

Aerospace Test Study Guide

Day 1 – Orbits and Gravity

Key Concepts

- **Gravity** = force pulling objects together
- Depends on:
 - Mass \uparrow \rightarrow gravity \uparrow
 - Distance \uparrow \rightarrow gravity \downarrow

Orbits

- Objects in orbit are **constantly falling around Earth**
- Caused by:
 - Forward velocity
 - Gravity pulling inward

Know

- More speed \rightarrow higher/wider orbit
- Too slow \rightarrow falls to Earth
- Too fast \rightarrow escapes gravity

Day 2 – Rocket Propulsion & Escaping Earth

Newton's 3rd Law

- Action \rightarrow exhaust pushed down
- Reaction \rightarrow rocket pushed up

Rocket Engines

- Fuel + oxygen \rightarrow combustion \rightarrow thrust
- Work in space because they **carry oxygen**

Escape Velocity

- Minimum speed to escape Earth: **~11.2 km/s**

Day 3 – Connecting the Journey

Big Idea

- Rockets get you to space
- Orbits keep you there
- Transfers move you between locations

Key Concept

- Space travel uses **curved paths**, not straight lines
- Engineers minimize **fuel use (efficiency)**

Day 4 – Apollo Moon Challenge

Mission Steps

1. Launch
2. Earth orbit
3. Transfer to Moon
4. Lunar orbit
5. Landing
6. Return

Engineering Challenges

- Limited fuel
- Weight constraints
- Precise timing

Big Idea

- Engineering = **trade-offs + planning**

Day 5 – Atmosphere & Forces of Flight

Atmosphere

- Air density decreases with altitude
- Lower density → less lift

Four Forces of Flight

- Lift ↑
- Weight ↓
- Thrust →
- Drag ←

Balanced flight:

- Lift = Weight
- Thrust = Drag

Day 6 – Flight Optimization

Goal

- Maximize lift, minimize drag, improve efficiency

Variables Engineers Adjust

- Wing shape
- Speed
- Angle of attack
- Surface design

Trade-Offs

- More lift → often more drag
- More speed → more drag

Day 7 – Lift, Angle of Attack, and Stall

Lift Equation

What Affects Lift

- Velocity (v) → BIGGEST effect
- Air density (ρ)
- Wing area (A)
- Lift coefficient (CL)

Angle of Attack (AoA)

- Angle between wing and airflow
- Increasing AoA → increases lift (at first)

Stall

- Occurs at high AoA
- Airflow separates from wing
- Lift drops suddenly

On a graph:

- Lift increases → peaks → drops
- Peak = **stall point**

Data Skills

- Read a **lift vs AoA graph**
- Identify:
 - Maximum lift
 - Stall angle
- Compare different airfoils

VTOL

- Aircraft that can take off/land vertically
- Can hover

Examples

- Helicopter
- Harrier Jet
- F-35B

How It Works

- Thrust is directed **downward**
- Push air down → aircraft goes up (Newton's 3rd Law)

Key Comparison

Traditional Aircraft	VTOL
Needs runway	No runway
Lift from wings	Lift from thrust
More efficient	Less efficient
Cannot hover	Can hover

Trade-Offs

- Uses more fuel
- More complex
- Less efficient