Electrophoresis

Nov 2011 /42

7 One of the key areas of investigation in understanding the structures of polypeptides and proteins is the sequence of amino acids that make up the polypeptide chains.

(a) One of the methods used to determine the amino acids present in a polypeptide chain is electrophoresis.

Sketch and label the apparatus used to carry out electrophoresis.

[4]

(b) In electrophoresis, different amino acids move in different directions and at different speeds.

(i) What factors determine the *direction of travel* of an amino acid?

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(ii) What factors determine the *speed of movement* of an amino acid?

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[3]

7 The technique of DNA fingerprinting has been one of the most important developments in biochemical analysis in recent times. It has enabled enormous advances to be made in forensic science, medicine and archaeology.

(a) The table shows different stages in the production of a genetic fingerprint. Use the numbers 1 to 6 to put the stages in the correct sequence in the blank column.

stages	process	correct sequence (numbers)
A	place samples on agarose gel	
B	use polymerase chain reaction	
C	label with radioactive isotope	
D	extract DNA	
E	use restriction enzyme	
F	carry out electrophoresis	

[3]

(b) One of the stages above uses a radioactive isotope.

(i) What isotope is used? .....

(ii) Why is this isotope chosen?

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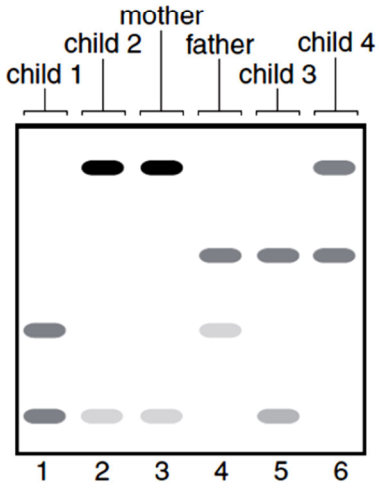
[2]

(c) The following DNA fingerprints were taken from a family of mother, father and four children.



(i) Are all of the children related to the mother? State the evidence for your answer.

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(ii) Which child is unlikely to be related to the father? State the evidence for your answer.

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.....

[2]

(d) DNA fingerprinting has been successfully used in archaeological investigations.

(i) Ancient writings were often made on goatskins. Over the centuries these have often become broken into fragments, making reconstruction of the writings almost impossible.

Suggest how the use of DNA fingerprinting might be able to identify which fragments came from a particular skin.

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(ii) Apart from the examples of human remains and goatskins, state one other material that could be investigated using this technique.

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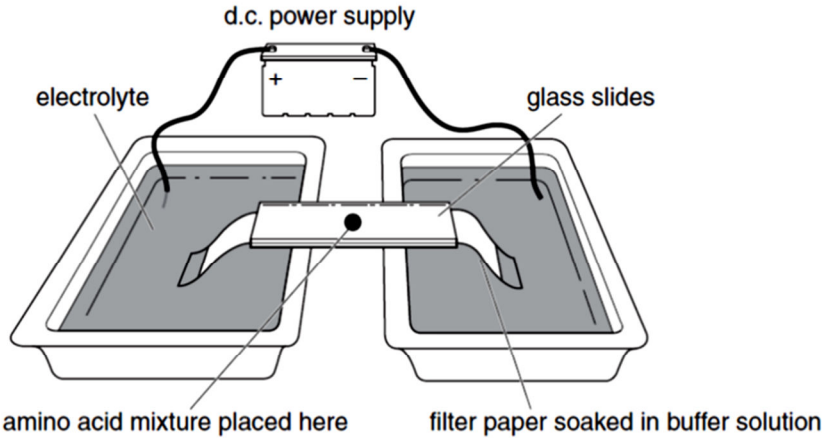
[3]

[Total: 10]

June 2010/42

7 A mixture of amino acids may be separated using electrophoresis. A typical practical set-up is shown in the diagram.



(a) When the power supply is switched on, some amino acids may **not** move, but remain stationary. Suggest an explanation for this observation.

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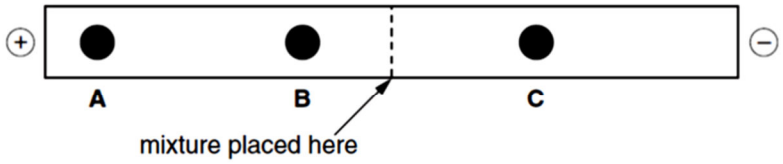
..... [2]

(b) The amino acid glycine has the formula $H_2NCH_2CO_2H$. Identify the species formed on the filter paper if glycine moves to the left (positive) end of the filter paper.

..... [1]

(c) The following result was obtained from another electrophoresis. What can be deduced about the relative sizes of, and charges on, the amino acid species **A**, **B** and **C**?



amino acid	relative size	charge
A		
B		
C		

[3]

(d) The sequence of amino acids in a polypeptide may be determined by partial hydrolysis of the chain into smaller pieces, often tripeptides.

(i) Following such a partial hydrolysis, the following tripeptides were obtained from a given polypeptide.

ala-gly-asp gly-ala-gly lys-val-ser ser-ala-gly val-ser-ala

Given that the N-terminal amino acid is lysine (lys) suggest the amino acid sequence of the **shortest** polypeptide that would give the above tripeptides.

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The structural formulae of the amino acids in the polypeptide are given below.

abbreviation	amino acid	structural formula
ala	alanine	$H_2NCH(CH_3)CO_2H$
asp	aspartic acid	$H_2NCH(CH_2CO_2H)CO_2H$
gly	glycine	$H_2NCH_2CO_2H$
lys	lysine	$H_2NCH(CH_2CH_2CH_2CH_2NH_2)CO_2H$
ser	serine	$H_2NCH(CH_2OH)CO_2H$
val	valine	$H_2NCH(CH(CH_3)_2)CO_2H$

(ii) Which of the tripeptides in **(i)** has the lowest M_r?

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(iii) Select **one** amino acid **from those listed in the table** which contains an ionic side-chain at pH 8.

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[4]

[Total: 10]