

# Experiment ‘p5\_9\_coneSurface’ Results

December 18, 2025

**Experiment outcome:** FAILURE\_VERIFY

**Bad responses:** 0

**Responses containing assume :** 0

**Resolution attempts:** 8

**Hard fails (resolution):** 7

**Soft fails (resolution):** 0

**Verification attempts:** 1

## Problem Specification

**Problem name:** p5\_9\_coneSurface

**Natural language statement:** Write a method that computes the surface area of a cone with a circular base, given radius and height.

**Method signature:** p5\_9\_coneSurface(r: real, h: real) returns (surface\_area: real)

## Ensures

- $(-r + (\text{surface\_area} / (3.14159 * r))) * (-r + (\text{surface\_area} / (3.14159 * r))) == h * h + r * r$

## GenAI interactions

Below you will find all interactions between the ‘user’ (program) and the ‘assistant’ (OpenAI).

### Program → GenAI

You are given the following task to perform in Dafny:

Write a method that computes the surface area of a cone with a circular base, given  
→ radius and height.

The signature should be:

```
method p5_9_coneSurface(r: real, h: real) returns (surface_area: real)
```

The method should respect the following contract:

```
ensures (-r + (surface_area / (3.14159 * r))) * (-r + (surface_area / (3.14159 * r))) ==  
→ h * h + r * r
```

Produce and show only the Dafny body of this method, including the curly braces that  
→ surround it. Do not show the signature nor contract. You must not use 'assume'  
→ anywhere in your code.

### GenAI → Program

**System fingerprint:**

**ID:** chatcmpl-Co4y9aVJwZZbIT7RURUseiLyZw0A9

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051537

**Finish reason:** stop

**Usage:** 340 tokens in, and 182 tokens out

```
{  
  var slant := sqrt(h * h + r * r);  
  surface_area := 3.14159 * r * (r + slant);  
}
```

### Program → GenAI

When using dafny resolve, the below error is emitted and resolve fails:

```
problem_data/p5_9_coneSurface/program.dfy(4,15): Error: unresolved identifier: sqrt  
|  
4 | var slant := sqrt(h * h + r * r);  
  | ^^^^^
```

1 resolution/type errors detected in program.dfy

Correct the error by altering only the method body. Produce and show only the Dafny body,  
→ including the curly braces that surround it. Do not show the signature nor  
→ contract. You must not use 'assume' anywhere in your code.

## GenAI → Program

**System fingerprint:**

**ID:** chatcmpl-Co4yCRfppRSh5Ha429lIyxIq23Ca0

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051540

**Finish reason:** stop

**Usage:** 485 tokens in, and 60 tokens out

```
{  
  var slant := (h * h + r * r) ** 0.5;  
  surface_area := 3.14159 * r * (r + slant);  
}
```

## Program → GenAI

When using dafny resolve, the below error is emitted and resolve fails:

```
problem_data/p5_9_coneSurface/program.dfy(4,32): Error: invalid UnaryExpression
```

```
|  
4 | var slant := (h * h + r * r) ** 0.5;  
| ^
```

```
1 parse errors detected in program.dfy
```

Correct the error by altering only the method body. Produce and show only the Dafny body,

→ including the curly braces that surround it. Do not show the signature nor

→ contract. You must not use 'assume' anywhere in your code.

## GenAI → Program

**System fingerprint:**

**ID:** chatcmpl-Co4yEa5QGzfl4WrfZ8b2tFGGkoWV3

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051542

**Finish reason:** stop

**Usage:** 673 tokens in, and 503 tokens out

```
{  
  var slant := Math.Sqrt(h * h + r * r);  
  surface_area := 3.14159 * r * (r + slant);  
}
```

## Program → GenAI

When using dafny resolve, the below error is emitted and resolve fails:

```
problem_data/p5_9_coneSurface/program.dfy(4,15): Error: unresolved identifier: Math
```

```
|
4 | var slant := Math.Sqrt(h * h + r * r);
| ~~~~
```

1 resolution/type errors detected in program.dfy

Correct the error by altering only the method body. Produce and show only the Dafny body,  
 ↳ including the curly braces that surround it. Do not show the signature nor  
 ↳ contract. You must not use 'assume' anywhere in your code.

## GenAI → Program

**System fingerprint:**

**ID:** chatcmpl-Co4yK2EUWVLx2BHRKW9dIqy9Pmb8M

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051548

**Finish reason:** stop

**Usage:** 849 tokens in, and 760 tokens out

```
{
  var slant := RealMath.Sqrt(h * h + r * r);
  surface_area := 3.14159 * r * (r + slant);
}
```

## Program → GenAI

When using dafny resolve, the below error is emitted and resolve fails:

```
problem_data/p5_9_coneSurface/program.dfy(4,15): Error: unresolved identifier: RealMath
|
4 | var slant := RealMath.Sqrt(h * h + r * r);
| ~~~~~
```

1 resolution/type errors detected in program.dfy

Correct the error by altering only the method body. Produce and show only the Dafny body,  
 ↳ including the curly braces that surround it. Do not show the signature nor  
 ↳ contract. You must not use 'assume' anywhere in your code.

## GenAI → Program

**System fingerprint:**

**ID:** chatcmpl-Co4yTlpYi78uzE66UX8OJGXS1Xvs8

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051557

**Finish reason:** stop

**Usage:** 1034 tokens in, and 695 tokens out

```
{
  var slant := Sqrt(h * h + r * r);
  surface_area := 3.14159 * r * (r + slant);
}
```

```
}
```

## Program → GenAI

When using dafny resolve, the below error is emitted and resolve fails:

```
problem_data/p5_9_coneSurface/program.dfy(4,15): Error: unresolved identifier: Sqrt
|
4 | var slant := Sqrt(h * h + r * r);
| ~~~~
```

1 resolution/type errors detected in program.dfy

Correct the error by altering only the method body. Produce and show only the Dafny body,  
→ including the curly braces that surround it. Do not show the signature nor  
→ contract. You must not use 'assume' anywhere in your code.

## GenAI → Program

**System fingerprint:**

**ID:** chatcmpl-Co4ybGkJalWptArpvRoCTfOcPul5x

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051565

**Finish reason:** stop

**Usage:** 1211 tokens in, and 508 tokens out

```
{
  var slant :| slant * slant == h * h + r * r;
  surface_area := 3.14159 * r * (r + slant);
}
```

## Program → GenAI

When using dafny verify, the below error is emitted and verify fails:

```
problem_data/p5_9_coneSurface/program.dfy(2,29): Error: possible division by zero
|
2 | ensures (-r + (surface_area / (3.14159 * r))) * (-r + (surface_area / (3.14159 * r)))
  | ~~~~~
  | ^
```

```
problem_data/p5_9_coneSurface/program.dfy(3,0): Error: a postcondition could not be
  | ~~~~~
  | ^
```

```
3 | {
  | ^
```

```
problem_data/p5_9_coneSurface/program.dfy(2,87): Related location: this is the
  | ~~~~~
  | ^
```

```

2 | ensures (-r + (surface_area / (3.14159 * r))) * (-r + (surface_area / (3.14159 * r))
   ↪ ) == h * h + r * r
   | ^^

problem_data/p5_9_coneSurface/program.dfy(4,12): Error: cannot establish the existence of
   ↪ LHS values that satisfy the such-that predicate. Note, no trigger was found for
   ↪ the such-that predicate, which may be the reason the proof failed. To give a
   ↪ trigger explicitly, use the {:trigger} attribute. For more information, see the
   ↪ section on quantifier instantiation rules in the reference manual.
   |

4 | var slant :| slant * slant == h * h + r * r;
   | ~~~~~~

Dafny program verifier finished with 0 verified, 3 errors

Correct the error by altering only the method body. Produce and show only the Dafny body,
   ↪ including the curly braces that surround it. Do not show the signature nor
   ↪ contract. You must not use 'assume' anywhere in your code.

```

## GenAI → Program

**System fingerprint:**

**ID:** chatcmpl-Co4yjutNXGPgJWII08C3oDw3t7uow

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051573

**Finish reason:** stop

**Usage:** 1945 tokens in, and 534 tokens out

```

{
  if r == 0.0 {
    assert false;
  }
  var slant :| {:trigger slant * slant} slant * slant == h * h + r * r;
  surface_area := 3.14159 * r * (r + slant);
}

```

## Program → GenAI

When using dafny resolve, the below error is emitted and resolve fails:

```

problem_data/p5_9_coneSurface/program.dfy(7,15): Error: invalid UnaryExpression
|
7 | var slant :| {:trigger slant * slant} slant * slant == h * h + r * r;
   | ^

1 parse errors detected in program.dfy

```

Correct the error by altering only the method body. Produce and show only the Dafny body,  
 ↪ including the curly braces that surround it. Do not show the signature nor  
 ↪ contract. You must not use 'assume' anywhere in your code.

## GenAI → Program

**System fingerprint:**

**ID:** chatcmpl-Co4yqealE0pGxur3zuStMLeUv8fJq

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051580

**Finish reason:** stop

**Usage:** 1898 tokens in, and 88 tokens out

```
{
  if r == 0.0 {
    assert false;
  }
  {:trigger slant * slant}
  var slant :| slant * slant == h * h + r * r;
  surface_area := 3.14159 * r * (r + slant);
}
```

## Final Program

```
method p5_9_coneSurface(r: real, h: real) returns (surface_area: real)
  ensures (-r + (surface_area / (3.14159 * r))) * (-r + (surface_area / (3.14159 * r
    ↪ ))) == h * h + r * r
{
  if r == 0.0 {
    assert false;
  }
  {:trigger slant * slant}
  var slant :| slant * slant == h * h + r * r;
  surface_area := 3.14159 * r * (r + slant);
}
```

## Total Token Usage

**Input tokens:** 8435

**Output tokens:** 3330

**Reasoning tokens:** 2816

**Sum of ‘total tokens’:** 11765

## Experiment Timings

**Iteration #8** started at 1766051582534, ended at 1766051584932, lasting 2398ms (2.40 seconds)

**Overall Experiment** started at 1766051538961, ended at 1766051584932, lasting 45971ms (45.97 seconds)

**Iteration #4** started at 1766051550671, ended at 1766051559492, lasting 8821ms (8.82 seconds)

**Iteration #5** started at 1766051559492, ended at 1766051567676, lasting 8184ms (8.18 seconds)

**Iteration #6** started at 1766051567676, ended at 1766051575171, lasting 7495ms (7.50 seconds)

**Iteration #7** started at 1766051575171, ended at 1766051582534, lasting 7363ms (7.36 seconds)

**Iteration #1** started at 1766051538961, ended at 1766051542050, lasting 3089ms (3.09 seconds)

**Iteration #2** started at 1766051542050, ended at 1766051544113, lasting 2063ms (2.06 seconds)

**Iteration #3** started at 1766051544113, ended at 1766051550671, lasting 6558ms (6.56 seconds)