

# COMMUNICATING USING GRAPHICAL TECHNIQUES

## Graph drawing:

### First graph

On one of the sheets of graph paper supplied draw a graph of the following function over the range  $t = 0$  to  $t = 50$

$$v = 0.03t^3 - 1.3t^2$$

*v = velocity in m/s, and t = time in s.*

### Second graph

The following results were obtained from a test on an internal combustion engine. They represent the power output (in kW) against engine speed (RPM) for a test at full throttle at standard sea level atmospheric conditions. Plot the results on a graph to show the variation of power output with speed.

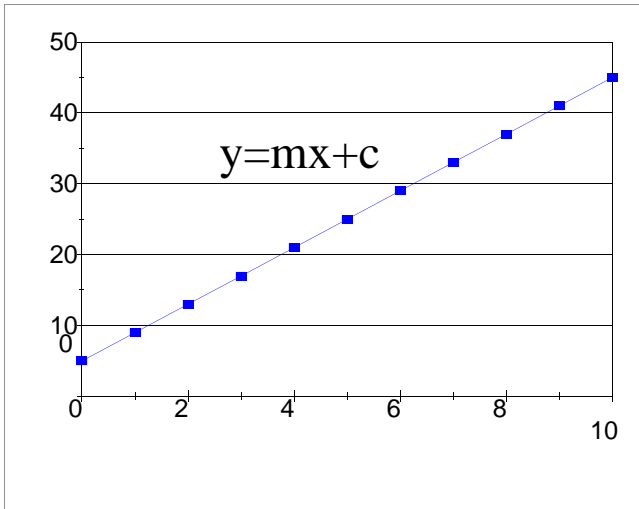
RPM	Power output (kW)
1000	21
1500	26
2000	33
2500	37
3000	44
3500	39
4000	44
4500	40

First graph:- check list

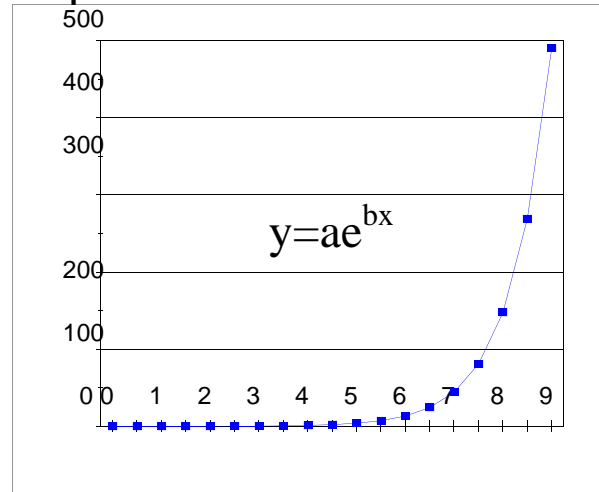
- 1) What technique did you use to obtain values for  $v$ ?  
-visualisation?, programmable calculator?, spreadsheet?
- 2) What is the purpose of the graph?
  - (a) to show the shape only? - a small compact graph will do this;
  - (b) to obtain values from? - a large clear accurate graph is needed depending on the precision required for  $v$  and  $t$ .  
Do you need the construction points? - NO - because you can calculate any value of  $v$  to any accuracy you need.
- 3) Is your graph labeled - with a title? axes and units?
- 4) What is the interpretation of the graph?
  - where is  $v=0$ ?
  - what does the slope represent?
  - what does the area under the graph represent?

Graphs of mathematical functions have characteristic shapes which you should be able to recognise from the functions themselves or from inspection - curve sketching.  
Some common shapes are shown over ..

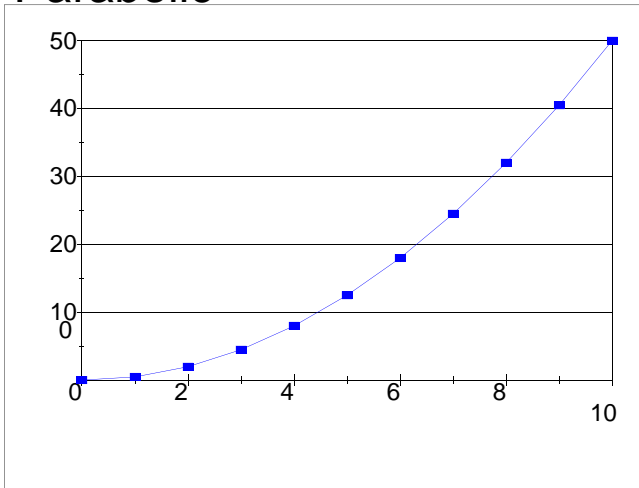
## Linear



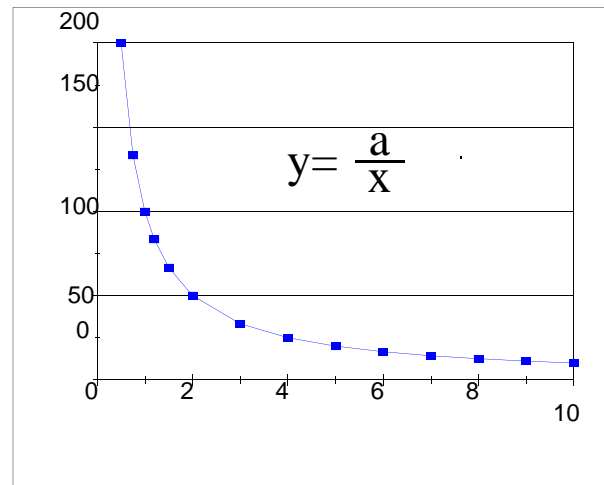
## Exponential



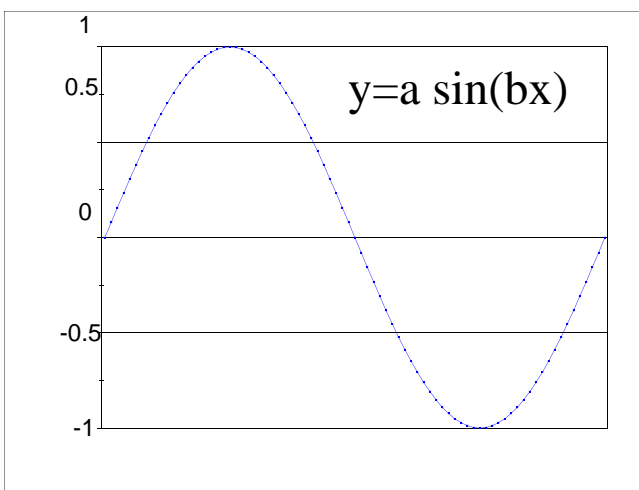
## Parabolic



## Inverse or Hyperbolic



## Sinusoidal or SHM



## Second graph:- Check list

- 1) What technique did you use to plot values of Power and RPM?

Are the points important or not? In this case they represent experimental readings and are therefore very important. Make them stand out - do not erase them!

If more than one graph is plotted (e.g say torque was also plotted against RPM) there will be the need to distinguish between points - so use different symbols.



- 2) What is the purpose of the graph?
  - to present results and show trends - a small compact graph will do this.

A smooth curve - 'nature' usually isn't discontinuous or jerky!

The points themselves

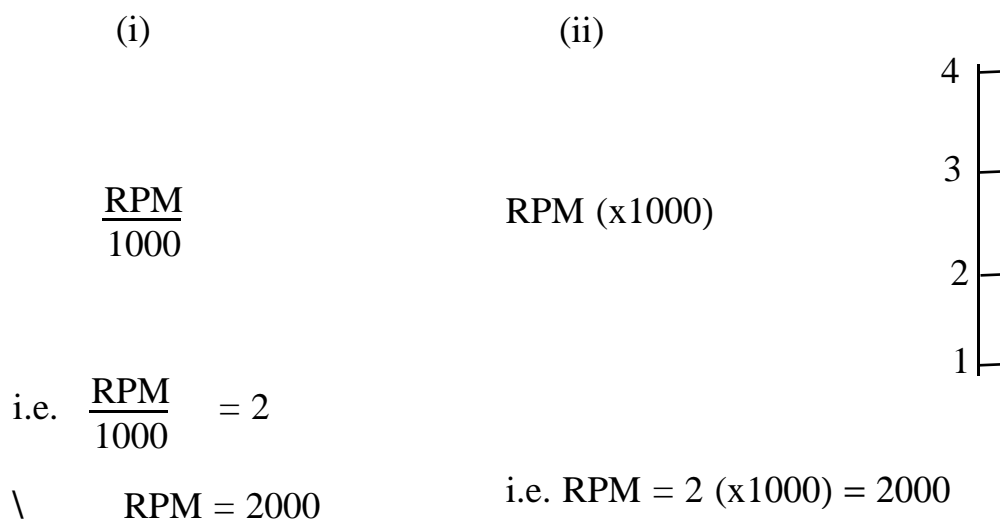
- 3) How did you choose the axes and scale?
  - Did you include the origin? - in this case it gives a correct sense of proportion.
  - Use of partial axes.
  - Space considerations

4) Is your graph labeled - with a title? axes and units?

Label the axes with actual scale values - if this is difficult because of shortage of space or the axes are used for more than one graph, values may be abbreviated - usual methods are:

(i) use a divider or multiplier

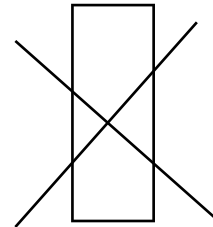
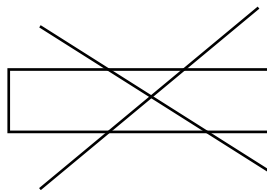
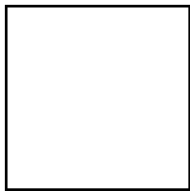
(ii) show what must be done to obtain the correct value by giving instructions in brackets



It is usually fairly obvious what has to be done - but take care if you are not familiar with the units being used.

## GOOD PRACTICE with GRAPHS

1. Decide on its purpose:
  - to show trends
  - to display results
  - to make comparisons
  - to 'use' (i.e. extract data from)
2. Choose the axes carefully : use units of 5 or 10 divisions  
(or sometimes  $12\frac{1}{2}$  !)
3. Proportion the graph close to 'square'.  
Avoid drawing graphs which require the reader to turn it sideways.



4. Include the origin where it aids interpretation or gives correct proportion -otherwise use 'broken' axes.
5. Use a grid/white-border format for a clean effect.
6. Ensure that the graph 'stands alone' - you ought to be able to copy it and it will make sense on its own - i.e. it will be complete with title, labelled axes - (units quoted) and include all relevant information.
7. Keep it clear, clean and neat.

## **Further Graphical Techniques**

1. Histograms - bar charts - pictograms

2. Pie charts

3. Sankey diagrams

4. Scale sketching

5. Circuit and symbolic diagrams

6. Sectional drawings

7. Cut-aways

8. Useful equipment

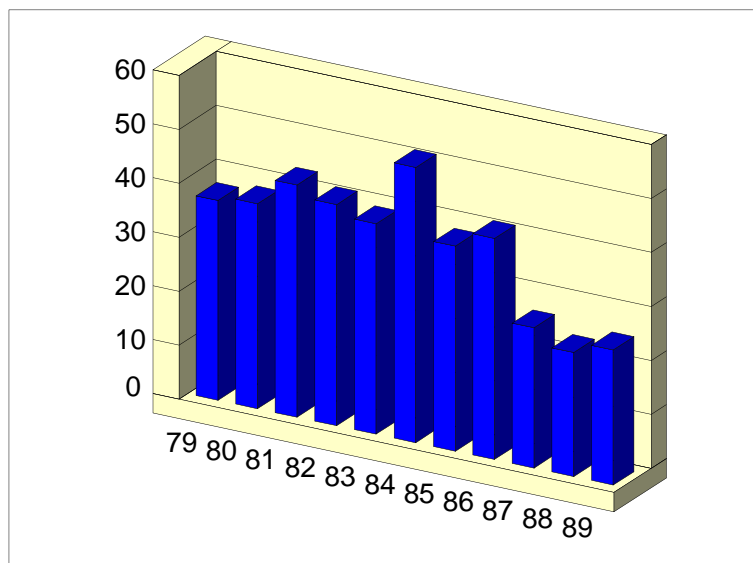
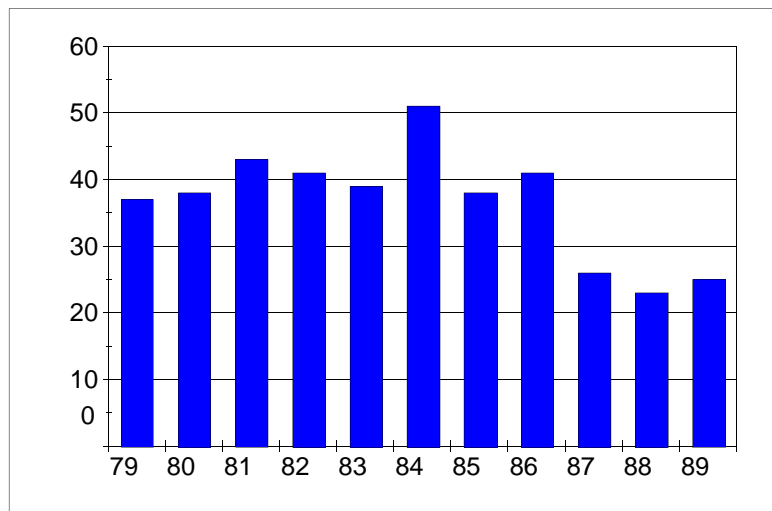
# HISTOGRAMS

## Intake to the HND course 1979 - 1989

Year	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89
Intake	37	38	43	41	39	51	38	41	26	23	25

Although all the data is given, it is not easy to detect trends or patterns from the figures alone.

Histograms are best used for showing discrete (statistical) data to show actual values, changes and trends. Include the origin!



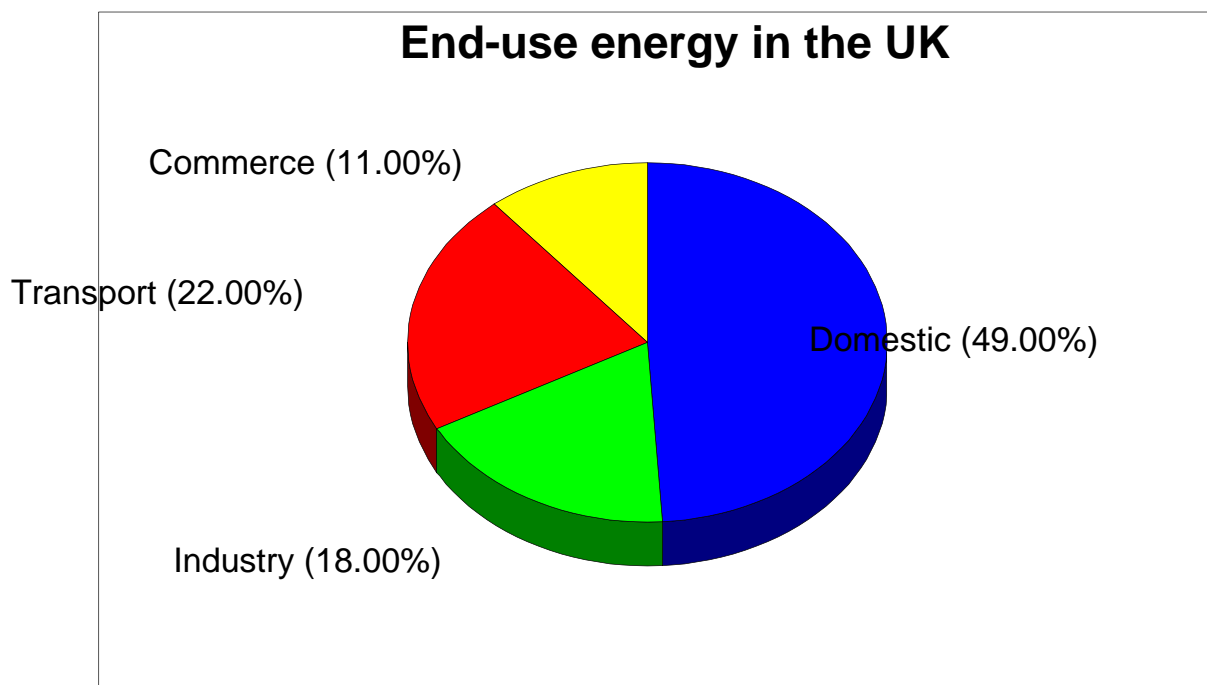
# PIE CHARTS

End use of delivered energy in the UK

INDUSTRY	18%
TRANSPORT	22%
DOMESTIC	49%
COMMERCE	11%

Although the data are given, the relative value of one quantity with respect to the remaining values is not immediately clear

Pie charts illustrate relative sizes of components which make up the whole

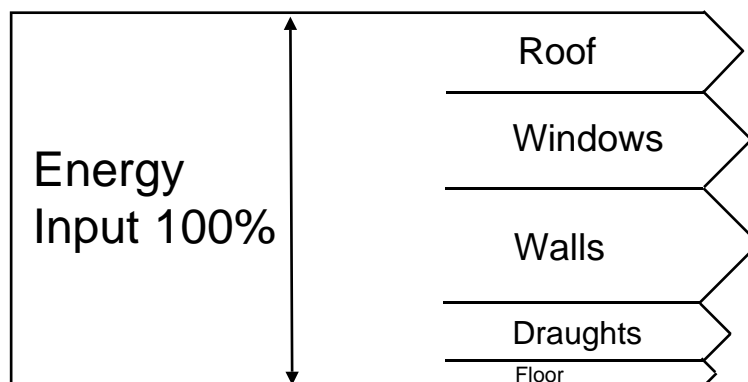


## SANKEY DIAGRAMS

A Sankey diagram illustrates an input output situation drawn to scale

Example - Energy losses from a typical dwelling

Floor	1.9 kW	7.5%
Walls	8.2 kW	32.3%
Windows	6.3 kW	24.8%
Ventilation	4.0 kW	15.7%
Roof	5.0 kW	19.7%
TOTAL	25.4 kW	100%



## **SCALE SKETCHING**

Often done on graph paper

Give actual proportions

Good for detail work

Helps to avoid errors of proportion

## **CIRCUIT & SYMBOLIC DIAGRAMS**

Often used for electrical/electronic/ pneumatic and hydraulic systems

Standard symbols are used (See British standards)

These diagrams help with understanding the system - especially its operation and control. They are virtually essential for trouble shooting

## **SECTIONAL DRAWINGS**

These drawings form part of 'Engineering Drawing'

They typically show cross-sections of components or assemblies

They are drawn to scale

The actual 'cut' areas are normally cross-hatched

They are frequently used to show operating principles and the main construction or assembly features.

## **CUT-AWAY DRAWINGS**

These perform the same function as Sectional Drawings but in 3-D.

Need specialist expertise, but simple cutaways can be relatively easily drawn.