

Summary Notes - Topic 9:

Exploring the Moon

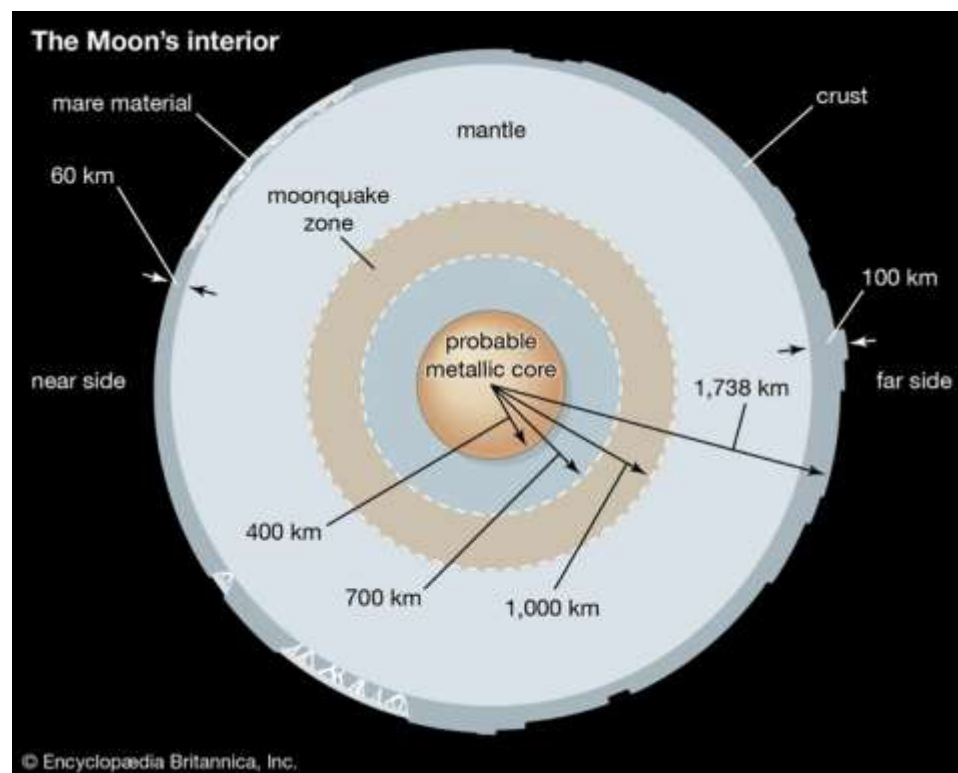


9.1 The Moon's Internal Structure Compared to Earth

The Moon's internal structure is similar to Earth's but has key differences:

Layers of the Moon:

- **Crust:** Thicker than Earth's (~60km) mostly composed of silicate rocks.
- **Mantle:** Contains minerals such as olivine and pyroxene, but lacks active convection currents.
- **Core:** Composed of iron and nickel, but much smaller (20% of the diameter of the Moon, instead of 50% in the case of the Earth's core) and cooler than Earth's (1000-1600 °C instead of 5000-6000 °C).



Comparison with Earth:

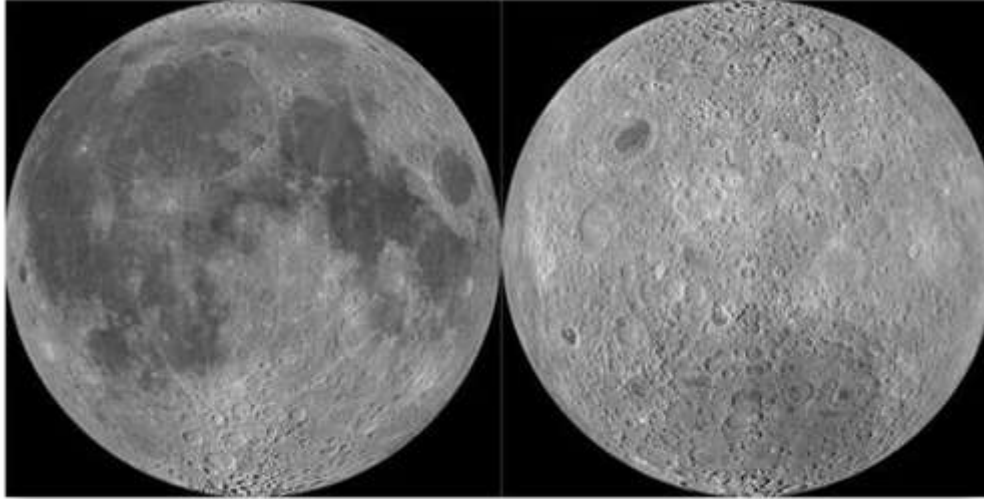
- The Moon lacks a significant atmosphere and plate tectonics.
- Earth has a liquid outer core, whereas the Moon's core is mostly solid or partially molten.

Study Tip:

Be able to label the Moon's internal structure and compare it to Earth's.

9.2 Differences Between the Near and Far Sides of the Moon

The Moon is tidally locked to Earth, meaning we always see the same side. However, the near and far sides are very different in appearance.



Near Side:

- Dominated by **maria** (31.2%) (large dark plains formed by ancient volcanic activity).
- Has fewer craters due to past lava flows.
- Smoother in appearance.
- Darker due to presence of maria.

Far Side:

- Heavily cratered with almost no maria (1%).
- Thicker crust, which prevented lava from forming maria.
- More rugged and mountainous.
- Brighter due to absence of maria.

Exam Tip:

Understand **why** the near and far sides look different (thicker crust on the far side = fewer lava flows).

9.3 How We Study the Moon's Far Side

Since the far side is never visible from Earth, we rely on space missions and satellites to study it:

Methods of Observation:

- **Space Probes:** The Soviet **Luna 3** (1959) was the first to photograph the far side.
- **Lunar Orbiters:** Satellites like NASA's **Lunar Reconnaissance Orbiter (LRO)** (2009) provide detailed images.
- **Human Missions:** Apollo missions provided rock samples and data about lunar geology.
- **China's Chang'e 4 (CE-4):** The first lander on the far side (2019), using a relay satellite to send data back to Earth.



The CE-6 lander (2024)

Study Tip:

Know key missions that explored the far side of the Moon.

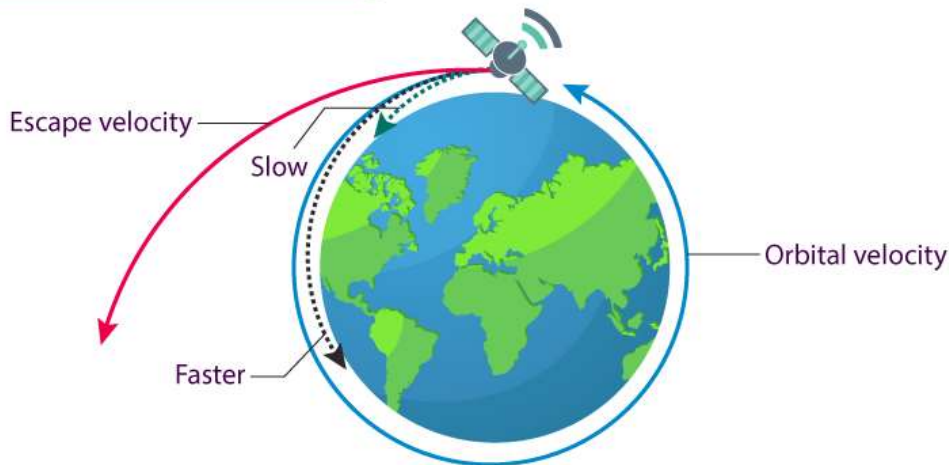
9.4 Escape Velocity and Space Travel to the Moon

For a spacecraft to reach the Moon, it must overcome Earth's **gravity** by reaching **escape velocity**.

Key Concepts:

- **Escape Velocity:** The speed needed to break free from Earth's gravity (~11.2 km/s).
- **Rocket Propulsion:** Chemical rockets provide the necessary thrust to reach the Moon.
- **Apollo Missions:** Used the **Saturn V** rocket, which had multiple stages to efficiently carry astronauts to the Moon.

ESCAPE VELOCITY



Exam Tip:

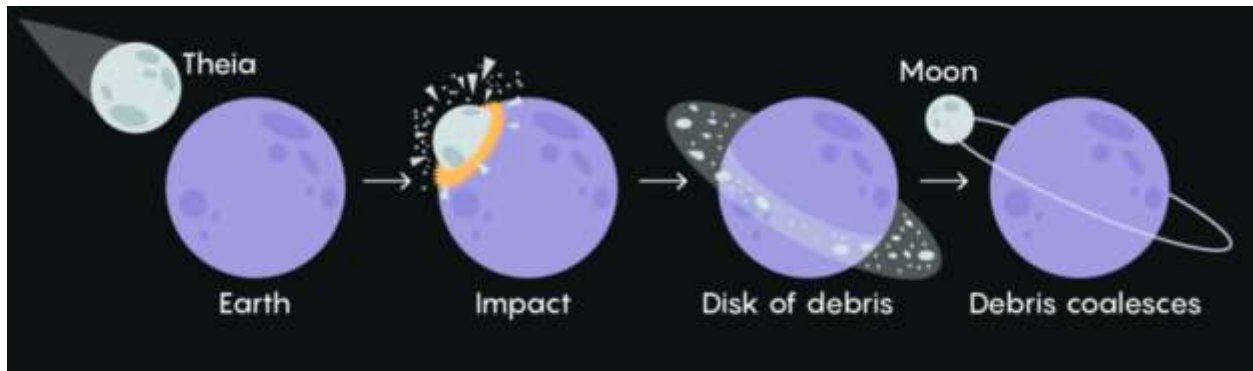
- Understand why escape velocity is needed and how rockets achieve it.
-

9.5 Theories of the Moon's Origin

Scientists have proposed several theories to explain how the Moon formed:

1. Giant Impact Hypothesis (Most Accepted)

- A Mars-sized body (**Theia**) collided with Earth ~4.5 billion years ago.
- The impact ejected debris into orbit, which eventually formed the Moon.
- Supported by Moon rock analysis (similar composition to Earth's mantle).



2. Capture Theory

- The Moon was an independent celestial body that Earth's gravity captured.
- Unlikely because the Moon's composition closely matches Earth's.

3. Co-accretion Theory

- The Earth and Moon formed together from the same cloud of dust and gas.
- Doesn't explain why the Moon lacks a large iron core like Earth.

Study Tip:

- Focus on the **Giant Impact Hypothesis** and its supporting evidence.
-

