1. Multiple choice (35 points).

(1a). In thermodynamics, a fixed quantity of mass selected for the purpose of study is called
(A) an equilibrium system
(B) a closed system
(C) an open system
(D) a control volume

(1b). The pressure drop in a duct is to be measured by a differential oil manometer. If the differential height between the two fluid columns is 3.2 cm, and the density of oil is 860 kg/m$^3$, the pressure drop in the duct is
(A) 28 Pa
(B) 135 Pa
(C) 482 Pa
(D) 270 Pa

(1c). Specific gravity is
(A) an extensive property
(B) an intensive property
(C) a dimensional property
(D) a mass-dependent property

(1d). Volume is
(A) a dimensionless quantity
(B) the product of two intensive properties
(C) an extensive property
(D) an intensive property

(1e). According to the state postulate, the number of properties required to fix the state is
(A) 0
(B) 1
(C) 2
(D) at least 3

(1f). During an isometric process, the following property remains constant
(A) temperature
(B) pressure
(C) volume
(D) specific volume
(E) mass
(1g). In a quasi-equilibrium process, the pressure in a system
(A) remains constant forever
(B) varies with temperature
(C) is everywhere constant at any given instant
(D) increases if volume increases

2. State the zeroth law of thermodynamics (5 points)

3. Convert the English units to SI units (12 points)

<table>
<thead>
<tr>
<th>English unit</th>
<th>SI unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 lbm</td>
<td>kg</td>
</tr>
<tr>
<td>1 ft</td>
<td>m</td>
</tr>
<tr>
<td>1 lbf</td>
<td>N</td>
</tr>
<tr>
<td>1 psi</td>
<td>kPa</td>
</tr>
<tr>
<td>1 U.S. gallon</td>
<td>L</td>
</tr>
<tr>
<td>1 Btu</td>
<td>kJ</td>
</tr>
</tbody>
</table>

4. A temperature of body is measured to be 26 °C. Determine the temperature in K, °F, and °R (6 points).

5. A vacuum gage indicates that the pressure of carbon dioxide in a closed tank is 10 kPa. A mercury barometer gives the local atmosphere pressure as 750 mmHg. The density of mercury is 13.59 g/cm³ and the gravity acceleration is g=9.81 m/s². Determine the absolute pressure of the carbon dioxide (12 points).

6. The gage pressure of the air in a pressurized tank shown in the figure on the right is measured to be 80 kPa. Taking the density of water to be $\rho_w = 1000$ kg/m³, determine the differential height $h$ of the mercury column (16 points).

7. Write an essay to describe how the modern technology helps Olympic sports. You can describe, but not limited to, how the modern technology improves the performance of athletes, the judgement of referees and the communication systems such as TV. The essay should cite at least three references, must be typed in single space, times new roman font, 12 point, no shorter than one page (24 points).

Optional Questions:
Chapter 1: Problem 39, 59, 62, 81, 91, 102 and 114 in the textbook. These optional questions will not be collected for grading.