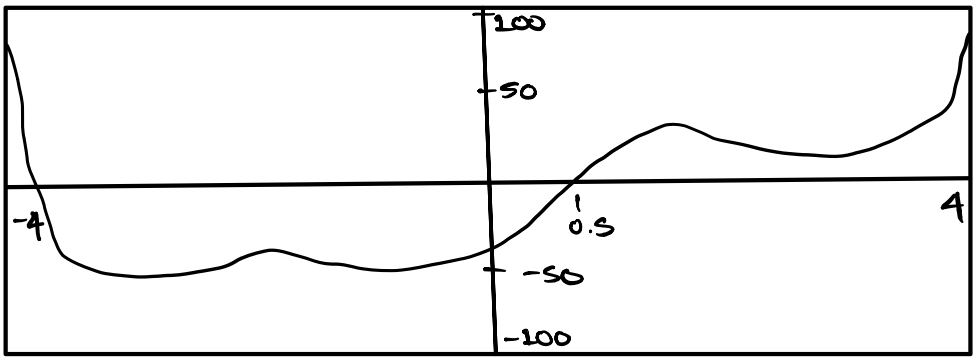
PROBLEM #1.

Given the function f(x) find the derivative.

$$f(x) = \frac{x^6}{6} - 3x^4 - \frac{2x^3}{3} + \frac{27x^2}{2} + 18x - 30$$

$$f'(x) = \frac{6x^5}{6} - 3(4)x^3 - 2\frac{(3)}{3}x^2 + \frac{(2)}{2}(27)x + 18$$

$$= x^5 - 12x^2 - 2x^2 + 27x + 18$$



PROBLEM #2.

Find the first estimate/iteration of the Newton-Raphson.

$x_0 = 1.$

$$x_{i+1} = x_0 - \frac{f(x_0)}{f'(x_0)}.$$

$$x_1 = 1 - \frac{\left[\frac{(1)^6}{6} - 3(1)^4 - 2\frac{(1)^3}{3} + 27\frac{(1)^2}{2} + 18(1) - 30\right]}{(1)^5 - 12(1)^2 - 2(1)^2 + 27 + 18}$$

$$= 1 - \frac{\left[1/6 - 3 - 2/3 + 27/2 + 18 - 30\right]}{1 - 12 - 2 + 27 + 18}$$

$$= 1 - \frac{\left[1/6 - 2/3 - 3/2\right]}{32}$$

$$= 1 + 1/16$$

PROBLEM #3

Perform Newton-Raphson to find the root around $x=-4$.

```python
def f (x) :
  return x**6/6 - 3*x**4 - 2*x**3/3 + 27*x**2/2 + 18*x - 30

def d_f (x) :
  return x**5 - 12*x**3 - 2*x**2 + 27*x + 18 # Complete this line with the derivative you have calculated.

x = -4.0

d = {"x" : [x], "f(x)": [f(x)]}
for i in range(0, 20):
  x = x - f(x) / d_f(x)
  d["x"].append(x)
  d["f(x)"].append(f(x))

pd.DataFrame(d, columns=['x', 'f(x)'])
```

Run

Reset

	x	f(x)
0	-4.000000	7.133333e+01
1	-3.811287	1.223161e+01
2	-3.763093	6.515564e-01
3	-3.760224	2.198858e-03
4	-3.760214	2.531156e-08
5	-3.760214	1.421085e-13
6	-3.760214	4.263256e-14
7	-3.760214	4.263256e-14
8	-3.760214	4.263256e-14
9	-3.760214	4.263256e-14
10	-3.760214	4.263256e-14
11	-3.760214	4.263256e-14
12	-3.760214	4.263256e-14
13	-3.760214	4.263256e-14
14	-3.760214	4.263256e-14
15	-3.760214	4.263256e-14
16	-3.760214	4.263256e-14
17	-3.760214	4.263256e-14
18	-3.760214	4.263256e-14
19	-3.760214	4.263256e-14
20	-3.760214	4.263256e-14

PROBLEM #4.

What would happen if Newton-Raphson was computed for $f(x)$ around point $x_0 = 1.99$.

- [x] method converges to root nearest $x=-4$.
- [ ] method does not converge, infinitely oscillates
- [ ] none of the other statements are true.
- [x] method takes over 15 iterations to converge
- [ ] method diverges to infinity
- [ ] method converges to the root nearest $x=1$.

PROBLEM #5

There are points which oscillate and do not converge - like $x = 3.1$.