



AERODYNAMICS

eSeries "GRADE SHEET"

| |
|-------------------|
| NAME: _____ |
| Partner: _____ |
| Period: _____ |
| Rotation #: _____ |

MODULE GRADE: COURSE GR. _____]
 POST TEST _____]

MODULE AVE.= _____

AERODYNAMICS "WORKSHEET"

WORKSHEET TOTAL = _____

LAB PERFORMANCE _____

(If you are absent, write ABS on the line for the day you miss and **DISCUSS** what you need to make up with the teacher)

LAB PERFORMANCE TOTAL = _____

Extra Credit—Discuss this with the instructor **BEFORE** beginning!!!

WORD SEARCH _____(5)
 MODULE REPORT _____(5)
 "AERODYNAMICS CONCEPTS" WORKSHEET _____(5)

CHALLENGES _____(5)
 Lessons in Advanced Level _____
 MODULE NOTES _____(0-10)

TOTAL EXTRA CREDIT= _____
BONUS _____

AERODYNAMICS "WORKSHEET"

LESSON 3- Wind Speed Measurement Activity (Table Below):

| Wind Speed Adjuster Distance | Speed of Air in Test Chamber |
|------------------------------|------------------------------|
| 1 inch | |
| 2 inches | |
| 3 inches | |
| 4 inches | |
| 5 inches | |
| 6 inches | |
| Pulled all the way out | |

_____ (5 pts.)

LESSON 4- Bernoulli's Principle

Describe "Lift": _____.

What are the four forces that affect the flight of an aircraft?

1. _____ 2. _____ 3. _____ 4. _____ (5)

Have the **instructor demonstrate** the wind tunnel(**BEFORE** Exercise #1). **Lesson 4** Part 2: T.I.: _____ (10)

BERNOULLI'S PRINCIPLE ACTIVITY

| | WIND SPEED | LIFT |
|-------------|------------|------|
| AIRFOIL "A" | | |
| AIRFOIL "B" | | |
| AIRFOIL "C" | | |
| AIRFOIL "D" | | |
| AIRFOIL "E" | | |
| AIRFOIL "F" | | |

Which airfoil creates the most lift? _____ Why (relate to Bernoulli's principle)? _____

Why does airfoil "E" have low lift? _____

Which airfoil creates the least lift? _____ Why? _____

Points for All of Lesson 4: _____ (10)

Explain this Activity to the instructor (explain how it relates to Bernoulli's principle). **T.I.:** _____ (5)

Environmental Impacts—Write notes from video clips. **Env. Impacts. Paper:** _____ (5)

LESSON 5--DRAG ACTIVITY

| | WIND SPEED | DRAG |
|--------------------|------------|------|
| CAR "A" | 30 | |
| CAR "B" | 30 | |
| RED TRUCK | 30 | |
| BLUE TRUCK | 30 | |
| RED "ELIMINATOR" | 30 | |
| GREEN VEHICLE 3981 | 30 | |

_____ (5 pts.)

Of the six vehicles, which had the most drag? _____

Of the six vehicles, which had the least drag? _____

Explain why (aerodynamically)? _____

_____ (5pts.)

LESSON 6- Angle of attack (fill out the table on the **next page**)

LESSON 6--ANGLE OF ATTACK ACTIVITY

| ANGLE OF ATTACK | WIND SPEED | AIRFOIL "A" | AIRFOIL "B" | AIRFOIL "C" | AIRFOIL "D" | AIRFOIL "E" | AIRFOIL "F" |
|-----------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 0 degrees | 25 | | | | | | |
| 5 degrees | 25 | | | | | | |
| 7.5 degrees | 25 | | | | | | |
| 10 degrees | 25 | | | | | | |
| -5 degrees | 25 | | | | | | |
| -10 degrees | 25 | | | | | | |

As the angle of attack increases, the lift: _____ (5)

What do you think is the best angle of attack (for maximum lift) on the airfoils you tested? _____
 Explain Lessons 4 & 6: **compare** the two types of lift and how a plane is designed for lift. **T.I.:** _____ (5)

LESSON 7-"AIRFOIL THEORY"

From the Activity, record the angle that you found to be the zero lift angle of attack on the chart below.

| | Airfoil B | Airfoil C | Airfoil D | Airfoil E | Airfoil F | |
|-----------------|-----------|-----------|-----------|-----------|-----------|--|
| Zero Lift Angle | | | | | | |

"Zero Lift Angle of Attack" Data Sheet (Above)
Airfoil Design Paper

A.D.C.: _____ (5)
Airfoil Design Paper: _____ (5)

LESSON 8-STABILITY AND CONTROL

Answer the questions below. Get the tape measure from the top of the wind tunnel.

1. Fly the airplane three times. Record the flight of the airplane (what happened and how far did the plane fly? Use the tape-measure to measure). Results: 1) _____ inches, 2) _____ in., 3) _____ in.
2. Place 2 tacks on the nose of the airplane. Fly the airplane three times. Record the results. _____ inches, _____ inches, _____ inches,
3. Place 2 tacks on the wings of the airplane. Fly the airplane three times. Record the results. _____ inches, _____ inches, _____ (5)

LESSON 9-ADVANCED TOPICS

Define Supersonic & Hypersonic: _____

_____. _____ (5pts.)

(In Lesson 9 you will finish your Atmospheric Data Log Sheet)

"ATMOSPHERIC DATA LOG SHEET".

Data Log Worksheet: _____ (5)

LESSON 12-Career Guidance Report.

C.G. NOTES: ____ (10)

STUDY GUIDE

Study Guide: ____ (5)

Worksheet Total: ____

If you finish your module early, before you do any other extra credit you will do this Lesson 8 Activity first!!!

LESSON 8- Lift & Drag Coefficients-

Do this lesson if you finish the other lessons

LESSON 8- Lift & Drag Coefficients Activity-- Do the activity below. Write what you did and explain how this relates to the Lift and Drag Coefficients it discussed in the lesson.

| ANGLE OF ATTACK | WIND SPEED | Airfoil "A" | Airfoil "B" | Airfoil "C" | Airfoil "D" | Airfoil "E" | Airfoil "F" |
|-----------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 0 degrees | 35 | | | | | | |
| 2.5 degrees | 35 | | | | | | |
| 5 degrees | 35 | | | | | | |
| 7.5 degrees | 35 | | | | | | |
| 10 degrees | 35 | | | | | | |
| -2.5 degrees | 35 | | | | | | |
| -5 degrees | 35 | | | | | | |
| -7.5 degrees | 35 | | | | | | |
| -10 degrees | 35 | | | | | | |

What made this part of Lesson 10 different than Lesson 6? Be **specific** (speed and angle) with the changes.

_____.

| | WIND SPEED | DRAG |
|----------------------|------------|------|
| CAR "1" | 35 | |
| CAR "2" | 35 | |
| RED TRUCK | 35 | |
| BLUE TRUCK | 35 | |
| RED "ELIMINATOR" | 35 | |
| GREEN VEHICLE "3981" | 35 | |

What made this part of Lesson 10 different than Lesson 5? Be **specific** (speed and drag)with the changes.

_____. (Total 5 pts.)

SKIP THIS ACTIVITY Atmospheric Data Summary Report

Using the information from the daily logs, complete the report in lesson 6:

1. Highest outside temperature was _____ °F, _____ °C recorded on _____ (date).
2. Lowest outside temperature was _____ °F, _____ °C recorded on _____ (date).
3. Average outside temperature for the time period covered was _____ °F, _____ °C (Remember to calculate an average, add all the daily temperature readings and divide by the number of items added.)
4. Highest barometric pressure was _____ inches of mercury (Hg) recorded on _____.
(date)
5. Lowest barometric pressure was _____ inches of mercury (Hg) recorded on _____.
(date)
6. Average barometric pressure for the time period covered was _____ inches of mercury (Hg).
7. Highest outside relative humidity was _____ percent.
8. Lowest outside relative humidity was _____ percent.
9. Average outside relative humidity for the time period covered was _____ percent.
10. Was there a wide spread in the various readings or were the readings all within a small range?

11. What were the trends (changes, similarities or differences) in the log records (humidity, temperature and pressure)?

12. What (explain) was the relationship between the various readings (temperature, humidity, pressure)?

13. What effect do you think changes in **atmospheric conditions** might have in aerodynamic performance? Think about what you learned from the Lessons. (Explain your answer.)

Total Points (5) _____



Aerodynamics Study Guide for Post Test

1. 1-Streamlining reduces friction by presenting a smooth surface to moving air molecules.
Aerodynamics Streamlining Contouring Waxing
2. Most of the flying machines we use today can be classified as 2-Flying Machines vehicles.
heavier-than-air lighter-than-air buoyant supersonic
3. 2-The Atmosphere is the amount of water in the air.
Cloud cover Barometric pressure Relative humidity Temperature
4. 2-The Atmosphere is how hard the air is pressing on us from all sides.
Air stress level Barometric pressure Relative humidity Temperature
5. Atmospheric pressure is measured in 2-The Atmosphere.
degrees Celsius degrees Fahrenheit pounds per square inch (psi) Both a and b are correct.
6. In order for the air to travel in a straight line through a wind tunnel, it must pass through a 3-Wind Tunnels.
funnel tube straightener None of the above is correct
7. The wind speed in the wind tunnel is measured with the 3-Wind Tunnels.
manometer hygrometer wind-o-meter barometer
8. Bernoulli's Principle states that under the same conditions, fast-moving air has 4-Lift & Bernoulli's Principle than/as slow-moving air.
the same pressure more pressure less pressure a lower temperature
9. A(n) 4-Lift & Bernoulli's Principle is the design of an airplane's wing.
blade airfoil aileron elevator
10. 5-Drag always resists the direction of travel.
Gravity Lift Thrust Drag
11. Drag is useful (instead of harmful) when a 5-Drag.
plane is landing car is moving plane is taking off Drag is never useful
12. The 6-Angle of Attack is the spot on the wing where the wind hits the airfoil first.
chord trailing edge leading edge flap
13. The 6-Angle of Attack is the angle between the chord and the direction that the wind is blowing.
angle of attack hypotenuse airfoil None of the above is correct
14. The mass flow equation is applied to the measurement and prediction of 7-Unit Review in the wind tunnel.
air quality air speed airfoil angles All of the above are correct

15. The mass flow equation shows that as area decreases, the velocity of the air 7-Mass Flow.
increases decreases remains the same fluctuates

16. The coefficient of lift is a constant value that has no units of measurement associated with it. This makes it a(n) 8-Lift & Drag Coefficients number.
infinite imaginary dimensionless prime

17. In the equations for the coefficients of lift and of drag, the “S” symbol represents the: (8-Lift & Drag Coefficients)
size of the wind tunnel. surface area of the wing. speed of the wind. curve of the path that the test object travels.

18. The curvature of an airfoil is called the 9-Airfoil Theory.
slope chord camber dome

19. 9-Airfoil Theory identifies an airfoil design that creates lift at zero angle of attack.
Positive camber Negative camber Mean camber line Zero camber

20. The point on each airfoil where the lift force is concentrated is called the 10-Stability & Control.
center of gravity center of lift airfoil center thruster

21. The 10-Stability & Control are located on the wings of the airplane and are used to roll and turn the plane.
flaps elevators ailerons airfoils

22. Aerospace engineers classify 11-Laminar Flow vs. Turbulent Flow into two types — laminar and turbulent.
airplanes atmospheric conditions air flow flights

23. In 11-Laminar Flow vs. Turbulent Flow flow, air particles travel in the same direction of the flow but tend to cross over from one layer to another.
turbulent laminar uneven irregular

24. Objects that move faster than the speed of sound are part of the branch of aerodynamics called 12-Supersonics.
subsonics supersonics stealth modes barrier breakers

25. A 12-Supersonics forms when the air particles that have already come in contact with the object cannot get out of the way of the air particles that are about to hit the object.
shock wave stall leading edge turbulent wave

AERODYNAMICS

Answer Key

This appendix provides the answer key to the paper course test.

The electronic course test is composed of 25 randomly selected questions taken from the bank of all unit test questions.

_____ reduces friction by presenting a smooth surface to moving air molecules.

Aerodynamicsa.

Streamliningb.

Contouringc.

Waxingd.

Most of the flying machines we use today can be classified as _____ vehicles.

heavier-than-aira.

lighter-than-airb.

buoyantc.

supersonicd.

_____ is the amount of water in the air.

Cloud covera.

Barometric pressureb.

Relative humidityc.

Temperatured.

_____ is how hard the air is pressing on us from all sides.

Air stress levela.

Barometric pressureb.

Relative humidityc.

Temperatured.

Atmospheric pressure is measured in _____.

degrees Celsiusa.

degrees Fahrenheitb.

pounds per square inch (psi)c.

Both a and b are correct.d.

In order for the air to travel in a straight line through a wind tunnel, it must pass through a _____.

funnela.

tubeb.

straightenerc.

None of the above is correct.d.

The wind speed in the wind tunnel is measured with the _____.

manometera.

hygrometerb.

windmeterc.

barometerd.

Bernoulli's Principle states that under the same conditions, fast-moving air has _____ than/as slow-moving air.

the same pressurea.

more pressureb.

less pressurec.

a lower temperatured.

A(n) _____ is the design of an airplane's wing.

bladea.

airfoilb.

aileronc.

elevatord.

_____ always resists the direction of travel.

Gravitya.

Liftb.

Thrustc.

Dragd.

Drag is useful (instead of harmful) when a _____.

plane is landinga.

car is movingb.

plane is taking offc.

Drag is never useful.d.

The _____ is the spot on the wing where the wind hits the airfoil first.

chorda.

trailing edgeb.

leading edgec.

flapd.

The _____ is the angle between the chord and the direction that the wind is blowing.

angle of attacka.

hypotenuseb.

airfoild.

None of the above is correct.d.

The mass flow equation is applied to the measurement and prediction of _____ in the wind tunnel.

air qualitya.

air speedb.

airfoil anglec.

All of the above are correct.d.

The mass flow equation shows that as area decreases, the velocity of the air _____.

increasesa.

decreasesb.

remains the samec.

fluctuatesd.

The coefficient of lift is a constant value that has no units of measurement associated with it. This makes it a(n) _____ number.

infinitea.

imaginaryb.

dimensionlessc.

primed.

In the equations for the coefficients of lift and of drag, the “S” symbol represents the:

size of the wind tunnel.a.

surface area of the wing.b.

speed of the wind.c.

curve of the path that the test object travels.

The curvature of an airfoil is called the _____.

slopea.

chordb.

camberc.

domed.

_____ identifies an airfoil design that creates lift at zero angle of attack.

Positive cambera.

Negative camberb.

Mean camber linec.

Zero camberd.

The point on each airfoil where the lift force is concentrated is called the _____.

center of gravitya.

center of liftb.

airfoil centera.

thrusterb.

The _____ are located on the wings of the airplane and are used to roll and turn the plane.

flapsa.

elevatorsb.

aileronsc.

airfoild.

Aerospace engineers classify _____ into two types — laminar and turbulent.

airplanesa.

atmospheric conditionsb.

air flowc.

flightsd.

In _____ flow, air particles travel in the same direction of the flow but tend to cross over from one layer to another.

turbulenta.

laminarb.

unevenc.

irregulard.

Objects that move faster than the speed of sound are part of the branch of aerodynamics called _____.

subsonicsa.

supersonicsb.

stealth modesc.

barrier breakersd.

A _____ forms when the air particles that have already come in contact with the object cannot get out of the way of the air particles that are about to hit the object.

shock wavea.

stallb.

leading edgec.

turbulent waved

Aerodynamics

Study Guide 6.0

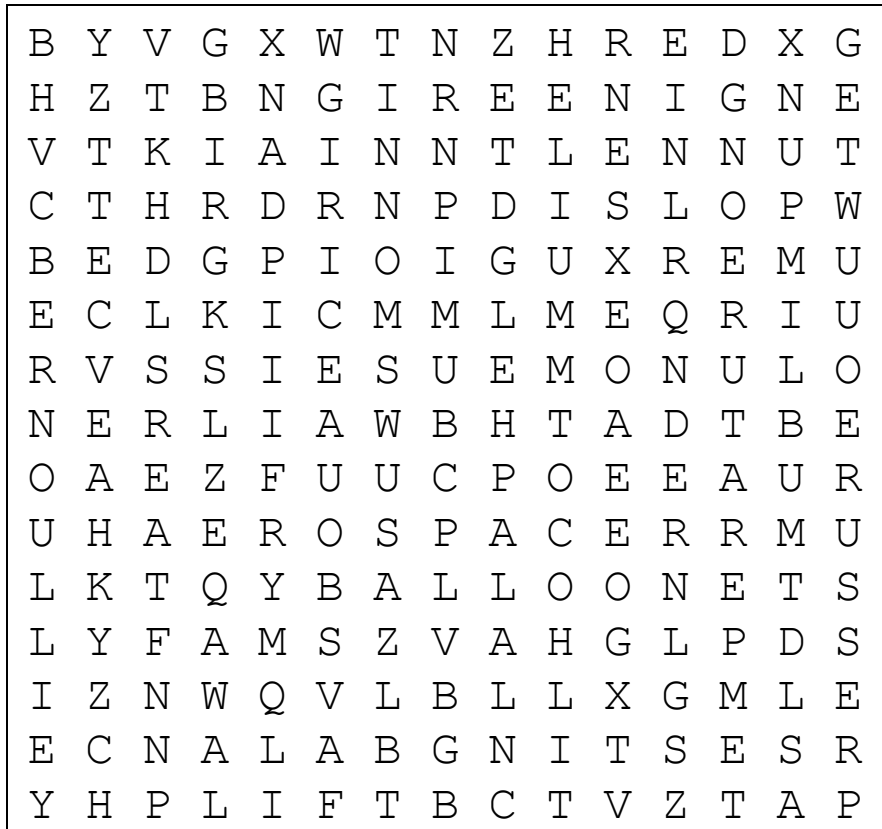
This study guide can then be used as a resource for your final test!

1. Which of the following is a lighter-than-air flying machine? (1- FLYING MACHINES)
passenger jet - helicopter - blimp - jet fighter
2. (1- FLYING MACHINES) are used to move people or goods into hard-to- reach areas.
Supersonic transports - Jet fighters - Dirigibles - Helicopters
3. Helium balloons use the principle of (1- FLYING MACHINES) to fly.
buoyancy - action/reaction - generated thrust - gravity
4. Automobile engineers design cars using aerodynamics to help save (1- STREAMLINING).
production costs - market share - fuel - management intervention
5. The Wright brothers made the first (1- FLYING MACHINES) flight.
lighter than air - transatlantic - around the world - heavier than air
6. (1- FLYING MACHINES), the famous Italian thinker and painter, made a sketch of a helicopter
that he called an air-screw.
Julius Caesar - Michelangelo - Leonardo da Vinci - Marco Polo
7. The first person to make a working helicopter was a Russian immigrant named
(1- FLYING MACHINES).
Leo Tolstoy - Igor Sikorski - Igor Stravinsky - Ivan Heliostatski
8. A barometer is used to measure (2- THE ATMOSPHERE).
temperature - air pressure - relative humidity - nitrogen content
9. The wings of an airplane create more lift in (2- REVIEW).
warm air - cold air - fresh air - humid air

10. A hygrometer is used to measure (2- THE ATMOSPHERE).
temperature - air pressure - relative humidity - nitrogen content
11. Temperature can be measured in (2- THE ATMOSPHERE).
inches of mercury - degrees Celsius - degrees Arvin - kilopascals
12. Barometric pressure can be measured in (2- ATMOSPHERIC DATA).
inches of mercury - degrees Celsius - degrees Arvin - parts per million
13. The most narrow part of the wind tunnel is usually the (3- WIND TUNNELS).
safety shield - test section - control panel - fan
14. Diffusers are used only with (3- WIND TUNNELS).
closed circuit - open circuit - industrial - small
15. Aerospace engineers use wind tunnels to test the (3- REVIEW) of different shapes.
weight - aerodynamics - specific gravity - geometry
16. A less expensive way to carry out aerodynamic testing is to (3- REVIEW).
use test pilots - use older aircraft - use a model aircraft - use the Doppler effect
17. A (3- WIND TUNNELS) causes the air in a wind tunnel to travel in a direct/straight line.
pusher fan - straightener - diffuser - puller fan
18. You should always close the (3- WIND TUNNEL SAFETY) before turning on the wind tunnel fans.
fulcrum - safety shield - airspeed indicator - diffuser
19. Which of the following is *not* an aerodynamic force? (4- LIFT AND BERNOULLI'S PRINCIPLE)
thrust - drag - weight - pressure
20. The force that keeps an airplane up in the air is (4- LIFT AND BERNOULLI'S PRINCIPLE).
thrust - weight - lift - humidity
21. Bernoulli's principle states that as a fluid moves faster, its pressure (4- LIFT AND BERNOULLI'S PRINCIPLE).
decreases - increases - remains constant - recovers
22. To have lift, the pressure (4- LIFT AND BERNOULLI'S PRINCIPLE) the wing must be greater than the pressure _____ the wing.
in front of, behind - behind, in front of - above, below - below, above
23. Bernoulli discover that, under the same conditions, fast moving air has (4- LIFT AND BERNOULLI'S PRINCIPLE) slow moving air.
more pressure than - the same pressure as - less pressure than - inverse proportionality to
24. Lift is used to overcome the (4- LIFT AND BERNOULLI'S PRINCIPLE) of an aircraft.
drag - dynamic stress - weight - thrust
25. The shape of a(n) (4- LIFT AND BERNOULLI'S PRINCIPLE) is designed to create lift based on Bernoulli's principle.
rudder - jet engine housing - airfoil - fuselage

26. Thrust is the force that opposes (5- DRAG). **drag - weight - lift - humidity**
27. Drag always (5- DRAG) in the direction of travel.
multiplies thrust - moves - resists motion - enhances motion
28. The angle of attack is measured between the chord and the (6- ANGLE OF ATTACK).
wind - wake - leading edge - trailing edge
29. A straight line drawn from the front of the cross section of an airfoil to the back is the (6- ANGLE OF ATTACK). **trailing edge - stall - chord - wingspan**
30. A (6- ANGLE OF ATTACK) occurs when the airflow over the wing separates from the airfoil.
stall - wake - chord - venturi

AERODYNAMICS



AEROSPACE
BALLOON
BAROMETER
BERNOULLI
BLIMP
BUOYANCY
CELSIUS

DRAG
ENGINEER
HELICOPTER
HELIUM
HUMIDITY
LIFT
PRESSURE

SAFETY
STINGBALANCE
STREAMLINING
TEMPERATURE
TUNNEL
WEIGHT
WIND



JET AIRPLANE REPORT

You have two research papers to choose from.

The first is to write a report on helicopters.

The second is to write a report on jet airplane.

Information on the report is listed below in the "Assignment".

Resources for the Concorde report are listed below under resources, but you can research any jet plane.

Assignment:

Find information about the jet airplane and write a short report with information that you find from your search. You should include a picture that you download off the Internet (if available, ask the instructor). You must include a bibliography of identify your sources. Your report must be 14pt. Arial or Times New Roman Font type, double spaced and 1 ½ pages or more.

Resources:

For the Jet Airplane report:

Internet: Ask the instructor if you may use the internet to do research for this report.

Possible internet sites to use:

Printed books: from the IMC

