AQA GCSE Biology | 8461

SPECIFICATION POINT 4.1.2.1

Chromosomes

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**64**
Available paper years	**2007–2025**

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.

4.1.2.1 Chromosomes

Answer 01 · Mark scheme

Question 4

	answers	extra information	mark
(a)	antibodies antitoxins antibiotics		1 1 1
(b)	any **two** from: • measles • mumps • rubella / German measles		2
(c)	less / low / no chance of getting named / all condition(s) if vaccinated quantitative figure(s) e.g. 5 times less likely to get convulsions	must be comparative	1 1
(d)	enzymes genes		1 1
total			9

4.1.2.1 Chromosomes

Answer 02 · Mark scheme March 2007 | BLY1B | Original Q4 | Legacy

Four	**A**	evolved	**1**
	B	genes	**3**
	C	natural selection	**2**
	D	survived	**4**

Answer 03 · Mark scheme March 2007 | BLY1B | Original Q5 | Legacy

Five	**A**	cell	**1**
	B	chromosome	**4**
	C	enzymes	**2**
	D	gene	**3**

Answer 04 · Mark scheme June 2007 | BLY1B | Original Q3 | Legacy

Three	**A**	characteristics	**1**
	B	chromosomes	**3**
	C	genes	**2**
	D	mutations	**4**

4.1.2.1 Chromosomes

Answer 05 · Mark scheme

January 2008 | BLY1F | Original Q5 | Legacy

Question 5

	answers	extra information	mark
(a)	genes chromosomes		1 1
(b)(i)	higher yield less use of pesticides		1 1
(b)(ii)	any **two** from: • uncertain about effects on health • fewer bees • might breed with wild plant • seeds only from one manufacturer		2
total			6

4.1.2.1 Chromosomes

Answer 05 · Mark scheme

January 2008 | BLY1F | Original Q5 | Legacy

BLY1F

4.1.2.1 Chromosomes

Answer 06 · Mark scheme

Question 3

	answers	extra information	mark
(a)	characteristics		1
(b)	genes		1
(c)	chromosomes		1
(d)	mitosis		1
(e)	asexual		1
total			5

4.1.2.1 Chromosomes

Answer 06 · Mark scheme

January 2008 | BLY2F | Original Q3 | Legacy

BLY2F

Answer 07 · Mark scheme

March 2008 | BLY1BP | Original Q2 | Legacy

Two	**A**	genes	**2**
	B	gametes	**3**
	C	embryos	**4**
	D	characteristics	**1**

Answer 08 · Mark scheme

March 2008 | BLY1BP | Original Q9 | Legacy

Nine	**3**	**2**	**4**	**3**

Answer 09 · Mark scheme

June 2008 | BLY1BP | Original Q5 | Legacy

Five	**A**	extinction	**4**
	B	natural selection	**1**
	C	mutation	**3**
	D	variation	**2**

4.1.2.1 Chromosomes

Answer 10 · Mark scheme

January 2009 | BLY1F | Original Q5 | Legacy

question	answers	extra information	mark
5(a)	sexual reproduction		1
5(b)	any **three** from: • coat colour inherited / controlled by genes • it has horse and zebra features • gets gametes from both parents • genes / DNA / chromosomes / genetic information in gametes • zorse receives genes / DNA / chromosomes / genetic information from parents		3
Total			**4**

4.1.2.1 Chromosomes

Answer 10 · Mark scheme

January 2009 | BLY1F | Original Q5 | Legacy

COMPONENT NUMBER: BLY1F

COMPONENT NAME: Science B / Biology

STATUS: Final

DATE: January 2009

4.1.2.1 Chromosomes

Answer 11 · Mark scheme

January 2009 | BLY2F | Original Q3 | Legacy

question	answers	extra information	mark
3(a)	2 and 3		1
3(b)	cell **P** has an X chromosome; cell **R** has a Y chromosome		1
3(c)	any **two** from: • (formed from) different egg / 2 eggs • (formed from) different sperm / 2 sperm • have different genes / alleles / chromosomes / DNA	allow genetics	2
3(d)(i)	stem cells		1
3(d)(ii)	the cells divide the cells differentiate		1 1
3(d)(iii)	(medical) research / named eg growing organs **or** medical / patient treatment	allow (embryo) cloning do **not** allow designer babies / more babies	1

Question 3 continued on next page…

4.1.2.1 Chromosomes

COMPONENT NUMBER: BLY2F

COMPONENT NAME: Additional Science / Biology

STATUS: Final

DATE: January 2009

Question 3 continued…

question	answers	extra information	mark
3(d)(iv)	any **one** from: • ethical / moral / religious objections • potential harm to embryo	ignore cruel / not natural / playing God allow deformed ignore harm to mother	1
Total			**9**

4.1.2.1 Chromosomes

Answer 11 · Mark scheme January 2009 | BLY2F | Original Q3 | Legacy

COMPONENT NUMBER: BLY2F

COMPONENT NAME: Additional Science / Biology

STATUS: Final

DATE: January 2009

Answer 12 · Mark scheme March 2009 | BLY1BP | Original Q4 | Legacy

Four	**A**	insulin is produced by genetically engineered bacteria	**3**
	B	diabetics inject insulin to control diabetes	**4**
	C	the insulin gene is 'cut out' using enzymes	**1**
	D	the insulin gene is transferred into a bacterium	**2**

Answer 13 · Mark scheme March 2009 | BLY1BP | Original Q5 | Legacy

Five	**A**	cell	**4**
	B	nucleus	**1**
	C	chromosome	**2**
	D	gene	**3**

	A	**B**	**C**	**D**

Answer 14 · Mark scheme June 2009 | BLY1BP | Original Q3 | Legacy

Three	**A**	evolution	**4**
	B	mutation	**2**
	C	selection	**3**
	D	variation	**1**

Answer 15 · Mark scheme June 2009 | BLY1BP | Original Q9 | Legacy

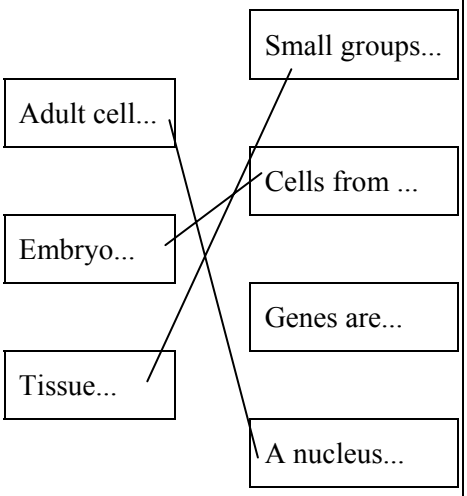
Nine	**2**	**2**	**1**	**3**

4.1.2.1 Chromosomes

Answer 16 · Mark scheme

June 2009 | BLY1F | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	killed by poachers / killed for tusks less trees / leaves to eat land available disappearing	 ignore feed on lots of leaves 	1 1 1
4(b)		all three correct = **3** marks two correct = **2** marks one correct = **1** mark extra line from a statement cancels the mark	max 3
Total			**6**

4.1.2.1 Chromosomes

Answer 16 · Mark scheme

June 2009 | BLY1F | Original Q4 | Legacy

BLY1F

4.1.2.1 Chromosomes

Answer 17 · Mark scheme June 2009 | BLY2F | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	chromosomes		1
5(b)	diagram showing four separate chromosomes two long and two short (as in diagram 1)	allow each chromosome shown as two joined chromatids do **not** allow if chromosomes touching each other	1
5(c)(i)	any **two** from: • can grow into any type of tissue / named tissue • used in medical research • used to treat human diseases • large numbers can be grown		2
5(c)(ii)	any **two** from: • expensive • grow out of control / ref cancers • may be rejected • need for drugs (for rest of life)		2
Total			**6**

4.1.2.1 Chromosomes

Answer 17 · Mark scheme

June 2009 | BLY2F | Original Q5 | Legacy

BLY2F

Answer 18 · Mark scheme

November 2009 | BLY1BP | Original Q4 | Legacy

Four	**A**	evolution	**1**
	B	extinction	**3**
	C	natural selection	**4**
	D	reproduction	**2**

4.1.2.1 Chromosomes

Answer 19 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)	sexual		1
4(b)	chromosome		1
4(c)(i)	any **two** from: • genetic-engineering can produce fast-growing food animals • genetic engineering can be used to clone animals in danger of extinction • using GM animals can reduce the number of animals used in medical research	ignore answers that do not relate to list	2
4(c)(ii)	GM animals might escape and breed with wild animals animals have the right to be free from genetic modification	ignore answers that do not relate to list	1 1
Total			**6**

4.1.2.1 Chromosomes

Answer 19 · Mark scheme

January 2010 | BLY1F | Original Q4 | Legacy

BLY1F

Question5

4.1.2.1 Chromosomes

Answer 20 · Mark scheme

January 2010 | BLY2F | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	sex cells		1
2(a)(ii)	chromosomes		1
2(b)(i)	two		1
2(b)(ii)	recessive		1
2(c)(i)	cell membrane	allow membrane	1
2(c)(ii)	cytoplasm		1
2(d)(i)	A		1
2(d)(ii)	B		1
Total			**8**

4.1.2.1 Chromosomes

Answer 20 · Mark scheme January 2010 | BLY2F | Original Q2 | Legacy

BLY2F

Answer 21 · Mark scheme March 2010 | BLY1BP | Original Q3 | Legacy

Three	**A**	genes	**2**
	B	gametes	**1**
	C	characteristics	**4**
	D	nucleus	**3**

Answer 22 · Mark scheme June 2010 | BLY1BP | Original Q9 | Legacy

No matching mark scheme was available in the supplied archive for this question.

4.1.2.1 Chromosomes

Answer 23 · Mark scheme

June 2010 | BLY1F | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	characteristic		1
4(a)(ii)	gene		1
4(a)(iii)	gamete		1
4(b)	sexual asexual clones		1 1 1
Total			**6**

4.1.2.1 Chromosomes

Answer 23 · Mark scheme June 2010 | BLY1F | Original Q4 | Legacy

BLY 1F

Answer 24 · Mark scheme November 2010 | BLY1BP | Original Q3 | Legacy

Three	**A**	extinction	**4**
	B	mutation	**1**
	C	natural selection	**3**
	D	variation	**2**

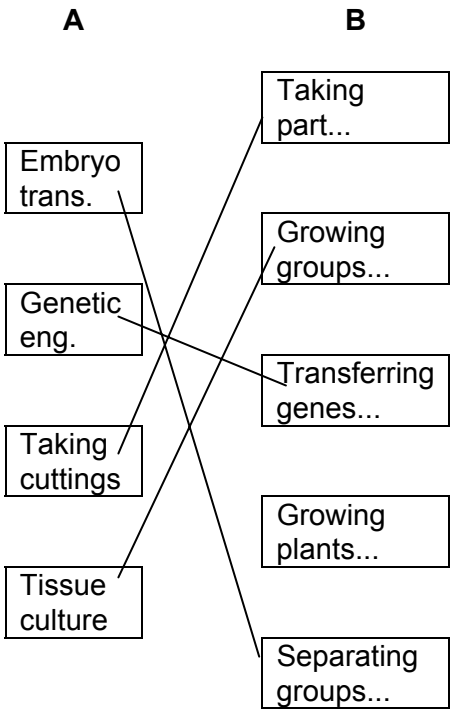
Answer 25 · Mark scheme November 2010 | BLY1BP | Original Q4 | Legacy

Four	**A**	chromosomes	**4**
	B	clones	**1**
	C	gametes	**3**
	D	genes	**2**

4.1.2.1 Chromosomes

Answer 26 · Mark scheme

Question 4

question	answers	extra information	mark
4		**1** mark for each correct line mark each line from left hand box two lines from left hand box cancels mark for that box	4
Total			**4**

4.1.2.1 Chromosomes

Answer 26 · Mark scheme

January 2011 | BLY1F | Original Q4 | Legacy

BLY1F

4.1.2.1 Chromosomes

Answer 27 · Mark scheme

January 2011 | BLY2F | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	any **one** from: • A • C		1
4(a)(ii)	any **one** from: • B • D		1
4(b)(i)	pig A		1
4(b)(ii)	a gamete		1
4(c)	XY **or** YX X Y XY **or** YX	 in this order only 	1 1 1
Total			**7**

4.1.2.1 Chromosomes

Answer 27 · Mark scheme

January 2011 | BLY2F | Original Q4 | Legacy

BLY2F

Answer 28 · Mark scheme

March 2011 | BLY1BP | Original Q4 | Legacy

Four	**A**	the organism is now a better competitor	**2**
	B	the mutated gene is passed on to offspring	**3**
	C	a gene mutates	**1**
	D	a new species is produced	**4**

Answer 29 · Mark scheme

March 2011 | BLY1BP | Original Q9 | Legacy

Nine	**3**	**4**	**3**	**2**

Answer 30 · Mark scheme

June 2011 | BLY1BP | Original Q9 | Legacy

Nine	**2**	**4**	**3**	**4**

4.1.2.1 Chromosomes

Answer 31 · Mark scheme

June 2011 | BLY2F | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	dominant	allow clear indication	1
5(a)(ii)	recessive	allow clear indication	1
5(b)(i)	aa	extra ring drawn cancels the mark	1
5(b)(ii)	Aa	extra ring drawn cancels the mark	1
5(c)	3 purple : 1 yellow	extra box ticked cancels the mark	1
Total			**5**

4.1.2.1 Chromosomes

Answer 31 · Mark scheme

June 2011 | BLY2F | Original Q5 | Legacy

BLY2F

Answer 32 · Mark scheme

November 2011 | BLY1BP | Original Q9 | Legacy

Nine	**4**	**3**	**2**	**1**

4.1.2.1 Chromosomes

Answer 33 · Mark scheme

January 2012 | BL1FP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	lemur(s)		1
3(b)	gorilla(s) chimpanzee(s)	in either order accept chimps	1 1
3(c)(i)	(Charles) Darwin	accept (Alfred) Wallace if first name given it must be correct	1
3(c)(ii)	variation environment survive generation	in this order allow phonetic spellings	1 1 1 1
Total			**8**

4.1.2.1 Chromosomes

Answer 33 · Mark scheme

January 2012 | BL1FP | Original Q3 | Legacy

BL1FP

4.1.2.1 Chromosomes

Answer 34 · Mark scheme

June 2012 | BL1FP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6 (a)	insects don't eat / damage crop	allow idea of insects carrying plant disease	1
6 (b)(i)	60		1
6 (b)(ii)	lower (yield) by 8 (arbitrary units)	accept 'higher' if answer clearly refers to wheat with transferred gene allow yield is only 52 **or** goes down to 52 accept ecf from (b)(i) for **2** marks	1 1
6 (b)(iii)	grow / use wheat without insect poison (gene) higher yield (in fields)	 accept bigger crop / more wheat ignore grows better	1 1
6 (c)	 (concerned about) effect on populations of (wild) flowers / insects effect of eating GM crops on human health	ignore unnatural / unethical / against religion unqualified accept specific examples given ignore harms the environment allow harmful to humans if eaten	 1 1
Total			8

4.1.2.1 Chromosomes

Answer 34 · Mark scheme

June 2012 | BL1FP | Original Q6 | Legacy

BL1FP

4.1.2.1 Chromosomes

Answer 35 · Mark scheme

June 2012 | BL2FP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	23		1
4(a)(ii)	nucleus / 'the head'	allow phonetic spelling	1
4(b)(i)	**X** and **X**		1
4(b)(ii)	**X** and **Y**		1
4(c)	150 million / 150,000,000 / half (of them) / 50% / 1in 2		1
Total			**5**

4.1.2.1 Chromosomes

Answer 35 · Mark scheme

June 2012 | BL2FP | Original Q4 | Legacy

BL2FP

4.1.2.1 Chromosomes

Answer 36 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)	DNA		1
2(b)	X and Y		1
2(c)(i)	46 chromosomes		1
2(c)(ii)	half the number		1
2(d)	meiosis		1
Total			5

4.1.2.1 Chromosomes

Answer 36 · Mark scheme

January 2013 | BL2FP | Original Q2 | Legacy

BL2FP

4.1.2.1 Chromosomes

Answer 37 · Mark scheme

Question 5

question	answers	extra information	mark
5(a)	Mendel		1
5(b)(i)	**TT**		1
5(b)(ii)	a dominant allele		1
5(c)	1 : 1		1
5(d)	100 short plants		1
Total			**5**

4.1.2.1 Chromosomes

Answer 37 · Mark scheme

January 2013 | BL2FP | Original Q5 | Legacy

BL2FP

4.1.2.1 Chromosomes

Answer 38 · Mark scheme

June 2013 | BL1FP | Original Q6 | Legacy

Question 6

question	answers	extra information	Mark
6(a)	sexual reproduction		1
6(b)(i)	genes		1
6(b)(ii)	gametes		1
6(c)(i)	any **two** from: • more meat (per cow) • more milk each day • can be milked for more time after giving birth / greater proportion of time	answers must be comparative ignore bigger unqualified accept '(produce) more milk', for **1** mark, if neither more milk each day nor can be milked for more time after giving birth are given	2
6(c)(ii)	(milk contains) more protein less time before having a calf when no milk produced	answers must be comparative	1 1
6(d)(i)	genes from one organism are transferred to a different organism		1
6(d)(ii)	(possible) harm to babies' long term health	allow don't know long-term / side effects (on baby) accept idea that there may be other things in (genetically engineered) cow's milk that might harm babies' health e.g. bacteria ignore ethical / religious arguments	1
Total			**9**

4.1.2.1 Chromosomes

Answer 39 · Mark scheme

June 2013 | BL2FP | Original Q3 | Legacy

Question 3

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>3(a)(i)</td><td>
<table>
<tr><th>Feature</th><th>Mitosis only</th><th>Meiosis only</th></tr>
<tr><td>Produces new cells during growth and repair</td><td>✓</td><td></td></tr>
<tr><td>Produces gametes (sex cells)</td><td></td><td>✓</td></tr>
<tr><td>Produces genetically identical cells</td><td>✓</td><td></td></tr>
</table>
All 3 correct = 2 marks
2 correct = 1 mark
0 or 1 correct = 0 marks
</td><td></td><td>2</td></tr>
<tr><td>3(a)(ii)</td><td>(a man) testis / testes
(a woman) ovary / ovaries</td><td>accept testicle(s)
do not accept ‘ova’ / ovule</td><td>1
1</td></tr>
<tr><td>3(b)(i)</td><td>XY / YX
or
X and Y</td><td></td><td>1</td></tr>
<tr><td>3(b)(ii)</td><td>XX
or
X and X or 2 X’s</td><td>accept X</td><td>1</td></tr>
<tr><td>3(c)</td><td>½ / 0.5 / 50% / 1:1 / 1 in 2</td><td>do not accept 1:2 / 50/50
allow 50:50
allow 2 in 4</td><td>1</td></tr>
<tr><td>Total</td><td></td><td></td><td>7</td></tr>
</table>

4.1.2.1 Chromosomes

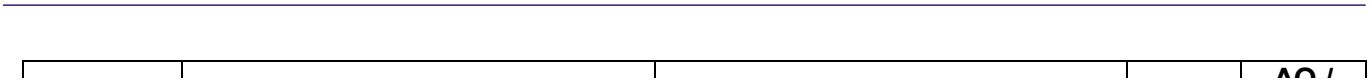
Answer 40 · Mark scheme June 2014 | BL1FP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / spec ref.
1(a)(i)	Chromosomes		1	AO1 1.7.1b
1(a)(ii)	Characteristics		1	AO1 1.7.1b
1(a)(iii)	Classify		1	AO1 1.8.1d
1(b)	Plants	ignore algae	1	AO1 1.8.1d
Total			4	

4.1.2.1 Chromosomes

Answer 40 · Mark scheme

June 2014 | BL1FP | Original Q1 | Legacy



4.1.2.1 Chromosomes

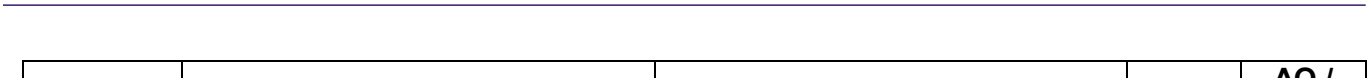
Answer 41 · Mark scheme June 2014 | BL1FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / spec ref.
5(a)(i)	gamete(s)	ignore reproductive cells	1	AO1 1.7.2a
5(a)(ii)	womb / uterus	allow phonetic spellings	1	AO1 1.7.2c
5(b)(i)	are formed from the same original embryo		1	AO2 1.7.2c
5(b)(ii)	embryo transplantation		1	AO1 1.7.2c
5(b)(iii)	any **one** from: • (calves will have some) genes / DNA from bull / sperm • idea that sexual reproduction produces variation	allow not all genes from the cow allow may be male allow idea that gene for low fat milk may not be passed on	1	AO2 1.7.2a
Total			**5**	

4.1.2.1 Chromosomes

Answer 41 · Mark scheme

June 2014 | BL1FP | Original Q5 | Legacy



4.1.2.1 Chromosomes

Answer 42 · Mark scheme June 2014 | BL2FP | Original Q5 | Legacy

5(a)(i)	fertilisation		1	AO1 2.7.1i
5(a)(ii)	in sequence: 1 gene 2 chromosome 3 nucleus	accept 1 next to gene, 2 next to chromosome and 3 next to nucleus in box allow 1 mark for smallest **or** largest in correct position	2	AO2 2.1.1a, 2.7.1b,e, 2.7.2f,g
5(a)(iii)	DNA		1	AO1 2.7.2f
5(b)(i)	On diagram: tick drawn next to **X** and / or **Y** from Parent 1	tick(s) must be totally outside grid squares allow ticks around "parent 1" extra ticks elsewhere cancel	1	AO1 2.7, 2.7.2a,b
5(b)(ii)	0.5 / ½ / 50% / 1:1 / 50:50 / 1 in 2 2 (out of 4) boxes are **XX** **or** half of the sperm contain an **X**-chromosome	allow 2/4 / 2 in 4 / 2 out of 4 / 'even(s)' / 'fifty – fifty' do **not** allow 1:2 or '50 / 50' or '50 – 50' allow **XY** is male and 2 (out of 4) boxes are **XY**	1 1	AO2 2.7, 2.7.2a,b
Total			**7**	

4.1.2.1 Chromosomes

Answer 42 · Mark scheme

June 2014 | BL2FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / spec ref.

4.1.2.1 Chromosomes

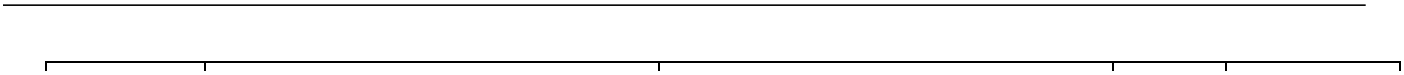
Answer 43 · Mark scheme June 2015 | BL1FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	64		1	AO2 1.1
2(a)(ii)	36	allow e.c.f from (a)(i) i.e. 100 – answer given in (a)(i)	1	AO2 1.1
2(a)(iii)	any **one** from: • only considers 16-year-olds • only about some / 5 countries	ignore lack of evidence allow does not refer to all ages allow does not refer to all countries	1	AO3 1.1
2(b)	the more exercise done the healthier a person is	allow the more exercise done the higher the health rating allow the less exercise done the lower the health rating	1	AO3 1.1.1e
2(c)	having a high cholesterol level		1	AO1 1.1.1d
2(d)(i)	antibodies		1	AO1 1.1.2c/d/e
2(d)(ii)	antibiotics		1	AO1 1.1.2i
Total			**7**	

4.1.2.1 Chromosomes

Answer 43 · Mark scheme

June 2015 | BL1FP | Original Q2 | Legacy



4.1.2.1 Chromosomes

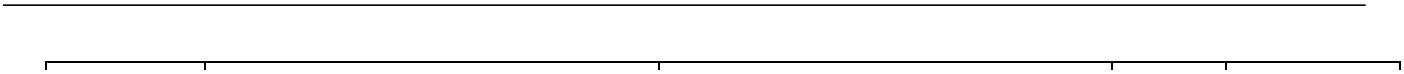
Answer 44 · Mark scheme June 2015 | BL2FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	(female) has XX / only X's / no Y	allow has X chromosomes ignore ref to genes / cells	1	AO2 2.7.2b, 2.7.3a
5(a)(ii)	extra chromosome / has 47 chromosomes / one set has 3 copies no. 18	ignore reference to chromosome numbers other than 47 or no. 18	1 1	AO2 2.7.1a,e, 2.7.3a
5(b)(i)	14	allow in range of 13.5 to 14.5	1	AO2 2.7.1a,e, 2.7.3a
5(b)(ii)	7	allow in range of 6.75 to 7.25 accept ecf from 5bi	1	AO2 2.7.1a,e, 2.7.3a
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 1	AO3 2.7, 2.7.3d
Total			**8**	

4.1.2.1 Chromosomes

Answer 44 · Mark scheme

June 2015 | BL2FP | Original Q5 | Legacy



4.1.2.1 Chromosomes

Answer 45 · Mark scheme June 2015 | BL2FP | Original Q9 | Legacy

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

4.1.2.1 Chromosomes

Answer 46 · Mark scheme

June 2016 | BL1FP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	three billion		1	AO1 1.8.1a
6(b)	mutation(s) breed / reproduce	in this order only allow pass on their genes	1 1	AO1 1.8.1e/f
Total			3	

4.1.2.1 Chromosomes

Answer 46 · Mark scheme

June 2016 | BL1FP | Original Q6 | Legacy

4.1.2.1 Chromosomes

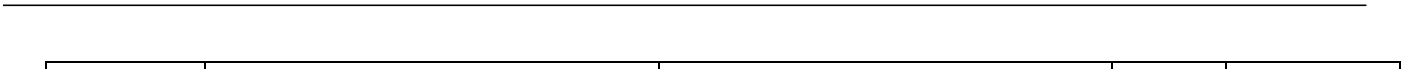
Answer 47 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	ovary		1	AO1 2.7.1f
6(b)	46		1	AO1 2.7.1e/i 2.7.2b
6(c)(i)	does not fit the pattern **or** it is higher than the 3rd value / it should be lower than the 3rd value / it should be between the 3rd and 5th values	do **not** allow use of incorrect figures	1	AO3 2.7
6(c)(ii)	As age increases % of women (having a baby) decreases		1	AO2 2.7
6(d)(i)	33	allow 1 mark for $\frac{66}{2}$ if no answer / wrong answer	2	AO2 2.7, 2.7.3d
6(d)(ii)	low success rate more likely to have a baby with health problems / abnormalities / a faulty chromosome		1 1	AO3 2.7, 2.7.3d
Total			**8**	

4.1.2.1 Chromosomes

Answer 47 · Mark scheme

June 2016 | BL2FP | Original Q6 | Legacy



4.1.2.1 Chromosomes

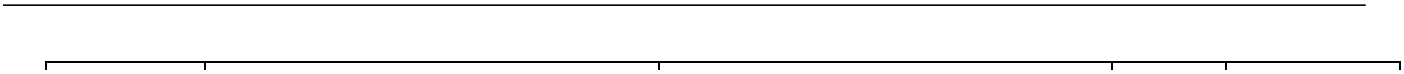
Answer 48 · Mark scheme June 2017 | BL1FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	gene chromosome nucleus cell	in this order all correct = **3** marks allow **1** mark for each consecutive pair of structures	3	AO1 1.7.1b 1.7.2d
2(b)(i)	(the greater the distance from sea) longer / deeper (roots) more branched (roots)	ignore descriptions of shoot / plant allow more spread out if no other mark awarded allow **1** mark for more / bigger (area) roots	1 1	AO2 1.7.1a/d
2(b)(ii)	(the) environment (only)		1	AO3 1.4.2b
Total			**6**	

4.1.2.1 Chromosomes

Answer 48 · Mark scheme

June 2017 | BL1FP | Original Q2 | Legacy



4.1.2.1 Chromosomes

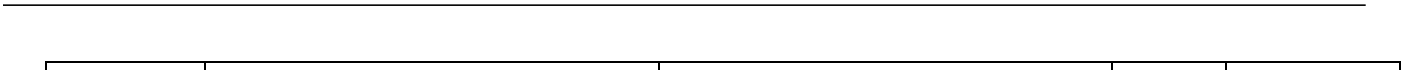
Answer 49 · Mark scheme June 2017 | BL2FP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	46		1	AO1 2.7.3a 2.7.2b
4(a)(ii)	An allele that shows its effect only if the dominant allele is not present		1	AO1 2.7.2e
4(b)(i)	(top left) **NN** (top right) **Nn** or **nN**		1 1	AO2 2.7 2.7.3a
4(b)(ii)	ring drawn around **nn**	allow alternative indication of **nn**, if unambiguous	1	AO2 2.7 2.7.3a
4(b)(iii)	1 in 4	allow ecf from 4bii	1	AO2 2.7 2.7.3a
Total			**6**	

4.1.2.1 Chromosomes

Answer 49 · Mark scheme

June 2017 | BL2FP | Original Q4 | Legacy



4.1.2.1 Chromosomes

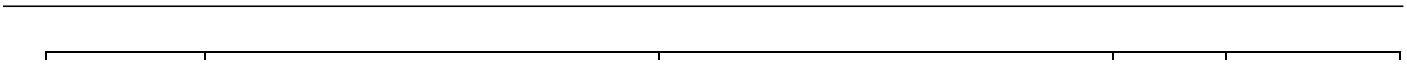
Answer 50 · Mark scheme June 2018 | 8461/1F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	nucleus		1	AO1 4.1.2.1
01.2	gene(s)	allow allele(s)	1	AO1 4.6.1.4
01.3	copying of chromosomes		1	AO2 4.1.2.2
01.4	mitochondria		1	AO1 4.1.1.2
01.5	60 – 45 **or** 120 – 105 15 (minutes)	an answer of 15 (minutes) scores **2** marks	1 1	AO2 4.1.2.2
01.6	C		1	AO2 4.1.2.2
01.7	8		1	AO2 4.1.2.2
01.8	to repair tissues		1	AO1 4.1.2.2
Total			**9**	

4.1.2.1 Chromosomes

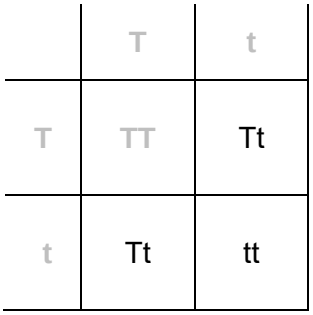
Answer 50 · Mark scheme

June 2018 | 8461/1F | Original Q1



4.1.2.1 Chromosomes

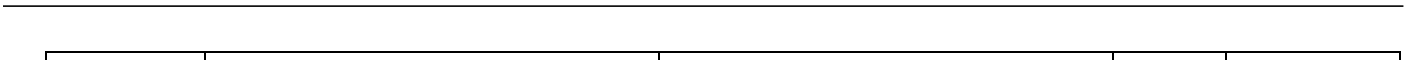
Answer 51 · Mark scheme June 2018 | 8461/2F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	Gregor Mendel		1	AO1 4.6.3.3
04.2	DNA		1	AO1 4.6.3.3
04.3	when the dominant allele is not present		1	AO1 4.6.1.6
04.4	tt	allow homozygous recessive	1	AO2 4.6.1.6
04.5		all 3 correct = **2** marks 2 correct = **1** mark 0 or 1 correct = **0** marks allow tT for Tt	2	AO2 4.6.1.6
04.6	circle drawn around either TT or tt on Figure 5	allow circles drawn round both	1	AO2 4.6.1.6
04.7	correct ratio from question **04.5** eg 3 : 1	allow multiples of stated ratio allow 3 : 1 if no answer to question **04.5**	1	AO3 4.6.1.6
Total			**8**	

4.1.2.1 Chromosomes

Answer 51 · Mark scheme

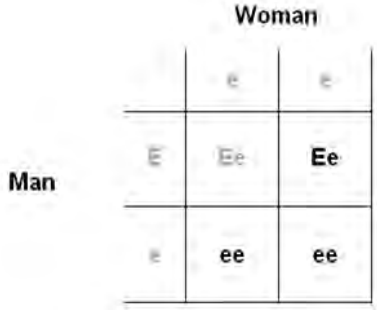
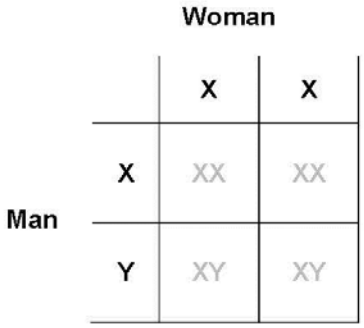
June 2018 | 8461/2F | Original Q4



4.1.2.1 Chromosomes

Answer 52 · Mark scheme

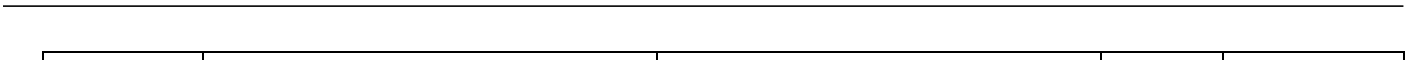
June 2019 | 8461/2F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	an allele expressed even if a person only has one copy of the allele		1	AO1 4.6.1.6
02.2		all 3 correct= 2 marks 1 or 2 correct = 1 mark	2	AO2 4.6.1.6
02.3	correct probability from Figure **4**	if no answer in Question **02.2** allow 0.5	1	AO3 4.6.1.6
02.4		gametes = X + X **and** X + Y allow in incorrect positions X, X, X and Y in correct boxes	1 1	AO2 4.6.1.6 4.6.1.8
02.5	 answer from Question **02.3** × 0.5 answer to calculation in mp1	an answer matching the answer from Question **02.3** × 0.5 scores **2** marks if no answer in Question **02.3**, an answer of 0.25 / ¼ / 1 in 4 / 25% scores **2** marks if no answer in Question **02.3** allow 0.5 × 0.5 if no answer in Question **02.3** allow 0.25 / ¼ / 1 in 4 / 25%	 1 1	AO2 4.6.1.6 4.6.1.8
Total			**8**	

4.1.2.1 Chromosomes

Answer 52 · Mark scheme

June 2019 | 8461/2F | Original Q2



4.1.2.1 Chromosomes

Answer 53 · Mark scheme June 2019 | 8461/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	46		1	AO1 4.6.1.2 4.6.1.8
03.2	half the mass of the DNA in cell **A**		1	AO2 4.6.1.2
03.3	meiosis		1	AO1 4.6.1.2
03.4	mutation		1	AO1 4.6
03.5	any **two** from: • different egg / sperm each time • genes from two parents • each gamete / egg / sperm has different alleles / genes / DNA / genetic information	ignore different chromosomes ignore the children have different genes / alleles	2	AO2 4.6 4.6.1.1
03.6	8		1	AO2 4.1.2.2 4.6.1.2
03.7	40	allow in range 39 to 41	1	AO2 4.6.1.2
03.8	$\frac{40}{500}$ × 1000 80	an answer of 80 scores **3** marks allow ecf from Question **03.7** for **3** marks an answer of 0.08 scores **2** marks allow $\frac{\text{answer to Question 03.7}}{500}$ an answer from mp1 but not × 1000 scores **2** marks	1 1 1	AO2 4.6.1.2

4.1.2.1 Chromosomes

Answer 53 · Mark scheme

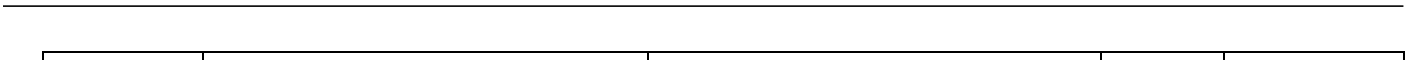
June 2019 | 8461/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.9	embryo is (very) small		1	AO2 4.5 4.5.3.4
	(so) embryo not seen / felt **or** lost in normal menstrual flow	ignore not noticed	1	AO3
Total			**13**	

4.1.2.1 Chromosomes

Answer 53 · Mark scheme

June 2019 | 8461/2F | Original Q3



Answer 54 · Mark scheme

November 2020 | 8461/1F | Original Q2

The full source mark scheme begins on page 97. Follow original question 2 in that document.

4.1.2.1 Chromosomes

Answer 55 · Mark scheme

November 2020 | 8461/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	4 / four		1	AO1 4.6.1.2
03.2	23 / twenty three	do **not** accept 23 pairs	1	AO1 4.6.1.2
03.3	a different form of a gene		1	AO1 4.6.1.6
03.4	heterozygous		1	AO2 4.6.1.6
03.5 mark with 3.6 and 3.7		allow 2 correct for **1** mark	2	AO2 4.6.1.1 4.6.1.2 4.6.1.6
03.6 mark with 3.5 and 3.7	ring around any **Dd**	allow ecf from question **03.5**	1	AO2 4.6.1.6
03.7 mark with 3.5 and 3.6	percentage must match answer given to questions **03.5** and **03.6**	if no answer in question **03.5** allow 50 %	1	AO3 4.6.1.6
03.8	mutation / mutated	do **not** accept mutant	1	AO1 4.6.2.1

4.1.2.1 Chromosomes

Answer 55 · Mark scheme

November 2020 | 8461/2F | Original Q3

03.9	any **one** from: • to help them prepare • to inform whether to consider having an abortion • to find out if they have passed on the disorder	allow to see if the child / embryo has the disorder allow answers referring to genetic disorders, or specific example such as Dupuytren's / cystic fibrosis	1	AO3 4.6.1.7
Total			**10**	

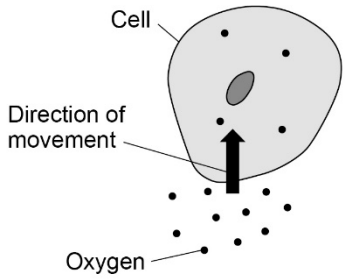
4.1.2.1 Chromosomes

Answer 55 · Mark scheme

November 2020 | 8461/2F | Original Q3

4.1.2.1 Chromosomes

Answer 56 · Mark scheme November 2021 | 8461/1F | Original Q1

01.1			1	AO3 4.1.3.1

01.2		in this order only		AO1 4.1.3.2 4.1.3.3 4.2.3.2
	water		1	
	mineral ions	allow minerals / ions	1	
	energy		1	

01.3	root hair (cell)	ignore root / hair unqualified	1	AO1 4.1.1.3 4.2.3.2

01.4	large surface / area	allow it has a long projection allow the walls are thin allow it has lots of mitochondria	1	AO1 4.1.1.3 4.2.3.2

01.5	**Feature of sperm cell** / **How the feature helps** Contains a nucleus → To provide the chromosomes for fertilisation Has a long tail → To help the cell to swim to the egg To break the outer layer of the egg To release energy do **not** accept more than one line from a box on the left		1 1	AO1 4.1.1.3

4.1.2.1 Chromosomes

Answer 56 · Mark scheme

01.6	nerve (cell) any **one** from: • long • has branches • has insulation	allow neuron(e) ignore motor / sensory / relay allow myelin / fat	1 1	AO1 4.1.1.3
Total			**10**	

4.1.2.1 Chromosomes

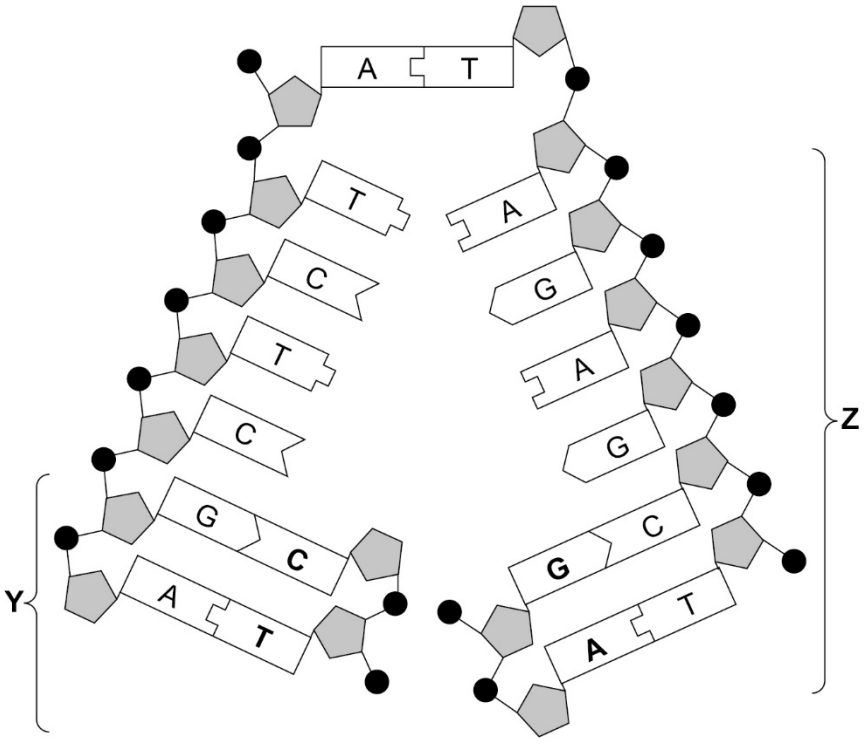
Answer 56 · Mark scheme

November 2021 | 8461/1F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.

4.1.2.1 Chromosomes

Answer 57 · Mark scheme November 2021 | 8461/2F | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	chromosome(s)	allow chromatid(s) / gene(s) / allele(s)	1	AO1 4.6.1.4
08.2	sugar	allow deoxyribose allow pentose do **not** accept ribose	1	AO1 4.6.1.5
08.3	base(s)	allow nitrogenous base(s) allow adenine **and** cytosine **and** guanine **and** thymine	1	AO1 4.6.1.5
08.4		all four required for the mark	1	AO3 4.6.1.5

4.1.2.1 Chromosomes

Answer 57 · Mark scheme

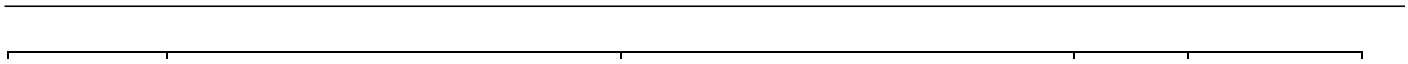
November 2021 | 8461/2F | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	replication		1	AO3 4.6.1.5 4.1.2.2
08.6	protein	allow polypeptide	1	AO1 4.6.1.4
08.7	3×10^{-12} grams		1	AO2 4.6.1.2
08.8	meiosis		1	AO1 4.6.1.2
Total			**8**	

4.1.2.1 Chromosomes

Answer 57 · Mark scheme

November 2021 | 8461/2F | Original Q8



4.1.2.1 Chromosomes

Answer 58 · Mark scheme

June 2022 | 8461/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	$\frac{1}{4}$		1	AO2 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	10		1	AO2 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	grows replicates divides	must be in this order	1 1 1	AO1 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	C		1	AO3 4.1.2.2

4.1.2.1 Chromosomes

Answer 58 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	10%		1	AO2 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	circulatory system		1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	cardiovascular disease / CVD **or** (coronary) heart disease / CHD	allow heart attack allow any correctly named heart condition eg arrhythmia, hole in the heart	1	AO1 4.2.2.4 4.1.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	any **one** from: • unethical • (against) religious / cultural / personal beliefs • the method is not (fully) tested • risk of infection • (heart cells) may be rejected	 allow examples of unethical such as destroying a (potential) life allow against God's will ignore religion unqualified allow the method might not work allow may cause side effects	1	AO2 4.1.2.3 4.2.2.4

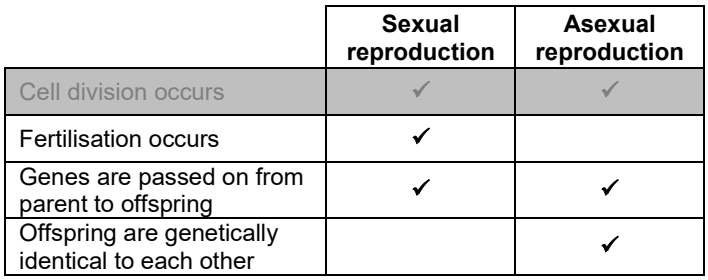
Total Question 2		10

4.1.2.1 Chromosomes

Answer 59 · Mark scheme

June 2022 | 8461/2F | Original Q8

Question 8

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

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

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	5 hours 6 hours		1 1	AO2 4.6.1.2

4.1.2.1 Chromosomes

Answer 59 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	2		1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	4		1	AO2 4.6.1.2

Total Question 8		**8**

4.1.2.1 Chromosomes

Answer 60 · Mark scheme

June 2023 | 8461/1F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.1	vector		1	AO1 4.3.1.5

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.2	any **two** from: • (it has) mitochondria • (it has a) nucleus • (it has) no plasmids	if neither mark awarded, allow **1** mark for protist has membrane-bound structures allow it does not have a loop of DNA allow other appropriate features do **not** accept (it has) cytoplasm do **not** accept (it has) a (cell) membrane do **not** accept it has no cell wall	2	AO2 4.3.1.5 4.1.1.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.3	Salmonella		1	AO2 4.1.1.1 4.3.1.3

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.4	only one parent is involved		1	AO1 4.3.1.5 4.6.1.1

4.1.2.1 Chromosomes

Answer 60 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.5	14		1	AO2 4.3.1.5 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.6	decreased haemoglobin		1	AO2 4.3.1.5 4.2.2.3

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.7		allow alternative route allow correct conversion to standard form at any stage		AO2 4.3.1.5
	$\frac{210\ 000\ 000}{2}$ **or** 105 000 000	allow $\frac{210 \text{ million}}{2}$ **or** 105 million	1	
	105 000 000 × 3	allow 105 million × 3	1	
	315 000 000	allow 315 million	1	
	3.15×10^8		1	

4.1.2.1 Chromosomes

Answer 60 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.8	any **two** from: • wear long(er) sleeves / clothes • use insect repellent or insecticides • don't go out in the evening • avoid going to countries / places with malaria / mosquitos • destroy breeding grounds • release sterile male mosquitos	ignore vaccination / anti-malarial drugs allow reduce bare skin exposure allow insect repellent methods such as citronella candles allow close doors / windows in the evening allow methods of destroying breeding grounds such as drain water holes allow other correct suggestions	2	AO2 4.3.1.5

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.9	percentage / chance (of getting malaria) decreases (with age) correct use of data such as two pairs of data from **Table 4**	do **not** accept percentage / chance of having disorder **S** decreases with age allow use of processed data	1 1	AO3 4.2.2.5 4.3.1.5

Total Question 4	15

4.1.2.1 Chromosomes

Answer 61 · Mark scheme

June 2023 | 8461/2F | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	any **one** from: • variation of a named / described (desirable) characteristic • not all susceptible to the same disease / pathogen • maintain / increase gene pool	allow eg different flavour / colour allow different customer preferences	1	AO2 4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	any **one** from: • they have the same named /(desirable) characteristic(s) • they grow at the same rate • they ready to harvest at same time	allow eg all high yield **or** all disease-resistant **or** same (desirable) flavour	1	AO2 4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	(a group of) cells are grown (into a new organism)	ignore clones	1	AO1 4.6.2.5

4.1.2.1 Chromosomes

Answer 61 · Mark scheme June 2023 | 8461/2F | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	any **one** from: different • water • minerals / ions • light • herbivores • disease • plant density • soil pH	 allow rain allow named example ignore nutrients ignore sun unqualified allow named example allow named example allow different temperature allow different environmental conditions	1	AO2 4.6.2.1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	male gametes = **X** + **Y** female gametes = **X** + **X** offspring genotypes correctly derived from gametes	if neither mark awarded, allow **1** mark for male = **X** + **X and** female = **X** + **Y** allow correct for chromosome assignment in mp1 & mp2	1 1 1	AO1 AO1 AO2 4.6.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	any **one** from: • half are XX and half are XY • equal probability of X or Y sperm fertilising an egg • (the Punnett square shows) 50% (chance of) male / female		1	AO2 4.6.1.8

4.1.2.1 Chromosomes

Answer 61 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.7	any **two** from: • temperature • type / amount of food • light • whether chickens are kept indoors or outdoors • amount of movement / space (allowed) • time of year	 allow (volume / amount of) water allow same stocking density allow same number of each type ignore same number unqualified allow mass at start allow age of chicken(s) allow same medication **or** all healthy	2	AO2 4.6.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.8	any **one** from: • (more) valid / representative **or** reduce the effect of anomalies • (more) accurate mean	 allow can calculate a valid mean allow (more) accurate results allow (more) reliable mean / results	1	AO2 4.6.2.3

4.1.2.1 Chromosomes

Answer 61 · Mark scheme

June 2023 | 8461/2F | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.9	breed best of **A** and **B** (together)	allow cross / mate best of **A** and **B**	1	AO2
	select offspring with highest egg numbers **and** heaviest / fastest growing	allow select the best offspring for both desired characteristics	1	AO1
	breed (these) offspring together		1	AO1
	repeat over many / several generations	do **not** accept reference to repeated breeding of the original parents	1	AO1 4.6.2.3

Total Question 9	**15**

4.1.2.1 Chromosomes

Answer 62 · Mark scheme

June 2024 | 8461/1F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.1	nucleus	allow chromosome ignore in the DNA	1	AO1 4.1.1.2 4.1.2.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.2	**A**, **D** and **E**		1	AO1 4.2.2.1 4.2.2.2

4.1.2.1 Chromosomes

Answer 62 · Mark scheme

Question	Answers	Mark	AO / Spec Ref.
08.3	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO2
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content.	0	4.2.2.1 4.4.2.1 4.4.2.3
	Indicative content: **Difficulty digesting food** • less / no lipase • (so) less / no fat broken down o into fatty acids o into glycerol • less / no carbohydrase / amylase • (so) less / no carbohydrate / starch broken down o into glucose / sugar • less / no protease • (so) less / no protein broken down o into amino acids **Difficulty gaining body mass** • less / no absorption o of small / soluble molecules o of fatty acids o of glycerol o of glucose / sugar o of amino acids • fewer molecules **or** fewer amino acids available for building protein / muscle / cells / tissues • less fat stored • less respiration • less energy • (so less energy) for building new molecules / cells / tissues For **Level 3** details of difficulty digesting food **and** difficulty gaining body mass are needed.		

4.1.2.1 Chromosomes

Answer 62 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.4	large surface / area	allow large surface / area to volume (ratio)	1	AO1 4.1.3.1 4.2.2.2
	(large) capillary network **or** good / efficient blood supply	allow many capillaries	1	
	walls are thin **or** walls are one cell thick	ignore references to membranes ignore alveoli are thin ignore alveoli are one cell thick do **not** accept thin cell walls ignore references to alveoli being moist ignore steep concentration gradient	1	

4.1.2.1 Chromosomes

Answer 62 · Mark scheme

June 2024 | 8461/1F | Original Q8

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.5	less (aerobic) respiration	allow (more) anaerobic respiration	1	AO2 4.4.2.1 4.4.2.2 4.4.2.3
	(so) less energy (released)	do **not** accept less energy produced / made / created	1	
	(results in) less muscle contraction **or** (results in) reduced metabolism **or** (results in) increased breathing rate / depth **or** (results in) increased heart rate	allow relevant named metabolic processes allow (results in) person getting out of breath	1	
	OR (more) anaerobic respiration (1) (so) lactic acid produced (1)			
	(results in) <u>muscle</u> fatigue **or** (results in) less <u>muscle</u> contraction **or** (results in) increased breathing rate / depth **or** (results in) increased heart rate (1)	allow <u>muscle</u> ache / cramp / tiredness / pain allow (results in) person getting out of breath		

Total Question 8	14

4.1.2.1 Chromosomes

Answer 63 · Mark scheme

June 2025 | 8461/2F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	an allele expressed when a rabbit has only one copy of the allele		1	AO1 4.6.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	**hh**		1	AO2 4.6.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	<table><tr><td></td><td>**H**</td><td>**h**</td></tr><tr><td>**H**</td><td>HH</td><td>Hh</td></tr><tr><td>**h**</td><td>Hh</td><td>hh</td></tr></table> male gametes correct all three offspring genotypes correctly derived from gametes	 allow **1** mark for 2 correct	 1 2	AO2 4.6.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	(on **Figure 2**) ring drawn around **HH** and / or **hh**		1	AO2 4.6.1.6

4.1.2.1 Chromosomes

Answer 63 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	3	answer must be consistent with genotypes in question **01.3** if given allow 3 if question **01.3** is not answered	1	AO3 4.6.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	1		1	AO1 4.6.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	2 / two	allow half / ½ (of them) ignore ratios	1	AO2 4.6.1.8

Total Question 1	**9**

4.1.2.1 Chromosomes

Answer 64 · Mark scheme

June 2025 | 8461/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	testis / testes / testicle(s)		1	AO1 4.5.3.4 4.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	**A** = 46 **D** = 23	if no other mark awarded allow **1** mark for **A** = 92 **and D** = 46	1 1	AO1 4.6.1.2 4.6.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	fertilisation		1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	pollen		1	AO1 4.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	mitosis		1	AO1 4.1.1.6 4.1.2.2 4.6.1.1 4.6.1.2 4.6.1.3

4.1.2.1 Chromosomes

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	sugar water		1 1	AO2 4.4.1.3 4.2.3.2 4.6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	any **one** from: • produces (genetic) variation (in offspring) • (seeds / fruits) can be dispersed (to new areas) • many seeds / offspring produced • offspring not competing (for light / water / ions) • can survive in a new environment • enables evolution	allow offspring are not (genetically) identical allow description of an advantage of variation eg not all killed by one pathogen / disease	1	AO1 4.6.1.1 4.6.1.3 4.6.2.2 4.6.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	any **one** from: • fast • many offspring produced • (genetically) identical offspring • only one parent needed • offspring less vulnerable (as attached to parent) • offspring receive water from parent • can out-compete other species • can colonise local area • less energy is needed	allow they are clones allow offspring receive named example of nutrient from parent allow pollinators / bees not required	1	AO1 4.6.1.1 4.6.1.3 4.6.2.2 4.6.3.1

Total Question 3	10

4.1.2.1 Chromosomes

AQA

GCSE
BIOLOGY
8461/1F

Paper 1 Foundation Tier

Mark scheme

June 2020

Version: 1.0 Final Mark Scheme

jun2084611F/MS

4.1.2.1 Chromosomes

MARK SCHEME – GCSE BIOLOGY – 8461/1F – JUNE 2020

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.

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MARK SCHEME – GCSE BIOLOGY – 8461/1F – JUNE 2020

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
- the Assessment Objectives, level of demand 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]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

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

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

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 ecf 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 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is 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.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- 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 two 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.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise 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.

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.

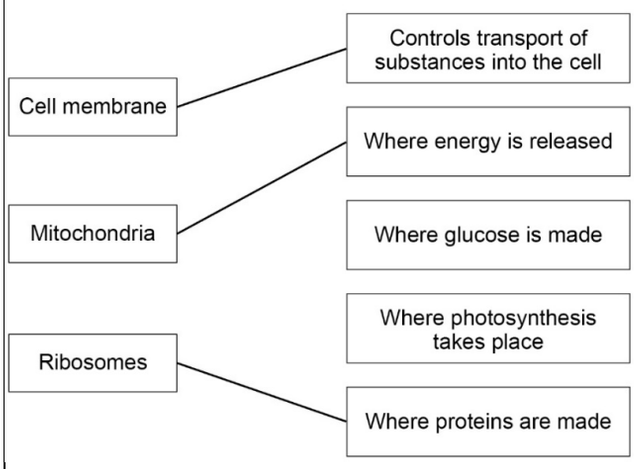
Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

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

4.1.2.1 Chromosomes

MARK SCHEME – GCSE BIOLOGY – 8461/1F – JUNE 2020

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	bacterium		1	AO2 4.1.1.1
01.2	to strengthen the cell		1	AO1 4.1.1.1 4.1.1.2
01.3	chloroplast		1	AO2 4.1.1.2 4.2.3.1
01.4	**Structure** **Function**  additional line from a box on the left negates the mark for that box		3	AO1 4.1.1.2 4.1.3.1
01.5	adjust the focus knob		1	AO3 4.1.1.2 RPA1
01.6	(A =) 15 (mm) (B =) 60 (mm)	allow a tolerance of ± 1mm	1 1	AO2 4.1.1.2 RPA 1
01.7	$\frac{60}{15} = 4(.0)$	allow ecf from question **01.6**	1	AO2 4.1.1.2 RPA 1

4.1.2.1 Chromosomes

01.8	$\frac{40}{0.1}$ 400	 do **not** accept if a unit is given	1 1	AO2 4.1.1.5 RPA 1
Total			**12**	

4.1.2.1 Chromosomes

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	mitosis		1	AO1 4.1.2.2
02.2	all lines correct = **2** marks 1 or 2 lines correct = **1** mark **Stage of cell cycle** / **What happens during that stage** Stage 1 → The cell grows and the chromosomes replicate Stage 2 → One set of chromosomes is pulled to each end of the cell Stage 3 → The cytoplasm and cell membrane divide to form two new cells additional line from a box on the left negates the credit for that box		2	AO1 4.1.2.2
02.3	$\frac{7}{10} \times 100$ 70(%)	allow $\frac{252}{300} \times 100$ allow answer calculated from angle in range 250° to 254° if no other mark awarded, allow 0.7 for **1** mark	1 1	AO2 4.1.2.2
02.4	3		1	AO2 4.1.2.2
02.5	DNA	allow deoxyribonucleic acid	1	AO1 4.1.2.1 4.1.2.2
02.6	a gene		1	AO1 4.1.2.1

4.1.2.1 Chromosomes

02.7	(bone marrow) cells differentiate into many / other types of (named) cell (so) will cure diseases where new cells are needed **or** will cure diseases where cells are damaged	allow (bone marrow) cells can become many / other types of (named) cell allow (so) will cure anaemia / leukaemia **or** blood cancer **or** blood disorders allow (so) will cure paralysis / diabetes	1 1	AO1 AO2 4.1.2.3
Total			**10**	

4.1.2.1 Chromosomes

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	any **one** from: • bacteria • fungi • protists	allow singular allow names of pathogens e.g. Salmonella ignore virus / germ	1	AO1 4.3.1.1 4.3.1.3 4.3.1.5
03.2	hydrochloric acid is produced by the stomach the skin is a barrier covering the whole body		1 1	AO1 4.2.2.1 4.3.1.6
03.3	white blood cells engulf the microorganisms.		1	AO1 4.2.2.3 4.3.1.6
03.4	weakened fast	in this order only	1 1	AO1 4.3.1.7
03.5	by coughs / sneezes	allow 'by droplets in the air' do **not** accept other means of transmission e.g. touch	1	AO1 4.3.1.1 4.3.1.2
03.6	(from day) 10 (to day) 18	allow (from day) 18 (to day) 10	1	AO2 4.3.1.2
03.7	14 (days)	allow in the range 13 to 15 (days)	1	AO3 4.3.1.2
03.8	any **one** from: • they had been vaccinated • they already had antibodies • they were immune • they had had it before • they did not get any / enough virus from infected child • they did not play (much) with the infected child	 ignore they were resistant ignore they wore a mask unqualified	1	AO3 4.3.1.2 4.3.1.7

4.1.2.1 Chromosomes

03.9	antibiotics do not kill viruses	allow antibiotics do not work on viruses allow antibiotics only kill bacteria	1	AO3 4.3.1.8
Total			**11**	

4.1.2.1 Chromosomes

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	increased (at first) until 4 minutes **or** 50 breaths per minute (then) stayed constant (from 4 minutes **or** at 50 breaths per minute)		1 1 1	AO2 4.4.2.2
04.2	175 (beats per minute)		1	AO2 4.4.2.2
04.3	140 (beats per minute)		1	AO2 4.4.2.2
04.4	because his rate is lower than the maximum safe rate	allow ecf for incorrect values in question **04.2** and question **04.3**	1	AO3 4.2.2.2 4.4.2.2

4.1.2.1 Chromosomes

04.5	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO2
	No relevant content	0	
	Indicative content • heart rate increased ○ to increase blood flowing to muscles / lungs ○ to provide more oxygen (to muscles) ○ to provide more glucose (to muscles) ○ to remove carbon dioxide more quickly (from the muscles / blood) ○ to remove lactic acid more quickly (from the muscles) • breathing rate increased ○ supplies more oxygen / air to lungs ○ so more oxygen to blood ○ more carbon dioxide removed • more oxygen to muscles ○ needed for (increased) respiration ○ to release / provide energy ○ for muscle contraction • anaerobic respiration occurs ○ due to lack of oxygen ○ which causes a build-up of lactic acid ○ oxygen debt ○ muscle fatigue / pain To reach **Level 3**, there must be reference to heart rate, breathing rate and respiration		4.2.2.2 4.2.2.3 4.4.2.1 4.4.2.3 4.4.2.2

Total			**12**

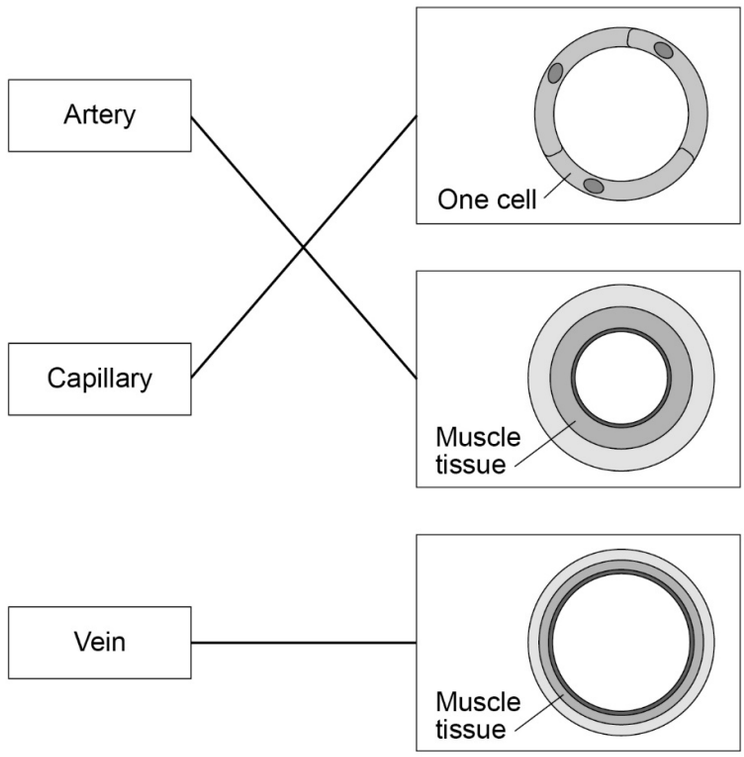
4.1.2.1 Chromosomes

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	will stop animals / herbivores eating it	allow it will not be eaten	1	AO3 4.3.3.2
05.2	chemical		1	AO1 4.3.3.2
05.3	thorns / spikes / spines / prickles (to stop animals / herbivores eating it)		1	AO3 4.3.3.2
05.4	for respiration to store as starch		1 1	AO1 4.4.1.3 4.4.2.1
05.5	add Benedict's (solution / reagent to the liquid) boil / heat (if glucose is present the blue) colour changes to yellow / green / orange / brown / (brick)red	 allow any temperature of 65 °C or above 	1 1 1	AO1 4.2.2.1 RPA 4
05.6	(nitrate ions are needed) to make proteins / amino acids which are needed for growth / enzymes / new cells	allow to make chlorophyll / DNA / ATP / nucleic acid allow correct process for named molecule in mp1	1 1	AO1 AO2 4.1.3.3 4.4.1.3 4.4.2.3
05.7	in / on the (soil) water	allow through air (spaces) in the soil	1	AO3 4.3.1.1 4.3.1.4
05.8	dosage toxicity		1 1	AO1 4.3.1.9

4.1.2.1 Chromosomes

05.9	placebos		1	AO1 4.3.1.9
Total			**14**	

4.1.2.1 Chromosomes

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	all lines correct = **2** marks 1 **or** 2 lines correct = **1** mark **Type of blood vessel** / **Structure of blood vessel**  additional line from a box on the left negates the credit for that box		2	AO2 4.2.2.2

4.1.2.1 Chromosomes

06.2	any **one** from: • thick(er) (muscle) walls / tissue (1) to push blood (all) around the body (1) **or** • thick(er) elastic walls / tissue (1) to maintain / withstand high (blood) pressure **or** to retain / regain shape (1) **or** • narrow lumen (1) to maintain high (blood) pressure (1)	allow to withstand high (blood) pressure do **not** accept to pump blood (all) around the body	2	AO1 4.2.2.2
06.3	(A) – white (blood) cell(s) (B) – platelet(s)	allow any named white (blood) cell(s)	1 1	AO2 4.2.2.3
06.4	(no nucleus) more space for haemoglobin / oxygen (has haemoglobin) to bind / carry oxygen	allow to carry more oxygen ignore carries carbon dioxide	1 1	AO3 4.1.1.2 4.1.1.3 4.2.2.3
06.5	plasma		1	AO1 4.2.2.3
06.6	platelets		1	AO3 4.2.2.3

4.1.2.1 Chromosomes

06.7	any **one** from: • (continued) bleeding • (more) bruising	allow described allow blood does not clot (at cuts) allow ecf from answer to question **06.6**	1	AO3 4.2.2.3
Total			**11**	

4.1.2.1 Chromosomes

MARK SCHEME – GCSE BIOLOGY – 8461/1F – JUNE 2020

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	*before arrow* carbon dioxide **and** water *after arrow* glucose	allow correct chemical symbols ignore any attempt at balancing equation ignore light / chlorophyll either order ignore sugar / carbohydrate do **not** accept starch	 1 1	AO1 4.4.1.1
07.2	<u>light</u> (light) is captured / trapped / absorbed by chlorophyll / chloroplasts	ignore description of subsequent parts of the photosynthesis reaction allow sun<u>light</u> ignore sun allow (light) is used by chlorophyll / chloroplasts	1 1	AO1 4.1.1.2 4.4.1.1
07.3	$\frac{(18.5 + 19.3 + 19.5)}{3}$ **or** $\frac{57.3}{3}$ 19.1 (cm^3/hour)	 allow an answer correctly calculated using only two correct values	1 1	AO2 4.4.1.2 RPA 6
07.4	a ring around 14.2	allow clear indication of correct result	1	AO3 4.4.1.2 RPA 6

4.1.2.1 Chromosomes

07.5	any **one** from: • scale / value was misread • there was air / oxygen in the syringe / measuring cylinder / apparatus • the lamp / light was moved • temperature changed • had different mass / length of pondweed • pondweed had not acclimatised	ignore human error ignore references to counting bubbles or time allow measurement error allow light intensity changed ignore different bulb / lamp unqualified	1	AO3 4.4.1.2 RPA 6
07.6	did not use it in calculation (of mean)		1	AO3 4.4.1.2 RPA 6
07.7	any **one** from: • light (intensity) • carbon dioxide (concentration) • pondweed size / amount • pondweed species	do **not** accept temperature ignore time allow distance / power / colour of lamp / light allow same (piece of) pondweed	1	AO3 4.4.1.2 RPA 6
07.8	enzyme(s) lose the shape of the active site	allow enzyme(s) (start to) denature allow enzyme(s) destroyed / damaged do **not** accept enzyme(s) killed	1	AO2 4.2.2.1

4.1.2.1 Chromosomes

07.9	y-axis labelled '(rate of) photosynthesis in cm^3/hour'		1	AO2 4.4.1.2 RPA 6
	suitable scale on y-axis	must take up half or more of grid provided	1	
	all points plotted to within ± ½ small square	allow 3 or 4 correct plots for **1** mark ignore any attempt to plot a point at 20 °C	2	
	correct curved line of best fit	ignore line joined point to point with straight lines ignore extrapolation	1	
Total			**16**	

4.1.2.1 Chromosomes

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	movement / spreading out of molecules / particles	allow movement / spreading out of (named) substances / chemicals / gases / liquids ignore reference to membranes / cells	1	AO1 4.1.3.1
	from (an area of) high(er) concentration to (an area of) low(er) concentration	allow down / with the concentration gradient ignore along / across the concentration gradient do **not** accept movement from / to a concentration gradient	1	
08.2	increased carbon dioxide concentration in the air		1	AO2 4.1.3.1 4.2.3.2
	increased number of stomata that are open		1	

4.1.2.1 Chromosomes

08.3	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1 4.1.3.1 4.2.2.2 4.2.2.3
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	

	Indicative content
	• (many) alveoli
	  • provide a large(r) surface area (**:** volume)
	
	• capillaries are thin
	  or alveoli / capillary walls are thin **or** one cell thick
	  or capillaries are close to the alveoli
	  • which provides short diffusion path (for oxygen / carbon dioxide)
	
	• breathing (mechanism) moves air in and out
	or lungs are ventilated
	  • to bring in (fresh) oxygen
	  • to remove carbon dioxide
	  • to maintain a concentration / diffusion gradient`
	
	• large capillary network (around alveoli)
	or good blood supply
	  • to remove oxygen(ated blood) quickly
	  • to bring carbon dioxide to the lungs quickly
	  • to maintain a concentration / diffusion gradient		

4.1.2.1 Chromosomes

08.4	Osmosis	allow diffusion	1	AO1 4.1.3.1 4.2.3.2 4.1.3.2
08.5	active transport (because) energy is needed (to move nitrate ions) from a low(er) concentration (in the soil) to a high(er) concentration (in the root / cell)	 allow (to move nitrate ions) against / up the concentration gradient allow (because) there is a lower concentration (of nitrate ions) in the soil **or** (because) there is a higher concentration (of nitrate ions) in the root / cell ignore reference to amount / number of nitrate ions ignore along / across the concentration gradient do **not** accept if reference to molecules / atoms moving	1 1 1	AO3 AO2 AO2 4.1.1.3 4.2.3.2 4.1.3.3
Total			**14**	

4.1.2.1 Chromosomes

Answer 54 · Examiner comments November 2020 | 8461/1F | Original Q2

Question 2 (low & standard demand)

In **02.3**, whilst there is no expectation for students to use a protractor to measure angles, this was occasionally seen. **02.7** was not answered well due to weak use of language, with 4% of students gaining both marks, and 23% gaining one mark. Many students talked generally about new cells replacing the old ones, and some new cells actually 'fixing' or repairing the damaged cells. The idea of stem cells 'adapting' was a common occurrence, as was a repeat of the stem of the question, in relation to stem cells becoming specialised. A few students thought that stem cells were made of plastic or metal (confusing them with replacement heart valves). There was confusion from some students regarding the bone marrow itself being damaged.

Answer 55 · Examiner comments November 2020 | 8461/2F | Original Q3

Question 3 (low & standard demand)

This question was about meiosis, chromosomes and an inherited disorder in humans. A little over one-third of students gave the correct answer of '4' cells being formed by meiosis in **03.1**. There were many other alternatives offered: '2' was, not unexpectedly, a common incorrect response and other suggestions included '8' and as many as '50 million' as these last students presumably either misread the question or misunderstood the process of meiosis.

For **03.6** most students ringed an appropriate offspring genotype although a significant minority (about 1 in 15) did not answer this question. The most likely reason for this is that students missed the question, rather than not understanding what they had to do. The lack of answer lines, spaces or boxes to tick should not be seen by students to mean that nothing needs to be done. Students should be reminded to read all of the words on the paper and respond accordingly. Those students who gave incorrect responses often ringed contradictory genotypes, showing a lack of understanding of genetic principles.

4.1.2.1 Chromosomes

Answer 58 · Examiner comments

June 2022 | 8461/1F | Original Q2

Question 2 (Low demand)

02.1 It was clear that many students had not previously had experience of viewing cells in different stages of division under a microscope, with just over a quarter of students gaining the mark in this question.

02.2 Students' understanding of mitosis maintaining the chromosome number was poor, with less than 40% of students gaining the mark in this question. The most common incorrect answer was 5, perhaps because students were confusing the process with meiosis, where the chromosome number is halved.

02.3 Many students struggled to select the correct terms to describe the cell cycle in this question, often confusing the word 'contracts' with 'divides'.

02.4 Nearly all students were able to determine the longest part of the cell cycle from **Figure 2**.

02.5 Over three quarters of students were able to calculate that stage **A** in **Figure 2** represented 10%, with the most common incorrect answer being 15%.

02.6 Over 75% of students were able to correctly identify the heart as being part of the circulatory system, with the most common incorrect answer being the respiratory system.

Answer 58 · Examiner comments

June 2022 | 8461/1F | Original Q2

02.7 Less than half of students were awarded a mark in this question. Common incorrect answers did not relate to the heart, such as diabetes, and students are reminded of the need to read all questions carefully, to avoid such errors. In addition, some students named parts of the heart rather than medical conditions, perhaps indicating that they had not read the question properly. 'Chronical' heart disease was more commonly seen than anticipated and cancer was often given, which was not creditworthy.

02.8 Over 55% of students gained credit in this question, with the most common answers relating to religious or personal beliefs. Occasionally, risk of infection was seen but rejection was a rarity. This is the type of question where many students had the right idea, but articulated themselves poorly and so did not get the mark. Vague descriptions such as 'they don't agree with it' were not given credit.

4.1.2.1 Chromosomes

Answer 59 · Examiner comments

June 2022 | 8461/2F | Original Q8

Question 8

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

08.1 Almost one third 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. A large proportion appeared to be using little more than guesswork.

08.2 A variety of plant parts, often not even of a flower, along with processes, sub-cellular structures and occasionally plant or even animal organs were suggested as the name of the male gamete in flowering plants. Fewer than a quarter gave the correct name, *pollen*.

08.3 and **08.4** Interpretation of the graph in **Figure 12**, which showed changing amounts of DNA in a cell before, during and after meiosis, was fairly good where, respectively, around 50 percent and 40 percent of students chose the correct period of DNA synthesis and the correct times of cell division. But it was odd that so many others chose 4-5 hours for copying of the DNA, a time when its mass remained constant, and chose times for cell division when the mass of DNA was not being halved.

08.5 and **08.6** Only one in seven suggested that the lowest value on the graph, at the end of meiosis, would be the amount of DNA in a sperm cell. In **08.6**, the suggested amount of DNA in an embryo was frequently a value lower than that given for the sperm cell, with fewer than one-third suggesting the same value as that found at the start of the graph.

4.1.2.1 Chromosomes

Answer 60 · Examiner comments

June 2023 | 8461/1F | Original Q4

Question 4 (Low and standard demand)

04.1 Nearly two thirds of students knew the term 'vector' correctly describes the mosquito.

04.2 Although the question states that Figure 2 showed a (single) cell of a malarial protist, some students remained confused and believed that there were 'cells depicted within a cell'. Others incorrectly discussed the absence of plant cell features, such as 'no chloroplasts', while others got prokaryotic and eukaryotic cells muddled. Reference to size was ignored. While 25% of students failed to gain any marks, the most frequently seen correct feature was 'nucleus', followed by 'mitochondria'. Phonetic spellings were obviously allowed as students have difficulty in spelling both of these words. As in all questions of this nature, the 'list rule' applied so that where a student gave 3 answers, 2 of which were correct and 1 wrong, only one mark could be given.

04.3 Over two thirds of students gained the mark by selecting *Salmonella* to be prokaryotic. While the remaining students indicated 'cow' or 'grass', in equal amounts.

04.4 Around 77% of students knew that asexual reproduction involved only one parent.

04.5 It is clear that many students still remain unclear about the number of chromosomes involved in mitosis. Only around a third of students correctly selected '14' as the number of chromosomes each new protist cell would have after mitosis. The most common incorrect answer seen was '28', which was selected by a further third of the students.

04.6 Around half of students were correct in selecting 'decreased haemoglobin' as a change that would happen in the blood of a person with malaria.

04.7 Nearly 35% of students who are adept at mathematics found this question very straightforward and an easy route to four marks. A further 31% managed three marks, via many routes, but most commonly by reaching the point of 350 million but then failing to convert to standard form or incorrectly doing so. Others forgot that the question referred to 'millions' of people being infected and used 105 and 315 but, nevertheless, an answer of 3.15×10^2 was still awarded three marks.

04.8 Many students were aware of what should be done to reduce the chance of being bitten by mosquitoes but then used inadequate scientific language to express themselves and as such only around 13% of students gained both available marks. Answers such as 'cover yourself up' or 'use bug spray / repellent' were not credited. 'Wear more / thicker clothes' was also deemed insufficient and 'close windows / doors' also failed to get credit without qualifying that this was only important in the evenings. Some correctly suggested not going to places with mosquitoes or where there was an incidence of malaria and a few answers referred to destruction of breeding grounds. Other correct suggestions were also awarded credit, but overall 42% of students scored zero marks.

04.9 Nearly three quarters of students gained one mark here for correctly describing that the chance of getting malaria decreased with age. A few incorrectly understood the context of disorder S, however, and said that the likelihood of having this, rather than malaria, was lower as age increased. Even though the instruction given in the question was to use data

4.1.2.1 Chromosomes

Answer 60 · Examiner comments June 2023 | 8461/1F | Original Q4

from Table 4 only around 10% of students went on to gain the second mark for an appropriate use of figures. Some, unfortunately, glanced too quickly at the results and believed there was a decrease of 5% every 2 years.

Answer 61 · Examiner comments June 2023 | 8461/2F | Original Q9

Question 9

This was the third of the three questions common to both the Foundation and Higher Tier papers. The topic was reproduction and selective breeding.

09.1 The most common advantage given for growing genetically-different tomatoes was that some might be less susceptible to disease, although others, such as producing different-sized tomatoes, were also given. Just over one-third of students gave a suitable answer.

4.1.2.1 Chromosomes

Answer 61 · Examiner comments

June 2023 | 8461/2F | Original Q9

09.2 Deciding on an advantage for growing genetically-identical tomatoes proved more problematic and only one-fifth could suggest a feature such as all growing at the same rate or all having the same named desirable feature such as high yield, disease resistance or flavour.

09.3 Very few students could successfully describe what is meant by tissue culture. Use of tissue as the starting material was deemed inadequate and required amplification in terms of cells being grown. Only around 2 percent gave an appropriate answer.

09.4 Almost half of all students were able to suggest why genetically-identical tomatoes growing in a garden might not all attain the same height – for example, due to variations in light intensity, ions, water or temperature in different areas of the garden.

09.5 This question was about sex determination in dogs. Students had to use the symbols X and Y to complete a blank Punnett square. Most knew that the male dog would produce gametes containing either an X or a Y chromosome, and that all the female gametes would contain an X chromosome, and over a quarter were successful in the completion of all aspects of the Punnett square.

09.6 The explanation of why a litter of six puppies might be expected to consist of three males and three females was straightforward for only a minority of students: either in terms of the expected 1:1 ratio of males and females or the inheritance of a Y chromosome by only half of the offspring (as demonstrated in a correct answer to the previous question).

09.7 This question was about the breeding of chickens for meat production and egg production. Given the results of an investigation in Figure 5 which showed that chicken variety A had high egg production while variety B grew more quickly, students had to suggest two control variables for the investigation. Many answers were rather vague – such as the same ‘living conditions’ / ‘environment’. More specific conditions, such as temperature, lighting, amount or type of food, all being kept indoors or all outdoors, were required. The most common correct answer related to the chickens’ food. Fewer than half of the students could suggest at least one suitable control variable, and only 1 in 8 could give two.

09.8 The data in the investigation had come from 500 chickens of each variety and students had to give a reason why such a large number had been used. Acceptable answers included the idea this would be more representative, or would give a more valid mean, or would reduce the effects of any anomalies (and not that it would ‘eliminate’ anomalies). A little over one-third of students were successful.

09.9 In this question, students had to describe how selective breeding of the two chicken varieties might produce a new variety of chicken that was good for both meat production and egg production. Many answers lacked precision: thus it was not often evident that only the best from varieties A and B would be mated and that the best (for both qualities) from the offspring would then be selected and mated, and that this would be continued over several generations. Often, it was impossible to tell from students’ answers which generation of chickens was being used: the original parents, the first generation offspring or subsequent generations of offspring. The term ‘repeat’ was often used in an ambiguous context. Thus only 1 in 500 students scored all 4 marks, and only 1 in 25 gained at least half-marks.

4.1.2.1 Chromosomes

Answer 61 · Examiner comments

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.1.2.1 Chromosomes

Answer 62 · Examiner comments

Question 8 (standard demand)

08.1 57% of students gained credit in this question.

08.2 88% of students selected the correct answer in this question.

08.3 This extended response question was not answered well. Most students found it very difficult to access and the majority of responses simply restated the information given in the question or detailed everything the student knew about cystic fibrosis (CF) and the lungs. Less than 13% of students achieved anything more than one mark, with 57% achieving zero.

Students achieving Level 1 gave one or more simple, unconnected, but appropriate statements which reflected the difficulties encountered. To enter Level 2, there had to be at least the attempted linking of one idea with another, which reflected either the difficulty in digesting food or the difficulty in gaining body mass. To enter Level 3 students had to show at least some attempted linking of two or more ideas and they had to address, even if only minimally, both difficulties in digesting food and gaining body mass.

Responses invariably focused only on difficulties with digestion, as the context of this topic probably seemed more familiar. General comments which simply reworded what had been given in the question such as 'people with CF have fewer enzymes so will find it hard to breakdown food' or 'the gut will find it difficult to function' were repeated time and again in paragraphs but added nothing of value to answers. Some students gravitated towards the familiarity of 'enzymes' and proceeded to give unnecessary details of enzyme action in general and of possible denaturation. Others followed on from the mention of CF by inappropriately referring to breathing difficulties or by suggesting that excess mucus might 'block the gut'. When ideas were successfully linked, these were most often in relation to individual digestive enzymes and their substrates. Occasional additional points were given such as 'reduced absorption' or 'less fat could be stored' but these were not often considered at this level.

The statements students make in these extended response questions do not need to be long or complex and it is never necessary to include all the points listed in the indicative content on the mark scheme to achieve the highest level. Neither do responses have to be written in complete sentences - succinct bullet points often suffice and may even help students to organise their ideas more effectively. As is always the case with extended response questions, however, answers are considered holistically and always in a positive framework.

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4.1.2.1 Chromosomes

Answer 62 · Examiner comments June 2024 | 8461/1F | Original Q8

08.4 3% of students achieved full marks in this question, with 13% achieving two marks and 31% achieving one mark. This question asked for a description of the features of the (individual) alveoli that help maximise gas exchange rather than the lungs in general. Most students struggled to describe three features, often missing out on marks due to their responses lacking specificity. An answer such as they are 'one cell thick' or 'thin' had to be related to the alveolar walls to be given credit. Some students referred to there being a 'short diffusion distance' but as this is a consequence of the thin walls and not a described feature, they could not gain the mark. Students should be reminded to double check the command word given in each question; explanatory detail in 'describe' questions is not required, nor creditworthy.

08.5 Fewer than 20% of students scored any credit in this question, despite many making lengthy attempts. Answers were usually too general and invariably did not offer any clear explanations. Two routes were available in the mark scheme – one which reflected there being less oxygen for aerobic respiration and the other which reflected the inevitable increase in anaerobic respiration. The variety of answers which did not gain credit included vague suggestions such as 'tiredness', it being 'hard to breathe', the 'heart rate is affected' or 'weak muscles' as well as incorrect ones such as 'blood stops flowing' or there is 'no respiration'.

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4.1.2.1 Chromosomes

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

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Answer 63 · Examiner comments

Question 1 (Low demand)

01.1
45% of students knew the definition of a dominant allele.

01.2
Three quarters of students correctly identified 'hh' as the genotype of the white rabbit.

01.3
Three quarters of students successfully identified the correct male gametes and used them to derive the offspring, demonstrating a secure understanding of fundamental genetic principles. A small number of students incorrectly provided diploid or no gametes, preventing them from earning marks for the Punnett Square portion. However, it is worth noting that some of these students were still able to gain marks in subsequent questions, indicating an understanding of other aspects of the problem despite the initial error. Similarly, other students who provided incorrect gametes still managed to pick up some marks elsewhere in their answers.

A common issue observed was students overwriting their letters, making it challenging to distinguish between 'H' and 'h'. For future assessments, students should be advised to clearly cross out any incorrect letters and rewrite their intended answer close to it, to ensure legibility.

01.4
60% of students correctly drew a ring around one homozygous offspring. A little over 10% of students did not attempt this question - even those who gained full marks on **01.3**. Students are reminded to check all question parts, including those without lines or space for an answer. There were a few students who drew a ring around two offspring, and of those that did some drew a ring around both homozygotes, so still gained the mark. A minority were unable to score because they drew a ring around a gamete.

01.5
Only 50% of students were able to identify how many of the offspring would be Himalayan rabbits from their genetic cross. Some students gave '3' as their answer even when this did not match their Punnett Square suggesting they were giving a learnt response rather than one matching their previous answers.

01.6
A pleasing two thirds of students knew that male rabbits have one X chromosome in each body cell.

01.7
Almost three quarters of students correctly predicted the number of female offspring expected - although a range of numbers was seen – including some that were higher than 4. The most common incorrect answers were 1 and 3.

Answer 64 · Examiner comments

June 2025 | 8461/2F | Original Q3

Question 3 (Low and Standard demand)

03.1
Three quarters of students knew that sperm are produced in the testes/testicles. There were many alternative phonetic spellings of testes and testicles seen which were given credit. The most common incorrect answers were ovaries and penis along with other parts of the male and female reproductive organs. 'Genitalia' and colloquial terms were also frequently seen uncreditworthy answers, along with a few unexpected parts such as pancreas, stomach and spine.

03.2
All combinations of numbers were seen, including that for the compensation mark. Just under 40% of students gained both marks.

03.3
95% of students knew that fertilisation was the process where a sperm cell joins with an egg cell.

03.4
Over 50% of students knew that pollen is the male gamete in a flower.

03.5
60% of students knew that mitosis produces new cells in runners.

03.6
Over half of students could identify at least one substance that passes through the runners, with a further 25% being able to identify both sugar and water.

03.7
A third of students were able to give one advantage of reproducing sexually.
The most commonly awarded mark was for the idea of variation, either given in those terms or that the offspring would not be the same. All other bullet points were seen, with the idea of dispersal being the next most common. The most frequent reason for not gaining the mark here was for giving an advantage of asexual reproduction, possibly through having misread the question.

03.8
Over 50% of students were able to give one advantage of reproducing asexually with bullet points 1, 3 and 4 most commonly seen. Several students gave more than one idea in a single sentence e.g. ' it is faster because there is no need to find a mate'. A few students implied the idea of the offspring gaining resources from the parent plant but did not specify water or a named nutrient, instead referring to 'nutrients', so were unable to gain credit for bullet point 6. Others referred to asexual reproduction as being 'easier' without elaborating as to how this manifested itself. As with question **03.7** some students were unable to gain this mark because they gave an advantage of the other type of reproduction.