AQA

A-LEVEL
Biology

7402/2 - Paper 2

Mark scheme

June 2018

Version/Stage: 1.0 Final

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

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 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 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	Marking Guidance	Mark	Comments
01.1	1. (Less/no) ATP; 2. (Less/no) reduced NADP;	2	2. Accept NADPH, NADPH + H, $NADPH_2$ $NADPH + H^+$ 2. Reject reduced NAD, NADH etc,
01.2	1. (Less/no) carbon dioxide (reacts) with RuBP; 2. (Less/no) GP;	2	
01.3	1. Stroma (of/in chloroplast);	1	Reject: stoma Reject stroma of cytoplasm/chlorophyll Reject stroma of mitochondrion Ignore references to Calvin cycle or the light-independent reaction
01.4	1. Rubisco activity increases with temperature **OR** Rubisco optimum temperature is above (**rubisco activase**); 2. (Rubisco) **activase** activity decreases at high temperatures (allow any temperature above 25 ºC.) **OR** (Rubisco) **activase** optimum (allow in range) 25 to 30 ºC.; 3. (Results/graphs suggest) **activase** cannot/does not affect activity of rubisco; 4. (Results are) only for cotton; 5. (Results are) for isolated enzymes; 6. No stats test;	4 max	2. Accept denatures at high temperature (allow any temperature above 25 ºC) 4. Accept may not be the same in other species/types of plant Ignore: only one study

Question	Marking Guidance	Mark	Comments
02.1	Box 2. An inversion will result in a change in the number of DNA bases.	1	Reject if more than one box with tick. Ignore crossed-out ticks
02.2	1.(Increased) methylation (of tumour suppressor genes); 2.Mutation (in tumour suppressor genes); 3. Tumour suppressor genes are not transcribed/expressed **OR** Amino acid sequence/primary structure altered; 4. (Results in) rapid/uncontrollable cell division;	3 max	1. Accept abnormal methylation or hypermethylation 1. Ignore decreased acetylation of histones 3. Accept mRNA for transcription/transcribed 3. Accept tertiary structure altered 3 Accept different amino acid 3. Ignore reference to protein not being formed 4. Accept cell division cannot be regulated 4 Ignore growth
02.3	1. Correct answer of 1.9/1.93 x 10^{25} = **2 marks**;; 2. Incorrect answer but shows 84 = **1 mark** **OR** 28 x 3 = **1 mark** **OR** Incorrect answer but shows 672 divided by 8 = **1 mark**;	2	1. Accept 2 x 10^{25} = **2 marks** 1. Ignore any numbers after 1.93

Question	Marking Guidance	Mark	Comments
03.1	1. (So the) oxygen is used/absorbed/respired;	1	
03.2	1. Anaerobic respiration produces carbon dioxide; 2. Increase in pressure/volume (of gas);	2	2. Reference to either volume or pressure required for the mark
03.3	1. Correct answer in range of 4.9×10^{-4} to 4.91×10^{-4} = **2 marks**;; 2. Incorrect answer buts shows division by 24 = **1 mark** **OR** Incorrect answer but shows a number from 1175 to 1178 (ignore position of decimal point, standard form and any numbers that follow) = **1 mark**; **OR** Incorrect answer but show the number 49 (ignore position of decimal point, standard form and any numbers after 49) = **1 mark**;	2	1. Accept any equivalent mathematical representation of this answer
03.4	Large range/difference/increase in numbers;	1	1. Accept reference to exponential (increase) 1. Ignore if the answer only refers to numbers being high I. Ignore to 'fit on the scale'
03.5	1. Decrease/no glucose/substrate **OR** Increase in ethanol/carbon dioxide/acidity;	1	Accept decrease/no oxygen as Figure 4 is not linked to Figure 3. Accept competition for glucose/oxygen. Accept any named sugar Accept decrease in pH Accept increase in toxins 1. Ignore food/nutrients

03.6	1. Correct answer of 298000 or 297766 or 297765.59 or 296826 = **2 marks**;; 2. Incorrect answer but working shows 2000 × 2.72 = **1 mark**; **OR** Incorrect answer but working shows $2.72^{0.5 \times 10}$ **/** 2.72^{5} / $e^{0.5 \times 10}$ / = **1 mark**	2	1. Accept: any equivalent answer with appropriate rounding e.g. 2.98×10^{5}, 29.78×10^{4} etc.

Question	Marking Guidance	Mark	Comments
04.1	1. Method of randomly determining position (of quadrats) e.g. random numbers table/generator; 2. Large number/sample of quadrats; 3. Divide total percentage by number of quadrats/samples/readings;	3	1. Ignore line/belt transect 2. Accept many/multiple 2. Ignore point quadrat 2. If a specified number is given, it must be 20 or more
04.2	1. Beach grass is the pioneer (species); 2. Pioneers/named species change the (abiotic) environment/habitat/conditions/factors; 3. (So) less <u>hostile</u> for named species **OR** (So) more <u>suitable</u> for named species; 4. Conifer/hardwood trees represent climax community;	4	2. Must convey idea of change being caused by a species 2. Accept example of change e.g. more humus
04.3	1. Trees block/reduce (sun)light;	1	Reject 'blocks' all of the light
04.4	1.(NPP) remains constant; 2. GPP/photosynthesis **and** respiration constant; **OR** 3. (NPP) low/decreases; 4. Less light so less photosynthesis/GPP;	2	Mark in paired statements 1 and 2 **or** 3 and 4 2. Accept GPP/photosynthesis equals respiration 4. Reject no photosynthesis

Question	Marking Guidance	Mark	Comments
05.1	1. Affects water potential (of blood/body); 2. Affects <u>volume</u> of urine (produced/removed);	2	1. Accept Ψ for water potential
05.2	1. Furosemide **and** CVT more effective than placebo/control/C **OR** Furosemide more effective (than CVT); 2. Correct reference to a significant increase/difference as SD's do not overlap;	2	1. Accept both (drugs)/A and B more effective than placebo/control/C
05.3	1. Lower <u>volume</u> of blood;	1	
05.4	1.Water potential of filtrate/tubule decreased; 2. Less water (reabsorbed) by <u>osmosis</u> (from filtrate/tubule); 3. Collecting duct (is where osmosis occurs);	3	1. Accept correct reference to water potential gradient 1. Accept maintains low water potential. 1 and 2. Accept nephron for filtrate/tubule. 2. Accept no water (reabsorbed) for 'less' 2. Accept (more) water (absorbed) by <u>osmosis</u> (into filtrate/tubule) 3. Accept proximal convoluted tubule or distal convoluted tubule or (descending) loop of Henle 3.Ignore PCT, DCT.
05.5	1. Accept answers in the range 33840 to 34680;	1	

<table>
<tr><th>Question</th><th>Marking Guidance</th><th>Mark</th><th>Comments</th></tr>
<tr><td>06.1</td><td>1. Small sample size;
2. Fusion/fertilisation of gametes is random;
3. Linked Genes;
4. Epistasis;
5. Lethal <u>genotypes</u>;</td><td>2 max</td><td>2. Ignore breeding is random
3. Accept crossing over / sex linkage</td></tr>
<tr><td>06.2</td><td>1. ttmm;</td><td>1</td><td>Accept mmtt or any order of these alleles e.g. mtmt, tmtm etc</td></tr>
<tr><td>06.3</td><td>1. Genes are linked;
2. Produces few(er) tall, mottled and dwarf, normal offspring;
3. Crossing over (has occurred);</td><td>3</td><td>1. Accept ‘Alleles are linked’ but reject if context suggests alleles of the ‘same gene’
2. Accept produces few Tm and tM gametes
2. Accept ‘fewer recombinants’</td></tr>
<tr><td>06.4</td><td>One mark for each correct column;;
<table><tr><th>Phenotype of offspring</th><th>Ratio of offspring</th></tr><tr><td>Tall (plant and) normal (leaves)</td><td>9</td></tr><tr><td>Tall (plant and) mottled (leaves)</td><td>3</td></tr><tr><td>Dwarf (plant and) normal (leaves)</td><td>3</td></tr><tr><td>Dwarf (plant and) mottled (leaves)</td><td>1</td></tr></table></td><td>2</td><td>Note: Accept correct phenotypes in any order for one mark and correct ratio in any order e.g. 3:9:3:1 for one mark However, phenotypes and ratio must match for two marks
Accept alternative wording e.g. short for dwarf
2. Accept $^{9}/_{16}$ $^{3}/_{16}$ $^{3}/_{16}$ $^{1}/_{16}$</td></tr>
</table>

Question	Marking Guidance	Mark	Comments
07.1	1. (Dopamine) diffuses across (synapse); 2. Attaches to receptors on postsynaptic membrane; 3. Stimulates entry of sodium ions **and** depolarisation/action potential;	3	2.Ignore name/nature of receptor e.g. cholinergic 3. Accept Na^+ for sodium ions 3. Accept generator potential for action potential
07.2	1. Morphine attaches to opioid receptors; 2. (More) dopamine released (to provide pain relief);	2	1. Reject reference to active site 2. Reject receptors release dopamine
07.3	1. (Inside of postsynaptic) neurone becomes more negative/hyperpolarisation/inhibitory postsynaptic potential; 2. More sodium ions required (to reach threshold) **OR** Not enough sodium ions enter (to reach threshold); 3. For depolarisation/action potential;	3	1. Ignore K^+ 1. Accept -75mV or any value below this as equivalent to more negative 1. Accept 'decrease in charge' 2. Accept Na^+ for sodium ions 3. Context must covey idea that depolarisation / action potential is less likely

Question	Marking Guidance	Mark	Comments
08.1	1. (All) the DNA in a cell/organism;	1	Accept '(all) the 'genes'/alleles' 'genetic material/code' in a cell/organism/ person' 'the total number of DNA bases in a cell/organism' Reject all the DNA/ genes within a <u>species</u>
08.2	1. (Transcriptional factor/antibody) has a specific/tertiary structure/shape; 2. <u>Complementary</u> (shape/structure);	2	1. Accept (antibody) has a specific variable region 1. Accept (transcription factor/antibody) has a specific binding site 1 and 2. Reject active site but only once.
08.3	1. DNA, transcription factor and antibody;	1	Accept Nucleotides for DNA Ignore 'reference to chemicals'
08.4	1. Binds to P34 gene/DNA/mRNA **OR** Binds to transcription factor gene/DNA **OR** Binds to promoter;	1	Reject binds to transcription factor
08.5	1. Restriction (endonuclease/enzyme) to cut plasmid/vector; 2. Ligase joins gene/DNA to plasmid/vector;	2	

08.6	1. Mass/number of amino acids/polypeptides; 2. Charge; 3. R groups (differ);	2 max	1. Accept weight for mass 1. Ignore density/size 1. Accept length of polypeptide/amino acid chain 1. Accept primary structure /sequence of amino acids. 1. Accept tertiary structure

Question	Marking Guidance	Mark	Comments
09.1	1. LP due to mutation **OR** Allele due to mutation; 2. Milk provides named nutrient; 3. Individuals with LP more likely to survive **and** reproduce **OR** Individuals with advantageous <u>allele</u> more likely to survive **and** reproduce; 4. Directional selection; 5. Frequency of <u>allele</u> increases (in the offspring/next generation);	4 max	1. Reject mutation caused by drinking milk. 2. Accept any correct named nutrient e.g. glucose, galactose, protein 2. Ignore 'sugar' 'lactose' as named nutrient 1. and 3. Reject (LP) gene 3. Accept 'individuals who produce lactase' for 'LP individuals' 3. Accept 'pass on allele/LP/characteristic' for reproduce. 5. Accept description of increasing frequency of allele e.g. 'higher proportion', 'more common' but ignore increase in **number** of allele
09.2	1. Dominant <u>allele</u>; 2. (Always) expressed/shown (when present in phenotype/offspring) **OR** Expressed when only one (dominant allele) present;	2	
09.3	1. Mutation in promoter (DNA/gene) for transcription factor **OR** Mutation in promoter (region/DNA) for the gene **OR** Mutation in gene for transcription factor; 2. Lactase gene continues to be transcribed/active;	2	1. Accept mutation in an epistatic gene

Question	Marking Guidance	Mark	Comments
10.1	1. No (functional) cones **OR** Only rods; 2. Cones are connected to a single neurone **OR** Several rods connected to a single neurone; 3. (Cones) Separate (sets of) impulses to brain **OR** (Rods) Single (set of) impulse/s to brain;	3	2. Accept correct reference to retinal convergence 2. Accept 'bipolar/nerve cell' for neurone 2. Accept 'many' 2 or more for 'several' 3. Accept 'optic nerve' for brain 3. Reject 'signals', 'messages' for 'impulses' 3. Accept 'action potential'
10.2	1. Correct answer in range 42 – 44% = **2 marks**;; 2. Incorrect answer but shows that understanding that 2pq = heterozygous/carriers = **1 mark**;	2	2. Accept $1 – (p^2 + q^2)$ 2. Accept understanding of 2pq by using calculation involving 2 × two different numbers
10.3	1. (Gene/allele) is on the <u>X chromosome</u>; 2. Females require two alleles/females can be heterozygous/carriers **and** males require one allele;	2	2. Reference to allele is essential but only required once 2. Reference to females **and** males required 2. Reject dominant allele
10.4	1. Green sensitive pigment/cones non-functional **OR** Cones that detect green light non-functional; 2. Three different types of pigment/cone;	3	1, 2 and 3. Reject reference to 'green cones'/ 'blue cones / 'red cones' but once only 1, 2 and 3. Reject reference to 'green pigment'/ 'blue pigment/ 'red pigment'

	3. Other/different colours ('seen') due to stimulation of more than one cone/pigment;		but once only **and only if 'green cones' etc, (see above) has not been rejected.**

10.5	1. (iPS cells) divide; 2.(iPS cells) develop/differentiate into (green sensitive) cones;	2	2. Accept 'produce'/'specialise' 'turn in to' / 'genes switched on' / 'turned on' for 'develop' but ignore 'grow' 2. Reject develop into 'green cones'/blue' cones'/'red cones' Ignore develop/differentiate into (blue/red sensitive) cones; Reject reference to develop in to 'green pigment'/ 'blue pigment/ 'red pigment

Question	**Marking Guidance**	**Mark**	**Comments**
10.6	1 (Use of iPS cells) long-term; 2. (Use of iPS cells) less chance of rejection/immune response; 3. (Use of iPS cells) single treatment; 4. Harm/side effects from using viruses (in gene therapy);	3 max	1. Accept 'gene therapy short-term' or 'only two years' 1. Accept 'permanent' 3. Accept 'gene therapy 'regular/frequent treatment''