

# GCSE

BIOLOGY

AQA - COMBINED SCIENCE

MARK SCHEME

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B6

INHERITANCE & VARIATION

TEST 2

## Mark schemes

1	(a)	a double helix	1
		a polymer	1
	(b)	gene	1
		genome	1
		<i>in this order only</i>	
	(c)	sperm <b>and</b> egg(s) / ova / ovum	1
		<i>in either order</i>	
	(d)	fertilisation	1
	(e)	the cell divides twice	1
		the new cells have half the number of chromosomes	1
		<b>[8]</b>	
2	(a)	DNA	1
		<i>allow deoxyribonucleic acid</i>	
		<i>allow lower case letters</i>	
	(b)	gametes	1
	(c)	meiosis	1
	(d)	20	1
	(e)	dominant	1
	(f)	Bb <b>or</b> bB	1
(g)	bb circled	1	
	<i>allow ecf from part (f)</i>		

(h) 1 in 4 / 25% / 1:3 / 0.25 /  $\frac{1}{4}$

*allow ecf from part (f)*

*do not accept 1:4*

1

[8]

3

(a)

	Genes	Environment	Both
Brown...	✓		
Light...			✓
Short...		✓	

1

1

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)
(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,  $\frac{1}{2}$

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

*ignore ratios*

1

(f) phenotype

1

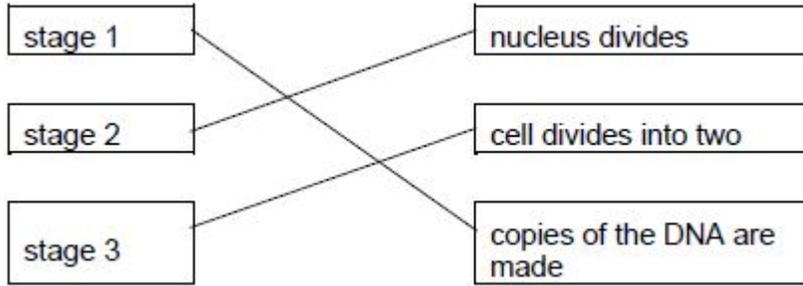
(g) almost certainly have no effect

1

[9]

4

(a)



*allow 1 mark for 1 or 2 correct*

*credit can be given where students have matched the boxes correctly, for example numbering the boxes*

2

(b) 6 picograms

1

(c) meristem cells in plants can differentiate throughout the life of the plant

1

(d) any **two** from:

- may cure / treat diseases  
**or**  
cure medical conditions  
**or**  
produce replacement cells / tissues / organs  
*allow example e.g. diabetes / paralysis*  
*allow cells can be stored for future use*  
*ignore used in medical treatments*  
*ignore patient makes / grows cells / tissues / organs*
- cells unlikely to be **rejected** by patient)  
*ignore same genetic information*
- cells / tissues of any type can be produced  
*ignore differentiated into most types of cells*
- many cells produced
- cells produced could be used for research
- would reduce waiting time for transplants

2

*ignore references to cost*

*ignore all reference to producing babies / IVF*

- (e) any **two** from:
- (potential) life is killed / destroyed  
*allow embryo is killed*  
*ignore embryo is destroyed*  
*ignore embryo is a life / becomes a baby*
  - shortage of donors / eggs
  - egg donation / collection has risks
  - do not yet know risks / side effects of the procedure on the patient  
*ignore long term effects are not well understood*  
*allow may cause tumours / cancer*
  - may transfer (viral) infection
  - poor success rate  
*allow in terms of viable egg / embryo / cell / tissue / organ production*

2

*ignore references to cost*  
*ignore unethical unqualified*  
*Ignore reference to religion / beliefs*

[8]

5

**Level 3:** Relevant points (advice / reasons) are identified, given in detail and logically linked to form a clear account.

5–6

**Level 2:** Relevant points (advice / reasons) 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**

**precautions with reasons**

- do not prescribe fluoroquinolone / antibiotics for mild infections
- because they will get better due to the body's normal immune system
  
- do not prescribe fluoroquinolone / antibiotics for viral infections / colds / flu
- because antibiotics do not kill viruses
  
- if you do prescribe fluoroquinolone / antibiotics make sure the patient finishes the course
- because any bacteria left may develop resistance, survive and reproduce rapidly (due to lack of competition)
  
- only prescribe fluoroquinolone if the patient has the new strain
- because routine use would lead to an increase in resistant bacteria

**other relevant content**

- doctors and nurses in the practice / hospital should be using antibacterial / alcohol hand wash between each patient **and / or** disinfectant to clean wards to kill (resistant) bacteria
  
- doctors should isolate patients with this strain of bacteria
- to prevent other patients getting the resistant infection

[6]

6

(a) any **one** from:

- meristem(s)
- **tip** of shoot  
*ignore stem and embryo*
- **tip** of root

1

(b) to produce large numbers of identical plants

1

(c)  $6 \times 10^{-12}$  (grams)

1

(d)  $\frac{28}{360} \times 15$

or

1.166666666(r)

allow  $\frac{7}{90} \times 15$

allow correct rounding

allow 1.16

1

1.17 (hours)

allow **1** mark for 1 hour 10 minutes **or** 1 and 1/6 hours  
**or** 70 minutes **only** if units given

1

an answer of 1.17 (hours) scores **2** marks

(e) **stage 1**

cell growth

or

increase in number of organelles

allow increase in named organelle e.g. ribosomes /  
mitochondria

1

DNA replicates\*

or

two copies of each chromosome form\*

\*allow DNA duplicates / doubles

\*ignore genetic information replicates

\*if this statement given as part of stage 2 allow **max 4**  
marks

1

**stage 2 / mitosis**

one set of chromosomes moves to each end of cell

allow chromosomes separate or are pulled apart

1

nucleus divides

allow nucleus splits into two

1

**stage 3**

cytoplasm / cell membrane divides to form two (genetically) identical cells

allow cytokinesis

1

**max 4** if correct sequence but no reference to stage  
numbers

**max 4** marks if no stage numbers given

ignore names of phases

marks can be awarded for labelled diagrams

(f) any **two** from:

**advantages:**

- may be used to cure / treat (current / future) diseases  
**or**  
cure medical conditions  
**or**  
produce replacement cells / tissues / organs  
*allow example e.g. diabetes / paralysis*  
*ignore used for medical treatments*
- cells / tissues of any type could be produced  
*allow cells differentiate into many types*
- cells / tissues of any type could be produced  
*ignore identical cells are produced unqualified*
- many cells produced
- cells produced could be used for research
- would reduce waiting time for organ transplants

2

any **two** from:

*ignore references to cost*  
*ignore unethical unqualified*  
*ignore references to religion / beliefs*

**disadvantages:**

- potential life is killed / destroyed  
*allow embryo is destroyed*  
*ignore cells destroyed or wasted*
- shortage of donors / eggs
- egg donation / collection has risks
- do not yet know risks /side effects of the procedure on the patient  
*allow may cause tumours / cancer*
- may transfer (viral) infection
- poor success rate to produce viable eggs / embryo

2

*ignore references to cost*

[14]

7

(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 1
- may be on diagram*
- (possible offspring genotypes shown) Rr Rr rr rr 1
- allow correct derivation of offspring genotypes from incorrect gametes*
- all offspring with Marfan syndrome phenotype circled / labelled 1
- probability 0.5 /  $\frac{1}{2}$  / 50% 1
- allow correct probability from incorrectly derived offspring*
- (f) gametes / sperm / eggs are produced by meiosis (cell division) 1
- when gametes fuse this mutation is in the fused / new cell 1
- allow at fertilisation for when gametes fuse*
- allow zygote for fused cell*
- (after fertilisation) mitosis produces every cell of embryo / offspring 1
- (which) will be genetically identical 1
- or**
- (mutated) DNA from gamete is in every cell of offspring 1

[12]

8

- (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 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

[15]

9

(a) (the scientists)

chose / used (traditional varieties of) rice plants with short stems and rice plants with large grains

**or**

chose rice plants with short stems and large grains.

1

(cross) bred the rice plants

*allow cross pollinated the rice plants*

1

(from the offspring) chose the plants with best / desired characteristics

**or**

chose plants with short(est) stems and big(gest) grains

1

bred repeatedly until all plants had desired characteristics

**or**

bred repeatedly until they bred true

**or**

bred repeatedly until they produced IR8

1

(b) agree (**max 3** marks)

- resistance to disease / pests / pathogens  
so higher yield
- resistant to herbicides  
so less competition for (sun)light / water / minerals / ions (from weeds)
- larger / more grains per plant or higher yield  
so more food for people or more income for farmers
- better nutritional content (vitamins / protein / low GI index)  
so will improve health  
*allow improved survival in harsh conditions so can be grown in wider area*

disagree (**max 3** marks)

- may affect wild plants (if genes transfer)  
so making them herbicide resistant
  - use of herbicides may reduce biodiversity  
because other plants are killed
  - traditional varieties no longer grown  
so reduction in biodiversity
  - may affect health of people who eat the rice  
because not enough research done yet
- allow (GM) seeds are expensive for farmers because they have to buy new seeds every year  
or because farmers have to buy specific herbicide  
if no explanations allow 1 mark for one agree reason  
and one disagree reason*

4

*each reason must be explained to gain credit*

[8]

10

- (a) they survive in high temperatures

1

they survive where it is acidic

1

- (b) C

1

- (c) because it has (high / optimum) activity at high temperature or 65 °C **and / or** low pH or pH 3 or high acidity

*allow it is the only enzyme that is active between 55 °C and 75 °C **and / or** below pH4*

1

*mark dependent on C correct for part (b)*

- (d) any **three** from:

- based on DNA / chemical evidence

(the three domains are)

- (Archaea) – primitive / simple bacteria
- Prokaryota / Bacteria – true / modern bacteria
- Eukaryota – includes (protists, fungi,) plants and animals

*allow Eukaryota – includes organisms with cells having a nucleus*

*if no other mark awarded allow for 1 mark mention of Archaea, Prokaryota / Bacteria and Eukaryota*

**or**

*three correct descriptions*

3

- (e) (these microorganisms) live in extreme conditions  
*allow (most Archaea) are extremophiles*

1

[8]