Biology CAT 3: Written examination

SPECIFIC INFORMATION

For each question, an outline answer (or answers) is provided. Each answer is broken into parts, to give an indication of the allocation of marks shown on the paper. The answer provided is not always the only answer that could have been awarded marks. Comments on student performance on the question follow the answer. The mean marks quoted are the mean marks awarded for answers over all markings.

Question 1

1a. (mean mark 1.21; possible mark 3)

a. Mode of inheritance – Autosomal dominant
Explanation – Gene locus found on an autosome **or** chromosome 6 **or** not a sex chromosome.
AND
Only one copy of an allele required for phenotypic expression, therefore the heterozygote has the SCA phenotype.

Most students could correctly identify the mode of inheritance. Some only gave half of the answer; for example, Dominant, and could not be awarded the mark.
Common incorrect explanations included:

- 'both males and females can inherit the trait, therefore autosomal'
- 'only requires one copy of the gene to result in spinocerebellar ataxia'.

A correct statement would have been 'only requires one copy of the allele to result in spinocerebellar ataxia'.

1b. (2.66; 5)

i. I–1, II–2 or III–2

ii. Zero **or** no chance.

iii. **SBsb** (spinocerebellar ataxia or loss of muscle coordination) and **sbsb** (normal coordination).

Most students correctly answered parts i. and ii. In part iii. some students gave incorrect genotypes such as SsBb and ssbb.

1c–e. (2.03; 4)

c. Amino acids

di. CAG

dii. GUC

e. Introns

Many students did not correctly identify the subunits of protein. Parts d. and e. were well done.

1f. (2.2; 3)

f. Transcription – nucleus
Translation – ribosome
DNA replication – nucleus

Well done by most students.

1g. (0.74; 2)

g. Correct unwinding and demonstrating an understanding that **each** strand acts as a template for a new strand.
AND
Complementary base pairing for all **or** part of one **or** both strands for the sequence shown.

Common errors included:

- Incorrect unravelling of the DNA molecule.
- Only using one side of the molecule as a template.
- Incorrect enzymes named in the process.
- Transcription, rather than DNA replication, being described.
- Not using the piece of DNA given as a starting point.

Question 2

2a–d. (2.37; 6)

a. A pair of chromosomes that carry the same genes.
AND
A pair in which one chromosome is from the maternal parent and one chromosome is from the paternal parent, **or** chromosomes have the same length, **or** chromosomes have the same centromere position.

b. 16

c. Some (half) 8 AND some (half) 7.

d. Heterozygous

Relatively few students were awarded full marks in part a. Incorrect responses included:

- A discussion of the difference between the terms homozygous and heterozygous.

- Stating that the chromosomes where identical.

Parts b. and d. were generally well answered. In part c. some students only gave one of the answers and were consequently awarded one mark only.

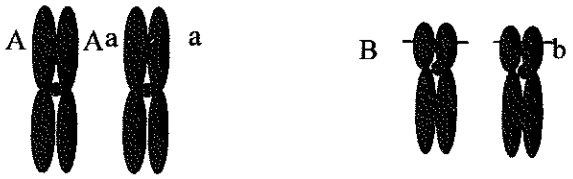
2e–f. (1.84; 5)

ei. Chromatid

eii. One

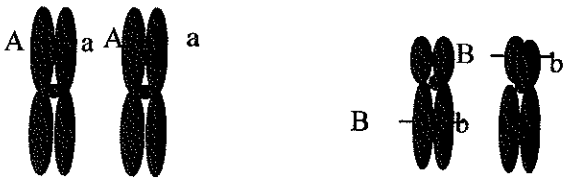
eiii. Two

f.



Part e. was well done by most students. One common incorrect answer to the number of DNA molecules in a chromatid was 'thousands'.

In part f. many students did not correctly label the position of the alleles on the chromosomes. The following illustrates the most common incorrect responses:



Question 3

3a. (0.25; 1)

a. Plant could be homozygous dominant or homozygous recessive and still get the same result, **or** the phenotype of the offspring is the same as the phenotype of the parent so cannot tell.

The question asked students to explain whether there was sufficient evidence to decide that single-flower phenotype was recessive. Many argued in terms of the parents being homozygous without any reference to whether it was the dominant or recessive phenotype.

3b. (0.99; 2)

bi. Cross 3

bii. The appearance of single flowers in cross bii from parents who were double flower indicates that double flower is dominant, **or** offspring exhibiting trait not seen in the parents.

The majority of students correctly suggested Cross 3; however, most explained the reason for dominance in terms of the greater number of double flower plants. This response was not awarded a mark.

3c–d. (2.17; 4)

c. An alternative form of a gene, **or** the result of a mutation of an original gene to another form of the gene, **or** a form of a gene, **or** a new variant at a gene locus arising from mutation.

di. $F^S F^S$

dii. $F^S F^d$ and $F^S f$

Generally well done. Most students correctly used the alleles given. Some made the mistake of using F^D instead of F^d.

3e. (0.82; 2)

e. Genotype $F^d f$
Phenotype double flower

The most common mistake made by students was to assign the incorrect genotype to the double flowered parent.

Question 4

4a–c. (1.92; 4)

a. tt dd

b. Linked genes

ci. Extra toes

cii. Students could argue in one of two ways:

Eliminate deafness:

Offspring in equal frequencies in cross 2 indicates independent assortment of **t** and **d**.

AND

Therefore these 2 mutations are likely to be located on different chromosomes (or are more than 50 map units apart on the same chromosome).

OR

Support extra toes:

Offspring in unequal frequencies in cross 1 indicates non independent assortment of **t** and **p**.

AND

Therefore these 2 mutations are linked or likely to be located on the same chromosomes.

Parts a. and b. were well done. Many students who correctly identified the gene locus in part c. had difficulty explaining their choice. Some made vague reference to the numbers in the data without a clear explanation of what these numbers indicated.

4d. (1.04; 3)

di. 9 normal coat, head straight: 3 normal coat, head tilted: 3 rough coat, head straight; 1 rough coat, head tilted

dii. 1/16 or 1:15

Some students made up their own phenotypes for the mice. For example, smooth fur rather than normal fur, or normal heads instead of straight heads. Students need to be reminded to use the information given in the question.

Question 5

5a–b. (2.25; 5)

a. Increase in the Bt-resistant allele

b. Answers to include all of the following 4 points:

- Selective agent is the insecticide, **or** insecticide kills sensitive moths when sprayed.
- Variation between moths with respect to resistance to insecticide, **or** Bt-sensitive and Bt-resistant moths are present in the population.
- Insecticide kills susceptible Diamond Black Moth; the resistance allele is passed on to next generation by the survivors.
- Therefore there is a higher frequency of the resistance allele in the next generation and this continues in subsequent generations.

In part a. some students discussed the change in the number of Bt-resistant moths, rather than the change to the Bt-resistant allele. Students were not awarded a mark if this was the case.

In part b, most students referred to the diamondback moth population and factors affecting their survival. The question asked students to discuss the steps to bring about a change in the

frequency of the Bt-resistant allele and therefore some reference to the allele frequency was required.

5c. (0.63; 2)

c. There will be gene flow (or interbreeding or mating) between Bt-sensitive and Bt-resistant moths.
AND
The Bt-sensitive allele/phenotype will be maintained in the population since the phenotype is dominant.

Most students correctly identified that gene flow would occur, but failed to make the point of maintaining the Bt-sensitive phenotype.

Question 6

6a–b. (0.75; 3)

a. Factor – climate change, disease, competition with flowering plants.
Explanation – The explanation given by the student had to refer to the factor that they had given. For example, some phenotypes present within the species could not survive a decrease in temperature and died out, reducing the range and diversity of phenotypes in the pines.

b. Hard/protective outer coating or structures present to assist dispersal to suitable areas for fossilisation.

Many students correctly identified a factor that could cause a decline in range and diversity. Fewer could go on and give an adequate explanation. Answers given were often vague or superficial.

6c. (0.63; 2)

ci. Look at nuclear DNA sequences, mitochondrial DNA or protein variants (e.g. allozymes).

cii. The closer the similarities in DNA sequences, the closer the evolutionary relationship.

Most students could indicate a source of additional evidence.

6d–e. (0.88; 3)

d. A clone is a population of cells derived from a single parent cell by mitosis, **or** asexual reproduction.
AND
There is no variation resulting from meiosis, **or** random fertilisation of gametes, **or** recombination, **or** independent assortment.

e. All phenotypically and genotypically identical, so any environmental change causing harm to one will affect all in the same way.

Most students in part d. restated the question without offering any further explanation.

Question 7

7a. (1.35; 2)

a.

	Traditional view Figure 3	Revised view Figure 4
Which animal/s share most features in common with the pig?	hippopotamus	camel
Which animal/s share most features in common with the pig?	dolphin	dolphin, cow and hippopotamus

Forty-five per cent of all responses were correct. Many students correctly filled in only 2 of the boxes.

7b. (0.27; 2)

b. An ancestor common to dolphins and all other artiodactyls would have possessed a three-lobed tooth.
AND
A different tooth shape in dolphins has evolved as an adaptation to suit a different diet.

Students did not appear to use Figure 8 to help formulate an answer to this question. The evidence of the common ancestor was most often missed. Overall, a poor performance by most students on this question.

7c. (0.70; 2)

ci. Convergent evolution, **or** analogous.

cii. Agree: in convergent evolution organisms look alike because of similar selection pressures not because of sharing a common ancestor.

Many students could name the term but could not give an adequate explanation of why they agreed with the student.

Question 8

8a–b. (0.79; 2)

a. Existed at the same time.

b. Very little or no sedimentation and, therefore, fossilisation did not occur, **or** conditions very dry and organisms not covered by sediments and therefore fossilisation did not occur.

Part a. was well done. In part b. students were asked to use the information given and therefore responses must have been related to what was evident in layer III.
Incorrect responses included:

- Volcano existed that killed all the fossils.
- Environment change causing the extinction of the species.
- No organisms living at this time.

8c. (2.49; 4)

ci. Any two of the following:
Use of tools to prepare food
- Gatherers
- Hunters
- Used fire.

cii. Any two of the following. Note that the explanation must be consistent with the feature listed in the first part of the question:
- Presence of seed grinding stones indicates that tools were used to prepare food.
- Weapons found near bones indicates that they were hunters.
- Charcoal remains indicate the use of fire.

Generally well done. Some student responses showed confusion between what was a feature and what was the evidence.

8d. (1.56; 3)

di. Sample II

dii. Explanation:
- Matched in region A, so an animal (not fern-like plant).
- Did not match in region B, so not a mammal like the wombat.

Part i. was well done. Some students were not awarded full marks in part ii. because they did not relate their choice to the information in the table.