



BIOLOGY 2016

Unit 4

Key Topic Test 3 – Molecular Biology

Recommended writing time*: 45 minutes

Total number of marks available: 45 marks

SOLUTIONS

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

Question 1

Answer: B

Explanation:

DNA helicase is not used in PCR as it is not stable to unwind all the DNA correctly for speedy amplification. Thermal denaturation works more effectively.

Question 2

Answer: B

Explanation:

The only sequence that correctly places the primers with the correct 3' and 5' ends would be solution B

Question 3

Answer: D

Explanation:

Images of DNA banding length would be produced from processes such as gel electrophoresis and not PCR. PCR is the amplification of DNA only.

Question 4

Answer: A

Explanation:

Plasmid vectors are segments of DNA that have been transferred from one organism to another.

Question 5

Answer: B

Explanation:

BamH1, produces 3 fragments, the last fragment is the smallest as this is linear DNA.

Question 6

Answer: C

Explanation:

Restriction enzymes work on specific DNA sequence in order to make a cutting site. They are not determined by the length of the DNA strand.

SECTION B – Short-answer solutions

Question 1

- a. Hybrid 1 mark
- b. A segment of DNA is isolated from two different species. 1 mark
- AND
- The heating of the solution denatures the bonds between the double stranded DNA and new ligation forms between the species 1 mark
- AND
- The greater temperature during re-heating process for the DNA from both species to disassociate the more closely related the two are. 1 mark
- c. The temperature at which they were able to re-separate the hybrid DNA was lower. 1 mark
- d. The temperature at which they were able to re-separate the hybrid DNA was higher. 1 mark
- e. The samples must have come from two different tigers with variation within the gene pool in the segments of DNA utilised in the hybridisation process. 1 mark
- f. The tiger or the lion had less and greater genetic similarities respectively to the liger in the particular segment of DNA used for the hybridisation process and thus produced different results. 1 mark
- g. It would be expected that they would be similar. 1 mark
- AND
- As the genetic material is 50% tiger and 50% lion, the same as the liger, it does not matter as to which parent the gametes came from. Other than if the X or Y chromosome was used. 1 mark
- h. The DNA is similar between the two and the gametes are compatible. 1 mark

- i. Only a small sample size was used to make conclusions from.

1 mark
Total 12 marks

Question 2

- a. Prokaryotic

1 mark

- b. Circular DNA lacks telomeres at the end of the DNA strand

1 mark

OR

Any other reasonable response

- c. 3

1 mark

- d. Sticky ends

1 mark

AND

Blunt ends

1 mark

AND

Sticky ends as they are able to more easily bind with DNA nucleotides on the primed ends in the correct orientation.

1 mark

- e. Gel electrophoresis

1 mark

OR

Any other reasonable response

- f. Cutting fragments of DNA with restriction enzymes at specific targeted sites allows the relative size of the segment to be examined based on the movement through the gel.

1 mark

OR

Any other reasonable response that is consistent with the technology outlined in part e.

Total 8 marks

Question 3

a.

- i. PCR

1 mark

- ii. The amplification of the DNA is required as only a small target site would be utilised and this allows larger portions of the blood containing the gene to be purified and analysed.

1 mark

- iii. DNA hybridisation

1 mark

OR

Any other reasonable response

- iv.** DNA is denatured at 95. Double stranded DNA molecules are heated to break the hydrogen bonds present between the template and complementary strands of nitrogenous bases. Two individual strands are formed. 2 marks

AND

Annealing occurs at 50-65°C. Free DNA primers attach to the 3' end of the individual DNA strands to initiate DNA synthesis. 2 marks

AND

Extension occurs at 72°C. The free nucleotides are attached to the DNA at the 3' end of the primer by Taq polymerase. Allowing the synthesis of the new DNA strand in a 5' to 3' direction. 2 marks

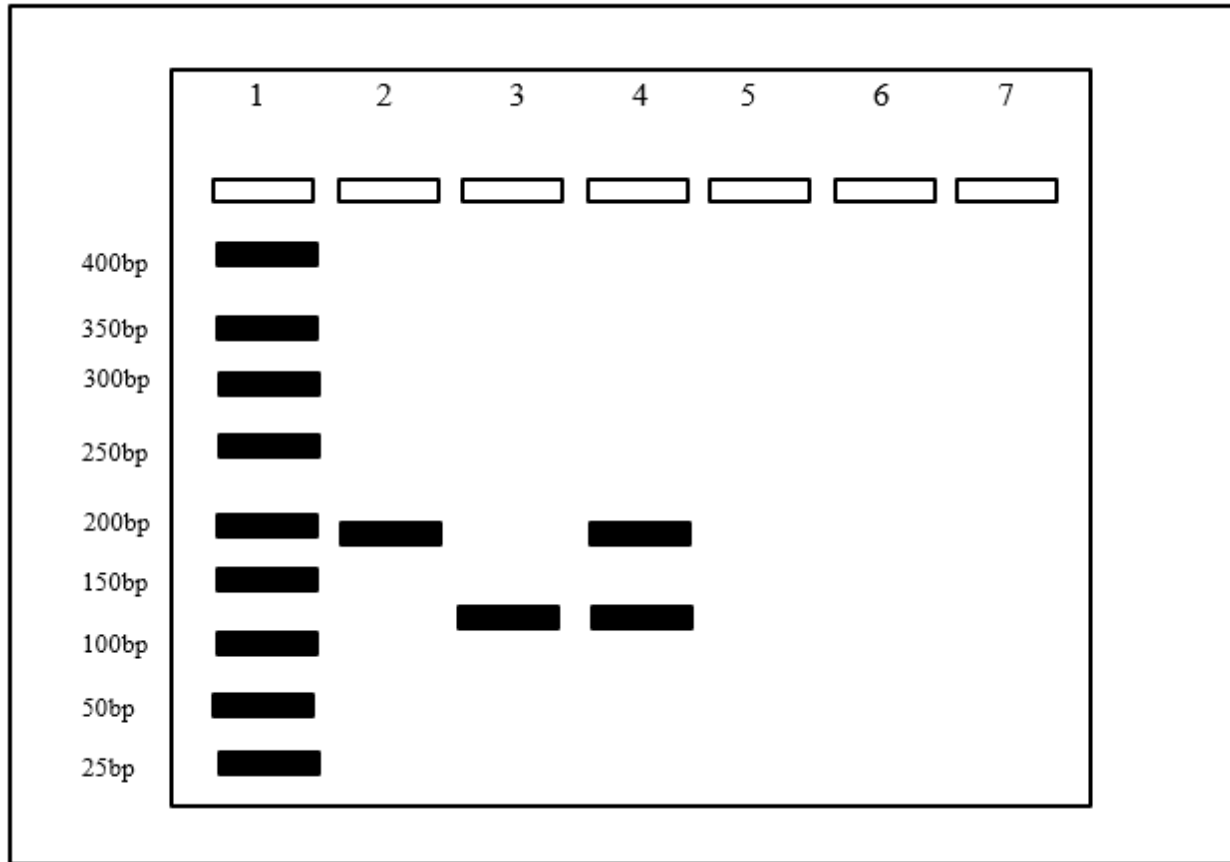
- v.** Nucleotide bases.
Free nitrogenous bases that form complementary pairing to the template strands, resulting in a double stranded DNA molecule. 2 marks

AND

Template DNA

The original DNA sample that is separated and used as a template for nitrogenous bases to attach to forming new double stranded DNA molecules. 2 marks

- b.** See diagram below, lane 2 – approx. 189bp 1 mark
- c.** See diagram below, lane 3 – approx. 110bp 1 mark
- d.** See diagram below, lane 4 – approx. 189 and 110bp 1 mark



e. Lane 1 is a molecular weight marker, it is a segment of known DNA lengths that is used to make inferences about the length of the DNA fragments in the experimental lanes.

1 mark

f. The negatively charged DNA molecules are attracted to the positively charged end of the gel and thus allow movement through the gel.

1 mark

AND

The shorter the length of the DNA fragment, the greater the distance it is able to move through the gel.

1 mark

Total 19 marks