Science & Technology · GS - III

Discuss the challenges associated with space debris and uncontrolled atmospheric re-entry of satellites. Suggest measures to ensure the long-term sustainability of outer space activities.

EXAM YEAR	PAPER	SUBJECT
DAILY PRACTICE 05/11/2026	GS - III	Science & Technology

MARKS	WORD LIMIT
10	~150 words

Answer Hint

Space debris, orbital congestion, atmospheric re-entry, collision risks, satellite safety, space situational awareness, debris mitigation, international cooperation, end-of-life disposal, sustainable space governance.

Model Answer

Introduction

The rapid expansion of satellite launches and space missions has increased the accumulation of human-made objects in Earth's orbit, creating challenges for the long-term sustainability of outer space activities.

Major Challenges

Space debris includes defunct satellites, discarded rocket stages and fragments from collisions. These objects can damage operational spacecraft and create cascading collisions, commonly associated with the Kessler Syndrome.

Uncontrolled atmospheric re-entry creates additional concerns because some spacecraft components may survive intense heating and reach Earth's surface. The failure of a proposed rescue mission for NASA's Neil Gehrels Swift Observatory also highlights the technical complexity of servicing ageing spacecraft.

Measures for Sustainability

Effective measures include improved space situational awareness, collision avoidance systems, responsible satellite design and controlled deorbiting. Technologies for active debris removal and international coordination are also important.

Conclusion

Space sustainability requires responsible conduct by governments and private operators, supported by international guidelines and technological innovation. Preventing debris generation is essential for protecting future access to space.

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