2 **(a)** **(i)** Define displacement.

.....

.....

(ii) Use your definition to explain how it is possible for a car to travel a certain distance and yet have zero displacement.

.....

.....

[3]

(b) A car starts from rest and travels upwards along a straight road inclined at an angle of 5.0° to the horizontal, as illustrated in Fig. 2.1.

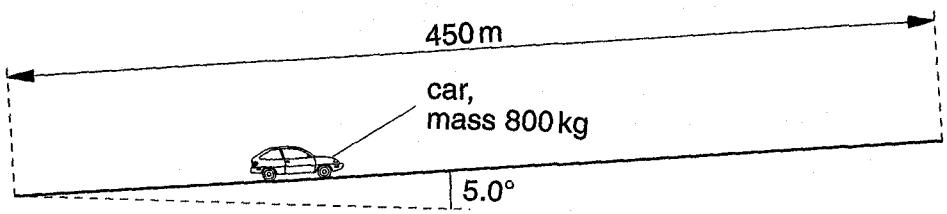

Fig. 2.1

The length of the road is 450 m and the car has mass 800 kg. The speed of the car increases at a constant rate and is 28 m s^{-1} at the top of the slope.

(i) Determine, for this car travelling up the slope,

1. its acceleration,

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

2. the time taken to travel the length of the slope,

time taken = ... s [2]

3. the gain in kinetic energy,

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

[Turn over

4. the gain in gravitational potential energy.

gain in potential energy = ... J [3]

(ii) Use your answers in **(i)** to determine the useful output power of the car.

power = ... W [3]

(iii) Suggest one reason why the actual power output of the car engine is greater than that calculated in **(ii)**.

.....

..... [2]

3 **(a)** Fig. 3.1 shows the variation with tensile force of the extension of a copper wire.

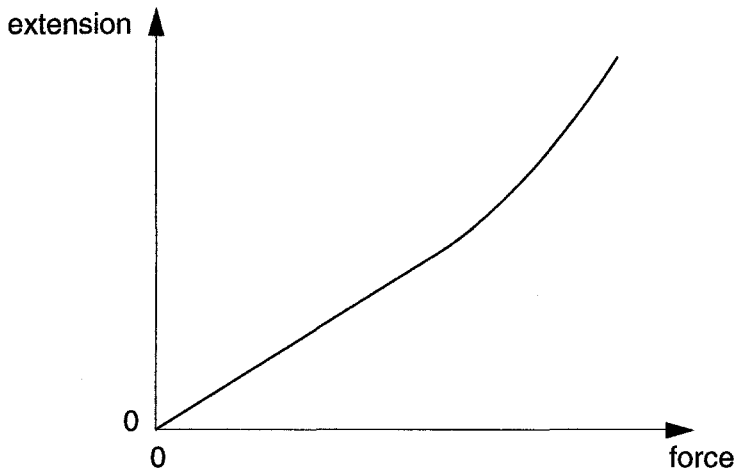

Fig. 3.1

(i) State whether copper is a ductile, brittle or polymeric material.

.....

(ii) **1.** On Fig. 3.1, mark with the letter L the point on the line beyond which Hooke's law does not apply.

2. State how the spring constant for the wire may be obtained from Fig. 3.1.

.....

.....

[3]

(b) A copper wire is fixed at one end and passes over a pulley. A mass hangs from the free end of the wire, as shown in Fig. 3.2.

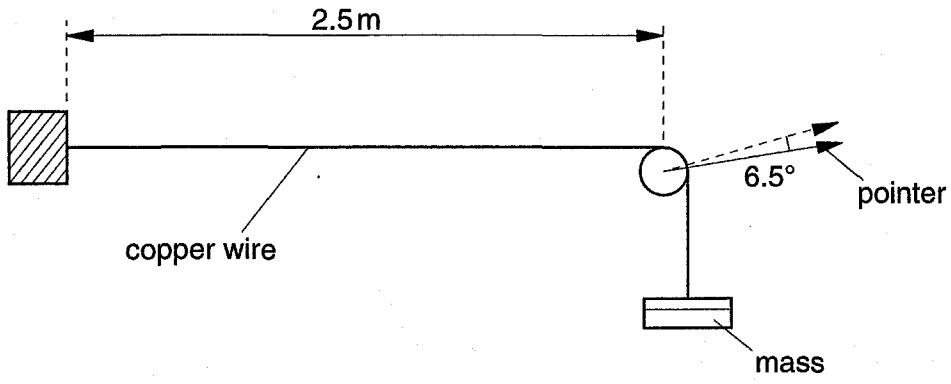

Fig. 3.2

The length of wire between the fixed end and the pulley is 2.5 m. When the mass on the wire is increased by 6.0 kg, a pointer attached to the pulley rotates through an angle of 6.5°. The pulley, of diameter 3.0 cm, is rough so that the wire does not slide over it.

(i) For this increase in mass,

1. show that the wire extends by 0.17 cm,

2. calculate the increase in strain of the wire.

increase in strain = ...

[4]

(ii) The area of cross-section of the wire is $7.9 \times 10^{-7}\,m^2$. Calculate the increase in stress produced by the increase in load.

increase in stress = ... Pa [3]

(iii) Use your answers to **(i) 2** and **(ii)** to determine the Young modulus of copper.

Young modulus = ... Pa [2]

(iv) Suggest how you could check that the elastic limit of the wire is not exceeded when the extra load is added.

.....

..... [1]