4.

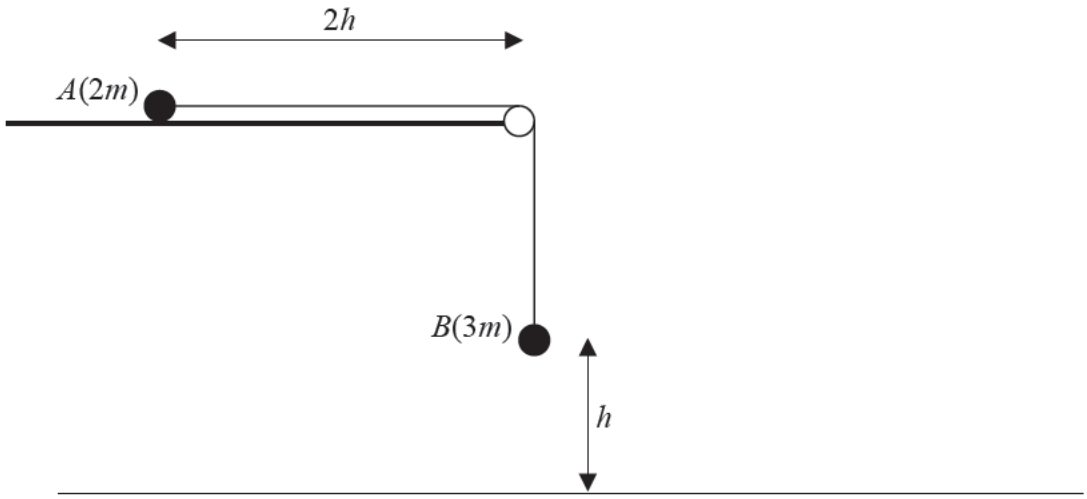

Figure 2

A small smooth light pulley is fixed to the edge of a rough horizontal table.

Two particles A and B are connected by a string which passes over the pulley.

- Particle A has mass $2m$
- Particle B has mass $3m$
- Particle A is held at rest on the rough table at a distance of $2h$ from the pulley
- Particle B hangs freely below the pulley, with the string taut, at a height h above a horizontal floor, as shown in Figure 2

Particle A is released from rest and begins to move along the table.

In an initial model,

- the string is modelled as being light and inextensible
- the resistance to motion that the table exerts on A is modelled as a constant force of magnitude $\frac{1}{2}mg$
- air resistance is modelled as being negligible

This model predicts that in the subsequent motion, B first strikes the floor with speed V

Using this initial model,

(a) write down an equation of motion for A

(2)

(b) find V in terms of g and h

(6)

Question 4 continued

In an improvement to the model, the effect of air resistance is included.

This improved model predicts that in the subsequent motion, B first strikes the floor with speed W

(c) State which speed is greater, V or W, explaining your answer.

(1)

(d) State one further improvement to the model that would make the model more realistic.

(1)