

# SESA2024 Astronautics

## Chapter 2: Environment – Exercises

1. What are induced environments and why are they important?

*The induced environments are the environments that occur prior to the spacecraft getting into its mission orbit. These include... Fabrication, Assembly, Test, Terrestrial transportation and Launch.*

*They are important as the spacecraft must be able to survive these environments and some are very different to what the spacecraft will experience on orbit.*

2. When do the worse periods of Solar storms occur?

*Typically the worst periods of Solar storms occur at times of Solar maximum.*

3. What are the common constituents of the Earth's atmosphere at orbital altitudes?

*Atomic Oxygen, Helium, Nitrogen, Oxygen, Argon and Hydrogen. (Slide 19)*

4. What is the natural space environment that will be encountered by a satellite in a 250 km altitude circular orbit?

*Answer should include:*

*Microgravity, vacuum, low temperatures, the Sun's electromagnetic radiation, the Sun's particle radiation (partially protected by the Earth's magnetic field) external particle radiation (partially protected by the Earth's magnetic field) atmospheric drag, Atomic oxygen, orbiting debris objects*

5. Discuss how the Sun's solar cycle affects the space environment around the Earth.

*The Sun outputs both electromagnetic radiation and particle radiation into the solar system and both these outputs increase with the solar cycle.*

*The change in electromagnetic radiation results in an increase in the solar flux at 1 AU. This raises the kinetic temperature of Earth's atmosphere, causing it to expand.*

*This increases the atmospheric drag experienced by satellites in low LEO altitudes.*

*The quantity of particle radiation and solar storms is at a maximum at the peak of the solar cycle. This increases the radiation environment around the Earth (especially if the matter emitted by a solar storm heads straight towards the Earth), and can have a buffeting effect on the Earth's magnetic field.*

6. How does the microgravity experienced in space affect satellite design?

*Answer should include:*

*Structural design, Difficulty in mechanism deployment testing on the ground, No convective heat transport, Propellant management problems, (Physiological effects on humans)*

7. How does the particle radiation environment that a satellite will encounter in the Earth's equatorial plane change as the orbital altitude increases?

*In low, LEO (200-500 km) the particle radiation environment is 'relatively' safe as this region is protected by the Earth's magnetic field.*

*As the altitude increases the environment becomes more severe due to the trapped particles in the Van Allen belts (student could go into more detail about the fluctuating intensity as outlined on slide 25).*

*As the altitude increases further past the GEO ring the satellite would be exposed to particle radiation from the Sun (the severity of which is linked to the solar cycle) and Galactic Cosmic Rays (GCR).*

8. Why are we concerned about material outgassing?

*This creates potential contamination issues (for sensors, instruments and test facilities).*

9. What are the sources of the harsh dynamic acceleration environment throughout launch?

*Generated by: Functioning machinery, Combustion phenomena, Structural excitation in the acoustic field*

10. Briefly discuss the effect of the Van Allen belts on satellite design.

*The Van Allen belts are regions of high particle radiation. Spacecraft spending long durations in these regions will require more shielding to protect the subsystems (from events such as SEU) and there will also be an increased degradation of solar arrays and spacecraft charging.*