Physical Security Countermeasures

This entire sheet

– Telmo, AHI

I'm going to put a heptadecagon into game.

– Cassie Huang

Mechanical lockpicking is mechanicked by geometric constructions with a compass and straightedge. Each lock will have a geometric figure you must reconstruct to open the lock.

Equipment for lockpicking is physrepped by a compass and a straightedge. The GMs will supply them, but you may bring your own. You should also bring a pad of paper. With your compass and straightedge, you may:

- Use the compass to draw arcs.
- Use the compass to mark off distances.
- Use the straightedge to make straight lines.

You may not:

- Use your straightedge as a ruler.
- Use lined paper for your constructions.
- Guess an angle.
- Guess a distance or location.

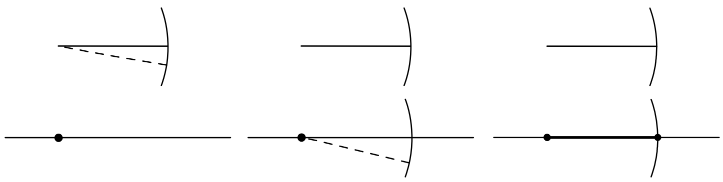
In general, if you want to put the little pointy end of the compass down on the paper, unless it's the first stroke of the figure, you need to put it down on a pencil line or intersection. Likewise, if you want to draw a straight line, it's usually going to be a straight line between two points.

Easy locks should be straightforward from the examples below. More difficult locks may require some thinking and/or several steps. Most geometric constructions can be solved in multiple ways, usually with a trade-off between complexity of construction and thinking, but in general if you know one solution it is a bad idea to try to find a better one during a mission.

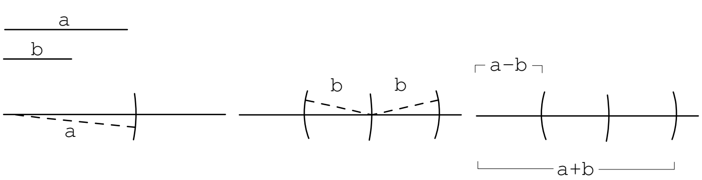
Elementary operations

You should be able to do these very well.

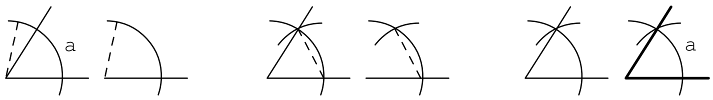
Copying a segment:



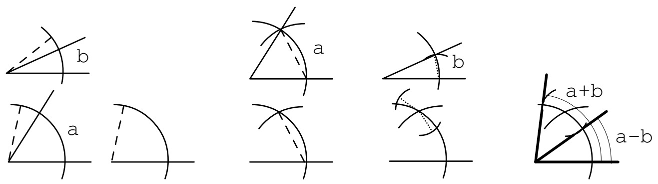
Adding/subtracting segments:



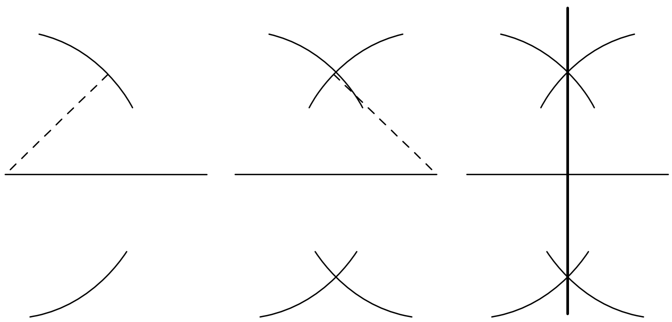
Copying an angle:



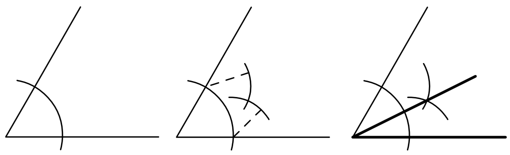
Adding/subtracting angles:



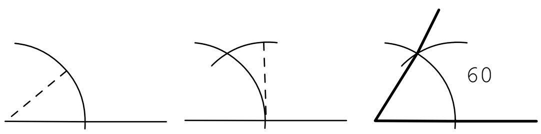
Bisecting a segment/constructing a perpendicular line:



Bisecting an angle:

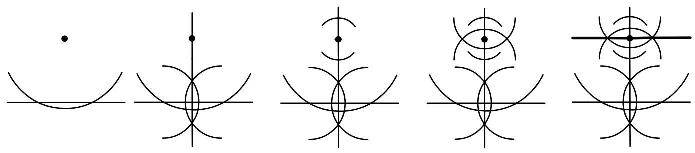


Angle of 60°:



Other common angles include 30° (= 60°/ 2) and 45° (= 90° / 2).

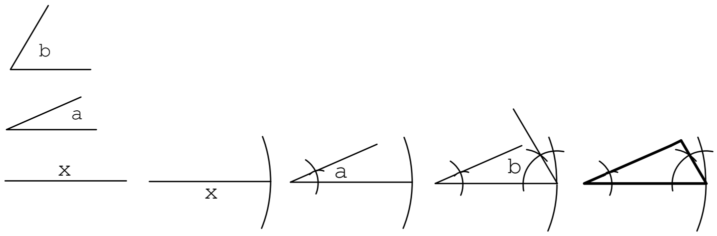
Line parallel to a line through a given point:



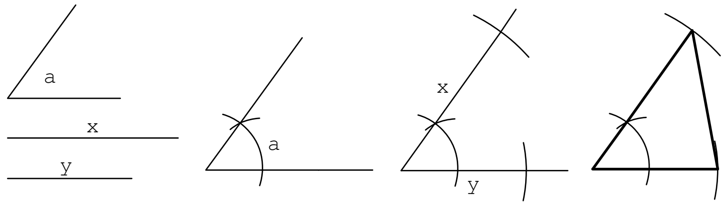
Triangles

You should be able to do these well.

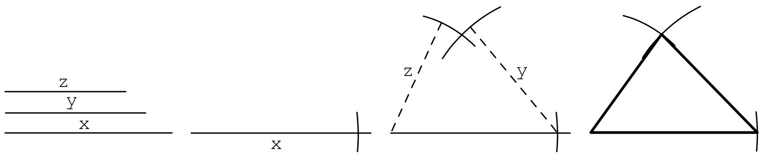
Given 2 angles and a common side:



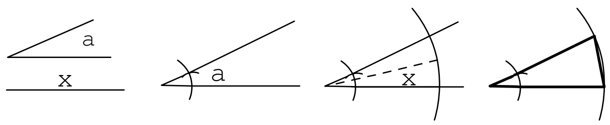
Given 2 sides and a common angle:



Given 3 sides:



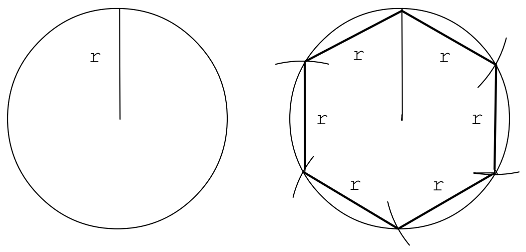
Isosceles triangle (two sides / two angles of same size):



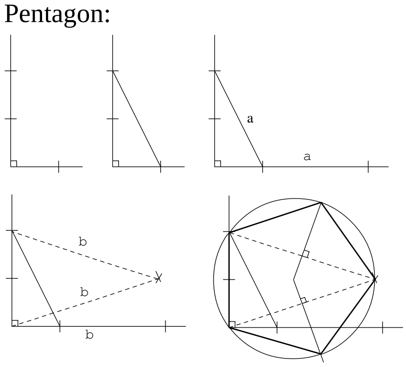
Regular polygons

You should be able to do these.

Hexagon:



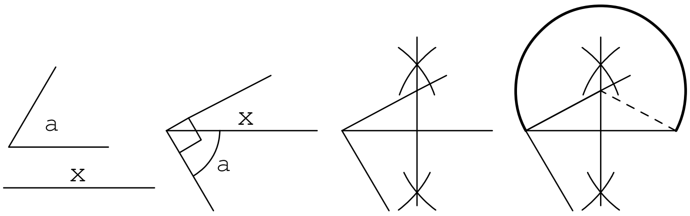
Pentagon:



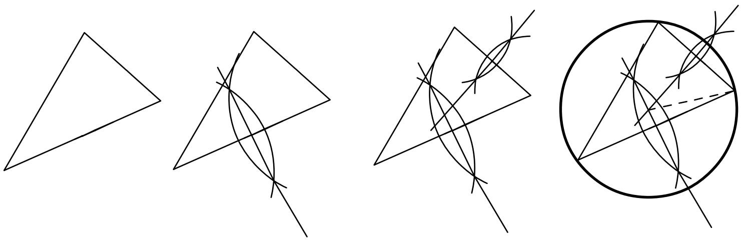
Other operations

You may want to understand these if you need to improvise.

Arc given chord and inscribed angle:



Circumcircle of a given triangle (for the center of a given circle, just mark 3 points on it and use this):

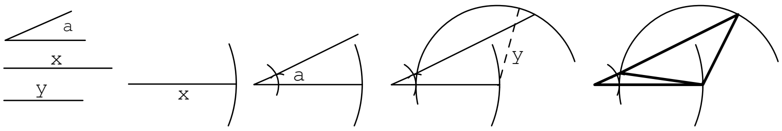


Segment of size $\sqrt{a^2+b^2}$: build a rectangular triangle with cathetus a and b and take the hypothenuse.

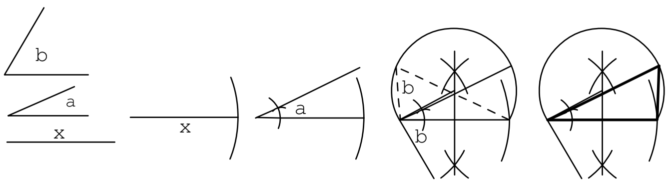
Other triangles

Constructions provided for informative purpose; you are not likely to need these.

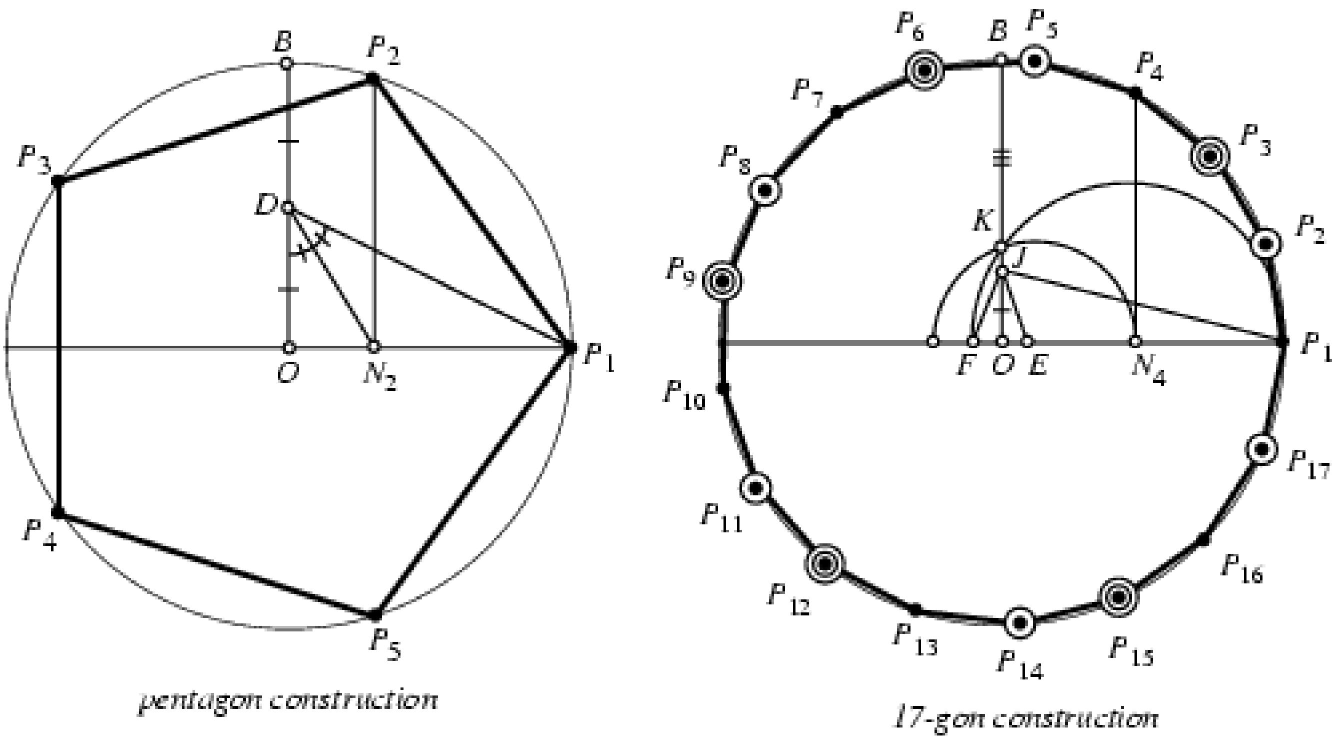
Given 2 sides and non-common angle (note that there are 2 solutions):



Given 2 angles and other side (note that there is a different solution if you switch the sides):



Hilarious Fermat-prime-related Constructions



(Image from http://isolatium.uhh.hawaii.edu/m198/w4/17gon.gif, instructions from http://mathworld.wolfram.com/Heptadecagon.ht

The following elegant construction for the heptadecagon (Yates 1949, Coxeter 1969, Stewart 1977, Wells 1991) was first given by Richmond (1893).

1. Given an arbitrary point O, draw a circle centered on O and a diameter drawn through O.
2. Call the right end of the diameter dividing the circle into a semicircle P_1.
3. Construct the diameter perpendicular to the original diameter by finding the perpendicular bisector OB.
4. Construct J a quarter of the way up OB.
5. Join JP_1 and find E so that $\angle OJE$ is a quarter of $\angle OJP_1$.
6. Find F so that $\angle EJF$ is 45 degrees.
7. Construct the semicircle with diameter FP_1.
8. This semicircle cuts OB at K.
9. Draw a semicircle with center E and radius EK.
10. This cuts the line segment OP_1 at N_4.
11. Construct a line perpendicular to OP_1 through N_4.
12. This line meets the original semicircle at P_4.
13. You now have points P_1 and P_4 of a heptadecagon.
14. Use P_1 and P_4 to get the remaining 15 points of the heptadecagon around the original circle by constructing P_1, P_4, P_7, P_{10}, P_{13}, P_{16} [filled circles], P_2, P_5, P_8, P_{11}, P_{14}, P_{17} [single-ringed filled circles], P_3, P_6, P_9, P_{12}, and P_{15} [double-ringed filled circles].
15. Connect the adjacent points P_i for i=1 to 17, forming the heptadecagon.