In a Nutshell

A Practical Guide to Studying Mechanical & Manufacturing Engineering

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Contents

These pages will help you with communication tasks during your degree, and later as a professional engineer.

You will need to present your calculations in ways that satisfy markers. Later on you will need similar skills as part of your professional work.

University is a new experience, and now is a good time to review your approach to study.

Engineering goes beyond brain work. It hits the emotions. So does studying engineering.

Learn the specialist words in each subject beforehand and get a head start.

Reports: Preparation

Purpose

When you've worked out a structure for a report (see previous pages), you then have to produce the content and describe it clearly and appropriately.

Description

Here are various tips to help you get your reports done so they get you good marks now, and compliments in later professional life.

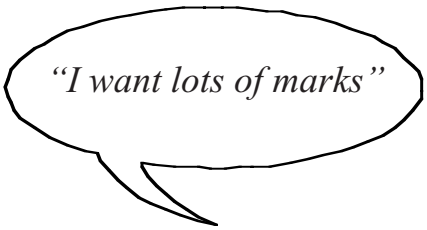
Vital Points When Preparing a Report

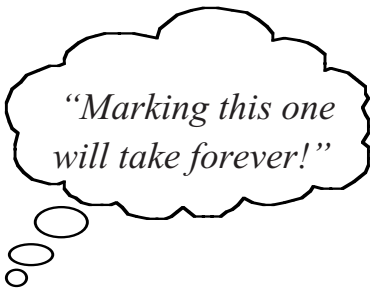
- **Intention** What are you trying to achieve?
- **Audience** Who will read it; and what do they want (or need) to know?
- **Style and Layout** What are the expected conventions? What will suit the audience?

As an example, this is how we approached In a Nutshell*:*

- Our **intention** was to give our audience (you) practical and immediate help in meeting the requirements of their study, and to suggest that this can be satisfying (even fun) too.
- Our **audience** (you) would be too busy (and distracted) to read through heavy and perhaps intimidating texts to get help with an assignment due very soon.
- For our **style** we wanted three aspects:
  1. an open, uncluttered, friendly look, so our audience (you) would want to read it and not be intimidated,
  2. a "plain English" style of words that is also open, uncluttered and friendly,
  3. a layout that put the help where you would find it when you needed it.

But our informal style would not suit typical engineering reports. Here we will concentrate on writing at University and the same ideas apply to professional engineering life.





Your Intention

Satisfy the marker
In early years you are often trying to provide the unspoken "correct" answer, and this can make writing awkward. Later, some of your reports will tell the marker something they don't know, which is more like professional writing and easier to do.

To show that you have a good grasp of the material, you'll need a clear logical flow (a "story line").

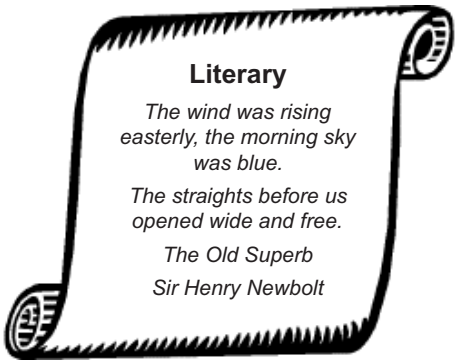
Audience

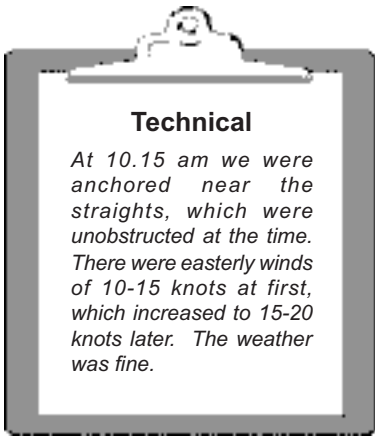
✘ Frustrated markers = lower marks
Overworked markers who are struggling to understand what you mean, or who think you are not conscientious (eg: the report is messy or doesn't obviously meet requirements) will be grumpy.

✔ Happy markers = higher marks
Markers who find a clear story line with the main points obvious, in a well presented document will be delighted.

✘ Small errors are deadly
If you can't be bothered to check details such as spelling, will the marker trust that the rest is accurate?

Style and Layout





Every type of writing (each genre) is different. Most technical writing aims to inform, and the style should be suitably formal without being pompous. Keep the language simple and direct.

A "professional" look is required. Formatting and layout must be neat and well organised so that readers can easily find what they want.

Examples and More Help

An annotated page from a good year 1 design report is on page 14.

For a typical professional engineering style, see the layout of "The Standard Specification for The Presentation of Student Written Assignments"
(available at http://www.mech.unsw.edu.au/undergraduate/assignments.html).

The Learning Centre has brochures on 'Technical Writing" and "Report Writing"
(available at http://www.lc.unsw.edu.au/olib.html)

Here is a sample page from the body of a report

clear headings

5.2. Vibration Isolation Products

personal pronouns are acceptable providing an objective tone is maintained

After consulting with various manufacturers and distributors, we have found two types of vibration suppression devices that are available for portable CD Players. Both are simple in design but have inherent drawbacks.

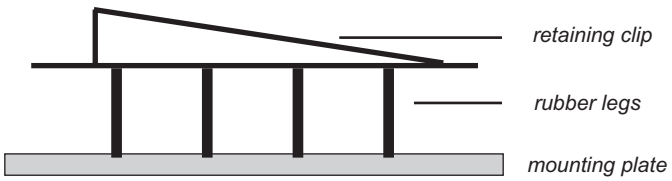
number or bullet lists

1. A foam padded carrying case. The CD player is placed inside the protective case, which is then placed on the seat or dashboard. One obvious limitation is that the unit is free to move about the car. There is no provision to secure the case. This can lead to track skipping and damage to the CD player itself.

factual and descriptive statements

2. A mounting bracket (Figure 2.). This bracket is made of plastic plates which sit on synthetic rubber legs.

complete and grammatically correct statements



clearly label and refer to tables and figures

Figure 2. Mounting Bracket

The bottom plate can be secured to the dashboard. The CD player is held in position by means of a plastic spring-loaded clip.

Comparing these two devices with CD players specifically designed to be fitted into cars highlights their limitations.

acknowledge sources

The majority of 'in car' CD players utilise a double floating anti-vibration system (Sony 1994). Only the laser pick-up, spindle motor, carriage motor and stage mechanism are isolated instead of the entire unit. This is achieved by using a combination of springs and air dampers. Pioneer have recently switched to silicon oil-filled dampers. This system can be installed between 0 and 90 degrees and still be effective (Pioneer 1997). Some manufacturers of four-wheel drive vehicles recommend this type of CD player be installed into their vehicles.

a concluding opinion is expressed objectively and on the basis of preceding discussion

Foam padding or rubber mounted brackets are better than nothing. However they are obviously inadequate when compared with the vibration suppression of CD players specifically designed for cars.

number pages

17

Free-body Diagrams

Purpose
The mystical Free Body Diagram makes visible the first conceptual step in mechanics analysis.

Description
An FBD is a diagram of the object on its own, showing all the forces that act on it.

"Look at this solution. Not even a proper free-body diagram!"
World-wide whinge of mechanics lecturers.

Rules for Free-body Diagrams

An annotated example is opposite

1. Isolate the system fully. Do not show any connections with the surroundings (not even a hint).
2. Replace external interations with force arrows, with either the head or tail where the forces are considered to act (not in mid-air or on the wrong line of action, for example).
3. Include all external forces (unless specifically excluded by a general statement, e.g. "weights of structures are neglected").
4. Show *only* external forces (do not show any internal forces).
5. Show the dimensions you use in the solution (but avoid extra ones; they confuse).
6. Show co-ordinate axes if you refer to them in the solution (e.g. in labelling forces).

Free Body Diagram

No contact with other objects

The object to be analysed is shown in a recognisable form

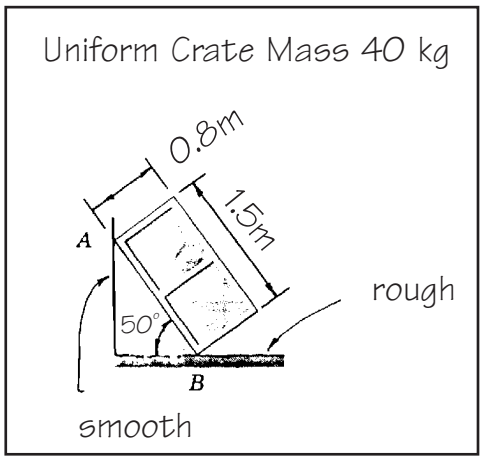
An abstraction for relating theory to physical reality. It shows all the information needed for a solution

ANNOTATED START OF A STATICS PROBLEM

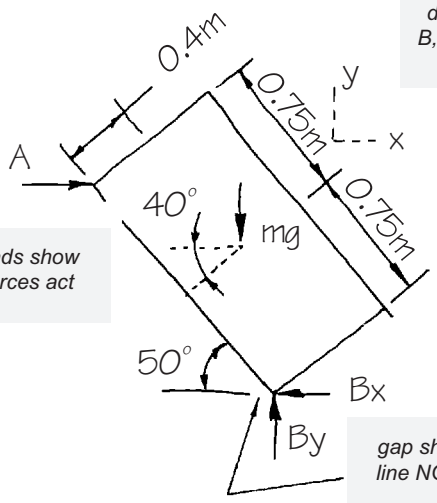
1. Draw an FBD of the crate which meets the rules.

2. Use this FBD and equilibrium equation(s) to calculate the horizontal force at A, setting out your solution so that it meets the rules.

The coefficient of friction at B is sufficient to prevent sliding.



1. FBD



directions x and y are referred to at B, so the x-y axes must be shown on the diagram.

dimensions used in the solution are shown on the FBD-easiest to add them as you proceed.

arrowheads show where forces act

The diagram looks like the object and is approximately to scale

gap shows that this is a dimension line NOT the surface of the ground

How Do You Learn?

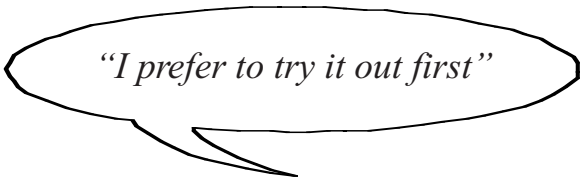
Purpose

Knowing how you learn best helps you study more effectively, which increases your understanding of subjects and assignments.

Description

There are various approaches to learning, each with their associated skills and study strategies. The types of approaches you use will depend on your preferred way of working and also the type of task at hand.

Which of the statements on these pages matches your preferred approach to learning new skills and new ideas? You can choose as many as you like.



By Doing?

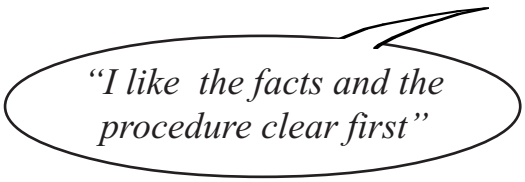
You remember information by doing something active or physical with it.

- Try organising group activities—get everyone to take turns demonstrating procedures or concepts.
- Guess exam questions and practise answering them—visit the Library home page for past exam papers on the internet.
- Look for interpretations and relationships that link the facts.
- Remember to take the time to read instructions and check your answers.

By Thinking?

You usually make accurate decisions and are careful to avoid hasty conclusions.

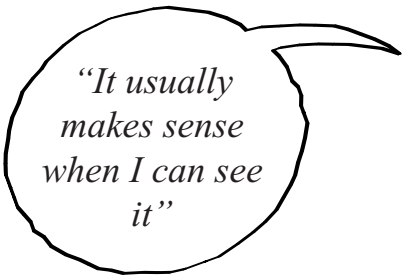
- When reading, stop regularly to recall material.
- Try writing short summaries of your class notes and readings.



- Try connecting new information to the real world.
- Look for specific examples of concepts and procedures in your textbooks or ask your lecturer for examples.

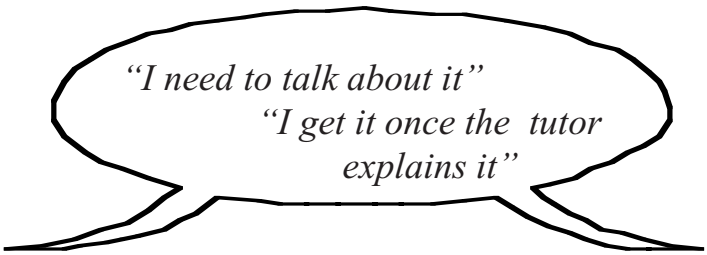
Discover your learning style—visit:
<http://www.engr.ncsu.edu/learningstyles/ilsweb.html>

By Looking?



You remember best when information is presented in a visual form.

- Locate diagrams, pictures, illustrated dictionaries, charts, AV material, CD ROMs to study.
- Make mind maps, flow charts or diagrams of topics to get an overview.
- Use colour and symbols in your notes to highlight key points.



By Talking?

You learn best when information is presented in words—spoken or written.

- Read aloud.
- Record lectures and playback while doing physical activity (exercise, cooking, gardening) or while relaxing.
- Watch videos of engineering topics.
- Organise a study group to discuss each other's explanations of topics and solutions to problems.

You have probably now realised that you use a number of these approaches at different times when learning a concept or skill. Perhaps someone has shown you how to learn in a particular way, perhaps you have chosen a particular way to learn because it seems to always work.

Being aware of how you are learning something gives you more control and confidence to decide if it is working or whether you need to try a different approach.

Remember: one approach on its own is not enough; try using a variety of approaches to maximise your learning.

IN A NUTSHELL

Learning the Sights & Sounds of Engineering

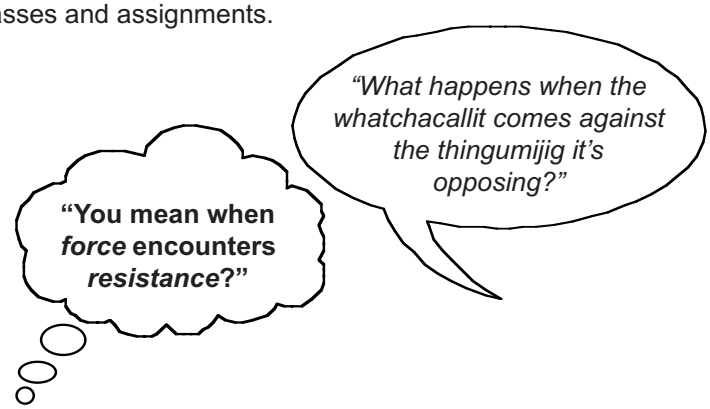
PURPOSE:
"To learn engineering, you must learn the language. To be an engineer you must use the language".

DESCRIPTION:
The following word list can give you a head start in MECH1300. Word lists for other courses are being developed.

1. When you start a new course, look over the word list for that course so you recognise the words in lectures and in your textbooks.

2. Learn how to say the words. Listen to how your lecturer says them. Use a good dictionary to look them up.

3. Build your understanding of the words and the concepts they represent by using them in your classes and assignments.



4. If you feel overwhelmed with the number of new words you are faced with, start with vaguely familiar words rather than completely unfamiliar words. You will learn more words this way!

WORD LISTS

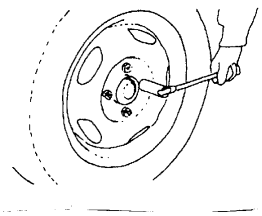
Knowing the words to expect can make understanding a lecture easier.

MECH1300 ENGINEERING MECHANICS 1

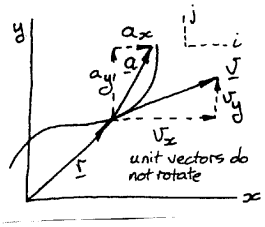
The words below will appear in this course, roughly in the order given. Some of them will be quite new; others will be familiar words but with an exact (and sometimes special) meaning. By the end of this course you should be familiar with them all.

If a word that is not on the list catches you out during class, please let me know so that we can include it in the next version of the word list.

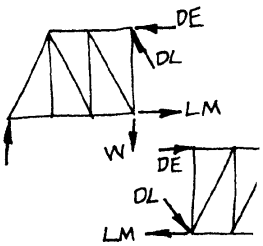
Robin Ford



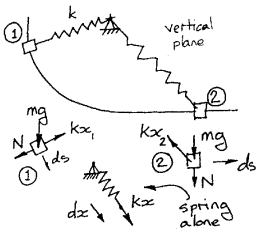
Isolating a system. Free Body Diagram, external, internal, vector, unit vector, parallelogram law, projections, rectangular components, resultant, scalar, interactions, cantilever, built-in, force, movement, couple, torque, point or distributed load, coefficient of friction, smooth, kinematics, kinetic, equilibrium, equivalence, transmissibility, collinear.



Particle, rectilinear, curvilinear, acceleration, velocity, speed, displacement, path, constrained, normal, tangential, radius of curvature, polar, radial, transverse, relative, absolute, unit vector, superposition, projectile, frame of reference, instantaneous.



Action/reaction, truss, tension, compression, centroid, composite bodies, elemental strip (or slice etc.), pressure, buoyancy.



Equations of motion, Newton's laws, work, energy, power, impulse, momentum, potential, torsion, conservation, impact, elastic, inelastic, restitution.

A tape recording of these words is available from The Learning Centre, Map Reference G23 (between the Mathews Building and the Upper Campus Parking Station).