

Continuity at a Point

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A function is continuous at $x = c$ if there is no interruption in the graph of $f(x)$ at $x = c$. Continuity can be destroyed by a hole, an asymptote, a break or a point that is undefined

When the discontinuity is because of an undefined point the discontinuity is known as removable.

Examples of discontinuities

<http://www.mathwarehouse.com/calculus/continuity/what-are-types-of-discontinuities.php>

There are three conditions for a function to be continuous at

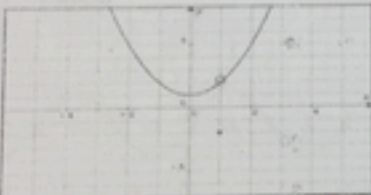
$x = c$:

- 1) $f(c)$ is defined
- 2) $\lim_{x \rightarrow c} f(x)$ Exists
- 3) $\lim_{x \rightarrow c} f(x) = f(c)$

1. With your teacher discuss the continuity at the given point

1)

$$y = \begin{cases} x^2 + 1 & \text{if } x \neq 1 \\ -2 & \text{if } x = 1 \end{cases}$$

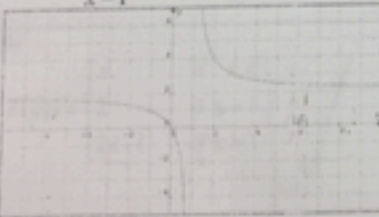


at $x = 1$

① Continuous except at $x = 1$
Discont. at $x = 1$
Removable

2)

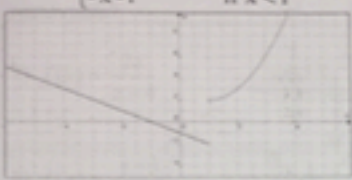
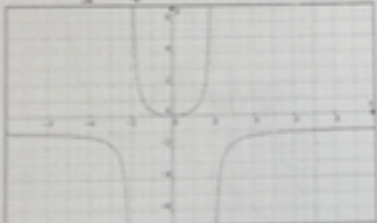
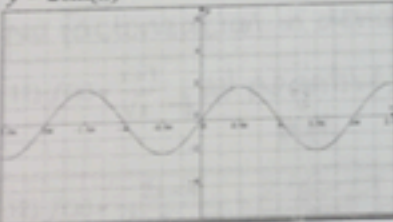
$$f(x) = \frac{2x}{x-1}$$

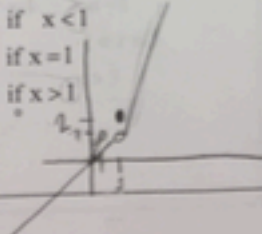


At $x = 1$

Cont. except at $x = 1$
Discont. at $x = 1$
Non-removable

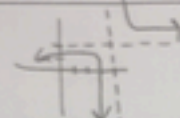
(no way to connect an asymptote)

<p>3)</p> $f(x) = \begin{cases} (x-1)^2 + 2 & \text{if } x \geq 1 \\ -x-1 & \text{if } x < 1 \end{cases}$ 	<p>At $x = 1$ Cont. except at $x = 1$ Discont. at $x = 1$ Non-removable</p>
<p>4)</p> $f(x) = \frac{-x^2}{x^2 - 4}$ 	<p>At $x = 2$ Cont. except at $x = +2, -2$ Discont. at $x = +2, -2$ Non-removable</p>
<p>5)</p> $y = 2 \sin(x)$ 	<p>At $x = 0.5\pi$ CONTINUOUS</p>

<p>6)</p> $f(x) = \begin{cases} x & \text{if } x < 1 \\ 2 & \text{if } x = 1 \\ 2x-1 & \text{if } x > 1 \end{cases}$ 	<p>At $x = 1$ Continuous except at $x = 1$ Discontinuous at $x = 1$ Removable.</p>
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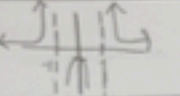
II. Find the x-values (if any) at which f is not continuous. Which of the discontinuities are removable?

7) $f(x) = \frac{2x}{x-4}$



* Continuous except at $x=4$
 * Discont. at $x=4$
 * Non-removable

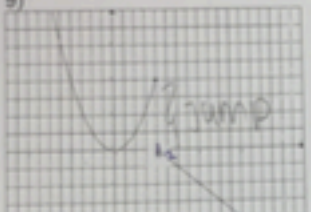
8) $f(x) = \frac{x-1}{x^2-1}$



* Continuous except at $x=-1$
 * Discont. at $x=-1$
 * Non-removable

①
Hole; removable

9)



* Continuous except at $x=2$
 * Discontinuous at $x=2$
 * Non-removable

10)

$f(x) = \frac{x}{x^2+x+2}$

NO factorization in denom.

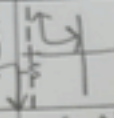
Continuous

11) $f(x) = \frac{x+1}{\sqrt{x}}$ → All negative x are

$f(x) = \frac{x+1}{\sqrt{x}}$ $(-10, 0] \rightarrow$ Discont.

12) $f(x) = \frac{2x-4}{x^2+3x-10} = \frac{2(x-2)}{(x+5)(x-2)}$

$f(x) = \frac{2}{x+5}$

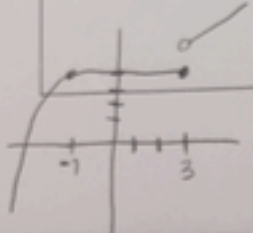


* Cont. except at $x=-5$
 * Discont. at $x=-5$
 * Non-removable

$x=-5$
 $x=2$
Hole
removable

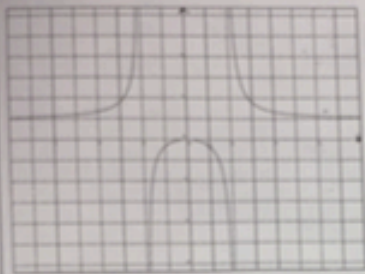
13)

$f(x) = \begin{cases} -(x+1)^2+4 & x \leq -1 \\ 4 & -1 < x \leq 3 \\ x+3 & x > 3 \end{cases}$



* Continuous except at $x=3$
 * Discontinuous at $x=3$
 * Non-removable

14)



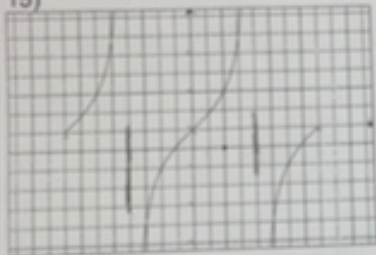
† Continuous except at $x = -2, +2$

‡ Discontinuous at $x = -2, +2$

‡ Non-removable

$x = 1$ (Hole)
↓
Removable

15)



† Continuous except at $x = -4, +4$

‡ Discontinuous at $x = -4, +4$

‡ Non-removable

$x = \frac{\pi}{2}$ (Hole)
↓
Removable