3 **(a)** Define the terms

(i) *power*,

.....[1]

(ii) the *Young modulus*.

.....

.....

.....[1]

(b) A crane is used to lift heavy objects, as shown in Fig. 3.1.

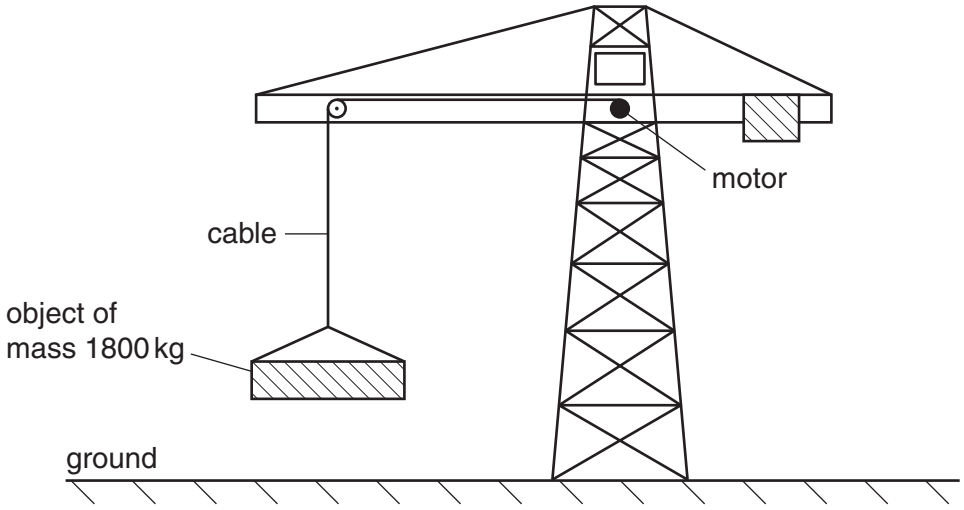

Fig. 3.1

The motor in the crane lifts a total mass of 1800 kg from rest on the ground. The cable supporting the mass is made of steel of Young modulus 2.4×10^{11} Pa. The cross-sectional area of the cable is 1.3×10^{-4} m^2. As the mass leaves the ground, the strain in the cable is 0.0010. Assume the weight of the cable to be negligible.

(i) **1.** the Young Modulus of the steel to show that the tension in the cable is 3.1×10^4 N.

[2]

2. Calculate the acceleration of the mass as it is lifted from the ground.

acceleration = ... m s^{-2} [3]

(ii) The motor now lifts the mass through a height of 15 m at a constant speed.

Calculate

1. the tension in the lifting cable,

tension = ... N [1]

2. the gain in potential energy of the mass.

gain in potential energy = ... J [2]

(iii) The motor of the crane is 30% efficient. Calculate the input power to the motor required to lift the mass at a constant speed of 0.55 m s^{-1}.

input power = ... W [3]