BTEC Extended Diploma in Applied Science

Skills Workbook: Student Copy

2020/2021

Name: …………………………………………………………….

Managing Assignments and Deadlines

Examinations & Assignments

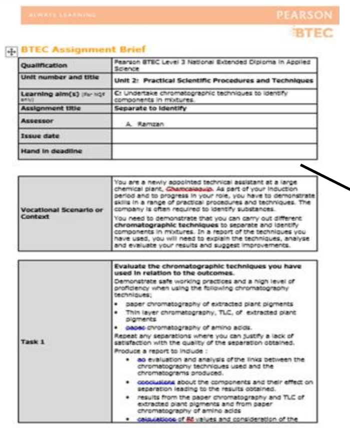
Unit	Year	Teacher	Topic	Final Submission
1	**1**	TBC	**Principles and Applications of Science I**	**External Exam:** **12/01/21 (Biology: AM) 13/01/21 (Chemistry: AM & Physics: PM)**
2	**1**	TBC	**Practical Scientific Procedures and techniques**	**Internal**
3	**1**	TBC	**Science Investigation skills**	**Part A (Practical): 26/04/2021 – 10/05/2021** **Part B (Written Exam): 11/05/2021**
4	**1**	TBC	**Laboratory techniques and their applications**	**Internal**
5	2	TBC	Principles and Applications of Science II	External Exam in ***2022***
6	2	TBC	Investigative project	Internal
7	2	TBC	Contemporary Issues in Science	External Exam in ***2022***
8	**1**	TBC	**Physiology of Human body systems**	**Internal**
10	2	TBC	Biological Molecules and Metabolic pathways	Internal
11	**1**	TBC	**Genetics and Genetic engineering**	**Internal**
14	2	TBC	Applications of Organic Chemistry	Internal
17	**1**	TBC	**Microbiology and Microbiological techniques**	**Internal**
21	2	TBC	Medical Physics Applications	Internal

When you start a new piece of assignment, you will generally be given a number of things from your teachers to help you achieve a good grade.

- An introduction to the task in class
- A practical or activity which demonstrates and explains the principles behind the coursework (if applicable)
- Deadlines for the task
- The pages in the textbook which cover that task, or written guidelines for the assignment

What to Include in Coursework?

An assignment brief will be handed out for each part during the assessment period. The brief is composed of different sections, these are highlighted below.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BTEC Assignment Brief

Qualification	Pearson BTEC Level 3 National Extended Diploma in Applied Science
Unit number and title	Unit 2: Practical Scientific Procedures and Techniques
Learning aim(s)	C: Undertake chromatographic techniques to identify components in mixtures.
Assignment title	Separate to Identify
Assessor	A. Ramzan
Issue date	
Hand in deadline	

Vocational Scenario or Context	You are a newly appointed technical assistant at a large chemical plant, Chemcalequip. As part of your induction period and to progress in your role, you have to demonstrate skills in a range of practical procedures and techniques. The company is often required to identify substances. You need to demonstrate that you can carry out different **chromatographic techniques** to separate and identify components in mixtures. In a report of the techniques you have used, you will need to explain the techniques, analyse and evaluate your results and suggest improvements.
Task 1	**Evaluate the chromatographic techniques you have used in relation to the outcomes.** Demonstrate safe working practices and a high level of proficiency when using the following chromatography techniques; • paper chromatography of extracted plant pigments • Thin layer chromatography, TLC, of extracted plant pigments • paper chromatography of amino acids. Repeat any separations where you can justify a lack of satisfaction with the quality of the separation obtained. Produce a report to include : • an evaluation and analysis of the links between the chromatography techniques used and the chromatograms produced. • conclusions about the components and their effect on separation leading to the results obtained. • results from the paper chromatography and TLC of extracted plant pigments and from paper chromatography of amino acids • calculations of Rf values and consideration of the

Key information:

Submission date: this date indicates when you may submit the assigned task. Please note after a resubmission the maximum a learner can achieve is a pass.

Scenario and a written guide, split up into sections, for what to include

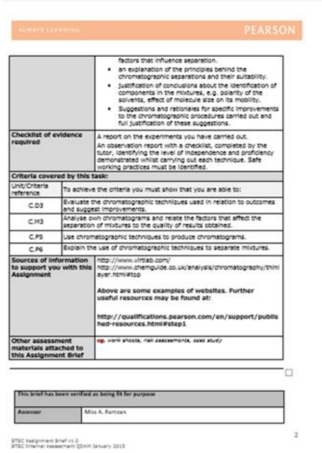
This explains in detail what you will need to cover in each section based on a given scenario

These sections contain examples of the type of work you need to include

Important key words and sources of information can also be found here

A grading criteria for the final report

- This is what your teacher will be marking your assignment with
- These sections tell you what you need to do to demonstrate that you have completed all tasks
- Sources of information are also available to help you support your assignement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	factors that influence separation. • an explanation of the principles behind the chromatographic separations and their suitability. • justification of conclusions about the identification of components in the mixtures, e.g. polarity of the solvents, effect of molecule size on its mobility. • Suggestions and rationales for specific improvements to the chromatographic procedures carried out and full justification of these suggestions.
Checklist of evidence required	A report on the experiments you have carried out. An observation report with a checklist, completed by the tutor, identifying the level of independence and proficiency demonstrated whilst carrying out each technique. Safe working practices must be identified.
Criteria covered by this task:	
Unit/Criteria reference	To achieve the criteria you must show that you are able to:
C.D3	Evaluate the chromatographic techniques used in relation to outcomes and suggest improvements.
C.M3	Analyse own chromatograms and relate the factors that affect the separation of mixtures to the quality of results obtained.
C.P5	Use chromatographic techniques to produce chromatograms.
C.P6	Explain the use of chromatographic techniques to separate mixtures.
Sources of information to support you with this Assignment	http://www.virtlab.com/ http://www.chemguide.co.uk/analysis/chromatography/thinlayer.html#top **Above are some examples of websites. Further useful resources may be found at:** **http://qualifications.pearson.com/en/support/published-resources.html#step1**
Other assessment materials attached to this Assignment Brief	eg. work sheets, risk assessments, case study

This brief has been verified as being fit for purpose	
Assessor	Miss A. Ramzan

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Feedback

In BTEC Applied Science, you will get support with any work you do not understand at any point during the lesson or during AST. It is important you seek for support before the assignment is issued. The teachers cannot provide help with how to construct the assignment or any questions specific to the assignment.

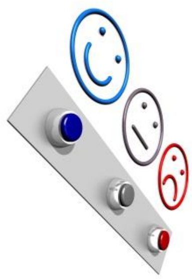
1. *Teaching time in class*

a. Most pieces of coursework will start with teaching time where you take part in activities and lessons to learn about the assignment topic you will write about
b. The taught material often ends up supporting the assignment – it's very important that you catch up with work you miss as quickly as possible or you might not understand any of your assignment at all

You can obviously also ask your teacher for help in class, or if you arrange to come and see them outside of lesson time.

2. *Final deadlines*

a. These are when you hand and sign in your work to be marked for the first and final time, and these are the marks which make up your final grade
b. Any work handed in late can only achieve a pass as the maximum grade
c. Every task in the assignment must be properly referenced
d. A declaration form must be signed to declare that the work handed in is your own and free from plagiarism.



Each deadline needs to be met otherwise the maximum grade you would achieve for that assignment would be a pass. Use the following pages to keep track of your deadlines throughout the course of the year:

	Teacher	**Task**	**Deadline**
		Unit 2	
Part 1			
Part 2			
Part 3			
Part 4			
		Unit 4	
Part 1			
Part 2			
Part 3			
Part 4			
		Unit 8	

Part 1			
Part 2			
Part 3			
Part 4			
Unit 10			
Part 1			
Part 2			
Part 3			
Part 4			
Unit 6			
Part 1			
Part 2			
Part 3			
Unit 11			
Part 1			
Part 2			
Part 3			
Part 4			
Unit 14			
Part 1			
Part 2			
Part 3			
Part 4			
Unit 17			
Part 1			
Part 2			
Part 3			
Part 4			
Unit 21			
Part1			
Part 2			
Part 3			
Part 4			

How to Hand In Work

Format of your work

- Font: Calibri (body)
- Font size: 12
- Line spacing: 1.5
- All work must be properly paragraphed
- Margins: Normal setting (Top and bottom, Right and left: 2.54cm)
- Header should include your full name (top left corner) and the assignment title and task number Eg: Unit 2, Aim A: Preparing and testing standard solutions.

All assignment work is due on the date and at the time specified.

- There will be a declaration sheet which must accompany each assignment you hand in.
- You must sign your work in – the teacher will not sign until they have seen your signature and your work

If you are off sick on a deadline day, then the work may be submitted as late

- You do not wait until the next lesson – this would mean that you would have more time than other students which is an unfair advantage.
- If you wait until the next lesson, your work will not be accepted.
- You must provide any relevant form of evidence for any late submissions. This will then go for approval by the internal verifier.

All** work must **be handed in to the teacher concerned.

- Do not try to leave it with another teacher to pass it on for you
- Do not leave it on desks or pigeon holes
- Do not leave it at reception or in labs/classrooms
- If you do any of these things your work will not be accepted.

Do not wait until the last minute to print your work

- Excuses such as 'lost USB, broken USB, broken printer, forgot to e-mail work, full LRC' etc. are not acceptable as excuses.

You will not be allowed to email work to your teacher

- Too many people have said they would do this and not, or sent it well after the agreed time, or "forgotten to attach" the file when sending the email.
- Some people are doing this for every piece of coursework, which is unacceptable.
- You will be asked to email your work by a process of random selection after your deadline has passed. Only certain students will be selected. This is to check for plagiarism.

Absences

- If you know in advance that you are going to be absent for a deadline day, for example visits and holidays, then you must submit your work **before** the deadline to the teacher concerned.

- Even if you miss a lesson, you are still responsible for the work and the deadlines which are set in that lesson. If in doubt, speak to your teacher. Do not trust your classmates to just tell you if you missed anything important!

Written Work and Standard Formatting

Scientific Writing

1. Check your spelling, punctuation and grammar before you hand in the report. Spellcheck should go without saying but you really need to read what you've written as well to make sure it makes sense. Spellcheck is sometimes actually **<u>wrong</u>** for technical terms and phrases, and it's pretty poor at picking up on bad grammar.

2. Explain any word you don't understand. It is very likely that your teachers will know if you're blagging it. They may simply decide to give you the marks anyway if the rest of your report shows a good understanding, but this doesn't happen often.

3. Style – this is not an essay or story. Scientific writing should be to the point, concise and accurate. Opinions, first person (I, we, you) and other things which give your writing any hint of a personal note or bias should be avoided. You can think of scientific language as being like a new language – you wouldn't go into a Sociology exam and write the answers in French, because you wouldn't get the marks even if your answers were right. Similarly, you should ensure that all your scientific work is written in the appropriate scientific style.

4. Following on from the previous point, be *very, very* sure that it is appropriate to use the following words before you put them in:
    a. However
    b. Furthermore
    c. Moreover
    d. Whereby
    e. In addition
    f. Consequently

    Whilst these words are extremely important for getting evaluation marks in. They sometimes work in an evaluation section, but not always. It actually makes your report sound **less** good if you use fancy words in the wrong context.

5. You should **never** use the above words words as part of a method – they don't make sense.
    Good phrases to use in a method instead are: "The mixture is then…"; "Following this…"; "In the next step…"

6. Use "this", "it" and other pronouns sparingly. Make sure it is very clear and <u>specific</u> what chemical or process you are referring to. It's almost always better to say the name of the chemical. Try using "species" or "chemical" or "particles" (or "acid" or "salt" or whatever it is, if you know what kind of chemical it is) instead of "it" or "thing" if you really don't want to say the name. To conclude: BE SPECIFIC

Technical Writing

Chemicals

Formulae

1. Any chemical which you show using a formula should have superscripts and subscripts where appropriate

   For example, CO_2 not CO2.

2. A space means a new chemical. Never put a space in the middle of a formula.

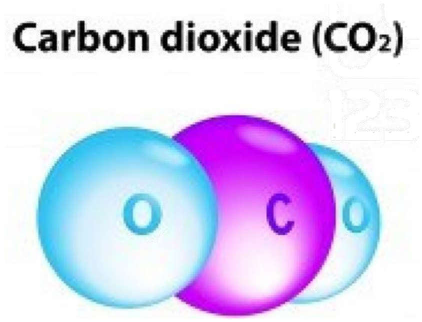
   For example, $CH_3CH_2CH_3$, not CH_3 CH_2 CH_3

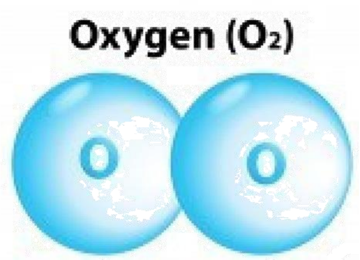
3. A chemical has one capital and one small letter, or just one capital letter. A new capital indicates a new atom/element.

   For example, Cl not CL.

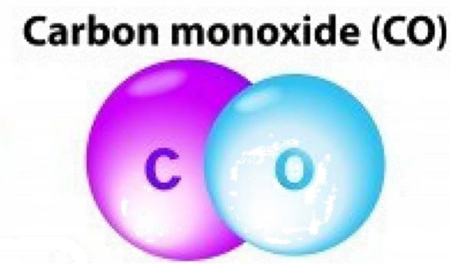
4. Ionic charges go at the top.

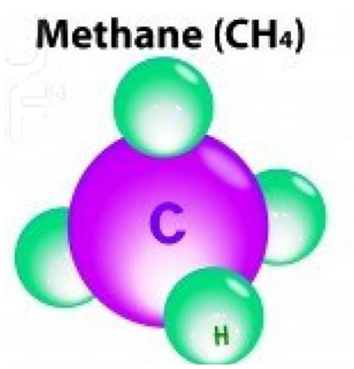
   For example CO_3^{2-} ***not*** *CO32-*





Wrong	Correct
CO2	CO_2
2HO	H_2O
NACL	NaCl
C2 H4	C_2H_4
Cl+	Cl^+
OH-	OH^-





The keyboard shortcut for a ^{superscript} is to press the Ctrl and Shift and +/= keys together
The keyboard shortcut for a $_{subscript}$ is to press the Ctrl and +/= keys together.

Both of these shortcuts are toggles – doing the same thing again will turn them on and off.
You can also just press the X^2 and X_2 buttons at the top of the screen.

Names

Chemicals can be named according to whether they are
inorganic (a metal and a non-metal)
or
organic (hydrocarbons)

Inorganic Compounds

(First element name) *(Prefix) + (Second element name) + (Suffix)*

- Prefixes tell you about numbers of that element, but usually only apply to covalent compounds (two non-metals bonding together)
    - Mono is one
    - Di is two
    - Tri is three

- Suffixes usually tell you what else is in that half of the chemical
    - "ide" means there is nothing else combined with the element in that half of the chemical.
    - "ite" means a little bit of oxygen
    - "ate" means a lot of oxygen
    - "hydrate" means hydrogen and oxygen

First element: Sodium
Second element: Carbon
Suffix: "ate" (there is oxygen in the second bit of the formula)
Therefore, this chemical is called *sodium carbonate*

For example: $K_2Cr_2O_7$
First element: Potassium
Second element: chromium
Prefix: di (two chromium atoms)
Suffix: "ate"
Therefore, this chemical is called *potassium dichromate*

Inorganic Compounds

Directions: In the space provided, write the correct name of the ***ionic*** compound.

1. NaI
2. $CaCl_2$
3. K_2S
4. MgO
5. Li_2SO_4 .
6. NH_4Br
7. $NaBrO_3$
8. Fe_2O
9. $Cu(NO_3)_2$
10. Ag_2CrO_4

Directions: In the space provided, write the correct formula for the ***ionic*** compound.

11. Beryllium nitride
12. Nickel (II) chloride
13. Iron (III) perchlorate
14. Magnesium sulfite
15. Potassium nitrate

Possible extension – what elements are in each of these compounds? How many of each element are there? What would the molecular mass of the whole compound be?

Other names and formulas of *covalent* compound.

16. CO carbon monoxide
17. N_2H_4 dinitrogen tetrahydrate
18. SO_3 sulphur trioxide
19. $SiCl_5$ silicon trichloride
20. S_4N_4 tetrasulphur tetranitrate
21. N_3O_6 trinitrogen hexaoxide
22. CO_2 carbon dioxide
23. AsO_7 arsenic heptaoxide
24. H_2O water
25. CCl_4 carbon tetrachloride

There are also some chemical chunks that you just need to know the names of:

Species	Name	Species	Name	Species	Name
NH_3	Ammonia	Cl^-/Br^-	Chloride/Bromide	OH^-	Hydroxide
NH_4^+	Ammonium	N^{3-}	Nitride	O^{2-}	Oxide
Cu^+	Copper (I)	NO_2^-	Nitrite	CO_3^{2-}	Carbonate
Cu^{2+}	Copper (II)	NO_3^-	Nitrate	HCO_3^-	Hydrogencarbonate
Fe^{2+}	Iron (II)	S^{2-}	Sulphide	$Cr_2O_7^{2-}$	Dichromate (VI)
Fe^{3+}	Iron (III)	SO_3^{2-}	Sulphite	CrO_4^{2-}	Chromate (VI)
Al^{3+}	Aluminium(III)	SO_4^{2-}	Sulphate	PO_4^{3-}	Phosphate

Core names for longest carbon chains

Carbons	1	2	3	4	5	6	7	8	9	10	20
Name	Meth-	Eth-	Prop-	But-	Pent-	Hex-	Hept-	Oct-	Non-	Dec-	Eicos-

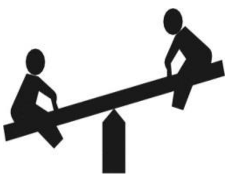
Types of prefix/suffix group

Homologous series	Functional Group	Name of functional group	Naming (x is number of functional carbon)
Alkane	$-C_nH_{2n+1}$	alkyl	but**ane**
Alkene	C=C	Carbon-to-carbon double bond	but**ene**
Alcohol	-OH	Hydroxyl	butan-**x-ol**
Haloalkene	-X (Where X is a halogen)	Halide (Chlorice, Fluoride etc)	**x-halo**butane (e.g. x-chlorobutane)
Aldehyde	C=O	Carbonyl	butan**al**
Ketone	C=O	Carbonyl	butan-**x-one**
Carboxyllic acid	CO_2H	Carboxyl	Butan**oic acid**
Ester	CO_2C	Ester linkage	Butyl propanoate

Equations

1. Should be on a line of their own
2. Should be balanced
3. A big 2 in **front** of a chemical means two lots of that chemical
4. A little 2 at the bottom of the chemical means that chemical has two of that atom in its structure

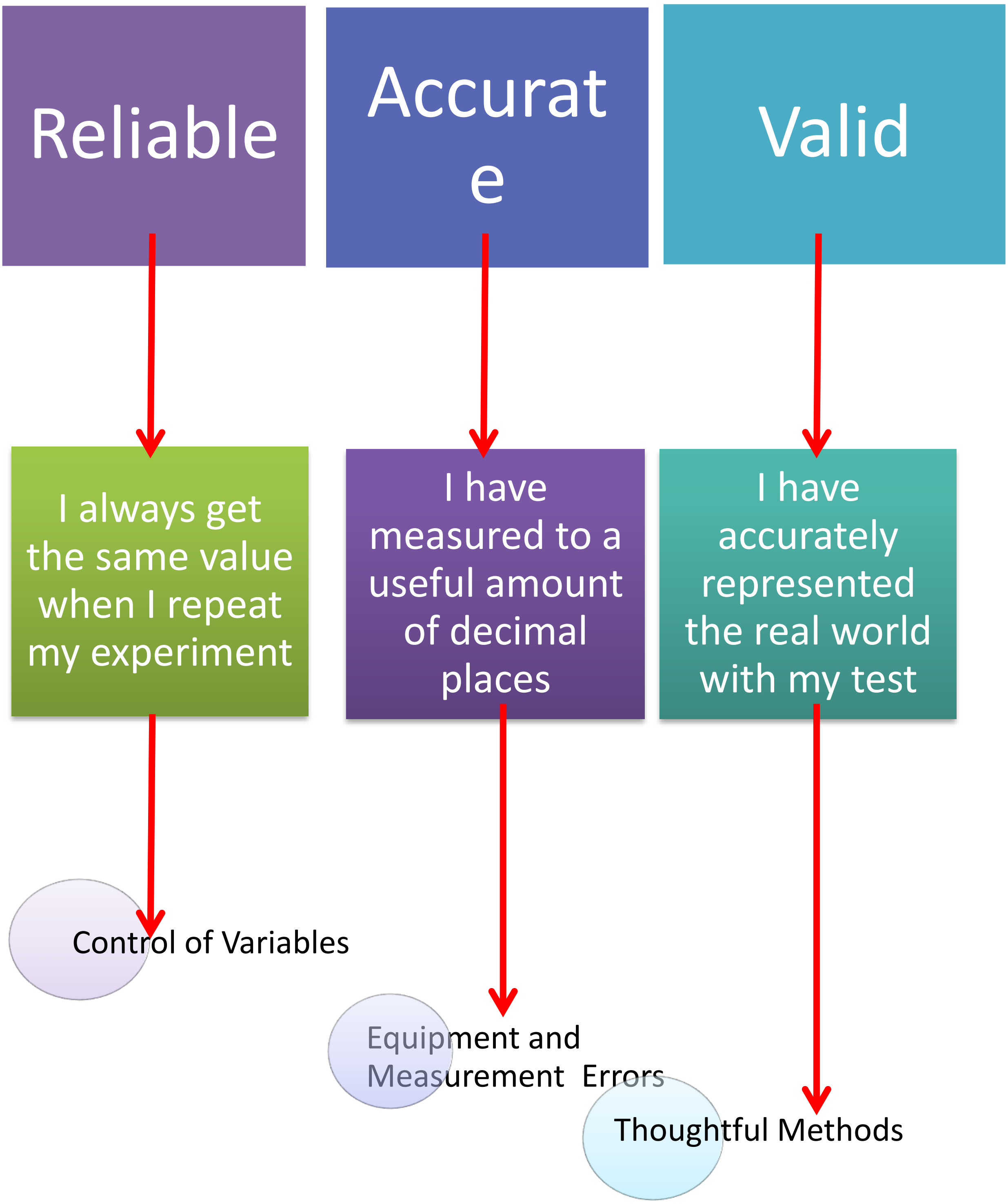
$$\_\_\_\_\_ Zn + \_\_\_\_\_ HCl \rightarrow \_\_\_\_\_ ZnCl_2 + \_\_\_\_\_ H_2$$



$$\_\_\_\_\_ NH_3 + \_\_\_\_\_ HCl \rightarrow \_\_\_\_\_ NH_4Cl$$

Reliability, Validity and Accuracy

There are three very important things you need to be able to say about scientific data:



Presenting Data

Variables

Dependent

- The aspect you are *investigating*
- You should only have one dependent variable per experiment

Independent

- The aspect you are *using to alter your dependent variable*
- This should change ina a linear way - for example, time taken for something to happen

Control

- The aspects you are *keeping the same*
- These should be measured and kept at the same value to make sure they don't affect your dependent variable too

Remember –

You might have to measure a different variable and do a calculation to get your dependent variable if you can't directly measure it - e.g concentration

What properties and measurements can you think of that might be used as variables? List them in the space below:

Units, Powers of Ten and Rounding

Units

- All numbers **must** have units, unless they are "just a number" (for example, pi is just a number)
- There is a list of standard units in Appendix A: SI Units

Rounding

Significant Figures

Are figures which represent "real numbers" – useful values telling you there are four tens (the 4 in 40) or 8 tenths (the 8 in 0.8).

They do not include "placeholder zeros" – for example, in 0.045, the 0 in the tenths column after the decimal place is not a significant figure, in the same way as we would ignore the first zero in 0450 (four hundred and fifty).

The only difference is, for 0.045, we still have to *write* the zero in the tenths column, because it is telling us that the 4 is one hundredth. It's just a function of the way we write numbers in the decimal system.

With significant figures, we start counting at the first "real number" then count all the digits after that. Therefore, 0.020567 to three significant figures would be 0.0205

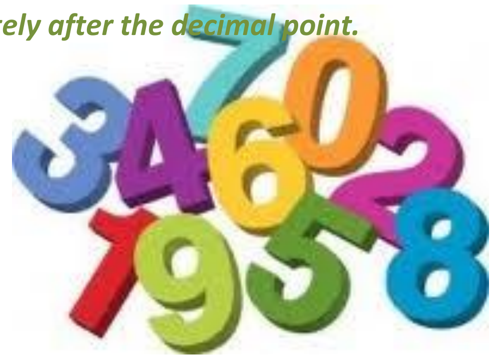
Decimal Places

Are just digits which occur after the decimal point, including all zeroes.

So, 0.045 to one decimal place would be 0.0, two decimal places would be 0.05 (remember to round up!) and to three decimal places would be as written, 0.045

If the question asked for four decimal places, you can simply fill in any extra slots with extra zeroes – for example, 0.045 becomes 0.0450. These are known as "trailing zeroes" and show a good accuracy level of the measurement. However, you can't just add on zeroes unless your measurement was actually to that many decimal places!

With decimal places we start counting immediately after the decimal point.



Try the following practise exercises in rounding:

1. **7.4562 to**
   a. One decimal place
   b. Three significant figures

2. **0.0249 to**
   a. Two decimal places
   b. Two significant figures

3. **0.0405 to**
   a. Three significant figures
   b. Three decimal places

4. **0.834**
   a. Four decimal places
   b. Two significant figures

Tables

Independent Variable (unit)	Dependent Variable (unit)			
	Repeat 1	Repeat 2	Repeat 3	Mean
IV test value 1				
IV test value 2				
IV test value 3				
IV test value 4				
IV test value 5				

Identify by circling any anomalies and do not account for anomalies in your mean.

Titration Tables

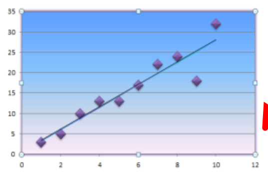
Titration readings are always to two decimal places, with the second decimal being 0 (on a graduation mark) or 5 (between two graduation marks)

	1	2	3
Final Volume /cm^3	**15.60**	**32.45**	This is the volume which was recorded after the colour change
Initial Volume /cm^3	**0.00**	**15.60**	This is the volume which you recorded before you started this repeat
Titre/cm^3	**15.60**	**17.85**	
Mean Titre /cm^3	**(15.60+17.85)/2 = 16.7 ← This must be to 1 d.p.** This is the average of the 2-3 closest numbers – ideally they should be within 0.5 cm^3 of each other, but if not just use the two closest		

Graphs

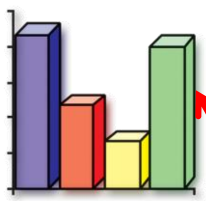
- I must have labels for:
    - **Axis Names**
    - **Axis Units**
    - **Axis Scales (appropriate scale)**
    - **Title (with relevant variables and units)**
    - **Key (if applicable)**
- Scales are linear and go up in easy-to count numbers
- The graph takes up at least half the page – use all the paper you want, but make it clear
- The graph is of an appropriate type
- Anomalies identified, and a line of best fit drawn if appropriate

Name the types of graph, and match them to the appropriate use



Used for showing relative quantities

e.g. different uses of a chemical



Used for showing correlation

e.g. resistance increase when wire length increases

Used for showing how information changes over different groups

e.g. biodiversity at different points in a wood

Example Practicals

Chemistry

An experiment is carried out to react different concentrations of acid with the same amount of base and see what volume of acid is needed to neutralise the base each time

Dependent Variable: ______________________________________

Independent Variable: ______________________________________

Possible Control Variables: ______________________________________

Results Table

Appropriate Graph:

Physics

An experiment is carried out to test the force required to stretch pieces of elastic of different thicknesses

Dependent Variable: ________________________________

Independent Variable: ________________________________

Possible Control Variables: ________________________________

Results Table

Appropriate Graph:

Introductions

An introduction should not start in any of the following ways:

"In this essay, I will be writing about…"
(Not objective)

"We have many chemicals in our world…"
(Non-scientific style)

"I am going to investigate…"
(Not objective)

"I am a scientist working for a chemical company…"
(Non-scientific, and plagiarised directly from the workbook!)

An introduction is there to do the following things:

Introduce the context

Provide background information, and define key terms

Set out aims of a report

Briefly discuss any research which already exists

Look at the following introduction to a report investigating the purity of baking soda.

- What errors has the student made?
- What have they done well?
- Can you write a better introduction?

In this report, I am acting as a scientist working at BakeChem company. I am testing baking soda for purity as part of routine quality checks. Baking soda is sodium hydrogen carbonate, NaHCO3. The company also produces and packages flour and sugar in the same factory.

I will carry out three tests:

- A reducing sugars test for glucose contamination
- A titration with acid to find the percentage purity
- A visual test and starch test for flour
- A melting point test to see if the baking soda is pure

This practical should reveal whether the baking soda is of acceptable purity and, if not, what is it contaminated with?

Research

For Reports

- Explain key Science ideas in topic
- Back up infromation learned in class
- Research points in the specification
- Gather data and information

- Short Reports: 5-10 References
- Long Reports:15-20 references

- You should aim for at least one reference for every paragraph

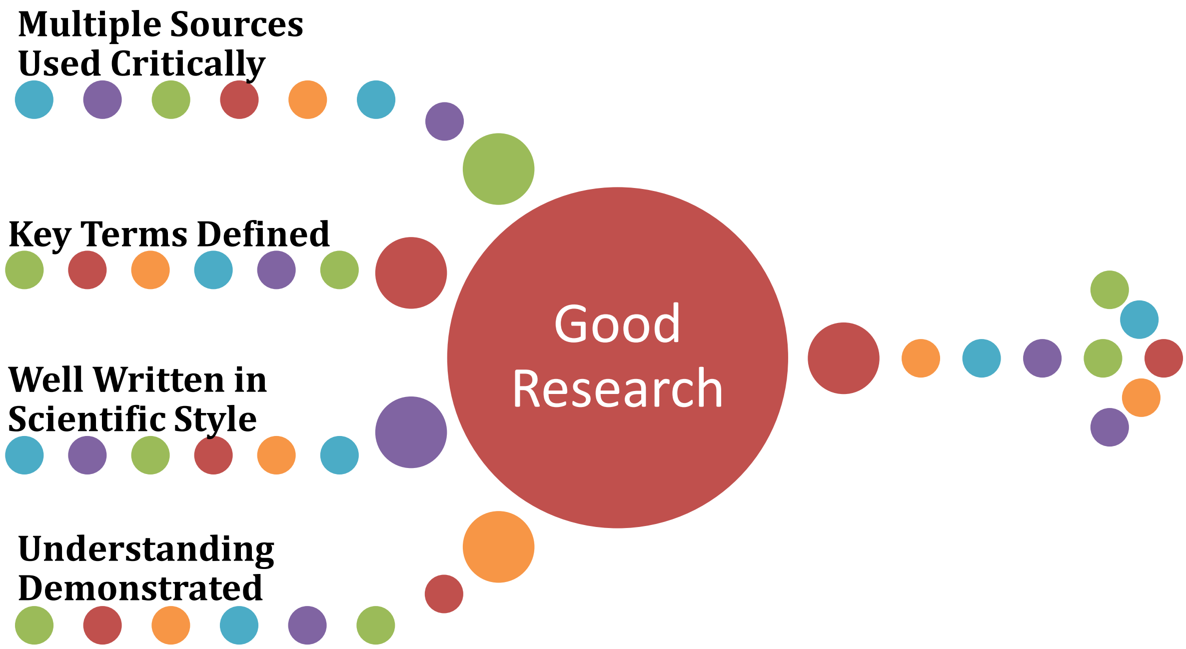
For Practicals

- Find methods
- Find equations
- Support risk assessments
- Define key terms

- Check your tables are appropriate
- Find data, e.g. masses of chemicals

- Explain Results
- Support Conclusions
- Suggest further research

If you want to get a good mark, you must also be **critical** of your information, rephrasing it in your own words and using more than one reference to confirm each idea. You need to compare several sources and decide what the **best, most reliable and accurate** information is. See the Referencing Section for more help with this.



Research Checklist

Use pencil so you can re-use this page

- ☐ I have answered all points in the report guidelines
- ☐ All points are addressed in their own section or paragraph
- ☐ I have defined or explained all the key terms I used
- ☐ I have put everything into my own words
- ☐ I have expanded on points I took from sources and explained them
- ☐ I have drawn my own conclusions for the research
- ☐ I have backed up scientific statements with at least one source
- ☐ I have cited all my sources in my text
- ☐ I have used around one source per paragraph

Practical Reports

Methods

Aim and Hypothesis

- This is a brief summary telling the reader what the point of the practical is
- You should write out the **vocational context** in your own words – you are acting as a scientist in a lab, not a student in a class
- You must write in a neutral way – don't use "I", "my", "your" etc. See the scientific writing section for more help on this.

Layout

- Each separate practical should have its own method
- When you list apparatus and chemicals, they should each be a separate list. Include concentrations and volumes for solutions, and masses for chemicals.
- Methods should be step-by-step and numbered 1, 2, 3 etc, NOT in paragraphs

Writing

- Methods should be written in the past tense
- Methods should not use "I" or "We" – try to write in the passive tense, for example "The beaker was placed on the stand"

3 Peartree Road
Stanway
Colchester
CO3 OJP

8 Briar Walk
Oadby
Leicester
LE2 5UE

Dearest June,

It was so lovely to see you last weekend! Leicestershire is beautiful but I do miss the company of the WI in Stanway, although the cake recipe I mentioned did come from the local WI here. To make it, you will need to use butter, sugar, two eggs, 50g of cocoa powder, 4 oz of flour, and some milk. The ladies here suggest using yoghurt instead of milk, but I find the milk gives that classic taste. They are rather younger and prefer to keep their cakes low fat – I remember when fat was hard to come by, June, and keep it in my recipes now it is available! I find it sad the levels these beautiful girls go to to stay pretty – they are far too active to keep up with ay my age. One rather splendid young lady (she dyes her hair pink, of all things – the fashions these young people have!) is organising a sponsored rock climb. Can you imagine me in a rock climb at my age? I told her that I would hold the money tin but that they will not get me up on that rock for love nor money!

That reminds me, June, you will need to use a 16-inch cake tin for this recipe – a 12 inch tin is too small. A small amount of bicarbonate of soda helps the cake to rise – not too much though, or the cake will fall in the middle.

I saw the girls when I came up to see you – the whole weekend was quite the adventure! Sara has just had her baby, 8lbs and 3oz so a big boy! They have named him Owen, being as Sara's future husband is Welsh. She tells me that he proposed whilst they were on holiday in Devon in a lovely little French restaurant by the sea, and they seem very happy. We tested the cake recipe, actually, and found that it works best when you cream together the butter and sugar, then add the eggs a little at a time, then sieve in the flour as you normally would, mixed with the cocoa powder. She's a very talented baker, our Sara! She has a very fancy electric mixer, but it works just as well with a whisk and some elbow grease. She made some lovely icing with chocolate and icing sugar, but I think the cake is delicious without icing.

I dearly hope your Arthur is feeling better after his slip and fall. I know you have had concerns with the local nurses before, and I would hope that they take his complaints seriously. One cannot be too careful at our age, and I worry when we are sent away from care with pills to take – one does not feel the doctor takes ones' welfare seriously these days. I miss the days of patient care and a good bedside manner. Lynne tells me that nurses must work these days to "patient-centered care guidelines" – what nonsense, to set up a list of rules for common courtesy towards your patients! But times are changing, and manners aren't what they once were, I suppose. All our love to Arthur, and I hope he feels better soon.

Anyway June, I must go as I need to tidy the house for Lois' arrival. Remember to try the cake – it only bakes for around 25 minutes, so it's a fabulous recipe for guests at short notice. I do look forward to seeing you again soon.

All my affection,

Mavis

P.S. Don't forget to pre-heat the oven to Gas 4 before starting. I think that's about 160 Celsius for a new oven

P.P.S You will need to butter the tin!

Use Mavis' letter to June to write a "method" for making the cake:

Chocolate Cake

Ingredients

Butter
Sugar
4 Eggs
Milk
50g Cocoa Powder
4oz Flour
Bicarbonate of Soda

Equipment

Whisk/mixer
16 inch cake tin

Method

1. Pre-heat oven to 160 °C
2. Cream together the butter and sugar
3. Add the eggs a little bit at a time
4. Sieve in the flour and cocoa powder
5. Pour the mixture into a pre-greased tin
6. Bake in the oven for 25 minutes

notes:

Mavis has used inconsistent and non-standard units, she has not given quantities for some ingredients, and she has missed a couple of steps out (when does the bicarb go in? When do you beat the eggs?). A spatula is also useful to get the mix into the tin.

This is a real recipe – if students want to try it at home, they can use the following added detials:

110g Butter
110g Sugar
2 Eggs (beat before adding)
30g Cocoa Powder
80g Flour
1 Tsp Bicarbonate of Soda (sieve in with flour)

The size and shape of tin doesn't really matter, as long as the mix fills the tin to a depth of at least 1in.

What should a method always include/look like?

1. *Instructions should be* numbered *and* clear
2. *There should be a list of* equipment
3. *There should also be a list of* chemicals
4. *There should be* titles , quantities *and* units
5. *It should be written as if it was done in the* past

Writing in the Past Tense (3rd person and past tense)

Sentence	Problem	Better sentence
I put the beaker on the stand	**First person**	**The beaker was placed on the stand**
Mix together sodium hydroxide and water	**Quantities and concs needed**	**Dilute 50cm^3 of 1mol dm^{-3} sodium hydroxide was added to 200 cm ^{3} water**
Leave it in a water bath	**For how long? What is "it"? What temp?**	**The test tube was then placed in a water bath at 80°C for 10 minutes**
You should put 5 drops of the hydrochloric acid into the mixture as a catalyst	**First person, inexact, no concs**	**1cm^3 of 1 mol dm^3 hydrochloric acid was added as a catalyst**
You should see a precipitate and some bubbles	**First person, non-scientific style, inexact**	**Expected observation: effervescence and a blue precipitate formed slowly**
Add 1 mol dm^{-3} of sodium hydroxide to the burette	**How much?**	**The burette was filled with 50.0 cm^3 of 1 mol dm^{-3} sodium hydroxide solution**
The product should be crystals	**Colour, shape?**	**Expected results: colourless, cubic crystals**
I will carry out an experiment where I will…	**First person**	**An experiment was carreid out to show that/test if…**

Risk Assessments

Important: You will not be allowed to complete any practical activities without a safe, completed risk assessment.

Risk assessments are mostly common sense. There are four main sections you need to complete:

Chemical Hazards

- List any chemicals being used
- You **must** give amounts - 10g of a hazardous substance is a very different situation to 100g of a hazardous substance
- Likewise, a more concentrated solution will probably be more hazardous than a more dilute solution -give concentrations and volumes fo solutions
- Use COSHH data (from the internet) to labe hazards - don't just guess

Practical Information

- Your name
- Practical Date
- Title
- Outline (this does mean outline - you don't need to copy the whole method)

Procedures

- Emergency actions - what you do if one of your chemical or physical hazards occurrs (usually tell the teacher)
- Standard Safety - lab coats, goggles and so on
- Disposal - when you are done, how will you get rid of your extra chemicals? Some can go down the sink, but some will need to be disposed of specially - ask your teacher or listen in class for further instructions

Non-Chemical Hazards

- This is things like slipping on spills, breaing glass etc
- You should fill out the box next to it as well describing how you will avoid these things happening

Making Risk Assessments Easier

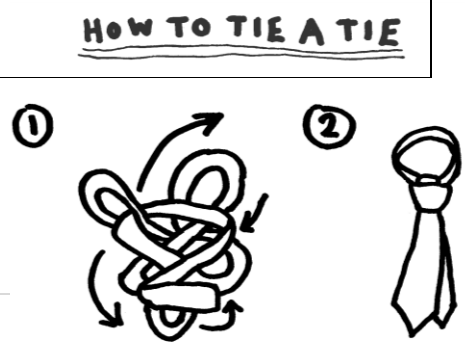
This is a copy of the standard risk assessment form – you might like to note down any common hazards or procedures here for future reference.

Name:	**Date:**
Title of practical activity:	
Outline of the procedure:	

Substance being used or made:	**Amount, or concentration and volume:**	**Nature of hazards:**

Non-chemical hazards:	**Steps to minimise non-chemical hazards:**	**Standard safety procedures for this practical:**
Glassware breakage Spills Fire	Glassware should be kept away from table edge Warn others in my area, mop up immediately, tell teacher Leave lit bunsens on a yellow flame if they are not being used	Lab caots Safety glasses Remove jewellery Cover legs and feet

Emergency action:
Eyes – eye wash, tell teacher Skin dmaage from burns or chemicals – rinse with plenty of cold running water, tell teacher Cuts – rinse if the object you cut yourself on could be dirty. Let teacher know.
Disposal of residues:
Liquids can be rinsed down the sink with running water Soluble solids can be washed down the sink with runnig water Insoluble solids can be thrown in the bin



Diagrams

Should be clear

- Must be labelled completely and thoroughly
- Should not include labels you don't understand
- Should not be stretched in funny directions. It's ok to have white space on either side of the diagram
- Should take up at least quarter to half a page – as with graphs, use as much space as you like but make it clear.

Should link to and support your text

- Should show how the equipment is set up for that part of the reaction.
- It should not just be separate pictures/diagrams of individual pieces of equipment
- The diagram should match what you're saying in the text – if you've given an example using certain chemicals, don't have a diagram with different chemicals in it.
- This should really go without saying, but put the diagram with the text it refers to!
- Giving diagrams a title, or labelling them as "Figure 1" so that you can link them directly to the text is also very helpful

Are not pictures

- No 3D
- Use a "cross-section" style picture

Are an important part of your work

- Unless you drew it yourself, you should give the source you got it from as a reference

You only need to include a diagram if you think someone with no experience of chemistry would not be able to set up the practical without it – for example, titrations.

Recording Results

It will make your life much easier if you set up a results table when you write your method –see the "tables" section for help with this. You can then print out a rough copy of the table to take results on when you carry out the practical, and then type it up neatly afterwards.

Describe your PRODUCTS

(State? Colour? Shape? Smell?)

Check ACCURACY

(Aim to measure one more decimal point than you need – for example, if your mean is to 1 d.p., measure to 2.d.p.)

BE HONEST – This is not a test to see if you did it right. We will not be telling you off if you had to change something. We already know if you messed the practical up – we were there.

The point of this part is to explain to someone else what you did so that they can copy you and repeat your results. If you discover the cure for cancer and then lie about what you did, we can never make more!

What did you SENSE?

(See, hear, and smell? Did solids form or disappear? Did anything fizz, bubble or heat up?)

What did you MEASURE?

(Variables – dependent/independen t, and check controls)

Never throw away anything you write down during a practical! You never know when your USB might crash. It might help you to keep a notebook specifically for practical work which you can add dates and notes to.

Calculations, Analysing Data and Conclusions.
Calculations

- Always show your working for calculations. Use / for "divided by" and x for "times"
- If you do the same calculation more than once (for example, Rf values for different spots in chromatography; or percentage errors) it is ok to only show the working once and then just list the answers for the rest of the experiments. However, you do need to show your working, with each step explained, at least once.
- Put your calculations in context. For example, for iron tablets – when you do this calculation:

$$\frac{(\text{Actual mass of iron per tablet} - \text{My mass of iron per tablet})}{\text{Actual mass of iron per tablet}} \times 100$$

  You are finding the percentage difference between what the iron tablets company said and what the tablets actually contained. This is a measure of how honest they were, and is the main point of your experiment! The bigger the number, the more the company lied.

- You should put units for each number you calculate
- Explanations of how you performed calculations should be written in the **present tense** as you are doing them now.
- Comment on final values – What does a high atom economy show? What does a steep gradient show? What does a poor yield suggest?

Percentage Yield	
40% or lower	Extremely Poor Yield
50%	Poor Yield
60%	Good Yield
70 - 80% or	Excellent Yield, assuming it doesn't look wet or impure
90% or higher	Ask your teacher – it depends on the experiment
100% or higher	Extremely Impure/Wet product

Conclusions

- Again, don't write "me", "you", "I" and so on.
- This should be written in the **past tense** as it comes after the practical.
- If part of the practical is answering set questions, your answers should be in full sentences – they should make sense if someone read them without the question. You can also write up the answers as a paragraph if you like.
- For independent practicals, you should explain why you got the results you did. If they are not the results you were expecting, you will need to consult both your evaluation and further references to find out and explain why.
- You should link the conclusion back to the expected results and research sections you did at the start of the practical - this is why method sections are so important, as you are totally unable to analyse your results with any degree of depth if you don't know what they should have been.

Calculations Checklist

- ☐ I have shown each step in my working clearly at least once
- ☐ I have annotated my working with the purpose of each step
- ☐ I have given the equations I used
- ☐ I have commented on what my numbers mean
- ☐ I have included correct units
- ☐ My significant figures are appropriate
- ☐ Someone else could follow my working

Conclusions Checklist

- ☐ I have answered the questions set out in my aims
- ☐ I have stated if my results met expectations
- ☐ I have explained the scientific reasons why I got the results I got
- ☐ I have explained how my results support my conclusions
- ☐ I have quoted values from my results in my conclusions
- ☐ I have suggested further research which could be carried out to support my findings

Use pencil so you can re-use this page

Evaluations

- You cannot possibly have a perfect experiment. Nobody can. Evaluations are not about you saying how bad a student you are, they are about acknowledging the flaws in our scientific method so we can see how reliable our results actually are.
- In fact, mistakes that you made through carelessness or messing up should **not** be listed in your evaluation, as they aren't a problem with the method.
- Even if you made no mistakes, you are still limited by things like fluctuations in temperature, the accuracy of your equipment, reading the meniscus and so on. Again, all scientists are – it's not just you!

Human Errors

- These errors identify and acknowledge the mistakes inherent to being human
- This includes things like reading the meniscus
- This also includes things like adding too much of one chemical by a small amount because of the limits of your dexterity

Procedural Errors

- This includes things like independent variables (did the temperature of the lab change during your experiment?)
- It also includes things like dodgy equipment
- They describe things which are outside your control

Percentage Errors

- You should use your % errors to say which bit of equipment caused the biggest errors in your results.
- Suggest a more accurate piece of equipment for each error
- A bigger number means the equipment is less accurate.

- Once you have identified your errors (you should have two of each) you should suggest how to avoid/minimise the impact of the problems you had next time, or explain how you overcame them this time. It is not enough to just say what went wrong; you must explain how to fix it so that the next person can get better results
- You should also link your improvements to your results – will they make your results more reliable? More accurate? More valid? See the section on Reliability and Accuracy for more help with this.

Common and Useful Errors and Improvements

Error	*Type of Error*	*How to minimise*
Misreading the meniscus of a liquid	**Human**	**Always have the same person reading from the same height**
Contamination from a dirty burette	**Procedural**	**Check all equipment you are provided with before starting**
Using a different set of scales for two readings	**N/A**	**This isn't an acceptable evaluation point – just do it properly in the first place.**
Adding too much of one chemical by a few drops	**Human**	**Repeats, use larger volumes**
A gas tap stops working half way through your experiment	**Procedural**	**Regularly carry out checks and maintainence on all lab equipment and supplies**
Results show very little concordance	**Procedural**	**Manage control variables more carefully, or design method differently**
Was extremely difficult to take readings because of how the practical was arranged	**Procedural**	**Think practically when designing a method**
Running out of time	**Procedural**	**Consider timings when you write the method**

Percentage errors are slightly different

- ***Remember that a larger reading can have a larger tolerance without being affected as much***
  - ***For example, a tolerance of ±0.5cm³ on a reading of 100cm³ is an error of 0.5%***
  - ***The same tolerance of ±0.5cm³ on a reading of 1cm³ is an error of 50%***
  - ***So it would be ok to measure out 100 cm³ of liquid with that piece of equipment, but if you wanted to measure 1cm³, you would need something more accurate***

When you calculate percentage error for your readings, you should look at the table below to decide about the accuracy of the measurement

Percentage Error	
Less than 0.1%	Very accurate readings, results will also be accurate
0.1-0.5%	This is a good level of accuracy
1-3%	Reasonable accuracy, but better equipment should still be used next time
5% or bigger	This is poor accuracy – it means that a measurement of 10cm^3 could actually be a measurement of 10.5 cm^3
10% or bigger	You must not use this piece of equipment for this measurement

Referencing

Reliability and Usefulness

Reliable does not mean useful. Just because it was easy to read and understand doesn't mean the information is right. Reliable means that you can trust the information 100%.

What things make a reference more reliable?

- ✓ **Peer Review**
- ✓ **Expert Authors**
- ✓ **Respected Sources**
- ✓ **No Personal Interest**
- ✓ **Concordance with other sources**

What things make a reference less reliable?

- × **Bias/Opinion and Personal Interest**
- × **Research Methods**
- × **Tertiary sourcing**
- × **Publication dates**
- × **Non-expert author or crowdsourcing**

www.slideshare.net/ande7997/reliabilityofsources

Unjustifiable references	Websites to avoid/justify	Good General Science websites
Wikipedia	eHow	Avogadro.co.uk
Essaywriter, markedbyteachers and other sites which actively encourage plagiarism	Yahoo answers	BBC GCSE Bitesize
Tumblr (I literally cannot believe someone used Tumblr as a reference. Seriously, guys. Come on.)	Wisegeek	www.bbc.co.uk/Science
	Answers.com	Chemchapterzero
	HowStuffWorks	Chemguide
		Chemistry.About.com
		Chemistry-videos.org.uk
		Chymist
		Creative-chemistry.org.uk
		GCSEScience
		Hyperphysics
		IBchem
		Nature
		New Scientist
		Physchem
		Practicalchemistry.org
		RSC
		Schoolscience.co.uk
		Sciencegeek.net
		Scientific American
		s-cool
		Snopes
		TheScienceLab
		Tutoring websites
		University websites if you can understand the information
		Webchem
		Webelements
		www.chem.iastate.edu

Remember, just because a reference is unreliable doesn't mean that you can't use it and the information is wrong. It *does* mean you need to back it up with another source. And you should justify why you've chosen to use it anyway in your referencing section.

References should be numbered at the end of the report, and the numbers should be in the text. For example, I might put [1] or (ref. 1) to label parts of my work which are backed up by my first reference.

To reference a book:

1. Title of book, *author*, **ISBN**, Edition, page number of information

To reference a website:

1. Website name, URL, *date consulted*

To reference a journal article:

1. *Title of Article,* Author , **Journal**, Volume, *Pages*

Plagiarism

All of the following things count as plagiarism:

1. ***Putting large chunks of text from a source into my work, with quote marks, and listing the site.***

Instead, I should: *Re-word and define key terms*

2. ***Giving my work to other people to help them, or taking someone else's work to help me, including risk assessments and researched work where we are trying to achieve the same outcome***

Instead, I should: *Ask the teacher, or ask a friend to comment and explain*

3. ***Copying a worked example of a calculation without explaining the steps and formatting it in a way which makes sense to me***

Instead, I should: *Organise the calculation and explain the steps in a way which makes sense and demonstrates my understanding*

4. ***Copying text and using the synonyms function in word to change a few words.***

Instead, I should: *Look up and define key terms or use a different source if I really don't get it.*

A quick easy way to reference is to use REF ME.

A Final Note

Applied Science is an intense Exam and coursework-based subject. There will be a lot of paper, a lot of coursework and a lot of deadlines – it is the nature of the course. If this is not the right thing for you, consider changing subjects.

* Your teachers carefully plan your deadlines based on how long previous years students have taken on pieces of coursework, and how hard students generally find each task.

* We have to complete tasks by a certain time, and we work very hard to try to make sure that deadlines don't overlap wherever possible.

* In addition, if a teacher is ill, or students ask for an extension, or miss deadlines, deadlines can end up piling up towards the end of the term and your grade will be massively affected. If you stick to the year plan we have set out for you and hand everything in on time and to the best of your ability, this won't happen.

* It's important that, as a class, you understand how your attitude to deadlines affects others.

* Your teachers also do a lot of marking for you, probably more than they do on any other course.

* We also end up saying the same thing over and over again, or we write it down so that sensible students can avoid making common mistakes in the first place.

* The idea of the course – and one of the things Universities really like about it – is that it makes you an independent learner who doesn't need a teacher supporting them all the time – you should end up being able to research, find out information and get on with work by yourself.

We hope you enjoy the Applied Science course, and we look forward to working with you to achieve your best possible grade ☺

Appendices

Appendix A: SI units

Aspect	Symbol	Standard Unit	Other possible measurements
Acceleration	a	Metres per second per second, m s^{-2}	-
Amount of chemical	n	Moles, mol	-
Area	a	Square metres, m^2	Square Centimetres, cm^2
Charge	Q	Coulombs, C	-
Concentration	c	Mols per decimetre cubed, mol dm^{-3} or M	-
Force	F	Newtons, N	-
Frequency	f	Hertz, Hz	-
Length	l	Metres, m	Centimetres, cm Inches, " Feet , '
Magnetic field strength	B	Teslas, T	-
Mass	m	Grams, g	Kilograms, kg
Power	P	Watts, W	-
Pressure	P	Kilopascals, kPa Atm, atmospheres	-
Resistance	R	Ohms, Ω (omega, see Appendix: Greek Letters)	-
Aspect	**Symbol**	**Standard Unit**	**Other possible measurements**

Speed	s	Metres per second, $m\ s^{-1}$	Kilometres per hour, $km\ h^{-1}$ Miles per hour, mph
Temperature	T	Degrees Kelvin, K	Degrees Celsius/centigrade, °C Degrees Fahrenheit, F
Time	t	Seconds, s	Minutes, min Hours, h
Velocity	u	Metres per second, $m\ s^{-1}$	-
Voltage	v	Volts, V	Millivolts, mV
Volume	V	Decimetres cubed, dm^3	Centimetres cubed, cm^3 Millilitres, mL Litres, L

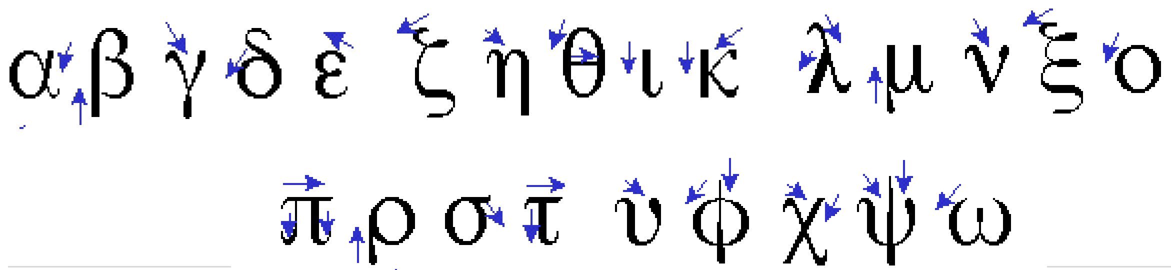
Other Useful Units

Aspect	Symbol	Standard Unit	Other possible measurements	Conversion

Appendix B: Greek letters

Α	α	alpha
Β	β	beta
Γ	γ	gamma
Δ	δ	delta
Ε	ε	epsilon
Ζ	ζ	zeta
Η	η	eta
Θ	θ	theta
Ι	ι	iota
Κ	κ	kappa
Λ	λ	lambda
Μ	μ	mu
Ν	ν	nu
Ξ	ξ	ksi
Ο	ο	omicron
Π	π	pi
Ρ	ρ	rho
Σ	σς	sigma
Τ	τ	tau
Υ	υ	upsilon
Φ	φ	phi
Χ	χ	chi
Ψ	ψ	psi
Ω	ω	omega

Letter	Use
Alpha	Alpha radiation
Beta	Beta radiation
Gamma	Gamma radiation
Delta	Change (lower case, small change e.g. diploes) (upper case = large change, e.g. energy during a reaction)
Theta	Angles
Lambda	Wavelength
Mu	Friction coefficiant
Nu	UV light, as hν
Pi	Fundamental constant, 3.14159 Molecular orbital, double bond
Sigma	Molecular orbital, single bond (lower case) Sum (upper case)
Phi	Fundamental constant, “the golden ratio”, 1.618
Omega	Ohms, unit of resistance



Appendix C: Tolerance Values

Reading accuracy	Reading format	Tolerance	Example reading	Possible piece of equipment
Nearest 10	10	$\pm$ 5	50cm^3 of acid	Beaker
Nearest 1	1	$\pm$ 0.5	2 mol dm^{-3} of solution	Measuring cylinder
1 d.p	0.1	$\pm$ 0.05	24.5 cm^3 titre	Volumetric flask
2 d.p	0.01	$\pm$ 0.005	2.45g of solid	Dropping pipette
3 d.p	0.001	$\pm$ 0.0005	2.453g of solid	Accurate balance

You should always measure to one more decimal place than you need. For example, if you want a final/mean reading of 1 decimal place, record all your readings to 2 decimal places.

Thermometers and burettes both produce values which end in a 0 (on a graduation mark) or a 5 (end between two graduation marks)

For Example:

A burette measures

24.00 cm^3, 24.10 cm^3, 24.15 cm^3, 24.20 cm^3

A thermometer measures

18.5°C, 19.0°C, 19.5°C, 20.0°C