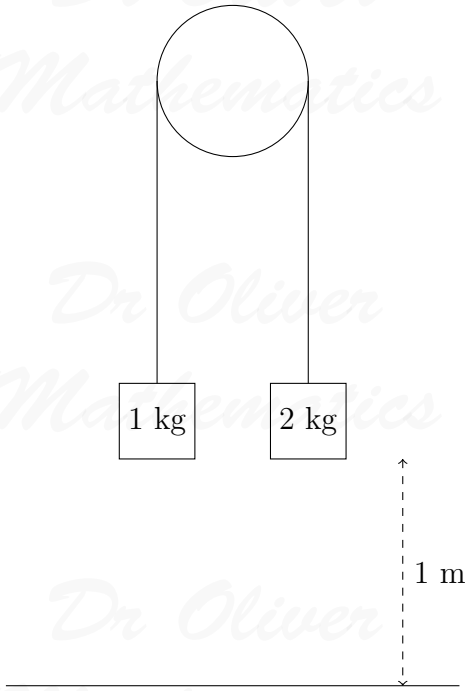
Dr Oliver Mathematics
Dynamics Worksheet

This worksheet consists of 2 questions. The total number of marks available is 27. If you require a numerical value for g use $g = 9.8\,\text{ms}^{-2}$

1. A 1 kg mass and a 2 kg mass are connected by a light inextensible string that runs over a smooth pulley, as shown in the diagram below.



Initially, the two masses are held at rest with each 1 m above a horizontal floor. The system is released from rest.

(a) Explain how you will you use of the following modelling assumptions in your working.
   (i) that the string is light, (1)
   (ii) that the string is inextensible, (1)
   (iii) that the pulley is smooth. (1)

(b) Write down any two other modelling assumptions that you will make in your working. (2)

Assuming that the string is long enough for the 2 kg mass to reach the ground, find

(c) the acceleration of the system, (4)

(d) the time that it takes for the 2 kg mass to reach the floor. (3)

Assuming that the 1 kg does not hit the pulley,

(e) find the maximum height above the floor that the 1 kg mass reaches. (4)

Another student proposes to re-run the initial experiment but this time using 4 kg and 8 kg masses instead.

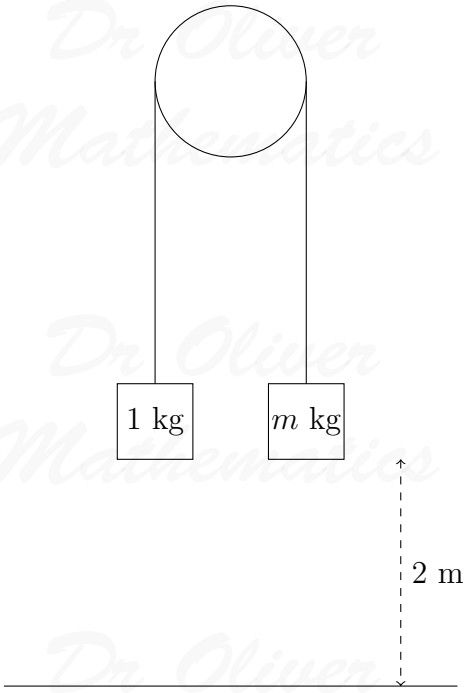
(f) Are the following statements true or false?

(i) The initial acceleration of the system will be the same in the second experiment as the first. (1)

(ii) The 8 kg mass in the second experiment will hit the ground with the same speed as the 2 kg mass did in the first experiment. (1)

(iii) The 4 kg mass will reach the same height above the floor in the second experiment as the 1 kg mass did in the first experiment. (1)

2. A 1 kg mass and a m kg mass are connected by a light inextensible string that runs over a smooth pulley, as shown in the diagram below. (8)



Initially, the two masses are held at rest with each 2 m above a horizontal floor. The system is released from rest. Two seconds later, the heavier of the two masses hits the floor. (You may assume that the string is sufficiently long to prevent the lighter of the two masses from reaching the pulley.)

Find the possible values of m.