AQA GCSE Biology | 8461

SPECIFICATION POINT 4.6.1.2

Meiosis

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**7**
Available paper years	**2010–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.6.1.2 Meiosis

Answer 01 · Mark scheme

June 2019 | BLY2H | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	any **one** from • chromosomes in pairs • inherited one of each pair from each parent • one of each pair in egg **and** one of each pair in sperm • so sex cells / gametes can have half the number	allow need to pair during cell division / meiosis	1
7(b)	any **two** from: • <u>code</u> • combination / sequence of amino acids • forming specific / particular proteins / examples	If **no other mark** gained allow reference to controlling characteristics / appearance for **1** mark	2
7(c)(i)	C		1
7(c)(ii)	30		1
7(d)(i)	for growth / repair / replacement / asexual reproduction	do **not** accept incorrect qualification, eg growth *of* cells **or** repair of cells they equals cells therefore do not accept they grow etc	1
7(d)(ii)	44 **or** 22 pairs		1
Total			**7**

4.6.1.2 Meiosis

Answer 02 · Mark scheme

June 2013 | BL2HP | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
8(a)(i)	DNA replication / copies of genetic material were made	'it' = a chromosome allow chromosomes replicate / duplicate / are copied ignore chromosomes divide / split / double	1
8(a)(ii)	one copy of each (chromosome / chromatid / strand) to each offspring cell	ignore ref. to gametes and fertilisation	1
	each offspring cell receives a complete set of / the same genetic material	allow 'so offspring (cells) are identical'	1
8(b)(i)	meiosis	allow mieosis as the only alternative spelling	1
8(b)(ii)	Species A = 4 **and** Species B = 8		1
8(b)(iii)	sum of A + B from (b)(ii) e.g. 12		1

Question 8 continues on the next page...

Question 8 continued...

question	answers	extra information	mark
8(c)(i)	similarities between chromosomes **or** similarities between flowers described	 e.g. shape of petals / pattern on petals / colour / stamens	1
	can breed / can sexually reproduce	allow can reproduce with each other / they can produce offspring	1
8(c)(ii)	any **two** from: • offspring contain 3 copies of each gene / of each chromosome / odd number of each of the chromosomes • some chromosomes unable to pair (in meiosis) • (viable) gametes not formed / some gametes with extra / too many genes / chromosomes **or** some gametes with missing genes / chromosomes		2
Total			**10**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

4.6.1.2 Meiosis

Answer 03 · Mark scheme

June 2018 | 8461/2H | Original Q5

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>05.1</td><td>
<table>
<tr><th></th><th colspan="3">statement is true for</th></tr>
<tr><th></th><th>mitosis only</th><th>meiosis only</th><th>both mitosis and meiosis</th></tr>
<tr><td>all cells produced are genetically identical</td><td>✓</td><td></td><td></td></tr>
<tr><td>in humans, at the end of cell division each cell contains 23 chromosomes</td><td></td><td>✓</td><td></td></tr>
<tr><td>involves DNA replication</td><td></td><td></td><td>✓</td></tr>
</table>
3 correct = 2 marks
2 correct = 1 mark
0 or 1 correct = 0 marks
</td><td></td><td>2</td><td>AO1
4.1.2.2
4.6.1.2</td></tr>
<tr><td>05.2</td><td>any two from:

• many offspring produced
• takes less time
• (more) energy efficient
• genetically identical offspring
• successful traits propagated / maintained / passed on (due to offspring being genetically identical)
• no transfer of gametes or seed dispersal
• not wasteful of flowers / pollen / seeds
• colonisation of local area</td><td>ignore references to one parent only

allow asexual is faster

allow offspring are clones

allow no vulnerable embryo stage
allow no need for animals

must imply local area</td><td>2</td><td>AO3
4.6.1.1
4.6.1.3</td></tr>
</table>

4.6.1.2 Meiosis

Answer 03 · Mark scheme

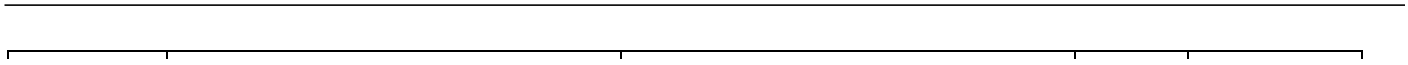
June 2018 | 8461/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3		allow bluebell example described (**max 3** if not bluebell)		
	genetic variation (in offspring)		1	AO1
	(so) better adapted survive	allow reference to natural selection or survival of the fittest	1	AO1
	(and) colonise new areas by seed dispersal **or** can escape adverse event in original area (by living in new area)	must imply new area	1	AO3
	many offspring **so** higher probability some will survive		1	AO3
				4.6.1.1 4.6.2.1 4.6.1.3 4.7.1.1
Total			**8**	

4.6.1.2 Meiosis

Answer 03 · Mark scheme

June 2018 | 8461/2H | Original Q5



4.6.1.2 Meiosis

Answer 04 · Mark scheme

November 2020 | 8461/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **three** from: • mitosis produces two (daughter) cells but meiosis produces four (daughter) cells • one cell division in mitosis but two cell divisions in meiosis • mitosis produces cells with two of each chromosome, but meiosis produces cells with one of each chromosome • mitosis produces genetically identical cells, but meiosis produced genetically different cells	answers must be comparative allow mitosis produces diploid cells but meiosis produces haploid cells allow mitosis maintains the number of chromosomes **or** mass of DNA **or** mass of genetic material but meiosis halves the number / mass allow mitosis produces cells with 23 pairs **or** 46 chromosomes but meiosis produces cells with 23 chromosomes allow other correct differences between the processes of mitosis and meiosis	3	AO1 4.6.1.1 4.6.1.2 4.1.2.2

05.2	any **one** from: • DNA doubles / copies / replicates (once) • increase in the number of mitochondria / ribosomes / sub-cellular structures	allow chromosomes **or** genetic material **or** genetic information double / replicate / are copied ignore mitochondria / ribosomes are copied / duplicated allow chromosomes / chromatids pulled to side (of cell) allow other correct similarities between the processes of mitosis and meiosis	1	AO1 4.6.1.1 4.6.1.2 4.1.2.2
05.3	Dd / dD has **D** because has Dupuytren's **and** has **d** because child / person 6 is homozygous recessive **or** does not have Dupuytren's **or** is **dd**	allow heterozygous allow has **D** because has Dupuytren's **and** person 1 and person 2 both passed **d** to child / person 6 allow has **D** because has Dupuytren's **and** cannot be homozygous / **DD** or all the children would have Dupuytren's	1 1	AO3 4.6.1.6 4.6.1.7
05.4	male / person 7 gametes correct: **D** and **d** female / person 8 gametes correct: **d** and **d** correct derivation of offspring genotypes: **Dd Dd dd dd** offspring with Dupuytren's identified probability correct from the correct identification given	allow **1** mark for both sets of gametes correct if parents not identified allow correct derivation of offspring genotypes from incorrect gametes allow correct for genotypes stated in mp3 allow probability correct from offspring genotypes if identification not given	1 1 1 1 1	4.6.1.6 4.6.1.7 AO2 AO2 AO2 AO2 AO3

4.6.1.2 Meiosis

05.5	female(s) / person(s) 3 / 11 / 12 have Dupuytren's females don't have Y chromosome **or** Dupuytren's is passed from fathers / 1 / 7 to daughters / 3 / 12, (so is not on the Y chromosome)	allow some females have Dupuytren's allow only males have Y chromosomes allow females are XX allow Dupuytren's is passed from mothers / 11 to children / 15, (so is not on the Y chromosome)	1 1	AO3 4.6.1.6 4.6.1.7 4.6.1.8
Total			**13**	

4.6.1.2 Meiosis

Answer 04 · Mark scheme

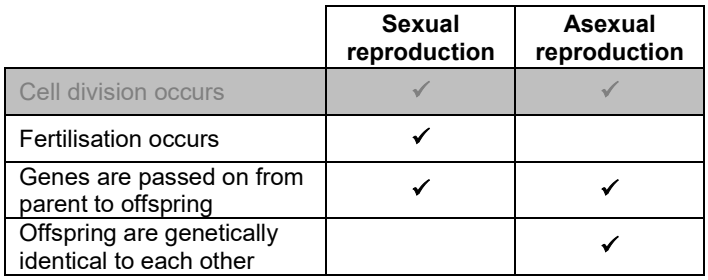
November 2020 | 8461/2H | Original Q5

4.6.1.2 Meiosis

Answer 05 · Mark scheme

June 2022 | 8461/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	 allow **1** mark for 1 or 2 correct rows ignore 'x' in blank boxes		2	AO1 4.6.1.1

	Sexual reproduction	Asexual reproduction
Cell division occurs	✓	✓
Fertilisation occurs	✓	
Genes are passed on from parent to offspring	✓	✓
Offspring are genetically identical to each other		✓

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	pollen (grain)	allow nucleus in pollen (grain)	1	AO1 4.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	between 3 and 4 hours		1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	5 hours 6 hours		1 1	AO2 4.6.1.2

4.6.1.2 Meiosis

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	2		1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	4		1	AO2 4.6.1.2

Total Question 1		**8**

4.6.1.2 Meiosis

Answer 06 · Mark scheme

June 2023 | 8461/2H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.1	(A) → E → D → C → B → (F)	must be in this order	1	AO3 4.6.1.2 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.2	(start) 16	allow 8 pairs	1	AO3
	(end) 8	the answer must be half the value of the number at the start	1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.3	(meiosis) forms gametes	allow (meiosis) forms sex cells allow (meiosis) forms eggs **and** sperm	1	AO1 4.6.1.2
	(two gametes) fuse / fertilise		1	
	(so) keeps chromosome number constant (from generation to generation) **or** (so) prevents doubling / increase in chromosome number (in each generation) **or** (so) gives normal / correct chromosome number (for embryo / new cell)	allow gives correct chromosome number (for offspring)	1	

4.6.1.2 Meiosis

Answer 06 · Mark scheme

June 2023 | 8461/2H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.4	random chromosome from each pair (of chromosomes)	ignore half the chromosomes ignore half the DNA allow other processes for creating variation ignore mutation	1	AO1 4.6.1.2
	moves to one end of the cell **or** goes into each new cell **or** gamete		1	

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.5	base(s)	allow organic / nitrogenous base(s) ignore adenine / cytosine / guanine / thymine	1	AO1 4.6.1.5

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.6	12 / twelve	allow 6 pairs **or** six pairs	1	AO3 4.6.1.5

Total Question 8	10

Answer 07 · Mark scheme

June 2025 | 8461/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	cell division **1**		1	AO2 4.1.2.2 4.6.1.1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	**A** and **C**		1	AO2 4.1.2.2 4.6.1.1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	23 **or** twenty three	do **not** accept 23 pairs	1	AO2 4.6.1.2 4.6.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	5 / five **or** 6 / six	ignore reference to letters	1	AO2 4.6.1.2 4.6.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	(only) mitosis	do **not** accept meiosis / meitosis / metosis	1	AO1
	(so) **all** cells receive a copy of every allele / gene	allow (so) **all** cells receive a copy of every chromosome **or** (so) **all** cells receive a copy of all the DNA **or** (so) **all** cells receive a full set of chromosomes	1	AO2 4.6.1.1 4.1.2.2 4.6.1.3

4.6.1.2 Meiosis

Answer 07 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	gametes are produced by meiosis (so) offspring have unique / different / random combinations of alleles / genes / chromosomes from each parent / gamete	 allow (so) gametes fuse creating unique / different / random combinations of alleles / genes / chromosomes in offspring	1 1	AO1 AO2 4.6.1.1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	any **two** from: • faster than sexual • many offspring produced to colonise local area **or** many offspring produced to out-compete other species • genetically identical offspring so well adapted to current conditions / environment • only one parent needed so no need for pollinators / bees • offspring receive water **and** sugars / minerals / ions / salts from parent • less energy / materials required as no need to produce gametes / flowers / seeds / fruits		2	AO1 4.6.1.1 4.6.1.3

4.6.1.2 Meiosis

Answer 07 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.8	any **two** from: • new combinations of alleles gives genetic variation **or** genetic variation gives selective advantage • seeds dispersed to new / wider area so less vulnerable to habitat loss **or** seeds dispersed to new / wider area so not competing with (parent / offspring) plants for space / water / minerals • larger number of offspring produced so will increase the population quickly	allow genetic variation provides the opportunity for evolution allow genetic variation enables species to adapt to new / changed environments allow larger number of offspring produced will improve survival of the species	2	AO1 4.6.1.1 4.6.1.3 4.6.2.2 4.6.3.1

Total Question 6	12

4.6.1.2 Meiosis

Answer 04 · Examiner comments — November 2020 | 8461/2H | Original Q5

Question 5 (standard/high & high demand)

This question was about cell division and genetics. In **05.1** many students confused the two types of cell division, mitosis and meiosis: 1 in 10 students were able to give 3 correct differences between the two. Some described only one type of division rather than giving the comparison demanded by the question; others fell short of giving sufficient detail – eg describing the daughter cells as 'identical / non-identical' rather than being *genetically* identical / non-identical'; many included irrelevant points about where in the body the cell division occurred (the question asked for differences in the 'processes'). Two common misunderstandings were that meiosis occurred 'in gametes' and that meiosis required two parents whereas mitosis required only one.

For **05.3** explanations of how students derived the genotype of person1 were frequently insufficient. Since this person had the condition Dupuytren's, he must have had either one or two of the dominant alleles. The fact that he had an unaffected child (person 6), showed he must also have had the recessive allele – hence his genotype was Dd or heterozygous. Most students mentioned only the children as evidence and did not relate person 1's genotype to his phenotype.

Students had to draw a Punnett square diagram in **05.4** to find the probability that persons 7 and 8 in could produce another child with Dupuytren's. Since persons 7 and 8 had *different* phenotypes, it was surprising how many students assigned the *same* genotype to each of them (usually both being Dd). Other common errors were not identifying which parent was which (ie gametes D and d from person 7, and only d gametes from person 8) and not assigning phenotypes to the offspring genotypes.

Answer 04 · Examiner comments — November 2020 | 8461/2H | Original Q5

In **05.5** explanations of the evidence in the pedigree diagram that the D allele is *not* on the Y chromosome, it was evident that many students did not know that males are XY and females XX as many thought the female had a Y chromosome. Those that did know this were able to point out that some females had Dupuytren's despite not having a Y chromosome, or that the condition can be passed from fathers to their daughters, or that an affected mother and unaffected father can have an affected son. Many students insisted, erroneously, that the allele must have been on the X chromosome.

4.6.1.2 Meiosis

Answer 05 · Examiner comments — June 2022 | 8461/2H | Original Q1

Question 1

This was the first of three questions common to both the Foundation and Higher Tier papers. The topic was reproduction and meiosis.

01.1 Three-quarters of students correctly selected whether each of the three statements applied to sexual and/or asexual reproduction. The most common error was not knowing that in *both* types of reproduction genes are passed from parents to offspring.

01.2 Almost the same proportion knew that pollen is the male gamete formed in flowering plants. Incorrect answers included 'anther', 'stamen, 'stem', 'stigma', 'sperm' and even 'testis'.

01.3 -01.6 Interpretation of the graph in **Figure 4**, which showed changing amounts of DNA in a cell before, during and after meiosis, was good in questions **01.3** and **01.4** where, respectively, the correct period of DNA synthesis and the correct times of cell divisions were selected. However, only half the students chose the correct values for the amount of DNA expected in a sperm cell and in an embryo in **01.5** and **01.6**.

Answer 06 · Examiner comments — June 2023 | 8461/2H | Original Q8

Question 8

This question was about meiosis and DNA structure.

08.1 Given the identity of the first and last diagrams in Figure 13, two-thirds of students were able to put the remaining four in the correct sequence to show the process of meiosis.

08.2 However, in this question, the vast majority did not follow the instruction to give the number of chromosomes per cell in Figure 13 but decided to use human chromosome numbers. Thus, the most common answer for the number of chromosomes at the start of meiosis was 46 and, at the end, 23. Various other numbers were given and, as long as the end number was half the starting number, 1 mark out of 2 was scored. Only 3 percent gave the correct values of 16 and 8 from Figure 13.

08.3 Fewer than a quarter of students were able to give a 3-mark answer explaining why it was necessary for the number of chromosomes at the end of meiosis to be different from that at the start. Many made just two points – either for meiosis producing gametes which could

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4.6.1.2 Meiosis

Answer 06 · Examiner comments June 2023 | 8461/2H | Original Q8

fuse at fertilisation or for stating that fertilisation would restore the correct chromosome number. Some students simply described the process of meiosis, while others gave a comparison of meiosis and mitosis, both of which were not relevant to the question.

08.4 Most students found it very difficult to describe how meiosis produces cells that are genetically different and so scored no marks. Some described how random fertilisation causes genetic differences which was not relevant. Very few students could describe that one chromosome from each **pair** of chromosomes would separate **randomly** to opposite ends of the cell or into each of the gametes.

08.5 Nearly three-quarters of students knew that the four substances labelled A, C, G or T in Figure 14 were bases. Common errors included ‘amino acids’, ‘proteins’ and ‘nucleotides’.

08.6 Two-thirds evidently knew the meaning of the term nucleotide and successfully counted twelve of them in the portion of DNA shown in Figure 14.

Answer 07 · Examiner comments

Question 6 (Standard, Standard/high and High demand)

06.1
Over 70% of students identified the correct cell division that represented mitosis.

06.2
Over half of students identified cells A and C as being genetically identical.

06.3
Just over 85% of students gained the marking point here, knowing that cell J had 23 chromosomes. The most common incorrect response was '23 *pairs*'.

06.4
Students appeared to struggle with the high demand of this question, with only around 15% of students gaining the mark. Knowledge of the *stages* of meiosis is not required for this specification – as such the exact point that the reduction in chromosome numbers happens is not needed, hence, it was reasonable for students to give an answer of 5 or 6 depending on their interpretation.
The most common correct answer was '6', and there was a range of incorrect responses, with '4' being the most common. Some responses gave a list of letters without a number which did not answer the question.

06.5
Students struggled to clearly explain why offspring produced using runners are genetically identical. While many students correctly identified mitosis as being involved for mark point 1, simply stating that offspring were 'clones' was not sufficient without mentioning mitosis. 30% of students gained 1 mark – overwhelmingly for mark point 1. Mark point 2 was rarely awarded due to ineffective articulation at this level of demand. Even answers containing pertinent details often struggled to fully meet the mark scheme requirements. Additionally, many students focused on describing asexual reproduction, with answers such as 'only one parent is required' or 'no gamete fusion,' rather than explaining **why** the offspring were genetically identical. Some described mitosis as producing two genetically identical cells, but this was insufficient to explain why the whole plant was genetically identical.
Despite detailed attempts by most students, only 1% of students gained both available marks.

06.6
Only 10% of students managed to gain any marks in this question. Again, features of sexual reproduction were given, with little additional detail explaining why the offspring produced using flowers, fruits and seeds are not genetical identical. To earn mark point 1, students needed to explicitly link meiosis with the production of gametes, a connection rarely seen in responses that typically mentioned one without the other. Mark point 2 proved highly demanding due to its strict detail requirements. Many good attempts were seen but

4.6.1.2 Meiosis

Answer 07 · Examiner comments

unfortunately lacked the precision needed at this level of demand. A very common error was the suggestion that meiosis actually produced the flowers, fruits and seeds which is incorrect.

06.7

One fifth of students were able to describe at least one advantage of asexual reproduction to the survival of the strawberry plants. For bullet point 1, a direct comparison to sexual reproduction had to be made, but many responses did not use this comparative language. However, if awarded bullet point 1 was by far the most common correct response seen.
For bullet points 2 through to 6, a clear link to a survival advantage was required. Many responses stated that 'less energy was needed', or 'only one parent needed' but then did not link it to the appropriate survival advantage and as such could not be awarded credit.

06.8

This question was set at very high demand with only a quarter of students gaining at least 1 mark. Bullet point 1 was the most common advantage of sexual reproduction given – articulated in many ways to match the variety of options on the mark scheme. Responses such as, 'genetic variation will decrease the chance of a disease killing all the plants' was most commonly awarded – which equated to 'genetic variation gives selective advantage' gaining one mark. Several good answers were seen but sadly students had only referred to 'variation' and not 'genetic variation' and so could not be credited. In addition, some responses correctly stated that 'seed dispersal would lead to less competition' but then didn't qualify this with any of the required examples from the mark scheme and as such were not credited.