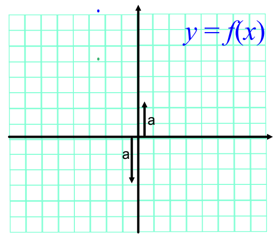
4. Graphs of Functions

To obtain the graph $y = f(x) + a$, **slide** $y = f(x)$ **vertically**

upwards for $a > 0$ — $y = f(x) + a$

downwards for $a < 0$ — $y = f(x) - a$



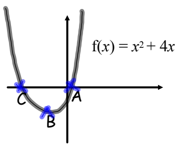
maths1_2.ppt

Example

1) Part of the graph $f(x) = x^2 + 4x$ is shown.

a) Identify the coordinates of A, B and C.

b) Sketch the graph $y = f(x) + 1$



a) when $f(x) = 0$

$x^2 + 4x = 0$

$x(x + 4) = 0$

$x = 0$ and $x = -4$

A(0, 0) and C(-4, 0)

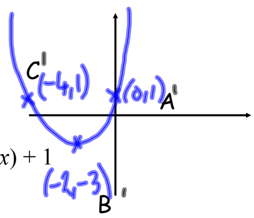
when $x = -2$

$f(x) = (-2)^2 + 4(-2)$

$f(x) = -4$

B(-2, -4)

b)



$f(x) = x^2 + 4x$

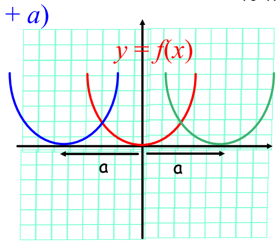
$y = f(x) + 1$

Graphs of $y = f(x + a)$

To obtain the graph $y = f(x + a)$, **slide** $y = f(x)$ **horizontally**

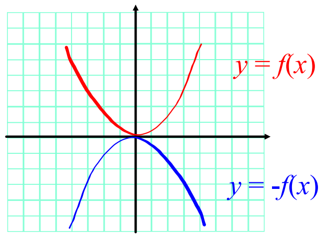
to the **left** for $a > 0$ — $y = f(x + a)$

to the **right** for $a < 0$ — $y = f(x - a)$



maths1_2.ppt

To obtain the graph $y = -f(x)$, **reflect** $y = f(x)$ **in the** x **axis**.



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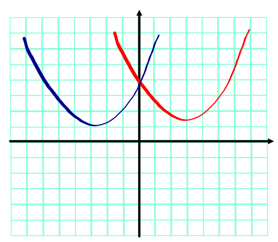
Graphs of $y = f(-x)$

To obtain the graph $y = f(-x)$, **reflect** $y = f(x)$ **in the** y **axis**.

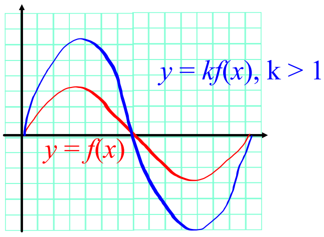


maths1_2.ppt

To obtain the graph $y = kf(x)$, **strech or compress** $y = f(x)$ **vertically** by a factor of k :

stretch for $k > 1$

compress for $k < 1$



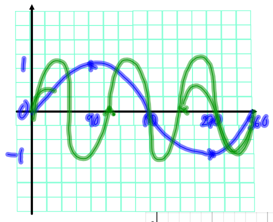
maths1_2.ppt

Page 43 - Ex 3K - Q1 onwards

Graphs of $y = f(kx)$

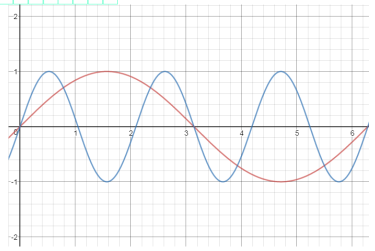
Today's Learning:
By the end of this lesson, you should know be able to sketch graphs of the form $y = f(kx)$.

Draw the graph $y = \sin x$



Draw the graph $y = \sin 3x$.

What do you notice?

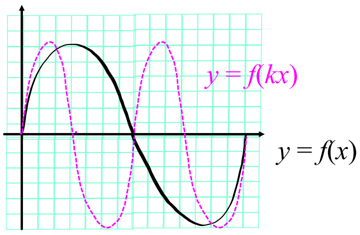


Graphs of $y = f(kx)$

To obtain the graph $y = f(kx)$, **stretch or compress** $y = f(x)$ **horizontally** by a factor of k :

compress for $k > 1$

stretch for $k < 1$



maths1_2.ppt

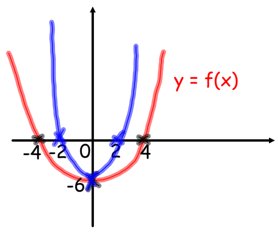
$y = f(kx)$

Example

Copy the following diagram and sketch the graph of y = f(2x) on the same diagram.

$\leftrightarrow \frac{1}{k}$

$\leftrightarrow \frac{1}{2}$



pg 45
ex 3M

y = f(2x)

Exponential Functions

Today's Learning:
By the end of this lesson, you should know be able to graph exponential functions.

$f(x) = a^x$ $\quad a, x \in$ R

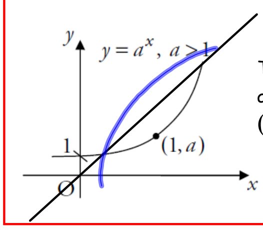
This is an exponential function.
a is the base and x is the power.

$f(x) = 2^x$
$f(x) = 5^x$

We can draw the graph of an exponential. $\quad f(x) = a^x$

When $x = 0$, $\quad f(x) = a^0$
$= 1$ $\quad$ Graph cuts y axis at $(0,1)$

When $x = 1$, $\quad f(x) = a^1$
$= a$ $\quad$ Graph passes through $(1,a)$

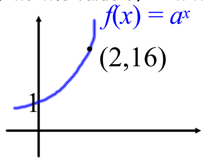


The graph of an exponential always passes through $(0,1)$ and $(1,a)$.

$f(x) = 3^x$
$(0,1)$ $\quad (1,3)$

Graphs of Related Exponential Functions

1) Find the value of a in the following.



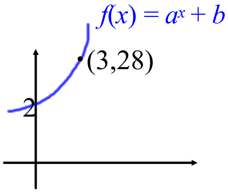
$f(x) = a^x$

$16 = a^2$

$4 = a$

$f(x) = 4^x$

2) Find the value of a and b in the following.



$f(x) = a^x + b$

$f(x) = a^x + 1$

$28 = a^3 + 1$

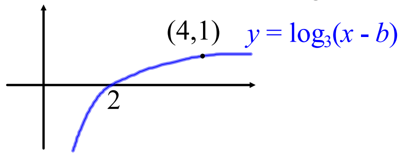
$27 = a^3$

$3 = a$

$f(x) = 3^x + 1$

Graphs of Related Logarithmic Functions

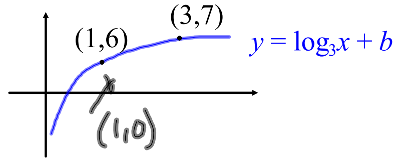
1) Find the value of b in the following.



$y = \log_3(x - b)$

$y = \log_3(x - 1)$

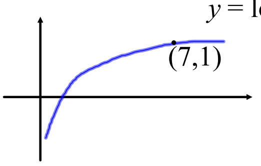
2) Find the value of b in the following.



$y = \log_3 x + b$

$y = \log_3 x + 6$

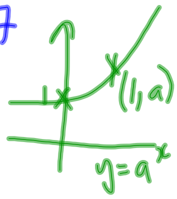
3) Find the value a in the following.



$y = \log_7 x$

$1 = \log_a 7$

$(a, 1)$



Ex 30

Putting the Transformations Together

Follow the rules of BIDMAS, doing reflecting and stretching before shifting up/down and left/right.

Starter

Specimen Paper for 2019

Functions f and g are defined on suitable domains by $f(x) = x^3 - 1$ and $g(x) = 3x + 1$.

(a) Find an expression for $k(x)$, where $k(x) = g(f(x))$. 2

(b) If $h(k(x)) = x$, find an expression for $h(x)$. 3

$k(x) = g(x^3 - 1)$
$= 3(x^3 - 1) + 1$
$= 3x^3 - 3 + 1$
$= 3x^3 - 2$

$k(x) = 3x^3 - 2$

$k(x) + 2 = 3x^3$

$\frac{k(x)+2}{3} = x^3$

$\sqrt[3]{\frac{k(x)+2}{3}} = x$

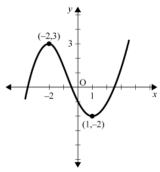
$\sqrt[3]{\frac{x+2}{3}} = k^{-1}(x) = h(x)$

Mixed Examples

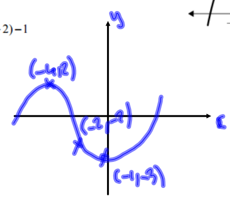
Examples

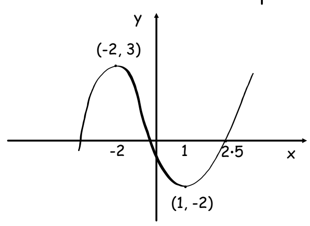
1)

The diagram shows the graph of $y = f(x)$ with a maximum turning point at (−2, 3) and a minimum turning point at (1, −2).



Sketch the graph of $y = f(x+2) - 1$



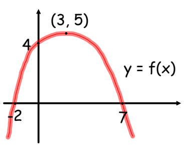


y = f(x + 2) -1

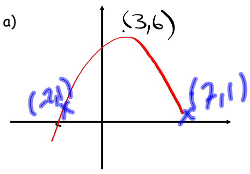
2) The graph of y = f(x) is shown. On separate diagrams sketch the graphs of:

a) y = f(x) + 1

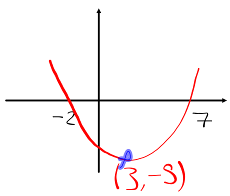
b) y = -f(x)



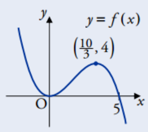
a)



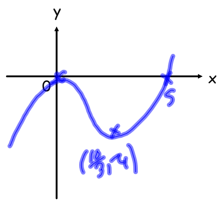
b)

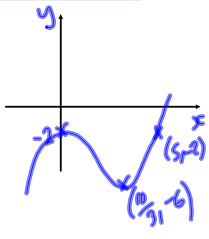


3) The graph of $y = f(x)$ is shown below.

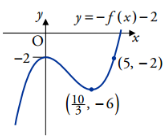


Sketch the graph of $y = -f(x) - 2$.

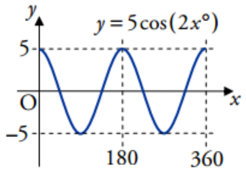




Reflect in the x-axis, then shift down by 2:

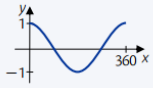


4) Sketch the graph of $y = 5\cos(2x°)$ where $0 \le x \le 360$.



Remember

The graph of $y = \cos x$:



Attachments

maths1_2.ppt