

## MAT.HS.TE.1.00FBF.N.227

Sample Item ID:	MAT.HS.TE.1.00FBF.N.227
Grade:	HS
Claim(s):	<b>Claim 1: Concepts and Procedures</b> Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.
Assessment Target(s):	1 N: Build a function that models a relationship between two quantities.
Content Domain:	Functions
Standard(s):	F-BF.1
Mathematical Practice(s):	1, 2, 7
DOK:	1
Item Type:	TE
Score Points:	2
Difficulty:	M
Key:	IMBE
Stimulus/Source:	
Target-specific attributes (e.g., accessibility issues):	
Notes:	TE Template: Select and Order

A new social networking website was made available. The website had 10 members its first week. Beginning the second week, the creators of the website have a goal to triple the number of members every week.

For *Part A* and *Part B* below, select the appropriate expression for each blank region. To place an expression in a region, click on the expression, move the pointer over the region, and click again to place the expression in the region. Only one expression can be placed in each region. To return all expressions to their original positions, click the Reset button.

0	1	3	7	10
$3n+7$	$3n+10$	$30(n-1)$	$10(3^{n-1})$	$3(10^{n-1})$
$f(n-1)+2$	$f(n-1)+30$	$3f(n-1)$	$3f(n-1)+10$	$f(3n-1)$

**Part A**

Determine an explicit formula for  $f(n)$ , the number of members the creators have a goal of getting  $n$  weeks after the website is made available.

$$f(n) = \boxed{\phantom{000000}}$$

**Part B**

Determine a recursive formula for  $f(n)$ .

$$f(n) = \boxed{\phantom{000000}} \quad \text{for } n > \boxed{\phantom{000000}}$$

$$f(1) = \boxed{\phantom{000000}}$$

*Key and Distractor Analysis:*

- A: Assumes general term of recursive formula holds for  $n=1$ .
- B: KEY for Part B,  $n >$ .
- C: Notices number of members triples.
- D: Wildcard.
- E: KEY for Part B,  $f(1) =$ .
- F: Notices correct week 1 value.
- G: Assumes relationship is linear, and assumes formula must involve 3 and 10.
- H: Notices correct week 2 value.
- I: KEY for Part A,  $f(n) =$ .
- J: Notices correct week 2 value, or switches 3 and 10 in key.
- K: Notices correct week 2 value.
- L: Assumes formula must involve product of 3 and 10.
- M: KEY for Part B,  $f(n) =$ .
- N: Assumes 10 must be included in general term of recursive formula.
- O: Places 3 in wrong position.

*Scoring Rubric:*

*Responses to this item will receive 0-2 points, based on the following:*

**2 points:** The student has a solid understanding of how to explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency for writing recursive and explicit functions to describe the relationship between two quantities. The student correctly selects  $f(n)$  for the explicit formula in part A. The student also completely defines the correct recursive formula in part B, selecting the correct  $f(n)$  definition, condition for  $n$ , and initial value for  $f(1)$ .

**1 point:** The student understands how to explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency for writing recursive and explicit functions to describe the relationship between two quantities. The student can identify both the explicit formula in part A and the correct  $f(n)$  definition in part B, but does not correctly identify the condition for  $n$  and/or the initial value for  $f(1)$  in part B.

**0 points:** The student has an inconsistent understanding of how to explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency for writing recursive and explicit functions to describe the relationship between two quantities. The student does not correctly select the  $f(n)$  definitions for both the explicit formula in part A and the  $f(n)$  definition in part B.

*TE Information:*

**Item Code:** MAT.HS.TE.1.00FBF.N.227

**Template:** Select and Order

**Interaction Space Parameters:**

A. *The image containing the regions:* the four blank rectangular areas next to:

- [1] " $f(n)=$ ",
- [2] " $f(n)=$ ",
- [3] "for  $n>$ ",
- [4] " $f(1)=$ "

B. *The images for the digital content objects:* 15 numbers and expressions starting with "0" and ending with " $f(3n - 1)$ "; for the scoring data, the objects are labeled A-0 starting with the top left (A="0") and going across and then down (O=" $f(3n - 1)$ ")

**Scoring Data: (X represents incorrect response)**

{IMBE}=2

{IMBX}=1

{IMXE}=1

{IMXX}=1