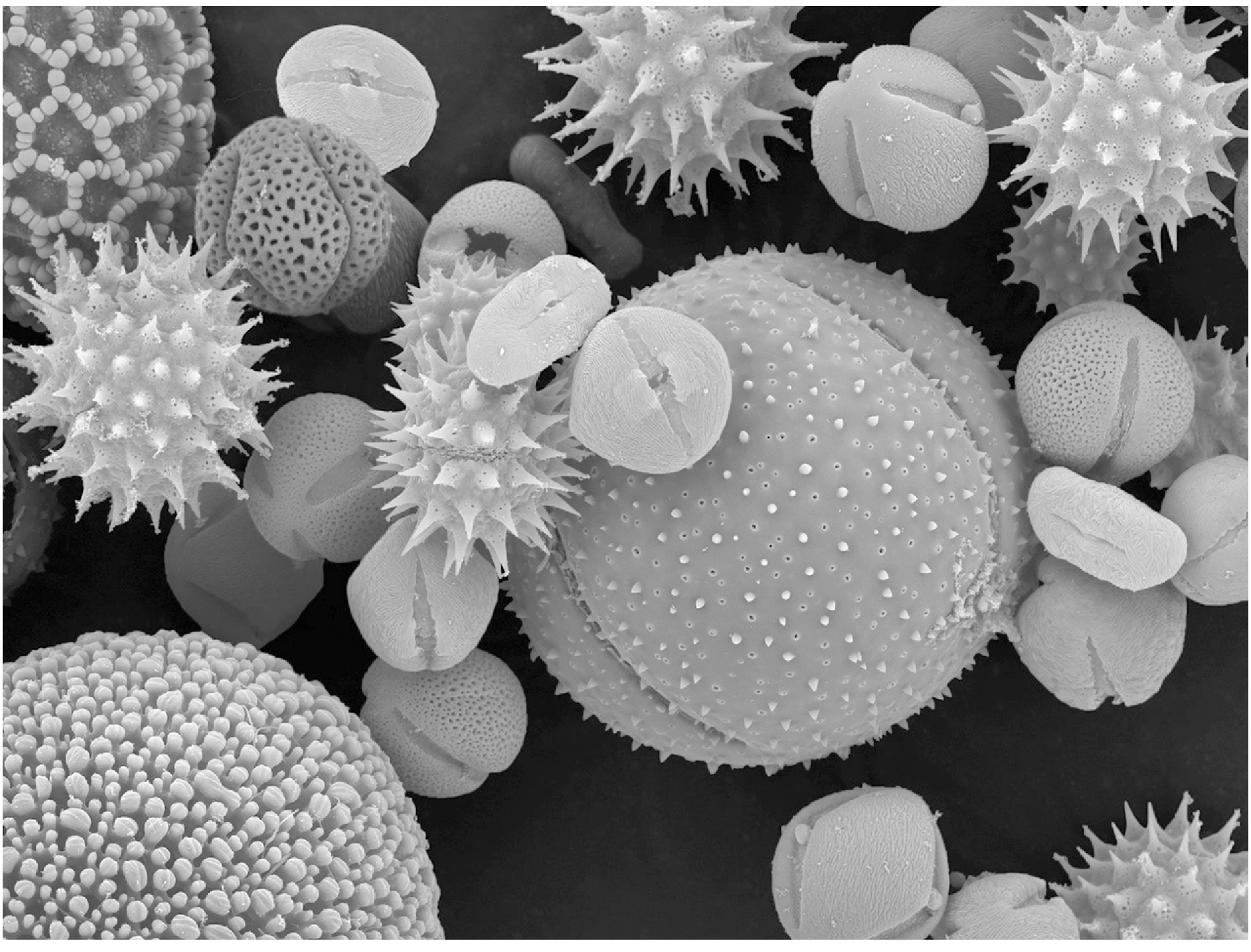
[Turn over]

Pollen from a crime scene can be examined by scientists through a microscope.

FIGURE 1 shows pollen from several different plants observed through a microscope.

FIGURE 1



0 5 . 2

Suggest ONE piece of information ABOUT POLLEN that scientists can determine by examining it through a microscope. [1 mark]

0 5 . 3

Give ONE OTHER example of evidence in SOURCE B that would need to be examined through a microscope.
[1 mark]

3

0 6

Forensic scientists use 'physical fit analysis' to find out if two or more fragments came from the same object.

'Physical fit analysis' relies on manual handling of evidence.

Use SOURCE C to answer Question 06.

0 6 . 1

Suggest how 'physical fit analysis' could show a link between two different crime scenes. [2 marks]

0 6 . 2

Give TWO problems involved with the manual handling of evidence in 'physical fit analysis'. [2 marks]

1 _____

_____

2 _____

_____

_____

0 6 . 3

What new technique are scientists using to reduce manual handling in 'physical fit analysis'? [1 mark]

_____

_____

[Turn over]

0 6 . 4

The new technique reduces manual handling.

Give ONE OTHER advantage of the new technique. [1 mark]

6

0 7

Forensic scientists use a process called fibre transfer to solve crimes.

SOURCE D describes a study to monitor fibre transfer between two people in an elevator.

0 7 . 1

What new information did forensic scientists in the study discover about fibre transfer? [1 mark]

0 7 . 2

How were the forensic scientists able to observe fibre transfer in the study?
[1 mark]

0 7 . 3

Several variables could have affected the fibre transfer in the study.

One variable was the opening and closing of the elevator doors.

Give TWO OTHER variables that could have affected the fibre transfer.
[2 marks]

1 _____

_____

_____

2 _____

_____

4

[Turn over]

0 8

SOURCE D states that the results of the study into fibre transfer will "help to increase the robustness and validity of forensic evidence being presented in court".

Explain how the results of the study could make sure that an innocent person is NOT convicted of a crime. [3 marks]

3

0 9

Many different types of scientist are involved in examining evidence from crime scenes to solve crimes.

Discuss the roles of the scientists in SOURCES A, B, C and D, and how they contribute to solving crimes.

You should name each type of scientist in your answer. [9 marks]


2 6

[Turn over]

[Turn over]

9

SECTION B

Answer ALL questions in this section.

1 0 Forensic scientists use DNA evidence to identify individuals involved in a crime.

FIGURE 2 contains information about DNA in human body cells.

FIGURE 2

- DNA contains the code that is needed for organisms to grow, develop and function.
- Sections of DNA are called genes.
- The complete set of genes in the human body is called the human genome.

- Only 1% of the genes in the human genome have different forms in different individuals.
- There are 200 genes that have different forms in different individuals.
- The 200 genes that have different forms explain the variations in characteristics, such as eye colour, hair colour and height.
- Scientists estimate that the human body has 30 000 000 000 000 (30 trillion) cells.
- 80% of human body cells are red blood cells.
- All cells in the body have a nucleus apart from red blood cells.
- Each cell nucleus contains 2 metres of DNA.

[Turn over]

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Use FIGURE 2, on pages 30 and 31, to answer Question 10.

10.1

Calculate the total number of genes in the human genome. [1 mark]

Total number of genes = _____

1 0 . 2

The total length of DNA in the body is estimated to be 12 000 000 000 km.

Show how this figure was calculated.
[3 marks]

1 0 . 3

In forensic science, the most important genes in the human genome are the genes that have different forms in different individuals.

Explain why the genes that have different forms are the most important genes in forensic science. [2 marks]

_____

_____

_____

_____

_____

6

[Turn over]

1 1

FIGURE 3 contains information about the National DNA Database (NDNAD) in the UK.

FIGURE 3

- **A DNA sample is taken by a police officer when a person is arrested.**
- **Precautions must be taken to make sure that DNA samples are not contaminated.**
- **The DNA sample is processed, and the DNA profile is stored on the National DNA Database (NDNAD).**
- **The person's name and other personal details are stored with the DNA profile.**
- **Before taking a DNA sample, the police first check to see if the person's DNA profile is already stored on the NDNAD.**

- **A new DNA sample is not taken if there is already a DNA profile for the person stored on the NDNAD.**

Use FIGURE 3 to answer Question 11.

1 1 . 1

Suggest the purpose of a DNA database.
[1 mark]

1 1 . 2

Suggest ONE reason why the police might ask volunteers to give a DNA sample. [1 mark]

1 1 . 3

One way that the police can collect DNA from a person is from a sample of hair.

Suggest ONE OTHER way that the police may collect DNA from a person. [1 mark]

1 1 . 4

Explain ONE precaution that a police officer could take to avoid contaminating the DNA sample.
[2 marks]

Precaution _____

Explanation _____

_____

_____

_____

[Turn over]

The total number of DNA profiles from people is more than the total number of individual people whose DNA profile is stored on the NDNAD.

This is because the DNA profiles of some people have been stored more than once.

1 1 . 5

Suggest ONE reason why the DNA profiles of some people have been stored more than once on the NDNAD.
[1 mark]

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[Turn over]

TABLE 1 shows the number of DNA profiles stored on the NDNAD on 30th September 2020.

TABLE 1

DNA profiles stored	Number of DNA profiles
Total DNA profiles from people	6 639 719
Total individual people	5 647 987
Volunteer profiles	4 342
Profiles from crime scenes not linked to individual people	654 724

11.6

Calculate how many DNA profiles have been stored more than once on the NDNAD.

Assume that no DNA profile has been stored three or more times.

Use TABLE 1. [1 mark]

Number of DNA profiles stored more than once = _____

[Turn over]

REPEAT OF TABLE 1

DNA profiles stored	Number of DNA profiles
Total DNA profiles from people	6 639 719
Total individual people	5 647 987
Volunteer profiles	4 342
Profiles from crime scenes not linked to individual people	654 724

11.7

The population of the UK was estimated to be 67.9 million in September 2020.

Calculate the percentage of the UK population who had their DNA profile stored on the NDNAD in September 2020.

Use TABLE 1. [2 marks]

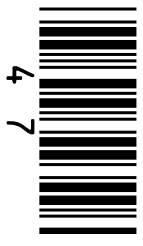
Percentage of the UK population =

_____ **%**

9

The personal data stored on the National DNA Database (NDNAD) can be used to generate statistics.

FIGURE 4, on page 48, shows a graph of the percentage of individuals on the NDNAD in each age category on 30th September 2020.



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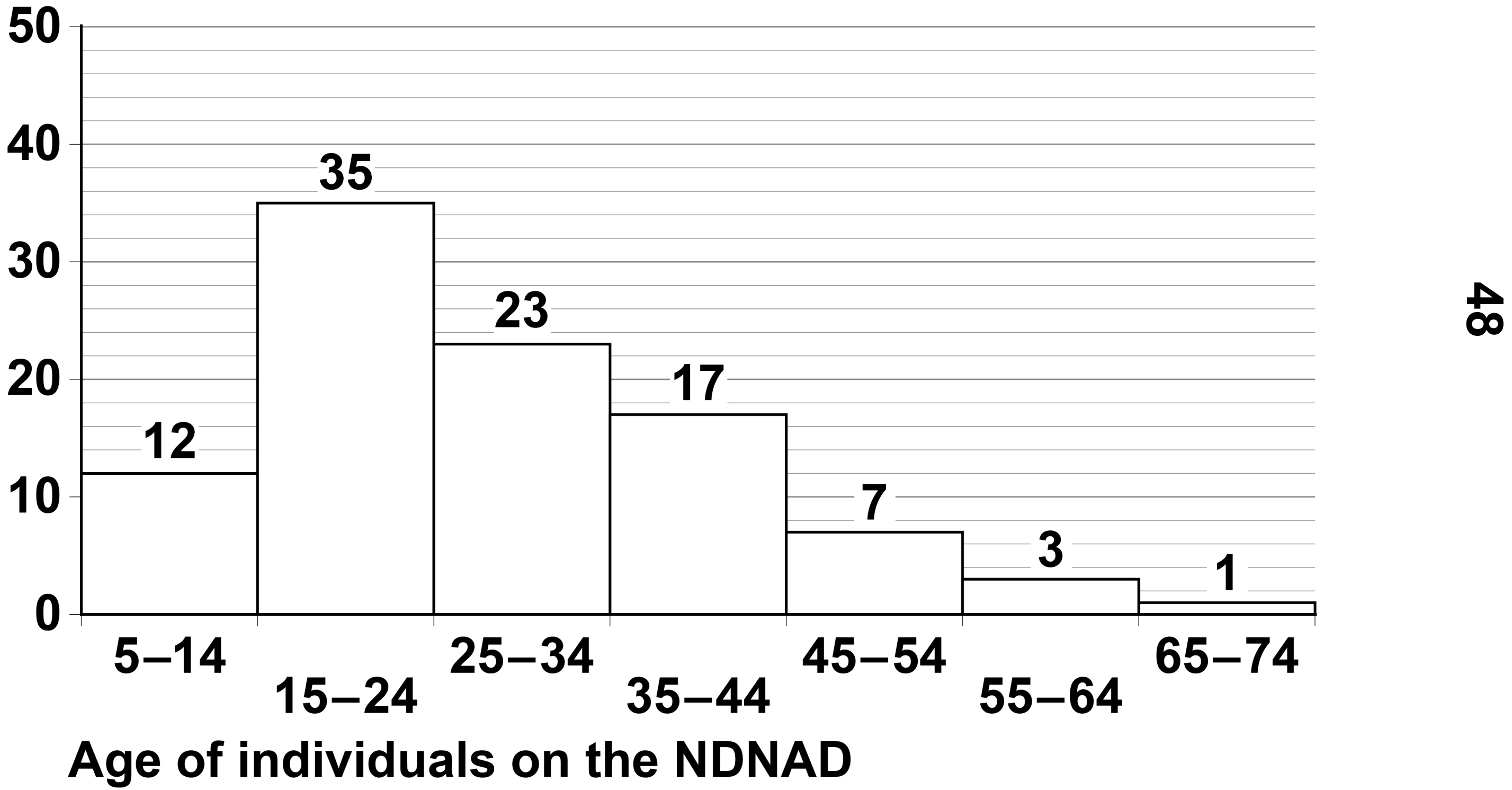
[Turn over]

FIGURE 4


Percentage of individuals on the NDNAD
50
40
30
20
10
0
12
35
23
17
7
3
1
5–14
15–24
25–34
35–44
45–54
55–64
65–74
Age of individuals on the NDNAD

1 2 . 1

Suggest ONE reason why a graph is used to represent this data in FIGURE 4. [1 mark]

_____

_____

1 2 . 2

Give ONE conclusion you can make from the graph in FIGURE 4. [1 mark]

_____

_____

50

1 2 . 3

It is estimated that more than 100 000 people who have their DNA profiles stored on the NDNAD do not have their date of birth recorded.

There were 5 647 987 people on the NDNAD on 30th September 2020.

Show that this estimate is correct.

Use data in FIGURE 4, on page 48. [2 marks]

50

[Turn over]

12.4

Suggest ONE additional piece of personal data that might be stored on the NDNAD as well as name and date of birth. [1 mark]

5

END OF QUESTIONS

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
1	
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