12Ma Mechanics Mini Test 03
Forces (Connected Particles/Pulleys)

Question 1

Edexcel IAL M1 June 2021 Q04 adapted

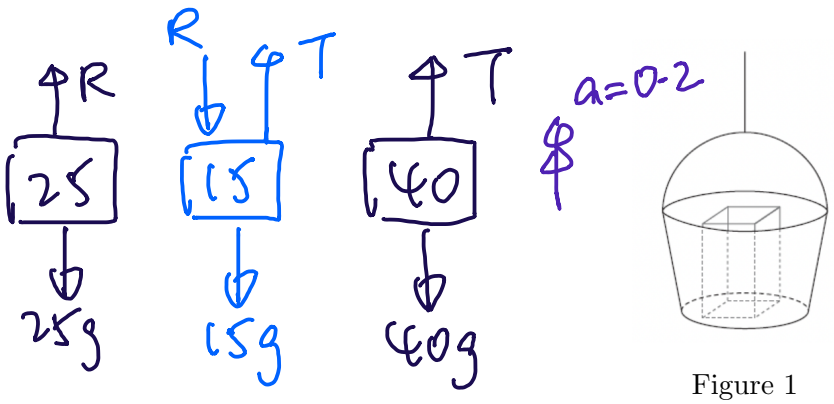


Figure 1

Figure 1 shows a large bucket used by a crane on a building site to move materials between the ground and the top of the building. The bucket is attached to a vertical cable with the bottom of the bucket horizontal.

The mass of the bucket is 15 kg. When the bucket is on the ground, a bag of cement of mass 25 kg is placed in the bucket.

The bucket with the bag of cement moves vertically upwards with constant acceleration 0.2 ms^{-2}.

The cable is modelled as light and inextensible, and air resistance is modelled as being negligible.

(a) Find the tension in the cable.

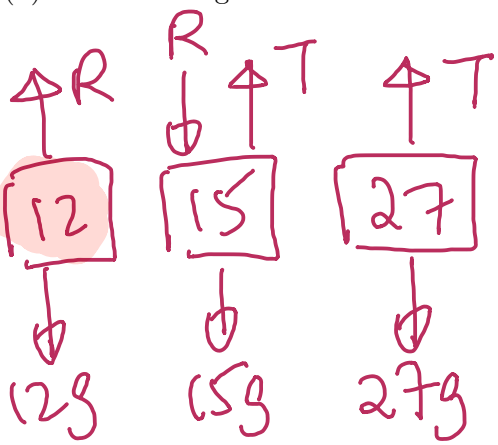
[3]

At the top of the building, the bag of cement is removed.

A box of tools of mass 12 kg is now placed in the bucket.
Later, the bucket with the box of tools is moving vertically downwards with constant deceleration 0.1 ms^{-2}.
Air resistance is again modelled as being negligible.

(b) Find the magnitude of the normal reaction between the bucket and the box of tools.

[3]



Question 2

OCR AS Maths Paper 2 June 2022 Q12 adapted

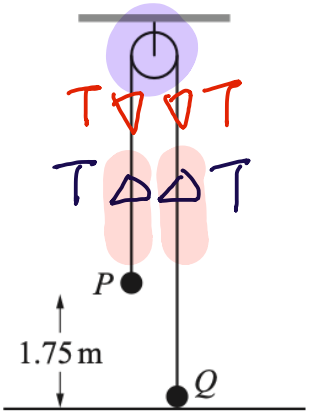


Figure 2

Figure 2 shows two particles P and Q, of masses 8 kg and 6 kg respectively. They are attached to the ends of a light inextensible string. The string passes over a smooth fixed pulley. The system is in equilibrium with P hanging 1.75 m above a horizontal plane and Q resting on the plane. The system is released from rest. You may assume that in the subsequent motion Q does not reach the pulley.

(a) Determine the magnitude of the force exerted on the pulley by the string before P strikes the plane. **[5]**

(b) Determine the total distance travelled by Q between the instant when the system is released and the instant when Q first comes momentarily to rest. **[4]**

(c) When the system is again in equilibrium, find the magnitude of the normal reaction force acting on P. **[2]**

When this motion is observed in practice, it is found that the total distance travelled by Q between the instant when the system is released and the instant when Q first comes momentarily to rest is less than the answer calculated in part (b).

(d) State **one** factor that could account for this difference. **[1]**

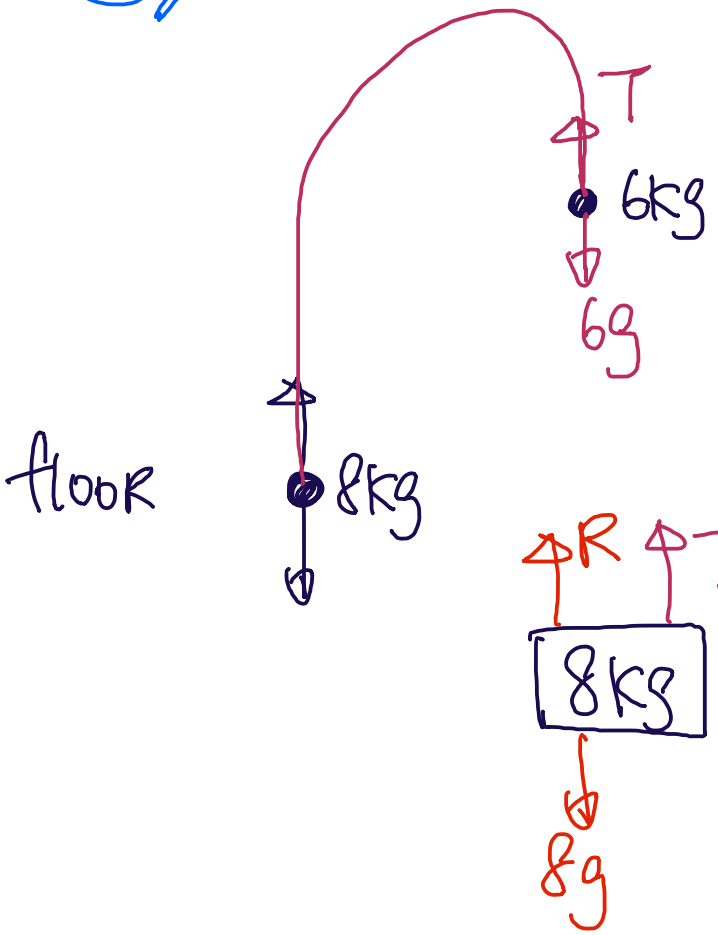
Stage 2

$s = ?$
$u = +\sqrt{4.9}$
$v = 0$
$a = -9.8$
t

$v^2 - u^2 = 2as$
$0 - 4.9 = 2(-9.8)s$
$4.9 = 19.6\ s$
$s = 0.25$ metre ✓

$1.75 + "0.25" = 2$ metres

(c) //



$F = ma = 0$
$T - 6g = 0$
$T = 6g$

$R = 2g$
$R = 19.6\ N$ //