

# Progression in Mathematics at Hessle Academy

## Algebra



## Learning Objective: Use function machines to determine inputs and outputs.

19. Look at the function machine below.

a) Calculate the output when the input is 6

Handwritten calculation:  $6 \times 4 = 24$ ,  $24 + 7 = 31$

Function machine diagram: Input  $\rightarrow \times 4 \rightarrow + 7 \rightarrow$  Output

Output: 31 (1)

b) Calculate the input when the output is 47

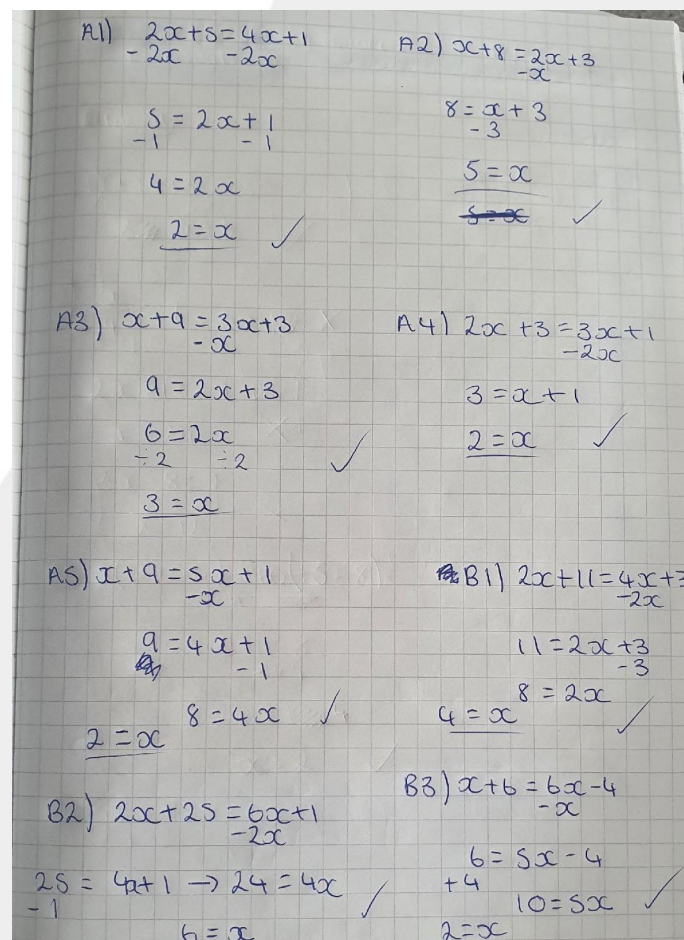
Function machine diagram: Input  $\rightarrow \times 4 \rightarrow + 7 \rightarrow$  Output

Output: 47

Input: 10 (1)

(Total 2 Marks)

## Learning Objective: Solve linear equations



A1)  $\begin{array}{r} 2x+5=4x+1 \\ -2x \quad -2x \\ \hline 5=2x+1 \\ -1 \quad -1 \\ \hline 4=2x \\ 2=x \quad \checkmark \end{array}$

A2)  $\begin{array}{r} x+8=2x+3 \\ -x \quad -x \\ \hline 8=x+3 \\ -3 \quad -3 \\ \hline 5=x \\ \underline{5=5} \quad \checkmark \end{array}$

A3)  $\begin{array}{r} x+9=3x+3 \\ -x \quad -x \\ \hline 9=2x+3 \\ 6=2x \\ -2 \quad -2 \\ \hline 3=x \quad \checkmark \end{array}$

A4)  $\begin{array}{r} 2x+3=3x+1 \\ -2x \quad -2x \\ \hline 3=x+1 \\ 2=x \quad \checkmark \end{array}$

A5)  $\begin{array}{r} x+9=5x+1 \\ -x \quad -x \\ \hline 9=4x+1 \\ 8=4x \\ 2=x \quad \checkmark \end{array}$

B1)  $\begin{array}{r} 2x+11=4x+3 \\ -2x \quad -2x \\ \hline 11=2x+3 \\ 8=2x \\ 4=x \quad \checkmark \end{array}$

B2)  $\begin{array}{r} 2x+25=6x+1 \\ -2x \quad -2x \\ \hline 25=4x+1 \\ -1 \quad -1 \\ \hline 24=4x \\ 6=x \quad \checkmark \end{array}$

B3)  $\begin{array}{r} x+6=6x-4 \\ -x \quad -x \\ \hline 6=5x-4 \\ +4 \quad +4 \\ \hline 10=5x \\ 2=x \quad \checkmark \end{array}$

## Learning Objective: Factorise and expand algebraic expressions

questions

- $x^2 + 4x + 4 = (x+2)(x+2)$  ✓
- $x^2 - 9 = (x+3)(x-3)$  ✓
- $x^2 - 7x + 12 = (x-3)(x-4)$  ✓
- $x^2 + 2x + 1 = (x+1)(x+1)$  ✓
- $x^2 - 4 = (x+2)(x-2)$  ✓
- $x^2 + 3x - 10 = (x-2)(x+5)$  ✓
- $x^2 - 10x + 25 = (x-5)(x-5)$  ✓
- $x^2 - 100 = (x-10)(x+10)$  ✓
- $x^2 - 8x - 20 = (x-10)(x+2)$  ✓
- $x^2 + 16x + 64 = (x+8)(x+8)$  ✓
- $x^2 - 1 = (x-1)(x+1)$  ✓
- $x^2 - 2x - 35 = (x-7)(x+5)$  ✓
- $x^2 - 8x + 16 = (x-4)(x-4)$  ✓
- $x^2 - 16 = (x+4)(x-4)$  ✓
- $x^2 - x - 12 = (x-4)(x+3)$  ✓
- $x^2 - 2x + 1 = (x-1)(x-1)$  ✓

Q	Expanded	Factorised
1	$3p + 15$	$3(p+5)$ ✓
2	$3p + 18$ ✓	$3(p+6)$
3	$6p + 18$	$3(2p+6)$ ✓
4	$6p + 15$	$3(p+5)$ ✓
5	$6p + 10$ ✓	$2(3p+5)$
6	$6p - 10$	$2(3p-5)$ ✓
7	$6p^2 - 10p$ ✓	$2p(3p-5)$
8	$6p^2 - 10$	$2(3p^2 - 5)$ ✓
9	$6 - 10p^2$	$2(3 - 5p^2)$ ✓
10	$-6 + 10p^2$ ✓	$-2(3 - 5p^2)$
11	$-6 + 12p^2$	$6(2p^2 - 1)$ ✓
12	$-6 + 11p^2$	



**Learning Objective:**  
Find solutions to non linear equations such as quadratic equations.

①  $x^2 + 4x + 3$   
 $x^2 + 3x + x + 3$   
 $x(x+3) + 1(x+3)$   
 $(x+3)(x+1)$  ✓

②  $3x^2 - 13x + 4 = 0$   
 $3x^2 - 12x - x + 4$   
 $3x(x-4) - 1(x-4)$   
 $(3x-1)(x-4)$   
 $x = \frac{1}{3} \quad x = 4$  ✓

③  $x^2 + 11x = 42$   
 $x^2 + 11x - 42 = 0$   
 $x^2 + 14x - 3x - 42$   
 $x(x+14) - 3(x+14)$   
 $(x+14)(x-3)$   
 $x = -14 \quad x = 3$  ✓

④  $f(x) = 3x - 4$   
 $f^{-1}(x) = \frac{x+4}{3}$  ✓

$y = 3x - 4$   
 $y + 4 = 3x$   
 $\frac{y+4}{3} = x$

⑤  $75^{-1/2} = \frac{1}{\sqrt{75}}$

③  $x^2 - 8x + 12 = 0$   
 $(x-4)^2 - 16 + 12 = 0$   
 $(x-4)^2 - 4 = 0$   
 $(x-4)^2 = 4$   
 $x-4 = \pm 2$   
 $+4$   
 $x = 4 \pm 2$   
 $x = 2$  ✓  $x = 6$  ✓

Learning Objective:  
Apply algebraic knowledge to solve  
multistep problems.

