# Lift Problems

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AS Textbook p170 Example 12 ✓

M1 June 2016 Q2 ✓

M1 June 2015 Q4 ✓

M1 Jan 2009 Q7 ✓

M1 June 2013 Q2 ✓

Crash Maths Bronze Paper Set B ✓
AS Stats & Mech Q8

# Example 12 p170 AS Textbook

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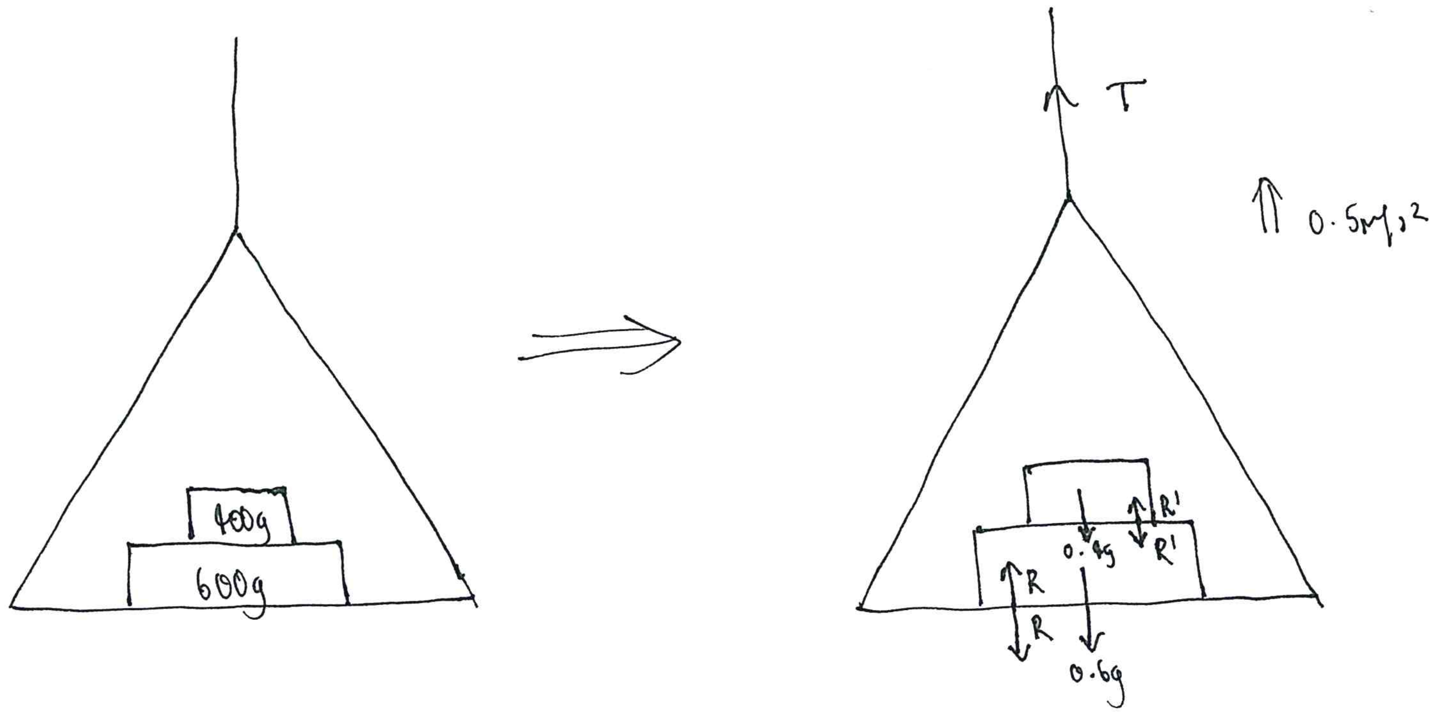


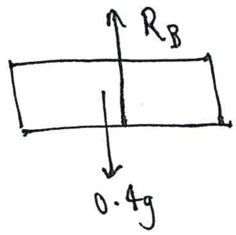

a) Tension in string?

Can think of this as


so $T - g = 1(0.5) \Rightarrow T = 10.3\,N.$

b) Force exerted on mass B by mass A?

By Newton III we can say force exerted on mass B by A is same as force exerted on mass A by B. So let's draw the forces on mass A.




$\Sigma F = ma$

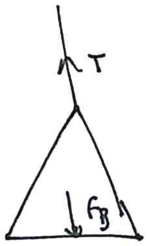
$R_B - 0.4g = 0.4(0.5)$

$R_B = 4.1N.$

So force exerted by B on A = 4.1N upwards. Therefore force exerted by A on B = 4.1N (2sf) downwards.

c) Use the same logic on b) to simplify c). 

Let us find the (reaction) force exerted on the scale pan by mass B instead. $\Rightarrow$




So $T - F_B = 0(0.5)$

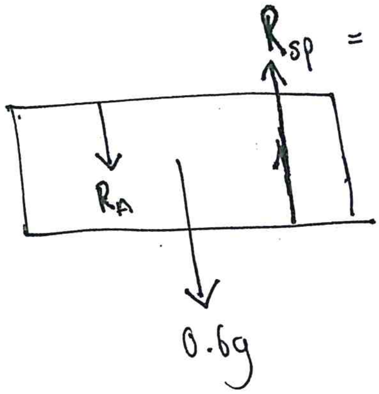
$T = F_B = 10.3\text{ N}$ downwards = reaction force of B on scale-pan.

Therefore force on B by scale-pan (by Newton III) is 10.3 N upwards.

b) alt. We could, instead, think about the forces on B and arrive at the same answer (but in a more complicated way.)

So let's draw B:

since we wish to consider a forces exerted on B




$R_{sp}$ = reaction from scale pan surface.

$R_A$ = reaction force exerted on the B by mass A (the thing we want to find)

so $\sum F = ma$

$$R_{sp} - R_A - 0.6g = 0.6(0.5)$$

$$\Rightarrow \cancel{R_A = 0.6(0.5) + 0.6g} = R$$

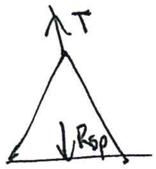
$$\Rightarrow R_A = R_{sp} - 0.6g - 0.6(0.5)$$

Now though, we have two unknowns so we are left to find $R_{sp}$ before we can find $R_A$.

Finding $R_{sp}$ (reaction from scale pan on B):

↳ we must use our knowledge of Newton's III and say that reaction from scale pan on B = reaction from B on scale pan.

so to find reaction from B on scale pan we must consider forces acting on scale-pan (as we did in part c)




$$T - R_{sp} = 0(0.5)$$
$$T = R_{sp} = 10.3\text{N}$$

Hence: $R_A = 10.3 - 0.6g - 0.6(0.5)$
$= 4.12\text{N}$

M1 June 2016 Q2

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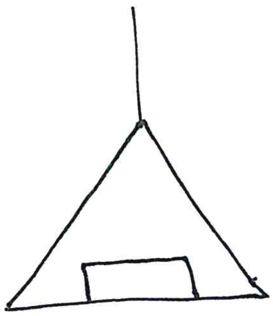
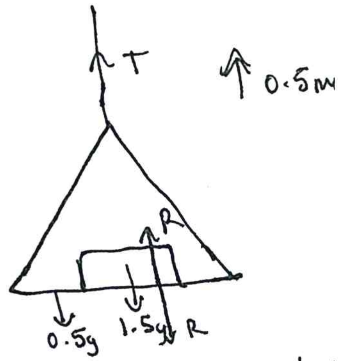


- scale pan mass = 0.5kg
- brick mass = 1.5kg
- vertical acceleration of 0.5 m/s$^2$ using the rope (hence we have tension in the ropes)
- rope is light, inextensible.

light → magnitude of tension constant throughout

inextensible → magnitude of acceleration constant throughout

⇒




a) Find Tension in string

Consider external system (ignore internal force eg R)

~~of f~~ (↑) $\Sigma F = ma$

so $T - 2g = 2a$

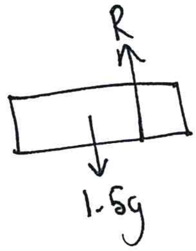
$T = 2(g+a)$

$= 20.6\text{N}$ (3sf)

$= 21\text{ N}$ (2sf)

b) find magnitude of force exerted on scale-pan by brick.

Let us find magnitude of force exerted on brick by scale-pan (because by Newton III we know it is ~~equal~~ equal in magnitude to the force we would like to find).




Here $R - 1.5g = 1.5(0.5)$

$= 15.5\text{N} \doteq 15\text{N}$ (2sf)

# M1 June 2015 Q4

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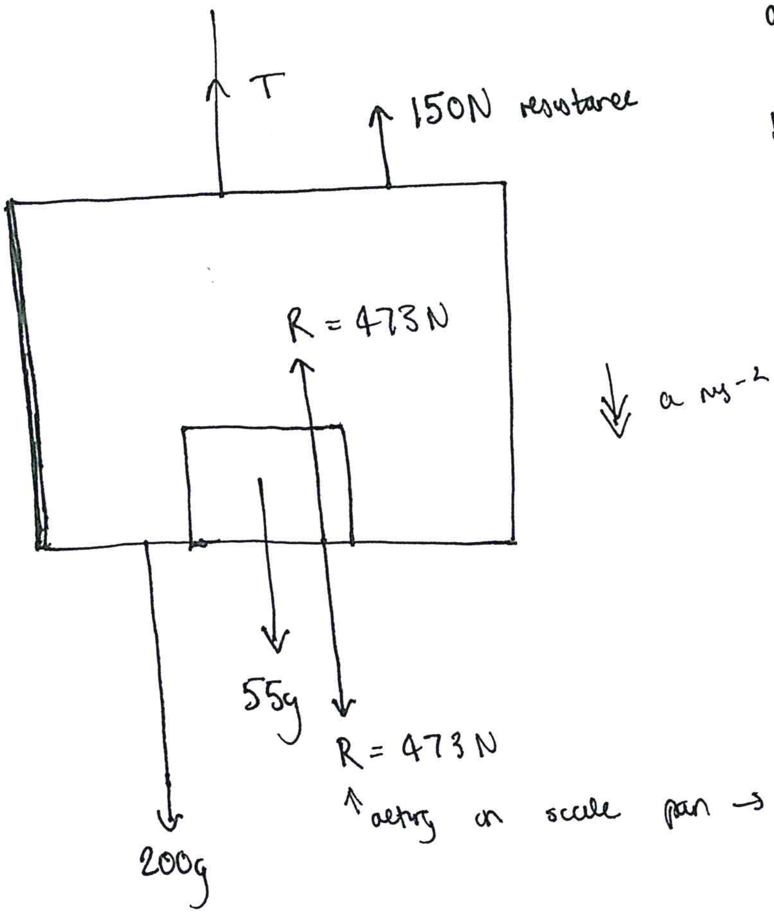
a) find acceleration of lift

b) find magnitude of the force exerted on the lift by the cable.




acting on scale pan → could be drawn like this

a) We could consider the whole system like so: $\Sigma F = ma$

$$255g - 150 - T = 255a$$

but then we have 2 unknowns and only one equation.

So we must realise that the acceleration of the block will be the same as the lift and hope that setting an equation up through considering the resultant force on B will provide us with the answer.

Consider forces on B: $55g - 473 = 55a$

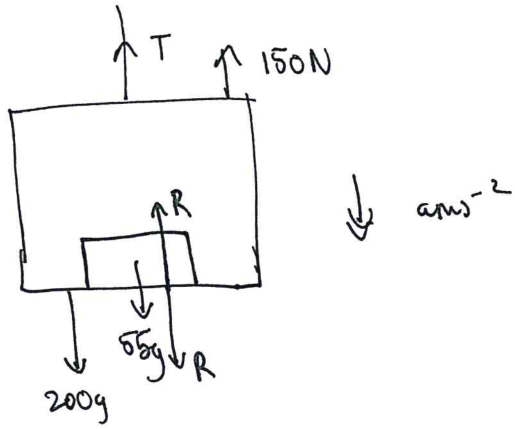
$$\Rightarrow a = 1.2 \text{ m/s}^2$$

b) See next page

b) Force exerted on the lift by the cable is the tension force.



So $\Rightarrow$




so consider whole system as before:

$$200g + 55g - 150 - T = \cancel{m}\ 255(1.2)$$

Solve for $T = 2040\ N$ (3sf)

M1 Jan 2009 Q7

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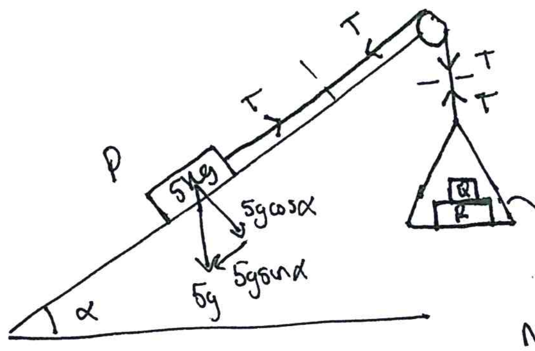
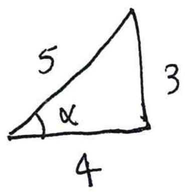



Light, inextensible string.

$\sin\alpha = \frac{3}{5} \Rightarrow$




$\cos\alpha = \frac{4}{5}$

$\tan\alpha = \frac{3}{4}$

$M_Q = 5kg$

$M_R = 10kg$

Model blocks as particles, ignore air resistance, assume motion uninterrupted.

a) i) acceleration of scale pan

We know acceleration of scale pan = acceleration of 5kg block (P) (because string is inextensible).

So consider 5kg block (P): ($\nearrow$) $T - 5g\sin\alpha = 5a$ ①

consider 15kg mass : ($\downarrow$) $15g - T = 15a$ ②

① + ② gives $12g = 20a \Rightarrow a = 0.6g = 5.88\ m/s^2$ (3sf)

Hence $T = 5(0.6g) + 5g\sin\alpha$ (from ①)

$= 6g = 58.8N$ (3sf)

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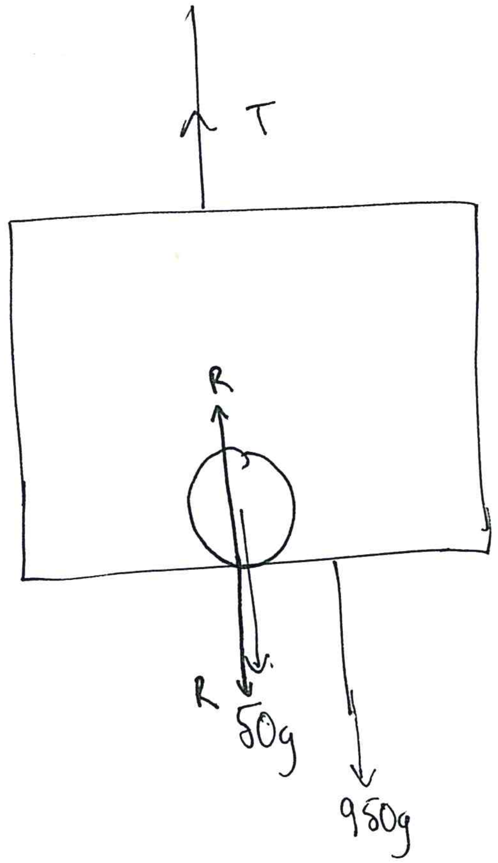
2(a)




$\uparrow a = -2 m/s^{-2}$

moving upwards with the constant deceleration $2 m/s^2$

a) Tension in cable.

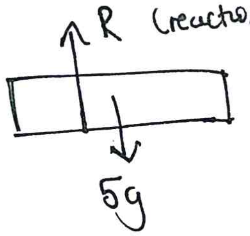
$$T - 1000g = 1000(-2)$$
$$T = 7800N$$

b) $R - 50g = 50a \qquad a = -2$

$$R = 390N.$$

b) Magnitude of force exerted on block Q by block R

Draw forces acting on Q



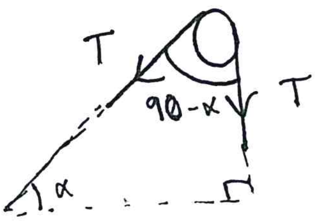

Hence $5g - R = 5a$

$R = 5(g-a)$

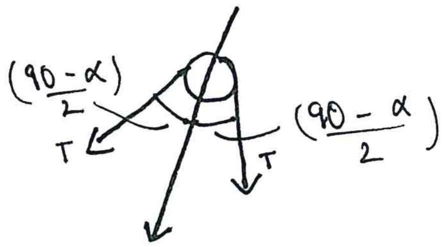
$= 19.6\,N$ (3sf) (upwards)

c) Magnitude of force exerted on pulley by the string

Draw pulley :




so




Method ①: Resolve forces $T\cos\left(\frac{90-\alpha}{2}\right) + T\cos\left(\frac{90-\alpha}{2}\right) = 2T\cos\left(\frac{90-\alpha}{2}\right)$

we know $\sin\alpha = \frac{3}{5}$ so $\alpha = \sin^{-1}\frac{3}{5} = 26.565..^\circ$ (A)

so magnitude of resultant force $= 2T\cos\left(\frac{90-26.565..}{2}\right) = 105\,N$ (3sf)

~~Method ②: resultant force T T 120° $a^2 = b^2 + c^2 - 2bc\cos A$ $a = \sqrt{T^2+T^2-2TT\cos}$ $\Rightarrow a = \sqrt{3T^2}$ $a =$ magnitude of resultant force~~

wrote.

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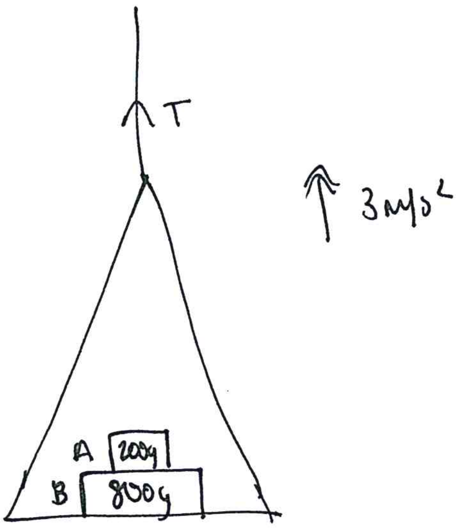
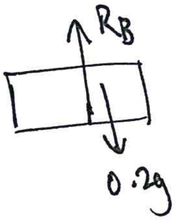



$T - g = 1(3)$

$T = \cancel{10.3N}$ $12.8N = 13N$ (2sf)

b) Mag of force exerted on A by B. ?




$R_B - 0.2g = 0.2(3)$

$R_B = 2.56N$

$= 2.6 N$ .

Mag of force exerted on B by A ?

magnitude of

) By Newton III force exerted on ~~Bg~~ B by A is same

as by A on B = 2.6 N

) Explain how you have used that lift is light in

calculations. → neglected mass of lift (=0)