Solutions posted

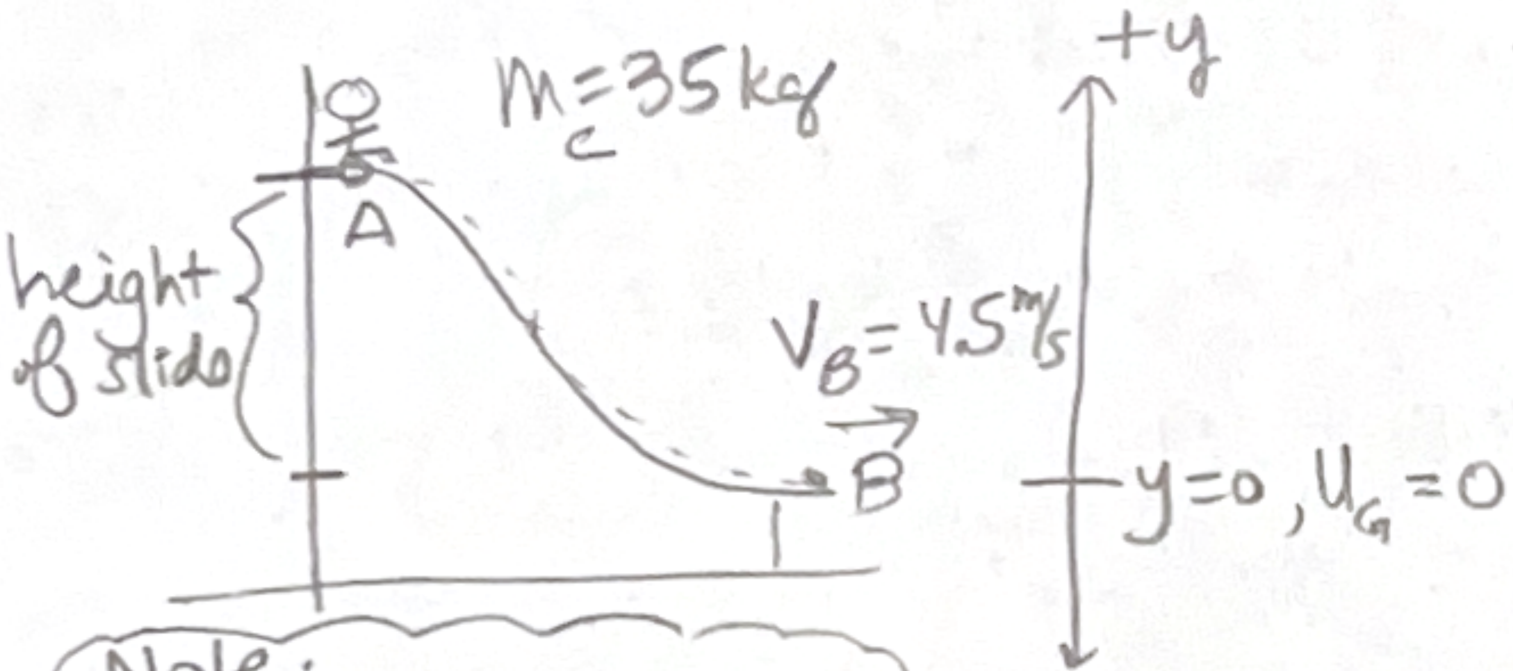
11

Name: ___________
Date: ___________

Energy Analysis / Two-Body

__Let's try this homework plan for Unit 5:__
- Homework is due at the very beginning of the class after it is assigned, ideally being turned in before the end of the passing period. I will not answer questions about the homework once the passing period has begun.
- However, if you have questions that you cannot resolve by studying the solutions or talking to friends, come find me (workroom or classroom) before the passing period begins before our class meeting to ask your questions, and you will receive a one-day extension on that homework assignment.

1. p.256 #6. Complete all the steps in the problem-solving strategy that were on today's classwork activity page.

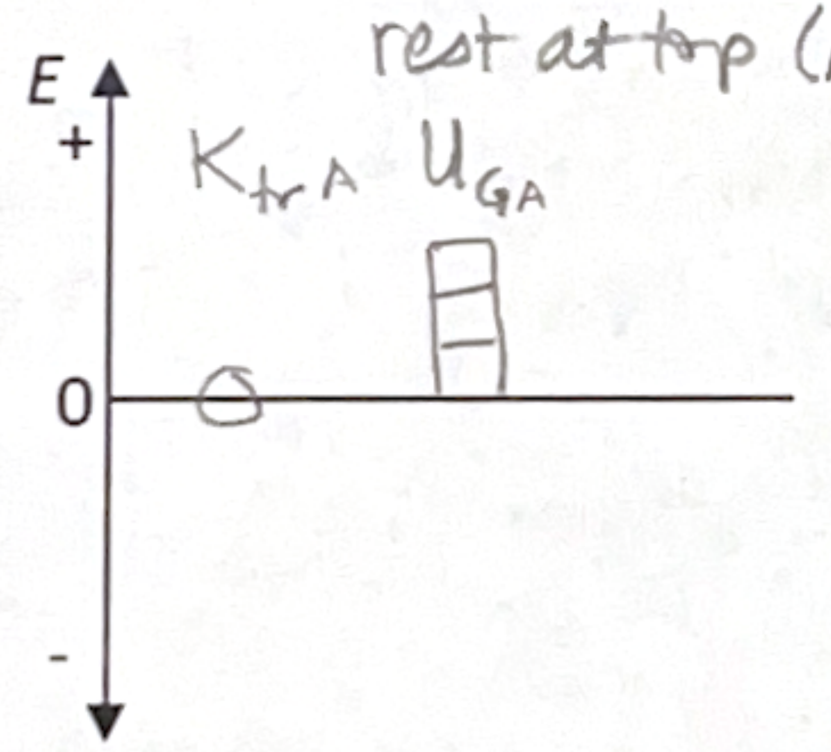


The forces on the child are $\vec{F}_G$ and $\vec{n}$. Because I included the slide and Earth in my system, there are no external forces, and so no transfers by work.

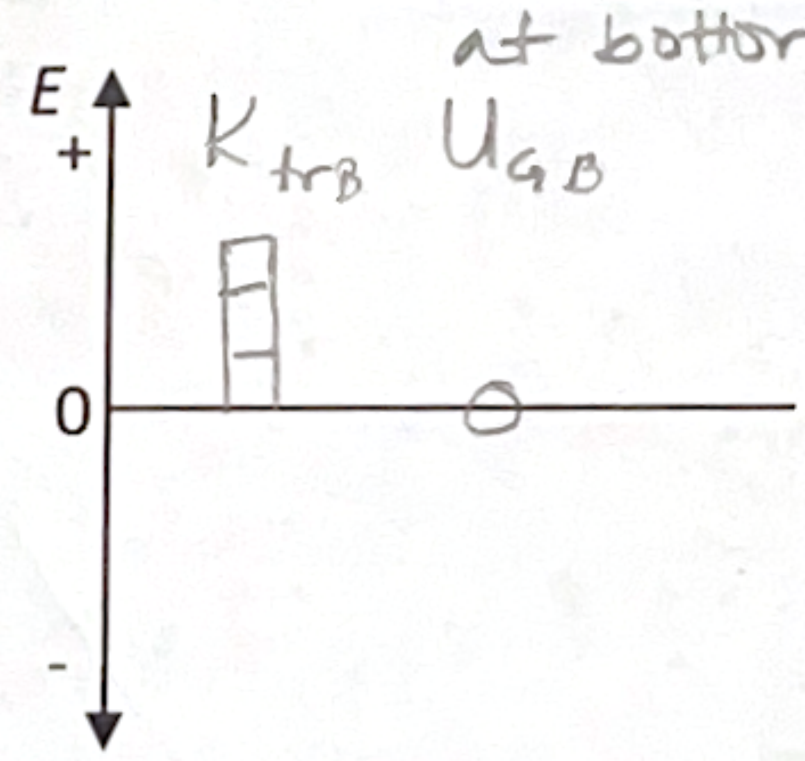
Note: If you don't include the slide in your system, it's fine. But then $\vec{n}$ is an external force. Then, since $\vec{n} \perp$ displacement at all points $W_{s\,nc} = 0$, so still there are no transfers

Note: A poorly worded problem because it ignores the fact that most slides are elevated at their endpoint. The text solution had this picture:

Initial time: Child is at rest at top (A)



Final time: Child is moving at bottom (B)



$$E_i + \Sigma\text{transfers} = E_f$$

$$U_{GA} + 0 = K_{trB}$$

$$m_c g y_A = \frac{1}{2} m_c V_B^2$$

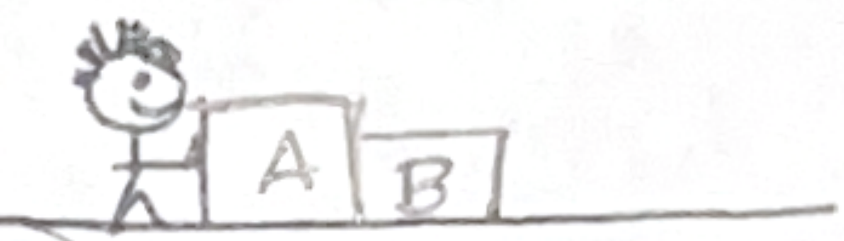
Find y_A:

$$\boxed{y_A = \frac{V_B^2}{2g}}$$

$$y_A = \frac{(4.5\,m/s)^2}{2(10\,N/kg)} = \boxed{1\,m}$$

with force F_{Joe}

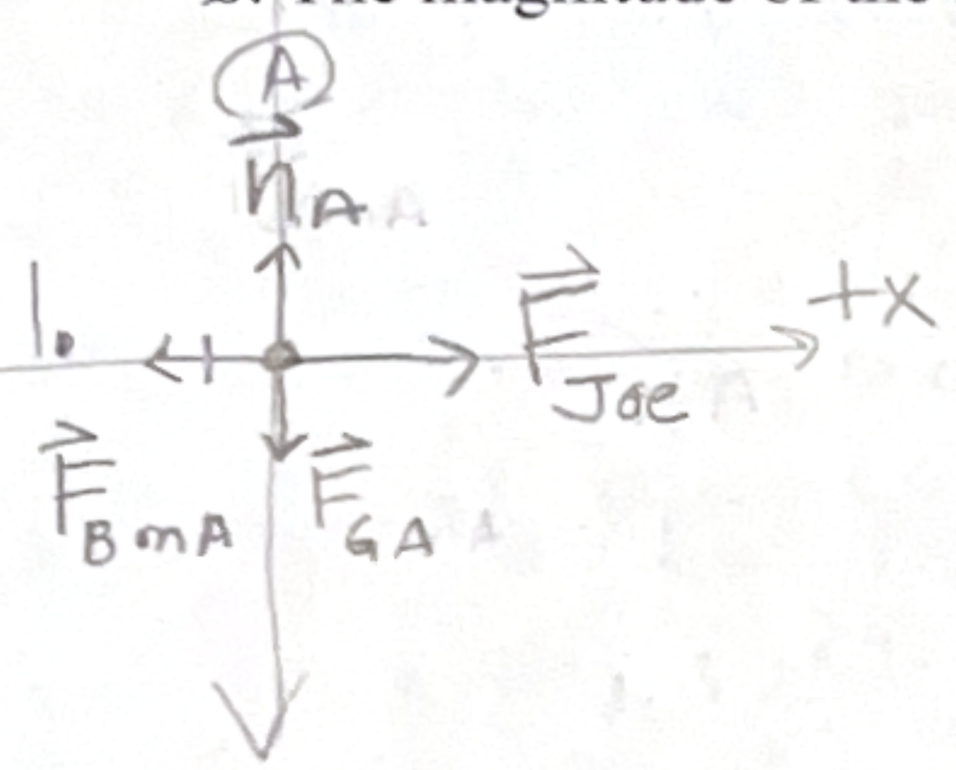
2. Joe pushes on block A which is in contact with block B on a horizontal surface with negligible friction. Find the following in terms of given variables and fundamental constants: (do x-direction only)

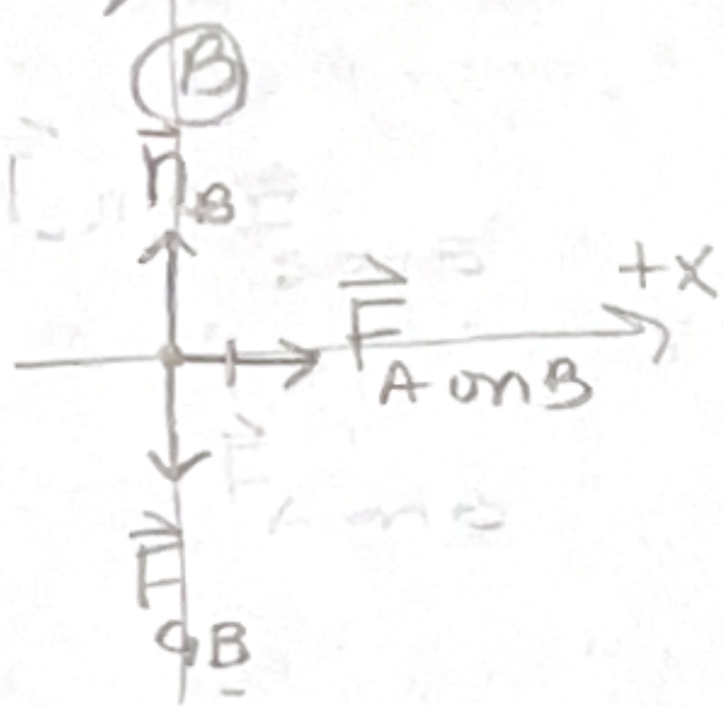


(Show the steps of the General Strategy from the Two-Body Problems activity sheet)

a. The acceleration of block B

b. The magnitude of the force exerted by block B on block A





Note:
Notice that the two contact forces, $\vec{F}_{B\,on\,A}$ and $\vec{F}_{A\,on\,B}$ are an interaction force pair, so by Newton's 3rd Law, they have equal magnitudes + opposite directions.

(A)

	F_x	F_y
$\vec{n}_A$	$n_{Ax} = 0$	$n_{Ay} = +n_A$
$\vec{F}_{GA}$	$F_{GAx} = 0$	$F_{Gx} = -m_A g$
$\vec{F}_{Joe}$	$F_{Joe\,x} = +F_{Joe}$	$F_{Joe\,y} = 0$
$\vec{F}_{B\,on\,A}$	$F_{B\,on\,Ax} = -F_{B\,on\,A}$	$F_{B\,on\,Ay} = 0$

(B)

	F_x	F_y
$\vec{n}_B$	$n_{Bx} = 0$	$n_{By} = +n_B$
$\vec{F}_{A\,on\,B}$	$F_{A\,on\,Bx} = +F_{A\,on\,B}$	$F_{A\,on\,By} = 0$
$\vec{F}_{GB}$	$F_{GBx} = 0$	$F_{GBy} = -m_B g$

Find accel:

Newton's Second Law (x-direction)

$$a_{Ax} = \frac{\Sigma F_{on\,A\,x}}{m_A} \qquad a_{Bx} = \frac{\Sigma F_{on\,B\,x}}{m_B}$$

$$a_{Ax} = \frac{+F_{Joe} - F_{B\,on\,A}}{m_A} \qquad a_{Bx} = \frac{F_{A\,on\,B}}{m_B}$$

Common variables:

$$a_{Ax} = a_{Bx} = a$$

$$F_{B\,on\,A} = F_{A\,on\,B} = F_{AB}$$

Rewrite eqns:

$$m_A a = F_{Joe} - F_{AB} \qquad m_B a = F_{AB}$$

Add equations:

$$m_A a = F_{Joe} - F_{AB}$$

$$+\; m_B a = F_{AB}$$

$$a(m_A + m_B) = F_{Joe}$$

$$a = \frac{F_{Joe}}{(m_A + m_B)}$$

b) Find F_{AB}

Use Block B eqn: $m_B a = F_{AB}$

$$m_B\left(\frac{F_{Joe}}{(m_A+m_B)}\right) = F_{AB}$$

$$F_{AB} = F_{B\,on\,A} = \left(\frac{m_B}{m_A+m_B}\right)F_{Joe}$$