Answers to Further Questions
in GCSE Biology for You (5th Edition)

On the following pages we show the detailed Answers and Mark Schemes for the Further Questions on Inheritance, evolution and variation.

The answers have been prepared by an Examiner using the mark schemes published by each Examination Board. They are laid out in the same way as the pages of Further Questions in the Students’ Book.

For the Student:

⦁ It is very important that you are able to answer the questions on your own, using your own knowledge of Biology.
   So it is important that you have a go at the questions first, and then afterwards you can check your answers using these pages.
   If you get a question wrong, try to work out where you have made an error. Discuss it with your teacher if you are not sure.

⦁ Be aware that in some answers the mark is for the idea in your own words (not necessarily the exact words shown), whereas in other answers the number and unit must be exactly correct.

For the Teacher:

⦁ You will find these sheets useful when marking the students’ homework, or when going over the Further Questions in class.
   The Answer Sheet will also enable you to assess how much work is involved in answering the questions when planning how much homework to set.

⦁ The PDFs are available for you to hand out to the students if you wish (perhaps as part of a Revision Programme).
   As with all mark schemes there may be alternative credit-worthy statements for qualitative answers (for the idea) and this may need to be explained to your students. Quantitative answers, however, are generally more prescriptive and your students may need to be encouraged to show the exact numerical value and the appropriate unit.

Gareth Williams
For answers marked by levels of response:
Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content indicates the expected parameters for candidates’ answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a ‘best-fit’ approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer. Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:
The skills and science content determines the level.
The communication statement determines the mark within a level.

Inheritance

1 (a) Two marks for a fully correct answer, one mark deducted for each mistake:
   C – G;
   A – T;
   C – G;
   G – C;
   T – A;
   T – A.

   (b) (i) 1 mark for each of two of the following ideas:
   X rays;
   nuclear radiation;
   ultra-violet light;
   some chemicals eg. mustard gas;

   (ii) 1 mark for each of the following ideas:
   DNA carries a particular sequence of nucleotide bases;
   three bases code for one amino acid;
   if the sequence of bases is changed the wrong amino acid is assembled into the protein chain.

   Total 7 marks

2 (a) (i) 1 mark for each of the following ideas:
   chromosomes lie on equator of spindle;
   chromatids pulled to opposite poles of spindle;
   each set of chromatids surrounded by new nuclear membrane;
   (ii) 1 mark for each of the following ideas:
   the number of chromosomes is halved during meiosis;
   in mitosis it is the same;
   the cells produced by meiosis do not contain identical genetic information;
   cells produced by mitosis are genetically identical;

   (iii) 1 mark each for:
   testes;
   ovaries.

   (b) (i) 1 mark for each of the following ideas:
   a change;
   in genetic information;

   (ii) 1 mark for each of the following ideas:
   the condition is Down’s syndrome;
   the child has an extra chromosome;
   in the first division of meiosis;
   24 chromosomes went to one pole rather than 23;
   resulting in an egg with 24 chromosomes rather than 23;
   egg was fertilised by a sperm with 23 chromosomes resulting in a zygote with 47 chromosomes.

   Total 20 marks

3 (a) 1 mark for each correct row:
   Hh;
   H h H h;
   HH hh Hh;
   normal, sickle, normal and sickle.

   (b) 1 mark for each of the following ideas:
   no possibility of them having children that have the sickle condition;
   since neither Joan nor Eric has the sickle allele.

   Total 6 marks

4 (a) 3 marks for each of the following points made in a description:
   filter the mixture to remove the insoluble kiwi material;
   add ice cold ethanol to the filtrate;
   remove the precipitated DNA with a glass rod.
   (Accept other suitable equipment)

   (b) 1 mark for B.

   (c) (i) 1 mark for heterozygous.
   (Accept alleles showing heterozygous genotype)

   (ii) 1 mark for correct Punnett square;
   1 mark for 75% normal fur pigmentation.
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(d) 1 mark each for:
- sexual reproduction produces variation in the offspring;
- influence of environmental factors on the phenotype;
- interaction of several genes to determine phenotype.

(Accept named environmental factors, e.g. food supply)

Total 10 marks

5  (a) 1 mark each for:
- DNA is made from four different nucleotides;
- DNA is a polymer.  

(If more than two statements are given, do not award the mark even if they include the correct statements)

(b) 1 mark for correct sequence of amino acids – glu, tyr, leu, tyr, thr. 

(allow glutamine, tyrosine, leucine, tyrosine, threonine)

(c) 1 mark each for any four from:
- Mutation is a substitution;
- Result could be no change / new triplet might still code for same amino acid;
- Result might be that the new triplet code for a different amino acid;
- This might cause the protein not to function correctly / not to form;
- Might affect a characteristic / the phenotype.

Total 7 marks

6  (a) 1 mark for each of:
- cross / breed / mate different breeds;
- only if offspring are fertile are they the same species.

(b) 1 mark for each of:
- select strongest / most intelligent / obedient male and female dogs to cross / mate;
- select strongest / most intelligent / obedient offspring to breed from;
- repeat over several generations to produce most suitable dog.

(c) 1 mark for any one from:
- may produce animals that are prone to disease;
- increase incidence of inherited disorders.

Total 6 marks

7  (a) 1 mark for having extra fingers or toes.

(b) 1 mark for man’s genotype: $Tt$ and woman’s genotype: $tt$.

(both genotypes needed for the mark)

(c) 1 mark each for:
- offspring genotypes correctly derived from gametes;
- all $Tt$ circled.

(Probability) 1 mark for any one from: 50%; $\frac{1}{2}$; $\frac{2}{4}$; 0.5; 1 in 2; 2 in 4; 1:1; 2:2.

(d) Please refer to the marking instructions at the beginning of this mark scheme for guidance on how to mark this question.

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 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 for 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.

Total 12 marks

8
(a) 1 mark for each of the following:
A = Dd;  B = dd;
If A were DD then there would be no non-affected offspring, so A must be Dd.
(b) 1 mark for each of the following ideas:
If the disease was caused by a recessive allele then:
A could have two recessive alleles (dd);
B could be a carrier (Dd).
Total 5 marks

9
(a) (i) 1 mark for from the udder;
(ii) 1 mark each for the idea to make sure that the new cell contained only new DNA (ie. not from the original cell)/ zygote must be diploid to develop (so cannot have three sets of chromosomes);
(iii) 1 mark for sheep A.
(b) 1 mark for the idea that the egg is normally fertilised by a sperm from the male sheep / ram.
(c) 1 mark each for the following ideas:
that people understand the work of scientists;
people can then see if the advances in science are important in their own work / occupation.
(d) 1 mark for the idea that people can get animals with desirable characteristcs (more quickly than with conventional breeding).
Total 8 marks

10 (a) 1 mark for idea that it is one that can be inherited / passed on through the genes / is due to a gene mutation.
(b) 1 mark for idea that passage for air to (and from) the lungs / bronchioles is blocked or restricted / air cannot reach air sacs / prevents gas exchange / prevents removal of carbon dioxide.
(c) 1 mark for the idea that bacteria are killed / destroyed / growth (of bacteria) is inhibited.
(d) 1 mark for each of the following:
(i) Nn;
(ii) Nn;
(iii) nn;
(iv) NN or Nn. (2 marks)
(e) 1 mark for one correct answer. (Note: There are many possible answers and these cannot all be listed here.) The likely answers depend on what is given in the syllabus / specification, eg. Huntington’s chorea / disease; haemophilia; sickle cell disease; muscular dystrophy, etc.
Total 9 marks

11 (a) 1 mark for a suggestion related to food shortages or fear of prison eg. there were food shortages so they wanted to believe him.
(b) 1 mark for DNA / genes are not changed;
1 mark for environmental changes are not inherited.
(c) 1 mark for choose plants with the largest fruit;
1 mark for breed;
1 mark for select largest offspring;
1 mark for repeat over several generations. (maximum of 3 marks if ideas are not well expressed)
Total 7 marks

12 (a) 4 marks for correct stage order: 4, 3, 2, 5, 1.
(b) 1 mark for virus / plasmid / gene gun.
(c) 1 mark for each of:
restriction enzyme: to cut DNA / chop DNA;
ligase enzymes: to join / stick DNA.
(d) (i) 1 mark for (substance that) kills plants.
(ii) 1 mark for to spray / kill weeds without killing crop.
(e) 1 mark each for any two from:
crops could alter food chains / webs;
lack of control on gene transfer;
GM crops could take over ecosystems;
might be effects on health. (accept gene gets into wild plants/weeds (so) weeds now resistant to herbicide / herbicide now non-functional)
Total 11 marks

13 (a) 1 mark for each of the following ideas:
quicker;
cheaper;
no allergic reaction
(b) (i) 1 mark for EDBAC;
(ii) 1 mark for each of the following ideas:
- bacteria multiply;
- gene is copied into each bacteria;
- lots of insulin produced.

(c) 1 mark for each of the following ideas:
- not natural;
- unknown consequences.

Total 9 marks

14 (a) (i) 1 mark for each of:
- Cornea – responsible for bending the light;
- Light rays will no longer meet on the retina so sight will be poor.
  (allow reference to blindness)
(ii) 1 mark for an unspecialised cell which can become any cell type.
(iii) 1 mark for any one from:
- Embryos killed in the process;
- Embryos could be a life.
(b) 2 marks for 27.42.
  (allow 1 mark for \((141 \div 360) \times 70\))

Total 6 marks

Evolution

15 (a) 1 mark for (Jean Baptiste) Lamarck.
  (allow phonetic spelling)
(b) 1 mark for each of:
- (snake is) covered in sediment / mud or sinks into the mud;
- then the soft parts decay / are eaten or bones / hard parts do not decay;
- (so) minerals enter bones or bones are replaced by minerals.
(c) Please refer to the marking instructions at the beginning of this mark scheme for guidance on how to mark this question.

Level 2 (3–4 marks)
Clear statements made about the Japanese rat snake, linked to relevant explanations of the process of natural selection.

Level 1 (1–2 marks)
Simple statements made, but no attempt to link to explanations.

0 marks for no relevant content.

Additional examiner guidance:
Allow converse points relating to the Texas rat snake if they clearly identify the reasons why this snake was at an evolutionary disadvantage, i.e. more likely to be caught and eaten by a predator.
A good level 2 answer will clearly link survival and breeding to the passing on of the advantageous genes / alleles / mutations and link the idea of colour (AO2) to a correct explanation of its significance for survival.

Examples of statements:
- there are lots of different colours of snakes;
- some shades of green are closer to the colour of the environment (in Japan) than others;
- survivors (in each generation) will breed and produce offspring.

Examples of explanations:
- different colours are controlled by different genes / alleles / are caused by mutations;
- being green means they are best suited to grassy / green environments;
- being green means they are camouflaged;
- those that are camouflaged best will be able to catch more food;
- those that are camouflaged best will be able to avoid being eaten;
- survivors’ offspring will inherit the genes / alleles / mutation for the shade of green colouration.

(d) 1 mark for any one from:
- changes to the environment;
- new predators;
- new diseases;
- new (more successful) competitors;
- catastrophic event / described event.

Total 9 marks

16 (a) (i) 1 mark for countryside;
(ii) 1 mark for each of the following ideas:
- light coloured moth increased in numbers because less soot was deposited on trees;
  therefore the moths were less conspicuous to birds;
- dark coloured moths decreased in numbers because they became more conspicuous to birds;
- survivors’ offspring will inherit the genes / alleles / mutation for the shade of green colouration.
(iii) 1 mark for natural selection.
(b) 1 mark for each correct total and mean
- 41 and 8.2;
- 13 and 2.6;
- 16 and 3.2;
- 36 and 7.2.
(c) 1 mark for city trees.

Total 11 marks

17 (a) 1 mark for (i) – B and (ii) – A and (iii) – C.
(b) (i) 1 mark for natural selection;
(ii) 1 mark for each of the following ideas:
- mutation produced some birds with thinner beaks;
- competition for small insects as food;
- birds with thinner beaks could eat smaller insects therefore survive to breed.

Total 5 marks

18 1 mark each for A – 3; B – 1; C – 4; D – 2.

Total 4 marks