General Certificate of Education
Advanced Level Examination
June 2013

Biology BIO6T/Q13/task

Unit 6T A2 Investigative Skills Assignment

Task Sheet

An investigation of the energy content of foods rich in carbohydrates

Introduction

If a food is burnt, heat energy is released. If the burning food is used to heat water, the change in temperature of the water can be used to determine the energy content of the food. You will use a simple method for obtaining a measure of the energy content of cream crackers and marshmallows. Cream crackers and marshmallows both contain a lot of carbohydrates but the types of carbohydrates are different.

Materials

You are provided with:

- 2 cream crackers
- 5 marshmallows
- test tubes
- 10 cm^3 measuring cylinder (or pipette with pipette filler)
- water
- clamp and stand
- thermometer
- mounted needle (or tongs)
- access to a balance
- Bunsen burner
- heat-resistant mat
- method of lighting Bunsen burner.

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

Method

Read these instructions carefully before you start your investigation.

1. Break each cream cracker into four pieces of approximately the same size.
2. Put 10 cm^3 of water into a test tube and record the temperature of the water in the tube.
3. Use the clamp and stand to hold the tube at an angle and facing away from you and anyone else.
4. Weigh one piece of cracker and record its mass.
5. Carefully use a mounted needle or tongs to hold the piece of cracker.
6. Light the Bunsen burner and use it to set fire to the piece of cracker.
7. As soon as the piece of cracker is burning, move it under the tube so that it heats the water in the tube as it burns. If the piece of cracker stops burning, see if it will relight and continue heating the water.
8. When the piece of cracker finally stops burning, record the temperature of the water in the tube.
9. Repeat steps 2 – 8 with four other pieces of cream cracker.
10. Repeat steps 2 – 8 with the five whole marshmallows. Do not break the marshmallows into smaller pieces.

You may assume that this will give you sufficient raw data for a statistical test.

You will need to decide for yourself:

- when the cracker or marshmallow is alight
- when the cracker or marshmallow has finished burning.

ISA BIO6T/Q13 Candidate Results Sheet: Stage 1

An investigation of the energy content of foods rich in carbohydrates

Centre Number | | | | | | Candidate Number | | | | |

Candidate Name.....

Record your data in an appropriate table in the space below.

No marks are awarded for the table at A2.

In this investigation, you will assume that:

- 1 cm^3 of water weighs 1 g
- 4.2 joules is the amount of energy required to increase the temperature of 1 g of water by 1 ^oC.

You can calculate the energy content of a food substance using the formula:

Energy content in joules = mass of water $\times$ increase in temperature $\times$ 4.2

1 Calculate the energy content per gram of each piece of cream cracker and of each marshmallow. You should express your answers in $J\,g^{-1}$.

Complete the table to show the results of your calculations.

Sample	Energy content of food / $J\,g^{-1}$	
	Cream crackers	**Marshmallows**
1		
2		
3		
4		
5		

(1 mark)

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

End of Stage 1

1

ISA BIO6T/Q13 Candidate Results Sheet: Stage 2

An investigation of the energy content of foods rich in carbohydrates

Centre Number | | | | | | Candidate Number | | | | |

Candidate Name .....

Use a statistical test to analyse your data. You may use a calculator and the AQA Students' Statistics Sheet that has been provided.

A sheet of graph paper is supplied. You may use this if you wish.

2 State your null hypothesis.

.....

.....

.....

.....

.....

(1 mark)

3 (a) Give your choice of statistical test.

.....

(1 mark)

3 (b) Give a reason for your choice of statistical test.

.....

.....

.....

.....

.....

(1 mark)

Turn over ▶

4 Carry out the test and calculate the test statistic. Show your working.

(1 mark)

5 Interpret the test statistic in relation to your null hypothesis being tested. Use the words *probability* and *chance* in your answer.

.....

.....

.....

.....

.....

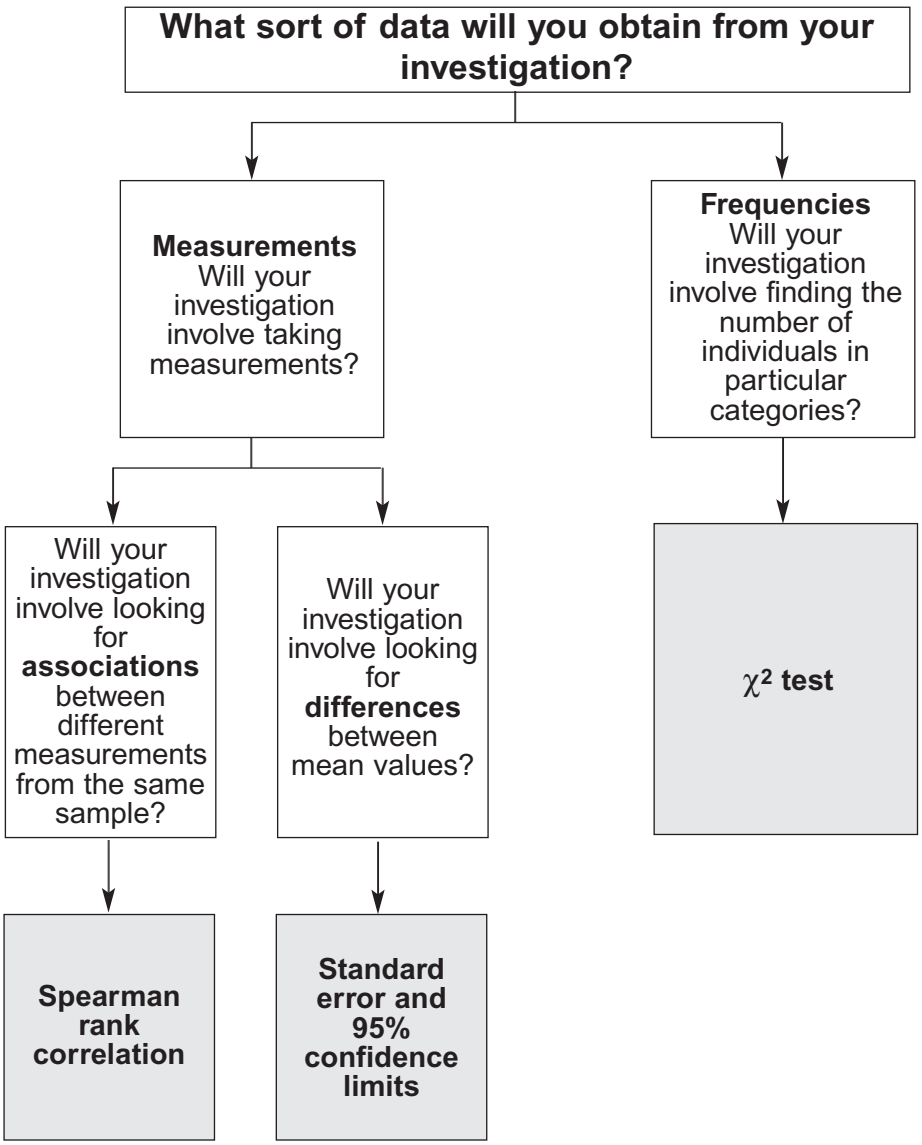
.....

(2 marks)

6

END OF QUESTIONS

AQA Students' Statistics Sheet (version 3)



Standard error and 95% confidence limits

Calculate standard error, SE, for each sample from the following formula

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

where SD = standard deviation
and n = sample size

95% confidence limits = $2 \times SE$ above and below the mean

The χ^2 test

The chi-square (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 results you observe in the investigation
and E represents the results you expect.

Table showing the critical values of χ^2 at P = 0.05 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

Spearman rank correlation test

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 and D is the difference between each pair of ranked measurements.

Table showing the critical values of r_s at P = 0.05 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

For use in the ISA and EMPA assessment