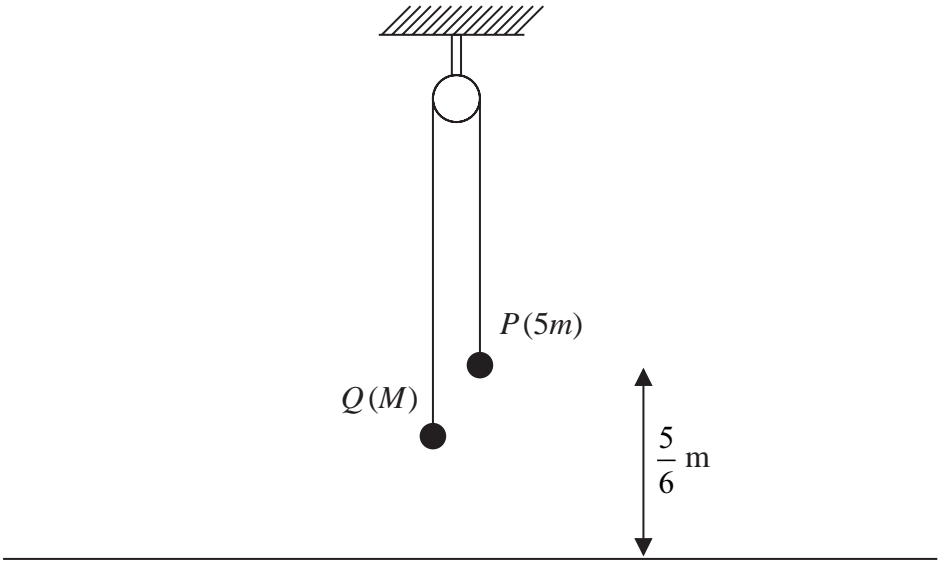**4.**

Figure 1

A particle P has mass $5m$.
A particle Q has mass M, where $M < 5m$.
The particles P and Q are connected by a light inextensible string.
The string passes over a small smooth light pulley that is fixed above horizontal ground.

Particle P is held at rest at a distance $\dfrac{5}{6}$ m above the ground.

Particle Q hangs freely with the string taut, as shown in Figure 1.

At time $t = 0$, P is released from rest and begins to move downwards.
The particle P reaches the ground before Q reaches the pulley.

As P moves downwards, the tension in the string is $\dfrac{10mg}{3}$

In an initial model,

- air resistance is negligible

- P hits the ground at time $t = T$ seconds

Using the model,

(a) find M in terms of m

(6)

(b) find the value of T

(2)

In a refinement to the model,

- air resistance is included

- P hits the ground at time $t = T_1$ seconds

(c) State which is greater, T or T_1. You must give a reason for your answer.

(2)