1. Students used a model cell to investigate the effect of temperature on the rate of diffusion across membranes.

They were provided with:

- a calibrated colorimeter
- a calibration curve
- Benedict's solution and all the apparatus required to carry out a Benedict's test
- glucose solution
- dialysis tubing.

i. Name **two** more pieces of apparatus they would need to make sure this is a controlled investigation.

1 _____

2 _____ **[2]**

ii. Outline the method that the students would use to carry out an investigation into the effect of **temperature** on the diffusion rate in their model cells.

_____

_____

_____

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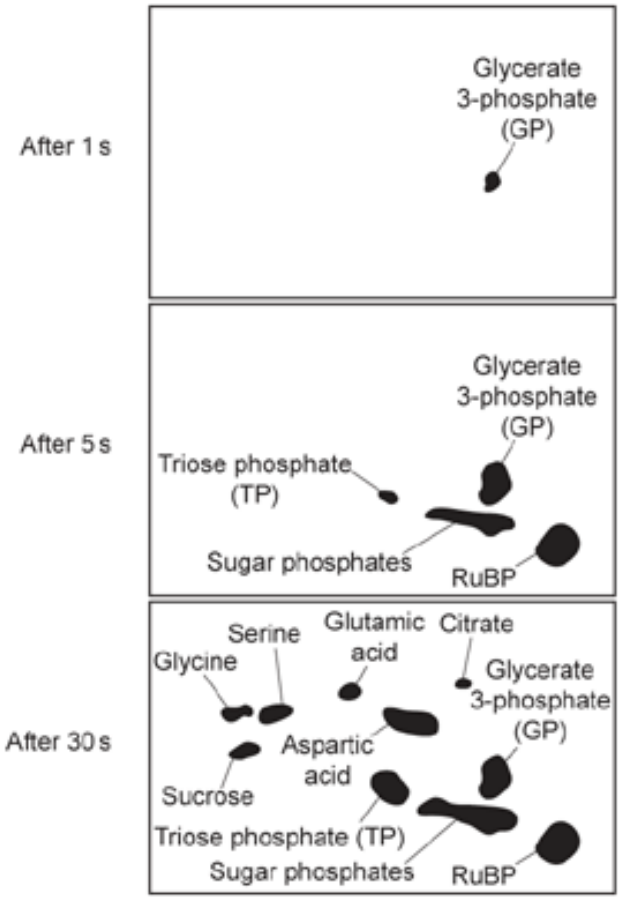
_____

_____ **[4]**

2. Melvin Calvin and co-workers worked out the reactions of the light independent stage of photosynthesis.

They illuminated a suspension of green algae in the presence of radioactive carbon dioxide. They removed samples of the suspension at different times after addition of the radioactive carbon dioxide and used paper chromatography to identify the compounds in what is now known as the Calvin cycle.

This figure shows their results.



i. Calvin concluded that GP was the first product of carbon fixation, and that GP was converted into TP.

Use the data in the figure above to explain how Calvin reached this conclusion.

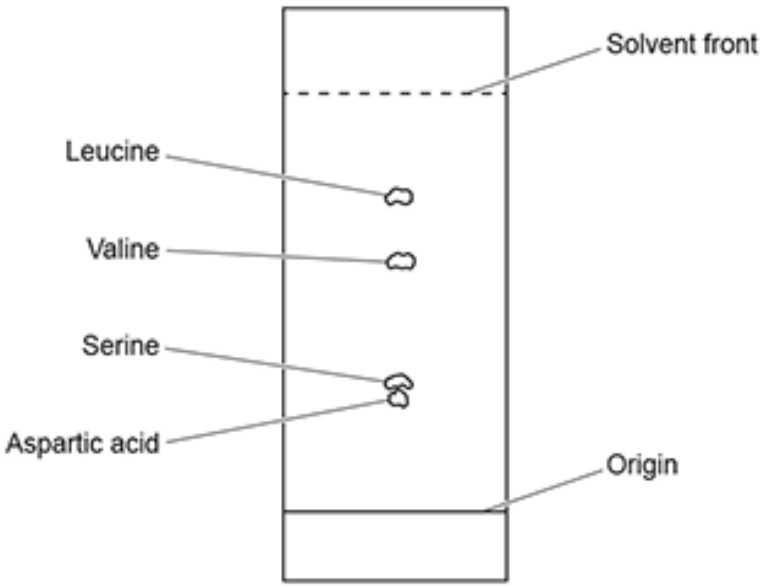
[2]

ii. State what you can conclude from the figure about what happens to TP.

[1]

3. Thin layer chromatography (TLC) can be used to separate and identify amino acids.

The diagram shows the chromatogram that was produced when using TLC to separate a mixture of amino acids.



i. Use the chromatogram to calculate the Rf value of valine.

Rf = ... **[2]**

ii. Serine and leucine have different R groups.

With reference to the chromatogram, suggest what can be concluded about the chemical properties of the R groups in serine and leucine.

---[1]

4. Vitamins are molecules that are consumed in the diet of animals and have essential roles in the body.

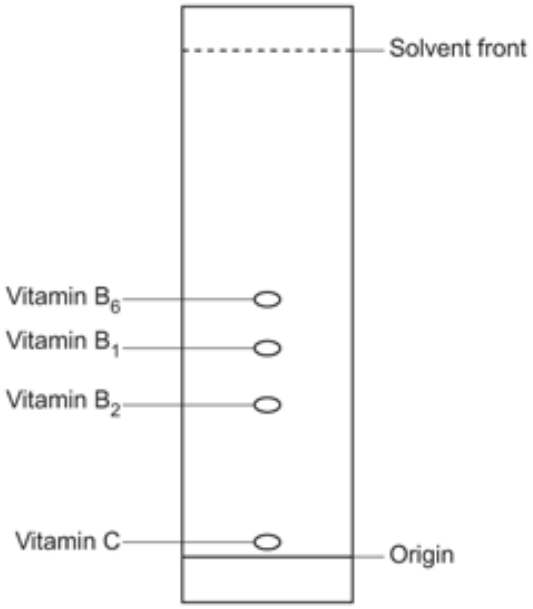
Thin layer chromatography (TLC) was used to separate a mixture of vitamins from a vitamin supplement tablet.

i. Most vitamins are colourless.

Suggest **one** method for visualising the vitamins in TLC.

---**[1]**

ii. The results of the TLC are shown in the chromatogram figure below.



Use this figure to calculate the R_f value of vitamin B_2.

R_f = ... **[2]**

5(a). A group of students was provided with a sample of an unknown liquid and various chemical reagents. It was suggested that the sample of unknown liquid contained protein.

Here is the chemical test proposed by one of the students to test this suggestion:

- Add 3 cm^3 of unknown liquid sample to an equal volume of sodium hydroxide solution
- Mix
- Leave to stand for 5 minutes.

i. The above test would not detect the presence of protein in the sample.

State the change that needs to be made to this test to enable protein to be detected.

_____

_____ **[1]**

ii. Sodium hydroxide is a white solid ionic compound which is highly soluble in water. It consists of anions and cations.

Complete the table below.

State the chemical symbol of the **anion** present in sodium hydroxide.	
State one use of this **anion** in a biological process.	

[2]

(b). Students were provided with a sample of an unknown liquid. They carried out chemical tests on this sample to determine what biological molecules were present. Their findings are shown in the table below.

Biological molecule	**Present**
Lipids	Yes
Starch	Yes

Describe the chemical tests you would carry out to see if the students' findings were correct.
Include the **apparatus** and **reagents** you would use and the results that you would expect.

[6]

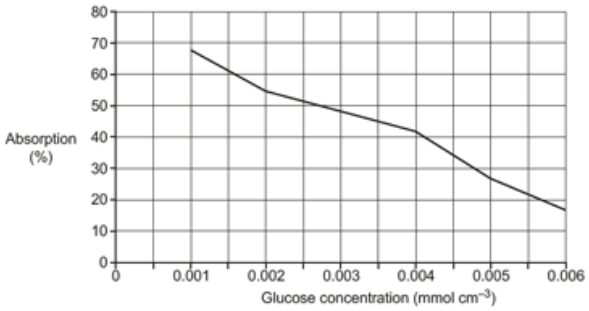
(c).

i. Students were asked to carry out an experiment to determine the glucose concentration of a test solution using a colorimeter.

Describe how the students would use a colorimeter in their experiment.

[3]

ii. The students plotted their results, shown in the graph.



The students found that the test solution had an absorption value of 45%.

Use the graph to estimate the glucose concentration in the test solution.

Give your answer in mmol dm^{-3}.

Concentration = ...mmol dm^{-3} **[2]**

6. Microorganisms can be used to produce a variety of food products.

The microorganism that is used to produce mycoprotein is a fungus.

Mycoprotein foods contain protein.

The presence of protein in a solution can be detected using biuret reagent.

In the presence of protein, biuret reagent turns from blue to violet.

i. A colorimeter can be used, along with biuret reagent, to determine the concentration of protein in a solution.

Outline how to use a colorimeter to determine the concentration of protein in a solution.

[4]

ii. State **one** alternative method for determining the concentration of protein in a solution.

[1]

7. A student carried out an investigation to see the effect of changing the concentration of the enzyme maltase. They used two different maltase concentrations (concentration **P** and **Q**) to break down the disaccharide maltose for 10 minutes. The student carried out the reducing sugar test and recorded the percentage absorbance of each solution using a colorimeter.

Their results are shown in the table.

Absorbance (arbitrary units)	
Maltase concentration P	**Maltase concentration Q**
0.235	0.452
0.253	0.523
0.436	0.541
0.258	0.361
0.224	0.256
0.236	0.236

Which statistical test would be used to determine if there was a significant difference between the mean glucose concentration produced by maltase concentration **P** and maltase concentration **Q**?

A Chi-squared test
B Spearman's rank correlation coefficient
C *t* -test – paired
D *t* -test – unpaired

Your answer ☐ **[1]**

END OF QUESTION PAPER