This document shows the layout of the examination paper and provides some sample questions for each of the sections.

The numbering of questions in this sample set of items is not indicative of their placement in a full examination paper.

Sample Questions

HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

General Instructions

• Reading time – 10 minutes
• Working time – 2 hours and 30 minutes
• Write using black pen
• Calculators approved by NESA may be used
• A reference sheet is provided at the back of this paper
• For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks: 100

Section I – 15 marks (pages 3–7)

• Attempt Questions 1–15
• Allow about 25 minutes for this section

Section II – 85 marks (pages 8–17)

• Attempt Questions 16–XX
• Allow about 2 hours and 5 minutes for this section

The first HSC examination for the new Mathematics Standard 2 Stage 6 syllabus will be held in 2019.
The first HSC examination for the new Mathematics Standard Stage 6 syllabus will be held in 2019.

The Mathematics Standard 2 examination specifications can be found in the Assessment and Reporting in Mathematics Standard Stage 6 document.

The examination will focus on the Mathematics Standard 2 Year 12 course, objectives and outcomes. Questions may require candidates to integrate knowledge, understanding and skills developed through studying the course. The Mathematics Standard Year 11 course content will be assumed knowledge for this examination and may be used to examine Year 12 outcomes.

There is no expectation that all the Year 12 content will be examined each year. In any given year, the examination will test a representative sample of the Year 12 content.

The following sample questions provide examples of some types of questions that may be found in HSC examinations for Mathematics Standard 2. Each sample question has been mapped to show how the question relates to syllabus outcomes and content. Answers for the objective-response questions (Section I) and marking guidelines for the short-answer questions (Section II) are provided. The marking guidelines indicate the criteria for each mark or mark range.

In the examination, students will record their answers to Section I on a multiple-choice answer sheet and their answers to Section II in the spaces provided on the examination paper.

The sample questions, sample answers, annotations and marking guidelines provide teachers and students with guidance as to the types of questions to expect and how they may be marked. They are not meant to be prescriptive. Each year the structure of the examination may differ in the number and types of questions, or focus on different syllabus outcomes and content.

From 2020, the Mathematics Standard 2 examination will include items that are common with the Mathematics Advanced HSC examination. Common items will be worth 20–25 marks and will be distributed throughout sections I and II.

Note:

- Comments in coloured boxes are annotations for the purpose of providing guidance for future examinations.

- In this set of sample questions, some stimuli are used in both Section I and Section II. This is to illustrate how the same content area can be examined differently.

- The new Mathematics Stage 6 syllabuses include topic areas which have been part of previous syllabuses. Teachers and students should still refer to past HSC examination papers for examples of other types of questions that may be relevant.
Section I

15 marks
Attempt Questions 1–15
Allow about 25 minutes for this section

Use the multiple-choice answer sheet for Questions 1–15.

A variety of stimulus material, such as text, diagrams, pictures, graphs, photographs and illustrations, may be included in the questions in Section I. However, stimulus material will only be included when it is essential for answering the question.

Multiple-choice options (A–D) may be presented in different formats, for example, text, graphs, photographs, diagrams.

1 This diagram shows the possible paths (in km) for laying gas pipes between various locations.

![Diagram of gas pipeline paths](image)

Gas is to be supplied from one location. Any one of the locations can be the source of the supply.

What is the minimum total length of the pipes required to provide gas to all the locations?

A. 32 km
B. 34 km
C. 36 km
D. 38 km

This question is common to Mathematics Standard 2 and Mathematics Standard 1 Question 3.

This question is based on new content.
A computer application was used to draw the graphs of the equations

\[ x + y = 5 \quad \text{and} \quad x - y = 5. \]

Part of the screen is shown.

Which row of the table correctly matches the equations with the lines drawn and identifies the solution when the equations are solved simultaneously?

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( x + y = 5 )</td>
<td>( x - y = 5 )</td>
<td>\textbf{Solution}</td>
</tr>
<tr>
<td>A.</td>
<td>Line 1</td>
<td>Line 2</td>
</tr>
<tr>
<td>B.</td>
<td>Line 1</td>
<td>Line 2</td>
</tr>
<tr>
<td>C.</td>
<td>Line 2</td>
<td>Line 1</td>
</tr>
<tr>
<td>D.</td>
<td>Line 2</td>
<td>Line 1</td>
</tr>
</tbody>
</table>

This question uses content from both Year 11 and Year 12 to examine a Year 12 outcome.

The Mathematics Standard Year 11 course content will be assumed knowledge for this examination and may be used to examine Year 12 outcomes.

This question uses stimulus material common to Mathematics Standard 1 Question 2.

This question is common to Mathematics Standard 2 and Mathematics Advanced Question 1.
3. What amount must be invested now at 4% per annum, compounded quarterly, so that in five years it will have grown to $60 000?

A. $8919
B. $11 156
C. $49 173
D. $49 316

This question is common to Mathematics Standard 2, Mathematics Standard 1 Question 6 and Mathematics Advanced Question 2.

4. The number of hours worked during a week by casual staff in the hospitality industry is normally distributed with a mean of 18 hours and a standard deviation of 2.5 hours.

What is the percentage of casual staff working fewer than 23 hours in a week?

A. 47.5%
B. 84%
C. 95%
D. 97.5%

This question is common to Mathematics Standard 2 and Mathematics Advanced Question 3.
The table shows the average energy used, in kilojoules per kilogram of body mass, by a person walking for 30 minutes at different speeds.

<table>
<thead>
<tr>
<th>Walking speed</th>
<th>Energy used in 30 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 km/h</td>
<td>5.53 kJ/kg</td>
</tr>
<tr>
<td>5 km/h</td>
<td>7.37 kJ/kg</td>
</tr>
</tbody>
</table>

Sam, who weighs 65 kg, drinks a regular cappuccino made with full cream milk. It contains 73 kilocalories.

For approximately how long must Sam walk at 3 km/h to burn off the energy contained in the cappuccino? (1 kilocalorie = 4.184 kJ)

A. 20 minutes
B. 25 minutes
C. 90 minutes
D. 120 minutes

This question uses Year 11 content to examine a Year 12 outcome.

The Mathematics Standard Year 11 course content will be assumed knowledge for this examination and may be used to examine Year 12 outcomes.

This question is based on new content.
The network diagram represents a system of roads connecting a shopping centre to the on-ramp of a freeway. Traffic moves via several routes. For example, there are two routes from the shopping centre to P and one route from T to U. The number on the edge of each road indicates the number of vehicles that can travel on it per hour.

At present, the capacity of the network from the shopping centre to the on-ramp is not maximised.

Which additional road(s) would increase the network capacity to its maximum?

A. A road from P to U with a capacity of 20 vehicles per hour
B. A road from Q to T with a capacity of 20 vehicles per hour
C. A road from R to T with a capacity of 20 vehicles per hour and a road from T to U with a capacity of 40 vehicles per hour
D. A road from Q to U with a capacity of 20 vehicles per hour and a road from S to U with a capacity of 20 vehicles per hour

Question 17 is a short-answer question based on the same stimulus and demonstrates another method of examining similar knowledge and skills.

This question is based on new content.
Mathematics Standard 2
Section II Answer Booklet

85 marks
Attempt Questions 16–XX
Allow about 2 hours and 5 minutes for this section

Instructions
• Answer the questions in the spaces provided. Sufficient spaces are provided for typical responses.
• Your responses should include relevant mathematical reasoning and/or calculations.
• Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.
A variety of stimulus material, such as text, diagrams, pictures, graphs, photographs and illustrations, may be included in the questions in Section II.

Equipment such as a ruler, a protractor and a pair of compasses may be required to answer questions in this examination.

Question 16 (3 marks)

The scale diagram shows the aerial view of a block of land bounded on one side by a road. The length of the block, $AB$, is known to be 45 metres.

Calculate the approximate area of the block of land, using three applications of the trapezoidal rule.

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Students should note whether diagrams are drawn to scale.
**Question 17** (3 marks)

The network diagram represents a system of roads connecting a shopping centre to the on-ramp of a freeway. Traffic moves via several routes. For example, there are two routes from the shopping centre to \( P \) and one route from \( T \) to \( U \). The number on the edge of each road indicates the number of vehicles that can travel on it per hour.

At present, the capacity of the network from the shopping centre to the on-ramp is not maximised. It is not possible to construct a road directly between the shopping centre and the on-ramp.

Suggest ONE way that the network capacity can be maximised with additional road(s). Justify your answer.
**Question 18 (7 marks)**

The diagram shows three towns X, Y and Z. Town Z is due east of Town X. The bearing of Town Y from Town X is N39°E and the bearing of Town Z from Town Y is S51°E. The distance between Town X and Town Y is 1330 km.

A plane flies between the three towns.

![Diagram of three towns X, Y, and Z with bearings and distances labeled.]

(a) Mark the given information on the diagram and explain why $\angle XYZ$ is 90°.  
.................................................................
.................................................................
.................................................................
.................................................................

(b) Find the distance between Town X and Town Z to the nearest kilometre.  
.................................................................
.................................................................
.................................................................
.................................................................

**Question 18 continues on page 12**
Question 18 (continued)

(c) The plane is going to fly from Town Y to Town X, stopping at Town Z on the way. Leaving Town Y, the pilot incorrectly sets the bearing of Town Z to S50°E. The pilot flies for 1650 km before realising the mistake, then changes course and flies directly to Town X without going to Town Z.

Which is closer to Town X: Town Z or the point where the pilot changes course? Justify your answer.

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Students should show all relevant working in responses involving calculations. This ensures that marks can be allocated for working even if the student's final answer is incorrect.

Whenever possible, question parts are sequenced in order of difficulty.

An incorrect answer in a previous part will not necessarily preclude students from achieving full marks in a later part.

This question is common to Mathematics Standard 2 and Mathematics Advanced Question 12. Parts (a) and (b) are common to Mathematics Standard 1 Question 12.

End of Question 18

Questions 16–18 are worth 13 marks in total

Students will be provided with a cumulative total/s indicating marks completed in Section II. These totals are intended to assist students to plan their time.
**Question 19** (2 marks)

The number of years *N* required to carry out a project varies inversely with how much money $M$ is spent on it.

If $50\,000$ is spent on the project, it takes 5 years to complete, as shown in the graph below.

![Graph showing the relationship between *N* and *M*](image)

(a) Find an equation for the graph in terms of *M* and *N* in the form $N = \frac{k}{M}$, where *k* is a constant.

...............................................................................................................................
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(b) The project needs to be carried out in one year or less.

What is the least amount of money that could be spent in order to achieve this timeline?

...............................................................................................................................
...............................................................................................................................

This question is common to Mathematics Standard 2 and Mathematics Advanced Question 14 parts (a) and (b).
Question 20 (2 marks)

The diastolic measurement for blood pressure in 50-year-old people is normally distributed, with a mean of 85 and standard deviation of 20.

(a) A person is considered to have low blood pressure if the diastolic measurement is 65 or less.

What percentage of 50-year-old people have low blood pressure?

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...............................................................................................................................

(b) Calculate the $z$-score for a diastolic measurement of 60.

...............................................................................................................................
...............................................................................................................................

This question is common to Mathematics Standard 2 and Mathematics Advanced Question 15 parts (a) and (b).
Question 21 (5 marks)

A project requires activities A to G to be completed, as shown in the table.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Immediate prerequisite(s)</th>
<th>Duration in days</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>–</td>
<td>?</td>
</tr>
<tr>
<td>B</td>
<td>–</td>
<td>15</td>
</tr>
<tr>
<td>C</td>
<td>A</td>
<td>?</td>
</tr>
<tr>
<td>D</td>
<td>A, B</td>
<td>20</td>
</tr>
<tr>
<td>E</td>
<td>D</td>
<td>8</td>
</tr>
<tr>
<td>F</td>
<td>C, E</td>
<td>?</td>
</tr>
<tr>
<td>G</td>
<td>D</td>
<td>?</td>
</tr>
</tbody>
</table>

The minimum completion time for the project is 50 days and the critical path includes activities B, D, E and F. The float for G is three days and the float for C is 8 days.

This question is based on new content.

Question 21 continues on page 16
Question 21 (continued)

Find a possible duration for each of the activities A, C, F and G. Include a network diagram in your answer.

Some questions in this section may specify that the response must be supported with a diagram or other material such as a graph.

In some cases, students may find it useful to support their answer with a diagram or other material although no specific requirement is made in the question.

End of sample questions
Section II extra writing space

If you use this space, clearly indicate which question you are answering.
HSC Mathematics Standard 2
Sample Questions Marking Guidelines

Section I

Multiple-choice Answer Key

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>2</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
</tr>
<tr>
<td>4</td>
<td>D</td>
</tr>
<tr>
<td>5</td>
<td>B</td>
</tr>
<tr>
<td>6</td>
<td>D</td>
</tr>
</tbody>
</table>
Section II

Question 16

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides correct solution</td>
<td>3</td>
</tr>
<tr>
<td>Demonstrates some understanding of a scale drawing</td>
<td>2</td>
</tr>
<tr>
<td>Applies the trapezoidal rule</td>
<td></td>
</tr>
<tr>
<td>Provides some relevant information</td>
<td>1</td>
</tr>
</tbody>
</table>

Sample answer:

4.5 cm represents 45 m

∴ 1 cm represents 10 m

\[
\begin{align*}
  h &= 15 \text{ m} \\
  A &= \frac{15}{2} (25 + 20) + \frac{15}{2} (20 + 25) + \frac{15}{2} (25 + 30) \\
  \therefore \text{ Area} &= 1087.5 \text{ m}^2
\end{align*}
\]
Question 17

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Identifies additional road(s) that can maximise the network capacity</td>
<td>3</td>
</tr>
<tr>
<td>• Relates the additional road(s) to maximising the capacity</td>
<td></td>
</tr>
<tr>
<td>• Demonstrates some understanding of maximising network capacity</td>
<td>2</td>
</tr>
<tr>
<td>and/or identifies areas where capacities are not maximised</td>
<td></td>
</tr>
<tr>
<td>• Provides some relevant information</td>
<td>1</td>
</tr>
</tbody>
</table>

**Sample answer:**

A road from Q to U and a road from S to U, each with a capacity of 20 vehicles per hour, can be added to maximise the capacity.

Q can handle 65 vehicles per hour travelling into it but only has 45 vehicles per hour travelling out of it. Building a road directly from Q to U with a capacity of 20 vehicles per hour will rectify this shortfall and maximise the capacity.

Similarly, S can handle 50 vehicles per hour travelling into it but only 30 vehicles per hour travelling out of it. Building a road directly from S to U with a capacity of 20 vehicles per hour will rectify the shortfall and maximise the capacity.

U is capable of taking on 40 extra vehicles per hour since it can handle 155 vehicles per hour (63 + 92) into the on-ramp but there are only 115 vehicles entering it. The two additional roads, each with a capacity of 20 vehicles per hour, will maximise the capacity at U.
### Question 18 (a)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marks the given information on the diagram</td>
<td>2</td>
</tr>
<tr>
<td>Provides an explanation of why $\angle XYZ$ is $90^\circ$</td>
<td></td>
</tr>
<tr>
<td>Provides some relevant information</td>
<td>1</td>
</tr>
</tbody>
</table>

**Sample answer:**

![Diagram](image1)

$\angle XYZ = a^\circ + 51^\circ = 90^\circ$

(Because $a$ and $\angle UXY$ are alternate angles)

### Question 18 (b)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculates the distance</td>
<td>2</td>
</tr>
<tr>
<td>Applies an appropriate method</td>
<td>1</td>
</tr>
</tbody>
</table>

**Sample answer:**

![Diagram](image2)

$$\cos 51^\circ = \frac{1330}{XZ}$$

$XZ = 2113$ km (to the nearest km)
### Question 18 (c)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concludes that the plane flies a shorter distance</td>
<td>3</td>
</tr>
<tr>
<td>Supports conclusion with relevant calculations</td>
<td>2</td>
</tr>
<tr>
<td>Substitutes correct values into the cosine rule</td>
<td>1</td>
</tr>
<tr>
<td>Provide some relevant information</td>
<td>1</td>
</tr>
</tbody>
</table>

**Sample answer:**

Since the bearing is S50°E instead of S51°E, \(\angle XYZ' = 89°\)

\[
(XZ')^2 = 1330^2 + 1650^2 - 2 \times 1330 \times 1650 \times \cos 89°
\]

\[XZ' = 2101 \text{ km (to the nearest km)}\]

Since \(XZ'\) is shorter than \(XZ\), the plane flies a shorter distance to Town X.
Question 19 (a)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides correct answer</td>
<td>1</td>
</tr>
</tbody>
</table>

Sample answer:

\[
N = \frac{k}{M}
\]

\[
5 = \frac{k}{50 000}
\]

\[
k = 5 \times 50 000
\]

\[
k = 250 000
\]

\[
\therefore N = \frac{250 000}{M}
\]

Question 19 (b)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides correct answer</td>
<td>1</td>
</tr>
</tbody>
</table>

Sample answer:

\[
N = \frac{250 000}{M}
\]

\[
1 = \frac{250 000}{M}
\]

\[
M = \frac{250 000}{1}
\]

\[
M = $250 000
\]

\[
\therefore \text{At least}\ $250 000 \text{ must be spent on the project to achieve this timeline of one year or less.}
\]
Question 20 (a)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provides correct answer</td>
<td>1</td>
</tr>
</tbody>
</table>

**Sample answer:**

16% of people have low blood pressure.

---

Question 20 (b)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provides correct solution</td>
<td>1</td>
</tr>
</tbody>
</table>

**Sample answer:**

\[
z\text{-score} = \frac{x - \overline{x}}{s} = \frac{60 - 85}{20} = -1.25
\]
## Question 21

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Finds possible values for the missing entries</td>
<td>5</td>
</tr>
<tr>
<td>• Supports the solution with a correct network diagram</td>
<td></td>
</tr>
<tr>
<td>• Finds possible values for some of the missing entries</td>
<td>4</td>
</tr>
<tr>
<td>• Supports the solution with a relevant network diagram</td>
<td></td>
</tr>
<tr>
<td>• Finds a value for a missing entry and supports the solution with a relevant network diagram</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td>3</td>
</tr>
<tr>
<td>• Correctly represents all the given information on a network diagram and demonstrates some understanding of critical path / LST / EST / float</td>
<td></td>
</tr>
<tr>
<td>• Shows the relationship between some of the activities using a diagram and/or calculations</td>
<td>2</td>
</tr>
<tr>
<td>• Provides some relevant information</td>
<td>1</td>
</tr>
</tbody>
</table>

### Sample answer:

F is on critical path and so has no float.
\[ \therefore \text{duration of F is } 50 - 43 - 0 = 7 \text{ days} \]

Float = LST of next activity – EST of this activity – duration of this activity
\[ \therefore \text{duration} = \text{LST of next activity} - \text{EST of this activity} - \text{Float} \]

The float of G is 3 days.
\[ \therefore \text{duration of G is } 50 - 35 - 3 = 12 \text{ days} \]

The float of C is 8 days.
\[ \therefore \text{duration of C is } 43 - \text{EST for C} - 8 \]

But EST for C is equal to the duration of A since A has no prerequisites.
\[ \therefore \text{duration of C is } 43 - \text{duration of A} - 8 \]

So, duration of A + duration of C = 43 – 8 = 35 days
\[ \therefore \text{possible durations for A and C may be A = 1 day and C = 34 days.} \]

![Network Diagram](image-url)
## HSC Mathematics Standard 2 Sample Questions Mapping Grid

### Section I

<table>
<thead>
<tr>
<th>Question</th>
<th>Marks</th>
<th>Content</th>
<th>Syllabus outcomes</th>
<th>Targeted performance bands</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>1</td>
<td>MS-N2 Network Concepts</td>
<td>MS2-12-8</td>
<td>2–3</td>
</tr>
<tr>
<td>2#</td>
<td>1</td>
<td>MS-A2 Linear Relationships</td>
<td>MS2-12-6</td>
<td>3–4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MS-A4 Types of Relationships</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3**#</td>
<td>1</td>
<td>MS-F4 Investments and Loans</td>
<td>MS2-12-5</td>
<td>3–4</td>
</tr>
<tr>
<td>4#</td>
<td>1</td>
<td>MS-S5 The Normal Distribution</td>
<td>MS2-12-7</td>
<td>3–4</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>MS-M1 Applications of Measurement</td>
<td>MS2-12-3</td>
<td>4–5</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>MS-N3 Critical Path Analysis</td>
<td>MS2-12-8</td>
<td>5–6</td>
</tr>
</tbody>
</table>

* These questions are common to Mathematics Standard 1 and Mathematics Standard 2.

# These questions are common to Mathematics Standard 2 and Mathematics Advanced.

### Section II

<table>
<thead>
<tr>
<th>Question</th>
<th>Marks</th>
<th>Content</th>
<th>Syllabus outcomes</th>
<th>Targeted performance bands</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>3</td>
<td>MS-M7 Rates and Ratio</td>
<td>MS2-12-4</td>
<td>2–5</td>
</tr>
<tr>
<td>17</td>
<td>3</td>
<td>MS-N3 Critical Path Analysis</td>
<td>MS2-12-8, MS2-12-10</td>
<td>3–6</td>
</tr>
<tr>
<td>18 (a)#</td>
<td>2</td>
<td>MS-M6 Non-right-angled Trigonometry</td>
<td>MS2-12-4</td>
<td>2–4</td>
</tr>
<tr>
<td>18 (b)#</td>
<td>2</td>
<td>MS-M6 Non-right-angled Trigonometry</td>
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<td>MS-N3 Critical Path Analysis</td>
<td>MS2-12-8</td>
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