
BIOLOGY VCE UNITS 3&4 DIAGNOSTIC TOPIC TESTS 2017

TEST 9: DNA MANIPULATION AND BIOLOGICAL KNOWLEDGE AND SOCIETY

SUGGESTED SOLUTIONS AND MARKING SCHEME

SECTION A – MULTIPLE-CHOICE QUESTIONS

Question 1 **C**

EcoR1 from *E. coli* is used in cutting desired lengths of DNA and is a restriction enzyme. A polymerase enzyme is used in the polymerase chain reaction (PCR) and ligase enzymes are used in joining pieces of DNA. Reverse transcriptase is used in making single strand lengths of DNA.

Question 2 **C**

The polymerase enzyme comes from a bacterial species (*Thermus aquaticus*) that lives in hot springs. It is known as the *Taq* polymerase. It transfers genes from one species to another and the production of insulin requires restriction enzymes then ligase enzymes. The chemicals used in making a gel are hazardous but once set in the sugar base are relatively harmless to enzymes.

Question 3 **B**

Electrophoresis identifies unknown DNA fragments according to their base pair size. Restriction enzymes cut DNA into fragments before electrophoresis. Vectors such as plasmids are used to carry DNA fragments into other species. DNA probes are carried out after gel electrophoresis.

Question 4 **D**

Polymerase enzymes help multiply DNA fragments, ligase enzymes help bind DNA fragments and gene probes are used in southern blotting to identify certain DNA fragments.

Question 5 **A**

Students should understand the health, ethical and social implications of both using and not using biological knowledge.

Question 6 **A**

Enucleation is the removal of the egg cell nucleus ready for the donor somatic cell nucleus to be inserted before embryogenesis takes place.

Question 7 **D**

Drug design is based around the physical complementary shape of the drug and target molecule.

Question 8 **B**

The term genetically modified organism (GMO) refers to any organism whose genetic makeup has been artificially changed. GMOs include organisms whose genotypes have been modified but the modification does not involve insertion of gene(s) from a different species. Such modifications can include the switching off (or silencing) of a gene that is normally active in an organism. Cloned organisms are genetically identical, therefore the whole genome is exactly the same as the donor nucleus. Not all transgenic organisms are enhanced due to foreign gene insertion, for example the production of insulin does not enhance the bacteria in any way.

Question 9 **B**

Genetically modified (GM) Roundup Ready canola was developed by a herbicide manufacturer. Plasmid vectors were used to transfer the GOX gene from a soil bacterium into the canola. The GOX gene encodes an enzyme that destroys glyphosate, the active ingredient of the Roundup herbicide. Spraying crops with this herbicide kills weeds and other plants that lack the GOX gene, but leaves GM canola plants unaffected and free from competition.

Question 10 **A**

The possible creation of superweeds could be devastating to the agricultural industry.

Question 11 **D**

Most antiviral drugs are used for specific viral infections.

Question 12 **A**

Diseases that spread locally are categorised as **epidemic**, whereas diseases that spread globally are called as **pandemic**.

Question 13 **B**

Antibiotics are only affective against bacteria.

Question 14 **C**

Longer overhangs are called sticky ends. They are most often created by restriction endonucleases when they cut DNA at specific sites.

Question 15 **D**

One recognition site is required for producing two strands of DNA. If three fragments are formed, then two recognition sites were recognised by PSTI.

SECTION B – SHORT-ANSWER QUESTIONS

Question 1 (2 marks)

- a. Prenatal testing can lead to what some people view as destruction of human life. 1 mark
- b. Pre-symptomatic testing is a form of genetic testing used for people who have a family history of a genetic disorder but are not showing any signs or symptoms of the disorder. It can also show people who are carriers of the disorder. 1 mark

Question 2 (1 mark)

The physical structure of a protein is used to design drugs that have a complementary structure that may block an active site of an enzyme or block a receptor.

Question 3 (2 marks)

- a. Gene therapy is the introduction of the normal gene/allele into cells in place of missing or defective genes/alleles to correct genetic disorders. 1 mark
- b. *Any one of:*
- using a microinjection
 - using a plasmid as a vector to carry the gene into the cell
 - using a virus as a vector to carry the gene into the cell 1 mark

Question 4 (3 marks)

Gel electrophoresis uses electricity to separate DNA fragments as they move through a gel. 1 mark

DNA is negatively charged so it migrates towards the positive electrode with longer fragments moving slower than shorter fragments. 1 mark

Any one of (uses):

- to find genes associated with genetic disorders
- to discover genetic disorder carriers
- to match DNA of suspects to crime scenes
- to match DNA of disaster victims to relatives 1 mark

Question 5 (2 marks)

A gene probe is a single-stranded piece of DNA or RNA that is complementary to the DNA strand of interest that has been tagged either radioactively or fluorescently. 1 mark

Gene probes work by hybridising with the DNA of interest and being observed by their tag. 1 mark

Question 6 (7 marks)

- a. The plasmid is carrying the gene of interest, the insulin gene, into the yeast cells. 1 mark
- b. i. Restriction endonucleases cut the DNA of the plasmid forming sticky ends that are complementary to the sticky ends of the insulin gene as it has been isolated using the same restriction endonuclease. 1 mark
- ii. Ligases are enzymes that facilitate the joining of complementary pieces of DNA at the sugar-phosphate backbone. 1 mark

- c. reading left to right
1 = G A T C 1 mark
2 = C T A G 1 mark
- d. DNA is universal; it is the same nucleotides in all species. 1 mark
The same codons code for the same amino acids irrespective of what species it is. 1 mark

Question 7 (5 marks)

- a. i. *Any one of:*
- The GMO is able to reproduce at a faster rate to increase crop numbers for food consumption.
 - The GMO is able to use less energy and resources to produce a high crop yield and thus reducing environmental strain.
- Or any other reasonable answer.* 1 mark
- ii. *Any one of:*
- The GMO may be detrimental to the environment and cause adverse changes in the food web.
 - As GMOs are relatively new, we do not entirely understand their potential impacts on the human body as potential agents of disease.
- Or any other reasonable answer.* 1 mark
- b. i. *Any one of:*
- Artificial insemination is used to take the gametes of one individual and impregnate another.
 - Artificial insemination is used by farmers choosing which individuals will breed based on desired traits.
- Or any other reasonable answer.* 1 mark
- ii. *For example:*
- Selective breeding can remove any negatively impacting genes from the gene pool. 1 mark
Note: Any other reasonable answer is accepted.
- iii. *For example:*
- Selective breeding can result in organisms with traits that do not support survival of the individual. For example, many pure-bred dogs have hip dysplasia issues or breathing issues. 1 mark
Note: Any other reasonable answer is accepted.

Question 8 (2 marks)

- Genetically modified organisms can refer to an organism where a gene has been switched on or off (gene expression or gene silencing). 1 mark
- Transgenic organisms contain DNA from another organism. 1 mark

Question 9 (1 mark)

Antibiotics destroy the target pathogen whereas antivirals inhibit the development of the target pathogenic agent.