## Lesson Plan

Grade 10 Academic Math
Unit: Analytic Geometry

Lesson: 3-7
Topic: Using Coordinates to Solve Problems
\# homework check: Principles of Mathematics 10 p. 102 \# 7, 10, 11
p. 110 \# 4, 8, 12, 15

## \# note: Using Coordinates to Solve Problems

If we lay a coordinate grid under any street map, we can use coordinate geometry to solve several city planning problems. For example, given the following map of a fictitious town,

a) A new Police Station must be built. Town planners and the police wish to have their station directly in between the furthest points of the town. Where will it be located?

Farthest points in town are at the Humphrey High school and Watch Repair store. Find the midpoint of these locations.

Humphrey High School is located at $(-6,5)$
Watch Repair is located at $(5,-5)$
$\left[\frac{-6+5}{2}, \frac{5+(-5)}{2}\right]=\left(\frac{-1}{2}, 0\right)$
(*check visually to see if this point makes sense in the context)
The new police station will be built at $\left(\frac{-1}{2}, 0\right)$
b) Town planners wish to have a new street light placed in the town. They decide that the light should be equal distance between the high school, the library and Walmart to be most effective.

In order to have a single spot that is the same distance from three locations, we need the circumcentre of the triangle. The circumcentre is the centre of a circle that passes through all three points in the triangle. The circumcentre is located at the intersection of two perpendicular bisectors.
*Walmart is located at ( $-5,-4$ ), the library at ( 7,1 ), and the high school at $(-6,5)$

Midpoint of Walmart and Library

$$
\left(\frac{-5+7}{2}, \frac{-4+1}{2}\right)=\left(1, \frac{-3}{2}\right)
$$

Slope of line from Walmart to the Library

$$
\text { slope of line: } \begin{aligned}
m= & \frac{-4-1}{-5-7} \\
& =\frac{-5}{-12} \\
& =\frac{5}{12}
\end{aligned}
$$

Midpoint of Walmart and High School

$$
\left(\frac{-5+(-6)}{2}, \frac{-4+5}{2}\right)=\left(\frac{-11}{2}, \frac{1}{2}\right)
$$

Slope of line from Walmart to High School

$$
\text { slope of line: } \begin{aligned}
m & =\frac{-4-5}{-5-(-6)} \\
& =\frac{-9}{1}
\end{aligned}
$$

perpendicular slope $=\frac{-12}{5}$

$$
\text { perpendicular slope }=\frac{1}{9}
$$

Equations of Perpendicular Bisectors using midpoint and perpendicular slope:

Walmart to Library
$y-(-1.5)=\frac{-12}{5}(x-1)$
$y=\frac{-12 x}{5}+\frac{12}{5}-\frac{1.5(5)}{5}$
$y=\frac{-12 x}{5}+\frac{4.5}{5}$
$y=\frac{-12 x}{5}+\frac{9}{10}$

Walmart to High School

$$
\begin{aligned}
& y-0.5=\frac{1}{9}(x-(-5.5)) \\
& y=\frac{1 x}{9}+\frac{5.5}{9}+\frac{0.5(9)}{9} \\
& y=\frac{x}{9}+\frac{10}{9}
\end{aligned}
$$

POI of Medians:

$$
\begin{aligned}
& \frac{-12 x}{5}+\frac{9}{10}=\frac{x}{9}+\frac{10}{9} \\
& {\left[\frac{-12 x}{5}+\frac{9}{10}=\frac{x}{9}+\frac{10}{9}\right] \times 90} \\
& \frac{-12 x(90)}{5}+\frac{9(90)}{10}=\frac{x(90)}{9}+\frac{10(90)}{9} \\
& -216 x+81=10 x+100 \\
& -226 x=19 \\
& x=\frac{-19}{226} \\
& x \doteq-0.08 \\
& y=\frac{-12(-0.08)}{5}+\frac{9}{10} \\
& y=1.1
\end{aligned}
$$

Now if we applied the distance formula to each of the original points and this new circumcentre
the distances should be equal.
*NOTE: Notice that when the application becomes more realistic, the numbers get ugly and you may want to use decimals.
\# homework assignment: Principles of Mathematics 10 p. 120 \# 6, 9, 12, 15

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