CHEMOLOGY EDUCATION SERVICES

Name:_____

Victorian Certificate of Education

2008 BIOLOGY UNIT 4
TRIAL EXAM 2

Time allowed: 1 hour 30 minutes

QUESTION AND ANSWER BOOKLET

Structure of booklet

Section	Number of questions	Number of questions to be answered
A	(25 multiple choice questions)	(25 multiple choice questions)
B	9	9

Directions to students

Materials
Question and answer booklet of 18 pages. Answer sheet for multiple choice items.
An approved calculator may be used.

The Task
Pleasure ensure that you write your name on the multiple choice answer sheet and this answer booklet.
Answer **all** items from Section A, which should be answered on the sheet provided.
Answer **all** questions from Section B, which should be answered in this booklet in the spaces provided. There is a total of 75 marks available.
All answers should be written in English.

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SECTION A – Multiple-choice questions

Instructions for Section A
Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

*Questions 1-3 refer to the following boxes (**A** to **E**) that show some of the events of the cell cycle*

A Chromatids separate

B Nuclear envelope disappears

C Cytoplasm divides

D Chromosomes condense and become visible

E Chromosomes on the equator of the spindle

Question 1
List these events in the correct order, starting with **D**.

A. D A B C E
B. D B E A C
C. D B A C E
D. D A E B C

Question 2
The stage described in box **E** is called.

A. anaphase
B. prophase
C. metaphase
D. telophase

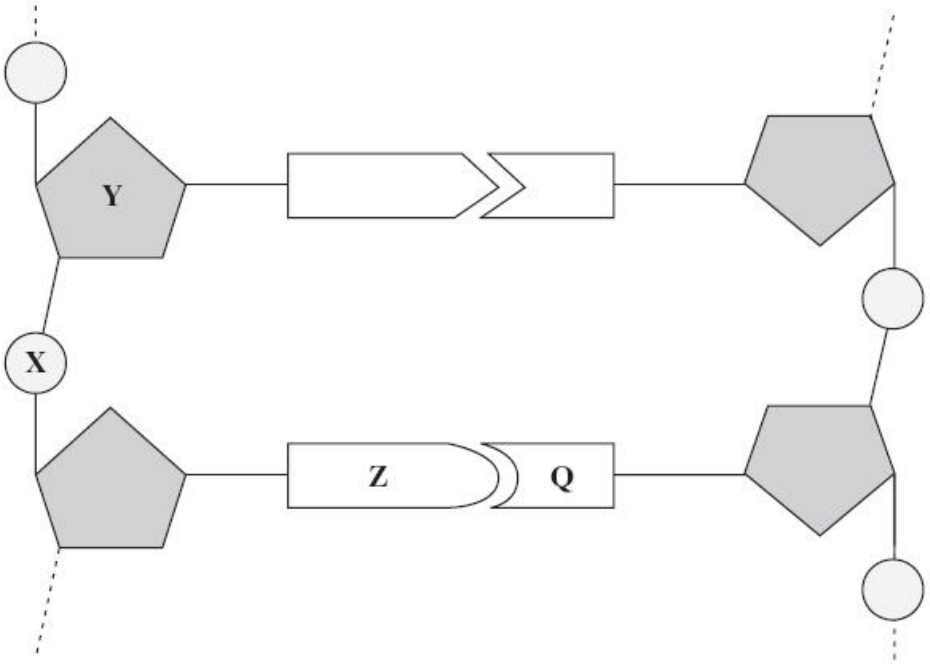
Question 3
Which phase represents DNA replication?

A. Box A
B. Box B
C. Box C
D. Box D

Question 4
Crossing over occurs in _____ of _____

A. prophase 1; meiosis
B. prophase II; meiosis
C. prophase; mitosis
D. anaphase I; meiosis

Questions 5 & 6 refer to Figure 1 that shows *two nucleotide pairs of a DNA molecule.*



Question 5
From the above Figure 1, it can be seen that X represents _____ and Y represents _____.

A. phosphate; nitrogenous base
B. deoxyribose; pentose
C. phosphate; deoxyribose
D. nitrogenous base; phosphate

Question 6
Which type of bond holds together **Z** and **Q**?

A. peptide
B. covalent
C. hydrogen
D. ionic

Use your knowledge of base pairing to answer questions 7 & 8

In an investigation, the DNA of a bacterium was isolated and separated into single strands. The percentage of each nitrogenous base in each strand was found.
The table shows some of the results.

	Percentage of base present			
DNA sample	Adenine	Cytosine	Guanine	Thymine
Strand 1	26	W	28	14
Strand 2	14	X	Y	Z

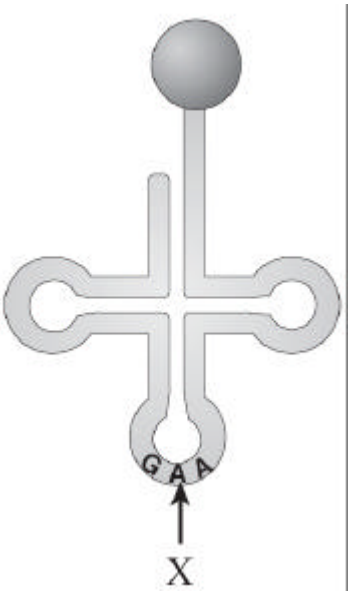
Question 7
The percentages of bases present in a sample of DNA would suggest that the values for W and Z are:

A. 14; 26
B. 28; 26
C. 32; 26
D. 28; 32

Question 8
The percentages of bases present in a sample of DNA would suggest that the values for X and Y are:

A. 14; 26
B. 28; 26
C. 32; 26
D. 28; 32

Figure 2 below relates to Question 9



Question 9
Which DNA base sequence corresponds to the sequence of bases at **X**?

A. C T T
B. C U U
C. G A A
D. G U U

Question 10
Which of the following molecules is produced during translation?

A. DNA
B. tRNA
C. protein
D. mRNA

Question 11
The organelle involved in translation is:

A. Mitochondria
B. Nucleus
C. Centriole
D. Ribosome

Refer to the table below for questions 12 – 14.

Three-letter codons of messenger RNA and the amino acids specified by the codons

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

Question 12
Which of the following correctly matches the amino acid, codon and anticodon?

	Amino acid	Codon	Anticodon
A.	alanine	G C C	C G G
B.	proline	G G C	C C G
C.	isoleucine	T A T	A U A
D.	asparagine	A A C	T T G

Question 13
The following arrangement of bases in a single strand of DNA is

C G C T A A G A T

What would be the arrangement of bases in a strand of messenger RNA coded by this DNA strand?

A. CGCUAAGAU
B. GCGAUUCUA
C. GCGUAACUA
D. CGUAUGGUA

Question 14
Using Table 1, the amino acids represented from the DNA sequence from Question 13 above is?

A. alanine, lysine, histidine
B. arginine, valine tyrosine
C. alanine; isoleucine, leucine
D. alanine; arginine; histidine

Question 15
Which of the following is an example of a human clone produced by natural processes?

A. A developing embryo is split into a number of cells and allowed to develop in host mothers.
B. One female gamete is fertilised by one male gamete and the resulting embryo splits into two separate embryos.
C. The nucleus of an egg cell is replaced by the nucleus of an adult cell.
D. Two female gametes are fertilised at the same time by two different male gametes.

Question 16
Human cloning is currently banned.
Which of the following possible problems associated with the cloning of humans is an issue that society must consider before human cloning can be allowed?

A. A human child created by cloning would not have been able to give consent to the procedure.
B. Scientists employed by commercial companies do not publish their research.
C. The procedures used in animal cloning have not been evaluated.
D. There is a high risk of injury to the host mothers in carrying the cloned embryos.

Question 17
Mitochondrial DNA is used to establish the relatedness between organisms in evolutionary biology, because it

A. Is only inherited in males.
B. Has more genes than nuclear DNA.
C. Mutates more slowly than nuclear DNA.
D. Is only inherited in females

Question 18
Catastrophic events such as fires and floods can cause a dramatic reduction in the population size and reduce genetic diversity. This is an example of:

A. Gene flow
B. Genetic drift
C. Founder effect
D. Mutation

Question 19
Occurs when a small population of limited variation is isolated and forms the basis for a new population

A. Gene flow
B. Genetic drift
C. Founder effect
D. Genetic bottleneck

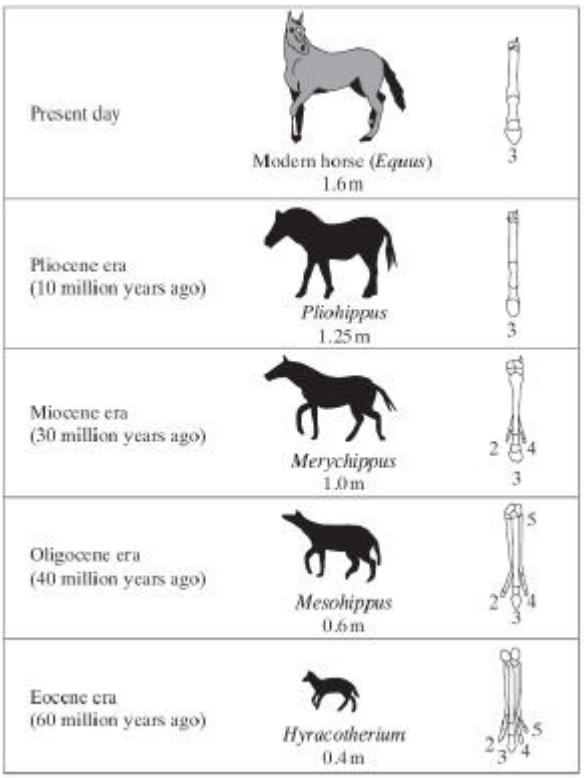
Question 20
When a characteristic is controlled by more than one gene, _____ inheritance occurs and traits controlled by these genes show _____ variation

A. hemizygous; discontinuous
B. polygenic; continuous
C. hemizygous; continuous
D. polygenic; discontinuous

Questions 21 – 23 refer to the following information:

The diagram shows some of the changes in horses that have taken place over the past 60 million years. The numbers on the foot bones refer to different toes.

Horses below the *Present day* are extinct. (The drawings are to the same scale.)



Question 21
The length of the foot bones of the horse changed over 60 million years.
The advantage of this to the horse is that it:

A. reduces the length of the leg so that the mass of the horse is spread evenly
B. allows the horse to balance on its third toe
C. brings the second and fourth toes in line with each other
D. increases the length of the leg so that the horse can run faster

Question 22
Hyracotherium is now extinct.
All of the following are possible causes for this extinction, **except:**

A. fossilisation
B. new predators.
C. a change in the environment.
D. a mutation in pathogens.

Question 23
The changes in the horses, shown in the diagram, are most likely to have happened because . . .

A. different genes control the development of different characteristics.
B. horses did not evolve before 60 million years ago.
C. genes were not mixed during sexual reproduction.
D. genetic changes made horses better adapted to their environment

Question 24
The wings of bats and insects are known as analogous structures as they

A. are similar features resulting from a common ancestor
B. have yet to be discovered as fossils
C. have arisen as a result of divergent evolution
D. have a similar function despite an independent evolution

Question 25
The earliest known hominid is:

A. Australopithecus afarensis
B. Approximately 10 million years old
C. Approximately 6 million years old
D. Approximately 2 million years old

END OF SECTION A

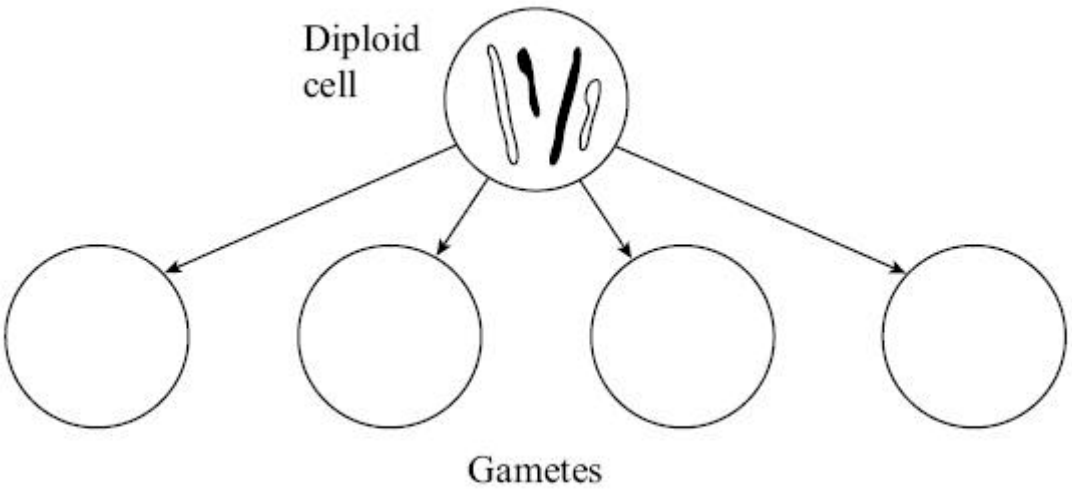
SECTION B – Short answer questions

Instructions for Section B

Answer **all** questions in the spaces provided.

Question 1

a. Complete the diagram below to show the four different combinations of these chromosomes in the gametes produced by meiosis.



(2 marks)

b. Explain why meiosis is known as a reduction division.

_____

_____

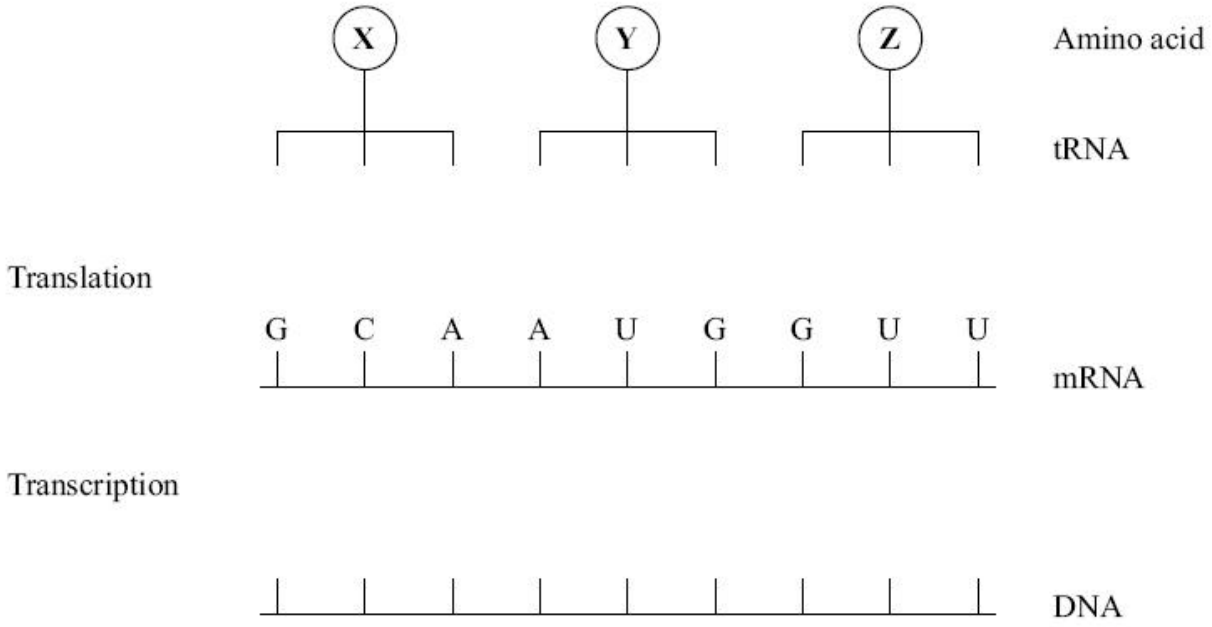
_____

_____

2 marks

Question 2

Figure 1 below shows some molecules involved in protein synthesis.



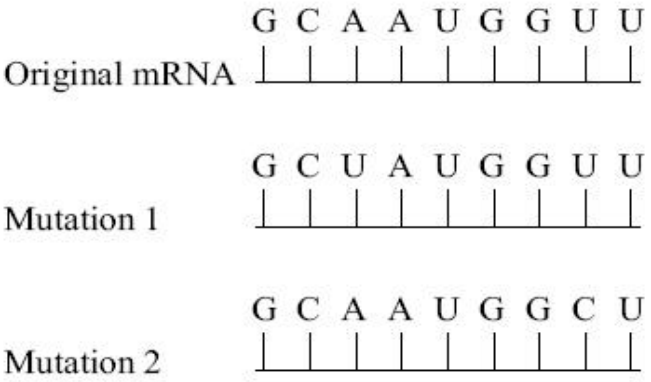
a. Complete the **Figure 1** above to show

(i) the bases on the DNA strand from which the mRNA was transcribed;

(ii) the bases forming the anticodons of the tRNA molecules

2 marks

Figure 2 shows the effects of two different mutations of the DNA on the base sequence of the mRNA. The table shows the mRNA codons for three amino acids.



Amino acid	mRNA codon
methionine	AUG
valine	GUC GUU
alanine	GCA GCC GCU

b. Use the information in the table above to identify amino acid **X** in **Figure 1**;

_____

1 mark

c. Explain how each mutation may affect the polypeptide for which this section of DNA is part of the code.

Mutation 1

_____

_____

_____

1 mark

Mutation 2

_____

_____

_____

1 mark

Question 3

a. Compare and contrast the roles of restriction enzymes (endonucleases) and ligases in genetic engineering.

_____

_____

_____

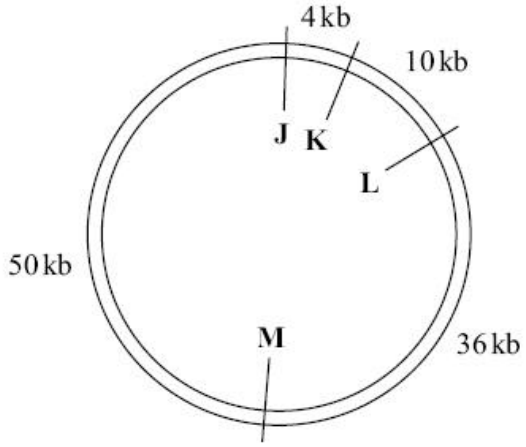
_____

_____

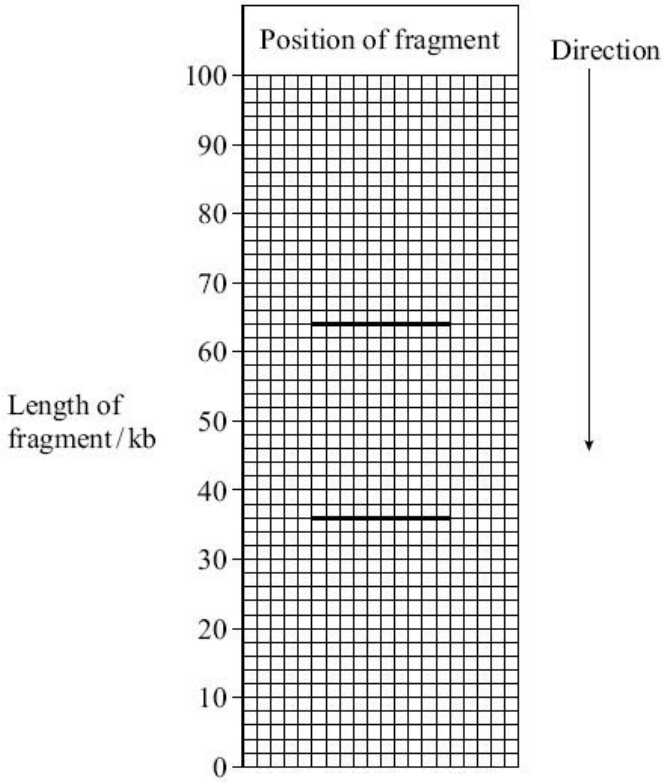
_____

3 marks

The diagram shows the position of four restriction sites, **J**, **K**, **L** and **M**, for four different enzymes on a single plasmid. The distances between the sites are measured in kilo-bases of DNA.



Only two restriction enzymes were used to produce these fragments and gel electrophoresis was used to separate them. The positions of the fragments are shown in the chart below.



b. Explain which of the restriction sites were cut.

_____

_____

_____

_____

2 marks

Question 4

Malaria is a disease which is spread by mosquitoes. Malaria is caused by a single-celled organism. In an investigation, a gene from a bee was transferred into mosquitoes using a plasmid. This gene prevented the mosquitoes and their offspring from spreading malaria.

a. Describe how the bee gene could have been inserted into the plasmid.

_____
_____
_____
_____
_____
_____
_____

2 marks

b. Explain why the plasmids were injected into fertilised eggs of mosquitoes rather than into adult mosquitoes.

_____
_____
_____
_____
_____
_____

2 marks

c. The plasmid contained a genetic marker. What is a genetic marker and why was it used in the experiment?

_____

_____

_____

_____

_____

_____

2 marks

d. Many years ago humans accidentally introduced a species of mosquito to some Hawaiian islands. This species of mosquito carries a type of malaria that only infects birds. Some of these birds are rare. It has been suggested that the control of malaria using genetically-engineered mosquitoes with the bee gene should be tested on these Hawaiian Islands. Suggest **one** advantage of using this approach.

_____

_____

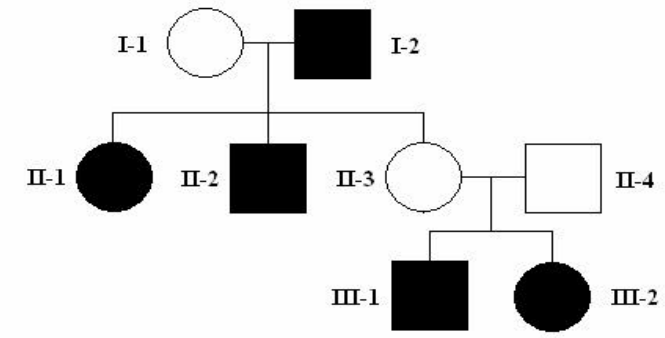
_____

_____

1 mark

Question 5

A pedigree chart for the genetic condition known as Thalassemia is shown below.



a. What type of trait does this disease show?

_____

1 mark

b. Write down the phenotypes and genotypes for each of the following individuals.

Individual	Phenotype	Genotype
I-1		
I-2		
II-3		
III-1		

2 marks

c. What is the chance that individuals II-3 and II-4 will have another affected child? Explain

_____

_____

_____

2 marks

d. Suppose individual **II-1** married a man who was homozygous normal for the trait. Using a punnet square, determine the genotype and phenotype ratio of the offspring.

Genotype Ratio: _____

Phenotype Ratio: _____

2 marks

Question 6

In genetic engineering, two procedures known as gel electrophoresis and PCR are commonly used. Explain the key differences in these two procedures.

4 marks

Question 7

a. A widely accepted theory of evolution states than species will gradually change over time. Name this theory and state 3 key elements involved with the theory

3 marks

b. List 3 pieces of evidence that support this theory of evolution

_____

_____

_____

_____

_____

_____

_____

3 marks

c. The echidna and sea urchin have both developed spines, yet share no common ancestor. Name and define this type of evolution.

_____

_____

_____

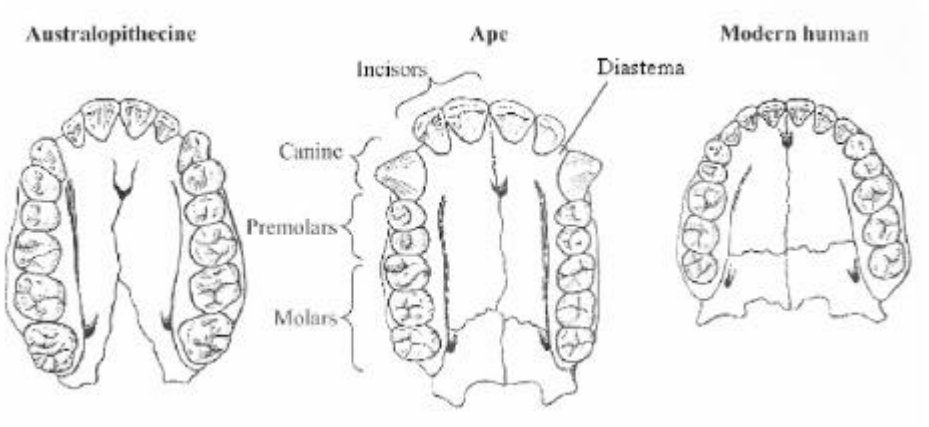
_____

_____

2 marks

Question 8

The drawings show the upper jaws of an *Australopithecine*, an ape and a modern human. All drawings are to the same scale.



a. Describe **one** way in which the teeth of the australopithecine are

(i) different from an ape

_____

_____

_____

1 mark

(ii) different from a modern human.

_____

_____

_____

1 mark

b. It has been suggested that this australopithecine ate large amounts of tough plant material. Using the evidence provided, how did this hypothesis arise?

_____

_____

_____

_____

_____

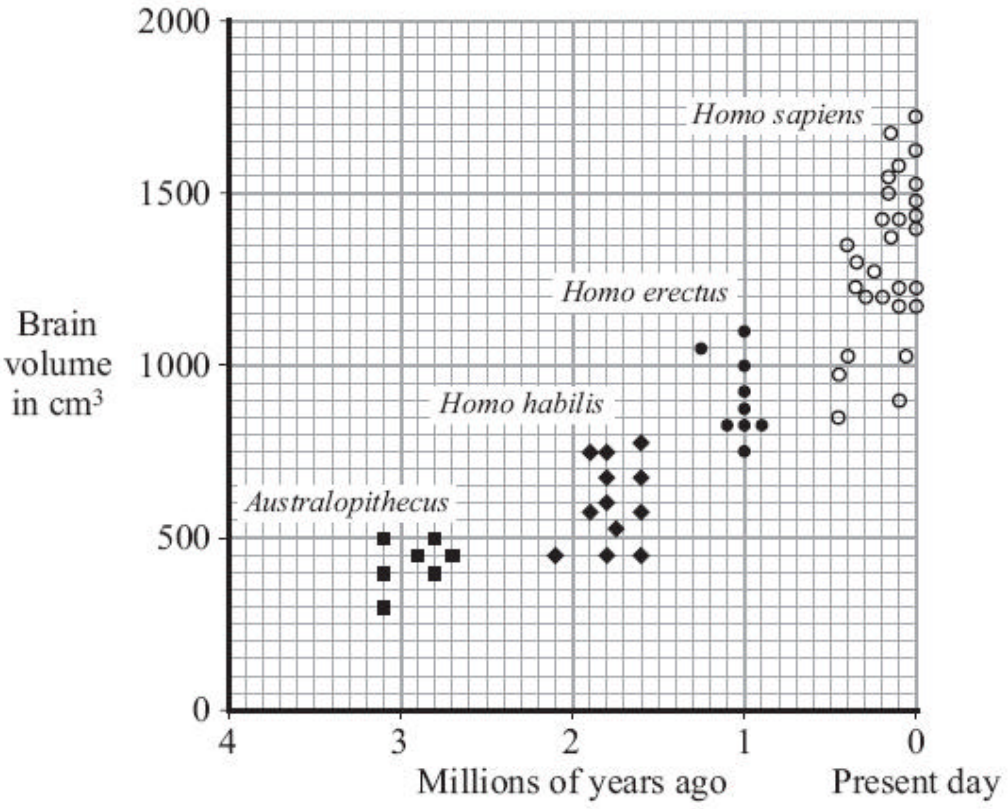
_____

2 marks

Question 9

Modern humans belong to the species *Homo sapiens*. Most scientists think that *Homo sapiens* are related to more primitive species. Three of these primitive species were *Australopithecus*, *Homo habilis* and *Homo erectus*. These three species are now extinct.

The graph shows the volume of the brain of several specimens from each of the species.



a. What can be concluded from the above graph on the previous page?

_____

_____

_____

_____

1 mark

b. Define the term 'cultural evolution'

_____

_____

_____

_____

1 mark

c. List 2 examples of cultural evolution and how your conclusion stated in (a) relates to your examples

_____

_____

_____

_____

_____

_____

_____

_____

2 marks

d. Name and describe one method by which it would be possible to determine how long ago *Australopithecus,* lived.

_____

_____

_____

_____

_____

_____

_____

_____

2 marks

END OF SECTION B

CHEMOLOGY EDUCATION SERVICES

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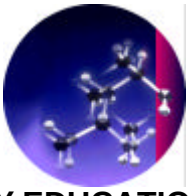
BIOLOGY UNIT 4 TRIAL EXAM

Shade the box corresponding to your answer.

1.	**A**☐	**B**☐	**C**☐	**D**☐	13.	**A**☐	**B**☐	**C**☐	**D**☐
2.	**A**☐	**B**☐	**C**☐	**D**☐	14.	**A**☐	**B**☐	**C**☐	**D**☐
3.	**A**☐	**B**☐	**C**☐	**D**☐	15.	**A**☐	**B**☐	**C**☐	**D**☐
4.	**A**☐	**B**☐	**C**☐	**D**☐	16.	**A**☐	**B**☐	**C**☐	**D**☐
5.	**A**☐	**B**☐	**C**☐	**D**☐	17.	**A**☐	**B**☐	**C**☐	**D**☐
6.	**A**☐	**B**☐	**C**☐	**D**☐	18.	**A**☐	**B**☐	**C**☐	**D**☐
7.	**A**☐	**B**☐	**C**☐	**D**☐	19.	**A**☐	**B**☐	**C**☐	**D**☐
8.	**A**☐	**B**☐	**C**☐	**D**☐	20.	**A**☐	**B**☐	**C**☐	**D**☐
9.	**A**☐	**B**☐	**C**☐	**D**☐	21.	**A**☐	**B**☐	**C**☐	**D**☐
10.	**A**☐	**B**☐	**C**☐	**D**☐	22.	**A**☐	**B**☐	**C**☐	**D**☐
11.	**A**☐	**B**☐	**C**☐	**D**☐	23.	**A**☐	**B**☐	**C**☐	**D**☐
12.	**A**☐	**B**☐	**C**☐	**D**☐	24.	**A**☐	**B**☐	**C**☐	**D**☐
					25.	**A**☐	**B**☐	**C**☐	**D**☐



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SUGGESTED SOLUTIONS TO 2008 BIOLOGY UNIT 4 TRIAL EXAM 2

SECTION A – Multiple-choice question

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

14	C
15	B
16	A
17	C
18	B
19	C
20	B
21	D
22	A
23	D
24	D
25	D

SECTION B – Short answer questions

Question 1

a. An appropriate placement of chromosomes in the correct position (2 marks)
b. Involves one diploid parent cell undergoing 2 divisions (1 mark) producing 4 haploid daughter cell each containing half the number of chromosomes of the parent cell (1 mark)

Question 2

a. (i) C G T T A C C A A
(ii) C G U U A C C U U
b. Alanine
c. Mutation 1 =
Mutation 2 =

Question 3

a. Both restriction endonucleases (enzymes) and ligases are enzymes (1 mark)
Restriction enzymes cuts at a specific base sequence (recognition site) along the DNA to create blunt or sticky ends (1 mark)
Ligases join together two pieces of DNA and assist in the formation of covalent bonds between the sugar phosphate backbones (1 mark)

b. Restriction site L and M were cut as from the gel electrophoresis, there was a 36kb length of DNA (between L and M) and this left over 50kb + 5kb + 10kb = 64kb.

Question 4

a. Plasmid cut using Restriction enzyme/endonuclease (1 mark)
(Complementary) sticky ends formed and the use of ligase helped join together (1 mark)

b. (Bee) gene will get into/expressed in all cells (of the mosquito) (1mark);
The gene gets passed onto future generations (1 mark)

c. To identify mosquitoes which had taken up the gene so only these are used (1 mark);
Identify by looking for those that produce green light (1 mark)

d. Any one of:
Could save birds from malaria, so reversing harm done by humans;
Islands isolated, so fewer problems if trial goes wrong;
If malaria parasite becomes resistant to bee protein, resistance not in human malaria strains;
Resistance will spread through the mosquito population;

Question 5

a. Autosomal recessive (1 mark)

b.

Individual	Phenotype	Genotype
I-1	Normal	Tt
I-2	Thalassemia	tt
II-3	Normal	Tt
III-1	Thalassemia	tt

c. 25 % probability (1 mark), because they both carry the affected gene. Both heterozygous (1 mark)

d. Genotype ratio: 100% Tt (1 mark)
Phenotype ratio: All Normal (carriers) (1 mark)

Question 6

Any relevant information such as:
Gel electrophoresis involves separating fragments of DNA of different lengths using agarose gel and an electric field (1 mark). The shorter DNA fragments move quicker and are drawn to the positive terminal of the gel – opposite end (1 mark)
Conversely, PCR is a technique for amplifying (making many copies) of DNA fragments from minute initial quantities (1 mark) Using the enzyme DNA polymerase, a single copy of the gene/fragment can be copied million of times, showing exponential growth rate (1 mark)

Question 7

a. Natural selection (1 mark);
   Any two of:
   - individuals in a population contain differing genotypes and therefore differing phenotypes
   - a struggle for survival occurs in populations due to selective pressures
   - the best suited phenotypes produce more offspring and therefore each new generation will contain proportionally more of the favourable phenotype
   - overtime, the new variations are so different from the original population that a new species has evolved

b. Any 3 of:
   - common embryology among different life forms
   - more structural similarities between more closely related organisms of common ancestory
   - more biochemical similarities between organisms of recent common ancestory
   - fossil records reveal gradual changes in organisms from ancestral forms over time
   - distribution of present day organisms reveals many cases of common ancestors, once separated, evolving into different species (continental drift)
   - In living organisms, the process of change via natural and artificial selection has been observed

c. Convergent evolution (1 mark)
   Similar features (spines) have developed in organisms that are NOT closely related (1 mark)

Question 8

a. (i) (Australopithicine has) smaller canines/smaller incisors/larger molars (1 mark)
   (ii) (Australopithicine has) gap between canines and incisors/diastema/larger molars(1 mark)

b. Larger molar teeth (1 mark)
   And any one of:
   Its teeth were adapted so that it could grind plant food effectively (1 mark) or Smaller canines so sideways movement is possible (1 mark) or Diastema, to allow movement of food around molars (1 mark)

Question 9

a. That the brain volume has increased as the years have passed (evolution has taken place) ranging from 500 cm3 in *Australopithecus* 3 million years age to ~1700cm in *Homo sapiens* present day (1 mark)

b. Cultural evolution is the gradual change in ideas, skills and customs. (1 mark)
OR It is the evolution of new characteristics, NOT transmitted by genes, but through communication (1 mark)

c. An increase in brain volume can lead to greater cultural developments such as
- moral values (behaviour)
- technical skills
- language
- art/music
- clothing
- housing/shelter
- technology (2 marks max for c.)