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 Assessment Writer.

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
Information to Examiners

1. General
The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available ‘any two from’ is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold and is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of or. Different terms in the mark scheme are shown by a /; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists
This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that ‘right + wrong = wrong’.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

<table>
<thead>
<tr>
<th>Student</th>
<th>Response</th>
<th>Marks awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>green, 5</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>red*, 5</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>red*, 8</td>
<td>0</td>
</tr>
</tbody>
</table>
Example 2: Name two planets in the solar system. (2 marks)

<table>
<thead>
<tr>
<th>Student</th>
<th>Response</th>
<th>Marks awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neptune, Mars, Moon</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Neptune, Sun, Mars, Moon</td>
<td>0</td>
</tr>
</tbody>
</table>

3.2 Use of chemical symbols / formulae
If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations
Full marks can be given for a correct numerical answer, without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the ‘extra information’ column or by each stage of a longer calculation.

3.4 Interpretation of ‘it’
Answers using the word ‘it’ should be given credit only if it is clear that the ‘it’ refers to the correct subject.

3.5 Errors carried forward
Any error in the answers to a structured question should be penalised once only. Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling
The phonetic spelling of correct scientific terminology should be credited unless there is a possible confusion with another technical term.

3.7 Brackets
(......) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do not allow
Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do not allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.
Quality of Written Communication and levels marking

In Question 8 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.
<table>
<thead>
<tr>
<th>Question</th>
<th>Answers</th>
<th>Extra information</th>
<th>Mark</th>
<th>AO / Spec. Ref.</th>
</tr>
</thead>
</table>
| 1(a)     | A = nucleus  
          B = (cell) membrane | allow phonetic spelling | 1    | AO1 2.1.1a, d |
<p>| 1(b)     | for repair / growth or to replace cells | ignore new cells / skin | 1    | AO1 2.7.1j    |
| 1(c)(i)  | embryos |                      | 1    | AO1 2.7.1k    |
| 1(c)(ii) | paralysis |                     | 1    | AO1 2.7.1l,m  |
| Total    |         |                    | 5    |                |</p>
<table>
<thead>
<tr>
<th>Question</th>
<th>Answers</th>
<th>Extra information</th>
<th>Mark</th>
<th>AO / Spec. Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2(a)(i)</td>
<td>a catalyst</td>
<td></td>
<td>1</td>
<td>AO1 2.5.1a,b, 2.6.1a</td>
</tr>
<tr>
<td>2(a)(ii)</td>
<td>protein</td>
<td></td>
<td>1</td>
<td>AO1 2.5.1b, 2.6.1a</td>
</tr>
<tr>
<td>2(a)(iii)</td>
<td>salivary glands</td>
<td></td>
<td>1</td>
<td>AO1 2.5.2d</td>
</tr>
<tr>
<td>2(b)</td>
<td></td>
<td></td>
<td>3</td>
<td>AO1 2.5, 2.5.2i</td>
</tr>
<tr>
<td></td>
<td><strong>Enzyme</strong></td>
<td><strong>Industrial use</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carbohydrase</td>
<td>Changes starch into sugars</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Isomerase</td>
<td>Removes grease stains from clothes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protease</td>
<td>Pre-digests proteins in some baby foods</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Changes glucose syrup into fructose syrup</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>extra lines from any enzyme cancels that mark</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Answers</td>
<td>Extra information</td>
<td>Mark</td>
<td>AO / Spec. Ref.</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------------------------------------------------------</td>
<td>--------------------------------</td>
<td>------</td>
<td>----------------</td>
</tr>
<tr>
<td>3(a)</td>
<td><strong>Structure</strong></td>
<td><strong>Organ</strong></td>
<td><strong>Organ system</strong></td>
<td><strong>Tissue</strong></td>
</tr>
<tr>
<td></td>
<td>Stomach</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cells lining the stomach</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Mouth, oesophagus, stomach, liver, pancreas, small and large intestine</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>all 3 correct = 2 marks 2 correct = 1 mark 1 or 0 correct = 0 marks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3(b)(i)</td>
<td>diffusion</td>
<td>allow phonetic spelling</td>
<td>1</td>
<td>AO1 2.1.2a,b,c</td>
</tr>
<tr>
<td>3(b)(ii)</td>
<td>glucose</td>
<td></td>
<td>1</td>
<td>AO1 2.6.1b</td>
</tr>
<tr>
<td>3(b)(iii)</td>
<td>mitochondria</td>
<td></td>
<td>1</td>
<td>AO1 2.6.1b,d</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

The table includes the following elements:

- **Question 3(a):**
  - **Structure:**
    - Stomach
    - Cells lining the stomach
    - Mouth, oesophagus, stomach, liver, pancreas, small and large intestine
  - Marking criteria:
    - All 3 correct = 2 marks
    - 2 correct = 1 mark
    - 1 or 0 correct = 0 marks
  - AO and Spec. Ref.:
    - AO1 2.2, 2.2.1a,b,c,d

- **Question 3(b)(i):**
  - **Answer:** diffusion
  - **Extra Information:** allow phonetic spelling
  - **Mark:** 1
  - **AO:** AO1 2.1.2a,b,c

- **Question 3(b)(ii):**
  - **Answer:** glucose
  - **Mark:** 1
  - **AO:** AO1 2.6.1b

- **Question 3(b)(iii):**
  - **Answer:** mitochondria
  - **Mark:** 1
  - **AO:** AO1 2.6.1b,d

- **Total Mark:** 5
<table>
<thead>
<tr>
<th>Question</th>
<th>Answers</th>
<th>Extra information</th>
<th>Mark</th>
<th>AO / Spec. Ref.</th>
</tr>
</thead>
</table>
| 4(a)(i)  | LHS = water  
RHS = oxygen | accept H₂O  
do not accept H₂O / H₂O  
accept O₂  
do not accept O / O² / O₂ | 1 | 1 | AO1
|          |         |                   |     | 2.3.1a,b      |
| 4(a)(ii) | light / sunlight | ignore solar / sun / sunshine  
do not allow thermal / heat | 1 | AO1 | 2.3.1a,b |
| 4(a)(iii)| chloroplasts | allow chlorophyll | 1 | AO1 | 2.3.1b |
| 4(b)(i)  | 20 |                   | 1 | AO2 | 2.3 |
| 4(b)(ii) | any one from:  
• light (intensity)  
• temperature |                   | 1 | AO2 | 2.3, 2.3.1c,d |
| 4(c)(i)  | To increase the rate of growth of the tomato plants |                   | 1 | AO2 | 2.3, 2.3.1c,d |
| 4(c)(ii) | Because it would cost more money than using 0.08%  
Because it would not increase the rate of photosynthesis of the tomato plants any further |                   | 1 | AO2 | 2.3, 2.3.1c,d |
<p>| <strong>Total</strong> |         |                   | 9 |     |      |</p>
<table>
<thead>
<tr>
<th>Question</th>
<th>Answers</th>
<th>Extra information</th>
<th>Mark</th>
<th>AO / Spec. Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5(a)(i)</td>
<td>(female) has XX / only X’s / no Y</td>
<td>allow has X chromosomes ignore ref to genes / cells</td>
<td>1</td>
<td>AO2 2.7.2b, 2.7.3a</td>
</tr>
<tr>
<td>5(a)(ii)</td>
<td>extra chromosome / has 47 chromosomes / one set has 3 copies no. 18</td>
<td>ignore reference to chromosome numbers other than 47 or no. 18</td>
<td>1</td>
<td>AO2 2.7.1a,e, 2.7.3a</td>
</tr>
<tr>
<td>5(b)(i)</td>
<td>14</td>
<td>allow in range of 13.5 to 14.5</td>
<td>1</td>
<td>AO2 2.7.1a,e, 2.7.3a</td>
</tr>
<tr>
<td>5(b)(ii)</td>
<td>7</td>
<td>allow in range of 6.75 to 7.25 accept ecf from 5bi</td>
<td>1</td>
<td>AO2 2.7.1a,e, 2.7.3a</td>
</tr>
</tbody>
</table>
| 5(c)     | **Advantages:** any two from:  
  • more than 1 embryo (so more chance of success)  
  • tested at 3 days cf 10 weeks or tested earlier  
  • tested before pregnancy  
  • no termination / abortion  
  • spare embryos have a potential use
  
**Disadvantages:** any one from:  
  • needs an operation  
  • (spare) embryos / human life destroyed / harmed  
  • higher cost  
  • embryos might not implant / might not develop | allow method 2 may cause a miscarriage tested when only 3 days old accept described hazard of operation must be comparative | 2 | AO3 2.7, 2.7.3d |

**Total** | 8 |
<table>
<thead>
<tr>
<th>Question</th>
<th>Answers</th>
<th>Extra information</th>
<th>Mark</th>
<th>AO / Spec. Ref.</th>
</tr>
</thead>
</table>
| 6(a)(i)  | any two from:  
- trapped / held (since sticky)  
- engulfed / covered by resin  
- prevented decay | allow engulfed / covered by amber | 2 | AO2 / AO3 2.8.1b |
| 6(a)(ii) | any two from:  
- animal / plant (dies and)  
  body covered in sediment / mud  
- bones / shells / hard parts  
  do not decay  
- minerals enter bones / parts  
  are replaced by other materials / mineralisation  
- preserved traces / footprints  
  / burrows / rootlet traces / impressions / casts | ignore ref to rock  
allow covered in tar / ice | 2 | AO1 2.8.1b |
<p>| 6(b)(i)  | New technology provides more valid evidence. | | 1 | AO3 2.8 |</p>
<table>
<thead>
<tr>
<th>Question</th>
<th>Answers</th>
<th>Extra information</th>
<th>Mark</th>
<th>AO / Spec. Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6(b)(ii)</td>
<td>any three from: examples of physical factors, eg  • flooding  • drought  • ice age / temperature change examples of biological factors, eg  • (new) predators (allow hunters)  • (new) disease / named pathogen  • competition for food  • competition for mates  • cyclical nature of speciation  • isolation  • lack of habitat or habitat change</td>
<td>accept 3 physical factors or 3 biological factors or some of each for full marks ignore pollution competition must be qualified if no other answers given allow natural disaster / weather change / catastrophic event / environmental change / climate change for 1 mark</td>
<td>3</td>
<td>AO1 2.8.1e</td>
</tr>
</tbody>
</table>

Total 8
<table>
<thead>
<tr>
<th>Question</th>
<th>Answers</th>
<th>Extra information</th>
<th>Mark</th>
<th>AO / Spec. Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7(a)(i)</td>
<td>glycerol</td>
<td></td>
<td>1</td>
<td>AO1 2.5.2f</td>
</tr>
<tr>
<td>7(a)(ii)</td>
<td>pancreas / small intestine</td>
<td>accept duodenum / ileum ignore intestine unqualified</td>
<td>1</td>
<td>AO1 2.5.2f</td>
</tr>
</tbody>
</table>
| 7(b)     | any two from:  
- type of milk  
- volume / amount of milk  
- vol. bile equals vol. water  
- volume of lipase  
- concentration of lipase  
- temperature | ignore time interval ignore solution unqualified do not allow pH ignore starting pH ignore volume / amount of bile / water ignore concentration of bile accept amount of lipase if neither volume nor concentration given | 2    | AO3 2.5.2f,h |
| 7(c)(i)  | fatty acid (production) |                   | 1    | AO2 2.5.2f,h |
| 7(c)(ii) | faster reaction / digestion (with bile)  
- pH decreases faster (with bile)  
- takes less time (with bile)  
- steeper fall / line (with bile) | allow use of data ignore easier | 1    | AO3 2.5.2f,h |
<table>
<thead>
<tr>
<th>Question</th>
<th>Answers</th>
<th>Extra information</th>
<th>Mark</th>
<th>AO / Spec. Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7(c)(iii)</td>
<td>all fat / milk digested or same amount of fatty acids present or (lower pH) denatures the enzyme / lipase</td>
<td>allow all reactants used up ignore reference to neutralisation allow enzyme won’t work at low pH do <strong>not</strong> allow enzyme killed</td>
<td>1</td>
<td>AO2 2.5.2f,h</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>7</strong></td>
<td></td>
</tr>
</tbody>
</table>
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 5 and apply a 'best-fit' approach to the marking.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answers</th>
<th>Extra information</th>
<th>Mark</th>
<th>AO / Spec. Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>6</td>
<td>AO1 / AO2 / AO3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0 marks</th>
<th>Level 1 (1–2 marks)</th>
<th>Level 2 (3–4 marks)</th>
<th>Level 3 (5–6 marks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No relevant content.</td>
<td>The apparatus needed to measure the leaf is identified or the apparatus needed to measure light intensity is identified or an appropriate use of the tape measure is identified.</td>
<td>There is a description of a leaf being measured at different locations or light being measured at different locations.</td>
<td>There is a description of a leaf and light being measured at different locations and repetitions are included or a control variable is described or appropriate mathematical treatment of the data is described.</td>
</tr>
</tbody>
</table>

examples of points made in the response:
- use of tape measure to produce transect
- transect placed coming out of shady area (e.g. woodland) into lighter area
- repeat transects
- samples at same height above ground
- samples at same aspect (N / E / S / W) on trees
- measurement of length, or width, of leaves using ruler
- measure several leaves at each location
- use of light meter to measure light intensity
- repeat measurements of light intensity on several days
- measure light intensities at same time of day
- calculate mean for each location
- plot graph of mean leaf length, or width, vs. light intensity

extra information
- allow attempt to overcome other variables – e.g. soil water / soil pH / temperature

Total | 6 |
<table>
<thead>
<tr>
<th>Question</th>
<th>Answers</th>
<th>Extra information</th>
<th>Mark</th>
<th>AO / Spec. Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>9(a)(i)</td>
<td>in the chromosome(s)</td>
<td>ignore genes / alleles</td>
<td>1</td>
<td>AO1 2.7.2f, 2.7.1b</td>
</tr>
<tr>
<td></td>
<td>in the nucleus</td>
<td>allow nuclei</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>allow mitochondria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9(a)(ii)</td>
<td>the DNA / chromosomes / genes are replicated / copied / multiplied / duplicated</td>
<td>allow DNA is cloned</td>
<td>1</td>
<td>AO1 2.7.1a,c,n</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ignore same DNA / chromosomes / genes if unqualified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9(b)(i)</td>
<td>1 / one</td>
<td></td>
<td>1</td>
<td>AO2 2.7.2c,e, 2.7.3a,c</td>
</tr>
<tr>
<td>9(b)(ii)</td>
<td>2 / two</td>
<td></td>
<td>1</td>
<td>AO2 2.7.2c,d, 2.7.3a,b</td>
</tr>
<tr>
<td>9(c)</td>
<td>B</td>
<td></td>
<td>1</td>
<td>AO3 2.7.2i</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>