

Modulus functions

Q1

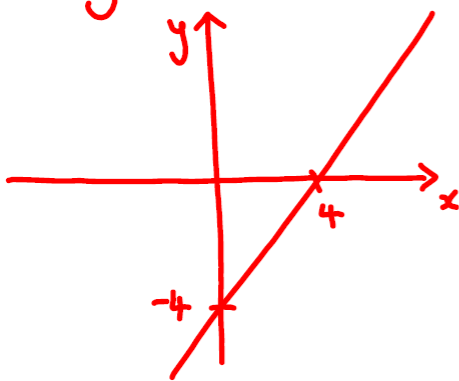
(i) Sketch the graph of $y = |x - 4|$

[2]

(ii) Solve the equation $|x - 4| = 7$

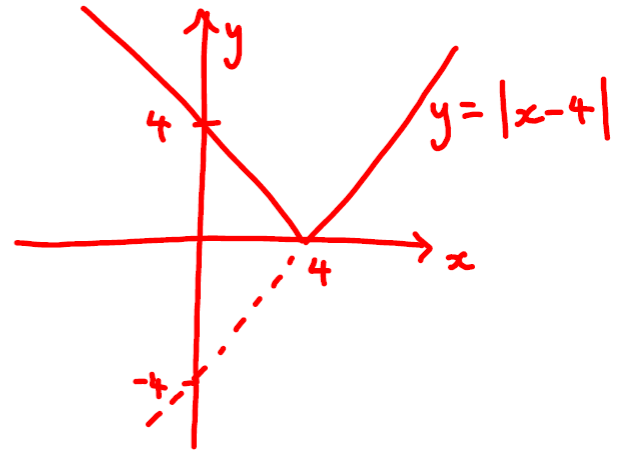
[3]

(i) First draw
 $y = x - 4$



then

$|x - 4|$



(ii) Now $|x - 4| = 7$

Look at graph

Draw line $y = 7$

solve

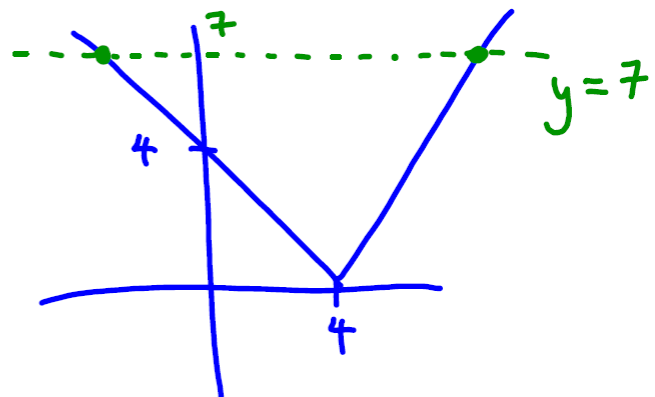
$$x - 4 = 7$$
$$\boxed{x = 11}$$

&

Answers

$$x - 4 = -7$$
$$\boxed{x = -3}$$

You can check
on your calculator



Q2

Fig. 3 below shows the graphs of $y = |2x - 1|$ and $y = 3$

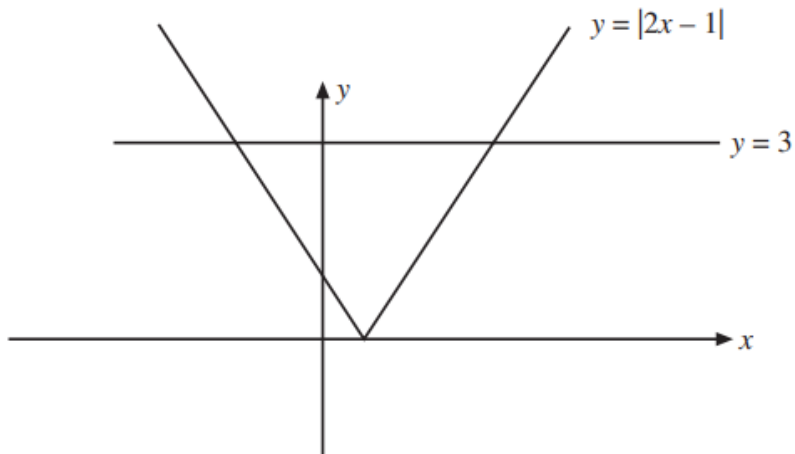


Fig. 3

Find the coordinates of their points of intersection.

[6]

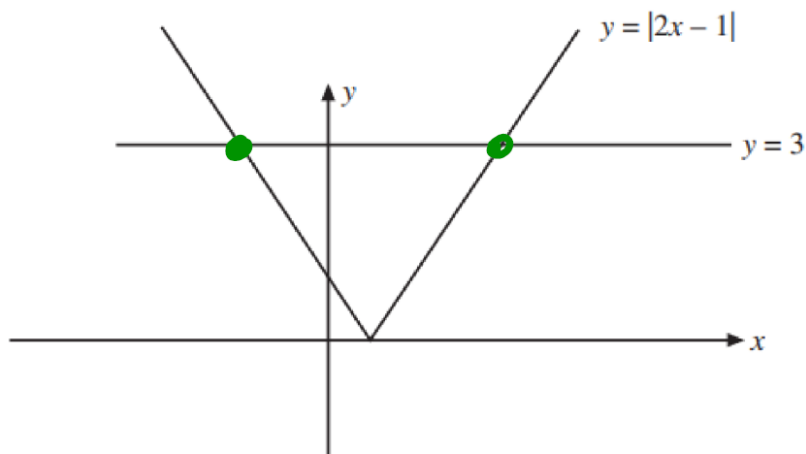


Fig. 3

Find the coordinates of their points of intersection.

[6]

$|2x - 1| = 3$ means look at $+3$ & -3

$$2x - 1 = -3$$

$$2x - 1 = 3$$

$$2x = -2$$

$$2x = 4$$

$$x = -1$$

Easy to check!!

$$x = 2$$

Q3

(i) Sketch the graph of

$$y = |2x - 5|$$

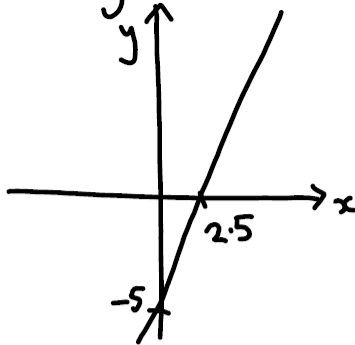
[2]

(ii) Solve

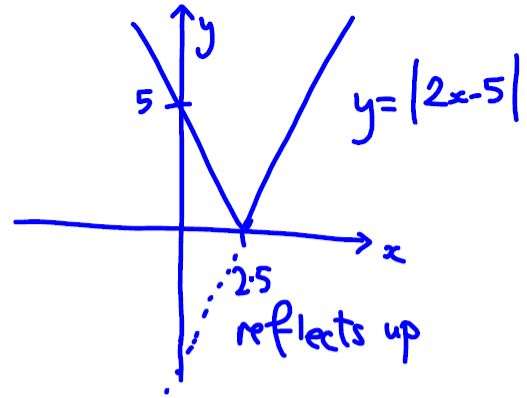
$$|2x - 5| > 10$$

[4]

(i) Draw $y = 2x - 5$

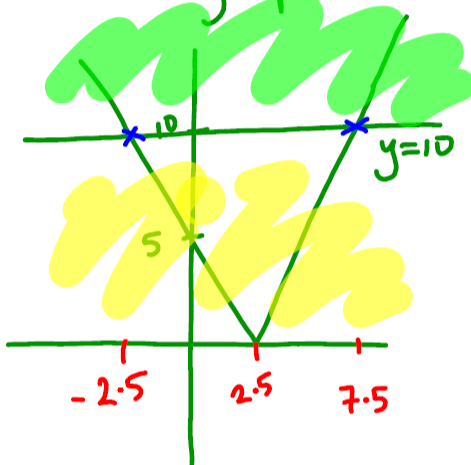


so $|2x - 5|$ means



(ii) $|2x - 5| > 10$

Look at graph



The points x are when
 $|2x - 5| = 10$

The yellow section is
when $|2x - 5| < 10$

The green section is
when $|2x - 5| > 10$

so find

$$|2x - 5| = 10$$

2 possible

$$2x - 5 = -10 \quad \& \quad 2x - 5 = 10$$

$$2x = -5$$

$$x = -2.5$$

$$2x = 15$$

$$x = 7.5$$

Answer $x < -2.5$ & $x > 7.5$

Q4

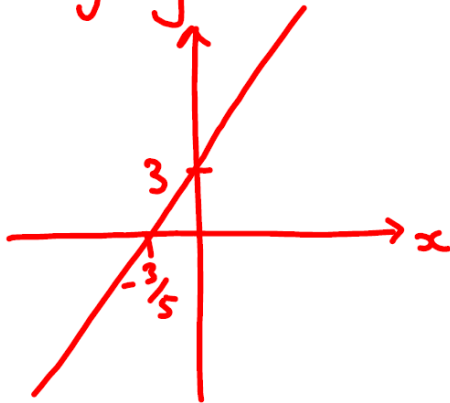
Solve

$$|5x + 3| < 2$$

[4]

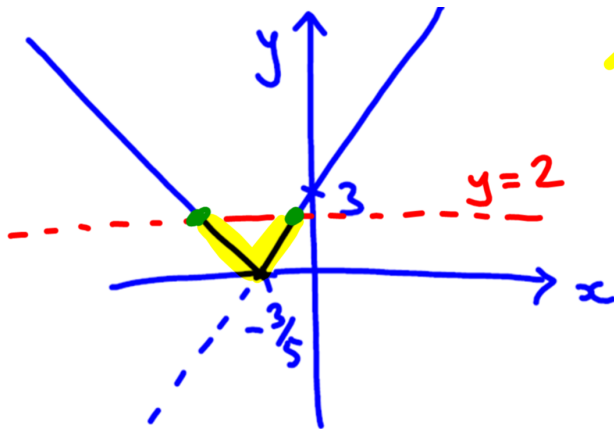
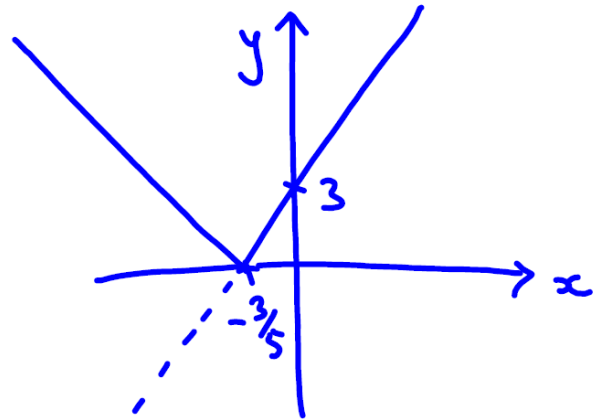
Draw graph $y = |5x + 3|$

Firstly $y = 5x + 3$



Then

$$y = |5x + 3|$$



$$|5x + 3| < 2$$

Draw line $y = 2$

We must work out points where

$$y = |5x + 3| = 2$$

$$5x + 3 = -2$$

$$5x = -5$$

$$x = -1$$

$$\& \quad 5x + 3 = 2$$

$$5x = -1$$

$$x = -1/5$$

$$\text{Ans} \quad -1 < x < -1/5$$

Q5

Sketched below in **Fig. 2** is the graph of $y = e^x$

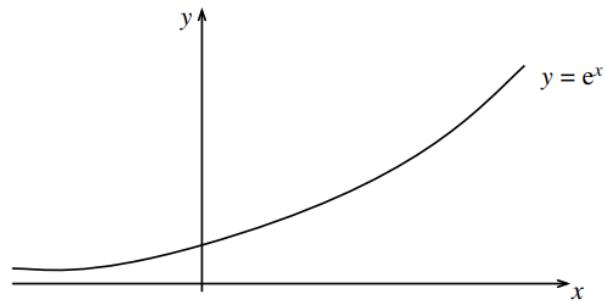


Fig. 2

(i) Sketch the graph of $y = e^x - 1$, marking on the horizontal asymptote. [2]

(ii) Sketch the graph of $y = |e^x - 1|$, marking on the horizontal asymptote. [3]

(iii) Find the exact values of x for which

$$|e^x - 1| = \frac{1}{2} \quad [5]$$

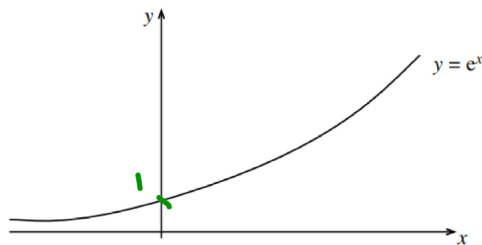


Fig. 2

moves down 1 unit

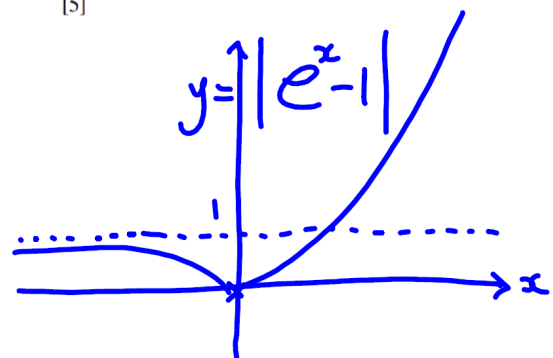
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(iii) Find the exact values of x for which

$$|e^x - 1| = \frac{1}{2} \quad [5]$$

(ii) Take the green graph then make it all positive



Look for 2 values

$$|e^x - 1| = \frac{1}{2}$$

$$e^x - 1 = -\frac{1}{2}$$

$$e^x = \frac{1}{2}$$

$$x = \ln\left(\frac{1}{2}\right)$$

$$e^x - 1 = \frac{1}{2}$$

$$e^x = \frac{3}{2}$$

$$x = \ln\left(\frac{3}{2}\right)$$

Easy enough to check on calculator!

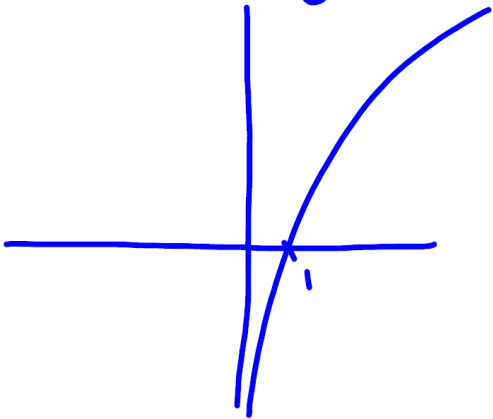
Q6

Find the exact values of x for which

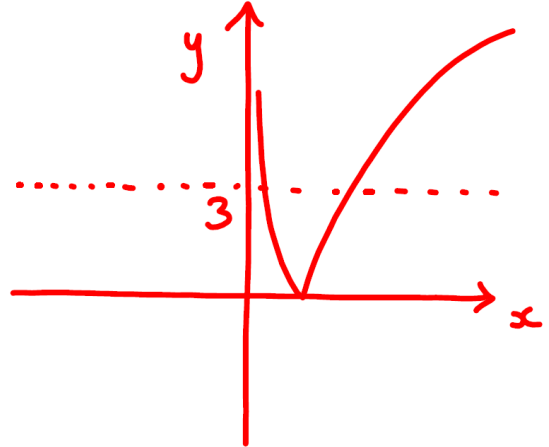
$$|\ln x| = 3$$

[5]

Draw line $y = \ln x$ then



$$y = |\ln x|$$



Solve

$$\ln x = 3$$

$$x = e^3$$

&

$$\ln x = -3$$

$$x = e^{-3}$$

Exact
Values