MPM2D Date: _____

Geometry - Applications

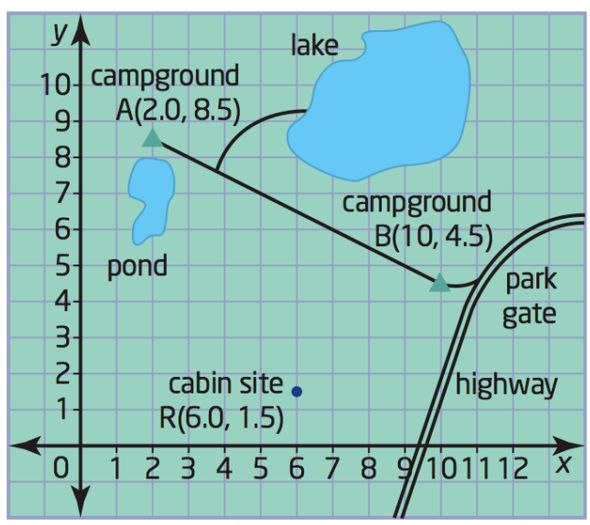
Ideally, the route of a power line should be as short as possible. A shorter route reduces the construction cost as well as the energy losses due to the resistance of the wire. Engineers use analytic geometry to find the best route for the transmission lines that deliver electricity throughout the province. Analytic geometry is also a powerful tool for designing roads, buildings, pipelines, industrial machinery, and consumer products.

Questions we are starting today show how to apply geometry and algebra to a variety of problems. Many of these problems involve several steps that require different skills. Developing a problem solving process is particularly important for dealing with such problems. These four steps can help you:

1. Understand the problem. What are you supposed to find?
2. Decide on a strategy. What steps are required?
3. Carry out your strategy. Take care to check each step as you go.
4. Reflect. Does your final answer make sense in the context of the problem?

Example

A ranger cabin is to be built in a flat wooded area near the straight road that connects the two campgrounds in a park. A new side road will connect the cabin to the campground road. On the park map, the campgrounds have coordinates *A(2.0, 8.5)* and *B(10.0, 4.5)*, while the site for the cabin is at *R(6.0, 1.5)*. Each unit on the map grid represents 500m.



a) Find the route that minimizes the cost and the number of trees that have to be cut down for the side road. Draw a diagram of this route.

b) Find the length of the side road, to the nearest tenth of a kilometre.

① Get slope of AB.

$$m_{AB} = \frac{\Delta y}{\Delta x}$$

$$= \frac{8.5 - 4.5}{2 - 10}$$

$$= \frac{4}{-8}$$

$$= -\frac{1}{2}$$

$\therefore$, $m_{\perp} = \frac{2}{1}$ or just 2.

② Get equation for AB.

$$m = \frac{\Delta y}{\Delta x}$$

$$\frac{-1}{2} = \frac{8.5 - y}{2.0 - x}$$

$$2(8.5 - y) = -1(2 - x)$$

$$17 - 2y = -2 + x$$

$$-2y = x - 2 - 17$$

$$-2y = x - 19$$

$$y = \frac{x - 19}{-2}$$

$$y = -\frac{1}{2}x + 9.5 \quad \text{or} \quad y = -0.5x + 9.5$$

③ Get equation for RD.

$$m = \frac{\Delta y}{\Delta x}$$

$$\frac{2}{1} = \frac{1.5 - y}{6 - x}$$

$$1(1.5 - y) = 2(6 - x)$$

$$1.5 - y = 12 - 2x$$

$$-y = -2x + 12 - 1.5$$

$$-y = -2x + 10.5$$

$$y = 2x - 10.5$$

(4) Find intersection point of RD and AB.

(A) $y = -0.5x + 9.5$
(B) $y = 2x - 10.5$

Sub (A) into (B)

$-0.5x + 9.5 = 2x - 10.5$
$9.5 + 0.5 = 2x + 0.5x$
$20 = 2.5x$
$\frac{20}{2.5} = x$
$8 = x$

Sub $x = 8$ into (A)

$y = -0.5(8) + 9.5$
$y = -4 + 9.5$
$y = 5.5$

∴ point of intersection is (8, 5.5)

(5) Find length of RD.

$l_{RD} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
$= \sqrt{(6-8)^2 + (1.5 - 5.5)^2}$
$= \sqrt{(-2)^2 + (-4)^2}$
$= \sqrt{4 + 16}$
$= \sqrt{20}$
$\doteq 4.5$

∴ each unit on map is 500m, side road is 4.5×500 or 2250m long.