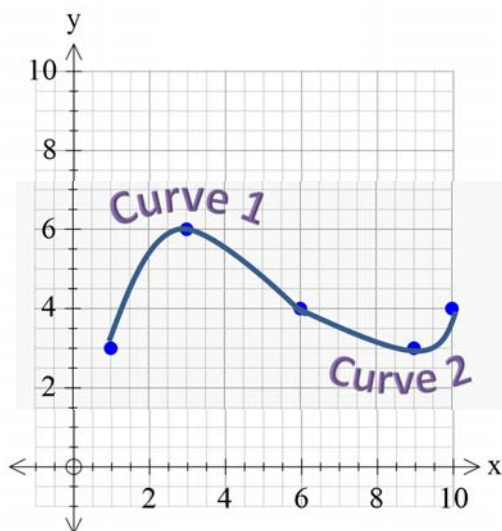


## 2018 SAC PREP 4

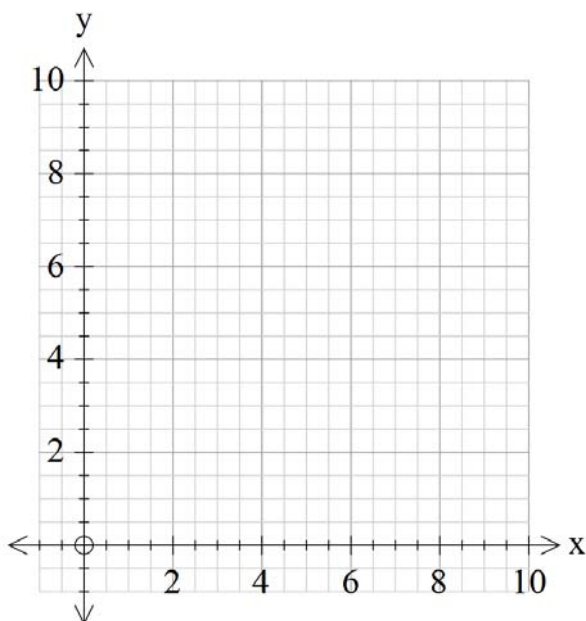
Previously John, a robot engineer had a robot follow a curve based on a piecewise function.



He decides that his main criteria is that the join needs to be smooth. He wants to transform the first part of the piecewise function so that the two parts of the piecewise function meets at  $(x_T, y_T)$  smoothly. The piecewise functions is:

$$f(x) = \begin{cases} \frac{-13}{30}x^2 + \frac{97}{30}x + \frac{1}{5}, & 0 \leq x \leq 6 \\ \frac{1}{3}x^2 - \frac{16}{3}x + 24, & 6 < x \leq 10 \end{cases}$$

- a) Given that  $f_1(x) = \frac{-13}{30}x^2 + \frac{97}{30}x + \frac{1}{5}$  and we wish to perform a translation of  $k$  units parallel to the y-axis. Create a new path  $f_2(x)$  that would join smoothly. Sketch the result on the axes below.



b) Investigate other options of transforming the first part of the piecewise function:

These could include:

Dilation from the x-axis

Dilation from the y-axis

Translation parallel to the x-axis

John enters a competition where he needs to follow a line in the demonstration area. The top of the line is defined as:

$$y = -0.3(x - 4)^2 + 7$$

The distance between the top of the line and the bottom of the line is 0.5 metres.

c) State the equation of the bottom of the line.

d) Determine if John's robot will follow the line. Explain your decision with algebraic or graphical evidence.