VCE BIOLOGY 2015

YEAR 12 UNIT 4

Topic Test 1 – Heredity

Time allowed: 50 minutes
Total marks: 41

14 Multiple Choice Questions
4 Short Answer Questions

An Answer Sheet is provided for Section A.
Answer all questions in Section B in the space provided.

Learning Materials *by Lisachem*
PO Box 2018, Hampton East, Victoria, 3188
Ph: (03) 9598 4564 Fax: (03) 8677 1725
Email: orders@learningmaterials.com.au or orders@lisachem.com.au
Website: www.learningmaterials.com.au

STUDENT NUMBER									Letter
Figures									
Words									

Student Name.....…….....

VCE Biology 2015 Year 12 Topic Test 1 Unit 4

Heredity

Student Answer Sheet
There are **14 Multiple Choice** questions to be answered by circling the correct letter in the table below. Use only a 2B pencil. If you make a mistake, erase and enter the correct answer. Marks will not be deducted for incorrect answers.

Question 1	A	B	C	D	*Question 2*	A	B	C	D
Question 3	A	B	C	D	*Question 4*	A	B	C	D
Question 5	A	B	C	D	*Question 6*	A	B	C	D
Question 7	A	B	C	D	*Question 8*	A	B	C	D
Question 9	A	B	C	D	*Question 10*	A	B	C	D
Question 11	A	B	C	D	*Question 12*	A	B	C	D
Question 13	A	B	C	D	*Question 14*	A	B	C	D

VCE Biology 2015 Year 12 Topic Test 1 Unit 4

Heredity

SECTION A – Multiple Choice Questions

Question 1
In eukaryotic DNA, most protein coding genes are not continuous. The non-coding regions of DNA are removed during transcription. The non-protein coding regions are called
A. exons.
B. plasmids.
C. introns.
D. vectors.

Question 2
In a normal human somatic cell you would expect to find
A. 22 pairs of autosomes.
B. 44 pairs of autosomes.
C. 46 pairs of autosomes.
D. 23 pairs of autosomes.

Question 3
Saccharomyces cerevisiae is a type of yeast often used in wine and bread making. This yeast reproduces asexually through a process called budding. In **Figure 1**, what is the process labelled P referring to?
A. Growth phase.
B. DNA replication.
C. Spindle formation.
D. Cytokinesis.

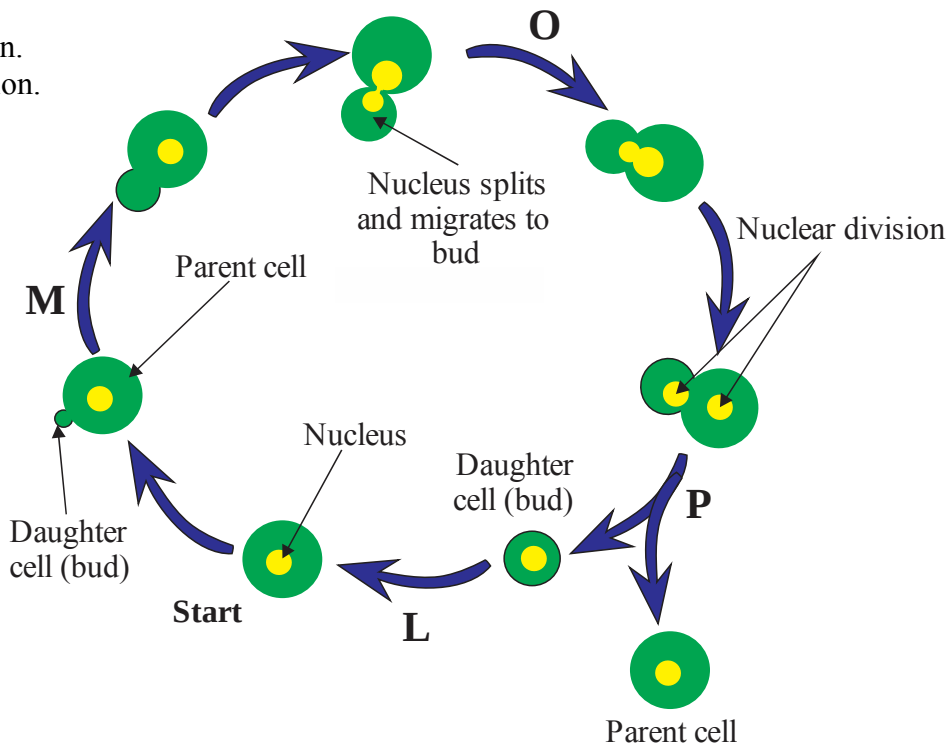


Figure 1: The life cycle of *Saccharomyces cerevisiae*.

Question 4
During gel electrophoresis, the fragments of DNA move from the
A. negative electrode towards the positive electrode.
B. negative electrode towards the negative electrode.
C. positive electrode towards the negative electrode.
D. positive electrode towards the positive electrode.

Question 5
Compared to large fragments of DNA, small fragments of DNA
A. move faster through the gel.
B. take longer to move through the gel.
C. move at the same speed as large fragments.
D. do not move through the gel.

Question 6
Forensic scientist, Ross, was at a crime scene and discovered a tiny spot of blood. To amplify the DNA in the blood spot, Ross should use
A. gel electrophoresis.
B. a recombinant plasmid.
C. the polymerase chain reaction.
D. microsatellites.

The following information refers to Questions 7 and 8.
Sandy has Edwards Syndrome, which can affect a range of organs and occurs in approximately 1 in 6000 live births. The karyotype for Sandy can be seen below in **Figure 2**.

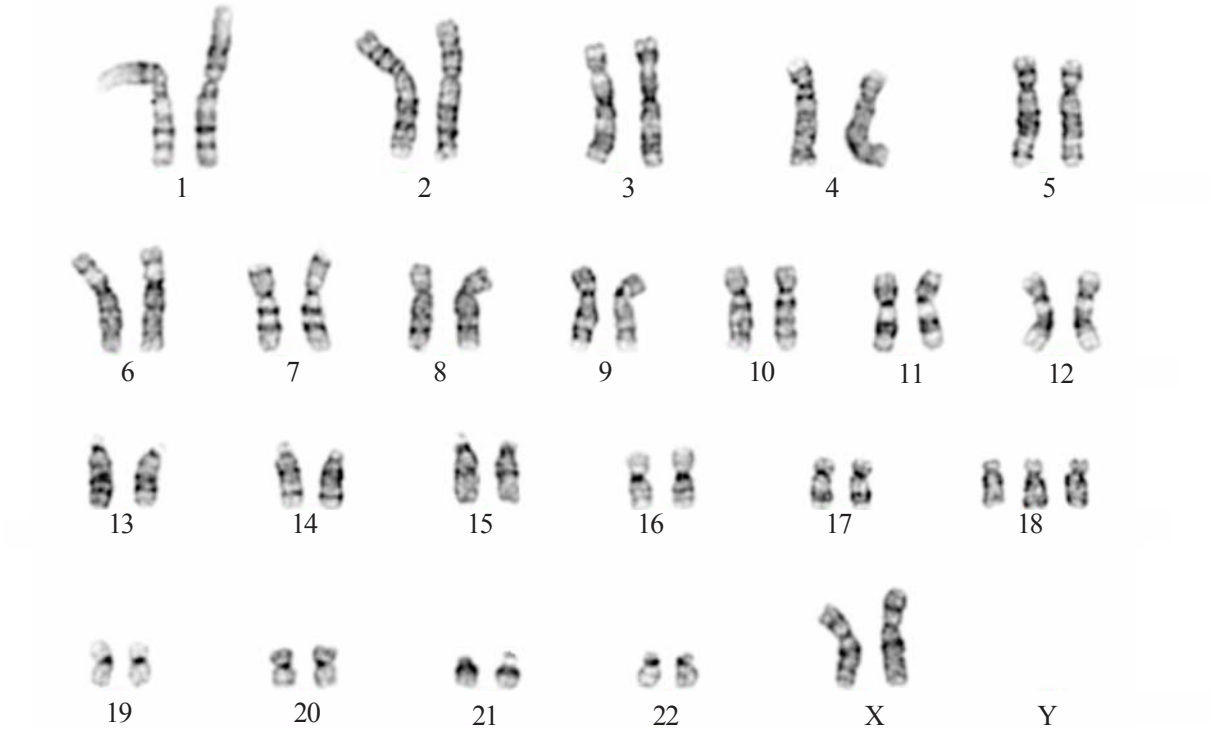


Figure 2: Sandy's karyotype.

Question 7
From the karyotype, the chromosomal pair affected is
A. autosome 4.
B. autosome 21.
C. sex chromosome Y.
D. autosome 18.

Question 8
Sandy's karyotype, shown in Figure 2, shows that Edwards Syndrome is a result of
A. monosomy.
B. trisomy.
C. apoptosis.
D. an error in meiosis.

Question 9
One difference between DNA and mRNA is that
A. mRNA is double stranded and DNA is single stranded.
B. mRNA contains the base uracil, whereas DNA contains the base thymine.
C. mRNA contains deoxyribose sugar and DNA contains ribose sugar.
D. mRNA is confined to the nucleus and DNA is not.

Question 10
During which stage of meiosis can crossing over occur?
A. Interphase I.
B. Prophase I.
C. Metaphase II.
D. Anaphase II.

Question 11
A benefit of genetic recombination is that
A. it increases genetic variation.
B. it preserves the phenotype of previous generations.
C. genetic variation is lessened in the population.
D. offspring are more likely to have the phenotype of one of their parents.

The following information refers to Questions 12 and 13.
Disease K is a rare disease in humans that is a sex-linked dominant condition. The gene for Disease K is found on the X chromosome.

Question 12
A couple decide to have children. The wife is not affected by Disease K but the husband is. If the couple have a daughter, what is the probability that she will be affected with Disease K?
A. 0%
B. 75%
C. 100%
D. 50%

Question 13
In another family, Disease K is also present. However, this time the husband is not affected but the wife is affected. The wife's father was not affected by Disease K. What is the probability that this couple will have an affected daughter?
A. 0%
B. 75%
C. 100%
D. 50%

Question 14
Which of the following is not an environmental factor that could affect the phenotype of an animal or plant?
A. Diet.
B. Temperature.
C. Mitochondrial DNA.
D. Altitude.

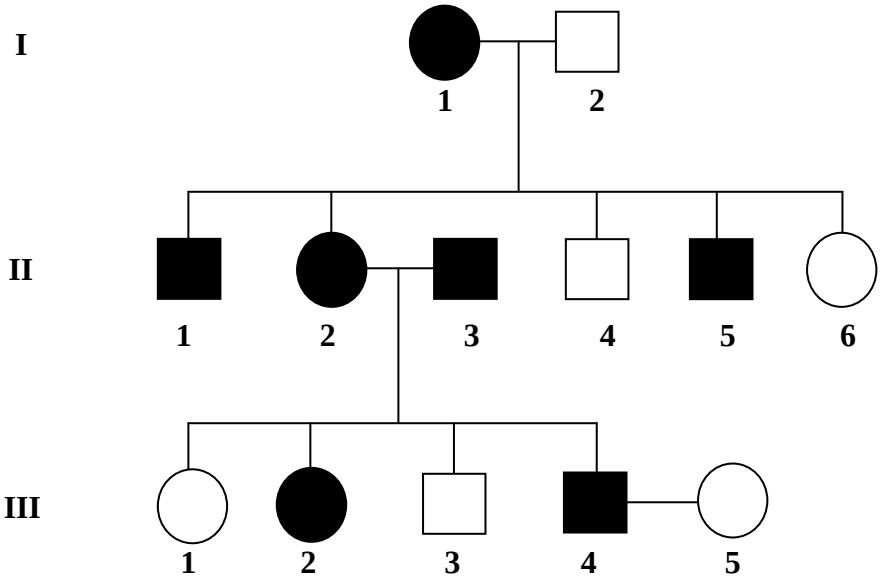
End of Section A

VCE Biology 2015 Year 12 Topic Test 1 Unit 4

Heredity

SECTION B – Short Answer Questions

Question 1 (8 marks)
An inherited nerve disorder, Neurofibromatosis-1, caused by the mutation of a single gene, results in the formation of nerve tissue tumours. The pedigree below illustrates the inheritance of Neurofibromatosis-1 in the Smith family. The shaded individuals are affected by Neurofibromatosis-1.



a. From analysing the Smith family pedigree, what is the mode of inheritance of Neurofibromatosis-1? Explain your answer**.** **3 marks**

_____

_____

_____

_____

_____

_____

_____

b. Assign appropriate symbols to the alleles involved in Neurofibromatosis-1 and write the genotype for individuals I-1, II-3, III-1 and III-4 in the Smith family pedigree. **2 marks**

_____

_____

_____

c. If Individual III-1 were to marry someone who did not have the condition, what is the probability (expressed in percentage) that their offspring would have the condition? Explain. **2 marks**

_____

_____

_____

d. If another family had no family history of Neurofibromatosis-1, what is one possible way an individual could develop Neurofibromatosis-1? **1 mark**

_____

Question 2 (7 marks)
An inherited condition, called sickle cell disease, is caused by a mutation in the HBB gene located on chromosome 11. If the mutation occurs, it affects haemoglobin molecules in the blood and can lead to anaemia and other serious health complications.

The following is the sequence of bases in the template strand of the **normal** segment of DNA coding for the HBB gene.

CAC CTG GAC TGA GGA CTC CTC

The following is the sequence of bases in the template strand of the **affected** segment of DNA coding for the HBB gene.

CAC CTG GAC TGA GGA CAC CTC

a. What type of mutation has occurred in the affected segment of DNA? **1 mark**

_____

b. Using **Table 1** on the following page, what is the sequence of amino acids for both the normal segment and affected segment of DNA? **2 marks**

Normal segment:_____

_____

Affected segment:_____

_____

Table 1: mRNA Amino Acid Table

	U	C	A	G	
U	**UUU** Phenylalanine	**UCU** Serine	**UAU** Tyrosine	**UGU** Cysteine	**U**
	UUC Phenylalanine	**UCC** Serine	**UAC** Tyrosine	**UGC** Cysteine	**C**
	UUA Leucine	**UCA** Serine	**UAA** STOP	**UGA** STOP	**A**
	UUG Leucine	**UCG** Serine	**UAG** STOP	**UGG** Tyrosine	**G**
C	**CUU** Leucine	**CCU** Proline	**CAU** Histidine	**CGU** Arginine	**U**
	CUC Leucine	**CCC** Proline	**CAC** Histidine	**CGC** Arginine	**C**
	CUA Leucine	**CCA** Proline	**CAA** Glutamine	**CGA** Arginine	**A**
	CUG Leucine	**CCG** Proline	**CAG** Glutamine	**CGG** Arginine	**G**
A	**AUU** Isoleucine	**ACU** Threonine	**AAU** Asparagine	**AGU** Serine	**U**
	AUC Isoleucine	**ACC** Threonine	**AAC** Asparagine	**AGC** Serine	**C**
	AUA Isoleucine	**ACA** Threonine	**AAA** Lysine	**AGA** Arginine	**A**
	AUG Methionine	**ACG** Threonine	**AAG** Lysine	**AGG** Arginine	**G**
G	**GUU** Valine	**GCU** Alanine	**GAU** Aspartic acid	**GGU** Glycine	**U**
	GUC Valine	**GCC** Alanine	**GAC** Aspartic acid	**GGC** Glycine	**C**
	GUA Valine	**GCA** Alanine	**GAA** Glutamic acid	**GGA** Glycine	**A**
	GUG Valine	**GCG** Alanine	**GAG** Glutamic acid	**GGG** Glycine	**G**

c. Explain the effect of the mutation in the HBB gene and why this mutation results in sickle cell disease. **2 marks**

_____

_____

_____

d. Give an example of a mutation that could occur in the normal segment of DNA coding for the HBB gene but has no effect on the individual. Explain why this is the case. **2 marks**

_____

_____

_____

Question 3 (5 marks)
Monica sells zebrafish in a pet shop in Euroa. In zebrafish, stripes (S) are dominant to spots (s) and a straight tail (C) is dominant to a curved tail (c). A female zebrafish that is homozygous for the striped trait and heterozygous for the straight tailed trait is crossed with a male zebrafish that is heterozygous for the striped trait but homozygous for the curved tail trait.

a. What are the genotypes for the female and male zebrafish? **1 mark**

_____

b. What percentage of the offspring will have spots? Explain your reasoning behind this. **2 marks**

_____

_____

_____

c. Explain how a marine biologist could determine whether or not a female zebrafish with stripes and a straight tail was homozygous or heterozygous for the two traits. **2 marks**

_____

_____

_____

_____

_____

Question 4 (6 marks)
Rachel is a unique individual and aspects of her phenotype are influenced by multiple genes.

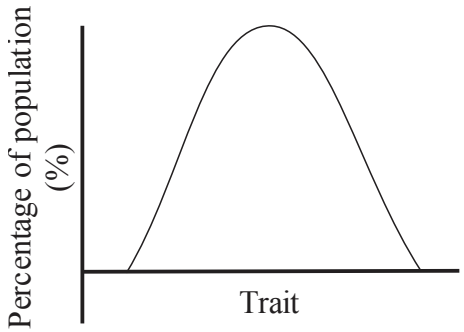
a. Define discontinuous variation and provide one example of a trait that Rachel might have that would be considered to have discontinuous variation. **2 marks**

_____

_____

_____

b. Below is **Graph 1**. Define what type of variation the graph is representing. Give an example of a trait that would fit this type of variation. **2 marks**



Graph 1: Variation of a trait in the population

_____

_____

_____

c. Rachel enjoys gardening and has planted a row of *Helianthus annuus* in her front garden. However, three of the *Helianthus annuus* are not growing as tall as the other four *Helianthus annuus*. Explain how this is possible if all the *Helianthus annuus* were planted from the same packet and on the same morning. **2 marks**

_____

_____

_____

End of Section B

End of Topic Test 1

Suggested Answers

VCE Biology 2015 Year 12 Topic Test 1 Unit 4

Heredity

SECTION A – Multiple Choice Questions

1. C	**2.** A	**3.** D	**4.** A	**5.** A	**6.** C	**7.** D
8. B	**9.** B	**10.** B	**11.** A	**12.** C	**13.** D	**14.** C

SECTION B – Short Answer (Answers)

Question 1 (8 marks)

a. Mode of inheritance is autosomal dominant **(1 mark)**. It is autosomal because in each generation at least one parent is affected and both males and females are approximately equally affected. It cannot be X-linked because otherwise individual III-1 would have to be affected **(1 mark).** It is dominant because individuals II-2 and II-3 both have the condition, yet some of their offspring do not. This would not occur if the condition was recessive **(1 mark)**.

b. N = affected and n = non-affected **(1 mark).** *Alternative symbols are possible for this answer, but a capital letter must be used to denote the affected condition and a lower case letter should be used to denote the non-affected condition.* I-1 = Nn; II-3 = Nn; III-1 = nn and III-4 = Nn or NN (could be either, students must have both alternatives for individual III-4) **(1 mark)**.

c. 0% **(1 mark)**. Individual III-1 and his wife would both be homozygous recessive for the condition because neither of them are affected. Their offspring cannot have the condition as neither parent has the dominant allele (nn x nn) **(1 mark)**.

d. A genetic mutation **(1 mark)**.

Question 2 (7 marks)

a. A single base substitution mutation **or** a point mutation **(1 mark)**.

b. Normal Segment = Valine – Aspartic acid – Leucine – Threonine – Proline – Glutamic acid – Glutamic acid **(1 mark)**. Affected segment = Valine – Aspartic acid – Leucine – Threonine – Proline – Valine – Glutamic acid **(1 mark)**.

c. The single base change (T→ A, in the sixth codon) has resulted in a different amino acid being produced (Glutamic acid → Valine) **(1 mark)**. Valine has different properties to Glutamic acid, which in turn changes the structure of the haemoglobin molecule, making it behave differently and resulting in the sickle cell shaped blood cell **(1 mark)**.

d. If a point mutation had occurred, in the form of a base substitution in the fifth codon (GGA → GGT), there would be no effect on the individual **(1 mark)**. Both GGA and GGT, when transcribed to mRNA, code for the same amino acid, Proline. As they both code for Proline, there is no change to the structure of haemoglobin. **(There are other possible silent mutations, students only need one example, 1 mark)**.

Question 3 (5 marks)

a. The genotype of female zebrafish is SSCc and the genotype of the male zebrafish is Sscc **(1 mark)**.

b. 0% **(1 mark)**. To have spots, a zebrafish offspring would need to be homozygous recessive for the trait (ss). However, this is not possible because the female zebrafish is homozygous for the striped trait (which is the dominant trait), all offspring will also be striped because they will each have at least one copy of the striped allele (S) **(1 mark)**.

c. By performing a test cross with a male zebrafish that is homozygous recessive for both traits **(1 mark)**. If the female is homozygous for both dominant traits, then no offspring will show the recessive traits. However, if the female is heterozygous for either or both traits, then some of the offspring will also show the recessive trait (spots or curved tail respectively for the trait that the female is heterozygous for) **(1 mark)**.

Question 4 (6 marks)

a. Discontinuous variation occurs within a population where traits are influenced by a single gene resulting in limited possible phenotypes **(1 mark)**. An example of a trait that Rachel may have is an attached earlobe or her blood type is B **(students only need one example and there are more possible examples, 1 mark)**.

b. The graph is representing continuous variation which occurs within a population where traits are influenced by a large number of genes, resulting in a number of possible differences in the phenotype of individuals **(1 mark)**. An example of a trait that would fit this variation is height or hand span or waist measurement **(students only need one example and there are more possible examples, 1 mark)**.

c. Both the genotype and the environment can affect the phenotype **(1 mark)**. Whilst the species are the same and were planted at the same time, the environment can still affect the phenotype, in this case the height of the plant. Factors such as the salinity of the soil, competing plants, availability of sunlight or genetic variation within the seeds could affect the height of the plant **(students only need one example and there are more possible examples, 1 mark)**.

End of Suggested Answers