

**GCE**  
**AS and A Level**

# **Human Biology**

**AS exams 2009 onwards**  
**A2 exams 2010 onwards**

## **Unit 3X:** **Specimen EMPA**

**Version 1.1**





**EXTERNALLY MARKED PRACTICAL ASSIGNMENT (EMPA)**

**GCE HUMAN BIOLOGY 1406/2406**

**HBI3X**

**SPECIMEN PAPER**

## INTRODUCTION

Visking tubing is made from cellulose. It is manufactured as a flattened tube. After it has been soaked in water, the tubing can be tied or sealed to make a bag that can hold a liquid. The cellulose wall of the bag is semi-permeable. This means that whether or not a particle can move through the wall depends on the size of the particle. In this investigation, you will investigate how size of molecules affects movement through membranes.

### TASK 1 – Preliminary Investigation

1. Find the largest length of visking tubing that will produce a sealed bag capable of full immersion in 20cm<sup>3</sup> distilled water in a boiling tube. The bag should be tied at the lower end but sealed with a paper clip at the top.
2. Determine the maximum volume of liquid that the bag can hold, without leaking, when sealed by the paper clip.
3. Fill the bag with 1% starch suspension and place into a boiling tube containing 20cm<sup>3</sup> distilled water. Leave for 10 minutes. Remove a small sample from the water surrounding the bag and test for the presence of starch. Note the colour obtained.
4. You are provided with 10 cm<sup>3</sup> reducing sugar solution. Your teacher will tell you its concentration. Use this solution to produce a range of 5 different concentrations of reducing sugar solution.

**QUESTIONS ON TASK 1**

**Answer the questions in the space provided.**

**You may do this while you carry out your investigation or at the end of your investigation.**

1. The liquid surrounding the visking tubing bag was tested for the presence of starch. Describe and explain the result obtained.

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*(2 marks)*

2. (a) The visking tubing bag will be filled with equal volumes of reducing sugar solution and starch suspension during the actual investigation (implementation). What volumes of these materials do you plan to use? Explain how you determined the values given.

Volumes .....

Explanation .....

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*(1 mark)*

2. (b) Describe a method to compare the amount of reducing sugar that might be found in the liquid surrounding the visking tubing bag.

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*(4 marks)*

3. (a) In the space below, draw a table to show how you produced the 5 different concentrations of reducing sugar solution.

*(2 marks)*

3. (b) Explain why a range of concentrations was used for this investigation.

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*(1 mark)*

10

TASK SHEET 2

**TASK 2 – Implementation (carrying out the investigation)**

You are provided with 5 reducing sugar solutions, each of a different concentration, and a starch suspension.

**For each concentration:**

1. Make a visking tubing bag of the length determined by the preliminary investigation.
2. Fill the bag, to the volumes determined by the preliminary investigation, with a mixture containing equal volumes of the reducing sugar solution and starch suspension.
3. Seal the top end of the visking tubing bag with a paper clip and place the bag into a boiling tube containing 20cm<sup>3</sup> of distilled water. Start the stop clock.
4. After 5 minutes, use a pipette to remove a small sample from the surrounding water. Add the sample to a small amount of Benedict's reagent and heat.
5. Remove further samples at fixed time intervals until there is a positive result for the presence of reducing sugar, or 30 minutes has elapsed.

**For the highest concentration only:**

At the end of the 30 minutes, remove the bag from the boiling tube, open the top and test the contents for the presence of both starch and reducing sugar.

**Record your results in a table of your own design on your *Candidate Results Sheet*.**

*(4 marks)*

**You must decide:**

- how many repeats to use with each concentration,
- how to control variables that might influence the data to be collected,
- what data to collect to determine the effect of the concentration of reducing sugar solution on movement through the membrane.

**TASK 3 – Processing of raw data**

1. Draw a graph to show how the rate of reaction varies with the concentration of the reducing sugar solution.
2. Calculate the rate of reaction as  $1/t$  where  $t$  = time (the time taken for reducing sugar to pass through the membrane is identified as the time when reducing sugar was found in the water surrounding the visking tubing bag).

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**EMPA HBI3X SPECIMEN**

**Candidate Results Sheet TASK 1**



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

Centre Number

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Candidate Name .....

Candidate number

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**Results**

Present your results in an appropriate form in the space below.

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**Candidate Results Sheet TASK 2**



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

Centre Number

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Candidate Name .....

Candidate number

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**Results**

Present your results in an appropriate form in the space below.

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**THE EMPA TEST: AS SPECIMEN HBI3X**

**SECTION A**

These questions are about your investigation on the use of membranes in dialysis.

You should use your instructions from **TASK 2**, your table and your graph when you answer them.

Answer **all** questions in the spaces provided.

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1. The rate of reaction was the dependent variable in your investigation. Explain why it is described as the *dependent* variable.

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(1 mark)

2. (a) Temperature can be an experiment variable. Was this variable controlled during your investigation? Explain your answer.

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(1 mark)

- 2 (b) If the investigation was conducted at 60<sup>0</sup>C, suggest how your results might be different? Explain your answer.

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(3 marks)

2 (c) Describe how you controlled **one** other variable during your investigation.

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*(1 mark)*

2 (d) Describe how monitoring a variable differs from controlling a variable.

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*(1 mark)*

3 (a) A positive result from the test for reducing sugar indicates the presence of glucose. Is this a reliable statement? Explain your answer.

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*(2 marks)*

3 (b) The conclusion of one student, who performed an identical investigation, was that reducing sugar had passed through the visking tubule membrane by facilitated diffusion. Do you agree with this conclusion? Explain your answer.

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*(3 marks)*

4 Use your table of raw data to identify whether the results you obtained were reliable or not. Explain your answer.

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*(2 marks)*

5. What conclusion are you able to draw from your graph?

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*(1 marks)*

15

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## **HBI3X EPMA**

### **SECTION B RESOURCE SHEET**

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#### **INTRODUCTION**

The liquid part of the blood, the blood plasma, contains components of different sizes including cells, proteins, dissolved ions and urea. Blood cells and proteins are essential parts of the blood and the concentrations of ions are closely controlled. Urea is a waste substance and has to be removed from the blood. The kidneys remove urea from the blood and help to regulate the concentrations of ions in the blood.

If a person's kidneys are damaged, a kidney dialysis machine can be used to perform the work of the kidney. Without the dialysis carried out by the machine, concentrations of some ions would not be maintained and toxic urea would build up in blood.

In a kidney dialysis machine, blood from an artery of a patient is pumped through a semi-permeable tube made of cellulose. This tube is surrounded by dialysis fluid. After passing through the cellulose tubing, the blood is returned to a vein. The patient remains connected to the dialysis machine for several hours for each treatment. The dialysis treatment has to be repeated every few days.

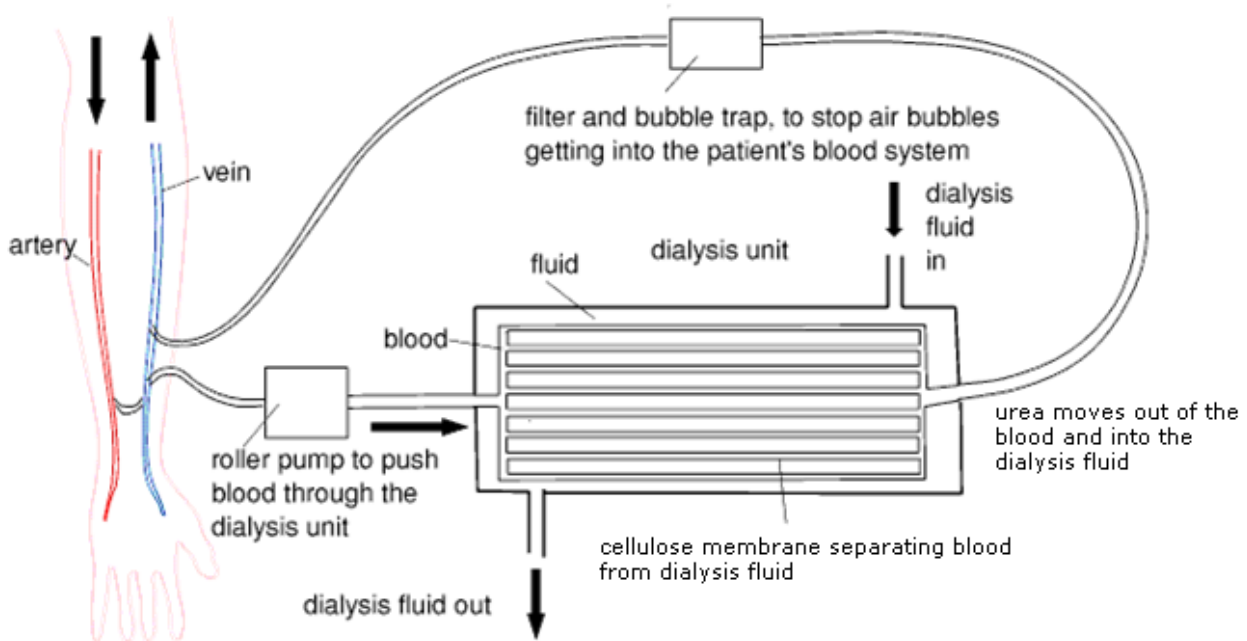
#### **Resource A**

One million people worldwide are undergoing long-term kidney dialysis. The death rate of patients in the first year of dialysis varies between 14 and 23% in different parts of the world. The death rate in the first year of dialysis is affected by other existing conditions such as diabetes and heart disease.

## Resource B

**Figure 1** shows a kidney dialysis machine. The kidney dialysis machine uses a cellulose membrane supported by a plastic structure. The cellulose membrane is made of cellulose fibres. There are pores between these fibres that allow water and dissolved ions to pass through the membrane. Blood flows past one side of this membrane and dialysis fluid passes on the other side. The membrane is folded-over many times. The dialysis fluid has the same solute concentration as a healthy blood plasma. However, the dialysis fluid does not contain any urea. A substance called heparin is added to blood as it enters the dialysis machine. Heparin prevents the blood clotting and blocking the cellulose filtration surface of the machine. No heparin is added for the last hour of dialysis.

**Figure 1**



## Resource C

Tap water is treated with a disinfectant called chloramine to kill any microorganisms. Chloramine adds chloride and ammonia ions to the water. Chloramine has to be removed from the water used to make the dialysis fluid used in kidney dialysis machines.

## Resource D

The composition of dialysis fluid can be adjusted for each patient. The table shows major components of dialysis fluid and their usual concentration ranges. The normal blood concentration range of some of the same components in blood is also shown.

Component	Normal concentration range in dialysis fluid / $\text{mmol dm}^{-3}$	Normal concentration range in blood / $\text{mmol dm}^{-3}$
Sodium	130 – 135	135 – 145
Potassium	1.5 – 3.0	3.5 – 5.2
Calcium	1.6 – 1.8	
Chlorine	95 – 100	96 - 107
Magnesium	0 - 25	
Glucose	0 -10	

Use the information provided and your own knowledge to answer the following questions.

- 6 (a) Use the information in **Resource A** to calculate how many fewer deaths occur worldwide when mortality rates during the first year of dialysis are at their lowest compared to their highest.

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(1 mark)

- 6 (b) The number of people dying during the first year of dialysis varies in different parts of the world. Suggest why.

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(2 marks)

- 7 Use the information provided in **Resource B** to answer the following questions.

- 7 (a) The cellulose membrane in the dialysis machine may be folded-over many times. This increases the efficiency of dialysis. Suggest why.

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(1 mark)

7 (b) The dialysis fluid flowing into the machine does not contain urea. This leads to the removal of urea from the blood flowing in the cellulose tubing. Explain why.

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*(2 marks)*

7 (c) Heparin is not added to the dialysis fluid in the last hour of dialysis. This is done to reduce risk of harm to the patient after dialysis. Explain why.

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*(2 marks)*

8 The cellulose membrane in a dialysis machine is made of cellulose fibres. There are pores between these fibres that allow water and dissolved ions to pass through the membrane.

8 (a) Substances pass through the cellulose membrane on the basis of their size. The passage of some substances across a cell membrane is different. Explain how.

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*(3 marks)*

8 (b) Use your knowledge of water potential to explain why glucose is a component of dialysis fluid. (**Resource D**)

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*(2 marks)*

9 Use the information provided in **Resource C** and **Resource D** to answer the following questions.

9 (a) The removal of chloramine from the water used to make dialysis fluid is essential. Explain why.

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*(1 mark)*

9 (b) The concentrations of the components of dialysis fluid are given as a range. Suggest why different concentration might be used within different patients.

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*(1 mark)*