Problem set 3 task 2 e)

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We import packages:

In [28]:
```
import numpy as np
import matplotlib.pyplot as plt
```

We set our variables, and make the meshgrid we wish to calculate on.

In [29]:
```
m = 1
w = 1

x = np.linspace(-10, 10, 1001)
p = np.linspace(-10, 10, 1001)

X, Y = np.meshgrid(x, p)
```

We make our hamiltonian equations of motion-function. It takes a list/tuple of q and p and returns dq/dt and dp/dt in a numpy array.

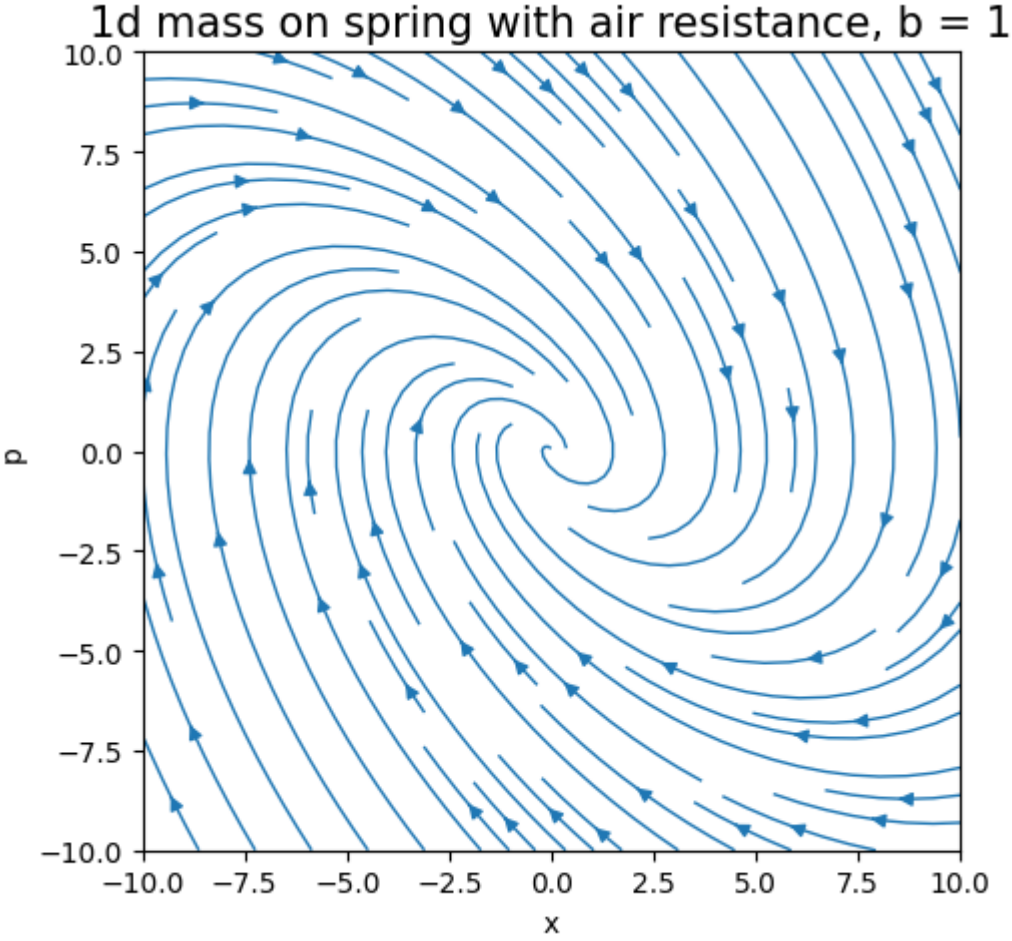
In [30]:
```
def Heom(qp, b):
    q, p = qp
    qdot = qdot = p / m
    pdot = -m * w**2 * q - b / m * p
    return np.array([qdot, pdot])
```

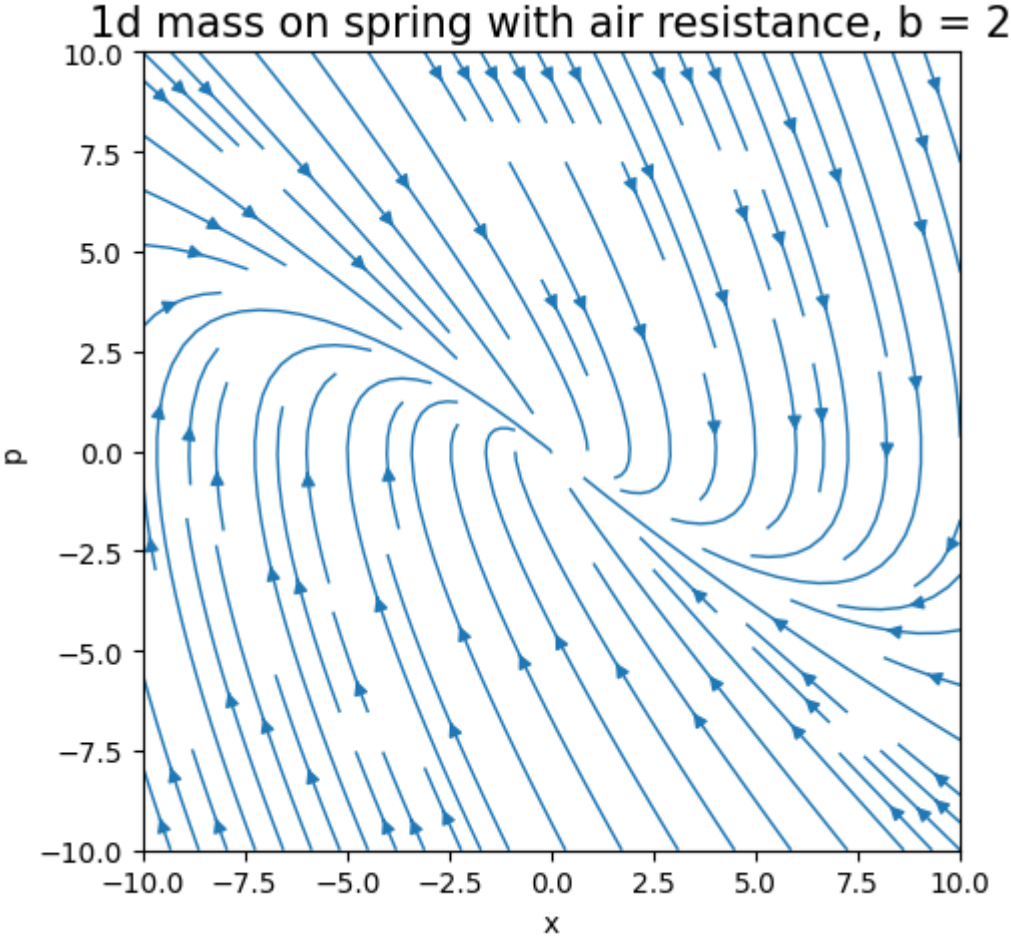
Designated plotting function:

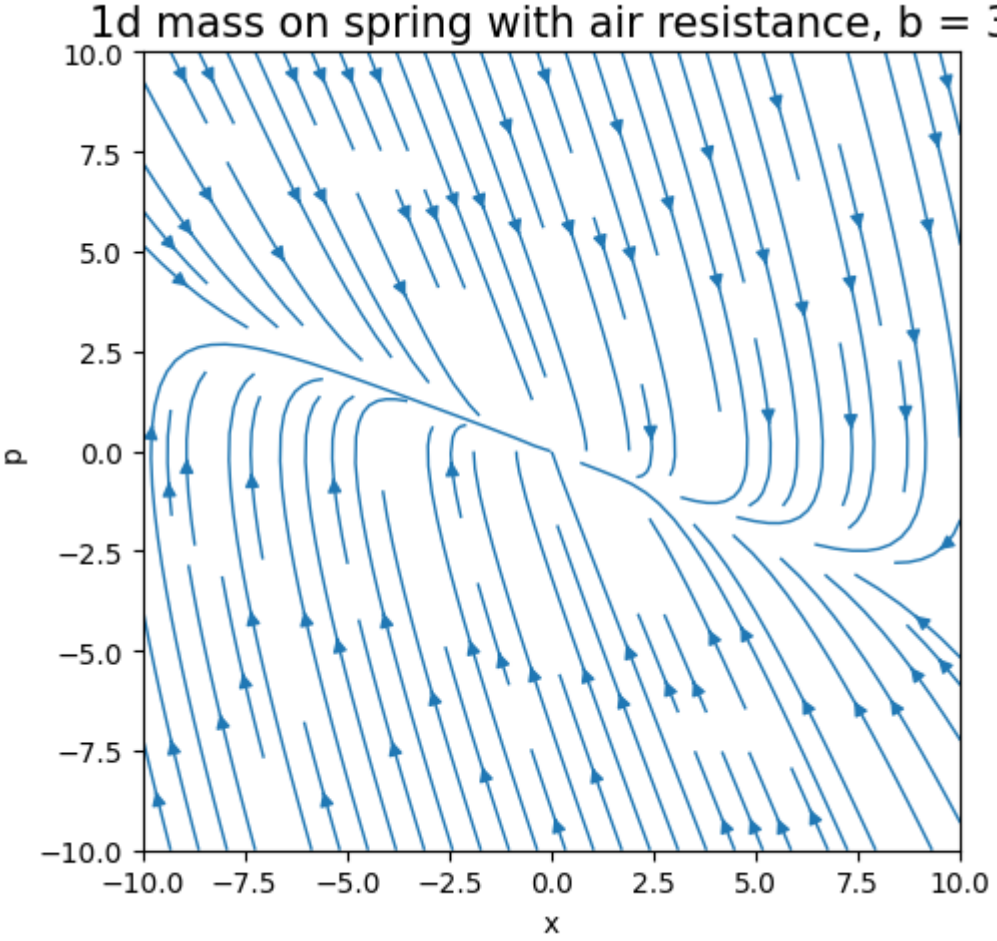
In [31]:
```
def Hplot(b, title):

    u, v = Heom(np.array([X, Y]), b)

    fig, ax = plt.subplots()
    ax.streamplot(X, Y, u, v, linewidth=1)
    plt.xlabel("x", fontsize=10)
    plt.ylabel("p", fontsize=10)
    plt.title(title, fontsize=15)
    plt.tight_layout()
    fig.set_figheight(5)
    fig.set_figwidth(5)
    fig.savefig(f'figure_ratio_{b}.png')
    plt.show()
```

Plotting with b/m > 2w, b/m = 2w, b/m < 2w, and setting names.

In [ ]:
```
for b in range(1, 4):
    Hplot(b, f"Mass on a spring with air resistance in 1D, b = {b}")
```


1d mass on spring with air resistance, b = 1
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0
p
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0
x


1d mass on spring with air resistance, b = 2
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0
p
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0
x


1d mass on spring with air resistance, b = 3
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0
p
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0
x