Level 3 Certificate/Extended Certificate
APPLIED SCIENCE
ASC3

Unit 3 Science in the Modern World

Mark scheme

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2 2 1 A A S C 3 / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.1	any **one** from: • written by scientists • references to other scientists / experts • peer reviewed	allow reference to well-regarded scientific journal	1	AO1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.2	any **one** from: • article is outdated • author is not identified		1	AO1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.3	any **two** from: • people are familiar with the fictional character • (Sherlock Holmes) used forensic / fingerprinting techniques • to solve crimes • makes the article more interesting		2	AO3

Total Question 1		**4**

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.1	a fingermark is what is left by our fingers in the real world **or** a fingermark includes chemicals (such as fat and protein) left behind by fingers a fingerprint is the print collected from individuals (in controlled conditions) **or** a fingerprint is the pattern of ridges on fingertips	If no other mark given, 1 mark can be given for fingermarks are from unknown subjects **and** fingerprints are from known subjects	1 1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.2	fingermarks collected from a crime scene can be matched to fingerprints of a suspect **or** to fingerprints on a database		1 1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.3	any **one** from: • needs a database match • analysts still make the final decision • analysts do not always agree		1	AO3

Total Question 2		**5**

Question 3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.1	DNA phenotyping		1	AO1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.2	any **two** from: • hair colour • skin colour • height	allow obesity / weight	2	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.3	200		1	AO2

Total Question 3		**4**

Question 4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.1	it is a scientific / professional / formal journal	allow it is written for scientists	1	AO1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.2	any **one** from: • it makes readers want to read more • it engages the audience / readers • it increases subscriptions / sales		1	AO1

Total Question 4		**2**

Question 5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.1	who committed a crime		1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.2	what plant it came from	allow shape / colour / size **or** any reference to matching	1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.3	any **one** from: • algae • diatoms • glitter • soil		1	AO3

Total Question 5		**3**

Question 6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.1	fragments found at both crime scenes originate from the same object		1 1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.2	any **two** from: • damage to the fragments • sharp fragments can cause injury • contamination of evidence	If no other mark given, 1 mark can be given for fragments are fragile **and** sharp	2	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.3	any **one** from: • 3D modelling • 3D technology • 3D imaging • 3D printing		1	AO1

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.4	juries can understand / visualise the evidence better		1	AO3

Total Question 6		**6**

Question 7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.1	fibre transfer can occur without direct contact		1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.2	(use of) fluorescent garments / fibres	allow use of UV imagery techniques	1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.3	any **two** from: • material of the donor garment • material of the recipient garment • movement of (other) people • number of people (in elevator)		2	AO3

Total Question 7		**4**

Question 8

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08	fibres on an (innocent) person's clothing		1	AO3
	may not link them to a crime		1	
	because the fibres have come from contactless fibre transfer		1	

Total Question 8		**3**

Question 9

Question	Answers	Mark	AO/ Spec. Ref.
09	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 3 and apply a 'best-fit' approach to the marking.	9	4 × AO1 5 × AO3

0 marks	Level 1 (1–3 marks)	Level 2 (4–6 marks)	Level 3 (7–9 marks)
incorrect no answer	• uses **1** source and discusses named types of scientists with roles or contributions • discussion shows little attempt at structure • little use of scientific vocabulary	• uses **at least 2** sources and discusses named types of scientists with roles and / or contributions • discussion shows some attempt at structure • some use of scientific vocabulary	• uses **3 or 4** sources and discusses named types of scientists with roles and contributions • discussion is well-structured with minimal repetition or irrelevant points • good use of scientific vocabulary

Source	Scientists – roles	Contribution to solving crimes
A	Research scientist – identified metabolites from foods, drugs and DNA in fingermarks. (Forensic) geneticist – DNA analysis – working on new way to use genetic profiles – DNA phenotyping. Microbiologist / Microbial ecologist – investigating microorganisms – specifically those that people leave when they touch things and in the air they breathe.	Can provide information about the person whose fingermarks are found which could help identify suspects. May be able to build up a picture of what a suspect looks like based on the DNA found at a crime scene. Looking at ways that microorganisms from humans can be used in criminal investigations – to help identify individuals.
B	(Forensic) botanist – studies plants, rate of plant growth. Entomologist – studies life cycles of insects / larvae. Soil scientist – analyse soil samples. Pollen specialist / palynologist – studies pollen to identify features and what plant it came from.	Can use evidence from growth of plants to find out when and where a crime was committed, and who did it. Can be used to estimate time of death or movement of a body after death when found on a decaying body. Soil samples from a suspect or suspect's house or car can be compared to soil from a crime scene. Can match pollen from suspect's clothing and crime scene.

C	Forensic scientist – using physical fit analysis to find out if fragments come from the same object – using the new 3D technology to reconstruct objects.	Can be used in forensic investigations to reconstruct objects, or link suspects to crime scenes or link two crime scenes.
D	Forensic scientist – investigating fibre transfer to find out of fibres can transfer without direct contact.	Forensic scientist evaluates the significance of the fibre transfer evidence and presents this evidence in court, ensuring that the evidence is valid and robust.

Total Question 9		**9**

Question 10

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
10.1	20 000		1	AO2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
10.2	20% × 30 trillion = 6 trillion 6 trillion × 2 m = 12 trillion metres $\frac{12 \text{ trillion}}{1000}$ = 12 000 000 000 km		1 1 1	AO2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
10.3	(different genes) can be used to identify a person because these genes make a person unique		1 1	AO3

Total Question 10		**6**

Question 11

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
11.1	DNA can be compared / matched	allow to identify a criminal	1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
11.2	eliminate a person / suspect (from enquiries)		1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
11.3	any **one** from: • saliva • blood	allow use a swab	1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
11.4	wear gloves / mask / hairnet so that there are no traces of the police officer's DNA	allow PPE	1 1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
11.5	any **one** from: • person may give a different name • person may give a different version of their name • person may give different personal details		1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
11.6	991 732		1	AO2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
11.7	$\frac{5\ 647\ 987}{67\ 900\ 000}$ (× 100 =) 8.3%		1 1	AO2

Total Question 11		**9**

Question 12

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
12.1	any **one** from: • clear to see the pattern • easy to visualise • quantitative data		1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
12.2	any **one** from: • more younger adults come to the attention of the police • more younger adults commit crimes • fewer older people come to the attention of the police • fewer older people commit crimes	allow the largest number of DNA profiles come from 15−24 age group	1	AO3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
12.3	(100 – 98 =) 2% 2% × 5 647 987 = 112 959		1 1	AO2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
12.4	any **one** from: • sex / gender • ethnic background		1	AO3

Total Question 12		**5**