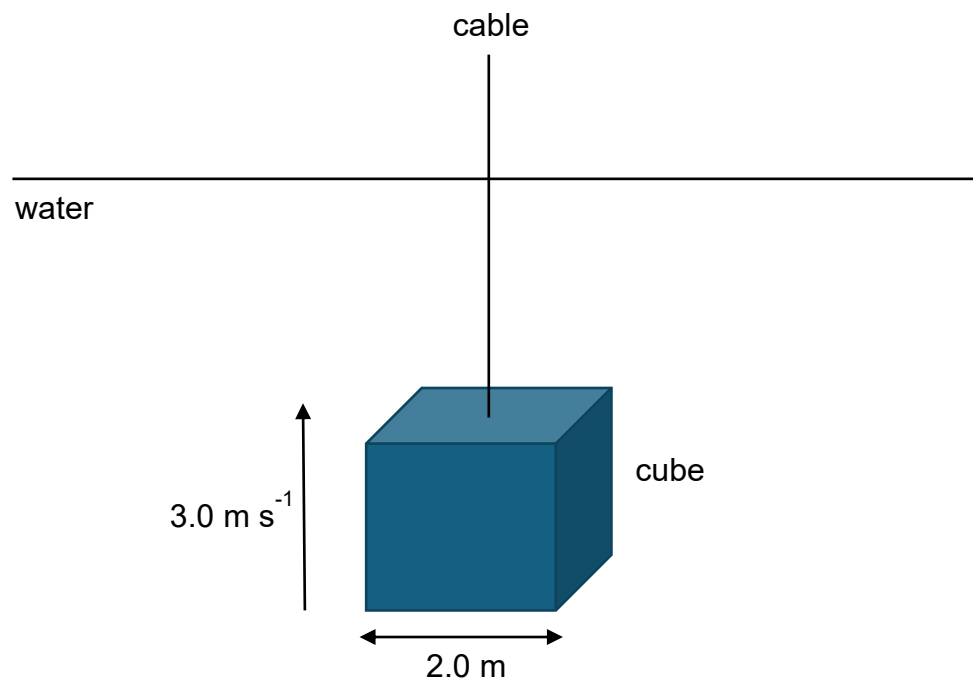


- 2 A salvage crane with an output power of 522 kW is lifting a fully submerged cube crate with sides of length 2.0 m out of the sea at a constant speed of  $3.0 \text{ m s}^{-1}$  as shown in Fig. 2.1.



**Fig. 2.1**

The average density of the cube is  $3060 \text{ kg m}^{-3}$  and the density of the sea water is  $1020 \text{ kg m}^{-3}$ . The drag force of the water acting on the crate is not negligible.

- (a) (i) State Archimedes' Principle.

.....

[1]

.....

**(ii)** Show that the upthrust acting on the crate is 80 kN.

[1]

**(b) (i)** Explain why the net work done on the crate is zero.

.....

.....

[2]

.....

.....

**(ii)** Hence, calculate the magnitude of the drag force of the water acting on the crate.

[3]

drag force = ..... kN

- (c) Using work and energy considerations, and assuming the power output of the crane remains constant throughout, describe and explain the motion of the crate when it is lifted above the surface of the water.

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[3]

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