Problem X – 10 marks

Remember the hoverpad video, the scene with the little girl pushing the adult man around? I estimate that the pad, in that case, was about 100cm x 80 cm. And the system (that consists of the man sitting on the cabinet,) weighs about 120kg.

What is the pressure and flow required from the air supply, to make that work? i.e:

(a) 2 marks: What is the air pressure in the air layer?

(b) 8 marks: Assuming that there is a 3mm gap all the way around, and that the air in the rest of the workshop is at atmospheric pressure of 100 kPa, what is the flow of air out through the gap?

For this exercise you may treat the air as incompressible. It's not, but that's a complication we could deal with later.

Density of air = 1.25 kg/m3

3mm air gap under here, supporting weight of man-plus-cabinet

Name:_____ Section:_____

Problem 2 [10 marks]

(a) [5 marks] Find the equation of the plane that is perpendicular to the line connecting points $P = \langle 6, -1, 5 \rangle$ and $Q = \langle 2, 4, 1 \rangle$ such that the plane is the same distance to both points.

(b) [5 marks] Find the equation of the plane containing the points $P = \langle 1, 0, -2 \rangle$, $Q = \langle 0, 2, 1 \rangle$ and $R = \langle 1, -2, 1 \rangle$.

Name:_____ Section:_____

Problem 3 [15 marks]

Find the center of mass of the solid S which lies above the cone $z = \sqrt{x^2 + y^2}$, inside the sphere $x^2 + y^2 + z^2 = 2$ and in the region $x \geq 0$, and has density $\rho(x, y, z) = x^2 + y^2 + z^2$.

16

Name:_____ Section:_____

Problem 4 [10 marks]

Find the centroid of the solid in the region $y \geq 0$ between the cylinders $x^2 + y^2 = 2$ and $x^2 + y^2 = 1$ and bounded by the planes $z = 0$ and $z = y$.

MECH 222-Thermodynamics

Test 2: February 16, 2017

Solutions.

Question (30 Marks)

2.5 kg of water vapor at 6 MPa and 350°C exists in a cylinder/piston assembly (state 1). Heat is removed from water vapor in a constant pressure process until the specific volume reaches v = 0.035 m^3/kg (state 2). Then, the piston is locked and cooling is continued until the temperature reaches 205.76°C (state 3).

a) Find the specific volume at state 1 (3 Marks)
b) Find the temperature at state 2 (6 Marks)
c) Using the ideal gas law estimate the temperature for state 2; Molecular weight of water is 18 g/mol. Comment on your results from part b and part c. (6 Marks)
d) Find the vapor quality at state 3 (6 Marks)
e) Find the total amount of work done from initial state 1 to final state 3 in kJ (6 Marks)
f) Show the process 1-2 and 2-3 on a T-v diagram and label clearly each state (3 Marks)

Note: Thermodynamic Tables for water are attached (4 pages).

Please write your final answers in the Table below:

Part a	$v_1 =$
Part b	$T_2 =$
Part c	$T_2 =$
Part d	$x_3 =$
Part e	$W_{1\text{-}3} =$