Absolute Value

$$|a| = \begin{cases} a, & a \geq 0 \\ -a, & a < 0 \end{cases}$$

Absolute value is **distance** of a number from **0**.

It is magnitude only, direction is **NOT** considered.

e.g. $(i) \; |-5| = 5$

$(ii) \; |6-8-2| = |-4|$
$$= 4$$

$(iii) 7 - |6 \times 3 - 20| = 7 - |-2|$
$$= 7 - 2$$
$$= 5$$

$(iv) 3|-6| = 3 \times 6$
$$= 18$$

Absolute Value Equations/Inequations

e.g. (i) $|x| = 7$

$\underline{x = 7 \text{ or } x = -7}$

(ii) $|2x - 3| = 7$

$2x - 3 = 7 \quad \text{or} \quad -(2x - 3) = 7$

$2x = 10 \qquad\qquad -2x + 3 = 7$

$x = 5 \qquad\qquad\qquad 2x = -4$

$\qquad\qquad\qquad\qquad x = -2$

$\underline{x = -2 \text{ or } x = 5}$

(iii) $|2x + 6| = 3x - 1$

$2x + 6 = 3x - 1 \quad \text{or} \quad -(2x + 6) = 3x - 1$

$-x = -7 \qquad\qquad\qquad -2x - 6 = 3x - 1$

$x = 7 \qquad\qquad\qquad\qquad -5x = 5$

$\qquad\qquad\qquad\qquad x = -1$

$\qquad\qquad\qquad$ (**NOT** a solution)

$\underline{\therefore x = 7}$
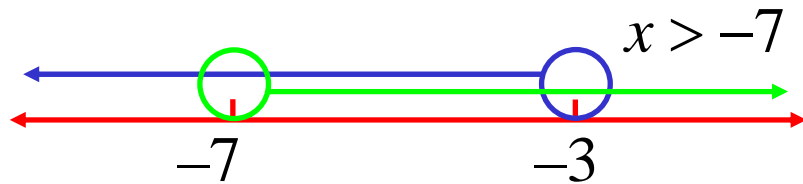
Note : the equation
$|\ | = something \ with \ pronumerals$
may produce an answer that
is not a solution

(iv) $|x+5|<2$

$x+5<2 \quad$ or $\quad -(x+5)<2$

$x<-3 \qquad\qquad -x-5<2$

$-x<7$

$x>-7$

$\therefore -7<x<-3$

(v) $|3x+2|\ge 1$

$3x+2\ge 1 \quad$ or $\quad -(3x+2)\ge 1$

$3x\ge -1 \qquad\qquad -3x-2\ge 1$

$x\ge -\dfrac{1}{3} \qquad\qquad -3x\ge 3$

$x\le -1$

$\therefore x\le -1 \quad$ or $\quad x\ge -\dfrac{1}{3}$

Absolute Value Graphs
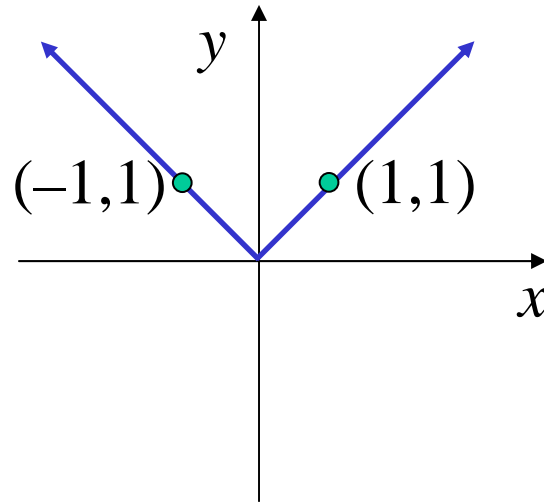
$$y = |f(x)|$$

the part of $f(x)$ below the x axis is reflected above the x axis

$$y = f(|x|)$$

the left side of $f(x)$ disappears and the right side is reflected in the y axis
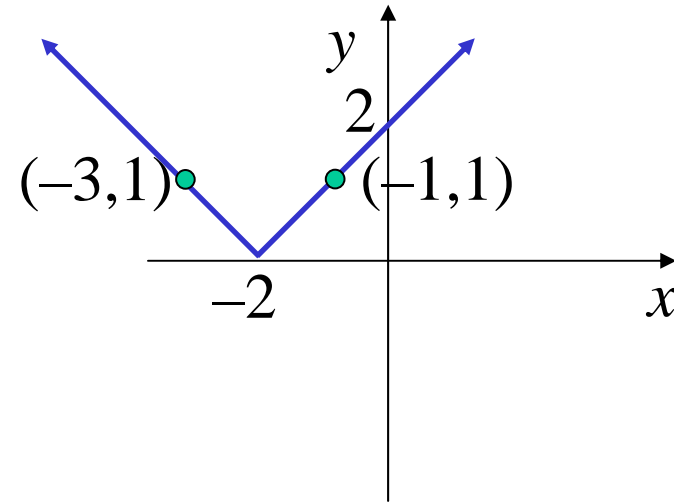
e.g. $(i)\ y = |x|$

(ii) $y = |x+2|$

    1. basic curve : $y = |x|$

    2. shift left 2 units

        OR

    1. basic curve : $y = x+2$

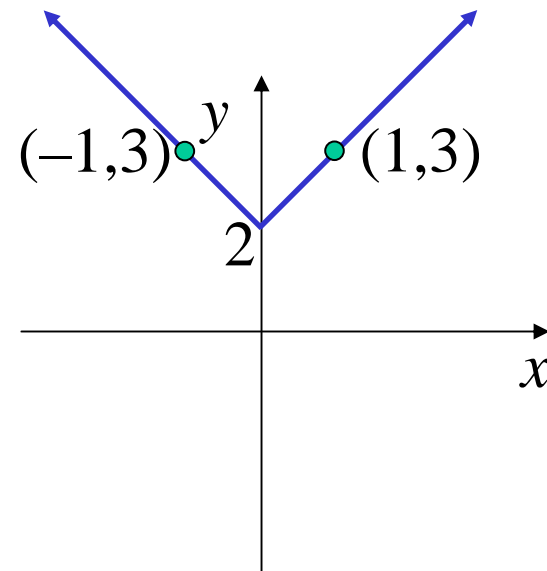   *2. reflect up in the x axis*

(iii) $y = |x|+2$

    1. basic curve : $y = |x|$

    2. shift up 2 units
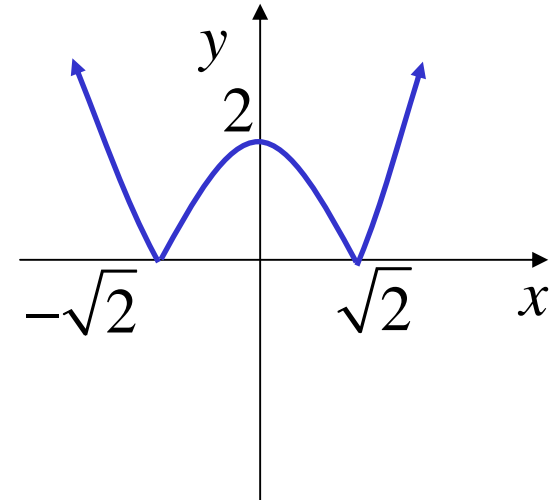
        OR

    1. basic curve : $y = x+2$

    2. reflect left in the y axis

(iv) $y = \left| x^2 - 2 \right|$
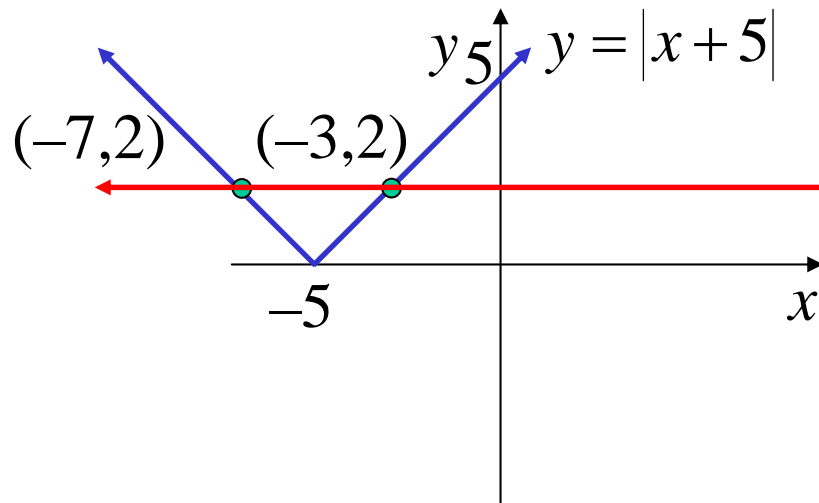
   1. *basic curve* : $y = x^2 - 2$

   2. *reflect up in the x axis*

(v) $\left| x + 5 \right| < 2$

Q: for what values of x is the absolute value curve below the line $y = 2$?

$-7 < x < -3$

$y = \left| x + 5 \right|$

$(-7, 2)$ $(-3, 2)$

$y = 2$

Exercise 3D; 2acfh, 3bdfh, 5adfh, 7bd, 8bdf, 9b *i*, *iii*, 11, 14, 18, 21*

Exercise 3E; 1, 2ab, 3ac, 4ac, 5ac, 14, 17c, 20*