1 A solid cylinder is lifted out of oil by a wire attached to a motor. Fig. 1.1 shows two different positions X and Y of the cylinder during the lifting process.
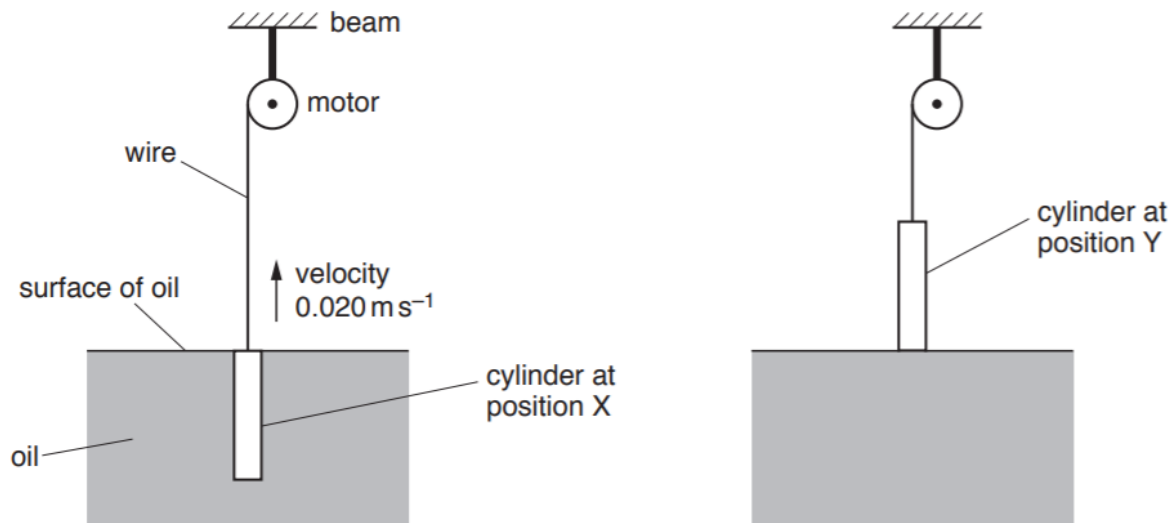

Fig. 1.1

The motor is fixed to an overhead beam.

The cylinder has a cross-sectional area of 0.018 m², length 1.2 m and weight 560 N.

The density of the oil is 940 kg m⁻³.

Throughout the lifting process, the cylinder moves vertically upwards with a constant velocity of 0.020 m s⁻¹. The viscous force of the oil acting on the cylinder is negligible.

(a) For the cylinder at position X in Fig. 1.1, calculate the upthrust acting on the cylinder.

upthrust = ... N   [2]

(b) Calculate, for the moving cylinder at position X,

   (i) the tension in the wire,

tension = …………………… N   [2]

(ii)   the power output of the motor.

power = ………………….. W   [2]

(c)   The cylinder is raised with constant velocity from position X to position Y.

Explain why the power output of the motor is seen to increase as the cylinder is raised. Numerical values are not required.

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[Total: 8]