

Help - I'm Melting!!!!

The students in Mrs. McNair's class stacked 31 ice cubes near the window at 8:05 in the morning. The sun came out and it melted 1 ice cube the first hour. It melted 2 ice cubes the second hour, and four ice cubes the third hour. If this pattern continues, at what time will all of the ice cubes have melted?

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Suggested Grade Span

Grades 3-5

Grade Level(s) in Which the Task Was Piloted

Grade 5

Task

The students in Mrs. McNair’s class stacked 31 ice cubes near the window at 8:05 in the morning. The sun came out and it melted 1 ice cube the first hour. It melted 2 ice cubes the second hour, and four ice cubes the third hour. If this pattern continues, at what time will all of the ice cubes have melted?

Alternate Versions of the Task

More Accessible Version:

The students in Mrs. McNair’s class stacked 31 ice cubes near the window in the morning. The sun came out and it melted 1 ice cube the first hour. It melted 2 ice cubes the second hour, and four ice cubes the third hour. If this pattern continues, how many hours will it take for all of the ice cubes to melt?

More Challenging Version:

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The students in Mrs. McNair’s class stacked ice cubes near the window at 8:05 in the morning. The sun came out and it melted 1 ice cube the first hour. It melted 2 ice cubes the second hour, and four ice cubes the third hour. If this pattern continues, at what time would more than ten thousand ice cubes have melted?

NCTM Content Standards and Evidence

Algebra Standards for Grades 3-5

Instructional programs from pre-kindergarten through grade 12 should enable all students to...

- Understand patterns, relations, and functions.
 - *NCTM Evidence:* Describe, extend, and make generalizations about geometric and numeric patterns.
 - *Exemplars Task Specific Evidence:* This task requires students to identify and extend the pattern in which the ice cubes melt in order to achieve a correct solution.

Time/Context/Qualifiers/Tip(s) From piloting Teacher

This task was given to lower-level 5th graders who were studying time. The pattern in which the ice cubes melt is a classic (powers of 2). The challenge is that students need to know to keep an accumulated total, or they will achieve an incorrect answer.

Links

This task could be used when studying boiling and melting points in science class. Students could conduct their own experiments to see how long it would take to melt 31 ice cubes in a window sill.

Common Strategies Used to Solve This Task

Most students create a chart as that in the solution below to solve this task.

Possible Solutions

Original Version:

Time	number melted	total melted
8:05 - 9:05	1	1
9:05 - 10:05	2	3
10:05 - 11:05	4	7
11:05 - 12:05	8	15
12:05 - 1:05	16	31

All were melted by 1:05.

Note, students could come up with alternative solutions by identifying and extending other correct patterns.

More Accessible Version:

It will take 5 hours for all cubes to melt.

More Challenging Version:

Between 9:00 and 10:00 P.M. , 8, 191 cubes would have melted for a total of 16,383 cubes melted.

Task Specific Assessment Notes

General Notes: This is a fairly simple task. The challenge is in identifying the correct pattern and keeping a running total.

Novice: The novice does not attempt to determine a pattern and/or randomly manipulates the numbers presented in the task. Little or no mathematical understanding will be present.

Apprentice: The apprentice will know to identify and extend a pattern, but will do so incorrectly either due to a computation error or due to an error in identifying a correct pattern.

Practitioner: The practitioner will identify and extend a correct pattern to achieve a correct solution.

Expert: The expert will not only identify and extend a correct pattern to achieve a correct solution, but will also go beyond the task requirements by making mathematically relevant observations or by extending the solution.

Author

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1 9:05	2 53:05
2 100 5	26 4:05
4 11:06	28 5:05
5 12:05	29 6:05
6 1:05	30 7:05
8 2:05	31 7:33
10 3:05	
12 4:05	
13 5:05	
16 6:05	
16 8:05	
17 9:05	
18 0:65	
20 11:05	
21 12:05	
22 1:05	
24 2:05	

M:25
is when all
the ice cubes
would be melted

The student does not acknowledge a pattern of melting.

Little or no understanding of the task is demonstrated.

It is unclear why the student changes from 1 hour intervals used throughout to a 20 minute interval for the last cube melting.

Novice (cont.)

Ice cubes
805
31
1
2
- 4

807

No parts of the solution make sense.

I think all of the ice cubes
will melt at 807

The student randomly manipulates
numbers with no correct reasoning.

Apprentice

1 ice cubes in the 1st hour
 2 ice cubes in the 2nd hour
 4 ice cubes in the 3rd hour
 6 ice cubes in the 4th hour
 8 ice cubes in the 5th hour
 10 ice cubes in the 6th hour
 12 ice cubes in the 7th hour
 14 ice cubes in the 8th hour
 16 ice cubes in the 9th hour
 18 ice cubes in the 10th hour
 20 ice cubes in the 11th hour
 22 ice cubes in the 12th hour
 24 ice cubes in the 13th hour
 26 ice cubes in the 14th hour
 28 ice cubes in the 15th hour
 30 ice cubes in the 16th hour
 31 ice cubes in the 17th hours

Connection
 It increases
 by 2 every
 time

Totals
 17 hours
 until the
 ice cube
 melted

17 hours

The student misidentifies the pattern.
 Some correct reasoning is present.

An incorrect solution is achieved.
 Some math language is used, all
 work is shown.

Practitioner

$$\begin{array}{r}
 8050 \\
 9051 \\
 10053 \\
 11054 \\
 12058 \\
 130510 \\
 \hline
 31
 \end{array}$$

Work is shown. Math language and representation are used to communicate the solution.

Time	number melted	Total number of cubes
805	0	0
905	1	1
1005	3	3
1105	4	7
1205	8	15
1305	16	31

A correct answer is achieved.

Expert

time of melting	# of ice cubes melted	# left
8:05-9:05	1	30
9:05-10:05	2	28
10:05-11:05	4	24
11:05-12:05	8	16
12:05-1:05	16	0

The student identifies the underlying mathematics in the task.

All work is shown, labeled and organized.

The number of ice cubes melted doubled with each hour. The last ice cube melted at 1:05. The cubes melted by powers of 2:

$$\begin{aligned} 2^0 &= 1 \\ 2^1 &= 2 \\ 2^2 &= 4 \\ 2^3 &= 8 \\ 2^4 &= 16 \end{aligned}$$

The student uses accurate and appropriate math language and representation.