Lesson 6: Solving 2 & 3-Dimensional Trig Problems

Two and three dimensional problems involving triangles can be solved using a combination of tools:

- Right Triangles
  - Primary trig ratios SOH CAH TOA
  - Pythagorean theorem $c^2 = a^2 + b^2$
- Oblique Triangles
  - Sine Law (ASA, AAS, SSA) $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$ $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$
  - Cosine Law (SSS, SAS) $c^2 = a^2 + b^2 - 2ab\cos C$

You will need to have these formulas memorized – they will NOT be provided on a test/exam.

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Some useful tips:

- Always create a diagram if one is not provided in the problem.
  - Label with all given information.
  - Where possible, draw diagrams roughly to scale.
  - Make it large so you can fit all the information!
- Create a plan to solve for the angle or side indicated.
  - Start where you have the most information (at least 3 pieces of info)
  - Think: is this the most efficient way to solve the problem?
- Execute the plan
  - Make sure your calculator is in degree mode
  - Refer back to you diagram to help stay on track
  - Check to see if your answers make sense
- Don't forget about those presentation marks! ($\therefore$, units, $\doteq$, etc)

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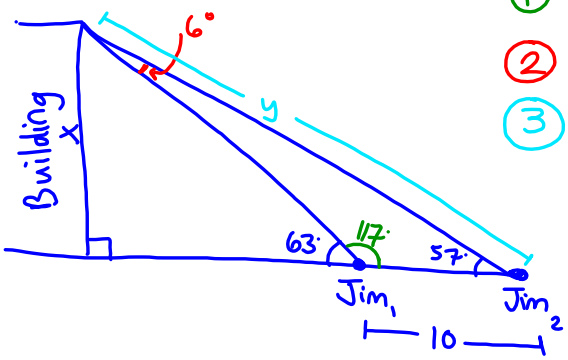
Ex 1) Jim uses a clinometer to measure the height of a building. He determines the angle of elevation to the top of the building is 63°. Then he steps back 10m and repeats the measurement and finds that the angle of elevation is now 57°. Determine the height of the building.



① $180 - 63 = 117°$

② $180 - 57 - 117 = 6°$

③ $\frac{\sin 6°}{10} = \frac{\sin 117°}{y}$

$y = 85.2\text{ m}$

④ $\sin 57° = \frac{x}{85.2}$

$x = 71.5\text{ m}$

∴ The building is 71.5 m tall.

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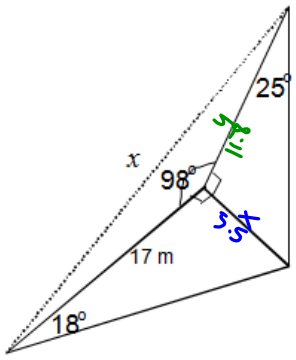
Ex 2) Determine the length of the dashed line, x, to the nearest tenth of a meter.



① $\tan 18° = \frac{x}{17}$

$x = 5.5$

② $\tan 25° = \frac{5.5}{y}$

$y = 11.8\text{ m}$

③ $x^2 = 11.8^2 + 17^2 - 2(11.8)(17)\cos 98°$

$x = 22\text{ m}$

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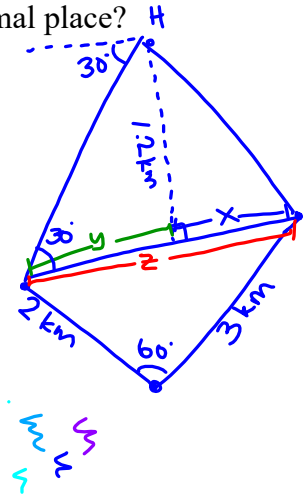
Ex 3) Two roads intersect at an angle of 60°. Two bicycles leave the intersection, each on a different road. One bike travels at 20km/h and the other car at 30km/h. After 6 min, a police helicopter 1200m directly above and between (not necessarily halfway between) the two bikes, notes the angle of depression to the slower bike is 30°. What is the horizontal distance from the helicopter to the faster bike to one decimal place?



$\frac{30\text{ km}}{?} = \frac{60\text{ min}}{6\text{ min}}$ $\frac{20\text{km}}{?} = \frac{60\text{ min}}{6\text{ min}}$

$? = 3$ km $? = 2$ km

① $z^2 = 2^2 + 3^2 - 2(2)(3)\cos 60°$

$z = 2.6$ km

② $\tan 30° = \frac{1.2}{y}$

$y = 2.1$ km

③ $x = 2.6 - 2.1$

$x = 0.5$ km

∴ The horizontal distance from the helicopter to the faster biker is 0.5 km

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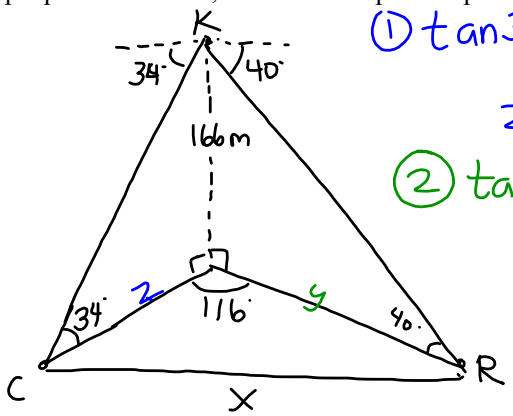
Ex 4) Keith is looking out the window of his condo that is 166m above ground. He sees a robbery take to his left at an angle of depression of 40° and he sees a police officer to his right at an angle of depression of 34°. If the angle between the two people seen is 116°, find how far apart the police officer is from the robbery.



① $\tan 34° \doteq \frac{166}{z}$

$z \doteq 246$ m

② $\tan 40° \doteq \frac{166}{y}$

$y \doteq 198$ m

③ $x^2 = 198^2 + 246^2 - 2(198)(246)\cos 116$

$x = 377$ m

∴ The robber and police officer are 377m apart.

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HW U3L6:

1. p. 319 #8, 12
2. p. 327 #10
3. handout