PROBLEM #1.
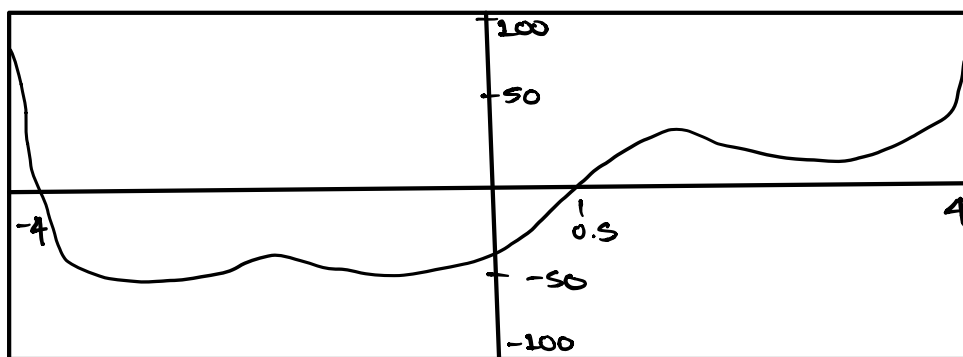
Given the function $f(x)$ find the derivative.

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

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

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

PROBLEM #2.

Find the first estimate/iteration of the Newton-Raphson. $x_0 = 1$.

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

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

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

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

$$= 1 + \frac{1}{16}$$

PROBLEM #3

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

```python
1  def f (x) :
2      return x**6/6 - 3*x**4 - 2*x**3/3 + 27*x**2/2 + 18*x - 30
3
4  def d_f (x) :
5      return x**5 - 12*x**3 - 2*x**2 + 27*x + 18 # Complete this line with
           the derivative you have calculated.
6
7  x = -4.0
8
9  d = {"x" : [x], "f(x)": [f(x)]}
10 for i in range(0, 20):
11     x = x - f(x) / d_f(x)
12     d["x"].append(x)
13     d["f(x)"].append(f(x))
14
15 pd.DataFrame(d, columns=['x', 'f(x)'])
16
```

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 $x = 3.1$.