G623: Cells and Molecules – Sample Investigation Plan

An investigation to compare the sugar content of *four* varieties of apple to *two* varieties of dessert apple and *two* varieties of cider apple.

This document includes marked examples of the type of investigation plan that might be submitted in response to the specimen materials provided for Unit G623.

- Candidate 1 – E Grade
- Candidate 2 – A Grade

The type of mark scheme used for the planning exercise is set out on this below.

The marking points **A to X** are based on the marking criteria stated on page 3 of the Plan booklet.

Marking Point	Marking Criteria	Mark	Additional notes
A	easily recognised safety procedures highlighted;	1	Evidence of something specific to the investigation, which is going to make the investigation safer.
B	prediction made;	1	Prediction related to comparison in task.
C	with justification;	1	Statement related to the sugar concentration for the varieties chosen.
D	description of preliminary work;	1	Relevant to task: mass of tissue to be used; processing of tissue; range of standards.
E	clear and in detail;	1	Explain how to do preliminary work.
F	reason (for doing it) explained;	1	Justification of preliminary work.
G	clear and in detail;	1	Detailed justification of preliminary work.
H	at least two secondary sources of information identified;	1	State at least two references.
I	relevance explained;	1	Brief explanation as to how references helped in the planning.
J	basic practical skills and accuracy;	1	Simple method/list of instructions.
K	sound practical skills and accuracy;	1	Could someone follow the instructions unaided? Are quantities shown? Is it repeatable to an appropriate degree of accuracy?
L	range of appropriate equipment listed;	1	List of names of main items of equipment and materials needed for the investigation.
M	full range of appropriate equipment listed;	1	Qualifications noted. Indication of number of each, specific sizes, e.g. 250cm^3 beaker.
N	appropriate number of measurements stated;	1	An indication of the need to replicate measurements/repeat readings.
O	need for range of measurements stated;	1	A statement stating the need for a comparison to be made.
P	appropriate range stated;	1	Appropriate range stated linked to the prediction, i.e. number of varieties of apples used.

Q	relevant variables are identified (stated);	1	At least two identified e.g. mass/volume/age of tissue; concentration/volume of Benedict's solution; temperature; time; type of colorimeter filter.
R	how variables to be controlled explained;	1	How two of the variables identified in Q are controlled.
S	one suitable method to display data;	1	One display of results e.g. table; calibration curve.
T	additional method to display data;	1	Any **different** display e.g. graph; photographic evidence.
U	simple data handling;	1	Calculation of means; colour comparisons; use of calibration curve to calculate glucose concentrations.
V	possible conclusions;	1	Statements of expectations or observations to confirm or reject prediction made in B. 'What would the results need to show to confirm or reject the prediction?'
W	recognises sources of error;	1	At least two examples, e.g. Age/ripeness of apple; different crops; source of origin; limited range of varieties; discrepancies in colour analysis; release of sugar from raw material.
X	suggests method(s) for improving accuracy and/ or validity;	1	Accuracy: related to 'W' or use of alternative technique(s). AND/OR Validity: state aspect of collected data to be compared with secondary sources.
Marks	Maximum for plan = 25	24 + *1 (scientific terminology)*	

Point mark up to 24 by placing letters **A** to **X** in the margin at appropriate points.
Then award 1 mark for use of scientific terminology.

Total marks available: 25

Exemplar Material: Candidate 1

This candidate produced evidence for 10 of the 24 marking points plus 1 mark for the use of scientific terminology.
- **Total mark = 11**
- **Grade awarded = E**

In this assignment I am going to plan an experiment in which I am going to compare two different types of apples, two desserts and two ciders. My aim will be to find out the sugar content of different types of apples and compare them.

Different types of dessert apples:
- White Jonaneting
- Tam Montgomery
- Irish Peach
- George Cave
- Ribston Pippin

Different types of cider apples:
- Cherry Norman
- Red Norman
- Old Bromley
- Cowarne Red
- Kingston Black

Risk assessment

Wear a lab coat and goggles though out the experiment to prevent yourself from getting contact with acids. Wear gloves and be very careful to prevent cuts, as you will be dealing with knives or other glass objects.

Sulphuric acid.

Sulphuric acid is very harmful and is highly corrosive to all parts of the body. The vapours are corrosive to the respiratory tract and can cause fluid build up in the lungs, which could prove fatal. If contact with the skin or eyes is made, it can cause severe burns and may cause permanent damage. We should also avoid inhaling this chemical.

Potassium manganate.

Potassium manganate can cause irritation and it is an oxidising agent. It is harmful if it is swallowed. Potassium manganate may also be flammable. Rinse eyes with plenty of water if potassium manganate gets splashed into the eye and seek medical advice.

A

Prediction.

My prediction is that the sugar content of dessert apples will be higher than in cider apples. This is because the dessert apples are full of juice. The cider apples are dry and also small in size compared with dessert apples.

B

Apparatus.

Beaker	Glass rod
Test tube rack	Weighing boat
Stopwatch	Knife
Beakers	Glucose solution
Syringes	Sulphuric acid
Blender	Potassium manganate
Balance	

L

Method

1. First of all label the syringes as glucose, potassium manganate and H_2SO_4.
2. After that you will need different solutions of glucose for later analysis.
3. From the glucose solution, take 100ml and put it in a beaker.
4. Label the test tubes A – D for the glucose concentrations. Label test tubes E & F for the dessert apple samples and G and H for the cider apple samples.
5. Then with a syringe, take 2ml into the test tube labelled A, 4ml in another test tube labelled B, 6ml in test tube C and 8ml in a test tube labelled D.
6. After this add distilled water to bring all this up to 10ml in all four test tubes. This will give you different dilutions of glucose and you can work out the unknown samples, i.e. by plotting a graph of time against concentration.
7. Get two types of dessert apples and two types of cider apples and then set up a beaker with water and heat it. P
8. After that place the apple into the beaker and heat it until it starts to boiling.
9. Cut the apple into smaller pieces and place it into a blender.
10. After blending, take the apple out and place it on a weighing boat and record the mass of the apple with a balance machine. J
11. Repeat steps 8 to 10 for the remaining varieties of apples. K
12. Add 5ml of sulphuric acid to the glucose solution in test tube A and add 2ml of potassium manganate. Record the time taken for potassium manganate to decolourise.
13. Repeat step 12 with the other solutions, B, C, D, E, F, G and H. Record the time taken to decolourise the potassium manganate in each sample. Record the results in a table.

Results

S

Test Tube	Concentration of glucose (%)	Time taken to decolourise potassium manganate (s)
A	20	
B	40	
C	60	
D	80	
E	Unknown	
F	Unknown	
G	Unknown	
H	Unknown	

Graph

This can be a straight line graph or maybe a curved one. It will depend on the results. Label the x-axis as concentration of glucose and the y-axis as time taken to decolourise the potassium manganate.

T

Conclusion.

In the conclusion you need to describe any trends you notice in your graph and describe anything you find out about the concentrations.

Evaluation.

In your evaluation you need to talk about the limitations of the apparatus, any sources of error and how you can improve the experiment.

Bibliography.

http://www.butterworthsorganicnursery.co.uk/apples.php?page=desert.htm (types of dessert apples).
http://homepage.ntlworld.com/scrumpy/cider/ciderapp.htm (types of cider apples).

H & I

Mark for scientific terminology awarded.

Commentary on Exemplar Candidate 1

Marking Point	Marking Criteria		Additional notes
A	easily recognised safety procedures highlighted;	✓	Achieved. Reference made to use of sulphuric acid and potassium manganate.
B	prediction made;	✓	Prediction given.
C	with justification;	*x*	No appropriate justification given related to sugar content and differences in possible juice extraction between the four varieties.
D	description of preliminary work;	*x*	No preliminary work described.
E	clear and in detail;	*x*	
F	reason (for doing it) explained;	*x*	
G	clear and in detail;	*x*	
H	at least two secondary sources of information identified;	✓	Two different sources given as full web addresses.
I	relevance explained;	✓	Relevance stated.
J	basic practical skills and accuracy;	✓	List of instructions provided as part of a feasible plan.
K	sound practical skills and accuracy;	✓	Quantities are provided in the method. Some detail provided.
L	range of appropriate equipment listed;	✓	Basic equipment listed.
M	full range of appropriate equipment listed;	*x*	Varieties of apples missing. Quantities and specific sizes of equipment not stated.
N	appropriate number of measurements stated;	*x*	Need for repeat measurements not stated.
O	need for range of measurements stated;	*x*	No reference given to the need to compare the four different varieties of apples chosen.
P	appropriate range stated;	✓	Two varieties of cider apples and two varieties of dessert apples stated.
Q	relevant variables are identified (stated);	*x*	Independent, dependent or control variables not identified.
R	how variables to be controlled explained;	*x*	
S	one suitable method to display data;	✓	Table of results given.
T	additional method to display data;	✓	A written description of a suitable graph is given. An actual graph of primary data or a drawing of the expected data is preferred.
U	simple data handling;	*x*	No mean values are calculated or comparisons of time taken to decolourise the potassium manganate solution are stated.
V	possible conclusions;	*x*	No statement of expectations or observations to confirm or reject prediction made in **B** has been given i.e. the higher the concentration of glucose, the faster the time taken to decolourise the potassium manganate.

W	recognises sources of error;	***x***	No relevant sources of error given. At least two examples are required e.g. Age/ripeness of apple; different crops; source of origin; limited range of varieties; discrepancies in colour analysis; release of sugar from raw material.
X	suggests methods for improving accuracy and/ or validity;	***x***	No reference made to improvements in (i) accuracy i.e. testing a larger number of each variety or method of sugar extraction and/or (ii) validity i.e. source of apple varieties.
Marks	10 + 1 *(scientific terminology)*		**Total Marks Awarded = 11**

Exemplar Material: Candidate 2

This candidate produced evidence for 20 of the 24 marking points plus 1 mark for the use of scientific terminology.
- **Total mark = 21**
- **Grade awarded = A**

Introduction.

I'm going to investigate the amount of sugar in four varieties of apple, two varieties of cider apple such as Kingston Black and Dymock Red[1], and two varieties of dessert apples such as Bramley[3] and Granny Smith[2]. To do this I will use a method of colorimetry[4]. I am using this technique as it will record % absorbance as a measure of glucose concentration in the apple tissue when it is heated with Benedict's solution.

P

Risk Assessment.

Before performing any experiments with the apples, an important task is doing a risk assessment.
Bags and coats should be under the desk away from the working area, glassware should be handled with care and if broken cleaned up quickly and safely. Glassware should be deposited in the appropriate glass bin. Goggles should be worn to protect eyes from chemicals. When using the Benedict's solution, gloves and goggles should also be worn as it is an irritant and is corrosive to skin. Care should be taken when using the water bath as it could cause burns. The colorimeter should be kept on the centre of the desk to avoid being knocked. There are electrical risks, so care should be taken to avoid spillages of liquids near or on it and to avoid using the equipment with wet hands to avoid shock.

A

Prediction.

I predict that the dessert apples will contain higher levels of sugar than the cider apples. This is because cider apples if eaten, taste quite bitter, whereas dessert apples taste sweet.

B & C

Preliminary work.

To find out how many apples it requires to produce 100ml of apple juice, I will require a pestle and mortar, knife, 4-5 apples, filter paper, funnel and a beaker. **F**
First I will cut the apples into eighths and then halve them. The apples are placed in a pestle and mortar and are crushed until apple pulp and juice are left in the mortar. Then using the filter paper and funnel, the juice will be filtered from the pulp into a 100ml beaker. The process will be repeated until the 100ml line is reached.

D & E

Equipment.

4 varieties of apple: 2 cider: Kinston Black; Dymock Red;
2 dessert: Bramley; Granny Smith;
Knife
Balance (2 figure)
Mortar and pestle
250cm^3 volumetric flask
Distilled water;
Benedict's solution; **L**
6 x 10cm^3 graduated pipettes and pipette bulb;
Test tubes and rack; **M**
Colorimeter and cuvettes;
Water bath at 100°C.
Labels and pen
250cm^3 10% Glucose solution
Filter paper & funnel.
Teat pipettes,
10cm^3 measuring cylinders.

Variables.

The independent variable is the type of apple used.
The dependent variable is the % absorbance from the colorimeter.
Control variables are the source of apple used, the volume of distilled water used, the concentration of the Benedict's solution; the wavelength of filter used in the colorimeter. **Q**
I will control these variables by using apples bought from the same source at the same time; I will tare the colorimeter with distilled water to make it more accurate before taking each reading; I will use Benedict's solution from the same stock solution. **R**

Method.

1. Peel the apples and cut into crushable sizes for each apple. Using a pestle and mortar, the chunks of the apples will be crushed into a pulp and then filtered using a funnel and filter paper into a beaker. Each type of apple will be filtered into a separate beaker so that the juices containing the soluble sugars from each variety are not mixed together.
2. 100ml of apple juice from each variety is required.
3. Using a graduated pipette, remove 5cm^3 of the apple juice and place in a test tube. Add 5 cm^3 of Benedict's solution.
4. Put the test tube into a water bath at 100°C for 6 minutes; a red precipitate may form.
5. Leave the test tube in the rack to cool.
6. Fill a cuvette with distilled water. Use this to tare the % absorbance scale on the colorimeter to 0%.
7. Using a pipette, remove some of the precipitate into a cuvette. Record % absorbance. **J**
8. Repeat steps 3-7 for all four apple varieties; label the test tubes so as to distinguish the apples. **K**
9. I will repeat each test on the apples. **N**
10. To make the standard glucose solutions at five different concentrations I will start with the 1% stock solution. I will use distilled water to dilute the stock solution as indicated below to produce the following concentrations: 1%; 0.75%; 0.5%; 0.25% and 0.1%.

Concentration of glucose %	Volume of 1% glucose needed cm^3	Volume of distilled water cm^3
1.0	10.0	0.0
0.75	7.5	2.5
0.5	5.0	5.0
0.25	2.5	7.5
0.1	1.0	9.0
0.0	0.0	10.0

11. Place each dilution into a test tube and add 5cm^3 of Benedict's solution. Heat in a boiling water bath. Place each dilution into a cuvette and record % absorbance in a table.

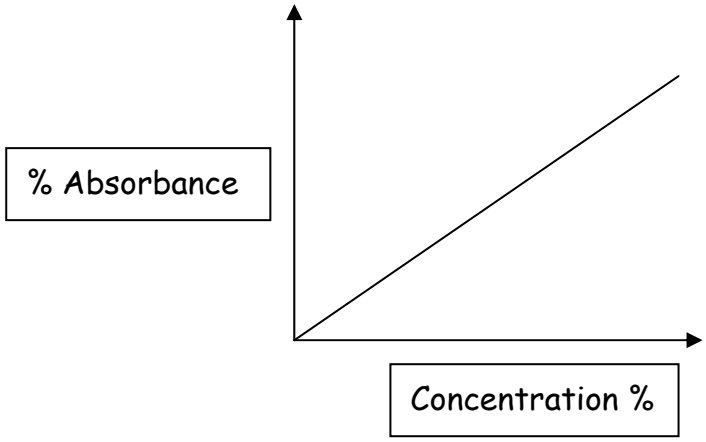
Results.

Standard solutions.

From the results of the standard solutions I will plot a graph of % absorbance against glucose concentration as a calibration curve.
I will draw a line of best fit through the data I have plotted.

S

Concentration of glucose %	% Absorbance
0.0	
0.1	
0.25	
0.5	
0.75	
1.0	



T

Apple Solutions

U

Apple Variety	% absorbance	% absorbance	Mean % absorbance
Kingston Black			
Dymock Red			
Bramley			
Granny Smith			

From the results I have got from the different apples, I will calculate the average absorbance for each apple. I will look at the % absorbance on the graph and read off the concentration of sugar in the apple, which I will write in the table.

Variety of apple	% glucose concentration
Kingston Black	
Dymock Red	
Bramley	
Granny Smith	

This will tell me the concentration in each of the extracts from the four different apple varieties.

Evaluation.

I think that errors that could arise in this experiment are when needing accurate measurements and losing some of the apple when extracting the juice using a pestle and mortar. To improve the accuracy of the experiment I could take extra care and use another method of juice extraction i.e. I could try to filter the extract using a Buchner funnel attached to a vacuum pump.

X

Bibliography.

[1]Pre-release material (used to find types of cider apple to test)
[2]http://en.wikipedia.org/wiki/Granny_smith
(dessert apple) H
[3]http://en.wikipedia.org/wiki/Bramley_apple
(dessert apple)
[4]http://www-saps.plantsci.cam.ac.uk/records/rec169.htm
(Used for an idea of how to test for sugar). I

Scientific Terminology mark awarded.

Commentary on Exemplar Candidate 2

Marking Point	Marking Criteria		Additional notes
A	easily recognised safety procedures highlighted;	✓	Achieved; relevant to the investigation.
B	prediction made;	✓	Achieved
C	with justification;	✓	Achieved
D	description of preliminary work;	✓	Preliminary work described.
E	clear and in detail;	✓	Sufficient detail of preliminary work provided.
F	reason (for doing it) explained;	✓	Reason for preliminary work given.
G	clear and in detail;	*x*	Reason for preliminary work lacks detail.
H	at least two secondary sources of information identified;	✓	At least two different sources provided: full addresses for websites given. Named textbooks; CAMRA resources also acceptable.
I	relevance explained;	✓	Relevance of at least two different sources given.
J	basic practical skills and accuracy;	✓	Achieved
K	sound practical skills and accuracy;	✓	Achieved
L	range of appropriate equipment listed;	✓	Achieved
M	full range of appropriate equipment listed;	✓	Achieved.
N	appropriate number of measurements stated;	✓	Repeat readings stated.
O	need for range of measurements stated;	*x*	No reference made to the need to compare the apple varieties.
P	appropriate range stated;	✓	4 different varieties stated. 2 cider and 2 dessert varieties.
Q	relevant variables are identified (stated);	✓	Independent and dependent variables clearly identified. Control variables listed.
R	how variables to be controlled explained;	✓	Brief outline given on how some of the variables are to be controlled.
S	one suitable method to display data;	✓	Table of results
T	additional method to display data;	✓	Graph
U	simple data handling;	✓	Mean % absorbance calculated. U could also be awarded for use of calibration curve to find glucose concentration.
V	possible conclusions;	*x*	No statements of observations given to confirm or reject prediction made in B. i.e. the greater the % absorbance, the higher the concentration of sugar.
W	recognises sources of error;	*x*	No appropriate or sufficient sources of error given. e.g. Age/ripeness of apple; different crops; source of origin; limited range of varieties; discrepancies in colour analysis; release of sugar from raw material.

X	suggests methods for improving accuracy and/ or validity;	✓	Achieved – states use of alternative method to produce apple juice extract.
Marks	20 + 1 *(scientific terminology)*		**Total Marks Awarded = 21**