Question:

An oil tankers engine has broken down, and the wind has accelerated the tanker to a speed of 1.5 m/s straight towards a reef. When the tanker is 500m from the reef the wind dies slowly as the engineers gets the engine running. The rudder is stuck, so the only choice is to try to accelerate straight backward away from the reef. The mass of the tanker and cargo is 36000000kg, and the engines produce a net horizontal force of 80000N on the tanker. Will the ship hit the reef? Provide full justification for your answer

Answer:

From Newton's second law deceleration of tanker equals:

$$a = \frac{F}{m}$$

For uniformly accelerated motion distance equals:

$$d = \frac{v_0^2 - v_f^2}{2a}$$

where v_0 is initial speed, v_f is final speed.

Therefore, distance to stopping equals ($v_f = 0$):

$$d = \frac{v_0^2}{2a} = \frac{v_0^2 m}{2F} = \frac{1.5^2 36000000}{2 \cdot 80000} \cong 510 \, m$$

$510 > 500$, therefore ship will hit the reef.