OCR
RECOGNISING ACHIEVEMENT

ADDITIONAL APPLIED SCIENCE

CANDIDATE STYLE ANSWERS - CANDIDATE A

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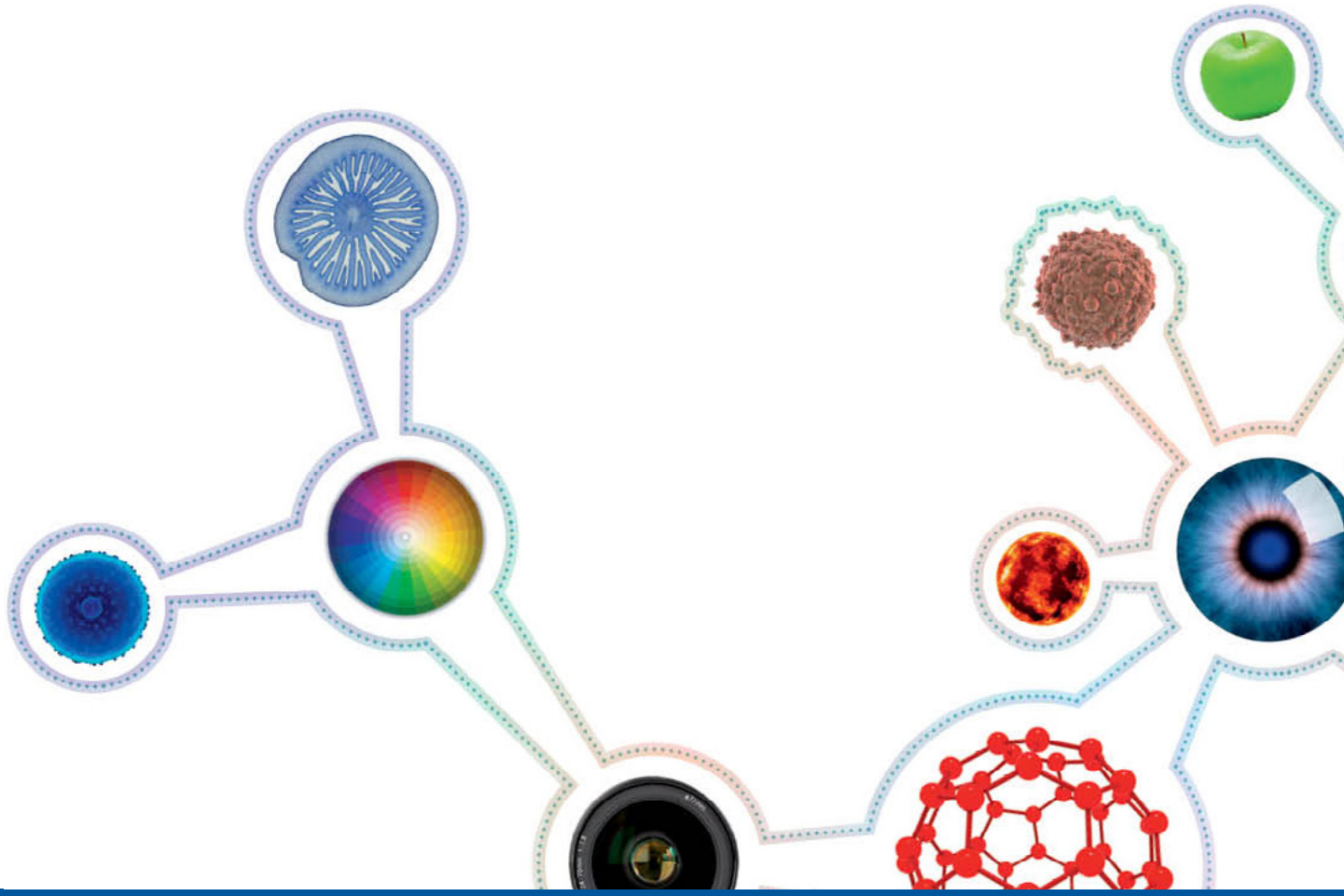


INTRODUCTION

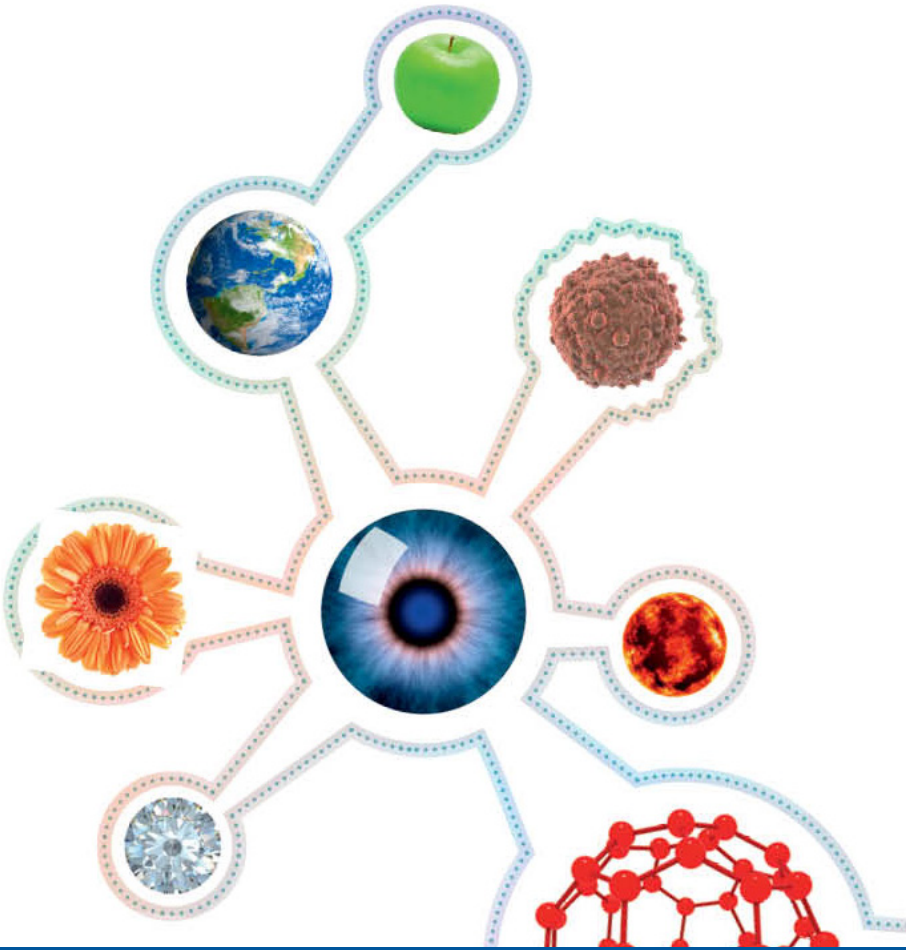
These support materials are intended to support teachers in their marking. There are three candidate style responses with accompanying commentary. These exemplars are based on the published Specimen Assessment Materials (SAMs), which can be downloaded from the relevant OCR webpage for the specification.

The exemplars and commentaries should be read alongside the Specifications and the Guide to Controlled Assessment for GCSE Gateway Science, all of which are available from the website.

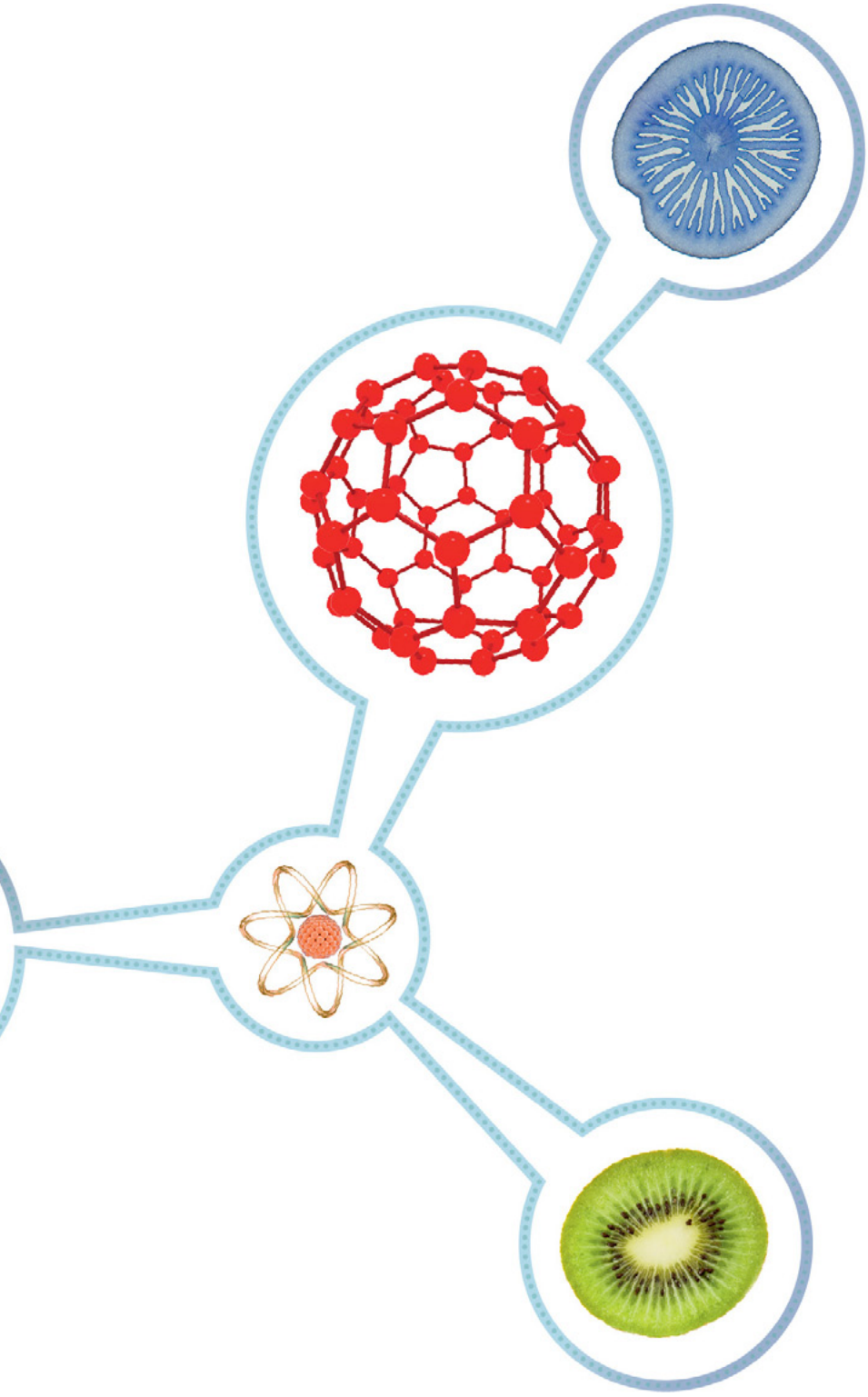
OCR will update these materials as appropriate.

Centres may wish to use these support materials in a number of ways:

- teacher training in interpretation of the marking criteria
- departmental standardisation meetings
- exemplars for candidates to review



STANDARD PROCEDURE



Standard Procedure
Candidates will be expected to provide four standard procedures

Properties such as strength, density, stiffness and toughness are all important when manufacturing sports' equipment.

You are going to measure the density of some materials found in sports' equipment.

The density of a material can be calculated by using the following formula:

$$\text{density} = \frac{\text{mass (g)}}{\text{volume (cm}^3\text{)}}$$

You are required to write a risk assessment, to follow the appropriate standard procedure, record your results in an appropriate manner, process the data you collected and evaluate how you managed risks during the procedure.

[Total: 6 marks]

(Information provided by the centre to put procedure into a vocational context – this is not essential)

Bicycles need different materials in their construction but why measure density?

Density, which is a measure of how light or heavy the material per unit volume is an important property in the manufacture of bicycles.

One of the most common materials used for the tubes of bicycle frames has been steel. Steel frames can be very inexpensive – from carbon steel to highly specialised materials using high performance alloys. Frames can also be made from other materials such as aluminum alloys, titanium, carbon fibre wood, plastics and even bamboo.

The properties of a material help decide manufactures to decide whether it is appropriate in the construction of a bicycle frame:

Steel


Taken by Degen Earthfast
http://en.wikipedia.org/wiki/File:2002_Trek_800_Sport.JPG

A steel-framed 2002 fully rigid Trek 800 Sport. Steel frames are often used - they are strong, easy to work, and relatively inexpensive, but denser (heavier) than many other structural materials.

Wood

Several bicycle frames have been made of wood, either solid or laminate. Although one survived 265 grueling kilometers of the Paris Road Race, aesthetic appeal has often been as much of a motivator as ride characteristics. Wood is used to fashion bicycles in East Africa.

Thermoplastics


Taken by Racerbyce
http://en.wikipedia.org/wiki/File:Itera_plastic_bicycle.jpg
A plastic bicycle from the early 1980s. Thermoplastics are polymers that can be reheated and reshaped, and there are several ways that they can be used to create a bicycle frame.

Aluminum alloys


Taken by Keanu4
http://en.wikipedia.org/wiki/File:CNC_machined_MTB_frame.JPG
Mountain bike frames are made of sections of machined aluminum welded and bolted together. Aluminum alloys have a lower density and lower strength compared with steel alloys, however, possess a better strength-to-weight ratio, giving them notable weight advantages over steel. Popular alloys for bicycle frames are 6061 aluminum and 7005 aluminum.

Information below was provided by the Centre.

Before you begin read the procedure and collect together the equipment you require, this is listed below.

Equipment available
balance – available on side bench
metre ruler
small ruler and pencil
samples of materials used in sports equipment.

Risk Assessment

Write a suitable risk assessment for this standard procedure before you begin. You can use the format provided. Comment on how you managed the risks when you have completed your experiment.

Standard procedure to Measure Density

Follow the standard procedure given below to collect and record your primary data.

Choose three samples which could be used for making bicycle frames:

1. Measure the mass of each sample of material using a suitable balance. Record each mass to the nearest 0.1 g.
2. Measure the length, width and height of each sample of material using a suitable rule. Record each measurement to the nearest 0.1 cm.
3. Record all your results in the format provided.

Candidate A Centre Number XXXXX Candidate Number XXXX Date

Complete the table below as you follow the standard procedure:

Standard procedure to find density of some materials used to make bicycle frames

Results

	Length/cm	Width/cm	Height/cm	mass, g
Material 1 wood	**6.1**	**2.0**	**1.0**	**5.9**
Material 2 steel	**4.2**	**2.0**	**0.5**	**30.0**
Material 3 aluminium	**8.0**	**1.5**	**1.0**	**32.5**

Data processing : Process your data using the information given below:

1. Calculate the volume of each material.
Using **volume = length x width x height (cm^3)**

2. Calculate the density of each material.
Using **density = mass (g) / volume (cm^3)**

Wood

Volume = 6.1x2.0x1.0 = 12.2 cm^3 mass = 5.9 g

Density = 5.9/12.2 g cm^{-3} = 0.48 g cm^{-3}

Steel

Volume = 4.2x2.0x0.5 = 4.2cm^3 mass = 30.0 g

Density = 30.0/4.2 g cm^{-3} = 7.1g cm^{-3}

Aluminium

Volume = 8.0x1.5x1.0 = 12.0 cm^3 mass = 32.5 g

Density = 32.5/12.0 g cm^{-3} = 2.7g cm^{-3}

Risk Assessment & Managing the Risks

Level of Risk :
This standard procedure is low risk. There are not many hazards and if I follow the normal laboratory safety rules the experiment should be completed without any problems.

Hazard	Risk involved	Safety precautions	What to do in the event of an accident
Sample blocks	Could cause physical harm through dropping.	Always place in the middle of the bench when not being used. Follow the safety rules of the lab at all times.	Report any accidents to the teacher/ complete an accident form
Electrical balances	Electric shock	Always check that portable electrical equipment has been tested for electrical safety before use. There should be a sticker on the balance. Do not use if there is no sticker – inform technician.	Report any accidents to the teacher and contact the first aider.

After the experiment: How the risks were managed

Before the experiment:

The correct equipment needed was selected and collected together. The balance was checked for safety (Sticker on the balance showed that it was tested last year). A risk assessment was written.

During the experiment:

The risk assessment was followed. This was a low risk procedure. I followed the instructions correctly and safely and the teacher confirmed that I was working safely by signing the safe working certificate attached to this procedure. I recorded the results accurately and during the procedure.

After the experiment:

All the equipment was returned to the technician's station and the balance turned off. There were no reported accidents during the practical session. Following the practical work I analysed and processed my results. The values of density were acceptable so it was not necessary to repeat any part of the procedure.

Standard Procedure Report: Mark Allocation

Skills to be assessed	0	1-2	3-4	5-6	Mark awarded
Collect primary data (a)				6	6
Process primary data (b)				6	6
Manage risks (c)				5	5
Average mark for 3 skills = 17/3 = 5.6					**6**

Standard Procedure (0-6 marks for each procedure)
Teachers are advised to read the guidance given in the specification 5.5 Task marking: Section 5.5.3.

(a) collect primary data

Mark allocated	Comments	Guidance
5-6	A range of data has been collected. The table has been provided by the centre. Dimensions of the materials have been recorded to the correct precision. The Standard Procedure states that measurements of length and mass should be recorded to the nearest 0.1 cm and 0.1 g, and this has been done	Candidates will have collected all data that is required by the procedure and will have recorded it accurately in a format which can be provided by the centre. There should be no errors for 6 marks.

(b) process primary data

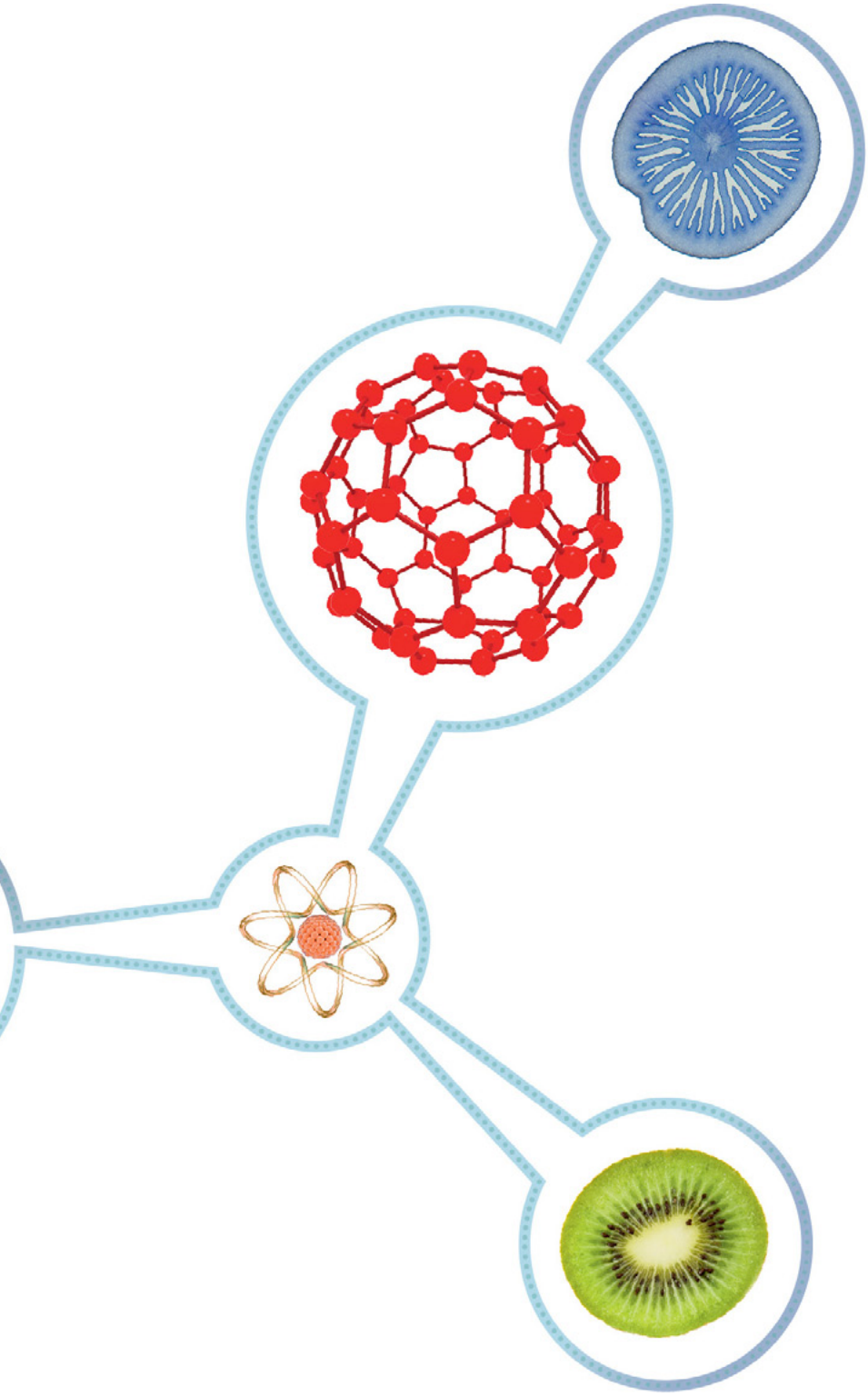
Mark allocated	Comments	Guidance
5-6	The calculations of data have been carried out correctly. The answers are clearly indicated, and the use of significant figures is correct and the units of density have been included.	Mathematical techniques will be correctly carried out with answers clearly and accurately presented.

(c) manage risks when carrying out standard procedures

Mark allocated	Comments	Guidance
5-6	The level of risk is indicated as being low for this Standard Procedure. The review at the end is a useful inclusion although a more critical approach would be needed for 6 marks. The risk assessment for this low-risk Standard Procedure is good, but perhaps a little more detail could be added, e.g. a note on the limited risks associated with the handling of the individual materials, and what to do in the event of an accident, in addition to reporting the incident to the teacher.	Candidates will produce information on potential hazards and whether they are high or low risk and the steps which were made in order to minimise these risks.

Candidates will probably produce a risk assessment for this strand. For 3-4 marks this must include how the risks are managed and for 5-6 marks this needs to be supported by a critical evaluation of how the risks are managed.

SUITABILITY TEST



SUITABILITY TEST

WHAT IS THE BEST METHOD FOR TESTING FOR GLUCOSE IN URINE IN A BUSY PATHOLOGY LABORATORY?

1

Contents

Suitability Test Report

Researching and purpose of the test (using secondary data)

Aim:
This suitability test report will use supporting data and information to decide on the most suitable method for a technician working in a pathology laboratory to use when measuring glucose in urine.

Why do we need to test for glucose in urine?
The testing for the presence of glucose in urine is usually performed to test if a person is a diabetic. Diabetes is a disease where the concentration of glucose in the blood is not controlled properly by the body.

In type 1 diabetes, the pancreas does not produce enough insulin. The cells in the body are unable to use the glucose in the blood, which is present after a sugary or starchy meal. [1]

Type 2 diabetes is when the body does not produce enough insulin to maintain a normal blood glucose level, or when the body is unable to use the insulin that is being produced effectively. [2]

Glucose is a type of sugar made by the body from food that has starch present. Starch is found in foods such as rice and pasta. Glucose is then used by cells in respiration. The blood glucose concentration is controlled to provide cells with a constant supply of energy. Cells in the pancreas monitor and control the concentration of glucose in the blood. It does this by producing a hormone called insulin. Insulin causes glucose to move from the blood into cells. It lowers the blood glucose concentration when it rises. This can happen after eating a meal that is rich in carbohydrates (for example, sweets, potatoes, bread, rice or pasta). [2] Glucose is absorbed through the small intestine into the blood capillaries in the tiny finger like projections that come out of the wall of the intestine.

Once you eat or drink anything containing glucose, it will enter the blood and gets used by the cells in your body. If glucose reaches a certain concentration in the blood, it gets put into your urine and is excreted. This concentration is called the renal threshold.

The renal threshold for glucose in the blood is 10 mmol/ litre. If a urine test is taken and the results show that glucose is present in the urine, it could be a sign of diabetes, which indicates that there are extremely high glucose levels in the blood. There should be no glucose present in urine, so if you there is this could indicate diabetes.

Diabetes is currently an incurable condition, but it can be controlled. Type 1 diabetes is usually treated with insulin injections and type 2 which is usually controlled by diet, exercise or tablets. Statistically, if you have diabetes you are at least twice as likely as other people to have heart disease or a stroke. This means that 80% of diabetics will develop heart disease and due to their condition are less likely to suffer any symptoms until their condition has worsened. [4]

Diabetes is a serious disease. In the short term, consistent high blood glucose levels can lead to a condition called diabetic ketoacidosis (DKA).

Eventually, if untreated, DKA will continue to rise and, combined with high blood glucose levels, a coma will develop, which can be fatal. [5]

Long term complications include how diabetes affects your eyes, heart, kidneys, nerves and feet. Retinopathy is damage to the retina of the eye and is a complication that can affect anyone

who has diabetes. Retinopathy is the most common cause of blindness among people of working age in the UK.

People with diabetes also have an up to fivefold increased risk of cardiovascular disease compared with those without diabetes. The prolonged, poorly controlled blood glucose levels affect the lining of the body's arterial walls. This leads to a furring up of the vessels, forming a narrowing of the arteries called atherosclerosis. People with Type 2 diabetes also often have low HDL cholesterol and raised triglyceride levels, which both increase the risk of atherosclerosis.

Diabetes statistics

- There are 2.6 million people who have been diagnosed with diabetes in the UK (2009).
- By 2025, there will be more than four million people with diabetes in the UK.
- In 2008 145,000 people were diagnosed with diabetes in the UK. [8]
-

It is estimated that there are up to half a million more people in the UK who have diabetes but have not been diagnosed, and overall, up to one in 20 people in England has diabetes (diagnosed and undiagnosed) (reported in reference 8).

It is important that these cases are diagnosed, so that at any of the early or intermediate stages, the diabetes can be treated and damage usually limited. Obviously, the sooner, the better.

Criteria for suitability

It is important to have a test that is specific to glucose and will not give any false positive results.

It is also important to accurately know how much glucose is present in a urine sample because if there is glucose present it means the patient could have diabetes. It is also important to know how much glucose is present as this can be used to determine the type of diabetes.

The results from the tests need to be accurate and reliable as if the wrong result was given to a patient this could result in incorrect treatment and further problems to the patient's health.

The test needs to be repeatable, so that tests could be carried out by a technician to enable standardised results to be obtained and compared. The instructions need to be straightforward to understand and easily followed and the test needs to be relatively quick with the results straightforward to analyse. The results can then be quickly found to allow the patient to be given the correct treatment.

Cost is always important and as this test needs to be carried out on lots of patients. It shouldn't be too expensive or else the NHS would not carry it out.

Tests available

Many people each year need to be checked for diabetes. There are various tests available to test to see if glucose is present in urine and therefore used to decide if a patient may be diabetic. The tests need to be accurate, repeatable, quick, easy to use and not too expensive. The tests being researched here are:

- Benedict's test
- Use of Clinistix
- Use of potassium manganate(VII) / (Standard curve)

Benedict's test

Benedict's test is used to identify reducing sugars (monosaccharides and some disaccharides).

- Add Benedict's solution to the chemical sample and heat.
- The solution changes from blue, through green, yellow, orange, to brick-red or red-brown if a reducing sugar is present.

Benedicts reagent is copper(II) sulfate in alkaline solution and is blue. If it is added to a reducing sugar its copper(II) ions will be reduced to copper(I) ions and the colour will change. [9]

Clinistix
Is a trademark for glucose oxidase reagent strips used to test for glucose in urine.

- The strip is dipped into the urine and positive or negative results are indicated by the colour of the strip - the impregnated paper tip which turns purple if glucose is present. [10]

Potassium manganate(VII)
Potassium manganate(VII) is an oxidising agent. It will oxidise glucose present in the urine. When potassium manganate(VII) acts as an oxidising agent it needs to be in an acid solution and changes from purple to colourless. [11]

Plan
Step 1: My range of glucose solutions to test
Investigations by paediatricians at the John Radcliffe Hospital in Oxford [12] have found that:

0% glucose in the urine is associated with blood glucose concentrations of less than 6.4 mmol/l
2% glucose in the urine with concentrations greater than 8.6 mmol/l
and over 5% glucose in the urine with concentrations greater than 11.3 mmol/l

They say that 'because many diabetics have blood glucose concentrations up to 11.1 mmol/l, it is advantageous if glycosuria up to 5% is detectable by routine home urine tests'.

I have therefore chosen my range of glucose solutions chosen to test was 2%, 4%, 6%, 8% and 10%, as I want to cover, but also exceed these levels.

Step 2: Assess the risks
A full risk assessment needs to be written before the tests are carried out.
This needs to be followed during the experimental procedures
The risk assessment is given in **Appendix 1.**

Step 3: Procedures to test, to see which one is the most suitable
1.Using the practical instructions given in **Appendix 2**.
The tests are:

- Benedict' test
- Clinistix
- Potassium manganate(VII) (Standard curve). In addition, with this experimental procedure, a graph needs to be plotted of the results obtained from the standard sugar solutions.

2.I am going to carry out the three tests on the standard sugar solutions, and also the patients' samples.

- The observations and results should be recorded and the test repeated.
- If any anomalous results appear further repeats need to be done.

3. Information also needs to be recorded on the

- ease of the test/to include time taken
- accessibility of the practical instructions/complexity of the test
- accuracy of the results
- cost

Results
The tests were carried out with my partner. The tables were designed and the results analysed independently.

Independent Work
This candidate devised all their own results tables and analysed and processed results
Signed A. Teacher

Benedict's Test
All solutions started off pale yellow before Benedict's reagent was added. Benedict's reagent is blue. The colour recorded is the final colour of the solution obtained after heating.

In addition the candidate attached a series of coloured photographs indicating the colours of the sample solutions and those of patient 1 and patient 2. These supported the colours recorded.

Sample solution	Final Colour	Final Colour (repeat)
10%	bright orange	bright orange
8%	brown with a hint of orange	brown with a hint of orange
6%	orangey red	orangey red
4%	light brown	light brown
2%	yellow	yellow
Patient 1	bright orange	bright orange
Patient 2	light brown	light brown

Cost of this procedure	Chemicals costs £9.50 (250cm^3) Each test approx 20p
Ease of test (1-5)	Standard procedure – straightforward (3)
Time taken	5– 10 min test + results
Accuracy of the results (1-5)	Only a qualitative decision (3)

Patient 1 Test Outcome
Glucose present 10%

Patient 2 Test Outcome
Glucose present range from 2% - 4%

Summary

A desirable characteristic of the glucose test in testing urine is accuracy - this test only gave qualitative decisions.

The test was repeatable as the colours were the same each time the test was carried out.

In a busy lab time could be a factor.

The sugar present in the solutions under test reduced the blue copper(II) ions in Benedict's reagent to copper(I) oxide (Cu_2O), which caused the orange/ red precipitates. The final colour can be green, yellow, orange, red or red-brown, depending on how much sugar is present.

Clinistix

Concentration of glucose, %	Colour of stick	Colour of stick (repeat)	Further repeats if necessary
2%	light	medium	light
4%	medium	medium	
6%	medium	medium	
8%	dark	medium	medium
10%	dark	medium	dark
Urine sample			
Patient 1	dark	medium	dark
Patient 2	light	light	

In addition the candidate attached the Clinistix that had been used in the testing indicating the colours of the sample solutions and those of patient 1 and patient 2. These supported the colours recorded.

Cost of this procedure	This procedure cost £5.35 for 50 strips, 11p per test.
Ease of test (1-5)	Procedure – very straightforward (1)
Time taken	1 min test + results (very quick)
Accuracy of the results (1-5)	Only a qualitative decision (3)

Patient 1 Test Outcome
Glucose present range from (8%)-10%

Patient 2 Test Outcome
Glucose present range from 2%

Summary

The desirable characteristics of the Clinistix test are that it is quick and the method of use is very straightforward.

It easy an easy way to test whether the patient has glucose in their urine but unfortunately does not tell how much glucose is present. It would be easy to use in a busy lab.

The cost is cheap as these can be bought easily from suppliers.

The test was mostly repeatable but a better description of dark medium and light would support observations more.

Potassium manganate(VII) test

A standard curve was produced using known concentrations of glucose.
My group carried out the tests shown in Time 1 and Time 2 in the table. Results from Time 3 were provided from another group in the class.

Concentration of glucose, %	Time taken for potassium manganate(VII) to turn colourless, seconds				
	Time 1, seconds	Time 2, seconds	Time 3, seconds	Time 4, seconds	Average time, seconds
2%	1055	1049	1022		1042
4%	859	827	833		840
6%	595	617	790	609	
8%	450	444	436		443
10%	211	238	245		231
Urine sample					
Patient 1	245	239	261		248
Patient 2	920	907	925		917

The third test (shaded) for the 6% glucose solution looks like an anomalous result. There is almost 200 second difference to the other two. Our group therefore decided to repeat this and ignore this result when calculating my average.

The standard curve is shown on page 9.

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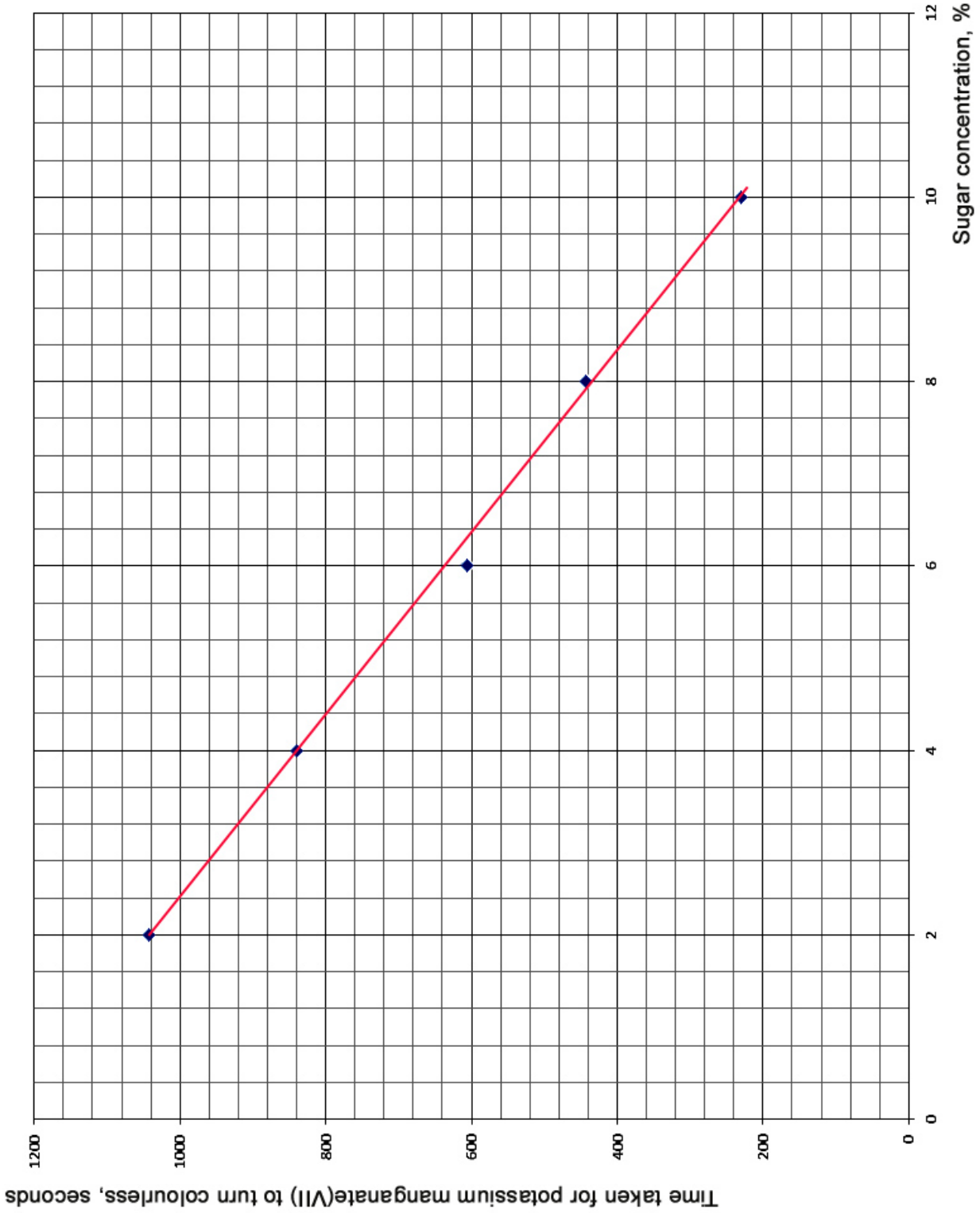
Sugar concentration, %
0
2
4
6
8
10
12
Time taken for potassium manganate(VII) to turn colourless, seconds
0
200
400
600
800
1000
1200

Cost of this procedure	Cheap: • potassium manganate(VII) is only 6p per gram [13]; 2 cm^3 of 0.4 g dm^{-3} solution was used per test • 0.1 M sulfuric acid is £9.46 per dm^3 [14]; 5 cm^3 was used per test
Ease of test (1-5)	Standard Procedure: • complex (4)
Time taken	Time consuming: • the test itself took a few minutes to set up. • the longest time for the reaction to take place was over 17 minutes (for the 2% solution). • the graph needed to be plotted (but you only need to do this once, provided the conditions are kept the same each time).
Accuracy of the results (1-5)	Quantitative decision (4)

Patient 1 Test Outcome
Glucose present range from standard curve = 9.7%

Patient 2 Test Outcome
Glucose present range from standard curve = 3.3%

Summary
This test would be the most useful for the technician to use
The desirable characteristics of the test using potassium manganate(VI) are that although it is a complex procedure the instructions could easily be followed by a technician. The results are quantitative and hence the glucose concentration could be determined and are therefore more accurate than the previous tests.

The anomalous result when repeated was found to be a mistake and was ignored. This figure was not used to calculate the average.

It did however take more time than the Clinistix.

The sugar present in the solutions under test was oxidised by acidic potassium manganate(VII) solution. The potassium manganate (VII) turns from purple to colourless when it is acting as an oxidising agent. The more glucose present, the quicker the reaction takes place.

Evaluation
There were no major problems with the different procedures, however, all three had limitations

Benedict's solution
It was important that the instructions were carefully followed, and it was important that the reactants were left long enough in the water bath to ensure the reaction was complete. A water bath needed to be set up and set at a constant temperature. This may already be set up in a pathology department.

To make the Benedict's test more reliable the same person needs to look at and describe the colours, and colours may be is open to interpretation by different lab technicians.

The tests needed to be repeated but again this took time.

This experiment could possibly be extended by using a colorimeter which could measure concentration by using standard solutions to plot a calibration curve which can then be used to find the concentrations of the unknown solutions. The copper(I) oxide tends to settle out, however, over time, and perhaps a better way of estimating the glucose would be to filter, wash, dry and weigh the copper oxide. This again would take time.

Clinistix
The instructions for this test are very simple and this is a quick and easy way to identify if sugar is present in the urine samples. It is not however a test that can be used to find the concentration of sugar in the sample under test.

This test is useful and can be used as an indicator to find out if glucose is present.

To make the Clinistix more reliable new/dated strips need to be used and a clear colour chart should be available.

Potassium manganate(VII)
Acidified potassium manganate(VII) solution is an excellent oxidising agent, and this test, although is quite complex to carry out, is a good method of finding glucose concentration in the samples. The colour change of purple to colourless is a good method of monitoring the redox reaction. The more glucose present the quicker the rate of reaction, consequently if an accurate calibration curve is a available to the technician this test is an accurate way of finding the glucose concentration. The results I obtained were very close together – they were reproducible – which enabled me to produce a reliable standard curve.

Concentration and volume of the reagents used for the test, and the temperature would all need to be kept constant if this test was to be fully reliable.

Management of Risks

There were no incidents during the practical and no help was needed from the teacher.
Signed A. Teacher

Conclusion
The results and research were considered and have stated my conclusions below:

Clinistix test
This test was a fast and easy test, although it was not quantitative. But it does give a positive result with glucose only (the other two will detect any reducing agent).

Technicians and doctors use this test as a quick method of identifying the presence of glucose.

It is reliable in doing this although I would advise this was used with the potassium manganate(VII) test in order to produce a more conclusive result. Cost is acceptable as this test would probably used very often.

The Benedict's test
This test proved to be the most difficult as it was difficult to keep the temperatures of the water at 70 °C. The test results gave similar colours when placing the test tubes side by side, but it might be difficult to distinguish well between different concentrations when not using standard solutions of glucose.

The chemicals were relatively cheap test but the cost of keeping a water bath hot so the test could be used any time would increase the cost.

Potassium manganate(VII)
This test was not the fastest but it was reliable as the repeats were similar (except for one value which we excluded). The test did give us a precise concentration of glucose.

Looking at my data I think my conclusion is quite reliable as it tells me which procedure was most effective and looked at the different characteristics. And why and what are the downsides of each of the methods. I have also included the costing of each test.

The problem with both the Benedict's test and the potassium manganate(VII) test is that both will give positive results with any reducing agent, and not just glucose. Substances in the urine called creatinine and uric acid could both give positive results. You would also get a positive result with someone taking vitamin C tablets, because a lot of the vitamin C gets excreted in the urine.

Overall, I think the technician may prefer to use the Clinistix, as this is a fast and easy method to use. However, it doesn't show the glucose concentration so this is not very informative test if actual values are needed.

Blood tests, however, are the best indicator of diabetes, so if a positive result is obtained from the patient's urine using Clinistix, a blood test could then be taken to support the diagnosis.

References List

Mrs Harris recommended a range of websites linked to this suitability test I have listed the ones which I used in my report .

[1] Diabetes UK. Type 1 diabetes. http://www.diabetes.org.uk/Guide-to-diabetes/Type-1-diabetes/ June 2011

[2] Diabetes UK. Type 2 diabetes. http://www.diabetes.org.uk/Guide-to-diabetes/Type-2-diabetes/ June 2011

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Appendix 1

Benedict's test
Equipment and chemicals needed:
- Benedict's reagent
- urine samples
- glucose samples
- small beaker (100 cm^3)/boiling tube
- water
- water bath and thermometer
- stop watch

Method
- Pour 5 cm^3 of Benedict's reagent into a beaker/boiling tube to 5 cm^3 of sample.
- Put the mixture into a water bath at 70 °C for 5 minutes.
- Record the results of the colour change in a table.

Clinistix
The apparatus needed:

- Reagent strips
- Urine samples
- Glucose samples
- Stopwatch
- Colour chart

Method
- Dip the reagent end of the strip into the sample solution and remove it immediately.
- Tap the edge of the strip against the container to remove excess sample solution.
- Time exactly 10 seconds after removing from the sample solution and compare the reagent side of the test area with the colour chart.
- Record the results of the colour change in a table.

Use of Potassium manganate(VII) to test for glucose in the samples.

Apparatus needed
- acid (dilute sulfuric)
- beaker (100cm^3)
- glass rod
- potassium manganate(VII) solution (0.4 g dm^{-3})
- glucose samples
- urine samples
- stop watch

Method
- Pour 25 cm^3 of acid into a beaker and 25cm^3 of potassium permanganate into another beaker.
- Put 10 cm^3 of the sample solution into a boiling tube and added 5 cm^3 of the acid solution and 2 cm^3 of the potassium permanganate solution.
- Start the stopwatch and time how long it takes for the colour to disappear. The mixture needs to be stirred using a glass rod.
- Record all the times in a table and plot the results.
- Use the graph to find the % of glucose in the patient's urine.

Appendix 2

Activity Testing for glucose in urine: using Clinistix, Benedict's and Potassium permanganate	
Hazards 1. Glassware 2. Chemicals 3. Hot water & water bath	**Risks** Getting cut Burns Scalds, electric shock
Control measures 1. wear goggles and follow laboratory safety rules 2. check Hazcards and follow guidelines 3. check water bath works correctly	
Emergency Action 1. contact teacher or lab technician 2. tell teacher if any chemicals in eyes 3. tell the teacher if water too hot.	
Notes Make sure to follow practical instructions; don't mess around in the laboratory.	

Chemical	**Hazard**	**Risk**	**Control Measures**
Potassium manganate(VII) 	**Harmful** if swallowed, inhaled, or absorbed through the skin. It is a strong oxidizing agent and may react very exothermically with organic materials. .	Can cause damage to skin or harm to the internal organs if inhaled.	**1,2**
Benedict's Reagent 	**Harmful** if swallowed and in contact with the skin.	Can cause poisoning if taken internally	**1,2,3**
Dilute sulfuric acid 	**Corrosive** in higher concentrations; **Irritant** at the concentration I am using it at. – however the more dilute the solution the less hazardous. More concentrated solutions can cause serious burns to the mouth, eyes and skin.	Can cause internal damage if taken or burn the skin if concentrated.	**1,2**

Suitability Test: Mark Allocation (A-A* grade candidate)

	0	1-2	3-4	5-6	7-8	Mark awarded
Strand A			a b	a b	**a b 8 8**	8
Stand B			a b c	a b c	**a b c 7 8 8**	8
Strand C			c	c	**c 7**	7
Strand D			a b	a b	**a b 8 7**	8
Strand E			a b c d	a b c d	**a b c d 7 7 7 8**	7
Strand F			a b	a b	**a b 8 8**	8

Teachers are advised to read the guidance given in the specification 5.5 Task marking: Section 5.5.3.

Strand A: Researching the Purpose of the Test

(a) Collect and process secondary data

The aim of this strand is for candidates to demonstrate that they can collect and use secondary data to describe the purpose of the material, process or device and its relevance in an applied, workplace context.

Mark allocated	Comments	Guidance
7-8 marks	The candidate puts the Suitability Test into perspective by giving a good description of the role of insulin in controlling the uptake of glucose by the cells. The implications of the lack of insulin and the occurrence in glucose in the urine are described, and related to the renal threshold of glucose in the blood. The applied context – the need to test many people each year for glucose in their urine – is described and supported by statistics.	Candidates will have selected suitable research, it will be well presented and easy to follow and a detailed description of the use or purpose will be included. Higher level marks will be awarded where candidates have been selective in only choosing relevant material and the description is detailed but precise

(b) Analyse and interpret secondary data

The aim of this strand is for candidates to demonstrate that they can use secondary data to describe the desirable properties of the material, process or device and explain their relevance.

Mark allocated	Comments	Guidance
7-8 marks	The candidate has described properties both qualitative and quantitative analysis for glucose; repeatability; accuracy; ease of use; cost), with limited explanations and reasons of why these criteria are necessary. Suitable chemical explanations were also given for Benedict's using reduction of Cu(II) ions and oxidising properties of potassium manganate (VII).	Candidates will have selected suitable research, and used it to give a description of the properties which will be studied in the suitability practical work. Explanation of why properties are necessary is required and for higher level marks, the level of description needs to be detailed, logical and both or more of the explanations need to show high level understanding

Strand B: Planning and risk assessment

(a) Assess risks for the collection of data

The aim of this strand is to assess how candidates can manage the risks for their experimental procedures. Candidates will need to write their risks assessments following completion of their planning.

Mark allocated	Comments	Guidance
7-8 marks	The candidate has identified materials and procedures that may be hazardous, and has extended this to identify the hazards, and associated risks in detail. Hazards are specific to each chemical/ procedure/ piece of equipment with the appropriate risk. The candidate could have been a little more precise by limiting the Risk Assessment to the concentrations of chemicals used	Higher level candidates will be producing detailed and relevant risk assessments which include all potential hazards and the ways in which risks are minimised will be fully identified.

(b) Devise methods to solve problems

The aim of this strand is for candidates to show their ability to plan how they will organise experimental procedures to demonstrate suitability of their chosen material/device/procedure.

Mark allocated	Comments	Guidance
7-8 marks	There is good justification of the range of glucose concentrations chosen. The candidate has produced a workable plan which includes the three tests to be carried out, with a repeat/ repeats carried out for each, making the procedure relatively complex. The production of a form of calibration curve adds to the complexity. The reference to the experimental work supports the requirements fro the higher marks	Candidates will need to be a carrying out at least one complex procedure and their plan should be linking to the purpose of the suitability of the chosen material/ procedure/ device. Higher level candidates should be completing a range of experimental work to enable comparisons to be made, rather than repeating the same procedure. Planning should reflect this. Their plans need to include experimental work which will enable them to collect high quality data. 7-8 marks should indicate that candidates have worked independently - centres can indicate this by annotating work.

***(c) Quality of written communication**

Quality of written communication will be assessed in this strand, alongside the science content in the planning section of this report.

Mark allocated	Comments	Guidance
7-8 marks	The plan has been communicated clearly, and information organised effectively.	7-8 mark, higher level candidates will make full and effective use of scientific terminology, the plan will be organised effectively, relevant and logically sequenced. It will be easy to follow and concise. (Refer to marking criteria for more detail)

Strand C: Collecting data

(a) Collect primary data

The aim of this strand is for candidates to collect and record sufficient data to support their experimental procedures to demonstrate suitability of their chosen material/device/procedure.

Mark allocated	Comments	Guidance
7-8 marks	The candidate devised their own results table, as indicated by the centre annotation. The amount of data collected covered an appropriate range, and more than one repeat was been carried out. There is nothing to indicate that the data are not of reasonably good quality, and an outlier has been identified for the potassium permanganate test (and the appropriate action taken). While the recording of quantitative data is very good, the qualitative data collected on colour change for the Benedict's test and Clinistix could have been more precise, e.g. the results for the Clinistix are limited to 'light', 'dark' and 'medium'. However, this may have been the only information provided. Reference to the colour photographs showing the standards could also support the results.	Candidates working at this level need to be given the opportunity to devise their own format for recording their data - centres can indicate this by annotating work. For 7-8 marks, the data needs to show that it has been collected from an appropriate range of experimental work which supports the plan to demonstrate suitability. Data will be recorded accurately and to an appropriate degree of precision (see marking criteria for more detail).

Strand D: Processing and analysing data

(a) Process primary data

The aim of this strand is for candidates to demonstrate that they can process and use the data they have collected.

Mark allocated	Comments	Guidance
7-8 marks	A graphical technique has been used to display data from the potassium manganate(VII) test. The candidate has calculated means appropriately. Axes have been well-chosen and appropriately labelled, and added a line of best fit (produced by the candidate using a draw package, and not generated by Microsoft Excel). This aspect is worth just 8 marks – range bars could have been added to the graph.	For 7-8 marks, candidates will produce and use well-drawn line graphs with appropriate lines of best fit. Axes will be labelled and appropriate scales will be chosen, or clearly labelled charts or correctly completed mathematical techniques with answers are clearly and accurately presented to support the Suitability tests. Some indication of level of uncertainty of data should be seen for full marks.

(b) Analyse and interpret primary data

The aim of this strand is for candidates to demonstrate that they can interpret and analyse the primary data they have collected to support the desirable properties of the material /process or device they have chosen.

Mark allocated	Comments	Guidance
7-8 marks	Trends are described across the three parameters investigated (glucose concentration; ease of use; cost), linking with the purpose of the test, with few, if any, errors, but interpretation is necessarily limited. Use of quantitative data is limited to one procedure. A result that is anomalous has been highlighted in the results table for the potassium manganate(VII) test, and some justification as to how this has been identified as an anomalous result/ outlier.	The level of description and evidence of understanding the data collected should support the mark awarded. Work at this higher level should show evidence of how the trends or patterns in the data link to the purpose of the test. For 8 marks there should be evidence of analysing the level of uncertainty of the data collected. (see marking criteria)

Strand E: Evaluating

(a) Evaluate methods used to solve practical problems

The aim of this strand is to assess (in this instance) how candidates evaluate the methods used to determine the suitability of the tests used to analyse urine for glucose.

Mark allocated	Comments	Guidance
7-8 marks	Possible limitations of the methods used to assess the suitability of the three tests have been stated, namely: • The age of the Clinistix strips (leading to colour variations) • Differences in judgement of colours, and there is a little practical detail in how to eliminate these problems.	5-6 marks - work at this level involves descriptions rather than simple comments or statements, with some suggestions on how to improve to include limited practical detail, e.g. change the temperature, but no information on how to do it. 7-8 marks needs to include an evaluation of the methods used with an explanation to support any improvements. If candidates work did not require any significant changes then a statement indicating this, with sufficient justification of why methods were successful, higher marks can still be supported.

(b) Evaluate the validity and quality of evidence
The aim of this strand is for candidates to show their ability to evaluate the quality and validity of the data they have collected.

Mark allocated	Comments	Guidance
7-8 marks	Comments are made on the 'repeatability' of data obtained, and it is stated that for the 'potassium manganate(VII) test', mistake was made. There is also discussion of 'anomalous' results. Claims are made for the accuracy of Benedict's test and the 'standard curve test', and these claims have been supported by the relevant science.	For 5-6 marks candidates will identify outliers or justify a claim if that there are no outliers and assess the accuracy and repeatability of the results from the spread of data and link it with the suitability of their chosen material/ device/ procedure. For 7-8 marks candidates may indicate a variation in data, in terms of its repeatability and link the quality of data to relevant limitations of the experimental techniques and procedures used a relevant link with the suitability of their chosen material/ device/ procedure (refer to marking criteria)

(c) Evaluate the management of risks when using practical techniques
The aim of this strand is for candidates to show their ability to demonstrate that the safety procedures put in place, i.e. suitable risk assessment allowed safe completion of the experimental work.

Mark allocated	Comments	Guidance
7-8 marks	Annotation is provided by the centre that risks were managed successfully and there were no incidents during the practical, and no help was needed from the teacher.	Higher level candidates should have shown evidence of safely completing experimental work, using an appropriate risk assessment with no intervention needed for the teacher. This can be indicated by a statement or brief annotation from both the candidate and the teacher.

***(d) Quality of scientific communication**
Quality of written communication will be assessed in this strand, alongside the science content in the evaluation of this suitability test.

Mark allocated	Comments	Guidance
7-8 marks	Use of technical and scientific vocabulary has been made, and spelling, punctuation and grammar are good	Higher level candidates will make full and effective use of scientific terminology, with evaluations suitably structured and focused, and supported by good spelling, punctuation and grammar. (refer to the marking criteria for detail)

Strand F: Justifying a conclusion

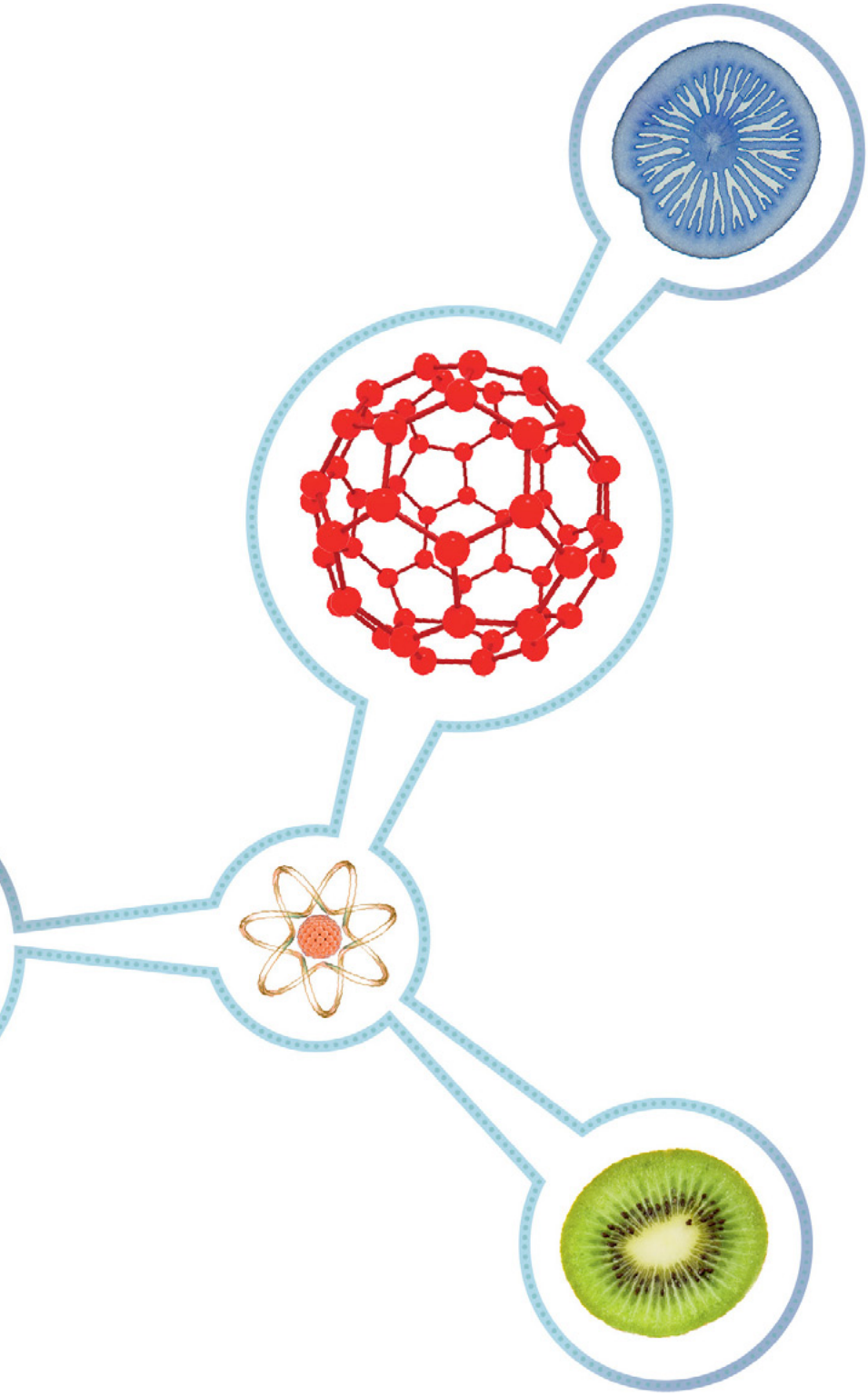
(a) Draw evidence-based conclusions
The aim of this strand is for candidates to show their ability to use the data collected and their scientific knowledge to conclude suitability of the material/device or procedure.

Mark allocated	Comments	Guidance
7-8 marks	The procedures used are sufficiently complex to attain this mark band. The conclusion is linked satisfactorily to the overall pattern of results and the science involved. Limitations of the respective methods have been discussed.	For 7-8 marks, higher level candidates should be completing a range of experimental work to enable the collection of high quality data. Conclusions should reflect the overall pattern of results and show full understanding of the scientific knowledge involved. Limitations of the data collected and the link to the recommendation of suitability of the material/ device/ procedure is required. For 7-8 marks, candidates should be demonstrating independent thought and work.

***(b) Quality of written communication**
Quality of written communication will be assessed in this strand, alongside the science content in the conclusion section of this report.

Mark allocated	Comments	Guidance
7-8 marks	Use of technical and scientific vocabulary has been made, and spelling, punctuation and grammar are generally sound. Five marks, rather than six, as there are some inconsistencies, e.g. the use of the term 'accuracy' (and also the inconsistent use of capitalisation when writing 'Clinistix').	Higher level candidates will make full and effective use of scientific terminology in their conclusions. The conclusions will be organised, easy to follow and well reported and suitably persuasive to support the suitability of the material/device/procedure. Spelling punctuation and grammar will show minimal or no errors. (refer to marking criteria for detail)

WORK RELATED REPORT



WORK RELATED REPORT

Research a practitioner in a job role linked to any profession that uses materials to support their every day work.

Image from: http://dentistoffices.info/files/2010/03/dentist23.jpg [1]

CONTENTS

Introduction

Dentistry is a profession that involves scientific understanding, surgical techniques and the use of a range of materials ranging from amalgams and composites to technical equipment and digital X-ray machines. There is a range of careers available to people interested in dentistry which include dental surgeons, orthodontists, dental nurses, dental hygienists and dental therapists. Dentists are health care professionals who have an important effect on society. They provide corrective *and* preventative treatments for problems that affect the mouth and teeth.

Primary data was collected by visiting a number of dental surgeries in my local area and interviewing the staff. I gathered information from:

- Two dental nurses
- A dentist
- Receptionist
- Dental therapist
- Dental hygienist

The questions which I planned are available in **Appendix 1.** I have included their answers in the report.

Secondary data was collected from my science notes, material on the Internet and my science text books. (Additional applied GCSE Science text book)

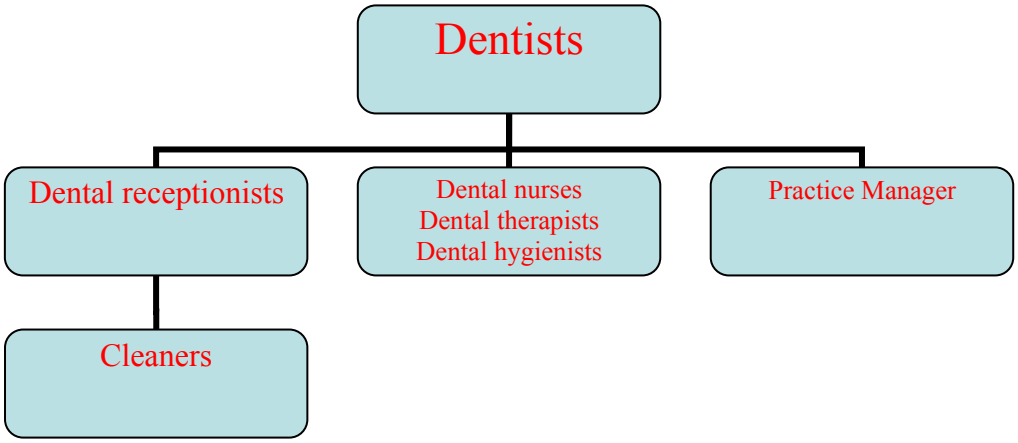
All references are recorded in **Appendix 2 (Bibliography).**

The Dental Practice which I will focus my report on is located at 23 High Road

Google map showing position of dental practice	Labelled Photograph showing Dental practice

There are three dentists in this practice; one is the senior partner, who works full time, and the other two have a job share.

The employees involved in the dental practice are shown below. Each employee has their own specific role to ensure that the dental practice runs smoothly, however I will explain in my report the importance of these individual roles and how the different employees support their work colleagues to ensure patient care and the efficient running of the organisation.



Work carried out

The **practice manager** over sees the running of the practice. Their main responsibilities include

- HR (staff management rotas/holidays/complaints etc)
- Financial responsibilities and targets (NHS claims/salaries/ UDAs etc)
- Liaising with the Primary Care Trust (PCT) and the Dental Practice Board
- Organising stock control

The **dental receptionists** work in the entrance to the practice desk on reception. There are two receptionists employed at High Road Practice.

Their role is to

- greet the patients and book them in as they come into the practice.
- Make sure the legal NHS consent forms and medical history forms are completed and signed
- arrange appointments with the dentists, the dental hygienists or therapists
- check the paper work is signed
- take payments for treatment
- update patient records.

Dental nurses, hygienists and therapists are also known as professionals complimentary to dentistry (PCDs). These professionals as well as dentists and dental technicians also need to be registered with the General Dental Council (GDC)

There were four **dental nurses** employed at the practice at High Road who worked as part of the dental team. They support the dentist in all aspects of patient care, this includes

- getting the appropriate instruments ready
- ensuring patient comfort and safety (goggles and bibs are worn by the patient)
- cross infection control including disinfecting the surgery and sterilising the instruments and lab work
- charting teeth
- taking notes from dentists dictation for records
- giving oral hygiene instruction (as the nurses had obtained Oral health Educator qualification)
- assisting the dentist in treatment by aspirating, retracting and mixing fillings and impression materials
- also responsible for checking stock and ensuring lab work is sent off and received

They also helped with reception work - making appointments, taking payments, dealing with paperwork and meeting and reassuring patients when needed. **[2]**

There is one **dental therapist** at the practice and he can carry out a range of procedures under the prescription of the dentist including:

- intra and extra oral assessment and although they are not able to diagnose they can

identify problem areas to the dentist

- scaling and polishing
- applying materials to teeth such as fluoride and fissure sealants
- taking dental radiographs
- providing dental health education to individual patients
- undertaking routine restorations in both deciduous and permanent teeth, on adults and children
- using all materials except pre cast or pinned placements
- extracting deciduous teeth under local infiltration analgesia.

As the therapist at this practice has had sufficient training he can

- place pre formed crowns on deciduous teeth.
- administer inferior dental nerve block analgesia under the supervision of a dentist.
- provide emergency temporary replacement of crowns and fillings.
- take impressions.
- treat patients under conscious sedation provided the dentist remains in the surgery throughout the treatment.

The therapist works closely with the dentists and has an important role in promoting dental health. **[3]**

The dental hygienist just works three days at the practice. She carries out the following procedures

- scaling and polishing teeth,
- applying topical fluoride and fissure sealants.

While dentists concentrate on treating tooth and gum conditions, the dental hygienist has a vital role in helping to prevent problems from arising.

The dental technicians or dental technologists work for dentists in providing materials for them the technicians used by this dental practice work about 2 miles from the practice..

- They work with a variety of materials including waxes, plastics precious and non precious alloys, stainless steel, a variety of porcelains and composites or polymer glass combinations to design and construct appliances to meet each patients needs
- They make the dentures, crowns, bridges and dental braces that improve patients appearance, speech and their ability to chew. **[4]**

There are four specialist areas.

- Prosthodontic technicians design and make dentures.
- Conservation technicians specialise in crown and bridge work.
- Orthodontic technicians make braces to correct tooth positions.

- Maxillo-facial technicians (sometimes also known as maxillofacial prosthetists) work is based in hospital oral surgery, ophthalmic, cancer and burns units, helping to reconstruct the faces of patients damaged by accident or disease.

It is important for a technician to help create tooth replacements that are both attractive and functional, both the dentist and the patient rely on the expertise of these technicians to support their requirements. **[4]**

The **dentist** is some one who is specially trained to care for teeth, gums and mouths. The dentists at this practice work with a dental nurse and there are two surgeries. The dentists at this practice work as self-employed practitioners in general practice, and provide dental care to the public under the National Health Service (NHS).

The full time dentist works for four to five days a week and will work at weekends to attend to the needs of their patients if required. She usually works up to 40 hours per week. The part-time dentists job share each working two and a half days per week.

The dentist is typically responsible for

- Educating patients on oral health care.
- Examining teeth and diagnosing patient's dental conditions, using tools such as x rays
- Assessing treatment options and agreeing treatment plans with patients.
- Carrying out agreed clinical treatments, such as treating gum disease, restoring teeth affected by decay etc.
- Maintaining patients' dental records including updating medical history (which is a legal responsibility) and for each course of treatment a consent and treatment plan is signed.
- Recruiting training and managing staff.
- Managing budgets and maintaining stock and equipment.
- Marketing services to new clients.
- Ensuring UDA (Units of Dental Activity) targets are met and the NHS claim forms are correctly completed and sent off to the Dental Practice Board

When you visit for check ups your dentist will look at your teeth and gums to check for any problems, and also check other soft tissues in your mouth to check for oral cancer and any other pathology. The dentist also wants to make sure your teeth are developing properly as you grow. They must be familiar with a wide variety of advanced equipment, including X rays and other technologies. Dentists treat problems with teeth and gums, provide preventative care and advice, straighten teeth and perform surgery.

The dentists not only work with the other dental professionals in their organisation they also refer patients to the hospital for further treatment or is they discover medical problems in the mouth.

At the heart of this profession is the patient and medical professionals will work together to ensure that each patient receives the correct treatment.

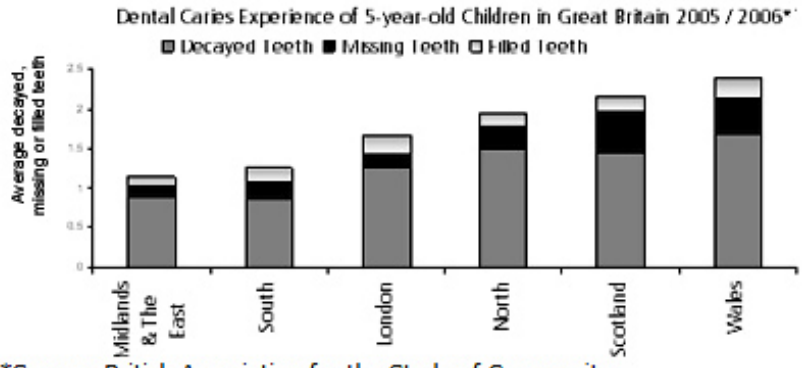
Location

Dental practices are usually located so that the public can get to the surgery easily. The practice at High Road is in the centre of town. It is easily accessible by public transport and there is a pay

and display car park two minutes-walk from the practice. The practice is also accessible for the disabled, with suitable ramps and wide doors to allow access.

The receptionist explained to me of the importance of making the surgery easily accessible, as it is important to ensure the public are not put off from going to the dentist in any way. The waiting room had lots of magazines available to help patients not get nervous while waiting to see the dentist. There was also a children's play area this was good as little children could play while they were waiting.

If people do not look after their teeth they will have pain and the cost to the NHS will be high as the treatment will not be preventative.



*Source: British Association for the Study of Community Dentistry (BASCD) Survey report 2005/2006 [5]

The dental practice I researched is in the West Midlands. Here, the water contains fluoride ions. In some areas where there is no fluoridation, schools offer fluoridated milk to pupils from the age of three. Dr Simpson **[6]** explained that "calcium fluoride is present in small amounts in teeth. It makes them hard, and more resistant to decay. In some parts of the country, fluoride is naturally present in water. In some others, it is added to the water. Research shows that in areas where there is more fluoride in the water, there is less tooth decay. This affects the number of cases of dental caries that different dental practices across the country see each year. We can see that in the West Midlands, the tooth decay is among the lowest in the country."

This map **[7]** shows the extent of fluoridated water usage around the world. Colours indicate the percentage of population in each country that receives fluoridated water, where the fluoridation is to levels recommended for preventing tooth decay. This includes both artificially and naturally fluoridated water.

Map of world

Fluoride that is absorbed by your body is used by the cells that build your teeth to make stronger enamel. Topical fluoride - fluoride that is applied to the outside of the enamel - makes the crystals that form enamel more durable. Tooth enamel crystals that have fluoride are much more resistant to acid. They are less likely to breakdown and cause the tooth surface to become porous.

If your dentist recommends a fluoride treatment during your next dental visit, you'll be receiving topical protection. The fluoride your dentist puts in your mouth will help make the crystals in your tooth enamel stronger. [8]

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In the UK, around half a million people receive naturally fluoridated water. A further 5.5 million receive water which has been artificially fluoridated at, or around, the optimum level of one part per million (1ppm). West Midlands Strategic Health Authority (SHA) oversees the most extensive fluoridation scheme serving 84 per cent of its population. Smaller schemes are in place in the North East (34.8 per cent of population), East Midlands (13.8), Eastern England (5.4), North West (3.8) and Yorkshire and Humber (2.6). [quoted in 5]

But Dr. Simpson says that adding fluoride to the water is controversial. “Some people think its addition to tap water should be banned. In the West Midlands, and in my practice, this would impact on the number of cases of tooth decay that I see.”

A source in Wikipedia [6] says that ‘like vaccination programmes, fluoridation presents a conflict between benefiting the common good and infringing on individual rights. Fluoridation can be viewed as a violation of ethical or legal rules that prohibit medical treatment without medical supervision or informed consent, and that prohibit administration of unlicensed medical substances.

The 2007 Nuffield Council on Bioethics publication, ‘Public Health: Ethical issues’, identified ethical issues to fluoridation of drinking water. It makes it impossible for concerned people to withdraw their consent or opt out of fluoridation. It removes personal choice. [9]

Dr Simpson says that part of the dentist’s job is to educate people to look after their teeth. She said that it’s important that people brush their teeth regularly, and that they are brushed in the correct way.

The Colgate website [10] shows you how to brush your teeth properly:

What is the right way to brush?

Proper brushing takes at least two minutes - that's right, 120 seconds! Most adults do not come close to brushing that long. To get a feel for the time involved, try using a stopwatch. To properly brush your teeth, use short, gentle strokes, paying extra attention to the gumline, hard-to-reach back teeth, and areas around fillings, crowns or other restoration. Concentrate on thoroughly cleaning each section as follows:

- Clean the outer surfaces of your upper teeth, then your lower teeth
- Clean the inner surfaces of your upper teeth, then your lower teeth
- Clean the chewing surfaces
- For fresher breath, be sure to brush your tongue, too

Tilt the brush at a 45 degree angle against the gumline and roll the bristles away from the gumline

Gently brush the outside, inside and chewing surface of each tooth using short back-and forth strokes

Gently brush your tongue to remove bacteria and freshen breath.

Reference [6]: Information from visit to Dental practice: 23 High Road

Qualifications and Skills

Qualifications needed in Dentistry

The dentist I talked to, Dr Louise Simpson BDS, had completed her degree at The University Dental School and had been working at the practice for 5 years.

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She said, “In order to become a dentist you need a degree in dentistry, which takes five years to complete and leads to a BDS or BChD. When you graduate, you also need to register with the General Dental Council (GDC) before you can practise. To get on to a degree course you will usually need

- At least five GCSEs (A –C) including maths, English and science subjects.
- Three A levels grades ranging from AAA to ABB, including chemistry and maths.”

Further Development and training that you can do

“Once you have graduated from dental school you will begin a period of work based vocational training (VT), working under supervision in an approved dental practice.

The next step many trainee dentists take is to join an established dental practice as an associate which involves working as a self employed dentist in a practice owned by another dental professional. With experience you could go on to become a partner in the practice or set up on your own.”

Personal Skills needed by a dentist

Communication

One of the main personal skills needed as a dentist is to be a good communicator. This means by having this skill you are able to listen to patients’ concerns and problems as well as being able to explain the problems and solutions.

Patience

Another good personal skill to have is patience. You will need patience in times of where you will need to be able to handle a wide range of patients: the very old to the very young and nervous. They may well test your ability to remain calm.

Kindness and Compassion

You need to be able to show kindness and compassion. People often only go to the dentist when they have a problem such as pain and swelling, broken teeth, infection, bleeding gums etc., It is therefore important to be non judgemental and supportive of your patients and show your desire to want to help relieve their suffering, regardless to their class or background.

Professionalism

Professionalism is a personal skill that is important to someone who becomes a dentist.

They need to put the needs of the patients first and have high clinical standards.

Physical Fitness and health

Working as a dentist can be tiring, both physically and mentally. It is important to be physically fit and healthy because the hands, eyes and back can be strained.

Dr Simpson said she “enjoyed being a dentist as she liked working with the patients and found it very rewarding when they went away happy.”

The dentist's tools [11]

The dentists need to be able to, and be skilled in using certain equipment:

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In the dentists, there are many instruments and tools that are used.

While some tools are specific to certain branches of dentistry, there are a few basic instruments that are used in just about all dental practices:

A **mouth mirror** is a hand-held tool that allows the dentist to see inside the patient's mouth, at a variety of angles. The tool is designed to provide indirect vision, as well as reflect light and magnify the interior of the mouth. Today's mouth mirrors can be single-sided or double-sided, and some are even disposable.

Several different kinds of **hand-held probes** are used by the dentist which allow them to detect pits and fissures, calculus, issues with bridges and crowns, and caries.

In addition to the tools used in a basic dental examination, other tools are used for other purposes. Most dentists and their hygienists use masks, protective gloves, safety glasses, and face shields during dental procedures to protect them from debris, bacteria, and chemicals.

Most dentists also have radiography equipment in their offices, to allow them to x-ray their patients' teeth. In addition to the actual x-ray machine, radiograph film is also needed to complete the procedure. Radiograph film comes in several sizes and shapes, depending upon the area of the mouth to be x-rayed.

Since dental work often results in excess saliva and moisture, most dentists use specific instruments designed to control moisture. The most commonly used is the disposable saliva ejector, which uses a low volume of suction to remove saliva from the mouth during procedures. A variety of cotton wool rolls and pellets are also available to absorb saliva, blood, and excess dental material.

For painful dental procedures, the dentist will need tools, like syringes and disposable needles that provide anaesthesia. In procedures where a dentist is isolating one tooth or one specific part of the mouth, a rubber dam is used to allow the dentist to see better, as well as protect the patient's airway.

When it comes to filling cavities, repairing chips, or any other process that requires smoothing, dental burs are used to smooth and polish. They are also used to remove tooth tissue before restorations or other work. Burs come in several sizes and shapes, depending upon where and how they are going to be used. Most of us are familiar with the dental hand piece, or dentist drill, which can rotate a bur at high speeds.

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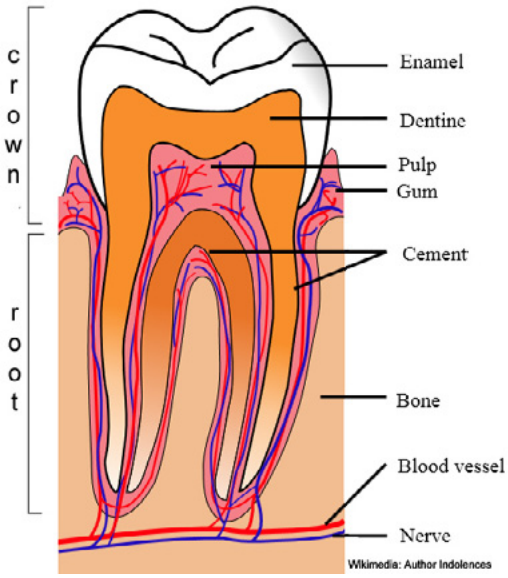
What science is used in dentistry?

There are many sciences used in dentistry, these include physics, microbiology, biology, chemistry, anatomy, physiology, biochemistry, histology, pathology, psychology and pharmacology.

The dentist needs to have a knowledge of teeth structure and development, and how these are affected by tooth decay. The diagram shows the structure of a tooth. [12]



It is important that dentists understand how tooth decay occurs so that they can help to prevent it and treat it at various stages. The inside the mouth is teeming with bacteria that feed on the sugars that are in the mouth, and are formed in the mouth. Dental plaque is a film that forms on teeth composed of saliva, bacteria, polysaccharide, and food particles. The bacteria start respiring anaerobically and produce acids, in particular, lactic acid. This leads to the growth of other organisms, such as lactobacilli, which eat lactic acid. The acids produced by plaque bacteria dissolve the calcium phosphate minerals of the tooth.

The tooth enamel (outer layer of crown) is very hard and doesn't dissolve easily even with acids, but the dentine underneath dissolves easily with lactic acid, and eventually a cavity is formed in the dentine below the enamel. When the cavity is large enough, the enamel will crack, exposing the dentine, bacteria quickly eat through the dentine into the underlying pulp (where the blood vessels and nerves are). This is now called caries. Eventually the hole can grow bigger until it reaches the nerve inside the tooth and causes a lot of pain. This is important for the dentist to know so that they can react to this by filling the hole to prevent further decay before it reaches the nerve. If this happens the patient will have to have root canal treatment or the tooth taken out. **[13]**

It is essential that dentists know the causes and stages of tooth decay, so they can take the appropriate action at each stage.

For many years dentists have used their chemical knowledge to decide how to fill holes in teeth. They used a mixture of metals called an amalgam. Dental amalgam is made by mixing together mercury with a silver tin alloy with the introduction of copper to increase corrosion resistance, creep, strength and durability of marginal integrity. The reason why they use alloys to fill holes is because these alloys are strong and can withstand the pressures on the back teeth when chewing and crunching. The disadvantages of having these fillings are that they are dark and silver. Also the filling is a good conductor of heat and therefore can cause discomfort when eating hot or cold things. Many people are also worried about amalgam fillings because mercury is toxic. It has been suggested that fillings may be linked with several conditions such as allergies, autoimmune diseases, Alzheimer's disease, Parkinson's disease, and multiple sclerosis.

Dr Simpson **[6]** explained that the UK's "Medicines and Healthcare Products Regulatory Agency (MHRA) supports the continued use of amalgam fillings. When people come into the practice with their concerns, I tell them that it's better to leave their existing amalgam fillings in place – drilling them out will contain higher levels of very toxic mercury vapour."

11

"But because of people's concerns, we do use more and more white composite materials for filling the holes in teeth instead of amalgam."

Composites used in dentistry are types of synthetic resins. Composites use the properties of the materials they are made from to make sure the mixture can be easily manipulated, hard and un-reactive in the mouth. These days they also have to have an attractive appearance.

Benefits of composites

Aesthetics – can be matched to the original tooth colour

The dentist has control of the time for setting. They are set using a light.

They are easy to work with.

Downside of composites

They shrink may have sensitivity.

Unlike amalgam which just fills a hole and requires retention features to hold the filling, composite cavity restorations when used with dentine and enamel bonding techniques restore the tooth back to near its original – need to take less of the tooth

They bond to the tooth via a bonding agent.

The composite is made of a resin matrix and filler materials. The filler is present to try and reduce the shrinkage.

Doing a composite filling [14]

1. Remove the decay and shape the cavity.
2. Wash and dry the cavity
3. Etch the cavity and then wash and dry it.
4. Place a dentine bonding agent on the tooth.
5. Air dry and light cure
6. place the composite in increments and light cure each stage
7. Finish and polish the final restoration, making sure it is not in the way the patients' bite.

The composite also contains a catalyst which causes the resin monomers to react to form the polymer. Crosslinking occurs between the polymer chains, which causes the final filling to harden.

Composites are tooth-coloured filling materials made of resin reinforced with silica or porcelain particles. They are used in dentistry as one of several alternatives to dental amalgams.

Composites are typically hardened using light

Dentists have to be trained to take and interpret X-rays

There are regulations on radiation protection in dental radiology. The safe use of radiography in dental practice is provided in the Ionising Radiations Regulations 1999 – these relate to protection of workers and the public and the equipment aspect of patient protection.

The Ionising Radiation Medical Exposure Regulations 2000 – relate to patient protection.

A summary of the regulations:

- Ensure that all doses are kept as low as reasonably acceptable (ALARA) - need reason to take X-ray / take accurately/ distance of everybody is 1.5m away
- Keep up to date with training (every 5 years renewal) and new developments
- Skill - the dentists accurately to fit the film.
- Accurately position the X-ray beam in the correct place –to minimise retakes.
- Use a rectangular collimator to reduce scattering of the rays.
- Check where manual processing takes place –person trained to ensure no retakes.
- Nurses can be trained to take x rays but need to do an extra course.
- X-rays be used for diagnosis treatment planning and monitoring treatment.
- Routine screening – bite wing X-rays – shows crowns of the teeth decay between teeth and under fillings.

It is important that dentists and other dental practitioners understand and comply with the regulations, and are skilled in handling radiological equipment so as to avoid exposure to themselves are their patients.

Dr Hathiari setting up the X-ray [16]

The dose needs to be kept as low as possible. This keeps the hazard to the patient at a minimum for the patient. The dentist, however, will take several, or many X-rays every day. The dentist needs to be at least 1.5 metres away from X-ray machine – as shown in the photo [16]

13

The impact of these regulations is very important. Research shows that with the regulations in place, exposure to radiation is kept very low, in fact lower than background radiation in some parts of the country, or radiation from space. **[17]**

Estimated exposure - bitewings (4 films) – *0.038 mSv*
Estimated exposure - full-mouth series (about 19 films) *0.150 mSv **[17]***

*Estimated exposure **[18]** -*

Average annual UK dose from cosmic rays	0.26	mSv
Average annual UK dose from gamma rays	0.35	mSv
Average annual UK dose natural background radiation	2.2	mSv

Nowadays digital X-rays which are processed on to the computer directly give an instant result.

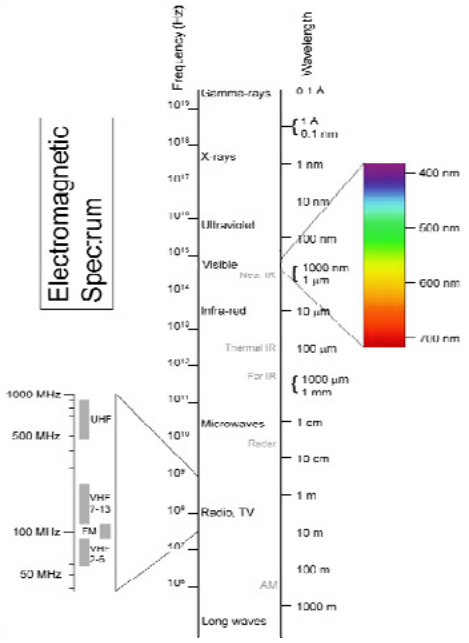
The electromagnetic spectrum

What are X-rays?

X-rays are a type of radiation. Radiation is a general term that refers to any sort of energy that can travel through space as either a wave or a particle. Examples of other types of radiation include:

- light,
- radio waves, and
- microwaves.

X-rays are similar to light, except that they have a much higher frequency, which makes them invisible to the naked eye. Due to their high frequency, X-rays can pass through the human body. This makes X-rays ideal for looking inside the body.



Finding and treating dental problems at an early stage can save time, money and unnecessary discomfort. It can detect damage to oral structures not visible during a regular exam. If you have a hidden tumour, radiographs may even help save your life.

While dental X-rays emit low amounts of radiation and every precaution is taken to protect patients from exposure, some dental patients may still put off dental X-rays for safety reasons. Dental X-rays bring up other issues for patients, including the wait time for film to be developed and environmental concerns. Dentists are addressing these issues with digital radiography, a high-tech replacement for traditional dental X-rays. **[17]**

The physical process for digital radiography is actually similar to traditional dental X-rays that use film: With digital radiography, your dentist inserts a sensor into your mouth to capture images of your teeth -- but that's where the similarities between conventional and digital dental X-rays end. Although it resembles the film used for bitewings and other X-rays, the digital sensor is electronic and connected to a computer. Once the X-ray is taken, the image is projected on a screen for your dentist to view.

There are several benefits to using digital radiography over traditional film X-rays:

- The equipment used in digital radiography exposes dental patients to much less radiation

- The sensor in the computer develops the picture almost instantaneously and projects it on to a computer screen
- The on screen images can be magnified and contrast and colour adjusted to enable higher quality images to be used.
- Digital images can be e-mailed to a dental specialist for immediate review, making it easier to transfer dental records or get a second opinion.
- Digital dental X-rays are better for the environment! With digital radiography, no chemicals are used to develop film. There's also no wasted space of a darkroom and no need to store film, which can pile up in a dentist's files. **[19]**

More on Safety

How often and how many dental X-rays are needed?

X-rays consist of a type of radiation known as ionising radiation. Ionising radiation is high-energy radiation. It can damage the cells of the body and cause mutations in the DNA (deoxyribonucleic acid), which can trigger cancer in later life. DNA is a type of acid that contains all human genetic material. However, ionising radiation is only a threat to health when a person is exposed to a significantly high dose.

The doses that are used in medical X-rays are very low and are thought to be very safe. They are similar in strength to other sources of natural radiation that people are exposed to every day.

Most dentists follow the ADA's recommendation, taking bitewing X-rays (4-7 radiographs) every year and a full set (18 radiographs) of X-rays every 3-5 years.

When and how many X-rays you have taken is always up to the individual. **[20]**

Dental professionals may be at risk from exposure to numerous biological, chemical, environmental, physical and psychological work place hazards. These hazards include exposure to blood borne pathogens, pharmaceuticals, X-rays, ergonomic factors, noise vibration and workplace violence. **[21]**

Sterilisation and Infection Control

- You need to be wearing gloves, masks and protective eyewear during each patient examination
- You need to sterilize instruments and equipment for germ free use.
- Regularly clean each exam room to eliminate bacteria
- Sterilisation of all dental hand pieces

Here, the dental technician is setting up dental tools for sterilisation. **[16]**

- Covering patients chair, x ray units and light handles with disposable plastic wraps.

Specimen Bottles

- Specimen bottles should be kept tightly capped until just before usage
- Tissue specimens should be placed in the specimen bottle and the cap secured. Care should be taken when collecting specimens to avoid contamination of the outside of the container. If contamination occurs, the container should be cleaned and disinfected

16

Appendix 1

Visit to the dentist: My plan and questions to be covered

What is the structure of the organisation?
How many employees are there?

Interview or find out from each of the employees:

- Qualifications
- Skills
- What they do
- How their work fits in with everyone else.

Why is the practice situated where it is
Also find out:
Its importance
How it links with the hospital and other technical support

Interview the dentists as well as the general questions
Find out about

- particular skills – carrying out fillings and doing X-rays
- health and safety

Note that all my notes and answers to these questions are in my file – if needed. I have used this information in my report.

The visit successfully took place on 15th March 2011 and I thanked the dentist for providing me with the answers required.

Appendix 2 References List

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[4] NHS Careers. Dental technician/ Dental technologist. http://www.nhscareers.nhs.uk/details/Default.aspx?Id=142 April 2011

[5] British Association for the Study of Community Dentistry. The Caries Experience of 5 year old children in Great Britain (2005/06). 2007. Online at http://www.bma.org.uk/health_promotion_ethics/environmental_health/Fluoriwater.jsp#_b_ Accessed April 2011

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[8] Nova Scotia Dental Association. Fluoride: How does it work? http://www.healthyteeth.org/prevention/fluoride.html Accessed April 2011

[9] Nuffield Council on Bioethics. Chapter 7. Water fluoridation. http://www.nuffieldbioethics.org/public-health/public-health-water-fluoridation 2007

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[18] Ministry of Defence. Nuclear Tests. UK atmospheric nuclear weapons tests Factsheet 4: Radiation and health. http://www.mod.uk/NR/rdonlyres/B1EB6EC5-1468-41D2-9F15-CF1BACC24A0A/0/ntvfactsheet4.pdf 2008

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[20] Gum-disease-cure.com Dental Xrays again? http://www.gum-disease-cure.com/dental-xrays.html Accessed May 2011

[21] United States Department of Labor. Dentistry. http://www.osha.gov/SLTC/dentistry/index.html April 2011

The websites I used

The websites I used for the scientific information are all professional bodies. As shown below, the website address indicates the type of website; this will justify my choice.

- .ac.uk are academic websites
- .gov.uk are government websites
- .co.uk commercial web sites
- .org.uk are non-profit or charity organisations websites.

I used Wikipedia the information on water fluoridation. I checked this information against other sources, and it was supported. The diagram of the tooth was from Wikimedia Commons. When checked against other diagrams showing the structure of a tooth, these again were correct.

I also looked up information about anaerobic respiration and lactic acid in my textbook, which is endorsed by OCR, so the information in it must be reliable.

I didn't refer to it directly in my report, but the information helped me to understand the information about anaerobic respiration and tooth decay in reference 13. The book was:

M.Brimicombe et al.. GCSE Additional Applied Science. Additional Applied Science. Oxford University Press.

National Health Service website/leaflets Published 2010

These leaflets are available in the public domain.

Data on the running of the dental practice and the job roles were provided by

- The employees of High Road practice during the visits taken in March 2011

Further information on the following

- X-rays and composites was gathered by asking a dentist Dr L. Simpson BDS, a practicing dentist with five years' experience.

She gave me the information on X-rays and safety from European guidelines on radiation protection in dental radiology. She also looked up the information on composites as well as the information she uses in her day to day work.

- Technical skill on carrying out a filling

I gained information on carrying out a filling from talking to the dentist.

Work-related Report: Mark Allocation (A-A* grade candidate)

	0	1-2	3-4	5-6	7-8	Mark awarded
Strand A			a b	a b	**a b 8 8**	8
Stand B			a b	a b	**a b 7 8**	8
Strand C			a b c	a b c	**a b c 7 7 8**	7
Strand D			a b	a b	**a b 8 7**	8
Strand E			a b	a b	**a b 8 8**	8
Strand F			a b c	a b c	**a b c 8 7 8**	8

Teachers are advised to read the guidance given in the specification 5.5 Task marking: Section 5.5.3.

Strand A: Collecting primary data (Information)

(a) Collecting primary data
The aim of this strand is for candidates to demonstrate that they have collected suitable primary information for their Work-related Report.

Mark allocated	Comments	Guidance
7-8 marks	The candidate has collected relevant and appropriate data from an appropriate source, i.e. a dentist/dental practice. The candidate has discussed the validity of the information sources used (the dentist 'was a practicing dentist with five years' experience').	Candidates will have collected and selected relevant primary data, for their report from a variety of sources which includes suitable selection of the data collected from a visit or practitioner. For 7-8 marks, candidates will comment on the validity of the sources used.

Note: 'Primary data', in this context, refers to data (numerical and/or textual information) collected by the candidate directly from their own observations and experiences. It is hoped that all candidates will have the opportunity to collect data from either a visit or a practitioner. If a face to face opportunity is not possible, candidates can obtain their data through telephone conversations, letters or electronic means and discussion.

(b) References to sources
The aim of this strand is for candidates to demonstrate that they can reference their sources accurately and correctly.

Mark allocated	Comments	Guidance
7-8 marks	The candidate has collected relevant and appropriate data from a variety of sources. A very detailed References List is attached as an appendix.	Candidates will have identified a range of sources that they have accessed to complete collection of primary data For higher marks source should be recorded in sufficient detail to know who/when/how data was collected. For candidates working at higher levels, it is also good practice to include reference to the practitioner in a references list at the end of the document. (see marking criteria)

Strand B: Collecting secondary data (Information)

(a) Collecting secondary data
The aim of this strand is for candidates to demonstrate that they can carry out research to collect relevant secondary data to support their Work-related Report.

Mark allocated	Comments	Guidance
7-8 marks	Several pieces of secondary data were used in the Work-related Report. The data has been reported accurately. There was evidence that 'Internet' researched had been suitably selected. The candidate has discussed the validity of the information sources used, and checked their reliability where this was thought necessary.	Evidence should show research, selection and use of relevant secondary data. For higher marks, candidates should show research skills demonstrating suitable selection of appropriate material from the available resources, rather than indiscriminate copying. 7-8 marks, higher level candidates will show the ability to adapt and re-structure secondary data collected to suit the purpose of the work related report. At this level candidates possibly will comment on the validity of the sources used.

Note: 'Secondary data', in this context, refers to data (numerical and/or textual information) that has already been collected and presented by somebody else, for a reason other than to use for this Work-related Report. There is a wide range of secondary data that can be accessed from published material, e.g. books, letters, records, policies, results from market research, as well as material on the Internet or the candidates' own notes.

(b) References to sources
The aim of this strand is for candidates to demonstrate that they can reference secondary sources accurately and correctly.

Mark allocated	Comments	Guidance
7-8 marks	The information sources used are identified clearly in-text and in a references list Suitable detail has been recorded for the Internet references provided, including the author and the title of the article (where it was possible to record these), rather than just the URL. The date of publication, or if unknown, the date of access, was recorded.	Higher marked candidates should be showing evidence of referencing through their report in addition to a references list or bibliography. Candidates will have identified a range of sources and should cite books or articles to one of the accepted conventions and websites should provide the full URL, and record date accessed.

Strand C: The work carried out

Note that in this strand, the marking depends on how the candidates have used their researched information in their report

1-2 marks: candidates **make a relevant statement**
3-4 marks: candidates **identify** the work etc.
5-6 marks: candidates need **to explain** roles of employees /purpose of work etc.
7-8 marks: candidates need **to analyse** importance /purpose/factors which influence.

(a) The organisation/workplace
The aim of this strand is to assess how candidates use their research from both primary and secondary sources on the structure of their chosen workplace in their work related report.

Mark allocated	Comments	Guidance
7-8 marks	The candidate describes and in some cases explains the roles of practitioners at their local dental practice and analyses the importance of the roles of the employees.	For 7-8 marks candidates need to use their researched information to analyse the importance of the roles of the employees. Material should be suitably selected form their research and link directly to the specific organisation the candidate is studying. At this level work should not be generic.

(b) The work carried out in a chosen job role and its place in the wider organisation
The aim of this strand is to assess how candidates use their research from both primary and secondary sources to identify and describe the work carried out in a chosen job role and how it fits into the wider organisation.

Mark allocated	Comments	Guidance
7-8 marks	There is some description of how the roles of the various practitioners fit within the dental practice. The research indicates what each of the employees do and it is linked to the dental surgery researched. Additional work from the Internet supported each person's role.	For 5-6 marks, candidates need to give explanations on the purpose of the job role showing understanding of how it fits in to the wider organisation rather than simple comments or statements. For 7-8 marks, candidates need to use their researched information to analyse the purpose of the work and its importance in the wider organisation. Material should be suitably selected from their research and linked directly to the specific organisation the candidate is studying. At this level, work should not be generic.

(c) The location of the organisation/workplace and the effect on society
The aim of this strand is to assess how candidates use their research from both primary and secondary sources on the location of the organisation and its effect on society in their Work-related Report.

Mark allocated	Comments	Guidance
7-8 marks	There is a discussion on the location of the practice, but this case study does not easily lend itself to giving detailed scientific reasons for its location. The candidate has discussed, however, the effect that dental practices have on tooth decay (including preventative measures), and the fact that this is also affected by water fluoridation in her area.	For 5-6 marks, candidates need to give explanations on the reasons for the location of the organisation and more than one effect the work has on society rather than simple comments or statements. For 7-8 marks candidates need to use their researched information to analyse the factors which influence the location of the organisation and its **impact on society**. Material should be suitably selected form their research and link directly to the specific organisation the candidate is studying. At this level work should not be generic.

Strand D: Skills used in the workplace

Note that in this strand, the marking depends on how the candidates have used their researched information in their report

1-2 marks: candidates **make a relevant statement**
3-4 marks: candidates **identify** the work etc.
5-6 marks: candidates need **to explain** roles of employees /purpose of work etc.
7-8 marks: candidates need **to analyse** importance /purpose/factors which influence.

(a) Technical skills applied in the workplace
The aim of this strand is to assess how candidates use their research skills and their understanding of skills needed at work, to find out about the technical skills used in their chosen job role is applied in the work place.

Mark allocated	Comments	Guidance
7-8 marks	One technical skill – the filling of teeth – has been described on page 12, to some reference above this giving some explanation of the application of amalgam and composite fillings. There is some detail on the technical skill required in the use of radiological equipment so as to avoid exposure to themselves and their patients. Other technical skills referred to, i.e. the use of tools for examinations and treatment, and sterilisation and infection control are identified and discussed in varying detail.	For 7-8 marks, candidates need to use their researched information to analyse the technical skills applied in the workplace, e.g. why and how these skills are necessary. Material should be suitably selected from their research and link directly to the specific organisation the candidate is studying. At this level, work should not be generic.

(b) The expertise needed by an individual, or a working group, with the vocational qualifications and personal qualities required.

The aim of this strand is to assess how candidates use their research skills from both primary and secondary sources to find out about the expertise, qualifications and personal qualities used in their chosen job role for their Work-related Report.

Mark allocated	Comments	Guidance
7-8 marks	There is a good description of the qualifications required to become a dentist, and reference to the expertise required (see technical skills, above), and the importance of these is explained. The section on personal skills required by the dentist includes some good explanation of why these skills are required, so the candidate is at the 7-8 mark band.	For 7-8 marks, candidates need to use their researched information to analyse the expertise needed in the workplace, e.g. why and how this expertise is needed. It is also necessary to explain the relevance of the personal qualities and qualifications needed in the job role. e.g. why and how they link within the job role. Material should be suitably selected form their research and link directly to the specific organisation the candidate is studying. At this level, work should not be generic.

Strand E: Scientific knowledge applied in the workplace

Note that in this strand, the marking depends on how the candidates have used their researched information in their report:

1-2 marks: candidates **make a relevant statement**.
3-4 marks: candidates **identify** the work etc..
5-6 marks: candidates need **to explain** roles of employees /purpose of work etc..
7-8 marks: candidates need **to analyse** importance /purpose/factors which influence.

(a) Scientific knowledge applied in the workplace

The aim of this strand is to assess how candidates use their research skills and their scientific knowledge to find out about how science knowledge is applied in their chosen job role.

Mark allocated	Comments	Guidance
7-8 marks	The information contained in the report identifies the scientific disciplines involved in dentistry and explains these in some detail. There is a good description of the decay of teeth and how important it is for the dentist to understand, recognise and be able to treat the different stages. Reference is also made to the chemistry of amalgams and composite filling materials, X-rays (a diagram of the electromagnetic spectrum has been included).	For 5-6 marks candidates need to explain how the scientific knowledge underpins the work described. Candidates at this level should not be just including the related science but must indicate how it is used by the practitioner chosen. For 7-8 marks candidates need to use their researched information and their scientific knowledge to analyse the science knowledge required in the workplace e.g. why and how this science is needed. It is also necessary to explain how the science underpins the job roles. Material should be suitably selected form their research and link directly to the specific organisation the candidate is studying. At this level work should not be generic.

(b) Financial or other regulatory contexts that impact on the work done

The aim of this strand is for candidates to show their ability to

Mark allocated	Comments	Guidance
7-8 marks	Regulatory factors identified include the use of X-rays on pages 12-14, and the impact of regulations to control exposure to these is discussed in some detail. There is also reference to the possible toxicity of amalgam fillings on page 11 as a factor regulating both their use by some dentists and their removal.	For 5-6 marks candidates need to explain the **impact of two examples** of financial or other regulatory factors on the work. Care needs to be taken that candidates explain the impact of their chosen factors rather than just give detail on these. For 7-8 marks candidates need to use their researched information to analyse the **impact of their two chosen examples**. Material should be suitably selected form their research and link directly to the specific organisation the candidate is studying. At this level work should not be generic.

Strand F: Quality of the presentation

(a) The structure and organisation of the scientific report

Mark allocated	Comments
7-8 marks	Relevant information is communicated well and the report is well-organised. Contents listing and page numbering is provided, and there is an excellent references list.

(b) Use of visual means of communication (charts, graphs, pictures etc)

Mark allocated	Comments
7-8 marks	Visual information is used to convey information and ideas. Captions have been used effectively, but not on all of the diagrams

(c) General quality of communication

The aim of this strand is to assess how candidates can organise and write a scientific report, using relevant scientific or technical vocabulary and suitable visual material.

It is advisable that candidates are given the marking criteria for this section so they are aware of what they need to do to complete a well-structured scientific report.

Mark allocated	Comments
7-8 marks	There is excellent use of scientific and technical vocabulary. Spelling, punctuation and grammar are also of a very high standard.

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