These Questions Can Be Used at Various Times Throughout the Year

This resource comprises five booklets. Each booklet is a compilation of all the questions in a particular strand released between 2012 and 2016. The multiple-choice questions appear first, followed by open-response. The questions are sorted according to the overall expectations in The Ontario Curriculum, Grades 1–8: Mathematics to which each is mapped. Detailed information about the questions, such as the year of release, the overall expectation and the category of knowledge and skills the question is mapped to, is listed after them. This detailed information also includes the answer key for each multiple-choice question. The scoring guides (with the item-specific rubric and student samples at each code) for each open-response question follow.
How to Use This Resource

Suggested uses of these booklets:

- Select specific questions by overall expectation based on student learning.
- Use the scoring guides for the open-response questions to assist students in evaluating the reasonableness and completeness of their solutions.
- Use multiple-choice questions as open-response questions, when appropriate, by not including the answer options. Students can answer the question and then discuss the steps required and other possible answers, including those arrived at through common errors. Discuss whether there are multiple methods that can be used to answer the question. Students can then compare their answer to the multiple-choice options. Encourage the students to identify ways to ensure their solution process is complete and the question is answered fully.
- Use technology in the classroom to have students record multiple-choice answers instantly, which will allow for discussion of correct answers and the common errors demonstrated by the incorrect options (along with other errors not included in these options). This discussion can lead to a deeper understanding of concepts and assist students in correcting their own misunderstandings. Another option is to have students start with the correct answer and work backward to formulate a question.
- Encourage students to use manipulatives, and model how to apply them. For example, number lines can be used with questions mapped to expectations in the Number Sense and Numeration strand as well as those mapped to other strands, such as Patterning and Algebra or Data Management and Probability.

Details of the Assessment

EQAO assessments are comparable from year to year, as they share a common structure. The blueprint, which can be found in the Framework, defines how the questions are spread throughout the curriculum. (For more information, see www.eqao.com.) EQAO releases only half of the assessment each year (and has done so since 2013), so the released questions from a particular year do not cover the full blueprint. The blueprint specifies the number and types of questions (multiple-choice or open-response) that are mapped to a particular group of expectations. Each group of expectations can consist of one or more overall expectations, which themselves include specific expectations. Although EQAO releases only the overall expectation, each question is mapped to a specific expectation. The specific expectations vary from year to year; however, some of them involve knowledge or skills that may be assessed every year, or different parts of the expectation can be assessed on a yearly basis.
EQAO's Definitions of the Categories of Knowledge and Skills

EQAO has adapted the definitions of the categories of knowledge and skills from the achievement chart found in The Ontario Curriculum. These definitions assist EQAO in mapping questions.

A question is mapped to the category of Knowledge and Understanding if students must demonstrate only subject-specific content (knowledge) or comprehension of its meaning and significance (understanding), or both, in order to answer the question. These questions assess basic knowledge or understanding of concepts.

A question is mapped to the category Application if students must select the appropriate tool or get the necessary information and “fit” it to the problem. A question may change from Knowledge and Understanding to Application if context is added.

Questions that require students either to select and sequence a variety of tools or to demonstrate a critical thinking process (e.g., reasoning) are mapped to the category Thinking. Consider whether students need to make a plan to answer the question. Thinking questions require students to select more than one tool and sequence them (e.g., add first then subtract) or use reasoning to determine the answer. There may be more than one way to answer these questions.

Each question is also mapped to a category of knowledge and skills. EQAO maps multiple-choice questions to the Knowledge and Understanding, Application and Thinking categories. Open-response questions are mapped to either Application or Thinking. EQAO does not map any questions to the category Communication, but teachers can evaluate this skill through any open-response questions where students need to show their work or justify their answer.

Questions where students need to select one tool and use it repeatedly (without any sequencing of tools) are usually mapped to the category Application. However, the selection of a tool, its use more than once and the addition or subtraction of the results requires a plan. Questions requiring such a plan are generally mapped to the category Thinking.

The category and specific expectation each question is mapped to is confirmed by many Ontario educators, including the question writer, review committees and an expert reviewer. In the classroom, these questions can be mapped to a category based on the knowledge and skills the students currently have. If students have never been taught a specific skill, the question could be mapped to Application or even Thinking; however, after they are taught the skill, it could be mapped to Knowledge and Understanding or Application.

As the EQAO assessment is written near the end of the school year, it assumes that students have been taught the knowledge and skills outlined in the curriculum for the year.
Here are some examples to help distinguish the different categories of knowledge and skills questions are mapped to.

Example 1:
When two multiple-choice questions are the same, the answer options can determine the category of knowledge and skills the question is mapped to.

**VERSION 1**

Which of these is equivalent to 8%?

- a 80
- b 8
- c 0.8
- d 0.08

**VERSION 1**

To answer this question, students need to determine which value is equivalent to 8%. By the end of Grade 6, students should know this answer or be able to calculate it quickly. The category that the question is mapped to is **Knowledge and Understanding**.

(correct answer: d)

**VERSION 2**

Which of these is equivalent to 8%?

- a \( \frac{2}{25} \)
- b \( \frac{2}{20} \)
- c \( \frac{1}{8} \)
- d \( \frac{8}{10} \)

**VERSION 2**

For version 2, the answer options have changed the category, as students need to determine which fraction is equivalent to 8%. One approach is to change 8% to a fraction and then compare \( \frac{8}{100} \) to the given fractions to determine which one is equivalent. The students can also change the fractions in the options to percentages and see which one is equivalent to 8%. As students are required to select a tool to answer this question, it is mapped to the category **Application**.

(correct answer: a)
Example 2:
When the answer options are similar, the question can be changed to influence the category of knowledge and skills.

### VERSION 1

The first term of a pattern is 28 672. The pattern rule is “divide by 4 to get the next term.”

What is the 5th term?

- a 28
- b 112
- c 448
- d 7168

Version 1

This question is mapped to the category **Knowledge and Understanding**. Students start with the first term and apply the given pattern rule to determine the 5th term.

(correct answer: b)

### VERSION 2

A pattern is shown below. Each term increases by the same amount.

4, 41, 78, 115, 152, …

What is the 9th term in the pattern?

- a 226
- b 263
- c 300
- d 337

Version 2

This question does not provide students with the pattern rule. They must first figure out the constant that the terms are increasing by and then apply it to determine the 9th term. Therefore, this question is mapped to **Application**, as the tool is not given.

(correct answer: c)

### VERSION 3

The terms of a pattern are made using toothpicks. Term 1 and Term 5 are not shown.

![Diagram of toothpick patterns]

Determine the **total** number of toothpicks used in Term 1 to Term 5 of this pattern.

Justify your answer.

The total number of toothpicks used in Term 1 to Term 5 of this pattern is _____.

Version 3

This is an open-response question. It is mapped to the category **Thinking**, as students must make a plan. They must first figure out the pattern and then determine both Term 1 and Term 5. After that, students must determine the number of toothpicks in each term and add them together. Refer to question 19 in this booklet for samples of student responses with annotations.
These polygons have been ordered from smallest to largest based on a geometric property.

Which property has been used to order the polygons?

a. number of sides
b. number of acute angles
c. number of lines of symmetry
d. number of pairs of parallel sides

Complete the chart.

<table>
<thead>
<tr>
<th>Name</th>
<th>Number of acute angles</th>
<th>Number of obtuse angles</th>
<th>Number of lines of symmetry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectangle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right trapezoid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isosceles trapezoid</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

On the grid, draw and name a quadrilateral that has 2 obtuse angles and no lines of symmetry.

Name of quadrilateral: ____________________

Example 3:
Multiple-choice and open-response questions can be mapped to the category Thinking.

VERSION 1
This multiple-choice question is mapped to the category Thinking. Students need to use reasoning or make a plan. They need to determine which property was used by considering the four properties for each shape and then determining which one is increasing in value. Students can also consider which of the first shape’s properties has a value less than that of the second shape’s, and then try using that property on the rest of the shapes to see if the value continues to increase.

(correct answer: c)

VERSION 2
This open-response question is also mapped to the category Thinking. Students need to use reasoning or make a plan to answer the second part. Students must consider which quadrilateral has the given properties and then draw it. They may consider each type of quadrilateral and determine its properties, or they may try to draw one with the given properties.

Refer to question 14 in the Geometry and Spatial Sense strand booklet for samples of student responses with annotations.
Examples of questions

Patterning and Algebra

Junior Division

Grade 6

Multiple-Choice and Open-Response Questions

INSTRUCTIONS

Answering Multiple-Choice Questions

Like this: ★ Not like this: ✗ ✔ ☻ ⬤

• Use a pencil only.
• Fill only one circle for each question.
• Fill the circle completely.
• Cleanly erase any answer you wish to change.

Answering Open-Response Questions

• Write on the space provided in this booklet.
1. The 4 terms of the pattern below are made of equilateral triangles with side lengths of 2 units.

![Pattern Diagram]

Which number sequence represents the perimeters of the 4 terms of this pattern?

- 1, 2, 3, 4
- 3, 4, 5, 6
- 6, 8, 10, 12
- 6, 10, 14, 18

2. The pattern shown below is made of triangles.

![Pattern Diagram]

The pattern continues.

Which of the following represents the number of triangles in Terms 4, 5 and 6?

- 2, 4, 6
- 6, 8, 10
- 8, 10, 12
- 10, 12, 14

3. Darren starts with a triangle and creates a pattern.

![Pattern Diagram]

Each term in the pattern is a polygon with one more side than the term before it.

How many sides will Term 8 have?

- 6
- 8
- 9
- 10
Consider the pattern rule below.

Start at 1, and then triple the term to get the next term.

Which graph represents this pattern?
5 Which of these patterns uses the rule “multiply by 2 and add 1” to get the next term?

○ 1, 2, 4, 5, 10, ...
○ 1, 2, 4, 8, 16, ...
○ 1, 3, 7, 15, 31, ...
○ 1, 4, 10, 22, 46, ...

6 Consider the growing pattern shown on the grid below.

![Grid with points plotted](image)

The pattern continues in the same way.
What ordered pair represents the next point to be plotted in this pattern?

○ (4, 9)
○ (10, 4)
○ (9, 4)
○ (4, 10)

7 A pattern is shown below.

\[1, 2, 4, 8, \ldots\]

Which rule best describes the pattern?
Start with 1 and

○ add 1 to get the next term.
○ add 2 to get the next term.
○ divide by 2 to get the next term.
○ multiply by 2 to get the next term.

8 Consider the pattern below.

\[1161, 387, 129, 43\]

Which is its pattern rule?
To get the next term,

○ divide each term by 3.
○ divide each term by 4.
○ subtract 86 from each term.
○ subtract 774 from each term.

9 A pattern is shown below.

\[64, 32, 16, 8, 4, \ldots\]

Which rule describes how to find the next term in the pattern?

○ divide the previous term by 2
○ divide the previous term by 4
○ subtract 16 from the previous term
○ subtract 32 from the previous term
10. The first term of a pattern is 28,672. The pattern rule is “divide by 4 to get the next term.” What is the 5th term?
- 28
- 112
- 448
- 7168

11. The chart below shows the first 4 terms of 4 non-repeating patterns.

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>15, 18, 21, 24</td>
</tr>
<tr>
<td>X</td>
<td>960, 480, 240, 120</td>
</tr>
<tr>
<td>Y</td>
<td>2, 9, 16, 23</td>
</tr>
<tr>
<td>Z</td>
<td>85, 74, 63, 52</td>
</tr>
</tbody>
</table>

If the 4 patterns continue, which pattern will reach 30 first?
- Pattern W
- Pattern X
- Pattern Y
- Pattern Z

12. Consider the repeating pattern below.

If the pattern continues in the same way, what will the 54th term be?
- 
- 
- 
- 

13. A pattern is created by rotating a rectangle 90° clockwise about Point X. This rotation is repeated. Which of the following shows the pattern?
14 If the equation $x + 4 = 12$ is true, which of the following best describes the variable $x$?

- one unknown value
- two unknown values
- three unknown values
- many unknown values

15 If $n \times a = 24$ and $n \times a + b = 33$, what is the value of $b$?

- 3
- 4
- 6
- 9

16 Consider these two equations.

\[ \square - 3 = 7 \]
\[ 4 \times \triangle = 8 \]

What is the value of $\square + \triangle$?

- 2
- 6
- 12
- 14

17 If $n \times 3 = 24$ and $n + 40 - s = 36$, what is the value of $s$?

- 8
- 10
- 12
- 14

18 Which two equations are true if $n = 2$?

- Equation 1: $4 + n + 3 = 5$
- Equation 2: $4 - n + 3 = 5$
- Equation 3: $4 \times n + 3 = 5$
- Equation 4: $4 \div n + 3 = 5$

- Equation 2 and Equation 4
- Equation 2 and Equation 3
- Equation 1 and Equation 4
- Equation 1 and Equation 2
The terms of a pattern are made using toothpicks. Term 1 and Term 5 are not shown.

Determine the **total** number of toothpicks used in Term 1 to Term 5 of this pattern. Justify your answer.

The total number of toothpicks used in Term 1 to Term 5 of this pattern is _______. 
Two patterns are shown below.

If both patterns continue in the same way, which pattern will reach a term with a value of 23 first?

Justify your answer.

Pattern ______ will reach a term with a value of 23 first.
Pattern A is created by repeating the 4 terms below in order.

### Pattern A

<table>
<thead>
<tr>
<th>Term number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
</table>

Pattern B is created by repeating the 3 terms below in order.

### Pattern B

<table>
<thead>
<tr>
<th>Term number</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
</table>

Find a term in both patterns that is the same and has the same term number. Show your work.

The term number is ________________.
# Detailed Information About the Questions

## Patterning and Algebra

### Multiple-Choice Questions

<table>
<thead>
<tr>
<th>QUESTION NUMBER</th>
<th>YEAR QUESTION RELEASED</th>
<th>OVERALL EXPECTATION *</th>
<th>COGNITIVE SKILL</th>
<th>KEY</th>
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<tbody>
<tr>
<td>1</td>
<td>2012</td>
<td>1</td>
<td>KU</td>
<td>c</td>
</tr>
<tr>
<td>2</td>
<td>2014</td>
<td>1</td>
<td>KU</td>
<td>c</td>
</tr>
<tr>
<td>3</td>
<td>2015</td>
<td>1</td>
<td>AP</td>
<td>d</td>
</tr>
<tr>
<td>4</td>
<td>2012</td>
<td>1</td>
<td>AP</td>
<td>d</td>
</tr>
<tr>
<td>5</td>
<td>2016</td>
<td>1</td>
<td>KU</td>
<td>c</td>
</tr>
<tr>
<td>6</td>
<td>2013</td>
<td>1</td>
<td>AP</td>
<td>d</td>
</tr>
<tr>
<td>7</td>
<td>2014</td>
<td>1</td>
<td>KU</td>
<td>d</td>
</tr>
<tr>
<td>8</td>
<td>2012</td>
<td>1</td>
<td>AP</td>
<td>a</td>
</tr>
<tr>
<td>9</td>
<td>2015</td>
<td>1</td>
<td>AP</td>
<td>a</td>
</tr>
<tr>
<td>10</td>
<td>2016</td>
<td>1</td>
<td>KU</td>
<td>b</td>
</tr>
<tr>
<td>11</td>
<td>2012</td>
<td>1</td>
<td>TH</td>
<td>c</td>
</tr>
<tr>
<td>12</td>
<td>2013</td>
<td>1</td>
<td>AP</td>
<td>c</td>
</tr>
<tr>
<td>13</td>
<td>2015</td>
<td>1</td>
<td>TH</td>
<td>a</td>
</tr>
<tr>
<td>14</td>
<td>2012</td>
<td>2</td>
<td>KU</td>
<td>a</td>
</tr>
<tr>
<td>15</td>
<td>2012</td>
<td>2</td>
<td>AP</td>
<td>a</td>
</tr>
<tr>
<td>16</td>
<td>2016</td>
<td>2</td>
<td>AP</td>
<td>d</td>
</tr>
<tr>
<td>17</td>
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<td>2</td>
<td>TH</td>
<td>c</td>
</tr>
<tr>
<td>18</td>
<td>2014</td>
<td>2</td>
<td>AP</td>
<td>a</td>
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### Open-Response Questions

<table>
<thead>
<tr>
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<th>YEAR QUESTION RELEASED</th>
<th>OVERALL EXPECTATION *</th>
<th>COGNITIVE SKILL</th>
</tr>
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<tbody>
<tr>
<td>19</td>
<td>2016</td>
<td>1</td>
<td>TH</td>
</tr>
<tr>
<td>20</td>
<td>2014</td>
<td>1</td>
<td>TH</td>
</tr>
<tr>
<td>21</td>
<td>2012</td>
<td>1</td>
<td>TH</td>
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</tbody>
</table>

### Legend

<table>
<thead>
<tr>
<th>Cognitive Skill</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>KU</td>
<td>Knowledge and Understanding</td>
</tr>
<tr>
<td>AP</td>
<td>Application</td>
</tr>
<tr>
<td>TH</td>
<td>Thinking</td>
</tr>
</tbody>
</table>

*This is the number of the overall expectation in the Patterning and Algebra strand that the question is mapped to. The overall expectations are numbered according to the order in which they appear in *The Ontario Curriculum.*
Item-specific rubrics and sample student responses with annotations

QUESTIONS 19 TO 21
Question 19

<table>
<thead>
<tr>
<th>Code</th>
<th>Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
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<td>• Blank: nothing written or drawn in response to the question</td>
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• Irrelevant content: does not attempt assigned question (e.g., comment on the task, drawings, “?”, “!”, “I don’t know”)  
• Off topic: no relationship of written work to the question |
| 10   | Thinking process to determine the total number of toothpicks used in Term 1 to Term 5 of a pattern shows limited effectiveness due to  
• minimal evidence of a solution process  
• limited identification of important elements of the problem  
• too much emphasis on unimportant elements of the problem  
• no conclusions presented  
• conclusion presented without supporting evidence |
| 20   | Thinking process to determine the total number of toothpicks used in Term 1 to Term 5 of a pattern shows some effectiveness due to  
• an incomplete solution process  
• identification of some of the important elements of the problem  
• some understanding of the relationships between important elements of the problem  
• simple conclusions with little supporting evidence |
| 30   | Thinking process to determine the total number of toothpicks used in Term 1 to Term 5 of a pattern shows considerable effectiveness due to  
• a solution process that is nearly complete  
• identification of most of the important elements of the problem  
• a considerable understanding of the relationships between important elements of the problem  
• appropriate conclusions with supporting evidence |
| 40   | Thinking process to determine the total number of toothpicks used in Term 1 to Term 5 of a pattern shows a high degree of effectiveness due to  
• a complete solution process  
• identification of all important elements of the problem  
• a thorough understanding of the relationships between all of the important elements of the problem  
• appropriate conclusions with thorough and insightful supporting evidence |
Question 19

**Code 10**

The terms of a pattern are made using toothpicks. Term 1 and Term 5 are not shown.

![Diagram of toothpick patterns for Terms 2, 3, and 4]

Determine the total number of toothpicks used in Term 1 to Term 5 of this pattern. Justify your answer.

- Term 2: 15
- Term 3: 11
- Term 4: 21
- Term 5: 15
- Term 2: 21

The total number of toothpicks used in Term 1 to Term 5 of this pattern is \( \frac{51}{27} \).

**Annotation:**
Response demonstrates limited identification of important elements of the problem; did not accurately extend the pattern to determine the number of toothpicks in Term 1 or Term 5 and only states the number of toothpicks for Term 2 and Term 4 (11 and 21).
The terms of a pattern are made using toothpicks. Term 1 and Term 5 are not shown.

Determine the total number of toothpicks used in Term 1 to Term 5 of this pattern. Justify your answer.

\[
\frac{11}{16} + \frac{16}{16} + \frac{21}{16} = \frac{a}{1} + \frac{a}{6}
\]

They add 1 to each side however there is a pattern just keep adding 5 from the original number to get to the next shape.

The total number of toothpicks used in Term 1 to Term 5 of this pattern is 26.

**Annotation:**
Response demonstrates an incomplete solution process; accurately extends the pattern to determine the number of toothpicks for **either** Term 1 or Term 5 (Term 5 correct) with or without the number of toothpicks for Term 2 to Term 4 (11, 16, 21).
The terms of a pattern are made using toothpicks. Term 1 and Term 5 are not shown.

Determine the total number of toothpicks used in Term 1 to Term 5 of this pattern. Justify your answer.

The number of toothpicks increases by 5.

\[11 - 5 = 6\]
\[21 + 5 = 26\]
\[26 + 6 = 32\]

The total number of toothpicks used in Term 1 to Term 5 of this pattern is 32.

**Annotation:**
Response demonstrates identification of most of the important elements of the problem; accurately extends the pattern to determine the number of toothpicks in both Term 1 and Term 5, but does not correctly determine the total number of toothpicks (adds the number of toothpicks for Term 1 and Term 5 only).
The terms of a pattern are made using toothpicks. Term 1 and Term 2 are not shown.

Determine the total number of toothpicks used in Term 1 to Term 5 of this pattern. Justify your answer.

\[
\begin{align*}
\text{Term 1} &= 6 + 5 \\
\text{Term 2} &= 11 + 5 \\
\text{Term 3} &= 16 + 5 \\
\text{Term 4} &= 21 + 5 \\
\text{Term 5} &= 26
\end{align*}
\]

\[6 + 11 + 16 + 21 + 26 = 80\]

The total number of toothpicks used in Term 1 to Term 5 of this pattern is 80.

**Annotation:**
Response demonstrates identification of all important elements of the problem; accurately extends the pattern to determine the number of toothpicks in both Term 1 and Term 5, and correctly determines the total number of toothpicks (80).
### Question 20

<table>
<thead>
<tr>
<th>Code</th>
<th>Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>• Blank: nothing written or drawn in response to the question</td>
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• appropriate conclusions with supporting evidence |
| 40   | Thinking process to determine which pattern will reach a term with a value of 23 first shows a high degree of effectiveness due to  
• a complete solution process  
• identification of all important elements of the problem  
• a thorough understanding of the relationships between all of the important elements of the problem  
• appropriate conclusions with thorough and insightful supporting evidence |
Question 20

Two patterns are shown below.

If both patterns continue in the same way, which pattern will reach a term with a value of 23 first?

Justify your answer.

Pattern B would reach a term with a value of 23 first because it would be a lot faster to start with 7 and add 2.

Pattern ___ will reach a term with a value of 23 first.

Annotation:
Response demonstrates minimal evidence of a solution process; patterns are not extended. Insufficient justification for conclusion (B).
Two patterns are shown below.

Pattern A

Pattern B

Start with 7 and add 2 to get the next term.

If both patterns continue in the same way, which pattern will reach a term with a value of 23 first?

Justify your answer.

Pattern A

Pattern rule is going very slowly

Pattern B

Pattern (B)

this pattern is even

because it's being added by 2 every time

15 + 2 = 17

17 + 2 = 19

21 + 2 = 23

Pattern [A] will reach a term with a value of 23 first.

Annotation:
Response demonstrates an incomplete solution process; Pattern B is extended correctly but starts with Term 2 and Pattern A is extended incorrectly (only one incorrect term on graph). Insufficient justification for conclusion (A).
Question 20

Code 30

Two patterns are shown below.

Pattern A

Pattern B

Start with 7 and add 2 to get the next term.

If both patterns continue in the same way, which pattern will reach a term with a value of 23 first?

Justify your answer.

Pattern A

Pattern B

Annotation:
Response demonstrates appropriate conclusions with supporting evidence; Pattern A and Pattern B are extended correctly but both patterns start with Term 2. Correct conclusion (A) based on error.
Question 20

Code 40

Two patterns are shown below.

Pattern A

Start with 7 and add 2 to get the next term.

\[
\begin{align*}
7 & \rightarrow 9 \\
9 & \rightarrow 11 \\
11 & \rightarrow 13 \\
13 & \rightarrow 15 \\
15 & \rightarrow 17 \\
17 & \rightarrow 19 \\
19 & \rightarrow 21 \\
21 & \rightarrow 23 \\
\end{align*}
\]

If both patterns continue in the same way, which pattern will reach a term with a value of 23 first?

Justify your answer.  

Pattern A reaches 23 first.  

Pattern B takes 9 terms. Pattern A takes 8.

Pattern _____ will reach a term with a value of 23 first.

Annotation:
Response demonstrates identification of all important elements of the problem; Pattern A and Pattern B are extended correctly (Pattern A extended on graph) and correct conclusion (A).
### Question 21

<table>
<thead>
<tr>
<th>Code</th>
<th>Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>• Blank: nothing written or drawn in response to the question</td>
</tr>
</tbody>
</table>
| I    | • Illegible: cannot be read; completely crossed out/erased; not written in English  
• Irrelevant content: does not attempt assigned question (e.g., comment on the task, drawings, “?”,”!”,”I don’t know”)  
• Off topic: no relationship of written work to the question |
| 10   | Problem-solving process to extend the patterns to find the term that is the same and has the same term number shows limited effectiveness due to  
• minimal evidence of a solution process  
• limited identification of important elements of the problem  
• too much emphasis on unimportant elements of the problem  
• no conclusions presented  
• conclusion presented without supporting evidence |
| 20   | Problem-solving process to extend the patterns to find the term that is the same and has the same term number shows some effectiveness due to  
• an incomplete solution process  
• identification of some of the important elements of the problem  
• some understanding of the relationships between important elements of the problem  
• simple conclusions with little supporting evidence |
| 30   | Problem-solving process to extend the patterns to find the term that is the same and has the same term number shows considerable effectiveness due to  
• a solution process that is nearly complete  
• identification of most of the important elements of the problem  
• a considerable understanding of the relationships between important elements of the problem  
• appropriate conclusions with supporting evidence |
| 40   | Problem-solving process to extend the patterns to find the term that is the same and has the same term number shows a high degree of effectiveness due to  
• a complete solution process  
• identification of all important elements of the problem  
• a thorough understanding of the relationships between all of the important elements of the problem  
• appropriate conclusions with thorough and insightful supporting evidence |
**Question 21**

**Code 10**

**Pattern A** is created by repeating the 4 terms below in order.

Pattern A

```
<table>
<thead>
<tr>
<th>Term number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
</table>
```

Pattern B is created by repeating the 3 terms below in order.

Pattern B

```
<table>
<thead>
<tr>
<th>Term number</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
</table>
```

Find a term in both patterns that is the same and has the same term number.

Show your work.

1 and 2 are the same and 3 - 4 are the same.

The term number is ____________.

**Annotation:**
Response demonstrates minimal evidence of a solution process; Patterns A & B are not extended, but the term number of the matching terms within the given patterns are listed.
Question 21

**Code 20**

Pattern A is created by repeating the 4 terms below in order.

**Pattern A**

<table>
<thead>
<tr>
<th>Term number</th>
<th>Term 1</th>
<th>Term 2</th>
<th>Term 3</th>
<th>Term 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pattern B is created by repeating the 3 terms below in order.

**Pattern B**

<table>
<thead>
<tr>
<th>Term number</th>
<th>Term 1</th>
<th>Term 2</th>
<th>Term 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Find a term in both patterns that is the same and has the same term number.

Show your work.

A

5 6 7 8 9 10

B

4 5 6 7 8 9

The term number is 9.

**Annotation:**
Response demonstrates an incomplete solution process; Pattern A is extended correctly, Pattern B is extended incorrectly (a new term for term 4 is introduced that was not part of the original pattern). A term number is identified, but the terms do not match.
**Question 21**

**Code 30**

Pattern A is created by repeating the 4 terms below in order.

Pattern A

<table>
<thead>
<tr>
<th>Term number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
</table>

Pattern B is created by repeating the 3 terms below in order.

Pattern B

<table>
<thead>
<tr>
<th>Term number</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
</table>

Find a term in both patterns that is the same and has the same term number.

Show your work.

A → A → A → A → A → 5 6 7 8 9 10 11 12 13 14

B → B → B → B → B → 4 4 4 4 14

The term number is 14

**Annotation:**
Response demonstrates a solution process that is nearly complete; Pattern A is extended correctly, Pattern B has an error (term 4 is identified as term number 5), and Pattern B continues from there. A term number at which Patterns A and B have the same term (14) is identified based on this error.
Question 21

Code 40

Pattern A is created by repeating the 4 terms below in order.

<table>
<thead>
<tr>
<th>Term number</th>
<th>Pattern A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Pattern B is created by repeating the 3 terms below in order.

<table>
<thead>
<tr>
<th>Term number</th>
<th>Pattern B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Find a term in both patterns that is the same and has the same term number.

Show your work.

The term number 12 has the same term and term number in both patterns A and B.

The term number is 12.

Annotation:
Response demonstrates a complete solution process; Pattern A and B are extended correctly and a term number at which both Patterns A and B have the same term is identified (12) (Note: Not the first time matching terms occurs).