Homework 1-1

Imports

```
In [ ]: from thermostate import Q_, units
```

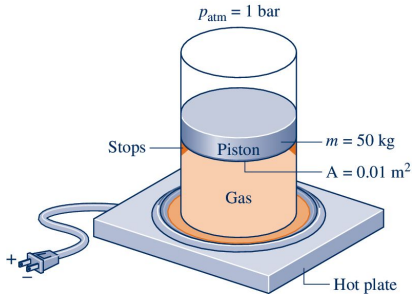
Definitions

```
In [ ]: piston_mass = Q_(50.0, 'kg')
        piston_area = Q_(0.01, 'meter**2')
        p_atm = Q_(1.0, 'bar')
        g = Q_(1.0, 'gravity').to('m/s**2')
```

Problem Statement

A vertical piston-cylinder assembly containing a gas is placed on a hot plate. The piston initially rests on some stops so that it cannot fall to the bottom of the cylinder. With the onset of heating, the gas pressure increases. The mass of the piston is 50.0 kg, the area is 0.01 m^2, and the atmospheric pressure is 1.0 bar. At what cylinder gas pressure, in bar, does the piston start rising? The piston moves smoothly in the cylinder and $g = 9.81$ m/s^2.

Hint: Draw a free body diagram of the piston.



Solution

1. Cylinder gas pressure

Attach an image of your solution for this problem in this cell. Attach multiple images if necessary. Please make sure the text is clear and legible.

Homework 1-2

Imports

```
In [ ]: from thermostate import Q_, units
```

Definitions

```
In [ ]: tower_volume = Q_(3.5E6, 'gallon')
        rho_h2o = Q_(62.416, 'lb/ft**3')
        g = Q_(1.0, 'gravity').to('ft/s**2')
        delta_rho = Q_(.0143, 'lb/(ft**3*delta_degF)')
        delta_T = Q_(50.0, 'delta_degF')
```

Problem Statement

A town has a water tower with a capacity of 3500000.0 gal. If the density of water is 62.416 lb/ft^3 and the local acceleration of gravity is 32.17 ft/s^2.

1. Determine the force required to hold support the water tower, in lbf
2. If the density of water decreases by 0.0143 lb/(ft^3 fahrenheit) when the temperature increases by 1.0 fahrenheit, determine the force required to support the water tower if the temperature increases by 50.0 fahrenheit.

Solution

1. Force required to support the water tower

Write your engineering model, equations, and explanation of your process here.

```
In [ ]: # Write your code here to solve the problem
        # Make sure to write your final answer in the cell below.
```

Answer:

2. The force when the temperature increases

Write your engineering model, equations, and explanation of your process here.

```
In [ ]: # Write your code here to solve the problem
        # Make sure to write your final answer in the cell below.
```

Answer:

Homework 1-3

Imports

```
In [ ]: from thermostate import Q_, units
```

Definitions

```
In [ ]: g_earth = Q_(32.174, 'foot/second**2')
        g_moon = Q_(5.471, 'foot/second**2')
        earth_ext = Q_(0.723, 'inch')
        mars_ext = Q_(0.273, 'inch')
```

Problem Statement

A simple instrument for measuring the acceleration of gravity employs a linear spring from which a mass is suspended. At a location on earth where the acceleration of gravity is 32.174 ft/s^2, the spring extends 0.723 in. Note that the equation for the force from a linear spring is $F_{\text{spring}} = -k\Delta x$ where k is the spring constant and Δx is the extension of the spring.

1. If the spring extends 0.273 in when the instrument is on Mars, what is the Martian acceleration of gravity, in ft/s^2?
2. How far would the spring extend on the moon, in inches, where $g_{\text{Moon}} = 5.471$ ft/s^2?

Hint: Draw a free-body diagram of the mass

Solution

1. The Martian acceleration of gravity, in ft/s^2

Write your engineering model, equations, and explanation of your process here.

```
In [ ]: # Write your code here to solve the problem
        # Make sure to write your final answer in the cell below.
```

Answer:

2. The spring extension on the moon

Write your engineering model, equations, and explanation of your process here.

```
In [ ]: # Write your code here to solve the problem
        # Make sure to write your final answer in the cell below.
```

Answer: