

CHEMOLOGY EDUCATION SERVICES

Name: _____

2009 BIOLOGY UNIT 4 TRIAL EXAM 2

Time allowed: 1 hour 30 minutes

QUESTION AND ANSWER BOOKLET

Structure of booklet

<u>Section</u>	<u>Number of questions</u>	<u>Number of questions to be answered</u>
A	25	25
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 responses.

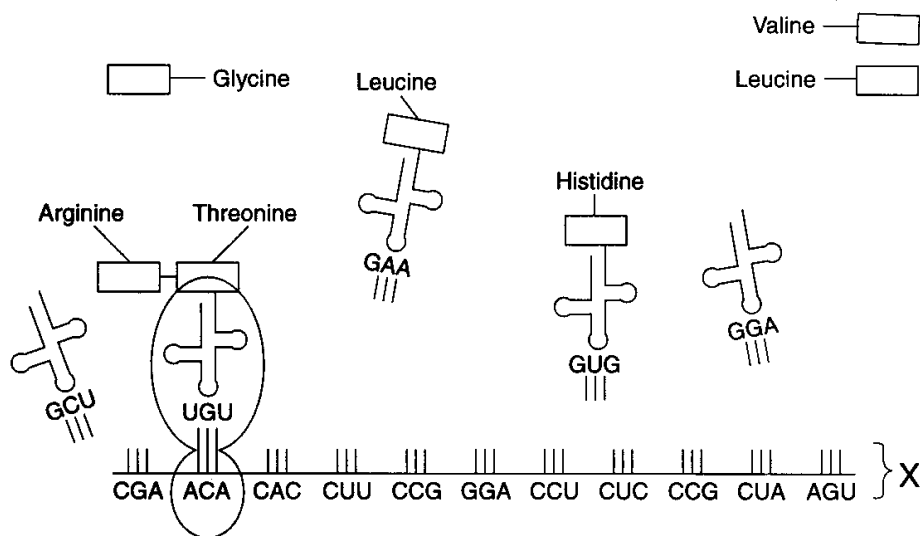
No marks will be given if more than one answer is completed for any question.

Question 1

Which statement regarding DNA is incorrect?

- A. Not all DNA codes for protein
- B. Parts of DNA that carry the genetic code for proteins are called introns
- C. The resulting mRNA is shorter than the DNA template
- D. Mutations involve changes in the DNA genetic code

Refer to the figure below to answer Questions 2 – 4



Question 2

The synthesis of structure X occurred in the

- A. nucleus
- B. cytoplasm
- C. lysosome
- D. vacuole

Question 3

Which amino acid would be transferred to the position of codon CAC?

- A. leucine
- B. glycine
- C. valine
- D. histidine

Question 4

The biochemical process represented in the diagram is most closely associated with the cell organelle known as

- A. nucleus
- B. ribosome
- C. chloroplast
- D. mitochondrion

Question 5

Refer to the Table below.

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

What is a base sequence for a section of DNA which codes for the amino acids lysine and valine?

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

Question 6

Which statement regarding mitochondrial DNA is incorrect?

- A. Mitochondria contain double stranded circular molecules
- B. It codes for approximately 37 genes
- C. Crossing over occurs in each mitochondria allowing for variation
- D. All mitochondrial DNA comes from the maternal line

Question 7

A woman with blood type A blood has several children by a man with blood type B. Their first child was blood type AB.

The number of phenotypes possible for any of their subsequent offspring is:

- A. 2
- B. 3
- C. 4
- D. cannot be determined from information provided

Question 8

Consider the cross between two cats with the following genotypes: Aabb and AaBb, where A and B represent 2 genes on different chromosomes.

The phenotypical ratio expected would be:

- A. 1:1
- B. 3:1
- C. 9:3:3:1
- D. 3:3:1:1

Question 9

Red/green colour-blindness is an X-linked recessive trait. Determine the expected offspring from a father with the colour blindness and a mother a carrier for the trait.

- A. 25% probability any son will have colour blindness
- B. 50% probability any daughter will have colour blindness
- C. 75% probability all daughters produced will have colour blindness
- D. 100% probability all sons will have colour blindness

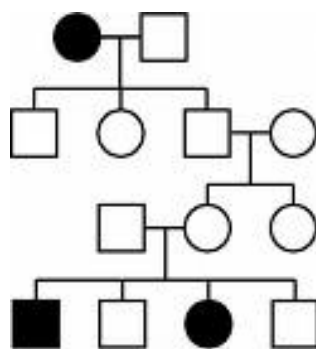
Question 10

What is the position of a gene on a chromosome called?

- A. location
- B. map unit
- C. locus
- D. allele

Question 11

Refer to the following pedigree to answer this question



The most probable mode of inheritance for the above pedigree is

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

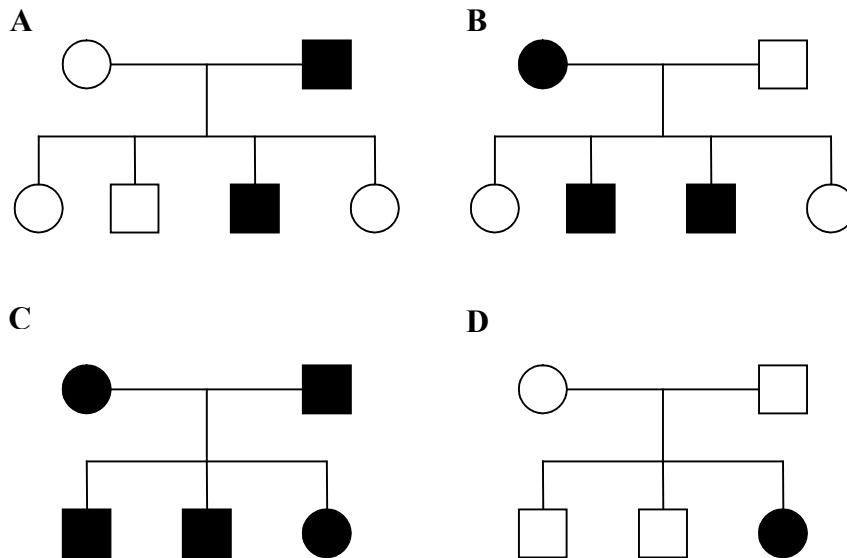
Question 12

The chance of individual II-2 being heterozygous for the condition is:

- A. 0%
- B. 50%
- C. 25%
- D. 100%

Question 13

From the evidence of the pedigrees shown below, which pedigree shows beyond doubt that it is an autosomal-recessive condition?

**Question 14**

The *Agrobacterium tumefaciens* bacterium will accept genes from another organism. The bacterium can then transfer those genes from itself into plants. The plant then grows a lump of cells (a gall) that contain the genes from the bacterium. New plants, containing the genes, can be grown from galls. This technique has been used to transfer genes from a firefly into a tobacco plant, which then glows in the dark.

From which structure in the firefly would scientists cut out the gene that causes glowing?

- A. gamete
- B. chromosome
- C. enzyme
- D. cell

Question 15

In the cross $\frac{AD}{ad}$ x $\frac{AD}{AD}$

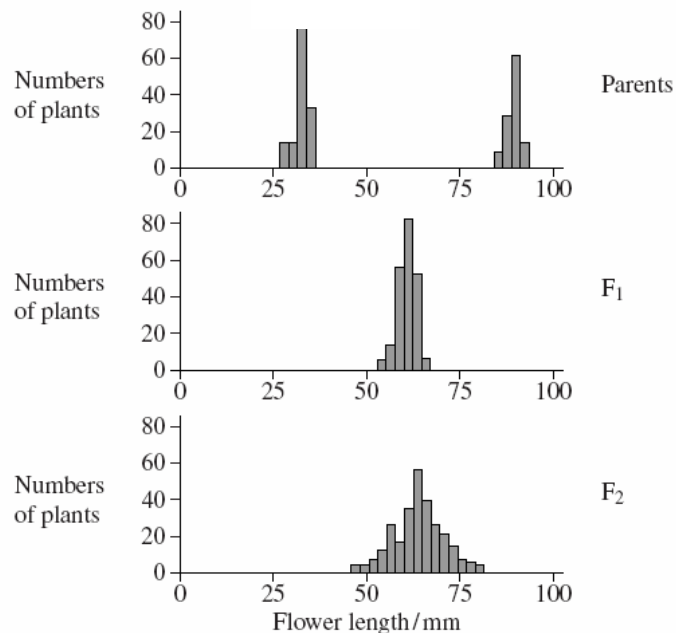
Which one of the following genotypes is possible for an offspring of the above mating?

- A. $\frac{ad}{ad}$
- B. $\frac{AD}{AD}$
- C. $\frac{aa}{DD}$
- D. $\frac{aD}{Ad}$

Questions 16 – 18 refer to the following information:

The inheritance of flower length in tobacco plants is an example of polygenic inheritance. Plants from a group homozygous for all the short-flower alleles were crossed with plants from a group homozygous for all the long-flower alleles. The offspring from this cross (the F₁) were then self-fertilised to produce the next generation (F₂).

The graphs below show the flower lengths in each of these groups of plants.

**Question 16**

Polygenic inheritance and multiple allele inheritance are different. Which statement best reflects the key difference?

- A. Polygenic inheritance requires several different genes to influence the same feature
- B. Multiple allele inheritance occurs when more than two alleles of one gene
- C. Neither A or B are correct
- D. Both A and B are correct

Question 17

The best possible cause for the variation in flower length of the long-flowered parent plants is due to:

- A. environmental influences
- B. the differing alleles of the parents
- C. genotype differences
- D. random assortment of genes

Question 18

How was the genotype of the F₁ plants different from the genotypes of the parent plants?

- A. they were genetically identical
- B. 100% heterozygous for flower-length
- C. 50% homozygous for long flower length
- D. 25% heterozygous for short flower length

Question 19

Which condition would most likely produce a change in the gene pool of a population?

- A. a large population
- B. random mating in the population
- C. migrations out of the population
- D. no mutations in the population

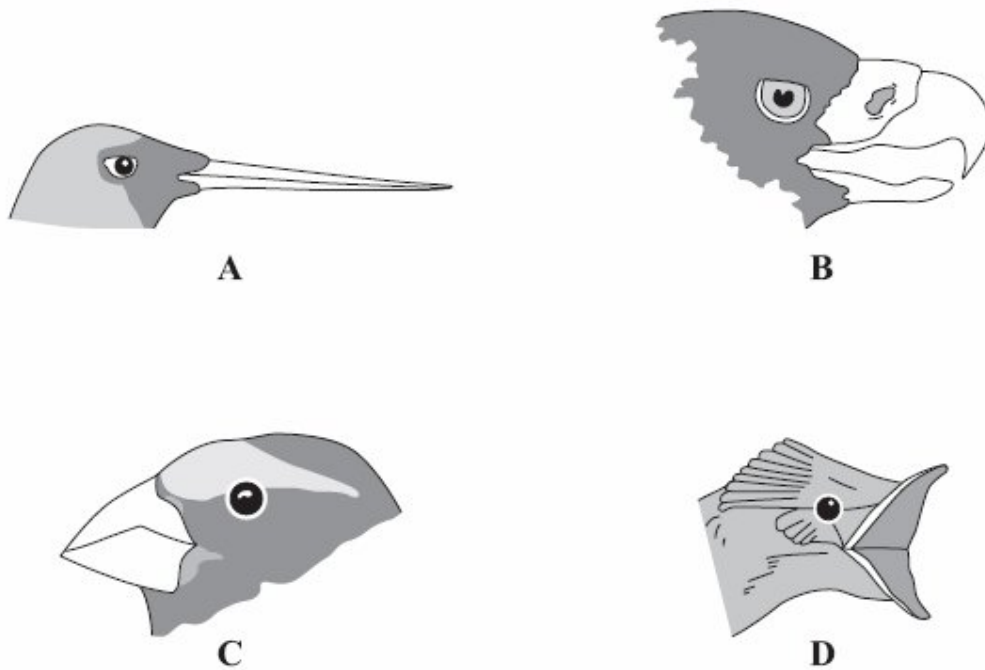
Question 20

A common source of variation which occurs in both humans and viruses is:

- A. mutation
- B. non-disjunction
- C. crossing-over
- D. polyploidy

Question 21

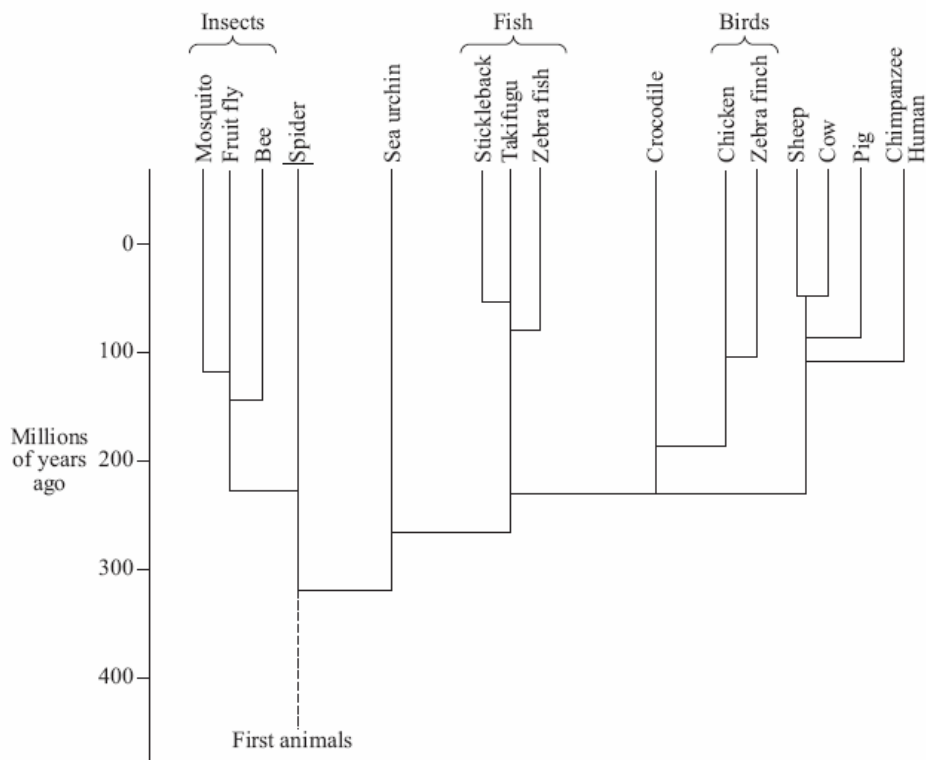
The birds shown below have beaks which are well-suited to the food they eat and the ways in which they obtain it.



According to the diagram above, the bird most likely to catch small insects as it flies is _____ and the bird most likely to feed on nectar deep inside its flowers is _____.

- A. bird A; bird C
- B. bird D; bird A
- C. bird B; bird C
- D. bird C; bird A

Refer to the figure below to answer Questions 22 & 23:



Question 22

The first fish, such as Takifugu, may have evolved from the ancestors of _____ . Birds could have evolved from the ancestors of _____ .

- A. sheep; insects
- B. insects; sea urchins
- C. sea urchins; crocodiles
- D. crocodiles; chickens

Question 23

The fruit fly was first observed approximately

- A. 110 million years ago
- B. 120 million years ago
- C. 220 million years ago
- D. 310 million years ago

Question 24

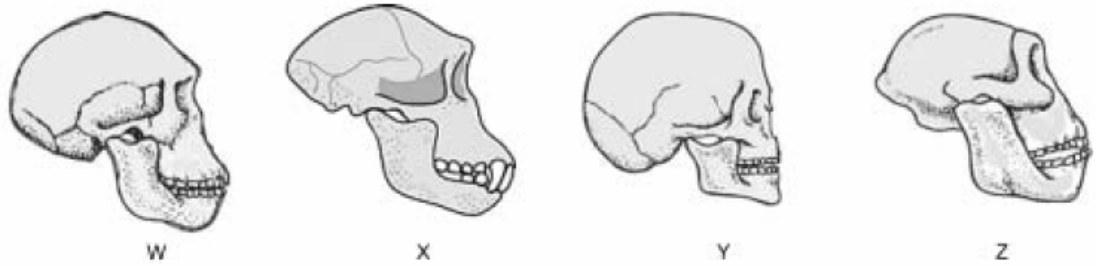
Bats have wings for flying as do flies and mosquitoes. Bats are mammals and therefore vertebrates with an internal skeleton. Conversely, flies and mosquitoes are insects and therefore invertebrates with an exoskeleton.

The wing of a bat and the wing of a fly are described as analogous because:

- A. they have no common evolutionary origin
- B. they have similar function, but different structure
- C. they have similar structure, but different structure
- D. they share a common evolutionary origin

Question 25

The skulls below illustrate different sizes and shape.



The skull that would most likely represent a chimpanzee would be:

- A. Z
- B. Y
- C. X
- D. W

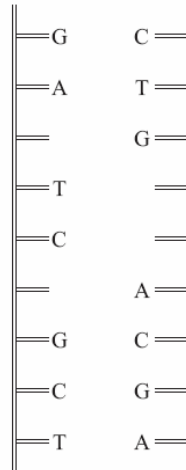
END OF SECTION A

SECTION B: Short Answer Section**Instructions for Section B**

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

Question 1

The diagram shows part of a DNA molecule.



a) Complete the missing bases of DNA in the diagram above 1 mark

b) A particular gene is 652 base pairs long. The mRNA produced from this gene is only 441 nucleotides long. Explain this difference.

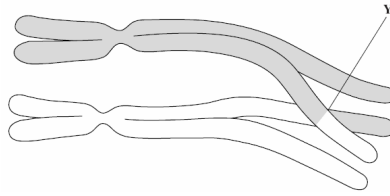
1 mark

c) What is a mutation?

1 mark

d) What possible effect would a deletion of the 4th base of the DNA sequence have on the phenotype of the organism? Explain your answer

2 mark

Question 2

The diagram above shows one pair of homologous chromosomes from a tobacco plant at a stage of meiosis.

a) Give **one** way in which the chromosomes of one homologous pair are:

i) Similar

1 mark

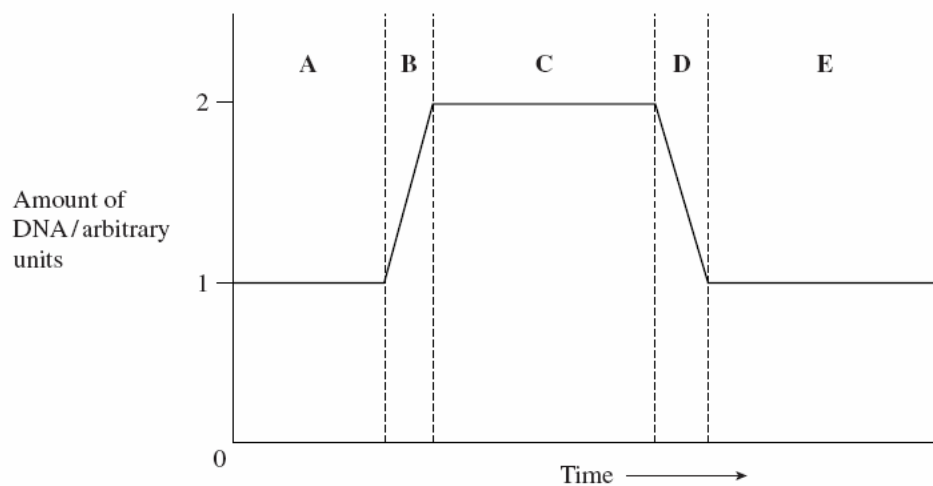
ii) Different

1 mark

b) What has happened at **Y**? Explain the biological importance of this stage in meiosis.

2 marks

The graph shows changes in the amount of DNA in a cell during one cell cycle. Use this graph to answer 2



Question 2 continued

- c) Name the phase of the cell cycle that occurs during time period **B**.

1 mark

Many drugs that are used to treat cancer work at different time periods during the cell cycle.

- d) Cisplatin binds to DNA, and stops free DNA nucleotides joining together.
In which time period, **A** to **E**, would you expect cisplatin to have the greatest effect? Explain your answer.

- (i) Time period

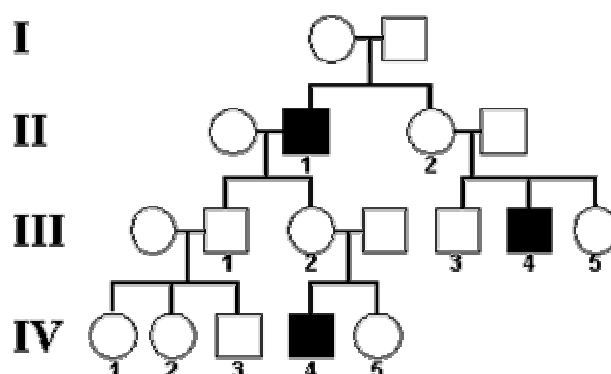
1 mark

- (ii) Explanation

1 mark

Question 3

The pedigree below shows an X-linked trait.



- a) Is the trait dominant or recessive? Explain.

1 mark

Question 3 continued

- b) What is the genotype of individuals II-2 and III-4 and III-5

Individual	Genotype
II-2	
III-3	
III-4	

3 marks

- c) If individual III-3 marries a person who is a carrier for the trait, what is the probability of the offspring showing the trait? Differentiate between the differences observed in sons and daughters. Show working.

3 marks

Question 4

Restriction enzymes are used in DNA technology.

- a) Shown below is the recognition sequence of a restriction enzyme called *EcoRI*. It cuts between the G and the A of the recognition sequence shown.



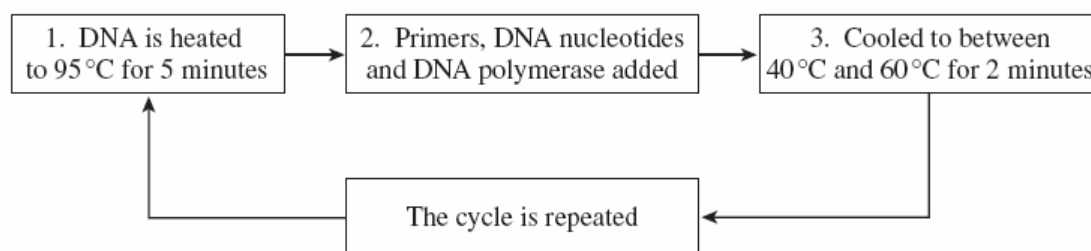
- (i) Name the type of reaction that occurs when *EcoRI* digests DNA.

1 mark

- (ii) Explain why *EcoRI* digests DNA only at the specific recognition sequence shown above.

1 mark

The polymerase chain reaction (PCR) can be used to make many copies of a gene. The diagram shows the main stages in the process.



- b) The DNA is cooled to between 40 °C and 60 °C. Explain why.

1 mark

Scientists obtained very small amounts of DNA from the fossilised jawbone of a mammoth that died 27 000 years ago. They used this DNA in the polymerase chain reaction (PCR).

Question 4 continued

- c) Name **two** substances, other than primers, that should be added to the mammoth DNA for the PCR to take place.

1.

2.

1 mark

- d) The mammoth DNA might have been contaminated with other DNA. Explain how the use of primers in the PCR ensured that only mammoth DNA was produced.

1 mark

- e) The scientists found that the DNA of the mammoth was very similar to that of modern African elephants. Suggest how they found this out.

1 mark

Question 5

Cytochrome c is a protein. The table shows the sequence of the last six amino acids in cytochrome c in humans and three other animals.

Animal	Sequence of amino acids in cytochrome c
Human	lys-ile-phe-ile-met-lys
	lys-th-rphe-val-glu-lys
	lys-ile-phe-ile-met-lys
	lys-ile-phe-val-glu-lys

The three other animals are a monkey, a fish and a horse.

- One of the three is in the same order as humans.
- Two are in the same class.

a) i) Complete the table to show the animal from which each sample of Cytochrome c was taken.

1 mark

ii) Justify your answer.

1 mark

b) Discuss why DNA hybridisation shows similarities between DNA samples.

1 mark

Question 5 continued

c) Explain why the following are used in producing a DNA fingerprint.

(i) Gel electrophoresis

1 mark

(ii) A radioactive probe

1 mark

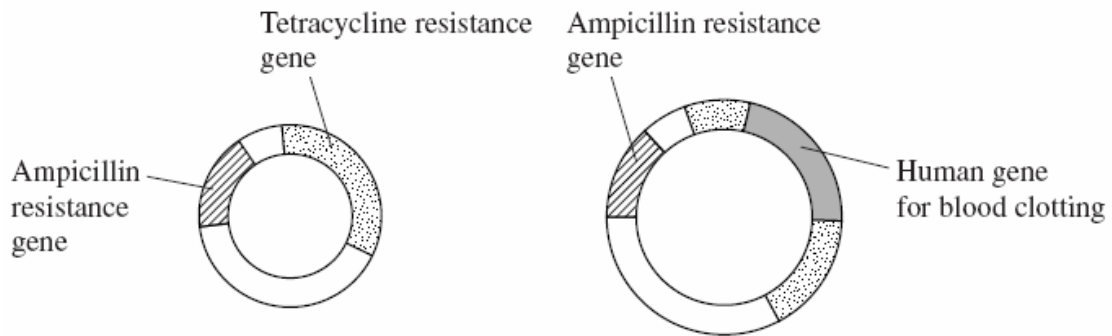
d) A baby shark was born in an aquarium. Scientists believed that a female shark produced the baby without mating with a male, in a process that uses only mitosis.

DNA fingerprints were made for the baby shark and the female. These DNA fingerprints proved that the female was the only parent of the baby shark. Explain how.

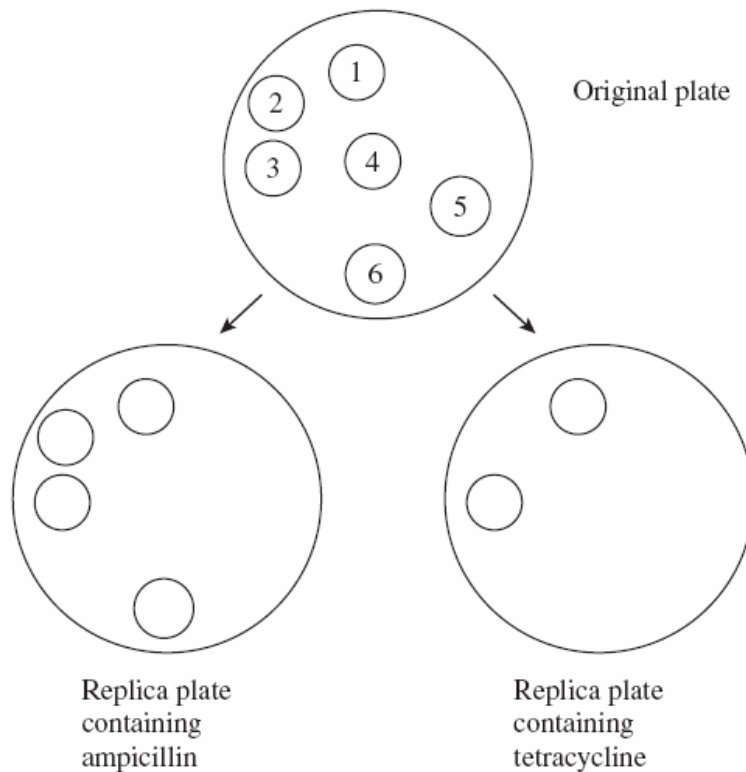
1 mark

Question 6

In genetic engineering, genes for antibiotic resistance in bacterial plasmids can be used as genetic markers. Scientists used a plasmid containing genes for resistance to two antibiotics, Ampicillin and Tetracycline. They inserted the human gene for blood clotting in the plasmid in the position shown below.



Plasmids were then inserted into bacteria. Some of the plasmids did not take up the human gene. Replica plating was used to identify the bacteria with the human gene. The bacterial colonies grew on two replica plates:



- a) Name the type of enzyme which is used to cut the plasmid.

1 mark

Question 6 continued

- b)** Name the type of enzyme which is used to join the plasmid to the human gene for blood clotting.

1 mark

- c)** Complete the previous from 6a) by writing the correct numbers for the bacterial colonies on the replica plates.

1 mark

- d)** Explain the results of the replica plate containing Ampicillin.

1 mark

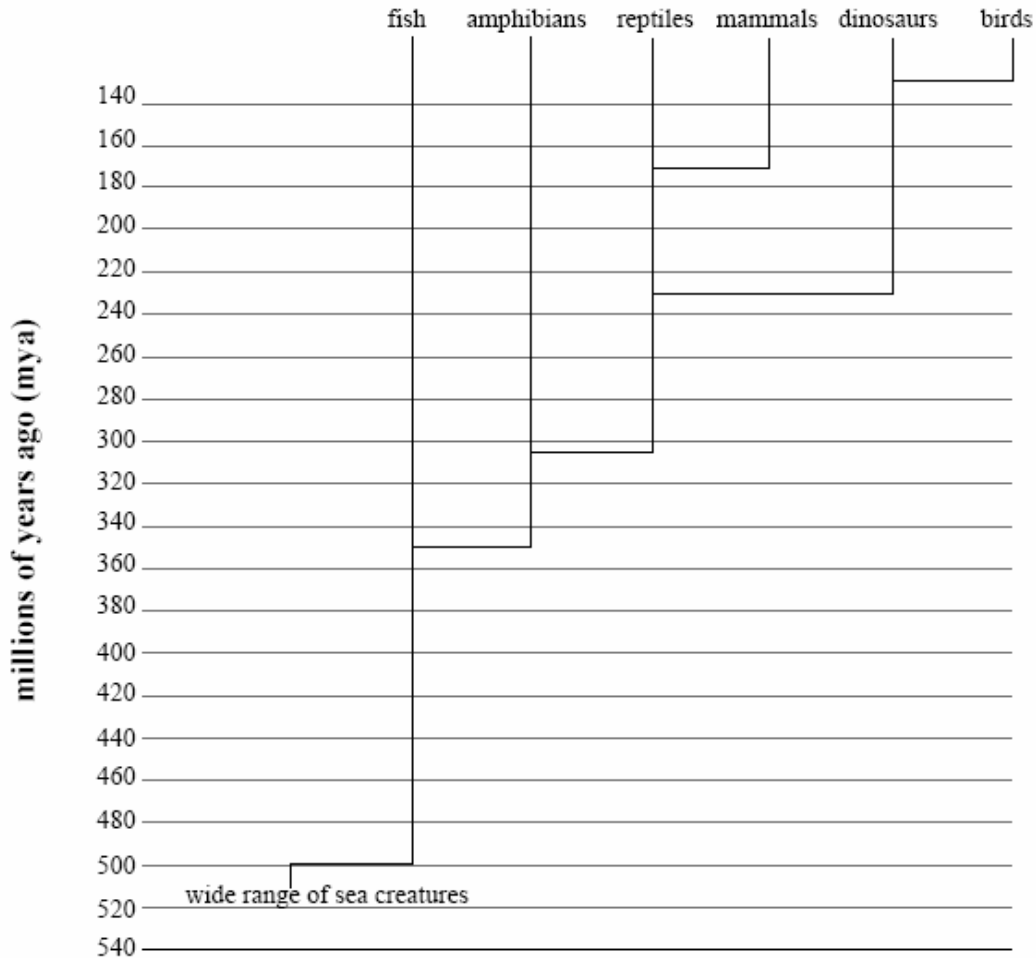
- e)** Explain the results of the replica plate containing tetracycline.

1 mark

Question 7

When Darwin proposed his theory of evolution by natural selection, one of the most important types of evidence he used to support the idea was the fossil record.

The evolutionary relationship between some important classes of animals are shown in the diagram. The estimated ages of the oldest fossils for each class are indicated by the horizontal lines on the diagram.



- a) From the information in **Figure 5** make an estimate of how long it took for the amphibians to evolve from the first fish.

1 mark

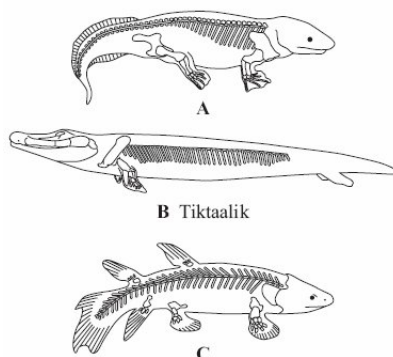
- b) One important evolutionary change was from fish to amphibians, the first air breathing four-legged animals. Until 20 years ago almost no fossils had been found that were intermediate between the two. Critics of evolution referred to a 'missing link'. However scientists predicted such intermediates would be found.

In what age of rock would they have predicted that intermediates, showing features of both fish and amphibians, should be found?

1 mark

Several such fossils have now been found, exactly as predicted. The reconstructions of fossils below, shows some of these intermediate forms in order of age, with the oldest at the bottom.

Reconstructions of some fossils intermediate between fish and four-legged air breathing animals



- c) Use Darwin's theory of evolution to explain the process by which the four-legged land animal, A, may have evolved, over about 20 million years, from the fish-like creature, C, in the swampy conditions of the time.

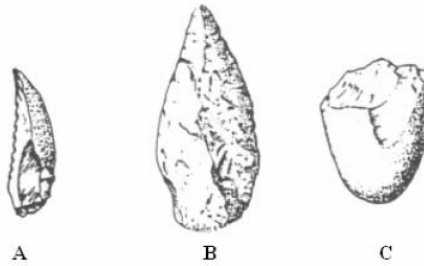
2 marks

- d) Those who oppose the theory of evolution often claim that gaps in the fossil record are important evidence against the theory. Explain why this is not a valid conclusion.

1 mark

Question 8

The diagrams A – C show stone tools found with the fossil remains of some early humans.



- a) Write the letters A – C in the order these tools appeared in evolutionary sequence. Start with the oldest.

Oldest _____; _____; _____ Newest

1 mark

- b) Explanation:

1 mark

- c) The table below refers to cultural developments during the evolution of humans.

Three species of *Homo* are listed in the table. Complete the table by placing a tick in the appropriate box if the statement is correct and a cross if it is incorrect.

Statement	<i>Homo habilis</i>	<i>Homo ergaster</i>	<i>Homo sapiens</i>
First use of fire			
First use of pebble tools (Oldowan culture)			
First use of hand axes (Acheulian culture)			
First tools made by striking flakes from a core			
First production of cave art			

5 marks

- d) Between 8000 and 12 000 years ago humans began the cultivation of wheat and the domestication of cattle.

Explain how the cultivation of plants and the domestication of animals influenced the development of human societies.

2 marks

END OF EXAM

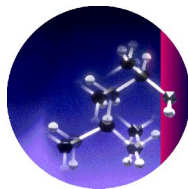
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Name: _____

Biology Unit 4 Multiple Choice Answer Sheet

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 2009 BIOLOGY UNIT 4 TRIAL EXAM

Multiple Choice Section

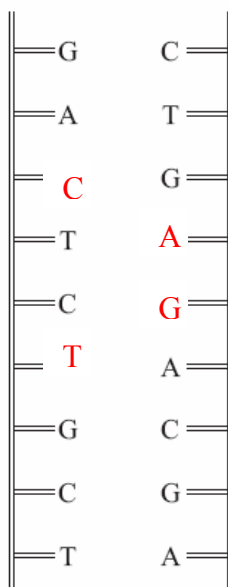
Section A

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

Short Answer Section

Question 1

a)



1 mark for C, A, G, T

- b) The resulting mRNA is shorter as introns from the DNA template are removed. These introns do not carry the genetic code for protein formation. (1)
- c) A mutation involves changes in the DNA genetic code (1)
- d) This would result in a Frameshift mutation to the left altering the base sequences. (1) This in turn would alter the codons, causing different amino acids to be coded for. This results in an altering of amino acid sequence which could cause a non-functional protein to be coded for, ultimately affecting the phenotype of individual (genotype + environment = phenotype). (1)

Question 2

- a) (i) Each chromosome pair contains genes for the same biological features, such as eye color, at the same location on the chromosome (1)
(ii) The 2 homologous chromosomes may carry different genes that code for the same biological feature (1)
- b) Crossing over (1) Prophase I (1). Exchange of genetic material (1)
- c) Interphase/S-(phase)/synthesis; (1)
- d) (i) B; (1)
(ii) Acts during DNA replication; 2

Question 3

- a) Recessive (1). If the female unaffected can pass onto son = recessive (1)
- b) Gene carried on the X-chromosome (1)
- c)

Individual	Genotype
II-2	$X^A X^a$
III-3	$X^A Y$
III-4	$X^a Y$

(1 mark each)

- d) $X^A Y \times X^A X^a$ (1)

	X^A	Y
X^A	$X^A X^A$	$X^A Y$
X^a	$X^A X^a$	$X^a Y$

(1 mark workings)

0% probability of having female with trait; 50% carrier female
 50% probability of having male with trait; 50% normal male
 (1 mark explanation + 1 mark differences in sons and daughters)

Question 4

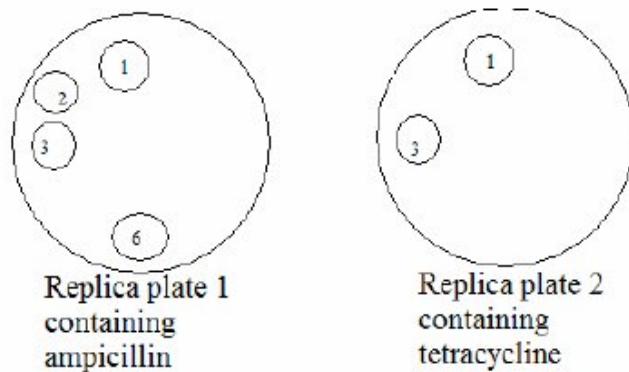
- a) (i) Hydrolysis; (1)
 (ii) Shape / configuration complementary to (shape of) active site of enzyme; (1)
- b) The primers will anneal to the two strands of DNA by complementary base pairing. (1) Allows replication/sequencing to start/keeps strands separate
- c) DNA polymerase, the DNA nucleotides from the fossilised jawbone of the mammoth (1 mark for both pieces of information)
- d) Primers have specific sequence; Join to mammoth DNA specifically/other DNA has different sequence (1)
- e) Find DNA base sequence; Compare; **OR** Single-stranded DNA; Compare degree of base pairing; **OR** Carry out genetic fingerprinting; Compare banding pattern; (1)

Question 5

- a) (Human)
Fish
Rhesus monkey
Horse; (1) for correct order
- b) As animals closely related, more amino acids in sequence; (1)
- c) Any 2 of: The more similar the DNA, the more similar the base sequences; (1)
The greater the number of hydrogen bonds/bonds between base pairs; (1)
More energy/heat needed to separate strands; (1)
- d) (i) Separates DNA;(1) *Accept mini satellites* By length/mass/charge/size; (1)
(ii) Binds to specific/complementary base sequences; (1)
Makes DNA visible/'show up'; (1)
- e) (DNA fingerprint) identical (to mother)/all bands/markers same/in same position; (1)

Question 6

- a) Restriction Enzyme/endonuclease; (1)
- b) Ligase; (1)
- c)



(All correct for 1 mark); 1

- d) Colonies 1, 2, 3 & 6 have taken up the plasmid; (1) Because they are resistant to ampicillin/able to grow on ampicillin; (1) (*Accept reverse argument*)
- e) Colonies 1 & 3 do not have the required gene /recombinant plasmid; As they are still resistant to tetracycline; (1) (Colonies) with the required gene/recombinant plasmid have tetracycline resistance destroyed; (1) OR So required gene must be in must be colonies 2 & 6; (1)

Question 7

- a) 150 million years (1)
- b) any value 350 – 450mya (1)
- c) natural variation/mutation (1); had survival advantage; changing environment; produce more offspring; offspring inherit advantage; gradual spread of the new characteristic; some fish able to breathe air better/some fish with stronger fins/did better in swamp.
- d) gaps can be explained within theory; e.g. not all creatures died in conditions to become fossils (1); not all fossils have been found / lack of fossils does not mean they did not exist; new fossils when found do fit into gaps /lots of fossil evidence for theory; lack of evidence is not the same as evidence for a contrary theory.

Question 8

- a) C, B, A (1)
- b) Increase in sophistication of arrow head (1)
- c)

Statement	<i>Homo habilis</i>	<i>Homo erectus</i>	<i>Homo sapiens</i>
Use of fire	✓	✓	✓ ;
Use of pebble tools (Oldowan culture)	✓		;
Use of hand axes (Acheulian culture)		✓	;
Tools made by striking flakes from a core			✓ ;
Production of cave art			✓ ;

5

- d) More reliable food supply; Allowed population growth; Led to settlements; Production of surplus; Start of trading; Division of labour; (1 mark for any 2 discussed)