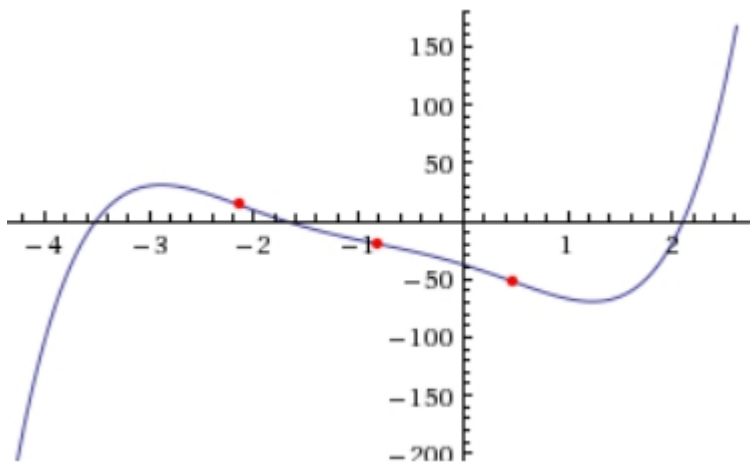


## STEM Math Boot Camp Challenge Answers:

1.  $-3.51, -1.700, +2.10, -0.498 + 1.66i, -0.498 - 1.66i$
2.  $(-2.89, 31.06)$  is a Maximum,  $(1.24, -69.4)$  is a Minimum.  $P(x)$  is increasing in the intervals  $(-\infty, -2.89)$  and  $(1.24, +\infty)$ , and decreasing in the interval  $(-2.89, 1.24)$
3.  $(-2.12, 13.3)$  and  $(-0.813, -19.8)$  and  $(0.475, -52.02)$  are the three inflection points and  $P(x)$  is concave down in the intervals  $(-\infty, -2.12)$  and  $(-0.813, 0.475)$  and concave up in the intervals  $(-2.12, -0.813)$  and  $(0.475, \infty)$

The Graph is below and the points of inflection are given on it.



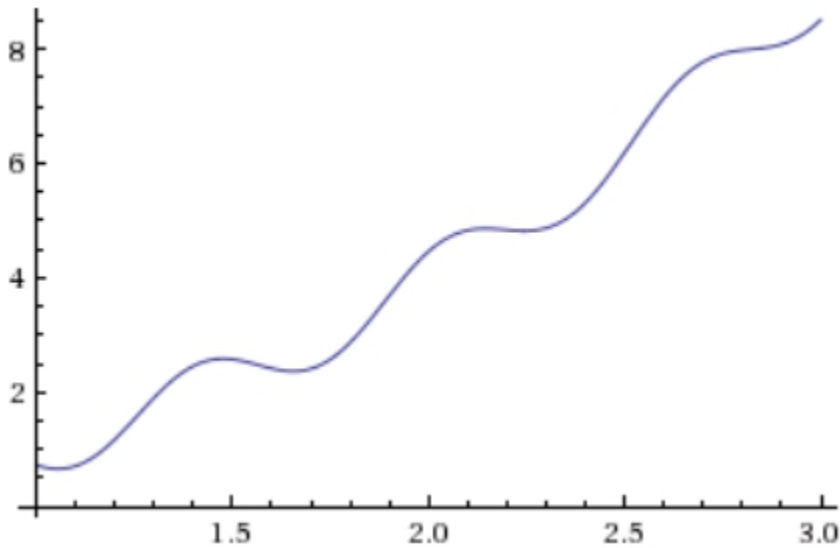
4. The Arc Length of the Graph of  $F(x)$  from 1 to 3 is:

$$\int_1^3 \sqrt{1 + (2x + 5 \cdot \cos(10x))^2} dx \approx 8.9013!$$

The Area under the Graph of  $F(x)$  from  $x = 1$  to 3 is:

$$\int_1^3 (x^2 + 0.5 \sin(10x)) dx = 8.617$$

Here is the Graph of  $F(x)$



5. Volume of Solid of Revolution of  $F(x)$  about the x axis:

$$\int_1^3 \pi (x^2 + 0.5 \sin(10x))^2 dx = 152.017$$

Surface Area of Solid of Revolution of  $F(x)$  about the x axis:

$$\int_1^3 2\pi |x^2 + 0.5 \sin(10x)| \sqrt{1 + (2x + 5 \cdot \cos(10x))^2} dx = 247.897$$

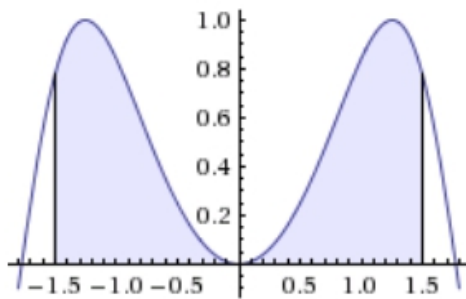
6. The anti-derivative of  $\sin(x^2)$  is a Special Function called a Fresnel Integral:

$$\int \sin(x^2) dx = \sqrt{\frac{\pi}{2}} S\left(\sqrt{\frac{2}{\pi}} x\right) + \text{constant}$$

The Area under the graph of  $\sin(x^2)$  from -1.5 to 1.5 is:

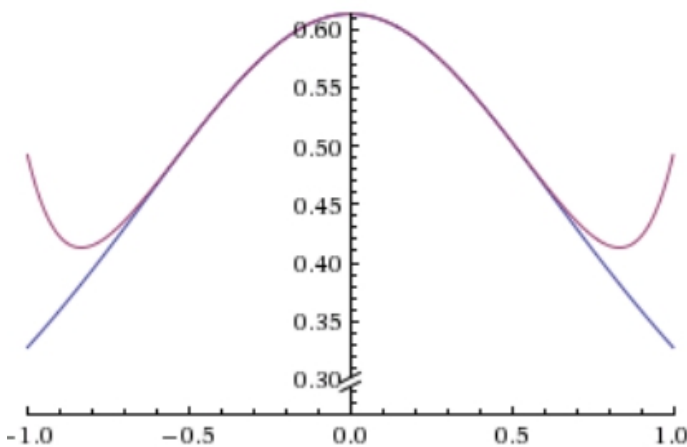
$$\int_{-1.5}^{1.5} \sin(x^2) dx = 1.55648$$

Visual representation of the integral:



7.  $x = -0.451$ ,  $y = 2.44$ ,  $z = .510$

8.  $P(x) = 0.353x^8 - 0.405x^6 + 0.465x^4 - 0.534x^2 + 0.613$



9. The solution of the differential equation is:

$$y(x) = \sin(x) - 0.519615 e^{-x/2} \sin\left(\frac{\sqrt{3} x}{2}\right) + 0.5 e^{-x/2} \cos\left(\frac{\sqrt{3} x}{2}\right)$$

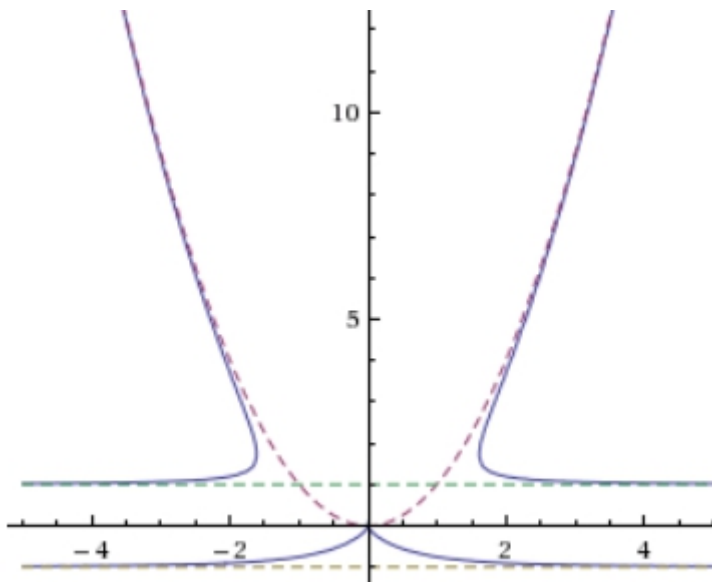
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10. The solution of the differential equation is:

$$y(t) = \frac{1}{2} e^{-t} (-e^{2t} + 4e + e^2)$$

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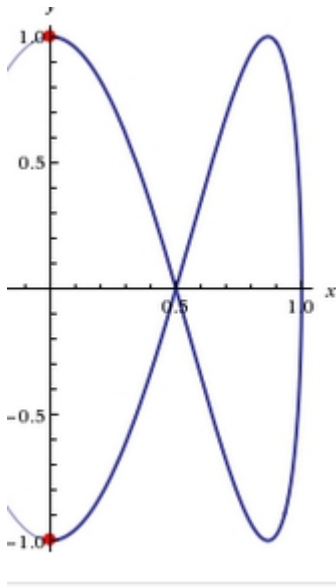
11. One function approaches  $y = x^2$  asymptotically in both directions, and a second function approaches  $y = +1$  in both directions, and the third function approaches  $y = -1$  in both directions. Notice the symmetry.



12. The length is:

$$\int_0^{\pi} \sqrt{\cos^2(t) + 9 \sin^2(3t)} dt \approx 6.5327$$

The Graph is:



The tools you will learn to use as a STEM professional will solve much more difficult math problems very easily. These modern tools will, in fact, enable the STEM professional to solve problems that would be simply intractable without the modern tools.

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