VCE BIOLOGY 2014

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.

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 2014 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

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SECTION A – Multiple Choice Questions

Question 1
The mRNA transcript of the following DNA sequence – AAATTGC - would be
A. TTTAACG.
B. GGCCTA.
C. UUUAACG.
D. TTTUUCG.

*Questions 2-4 refer to the diagram shown in **Figure 1**.*

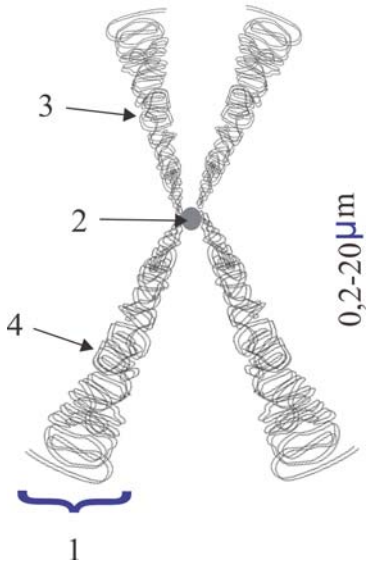

Figure 1

Question 2
In **Figure 1**, the structure labelled 2 is the
A. centriole.
B. nucleus.
C. histone.
D. centromere.

Question 3
In **Figure 1**, the structure labelled 1 is a
A. chromosome.
B. chromatid.
C. centriole.
D. centromere.

Question 4
In **Figure 1**, the most accurate description of the material located in the structure labelled 4 is
A. chromatin and is composed of DNA wrapped around histone proteins.
B. chromatin and is composed of DNA tightly coiled.
C. a long strand of DNA.
D. chromatin and contains both DNA and RNA wrapped around histone proteins.

Questions 5 and 6 refer to the following karyotype.
Consider the following karyotype in **Table 1.**

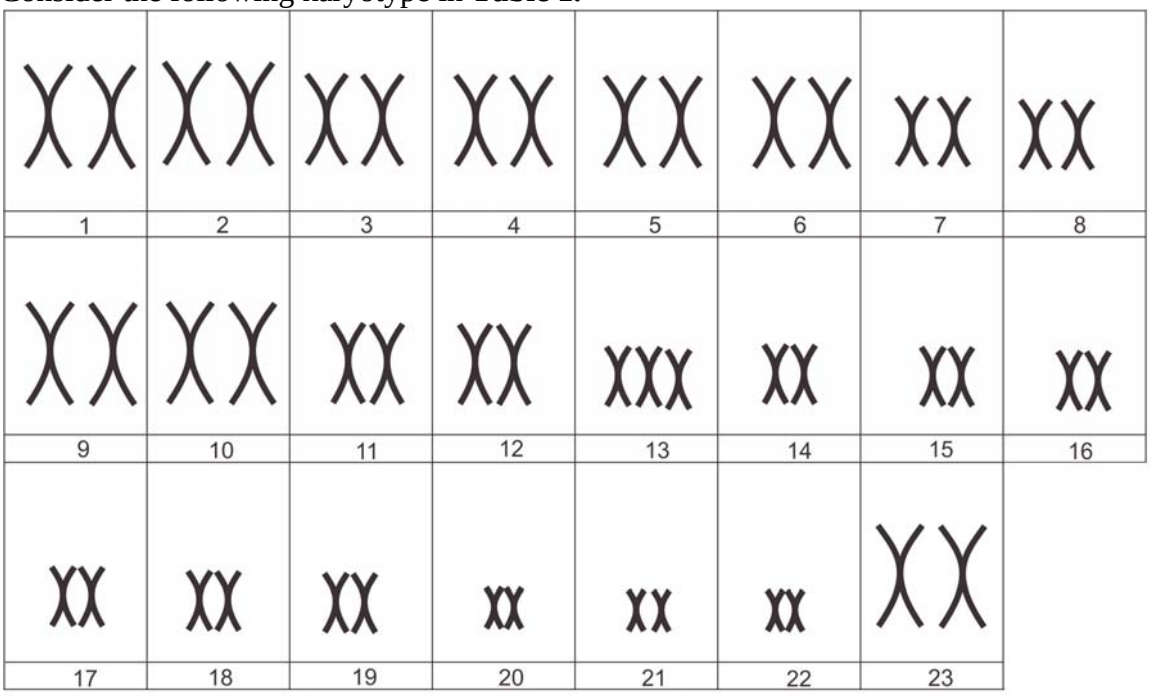

Table 1

Question 5
This karyotype shows a condition termed
A. trisomy.
B. polyploidy.
C. monosomy.
D. polyteny.

Question 6
Box 1 contains two chromosomes. How many molecules of DNA does it contain?
A. 2
B. 4
C. 8
D. 1000's

Question 7
The mitochondrial chromosome is different to the chromosomes in the nucleus because it
A. is single stranded.
B. is circular.
C. contains a greater number of genes.
D. contains sections where there are no genes.

Question 8
Cystic fibrosis is an autosomal recessive disorder. If a husband and wife are both heterozygous for the affected allele, what is the chance that their firstborn child will have the disease?

A. 100%
B. 75%
C. 50%
D. 25%

Question 9
A genetic disease is traced back to the paternal grandfather of a family. The mutation causing the disease must have occurred in the

A. mitochondrial DNA of a somatic cell.
B. mitochondrial DNA of a germline cell.
C. nuclear DNA of a somatic cell.
D. nuclear DNA of a germline cell.

Question 10
A white, long haired goat (WWLL) is crossed with a black short haired goat (wwll). The offspring are then crossed to produce a third generation. The probability of a white, long haired goat being born in this third generation is

A. $\frac{1}{16}$
B. $\frac{3}{16}$
C. $\frac{9}{16}$
D. $\frac{12}{16}$

Question 11

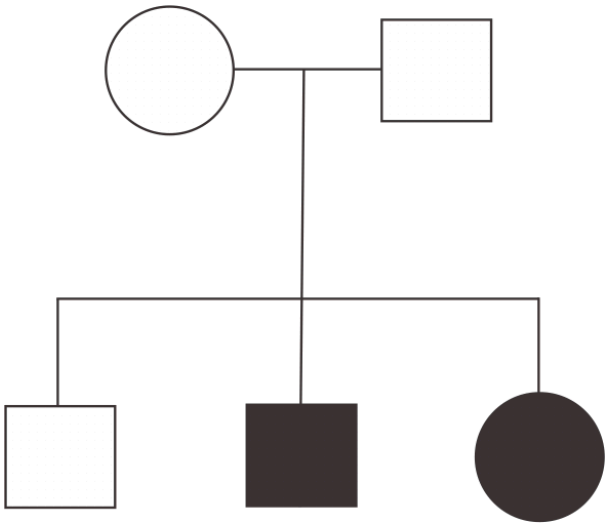

Figure 2

The mode of inheritance for the trait depicted in the pedigree in **Figure 2** is most likely to be

A. autosomal recessive.
B. x – linked recessive.
C. autosomal dominant.
D. x – linked dominant.

Question 12
The graph in **Figure 3** shows the skin colours of a species of Amazonian frog.

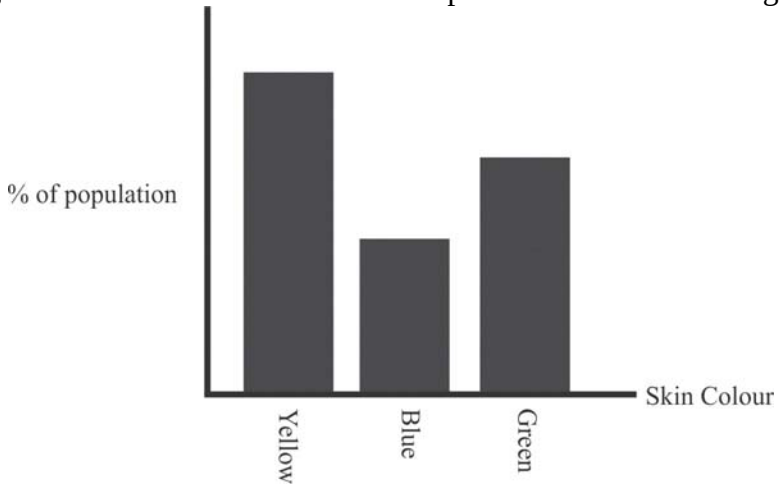

Figure 3

Based on the information in the graph, it would be reasonable to assume that skin colour in this species is a

A. discontinuous trait controlled by a single gene.
B. discontinuous trait controlled by many genes.
C. continuous trait controlled by a single gene.
D. continuous trait controlled by many genes.

Question 13
Which of the following scenarios would **not** be an appropriate application for PCR (polymerase chain reaction)?

A. Blood and hair are found at a crime scene and PCR is used to amplify some DNA isolated from cells of these specimens.
B. The karyotype of a person is to be analysed. In preparation, an individual's chromosomes are copied many times by PCR.
C. A tooth of an ancient human is found and a small amount of DNA is obtained. PCR is then used to amplify this fragment for further research.
D. A pig gene is to be inserted into a tomato plant. It is first amplified by PCR before an attempt is made to insert it into tomato cells.

Question 14
The gene for haemoglobin is exposed to UV light. When the gene is subsequently transcribed and translated only half the haemoglobin protein is manufactured. This suggests that the UV light caused the following type of mutation in the haemoglobin gene.

A. Translocation.
B. Silent.
C. Nonsense.
D. Missense.

End of Section A

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SECTION B – Short Answer Questions

Question 1 (7 marks)
In **Figure 4**, two important cellular processes are illustrated.

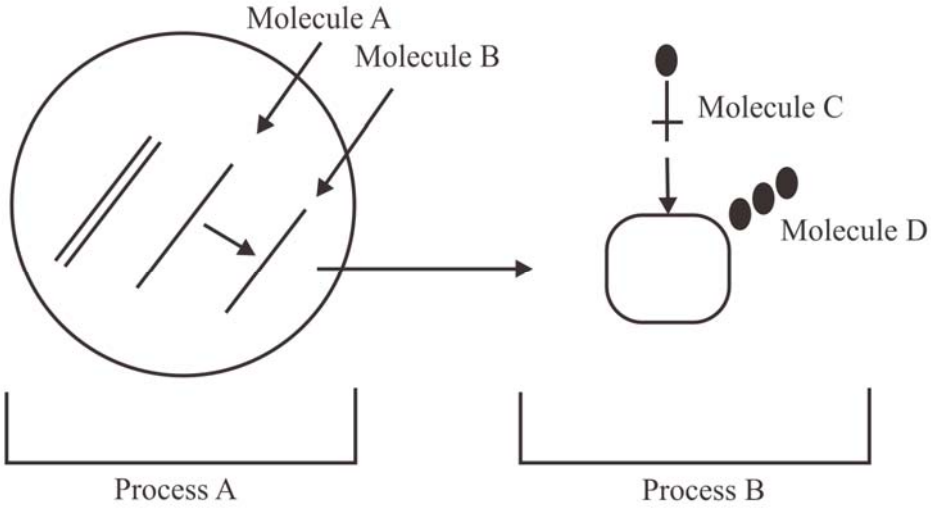

Figure 4

a. In **Figure 4** name process A and process B. **2 marks**

_____

_____

b. Identify Molecule B in **Figure 4** and explain why it is shorter than Molecule A. **2 marks**

_____

_____

_____

c. In **Figure 4** name Molecule C and explain its function. **2 marks**

_____

_____

d. Identify Molecule D in **Figure 4**. **1 mark**

_____

Question 2 (7 marks)
This question refers to **Figure 5** below.

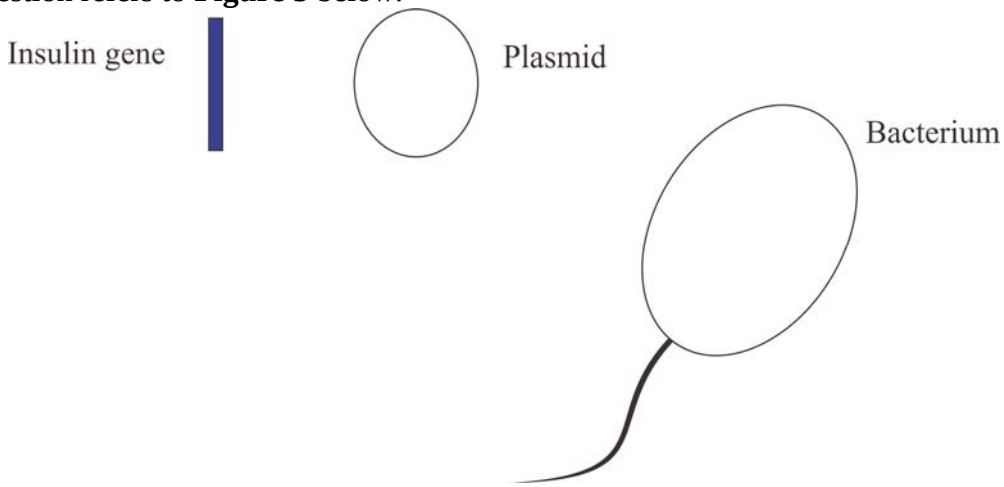

Figure 5

Human insulin can be manufactured by incorporating the human insulin gene into the bacterial cells genome. Some of the components required in this process are illustrated in **Figure 5**.

a. In **Figure 5** what is a plasmid and how is it used in this process? **2 marks**

_____

_____

_____

b. What tool of genetic engineering must be kept constant, both for the isolation of the gene and the cutting of the plasmid? **1 mark**

_____

_____

c. Identify the enzyme that is used to ensure the gene is joined into the plasmid? **1 mark**

_____

d. What is the term used to describe the process by which bacterial cells take up a foreign gene? **1 mark**

_____

e. When the process is complete there will be many bacteria with the gene and many without it. Describe the procedure necessary to isolate only the bacteria that have successfully taken up the gene. **2 marks**

_____

_____

_____

Question 3 (6 marks)
The seeds of a species of pea plant have two distinctive traits; they can be round (dominant) or wrinkled (recessive) and yellow (dominant) or green (recessive). If a seed has the phenotype round and yellow, a test cross can be completed to determine its genotype.

Test cross: Yellow, round plant × wrinkled, green plant.

a. Assign appropriate symbols to **all** the alleles involved in these two traits. **1 mark**

_____

b. Why is a test-cross required to determine the genotype of a plant with round, yellow seeds? **1 mark**

_____

_____

c. Explain how the test-cross is completed. In your answer, include the possible results of the cross and how they are interpreted. **2 marks**

_____

_____

_____

_____

_____

_____

_____

It is also possible to determine whether the genes are linked or not when a dihybrid cross is completed. The table below shows the genotypes of 100 offspring produced from the following cross: *GgHh* × *gghh.*

genotype	Number of offspring
GgHh	5
ggHh	45
Gghh	45
gghh	5

Table 2

d. Are these two genes linked? Explain your answer. **2 marks**

_____

_____

_____

Question 4 (6 marks)
The pedigree below illustrates the inheritance of a trait in the Spanish Royal family.

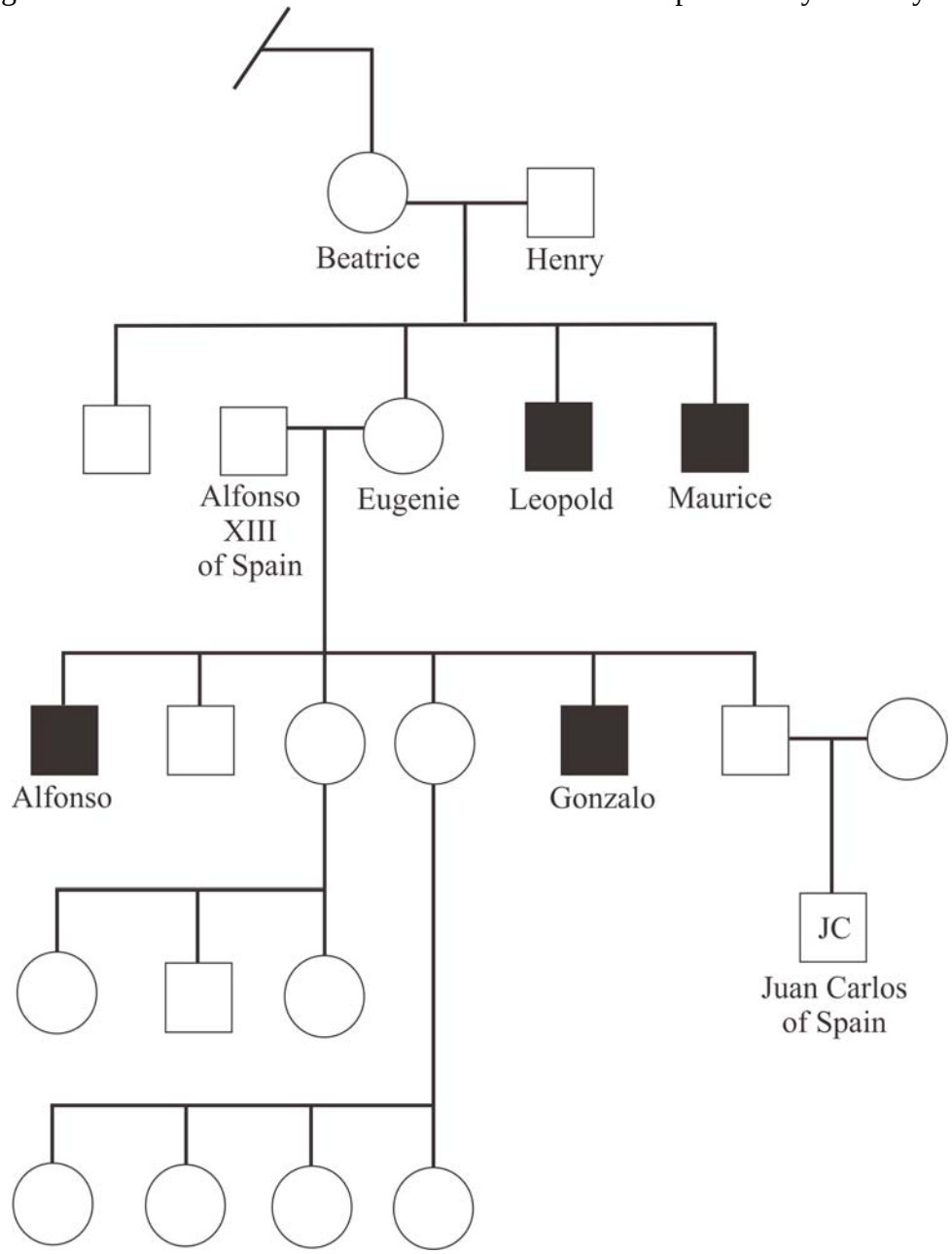

Figure 6

a. What is the mode of inheritance of the disease in the pedigree shown in **Figure 6**? Provide a reason for your answer. **2 marks**

_____

_____

_____

_____

b. What is the genetic status of Eugenie in regard to this disease? Explain. **2 marks**

_____

_____

_____

c. If Alfonso marries a woman with no history of the disease in her family and they have a son together, what is the chance that this son will have the disease? **1 mark**

_____

d. Suggest how this disease might have started in this family. **1 mark**

_____

End of Section B

End of Topic Test 1

Suggested Answers

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SECTION A – Multiple Choice Answers

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

SECTION B – Short Answer (Answers)

Question 1 (7 marks)

a. Process A is transcription, process B is translation **(2 marks)**.

b. Molecule B is mRNA while Molecule A is pre-mRNA **(1 mark)**. Molecule A contains introns and exons while Molecule B has had the introns spliced out and only contains exons **(1 mark)**.

c. Molecule C is a tRNA molecule **(1 mark)**. Its function is to deliver an amino acid to the ribosome in the process of translation **(1 mark)**.

d. Molecule D is a growing polypeptide chain **(1 mark)**.

Question 2 (7 marks)

a. A plasmid is a small circular piece of double stranded DNA that is contained in bacteria but which lies separate to the bacterial chromosome **(1 mark)**. A plasmid can serve as a vector for genes and serves as a means by which genetic material can be incorporated into target cells **(1 mark)**.

b. The same restriction enzyme must be used when isolating the gene of interest and cutting open the plasmid prior to inserting the gene **(1 mark)**.

c. DNA ligase **(1 mark)**.

d. Transformations **(1 mark)**.

e. An antibiotic resistance gene is incorporated into the plasmid alongside the gene of interest **(1 mark)**. Thus bacteria can be grown on agar containing the antibiotic and only the bacteria that have successfully taken up the gene will survive and grow **(1 mark)**.

Question 3 (6 marks)

a. Round – R, wrinkled – r, Yellow – Y, green – y **(1 mark)**.

b. A plant with round, yellow seeds could be homozygous dominant (RRYY) or heterozygous (RrYy) at both these loci. Thus a test cross is required to determine which of these two genotypes is involved **(1 mark)**.

c. A plant of the unknown genotype (round, yellow) is crossed with a homozygous recessive plant (wrinkled, green) **(1 mark)**. If the resultant offspring are all round and yellow then the genotype in question is homozygous dominant. If some offspring are round and yellow and some wrinkled and green then the genotype of the plant in question is heterozygous at these two loci **(1 mark)**.

d. Yes, the two genes are linked **(1 mark)**. The expected genotypic ratio of this cross is 1:1:1:1. The actual ratio is very different from the expected ratio with two genotypes being heavily overrepresented and the other two underrepresented – this is indicative of linked genes **(1 mark)**.

Question 4 (6 marks)

a. The mode of inheritance of this disease is x-linked recessive **(1 mark)**. X-linked because males have the disease much more often than females. This occurs because males only need to inherit one X chromosome bearing a copy of the defective allele to be affected. Recessive because an X chromosome bearing the defective allele can be carried in females when they don't have the disease **(1 mark)**.

b. Eugenie is heterozygous for this disease **(1 mark)**. She must contain one X chromosome bearing the defective allele as she has sons with the disease who inherit it from her. She also must have one unaffected chromosome as she herself doesn't have the disease **(1 mark)**.

c. 0% chance **(1 mark)**.

d. A mutation in a germ line cell or gamete in Beatrice's parent or ancestor. **(1 mark)**.

End of Suggested Answers