

TRIALS FOR TEACHERS

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STUDENT NAME _____

VCE BIOLOGY – TRIAL EXAMINATION

UNIT 4 – OCTOBER 2006

INSTRUCTIONS

Reading Time - 15 minutes
Writing time - 1 hour 30 minutes

ANSWER ALL THE QUESTIONS

SECTION A **25 Questions 25 marks** **Suggested Time: 30 minutes**

Answer the multiple choice questions on the answer sheet provided.

SECTION B **8 Questions 50 marks** **Suggested time: 60 minutes**

Answer the short answer questions in this booklet.

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SECTION A – Multiple Choice Questions

Question 1:

The cell cycle

- A. is a discontinuous process
- B. varies in length in different cells
- C. occurs in all cells
- D. requires DNA replication prior to cell growth

Question 2:

All cells have a predetermined life span, they get old and die. This is known as

- A. apoplast
- B. apoptosis
- C. apophysis
- D. apoplexy

Question 3:

After a prokaryotic cell has grown to a certain optimum size, the cytoplasm undergoes cleavage into roughly equal halves. This asexual process is known as;

- A. oogenesis
- B. meiosis
- C. binary fission
- D. mitosis

Question 4:

The phenotype of an organism can be modified by external environmental factors. Which of the following factors are **NOT** sources of environmentally induced variation?

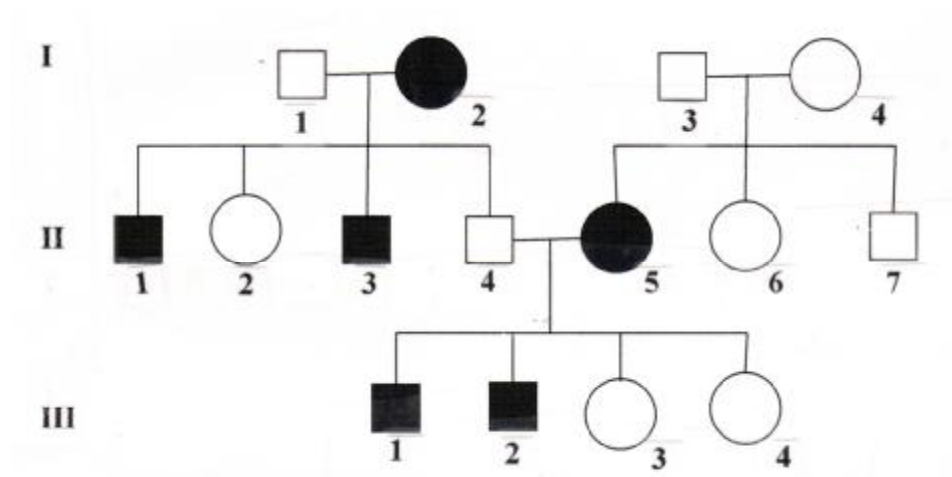
- A. mutations
- B. predation
- C. wind
- D. soil type

Question 5:

DNA and RNA are very similar compounds; they differ in three important ways. Which of the following is **incorrect**?

- A. the sugar in RNA is ribose
- B. RNA contains the nucleotide uracil whereas DNA contains the nucleotide thymine
- C. RNA is ordinarily single stranded
- D. RNA is found only in the nucleus

The following pedigree relates to Questions 6, 7 and 8



Pedigree showing the incidence of deafness in a particular family. (Affected individuals are shaded.)

Question 6

It is reasonable to conclude from the above pedigree that deafness in this family is inherited as;

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

Question 7

It is also reasonable to conclude from the above pedigree that the genotype of individual

- A. I-2 is heterozygous
- B. II-3 is heterozygous
- C. II-7 is homozygous
- D. III-2 is homozygous

Question 8

The chance that a fourth child of I-3 and I-4 is a carrier is

- A. One in four
- B. One in two
- C. Two in three
- D. Three in four

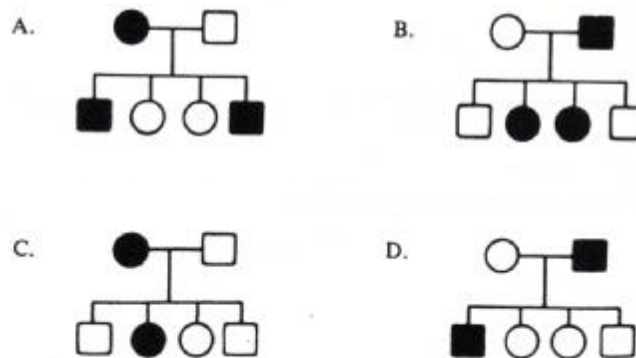
Question 9

Crossing over can involve chromatids from one chromosome exchanging fragments of chromatids from another chromosome to create hybrid chromatids. This process

- A. does not alter the genotype of gametes
- B. can only occur during the first division of meiosis
- C. decreases variation within a population
- D. does not involve homologous chromosomes

Question 10

Which of the following pedigrees is **NOT** consistent with the inheritance of a recessive characteristic controlled by a gene on the X chromosome?. (*Shaded individuals show the trait.*)



Question 11

Below is a diagram showing an original sequence of DNA and the same length of DNA after it has undergone a mutation.

Original DNA strand: CCG TGG TAA TTT CTT
Mutated DNA strand: CCG TGG TAC TTT CTT

Name the type of mutation the original sequence of DNA has undergone.

- A. substitution
- B. duplication
- C. inversion
- D. deletion

Question 12

In guinea pigs, black hair (B) is dominant over white hair (b) and short hair (S) is dominant over long hair (s). A dihybrid cross was performed between a pure breeding white short hair guinea pig and a pure breeding black long hair guinea pig. The offspring of this cross were then mated and the ratio of the phenotypes of their offspring were

- A. 9 : 3 : 3 : 9
- B. 7 : 4 : 2 : 1
- C. 9 : 3 : 3 : 1
- D. 6 : 7 : 5 : 1

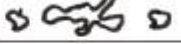
Question 13

A large population with plenty of genetic diversity goes through a period where the population diminishes to a very low number of individuals. These individuals survive and reproduce to build up the species again but have lost much of their genetic diversity. This type of event is known as

- A. Genetic drift
- B. Population bottleneck
- C. Founder effect
- D. Artificial selection

Question 14

By comparing fossils in different layers of rock strata (sedimentary rocks), it is possible to determine the relative ages of the fossils. Which of the following rock strata contains the oldest fossils?

A		B		C		D
						
						
						
						
						

Question 15

An index fossil can be used to date rock in which it is found. A useful feature of an index fossil is:

- A. An index fossil should be abundant
- B. An index fossil lived through a long range of time
- C. An index fossil lived in a narrow geographic region
- D. An index fossil should always be part of a skeleton

Question 16

Australia and Antarctica were part of which supercontinent?

- A. Gondwana
- B. Cambria
- C. Laurasia
- D. Pangaea

Question 17

A bat and a butterfly have wings with which they fly. These wings have a similar function but a very different construction. They are

- A. Comparative structures
- B. Convergent structures
- C. Homologous structures
- D. Analogous structures

Question 18

Episodes of mass extinction have occurred over the last 500 million years. Which of the following is **NOT** a possible cause of mass extinction?

- A. Large solar flares
- B. Continental drift
- C. Predation
- D. Sea level change

Question 19

“Ancestral giraffes with short necks tended to stretch their necks to reach tree foliage that served as a major part of their food source. This frequent neck stretching caused their offspring to have slightly longer necks. As these offspring also stretched their necks, the next generation had still longer necks. And so, as a result of neck stretching to reach higher and higher foliage, each generation had slightly longer necks than the preceding generation.” This theory was put forward by;

- A. Charles Darwin
- B. Erasmus Darwin
- C. John Baptiste de Lamarck
- D. Gregor Mendel

Question 20

Mitochondria were once free living organisms that became incorporated into eukaryotic cells bringing their DNA with them. Mitochondrial DNA has been used extensively in evolutionary studies because

- A. It is easier to access
- B. It does not recombine
- C. It is present in tiny amounts in the cell
- D. It can tell us about the environment the individual lived in as well as the genetic line of the individual

Question 21

Consider the following table of percentage divergence of nucleotide sequences in a rapidly evolving psuedogene in four primate species.

DNA from ↓ compared with DNA from →	Human	Chimpanzee	Gorilla	Orangutan
Human	-	1.56	1.69	3.30
Chimpanzee	1.56	-	1.82	3.42
Gorilla	1.69	1.82	-	3.39
Orangutan	3.30	3.42	3.39	-

From the above data on DNA comparison it is reasonable to conclude;

- A. Chimpanzees and Orangutans are the most closely related species.
- B. Humans and Orangutans are the most closely related species.
- C. Chimpanzees and Humans are the most closely related species.
- D. Chimpanzees and Gorillas are the most closely related species.

Question 22

Humans have shown extensive adaptation and have migrated into more habitats than any other primate species. This is most likely due to

- A. color vision
- B. large brain
- C. opposable thumb
- D. upright locomotion

Question 23

Which of the following is an example of cultural evolution?

- A. bony brow ridge
- B. well developed collar bone
- C. long gestation period
- D. religious rituals and burials

Question 24

Modern technology now allows scientists to manipulate the genetic complements of an organism. Which of the following is **NOT** a gene manipulation technique?

- A. gene transfer
- B. DNA sequencing
- C. selective breeding
- D. cloning

Question 25

Which of the following correctly identifies a stage of mitosis?

- A. cytokinesis is when two new nuclei form
- B. the mitotic spindle forms during early telophase
- C. during telophase the DNA condenses into chromosomes
- D. chromatids separate along the mitotic spindle during anaphase

SECTION B – Short-answer questions**Question 1**

A normal zebra finch is brightly colored but there are also two distinct forms of albino finch. One form, though almost totally white, has a slight brown tinge near its eyes (Strain A). The other is a classic albino (Strain B). If the two forms of albino finches are crossed, the offspring are normal wild types; they have slate grey bodies and colorful markings.

- a. Name the study of a mating between two organisms where two pairs of contrasting characters are followed.

1 mark

The failure of the normal pigmentation system in zebra finches can occur at two known points; the pigment protein can be defective which is the problem with strain B; or the control mechanisms that turn on pigment production and control the amount made can be defective, which is the problem for strain A.

- b. Use allelic symbols Q and q for pigment production and R and r for defective proteins.
 - i. What are the genotypes of the two varieties of purebred albino zebra finches? (Indicate in your answer which genotype matches which phenotype.)

- ii. If the above two zebra finches mate, what is the genotype and phenotype of their F₁ offspring?

1 + 1 = 2 marks

A mating occurred between a female albino zebra finch (qqRr) and a normal male colorful finch (QqRr).

- c. What are the gametes produced by each parent?

1 mark

- d. Draw a punnet square to represent the possible zygotes formed by different combinations of gametes coming together at fertilization.

2 marks

- e. What is the phenotypic ratio of the offspring in (d)?

1 mark

Total 7 marks

Question 2

New cells are constantly being produced in organisms. As cells reproduce, it is critical that the genetic material is also reproduced so that any new cells produced have the same amount and kind of genetic material as the parent cell.

- a. Briefly explain the purpose of DNA replication.

1 mark

b. DNA replication involves many stages that are controlled by enzymes. One such enzyme is *helicase*. Describe the role of *helicase* in DNA replication.

1 mark

c. Meiosis is a specialized form of cell division. Label the following statements as *true* or *false*.

As a result of meiosis;

i. Variation and diversity of offspring is narrowed.	
ii. Each daughter cell contains the haploid number of chromosomes.	
iii. Meiosis takes place in the reproductive organs of living things.	
iv. One cell division completes the process of meiosis.	
v. Asexually reproducing organisms reproduce by meiotic division of cells.	
vi. Gametes are the output of this process.	

3 marks

Total 5 marks

Question 3

A group of Year 12 Biologists are to visit the CSIRO to undertake some experiments relating to DNA manipulation and modification. The first experiment is to insert a plasmid into *E.coli* then select and amplify those cells which have taken up the plasmid.

a.

i. What is a plasmid?

- ii. Gene cloning is a process of making large quantities of a desired piece of DNA, for example a hormone. How would you clone a gene for a specific hormone using a recombinant DNA plasmid? Space has been provided for you to include a diagram. 1 + 2 = 3 marks

- b. Name the method you would use to amplify the recombinant DNA plasmid.

1 mark

The second experiment the students must undertake is to separate fragments of a plasmid which has been cut using restriction enzymes. They will be using gel electrophoresis.

- d. Name two factors that gel electrophoresis would use to separate large molecules.

2 marks

- e. Describe one situation where only a small amount of DNA may be available for sampling and would need to be amplified.

1 mark
Total 10 marks

Question 4

Below is a DNA sequence from the beginning of a gene coding for an enzyme involved in the process of cellular respiration. It represents a synthesized DNA sample.

A	T	G	C	C	G	T	G	G	A	T	A	T	T	T	C	T	T	T	T	A	T	A	T	A	A	A	T	A	G
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

a.

i. What do the letters **A** and **C** stand for?

ii. Convert the above synthesized DNA sample into the complementary sequence of the sample DNA.

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

1 + 1 = 2 marks

b.

i. The sample DNA now undergoes a process by which the code is rewritten into a mRNA molecule. Name this process.

ii. Complete the mRNA sequence.

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

1 + 1 = 2 marks

Consider the following genetic code table.

SECOND LETTER											
		U		C		A		G			
F I R S T L E T T E R	U	UUU	phe	UCU	ser	UAU	tyr	UGU	cys	U	T H I R D L E T T E R
		UUC		UCC		UAC		UGC		C	
		UUA	leu	UCA		UAA	stop	UGA	stop	A	
		UUG		UCG		UAG	stop	UGG	trp	G	
	C	CUU	leu	CCU	pro	CAU	his	CGU	arg	U	
		CUC		CCC		CAC		CGC		C	
		CUA		CCA		CAA	gin	CGA		A	
		CUG		CCG		CAG		CGG		G	
	A	AUU	ile	ACU	thr	AAU	asn	AGU	ser	U	
		AUC		ACC		AAC		AGC	C		
		AUA		ACA		AAA	lys	AGA	arg	A	
		AUG	met	ACG		AAG		AGG		G	
	G	GUU	val	GCU	ala	GAU	his	GGU	gly	U	
		GUC		GCC		GAC		GGC		C	
		GUA		GCA		GAA	gin	GGA		A	
		GUG		GCG		GAG		GGG		G	

c. Determine the amino acid sequence of the above mRNA sequence by using the genetic code table.

--	--	--	--	--	--	--	--	--	--

1 mark

d. What is an anticodon and where is it located?

2 marks

Total 7 marks

Question 5

The Tamar wallaby, *Macropus eugenii*, lives today in regions in the south west corner of Western Australia, on a few islands and in a small area of South Australia. During the day they rest and at night travel to feed in open grassy areas up to 1 km away from the protective thickets in which they sleep.

- a. Describe one way that will cause animals to move on to new environments, away from their original habitats.

1 mark

- b. Another species of *Macropus*, is a form of desert wallaby. It is also nocturnal but does not have access to open grassy areas. Describe the process of speciation and outline how it may have occurred with respect to *Macropus*.

2 marks

- c. Isolated populations, such as the Tamar wallaby, may be subjected to quite different selection pressures.

- i. Define the term selection pressure.

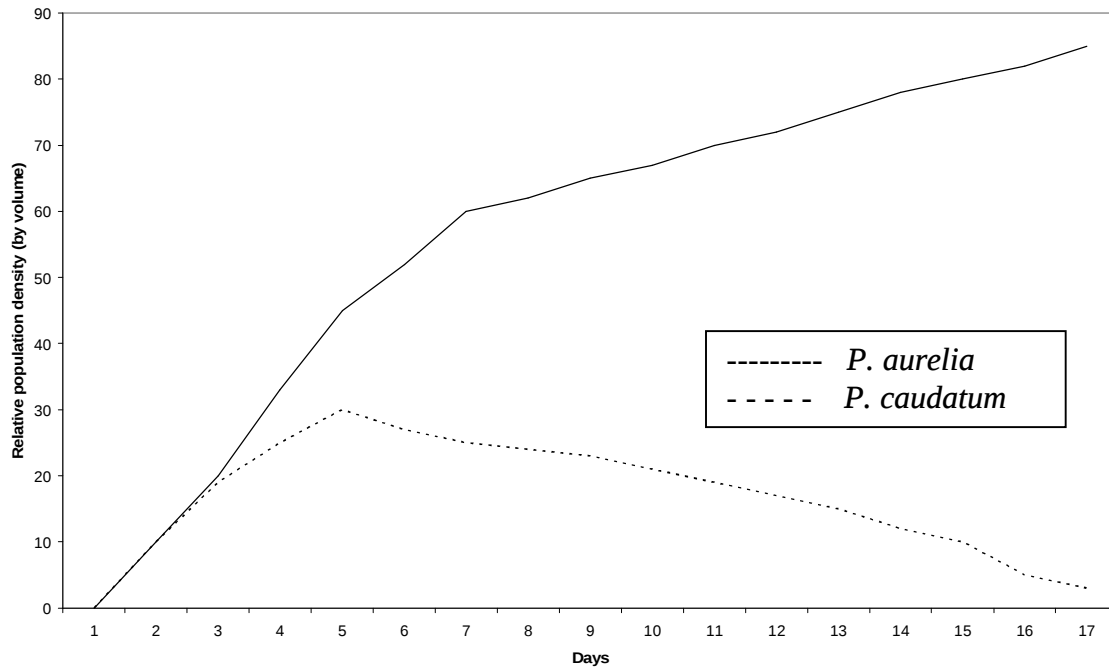
- ii. Give an example

1 + 1 = 2 marks

Total 5 marks

Question 6

When a few individuals of two species of *Paramecium* are introduced into a tank alone they multiply until they reach a limiting density. The graph below shows what occurs when individuals of both species are introduced together.



- a. Describe what has occurred in both populations of *Paramecium* in the first three days.

1 mark

- b. Discuss what has occurred to the population of *P. aurelia* compared to *P. caudatum* over the three week experiment.

2 marks
Total 3 marks

Question 7

Accurate diagnostic tools are increasingly being used to detect genetic diseases, such as Huntington's Disease, in embryos. Genetic screening for inherited diseases and the associated approved termination of affected fetuses will affect the human gene pool.

- a. As a result of medical advances for the sufferers of genetic diseases, some are living to adulthood and thus reproducing. In what way will the gene pool be affected by
- i. genetic screening

- ii. longer life span for sufferers of genetic diseases.

1 + 1 = 2 marks

Current research in Australia is looking at ways to control the differentiation of stem cells and their possible applications to the general population.

- b. What are stem cells?

1 mark

The research has both commercial and therapeutic possibilities. Once cells are grown they can be transplanted into people who need them.

- c. Give a specific example of the possible use of stem cells.

1 mark

Total 4 marks

Question 8

The African rhinoceros has been slaughtered over many years for its horns. It appears, however that a change in the phenotype of the rhinoceros may be allowing for its long term survival. In 1920, only 1 percent of rhinoceros were born without horns, but recent surveys show that 13.6 percent of females and 8.3 percent of males are now hornless. It is unknown what effect the lack of horns will have on the rhinoceros.

- a. How did the absence of horns originate? Define this term.

1 mark

- b. Name the process which has allowed the increase in frequency of the hornless rhinoceros.

1 mark

- c. Explain how this process had lead to this change in the rhinoceros population.

3 marks

- d. A rhinoceros would generally be expected to show a slower evolutionary change over time than a mouse. Explain.

1 mark

- e. The change in the rhinoceros has occurred at a faster rate than that which would normally be expected. Why has there been such a rapid change in the rhinoceros?

1 mark

- f. Name and describe one mechanism which allows the shuffling of existing genetic information.

2 marks

Total 9 marks