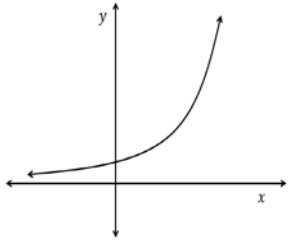
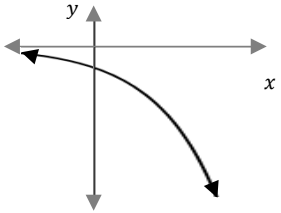
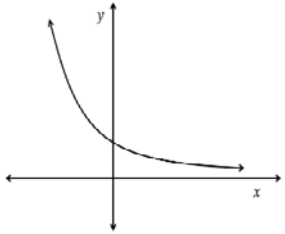
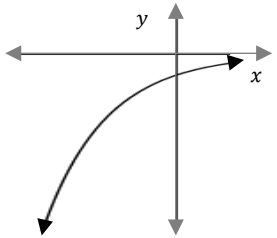
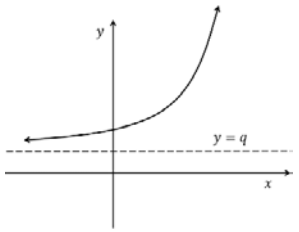
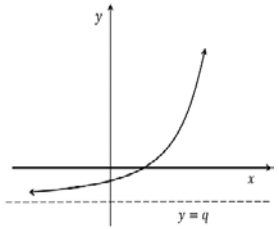
SUBJECT and GRADE	**MATHEMATICS GR 11**	
TERM 2	**Week 3**	
TOPIC	**FUNCTIONS – LESSON 1**	
AIMS OF LESSON	IMPACT of p & REVISION: Impact of a *and* q , shape, turning point and asymptotes.	
RESOURCES	***Paper based resources***	***Digital resources***
	Go to the chapter on Functions in your Mathematics Textbook. *(for example Siyavula page 148)*	https://learn.mindset.africa/resources/mathematics/grade-11/algebraic-functions/learn-xtra-live-2013/functions-ii *https://bit.ly/34mizVP*
INTRODUCTION	*What learners should already know from previous grade:*	

EXPONENTIAL FUNCTION

Standard form: $\mathbf{y = ab^x + q}$; $b > 0$; $b \neq 1$

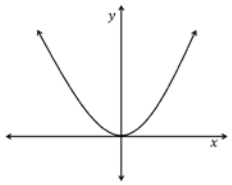
Influence of a				**Influence of q**	
$a > 0$ & $b > 1$	$a < 0$ & $b > 1$	$a > 0$ & $0 < b < 1$	$a < 0$ & $0 < b < 1$	$q > 0$	$q < 0$
					
Asymptote: $y = 0$ $(horizontal)$	Asymptote: $y = 0$ $(horizontal)$	Asymptote: $y = 0$ $(horizontal)$	Asymptote: $y = 0$ $(horizontal)$	Asymptote: $y = q$ $(horizontal)$	Asymptote: $y = q$ $(horizontal)$

PARABOLA

Standard form: $y = ax^2 + q \; ; \; a \neq 0$

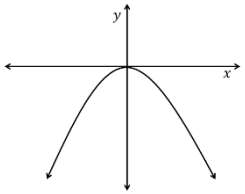
Influence of a

- $a > 0$

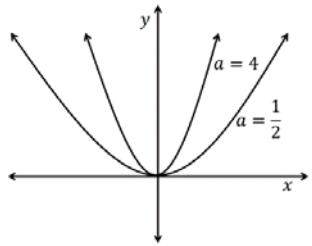


minimum value

- $a < 0$

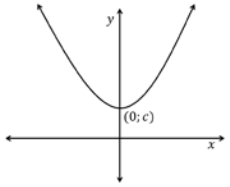


maximum value

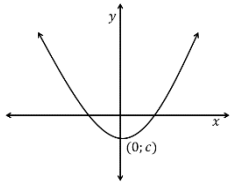


Influence of q

- $q > 0$



- $q < 0$



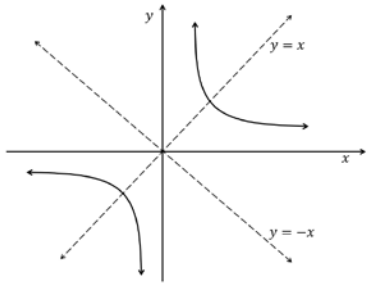
Axis of symmetry: $x = 0 \;\; (y - axis)$

HYPERBOLA

Standard form: $y = \frac{a}{x} + q \; ; \; x \neq 0$

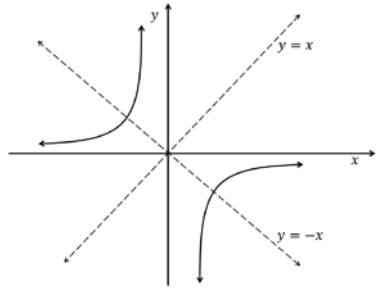
Influence of a

- $a > 0$



Axis of symmetry: $y = x$ and $y = -x$

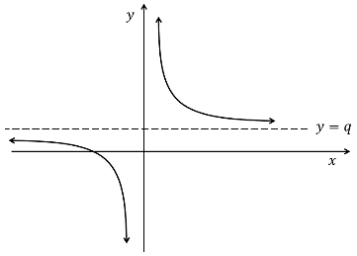
- $a < 0$



Axis of symmetry: $y = x$ and $y = -x$

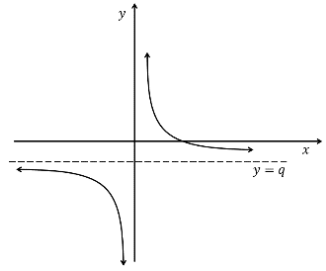
Influence of q

- $q > 0$



Asymptote: $y = q \; (horisontal)$
$and \; x = 0 \; (vertical)$

- $q < 0$



Asymptote: $y = q \; (horisontal)$
$and \; x = 0 \; (vertical)$

CONCEPTS AND SKILLS
(1) PARABOLA

We will now look at NEW concepts for GRADE 11

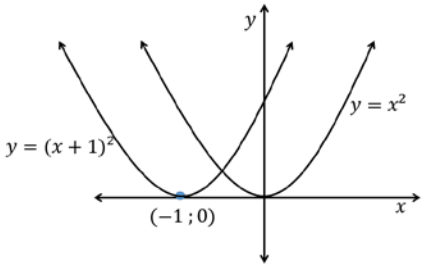
PARABOLA

Standard form: $y = a(x + p)^2 + q \; ; \; a \neq 0$

NOTE: The axis of symmetry has also moved from the y-axis to the line $x = 1$

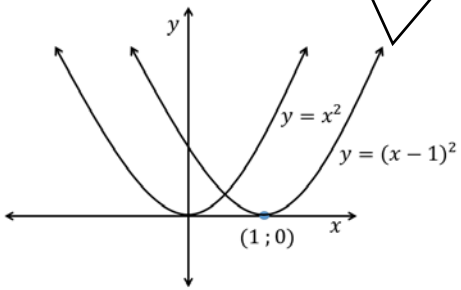
Influence of p

- $p > 0$



The graph moves to the **LEFT.**
New TURNING POINT: $(-1; 0)$

- $p < 0$



The graph moves to the **RIGHT.**
New TURNING POINT: $(1; 0)$

Influence of q

- $q > 0$

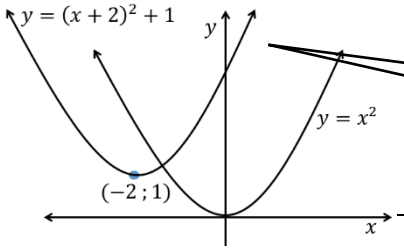
In GR 10 we have seen that the graph will move **UP.**

- $q < 0$

In GR 10 we have seen that the graph will move **DOWN.**

EXAMPLE 1

Give the turning point for the graph $y = (x + 2)^2 + 1$



ANSWER: TP $(2; 1)$

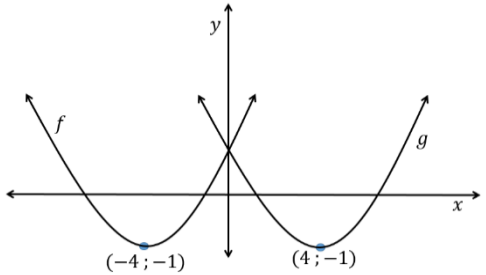
The graph moved

2 to the LEFT and 1 UP

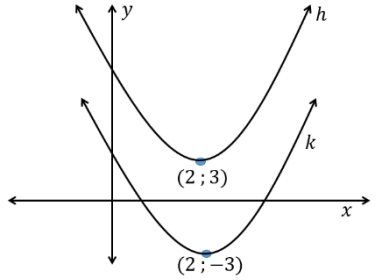
CAN YOU?

1) Give the turning point for the graph $y = (x + 3)^2 - 2$

2) Choose the graph below (f *or* g) that represent the following graph: $y = (x - 4)^2 - 1$



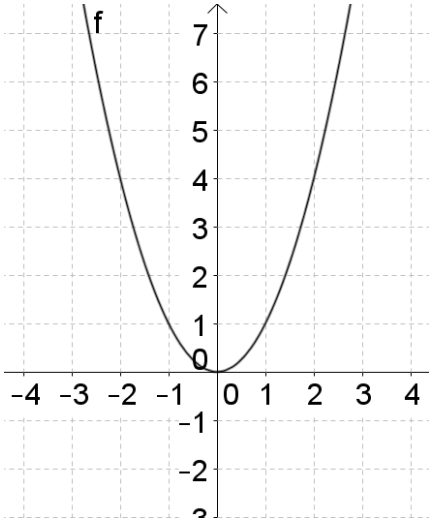
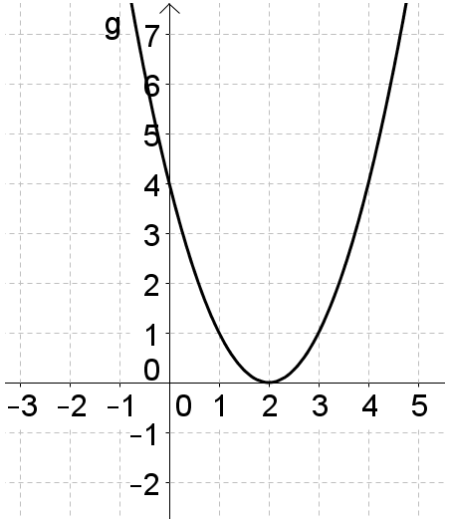
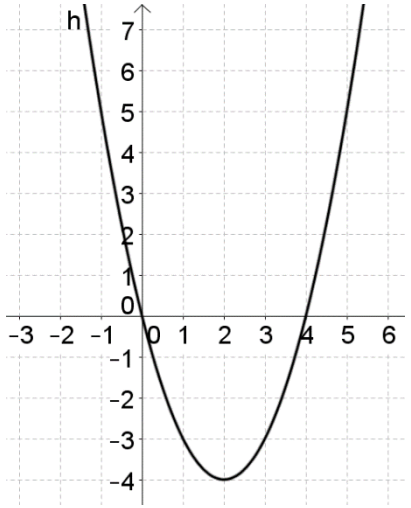
3) Choose the graph below (h *or* k) that represent the following graph: $y = (x - 2)^2 - 3$



ANSWERS:

1) TP $(-3; -2)$ 2) g 3) k

Common mistakes made: Learners do not realize that $y = (x + 3)^2 - 2$ will have a TP of $(-3; -2)$ → that is the x −coordinate have the **OPPOSITE SIGN** from the number in the bracket.

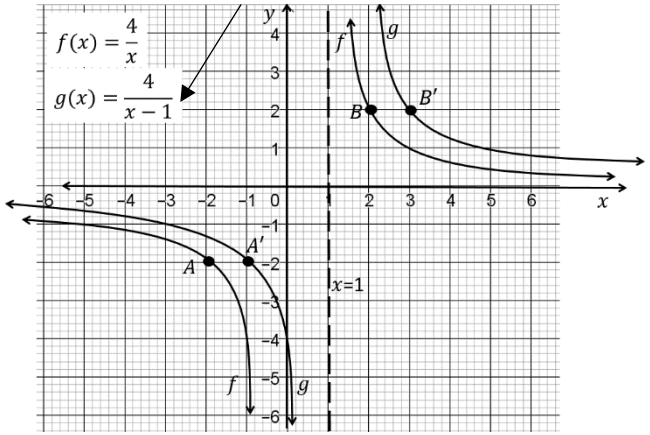
SUMMARY: Influence of p and q.		
$f(x) = x^2$ 	$g(x) = (x-2)^2$ 	$h(x) = (x-2)^2 - 4$ 
TURNING POINT: $(0;0)$	**TURNING POINT: $(2;0)$** **Moved 2 units to the right.**	**TURNING POINT: $(2;4)$** **Moved 2 units to the right and 4 units down.**

CONCEPTS AND SKILLS
(2) HYPERBOLA

Standard form: $\boldsymbol{y = \frac{a}{x+p} + q \; ; \; x \neq -p}$

Influence of p

- $p < 0$ (Let $p = -1$)



- $p > 0$

We can predict from what we have learned that the graph will move to the **LEFT** if p is a positive value.

Influence of q

We know from GR 10:

$\boldsymbol{q > 0}$ → graph moves **UP**

$\boldsymbol{q < 0}$ → graph moves **DOWN**

What changes can we observe from the original graph f → the new graph g?

1) The graph moved one unit to the **RIGHT**.
   $A(-2;-2) \rightarrow A'(-1;-2)$ ….. 1 *unit to the right*
   $B(2;2) \rightarrow B'(3;2)$ ….. 1 *unit to the right*
2) The vertical asymptote of f is the y-axis, that is the line $x = 0$.
   The vertical asymptote of the new graph g is $x = 1$
   Therefore, the **VERTICAL ASYMPTOTE** ALSO moved one unit to the **RIGHT**.
3) The horizontal asymptote has NOT changed, it is still the x-axis, that is the line $y = 0$.

CAN YOU?

4) Given $\boldsymbol{h(x) = \frac{4}{x-2}}$ and $\boldsymbol{f(x) = \frac{4}{x}}$

4.1) Describe the translation (shift) from f to get the equation of graph h.
4.2) Determine the coordinates of A' a point on h if $A(-2;-2)$ is a point on f.
4.3) Give the equation of the vertical asymptote for h.
4.4) Give the equation of the horizontal asymptote for h.

5) If $f(x) = \frac{4}{x}$ give the equation of the graph k if k is the graph when f moved 3 units to the left.

ANSWER:

4.1) f translated 2 units to the right.
4.2) $A'(0;-2)$
4.3) $x = 2$
4.4) $y = 0$
5) $f(x) = \frac{4}{x-3}$

SUMMARY

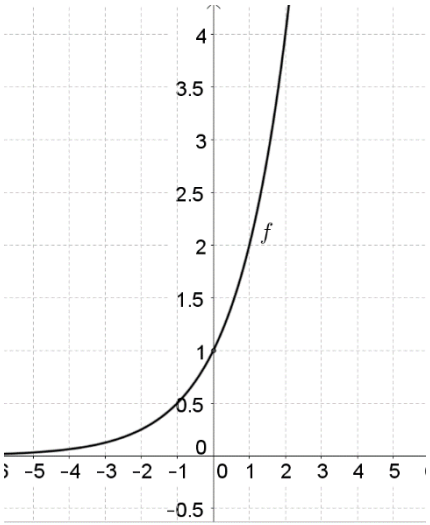
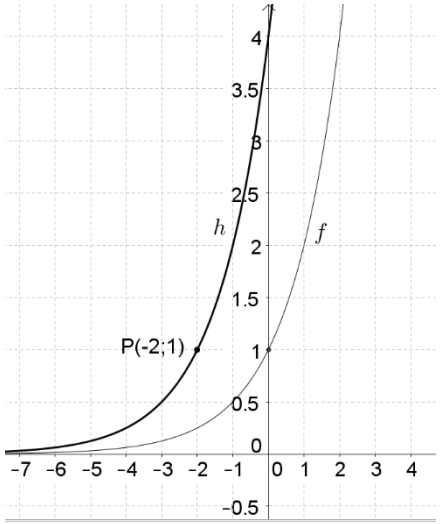
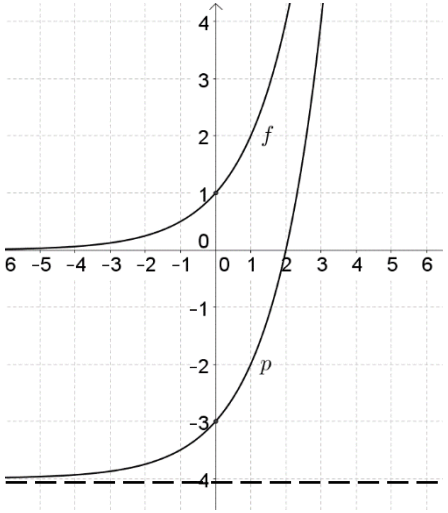
$$\boldsymbol{y = \frac{a}{x+p} + q}$$

Vertical asymptote: $y = -p$

horizontal asymptote: $y = q$

CONCEPTS AND SKILLS
(3) EXPONENTIAL GRAPH

Standard form: $y = a^{x+p} + q$

$f(x) = 2^x$	$h(x) = 2^{x+2}$	$p(x) = 2^x - 4$
		
Asymptote: $y = q$	$\boldsymbol{p > 0}$ Graph moves to the **RIGHT** $\boldsymbol{p < 0}$ Graph moves to the **LEFT**	$\boldsymbol{q > 0}$ Graph moves **UP** $\boldsymbol{q < 0}$ Graph moves **DOWN**
Asymptote for f : $y = 0$	**Asymptote for h** : $y = 0$	**Asymptote for p** : $y = -4$

CAN YOU?

6) Given $f(x) = 2^x$
Which graph represent the graph of f moving 1 unit to the left and 3 units up.

A) $f(x) = 2^{x-1} + 3$
B) $f(x) = 2^{x+1} + 3$
C) $f(x) = 2^{x-1} - 3$
D) $f(x) = 2^{x+1} - 3$

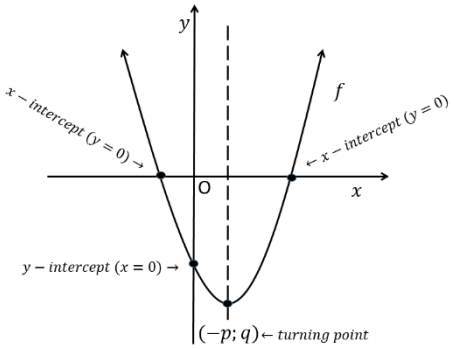
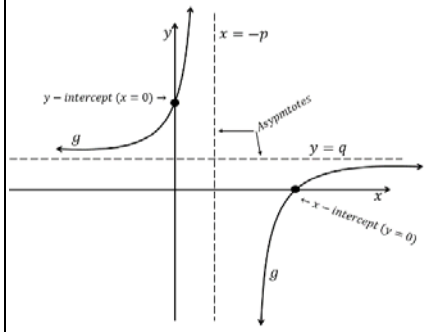
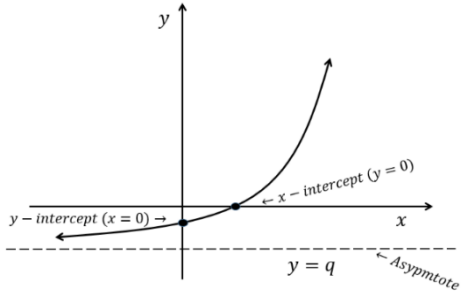
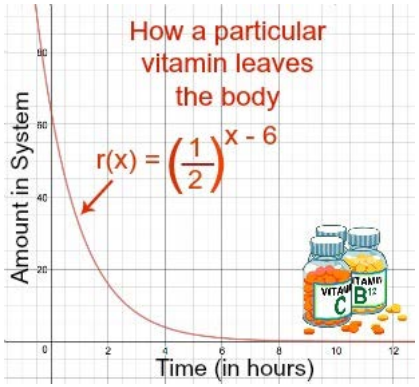
ANSWER: B

7) Give the equation for the Asymptotes for each of the following graphs:

7.1) $f(x) = 2^{x+1} - 3$
7.2) $g(x) = \frac{1}{2}^x + 4$
7.3) $f(x) = 2^{x-1} - 2$

ANSWER:

7.1) $y = -3$
7.2) $y = +4$
7.3) $y = -2$

ACTIVITIES/ASSESSMENT	• VIA AFRICA: Chapter 5 $pg.52-56,\ Q1-9$ • MIND ACTION SERIES: Chapter 5, $pg.87-114$ Exercise $1-6$		
CONSOLIDATION 1) We have learned that all functions have a **STANDARD FORM.** 2) For all the functions the: • **p − value** will move the graph **LEFT** $(\mathbf{p>0})$ and **RIGHT** $(\mathbf{p<0})$ • **q −value** will move the graph **UP** $(\mathbf{q<0})$ and **DOWN** $(\mathbf{q<0})$	***PARABOLA*** $\boldsymbol{y=a(x+p)^2+q}$ 	***HYPERBOLA*** $\boldsymbol{y=\frac{a}{x+p}+q}$ 	***EXPONENTIAL*** $\boldsymbol{y=b.a^{x+p}+q}$ 
VALUES	*Concepts/skills in real life scenarios*   http://passyworldofmathematics.com/sydney-harbour-bridge-mathematics/ https://study.com/academy/lesson/modeling-the-real-world-with-families-of-functions.html		