# Optimization Problem Set 2020 (Hand-in)

1. Walmart, in Squamish, wants to build a 600 m² *rectangular* enclosure in the store's parking lot to sell diapers. Three sides of the enclosure will be built using redwood fencing which costs $14 per meter. The fourth side will be built using cement blocks which cost $28 per meter. Find the dimensions of the enclosure that will **minimize the total cost** of the building materials. [*Answer: 20m by 30 m*]

2. Tyrion Lannister decides to build a castle. He has put in a window like the one shown below. If the perimeter of the window must be 12 meters, determine the dimensions of the window so that he will get the most light from the window (most area). [*Answer: x=1.68, y=1.68*]

Semi-circle on top with a radius of x

y

2x
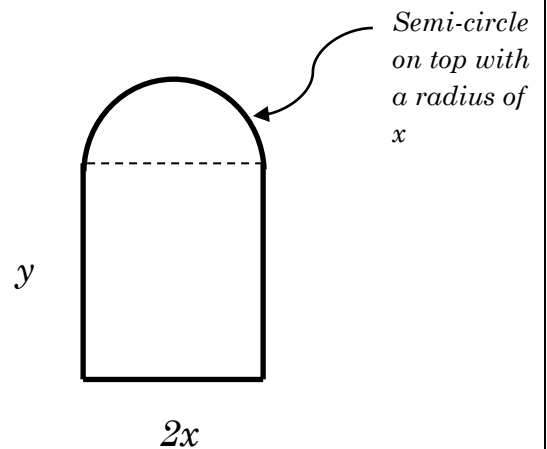
3. A dune buggy is in the desert at a point A located 40 km (north) from a point B. The driver can travel 45 km/hr on the desert *but it can travel 90 km/hr on the road*. If the distance from B to D is 28 km, What path should he take to minimize the *time* it take to get from A to D? find x [*answer: 23.1 km*]

A

D   C   B

x
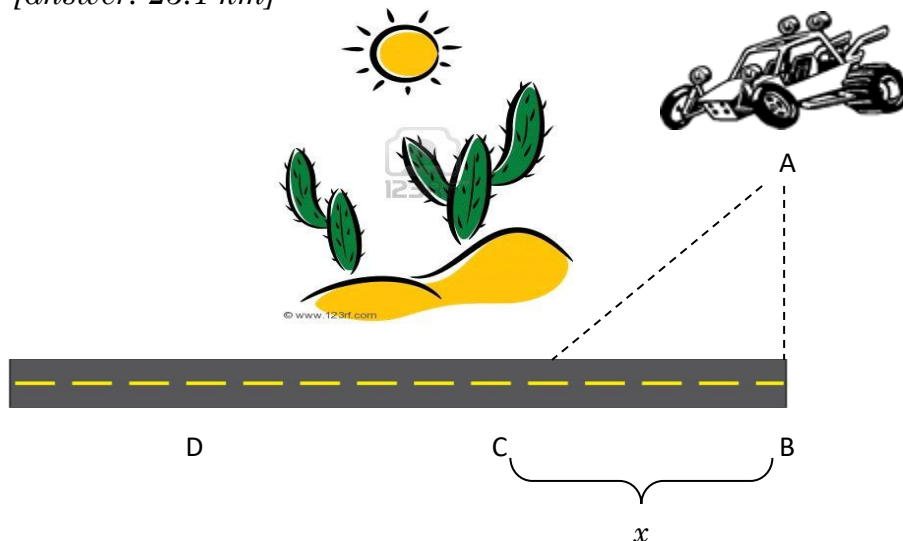
4. There are 50 apple trees in an orchard. Each tree produces 800 apples. For each additional tree planted in the orchard, the output per tree drops by 10 apples (as it takes up more resources). How many trees should be added to the existing orchard in order to maximize the total output of trees ? *(answer: add 15 more trees)*

5. Find the point (x, y) on the graph of $y = \sqrt{x}$ nearest the point (4, 0). *Also: sketch a diagram of the function showing the nearest point to (4,0).* *[answer: (7/2, $\sqrt{7/2}$)]*

6. Angela wants to construct a box whose base length is 3 times the base width. The material used to build the top and bottom cost $10/ft^2 and the material used to build the sides cost $6/ft^2. If the box must have a volume of 50ft^3 determine the dimensions that will minimize the cost to build the box. *[Answer: w= 1.88 ft, l= 5.65 ft, h= 4.7 ft]*

7. A manufacturer needs to make a **cylindrical** can that will hold 1.5 liters of Tasty Mango Jucie. Determine the dimensions of the can that will minimize the amount of material used in its construction. *[Answer: radius of 6.2035 cm and a height of 12.4070 cm]*

8. What base is needed to maximize the area of an isosceles triangle if the two equal legs are each 12cm long. [Answer *Base = 16.97*]

9. A piece of wire 20 in. long is to be cut in two pieces, one to form a circle and the other a square. How should the wire be cut in order that the sum of the two areas enclosed by the wire is maximized? Ans. Circle 20 in.

10. A rectangle is inscribed as shown, in a right angle triangle. Find the dimensions of the rectangle with **maximum area**.

9

14
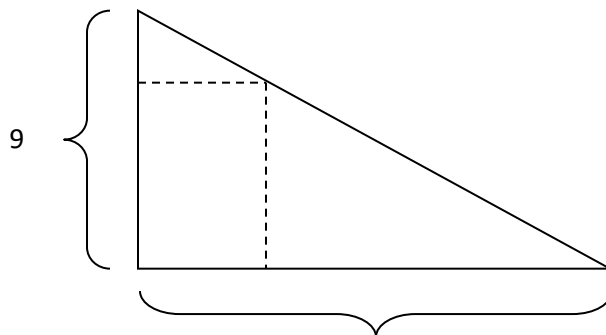
11. The owner of a condominium complex has 45 units all of which will be occupied if the rent charged is $600 per month. The owner estimates that for every $20 increase in rent, one of the units will become vacant. The owner sets aside $60 per month from each of the occupied units to establish a repair fund. What rent should be charged per month in order to maximize the owner's profit if there are no other expenses? What is the owner's maximum monthly profit? How many units are occupied?

12. An oil well has been discovered offshore at W, 200 m from S, the nearest point on the shoreline. Town T is located 1000 m along the shore from point S. A pipeline must be installed underwater from W to V and then along the shoreline from V to T. If it costs $500/m to run the pipe underwater and $200/m to run the pipe along the shore, how far from S should V be located to minimize the total cost of the pipeline?

Answer: V should be 87.3 meters from S
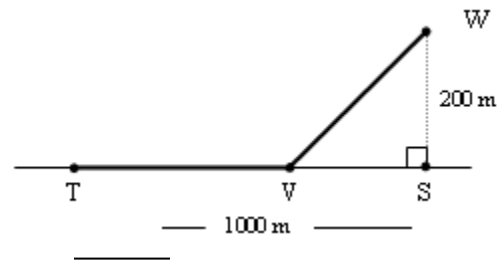
Answers:

#11

$$\text{Profit} = \text{Revenue} - \text{Expenses}$$
$$P = (600 + 20x)(45 - x) - 60(45 - x)$$
$$P = -20x^2 + 360x + 24300$$
$$P' = -40x + 360$$
$$0 = -40(x - 9)$$
$$x = 9$$
$$\therefore \ P = -20(9^2) + 360(9) + 24300$$
$$P = \$25920 \qquad 45 - 9 = 36 \text{ units}$$