Aerospace Engineering

EA 203

Fall 2005

Exam No. 1
27/29 September 2005

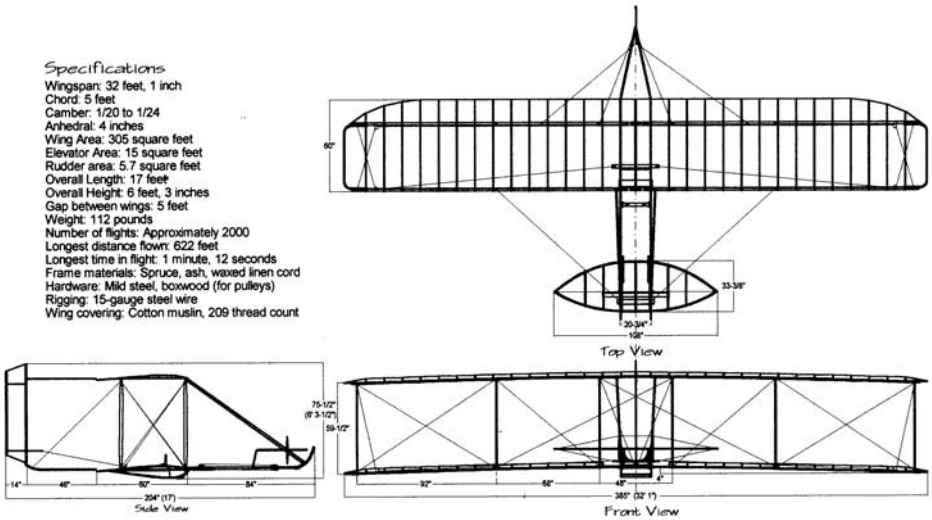

Figure 1. The 1902 Wright glider

NAME: _____

SECTION: _____

	Part "A" Score
	Part "B" Score
	TOTAL SCORE

NOTE: This is a common exam among all sections of EA203. You are prohibited from discussing the content of this exam with anyone but your instructor until after the last sections have completed it. Please initial here to indicate that you have read and understand this agreement .....

1. (3 points) *"A perfect gas may be legitimately assumed in most aerospace applications."* Circle that which best validates this statement:

a) This is valid in the lower atmosphere, but cannot be assumed in low Earth orbit.
b) True. The distance between molecules is usually sufficient to avoid intermolecular forces.
c) This is true only for incompressible, inviscid flow.

2. (4 points) Fill in the gas constant and its appropriate units for air in both English and SI:

R = _____ (Eng) _____ (SI)

3. (6 points) Identify the six properties that describe a flow field, with common English units of measure.

4. (5 points) The field elevation of Baltimore-Washington International Airport is 146 feet above mean sea level (MSL). A high pressure, low temperature weather system presses in from the Artic region.

a) Would you expect the density altitude to be less than, equal to, or greater than 146 feet? (circle one).

b) Explain your reasoning.

5. (4 points) Name the layers in the atmosphere up to an altitude of 65,000 feet. What assumptions are made concerning the temperature profile in each of these regions?

6. (4 points) Define the following:

a) q = _____.

b) $KEAS$ = _____.

7. (14 points) Derive the Euler Equation for a fluid having negligible body forces (i.e., weight). Draw a free-body diagram, state your assumptions, and show all your work.

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	Part “B” Score

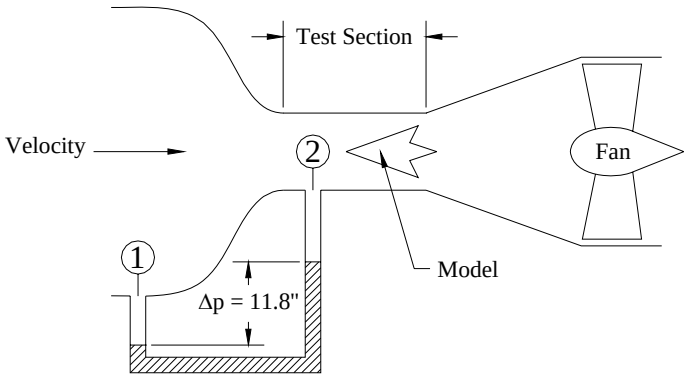
1. (20 points) A Mooney Ovation is cruising at a pressure altitude of 5,000 feet en route from Baltimore to Philadelphia at a true airspeed of 140 kts. The outside air temperature (OAT) gauge in the cockpit reads 36 °F. As an amateur aeronautics enthusiast, the owner has installed a static pressure port (p_1) on the top of the right wing, 10% back from the leading edge. This static port is connected to a separate altimeter in the cockpit, and indicates a pressure altitude of 7,200 feet.

a) What is the percent increase or decrease in speed from free stream conditions that the flow experiences as it is passing over port p_1?

2. (20 points) On 13 JAN 2005, the firsties in the flight test course (EA417) calibrated the Pitot-static system of the Department's A-3 Bonanza. Prior to take-off, the sea-level pressure and temperature were 30.12" Hg and 60 °F, respectively. They then climbed to 2,000 ft pressure altitude, where the temperature was 65 °F (surprisingly warm for January, but the data's the data).

a) What is the pressure altitude at sea level (to the nearest 10 ft)?
b) What was the ratio of density at altitude to the density at sea level?

3. (20 points) A group of 2/c in EA303 conducted a test in the USNA Eiffel wind tunnel, shown, and they need to determine the air speed. Because there is a model mounted in the test section (1.09m x 0.79m), installing a Pitot-static probe there is unfeasible. So they connected a water manometer across the contraction (contraction ratio = 10) and measured the differential shown. The test section temperature is 28 °C and the density altitude on the day of this test was zero.



a) Determine the test section velocity.
b) Determine the test section Mach number.