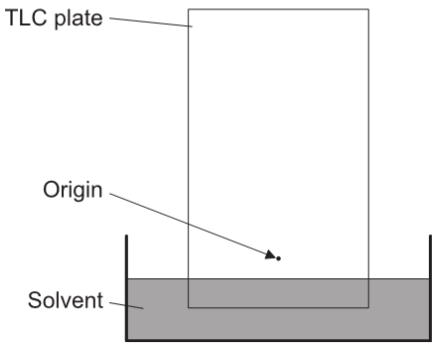
HL Paper 3

R_f values for photosynthetic pigments may be determined using the technique of thin-layer chromatography (TLC).



a. Outline what happens when spinach extract is spotted on a TLC plate and placed into a container of solvent. [2]

b. Explain what the R_f values represent in chromatography. [3]

c. State **two** photosynthetic pigments that could be identified using chromatography. [1]

Markscheme

a. a. solvent will move up «the TLC plate/stationary phase»

b. pigments will move up «the TLC plate/stationary phase carried by solvent»

c. pigments will move at different rates/separate

[Max 2 Marks]

b. a. $R_f = \frac{\text{distance moved by pigment}}{\text{distance moved by solvent «front»}}$

OR

distance moved by pigment relative to distance moved by solvent

b. each pigment has/is represented by a specific R_f «value»

c. used to identify different pigments

d. R_f «value» depends on density/solubility/polarity of the pigment in solvent

Allow "compound" or "molecule" instead of pigment

[Max 3 Marks]

c. chlorophyll

carotene

xanthophyll

Accept other valid pigments

Do not accept pigments named by colour

*Award **[1]** for any two correct*

*Award **[1]** for chlorophyll a **AND** (chlorophyll) b*

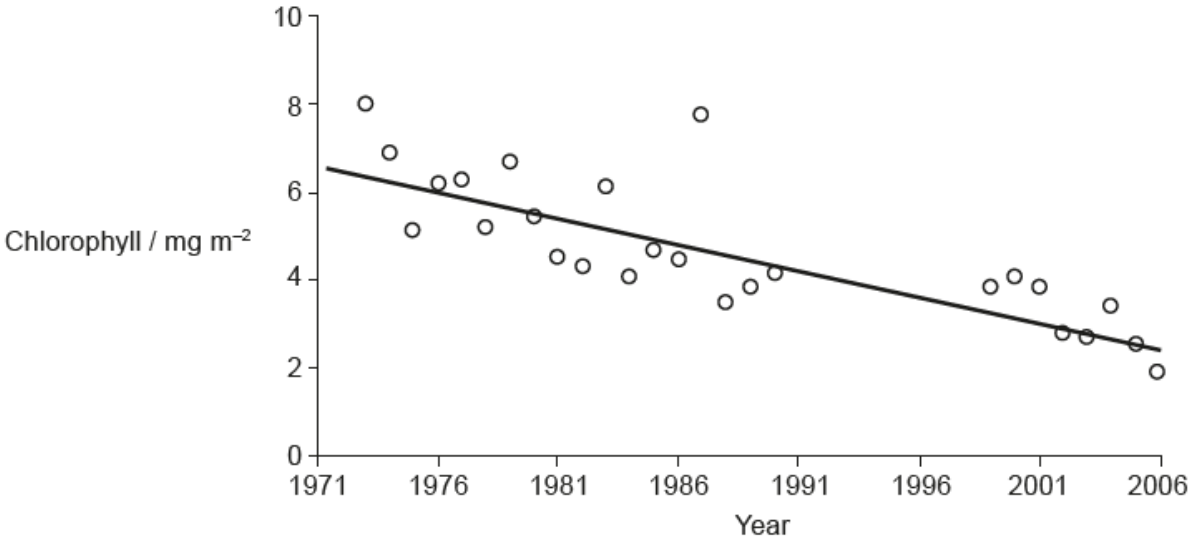
[Max 1 Mark]

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]

Mean annual chlorophyll concentration was measured in surface water of Narragansett Bay along the Atlantic coast of the USA, from 1971 to 2006.

Field data of chlorophyll concentrations are shown below.



[Source: Reprinted by permission from Macmillan Publishers Ltd: *Nature*, Vol. 448, R. W. Fulweiler, S. W. Nixon, B. A. Buckley and S. L. Granger, Reversal of the net dinitrogen flux in coastal marine sediments, copyright (2007)]

a. Suggest a hypothesis for the trend in the graph. [2]

b. Mesocosm experiments using water from Narragansett Bay were completed in the laboratory during a six month period. Discuss advantages and limitations of carrying out mesocosm investigations. [3]

Markscheme

a. a. decrease in chlorophyll concentrations as decrease in phytoplankton/plants

   b. due to increase in pollution / increase in sea temperatures / decrease in pH/climate change

   Accept other reasonable reason for mp b.

b. *Advantages of mesocosm experiments*:

   a. scientist can alter/manipulate/control environmental conditions

   b. allows carrying out experiments with many samples / replicates

   c. ease of collection of continuous data

   Limitations of mesocosm experiments:

   d. difficult to mimic natural environmental conditions exactly

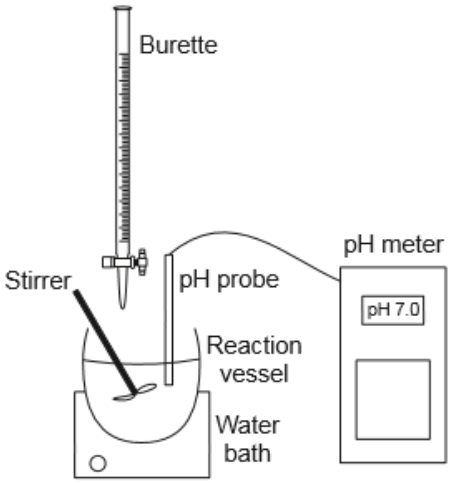
   e. Natural environments change /are not static

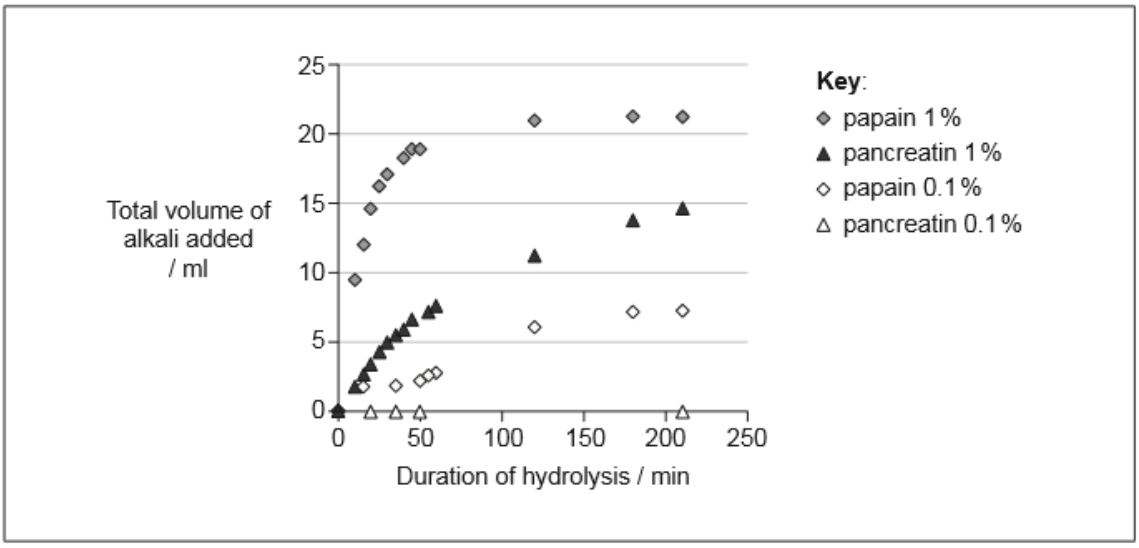
   Needs to suggest advantage and limitation for full marks.

Examiners report

a. [N/A]
b. [N/A]

The rate of hydrolysis of fish proteins using the enzymes papain and pancreatin was monitored using the apparatus shown. The pH decreased with the progress of hydrolysis, so alkali in the burette was added as necessary in order for the hydrolysis to proceed at constant pH. The rate of protein hydrolysis was measured as the amount of alkali added. Measurements were taken at constant conditions of temperature and pH for two enzyme concentrations, 1 % and 0.1 %.





[Source: adapted from "A Study of the Enzymatic Hydrolysis of Fish Frames Using Model Systems", written by Aristotelis T. Himonides, Anthony K. D. Taylor, Anne J. Morris, published by *Food and Nutrition Sciences*, Vol. 2 No. 6, 2011. Copyright © 2011 SciRes.]

a. State the effect of enzyme concentration on the hydrolysis of proteins. [1]

b. Sketch on the graph the curve expected if the hydrolysis were performed using papain 0.5 %. [1]

c. Explain what would happen to fish protein hydrolysis if no alkali were added to the reaction vessel. [3]

Markscheme

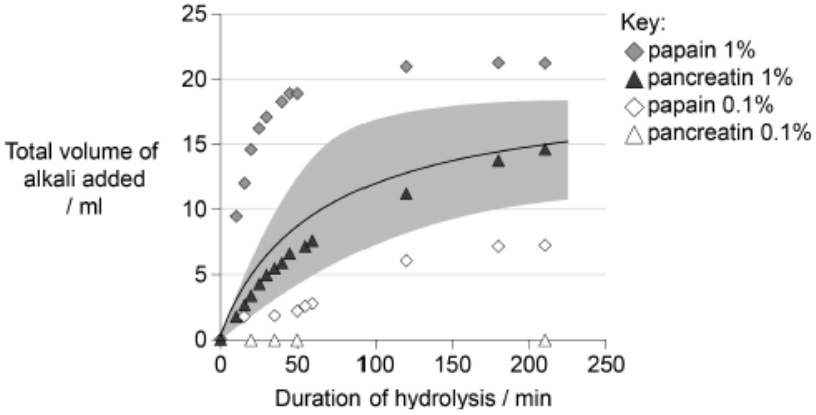
a. positive correlation

OR

faster hydrolysis at higher concentration

b. curve with similar shape between papain 0.1 % and 1 %

eg:



Curve to start at 0.
Allow a similar/same shaped curve to papain 1 % to be anywhere within the shaded area shown on the graph.

c. a. hydrolysis of protein produces hydrogen ions/amino acids

b. pH decreases / increased acidity

c. causing denaturation of enzyme/pancreatin/papain

d. decrease of reaction «rate»/no hydrolysis

e. enzymes work best at the optimum pH / OWTTE

Examiners report

a. [N/A]
b. [N/A]
c. [N/A]