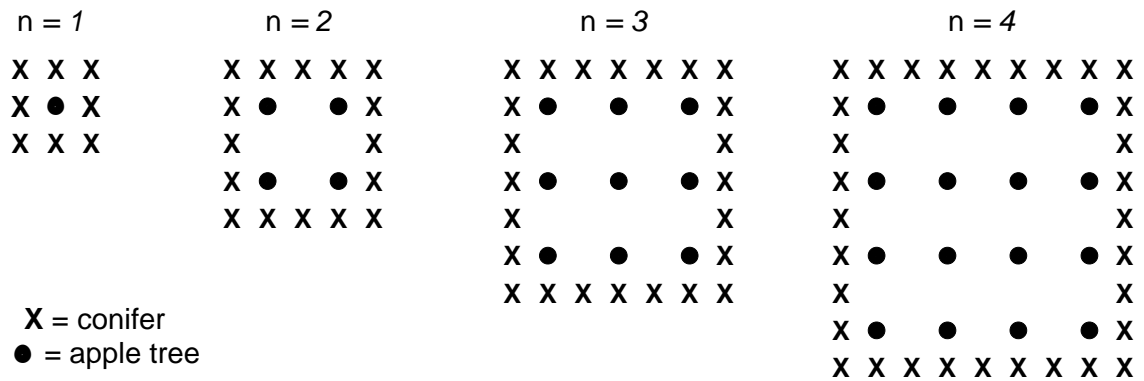


APPLES

A farmer plants apple trees in a square pattern. In order to protect the trees against the wind he plants conifers all around the orchard.

Here you see a diagram of this situation where you can see the pattern of apple trees and conifers for any number (n) of rows of apple trees :



Question 1: APPLES

M136Q01- 01 02 11 12 21 99

Complete the table:

n	Number of apple trees	Number of pine trees
1	1	8
2	4	
3		
4		
5		

APPLES SCORING 1

Complete the table:

n	Number of apple trees	Number of pine trees
1	1	8
2	4	16
3	9	24
4	16	32
5	25	40

Full credit

Code 21: All 7 entries correct

Partial credit

[These codes are for ONE error/missing in the table. Code 11 is for ONE error for n=5, and Code 12 is for ONE error for n=2 or 3 or 4]

Code 11: Correct entries for n=2,3,4, but ONE cell for n=5 incorrect or missing

- The last entry '40' is incorrect; everything else is correct.
- '25' incorrect; everything else is correct.

Code 12: The numbers for n=5 are correct, but there is ONE error /missing for n=2 or 3 or 4.

No credit

[These codes are for TWO or more errors or missing responses]

Code 01: Correct entries for n=2,3,4, but BOTH cells for n=5 incorrect

- Both '25' and '40' are incorrect; everything else is correct.

Code 02: Other responses

Code 99: Missing

Question 2: APPLES

M136Q02- 00 11 12 13 14 15 99

There are two formulae you can use to calculate the number of apple trees and the number of pine trees for the pattern described above:

$$\text{Number of apple trees} = n^2$$

$$\text{Number of pine trees} = 8n$$

where n is the number of rows of apple trees.

There is a value of n for which the number of apple trees equals the number of pine trees. Find the value of n and show your method of calculating this.

.....
.....

APPLES SCORING 2**Full credit**

[These codes are for responses with the correct answer, $n=8$, using different approaches]

Code 11: $n=8$, algebraic method explicitly shown

- $n^2 = 8n$, $n^2 - 8n = 0$, $n(n - 8) = 0$, $n = 0$ & $n = 8$, so $n = 8$

Code 12: $n=8$, no clear algebra presented, or no work shown

- $n^2 = 8^2 = 64$, $8n = 8 \cdot 8 = 64$
- $n^2 = 8n$. This gives $n=8$.
- $8 \times 8 = 64$, $n=8$
- $n = 8$
- $8 \times 8 = 8^2$

Code 13: $n=8$, using other methods, e.g., using pattern expansion or drawing.

[These codes are for responses with the correct answer, $n=8$, PLUS the answer $n=0$, with different approaches.]

Code 14: As for Code 11 (clear algebra), but gives both answers $n=8$ AND $n=0$

- $n^2 = 8n$, $n^2 - 8n = 0$, $n(n - 8) = 0$, $n = 0$ & $n = 8$

Code 15: As for Code 12 (no clear algebra), but gives both answers $n=8$ AND $n=0$

No credit

Code 00: Other responses, including just the response $n=0$.

- $n^2 = 8n$ (a repeat of the statement from the question)
- $n^2 = 8$
- $n=0$. You can't have the same number, because for every apple tree, there are 8 pine trees.

Code 99: Missing

Question 3: APPLES

M136Q03- 01 02 11 21 99

Suppose the farmer wants to make a much larger orchard with many rows of trees. As the farmer makes the orchard bigger, which will increase more quickly: the number of apple trees or the number of pine trees? Explain how you found your answer.

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.....

APPLES SCORING 3**Full Credit**

Code 21: Correct response (apple trees) accompanied by a valid explanation. For example:

- Apple trees = $n \times n$ and pine trees = $8 \times n$ both formulas have a factor n , but apple trees have another n which will get larger where the factor 8 stays the same. The number of apple trees increases more quickly.
- The number of apple trees increases faster because that number is being squared instead of multiplied by 8
- Number of apple trees is quadratic. Number of pine trees is linear. So apple trees will increase faster.
- Response uses graph to demonstrate that n^2 exceeds $8n$ after $n=8$.

*[Note that code 21 is given if the student gives some algebraic explanations **based on the formulae n^2 and $8n$**].*

Partial credit

Code 11: Correct response (apple trees) based on specific examples or based on extending the table.

- The number of apple trees will increase more quickly because, if we use the table (previous page), we find that the no. of apple trees increases faster than the no. of pine trees. This happens especially after the no. of apple trees and the number of pine trees are equivalent.
- The table shows that the number of apple trees increases faster.

OR

Correct response (apple trees) with SOME evidence that the relationship between n^2 and $8n$ is understood, but not so clearly expressed as in Code 21.

- Apple trees after $n > 8$.
- After 8 rows, the number of apple trees will increase more quickly than pine trees.
- Pine trees until you get to 8 rows, then there will be more apple trees.

No credit

Code 01: Correct response (apple trees) with no, insufficient or wrong explanation

- Apple trees
- Apple trees because they are populating the inside which is bigger than just the perimeter.
- Apples trees because they are surrounded by pine trees.

Code 02: Other incorrect responses

- Pine trees
- Pine trees because for every additional row of apple trees, you need lots of pine trees.
- Pine trees. Because for every apple tree there are 8 pine trees.
- I don't know.

Code 99: Missing