

AEM 313: Practice Exam 1 Name: _____

29th Sept 2016 75 minutes 6 Pages Closed books, Closed notes, Calculator
One page of notes.

100 total points **Read, think, plan, and then write.**

University of Alabama Academic Honor Pledge:

I promise or affirm that I will not at any time be involved with cheating, plagiarism, fabrication, or misrepresentation while enrolled as a student at The University of Alabama. I have read the Academic Honor Code, which explains disciplinary procedures that will result from the aforementioned. I understand that violation of this code will result in penalties as severe as indefinite suspension from the University.

Signature: _____

Date: _____

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Multiple Choice Problems: Circle **EVERY** correct answer [5 pts each]

1. Which of the following are definitions of vorticity?

A. $\omega = \nabla \times V$	B. $\omega = \nabla \cdot V$	C. $\omega = \frac{dv}{dy} - \frac{du}{dx}$	D. $\omega = \frac{dv}{dx} - \frac{du}{dy}$	E. None of the above
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2. How can a fluid particle's vorticity magnitude increase?

A. Never	B. Vortex Stretching	C. Unaligned Pressure and Density Gradients	D. Viscosity Shear Stress	E. None of the above
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3. Which airfoil is an NACA 0012?

				None of the above
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4. In a wind tunnel, a wing is mounted at 20 degrees AOA. The normal force is 40 lbs. The axial force is -10 lbs. What is the lift to drag ratio?

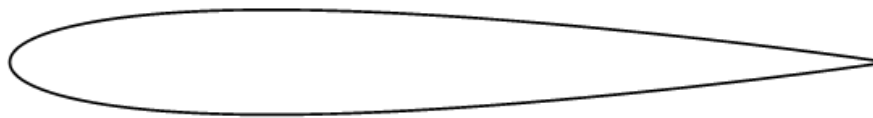
A. 4.0	B. -4.0	C. 0.78	D. 9.58	E. None of the above
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5. How many slugs are in one slinch?

A. 12	B. 32.174	C. 1/12	D. 1/144	E. None of the above
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6. Given the following symmetrical NACA 0012 airfoil, estimate C_m at the aerodynamic center.

A. 0	B. 0.12	C. -0.12	D. 2π	E. None of the above
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7. A flow is irrotational and incompressible. Which of the following are true?

A. Zero Lift	B. Zero Drag	C. Zero Divergence	D. $\nabla \cdot V = 0$	E. $p + \frac{1}{2}\rho V^2 = p_0$
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8. For an NACA 64₃-418 airfoil at Re=9 million, what is the drag coefficient at 0 degrees AOA? The experimental data is plotted below (source: Theory of Wing Sections)

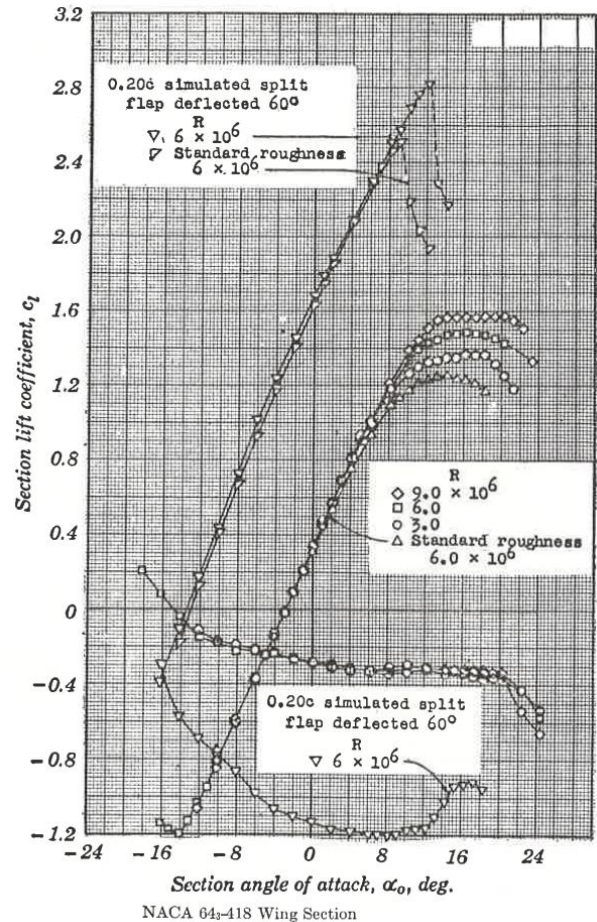
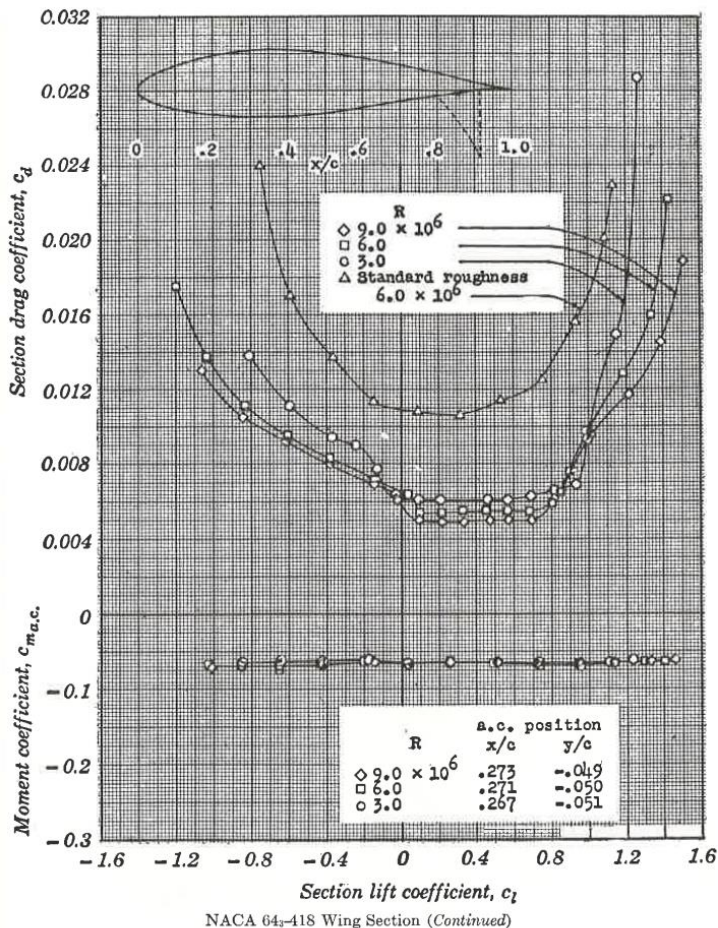
A. 60 counts	B. -0.0620	C. 0.0055	D. 0.35	E. None of the above
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9. Given an unsteady flow, which of the following visualizes a trace of all fluid elements that flowed through a fixed location?

F. Pathline	G. Streakline	H. Timeline	I. Streamline	J. None of the above
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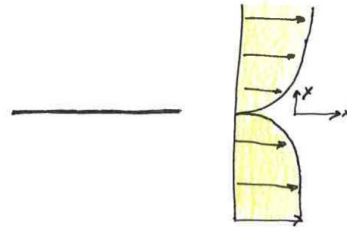
10. Given a 10% thick Joukowski airfoil at 10 degrees AOA, estimate $C_{l\alpha}$ per radian?

K. 6.8	L. 20π	M. 0.11	N. 2π	O. None of the above
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11. [20 pts] A flat plate with a chord of 1 foot and span of 10 feet generates a downstream wake described by:

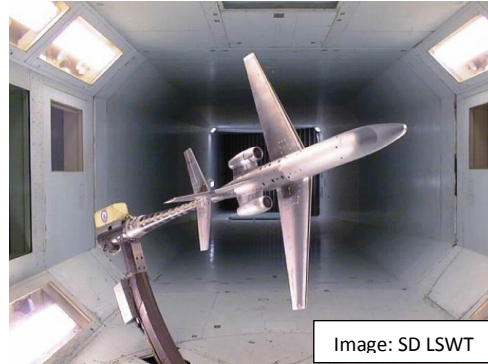
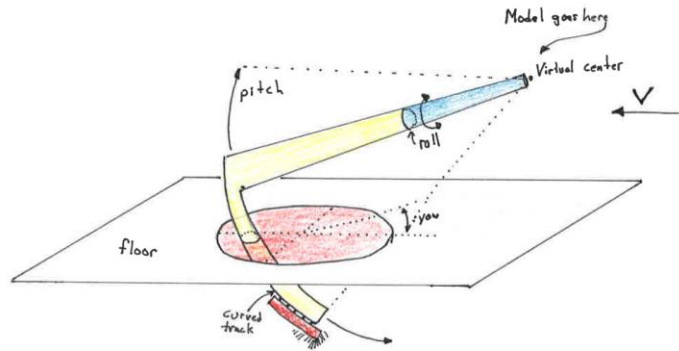
$$u(y) = \begin{cases} y^{1/7} & 0 < y < 1 \\ (-y)^{1/7} & -1 < y < 0 \\ 1 & \text{otherwise} \end{cases}$$



The upstream velocity is $V=1$. The distance y is measured in feet.

What is the sectional drag coefficient C_d ?

12. [10 pts] A wind-tunnel model is connected to the following sting in a level attitude. The sting is initially pointed directly into the freestream velocity vector. The sting's roll mount is rotated right to $\phi=90^\circ$. The sting's pitch mount is rotated up to $\theta=30^\circ$. Then the sting's yaw mount is rotated left to $\psi=-30^\circ$ (note the minus). **Determine α and β of the model with respect to the freestream.**



13. [20 pts] Given a cylinder of radius 10 inches in a freestream flow of 100 ft/s at SSL, you measure stagnation points at -10 degrees below the chordline. What is the lift generated per unit span?

