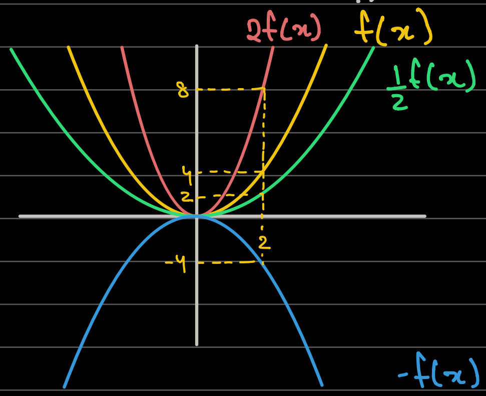
TRANSFORMATIONS : FUNCTIONS

1. $y = af(x)$

For each x value, the y values are multiplied by 'a'

If $f(x)$ was $= x^2$...

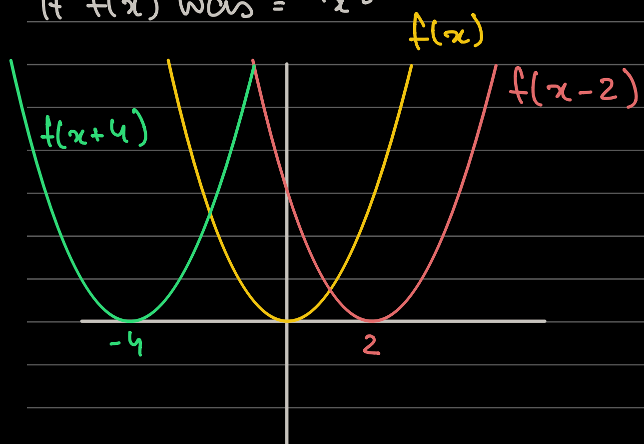


When describing :
For all positive values of a, this transformation can be described as a stretch in the y direction by a factor of a

For values of $a < 0$, "reflection across the x-axis" must also be included

2. $y = f(x-b)$
A particular value y which corresponded with x now corresponds with $x+b$

If $f(x)$ was $= x^2$



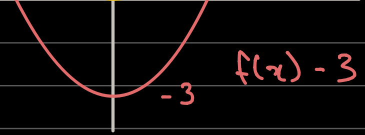
In words, this can be described as shifting 'b' units in the x direction

$f(x-b)$ indicates rightwards shift
$f(x+b)$ indicates leftwards shift

3. $y = f(x) + c$

If $f(x)$ was $= x^2$

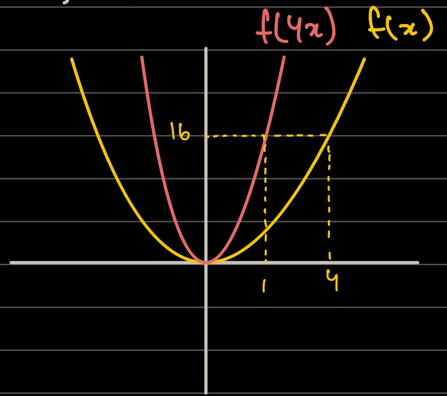
This transformation can be described as a vertical shift by 'c' units



4. $y = f(dx)$

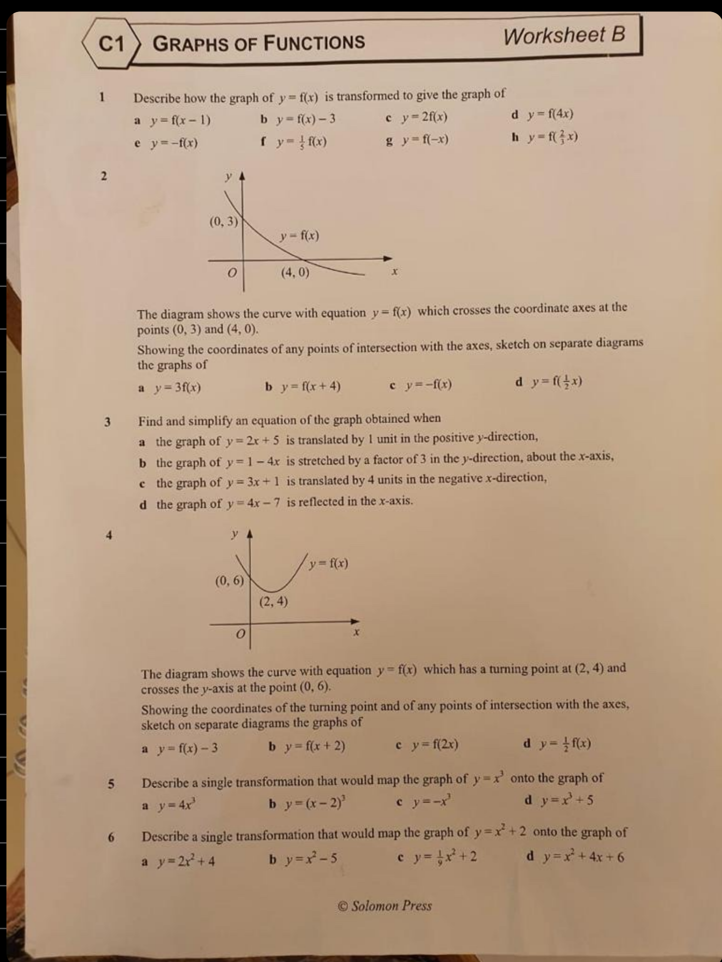
Any given value y that previously corresponded to a value x now corresponds to a value $\frac{x}{4}$

$f(x) = x^2$



This transformation can be described as a stretch in the x direction by a factor of $\frac{1}{d}$

ATTEMPTING THE FOLLOWING WS :



C1 GRAPHS OF FUNCTIONS — Worksheet B

1 Describe how the graph of $y = f(x)$ is transformed to give the graph of

a $y = f(x - 1)$ b $y = f(x) - 3$ c $y = 2f(x)$ d $y = f(4x)$

e $y = -f(x)$ f $y = \frac{1}{5}f(x)$ g $y = f(-x)$ h $y = f(\frac{2}{3}x)$

2

(0, 3) $y = f(x)$ O (4, 0) x y

The diagram shows the curve with equation $y = f(x)$ which crosses the coordinate axes at the points (0, 3) and (4, 0).

Showing the coordinates of any points of intersection with the axes, sketch on separate diagrams the graphs of

a $y = 3f(x)$ b $y = f(x + 4)$ c $y = -f(x)$ d $y = f(\frac{1}{2}x)$

3 Find and simplify an equation of the graph obtained when

a the graph of $y = 2x + 5$ is translated by 1 unit in the positive y-direction,

b the graph of $y = 1 - 4x$ is stretched by a factor of 3 in the y-direction, about the x-axis,

c the graph of $y = 3x + 1$ is translated by 4 units in the negative x-direction,

d the graph of $y = 4x - 7$ is reflected in the x-axis.

4

y $y = f(x)$ (0, 6) (2, 4) O x

The diagram shows the curve with equation $y = f(x)$ which has a turning point at (2, 4) and crosses the y-axis at the point (0, 6).

Showing the coordinates of the turning point and of any points of intersection with the axes, sketch on separate diagrams the graphs of

a $y = f(x) - 3$ b $y = f(x + 2)$ c $y = f(2x)$ d $y = \frac{1}{2}f(x)$

5 Describe a single transformation that would map the graph of $y = x^3$ onto the graph of

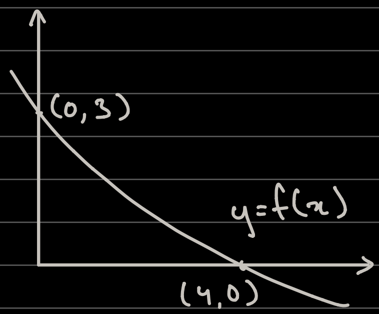
a $y = 4x^3$ b $y = (x - 2)^3$ c $y = -x^3$ d $y = x^3 + 5$

6 Describe a single transformation that would map the graph of $y = x^2 + 2$ onto the graph of

a $y = 2x^2 + 4$ b $y = x^2 - 5$ c $y = \frac{1}{9}x^2 + 2$ d $y = x^2 + 4x + 6$

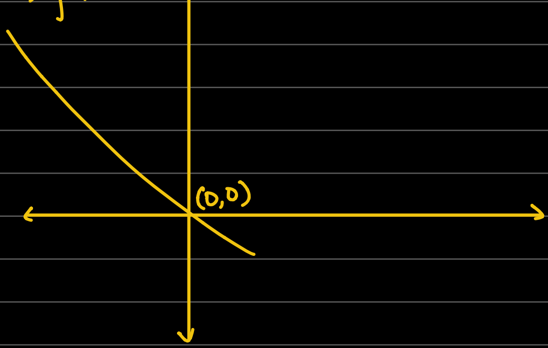
1
a) A shift of 1 unit in the positive x direction
b) A shift of 3 units in the negative y direction
c) A stretch in the y direction by a factor of 2
d) A stretch in the x direction by a factor of $\frac{1}{4}$
e) Reflection across the x-axis
f) A stretch in the y direction by a factor of $\frac{1}{5}$
g) Reflection across the y-axis
h) Stretch in the x direction by a factor of $\frac{3}{2}$

2



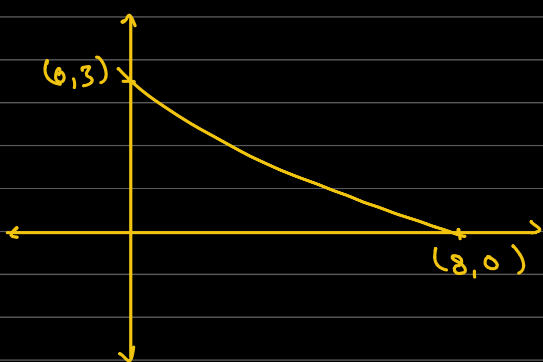
a) $y = 3f(x)$

b) $y = f(x+4)$



c) $y = -f(x)$

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



3 a) $y = 2x + 5 \xrightarrow{1}$

$y = 2(x-1) + 5$ → Ans

b) $y = 1 - 4x$

$y = 1 - 4(\frac{x}{3})$ → Ans

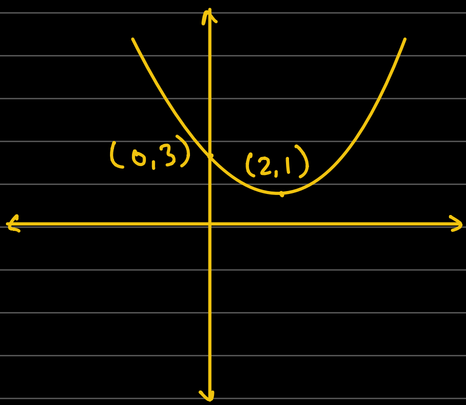
c) $y = 3x + 1$

$y = 3(x + 4) + 1 \longrightarrow$ Ans

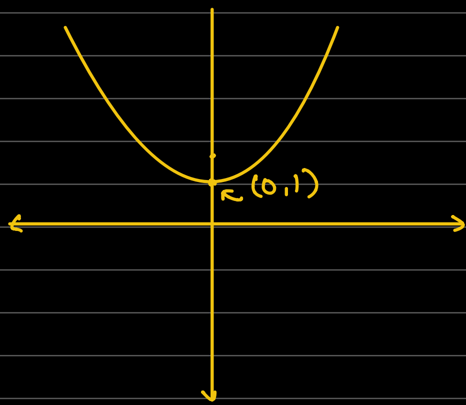
d) $y = 4x - 7$

$y = -4x - 7 \longrightarrow$ Ans

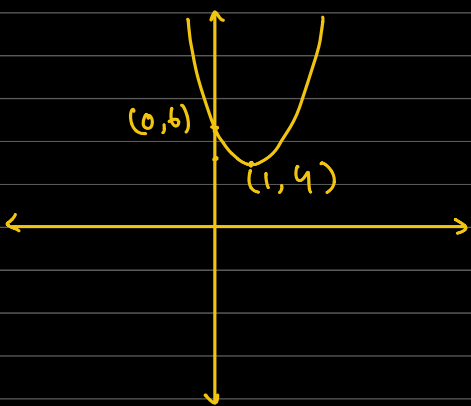
4 a) $y = f(x) - 3$



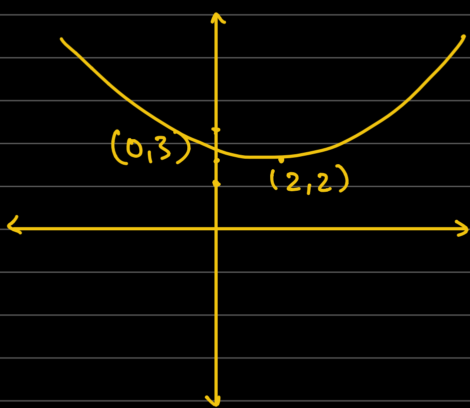
b) $y = f(x+2)$



c) $y = f(2x)$



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



5 a) $y = 4x^3$

Stretch in the y direction by a factor of 4

b) $y = (x-2)^3$

Shift by 2 units in the positive x direction

c) $y = -x^3$

Reflection across the x-axis

d) $y = x^3 + 5$

Shift by 5 units in the positive y direction

(6) $y = x^2 + 2$

a) $y = 2x^2 + 4 \rightarrow y = 2f(x)$

Stretch in the y direction by a factor of 2

b) $y = x^2 - 5 \longrightarrow y = x^2 + 2 - 7$

Shift by 7 units in the negative y direction

c) $y = \frac{1}{9}x^2 + 2$

Stretch in the x direction by a factor of 9

d) $y = x^2 + 4x + 6$

$= x^2 + 4x + 2^2 - 2^2 + 6$

$= (x+2)^2 - 4 + 6$

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

$f(x+2)$

$y = (x+2)^2 + 2$

Shift by 2 units in the negative x direction