

1.12 Transformations of Functions

Name: _____ Class: _____ Date: _____ **Total: 8 marks**

KEY WORDS transformation 变换 • horizontal translation 水平平移
• vertical translation 竖直平移 • translations 平移 • function 函数

Objective

Build the skills to answer exam questions on **transformations of functions**.

You must be able to:

- describe $g(x) = f(x) + k$ as a **vertical translation** 竖直平移
- describe $g(x) = f(x + h)$ as a **horizontal translation** 水平平移

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Translations

- $g(x) = f(x) + k$ shifts the graph **vertically** by k (up if $k > 0$).
- $g(x) = f(x + h)$ shifts the graph **horizontally** by $-h$ (so $f(x - 2)$ shifts **right** 2).

■ Example

From $f(x) = x^2$: $g(x) = x^2 + 3$ shifts up 3; $h(x) = (x - 1)^2$ shifts right 1, with vertex at $(1, 0)$.

2 Practice

2.1 State the transformation given by $f(x) + 3$. [1]

2.2 State the transformation given by $f(x - 2)$. [1]

2.3 Describe the graph of $g(x) = f(x) + 5$ compared with f . [1]

3 Exam-style questions

3.1 $g(x) = f(x) + k$ is a [1]

- **A** horizontal shift
- **B** vertical shift by k
- **C** reflection
- **D** stretch

3.2 $g(x) = f(x - 4)$ shifts the graph of f [1]

- **A** left 4
- **B** right 4
- **C** up 4
- **D** down 4

3.3 Start from $f(x) = x^2$.

(a) Describe $g(x) = x^2 + 3$. [1]

(b) Describe $h(x) = (x - 1)^2$. [1]

(c) State the vertex of h . [1]

Solutions

2.1 a vertical shift up by 3.

2.2 a horizontal shift right by 2.

2.3 it is the graph of f shifted up 5 units.

3.1 B.

3.2 B.

3.3 (a) shift f up 3. (b) shift f right 1. (c) $(1, 0)$.