3 (a) (i) Define power.

....

.... [1]

(ii) A force F takes time t to move an object through a displacement x at constant velocity v in the direction of the force. The work done by the force is W.

Use the definition of power to show that the power P transferred by the force is given by

$$P = Fv.$$

[2]

(b) A block is pulled up a slope by a wire attached to a motor, as shown in Fig. 3.1.
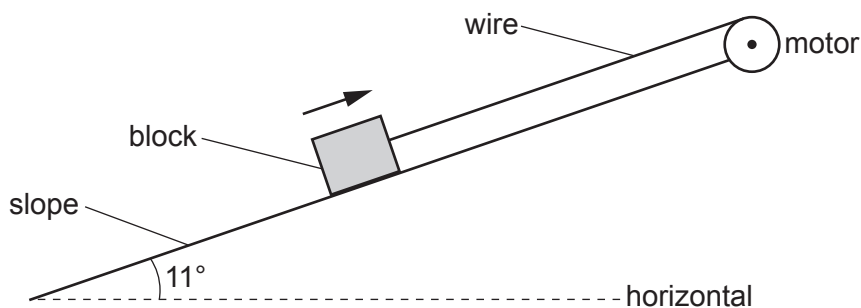

Fig. 3.1 (not to scale)

The useful power output of the motor is 56 W. The block has a weight of 430 N and travels with constant velocity along the slope at an angle of 11° to the horizontal.

Assume that there are no resistive forces opposing the motion of the block.

(i) Calculate the tension T in the wire.

$T =$ .... N [2]

(ii) Calculate the speed of the block.

speed = ... m s^{-1} [1]

(iii) The rate of increase of gravitational potential energy of the block is equal to the useful power output of the motor. One of the reasons for this is that there is no work done against resistive forces.

By considering the motion of the block, state another reason for this.

....

.... [1]

(iv) The motor has an efficiency of 80%.

Calculate the time taken for an input energy of 1.2 kJ to be supplied to the motor.

time taken = ... s [2]