1. [15 points]
A wave’s displacement is given by \( s(x,t) = (0.47\text{m}) \sin(0.576x + 36.8t) \).

[The variables \( x \) and \( t \) are in m and s.]

What is the (vector) velocity of this wave?

What is its displacement when \( x = 1 \text{ m} \) and \( t = 0.1 \text{ s} \)?

2. [10 points]
You have 1.3 moles of an ideal gas in a sealed container that has a volume of \( 3.5 \text{ Liters} \). It is at a temperature of \( 350 \degree \text{C} \). What is its pressure in Pa?

3. [10 points]
A mass of 0.1 kg attached to a spring with a force constant of 21 N/m oscillates on a horizontal, frictionless track after being released from rest with the spring stretched by 0.3 m from its equilibrium position.

What is the frequency [in Hz] of this oscillator?

4. [10 points]
Find the final temperature when 6.5 kg of water at \( 81 \degree \text{C} \) is mixed with 12.4 kg of water at \( 9 \degree \text{C} \).

5. [20 points]
The diagram at right shows a 170 kg mass on the y axis, 20 cm above the origin and a 120 kg mass on the x axis, 17 cm to the right of the origin.

Find the (vector) force of gravity on the 10 kg mass located at the origin.
6. [10 points]
A 4 m long, thin rod of mass 7.6 kg is free to rotate about a fixed pivot at its center as shown in the diagram at right. The only force acting is 1.5 N and is applied at one end, perpendicular to the rod as shown.

What is the rod’s angular acceleration about the center pivot in rad/s²? Show all intermediate results.

7. [10 points]
A segment of a concrete (α = 12 × 10⁻⁶/°C) highway that is 3.2 km long increases in temperature from 2°C to 40°C between winter and summer in north Florida. How much does its length increase?

8. [20 points]
A crane consists of a uniform bar of mass 121 kg and length 7 m held by a frictionless pivot and a horizontal rope attached a distance d = 1 m from the top as shown. The crane is at an angle of 25° above the horizontal.

A 100 N weight W hangs from the end.

Three unknowns are defined in the diagram.

Be sure your answer includes the equations you used to find these unknowns.

What is $R_Y$?

What is the tension $T$?

What is $R_X$?