

Understanding Genetics And Evolution

Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science – Trilogy - Biology
Exam Board	AQA
Topic	4.6 Inheritance Variation and Evolution
Sub-Topic	Dev. Understanding Genetics + Evolution
Difficulty Level	Gold Level
Booklet	Mark Scheme 1

Time Allowed: 60 minutes

Score: / 58

Percentage: /100

Grade Boundaries:

- M1.(a)** human cells have cell membrane
or
human cells have no cell wall 1
- (b) can no longer synthesise proteins 1
- (c) antibiotics are being developed at a slower rate than emergence of new resistant strains 1
- resistant strains mean we cannot treat (common) infections 1
- reduce (future) cost of antibiotic resistant infections 1
- [5]
- M2.(a)** cross / breed / mate different breeds of horse 1
- if the offspring are fertile then the two breeds are of the same species 1
- (b) select the fastest male and female to cross / mate
allow any relevant characteristic, eg stamina 1
- select the fastest offspring and breed them 1

repeat over several generations to produce faster horses

1

- (c) gene for the Bt poison is cut from the bacterial DNA / plasmid / chromosome
ignore characteristic
accept Bacillus thuringiensis

1

using enzymes(s)

1

and transferred to cotton plant cells / DNA / chromosome
*do **not** allow to cotton plant plasmid*

1

- (d) any **four** from:
must have both advantages and disadvantages for full marks

advantages

- increased yield as less eaten by insects
 - fewer pesticides need to be used
 - (so) producer can make more money
- this point may only be gained if linked to one of the points above*

Disadvantages:

- gene (for poison) could be passed on to wild plants
 - may kill useful insects
- allow named insect eg bees*
- ecosystem / food chain could be affected
 - gene pool of cotton plants could be reduced
- allow less variation in cotton plant population*

max. 4

[12]

M3.(a) Man's genotype **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 gamete s		Woman's gametes	
		h	h
	H	Hh	Hh
	h	hh	hh

1

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

- 50%
- $\frac{1}{2}$
- 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.

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 healthy 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 unhealthy
- baby may be aborted
- ethical / religious issues of abortion
- a justified conclusion

M4.(a) (i) any **two** from:

- (dead) animal buried in sediment
allow imprint in mud
- hard parts / bones do not decay **or** soft parts do decay
allow (one of) the conditions for decay is missing – accept example, eg oxygen / water / correct temperature / bacteria
- mineralisation (of hard parts / bones)
allow replacement by other materials

2

(ii) any **two** from:

- conditions not right for fossilisation
ignore references to soft-bodied
- geological activity has destroyed fossils / has destroyed evidence
allow a named / described example – eg vulcanism / earth movements / erosion
- fossils not yet found
allow description of why not yet found

2

(b) any **four** from:

- separation / isolation (of different populations)
- different environmental conditions (between locations)
- mutation(s) occur **or** genetic variation (within each population)
- better adapted survive **or** natural selection occurs
allow 'survival of the fittest'
ignore animals adapt to their environment
ignore reference to stronger survive
- favourable alleles passed on (in each population)
allow genes for alleles
- eventually different populations unable to breed successfully with each other
allow unable to produce fertile offspring

4

[8]

M5.(a) variation (between organisms within species)

allow described example

*allow mutation – but **not** if caused by change in conditions*

1

those most suited / fittest survive

1

genes / alleles passed on (to offspring / next generation)

allow mutation passed on

1

(b) (i) any **two** from:

allow converse

- increase in latitude reduces number of (living) species
ignore references to severity of conditions
- increase in latitude reduces time for evolution (of new species)
- the less the time to evolve the fewer the number of (living) species

2

(ii) any **two** from:

*do **not** accept intention or need to evolve*

- (increase in latitude reduces number of (living) species because)
less food / habitats / more competition at high latitude
allow only extremophiles / well-adapted species can survive
- (increase in latitude reduces time for evolution (of new species)
because) severe conditions act more quickly / to a greater extent
on the weakest
- (the less the time to evolve the fewer the number of (living) species
because) species that evolve slowly don't survive

2

[7]

M6.(a) wing pattern similar to *Amauris*

allow looks similar to Amauris

1

birds assume it will have an unpleasant taste

1

- (b) mutation / variation produced wing pattern similar to *Amauris*
do not accept breeds with Amauris
do not accept idea of intentional adaptation

1

these butterflies not eaten (by birds)

1

these butterflies breed **or** their genes are passed to the next generation

1

[5]

- M7.(a)** (i) DNA replication / copies of genetic material were made

'it' = a chromosome

allow chromosomes replicate / duplicate / are copied

ignore chromosomes divide / split / double

1

- (ii) one copy of each (chromosome / chromatid / strand) to each offspring cell

ignore ref. to gametes and fertilisation

1

each offspring cell receives a complete set of / the same genetic material

allow 'so offspring (cells) are identical'

1

- (b) (i) meiosis
allow mieosis as the only alternative spelling 1
- (ii) Species A = 4 **and** Species B = 8 1
- (iii) sum of A + B from (b)(ii) e.g. 12 1
- (c) (i) similarities between chromosomes **or** similarities between flowers described
e.g. shape of petals / pattern on petals / colour / stamens 1
- can breed / can sexually reproduce
allow can reproduce with each other / they can produce offspring 1
- (ii) any **two** from:
- offspring contain 3 copies of each gene / of each chromosome / odd number of each of the chromosomes
 - some chromosomes unable to pair (in meiosis)
 - (viable) gametes not formed / some gametes with extra / too many genes / chromosomes
- or** some gametes with missing genes / chromosomes 2
- [10]