A helicopter has a cable hanging from it towards the sea below, as shown in Fig. 3.1.

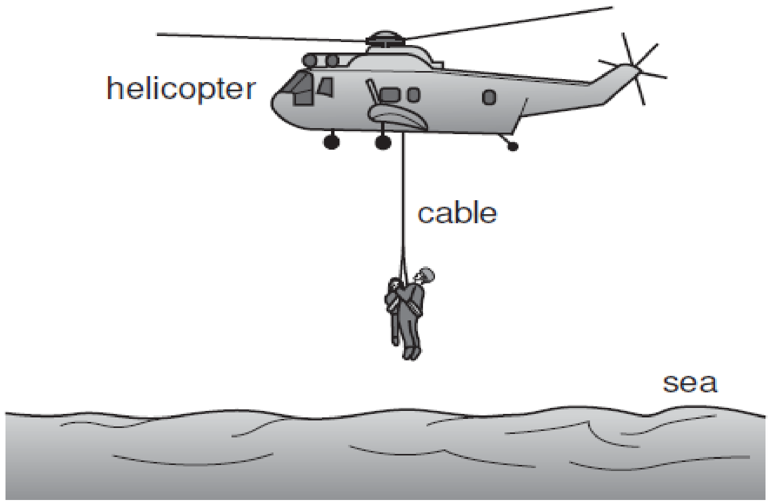

Fig. 3.1

A man of mass 80 kg rescues a child of mass 50.5 kg. The two are attached to the cable and are lifted from the sea to the helicopter. The lifting process consists of an initial uniform acceleration followed by a period of constant velocity and then completed by a final uniform deceleration.

(a) Calculate the combined weight of the man and child.

weight = ... N [1]

(b) Calculate the tension in the cable during

(i) the initial acceleration of 0.570 m s^{-2},

tension = ... N [2]

(ii) the period of constant velocity of 2.00 m s^{-1}.

tension = ... N [1]

(c) During the final deceleration the tension in the cable is 1240 N. Calculate this deceleration.

deceleration = ... $m\,s^{-2}$ [2]

(d) **(i)** Calculate the time over which the man and child are

1. moving with uniform acceleration,

time = ... s [1]

2. moving with uniform deceleration.

time = ... s [1]

(ii) The time over which the man and child are moving with constant velocity is 20 s. On Fig. 3.2, sketch a graph to show the variation with time of the velocity of the man and child for the complete lifting process.

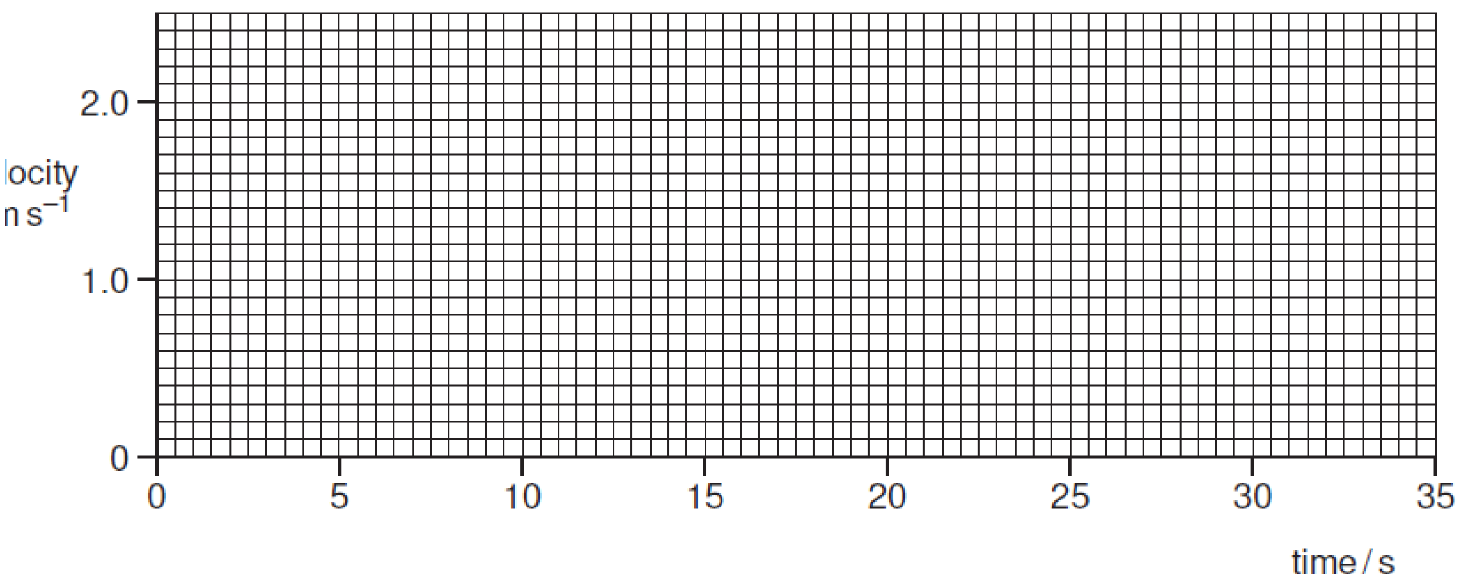

Fig. 3.2

[2]

(a) State Newton's first law.

....

....[1]

(b) A log of mass 450 kg is pulled up a slope by a wire attached to a motor, as shown in Fig. 3.1.

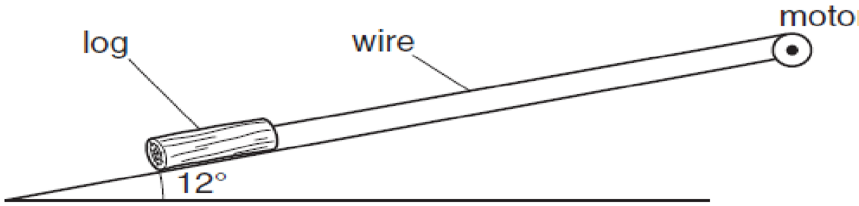

Fig. 3.1

The angle that the slope makes with the horizontal is 12°. The frictional force acting on the log is 650 N. The log travels with constant velocity.

(i) With reference to the motion of the log, discuss whether the log is in equilibrium.

....

....

....

....[2]

(ii) Calculate the tension in the wire.

tension = ... N [3]

(iii) State and explain whether the gain in the potential energy per unit time of the log is equal to the output power of the motor.

....

....

....

....[2]

A motor drags a log of mass 452 kg up a slope by means of a cable, as shown in Fig. 2.1.

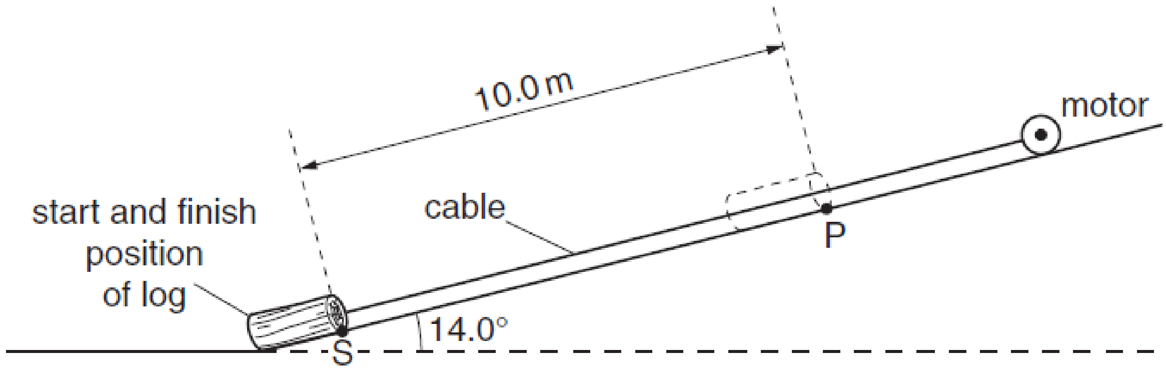

Fig. 2.1

The slope is inclined at 14.0° to the horizontal.

(a) Show that the component of the weight of the log acting down the slope is 1070 N.

[1]

(b) The log starts from rest. A constant frictional force of 525 N acts on the log. The log accelerates up the slope at 0.130 m s^{-2}.

(i) Calculate the tension in the cable.

tension = ... N [3]

(ii) The log is initially at rest at point S. It is pulled through a distance of 10.0 m to point P.

Calculate, for the log,

1. the time taken to move from S to P,

time = ... s [2]

2. the magnitude of the velocity at P.

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

The cable breaks when the log reaches point P. On Fig. 2.2, sketch the variation with time t of the velocity v of the log. The graph should show v from the start at S until the log returns to S. [4]

(a) State Newton's first law of motion.

....

.... [1]

(b) A box slides down a slope, as shown in Fig. 3.1.

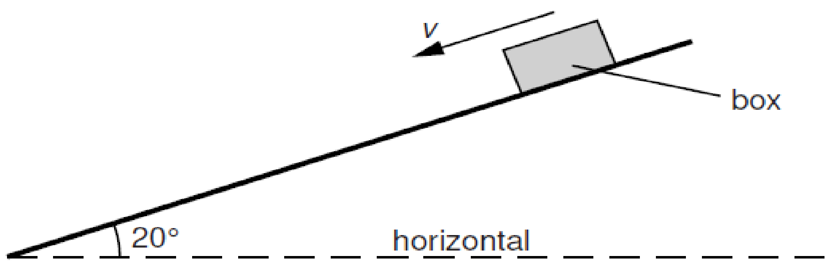

Fig. 3.1

The angle of the slope to the horizontal is 20°. The box has a mass of 65 kg. The total resistive force R acting on the box is constant as it slides down the slope.

(i) State the names and directions of the other two forces acting on the box.

1. ....

2. ....
[2]

(ii) The variation with time t of the velocity v of the box as it moves down the slope is shown in Fig. 3.2.

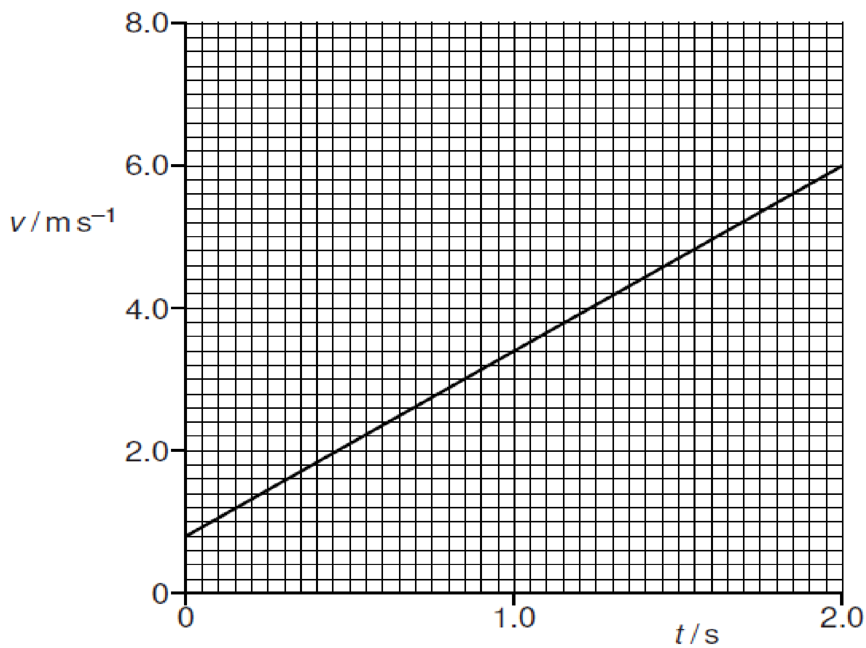

Fig. 3.2

1. Use data from Fig. 3.2 to show that the acceleration of the box is 2.6 $m s^{-2}$.

[2]

2. Calculate the resultant force on the box.

resultant force = ... N [1]

3. Determine the resistive force R on the box.

R = ... N [3]