

# Reproduction

## Mark Scheme 1

<b>Level</b>	GCSE (9-1)
<b>Subject</b>	Combined Science – Trilogy - Biology
<b>Exam Board</b>	AQA
<b>Topic</b>	4.6 Inheritance Variation and Evolution
<b>Sub-Topic</b>	Reproduction
<b>Difficulty Level</b>	Gold Level
<b>Booklet</b>	Mark Scheme 1

**Time Allowed:** 56 minutes

**Score:** / 54

**Percentage:** /100

**Grade Boundaries:**

<b>M1.(a)</b>	a change in the DNA / gene	1
(b)	produces a different protein / enzyme that is responsible for colour	1
(c)	parents genotype both Bb <i>allow correctly derived gametes</i>	1
	offspring genotypes correctly derived	1
	bb identified as blue <i>allow ring around bb only</i>	1
	65 000 <i>allow ecf or <math>260\,000 \times 0.25</math></i>	1
	$6.5 \times 10^4$	1
(d)	cross with <b>bb</b> / blue carp <i>allow annotated Punnett square diagram(s) of cross with <b>bb</b> carp</i>	1
	if any offspring are blue, the parent was <b>Bb</b> / heterozygous <i>allow converse</i>	1

allow cross with known **Bb** carp

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

[9]

**M2.(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 unhealthly
- baby may be aborted
- ethical / religious issues of abortion
- a justified conclusion

6

[11]

**M3.(a)** any **three** from:

- (gene) cut out
- (gene / cut out) from (bacterial) chromosome / DNA  
*accept (gene / cut out) from (bacterial) plasmid*
- ref to enzymes (at any point)
- (gene spliced) into maize chromosome / DNA
- (gene added) at an early stage of development

3

(b) any **four** from:

- justification based on comparison of the relative merits of at least one advantage and one disadvantage  
*max 3 marks if only advantages or disadvantages given*

### **Advantages:**

- less effort for farmer **or** less likely to harm farmer  
*ignore ref to cost*
- (pesticide) always there **or** doesn't wash away  
*allow examples eg no need to spray*
- less insects to eat crop / maize **or** carry disease  
*allow pesticide doesn't contaminate water courses*
- so greater crop production / yield

### **Disadvantages:**

- (toxin) kills other insects  
*ignore ref to cost*
- so (some) crops don't get pollinated / (sexually) reproduce  
*allow maize not pollinated*

- possible harm when eaten by humans / animals  
*allow may have unpleasant taste*
- damage to food chains  
*allow reduced biodiversity*
- gene may spread to other species

4

[7]

**M4.(a)** (i) one form of a / one gene

*do **not** allow 'a type of gene'*  
*allow a mutation of a gene*

1

(ii) not expressed if dominant / other allele is present / if heterozygous

**or**

only expressed if dominant allele not present / or no other allele present  
*allow need two copies to be expressed / not expressed if*  
*only one copy / only expressed if homozygous*

1

(b) (i) two parents without PKU produce a child with PKU / **6** and **7** → **10**  
*allow 'it skips a generation'*

1

(ii) genetic diagram including:

*accept alternative symbols if defined*

Parental gametes:

6: **N** and **n**  
and 7: **N** and **n**

1

derivation of offspring genotypes:

**NN**   **Nn**   **Nn**   **nn**

*allow genotypes correctly derived from student's parental gametes*

1

identification: **NN** and **Nn** as non-PKU

OR nn as PKU

*allow correct identification of student's offspring genotypes*

1

correct probability only: 0.25 /  $\frac{1}{4}$  / 1 in 4 / 25% / 1 : 3

*do **not** allow 3 : 1 / 1 : 4*

*do **not** allow if extra incorrect probabilities given*

1

(c) (i) mitosis

*correct spelling only*

1

(ii) 8

1

(iii) DNA

*allow deoxyribonucleic acid*

*do **not** allow RNA / ribonucleic acid*

1

(d) (i) may lead to damage to embryo / may destroy embryos / embryo cannot give consent

*allow avoid abortion*

*allow emotive terms – eg murder religious argument must be qualified*

*allow ref to miscarriage*

*allow idea of avoiding prejudice against disabled people*

*allow idea of not producing designer babies*

1

(ii) any **one** from:

- prevent having child with the disorder / prevent future suffering / reduce incidence of the disease  
*ignore ref to having a healthy child*  
*ignore ref to selection of gender*
- embryo cells could be used in stem cell treatment  
*allow ref to long term cost of treating a child (with a disorder)*  
*allow ref to time for parents to become prepared*

1

[12]

- M5.(a)** (i) allele expressed even when other allele present **or** expressed if just one copy of allele is present **or** expressed if heterozygous  
*if present other allele not expressed* 1
- (ii) 2 affected parents have unaffected child **or** 1 and 2 → **5 / 6**  
**or** if recessive all of **1** and **2**'s children would have CADASIL 1
- (iii) heterozygous – has unaffected children **or** because if homozygous all children would have CADASIL 1
- (b) genetic diagram including:  
*accept alternative symbols, if defined* 1
- correct gametes:  
**D** and **d**  
**and d** (and **d**)  
*ignore 7 / 8 or male / female* 1
- derivation of offspring genotypes:  
**Dd Dd dd dd**  
*allow just **Dd dd** if ½-diagram*  
*allow ecf if correct for student's gametes* 1
- identification **of Dd** as CADASIL **or dd** as unaffected  
*allow ecf if correct for student's gametes* 1



correct probability: 0.5 /  $\frac{1}{2}$  / 1 in 2 / 50% / 1 : 1

1

- (c) (i) stem cells can differentiate **or** are undifferentiated / unspecialised

1

can form blood vessel cells / brain cells

**or**

stem cells can divide

1

- (ii) ethical argument - eg no risk of damage to embryo or adult can give consent for removal of cells **or** adult can re-grow skin

*more ethical qualified*

*ignore religion unqualified*

**or** if from a relative then less chance of rejection **or** if from self then no chance of rejection **or** skin cells more accessible

1

[10]

**M6.(a)** (use of) enzymes

1

- (b) asexual reproduction / no gametes / no fusion / only one parent

*ignore clones*

1

cells all contain same genetic information / same genes (as parent) / same DNA

1

- (c) can spray crop with herbicide – only weeds killed

*crop survives herbicide insufficient*

1

(d) any **one** from:

*allow 'think that GM food is bad for health'*

- fears / lack of knowledge about effects of GM food on health  
*ignore not natural or against religion*
- crop plants may pass on gene to wild plants
- encourages use of herbicides

1

[5]