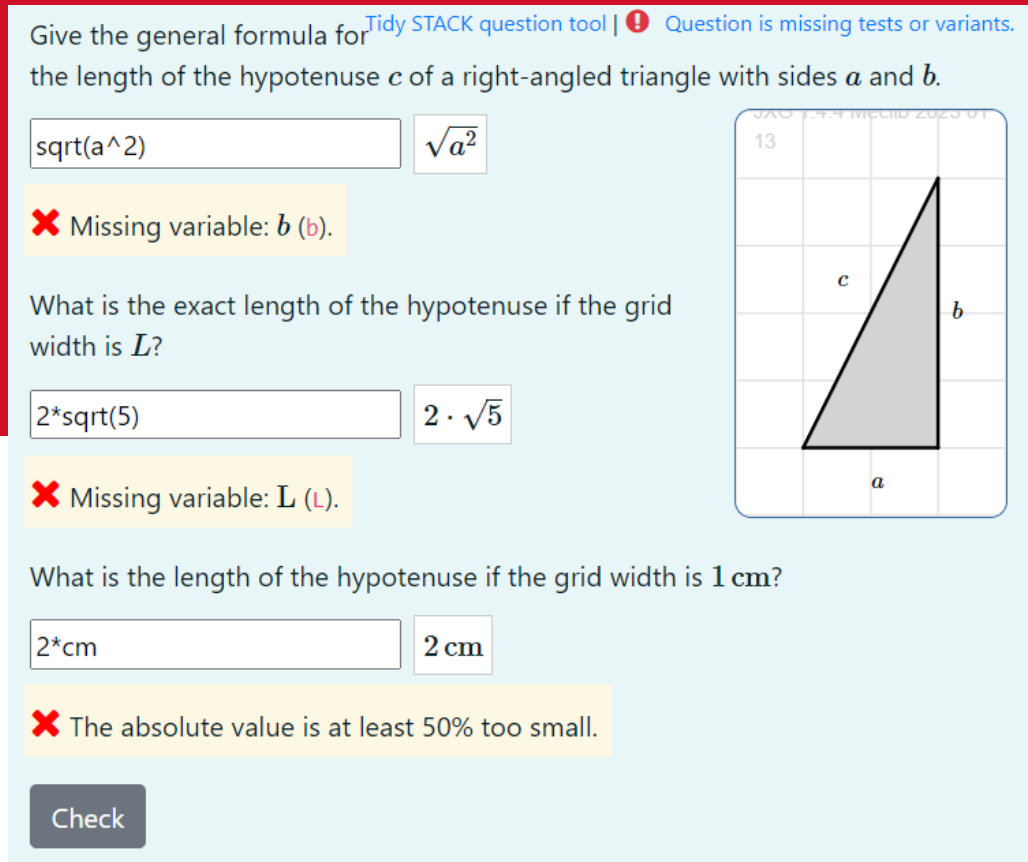
Technische Hochschule
Brandenburg
University of
Applied Sciences
Fachbereich
Technik

Workshop: Using Meclib in STACK Questions

Prof. Dr.-Ing. Martin Kraska

2023 STACK Community Meeting



Outline

- Ressources
- Task
- Creating a static Meclib image
- Randomize the question
- Add formative feedback
- Add interactivity
- Add teachers solution for the graphics

Ressources

Meclib Wiki on Github https://github.com/mkraska/meclib/wiki

- Primary handbook for Meclib
- Description of objects and functions

Demo Moodle Course at TH Brandenburg https://extmoodle.th-brandenburg.de/course/view.php?id=138&section=1

- Set of Meclib interactive demo questions
- Set of interactive and automatic tests for feedback functions
- Publications

Jsfiddle https://jsfiddle.net/gbt7y8cw/1/

- Site for rapid prototyping
- Uses JSXGraph 1.4.4 (as of STACK 4.4.2)
- Limitation: No variables in object definitions

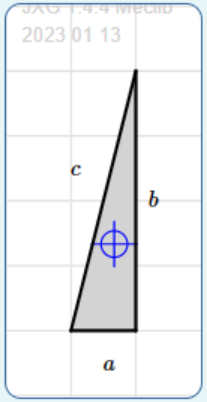
Task

Compute the length of the hypotenuse in the given rectangular triangle and interactively specify the center of gravity.

Meclib Demo

Tidy STACK question tool | Question is missing tests or variants.

Indicate the center of gravity using the blue crosshair.



✔ The distance to the actual CG is **0.00** grid units.

Give the general formula for the length of the hypotenuse c of a right-angled triangle with sides a and b.

sqrt(b^2+a^2) $\sqrt{b^2+a^2}$ ✔

What is the exact length of the hypotenuse if the grid width is L?

sqrt(17)*L $\sqrt{17}\cdot L$ ✔

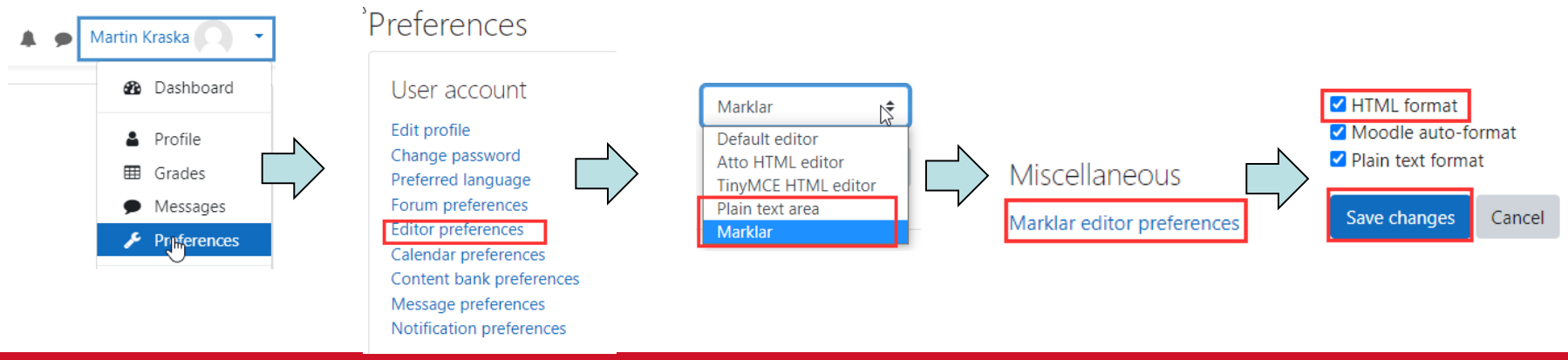
What is the length of the hypotenuse if the grid width is $1\,\mathrm{cm}$?

4.12310562562*cm $4.12310562562\,\mathrm{cm}$ ✔

Check

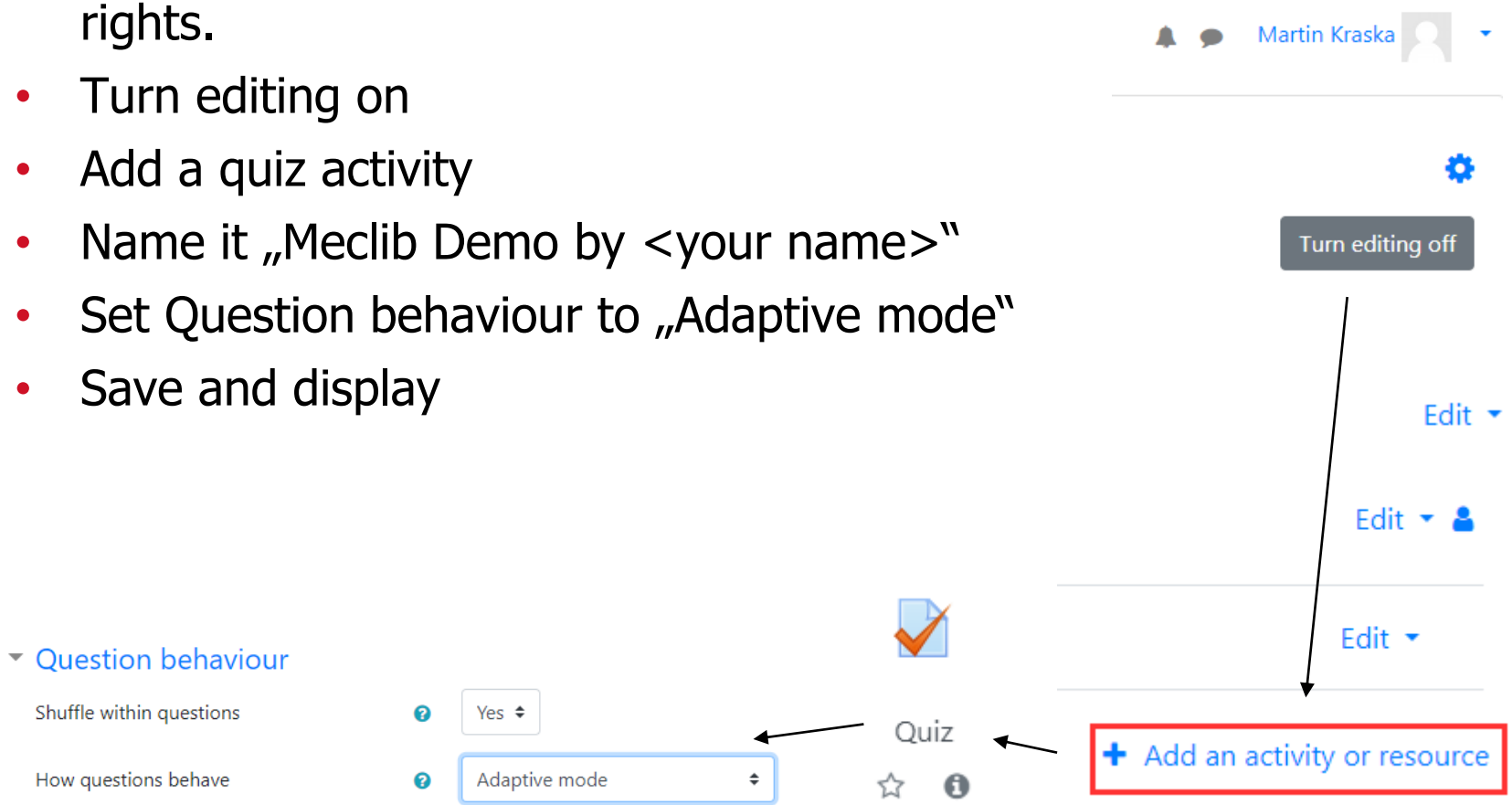
Moodle Editor Settings

- In your profile, select „Preferences“
- Select „Editor preferences“
- Select „Marklar“ or „Plain text area“, Save changes.
- If you selected Marklar, you get a link to it‘s preferences.
  - Make sure that HTML format is checked
  - Save changes



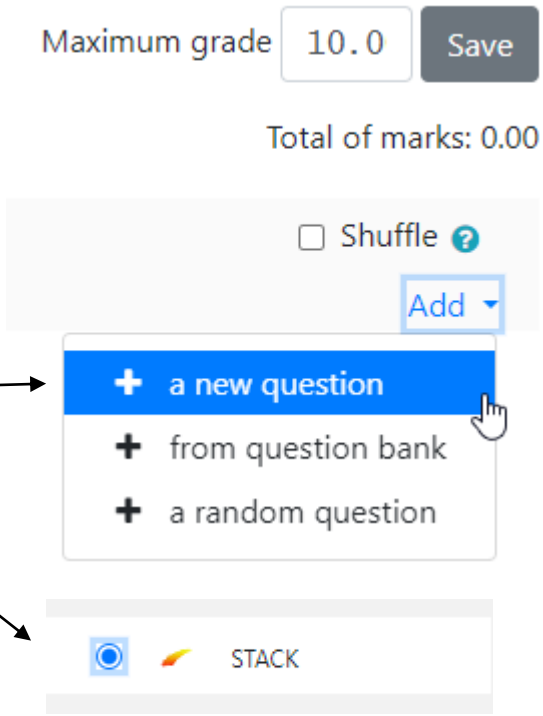
Creating The Quiz

- Enter a moodle course where you are trainer with editing rights.
- Turn editing on
- Add a quiz activity
- Name it „Meclib Demo by <your name>“
- Set Question behaviour to „Adaptive mode“
- Save and display



Creating The Question

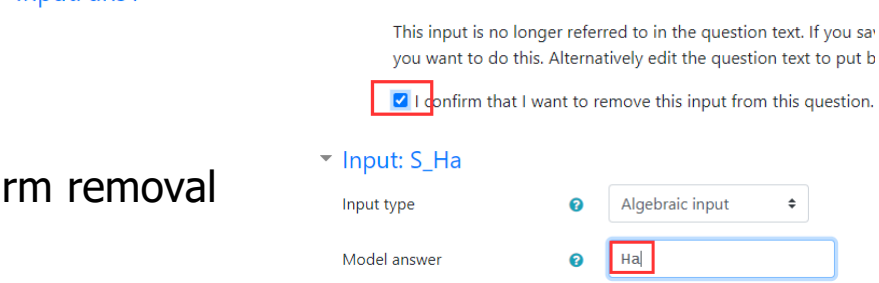
- Quiz administration> Edit quiz
- Add> a new question
- Choose a question type to add> STACK
  - Press button „Add“
- Next, we make the minimal edits which allow us to save the question.



Creating The Question

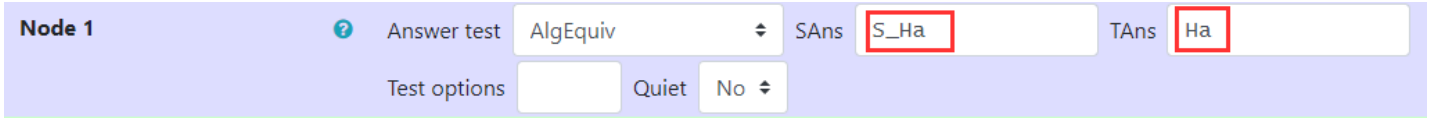
- **Category**: Select category (optional, question bank allows limiting of lists to categories)
- **Question name**: Enter a question name (appears in the question bank list)
- **Question text**
  `<p>[[input:S_Ha]] [[validation:S_Ha]] [[feedback:Ha]]</p>`
- **Specific feedback**: Remove contents

Press button „Verify the question text and update the form“



- **Input ans1**: Confirm removal
- **Input S_Ha**: Set model answer to Ha
- **Potential response tree: prt1**: Confirm removal
- **Potential response tree: S_Ha**:

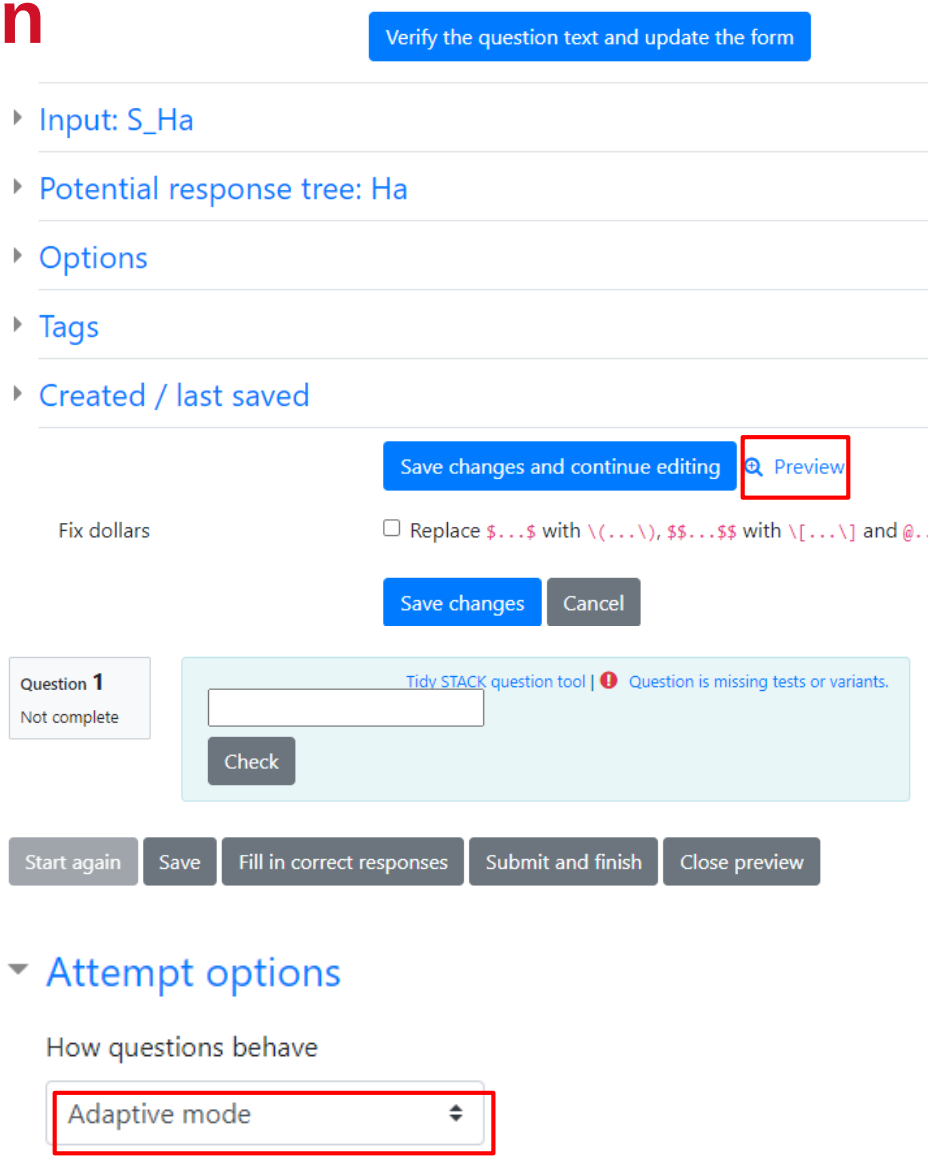
  Enter SAns and TAns (S_Ha and Ha)



- Press button „Save changes and continue editing“

Creating The Question

Now the lower part of the question should look like this:



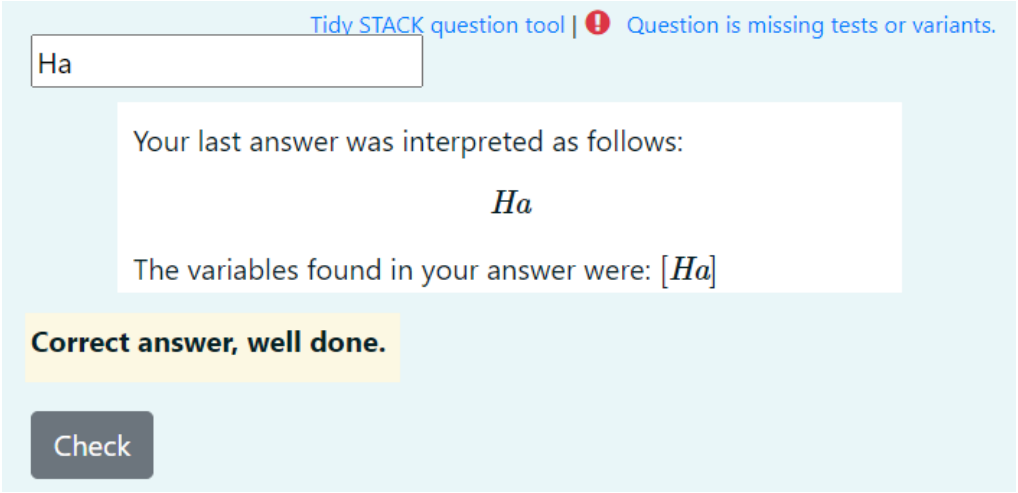
Press „Preview"

Make sure the question behaviour is set to „Adaptive mode!" in the preview window

Save Point 1

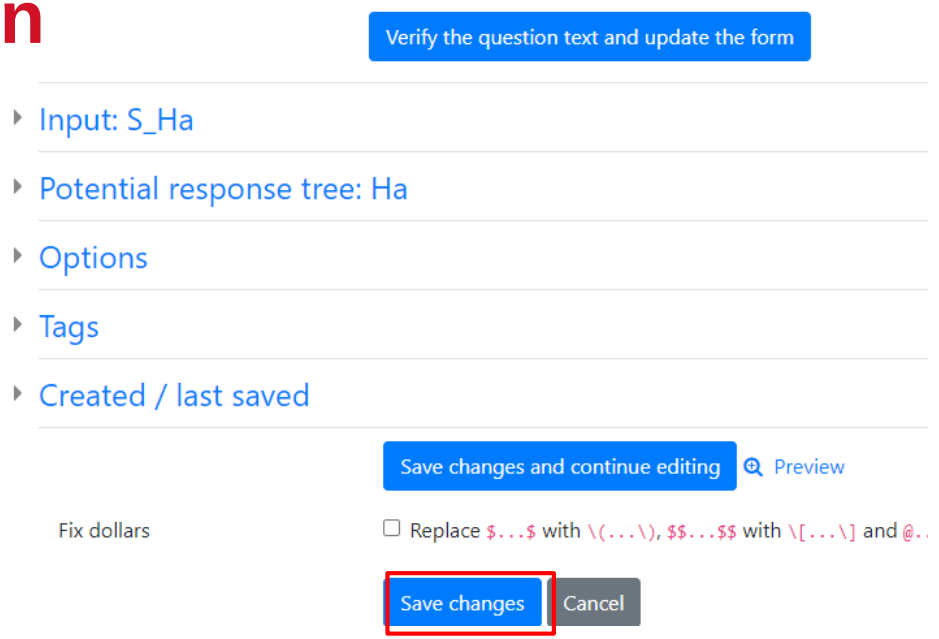
Import this question to start over from here:

MK Meclib workshop P1 minimum version

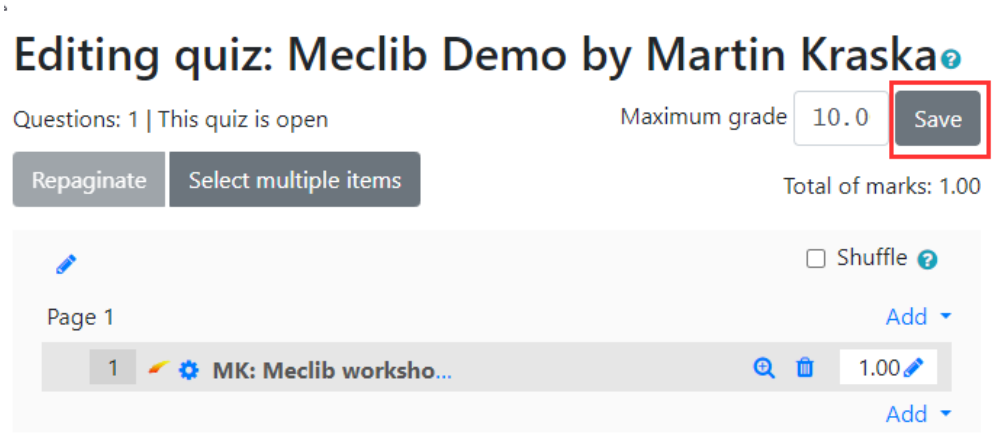


Creating The Question

Close the preview and save the question (Button „Save changes“)



In the quiz editing page press „Save“

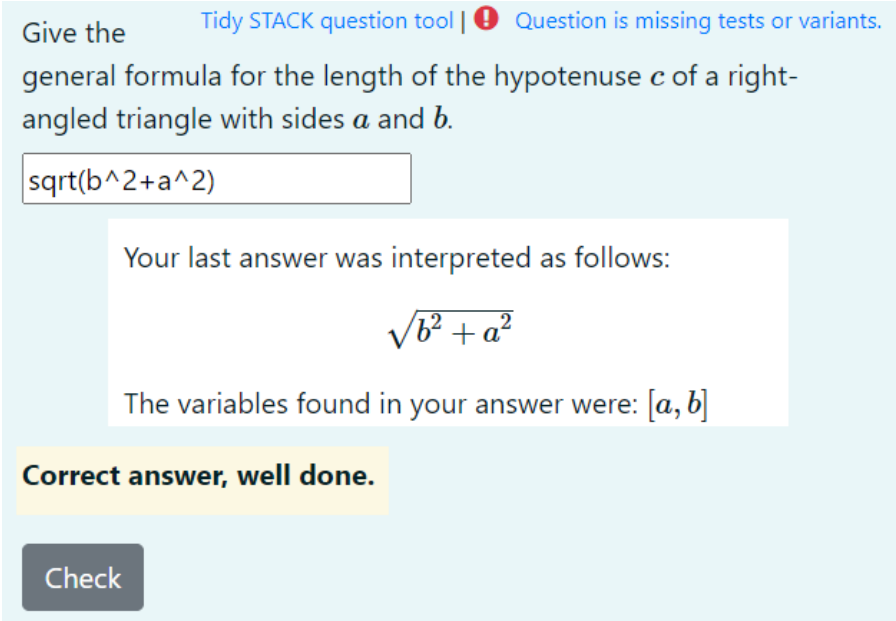


Adding Solution and Question text

Question variables: `Ha: sqrt(a^2+b^2);`

Question text: add this at the beginning

```
<p>Give the general formula for the length of the hypotenuse \(c\) of a right-angled triangle with sides \(a\) and \(b\).</p>
```



Next step:
Compact validation
Compact feedback

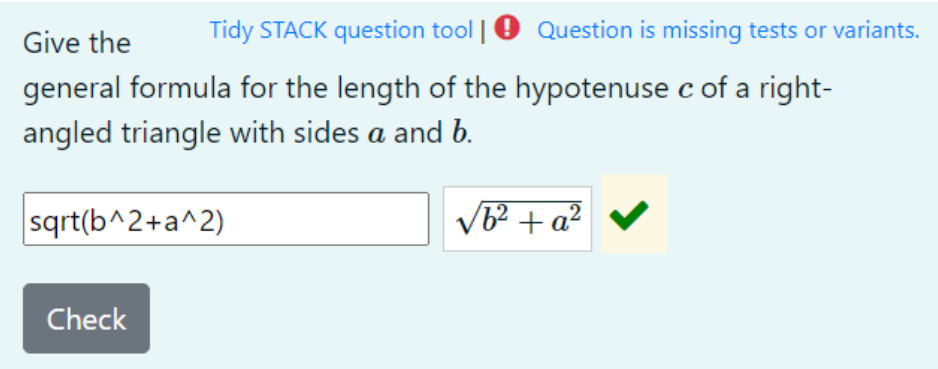
Compact Validation and Feedback

Input S_Ha

- Insert stars: Insert stars for spaces only
- Show the validation: Yes, compact

Potential response tree: Ha:

- PRT feedback style: Compact



Next step: Meclib image

Save Point 1b

Import this question to start over from here:

MK Meclib workshop P2b extended version

Tidy STACK question tool | Question is missing tests or variants.

Give the general formula for the length of the hypotenuse c of a right-angled triangle with sides a and b.

sqrt(b^2+a^2) $\sqrt{b^2+a^2}$

Check

Meclib image

- Goto Meclib Wiki https://github.com/mkraska/meclib/wiki
- Goto Page Meclib Question Setup
- Find the template for meclib objects for the question variables.
- **Question variables**: Copy the template to the question variables and remove the dummy line including the comma at the end of the second line:

```
initdata: [
  [ "grid", "x","y", -5,5,-5,5, 50 ]
];
```

- Find the text block for Meclib image in section Question text, Non-interactive mode
- **Question text**: Copy the block to the question text between text and input definition

Meclib image

Should look like this (Marklar editor)

```
Ha: sqrt(a^2+b^2);

initdata: [
  [ "grid", "x","y", -5,5,-4,5, 50 ]
];
init: stackjson_stringify(initdata);
```

```
<p>Give the general formula for the length of the hypotenuse \(c\) of a rectangular triangle
with kathedes \(a\) and \(b\).</p>

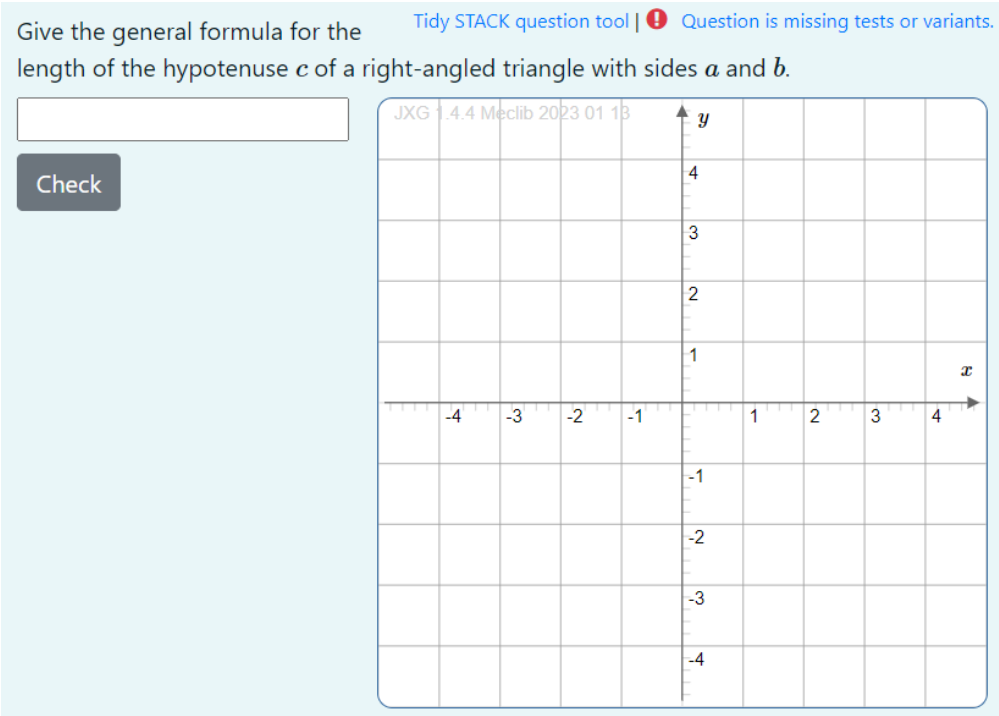
<div style="float:right">
[[jsxgraph width='250px' height='250px' ]]
var mode  = "STACK";
var stateRef;
const initstring = {#init#};
const centeredLabelStyle = {size:0, showInfobox:false, label:{offset:[-6,0],
  anchorX:'left', anchorY:'middle'}};
// End of STACK header
[[include src="https://raw.githubusercontent.com/mkraska/meclib/main/meclib.js" /]]
[[/jsxgraph]]</div>

<p>[[input:S_Ha]] [[validation:S_Ha]] [[feedback:Ha]]</p>
```

HTML format | Show syntax | Insert image | Insert file | Preview

Meclib image

Save changes and continue editing, Preview. The appearance depends on the with ofh the window.



Congratulation, this is your first STACK question with a Meclib image. We are going to adjust the canvas and add objects.

Meclib image

Add a triangle with edges at B at [0,0], C at [a,0] and A at [a,b]

- Goto Wiki, find the List of Objects page (link in the bottom line) and look for appropriate objects.
- Candidates are „polygon“ and „line“. We want a solid triangle, so we go to the „polygon“ page

"line"		0	
"polygon"	Switch	state	

- A polygon without a hole is defined by the vertex points `[ "polygon", "", ], [2,3], [3,2], [2.5,1], [1.5,1] ]`
- We will define the polygon using some helper variables, which later also facilitate randomization.

Meclib image

Question variables:

- Add some definitions, adjust the grid and add a line for the polygon

```
Ha: sqrt(a^2+b^2);

aa:4; bb: 3;
pB: [0,0]; pC: [aa,0]; pA: [aa,bb];

initdata: [
  [ "grid", "","", -1,aa+1,-1,bb+1, 40 ],
  [ "polygon", "", pA, pB, pC ]
];
init: stackjson_stringify(initdata);
```

Use aa and bb in order to keep a and b free for symbolic input

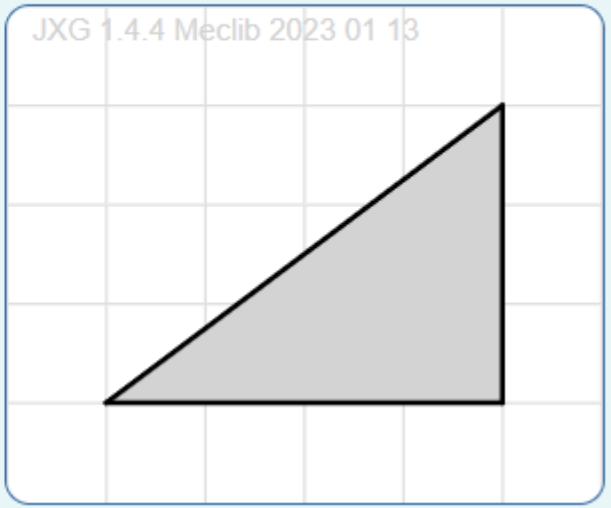
- Save changes and continue editing,
- Switch to the preview Window and refresh (Ctrl-R)

Meclib image

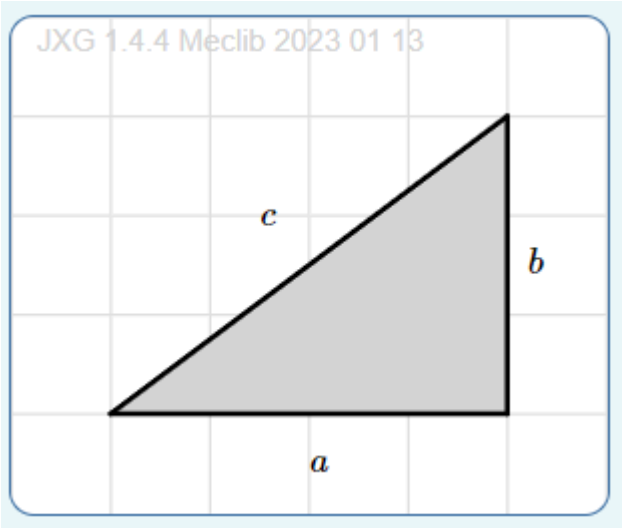
Tidy STACK question tool | Question is missing tests or variants.

Give the general formula for the length of the hypotenuse c of a right-angled triangle with sides a and b.

Check



Meclib image



Question variables:

- Add labels. Position them at the center of the edges plus a manually adjusted offset.
- Text of „label" objects is not in TeX mode by default.
- ```
  initdata: [
     [ "grid", "","", -1,aa+1,-1,bb+1, 40 ],
     [ "polygon", "", pA, pB, pC ],
     [ "label", "\\(a\\)", (pB+pC)/2 +[ 0,-0.5] ],
     [ "label", "\\(b\\)", (pA+pC)/2 +[0.2,0] ],
     [ "label", "\\(c\\)", (pA+pB)/2 +[-0.5,0.5] ]
  ];
  init: stackjson_stringify(initdata);
  ```
- Save changes and continue editing,
- Switch to the preview Window and refresh (Ctrl-R)
  ```

Save Point 2

Import this question to start over from here:

MK Meclib workshop P2 Meclib image

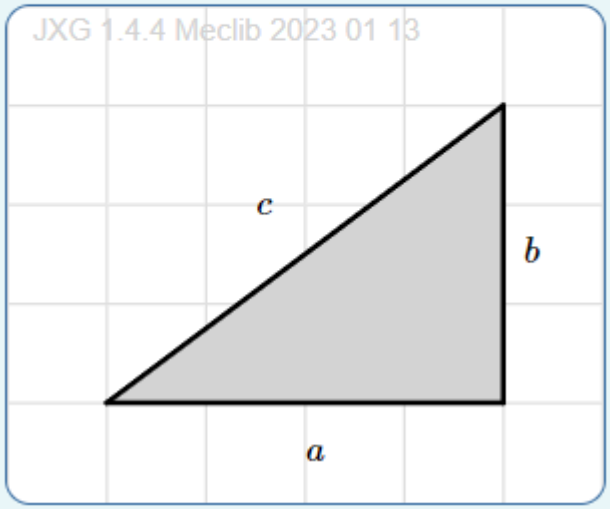
Tidy STACK question tool | Question is missing tests or variants.

Give the general formula for the length of the hypotenuse c of a right-angled triangle with sides a and b.

sqrt(b^2+a^2)

$\sqrt{b^2+a^2}$

Check



Randomization

Question variables: add symbolic and numeric reference values for the length of c

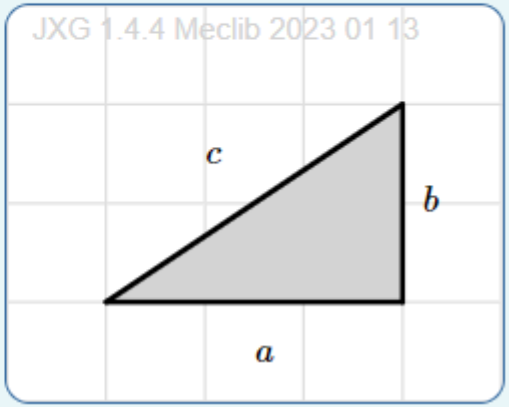
```
[aa,bb]: rand([ [1,4], [1,3], [2,4], [2,3], [2,2],
[3,3], [3,2], [3,1], [4,2], [4,1] ]);
```

Question note: `{@'a=aa@},{@'b=bb@}`

Tidy STACK question tool | Question is missing tests or variants.

Give the general formula for the length of the hypotenuse c of a right-angled triangle with sides a and b.

Check



Save Point P3

Import this question to start over from here:

MK Meclib workshop P3 Randomization

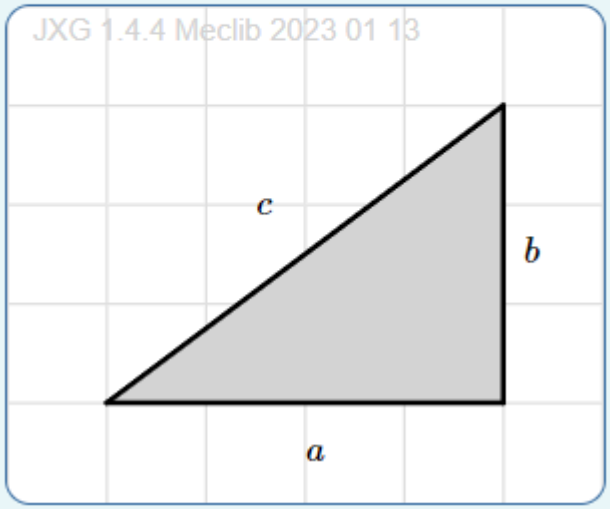
Tidy STACK question tool | Question is missing tests or variants.

Give the general formula for the length of the hypotenuse c of a right-angled triangle with sides a and b.

sqrt(b^2+a^2)

$\sqrt{b^2+a^2}$ ✔

Check



Add Input for Exact Length

Question variables: add referenc values for exact and numeric result

```
Ha: sqrt(a^2+b^2);

aa:4; bb: 3;

[aa,bb]: rand([ [1,4], [1,3], [2,4], [2,3], [2,2],
[3,3], [3,2], [3,1], [4,2], [4,1] ]);

H: sqrt(aa^2+bb^2)*L;

Hnum: float(sqrt(aa^2+bb^2));
```

We will need that for the numeric input

Question text: add input field for exact length:

```
<p>What is the exact length of the hypotenuse if the
grid width is \(L\)?

<p>[[input:S_H]] [[validation:S_H]]
[[feedback:H]]</p>
```

Press button „Verify question text and update the form“

Add Input for Exact Length

Input H:

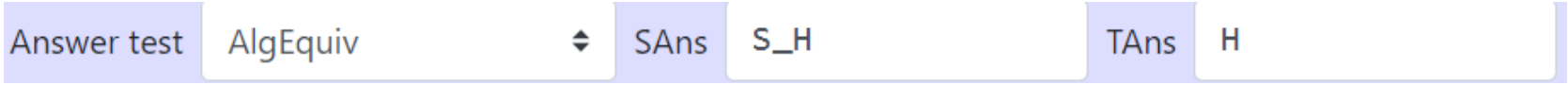
- Model answer: H
- Insert stars: Insert stars for spaces only
- Syntax hint: `expression`
- Hint attribute: Placeholder
- Show the validation: Yes, compact

Input Ha: add syntax hint (could have been done earlier)

- Syntax hint: `expression`
- Hint attribute: Placeholder

Potential response tree: H:

- PRT feedback style: Compact



Save Point P4

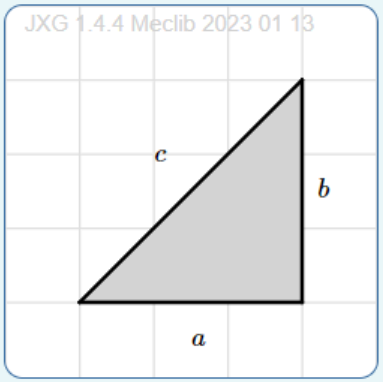
Import this question to start over from here:

MK Meclib workshop P4 Input 2

Tidy STACK question tool | Question is missing tests or variants.

Give the general formula for the length of the hypotenuse c of a right-angled triangle with sides a and b.

sqrt(b^2+a^2) $\sqrt{b^2+a^2}$



What is the exact length of the hypotenuse if the grid width is L?

3*sqrt(2)*L $3 \cdot \sqrt{2} \cdot L$

Check

Add Input for Numeric Length

Question text: add input field for numeric length:

```
<p>What is the numeric value of the length of the
hypotenuse if the grid width is \(1\,\rm{cm}\)?
```

```
<p>[[input:S_Hnum]] [[validation:S_Hnum]]
[[feedback:Hnum]]</p>
```

Press button „Verify question text and update the form“

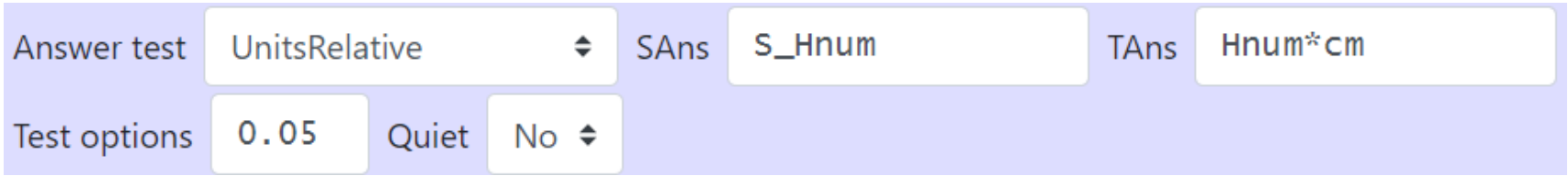
Add Input for Numeric Length

Input Hnum:

- Input type: Units
- Model answer: `Hnum*cm`
- Insert stars: Insert stars for spaces only
- Syntax hint: `number with unit`
- Forbidden words: +, -, sqrt
- Hint attribute: Placeholder
- Forbid floats: No
- Show the validation: Yes, compact

Potential response tree: Hnum:

- PRT feedback style: Compact



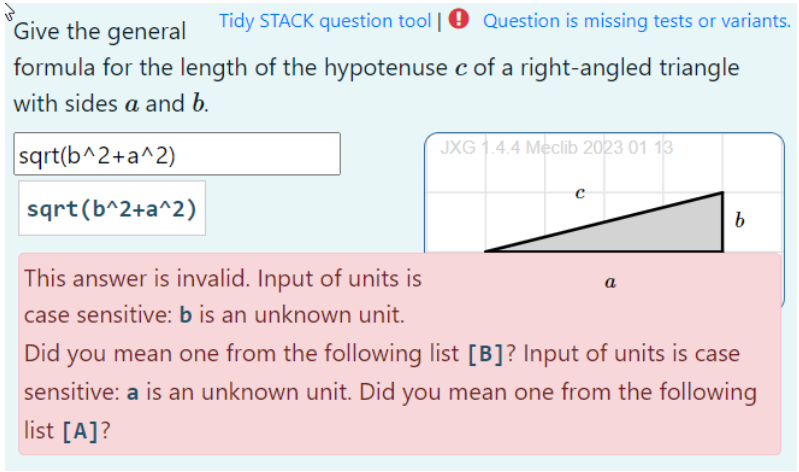
Add Input for Numeric Length

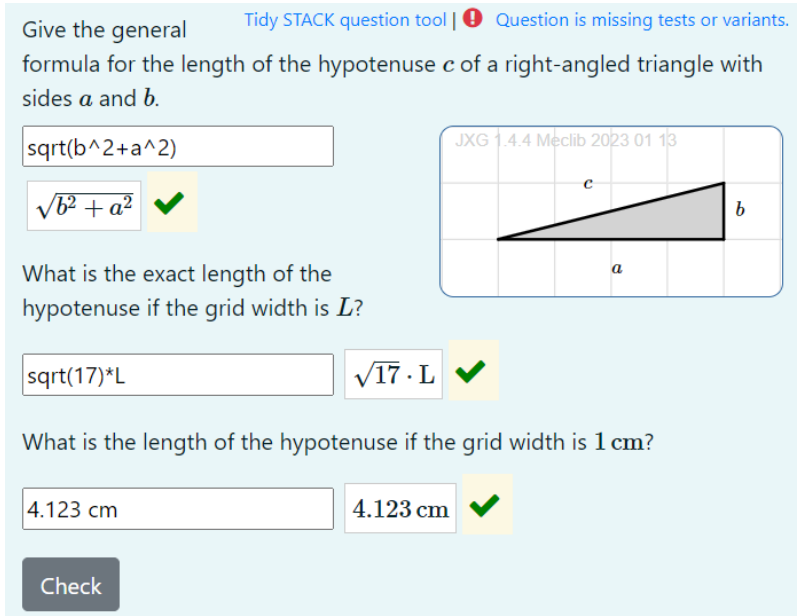
Parallel use of Units and Algebraic input fields has unintended cross effects. The validation of the Algebraic input checks for unknown units but should not do that.

Mitigation is by explicitly allowing the variables a and b in the input.

Input Ha:

- Allowed words: `a,b`





Save Point P5

Import this question to start over from here:

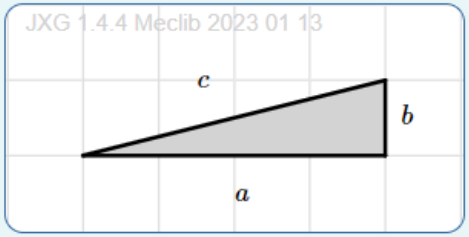
MK Meclib workshop P5 Input 3

Tidy STACK question tool | Question is missing tests or variants.

Give the general formula for the length of the hypotenuse c of a right-angled triangle with sides a and b.

sqrt(b^2+a^2)

$\sqrt{b^2+a^2}$ ✔



What is the exact length of the hypotenuse if the grid width is L?

sqrt(17)*L

$\sqrt{17} \cdot \mathrm{L}$ ✔

What is the length of the hypotenuse if the grid width is $1\,\mathrm{cm}$?

4.123*cm

$4.123\,\mathrm{cm}$ ✔

Check

Add Feedback

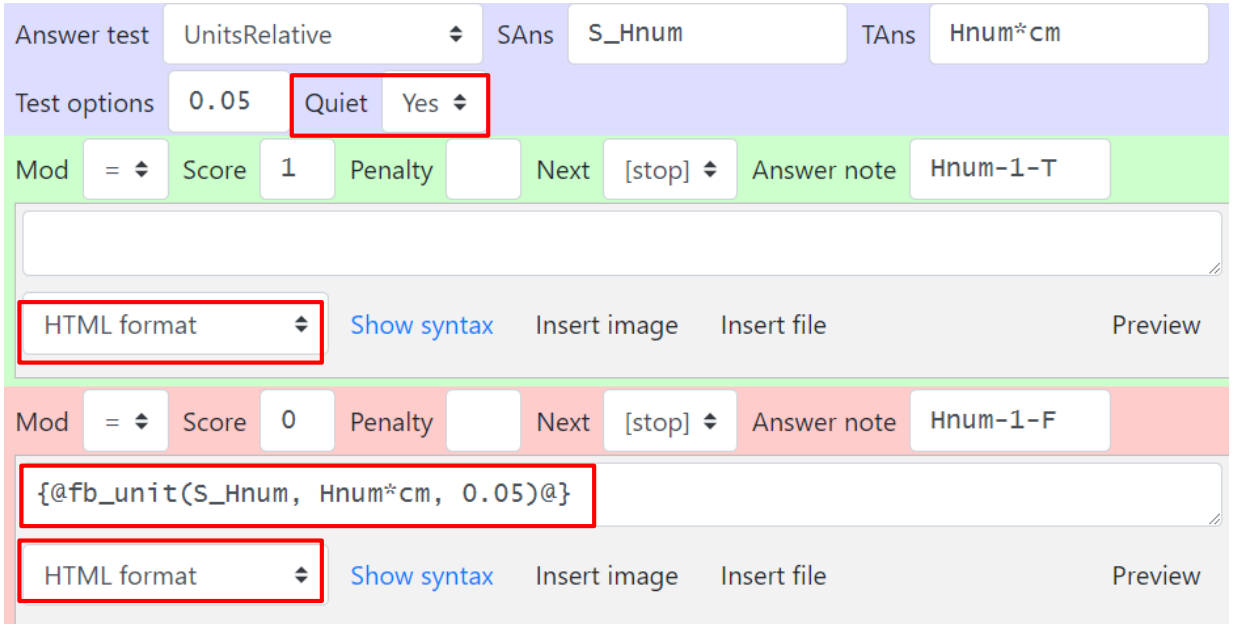
- Goto Meclib Wiki https://github.com/mkraska/meclib/wiki
- Goto Page Meclib Question Setup
- Find the command for inclusion of feedback functions (English version)
- **Question variables**: Copy the command as last line.

```
stack_include("https://raw.githubusercontent.com/mkraska/meclib/main/Maxima/fb_value_EN.mac");
```

Add Feedback

Potential response tree: Hnum:

- Change Quiet to Yes
- Change Text format to HTML
- Add `{@fb_unit(S_Hnum, Hnum*cm, 0.05)@}` to the false feedback



Save Point P6

Import this question to start over from here:

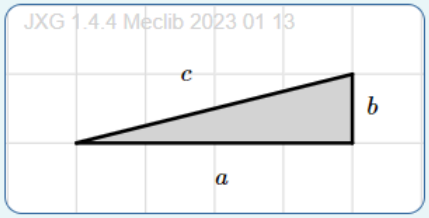
MK: Meclib workshop P6 Feedback on unit input

Tidy STACK question tool | Question is missing tests or variants.

Give the general formula for the length of the hypotenuse c of a right-angled triangle with sides a and b.

sqrt(b^2+a^2)

$\sqrt{b^2+a^2}$



What is the exact length of the hypotenuse if the grid width is L?

sqrt(17)*L

$\sqrt{17} \cdot \mathrm{L}$

What is the length of the hypotenuse if the grid width is $1\,\mathrm{cm}$?

4.12310562562*m

$4.12310562562\,\mathrm{m}$

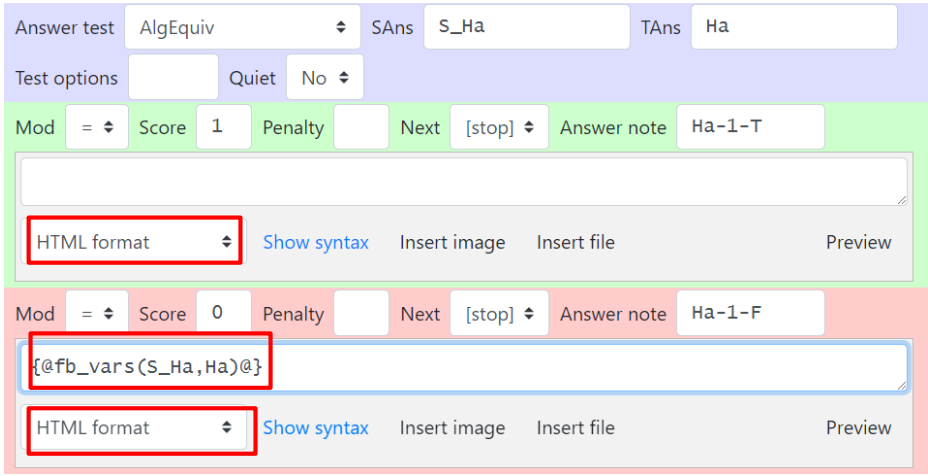
✖ The mantissa is correct, yet the value is off by at least one order of magnitude. Check your unit conversions.

Check

Add More Feedback

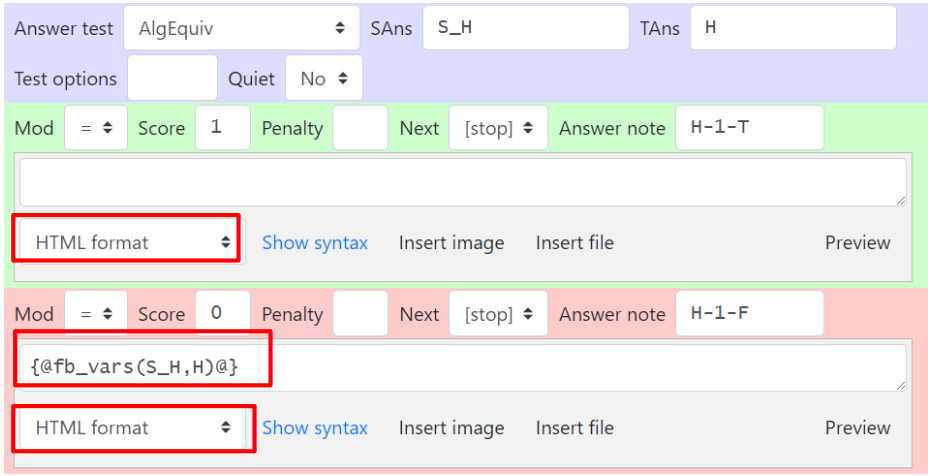
Potential response tree: Ha:

- Change Text format to HTML
- Add `{@fb_vars(S_Ha,Ha)@}` to the false feedback



Potential response tree: H:

- Change Text format to HTML
- Add `{@fb_vars(S_H,H)@}` to the false feedback



Save Point P7

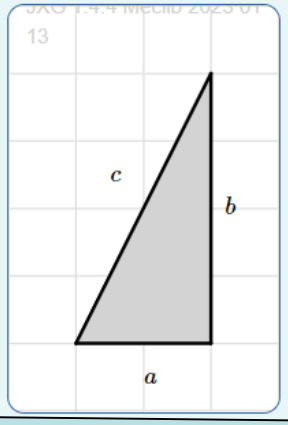
Import this question to start over from here:

MK: Meclib workshop P6 More Feedback

Give the general formula for Tidy STACK question tool | Question is missing tests or variants.
the length of the hypotenuse c of a right-angled triangle with sides a and b.

sqrt(a^2) $\sqrt{a^2}$

✖ Missing variable: b (b).



What is the exact length of the hypotenuse if the grid width is L?

2*sqrt(5) $2 \cdot \sqrt{5}$

✖ Missing variable: L (L).

What is the length of the hypotenuse if the grid width is $1\,\mathrm{cm}$?

2*cm $2\,\mathrm{cm}$

✖ The absolute value is at least 50% too small.

Check

Another glitch if mixing Algebraic and Units input in a single question.
L is taken as unit and not written italic.

Interactive Input

Objective: Interactive input of the center of gravity and feedback on the error.

We have to switch to interactive use of Meclib.

- Goto Meclib Wiki https://github.com/mkraska/meclib/wiki
- Goto Page Meclib Question Setup
- Find the text block for Meclib image in section Question text, interactive mode
- **Question text**:
  - Replace the existing Meclib block with the new one (move it to the top of the question text.
  - Add instruction and feedback definition for the center of gravity

```
<p>Indicate the center of gravity using the blue crosshair.</p>
<p>[[feedback:CG]]</p>
```

Interactive Input

- Two hidden input definitions are added. They need some settings later.
- Also, the [[jsxgraph]] block has different contents.

```
<p hidden>[[input:objects]] [[validation:objects]]</p>
<p hidden>[[input:names]] [[validation:names]] </p>
<div style="float:right">
[[jsxgraph width='500px' height='400px' input-ref-objects="stateRef" input-ref-
names="fbd_names" ]]
var mode  = "STACK";
const initstring = {#init#};
const centeredLabelStyle = {size:0, showInfobox:false, label:{offset:[-6,0],
  anchorX:'left', anchorY:'middle'}};
// End of STACK header
[[include src="https://raw.githubusercontent.com/mkraska/meclib/main/meclib.js" /]]
[[/jsxgraph]]</div>
```

Interactive Input

Push button „Verify the question text update the form“

Input objects

- Input type: String
- Model answer: tans
- Students must verify: no
- Show validation: no

Stores the state of the Graphics
Initialized with variable init and is modified by interactive input

Input names

- Input type: algebraic
- Model answer: []
- Forbid float: no
- Students must verify: no
- Show validation: no

Conveys data for feedback generation

Interactive Input

- Add the crosshair to the Meclib objects and store the object index of the crosshair for use in the feedback tree.
- **Question variables:**

```
initdata: [
   [ "grid", "","", -1,aa+1,-1,bb+1, 40 ],
   [ "crosshair", "", [0, bb], [0,0], [1,1], [2,2] ],
   [ "polygon", "", pA, pB, pC ],
   [ "label", "\\(a\\)", (pB+pC)/2 +[ 0,-0.5] ],
   [ "label", "\\(b\\)", (pA+pC)/2 +[0.2,0] ],
   [ "label", "\\(c\\)", (pA+pB)/2 +[-0.5,0.5] ]
];
init: stackjson_stringify(initdata);
ic: 2;
```

- Save and preview…

Interactive Input

Inspection of the names field

Question text:

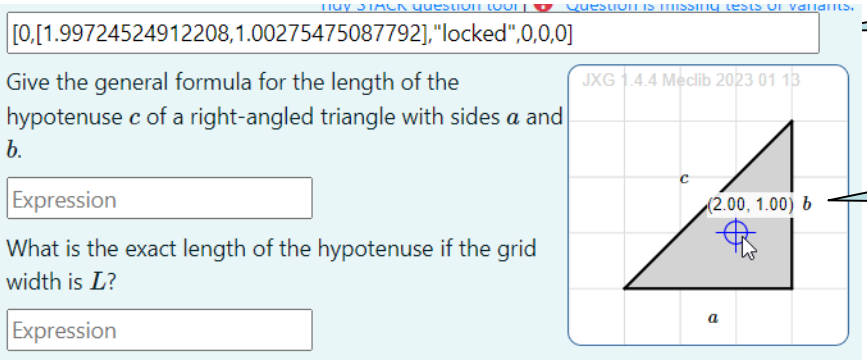
- Remove the „hidden" attribute from the names input field

```
<p hidden>[[input:objects]]
[[validation:objects]]</p>
```

```
<p >[[input:names]] [[validation:names]] </p>
```

Input names: Make the field wide

- Input box size: 40



„crosshair" returns the coordinates [x,y] (second entry in the names list.

The infobox display shows rounded values (two decimal places, as specified in the definition

Interactive Input

Question text:

- Add a title to the text

```
<p><strong>Meclib Demo</strong></p>
```

- Restore the „hidden“ attribute in the names input definition

```
<p hidden>[[input:objects]] [[validation:objects]]</p>
<p hidden>[[input:names]] [[validation:names]] </p
```

- and add instruction and feedback definition for the center of gravity below the graphics (any other location would also do)

```
<p>Indicate the center of gravity using the blue
crosshair.</p>
<p>[[feedback:CG]]</p>
```

- Push button „Verify the question text update the form“

Interactive Input

Potential response tree: CG

- PRT feedback style: Compact
- Feedback variables:

```
CG: [2/3*aa, 1/3*bb];
S_CG: names[ic];
vec: CG-S_CG;
dist: sqrt(vec[1]^2+vec[2]^2);
```

Actual CG

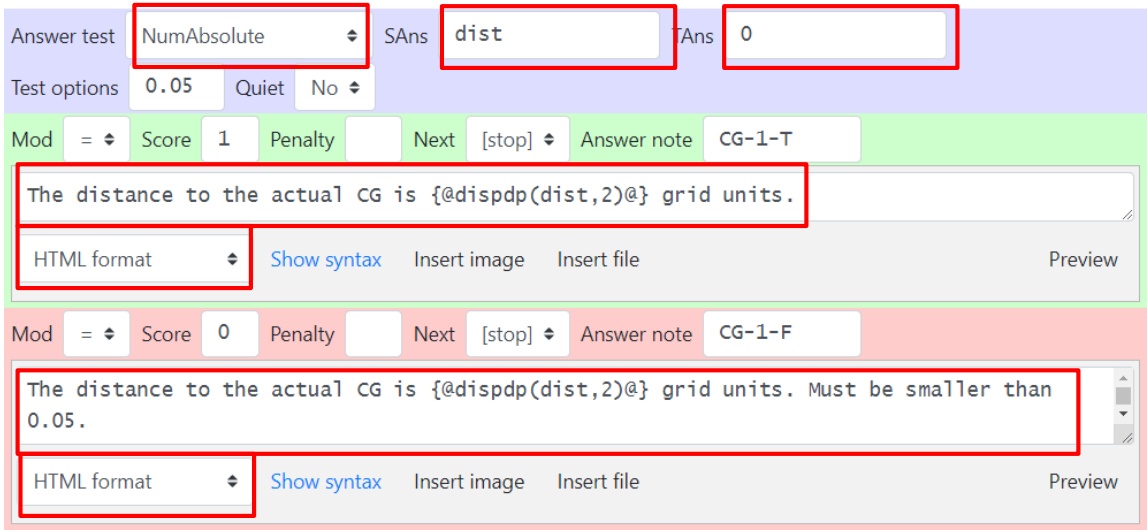
Crosshair location

Distance vector

Distance

- Feedback text

```
The distance to
the actual CG is
{@dispdp(dist,2)@}
 grid units.
Must be smaller
than 0.05.
```



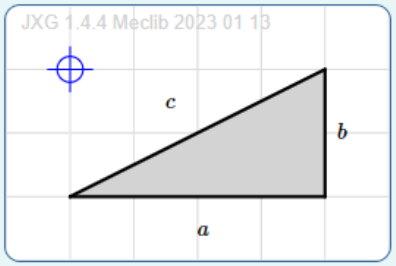
Save Point P8

Import this question to start over from here:

MK: Meclib workshop P8 Interactive

Meclib Demo Tidy STACK question tool | Question is missing tests or variants.

Indicate the center of gravity using the blue crosshair.



✖ The distance to the actual CG is 2.98 grid units. Must be smaller than 0.05.

Give the general formula for the length of the hypotenuse c of a right-angled triangle with sides a and b.

Expression

What is the exact length of the hypotenuse if the grid width is L?

Expression

What is the length of the hypotenuse if the grid width is $1\,\mathrm{cm}$?

number with unit

Check

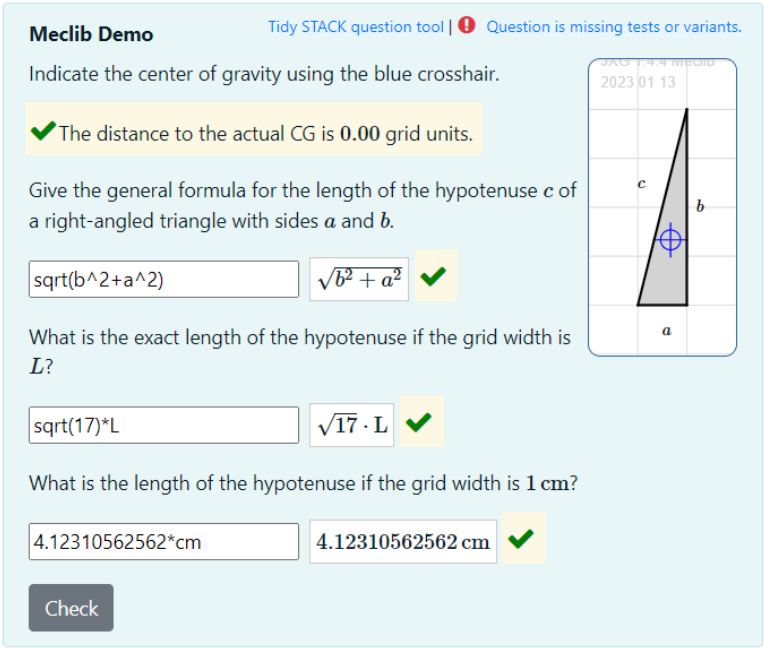
Convenience Stuff

Add a reference solution for the graphics for „Fill in correct responses“ in the preview.

Question variables: below definition of initdata

```
CG: [2/3*aa, 1/3*bb];
tansdata: initdata;
tansdata[ic]: [ "crosshair", "", CG, [0,0], [1,1], [2,2] ];
tans: stackjson_stringify(tansdata);
```

The definition of CG can be removed from the Feedback variables in the CG-PRT.



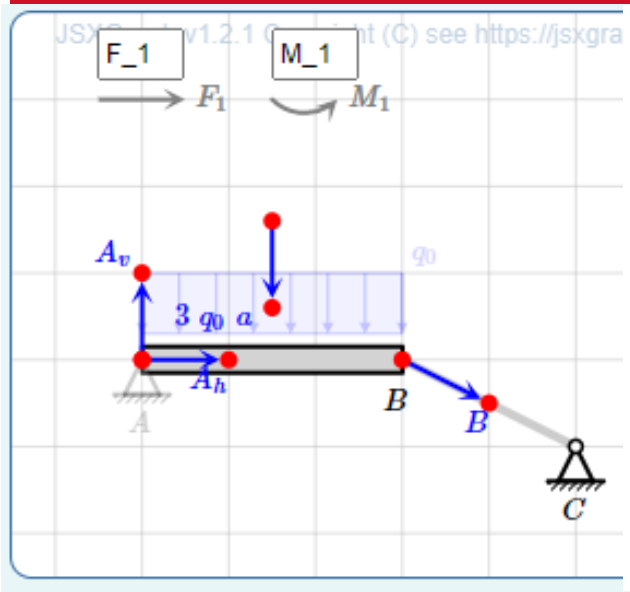
Cleanup

Question text:

- Restore the „hidden“ attribute in the names input definition

Technische Hochschule
Brandenburg
University of
Applied Sciences
Fachbereich
Technik

Thank you for your attention!



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