Cheatsheet - Graphs of Functions and Kinematics

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1. Intro

We introduce horizontal and vertical axes. These axes intersect at a point O called the origin. The horizontal axis is used to represent the **independent** variable, commonly x, and the vertical axis is used to represent the **dependent** variable, commonly y. The region shown is then referred to as the x-y plane.

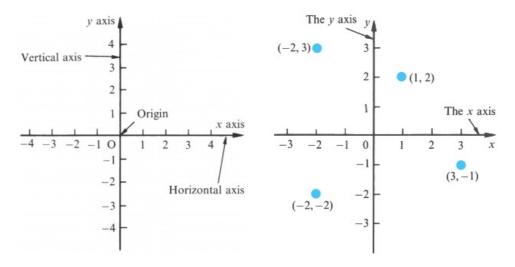


Figure 17.1 The x-y plane

Figure 17.2 Several points in the x-y plane

2. Intervals

We only need part of the x/y axis when plotting graphs. Each coordinate on the axis is called an **interval**. There are three types of intervals:

- Closed interval: includes its end-points, e.g. $\{x\colon x\in\mathbb{R},\,1\leq x\leq 3\}$, denoted as [1,3] (square brackets).
- *Open interval*: does not include its end-points, e.g. $\{x : x \in \mathbb{R}, 1 < x < 3\}$, denoted as (1,3) (round brackets).
- Semi-open and semi-closed interval: may be open at one end and closed at the other, e.g. $\{x: x \in \mathbb{R}, 1 < x \leq 3\}$, denoted as (1,3] (round and square bracket).

Closed intervals use the filled marking, [-3, 4]:



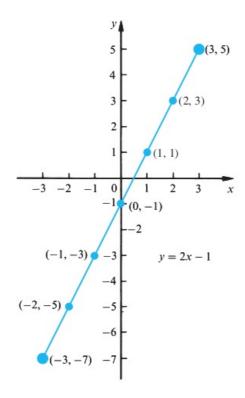
Open intervals used the hollow marking, (1, 4):



3. Plotting Graphs of a Function

Plotting a graph of y=2x-1 for $-3 \le x \le 3$:

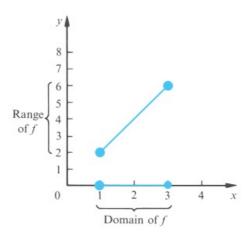
x	-3	-2	-1	0	1	2	3
y	-7	-5	-3	-1	1	3	5



4. Domain and Range of Function

The set of values that we allow the independent variable to take is called the **domain** of the function. If the domain is not specified, we take the largest set possible. The set of values taken by the output is called the **range** of function. The domain and range can extend indefinitely (infinite) in one or both directions.

For example, the function f is given by y=f(x)=2x, for $1\leq x\leq 3$.



5. Kinematics

Describes the motion of objects without reference to forces, hence acceleration will always be constant.

Basic definitions:

$$d = displacement$$

$$v = \text{velocity}$$

$$a = acceleration$$

$$t = time$$

Velocity and displacement can have subscripts that indicate initial conditions:

$$v_o = v_i = \text{initial velocity}$$

$$v_t = v_f = \text{final velocity}$$

Fundamental equations:

- $\bullet \ v_t = v_i + at$
- \circ The velocity of any object at time t is equal to the $\emph{initial}$ velocity plus the acceleration times t

$$\bullet \ \ x_t = x_o \times v_i t + \frac{1}{2} a t^2$$

 \circ The position of the object at time t is qual to the *initial* position x_o plus its *initial* velocity v_i multiplied by time t plus $\frac{1}{2}at^2$.

•
$$v_f^2 = v_i^2 + 2ad$$

 $\circ~$ Velocity squared at time t is equal to the $\emph{initial}$ velocity squared plus $2\emph{ad}.$

Additionally:

$$d=v_it+rac{1}{2}at^2 \ v_f^2=v_i^2+2ad \ v_f=v_i+at \ d=igg(rac{v_i+v_f}{2}igg)t$$

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