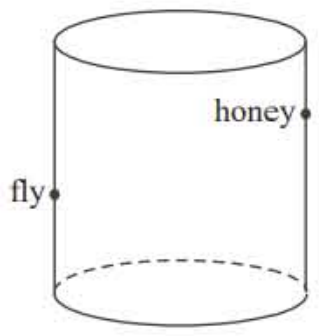
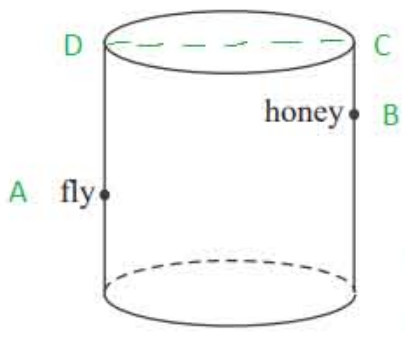
12. A fly lands on the outside of a cylindrical drinking glass 6 cm from the top. Diametrically opposite the fly and 7 cm from the bottom, but on the inside of the glass, there is a drop of honey. The glass has circumference 24 cm, height 10 cm. Find the shortest path, in cm, that the fly must walk **on the surface** of the glass to reach the honey.



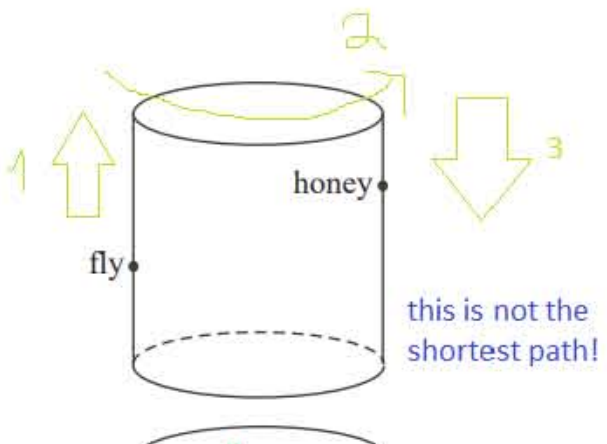


DC is diametrically opposed

=> A is right below D
=> B is right below C

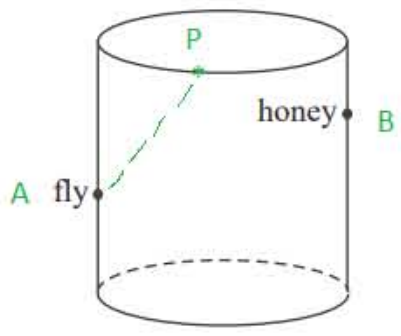
if the fly goes straight up and then to the honey frm there, that will not be the shortest path.

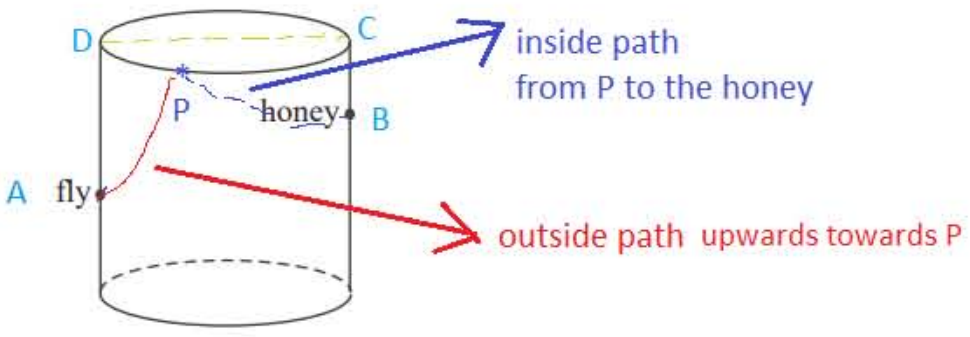
The fly doesn't have to go straight up, can tranvel diagonally to some point P on the top rim.



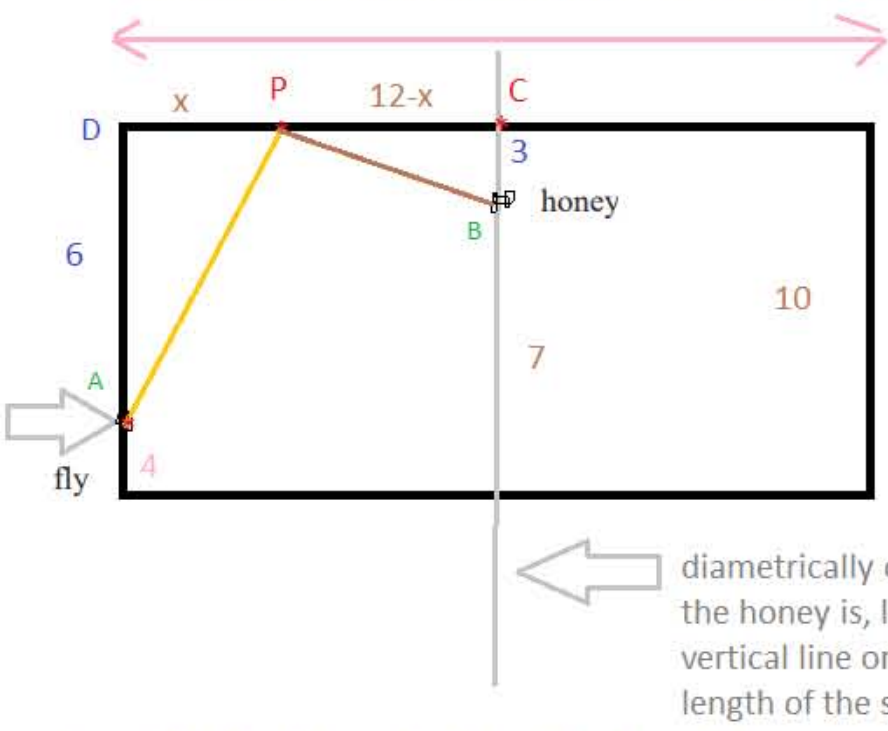
Then the path is AP (outside) -> PB (inside)

Your job is to find the ideal P that gives a minimum distance of AP + PB.





stretch out the cylinder and project the path to P, and from P to the honey



full circumference = 24
then half of it = 12
any two points that are diametrically opposed would have a distance of 12 between them on the stretched out cylinder.

diametrically opposed => the vertical line on which the honey is, lays at half the distance between the vertical line on which the fly resides and the full length of the stretched out cylinder

BTW

triangle ADP is a right triangle, we are assured to have its hypotenuse shorter than the sum of its two catheti so
$6 + x < AP$ always

if the fly follows the AP path, it is always going to be shorter than the goind straight up (i.e. AD) followed by a walk on the rim from D to P before entering inside the glass.

The path is then the yellow line + the brown line
and it's minimal for some ideal point P, and not so for all other P-s.

$$\sqrt{36+x^2} + \sqrt{9+(12-x)^2}$$

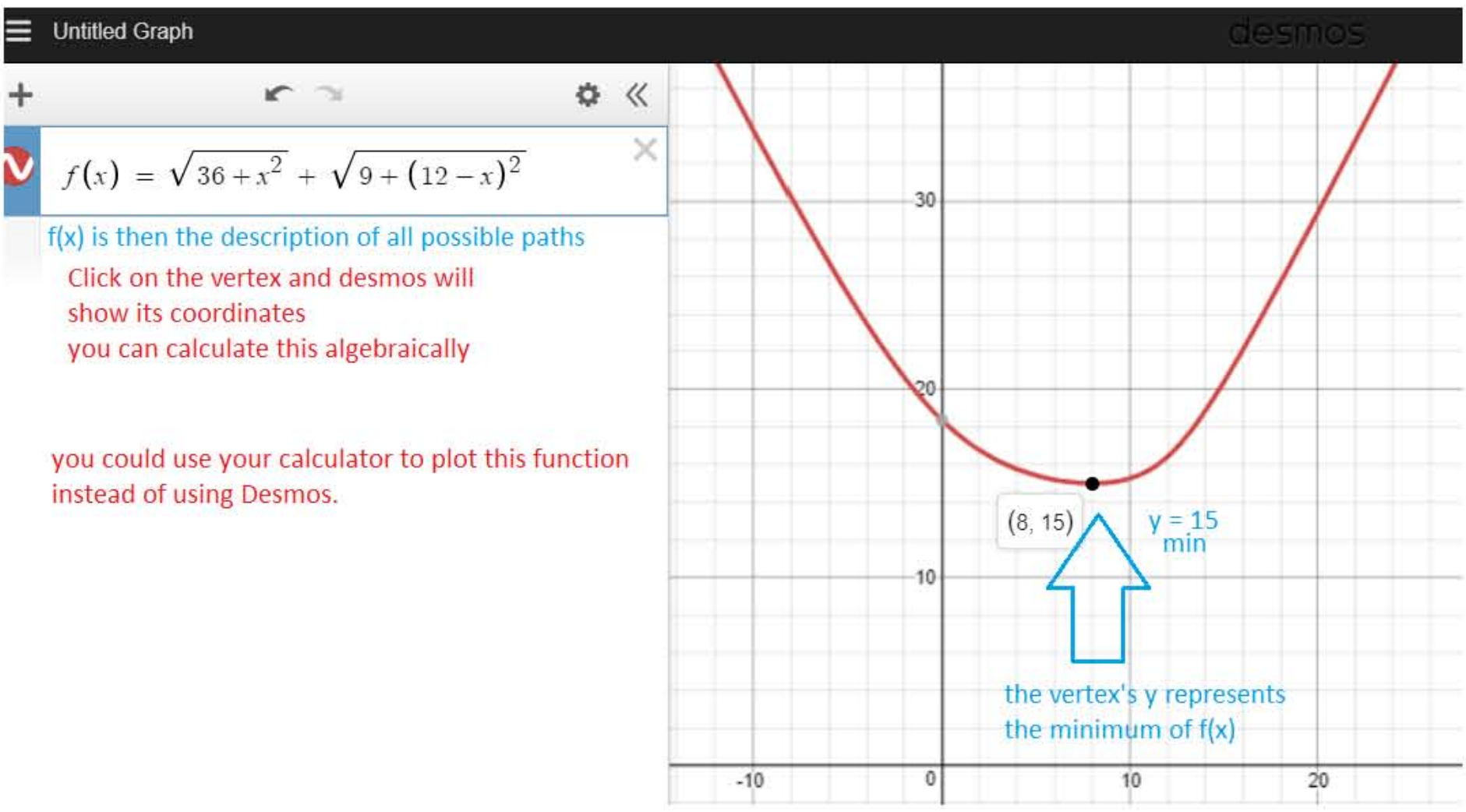
yellow path — brown path

Your choice of x gives possibilities, that are all described by a parabola
we are interested in the shortest possible value to this relation, what is x then?

the distance of the path = y = f(x) = $\sqrt{36+x^2} + \sqrt{9+(12-x)^2}$

This parabola has a vertex and it represents the min of the function, i.e. the min of the distance the function describes

draw this in desmos



f(x) is then the description of all possible paths

Click on the vertex and desmos will show its coordinates
you can calculate this algebraically

you could use your calculator to plot this function instead of using Desmos.