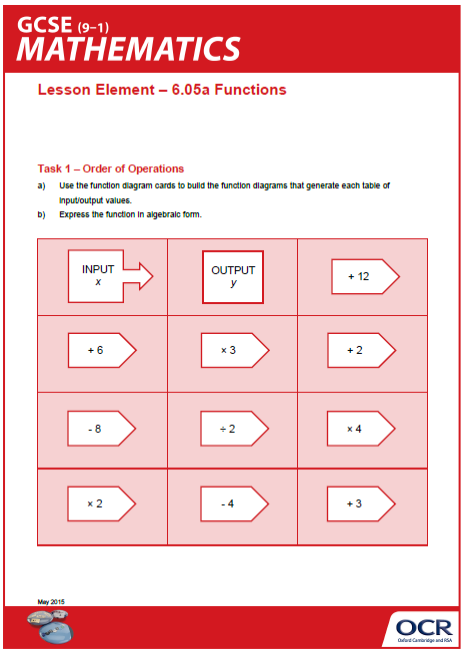
GCSE (9–1)
MATHEMATICS

Lesson Element – 6.05a Functions

Instructions and answers for teachers

These instructions should accompany the OCR resource 'Lesson Element – 6.05a Functions' activity *which supports OCR GCSE (9–1) Mathematics.*


GCSE (9–1)
MATHEMATICS

Lesson Element – 6.05a Functions

Task 1 – Order of Operations

a) Use the function diagram cards to build the function diagrams that generate each table of input/output values.

b) Express the function in algebraic form.

INPUT x	OUTPUT y	+ 12
+ 6	× 3	+ 2
- 8	÷ 2	× 4
× 2	- 4	+ 3

May 2015

OCR Oxford Cambridge and RSA

The Activity:

This resource comprises of 3 tasks.

This activity offers an opportunity for English skills development.

This activity offers an opportunity for maths skills development.

This activity offers an opportunity for work experience.

Associated materials:

'Lesson Element – 6.05a Functions' Lesson Element learner activity sheet.

Suggested timings:

Task 1: 20-30 minutes

Task 2: 20-30 minutes

Task 3: 20-30 minutes

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Rationale

All learners at GCSE are expected to be able to interpret simple expressions as functions with inputs and outputs, so it is imperative that they understand the importance of order of operation. In addition, higher tier learners are now expected to be able to interpret the reverse process as the 'inverse function' as well as the succession of two functions as a 'composite function'. Knowledge of function notation is not required for the J560 GCSE specification, but learners should have met the reverse process of a function as well as the succession of two functions in a less formalised way than is expected at A level.

Assumed Knowledge

Learners should have already met inverse operations, substitution and basic algebraic manipulation, including multiplying out brackets. In functions, it is assumed that learners can:

- Interpret a simple expression as a function, e.g. $y = 2x + 1$.
- Use a function diagram to find inputs and outputs, e.g. $x \rightarrow \times 2 \rightarrow + 1 \rightarrow y$.
- Express a function diagram or table of values in algebraic form.
- Use a function diagram in reverse to find an inverse function.
- Interpret two successive functions to find a composite function.

Possible Misconceptions

- Knowing when or how to use brackets when writing a function algebraically from a function diagram or table of values.
- Forgetting that the inverse operations must also be calculated in the reverse order when working with inverse functions. This can be reinforced visually by demonstrating the reverse order of operations using function diagrams.
- Understanding the concept that an output of one function can be an input of another function when interpreting composite functions.

The following activities focus on functions containing **two** operations and can be used to help learners develop a greater understanding of functions:

Task 1 – Order of Operations

This activity encourages learners to think about the order of the operators within a function diagram. The function diagram cards are be used by learners as a tool kit to help them to build the function diagrams that generate each of the tables of input/output values. Cards will be used more than once, so once a correct function diagram is discovered, the learner draws it in their book, along with the corresponding table of values. Once all the function diagrams have been found, learners are to attempt to write the functions algebraically. There is often more than one way, so this may prompt discussion when checking answers. The correct answers are given below:

Input x	Output y
-4	-10
-2	-4
0	2
2	8
4	14
$y = 3x + 2$	

Input x	Output y
-4	4
-2	5
0	6
2	7
4	8
$y = \frac{x}{2} + 6$ or $y = \frac{x+12}{2}$	

Input x	Output y
-4	-4
-2	4
0	12
2	20
4	28
$y = 4(x + 3)$ or $y = 4x + 12$	

Input x	Output y
-4	-2
-2	2
0	6
2	10
4	14
$y = 2(x + 3)$ or $y = 2x + 6$	

Input x	Output y
-4	-13
-2	-5
0	3
2	11
4	19
$y = 4x + 3$	

Input x	Output y
-4	-20
-2	-14
0	-8
2	-2
4	4
$y = 3x - 8$	

Input x	Output y
-4	1
-2	2
0	3
2	4
4	5
$y = \frac{x}{2} + 3$ or $y = \frac{x+6}{2}$	

Input x	Output y
-4	-6
-2	0
0	6
2	12
4	18
$y = 3(x + 2)$ or $y = 3x + 6$	

Input x	Output y
-4	-16
-2	-12
0	-8
2	-4
4	0
$y = 2(x - 4)$ or $y = 2x - 8$	

Task 2 – Inverse Functions Card Sort

Task 2 is a matching exercise which provides practice of the reverse process of inverse functions. It can be conducted individually or in small groups.

Learners are initially tasked with matching the functions to their respective table of input/output values. Function diagram cards can be used by learners as a tool kit to help them build the function diagrams that generate each of the tables of values. Cards will be used more than once during this investigative process. Once a correct function diagram is discovered, the learner should be able to use the information to match the correct 'function' card to its corresponding 'table of input/output values' card.

Once all the functions have been matched to their table of values, learners are to attempt to find which functions are the inverse of other functions within the set. There are seven pairs in total, however, to differentiate; some cards could be removed so that the learners then need to write them for themselves.

The **Extension** to the task is for learners to draw their own function diagrams and corresponding inverse function diagrams and to express them in algebraic form.

The correct pairs are given on the next page.

$y = 2x + 5$

x	y
-2	1
-1	3
0	5
1	7
2	9

$y = \frac{x - 5}{2}$

x	y
-2	-3.5
-1	-3
0	-2.5
1	-2
2	-1.5

$y = 5x - 2$

x	y
-2	-12
-1	-7
0	-2
1	3
2	8

$y = \frac{x + 2}{5}$

x	y
-2	0
-1	0.2
0	0.4
1	0.6
2	0.8

$y = 5(x + 2)$

x	y
-2	0
-1	5
0	10
1	15
2	20

$y = \frac{x}{5} - 2$

x	y
-2	-2.4
-1	-2.2
0	-2
1	-1.8
2	-1.6

$y = \frac{x}{2} + 5$

x	y
-2	4
-1	4.5
0	5
1	5.5
2	6

$y = 2(x - 5)$

x	y
-2	-14
-1	-12
0	-10
1	-8
2	-6

$y = \frac{x + 5}{2}$

x	y
-2	1.5
-1	2
0	2.5
1	3
2	3.5

$y = 2x - 5$

x	y
-2	-9
-1	-7
0	-5
1	-3
2	-1

$y = \frac{x - 2}{5}$

x	y
-2	-0.8
-1	-0.6
0	-0.4
1	-0.2
2	0

$y = 5x + 2$

x	y
-2	-8
-1	-3
0	2
1	7
2	12

$y = \frac{5x}{2}$

x	y
-2	-5
-1	-2.5
0	0
1	2.5
2	5

$y = \frac{2x}{5}$

x	y
-2	-0.8
-1	-0.4
0	0
1	0.4
2	0.8

Task 3 – Composite Functions

This activity provides practice of the concept of a composite function being the succession of two functions. It can be conducted individually or in small groups.

Learners are given a copy of four function diagrams, A to D, and eight tables of input/output values which are the result of a combination of the functions A to D. Learners are tasked with investigating which combinations of A to D have been used to create the tables of values. Once all the combinations have been found, learners are to attempt to write the composite function algebraically.

The **Extension** allows learners to create two new function diagrams, E and F, and three tables of input/output values for any combination of functions A to F. These additional diagrams and tables are then given to their peers to investigate.

The correct answers are given below:

x	y
0	4
1	25
2	64
3	121
4	196

A followed by B,
$(3x + 2)^2$

x	y
0	8
1	17
2	26
3	35
4	44

A followed by A,
$9x + 8$

x	y
0	3
1	5
2	11
3	21
4	35

B followed by C,
$2x^2 + 3$

x	y
0	13
1	25
2	37
3	49
4	61

D followed by C,
$12x + 13$

x	y
0	7
1	13
2	19
3	25
4	31

A followed by C,
$6x + 7$

x	y
0	11
1	17
2	23
3	29
4	35

C followed by A,
$6x + 11$

x	y
0	0
1	1
2	16
3	81
4	256

B followed by B,
x^4

x	y
0	17
1	35
2	53
3	71
4	89

D followed by A,
$18x + 17$

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