**Biotechnology Scientific Inquiry Test Marking Key**

**Question 1**

What is the function of each of the following in gel electrophoresis of DNA?

a) Agarose gel: (1 mark)

The agarose gel provides a matrix with pores to allow molecules to travel through and be sorted by size.

b) Electric current: (1 mark)

The electric current is the force that causes the negatively charged DNA molecules to move toward the positive pole.

c) "Wells" in the gel: (1 mark)

The wells are the "starting gates" for the DNA molecules to be loaded into before starting the "race".

**Question 2**

a) Toward which pole (positive or negative) does DNA migrate when electric current is run through the gel? (1 mark)

positive

b) Why do the DNA molecules move toward this pole? (1 mark)

The DNA molecues are negatively charged (opposite charges attract one another).

**Question 3**

What would happen to the DNA fragments if you forgot to turn the current off? (1 mark)

The DNA fragments would keep on running through the gel until they ran off the end.

**Question 4**

a) Describe how different sized DNA fragments are separated by the gel matrix. (1 mark)

Longer DNA fragments take longer to work their way through the pores of the gel matrix, they don't travel as far through the gel as the shorter fragments in the same amount of time.

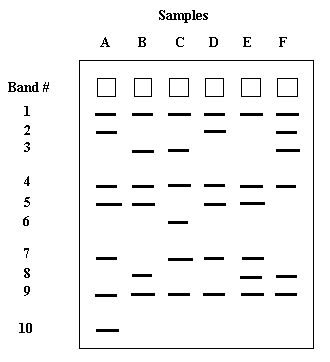
Must refer to distance travelled

b) What is a DNA ladder, and why is it used? (2 marks)

A sample containing DNA fragments of known size (1), enabling you to estimate the size of your DNA product (1)

**Question 5**

Examine the diagram of an agarose gel below and answer the following questions.



a) What do the bands in the drawing of the agarose gel represent? (1 mark)

Many DNA fragments of differing lengths/specific lengths

b) Which band(s) travelled fastest? (1 mark)

The bands furthest from the wells (containing the shortest DNA fragments) travelled the fastest. Bands #10.

c) On the above drawing, label the positive and negative ends of the gel. (2 marks)

The negative pole is located closest to the wells. The positive pole is located further from the wells.

d) How many bands are shared in common by all of the individuals? (1 mark)

3 (Bands #1, #4 and #9)

e) Are there any bands which are unique to only one individual? If so, which one/s? (2 marks)

Bands #6 (sample C) (1) and #10 (sample A). (1)

**Question 6**



Orangutans are an endangered species of ape that live in Southeast Asia. Their numbers have dwindled due to habitat loss and poaching, but there are currently efforts to save the orangutans.

DNA fingerprinting has been used by Dr. Benoit Goossens at Cardiff University to better understand mating and genetic variation in orangutans.

Use DNA fingerprinting (see below) to determine which male orangutan is the father of a baby orangutan. You will have DNA from the baby orangutan and several possible father orangutans. It is your job to determine which is the father .

In the BIO-RAD DNA Fingerprinting scenario which follows, each DNA sample stands for a different suspect, here (orangutan parentage scenario) each DNA sample stands for an individual orangutan. The picture below shows the results you would expect from the DNA Fingerprinting practical outlined here.

Mother baby Male 1 Male 2



1. Who is the father of the baby orangutan? ( 1mark)

Male 1

1. Explain how you reached this conclusion (2 marks)

When comparing DNA profiles of the baby and mother, any bands not found in the Mother’s profile match the bands of the DNA profile of Male 1 (1) but not in Male 2 (2). Hence, Male 1 must be the father.

OR

Baby’s DNA profile has bands that match with either the mother or male 1 (1). There are no bands in the baby’s profile that only match male 2 (1), therefore male 1 must the father.

**Question 7**

**a)** Explain what is meant by DNA profiling/fingerprinting. (2 marks)

DNA profiling is the process whereby the unique pattern of each person’s DNA can be identified. (1) A DNA profile is created using the process of gel electrophoresis (1).

b) List 2 fields that would use PCR in their work on a regular basis (other than medical). (2 marks)

Crime investigators, food analysis, paternity testing, study of human evolution (Paleoanthropology).

**Question 8**

a) What is PCR? (2 marks)

PCR (Polymerase Chain Reaction) (1) is a technique that involves producing large quantities of DNA identical to a sample provided. (1)

b) What is a primer?

A short single strand of DNA (1) that is complementary to the end of the DNA being copied. (1)

c) What is Taq polymerase and what does it do? (2 marks)

It is a heat resistant form of DNA polyermase (1) that adds nucleotides to the end of the primer and builds a complementary strand of DNA (1)

d) List the three stages in PCR and describe what occurs at each stage. (6 marks)

1. denaturation: high temperature that causes double stranded DNA to denature (separate into single strands);

2. annealing: cooling that allows primers to anneal (bind) to DNA strands; and

3. elongation: increased temperature that allows Taq polymerase to add nucleotides, to build new DNA strands.

1 mark name and 1 mark description – must refer to temperature change (words or numbers)

e) Why did you place a water sample in the thermocycler? (1 mark)

To act as a control