

- 14 The photograph shows a fireboat used to put out fires on ships at sea. A pump, fixed to the boat, pumps water from the sea. The seawater is projected at high speed out of a pipe connected to the pump.



(Source: © Konrad Zelazowski/age fotostock/Superstock)

- (a) The mass of seawater pumped each second is 300 kg. The pipe has a diameter of 10.0 cm.
density of seawater = 1030 kg m^{-3}

- (i) Show that the speed at which the seawater is projected from the pipe is about 37 m s^{-1} .
(4)

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- (ii) Determine the rate at which the momentum of the seawater is changed by the pump. You may assume that the seawater is initially stationary.

(2)

Rate of change of momentum =

- (b) Projecting water from the pipe causes a force to be exerted on the pump.

Explain the direction of the force on the pump.

(2)

- (c) Initially the pump is turned off and the fireboat moves forwards through the water at a constant speed. The boat's engine provides a constant forward force.

When the pump is turned on, water is projected forwards and the fireboat slows to a lower constant speed.

Explain why the boat now has a lower constant speed.

Your answer should refer to all the horizontal forces on the boat.

(3)