AQA

Level 3 Certificate/Extended Certificate
APPLIED SCIENCE

Unit 3 Science in the Modern World

Time allowed: 1 hour 30 minutes

Materials
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.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do **not** write outside the box around each page or 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.

For Examiner's Use	
Question	Mark
1	
2	
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9	
10	
11	
12	
TOTAL	

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 _____

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4

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]

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0 2 . 2 Describe how **fingermarks** and **fingerprints** can be used together to solve a crime.

[2 marks]

_____

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0 2 . 3 Give **one** limitation of using fingerprinting techniques.

[1 mark]

_____

_____

5

Turn over for the next question

Turn over ▶

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]

_____

_____

Turn over for the next question

Turn over ▶

IB/M/Jan22/ASC3

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 ☐

IB/M/Jan22/ASC3

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
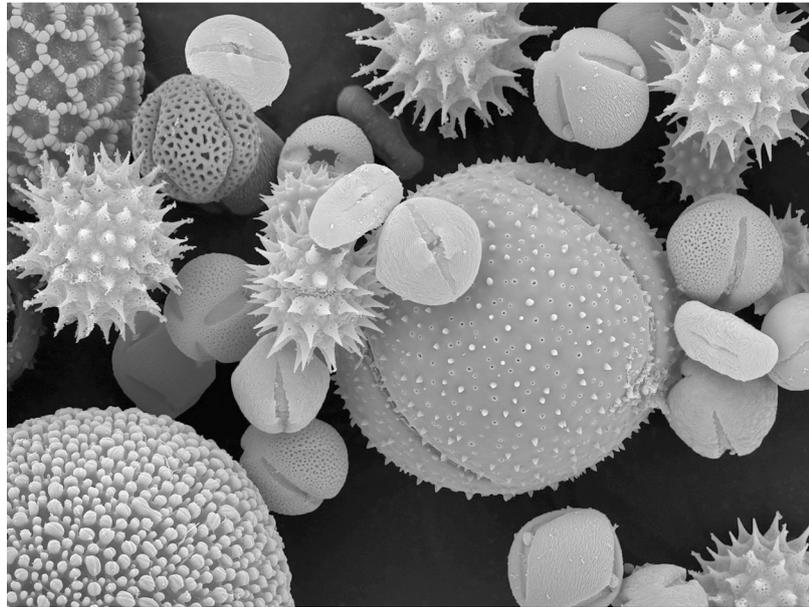
| 0 | 5 |.| 2 | Suggest **one** piece of information **about pollen** that scientists can determine by examining it through a microscope.

[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

Turn over ▶

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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]

_____

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_____

_____

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]

_____

_____

0 6 . 4 The new technique reduces manual handling.

Give **one other** advantage of the new technique.

[1 mark]

_____

_____

6

IB/M/Jan22/ASC3

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 for the next question

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]

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3

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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]

Extra space

9

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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.

Use **Figure 2** to answer Question **10**.

1 0 . **1** Calculate the total number of genes in the human genome.

[1 mark]

Total number of genes = _____

IB/M/Jan22/ASC3

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]

_____

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6

Turn over for the next question

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 _____

_____

_____

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]

_____

_____

Question 11 continues on the next page

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

1 1 . 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 = _____

1 1 . 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 = _____ %

Turn over for the next question

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1 2 The personal data stored on the National DNA Database (NDNAD) can be used to generate statistics.

Figure 4 shows a graph of the percentage of individuals on the NDNAD in each age category on 30th September 2020.

Figure 4
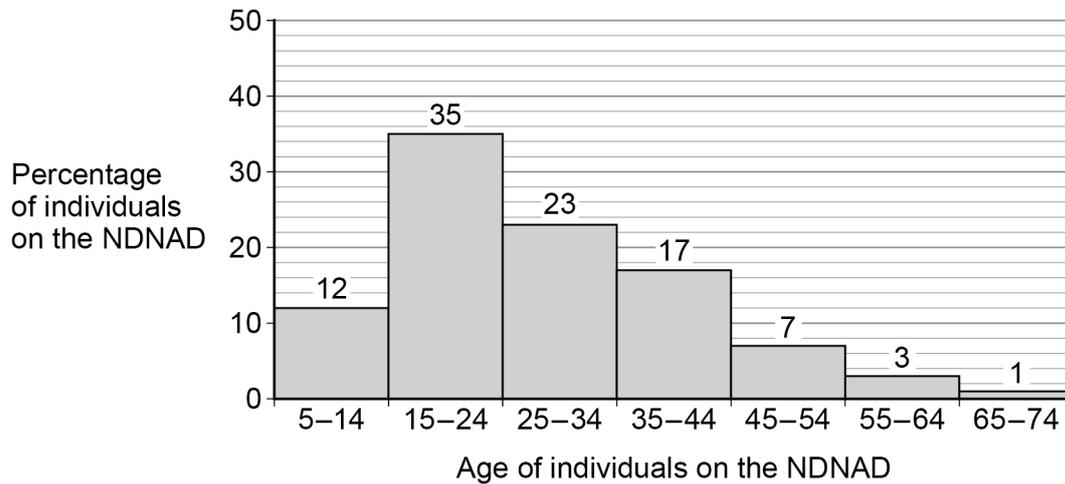
1 2 . 1 Suggest **one** reason why a graph is used to represent this data in **Figure 4**.

[1 mark]

_____

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1 2 . 2 Give **one** conclusion you can make from the graph in **Figure 4**.

[1 mark]

_____

_____

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**.

[2 marks]

1 2 . 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]

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5

END OF QUESTIONS

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