

**2 (a) (i)** Explain what is meant by the term *work done*.

.....

[1]

**(ii)** Hence derive the equation

$$E_p = mgh$$

for the potential energy change of a mass  $m$  moved through a vertical distance  $h$  near the Earth's surface.

[3]

**(b)** A typical escalator in a mall rises at an angle of  $45^\circ$  to the horizontal. It lifts people through a vertical height of 32 m in each minute. 60 people can fit on the escalator and there is a constant stream of people such that the escalator is always fully loaded. It can be assumed that all passengers remain standing still while on the escalator and the average mass of one passenger is 55 kg.

**(i)** Calculate the power needed to lift the passengers when the escalator is fully loaded.

$$\text{power} = \dots \text{W} [2]$$

**(ii)** The total frictional force acting against motion of the escalator is  $1.5 \times 10^4$  N when the escalator is fully loaded.

1. Calculate the power needed to overcome the friction.

power = ..... W [2]

2. In lifting the passengers and overcoming friction, the motor is only 70% efficient due to other forms of energy loss. Calculate the power input for the motor driving the fully loaded escalator.

power = ..... W [2]

[Total: 10]