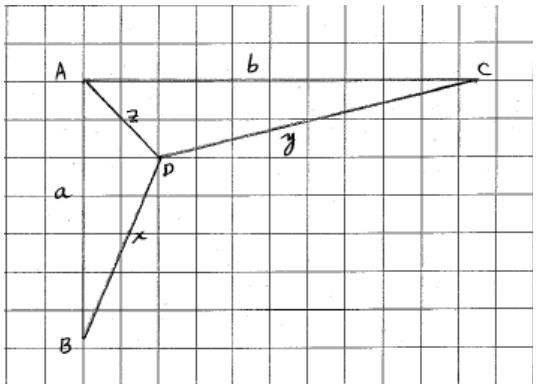
Chapter 1 TASK: Not Your Typical Bookcase

Level 4 Sample Response

1. a)



Since AD bisects the right angle at A, each acute angle at A is 45°.

Use the Law of Sines to find acute $\angle$ ABD.

$$\frac{\sin\angle ABD}{z} = \frac{\sin\angle BAD}{x}$$
$$\frac{\sin\angle ABD}{5.5} = \frac{\sin\angle BAD}{10.4}$$
$$\sin\angle ABD = \frac{5.5\sin 45°}{10.4}$$
$$\angle ABD = 21.959°$$

$\angle ABD = 22^\circ$ (to the nearest degree)

Use the Law of Sines to find acute $\angle ACD$

$$\frac{\sin\angle ACD}{5.5} = \frac{\sin\angle CAD}{17.5}$$
$$\sin\angle ACD = \frac{5.5\sin 45°}{17.5}$$
$$\angle ACD = 12.840°$$

$\angle ACD = 13^\circ$ (to the nearest degree)

Use the Law of Cosines to find side *x*.

$$x^2 = 5.5^2 + 13.5^2 - 2(5.5)(13.5)(\cos 45^\circ)$$
$$x^2 = 107.494...$$
$$x = \pm 10.367...$$

Since $x > 0$, x = 10.4 cm (to the nearest millimetre).

Use the Law of Cosines to find side *y*.

$$y^2 = 5.5^2 + 21^2 - 2(5.5)(21)(\cos 45^\circ)$$
$$y^2 = 307.908...$$
$$y = \pm 17.547...$$

Since $y > 0$, y = 17.5 cm (to the nearest millimetre)

b) Use the Angle Sum Triangle Theorem to find obtuse $\angle ADB$.

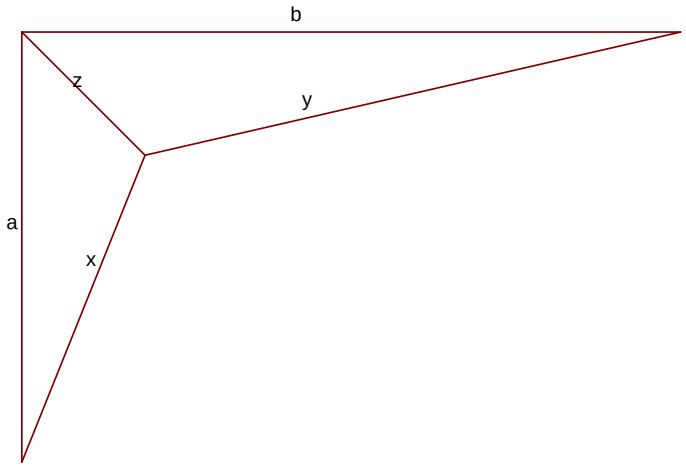
$$\angle ADB + \angle BAD + \angle ABD = 180^\circ$$
$$\angle ADB + 45^\circ + 22^\circ = 180^\circ$$
$$\angle ADB = 180^\circ - 45^\circ - 22^\circ$$
$$\angle ADB = 113^\circ$$

Use the Angle Sum Triangle Theorem to find obtuse $\angle ADC$.

$$\angle ADC + \angle CAD + \angle ACD = 180^\circ$$
$$\angle ADB + 45^\circ + 13^\circ = 180^\circ$$
$$\angle ADB = 180^\circ - 45^\circ - 13^\circ$$
$$\angle ADB = 122^\circ$$

2. Electronic template of the shelf support created using *Geometer's Sketchpad*®.

$\angle BAD = 45^\circ$
$\angle CAD = 45^\circ$
a = 13.5 cm
b = 21.0 cm
z = 5.5 cm



3. Template of the shelf support created using a piece of spruce wood.

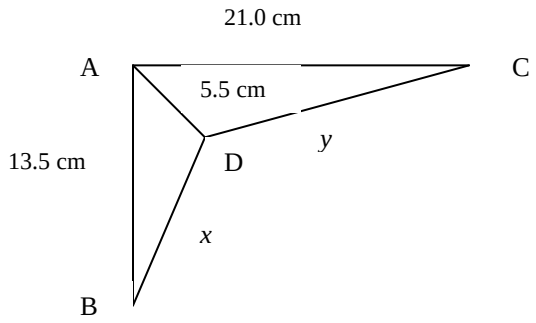
Level 4 Notes

Look for the following:

- a clearly-labelled accurate diagram representing the shelf support
- a highly organized detailed solution showing accurate calculations and justifications for the responses in the solution
- very few or no errors in the solutions
- a thorough understanding of the problem and how it relates to trigonometry
- calculations are made using degrees and not radians
- side lengths are rounded correctly to the nearest millimeter
- angle measures are rounded correctly to the nearest degree
- use of technology, such as *The Geometer's Sketchpad*® to create an electronic template for the shelf support, with the lines in colour
- some use of building materials, such as wood, to create a template of the shelf support

Level 3 Sample Response

1. a)



Use the Law of Cosines to find side *x*.

$$x^2 = 5.5^2 + 13.5^2 - 2(5.5)(13.5)(\cos 45^\circ)$$
$$x^2 = 45.254...$$
$$x = \pm 6.727...$$

Since $x > 0$, $x = 6.7$ cm (to the nearest millimetre).

Use the Law of Cosines to find side *y*.

$$y^2 = 5.5^2 + 21^2 - 2(5.5)(21)(\cos 45^\circ)$$
$$y^2 = 169.882...$$
$$y = \pm 13.033...$$

Since $y > 0$, $y = 13.0$ cm (to the nearest millimetre).

Use the Law of Sines to find acute $\angle ABD$.

$$\frac{\sin \angle ABD}{5.5} = \frac{\sin 45^\circ}{6.7}$$
$$\sin \angle ABD = \frac{5.5 \sin 45^\circ}{6.7}$$
$$\angle ABD = 35.482^\circ$$

$\angle ABD = 35^\circ$ (to the nearest degree)

Use the Law of Sines to find acute $\angle ACD$.

$$\frac{\sin \angle ACD}{5.5} = \frac{\sin 45^\circ}{13.0}$$
$$\sin \angle ABD = \frac{5.5 \sin 45^\circ}{13.0}$$
$$\angle ABD = 17.407^\circ$$

$\angle ACD = 17^\circ$ (to the nearest degree)

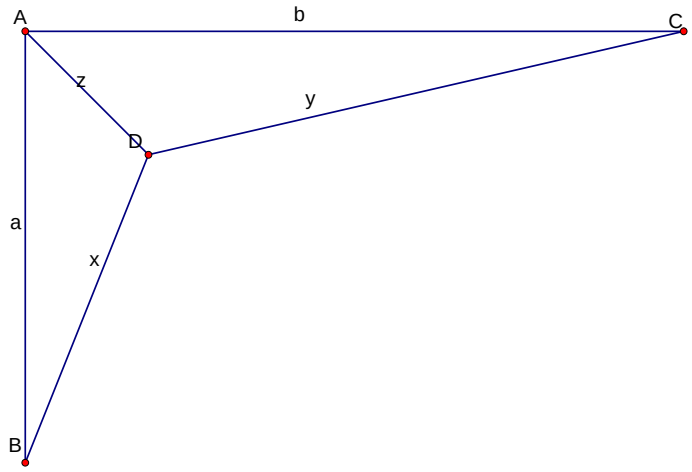
b) Use the Angle Sum Triangle Theorem to find obtuse $\angle ADB$

$$\angle ADB + \angle BAD + \angle ABD = 180^\circ$$
$$\angle ADB + 45^\circ + 35^\circ = 180^\circ$$
$$\angle ADB = 180^\circ - 45^\circ - 35^\circ$$
$$\angle ADB = 100^\circ$$

Use the Angle Sum Triangle Theorem to find obtuse $\angle ADC$

$$\angle ADC + \angle CAD + \angle ACD = 180^\circ$$
$$\angle ADB + 45^\circ + 17^\circ = 180^\circ$$
$$\angle ADB = 180^\circ - 45^\circ - 17^\circ$$
$$\angle ADB = 118^\circ$$

2. Electronic template of the shelf support drawn using *Geometer's Sketchpad*®.



3. Template of the shelf support created using a piece of spruce wood.

Level 3 Notes

A level 3 response to the three questions will be very similar to the level 4 response with the following exceptions.

For **question 1**, the Cosine Law will be applied correctly but there may be errors in calculating the final answers. The final answers may be incorrect if the students do not follow the correct order of operations when calculating the answers or use calculators that are set to radians instead of degrees. The students may not round the answers correctly to the nearest millimeter.
For **question 2**, the electronic template of the shelf support may not be drawn accurately and the sides and side lengths may be labelled incorrectly or missing.
For **question 3**, the template of the shelf support may be made using building materials that are not wood.

Level 2 Sample Response

1. a)

$x^2 = 5.5^2 + 13.5^2 - 2(5.5)(13.5)(\cos 45^\circ)$

x = 10.4 cm (to the nearest millimetre).

$y^2 = 5.5^2 + 21^2 - 2(5.5)(21)(\cos 45^\circ)$

y = 17.5 cm (to the nearest millimetre)

$$\frac{\sin \angle ABD}{5.5} = \frac{\sin \angle BAD}{10.4}$$

$\angle ABD = 22^\circ$ (to the nearest degree)

$$\frac{\sin \angle ACD}{5.5} = \frac{\sin \angle CAD}{17.5}$$

$\angle ACD = 13^\circ$ (to the nearest degree)

b) Use the Angle Sum Triangle Theorem to find obtuse $\angle ADB$

$\angle ADB + 45^\circ + 22^\circ = 180^\circ$

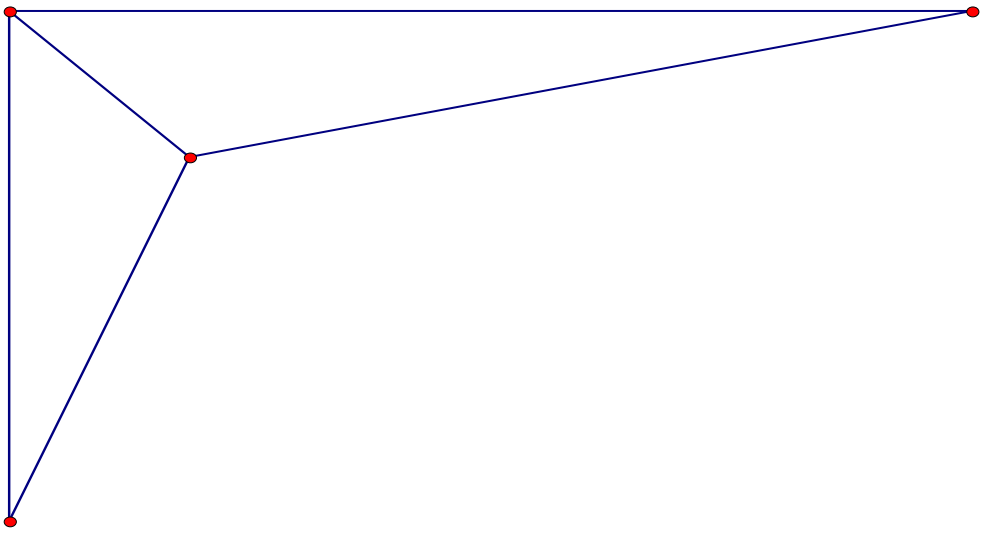
$\angle ADB = 113^\circ$

Use the Angle Sum Triangle Theorem to find obtuse $\angle ADC$

$\angle ADB + 45^\circ + 13^\circ = 180^\circ$

$\angle ADB = 122^\circ$

2. Electronic template of the shelf support drawn using *Geometer's Sketchpad*®.



3. Template of the shelf support created using a piece of spruce wood.

Level 2 Notes

Look for the following:

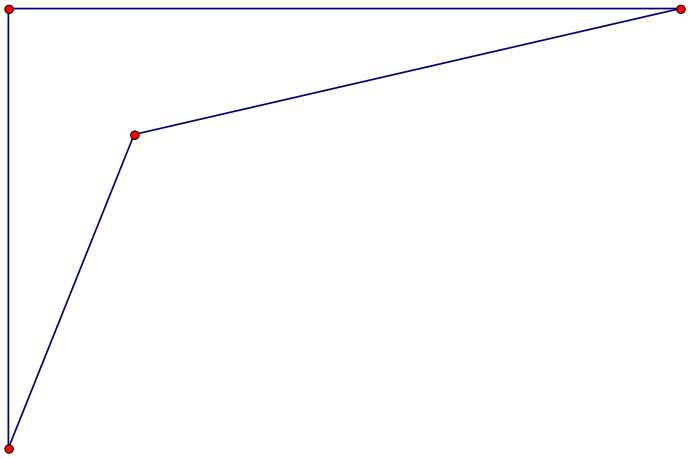
- some justification and correctness in the student responses; however, the structure that is apparent in the level 3 and level 4 solutions will be missing
- for question **2**, the electronic template of the shelf support created using *The Geometer's Sketchpad*® is not drawn accurately
- for question **3**, the template of the shelf support created using building materials is not an accurate representation of the shelf support.

Level 1 Sample Response

1. a) x = 10.4 cm (to the nearest millimetre).
y = 17.5 cm (to the nearest millimetre)
$\angle ABD = 22^\circ$ (to the nearest degree)
$\angle ACD = 13^\circ$ (to the nearest degree)

b) $\angle ADB = 113^\circ$
$\angle ADB = 122^\circ$

2. Electronic template of the shelf support created using *Geometer's Sketchpad*®



3. Template of the shelf support created using a piece of spruce wood.

Level 1 Notes

Look for the following:

- little or no effort to justify the answers using trigonometry
- for **question 2**, the electronic template of the shelf support created using *The Geometer's Sketchpad*® may not be complete
- for **question 3**, the template of the shelf support created using building materials may be missing or created incorrectly