Microbial Growth

Paul and Tom observed the growth of a special kind of microbe which was growing in the following pattern every minute.

At one minute  At two minutes  At three minutes  At four minutes

1. Complete the following table.

<table>
<thead>
<tr>
<th>Minutes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Microbes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Is the relation between the “Minutes” and the “Number of Microbes” a function? Why or Why not?

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3. Write the first eight terms of the sequence for the number of microbes.

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4. What kind of sequence is this? Justify your reasoning.

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5. If $a_1$ denotes the first term of the sequence and $d$ represents the common difference, then find the values of $a_1$ and $d$.

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6. Write the “Recursive Formula” to find the n\textsuperscript{th} term \(a_n\) for this sequence.

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Observe the conversation between Paul and Tom:

**Paul:** This pattern is constantly increasing by 4, so I know it is linear. It starts with 5 microbes and increases by 4 every minute, so the nth term of the sequence is \(a_n = 5 + 4n\)

**Tom:** I don’t know about that. I agree that it is a linear function—just look at that growth pattern. However, I used the numbers in the table and got \(a_n = 5 + 4(n – 1)\)

7. What is different about the process that Paul and Tom used to create their equations?

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8. Who is right? Why? Write the correct explicit formula to find the nth term \(a_n\) of this arithmetic sequence.

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9. Use the above explicit formula to find the number of microbes at 10 minutes, 17 minutes, and at 40 minutes.

Number of microbes at 10 minutes, \(a_{10}\) = ______________________________

Number of microbes at 17 minutes, \(a_{17}\) = ______________________________

Number of microbes at 40 minutes, \(a_{40}\) = ______________________________

10. At how many minutes there would be 173 microbes? Explain your reasoning.

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11. Complete the following table and graph the sequence.

<table>
<thead>
<tr>
<th>Minutes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of microbes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
12. Should we connect the points on the graph? Explain your reasoning.

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13. Use technology, derive the **linear function** \( f(x) \) for this sequence.

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14. What can you conclude about the recursive formula, explicit formula, and the function form of this arithmetic sequence?

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15. Write a real-life example of an arithmetic sequence. Express it as a linear function.

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