2 A motor uses a wire to raise a block, as illustrated in Fig. 2.1.

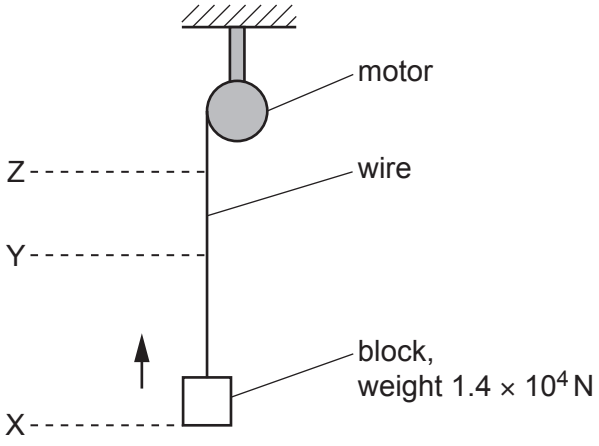

Fig. 2.1 (not to scale)

The base of the block takes a time of 0.49 s to move vertically upwards from level X to level Y at a constant speed of 0.64 m s^{-1}. During this time the wire has a strain of 0.0012. The wire is made of metal of Young modulus 2.2 × 10^{11} Pa and has a uniform cross-section.

The block has a weight of 1.4 × 10^4 N. Assume that the weight of the wire is negligible.

(a) Calculate:

(i) the cross-sectional area A of the wire

A = ... m^2 [2]

(ii) the increase in the gravitational potential energy of the block for the movement of its base from X to Y.

increase in gravitational potential energy = ... J [3]

(b) The motor has an efficiency of 56%.

Calculate the input power to the motor as the base of the block moves from X to Y.

input power = ... W [3]

(c) The base of the block now has a uniform deceleration of magnitude $1.3\,m\,s^{-2}$ from level Y until the base of the block stops at level Z.

Calculate the tension T in the wire as the base of the block moves from Y to Z.

T = ... N [3]

(d) The base of the block is at levels X, Y and Z at times t_X, t_Y and t_Z respectively.

On Fig. 2.2, sketch a graph to show the variation with time t of the distance d of the base of the block from level X. Numerical values of d and t are not required.

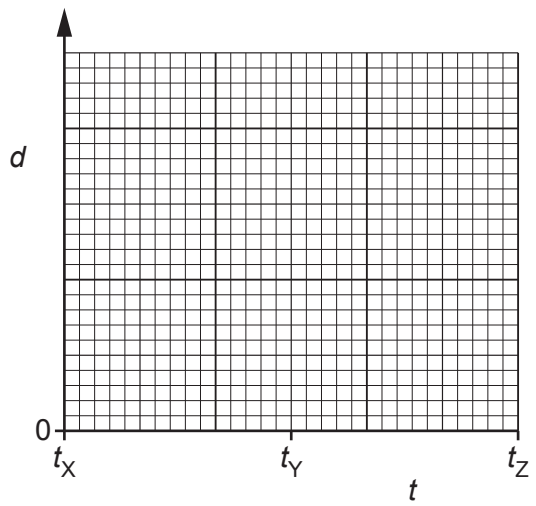

Fig. 2.2

[2]

[Total: 12]