GCSE BIOLOGY AQA - COMBINED SCIENCE MARK SCHEME

B6 INHERITANCE & VARIATION TEST 2
Mark schemes

(a) a double helix
   a polymer

(b) gene
   genome
   *in this order only*

(c) sperm and egg(s) / ova / ovum
   *in either order*

(d) fertilisation

(e) the cell divides twice
   the new cells have half the number of chromosomes
   [8]

2

(a) DNA
   *allow deoxyribonucleic acid*
   *allow lower case letters*

(b) gametes

(c) meiosis

(d) 20

(e) dominant

(f) Bb
   or
   bB

(g) bb circled
   *allow ecf from part (f)*
(h) 1 in 4 / 25% / 1:3 / 0.25 / ¼
alow ecf from part (f)
do not accept 1:4

<table>
<thead>
<tr>
<th></th>
<th>Genes</th>
<th>Environment</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown...</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light...</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Short...</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

(b) bb

c (c) brown

allow light brown or dark brown

d (using bb for mother’s gametes)
correct combination in all four boxes, e.g.

<table>
<thead>
<tr>
<th></th>
<th>(b)</th>
<th>(b)</th>
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</thead>
<tbody>
<tr>
<td>(B)</td>
<td>Bb</td>
<td>Bb</td>
</tr>
<tr>
<td>(b)</td>
<td>bb</td>
<td>bb</td>
</tr>
</tbody>
</table>

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

(e) 50%, 0.5, ½

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

(f) phenotype

(g) almost certainly have no effect
(a)  

- stage 1: nucleus divides
- stage 2: cell divides into two
- stage 3: copies of the DNA are made

allow 1 mark for 1 or 2 correct  
credit can be given where students have matched the boxes correctly, for example numbering the boxes.

(b) 6 picograms

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

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

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

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6

(a) any **one** from:

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

(b) to produce large numbers of identical plants

(c) $6 \times 10^{-12}$ (grams)
(d) \[
\frac{28}{360} \times 15
\]

or

1.166666666(r)

allow \(\frac{7}{90} \times 15\)

allow correct rounding

allow 1.16

1.17 (hours)

allow 1 mark for 1 hour 10 minutes or 1 and 1/6 hours

or 70 minutes only if units given

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

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

stage 2 / mitosis

one set of chromosomes moves to each end of cell

allow chromosomes separate or are pulled apart

nucleus divides

allow nucleus splits into two

stage 3

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

allow cytokinesis

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
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

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

ignore references to cost

(a) a short section of DNA
(b) a sequence of amino acids
(c) genome
(d) phenotype

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

\[ \text{may be on diagram} \]

(possible offspring genotypes shown) Rr Rr rr rr

\[ \text{allow correct derivation of offspring genotypes from incorrect gametes} \]

all offspring with Marfan syndrome phenotype circled / labelled

probability 0.5 / ½ / 50%

\[ \text{allow correct probability from incorrectly derived offspring} \]

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

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

\[ \text{allow at fertilisation for when gametes fuse} \]
\[ \text{allow zygote for fused cell} \]

(after fertilisation) \text{mitosis} produces every cell of embryo / offspring

(whic\(h\)) will be genetically identical

or

(mutated) DNA from gamete is in every cell of offspring

\[12\]

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

(c) (meiosis will not work because) number of chromosomes cannot halve
  allow chromosomes cannot form pairs
  allow chromosomes cannot split up evenly

(d) do not use energy in reproduction
  so more (energy) available to synthesise proteins
  allow other correct molecules or cell components
  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
Level 3: A judgement strongly linked and logically supported by a sufficient range of correct reasons is given.

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

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

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]
(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.

(cross) bred the rice plants

allow cross pollinated the rice plants

(from the offspring) chose the plants with best / desired characteristics
or
chose plants with short(est) stems and big(gest) grains

bred repeatedly until all plants had desired characteristics
or
bred repeatedly until they bred true
or
bred repeatedly until they produced IR8

(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

each reason must be explained to gain credit

(a) they survive in high temperatures

they survive where it is acidic

(b) C

(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

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
(e) These microorganisms live in extreme conditions
  
  allow (most Archaea) are extremophiles