BIOLOGY

Unit 4 – Written examination 2

2007 Trial Examination

SOLUTIONS

SECTION A: Multiple-choice questions (1 mark each)

Question 1

Answer: A

Explanation:

They cannot perform their functions while dividing, so during interphase they complete their functions and replicate DNA in preparation for cell division.

Question 2

Answer: C

Explanation:

Each chromatid is a separate molecule of DNA that will not end up in the same daughter cell.

Question 3

Answer: B

Explanation:

After cell division a muscle cell would contain the diploid number of chromosomes, which is 46 (or 23 pairs) for humans.

Question 4

Answer: B

Explanation:

Semi-conservative replication means that the daughter double helix has 1 parental strand and 1 newly-synthesised strand.

Question 5

Answer: D

Explanation:

Two affected parents have 2 affected children. All of these individuals must be homozygous recessive.

Question 6

Answer: C

Explanation:

Both of the parents must be heterozygous. They are unaffected, but they have an affected offspring who must have received 1 copy of the allele for the condition from each parent.

Question 7

Answer: C

Explanation:

The phenotype of the F1 generation is a blend of that of the parents. Neither allele is dominant.

Question 8

Answer: A

Explanation:

There are 4 possible outcomes from this cross, GGRr, GgRr, GgRr and ggRr. So the chance of producing offspring with the GgRr genotype is 2/4 or 1/2.

Question 9

Answer: D

Explanation:

The ratio of a dihybrid test cross for two unlinked genes is 1:1:1:1.

Question 10

Answer: C

Explanation:

All 3 organelles contain DNA, so each organelle must be in a column where DNA is present.

Question 11

Answer: B

Explanation:

A pollen grain is a haploid gamete and must contain half the DNA of a somatic cell.

Question 12

Answer: D

Explanation:

DNA does not contain uracil.

Question 13

Answer: B

Explanation:

Each of the letters stand for the nitrogenous base located in the nucleotide.

Question 14

Answer: A

Explanation:

Most amino acids can be coded for by 4 to 6 different codons.

Question 15

Answer: A

Explanation:

Since the man has 2 Y chromosomes, the problem must be in the cell from his father. Sperm is produced by meiosis.

Question 16

Answer: C

Explanation:

Transcription occurs, then translation, then the amino acids carried to the ribosome by tRNA and peptide bonds form between amino acids.

Question 17

Answer: A

Explanation:

Probes are short sequences of DNA that are single stranded and complementary to the sequence being sought.

Question 18

Answer: B

Explanation:

These 2 species have a common ancestor further back than the other possible combinations.

Question 19

Answer: D

Explanation:

The founder effect involves a small, non-representative group leaving a larger population, as in this case.

Question 20

Answer: C

Explanation:

Six half-lives have occurred during this time, so approximately 4200 million years have elapsed.

Question 21

Answer: B

Explanation:

The Bonobo has the greatest % genome similarity so will have the strongest precipitation reaction.

Question 22

Answer: A

Explanation:

The species are analogous. They are shaped by similar environmental pressures, rather than recent common ancestry.

Question 23

Answer: D

Explanation:

The foreman magnum of a bipedal organism is further forward, allowing the skull to be aligned with the rest of the body.

Question 24

Answer: C

Explanation:

A high rate of decay is counter productive to preservation of remains.

Question 25

Answer: D

Explanation:

Many organisms herd their prey.

SECTION B: Short-answer questions

Question 1

a. Let T = allele for being unaffected, t = alleles for chondrodystrophy.

Note: It doesn't matter what symbols are used as long as the following rules are kept:
- Upper and lower case version of the same letter must be used
- Upper case refers to the dominant allele and lower case to the recessive allele
- The notation must reflect the autosomal nature of this condition
- It is best to use letters where the upper and lower case versions are distinct.

1 mark

b.

Phenotypes: Unaffected x Unaffected
Genotypes: Tt x Tt

1 mark

AND

	T	t
T	TT	Tt
t	Tt	Tt

1 mark

AND

Genotypic ratio 1TT: 2Tt:1tt
Phenotypic ratio 3 Unaffected : 1 with chondrodystrophy
Note: All working must be shown to gain 3 marks. The answer must specify which is the genotypic ratio and which is the phenotypic ratio. Percentages or fractions may also be used for the ratios.

1 mark

c. A normal test cross involves the suspected heterozygote being crossed with an individual that is **homozygous recessive.**

1 mark

AND

This is not possible, as the homozygous recessive individuals do not hatch and are unavailable for mating.

1 mark

d. The hen would have to be heterozygous.

1 mark

AND

Even if the gobbler is heterozygous, there is no chance that using a homozygous unaffected hen would produce any offspring that are homozygous recessive.

1 mark

e. If both parents are heterozygous then there is a $\frac{1}{4}$ chance that any of their offspring will have the homozygous recessive genotype and be affected.

1 mark

AND

This means there should be 4 to 5 eggs that do not hatch. The presence of a significant number of unhatched eggs should support the farmer's hypothesis (assuming the others hatch).

1 mark

Total 10 marks

Question 2

a. The mode of inheritance is dominant as there is an affected individual in each generation.
OR
Each affected individual only has 1 affected parent. Two would be required in a case of recessive inheritance.

1 mark

AND

The mode of inheritance is X-linked. All of the daughters of Male individual's I-2 and III-2 are affected, indicating the gene is located on the X chromosome.

1 mark

b. Their mother II-5, is heterozygous for the condition.

1 mark

AND

Individual III-2 has inherited the X chromosome with the allele for this condition, while individual III-3 inherited the X chromosome with the allele for normal function. Both inherited a Y chromosome from their father.

1 mark

c. 50%

1 mark

d. 50%

1 mark
Total 6 marks

Question 3

a.

DNA	TGA	CGG	GAC	ACC	CCG	TTC	CAG
mRNA	ACU	GCC	CUG	UGG	GGC	AAG	GUC
tRNA	UGA	CGG	GAC	ACC	CCG	UUC	CAG
Amino Acid	Thr	Ala	Leu	Trp	Gly	Lys	Val

3 marks

b. A point mutation occurred in the 6th codon, which now reads UAG instead of AAG.

1 mark

AND

This causes the formation of a premature stop codon, resulting in a truncated protein.

1 mark

c. Polymerase Chain Reaction

1 mark

d. Restriction enzyme or endonuclease

1 mark

e. Recombinant

1 mark

f.

Process 1	Transcription
Process 2	Translation
Product 1	mRNA
Product 2	Polypeptide chain or amino acid chain
Structure X	Ribosome

5 Correct = 3 marks
3 or 4 correct = 2 marks
2 correct = 1 mark
0 or 1 correct = 0 marks

g. Introns
OR
Non-coding regions

1 mark

h. Group A.

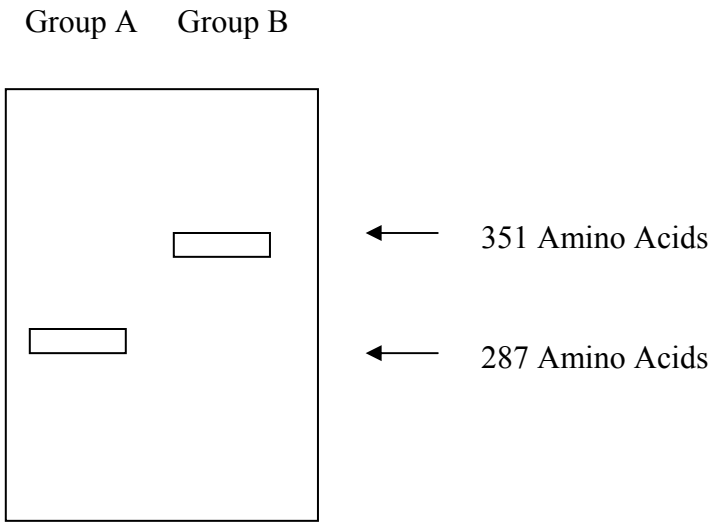
1 mark

AND

The polypeptide produced by a person with thalassemia was truncated (shorter). The group A polypeptide was 64 amino acids shorter than the group B polypeptide.

1 mark

i.



Correct labelling 1 mark
Correct diagram 1 mark
Total 16 marks

Question 4

a. Convergent evolution

1 mark

b. Any two of the following:
- Long tongues
- Sticky tongues
- Long snouts
- Claws for digging
- Any other reasonable suggestion

2 marks

c. Analogous

1 mark

AND

These two species do not share a recent common ancestor.
OR
The similarities between these organisms are caused by adaptations to the environment rather than by sharing recent common ancestry.

1 mark

d. Nuclear DNA changes by 50% every generation.

1 mark

AND

Changes to mitochondrial DNA accumulate at a known rate.

1 mark

e. Initially there was variation in the population with a few flies having the ability to consume apples.

1 mark

AND

With a limited food supply the flies able to utilise apples as a food source became biologically fitter than those that could not.

1 mark

AND

The flies that could utilise apples as a food supply were more likely to survive long enough to reproduce. The following generations would have a higher frequency of the favoured trait, which would continue to increase over subsequent generations.

1 mark
Total 10 marks

Question 5

a. There is no difference between the mitochondrial DNA of modern humans compared to that of Cro Magnon, but there is a difference between modern human and Neanderthal mitochondrial DNA.

1 mark

AND

This suggests that Cro Magnon are the direct ancestors of modern humans and Neanderthals are not.

OR

Based on the available data, there was no interbreeding between Cro Magnons and Neanderthals.

1 mark

b. Yes. The last mitochondrial split between Cro Magnons and Neanderthals took place half a million years after that of domestic dogs.

1 mark

AND

Since different breeds of domestic dogs are still genetically close enough to interbreed, but split earlier, it is possible interbreeding could have occurred between these 2 hominids.

1 mark

c. Any of the following:

- Group hunting
- Protection
- Developing agriculture
- Passing on knowledge
- Any other reasonable suggestion

1 mark

d. Any of the following:

- The oldest examples of modern skeletons would need to be found only in Africa and nowhere else.
- If evolution is correct then there should be transitional stages. Skeletons of these transitional stages should only occur in Africa.

1 mark

e. Any of the following

- Germ line gene therapy: if a faulty allele is replaced at a germ line level, then the offspring of that individual will not inherit the faulty allele, thus altering the frequency of alleles in the gene pool.
- IVF: people who previously lacked the ability to have offspring, now have the ability to contribute to the gene pool.
- Advancement in medical treatments: people with serious conditions which would have caused death in infancy may now be able to survive long enough to have offspring, increasing the frequency of the responsible alleles in the population.
- Prenatal testing: techniques such as karyotyping can be used to identify chromosomal abnormalities in an unborn child. Parents can undergo genetic counseling and decide whether or not to have a specific child.
- Any other reasonable suggestion.

2 marks
Total 8 marks

