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PHYS 373 Galactic Astrophysics Review Questio

Part A: An imperial star destroyer has to make a crash landing on Mandalore after being damaged in battle. The mass of the star destroyer is 3.6×10^{10} kg and it is traveling at 120 m/s. How much energy is imparted on Mandalore during the crash?

Part B: While scanning the wreckage, the Empire discovers rebels hiding on Mandalore and Lord Vader decides to eliminate the planet. How much energy would the death star need to destroy Mandalore if its mass is 1.2×10^{25} kg and its radius is 6300 km?

Part C: After the destruction of the planet, emission lines from Beskar are observed on Coruscant at a wavelength of 285nm. The rest wavelength is known to be 255nm for Beskar emission lines. Based on this, how fast are the remnants of Mandalore moving towards or away from Coruscant?

Solution:

Part A: $KE = \frac{1}{2}mv^2 = 2.59 \times 10^{14}$ J

Part B: $GPE = \frac{3}{5}\left(\frac{GM^2}{R}\right) = 9.15 \times 10^{32}$ J

Part C: $v = \frac{\Delta\lambda}{\lambda_0} c = 3.53 \times 10^7$ m/s