AQA GCSE BIOLOGY (HIGHER) · 8461

BIOLOGY



MARK SCHEME

4.6.1 REPRODUCTION (PACK 6)

SCORE	PERCENTAGE
/149	%

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Q1.

(a) a double helix

1

a polymer

1

(b) gene

1

genome

1

in this order only

(c) sperm **and** egg(s) / ova / ovum

in either order

1

(d) fertilisation

1

(e) the cell divides twice

1

the new cells have half the number of chromosomes

1

[8]

Q2.

(a)

	Genes	Environment	Both	
Brown…	✓			1
Light…			✓	1
Short…		✓		1

(b) bb

1

(c) brown

*allow light brown **or** dark brown*

1

(d) (using bb for mother's gametes)

correct combination in all four boxes, e.g.

(b)	*(b)*

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(B)	Bb	Bb
(b)	bb	bb

allow any combination of mother's gametes as mark is for filling in boxes correctly

1

(e) 50%, 0.5, ½

*the award of this mark is consequential to the answer in part **(d)***

ignore ratios

1

(f) phenotype

1

(g) almost certainly have no effect

1

[9]

Q3.

(a) one X and one Y chromosome and 9 pairs of other chromosomes

1

(b) any **three** from:

- (called) meiosis

  correct spelling only

- DNA / chromosomes replicate
  or
  DNA makes a copy
- two divisions to form 4 cells
- so only 1 set of chromosomes per cell

  allow cells are haploid
  ignore half the DNA

- (daughter cells / gametes) are all genetically different

  *if no other mark awarded allow **1** mark for forms gametes / cells which are all different*
  ***or** only happens in testes and (embryonic) ovaries*

3

(c) (meiosis will not work because) number of chromosomes cannot halve

allow chromosomes cannot form pairs
allow chromosomes cannot split up evenly

1

(d) do not use energy in reproduction

1

so more (energy) available to synthesise proteins

allow other correct molecules or cell components

1

allow converse if clearly describing diploid

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oysters

(e) any **two** from:

- global warming may be raising temperature of water and killing oysters
- pollutants in the water may be toxic and kill the oysters
  or
  increased acidity of the oceans is killing oysters

  allow correctly named pollutant with reason

- new competitors / triploid oysters are using up the normal food source
- new pathogens may be causing diseases
- new predators eating oysters

  ignore over harvesting

2

(f) **Level 3:** A judgement strongly linked and logically supported by a sufficient range of correct reasons is given.

5–6

Level 2: Some logically linked reasons are given. There also may be a simple judgement.

3–4

Level 1: Relevant points are made. They are not logically linked.

1–2

No relevant content

Indicative content

for:

- oysters are available to eat all year **so** eating oysters has become very popular
- cheaper to produce **so** more food for expanding population
- oysters grow faster **so** more oysters for supermarkets / restaurants or more profit for farmers
- stocks are replenished each year **so** more sustainable fishing
- they can harvest / sell all year **so** more stable and profitable for oyster farmers

against:

- carcinogen put into environment / oysters **so** may enter the food chain or cause cancer in humans
- bigger triploid oysters may outcompete the smaller native diploid oysters **so** upset balance of the ecosystem / cause extinction
- people may not buy / eat them because they have used a carcinogenic chemical **so** reduced profit for farmers / suppliers / supermarkets / restaurants
- farmers have to buy new seed oysters every time **so** more expensive

other content:

- shouldn't be eating the oysters until they are thoroughly tested
- should be looking for alternative ways to get triploid oysters
- should stop using triploid oysters until the effect on the (marine) environment is known
- would replace lost oyster beds **but** could change the ecosystem
- oysters available to eat all year **but** probably do not taste the same or have the same flavour

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[15]

Q4.

(a) DNA

allow deoxyribonucleic acid
allow lower case letters

1

(b) gametes

1

(c) meiosis

1

(d) 20

1

(e) dominant

1

(f) Bb
or
bB

1

(g) bb circled

*allow ecf from part **(f)***

1

(h) 1 in 4 / 25% / 1:3 / 0.25 / ¼

*allow ecf from part **(f)***
*do **not** accept 1:4*

1

[8]

Q5.

(a) a short section of DNA

1

(b) a sequence of amino acids

1

(c) genome

1

(d) phenotype

1

(e) (parents genotype shown one homozygous recessive, one heterozygous dominant)
rr and Rr

may be on diagram

1

(possible offspring genotypes shown) Rr Rr rr rr

allow correct derivation of offspring genotypes

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from incorrect gametes

1

all offspring with Marfan syndrome phenotype circled / labelled

1

probability 0.5 / ½ / 50%

allow correct probability from incorrectly derived offspring

1

(f) gametes / sperm / eggs are produced by meiosis (cell division)

1

when gametes fuse this mutation is in the fused / new cell

allow at fertilisation for when gametes fuse
allow zygote for fused cell

1

(after fertilisation) mitosis produces every cell of embryo / offspring

1

(which) will be genetically identical
or
(mutated) DNA from gamete is in every cell of offspring

1

[12]

Q6.

(a) asexual

1

clones

1

gametes

1

variation

1

mitosis

in this order

1

(b) 8

1

(c) XY

1

(d) both bars correctly plotted

1

correct labels on x-axis

allow labels mark even if bars incorrect

1

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(e) 30

1

(f) any **one** from:

- because zebra fish is small and has high number of chromosomes
- not all animals are listed
- not enough data
- animals have different sizes during their life but the chromosome number stays the same

allow other sensible conclusions

1

[11]

Q7.

(a) (hormonal uses chemicals / synthetic) hormones to prevent an egg being released

allow 'to prevent maturation of eggs'

1

(non-hormonal has a barrier which) prevents the sperm reaching an egg **or** prevents implantation

1

a correct example of each type

1

(b) suitable scales and axes labels correct

1

all points plotted accurately

*allow **1** mark for 5 accurate points*

2

line of best fit

*allow a bar chart for max **3** marks*

1

(c) decrease egg production

1

by between 6–10 times

allow ecf from their graph

1

[9]

Q8.

(a) **only genetic causes**

any **one** from:

- pattern of scales
- number of fins
- eye colour

1

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only environmental causes:

- scar

1

both genetic and environmental causes:

- length

1

(b)

	B	**b**
b		bb
b	Bb	bb

*allow 2 correct for **1** mark*

2

(c) any bb circled

1

(d) 0.5

*allow ecf from **04.2***

1

(e) (260 000 / 2 =) 130 000

*allow ecf from **04.4***

1

(f) mutation

allow change in diet / hormones / DNA

1

[9]

Q9.

(a) asexual reproduction

1

(b) mitosis

1

(c) clones

1

(d) 44

1

[4]

Q10.

(a) wolves

1

(b) moose and wolves are on different scales

1

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(c) wolf population has increased so more moose are eaten

*do **not** accept there are more wolves than moose*

1

(d) any **two** from:

- (other) predators
  allow correct examples
  allow 'humans hunting moose'
- (new) pathogens
  allow diseases
- competition

2

(e) any **four** from:

- variation (within species) of antler size
  allow description relating to antlers
- (caused by) different genes
- as a result of sexual reproduction / process of meiosis / mutation
- (phenotype) most suited to environment most likely to survive and breed
  ignore natural selection unqualified
- genes for large antlers (more likely to be) passed on to next generation

4

reference to mate selection
or
fighting
or
gaining territory
or
competition for mates
or
avoiding predation

1

[10]

Q11.

(a) a change in the DNA / gene

1

(b) produces a different protein / enzyme that is responsible for colour

1

(c) parents genotype both Bb

allow correctly derived gametes

1

offspring genotypes correctly derived

1

bb identified as blue

allow ring around bb only

1

65 000

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allow ecf or 260 000 × 0.25

1

6.5×10^4

1

(d) cross with **bb** / blue carp

*allow annotated Punnett square diagram(s) of cross with **bb** carp*

1

if any offspring are blue, the parent was **Bb** / heterozygous

allow converse

1

*allow cross with known **Bb** carp*
*if any offspring are blue, other parent was **Bb** / heterozygous*

[9]

Q12.

(a) Nucleus

1

(b)

Type of cell	**Number of chromosomes**
Sperm cell	23
	26
Embryo cell	46
	52
	69

extra lines from left cancel the mark

2

(c)

	X	**X**
X	**XX**	**XX**
Y	**XY**	**XY**

*all three correct for **2** marks*
*one or two correct for **1** mark*
allow XY or YX in correct places

2

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(d)

	X	X
X	XX	XX
Y	XY	XY

either circled

1

(e) 1 in 2

1

[7]

Q13.

(a) Man's genotpe **Hh**

both needed for the mark

Woman's genotype **hh**

1

(b) gametes correctly derived from parents genotypes in 05.1

1

offspring genotypes correctly derived from gametes

1

all Hh circled

Man's gametes		**Woman's gametes**	
		h	h
	H	Hh	Hh
	h	hh	hh

1

(Probability =) any **one** from:

- 50%
- ½
- 2 / 4
- 0.5
- 1 in 2
- 2 in 4
- 1:1
- 2:2

1

(c) **Level 3 (5–6 marks):**
A detailed and coherent evaluation is provided which considers a range of relevant points and comes to a conclusion consistent with the reasoning.

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Level 2 (3–4 marks):
An attempt is made to relate relevant points and come to a conclusion. The logic may be inconsistent at times but builds towards a coherent argument.

Level 1 (1–2 marks):
Discrete relevant points made. The logic may be unclear and the conclusion, if present,
may not be consistent with the reasoning.

0 marks:
No relevant content

Indicative content

- adoption / gamete donation unsuitable as offspring not biologically theirs
- natural conception too risky / only 50% chance of healthy offspring
- natural conception would cause worry whether baby would be healthy or not
- (therefore) choice is between PGD and PND

pros of PGD

- baby would be theirs
- results obtained at an early stage
- high chance baby produced would be healthy
- parents would have confidence of having a heathy baby from start of pregnancy
- lower risk of miscarriage compared to PND
- frozen embryos can be used to have another healthy child
- PGD occurs before pregnancy / implantation
- PGD does not involve abortion so less trauma / less pain / ethical comparison
- spare healthy embryos may be used for research / medical treatment

cons of PGD

- slight / 0.2% chance of misdiagnosed embryo
- expensive procedure
- cost to NHS of non-essential procedure
- (unhealthy) embryos might be destroyed
- large number of embryos produced so healthy embryos may be destroyed
- ethical issues of using embryos for research
- some people are opposed to IVF due to their religious beliefs

pros of PND

- natural conception less invasive for mother
- psychological benefit of producing child naturally
- 99% / high chance that result of test will be conclusive

cons of PND

- sampling technique invasive to mother
- risk of miscarriage
- risk of infection
- long wait before test can be carried out
- 50% chance baby will have allele for Huntington's disease
- parents will have a difficult decision to make if baby is unheathly
- baby may be aborted
- ethical / religious issues of abortion

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- a justified conclusion

6

[11]

Q115.

(a) (i) egg (cell)

accept ovum

allow ova

ignore gamete

1

(ii) gamete

1

sexual reproduction

1

(b) (i) *Labrador father*

any **one** from:

- (fur) colour
- (shape of) nose / face / head.

allow (shape of) eyes

*do **not** allow references to ears / tail*

1

(ii) *Poodle mother*

any **one** from:

- curly fur
- furry legs
- (shape of) tail
- (shape of) legs
- (shape of) ears.

allow same body shape

1

[5]

Q116.

(a) sexual reproduction

1

(each embryo produced from) different sperm and egg

or

from different gametes

1

(so have) different genetic information

allow (so have) different genes / DNA / chromosomes / alleles

1

(b) any **one** from:

- *idea* that not all individuals would be killed by a change in the environment eg disease

allow species less likely to die out

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- more variation in the population increases chance of survival.

  allow idea of restricted gene pool makes species more vulnerable to diseases

1

[4]

Q117.

(a) categoric

extra words circled negates mark

1

(b) (i) 11

1

(ii) 25

*allow ecf from part **(i)***
ie (i) +14

1

(iii) any **one** from:

- blue is the most common eye colour
- green is the least common eye colour

ignore figures
allow mode / modal
allow more have blue eyes

1

(c) (i) a gene

1

(ii) sex cells

1

[6]

Q118.

variation

must be in correct order

1

natural selection

1

(sexual) reproduction

1

[3]

Q119.

(sexual reproduction involves) the joining / fusion of (male and female) gametes / sex cells / named gametes

*accept fertilisation of gametes / sex cells / named gametes for **2** marks*

*allow fertilisation for **1** mark*

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*allow gametes / sex cells / named gametes for **1** mark*

2

(so) genetic information / genes / DNA / chromosomes

1

(from) two parents / mother and father / organisms / individuals (is mixed)

allow (from) each parent / her parents / their parents

1

[4]

Q120.

(a) *must be in correct order*

sexual

1

gametes

1

genes

1

(b) *must be in correct order*

ignore twins / genetic engineering

clones

1

asexual

1

[5]

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Q1.

(a) Students had to identify two descriptions of DNA. Double helix was almost always selected but the second answer selected by students was often protein rather than polymer. A large number selected both ‘Double helix’ and ‘Single strand’ which is contradictory. 29% of students achieved full marks.

(b) Students had to complete sentences by selecting words from the box. Many students did not attempt this question (43%) and those that did, often reversed the answers. 57% of students achieved one or two marks.

(c) Students were asked for two types of gametes in humans. Common incorrect answers seen were ovary and testes or X and Y.

(d) 22% of students answered correctly. The most common incorrect responses for the process when gametes join were fusion, reproduction and meiosis.

(e) Students had to identify two features that showed the cell division was meiosis. Many identified ‘the cell divides twice’ but often failed to gain the second mark giving a range of incorrect responses.

Q2.

(a) Students were asked for the cause of three types of variation. 58% of students gave all three correctly. Many identified eye colour but less were able to correctly identify skin colour and short hair.

(b) Students were generally good at identifying the alleles for blue eyes with 82% answering correctly.

(c) 78% of students got the eye colour of the man when given the alleles. ‘Green eyes’ was also seen a fair number of times even though only brown and blue had been mentioned in the question stem.

(d) 78% of students were able to complete the Punnett square correctly. A very small number appeared to be confused about inserting the alleles for the woman and hence could not gain credit.

A large number of students used Bb or BB as their female’s gametes and gained credit for the correct derivation.

(e) When the Punnett square was completed correctly using bb, the student generally also gained this mark. However, where the student had used BB or Bb then the percentage quoted was usually incorrect.

Many students gave their response in the form of a ratio; often 2/4 was encountered, rather than 1/2. Students need to understand the difference between probability and ratios.

(f) The most common misconception for this question was that genotype, rather than phenotype, was the scientific term used for the child’s eye colour. 23% of students answered correctly.

(g) The effect of a mutation as usually having no effect was not a common response

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from students (14%). Most responses were ‘definitely change appearance’ or ‘probably cause a disease’.

Q3.

As expected with this question being higher demand, students generally achieved lower marks. Some excellent answers were seen where students were able to access knowledge from different parts of the specification as well as use information from the question stem and their own wider reading to express complex concepts.

(a) This was not a straightforward knowledge question as students needed to use logical thinking as well as knowledge of chromosomes to work out the correct alternative. 50% of students arrived at the correct response. Many realised that there would be one X and one Y chromosome but their maths let them down when they computed that only eight more pairs would be needed.

(b) A large number of students understood meiosis was the type of cell division and many students could not spell it correctly. Being able to understand the differences in mitosis and meiosis is crucial as is being able to correctly spell all keywords. 28% of students achieved two or three marks.

(c) Students seemed to struggle with the idea that meiosis created four daughter cells from the two divisions, although they did tend to identify that the cells would be haploid. Many just stated the cells would be not identical rather than being genetically different.

The majority of students found it difficult to transfer their knowledge of humans and their 23 pairs of chromosomes to oysters with ten pairs and so their answers were confused. 19% of students achieved the mark here.

(d) While students were able to note that triploid oysters didn’t spend time reproducing, very few related this to energy. Many went down the route of not needing time to look for a mate. The few that did identify energy and reproduction (6% of students) rarely linked the energy available to synthesising proteins, and instead going with vague references to ‘growth’ which is insufficient at this level.

(e) Students had the idea that global warming, pollutants, competition or predators could be involved, but rarely gained credit as they did not express this with the necessary high demand biological detail required to explain how it would lead to a reduction in population.

Key points were generally missing such as toxic pollutants and new predators or pathogens. Some students mentioned disease but did not relate it to pathogens. 3% of students achieved full marks.

(f) This ‘extended response’ question was targeted at grades 6–9. Many students were able to access level 1 (43%) and level 2 (27%). It served its purpose of allowing the higher-attaining students to perform well, while not discouraging lower-attaining students from answering, and very few students made no attempt.

It was felt that students engaged with the opportunity to have an opinion about ideas on whether supermarkets and restaurants should be allowed to stock a product which may have a link to a carcinogen.

Q4.

(a) 45% of students could identify DNA as the name of the chemical that carries genetic

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information.

(b) 49% of students could recall that sperm cells and eggs cells are gametes. Almost as many thought these cells were genes.

(c) Slightly more students selected that fertilisation produces sperm cells, compared with the correct answer of meiosis.

(d) 75% of students knew that sperm cells contain half the number of chromosomes as body cells and could apply that concept to the scenario given.

(e) This question was very well answered with 71% of students applying the word dominant correctly.

(f) 91% of students could correctly derive the missing genotype as Bb.

(g) 75% of students could identify which of the offspring would have brown fur.

(h) Many incorrect answers were seen, including vague statements such as likely or not likely. The number of incorrect percentages and fractions given suggests that whilst students are learning how to complete a Punnett square diagram, they do not fully understand the meaning of these diagrams.

Q5.

(a) 83% of students could identify that the best description of a gene from the options given was a short section of DNA.

(b) 71% of students incorrectly selected that a gene codes for a DNA helix, rather than a sequence of amino acids.

(c) 12% of students could give the scientific term ‘genome’.

(d) 44% of students knew that the term phenotype describes the observable characteristics of an individual.

(e) Most students attempted to draw a Punnett square diagram, as stated in the specification. Credit could still be awarded for other genetic diagrams, but mistakes were seen more frequently if other methods were used.

Students were asked to use a genetic diagram to show the probability of the offspring inheriting Marfan syndrome. Few students identified which offspring genotypes would inherit Marfan syndrome, therefore marking point three was awarded infrequently.

This question discriminated well with a good spread across the mark range. The most frequent mark achieved was three (40% of students).

(f) Students found this high demand question challenging with 3% of students achieving two or more marks. Many misconceptions regarding mutations, meiosis and mitosis were seen.

The most frequently awarded mark was for recall that meiosis produces gametes. Few students could go on to explain how a mutation in a gamete could be present in every cell of an individual.

Q115.

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(a) (i) Most students correctly named the cell as an egg, and a few said ‘ovum’. Some said that the cell was a gamete, but this did not name the cell so was insufficient. Incorrect responses included ovary, uterus, embryo and sperm cell.

(ii) Most students gained at least 1 mark, usually for realising that the type of reproduction was sexual.

(b) (i) The most obvious similarity between the Labrador and the puppy was probably the fur colour, but students often selected more obscure characteristics such as shape of face, nose or eyes, all of which were credited. Quite a lot of students did not use the drawings to guide them and gave answers such as ‘both are male’, ‘both are friendly’, ‘soft mouth for shooting’. These characteristics could not be seen on the drawings so were not credited.

(ii) As the Labrador and the poodle both have fur, ‘fur’ on its own could not gain credit as a characteristic common with the mother and not with the father. Some feature of the fur had to be stated, for example, ‘curly fur’.

Q116.

(a) A surprising number of students did not mention that the wolf cubs were produced by sexual reproduction, although most students gained a mark for saying that the cubs would have different genes or chromosomes. The question referred to the biological parents, but many missed this and gave answers that related to a surrogate mother.

(b) Students who obtained the mark usually did so by explaining that it would be better to produce wolves that were different from each other because then there would be less chance of the population being wiped out by a disease.

Q117.

(a) Over three quarters of the students gained the mark for recognising that eye colour is a categoric variable. The most common distractor was control variable.

(b) (i) The majority of students correctly read the bar chart.

(ii) The majority of students answered this question correctly. A few errors in the addition of the correctly read numbers from the bar chart were seen, mainly resulting in an answer of 24 or 26. A few gave an answer of 12, and some who had incorrectly read the number of people with blue eyes in part (i), then correctly added this figure to 14 to gain this mark.

(c) The question was well answered with most students gaining the mark for saying that more people had blue eyes. Only a few didn’t attempt to make a conclusion.

Q118.

Almost all students scored at least 1 mark, with well over half gaining full marks.

Q119.

This question was answered very well in terms of both scientific content and well written responses. Marks were lost for incomplete answers, rather than for incorrect science. About a quarter of the students gained full marks. Most gained 2 marks for saying that genetic information from two parents was mixed, or that gametes fused together. Weaker

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responses usually gained 1 mark for mention of genes or chromosomes.

Q120.

(a) Most students knew that the puppies were produced by sexual reproduction. Some said embryos or genes were fused together instead of gametes. Also, some students thought the puppies all looked different because their cells contained different mixtures of gametes. Gametes and genes were most commonly confused. Half the students attempting the question scored all three marks.

(b) Most students knew that genetically identical organisms are called clones. Some said twins, which was ignored, whilst others stated gametes. Most students knew that clones are produced by asexual reproduction.

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