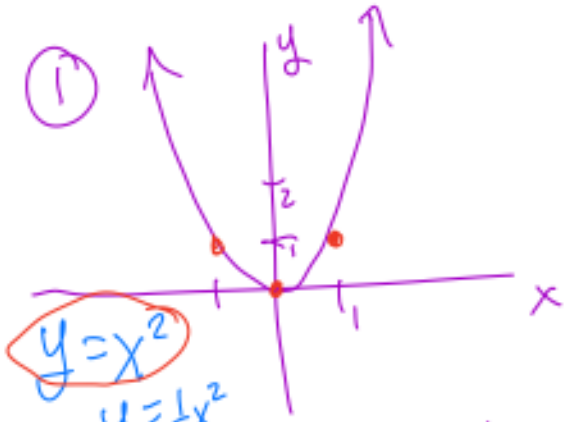
Warmups:

- Curve jeopardy.

(1)



$y = x^2$

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

(2)

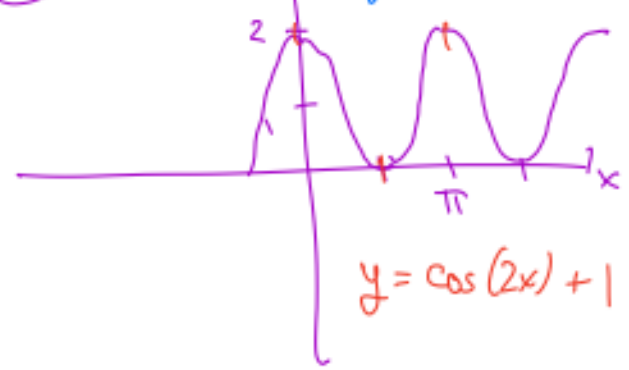
$y = \cos x + 1$

$y = 2\cos(x) + 1$

$y = 2\sin(x)$

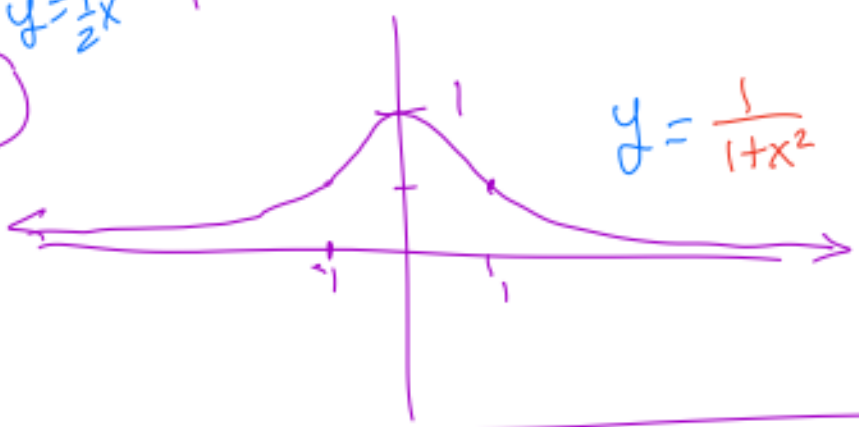
$y = 5\sin(x)$

$y = 2\cos(x)$



$y = \cos(2x) + 1$

(3)



$y = \frac{1}{1+x^2}$

Simplification

- Simplify $B = \dfrac{x^3t - 8x^2t + 12xt}{x^{10} - 6x^9} \Big/ \underbrace{2xt + x^2}_{\text{no parentheses}}$

$$B = \frac{xt(x^2 - 8x + 12)}{x^9(x-6)} \cdot \frac{1}{2xt} + x^2$$

$$= \frac{\cancel{xt}\cancel{(x-6)}(x-2)}{2x^{10}\cancel{t}\cancel{(x-6)}} + x^2 = \frac{x-2}{2x^9} + x^2$$

$\left(\frac{2x^9 \cdot x^2}{2x^9}\right)$

$= \boxed{\frac{2x^{11}+x-2}{2x^9}}$

- Rewrite as a sum of power functions

$\left(\frac{2}{\sqrt{x}} - 3x\right)^5 = \left(2x^{-1/2} - 3x\right)^5$

$x^4 \quad \sqrt{x} = x^{1/2}$

$(A^C B^D)^E = A^{CE} B^{DE}$

$(A^C + B^D)^E = \text{Aaah...}$

Pascal's Triangle

```
        1
      1   1
    1   2   1
  1   3   3   1
1   4   6   4   1
1   5  10  10   5   1
```

$(A+B)^4 = A^4 + 4A^3B + 6A^2B^2 + 4AB^3 + B^4$

$(A+B)^2 = A^2 + 2AB + B^2$

$(A+B)^3 = (A+B)(A^2+2AB+B^2)$

$= (A+B)A^2 + (A+B)(2AB) + (A+B)B^2$

$= A^3 + BA^2 + 2A^2B + 2AB^2 + AB^2 + B^3$

$= A^3 + 3A^2B + 3AB^2 + B^3$

$(A-B)^3 = (A+(-B))^3 = A^3 - 3A^2B + 3AB^2 - B^3$

$(A+B)^5 = A^5 + 5A^4B + 10A^3B^2 + 10A^2B^3 + 5AB^4 + B^5$

$\Rightarrow \left(2x^{-1/2} - 3x\right)^5 = \left(2x^{-1/2}\right)^5 + 5\left(2x^{-1/2}\right)^4(-3x) + 10\left(2x^{-1/2}\right)^3(-3x)^2$

$A = 2x^{-1/2}, \; B = -3x$

$+ 10\left(2x^{-1/2}\right)^2(-3x)^3 + 5\left(2x^{-1/2}\right)(-3x)^4$

$+ (-3x)^5$

$$= 32x^{-5/2} + 5 \cdot 16x^{-2}(-3x) + 10 \cdot 8x^{-3/2}(9x^2)$$
$$+ 10(4x^{-1})(-27x^3) + 10x^{-1/2}81x^4$$
$$+ -243x^5$$

$$= 32x^{-5/2} - 240x^{-1} + 720x^{1/2} - 1080x^2 + 810x^{7/2} - 243x^5$$

Math = Fun

Calculus – study of FUNctions

Limits – $\lim_{x \to a} f(x) = L$ means

- a^* is in the domain of the function f
  - ↑ real numbers where the function is defined -
- If x is getting really close to a (but not equal to a), then the $f(x)$ is getting really close to L^*.

Examples

① $\lim_{x \to 3} x^3 - 7x = ?$

- ie, What is $x^3 - 7x$ getting close to, if x is getting really close to 3 (but not = to 3)?

x	$f(x) = x^3 - 7x$
2.9	⋮
2.99	
3.002	

```
f(x)= x^3-7*x
[f(2.9),f(2.99),f(3.002)];
[f(b) for b in [2.9,3.002,2.9999,3.000008,2.9999999999]]
```

Evaluate

```
[4.08900000000000,
 6.04003600799999,
 5.99800008999900,
 6.00016000057600,
 5.99999999800000]
```

from this data, $\lim_{x \to 3} x^3 - 7x = 6$

Note: $3^3 - 7 \cdot 3 = 27 - 21 = 6$!

We say $f(x) = x^3 - 7x$ is continuous at $x = 3$ because $\lim_{x \to 3} f(x) = f(3)$

Note: we can see this graphically:

$y = x^3 - 7x$