Exemplar Material
Unit 1 (U1): Science at Work

(This is not intended to be a scheme)

Assignment Brief	Strand Coverage	Exemplar Material	Page No.
A7 **Data Analysis**	AO2b	MB3	54 56

(MB = mark band)

Evidence shows different ways of approaching assessment of AO2b. It is not necessary for it to be assessed more than once.

Sometimes teachers may choose to set work which does not allow MB3 to be accessed e.g. 1.5.

See the Asssessment Evidence Grid in the Unit Specification for details of the mark band criteria. For reference a copy is included at the end of this document.

Please Note:

The exemplar material shown in this teacher's guide represents work produced by candidates of varying abilities. They should not to be taken as model answers.

Assignment Brief A1

Unit Name: Science at Work		**Unit Number:** Unit 1
Assignment Title: Survey in the Work Place		**Assignment Number:** A1
Date Set:	**Due Date:**	
Assessment Objective(s): AO1a, AO1c		

Brief:

Science is important in all aspects of our lives. Organisations that use science can be either those that manufacture or process products for sale, or those that provide a service. The range of these organisations is huge ranging from food production to the manufacturing of electrical or electronic devices. Services include health care, education, energy and communications, the list of associated organisations is endless.

Task:

The aim of this assignment is to carry out research into **five** science based organisations and produce a presentation to include one service and one industry.

Task 1 (AO1a)

Research each of your chosen services and industries and find out the following:

- The services offered or the products made
- The type of work that takes place
- The scientific involvement
- Health and Safety involvement with the service or industry

When you have gathered together your research, put together either a presentation or a leaflet explaining clearly what you have found out.

Max marks possible for this task: 6

Task 2 (AO1c)

Choose **one** of your organisations and research into their health and safety laws and regulations associated with the organisation you have chosen. Produce a report on:

- how the organisation conforms to health and safety;
- how the regulations are monitored;
- the hazards that are involved.

Max marks possible for this task: 6

Exemplar portfolio work – Assignment A1	Commentary on mark allocation
See attached presentation; as work is based on actual candidate work, there will be inaccuracies. **Task (AO1a)** Work shows candidates have produced a presentation on 5 science-based organisations. The slides show that in most cases relevant information has been selected. Work has been reasonably presented. But work not in order as indicated by slide 1. The information, for the most part, includes work on the bullet points listed in the specification: ▪ state the products made or the service offered ▪ describe the type of work that takes place ▪ identify the science involved ▪ state any legal/health and safety constraints on the organisation. The work for: Environmental Health - good detailed survey. Champagne is rather basic on science - and jobs. Steel works - just level 2. Supermarket - interesting science - more detail for MB3 jobs weak. MB3 - not achieved. Detail for each organisation needs to be comparable with Environmental Health Service. Sources of information used need to be identified and reviewed. MB1 - work **Task 1 AO1c** All organisations have information related to Health & Safety which could be used for AO1c - this information would be MB1 for this strand. If task 2 was completed, focussing more detail on one of these organisations, MB2 & MB3 could easily be achieved. If all work for organisations was at level of Champagne - MB1, 1 or 2 marks would be awarded. **Task 2** This candidate did not complete task 2 however the work presented for task 1 covers some of the requirements for AO1c. Therefore, for MB1 - 1 mark will be allocated.	4 marks allocated for task **AO1a** **2** marks allocated

Exemplar portfolio work - Assignment A1

These are copies of the slides produced by the candidate for Task 1.

1

Survey of 5 organisations

- Environmental Health Service
- Local Hospital Trust
- The Steel Works
- Champagne
- Supermarkets

2

Environmental Health Service

Environmental Health Officers are responsible for :

- Investigating possible public health hazards
- Removing or destroying such hazards
- To enforce health laws and permit conditions
- To take necessary steps to enforce such orders

3

Staff in Dept of Environmental Health

- Management
- Technical Officers
- Pollution Supervisor
- Trading Standards Supervisor
- Environmental Health Officer
- Pest Control Officers
- House Cleaning Team
- Administration Staff

4

Environmental Health Officer Key Responsibilities

- Inspect houses that are a danger to the occupants
- Inspect houses for lack of hygiene
- To sort out pest control
- Deal with complaints
- To follow the fitness standard in House Act 1985

5

Main Areas of Scientific Knowledge

Condensation

- Caused by wet material such as washing being put on radiators
- Can cause spores to be inhaled into the lungs, the mucus in the lungs will trap spores which will then result in a build up of mucus
- To solve this need a balance between heating and ventilation

6

Dry Rot : Mycelium/Mycelia

- Type of fungi found in wooden furniture, skirting boards and floor boards

Damp

- Caused by the failure of damp proof courses.
- e.g. if soil put up against wall over a DPC moisture from soil will be absorbed by the wall causing damp – will produce a wavy line made by hygroscopic salts

7

Pests

- The classification of pests is important to inform the inhabitants of the best way to dispose of them
- German cockroaches
- And rodents are most common
- Cockroaches leave a musty smell and faecal deposits
- Rodents leave grease marks on skirting boards

8

Health & Safety

The following safety regulations/legislations need to be complied with

- Maximum working hours/week
- Safety practices in relation to visits
- Basic rules set for inspection of premises
- General Health & Safety Rules that apply to the working conditions of an EHO

9

Local Hospital Trust

Services offered by a biomedical scientist involved in experimental work including

- Blood transfusion
- Infection control
- HIV diagnosis
- Food poisoning

10

Biomedical Scientist Job

- Analysing swabs from in – patients
- Take out tests on patients who have over dosed on unknown substances followed by analysis
- Assessment of blood samples

11

Other Positions in the Department

Consultants (haematology specialists)
Registrars
Senior House Officers
Junior House Officers
Chief BMS
BMS

12

Scientific Knowledge

- A BMS can determine the amounts of abnormal cells (blasts) that are in a blood sample by using their medical knowledge and by using high tech equipment.
- Also need to know reason behind a patients blood clotting or not clotting. Haemophilia is a condition where a clotting factor is partially or completely missing, this means a person with haemophilia will bleed for a longer period of time than normal.

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Haemophilia A & B have a deficiency of factor 8 & 9 on the X chromosome.

Haemophilia A & B mostly occurs in males because they inherit a single X chromosome

This means that if the gene for factor 8 or 9 is faulty then the person will suffer from the disease.

Haemophilia is diagnosed by testing the level of factor 8 coagulation activities within the blood.

Coagulation is a process of blood clotting where by the fibrin strands and blood cells that have been damaged can prevent further bleeding

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Health & Safety

All employees must assess the potential hazards made by substances used and use the appropriate action to prevent accidents

Main Guidelines

- Wash hands frequently
- Do not overfill waste containers
- Wear a white coat at all time when handling samples
- Avoid touching face
- No eating drinking or smoking or putting anything into mouth in laboratories
- Dispose of any contaminated tissues in the correct waste bins
- Gloves must be worn when handling samples

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Champagne

Product made is the sparkling wine known as champagne

16

Stages in Production

- Fermentation
- Assemblage
- Bottling & bottle fermentation
- Ageing
- Riddling
- Disgorging to labelling & presentation

17

Health & Safety

- The riddling process takes place over a period of 6 to 8 weeks, the bottles are turned once a day
- The risk towards the riddlers is high as when they turn the bottles of champagne the pressure from the gases inside increases, this pressure build up to could in turn dislodge the corks from the bottles , the dislodging the corks would be at high speeds sequentially causing damage to the riddler

18

Steel Works

- Is an international metal producing company
- Annual production 17 million tonnes of steel
- Produces carbon steel by the basic oxygen steel making method
- It uses the arc furnace method

19

Laws and Regulations which the steel works follows

Use of Work Equipment Regulations 1998

- Minimum safety checks that should be carried out

Health & safety in the Use of a Furnace

- Guidelines on action to deal with spillages

Personal protective equipment (PPE) 1989

- When and where safety helmets should be worn

20

Jobs at the Steel Works

- Researcher –development of new materials /improving existing products
- Department Manager –covers products –railway tracks/shipbuilding plates
- Design engineer –works in prototype department
- Research assistant –hands on conducting experiments
- Knowledge Group Leader – works on fracture and fatigue prevention

21

Supermarket as a Service provider

Sells goods to the local community – therefore providing a service to them

22

Scientific Work at the supermarket

Main objective is to stop the spread of microbes

- **Salmonella**
- **Yarsiniosis**
- **Cryptosporidium parvum**

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How this is done

- Keep food chilled below 5 ^{o}C - because bacteria cannot multiply at this temperature.
- Employees washing their hands and wearing gloves when preparing food to avoid cross contamination.
- Changing knives, gloves and surfaces when working with raw and cooked food, so the bacteria does not get onto the cooked food from the raw food.

Assignment Brief A2

Unit Name: Science at Work	**Unit Number:** Unit 1
Assignment Title: An in-depth study of The Gum Company	**Assignment Number:** A2
Date Set:	**Due Date:**

Assessment Objective(s): AO1b, AO1c, AO2a

Brief:

Gum UK is home to some of the world's well known and best loved chewing gum and bubble gum brands. The factory based in Southern England contains state of the art technology and receives constant investment to ensure innovation and research continues. This industry uses science not only in the manufacture of its products but also in quality control. It has a range of employees with various skills and qualifications.

Task: AO1b

Task 1

Produce a presentation introducing the Gum Company.

Task 2

Describe the type of products made by Gum include any scientific facts and knowledge related to these.

Task 3

Describe the types of work done at the factory, the knowledge and skills the staff need and the tasks they do.

Max marks possible for this task: 7

Task 4 (AO1c)

Health and safety – how does the company comply with the law?

Max marks possible for this task: 6

Task 5 (AO2a)

How does the Company manage its impact on the both the community and the environment.

Max marks possible for this task: 6

Exemplar portfolio work - Assignment A2	Commentary on mark allocation
Task 1: Presentation of slides – to which candidate talked **Confectionery Manufacturer** • History • Range of Products **Staff Information** • Numbers • Female/male ratio • Staff turnover • Earnings/Pensions **Career Opportunities** • Typical Jobs qualifications • Career structure • Facilities available **Health & Safety** • General Guidelines **Annual Sales** • Annual turnover • Exports	**Work presented is at MB2** **Candidate was observed giving presentation with explanation given for each heading** **MB1** – candidate would give a basic coverage of a presentation **MB3** – the talk given by the candidate would need to be detailed and supported by structured notes with evidence of sources used.

Exemplar portfolio work – Assignment A2	Commentary on mark allocation
Task 2: Describe the type of products made by Gum, including any scientific facts and knowledge **Products made - Chewing gums which include** • Extra – the nations number one selling gum • Extra thin Ice – new micro strips of peppermint and spearmint that instantly dissolve on the tongue for fresh breath • Airwaves- the clearway to breathe easily • Orbit combats tooth decay • Spearmint 7 double mint –classic chewing gums • Hubba Bubba –flavoured bubble gum All chewing gum manufactured by Gum contain the following ingredients • Gum base • Sweeteners • Softeners • Flavourings It must be noted that all ingredients are extensively tested by the company to make sure that they are completely safe and wholesome **Gum Base** – puts the chew in the gum by binding all the ingredients together and creating a smooth soft texture. Historically, gum base was derived from various natural resins, including sorva and jelutong. Nowadays synthetic gum base materials are used which give a longer lasting flavour, improve texture and reduce tackiness. The Gum Company still uses a number of all natural rosins or softeners in the base. Rosin, which comes from pine trees grown in the US enhances the texture of the gum base. Corn syrup also helps to sweeten the gum and keep it fresh and flexible. **What is in sugar free Gum??-** aspartame, mannitol, sorbitol or xylitol replace sugar and corn syrup. Aspartame is a highly concentrated sweetener with a taste virtually indistinguishable from sugar. It is formed from aspartic acid and phenylalanine, two common amino acids found naturally in many foods. Sorbitol and mannitol are also founding some fruits, although most of the raw material used today comes from corn. Xylitol a naturally occurring sweetener which is also present in some fruits such as strawberries is known for its benefit to teeth. **Softeners** –glycerin and other vegetable oil products help to blend the ingredients and keep the gum soft and flexible by retaining the proper amount of moisture. **Flavourings** –the most popular for chewing gum are those obtained from mint plants. Mint plants need to be carefully cultivated for delicate, lasting flavour. After plants are harvested they go through a distillation process, which extracts the pure mint oils used in the gum. The basic flavour for spearmint gum is extracted from fresh garden spearmint plants. The main flavour from double mint comes from an extract of peppermint.	Work presented MB2 as this shows competent research work and scientific knowledge linked to products. **MB3:** candidates would need to show a more comprehensive understanding of the scientific terms/ chemical names used – include formula etc.

Additional Ingredients for specific products include Sodium Bicarbonate –which has a bleaching effect on teeth Glycerol – which is a plasticizer used to keep the gum plastic, it is also a sweet substance.	

Exemplar portfolio work – Assignment A2	Commentary on mark allocation
Task 3: Describe the types of work done at the factory, the knowledge and skills the staff need and the tasks they do **How the Gum is made** **Areas of Work** **Staff Numbers 716 male female Ratio 67:33** **Under 35s: over 55s 34% : 10%** **Staff Turnover 8%** **Earning over £35 000 + 8%** **40% + employees hold shares in the company** People are employed in a full range of business and scientific areas including • Sales • Marketing • Customer services • Engineering • Mechanical, electrical and technical line operatives • Food technologists, chemists, lab technicians development analysts (Level 3 qualifications min/most have at least a scientific degree/MSc –for research work is required) • Warehousing • Quality control • Finance • Humane resources • Catering • Building maintenance • Hygienists (at least advanced level L3 /VCE /BTEC qualifications) Opportunities for traning offered for all employees – NVQ and further degrees also offered as part of the package) **Stages of Production** **Step One: Quality Assurance** • All ingredients and wrapping materials are inspected when they arrive at the factory. Before any shipment is accepted, samples are taken and tested in modern quality assurance laboratories. **Step Two: Grinding** • The process begins with the grinding of the base materials **Step Three: Filtering** • The base is then melted and purified through high speed centrifuges and filter machines. Then still hot, the base goes to the mixers, each of which can hold up to 1 ton of ingredients.	

Step Four: Mixing

- After the gum base is poured into the mixer, sweeteners and flavours are added, at just the right moment and in just the right amounts. These ingredients are then mixed slowly for a known calculated time. At this point the gum looks like stiff bread dough.
-

Step Five: Rolling

- From the mixers, the gum is snet through a series of rollers that form it into a thin, wide ribbon. Each pair of rollers is set closer together than the previous pair, gradually reducing the thickness of the gum. A light coating of finely powdered sugar or chemical sugar substitute is added to keep the gum from sticking –to enhance the flavour
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Step Six: Scoring

- The continuous ribbon of gum is then scored in a pattern of single sticks

Step Seven: Conditioning

- The gum is then allowed to coll. The temperature and humidity are carefully controlled to make sure the finished gum will stay fresh on store shelves for an extended period of time.

Step Eight: Wrapping

- The packaging materials are vital in protecting the freshness of the gum. In one continuous process the wrapping machine receives and wraps the sticks, applies the outer wrapper and seals the ends of each package.

Step Nine: Packing

- The packages are automatically packed into boxes or clear plastic bags that move on conveyor belts for final inspection..
- Boxes are wrapped with a clear covering and both boxes and bags are packed into shipping cases to be shipped all over the world.

What Some of the Scientists Do & what they find out

The Company chemists and laboratory technicians work hard to perfect formulations and ensure the pleasant, long lasting flavour of the chewing gum. They need to extract some of the main ingredients and quality control all the reactants used. Testing of possible side effects of the ingredients is needed – e.g. laxative effects, vegetarian requirements, prevention of dental problems.

Research assistants in the company investigate the benefits of sugar free gum on oral health. Results have shown that chewing sugar free gum for up to 20 minutes after eating stimulates the production of saliva and so helps to neutralize paque acids that cause tooth decay.It has also been shown that chewing sugar free gum stimulates salivary production and an additional volume of saliva is produced. The higher salivary flow rate provides faster oral clearance of any fermentable carbohydrates and removes food particles between teeth,.

Research results show that the role of chewing sugar free gum not only reduces demineralization but also increases enamel remineralization.

MB2 – **5** marks allocated for all tasks.
This shows evidence the candidate has selected appropriate information and is clearly and logically presented.

MB3 – material is needed from a range of sources and that work has been understood by the candidate. This might include satisfactory

Caries demineralization develops in an acidic environment when the pH of saliva drops below 5.5 to 5.7 after food ingestion, especially fermentable carbohydrates. When people chew sugar free gum, the increase in the salivary flow rate buffers and raises both the salivary and plaque pH, thus reducing the potential time demineralization of teeth that can occur in an acidic environment An increased volume of saliva also produces more calcium, phosphate and fluoride minerals to help remineralize tooth enamel; it also combats complaints such as a dry mouth. In an effort to reduce packaging, research into alternative materials and procedures continues to be an ongoing process. Wrapping and packaging materials play an important and essential role in ensuring quality and freshness of the chewing gum. Scientists work on making material source adjustments, such as reducing the weight of the outer wrappers and narrowing the size of labels –this leads to thousands of pounds of savings. In terms of reuse of raw materials and their approach to recycling takes many inventive forms. Waste sugar is supplied to animal feeders and local bee keepers. Waste sugar and gum production overruns are recycled as a binding agent for fertilisers. m Safety officers - are responsible for assisting the regulator compliance supervisor in developing, implementing and maintaining the safety policies, procedures, systems and programs that are designed to minimise and eliminate occupational hazards. They will also assist in all training, evaluations and attend committee meetings. They must have the ability to multi task, excellent people skills and additional languages are a plus.	answers to teachers' questions as part of evaluation and justification of material used.

Exemplar portfolio work – Assignment A2	Commentary on mark allocation
Task 4: Health and Safety: How does the company comply with the law? Employees working on the factory floor need to wear anti contaminatory clothing which consists of hair nets, white coats, face masks and where required gloves. Hand washing is essential for food handling. Eye goggles and ear plugs are required around noisy machinery. There is a non smoking policy throughout the factory, this is especially important in the storage rooms, where the concentrated flavourings are flammable and toxic, and also where coatings are applied to the chewing gum there is airborne dust which if ignited could cause explosion, so it is doubly important that there are no sparks or sources of ignition they are also kept at low temperature, to prevent the product being contaminated with foreign materials such as metals they X-ray the boxes and they calibrate the X ray machine with a box containing metal (clearly labelled to prevent confusion). The company provides colour coded walkways for forklift trucks and where people are walking to ensure everyone's safety. The whole site is guarded by security camera to prevent theft but also to keep the public out for their own safety.	**AO1 MB1** – **2** (just). Work shows a basic knowledge of health and safety -but no reference to specific laws. Limited information on hazards. It does however show importance of Health and Safety in the work place. **AO1 MB2** Much more detail is needed – refer to 1.2.1 in the specification – link the relevant laws stated here and include the hazards involved. **AO1 MB3** Detailed work on the laws linked to the company, how the regulations are monitored and hazards.

Exemplar portfolio work – Assignment A2	Commentary on mark allocation
Task 5: How does the Company manage its impact on both the community and the environment. The Gum Company recognises that responsibility to the environment is a global concern. Their environmental policy, which applies to all domestic and associated companies and operations, outlines their specific objectives in contributing to a safe and clean environment. This policy is being carried out in a variety of ways. 1. The manufacture of chewing gum does not result in a significant air or water pollution and contributes little to the solid waste stream. They do, however rely primarily on the use of their wrapping and packaging materials to ensure quality and freshness of their product, because of the importance of the packaging the scientist are constantly evaluating and making changes to current packaging materials and researching alternative materials to meet future disposal and recycling requirements. Additionally recycled materials are being incorporated into various elements of their packaging where possible and allowed by government regulations. 2. At the company offices and plants employees are increasing their awareness of how they can contribute to a better environment. They are serving on committees to identify ways to reduce waste and conserve materials. They are also participating in programs to minimize waste in the work place. 3. As a result of recycling of office and manufacturing materials is practised throughout the organisation. Materials such as computer paper, corrugated card board, plastic, glass, aluminium and steel are recycled. Recycling not only prolongs the usefulness of resources, it reduces the need for landfill. 4. The Company is also a user of recycled goods. More and more of their offices use recycled paper for letterheads, forms and computer paper. There is a heightened effort to encourage their suppliers and vendors to be responsive to environmental concerns. 5. Good environmental practices are as varied as the countries and cities where the company and it associates are located. The company in Plymouth has turned part of its grounds into a natural wildlife habitat and sponsor s environmental activities for the community. In the United States where air pollution is a concern the company underwrites part of the cost for public transportation to encourage employees to leave their cars at home. 6. Finally, the company continues its anti litter campaign, one of which began in 1933 when a message was first printed of the wrapper of each stick of gum, reminding consumers to dispose of their gum responsibly. One of their waste reduction goals is to divert waste from landfills. Toward	**AO2 MB1** Basic information on managing waste; effects on the community and environment, some benefits to society.

that end, every shipping case used throughout the United States is made from a minimum 50% recycled materials; all vending machine trays are made of 100% recycled materials. At the printing plant alone recycling of paper, fibre cores, wood pallets, corrugated board and stretch wrap form among other materials, has resulted in a 65% reduction of solid waste to landfills in just one year.	

Assignment Brief A3

Unit Name: Science at Work	**Unit Number:** Unit 1
Assignment Title: Aspirin – a useful drug	**Assignment Number:** A3
Date Set:	**Due Date:**

Assessment Objective(s): AO2a and b, AO3a, b and c

Brief:

More than 10 million kilograms of aspirin are manufactured in the US each year. Nowadays aspirin is used not only as a painkiller but it is also effective in reducing the incidence of heart disease. Aspirin can be prepared in the laboratory by the esterification of salicylic acid with ethanoic anhydride. The aspirin that is manufactured must be of a very high purity.

Task 1 AO2a

Write a report that assesses the impact that the manufacture of drugs, such as aspirin, has on society. In the report include:

- the benefit to the economy
- the benefit to society (local, national and global)
- the benefit to the local employment situation
- the control of energy
- the management of waste
- the demand on transport and communication systems
- the effect on the environment.

Task 2 AO3a, b, c and AO2b

The preparation of aspirin following a standard procedure and the determination of the melting point of the prepared sample.

Task 3 AO3a, b, c and AO2b

The determination of the purity of aspirin by thin layer chromatography.

For each of tasks 2 and 3 you are required to:

- Identify hazards and carry out a risk assessment
- Follow practical instructions.
- Record any observations and/ or measurements
- Process the results using suitable calculations (for AO2b)
- Evaluate the results

Teachers may find it useful to mark each practical task (2 and 3) out of a maximum of 21 and divide the total by 2.

Resources: Visits to pharmaceutical companies. Company videos/DVDs, websites (e.g. www.abpischools.org.uk. *Which?*, newspaper articles, interviews with employees, *The Constant Gardener* (John Le Carre; ISBN 034073339X), *Aspirin* (RSC; 0854043888).

Exemplar Portfolio Work – Assignment A3 Task 1	Commentary on mark allocation
<u>The Impact on Society of a Company manufacturing Pharmaceuticals</u>.	Work presented at **MB1**. The assignment scores **2** marks. This piece of work contains only brief remarks on all bullet points in 1.2.3 except for the contribution to the economy. One or two references would be expected. The notes identify which of the bullet points in the specification 1.2.3 have been mentioned.
Pharmaceutical companies manufacture medicines , which help to improve/maintain the health of people. The company will usually manufacture the medicines from raw materials and then package and distribute the medicines. A common medicine is Aspirin which is a painkiller and also helps reduce heart disease.	benefits society
Medicines have to be produced and packaged in sterile conditions. Some are mass produced on a continuous process and so the process is automated. Batch process will be used for specialised medicines. Production process will be followed using electronic sensors in both cases.	use of ICT
Some people will be employed to clean out vessels between batches. However the sterile conditions will mean that handling of materials is kept to a minimum and so there will not be many people employed. Pharmaceutical companies are continually looking for new drugs. Research scientists will be employed. However as these are specialists they will be recruited nation wide or even world wide and so will not benefit the local economy except in their local buying power.	employment
The production process will use energy. The company will try to keep energy use to a minimum. Water usage in the production process will be at a minimum.	energy consumption

The pharmaceutical company will try to ensure that • there is as little waste as possible as disposal of wastes is expensive • there are no substances which could harm the environment	waste management/ environment
New medicines take a long time to develop and even longer to test. The price reflects this and the large pharmaceutical companies are unwilling to reduce prices.	manages relevant costs
Transport of both staff and goods occurs and impacts on the local environment. The company will usually be sited where there are good transport links to road, rail and air .	transport and communication systems

In order to reach mark bands 2 and 3 more detail would be expected.
It is expected that actual examples from the organisation will be discussed.

Mark band 2 could be given, even if one of the bullet points is omitted, so long as the discussion is detailed. Several references, (more than two) would be expected.

Mark band 3
- would involve a discussion on both positive and negative aspects, where appropriate.
- data, e.g. number of employees, would be expected.
- a range of references is expected.

There is further clarification in the next piece of exemplar portfolio work, showing how mark band 2 and mark band 3 can be achieved. The information given is brief and in note form. Expansion would be expected and some indications have been given in the commentary.

Exemplar Portfolio Work – Assignment A3 Task 1	Commentary on mark allocation
<u>The Impact on Society of a Company manufacturing Pharmaceuticals</u> Pharmaceutical companies are often international organisations e.g Profile of company being considered. Initially medicines are expensive so countries where the average per capita income is low may not be able to benefit. e.g. AIDs medicines in Africa. Medicines have to be tested. There is controversy over testing as to who is tested and whether the length of time is sufficient. There are regulations governing testing. The thalidomide case is a spectre hanging over implementation of medicines. Pharmaceutivcals are both imported and exported from the U.K. However more is exported than imported so there, pharmaceutical companies make a significant contribution to U.K'.s balance of payment Minimum energy usage can be obtained by using Combined heat and power plants . One company used natural gas as the fuel . There was a reduction in the emission of greenhouse gases. A waste water treatment facility was built by one company at a cost of £20 million . The final discharge meets the current water regulatory standards set by the Environmental Agency. The amount of solvents used is at a minimum. This reduces the amount of waste that needs disposing of off site. The solvents could be recycled if economic New ways of coating the tablets using water as a solvent rather than an organic solvent which has to be dealt with either by recycling or by burning.	Work presented at **MB2** with comments for MB3 benefits society/ global effect **MB2** discussion would be **MB3** benefit to society; depth of discussion would decide which MB – 2 or 3. contributes to the economy **MB2** MB3 would need a lengthier discussion with perhaps some actual figures. energy consumption **MB2**. more discussion needed for MB3. managing waste **MB2** Such comments would be **MB3**

The price of medicines has to include the research and development aspect. Patents are taken out for drugs developed by companies. A patent lasts for 20 years and allow the company to sell the product under its brand name at a price it decides. Quality assurance is very important in the manufacture of medicines . This increases expenditure by the company. When the term of the patent has ended, the drug can still be sold under its brand name but also it can be sold as a generic drug and the price reflects the cost of production. The company aims to recoup its costs during the time of the patent. ICT is used in tracking the entire production process. Each batch of drugs is coded from the raw materials to the final packet. ICT is used in the development of new medicines. Structure of molecules and properties of the compound found using data bases. Types of employees not just those involved in science. Number of employees and organisational structure . Discussion on transport and communication links should be focused on the actual site and the proximity of motorways, airports an rail networks.. Medicines are not bulky so this effects the transport links that can be used. Production of medicines must be done in a clean environment so plant is usually clean a. Discussion on actual site (photos or plan) Discussion on emissions. Local issues for local papers could be included. Most pharmaceutical firms take an active part in the community in order to improve their image. Examples should be given Resources: Visits to Boots company and Astra Zeneca , Web sites e.g. www.wallisgroup.com which produces aspirin tablets for Sainsburys(this web site has pictures) A Constant Gardener by John Le Carre	manages relevant costs **MB2** **MB2** For MB3 actual examples needed. use of ICT **MB2** actual examples needed for MB3 employment. **MB2** **MB3** transport/communi-cation systems level of detail and accuracy will determine MB2 or MB3. community/ environment level of detail will determine whether MB2 or MB3. level of detail and relevance will determine whether MB2 or 3. number and relevance of resources will help determine MB2 or MB3.

Assignment Title: Aspirin – a useful drug
Assignment A3

Task 2: Preparation of a sample of aspirin and determination of melting point.

PRACTICAL INSTRUCTIONS

AO3a and b

1. Complete the risk assessment before starting the experiment.
2. Weigh accurately about 2.00g of 2-hydroxybenzoic acid (salicylic acid) into a **dry** 50 cm^3 pear-shaped flask. Record all the weighings. The mass need not be exactly 2.00g but the mass must be known to two decimal places.
3. Add 5 cm^3 ethanoic anhydride and 10 drops concentrated phosphoric acid.
4. Mix the reagents carefully by gently swirling the flask.
5. Attach a reflux condenser to the flask.
6. When the apparatus is assembled correctly, use a water bath to heat the flask for ten minutes.
7. Allow the pear shaped flask to cool to room temperature.
8. Carefully remove the water bath and then very slowly and cautiously pour 5cm3 water down the condenser. CARE: the water may boil violently due to the reaction with excess ethanoic anhydride.
9. When the reaction has finished, pour the contents of the flask into a beaker containing about 30cm^3 cold water.
10. Cool the products in an ice bath.
11. Filter the mixture using vacuum filtration.
12. Recrystallise the crude aspirin using the minimum amount of boiling water.
13. Filter the solid using vacuum filtration.
14. Dry the solid.
15. Weigh the solid recording all masses measured.
16. Put a sample of the aspirin in a sample tube. Label the tube appropriately.
17. Determine the melting point of the aspirin, recording all appropriate measurements.

TREATMENT OF RESULTS

AO2b

1. Calculate the theoretical yield of aspirin for the mass of 2 hydroxybenzoic acid used.
2. Calculate the percentage yield.
3. Look up the melting point of aspirin and compare with the results for your solid.

EVALUATION OF METHOD AND RESULTS

AO3c

Comment on

- the method;
- the results that you obtained for the percentage yield and the melting point.

Exemplar portfolio work – Assignment A3 Task 2	Commentary on mark allocation
	Work presented at MB1 The assignment scores 7 marks out of 21 Statement of teacher showed that help was needed in carrying out the experiment.
Risk Assessment Chemicals 2-hydroxybenzoic acid (salicylic acid) harmful if ingested, irritating to skin and eyes therefore weighed out into a weighing pot using a spatula. Ethanoic anhydride flammable and reacts violently with water so pear-shaped flask should be dry. Measured out using a measuring cylinder. Phosphoric acid is irritating and causes burns. Measured out carefully using a measuring cylinder.	**4** marks given for **AO3a** as risk assessments have been used but the practical was not carried out confidently. Confident completion and evidence of use and development of risk assessment give marks 5 or 6 for AO3a (teacher assessment).
Apparatus Quick fit Top pan balance Assuring cylinders Vacuum filtration apparatus Melting point apparatus	7 and 8 marks for AO3a will depend on the actual melting point as compared to the data value and also on the appearance and dryness of the product. (teacher assessment) This will show that the apparatus has been completed accurately.
Melting point of aspirin 144 ^{o}C Mass of crude aspirin 1.82 g Mass of pure aspirin 1.03 g The melting point of aspirin during this experiment was 144 ^{o}C and the value from the Chemistry Data (JG Stark and HG Wallace) is 135 ^{o}C.	3 or 4 marks: if mass of weighing pot etc. recorded for weighing out of salicylic acid and several results for melting point. 5 or 6 marks: accuracy should be appropriate to that of the apparatus.

Equation for the reaction Aspirin can be made by an esterification reaction moles = $\frac{\text{mass}}{\text{molar mass}} = \frac{2.00}{138} = 0.014492753$ moles x mass of aspirin = mass (theoretical yield) 0.014492753 x 180 = 2.60g % yield = $\frac{\text{yield}}{\text{theoretical yield}} \times 100 = \frac{1.03}{2.60} \times 100 = 40\ \%$ Fortunately no problems occurred during the experiment.	This would be worth **2** marks for some processing of but only statement of how to calculate % yield. For marks 3, 4 and 5 some attempt at accounting for 40 % yield, e.g. solid left in beaker on precipitation, solid left in funnel after vacuum filtration. For marks 6 and 7: several reasons for low percentage yield e.g. those above + side reactions. Discussion of melting points of which there will be more than one obtained.

The calculations of theoretical yield and percentage yield from this experiment can be used for Unit 1 AO2b

Exemplar Portfolio Work – Unit A3 Task 2	Commentary on mark allocation
moles = $\frac{\text{mass}}{\text{molar mass}}$ = $\frac{2.00}{138}$ = 0.014492753 moles x mass of aspirin = mass(theoretical yield) 0.014492753 x 180 = 2.60g % yield = $\frac{\text{yield}}{\text{theoretical yield}}$ x 100 = $\frac{1.03}{2.60}$ x 100 = 40%	Work presented at **MB1** for **AO2b** this assignment scores **1** mark **AO3c** **1** mark only awarded as straightforward calculations and answers given to inappropriate accuracy. 2 or 3 marks would have been awarded if: mass calculated from weighing results. mass of 1 mole calculated from formula. mean melting point calculated. 4 marks awarded if the calculations were to a suitable degree of accuracy for the equipment and the method involved.

Summary of marks awarded for Task 2 for AO3:

AO3a mark band 2 4 marks
AO3b mark band 1 2 marks
AO3c mark band 1 2 marks

Total = **8** marks

Assignment Title: Aspirin – a useful drug
Assignment A3

Task 3: Determination of the purity of aspirin by thin layer chromatography.

PRACTICAL INSTRUCTIONS

AO3a and b

1. Complete the risk assessment before starting the experiment.
2. Crush a tablet of aspirin using a spatula on a dimple tile (the aspirin tablet should be that of a proprietary brand).
3. Put the crushed tablet into a test tube and add 5 cm^3 ethanol.
4. Cork the test tube and shake well.
5. If all the tablet has not dissolved, warm the test tube in a water bath (make sure that the cork is removed before heating the test tube) until all the aspirin has dissolved.
6. Repeat the method for the sample of aspirin that you have prepared.
7. Mark the TLC plate by drawing a faint pencil line 1 cm from the bottom of the plate. On this pencil line, make two marks and label them T (for the aspirin tablet) and P (for the sample of aspirin).
8. Using a micro pipette, carefully put a small spot of the aspirin tablet solution on to T.
9. Using a micro pipette, carefully put a small spot of the aspirin sample solution on to P.
10. Put ethyl ethanoate into a beaker so that the level of the liquid is below the pencil line on the plate.
11. Put the TLC plate into the beaker and cover the beaker with a watch glass.
12. Leave the apparatus until the ethyl ethanoate has risen almost to the top of the plate.
13. Remove the plate and mark the position of the solvent with a pencil (this is the solvent front).
14. Dry the plate with a hair drier and then look at the plate under an ultra violet (UV) lamp.
15. Draw a circle in pencil round any spots that appear.
16. Give your plate to the teacher who will place it in a beaker containing a few iodine crystals. In a fume cupboard, the beaker and contents are warmed gently on a steam bath until spots begin to appear. The positions of the spots are ringed with a pencil. The iodine is the locating agent.

TREATMENT OF RESULTS

17. Measure the distance of the spots and the solvent front from the pencil line on which the marks T and P were made.
18. Calculate the R_f values for each spot.
19. Draw a diagram or take a photo of your TLC plate.
20. Show the plate to your teacher for assessment.

EVALUATION OF METHOD AND RESULTS

Comment on

- the method (accuracy, ability to identify substances etc.);
- the results that you obtained.

Exemplar Portfolio Work – Unit A3	Commentary on mark allocation
Risk Assessment **Chemicals** Aspirin tablet Prepared aspirin Ethanol is flammable so if aspirin does not dissolve in cold ethanol, the mixture is warmed on a water bath. Ethyl ethanoate is volatile and flammable and the vapour may irritate the eyes. The vapour must not be breathed in and ethyl ethanoate is used away from a naked flame. Iodine crystals **Apparatus** Pestle and mortar Spatula Water bath UV lamp may cause skin cancer and eye damage so lamp should not be looked at directly and there should be a screen to avoid direct radiation. **Results** Actual chromatogram Showing base line, solvent front, position of spots at end of experiment, measurement of position of distance moved by spots.	Work presented at **MB2** The assignment scores **10** marks /21 Statement by teacher that the candidate has completed the practical and that it is the candidate's own work but help was given and risk assessment used. **4** marks given for **AO3a** Confident working and more detailed risk assessment marks 5 or 6 given for AO3a Marks 7 or 8 for AO3a will depend on the quality of the chromatogram when shown to teacher (i.e. small spots, reasonably clean TLC with no fingerprints, biro use etc.) Some of these: marks 1 or 2 for AO3b If all of these: Marks 3 or 4 for AO3b (4 marks allocated) Neat lines going from spots on base line to centre of spots at end of experiment. Marks 5 or 6.

Rf = distance moved by spot / distance moved by solvent Rf aspirin tablet = 4.0 / 4.1 = 0.0966 Rf prepared aspirin = 4.0 / 4.1 = 0.0966 There are no other spots present on the chromatography paper, indicating there are no impurities. So the prepared aspirin is equally pure as the tablet.	This would be worth **2** marks for AO3c as processing correct and an attempt at interpretation. 3, 4 or 5 would be given if: Rf value given as 0.1/sig figs. Correct units included in distance measurement. A comment on the state of the chromatogram e.g. size / shape of spot. Marks of 6 and 7 given if evaluation such as: Discussion on possibility of presence of other substances. Effectiveness of locating agent.

Summary of marks awarded for Task 3 for AO3:

AO3a mark band 2 4 marks
AO3b mark band 1 4 marks
AO3c mark band 1 2 marks
Total = **10** marks

Note: if other tasks were used for Unit 1 marks given should be averaged. In this case 8 marks were awarded for task 2 and 10 for task 3:
(8 + 10 = 18)/42 giving a final mark of **9**/21

Assignment Brief A4

Unit Name: Science at Work	**Unit Number:** Unit 1
Assignment Title: The impact on society of Snodkins Plastics	**Assignment Number:** A4
Date Set:	**Due Date:**

Assessment Objective(s): AO2a

Brief:

Our class recently visited Snodkins Plastics, a major local employer making plastic film and components for cars. The site includes the production facilities, offices and laboratories.

You are required to present information showing an understanding of the impact on society of Snodkins Plastics in your portfolio.

Task: AO2a

Task 1:

Summarise your notes from your visit to Snodkins and collect this together with any other information you were given.

Task 2:

Make a note of other information you need to research and how (e.g. email to people at the factory, local library, talk to local people contact local environmental groups).

Task 3:

Include in your study how the organisation:

- contributes to the economy;
- manages its waste materials;
- uses ICT in data management;
- controls energy consumption;
- makes demands on transport and communication systems;
- has effects on the community and the environment;
- impacts in terms of employment;
- manages relevant costs (if available);
- benefits our society (include local, national and global if possible).

Max marks possible for these tasks: 6

Resources:

Visit to Snodkins factory including tour, talks and video. Snodkins literature including annual report. Email access to Snodkins personnel for follow-up questions after visit. Environmental literature in local library.

Exemplar portfolio work – Assignment A4 (MB1)	Commentary on mark allocation
<u>The Impact on Society of Snodkins Plastics.</u> I visited Snodkins Plastics with my class. We were shown round the factory and laboratory, and shown a film about the work of the company. Snodkins factory was built about fifty years ago. The site of the factory is at least half a mile away from the nearest houses, and on a river estuary. This site was chosen because the old factory that used to be there made TNT. These days the factory makes plastic film which is a lot safer, but there is still a danger of fire because of all the inflammable solvents they use. Mr Tomson, the safety officer, told us that twenty years ago there was a big explosion at the factory when some of the solvents caught fire. It was so hot that the aluminium dripped from the ceiling. No-one at the factory is allowed to smoke and people in my group had to leave their lighters at the factory gate when we visited. The company use special electrical sockets to keep sparks away from the air. They even use special plastic hammers in case of sparks. Really the factory is very safe because of the precautions they take. When they did have the fire only one of the men working on the factory was injured. It is still a good thing that the factory is not located in the middle of a town. Snodkins make plastic film called acetate, like for the overhead projector. Demand for this film is less than it was because some people use data projectors instead. Snodkins also make plastic components for cars, such as dashboards and bumpers. The marketing director at the factory said they are a bit worried because people don't want so much acetate film nowadays and it's cheaper to make components for cars in developing countries, but he said they don't make them as well as Snodkins. It's better if they make the parts here because it's closer to the car factory, saving transport costs. The factory has a special railway branch line that links it to the main line a mile away. The raw material are all brought in by train and the company has a special computer programme that makes sure that they've always got enough materials but don't order more than they need. In the laboratory they do lots of quality control tests. They've got a special machine that bends the bumpers to make sure they don't break too easily. This is destructive testing, they have to throw away the sample they have tested which is a bit of a waste and bad for the environment. In another part of the laboratory they are developing new kinds of plastics that are biodegradable. In the future cars will have to be made of recyclable materials to protect the planet. Snodkins are good at inventing new kinds of plastic like this, they hope that this will ensure that not all the work will be done abroad in future.	Work presented at **MB1** The assignment scores **2** marks. This piece of work demonstrates understanding of the impact the chosen organisation has on society but lacks detail and includes some omissions. has effects on the community and the environment manages relevant costs makes demands on transport (partial) uses ICT in data management manages its waste materials (partial) benefits our society (partial)

It would be a shame if Snodkins factory did have to close down, because it employs lots of local people. Snodkins employs people with lots of different skills. My Aunt is a secretary in the office. They also have engineers who keep the machines working, scientists in the laboratory and salesmen who travel round the country. Mr Gray, who showed us round, is the personnel manager. He interviews new staff and arranges for them to be trained. Two years ago when the company lost one of its big customers he had to make some people redundant. He explained that otherwise the factory might lose so much money that they might go bankrupt. I think the Government should help the company so that they don't have to make people redundant. Still it's better than if the factory wasn't there in the first place, because then the only jobs round here would be in agriculture and tourism. People working on farms don't get paid much and tourism is mainly in the summer.	impacts in terms of employment contributes to the economy
When Snodkins factory was first built it wasn't very good for the environment because of all the chemicals they used. Nowadays they have to be very careful what they do with their waste solvents called effluent. Mr Tomson said that was because they are a very responsible factory, but really it's because of the Government rules. He said that some third world countries don't bother with rules so they can make things more cheaply. This is not good for their workers but they don't understand because they are not as well educated as people in this country. Mr Gray was also very proud of the work that Snodkins do for the local community. They helped to sponsor a playing field and pay for the pensioners' Christmas party and the November 5th Fireworks every year. And they work with schools, like showing us their factory.	has effects on the community and the environment
It costs a lot of money to run the factory. The employees' wages are just a small part of it. The machinery was very expensive, although some of it is quite old and has been paid for. Heating the cabinets uses up a lot of energy which is expensive.	manages relevant costs
The factory uses so much energy that turning off a few light bulbs would not make much difference. The drying cabinets have to be hot to dry the products out in time, otherwise production would be too slow. The factory also has to have special cooling systems to condense the solvent vapours so that not too much is released into the atmosphere.	controls energy consumption has effects on the environment

Exemplar portfolio work – Assignment A4 (MB2)	Commentary on mark allocation
The Impact on Society of Snodkins Plastics Snodkins Plastics make plastic film called acetate (used, for example with overhead projectors) and plastic components for cars, such as dashboards and bumpers. The company is based on a single site on the estuary of the river Brog. The site includes the production facilities, offices and a small laboratory block. Impact on the local environment Snodkins factory was built originally built in during the Second World War to make TNT. The location was chosen because it was remote from other buildings in case of accident. It is unlikely that planning permission would be granted for the factory today because of the impact it might have on the local wildlife. The Brog bird sanctuary is just two miles downstream. The nearest houses are still at least half a mile away from the site of the factory. Although the risk of explosion is far less than when TNT was produced, there is still a danger of fire because of all the inflammable solvents used. Fire precautions at the factory are very strict. Smoking is strictly forbidden on the site and all matches and lighters have to be left at the gatehouse. Precautions have been stricter since a big explosion at the factory twenty years ago when some of the solvents caught fire. If there was another incident like this there would be some release of chemicals into the atmosphere but these would be quickly diluted in the air so would not be harmful to the local population or wildlife according to the company. The company admit that when the factory was first built, during the war, it wasn't as careful with their waste solvents, some of which were released as effluent into the river Brog. Nowadays this is not allowed.	Work presented at **MB2** This piece of work is a detailed and researched study of the impact the chosen organisation has on society that has few errors or omissions. The assignment scores **4** marks. The notes identify which of the bullet points in the specification have been addressed. has effects on the environment manages its waste materials

Impact on local people. The company employs approximately 200 people. 90% of these are local. I have spoken to local people and the company is generally regarded as a "good employer" offering better wages than agriculture and more stable employment than tourism, these being the other main alternative occupations available in the area. Snodkins employs people with many different skills: production workers secretaries in the office, engineers who maintain the machines, scientists working on quality control and research in the laboratory, and salesmen. Cleaning and catering are franchised out. The company has a good safety record having had only 5 accidents involving hospital treatment in the last three years. Even when the big explosion happened twenty years ago only one man was injured. He was able to return to work after six months. Two years ago the company lost one of its big customers and, as a result, it had to reduce its labour force by 15. Some of this was achieved by voluntary early retirements, but five people were made compulsorily redundant. Impact on local community. As well as employing local people, Snodkins is very proud of the work the company that does for the local community. The company paid £20 000 towards the cost of setting up the Brog bird sanctuary and continue to help with its upkeep. More recently they helped to sponsor a local playing field and every year pay for the pensioners' Christmas party and the November 5th fireworks. As part of their community work they invite visits from local schools, which is why we were shown round their factory. They were very welcoming and gave us their email addresses, so that we could ask them other questions we thought of when we were working on our assignments. The answers I received were very helpful. Impact on the economy. Snodkins contributes to the local economy because it and its employees use local services. Snodkins buys most of its raw materials from international chemical companies. It does not sell its products directly to the public. Its customers are large companies such as car manufacturers and stationery suppliers who package and sell the acetate film. 50% of its products are sold abroad. Demand for acetate film has declined over the last five years due to the increased use of video projectors. Snodkins are facing competition from developing countries which is driving down the price they can charge for the components they make for cars. The company is now doig the following things:	impacts in terms of employment has effects on the community (Note: copies of the emails sent and received were appended to the original assignment, but are omitted here.) contributes to the economy

They have developed a new line in plastic cases for data projectors. They are about to market a new type of case for portable data projectors which is particularly strong. They are thinking about setting up a factory either in Eastern Europe or Asia. This would mean local people losing their jobs. In another part of the laboratory they are developing new kinds of plastics that are biodegradable.	benefits our society
<u>ICT</u> The company uses computers for many different jobs. The secretaries use them for word processing. The accounts people use them to work out the finances and pay salaries. The speed and temperature of the machines is controlled by computer. Computers are also used to organise the production and to make sure that enough raw materials are ordered to keep the factory working without having to store too much.	uses ICT in data management
<u>Transport</u> The factory still has its own special railway siding which links it to the main line a mile away. This was built when the factory made TNT because rail transport was safer. Now it is used to bring in raw materials and take away the finished product so that avoids clogging up the roads.	makes demands on transport systems
<u>Costs</u> Some of the costs of running the factory are: Employees wages Capital costs of machinery and buildings Taxes Raw materials Energy. Wages.	manages relevant costs
<u>Energy</u> The factory uses special drying cabinets to dry the things it makes. These use a lot of energy which is expensive. They have done a lot of work to make sure that the cabinets themselves are well insulated, but this does not completely solve the problem as environmental regulations say that they also have to have special cooling systems to condense the solvent vapours so that not too much is released into the atmosphere.	controls energy consumption
1. "Snodkins: manufacturing for Britain's future", a publicity video made by the company in 1999.	

2. Information in a talk by Mr Tomson, the safety officer at the factory, during a school visit 3. Reply to an email I sent to Mr Tomson following our school visit. 4. Information leaflet from leaflet “protect the Brog estuary published by the Brog preservation society in 1955. (Thanks to Mrs Perkins at the local library for helping me to find this) 6. My teacher.	

Exemplar portfolio work – Assignment A4 (MB3)	Commentary on mark allocation
Snodkins Plastics – an in-depth study of its impact on Society. Snodkins Plastics make plastic film called acetate (used, for example with overhead projectors) and plastic components for cars, such as dashboards and bumpers. Contribution to the economy. The company has an annual turnover of about £30 million[4] and is based on a single site on the estuary of the river Brog. The site includes the production facilities, offices and a small laboratory block. As well as directly employing 200 people, Snodkins contributes to the local economy because it and its employees use local services. Snodkins buys most of its raw materials from international chemical companies. It does not sell its products directly to the public. Its customers are large companies such as car manufacturers and stationery suppliers who package and sell the acetate film. 50% of its products are sold abroad[4]. Demand for acetate film has declined over the last five years due to the increased use of data projectors. Snodkins are facing competition from developing countries which is driving down the price they can charge for the components they make for cars. The company is taking the following actions in the face of these challenges:[7] They have developed a new line in plastic cases for data projectors. They are about to market a new type of case for portable projectors which is particularly robust. They are carrying out an assessment of the viability of setting up a factory either in Eastern Europe or Asia. This might be good for the shareholders, but would mean local people losing their jobs. The marketing department are stressing the high quality of their automotive products. The quality control laboratory carries out destructive testing on a sample of products from every batch and the company have invested in special machinery to carry out these tests. In another part of the laboratory they are developing new kinds of plastics that are biodegradable. Snodkins believe that they can stay ahead of competition from the developing world by responding more quickly to the legislation requiring that future cars will have to be made of recyclable materials.	Work presented at **MB3** The assignment scores **6** marks. This piece of work is a comprehensive and thoroughly researched study of the impact the chosen organisation has on society focusing on all the issues stated. The account is organised into sections corresponding to the bullet points in the specification making it immediately clear where each is addressed.

Management of waste materials.

The company takes a lot of trouble to ensure that it complies with all the legislation to avoid polluting the environment. The company admit that when the factory was first built, during the war, it wasn't as careful with their waste solvents, some of which were released as effluent into the river Brog.[5]

The local branch of "Friends of the waterways", an environmental group say that the factory should do more to clean up the estuary where it has been polluted in the past. One of their members used to work at the factory until he was made redundant a few years ago, so he says he knows all about the damage they have caused. In their leaflet[7] "Friends of the waterways" say that the factory is not really necessary anyway because people should walk and ride bicycles instead buying cars and that would avoid even more pollution. Most people carry on driving cars, so presumably don't agree with this!

Use of ICT in data management.

The company uses computers in many including the following:

Word processing
Accounts
Salaries
Controlling the speed and temperature of the machines
Organise production schedules
Ordering raw materials to keep the factory working without having to store too much.
Keeping records of production and testing
Keeping records of customers and orders.

Records that refer to individual people, such as employees have to be kept confidential because of the Data Protection Act. The company is very careful about this. Their customers tend to be big companies rather than individuals but the records still have to be kept secret because of commercial confidentiality.

Control of energy consumption

7% of the factory running costs is spent on energy. Much of this is used to heat special drying cabinets which are part of the production process. The company commissioned a special study a few years ago to try to reduce their use of energy. As a result they did a lot of work to insulate the cabinets, but energy is still a major cost. Environmental regulations require Snodkins to have special cooling systems to condense the solvent vapours so that not too much is released into the atmosphere. This uses up more energy which is also bad for the environment

Demands on transport and communication systems.

The factory still has its own special railway siding which links it to the main line a mile away. This was built when the factory made TNT because rail transport was safer. Now it is used to bring in raw materials and take away the finished product. This works well because they have a small number of customers who need a lot of the goods that Snodkins make. The local roads are fairly narrow and so are not well suited to big lorries. The company uses electronic systems to automatically order the raw materials it needs. However it still uses salesmen to keep in touch with its customers. This is to make sure that they can respond to new demands and make sure that customers know about improvements to their products.

Internally there is a loudspeaker system which is used to make announcements. Key workers such as the shift manager also carry a pager. The company also has a monthly news letter which tells employees about social news as well as how well the company is doing.

Effects on the community and the environment.

Snodkins factory was originally built during the Second World War to make TNT. The location was chosen because it was remote from other buildings in case of accident. It is unlikely that planning permission would be granted for the factory today because of the impact it might have on the local wildlife. The Brog bird sanctuary is just two miles downstream. According to the film "Snodkins: manufacturing for Britain's future"[1] the birds are accustomed to the presence of the factory and sometimes nest within its perimeter fence because they are safer from predators The nearest houses are still at least half a mile away from the site of the factory. Although the risk of explosion is far less than when TNT was produced, there is still a danger of fire because of all the inflammable solvents used.

Fire precautions at the factory are very strict. Smoking is strictly forbidden on the site and all matches and lighters have to be left at the gatehouse. The company use special flame-proof electrical sockets in areas where there may be inflammable solvents in the air. They even use special plastic hammers in case of sparks. Precautions have been even stricter since a big explosion at the factory twenty years ago[2] when some of the solvents caught fire. If there was another incident like this there would be some release of chemicals into the atmosphere but these would be quickly diluted in the air so would not be harmful to the local population or wildlife according to the company[3].

Impact in terms of employment.

The company employs approximately 200 people of whom 150 work full time. 90% of these are recruited locally[4]. I have spoken to local people and the company is generally regarded as a "good employer" offering better wages than agriculture and more stable employment than tourism, these being the other main alternative occupations available in the area.

Snodkins employs people with many different skills: production workers secretaries in the office, engineers who maintain the machines, scientists working on quality control and research in the laboratory, and salesmen. Cleaning and catering are franchised out. This is another way in which Snodkins contributes indirectly to then local economy.

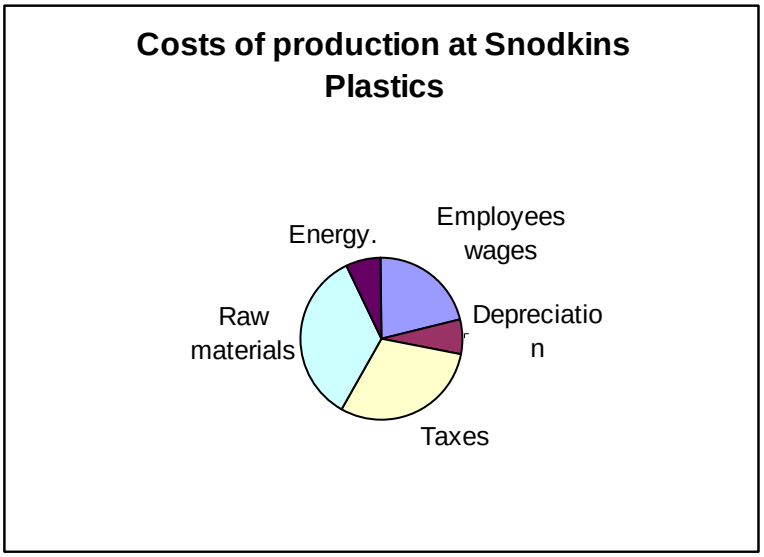
The company has a good safety record having had only 5 accidents involving hospital treatment in the last three years[2]. Even when the big explosion happened twenty years ago only one man was injured. He was able to return to work after six months.

Two years ago when the company lost one of its big customers and, as a result, it had to reduce its labour force by 15. Some of this was achieved by voluntary early retirements, but five people were made compulsorily redundant. The company was able to help three of these to find new jobs and paid for training courses for the other two.

<u>Management of relevant costs.</u>

Some of the costs of running the factory are:

Employees wages
Capital costs of machinery and buildings
Taxes
Raw materials
Energy.
The chart show how much is spent on each of these



<u>Benefit to our society.</u>

As well as employing local people, Snodkins is very proud of the work the company that does for the local community.[6] The company paid £20 000 towards the cost of setting up the Brog bird sanctuary and continue to help with its upkeep. More recently they helped to sponsor a local playing field and every year pay for the pensioners' Christmas party and the November 5th fireworks. As part of their community work they invite visits from local schools, which is why we were shown round their factory. They were very welcoming and gave us their email addresses, so that we could ask them other questions we thought of when we were working on our assignments. The answers I received were very helpful.

(Note: copies of the emails sent and received were appended to the original assignment, but are omitted here.)

<u>Summary</u>

Snodkins plastics make a very positive contribution to the local and national economy. It takes great care to protect the environment and local people including its own employees from the harm that might otherwise be done by the chemicals it works with. If the factory were to close down, due to foreign completion there would be unemployment in the area, and the local bird sanctuary would lose its major sponsor. The products made by Snodkins are an important part of our technological society and the company is committed to continued development of its products and materials by its research department.
I wish to thank Snodkins for helping me in preparing this assignment.

Sources:

1. "Snodkins: manufacturing for Britain's future", a publicity video made by the company in 1999.

2. Information in a talk by Mr Tomson, the safety officer at the factory, during a school visit

3. Reply to an email I sent to Mr Tomson following our school visit.

4. Data from 2003 company report.

5. Information leaflet from leaflet "protect the Brog estuary published by the Brog preservation society in 1955. (Thanks to Mrs Perkins at the local library for helping me to find this)

6. Information in a talk by Mr Gray, the human resources manager at the factory, during a school visit

7. Information in a talk by Mr Pearson, the marketing manager at the factory, during a school visit.

8. Leaflet "Stamp out pollution - clean the waterways" published in 2002 by "Friends of the waterways"

Assignment Brief A5

Unit Name: Science at Work	**Unit Number:** Unit 1
Assignment Title: The effect of exercise on cardio-respiratory performance in fit and unfit individuals.	**Assignment Number:** A5
Date Set:	**Due Date:**

Assessment Objective(s): AO3a, b and c (A02b)

Brief:

Heart disease accounts for the greatest number of premature deaths in most industrial countries.

Physical inactivity is thought to be one of the primary risk factors for cardiovascular disease.

The effect of exercise on cardiovascular efficiency can be assessed by measuring pulse rate.

Task:

Compare the pulse rate of fit and unfit individuals before and after exercise.

In this task you are required to:

- identify hazards and carry out a risk assessment
- follow set procedures
- record any observations and measurements
- process and evaluate results.

Max marks possible for this task: 10 or 11

This task should be marked to a maximum of 21 and will need to be divided by two and the mark added to that of the second practical task.

(NB in addition you can gain AO2b if you complete:

- treatment of results.)

Max marks possible for this task: 21 (+4)

Resources:

The complete A –Z Physical Education Handbook, James, Thompson and Wiggins ISBN 0-340-77213-1

Assignment Title: The effect of exercise on cardio-vascular performance in fit and unfit individuals.
Assignment A5

Task: Measure and compare the pulse rate of fit and unfit individuals before and after exercise.

PRACTICAL INSTRUCTIONS

AO3a and b

1. Complete the risk assessment before starting the investigation.
2. Ask your teacher to check your plans before you start.
3. Choose two friends, one of whom thinks they are fitter than the other.
4. The individuals under investigation should be invited to sit for 5 minutes.
5. During this time explain what they are expected to do and what you will do.
6. After five minutes, measure and record their resting pulse rate (count for 15 seconds).
7. Each individual should be invited to perform the same, pre-determined, step test for 5 minutes.
8. Measure and record their pulse rate immediately the exercise finishes and at 1 minute intervals until their pulse rate returns to the resting rate.

TREATMENT OF RESULTS

AO2b

1. Calculate the resting pulse rate value/beats per minute.
2. Calculate the post-exercise pulse rate values/beats per minute.
3. Plot graphs of pulse rate against time.
4. Look up data for age-related, pre- and post-exercise pulse rates.

EVALUATION OF RESULTS

AO3c

Comment on:

- the method;
- the results that you obtained for fit and unfit individuals;
- possible extension to the investigation.

Exemplar portfolio work – Assignment A5	Commentary on mark allocation

Statement by the teacher that the candidate has completed the practical and that it is the candidate's own work.

This task is not sufficiently complex to allow **MB3** to be assessed.

Work presented at **Mark Band 1**.
The assignment scores **8** marks out of 21.
(4/10 for this practical).

Risk assessment

Non-chemical hazards
Talk to each individual involved (in private) to confirm that they have no current or past physical or medical condition likely to result in problems if they carry out the step test.

Make sure that the bench used in the step test is stable.

Make sure that the step test area is clear of obstructions and the floor surface is not slippy.

Emergency action
In the event of an accident seek immediate help from a member of the teaching staff or a laboratory technician.

Statement by the teacher showed support was given and risk assessment used.
4 marks given for **AO3a** (teacher assessed).

Observations and measurements

AO3b
2 marks awarded.
(3 or 4 marks could have been gained for recording results for a larger sample and for repeats.)

individual	*gender*	*state*	*resting pulse rate/beats min^{-1}*
A	male	fit	76
B	male	unfit	96
C	female	fit	80
D	female	unfit	72

time after test finished /mins	*pulse rate/beats min^{-1}*			
	A	B	C	D
0	148	176	156	180
1	136	152	136	156
2	92	136	104	120
3	76	120	80	108
4	76	112	72	88
5	76	96	72	72

Evidence that the accuracy was appropriate to that of the apparatus for 5 or 6 marks.

Process, interpretation and evaluation of results From analysing my results I have identified some patterns which support my predictions. Each given person who took part in the investigation produced the same results: in that their heart rates increased during exercise and after exercise had ceased their heart rate gradually returned to normal. However the duration it took for their pulse rate to return to resting rate dictates the fitness of a person which in turn is determined by diet, amount of physical exercise received, and the general health of the person. In particular my results show how the pulse rate of the unfit people increases to about 175 – 180 beats per minute. In contrast to this the pulse rate of the fit people only rises to 148 – 156 beats in the first minute. This indicates that an unfit person would need a greater amount of oxygen when carrying out the same type of exercise for the same duration of time as that of a fitter person. Another important detail to note was how the fit people had a shorter recovery rate than that of the unfit people. **(Treatment of results** Pulse rate values calculated.)	**AO3c** **2** marks awarded. Results have been suitably processed. Some attempt at interpretation has been made. For Mark Band 2, results could have been presented in graphical form to contrast the four sets of data. **(AO2b** The pulse rate beats per minute values recorded in the table were determined by counting pulse for 15 seconds and multiplying by 4. These straightforward calculations are awarded **1** mark).

Summary of marks awarded for tasks:

AO3a mark band 1 4 marks
AO3b mark band 1 2 marks
AO3c mark band 1 2 marks
Total = **8**

Assignment Brief A6

Unit Name: Science at Work	**Unit Number:** Unit 1
Assignment Title: Quantitative assessment of the effect of cooking on the vitamin C content of food	**Assignment Number:** A6
Date Set:	**Due Date:**

Assessment Objective(s): AO3a, b and c, (AO2b)

Brief:

Vitamin C (ascorbic acid) is an important component of a balanced diet. Its function is to promote the formation of collagen and the proper functioning of the skin and mucous membranes. It also functions as an antioxidant and stimulates the absorption of iron from the gut.

DCPIP is a dye. DCPIP in an oxidised state is blue. It becomes colourless when it is reduced.

Ascorbic acid is a reducing agent.

Task:

Carry out an investigation to quantitatively assess the vitamin C content of fresh cabbage, cabbage heated to 100ºC for 10 minutes and cabbage heated to 100ºC for 20 minutes.

In this task you are required to:

- identify hazards and carry out a risk assessment
- follow set procedures
- record any observations and measurements
- process and evaluate results

Max marks possible for this task: 21

This task should be marked to a maximum of 21 and will need to be divided by two and the mark added to that of the second practical task.

(NB in addition you can gain AO2b if you complete:

- treatment of results.

Max marks possible for this task: 4)

Resources:

Human Health and Disease, Richard Fosbery, Cambridge Modular Sciences, CUP ISBN 0-521-42159-4

Advanced Biology, Mary Jones and Geoff Jones, CUP, ISBN 0-521-48473-1

Assignment Title: Quantitative assessment of the effect of heat on the vitamin C content of cabbage
Assignment A6

PRACTICAL INSTRUCTIONS

AO3a and b

1. Complete a risk assessment before starting the investigation.
2. Ask your teacher to check your plans before you start.
3. Weigh accurately 5.00g uncooked cabbage.
4. Put the cabbage in a mortar with 2 spatulas of sand and 25cm^3 of dilute ethanoic acid.
5. Grind the mixture together for 5 minutes.
6. Filter the mixture using vacuum filtration.
7. Transfer the filtrate in a 100cm^3 measuring cylinder.
8. Make up to 100cm^3 with distilled water.
9. Load the burette with the cabbage extract.
10. Use a syringe to place 1cm^3 DCPIP solution into a conical flask.
11. Place the conical flask on a white tile under the burette.
12. Titrate the extract against the DCPIP solution adding 1cm^3 at a time.
13. The end point is reached when the DCPIP is colourless.
14. (Do not use any more than 100 cm^3 of cabbage extract in any single titration.)
15. Record the volume of extract needed to decolourise the DCPIP.
16. Repeat steps 8-12 to obtain an accurate value.
17. Repeat steps 3-13 with two extracts made from 5.00g of cabbage heated to 100^oC for 10 and 20 minutes respectively.

TREATMENT OF RESULTS

AO2b

Calculate the concentration of vitamin C in the three samples of cabbage.

EVALUATION OF RESULTS

AO3c

Comment on:

- the method;
- the results that you obtained for raw cabbage, cabbage heated to 100^oC for 10 minutes and cabbage heated to 100^oC for 20 minutes;
- possible extension to the investigation.

Exemplar portfolio work – Assignment A6	Commentary on mark allocation
Risk assessment *Substances being used or made* The solution of DCPIP isn't really harmful, but it should still not be put in the eyes or ingested as some people could react to it differently from others. *Non-chemical hazards* *Disposal of residues* *Emergency action* If it (DCPIP) does get in the eyes, rinse them for 5 minutes and then if irritation persists, contact medical help. If DCPIP is swallowed, then give the person a lot of water and take them to get medical help just to get them checked out.	Work presented at **MB2**. This work was accompanied by a statement from the teacher that the candidate has confidently completed the practical, used their risk assessment and that it is the candidate's own work. The assignment scores **5** marks for **AO3a**. Although the work does not fully meet the criteria for **MB1** because of the gaps in the risk assessment this is compensated for by the high quality of experimental work evidenced in the teacher's statement. [Incomplete. No reference to ethanoic acid. Emergency contact needs to be more precise.]

Observations and measurements

type of cabbage	volume of extract required to decolourise DCPIP sample / cm^3						
	trial	1	2	3	4	5	average
raw	24.00	23.60	23.50	23.60	23.70	23.60	23.60
boiled for 20 minutes	>100	>100	>100	>100	>100	>100	>100
boiled for 10 minutes	>100	>100	>100	>100	>100	>100	>100

Work presented at **MB3**.

The assignment scores **5** marks for **AO3b**.

Evidence that the accuracy of titration was appropriate to that of the apparatus for 5.

Burette readings at start at start and finish should be recorded for 6 marks.

Exemplar portfolio work – Assignment A6	Commentary on mark allocation
Process, interpretation and evaluation of results The raw cabbage showed very clear results. The DCPIP solution only needed 23.5 cm^3 of the raw cabbage solution to change its colour from blue. This means that the raw cabbage showed that it contained quite a lot of vitamin C in it. When I tested the heated cabbage for 20 minutes, the solution did not ever loose its blue colour. The other 10 minute cabbage stayed blue as well but fainter. I did not have time to make up some more of the solutions to carry on testing them. The cabbage heated for 10 minutes would probably clear quicker. This shows that cooking cabbage really does get rid of vitamin C as the raw cabbage definitely showed vitamin C present but when I tested the heated cabbage, it had virtually disappeared as far as I tested it. Also, the longer you cook it for, the more vitamin C is lost as the 20 minute heated cabbage was a brighter blue than the 10 minute cooked cabbage. Different people have different opinions as to when to say the colour has gone. I did use the same cabbage sample though, so that the comparison of uncooked and cooked was fair. This eliminates any problems associated with the age of the cabbage, as different aged cabbages could show different amounts of vitamin C and start of as different coloured juices. If I was to repeat the experiment again I would first of all do repeat readings for all the tests so that I can work out an average. This would give me more accurate results to compare. I would also make up a larger quantity of the solutions to complete the tests.	Work presented at **MB2** The assignment scored **5** marks for **AO3c**. Although the processing of results is not correct because using> 100 gave a precise number, this is compensated for by the evaluation. To reach MB3, consistent use of significant figures would be required (23.60).
Treatment of results Working out the concentration of the vitamin C in the cabbage: No. of moles $= \frac{\text{concentration x volume}}{1000}$ No. of moles of DCPIP $= \frac{0.01 \times 1.0}{1000}$ $= 1 \times 10^{-5}$ Therefore concentration $= \frac{\text{moles x 1000}}{\text{volume}}$ Raw cabbage concentration $= \frac{1 \times 10^{-5} \times 1000}{23.6}$ $= 4.237 \times 10^{-4}$ mol dm^{-3}	Work presented at **MB2** for **AO2b**. The assignment scores **2** marks. Complex calculations carried out involving rearrangement of formula. Additional calculations would be needed to score third mark.

Cooked cabbage for 20 minutes concentration = $\frac{1 \times 10^{-5} \times 1000}{>100}$ = 1×10^{-4} mol dm^{-3} Cooked cabbage for 10 minutes concentration = $\frac{1 \times 10^{-5} \times 1000}{>100}$ = 1×10^{-4} mol dm^{-3}	

Summary of marks awarded for task for AO3:

AO3a mark band 2 5
AO3b mark band 3 5
AO3c mark band 2 5
Total = **15**

Note: If task A5 and A6 were used for Unit 1, marks given = (8 + 15 = 23)/42
Based on both practicals, the final mark = **12**/21 (mark rounded up)

Assignment Brief A7

Unit Name: Science at Work	**Unit Number:** Unit 1
Assignment Title: Data Analysis	**Assignment Number:** A7
Date Set:	**Due Date:**
Assessment Objective(s): AO2b	
Brief: Scientists in a laboratory often need to calculate answers from their results and use these to form conclusions.	
Tasks: **Task 1:** Organic microanalysis **Task 2:** The expansion of metals **Task 3:** The Brinell test for hardness (This assignment is an example of achieving AO2b by using provided data. In order to fully achieve MB3 it is necessary to complete at least two tasks.) **Max marks possible for this task: 4**	

Assignment A7
Task Sheet 1: Organic Microanalysis

Scenario

An important procedure carried out by analytical laboratories is the determination of percentages of elements in organic compounds. These compounds may be new compounds made in the research laboratory, or as part of a routine sampling procedure in quality control.

The compound is usually analysed for its carbon and hydrogen content as well as for other elements such as chlorine and sulphur.

A weighed sample is completely burnt in an atmosphere of pure oxygen at 900^{o}C. All the carbon is converted to carbon dioxide, which is then absorbed by sodium hydroxide and all the hydrogen is converted to water and absorbed by magnesium chlorate(VII). The increase in mass gives the amounts of carbon dioxide and water produced.

The results are then used to calculate the percentage of carbon and hydrogen in the compound. If the compound only contains carbon, hydrogen and oxygen, then the percentage of oxygen is found by difference.

Some sample results are given for a compound that only contains carbon, hydrogen and oxygen.

Your task is to:

- Calculate the percentage of each element in the compound.
- Work out the empirical formula of the compound.

The empirical formula is the simplest possible ratio of each atom in the compound.

Results

Mass of platinum vessel + sample = 2.9356 g
Mass of platinum vessel = 2.7708 g
Mass of sodium hydroxide after the experiment = 3.7812 g
Mass of sodium hydroxide before the experiment = 3.4317 g
Mass of magnesium chlorate(VII) after the experiment = 4.5568g
Mass of magnesium chlorate(VII) before the experiment = 4.5032g

Data

Percentage by mass of carbon in carbon dioxide = 27.27
Percentage by mass of hydrogen in water = 11.11
Relative atomic masses (A_r) : H = 1.01; C = 12.0; O = 16.0.

Exemplar portfolio work – A7	Commentary on mark allocation
Mass of sample = 2.9356 – 2.7708 g = 0.1648 g Mass of carbon dioxide produced = 3.7812 – 3.4317 g = 0.3495 g Mass of water produced = 4.5568 – 4.5032 g = 0.0536 g Mass of carbon in the carbon dioxide= $\frac{0.3495 \times 27.27}{100}$ = 0.0953 g Mass of hydrogen in the water = $\frac{0.0536 \times 11.11}{100}$ = 0.0060 g Since the compound contains only carbon, hydrogen and oxygen the mass of oxygen in the sample must be: 0.1648 – (0.0953 + 0.0060) = 0.0635 g To find the empirical formula divide each mass by the relevant A_r C $\frac{0.0953}{12.0}$ = 0.0079 H $\frac{0.0060}{1.01}$ = 0.0059 O $\frac{0.0635}{16.0}$ = 0.0040 Divide each value by the smallest to find the ratio of atoms $\frac{0.0079}{0.0040}$ ≈ 2 $\frac{0.0059}{0.0040}$ ≈ 1.5 $\frac{0.0040}{0.0040}$ ≈ 1 The ratio of atoms must be in whole numbers therefore the empirical formula is **$C_4H_3O_2$**	Mark 1 awarded for finding the mass of the sample used and the masses of carbon dioxide and water produced. Straightforward calculations. Mark 2 awarded for finding the masses of carbon and hydrogen in the sample. Straightforward and complex calculations. Mark 3 partially achieved for finding the mass of oxygen in the sample and for correctly dividing each value by its own relative atomic mass. Straightforward and complex calculations. Mark 4 achieved for finding the correct ratio of atoms present, realising the need for approximation from the experimental results and deducing that the empirical formula must be given as a whole number of each atom present. Straightforward and complex calculations to the appropriate level of accuracy.

Assignment A7
Task Sheet 2: The Expansion of Metals

Scenario

Most materials expand when heated and large forces may be set up if there is any opposition to the expansion and contraction occurring. For this reason concrete road surfaces are laid in sections, with each section being separated from the next by a layer of flexible pitch.

The expansion of metals is an important engineering consideration and, for example, buckling of railway lines can occur if allowance is not made for the expansion of rails in hot weather. Another example is a bimetallic strip where strips of two different metals are riveted together. When the strip is heated bending occurs as the two metals have different expansion rates. Bimetallic strips have important uses in thermostats.

Linear expansivity is used to calculate the expansion of metals at different temperatures.

$$\text{Linear expansivity } (\text{in } ^{o}C^{-1}) = \frac{\text{expansion}}{\text{original length} \times \text{rise in temperature}}$$

Some sample results are given below.

Your task is to:

- Calculate the linear expansivity of brass.
- Use this figure to calculate the expansion of a smaller rod of the same material.

Results

Original length of first brass rod	= 71.4cm
Starting temperature of rod	= 18.7^{o}C
Final temperature of rod	= 99.8^{o}C
Expansion of rod	= 0.110cm
Original length of second brass rod	= 67.4cm
Starting temperature of second rod	= 19.6^{o}C
Final temperature of second rod	= 78.2^{o}C

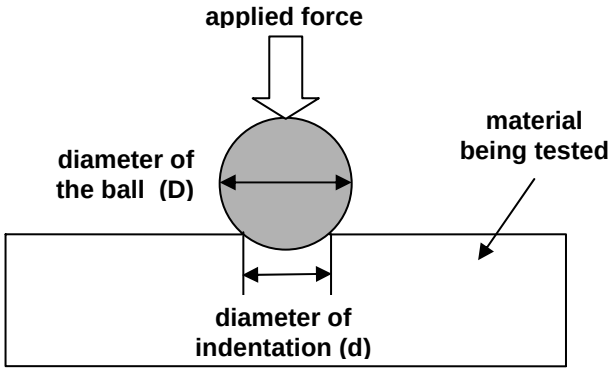
Exemplar portfolio work – A7	Commentary on mark allocation
Rise in temperature = 99.8 – 18.7 = 81.1 ^{o}C	Mark 1 awarded for finding the overall temperature change. Straightforward calculations.
Expansion of first brass rod = 0.110 cm	
Substituting in the equation Linear expansivity = $\frac{0.110}{71.4 \times 81.1}$	Mark 2 awarded for finding the linear expansivity of brass.
= 1.90 x 10^{-5} $^{o}C^{-1}$	Straightforward and complex calculations.
Expansion of second brass rod = linear expansivity x original length x change in temperature	Mark 3 awarded for correct rearrangement of linear expansivity equation.
$\therefore$ Expansion = 1.9 x 10^{-5} x 67.4 x 58.6	Straightforward and complex calculations.
= 0.075 cm	Mark 4 awarded for calculating the expansion of the second brass rod. Straightforward and complex calculations to the appropriate level of accuracy.

Assignment A7
Task Sheet 3: The Brinell Test for Hardness

Scenario

It is easy to state that one material is harder than another but industry requires quantitative tests to compare the hardness of materials.

One way of measuring hardness is by using the Brinell test. In this test a hardened steel ball is pressed for a known period of time into the surface of a material using a known force.



The Brinell hardness number is give by:

$$\text{Brinell hardness number} = \frac{\text{Applied force}}{\text{Area of indentation}}$$

The area of indentation is found using the equation:

$$\text{area of indentation} = \tfrac{1}{2}\pi D[\, D - \sqrt{(D^2 - d^2)}\,]$$

where D = diameter of the ball d = diameter of the indentation

The results of an experiment to find the hardness of a piece of copper are given below.

Your task is to:

- use the results to calculate the Brinell hardness number of this sample of copper.

You should show all your working in this calculation.

Results

Diameter of ball (D) = 1.50mm
Applied force = 200N
Diameter of indentation (d) = 0.959mm

Exemplar portfolio work - Unit A7	Commentary on mark allocation
Equation to be used area of indentation = ½ π D [D - √ (D^2 – d^2)]	Mark 1 awarded for finding the partial expression in the equation.
½ π D = ½ x π x 1.50 = 2.36 mm	Straightforward calculations.
D^2 = 1.50^2 = 2.25 mm^2 d^2 = 0.959^2 = 0.920 mm^2	Mark 2 for squaring D and d and giving the correct units. Straightforward and complex calculations.
(D^2 – d^2) = 2.25 – 0.920 = 1.33 mm^2 √ (D^2 – d^2) = 1.15 mm	
D - √ (D^2 – d^2) = 1.50 – 1.15 = 0.35 mm	Mark 3 partially awarded for correct calculation of 0.35 mm. Straightforward and complex calculations.
area of indentation = ½ π D [D - √ (D^2 – d^2)] = 2.36 x 0.35 = 0.826 mm^2	Mark 4 awarded for calculating the area of indentation and the Brinell hardness number.
Brinell hardness number = $\frac{\text{applied force}}{\text{area of indentation}}$ = $\frac{200}{0.826}$ = 242 N mm^{-2}	Straightforward and complex calculations to the appropriate level of accuracy.

Assessment Evidence Grid

Unit 1: Science at work

What you need to do:

You need to produce a research portfolio related to information on organisations that use science [**50** marks].

This evidence needs to include:

AO1: records of your survey of **five** science-based organisations; an in-depth study of **one** of them, including information on health and safety issues [**19**];

AO2: information showing an understanding of the impact on society of your **one** chosen organisation, with evidence that you have completed relevant calculations *either* using provided data *or* on at least **one** practical procedure carried out [**10**];

AO3: evidence that you have completed safely **two** practical procedures and recorded, processed and evaluated the results [**21**].

How you will be assessed:

Assessment Objective	Mark Band 1	Mark Band 2	Mark Band 3	Mark Awarded
AO1	You will demonstrate you have carried out a survey on **five** science-based organisations with some information selected and presented; **[0 1 2]**	you will demonstrate a researched survey on **five** science-based organisations with the relevant information selected and clearly presented; **[3 4]**	you will demonstrate a thorough researched survey on **five** science-based organisations with evidence that relevant information has been selected from a range of sources and is clearly and logically presented. **[5 6]**	**/19**
	You will produce a study on **one** science-based organisation which shows some information has been selected and presented; **[0 1 2]**	you will produce a researched study based on **one** science-based organisation with relevant information selected and clearly and logically presented; **[3 4 5]**	you will produce a thorough researched in-depth study on **one** science-based organisation, with evidence that relevant information has been selected from a range of sources and is clearly and logically presented with accurate use of grammar; you will include some evaluation and justification of the material used. **[6 7]**	
	You will demonstrate a basic knowledge and understanding of health and safety laws and regulations; **[0 1 2]**	you will demonstrate knowledge and understanding of the appropriate health and safety laws and regulations; there will be few omissions or inaccuracies; **[3 4]**	you will demonstrate a comprehensive knowledge and understanding of health and safety laws and regulations with information on how organisations comply with the legislation. **[5 6]**	

Unit 1: Science at work (continued)				
Assessment Objective	**Mark Band 1**	**Mark Band 2**	**Mark Band 3**	**Mark Awarded**
AO2	You will include some understanding of the impact **one** organisation has on society; this lacks detail and includes some omissions; **[0 1 2]**	you will include a detailed and researched study of the impact of **one** organisation on society; the report will have few errors or omissions; **[3 4]**	you will produce a comprehensive and thoroughly researched study of the impact of **one** organisation on society focusing on all the issues stated. **[5 6]**	**/10**
	You will perform a number of straightforward calculations using provided data, or data obtained from **one** practical procedure, and generally obtain the correct solutions; **[0 1]**	you will perform a number of straightforward and complex calculations using provided data, or data obtained from at least **one** practical procedure, and generally obtain the correct solutions; **[2 3]**	you will perform a number of straightforward and complex calculations using researched data, or data obtained from at least **one** practical procedure, and obtain the correct solutions to an appropriate degree of accuracy. **[4]**	
AO3	You will record the completion of **two** practical tasks linked to a vocational context in which risk assessments have been used; **[0 1 2 3 4]**	you will record the confident completion of **two** practical tasks linked to a vocational context in which risk assessments have been developed and used; **[5 6]**	you will record the accurate completion of **two** practical tasks linked to a vocational context in which risk assessments have been produced with evidence that equipment has been used safely and to the appropriate degree of accuracy. **[7 8]**	**/21**
	You have made some relevant observations or measurements; **[0 1 2]**	you have made all relevant observations or measurements; **[3 4]**	you have made all relevant observations or measurements with the appropriate precision. **[5 6]**	
	You have suitably processed results, with some interpretation; **[0 1 2]**	you have accurately processed and interpreted some results; **[3 4 5]**	you have accurately processed and interpreted all results and evaluated where appropriate. **[6 7]**	
			Total mark awarded:	**/50**