

UNIT 4 BIOLOGY

Revision Booklet 11 - SOLUTIONS

2012 – Question 2

Question 2

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 36 | 18 | 46 | 1.1 |

| Point of comparison | Discontinuous variation | Continuous variation |
|---|-------------------------|----------------------|
| number of genes and/or alleles involved | small number | many |
| impact on phenotypes | few/discrete | many |

Many students didn't appear to understand the different types of variation, often mixing them up. There were a variety of ways of expressing the correct answer.

2012 – Question 3

Question 3a.

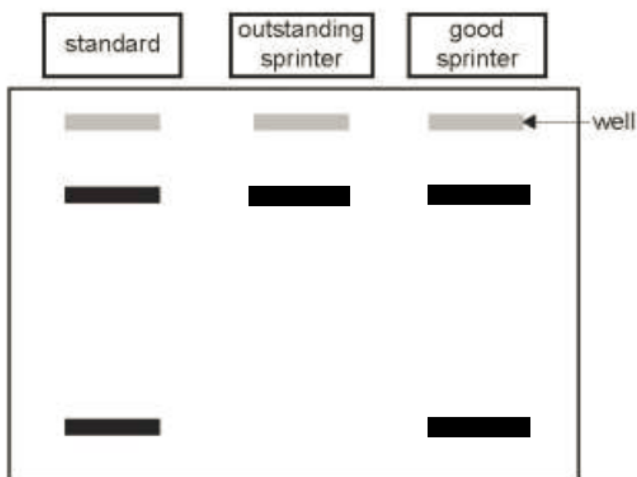
| Marks | 0 | 1 | 2 | 3 | 4 | Average |
|-------|----|----|----|----|----|---------|
| % | 30 | 11 | 14 | 23 | 23 | 2 |

- heat DNA to approximately 90 °C or to separate strands
- cool to approximately 50 °C or to anneal/attach primers
- heat to approx 72 °C or Taq/DNA polymerase copies strands
- repeat cycle.

Many students set out clear answers that demonstrated a sound understanding of the process. Many other students missed out on full marks by not stating that the process needed to be repeated.

Question 3b.

| Marks | 0 | 1 | 2 | 3 | Average |
|-------|----|----|----|----|---------|
| % | 34 | 13 | 11 | 42 | 1.6 |



An outstanding sprinter would have only one band as only one allele is present/homozygous. A good sprinter has two different alleles/heterozygous.

Students who could not correctly place bands on the gel were still able to receive two marks for a suitable explanation.

2010 – Question 6

Question 6a.

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 41 | 16 | 43 | 1 |

Either of:

- DNA hybridisation: DNA from two different sources is made single-stranded and mixed together, and the degree of bonding is determined by the melting temperature
- mitochondrial DNA sequencing: the DNA from different species is extracted, sequenced and compared.

To gain full marks it was important that the DNA method and its description were relevant to determining species relatedness.

Question 6b.

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 42 | 38 | 20 | 0.8 |

A sample is compared to the database and used to:

- identify endangered species
- identify people selling incorrectly labelled fish
- monitor fish numbers.

Some students gave identifying illegal fishing as the reason; however, the question specifically asked for a reason other than illegal fishing.

Question 6c.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 80 | 20 | 0.2 |

One amino acid is coded for by more than one triplet/codon.

It was evident that many students did not understand the term 'redundancy'. Other students gave incorrect answers such as 'many codons code for amino acids'.

Question 6d.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 46 | 54 | 0.6 |

Either of:

- to ensure the accuracy of results
- to identify variations that exist in a species.

2010 – Question 8

Question 8a.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 70 | 30 | 0.3 |

The repeats occur in non-coding regions of DNA or mutations occur in introns.

A common incorrect answer was 'the mutation is silent.'

Question 8b.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 31 | 69 | 0.7 |

PCR or Polymerase Chain Reaction

Question 8c.

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 10 | 14 | 77 | 1.7 |

Family Y and one of:

- there is only one difference/mutation between Y and Ben
- Y has more or four out of five STR markers, the same as Ben
- X and Z have a greater number of differences than Y does to Ben.

2009 – Question 5

Question 5a.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 58 | 42 | 0.4 |

The characteristic is controlled by many genes or is an example of polygenic inheritance.

This was not an example of multiple alleles.

Question 5b.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 57 | 43 | 0.5 |

The chemical code is identical/very similar.

Some students stated that the code was 'similar', which was not precise enough. Answers which made inferences on evolutionary relationships were not awarded any marks as they were not addressing the question. Some students added 'due to the universal nature of DNA'; however, this was incorrect.

Question 5ci-iii.

| Marks | 0 | 1 | 2 | 3 | Average |
|-------|----|----|----|---|---------|
| % | 18 | 43 | 30 | 9 | 1.3 |

5ci.

A circle was to be drawn

5cii.

Either of:

- the centromere was required for spindles to attach
- to allow mitosis to occur.

5ciii.

Gene cloning

Gene replication and DNA replication were also accepted. PCR and transcription were incorrect answers and replication was deemed too vague.

Question 5di-ii.

| Marks | 0 | 1 | 2 | 3 | Average |
|-------|----|----|----|----|---------|
| % | 39 | 25 | 16 | 20 | 1.2 |

5di.

Both of:

- heterozygous
- it has different alleles (sequences).

To gain the mark students had to state 'heterozygous' and identify the reason for their choice.

5dii.

Two bands needed to be illustrated:

- near but slightly above 100
- near but slightly above 50.

Some students included extra bands or only one band, indicating that the DNA had not been cut.

Question 5e.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 52 | 48 | 0.5 |

The electrode had been connected the wrong way.

2009 – Question 7

Question 7a.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 79 | 21 | 0.2 |

A single-stranded segment of DNA which is (radioactively) labelled

It was important that students' answers distinguished a probe from a primer. It was clear that the concept of a probe was not well understood.

Question 7b.

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 31 | 43 | 27 | 1 |

Both of:

- green – indicates hybridisation with a normal allele
- red – indicates a specific mutation and hybridisation with that allele have occurred.

This was essentially a comprehension question.

Questions 7c.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 87 | 13 | 0.2 |

The joining of complementary DNA from different sources

Question 7d.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 75 | 25 | 0.3 |

G was replaced by A

A point mutation occurred. The specific type of mutation was a base substitution; however, in light of the data, the best answer was: G was replaced by A.

Question 7e.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 80 | 20 | 0.2 |

Either of:

- green if she inherited a normal allele from her mother
- red if she inherited the defective allele from her mother.

Students struggled to read and interpret this question.

2008 – Question 2

Question 2

Question 2a.

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|---|---------|
| % | 60 | 31 | 9 | 0.5 |

The newborn baby is DS 11, 15.

- either allele could have come from the mother
- neither allele could have come from the father

It was of great concern that many students could not recognise the symbols of circle for female and square for male. As the stem indicated that the baby was a boy, students should have been able to identify the correct symbol.

Other students incorrectly stated that it had to be the mother's child as the baby had identical alleles as the mother, indicating that he was a clone, or that no alleles came from the father.

Question 2b.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 66 | 34 | 0.4 |

Gene therapy aims to insert a normal/functioning allele into a cell.

An example of incorrect information provided by students was 'the removal of an allele or the insertion of an allele into the body'.

Question 2c.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 70 | 30 | 0.3 |

Virus or liposome

A common incorrect answer was 'plasmid'. This is not a vector used for humans. Gene delivery systems such as gene guns are not vectors. Mosquitoes, which are vectors of parasites, are not involved in gene therapy.

Question 2d.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 71 | 29 | 0.3 |

Either of:

- the virus may have reverted to active state
- insertion disrupted an essential gene.

As the patient died in four days and the question stated that he was healthy, cancer was not a suitable answer. However, a suitably explained immune response, such as infection contracted during the procedure, was acceptable.

2008 – Question 6

Question 6

Question 6a.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 60 | 40 | 0.4 |

Restriction enzymes cut at a **particular base sequence/recognition site**.

Answers that referred to cutting at 'a place or gene locus' were not awarded a mark.

Many students incorrectly thought that specific restriction enzymes cut DNA into specific lengths.

Question 6b.

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 29 | 42 | 30 | 1.1 |

6bi.

Either of:

- DNA is negatively charged and moves towards the positive electrode
- shorter DNA fragments travel further/more quickly through a gel.

6bii.

DNA of individuals is different, therefore will be cut at different places and produce fragments of different length.

Question 6c.

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 61 | 27 | 12 | 0.5 |

Both of:

- the RNA probe is complementary to the single stranded DNA sample and these join together/hybridise
- this enables the DNA to be seen/identified.

Many students treated this question as 'describe DNA hybridisation' and in doing so, they ignored the instruction to 'examine stages Y and Z'.

2007 – Question 2

Question 2a.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 29 | 71 | 0.7 |

PCR (or Polymerase Chain Reaction)

Question 2b.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 48 | 52 | 0.5 |

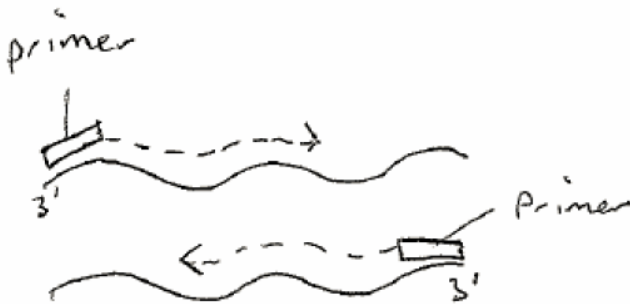
Heating:

- to 90°C or greater
- to dissociate the strands
- to break the hydrogen bonds.

Heating had to be mentioned, and the effect it had on the process.

Question 2c.

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 62 | 22 | 16 | 0.6 |



On the diagram or in the space below the question, students needed to show primers anneal, one per strand, at opposite ends (for the first mark), and show one of:

- primers attach at 3' end
- temperature reduced to approximately 50°C
- DNA/Taq polymerase is added
- propagation occurs away from the primer.

Question 2d.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 30 | 70 | 0.7 |

The arrow needed to point towards the top of the page.

Students were required to know that DNA has a negative charge and hence would move towards the positive electrode.

Question 2e.

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 46 | 23 | 31 | 0.9 |

Both of:

- the standard consists of fragments of known length
- they are used to estimate the size of the samples.

To gain the two marks, a link had to be established between the comparison of known to unknown. Too often students made vague statements such as 'The standard is used to compare to the sample'.

Question 2f.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 61 | 39 | 0.4 |

A suitable conclusion could be:

- the sample is not from the victim
- the sample could be from either suspect.

To gain the mark here students had to make a valid conclusion rather than a simple observation such as 'The sample matched the suspects'. Some incorrect conclusions included 'both suspects must be guilty', 'both suspects are identical twins' or even 'the victim wasn't at the crime scene'.

Question 2g.

| Marks | 0 | 1 | Average |
|-------|----|----|---------|
| % | 63 | 37 | 0.4 |

Any one of:

- apply the same process to a different gene locus
- use another suitable DNA technique, such as DNA sequencing
- use another forensic method, such as blood analysis or fingerprinting.

To gain the mark, a forensic, logical and feasible action had to be recommended. Incorrect suggestions included 'check alibis' and 'interview the victim'.

2006 – Question 4**Questions 4a–b.**

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 36 | 54 | 10 | 0.8 |

Question 4a.

Circular

Question 4b.

Transformation

'Heat shock' was not an acceptable answer as this is a process of taking up the plasmid. Neither was 'transfection' as this applies to viral vectors.

Many students were aware that the required answer began with 'trans'. Examples of common incorrect answers included transduction, translocation and transgenic. Recombination was also a common incorrect answer.

Question 4c.

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 34 | 12 | 54 | 1.2 |

4ci.

No growth of bacteria.

4cii.

The bacteria are sensitive to the antibiotic tetracycline and therefore do not grow.

Question 4d.

| Marks | 0 | 1 | 2 | Average |
|-------|----|----|----|---------|
| % | 51 | 27 | 22 | 0.7 |

- Plate A: The bacteria are able to grow as there is no tetracycline present.
- Plate C: Only those bacteria which take up the plasmid can grow in the presence of tetracycline.

It was important that students distinguished between Plates A and C, recognised the significance of the presence/absence of the antibiotic and realised that only **some** of the bacteria were transformed. One mark was awarded for each of the points above. Some students gave a specific percentage transformation which could not be deduced from the information. Students need to be aware that if their answers include incorrect information they may not receive full marks.