VCE BIOLOGY 2016

YEAR 12 UNIT 4

Topic Test 1 – Heredity

Time allowed: 50 minutes
Total marks: 40

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.

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STUDENT NUMBER									Letter
Figures									
Words									

Student Name.....…….....

VCE Biology 2016 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 2016 Year 12 Topic Test 1 Unit 4

Heredity

SECTION A – Multiple Choice Questions

Question 1
Consider the following single strand of DNA.

The complementary strand for this section of DNA would be
A. 5’ A C A T G C A G A T A C 3’
B. 5’ T G T A C G T C T A T G 3’
C. 5’ C A T A G A C G T A C A 3’
D. 5’ G T A T C T G C A T G T 3’

Question 2
Mitochondria have a region of their DNA that is highly varied between individuals called the hypervariable region. Recently in France, two skeletons were discovered, one male and one female, that were believed to date from the Neolithic period. When their DNA was extracted and tested, their hypervariable region was found to be an exact match. The most likely relationship between these two individuals would be
A. father and daughter.
B. mother and son.
C. husband and wife.
D. identical twins.

Question 3
During which stage of the cell cycle do the chromosomes become double stranded?
A. G_1
B. S
C. G_2
D. Metaphase

Question 4
The Rhesus gene is responsible for a protein found on red blood cells. If the Rhesus gene is functional, a Rhesus positive blood type results. If the Rhesus gene is non-functional, no Rhesus protein is produced and a Rhesus negative blood type results. Gina and Derek both have positive blood types. Their first child, Cameron, is negative for the Rhesus protein. Their second son, Findlay, is positive. What is the probability that Findlay is heterozygous for the Rhesus gene?
A. 100%
B. 67%
C. 50%
D. 25%

*The pedigree shown in **Figure 1** refers to Questions 5 to 7.*

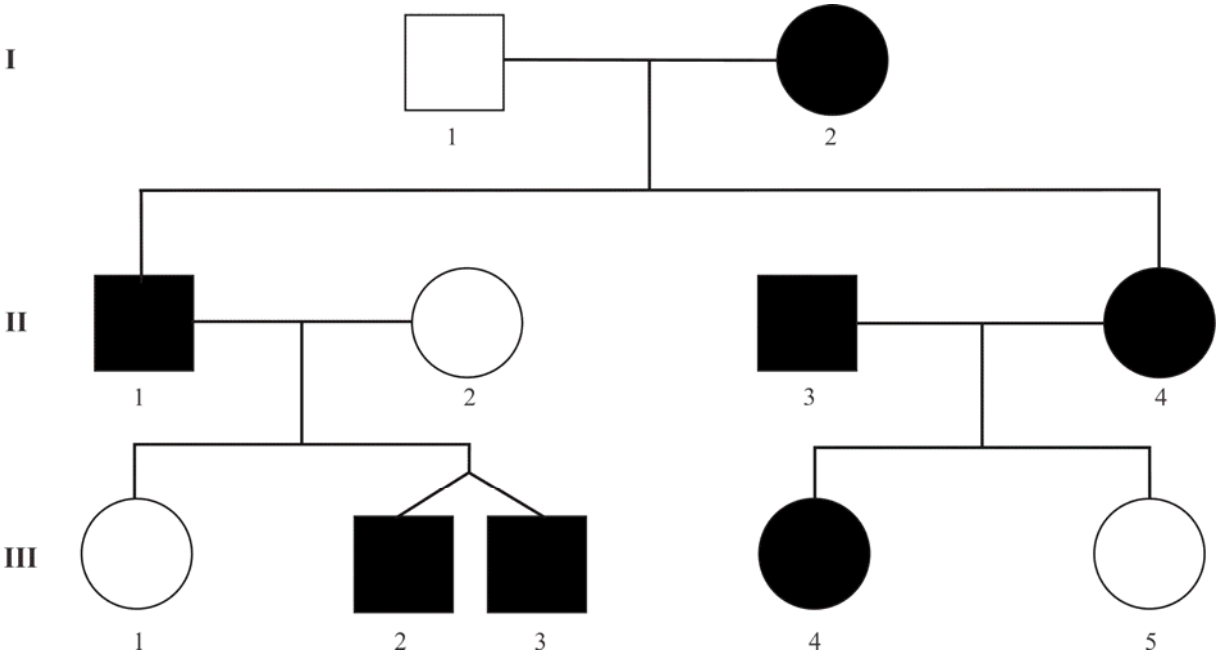


Figure 1

Question 5
Hair that grows to a sharp point in the middle of the forehead is known as a widow's peak. It is controlled by a single gene.
Figure 1 is a pedigree from a particular family showing the incidence of widow's peak over a number of generations. Shaded individuals have the widow's peak.
The mode of inheritance for widow's peak is
A. autosomal dominant.
B. autosomal recessive.
C. X linked recessive.
D. X linked dominant.

Question 6
Individuals most likely to be homozygous at the widow's peak gene locus would be
A. II 3 and II 4.
B. III 2 and III 3.
C. II 2 and III 1.
D. II 1 and III 2.

Question 7
Individuals III 2 and III 3 are
A. identical twin sisters.
B. non identical twin sisters.
C. identical twin brothers.
D. non identical twin brothers.

Question 8
A restriction enzyme with the recognition sequence AACGTT has been found to cut a bacterial plasmid at three sites. A different restriction enzyme with the recognition sequence ACGT has been shown to cut the plasmid at five sites. If both restriction enzymes were placed with the plasmid it would be cut into how many pieces?
A. 3
B. 5
C. 8
D. 6

Table 1 *refers to Questions 9 and 10.*

Table 1 shows the result of a paternity test. DNA fingerprinting was used on a number of individuals. This test looked at **two** autosomal genes only.

Individuals					
Mother	**Child**	**Male 1**	**Male 2**	**Male 3**	**Male 4**
_____	_____		_____		
		_____	_____		_____
_____				_____	
		_____	_____	_____	
	_____	_____		_____	
					_____
_____	_____				_____
_____	_____			_____	
			_____		_____

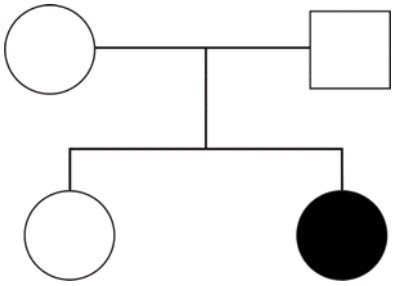
Table 1

Question 9
Which person is most likely to be the father of the child?
A. Male 1.
B. Male 2.
C. Male 3.
D. Male 4.

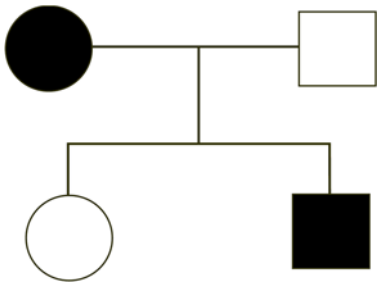
Question 10
Male 1 only shows three bars while everyone else in the DNA fingerprint displays four. This is probably because Male 1
A. is missing a chromosome.
B. is homozygous for one of the loci that were tested.
C. did not give enough DNA to use for the test.
D. is heterozygous for both gene loci tests.

Question 11
Which of the following human pedigrees is only possible if the trait in question is autosomal recessive, rather than sex linked or dominant traits?

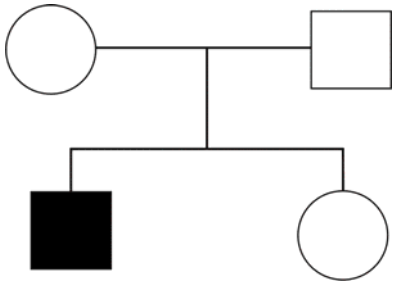
A.



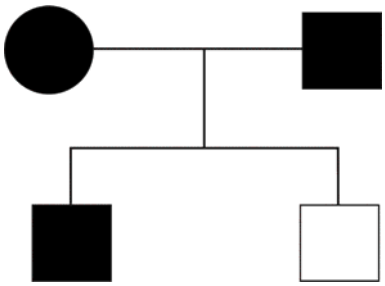
B.



C.



D.



Question 12
Which of the following mutations in the DNA of an individual would be likely to have the **least** effect on the production of a particular protein?

A. Point addition on the second base of a codon.
B. Point deletion on the third base of a codon.
C. Point substitution on the first base of a codon.
D. Point substitution on the third base of a codon.

Question 13
Seedless watermelons are unusual in that they have three copies of every chromosome in their cells instead of the two found in normal watermelons. This unusual number of chromosomes is referred to as

A. trisomy.
B. triploid.
C. aneuploidy.
D. monosomy.

Question 14
A pure breeding pea plant that produced yellow, wrinkled seeds was crossed with a pure breeding pea plant that produced green, smooth seeds. The F1 generation all had the phenotype of yellow and wrinkled seeds. When the F1 generation was crossed, 75% of the offspring produced yellow, wrinkled seeds and 25% produced green, smooth seeds.

Using the allele symbols Y – yellow, y – green, W – wrinkled and w – smooth, the genotypes of the original pure breeding pea plants must have been

A. YYWW x yyww
B. YYww x yyWW
C. YY/WW x yy/ww
D. YW/YW x yw/yw

End of Section A

VCE Biology 2016 Year 12 Topic Test 1 Unit 4

Heredity

SECTION B – Short Answer Questions

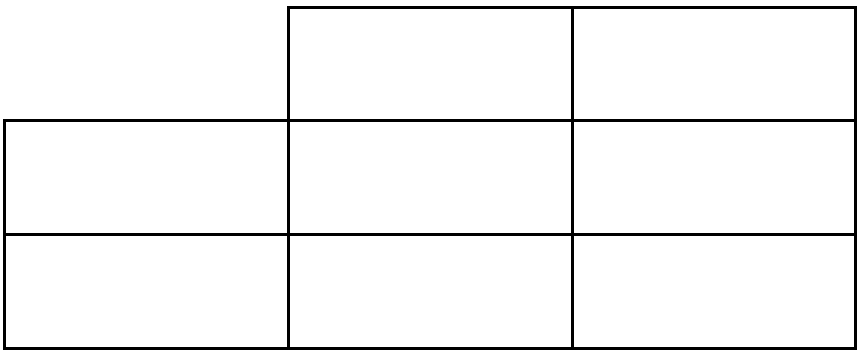
Question 1 (4 marks)
Achondroplasia is a form of dwarfism that is passed on genetically from parent to child. Every person with achondroplasia has at least one parent with the trait, but it is possible for two individuals with achondroplasia to give birth to a child without achondroplasia. There are approximately equal numbers of males and females with the trait.

a. What mode of inheritance does achondroplasia display? **1 mark**

_____

The chance of two achondroplasia individuals producing a child with the same phenotype is two in three.

b. Explain why this unusual ratio occurs, using relevant allelic symbols and a punnet square, to demonstrate your understanding. **3 marks**



Question 2 (7 marks)
RNA typically occurs as a single stranded molecule but tRNA molecules usually take the shape as shown in **Figure 2**.

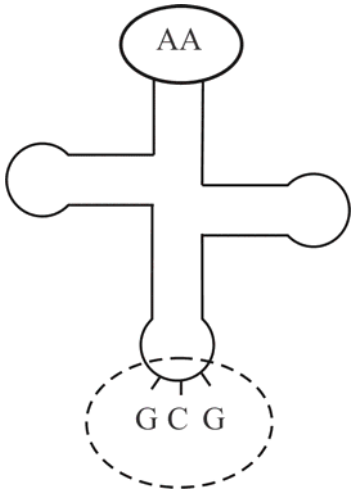


Figure 2

a. What does the term tRNA stand for? **1 mark**

_____

b. Name **two** other forms of RNA involved in protein synthesis. **1 mark**

_____

c. Explain what structural features of the tRNA molecule enable it to form the functional shape shown in **Figure 2** rather than remaining as a linear strand. **2 marks**

_____

_____

_____

d. What term is given to the three nucleotides that are circled in **Figure 2**? **1 mark**

_____

e. Describe the role of tRNA in translation. **2 marks**

_____

_____

_____

Question 3 (8 marks)
Deinococcus radiodurans is a recently discovered extremophile. Extremophiles are a group of bacteria that can cope with extreme heat, cold and, in the case of *Deinococcus radiodurans*, gamma radiation levels that would easily kill a human.

Scientists have given this species of bacteria the nickname 'Conan the Bacterium' due to its incredible resistance. When researching these bacteria, scientists have discovered that *Deinococcus radiodurans* have large amounts of repeated genes, up to ten copies of every gene per cell. Having multiple copies of a gene helps the bacteria survive when one or more of their genes is damaged or altered by radiation.

a. What term is given to agents like radiation that can alter or damage DNA? **1 mark**

_____

b. How many copies of each autosomal gene are there in a human's somatic cell? **1 mark**

_____

c. Unlike females, who possess two copies of every gene in their somatic cells, human males possess only one copy of certain genes in their somatic cells. Explain why and give the term for a trait in humans where there is only one copy of a particular gene rather than the expected two. **2 marks**

_____

_____

_____

Another closely related extremophile is the bacterium, *Thermus aquaticus*, that lives in hot mineral springs. It thrives in water above 70^0C.

d. Name the process by which *Thermus aquaticus* and *Deinococcus radiodurans* multiply. **1 mark**

_____

e. Name the organic molecule produced by *Thermus aquaticus* that is used in PCR and outline why it is suitable for this purpose. Explain why the human equivalent is considered unsuitable for use in this technique. **3 marks**

_____

_____

_____

_____

Question 4 (7 marks)
Fiona was in the kitchen complaining about her garden.

"*Last year when I planted sweet peas, I had two types. The short little bushes all produced white flowers and the tall plants all had red flowers. When they died off, I collected and used last year's seeds but this year they all seem to be tall and pink for some reason. I don't want pink, I just like the white ones."*

Milla, who is studying Year 12 Biology, looked up from her homework and replied,

"*Don't worry mum, just plant the seeds from the pink flowers and you will get some white ones back next year."*

a. What mode of inheritance is **colour** in sweet peas? **1 mark**

_____

b. What mode of inheritance is **plant height** in sweet peas? **1 mark**

_____

Fiona did as her daughter suggested and found the following year that she did indeed get some white flowers. In fact, there now seemed to be six different variations of the sweet peas.

c. Using appropriate allele symbols, what were the genotypes of the original short, white flowered plants and tall, red flowered plants (include a key to explain your allele symbols).

Tall, red flowered plant _____

Short, white flowered plant _____ **1 mark**

Key: **1 mark**

d. Assuming the traits for colour and height are carried on different chromosomes, give the probabilities of the six different phenotypes of sweet peas that Fiona found in her garden the following year.

3 marks

_____

_____

_____

_____

_____

_____

End of Section B

End of Topic Test 1

Suggested Answers

VCE Biology 2016 Year 12 Topic Test 1 Unit 4

Heredity

SECTION A – Multiple Choice Answers

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

SECTION B – Short Answer (Answers)

Question 1 (4 marks)

a. Autosomal dominant **(1 mark)**.

b. Achondroplasia is a lethal condition in the homozygous state. Individuals who are homozygous for this allele die in utero. **(1 mark)**.
This leaves the 2:1 phenotype ratio seen when two parents with achondroplasia produce children.
A – Achondroplasia
a – Normal height **(1 mark)**.

	A	a
A	AA (not viable)	Aa
a	Aa	aa

(1 mark)

Genotype ratio
Aa:aa
2:1

Phenotype ratio
Achondroplasia : Normal height
2:1

Question 2 (7 marks)

a. Transfer ribonucleic acid **(1 mark)**.

b. Messenger ribonucleic acid (mRNA) and ribosomal ribonucleic acid (rRNA) **(1 mark)**.

c. Hydrogen bonds form between neighbouring nucleotides in the ribonucleic acid strand **(1 mark)**.
Adenine bonds to uracil and cytosine bonds to guanine **(1 mark)**.

d. Anticodon **(1 mark)**.

e. tRNA brings a *specific* amino acid to the ribosome for translation **(1 mark)**. The anticodon that is complementary to the codon of the mRNA strand binds at the ribosome and the amino acid is removed to join the growing polypeptide chain **(1 mark)**.

Question 3 (8 marks)

a. Mutagenic agent or mutagen **(1 mark)**.

b. Two **(1 mark)**.

c. Unlike females that have matching XX chromosomes, males have an X and a Y chromosome with different genes carried on each **(1 mark)**.
This makes the trait hemizygous **(1 mark)**.

d. Binary fission **(1 mark)**.

e. Taq polymerase **(1 mark)** can withstand the high temperature needed in PCR to separate the DNA strand **(1 mark)**. Human DNA polymerase would denature in the extreme temperature and would no longer work **(1 mark)**.

Question 4 (7 marks)

a. Incomplete dominance **(1 mark)**.

b. Dominant / recessive **(1 mark)**.

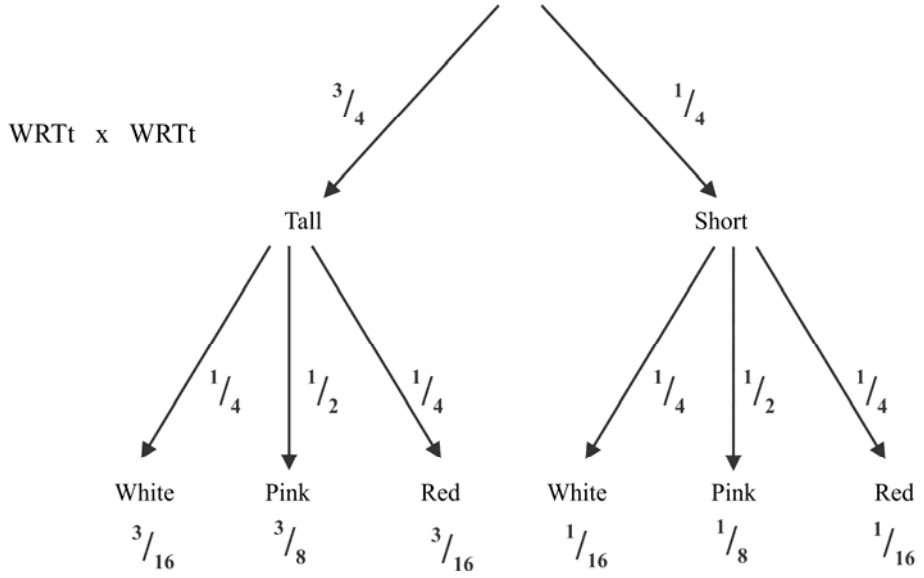
c. Allele symbols (or any other suitable symbol)
W – White
R – Red
T – Tall
t – Short **(1 mark)**
Tall red plant RR TT
Short white plant WW tt **(1 mark)**

d.
F1: WR Tt x WRTt

	WT	**Wt**	**RT**	**Rt**
WT	WWTT (White Tall)	WWTt (White Tall)	WRTT (Pink Tall)	WRTt (Pink Tall)
Wt	WWTt (White Tall)	WWtt (White Short)	WRTt (Pink Tall)	WRtt (Pink Short
RT	WRTT (Pink Tall)	WRTt (Pink Tall)	RRTT (Red Tall)	RRTt (Red Tall)
Rt	WRTt (Pink Tall)	WRtt (Pink Short)	RRTt (Red Tall)	RRtt (Red Short)

White Tall $^{3}/_{16}$ **(1/2 mark)**.
White Short $^{1}/_{16}$ **(1/2 mark)**.
Pink Tall $^{6}/_{16}$ **(1/2 mark)**.
Pink Short $^{2}/_{16}$ **(1/2 mark)**.
Red Tall $^{3}/_{16}$ **(1/2 mark)**.
Red Short $^{1}/_{16}$ **(1/2 mark)**.

or



End of Suggested Answers