Aviation
Merit Badge Workbook

This workbook can help you but you still need to read the merit badge pamphlet. You should use the work space provided each requirement to make notes for discussing the item with your counselor, not for providing full and complete answers. If a requirement says that you must take an action using words such as "discuss", "show", "tell", "explain", "demonstrate", "identify", etc., that is what you must do.

Merit Badge Counselors may not require the use of this or any similar workbooks. No one may add or subtract from the official requirements found in the Scouts BSA Requirements Handbook 2025. The Guide To Advancement is the official Scouting America source on advancement procedures. The requirements were last issued or revised in 2025, with the revision/ latest printing in 2025. This workbook was updated in January 2025.

SCOUTS NAME: _____ UNIT: _____

Requirement 1: Aviation Basics and Mechanics of Flight

1a. Define "aircraft."

An aircraft is any ___ ___ ___ ___ ___ ___ ___ that can fly through the air. They include airplanes, helicopters, gliders, and even drones. These vehicles are designed to lift off the ground and stay in the sky, using engined, propellers, or other technology.

Describe three kinds of aircraft today, and their typical uses. You may choose from the examples shown below.

	Kind:	Uses:
		
		
		
		
		

1.b Provide a brief overview of the evolution of flight, and discuss three notable time in history important to aviation.

_____

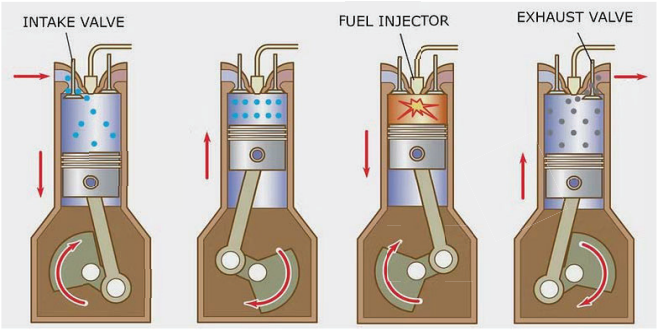
_____

_____

1c. Explain the difference between a fixed wing and rotary wing aircraft, and the benefits if each.

1d. Explain the operation of piston, turbine, and jet engines.

Piston



In a piston engine, the intake valve _ _ _ _ _ to let in a fresh mixture of _ _ _ and _ _ _ _ _ _ _ _.

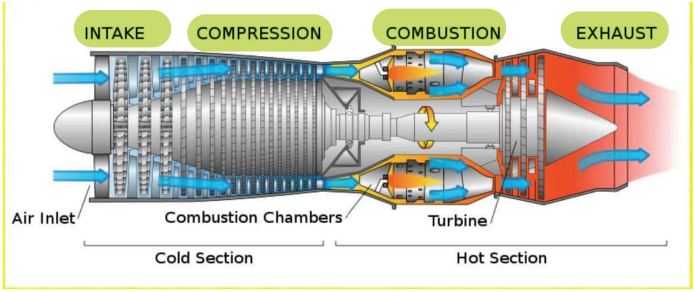
The second operation of the _ _ _ _ _ _ _ _ allows the mixture to be compressed.

The mixture is then _ _ _ _ _ _ _ by an electrical current; the rapid expansion of the gases generates _ _ _ _ _.

The final stage produces exhaust which is transmitted by a crankshaft to the _ _ _ _ _ _ _ _ _.

Each movement of a piston in one direction is a _ _ _ _ _ _ . The series of actions from intake through the exhaust is called a _ _ _ _ _.

Turbine



A turbine engine has 4 main sections. These sections work to produce _ _ _ _ _ _. Each section is highlighted for identification purposes. Briefly describe how this engine works.

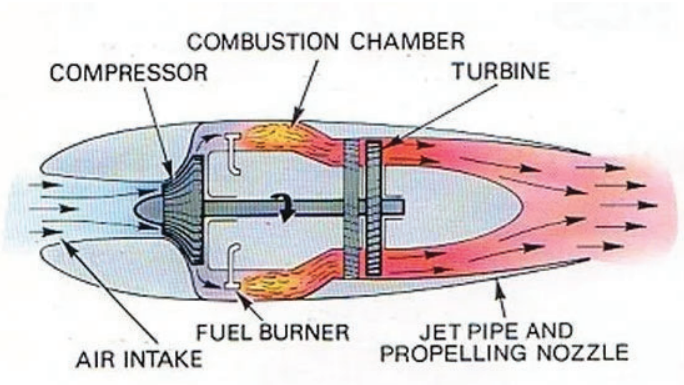
Intake: _____

Compression: _____

Combustion: _____

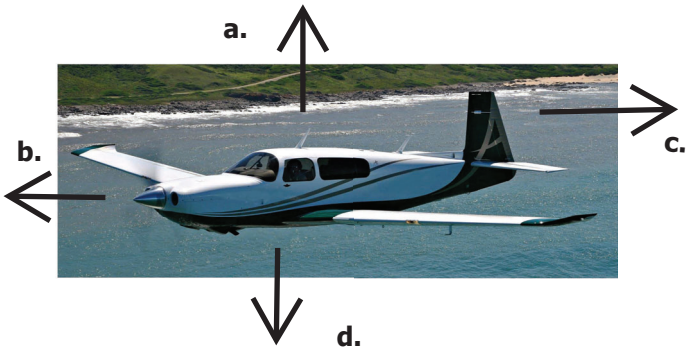
Exhaust: _____

Jet Engines



Jet engines are a type of _ _ _ _ _ _ _ _ _ _ _ _ _ _ that specifically use _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ gases to push the aircraft forward. Because of this design, the jet engine employs Jet Pipe and Propelling Nozzles to improve exhaust speeds. This engine is most often used in what types of aircraft: _____, _____, and _____.

1e. Using a model aircraft, describe the the four forces that act on an aircraft in flight.



a. _____

_____.

b. _____

_____.

c. _____

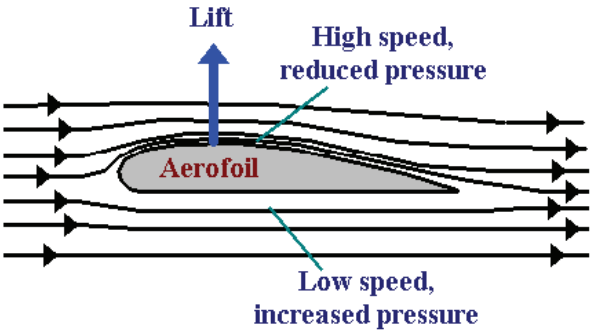
_____.

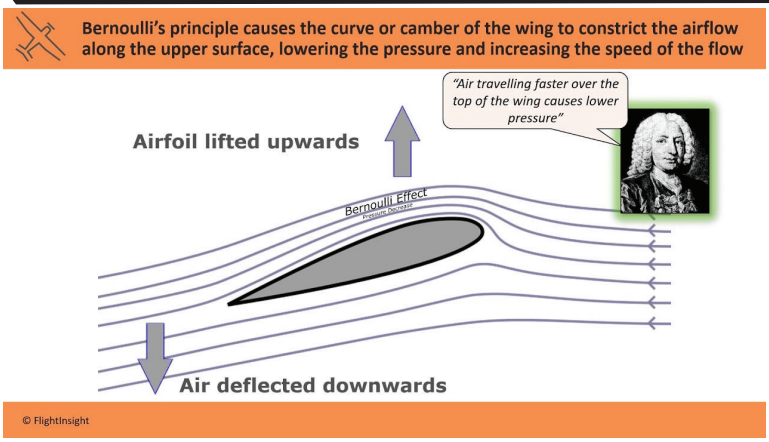
d. _____

_____.

1 f.

Explain how an airfoil generates lift, specifically noting Bernoulli's principle.





You will be asked to explain the above principle when you present your merit badge card to a MB Counselor.

1 g.

Identify and describe the aerodynamic control surfaces on the aircraft of your choice and explain how they operate to control its attitude and direction of flight. (Model aircraft will be available at the Alaska Air Aviation Day)

Maneuver	Ailerons	Elevators	Rudder	Flaps
Takeoff	Lf up neutral Rt up	Up neutral Down	Left neutral Right	Down Retracted
Straight Climb	Lf up neutral Rt up	Up neutral Down	Left neutral Right	Down Retracted
Right Level Turn	Lf up neutral Rt up	Up neutral Down	Left neutral Right	Down Retracted
Left Climbing Turn	Lf up neutral Rt up	Up neutral Down	Left neutral Right	Down Retracted
Left Descending Turn	Lf up neutral Rt up	Up neutral Down	Left neutral Right	Down Retracted
Straight Descent	Lf up neutral Rt up	Up neutral Down	Left neutral Right	Down Retracted
Landing	Lf up neutral Rt up	Up neutral Down	Left neutral Right	Down Retracted

1.h

Explain the purposes and functions functions found in a typical single-engine aircraft: attitude indicator, heading indicator, altimeter, airspeed indicator, turn and bank indicator, vertical speed indicator, compass, navigation, communication, and engine performance indicators.

1. Airspeed Indicator: _____
_____.
2. Attitude Indicator: _____
_____.
3. Altimeter: _____
_____.
4. Turn and Bank Indicator: _____
_____.
5. Heading Indicator: _____
_____.
6. Vertical Speed Indicator: _____
_____.
7. Compass (located in the illustration below):
_____.

Engine Performance Indicators include CHT (Cylinder Head Temperature); EHG (Exhaust Gas Temperature); RPM, Fuel, Oil Temp and Pressure indicators. Explain their purpose and function.

The illustrations below is a display of a Digital Navigation system. The top 2 displays are VHF Comm/ Navigation units; the 3rd unit is ADF; the last 2 units are a matched GPS and Transponder system. Explain the purpose and function of the Comm/Navigation unit.

Requirement 2: Principles of Flight

Do the following:

2a. Build a model FPG-9. Get others in your troop or patrol to make their own model, then organize a competition to test the precision of flight and landing of the models.

Requirement 3: Flight Operations

Do the following:

3b. Under supervision, perform a preflight inspection of a light airplane

3d. Obtain and learn how to read an aeronautical chart. Measure a true course on the chart, correct it for magnetic variation, compass deviation, and wind drift to determine a navigational heading for the aircraft.

From _____ to _____ the true course is: _____°

Correct for wind drift +/- _____° Gives you a True Heading of _____°

Correct for variation +/- _____° Gives you a Magnetic Heading of _____°

Correct for compass deviation +/- _____° Gives you a Compass Heading of _____°

Requirement 4: Aircraft Operations

4a. Do the following:

Visit an airport. After the visit, report on how the facilities are used, how runways are numbered, and how runways are determined to be "active."

How the facilities are used

_____

_____

How runways are numbered,

_____

_____

How runways are determined to be "active."

_____

_____

Requirement 5: Personal & Professional Aviation Opportunities

5a. Explain the following: the student pilot, the recreational pilot, the remote pilot, and the private pilot certificates.

Certificate/Rating	Minimum Hours	Number of Passengers	Visibility VFR/IFR	Flight Max Distance	Night Flights	Fly for Hire
Student Pilot Certificate						
Recreational Pilot Certificate						
Remote Pilot Certificate						
Private Pilot Certificate						

5b.

Describe the benefits of the instrument rating.

Increased Safety: _____

More Flight Opportunities: _____

Better Navigation:_____

Career Opportunities: _____

More Control in Emergencies: _____

5c.

Explain the following: the commercial pilot certificate, the air transport pilot transport certificate, and the and certified flight instructor (CFI).

Commercial Pilot Certificate: _____

_____.

Airline Transport Pilot Certificate: _____

_____.

Certified Flight Instructor: _____

_____.

5d.
Identify an Aviation Exploring Post and /or Civil Air Patrol Facility in your area. Learn about their activities and membership requirements.
This is one of two requirements which you will be asked to research on your own. Please bring a compendium of the information with you to the Alaska Air/Horizon Aviation Day on May 10. All of the Districts in Cascade Pacific Council have at least one Civil Air Patrol Unit in their respective area, with the exception of Timberline. A CAP unit will be present at the Aviation Day to answers any questions you might have. This link is a good place to start: https://pcr.cap.gov/

5e. This is the second of the two requirements to complete before the event on May 10.

Identify three career opportunities that would use skills and knowledge in aviation. Pick one and research the training, education, certification requirements, experience, and expenses associated with entering this field. Research the prospects for employment, starting salary, advancement opportunities, and career goals associated with this career. Discuss what you learned with you counselor and whether you might be interested in this career.

1. _____

2. _____

3. _____

Pick one and find out the education, training, and experience required for this profession.

Education:

_____

_____

Training:

_____

Experience:

_____

_____

Discuss what you learned; include prospects for employment, starting salary, advancement opportunities, and career goals in your research.

_____

_____

_____

_____

_____

_____

_____

Requirement resources can be found here:

Updated pamphlet release scheduled for mid-late March 2025