3 **(a)** State what is meant by the work done by a force.

.....

..... [1]

(b) A block of mass m is raised vertically at constant speed. The vertical height gained by the block is Δh, as shown in Fig. 3.1.

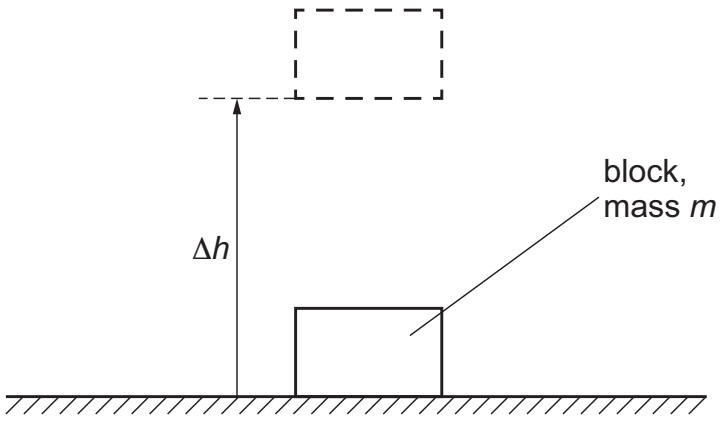

Fig. 3.1

Derive an expression, in terms of m and Δh, for the change in gravitational potential energy ΔE_P of the block. State the meaning of any other symbols you use.

[2]

(c) An electric motor has an input power of 900 W. The motor takes 1.0 minute to lift a load of weight 240 N at constant speed through a vertical height of 150 m. Resistive forces are negligible.

(i) Show that the work done by the motor on the load in 1.0 minute is 36 kJ.

[1]

(ii) Determine the useful output power of the motor.

power = ... W [2]

(iii) Use your answer in **(c)(ii)** to determine the efficiency of the motor.

efficiency = ... [2]

(iv) Some of the power wasted in the motor is dissipated by the resistance of its coil. This dissipated power is 280 W.

The coil of the motor is made from wire of total length 23 m. The wire has a cross-sectional area of $2.6 \times 10^{-8}\,m^2$ and is made from metal of resistivity $1.7 \times 10^{-8}\,\Omega\,m$.

Calculate the current in the coil.

current = ...A [3]

[Total: 11]