General Certificate of Education
Advanced Level Examination
June 2012

Human Biology HBI6X/TN

Unit 6X A2 Externally Marked Practical Assignment

Teachers' Notes Confidential

A copy should be given immediately to the teacher(s) responsible for GCE Human Biology

Estimated Entries must be submitted to AQA in order for centres to receive hard copies of the materials to be used by candidates.

Open on receipt

Teachers' Notes

CONFIDENTIAL

These notes must be read in conjunction with *Instructions for the Administration of the Externally Marked Practical Assignment* for GCE Human Biology published on the AQA website.

Allergies and the food we eat

Task 1 - Testing for the presence of vitamin C

Some doctors believe that vitamin C (ascorbic acid) helps protect the body against allergies. Testing for the presence of vitamin C is the context for Task 1. Candidates will use a method that allows them to determine the mass of vitamin C in a food substance. Candidates are not expected or required to know anything about vitamin C.

Materials

In addition to access to general laboratory equipment, each candidate needs

- 30 cm^3 vitamin C solution (1 mg cm^{-3})
- 10 cm^3 of 0.5% starch solution
- 30 cm^3 of 0.1% iodine solution
- 10 cm^3 syringe (to contain iodine solution)
- two 100 cm^3 conical flasks
- dropping pipette
- graduated pipette or syringe capable of measuring 10 cm^3 (for vitamin C solution)
- pipette filler (if a graduated pipette is used)
- timer
- marker pen

Managing the investigation

The method to determine the mass of vitamin C in a food substance is based on the principle that, when iodine is added to a vitamin C-starch mixture, the iodine reacts with the vitamin C first. The iodine will then react with the starch and produce a colour change. The concentrations of the iodine and starch solutions are not relevant for the candidates.

The method requires a syringe for the addition of an iodine solution. A graduated pipette with pipette filler attached or a burette can be used if preferred. In this case, it is acceptable for the teacher to show candidates how to control the flow of liquid from the pipette or burette.

This investigation was successfully trialled using materials available from biological and chemical suppliers such as Philip Harris and Griffin Education. Vitamin C tablets can also be purchased from health food shops.

Technical Information

0.5% starch solution - labelled 'Starch solution'
Use *soluble* starch powder to make the solution.

0.1% iodine solution - labelled 'Iodine solution'
Iodine is usually supplied as a 1% solution in potassium iodide. If the iodine is supplied as 0.05 mol dm^{-3}, this approximates to a 1% solution and can be treated as such. Centres can make their own iodine solution using iodine and potassium iodide but this solution should be trialled before use.

Vitamin C (ascorbic acid) solution (1 mg cm^{-3})
This should be made freshly on the day required. An exact concentration is not critical - it will not affect the investigation or questions that arise - but candidates are told that 10 cm^3 contains 10 mg of vitamin C. Vitamin C tablets were found to be easier to use than measuring a small mass of vitamin C powder.

The task must be trialled before use.

Please note the result of this trial must be used in the instruction you give candidates at the start of Task 2.

During Task 2, candidates will need to know the mass of vitamin C that reacts with 1 cm^3 of iodine solution. To avoid issues arising from calculation errors by candidates, the teacher will give candidates the value to use at the Task 2 stage.

Candidates **must not** be given information about an EMPA until one week before Task 1. One week before Task 1 candidates should be given the following information.

You will investigate how the vitamin C content of food can be measured, how it might be affected by the way food is cooked or stored and the relationship between food and allergies.

There **must** be no further discussion and candidates **must not** be given any further resources to prepare for the assessment.

In Task 1, teachers must not give candidates the following information

- how to determine when an end point is reached
- how to carry out the calculation

Task 2 - Finding whether the mass of vitamin C in potato is affected by cooking

The way a food is cooked or stored before it is eaten affects the mass of vitamin C within it. If vitamin C helps protect the body against allergies then the degree of protection might depend on the mass of vitamin C the body receives. Potatoes are used as a readily available type of food. Raw and cooked potatoes might have different masses of vitamin C. This is the context for Task 2.

Materials

In addition to access to general laboratory equipment, each candidate needs

- a potato (or piece of potato) capable of providing 60 g when peeled
- access to a balance
- access to a blender/liquidiser
- 400 cm^3 of water (tap water can be used)
- 25 cm^3 of starch solution
- 120 cm^3 of iodine solution
- measuring cylinder capable of measuring 200 cm^3
- two large beakers (400 cm^3 or 500 cm^3)
- 10 cm^3 syringe (for iodine solution)
- two 100 cm^3 conical flasks
- dropping pipette
- two graduated pipettes or syringes capable of measuring 10 cm^3 (for potato solutions)
- pipette filler (if graduated pipettes used)
- funnel
- cloth for filtering (muslin or dish cloth material is sufficient)
- knife
- Bunsen burner
- means of lighting the Bunsen burner
- tripod and gauze
- timer
- marker pen

Managing the investigation

Chemicals and preparation of solutions are the same as for Task 1. This investigation was successfully trialled using the materials as outlined. The volumes provided should allow a candidate to collect 5 sets of data. Each candidate requires <u>one</u> whole potato or piece of potato large enough to yield 60 g when peeled. The peeled potato is used to make both raw and cooked potato solutions. It does not matter that some starch may be released from the potato samples. Candidates require access to a blender but they do not have to use the blender themselves. They could hand their beaker to the teacher or technician who could carry out the blending and return the blended mixture in the same beaker as prescribed. The blender should be rinsed after each use.

In this investigation, five sets of data will be considered sufficient for processing and statistical analysis.

The task must be trialled before use.

In Task 2, teachers must not give candidates the following information

- how to determine when an end point is reached.

Please note before candidates begin Task 2, teachers **must tell** candidates

"1 cm^3 of iodine solution reacts with _____ mg vitamin C."

Instruct candidates to complete the sentence before the start of Question **6** with the value to be used. The value is the one the teacher obtained in the trial of Task 1.

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use
Total Task 1

General Certificate of Education
Advanced Level Examination
June 2012

Human Biology HBI6X/PM1

Unit 6X A2 Externally Marked Practical Assignment

Task Sheet 1

To be completed before Task Sheet 2

For submission by 15 May 2012

For this paper you must have:
- a ruler with millimetre measurements
- a calculator.

Allergies and the food we eat

Introduction

Some doctors believe that vitamin C (ascorbic acid) helps protect the body from allergies.

Task 1 - Testing for the presence of vitamin C

In Task 1, you will carry out a test for the presence of vitamin C. This test uses iodine and starch.

If iodine solution is added to a solution containing starch, a blue-black colour develops. If iodine solution is added to a solution containing vitamin C and starch, it reacts with both starch and vitamin C. Until the iodine has reacted with all the vitamin C in the solution, any blue-black colour change only lasts for a few seconds. A permanent blue-black colour develops after iodine has reacted with all of the vitamin C in the solution.

The volume of iodine solution added to get a permanent blue-black colour can be used to calculate the mass of vitamin C in a solution.

You will carry out two trials to help you identify when the reaction is complete.

Materials

You are provided with

- vitamin C solution
- starch solution
- iodine solution
- 10 cm^3 syringe
- two conical flasks
- dropping pipette (for use with starch solution)
- graduated pipette or syringe
- pipette filler (if pipette used)
- timer
- marker pen

You may ask your teacher for any other apparatus you require.

Outline method

Read these instructions carefully before you start your investigation.

1. Label two conical flasks **A** and **B**.
2. Put 10 cm^3 of vitamin C solution and 5 drops of starch solution into flask **A**.
3. Fill a syringe with about 10 cm^3 of iodine solution. Record the starting volume in the syringe.
4. Add a small volume of the iodine solution to the mixture in flask **A** and swirl the contents of the flask allowing them to mix.
5. Repeat step 4 until the reaction is complete. The reaction is complete when the mixture changes colour and remains coloured for longer than 20 seconds.
6. Record the final volume of the iodine solution in the syringe.
7. Repeat steps 2 to 6 with flask **B**.

You will need to decide for yourself

- what volume of iodine solution you should add each time
- when the reaction is complete

Recording your results

Record your results in the table.

Flask	Iodine solution		
	Starting volume / cm^3	Final volume / cm^3	Volume required to complete the reaction / cm^3
A (trial 1)			
B (trial 2)			

Questions on Task 1

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

1 You used a dropping pipette to place 5 drops of starch solution into flask **A** (step 2). Did the use of a dropping pipette affect the accuracy with which you were able to find when the reaction was complete? Explain your answer.

2 When you first added iodine solution to the vitamin C and starch mixture in flask **A** (step 4), a blue-black colour appeared but this soon disappeared.

Explain why the colour disappeared.

3 In this investigation you did not control temperature. Explain why this had no effect on your result.

4 The 10 cm^3 of vitamin C solution in your flasks contained 10 mg vitamin C. This mass of vitamin C reacted with the volume of iodine solution that you added from the syringe.

A student who carried out this investigation found that she needed 8.5 cm^3 of iodine solution to complete the reaction.

Use her result to calculate the mass of vitamin C that reacts with 1 cm^3 of iodine solution. Show your working.

1 cm^3 of iodine solution reacts with ..... mg vitamin C

5 Another student carried out a similar investigation to you. He used DCPIP to detect vitamin C. DCPIP is a blue solution that turns colourless when it reacts with vitamin C. He used a syringe to add DCPIP to a solution containing vitamin C.

5 (a) Apart from the use of DCPIP give **one** way in which the student's method was different from yours.

5 (b) How would he know when the reaction was complete?

5 (c) What reading would he take when the reaction was complete?
Explain your answer.

END OF TASK 1

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use
Total Task 2

AQA

General Certificate of Education
Advanced Level Examination
June 2012

Human Biology HBI6X/PM2

Unit 6X A2 Externally Marked Practical Assignment

Task Sheet 2

To be completed before the EMPA Written Test

For submission by 15 May 2012

For this paper you must have:
- a ruler with millimetre measurements
- a calculator.

Allergies and the food we eat

Introduction

Some doctors believe that vitamin C (ascorbic acid) helps protect the body from allergies. Many of the foods we eat contain vitamin C. The way that a food is stored or cooked before it is eaten affects the mass of vitamin C in the food.

Task 2 - Finding whether the mass of vitamin C in potato is affected by cooking

In Task 2, you will investigate whether cooking affects the mass of vitamin C in potato. You will compare the mass of vitamin C in solutions made using raw potato and using cooked potato.

Materials

You are provided with

- a potato
- access to a balance
- access to a blender/liquidiser
- water
- starch solution
- iodine solution
- measuring cylinder
- two large beakers
- 10 cm^3 syringe (for use with the iodine solution)
- two conical flasks
- dropping pipette
- two graduated pipettes or syringes (for use with the potato solutions)
- pipette filler (if graduated pipettes are used)
- funnel
- cloth for filtering
- knife
- Bunsen burner
- means of lighting the Bunsen burner
- tripod and gauze
- timer
- marker pen

You may ask your teacher for any other apparatus you require.

Outline Method

Read these instructions carefully before you start your investigation.

Preparing your raw and cooked potato solutions

1. Label two large beakers **A** and **B**.
2. Add 200 cm^3 of water to each beaker.
3. Carefully peel the potato and cut it in half.
4. Cut small pieces from one half of the peeled potato to obtain 30 g of potato. Put the pieces into the water in beaker **A**.
5. Repeat with the other half of potato and put 30 g of potato in the water in beaker **B**.
6. Pour the contents of beaker **A** into a blender and blend for 10 seconds.
7. Pour your blended mixture through a cloth placed over a funnel and collect the filtrate back in beaker **A**. This filtrate is your **raw** potato solution.
8. Use the Bunsen burner to heat beaker **B** until the water starts to bubble. Turn off the Bunsen burner and leave to cool for about 10 minutes.
9. When cool, pour the contents of beaker **B** into a blender and blend for 10 seconds. Rinse beaker **B**.
10. Pour your blended mixture through a cloth placed over a funnel and collect the filtrate back in beaker **B**. This filtrate is your **cooked** potato solution.

Finding the volume of iodine required

11. Put 10 cm^3 **raw** potato solution (beaker **A**) and 5 drops of starch solution into a conical flask.
12. Fill a 10 cm^3 syringe with about 10 cm^3 iodine solution. Record the starting volume in the syringe.
13. Add a small volume of the iodine solution to the **raw** potato solution. Swirl the contents of the flask allowing them to mix. Repeat until the reaction is complete. The reaction is complete when the mixture changes colour and remains coloured for longer than 20 seconds.
14. Record the final volume of the iodine solution.
15. Repeat steps 11 to 14 using your **cooked** potato solution (beaker **B**).
16. Repeat steps 11 to 15 so that you have 5 sets of data for both your raw and cooked potato solutions.

You will need to decide for yourself

- what volume of iodine solution you should add each time
- when the reaction is complete.

Presenting data

Complete the sentence below with the value that your teacher gives you. You will need this information to complete the processing of your data.

1 cm^3 of iodine solution reacts with _____ mg vitamin C.

6 Record the results of your investigation in an appropriate table in the space below.

7 Analyse your data with a suitable statistical test. You may use a calculator and the AQA Students' Statistics Sheet that has been provided.

You are provided with a sheet of graph paper. You may use this if you wish.

Hand in this sheet at the end of the practical session.

7 (a) State your null hypothesis.

7 (b) Give your choice of statistical test.

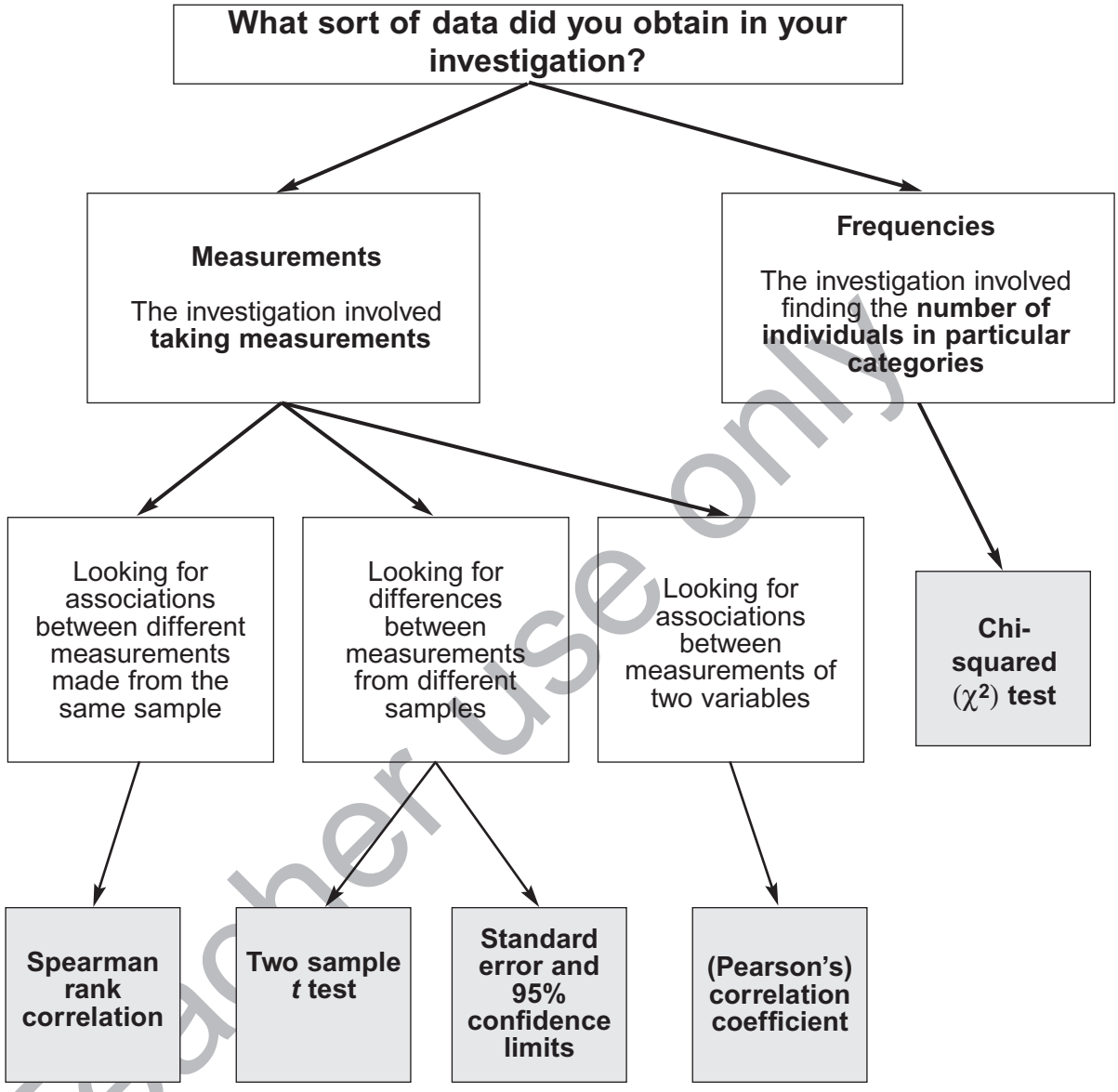
7 (c) Give a reason for your choice of statistical test.

7 (d) Carry out the test and calculate the test statistic. Show your working.

7 (e) Interpret the test statistic in relation to your null hypothesis. Use the words *probability* and *chance* in your answer.

END OF TASK 2

Students' Statistics Sheet



For use in the A2 ISA and EMPA assessment

Statistical tests and tables of critical values

Tables of critical values

A table of critical values is provided with each statistical test. If your calculated test statistic is greater than, or equal to, the critical value, then the result of your statistical test is significant. This means that your null hypothesis should be rejected.

Spearman rank correlation test

Use this test when
- you wish to find out if there is a significant association between two sets of measurements from the same sample
- you have between 5 and 30 pairs of measurements.

Record the data as values of X and Y.

Convert these values to rank orders, 1 for largest, 2 for second largest, etc.

Now calculate the value of the Spearman rank correlation, r_s, from the equation

$$r_s = 1 - \left[\frac{6 \times \Sigma D^2}{N^3 - N}\right]$$

where N is the number of pairs of items in the sample
D is the difference between each pair (X-Y) of measurements.

A table showing the critical values of r_s for different numbers of paired values

Number of pairs of measurements	Critical value
5	1.00
6	0.89
7	0.79
8	0.74
9	0.68
10	0.65
12	0.59
14	0.54
16	0.51
18	0.48

Correlation coefficient (Pearson's correlation coefficient)

Use this test when
- you wish to find out if there is a significant association between two sets of measurements measured on interval or ratio scales
- the data are normally distributed.

Record the data as values of variables X and Y.

Now calculate the value of the (Pearson) correlation coefficient, r, from the equation

$$r = \frac{\Sigma XY - [(\Sigma X)(\Sigma Y)]/n}{\sqrt{\{\Sigma X^2 - [(\Sigma X)^2/n]\}\ \{\Sigma Y^2 - [(\Sigma Y)^2/n]\}}}$$

where n is the number of values of X and Y.

A table showing the critical values of *r* for different degrees of freedom

Degrees of freedom	Critical value	Degrees of freedom	Critical value
1	1.00	12	0.53
2	0.95	14	0.50
3	0.88	16	0.47
4	0.81	18	0.44
5	0.75	20	0.42
6	0.71	22	0.40
7	0.67	24	0.39
8	0.63	26	0.37
9	0.60	28	0.36
10	0.58	30	0.35

For most cases, the number of degrees of freedom = $n - 2$

The *t* test

Use this test when
- you wish to find out if there is a significant difference between two means
- the data are normally distributed
- the sample size is less than 25.

t can be calculated from the formula

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{(s_1^2/n_1) + (s_2^2/n_2)}}$$

where $\bar{x}_1$ = mean of first sample
$\bar{x}_2$ = mean of second sample
s_1 = standard deviation of first sample
s_2 = standard deviation of second sample
n_1 = number of measurements in first sample
n_2 = number of measurements in second sample

A table showing the critical values of *t* for different degrees of freedom

Degrees of freedom	Critical value	Degrees of freedom	Critical value
4	2.78		
5	2.57	15	2.13
6	2.48	16	2.12
7	2.37	18	2.10
8	2.31	20	2.09
9	2.26	22	2.07
10	2.23	24	2.06
11	2.20	26	2.06
12	2.18	28	2.05
13	2.16	30	2.04
14	2.15	40	2.02

The number of degrees of freedom = $(n_1 + n_2) - 2$

Standard error and 95% confidence limits

Use this when
- you wish to find out if the difference between two means is significant
- the data are normally distributed
- the sizes of the samples are at least 30. For assessment purposes, five samples are acceptable providing that this is acknowledged either at a convenient place in the statistical analysis or in the conclusions.

Standard error
Calculate the standard error of the mean, SE, for each sample from the following formula:

$$SE = \frac{SD}{\sqrt{n}}$$

where SD = the standard deviation
n = sample size

95% confidence limits
In a normal distribution, 95% of data points fall within ± 2 standard deviations of the mean.

Usually, you are dealing with a sample of a larger population. In this case, the 95% confidence limits for the sample mean are calculated using the following formula

95% confidence limits = $\bar{x} \pm 2 \times \frac{\mathrm{SD}}{\sqrt{n}}$ **OR** $\bar{x} \pm 2 \times \mathrm{SE}$

The chi-squared test

Use this test when
- the measurements relate to the number of individuals in particular categories
- the observed number can be compared with an expected number which is calculated from a theory, as in the case of genetics experiments.

The chi-squared (χ^2) test is based on calculating the value of χ^2 from the equation

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

where O represents the observed results
E represents the results we expect.

A table showing the critical values of χ^2 for different degrees of freedom

Degrees of freedom	Critical value
1	3.84
2	5.99
3	7.82
4	9.49
5	11.07
6	12.59
7	14.07
8	15.51
9	16.92
10	18.31

The number of degrees of freedom = number of categories – 1

Centre Number						Candidate Number				
Surname						Other Names				

Notice to Candidate. The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.

Candidate Declaration. I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate Signature		Date	

For Examiner's Use	
Total EMPA mark	
Examiner's Initials	
Section	Mark
Task 1	
Task 2	
Section A	
Section B	
TOTAL EMPA MARK	

General Certificate of Education
Advanced Level Examination
June 2012

Human Biology HBI6X

Unit 6X A2 Externally Marked Practical Assignment Written Test

For submission by 15 May 2012

For this paper you must have:	**Time allowed**
• your Task Sheet 2, your results and your calculations • a ruler with millimetre measurements • a calculator.	• 1 hour 15 minutes
Instructions:	**Information**
• Use black ink or black ball-point pen. • Fill in the boxes at the top of this page. • Answer **all** questions. • You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages. • Do all rough work in this book. Cross through any work you do not want to be marked.	• The marks for questions are shown in brackets. • The maximum mark for this paper is 30. • You will be marked on your ability to: – use good English – organise information clearly – use scientific terminology accurately.

Details of additional assistance (if any). Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page.

Yes ☐ No ☐

Teacher Declaration:

I confirm that the candidate has met the requirements of the practical skills verification (PSV) in accordance with the instructions and criteria in section 3.8 of the specification.

Practical Skills Verification	**Yes** ☐

Signature of teacher ..... Date .....

Section A

These questions relate to your investigation about vitamin C.

Use your Task Sheet 2, your results and your statistical calculation to answer the questions.

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

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8 When making your potato solutions, suggest why it was necessary to

8 (a) peel the potato (step 3).

8 (b) use two halves of the same potato (step 4 and step 5).

8 (c) blend the contents of beaker **A** (step 6).

9 Other than those in Question **8**, give **two** experimental variables that you controlled when making your potato solutions.

10 Your investigation involved a reaction between iodine and vitamin C (ascorbic acid) in the potato solution. This reaction is shown by the equation

iodine + ascorbic acid $\rightarrow$ dehydroxyascorbic acid

Use observations you made during your investigation to give the colour, if any, of a solution of dehydroxyascorbic acid.

11 What type of graph should you use to show a comparison of the mean mass of vitamin C in raw and cooked potato solutions? Explain your answer.

12 A student carried out a similar investigation to you but there were some differences in the method used. The differences are shown in **Figure 1**.
Complete **Figure 1** to suggest the effect, if any, of each of the changes in the method on their results.

Figure 1

Change in the method	Effect of change in the method on the result
Use a more dilute iodine solution	....
Increase the number of drops of starch solution used	....
Use 100 cm^3 of water to make the raw potato solution	....

13 A group of students investigated whether there was a correlation between the concentration of vitamin C in potatoes and how long they had been stored. They obtained potatoes which had been dug out of the ground on that day from a farm and kept them in the laboratory. On the first day and then at 7-day intervals, they found the mean concentration of vitamin C in five potatoes.

Their results are shown in **Figure 2**.

Figure 2

Time after potatoes were dug out of the ground / days	Mean concentration of vitamin C / mg $100g^{-1}$
0	3.5
7	3.1
14	2.5
21	1.8
28	1.6

13 (a) Suggest the null hypothesis for their investigation.

13 (b) Which statistical test should they use to analyse their results?

13 (c) One student realised that they knew when the potatoes were dug out of the ground but they did not know how old the plants were from which the potatoes came.
Would this affect the reliability of their results? Explain your answer.

Resource Sheet

Introduction

An allergy is an abnormal immune response to a specific substance. Hay fever is caused by an allergic reaction.

Resource A

During an allergic reaction, histamine is released. Histamine causes some symptoms associated with allergies such as hay fever. It has been discovered that people who suffer from hay fever have a lower mass of vitamin C in their blood than people who do not suffer from hay fever. This is especially true during summer.

Here are some facts about vitamin C.

- 500 mg tablets of vitamin C can be bought from health food shops.
- The body cannot store excess vitamin C. The excess is lost in the urine.
- An excessive intake of vitamin C can cause diarrhoea.
- The recommended safe upper limit for vitamin C intake is 2000 mg per day.
- The recommended daily intake for adults is 75 mg for females and 90 mg for males.
- Vitamin C acts by blocking histamine receptors.
- Some doctors recommend that hay fever sufferers take between 1000 mg and 3000 mg of vitamin C per day.

Resource B

A researcher investigated the effect of taking different doses of vitamin C on symptoms of sufferers from hay fever. Six volunteers were asked to take different doses of vitamin C and record any effects on their symptoms. The researcher also measured the mass of vitamin C lost in the volunteers' urine before and one day after receiving a 100 mg dose of vitamin C.

A healthy person loses between 30 mg and 50 mg of vitamin C in the urine each day.

The results of the investigation are shown in **Figure 3** in the form in which the researcher presented them.

Figure 3

Volunteer	Vitamin C loss in urine / mg day^{-1}		Effect of dose of vitamin C on symptoms of hay fever recorded by volunteers		
	Before dose of vitamin C	One day after dose of vitamin C	One week after receiving a 100 mg dose	One week after receiving a 200 mg dose	After receiving a 500 mg dose
1	43	91	No relief	Slight relief	No hay fever after 4 days
2	21	36	Some relief	Clear relief	Little hay fever after 2 days
3	11	72	No relief	No relief	Still suffering from hay fever
4	17	105	No relief	(not recorded)	Feeling better after 3 days
5	9	104	Some relief	(not recorded)	(not recorded)
6	62	117	No relief	(not recorded)	No relief by 3 days later

Section B

Use the information in the **Resource Sheet** to answer the questions.

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

Use the information provided in **Resource A** to answer **Questions 14** to **17**.

14 Vitamin C can be bought as 500 mg tablets.
Give **two** reasons why buying tablets containing 250 mg of vitamin C might be more appropriate.

15 Vitamin C acts by blocking histamine receptors. These receptors are proteins on the surface of target cells.
Suggest how vitamin C prevents histamine binding to its receptor.

16 Suggest why there is a difference in the recommended daily intake of vitamin C for adult females and for adult males.

17 Some doctors suggest hay fever sufferers take between 1000 mg and 3000 mg of vitamin C per day. Suggest **one** reason why this may **not** be an advantage to hay fever sufferers.

Use the information provided in **Resource B** to answer **Questions 18** to **20**.

18 The amount of vitamin C that a healthy person loses in urine varies between 30 mg and 50 mg per day.
Suggest **one** reason for this variation.

19 One effect of taking vitamin C on hay fever as recorded by volunteers was 'Some relief'.
Suggest why

19 (a) this may be an appropriate way to record the effect of taking vitamin C.

19 (b) this may **not** be an appropriate way to record the effect of taking vitamin C.

20 A health food company produced 500 mg tablets of vitamin C. They produced an advertisement for their tablets based on the data presented in **Figure 3**. The advertisement stated that, "Scientists have proved that our vitamin C tablets ease suffering caused by hay fever."

Explain why the data in **Figure 3** do **not** support this statement.

END OF QUESTIONS