M1 Chapter 10: Forces and Motion

Lifting

Contact Forces

2.

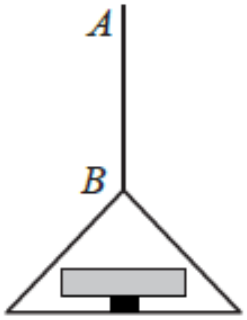

Figure 1

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?

A vertical rope AB has its end B attached to the top of a scale pan. The scale pan has mass 0.5 kg and carries a brick of mass 1.5 kg, as shown in Figure 1. The scale pan is raised vertically upwards with constant acceleration 0.5 m s^{-2} using the rope AB. The rope is modelled as a light inextensible string. The brick is resting on a light inextensible rod.

(a) Find the tension in the rope AB. **(3)**

(b) Find the magnitude of the force in the light inextensible rod. **(3)**

(c) How does the acceleration of the brick get affected by the height of the supporting rod?

(d) What happens to the acceleration of the brick if the supporting rod has it's thickness made equal to zero?

(e) What is the normal supporting force during the acceleration when there is no rod?

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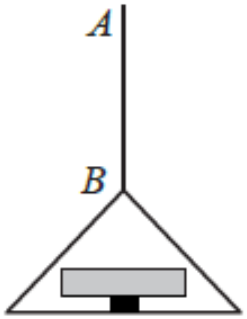

Figure 1

$T - 0.5g - 1.5g = 2 \times 0.5$	M1 A1
$T = 20.6$ (N)	A1
$N - 1.5g = 1.5 \times 0.5$	M1 A1
Force = 15.5 (N)	A1

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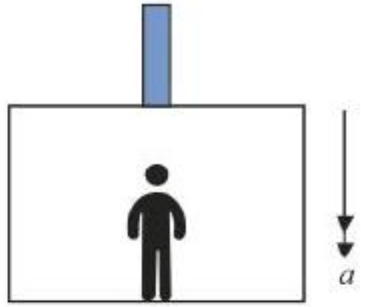
Newton's 3rd Law

Newton's 3rd Law: For every action there is an equal and opposite reaction.

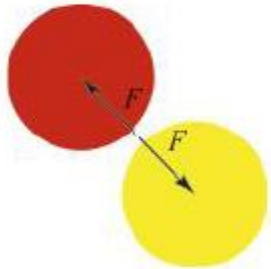
If object A causes an action-force on object B, the object *causing the action* feels a recoiling force. The recoil is the reaction *object A has* to causing an action force on B.

A person standing in a lift exerts a force, acting vertically downwards, on the floor of the lift. The lift exerts a force, acting vertically upwards, on the person. As the lift moves up and down, the size of this force changes but the force that the person exerts on the lift is always equal and opposite to the force the lift exerts on the person.



Key point

Newton's third law states that when an object A exerts a force on an object B, object B exerts an equal and opposite force on object A.



If a red ball hits a yellow ball, the force that the red ball exerts on the yellow ball has equal magnitude to the force that the yellow ball exerts on the red ball. These forces act in opposite directions.

Confused.com: "If the reaction is equal but opposite, surely the object can't move?"

Solution: The action and reaction are acting on different objects!

Lifting

[Textbook] A light scale-pan is attached to a vertical light inextensible string. The scale-pan carries two masses A and B. The mass of A is 400g and the mass of B is 600g. A rests on top of B, as shown in the diagram.
The scale-pan is raised vertically, using the string, with acceleration 0.5 ms^{-2}.

(a) Find the tension in the string.
(b) Find the force exerted on mass B by mass A.
(c) Find the force exerted on mass B by the scale-pan.

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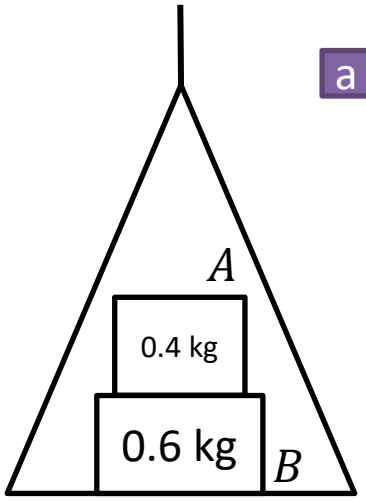

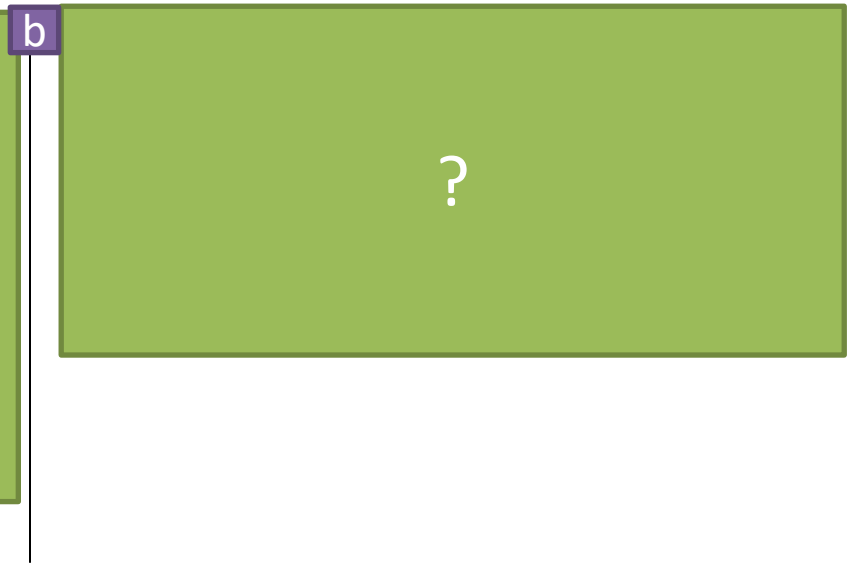

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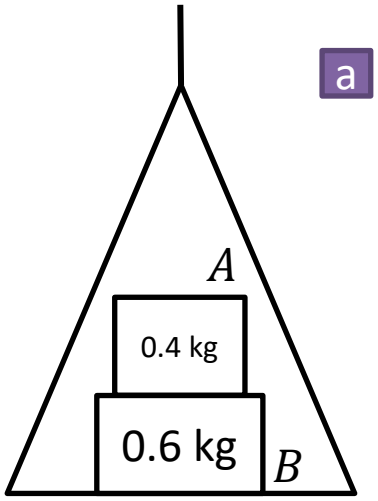
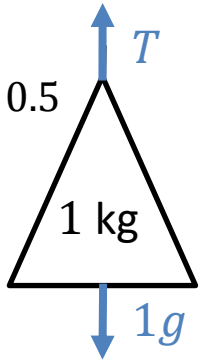


a

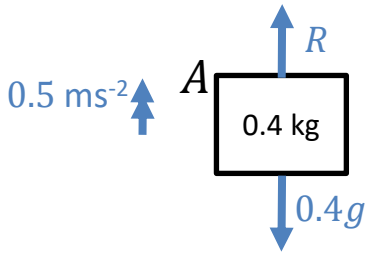
Considering the whole system (i.e. the triangle):

$$R(\uparrow): \quad T - 1g = 1 \times 0.5$$
$$T = 10.3 \text{ N}$$



b

By Newton's 3rd Law, we force exerted on B by A is the same as that exerted on A by B. So considering forces at A:



$R(\uparrow): \quad R - 0.4g = 0.4 \times 0.5$
$R = 4.12$ N
So force exerted on B by A is 4.1N downwards.

Test Your Understanding

Edexcel M1 May 2013 Q2

A woman travels in a lift. The mass of the woman is 50 kg and the mass of the lift is 950 kg. The lift is being raised vertically by a vertical cable which is attached to the top of the lift. The lift is moving upwards and has constant deceleration of 2 m s^{-2}. By modelling the cable as being light and inextensible, find

(a) the tension in the cable, **(3)**

(b) the magnitude of the force exerted on the woman by the floor of the lift. **(3)**

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(a)	For system, $(\uparrow)$, $T - 950g - 50g = 1000 \times -2$	M1 A1
	$T = 7800$ N	A1
		(3)
(b)	For woman, $(\uparrow)$, $R - 50g = 50 \times -2$	M1 A1
	$R = 390$ N	A1
		(3)
		[6]

Classwork Exercise 10.5

Pearson Stats/Mechanics Year 1 Exercise Book
Page 72
Question 4