Biotechnology

Section One: Multiple-choice

1. Cell replacement therapy

   a) involves the use of stem cells, which replace diseased or dying tissue.
   b) is currently only used in the research of Alzheimer's and Parkinson's disease.
   c) raises only minor ethical concerns about embryonic tissue use.
   d) always relies on multipotent stem cells.

2. Replacing a faulty gene by inserting a gene that codes for a functional protein is known as

   a) cell replacement therapy.
   b) organ transplant.
   c) gene therapy.
   d) tissue culturing.

3. A major ethical concern regarding cell replacement therapy is

   a) the side effects of vaccines.
   b) the use of embryos for research.
   c) replacing dying tissue with regenerated tissue.
   d) the cell culture techniques are poorly researched.

4. The following statements involve the use of recombinant DNA technology to produce insulin for the treatment of diabetes.

   i) insertion of insulin gene into bacterial DNA via DNA ligase
   ii) isolate insulin gene from human cell via restriction enzyme
   iii) isolate bacterial DNA via restriction enzyme
   iv) bacteria produce insulin
   v) DNA reinserted into bacteria

   Which of the following represent the correct order of events in insulin production?

   a) ii, i, iii, v, iv.
   b) i, ii, iii, v, iv.
   c) iii, ii, i, v, iv.
   d) ii, iii, i, v, iv.

5. Elongation is a phase in which of the following processes?

a) DNA sequencing.
b) gel electrophoresis.
c) DNA profiling.
d) polymerase chain reaction.

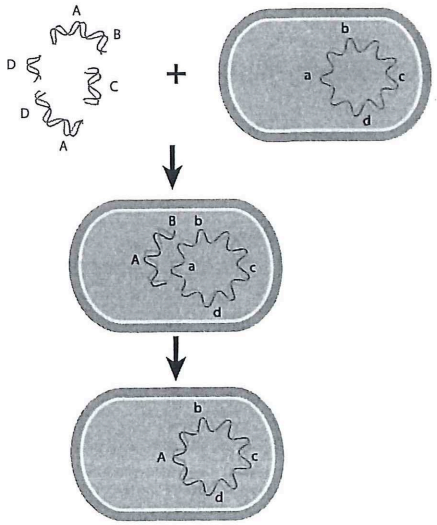
6. Select the **incorrect** statement concerning gel electrophoresis.

a) electrophoresis uses restriction enzymes isolated from bacteria in order to cut specific sequences of DNA and place them on an agarose gel.
b) on an agarose gel, smaller pieces of DNA move slower than larger pieces of DNA.
c) in gel electrophoresis a current is applied to the agarose gel.
d) DNA, being negatively charged, is attracted to the positive electrode.

7. Select the **incorrect** answer concerning DNA.

a) DNA is only found in the nucleus of the cell.
b) DNA containing a high number of cytosine-guanine bonds will be highly stable.
c) DNA can be sequenced using biotechnological techniques including bacterial enzymes, PCR and gel electrophoresis.
d) nuclear DNA is composed of two strands, arranged in a double helix.

8. The graphic below illustrates the process of genetically altering bacteria. The resultant bacteria are best referred to as



a) mutagens.
b) mutants.
c) recombinant organisms.
d) transgenic organisms.

Section Two: Short Answer

Question 9. **(8 marks)**

a) List the phases of the polymerase chain reaction. (1 mark)

b) What is the main function of the PCR? (1 mark)

c) Each time the PCR takes place, what happens to the number of DNA fragments? (1 mark)

d) Primers are essential to the PCR. Provide a definition of a primer, clearly explaining why it is essential for the chain reaction, and identify the stage(s) during which it is introduced. (3 marks)

e) What property of Taq polymerase makes it suitable for use in the PCR? What is the function of Taq polymerase? (2 marks)

Review Page 64 of the Coursebook.

Question 10. **(12 marks)**

Gel electrophoresis is a technique used in biotechnology to create a DNA profile.

a) List **two instances** when a DNA profile might be required. (2 marks)

b) What is the name of the gel used in gel electrophoresis? (1 mark)

c) The electrical charge of DNA plays an important role in the operation of electrophoresis. Describe how, and indicate the charge of DNA in your answer.

(2 marks)

d) Explain the function of restriction enzymes. (2 marks)

e) Explain how bacteria are used to generate gene products. (5 marks)

Review Page 64 of the Coursebook.

Section Three: Extended Answer

Question 11. **(20 marks)**

a) Explain how synthetic hormones are manufactured and how they are useful in treating hypothyroid disease. (10 marks)

b) Explain the importance of a DNA profile. (1 mark)

c) How is DNA profiled? (3 marks)

d) Describe in detail the **three phases** of the PCR. Ensure you mention the temperature and enzyme(s) used in each phase. (6 marks)