CHEMOLOGY EDUCATION SERVICES

Name:_____

Victorian Certificate of Education
2006 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	8	8

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

Specific instructions for Section A

Consists of 25 multiple choice questions. Section A is worth approximately 30% of the marks available. You should spend about 30 minutes on this section.

Choose the response that is **correct** or **best answers the question,** and mark your choice on the multiple choice answer sheet provided.

No credit will be given for an item if two or more letters are marked for that item. Marks will not be deducted for incorrect answers and you should attempt every item.

Question 1

In a human, what is the ratio of the normal chromosome number in a nucleus produced by mitosis to the normal chromosome number in a nucleus produced by meiosis?

A. 1:1
B. 2:1
C. 3:1
D. 4:1

Question 2

The principles of dominance, segregation, and independent assortment were first described by

A. Watson B. Linnaeus C. Mendel D. Morgan

Question 3

In humans, the gene for polydactyly (having extra fingers or toes) is dominant over the gene for the normal number of digits. If parents who are both homozygous dominant for polydactyly have four children, how many of these children would most likely have extra fingers or toes?

A. 0 B. 2 C. 3 D. 4

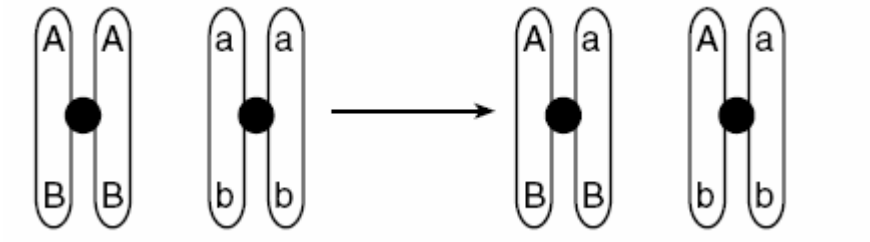
Question 4

In human females, how many egg cells are formed as a result of one primary sex cell undergoing normal meiotic cell division?

A. 1 B. 2 C. 3 D. 4

Question 5

The diagram below represents a change in composition of homologous chromosomes during synapsis.



This change is most likely the result of the process of

A. nondisjunction B. gene linkage C. crossing-over D. polyploidy

Question 6
A cross between two plants that have pink flowers produced plants that have red, pink, or white flowers. Which is the most likely explanation for these results?

A. Intermediate inheritance involved alleles that were not clearly dominant or recessive.
B. Mutations occurred during gametogenesis.
C. Crossing-over of white and red alleles occurred during meiosis.
D. Nondisjunction of homologous pairs of chromosomes resulted in the production of abnormal offspring.

Question 7
Chromosomal mutations occurring in gametes of humans can affect the appearance of offspring because

A. many traits are usually affected
B. only one trait is usually affected
C. these mutations usually speed up embryonic development
D. these mutations usually result in sex-linked traits

Question 8
When 100 white corn seedlings were placed near a light source, 76 turned green within 48 hours. Which statement best explains why some of the plants turned green?

A. A white plant results only from the lack of light.
B. Genes are not affected by environmental conditions.
C. A white plant results only from a homozygous genotype.
D. The environment affects the expression of inherited traits.

Question 9
The types of enzymes produced in a cell are regulated by the

A. order of nucleotides in DNA molecules
B. shape of DNA molecules
C. size of nucleotides in DNA molecules
D. location of DNA molecules

Question 10
Many scientists believe that the earliest cells on Earth were relatively simple, lacking nuclear membranes and other organized cellular structures. Over time, more complex cells developed from these simple cells. These statements describe the concept of

A. inheritance of acquired characteristics
B. evolution
C. dominance
D. use and disuse

Question 11
In the early stages of development, the embryos of dogs, pigs, and humans resemble one another. This observation suggests that these animals may have

A. a similar number of chromosomes
B. similar habitat requirements
C. the same blood components
D. a common ancestry

Question 12
Differences between the members of a population will most likely be passed to future generations if they are

A. due to genetic changes and result in unfavourable variations
B. due to genetic changes and result in favourable variations
C. not due to genetic changes and result in unfavourable variations
D. not due to genetic changes and result in favourable variations

Question 13
Geographic and reproductive isolation are most closely associated with

A. speciation
B. extinction
C. overproduction
D. competition

Question 14
The idea that evolution takes place at a continuous but very slow rate is known as

A. succession
B. artificial selection
C. punctuated equilibrium
D. gradualism

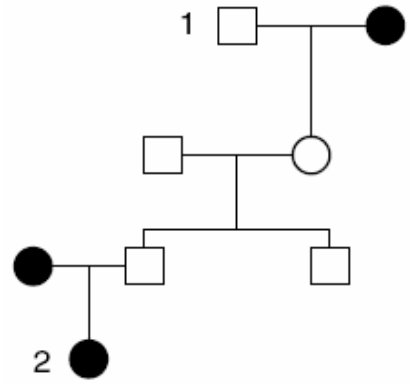
Question 15
In 1994, a new tomato variety that ripens slowly was developed by a laboratory technique that did not involve methods of natural reproduction. This new variety contains a section of a DNA molecule not found in the tomato from which it was originally developed. Which technique was most likely used to develop this new variety of tomato?

A. amniocentesis
B. cross-pollination
C. genetic engineering
D. karyotyping

Question 16
A gene pool consists of

A. all the genes that mutate in a single generation
B. all the heritable genes for traits in a population
C. all the gametes produced by a population
D. the mutated alleles for a particular trait

Base your answers to questions 17 and 18 on the pedigree chart below, which shows a history of ear lobe shape, and on your knowledge of biology.



KEY

E = Allele for free ear lobes (dominant)
e = Allele for attached ear lobes (recessive)

= Male with free ear lobes
= Female with free ear lobes
= Male with attached ear lobes
= Female with attached ear lobes

Question 17
The genotype of individual 1 could be

A. *EE*
B. *Ee,* only
C. *ee*
D. *EE* or *Ee*

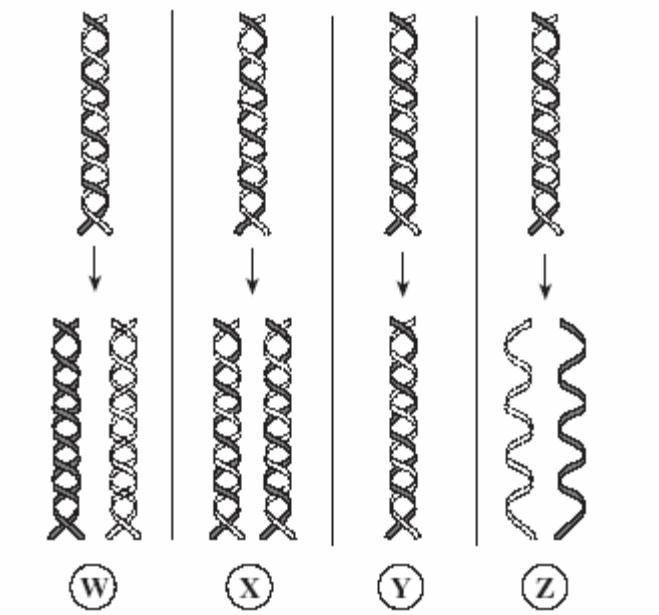
Question 18
The genotype of individual 2 could be

A. *EE,* only
B. *Ee,* only
C. *ee*
D. *EE* or *Ee*

Question 19
Which of the following is the second step of replication?

A. the formation of two new DNA molecules
B. complementary base pairing of nitrogenous bases
C. the breaking of hydrogen bonds between nitrogenous bases
D. the joining of bonds between the sugar and phosphate backbone

Use the following diagram to answer questions 20 and 21.

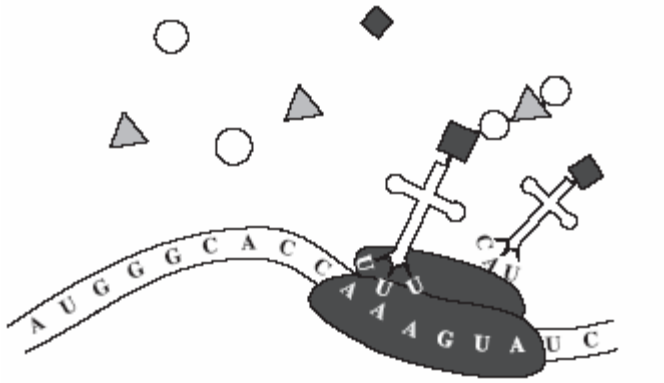


Question 20
Which of the above illustrates the result of replication?
A. W
B. X
C. Y
D. Z

Question 21
Where does this process take place?
A. the nucleus
B. the ribosome
C. the nucleolus
D. the Golgi body

Question 22
Which of the following is a step in transcription?
A. Ribosomes move along mRNA.
B. Amino acids are joined by peptide bonds.
C. Adenine in DNA bonds to thymine in mRNA.
D. Hydrogen bonds are broken to expose a section of the DNA helix.

Use the following diagram to answer questions 23 and 24.



Question 23
The process shown includes which of the following steps?
A. denaturing of tRNA
B. codon-anticodon base pairing
C. joining of adjacent nucleotides
D. formation of hydrogen bonds between amino acids

Question 24
Where in the cell does this process take place?
A. the nucleus
B. the nucleolus
C. the Golgi bodies
D. the rough endoplasmic reticulum

Question 25
Ultraviolet light, which can alter DNA, is an example of which of the following?
A. a mutagen
B. polymerase
C. an anticodon
D. recombinant DNA

END OF SECTION A

SECTION B

Specific Instructions for Section B

Section B consists of 7 short answer questions (question 26 to 32). You must answer all of these questions. The section is worth 50 marks or approximately 70% of the total. You should spend approximately 60 minutes on this section. The marks allocated at the end of each question are an indication of the time required to spend on each question..

Questions should be answered in the spaces provided in this booklet.

Question 1.

(a) The table shows the mRNA codons for some amino acids.

Codon	Amino acid
CUA	Leucine
GUC	Valine
ACG	Threonine
UGC	Cysteine
GCU	Alanine
AGU	Serine

(i) Give the DNA sequence coding for cysteine. (1 mark)

_____

(ii) Name the amino acid coded by the tRNA anticodon UCA. (1 mark)

_____

(b) A particular gene is 562 base-pairs long. However, the resulting mRNA is only 441 nucleotides long. Explain this difference. (1 mark)

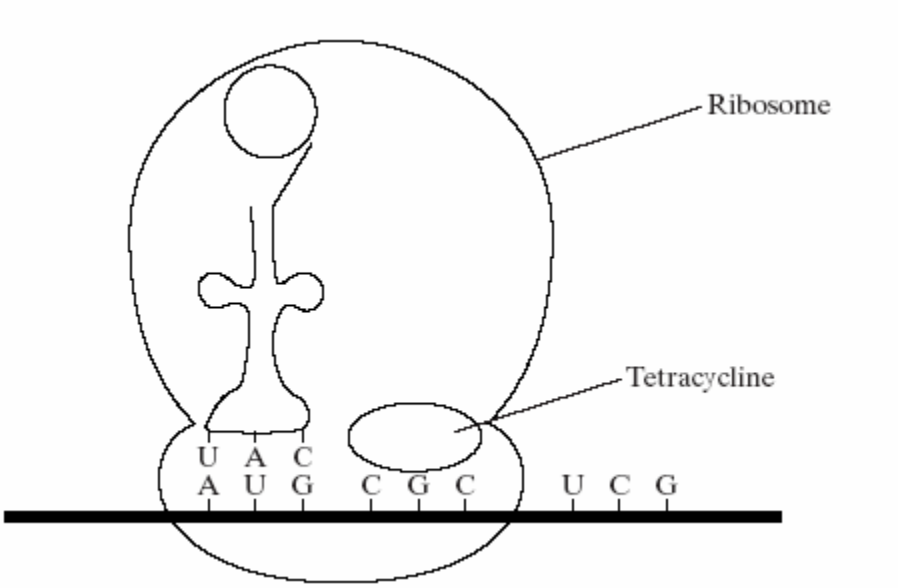
_____

_____

_____

Question 1 continued

Tetracycline binds to bacterial ribosomes. This is shown in the diagram.



Protein synthesis in bacteria is similar to that in eukaryotic cells. Explain how tetracycline stops protein synthesis. (2 marks)

Question 2

Read the following passage.

DNA tests were used to confirm the identity of deposed Iraqi leader Saddam Hussein, after his capture in December 2003. DNA tests were carried out to prove the suspect was not one of the many alleged "look alikes" of the former leader.

Firstly, the DNA was extracted from the mouth of the captured man using a swab. Great care was taken to check that the swab did not become contaminated with any other DNA. DNA extracted from the swab was then subjected to a standard technique called the polymerase chain reaction (PCR), which takes a couple of hours. Lastly, the sample was "typed" to give the genetic fingerprint. This was produced within 24 hours of Saddam Hussein's capture. Tests for use in criminal cases often take much longer because samples are very small or contaminated. It appears that Hussein's genetic fingerprint was already stored away for comparison. This was obtained from personal items such as his toothbrush. DNA from the toothbrush would have been subjected to PCR before a DNA fingerprint could have been obtained.

Source: adapted from SHAONI BHATTACHARYA, New Scientist 15 December, 2003

Use information from the passage and your own knowledge to answer the questions.

(a) Describe how the technique of genetic fingerprinting is carried out and explain how it can be used to identify a person, such as Saddam Hussein.

_____

_____

_____

_____

b) Explain how DNA could be present on a toothbrush.

_____

_____

(c) (i) Explain why the polymerase chain reaction was used on the sample of DNA from the toothbrush.

_____

_____

(ii) Explain **one** way in which the polymerase chain reaction differs from DNA replication in a cell.

_____

_____

Question 2 continued

(d) Tests for use in criminal cases often take much longer because samples are very small or contaminated (lines 8-10). Explain why it takes longer to obtain a genetic fingerprint if the sample is

(i) very small; (1 mark)

(ii) contaminated. (1 mark)

Question 3

(a) Some antibiotics bind with specific receptors in the plasma membranes of bacteria. The structure of these receptors is determined genetically. Bacteria can become resistant to an antibiotic because a gene mutation results in an altered receptor.

(i) Explain how resistance to an antibiotic could become widespread in a bacterial population following a gene mutation conferring resistance in just one bacterium. (5 marks)

(ii) Deletion and substitution are two types of gene mutation. Explain why a deletion is more likely to lead to a bacterium becoming resistant to an antibiotic than a substitution.

Question 3 continued

(b) Some humans have a genetic resistance to infection. A recessive allele gives increased resistance to infection by the malarial parasite. In a population, the proportion of babies born who are homozygous for this allele is 0.01. Use the Hardy-Weinberg equation to calculate the expected proportion of heterozygotes in this population. Show your working.

_____

_____

_____

_____

_____

_____

_____

_____

Question 4

Scientists are working to produce a genetically modified bacterium to treat patients suffering from a disease of the digestive system. They plan to collect mRNA from human cells. This will be used to produce the DNA of the gene for the protein interleukin. They will then transfer this human gene into the bacterium *Lactococcus*. The scientists intend patients to swallow the genetically modified bacteria. These bacteria will release interleukin inside the digestive system to treat the disease.

(a) (i) Name the type of enzyme which will be used to produce the DNA from the mRNA. (1 mark)

_____

(ii) It is easier to obtain the interleukin gene from mRNA rather than directly from the DNA removed from human cells. Explain why. (1 mark)

_____

_____

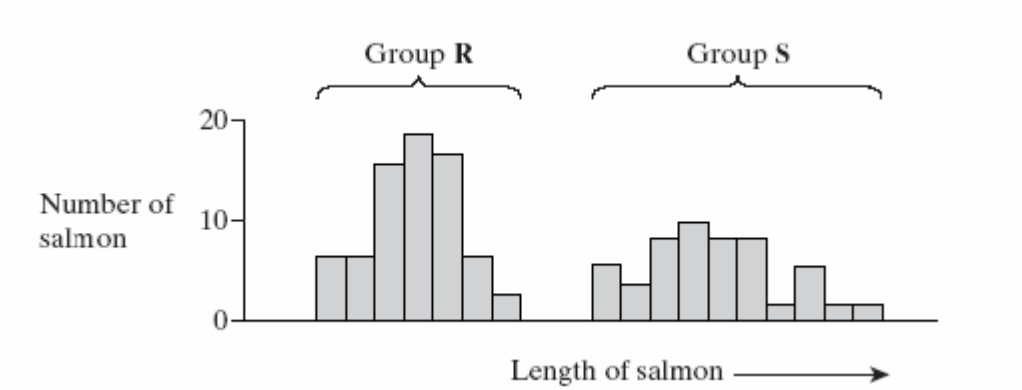
(b) The scientists propose to put the gene directly into the DNA of *Lactococcus*. Describe the role of the enzyme ligase in this process. (1 mark)

_____

_____

Question 5

The graph shows the variation in length of 86 Atlantic salmon.



(i) What type of variation is shown by the lengths of the salmon in group **R**? Give the evidence to support your answer. (1 mark)

.

_____

_____

_____

(ii) Give **two** possible causes of this variation that result from meiosis during gamete formation. (2 marks)

1.

_____

_____

2.

_____

_____

(b) When comparing variation in size between two groups of organisms, it is often considered more useful to compare standard deviations rather than ranges. Explain why.

_____

_____

_____

_____

Question 6

Of all the living primates, the apes that appear most closely related to humans are the chimpanzee, the gorilla and the orangutan. All of these three apes live in tropical rainforests and spend alot of time climbing amongst the trees, collecting food and avoiding large predators! In terms of classification, apes have been placed together in the family Pongidae, based on the fact that they are more closely related to each other than to humans who are classified into family Hominidae. This has been diagrammatically presented below in Fig 3.1

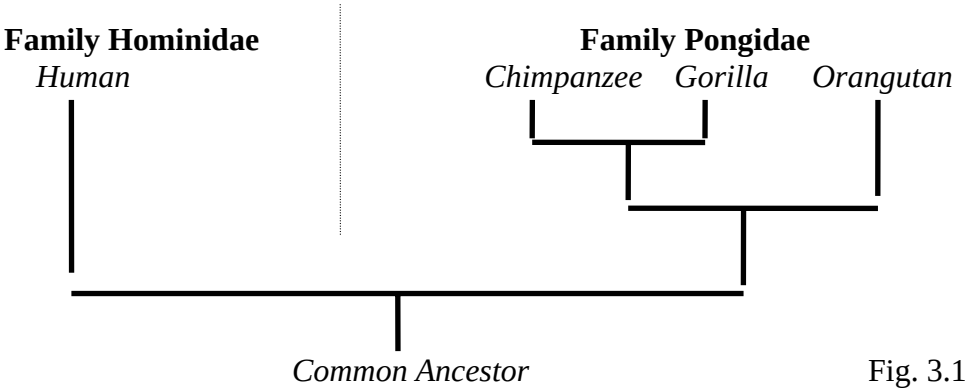


Fig. 3.1

Some phenotypic characteristics do not lend support to his notion of relationship. The table below (table 3A) lists some of the phenotypic characteristics that are varied between humans and apes.

Characteristic	Human	Chimpanzee	Gorilla	Orangutan
Pelvis	Rounded	Elongated	Elongated	Elongated
Enamel on molar teeth	Thick	thin	thin	thick
Sinuses in bones of forehead	present	present	present	absent
Arm length	Shorter than leg	Longer than leg	Longer than leg	Longer than leg
Brow bridges	Weak	Strong	Strong	Weak

Table 3A

a) State two characteristics which support the classification of humans into family Hominidae and the apes into Family Pongidae. (2marks)

_____

_____

Question 6 continued

b) Which characteristic **does not** support this classification? (1 mark)

_____

Biologists can now compare the DNA of different species and see how many of the nucleotides are the same.

d) What is the term used to describe this type of comparison? (1 mark)

_____

c) Describe how this comparison is carried out. (3 marks)

_____

_____

_____

_____

_____

When the nucleotides in a number of human genes are compared with those in the apes, the results are summarised in the table below:

Chimpanzee	Gorilla	Orangutan
98.7	98.4	96.8

% similarities of nucleotides between humans and apes.

d) Using the information from the Table above, with which of the 3 species shown do humans share the **most** recent common ancestry? (1 mark)

_____

e) Why is it more reliable to compare DNA than phenotypic characteristics in determining the evolutionary relationship between species? (2marks)

_____

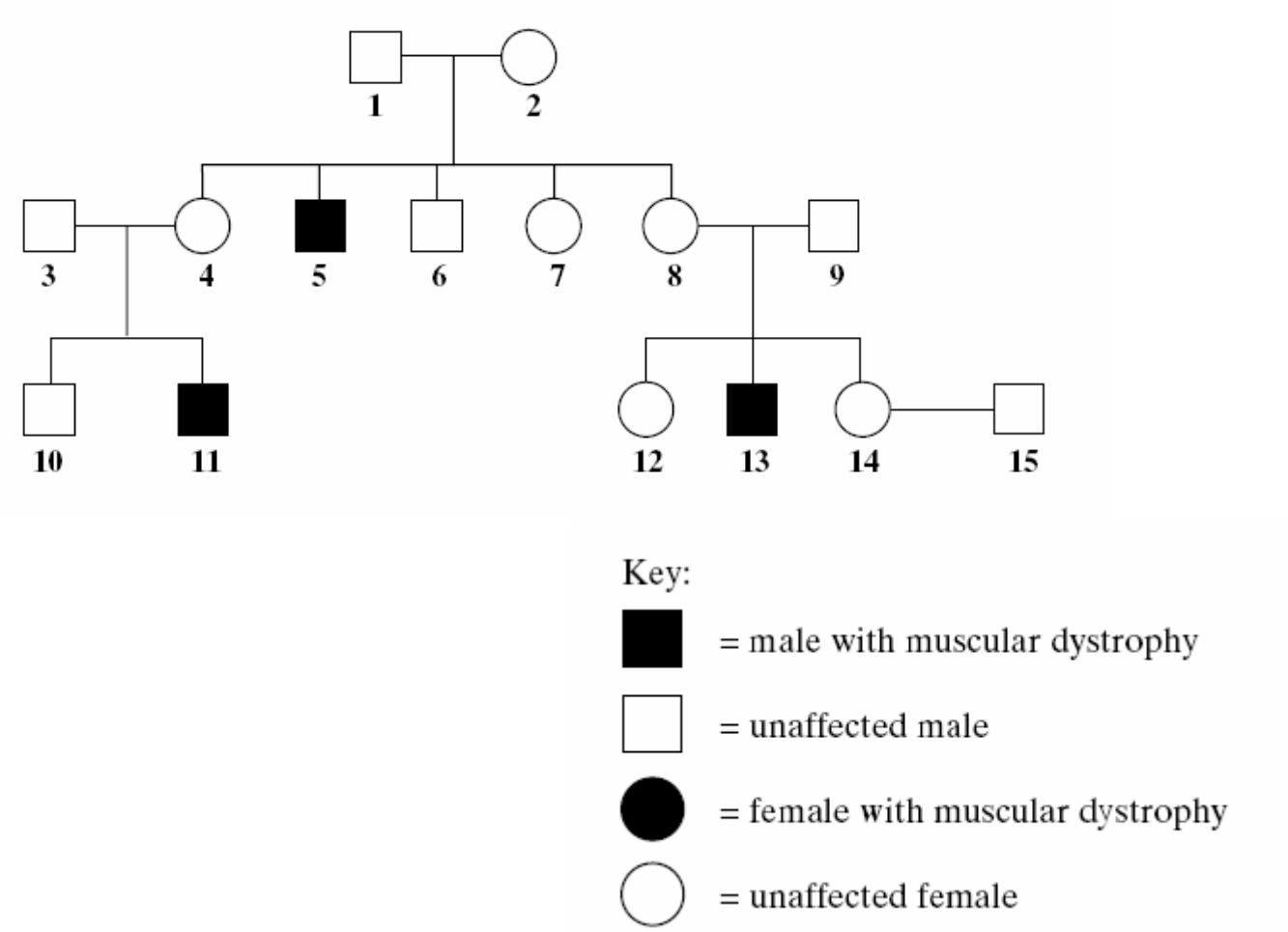
_____

_____

_____

Question 7

Duchenne muscular dystrophy is a sex-linked inherited condition which causes degeneration of muscle tissue. It is caused by a recessive allele. The diagram shows the inheritance of muscular dystrophy in one family.



(a) Give evidence from the diagram which suggests that muscular dystrophy is

(i) sex-linked; (1 mark)

(ii) caused by a recessive allele. (1 mark)

Question 7 continued

(b) Using the following symbols,
XD = an X chromosome carrying the normal allele
Xd = an X chromosome carrying the allele for muscular dystrophy
Y = a Y chromosome
give **all** the possible genotypes of each of the following persons. (2 marks)

5

_____

6

_____

7 .

_____

8

_____

(c) A blood test shows that person **14** is a carrier of muscular dystrophy. Person **15** has recently married person **14** but as yet they have had no children. What is the probability that their first child will be a male who develops muscular dystrophy? (1 mark)

_____.

Question 8

Prokaryotic cells such as some bacteria and viruses possess small circular rings of DNA separate to their normal cellular chromosomal material. Scientists and genetic engineers researching for genetic diseases such as Cystic Fibrosis and Diabetes take great interest in these "extra rings".

a) What is the term used to describe these rings of DNA? (1 mark)

_____

_____

The technology of introducing the DNA of one organism into another is referred to as Recombinant DNA Technology.

b) Describe the process scientists would follow if they wished to clone a human gene using the bacterial rings referred to in (a). (4 marks)

_____

_____

_____

_____

_____

_____

_____

(c) An old form of wheat, emmer wheat (*Triticum turgidum*), has a diploid chromosome number of 28 (2n = 28). A wild wheat, einkorn wheat (*Triticum tauschii*), has a diploid chromosome number of 14 (2n = 14). These two species occasionally crossed and produced sterile hybrid plants. Due to an error during cell division, one of these hybrid plants formed male and female gametes with 21 chromosomes. Fusion of these gametes resulted in viable offspring. These plants were a new species, *Triticum aestivum* (2n = 42), our modern bread wheat.

(i) How many chromosomes would there have been in each of the cells of the hybrid plant produced by crossing *Triticum turgidum* with *Triticum tauschii*? (1 mark)

_____

Question 8 continued

(ii) Explain why *Triticum aestivum* is fertile while the majority of hybrid plants were not.

(3 marks)

_____

_____

_____

_____

_____

_____

END OF EXAM

CHEMOLOGY EDUCATION SERVICES

Name:_____

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 2006 BIOLOGY UNIT 4 TRIAL EXAM 2

Section A - MULTIPLE CHOICE

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

SECTION 2 SHORT ANSWERS

❶= MARKS

Question 1

(a) (i) ACG; ❶
(ii) serine; ❶
(b) idea that DNA contains introns/ mRNA is only exons/ mRNA is .edited.;
(allow junk/ non-sense DNA) ❶
(c) translation cannot occur;
binds to/blocks codon/ triplet on mRNA;
anticodon/tRNA will not fit in/base-pair;
amino acids not delivered/ joined; ❶

Question 2

(a) 1. DNA is cut;
2. using restriction enzyme;
3. electrophoresis;
4. separates according to length/mass/size;
5. DNA made single-stranded;
6. transfer to membrane/ Southern blotting;
7. apply probe;
8. radioactive/ single stranded/ detected on film/ fluorescent;
9. reference to tandem repeats/VNTRs/minisatellites;
10. pattern unique to every individual; ❶❶❶❶❶❶ max
(b) cells on toothbrush;
DNA present in cell; ❶❶
(c) (i) toothbrush gives small sample of DNA/ need more DNA for analysis;
PCR gives many copies; ❶❶
(ii) uses heat;
to separate strands;
OR

PCR replicates pieces of DNA;
because DNA has been cut;
OR
primer added in PCR;
to initiate replication ❶❶ max
(d) (i) PCR/amplification needed; ❶
(ii) other DNA present;
need to identify .required. DNA from rest; ❶❶

Question 3
(a) (i) 1. frequent use of antibiotic creates selection pressure/ antibiotic kills bacteria;
2. bacteria with mutation/ resistance have (selective) advantage over others / described;
3. (survive to) reproduce more than other types;
4. pass on advantageous allele/ mutated allele in greater numbers;
5. frequency of (advantageous) allele increases in subsequent generations;
(penalise use of .gene.instead of allele once only)
6. frequency of resistant types increases in subsequent generations; ❶❶❶❶❶
(ii) 1. deletion removes a base;
2. substitution replaces a base with a different one;

AND
four marks for correct reference to four of:
3. frameshift occurring/ not occurring;
4. alteration of triplets after point of mutation;
5. alteration of sequence of amino acids after point of mutation;
6. concept of degenerate code;
7. alteration of tertiary structure/ shape of protein/ receptor;
(for deletion, allow protein not made)
(ignore references to active site)
8. ability of antibiotic to bind; ❶❶❶❶❶❶ max
(b) correct answer = 0.18;
And three marks for three of:
$p + q = 1$ and $p^2 + 2pq + q^2 = 1$;
$0.01 = q^2$;
$q = 0.1$;
$p = 0.9$
frequency of heterozygotes = $2pq = 2 \times 0.1 \times 0.9$/
2 x candidates p x candidates q;
❶❶❶❶ max

Question 4
(a) (i) Reverse transcriptase; ❶
(ii) Idea that mRNA is present in large amounts in cell making the protein / mRNA has been edited / does not contain introns / mRNA codes for single protein; ❶
(b) (Ligase) splices / joins two pieces of DNA / .sticky ends.; ❶

Question 5
(a) (i) Continuous variation . range of values/not discrete categories/many categories/ no gaps; ❶
(ii) Crossing over / chiasmata;
Random segregation / independent assortment;
In meiosis I and meiosis II; max ❶❶
(b) Range influenced by single .outlier. (*accept anomaly*) / converse for S.D.;
S.D. shows dispersion/spread about mean;
Range only shows highest and lowest values/extremes;
S.D. allows statistical use;
Tests whether or not differences are significant; max ❶❶

Question 6
a) Pelvis Arm length ❶
b) Enamel on molar teeth❶

c) DNA hybridisation❶
d) Samples of DNA from organisms to be compared are placed together & heated so they denature & become single stranded. ❶ They are allowed to cool thus allowing strands to join up into double stranded molecules. ❶ The degree to which the different strands match up when they form double stranded molecules can be analysed. ❶

e) Chimpanzee❶
f) The DNA of an organism is less likely to be altered as phenotypic characteristics are by the environmental conditions that the organism is exposed to. As the DNA is inherited from parent to offspring, it will be more stable and constant than phenotypuc characteristics of the same organism. ❶❶

Question 7
(a) (i) Only seen in males / not in females; ❶
(ii) Unaffected parents/mother → child with M.D. /
(1 x)2 → 5 / (3 x) 4 → 11 / 8 (x 9) → 13; 1
(b) 5 = X_dY
6 = X_DY
7 = X_DX_d AND X_DX_D
8 = X_DX_d;; All 4 correct = 2 marks
2 or 3 correct = ❶ mark max ❶❶
(c) ¼ / 0.25 / 25% / 1:3 / 1 in 4; (NOT '1:4') ❶

Question 8

a) Plasmid ❶

b) The human gene of interest is removed from the donors' DNA sample using a specific restriction enzyme, leaving sticky ends at either end of the gene. ❶ The plasmid from the bacteria are cut with the same restriction enzyme, leaving complimentary sticky ends. ❶ The isolated human gene is joined to the plasmid using DNA ligase. ❶ The plasmid is then replaced inside the bacteria, which then divides many times producing many copies of the human gene. The human gene has been cloned. ❶

c) i) 21 ❶

ii) *Triticum aestivum* is fertile as diploid number is even and hence can produce gametes with the same haploid number. ❶

The majority of the hybrid plants are not fertile as the diploid number is not even, so gametes produced would contain different haploid numbers. ❶

So when hybrid gametes fused at fertilisation the diploid number is uneven. ❶