Name: Solutions
1/21/2014

CE 3305 Water Systems Design
Quiz 1
Spring 2014

1. Argon gas is used as a shielding gas in welding for fabrication of metal objects. What is the total weight of an 160 liter tank of argon at a pressure of 3500 psia, at a temperature of 293 °K. The vessel itself has an empty mass (unpressurized) of 40 kg.

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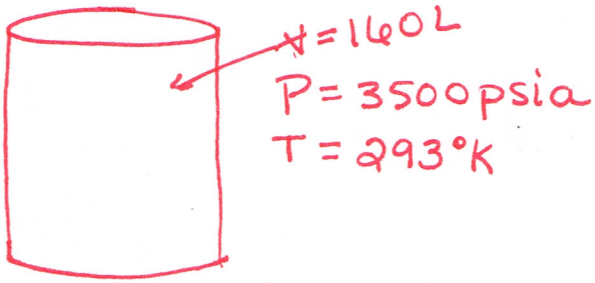
Given:

Pressure = 3500psia
Volume = 160 L
T = 293°K
Argon Gas
weight of tank = 40kg

Find:

Total weight of tank.
W_{Gas} = ?

Sketch:



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Governing Equations:

Ideal gas law: $PV = \frac{m}{M} RT$

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$W_{Total} = W_{Tank} + W_{Gas}$

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Solution:

$W_{gas} = m_{gas} \cdot g$

$m_{gas} = \frac{PVM}{RT}$ $R = 0.0821 \frac{L \cdot atm}{K \cdot mol}$

$M_{argon} = 39.95 \text{ g/mol}$

Pressure in atm

$P = 3500 \text{psia} * \frac{1 \text{atm}}{14.7 \text{psia}} = 238.09 \text{ atm}$

$m_{gas} = \frac{238.09 \text{atm} (1600 L)(39.95 \text{ g/mol})}{0.0821 \frac{L \cdot \text{atm}}{K \cdot \text{mol}} (293 K)} = 63265.53 \text{ g Ar}$

$W_{gas} = 63265.53 \text{ g Ar} (9.81 \text{ m/s}^2)(1 \text{kg}/1000 \text{g}) = 620.6 \frac{\text{kg} \cdot \text{m}}{\text{s}^2}$

$W_{gas} = 620.6 \text{ N}$

$W_{Tank} = 40 \text{ kg} (9.81 \text{ m/s}^2) = 392.4 \text{ N}$

$W_T = 392.4 \text{N} + 620.6 \text{N} = \boxed{1013 \text{ N} = W_T}$

Total weight of tank in kg.

$\frac{1013 \text{N}}{9.81 \text{ m/s}^2} = \boxed{103.3 \text{ kg} = W_T}$

UNITS

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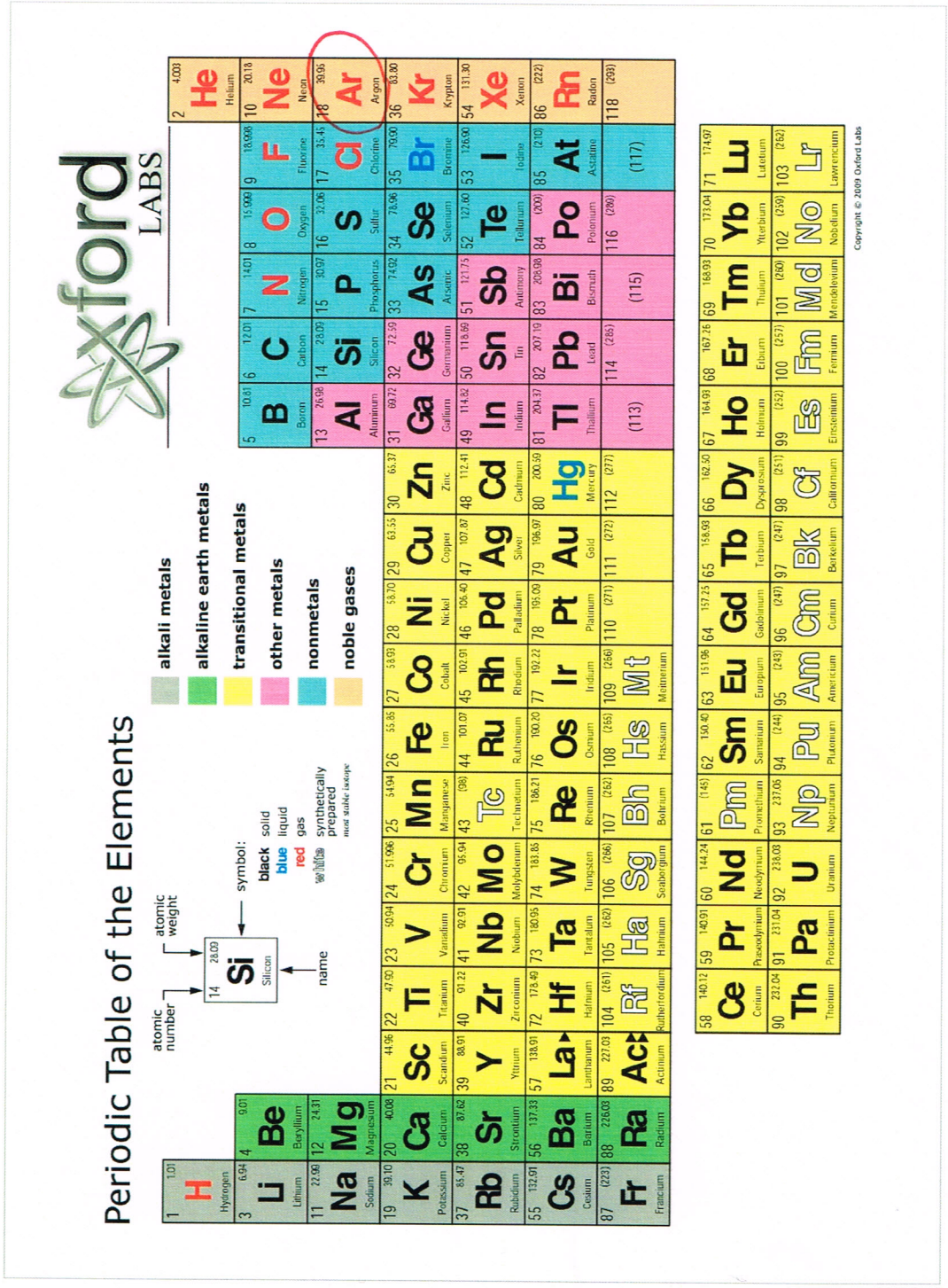

Figure 1: Periodic Table of Elements