Efficiency of a Ramp

Machines make work easier for us; either the work happens faster or with less force.
A ramp is a simple machine designed to lift objects up with less applied force.
This is a formal lab report. Make sure you examine the rubric to see how you will be assessed. Some direction/hints below.
Remember a full note on 'formal lab report' style is on the website on the 'other useful notes' page.

Some hints & directions

Purpose:
To compare the efficiency of a ramp when: a) pulling a block up versus pulling a cart up and b) when pulling a block up at a low incline versus pulling the same block up a steep incline.

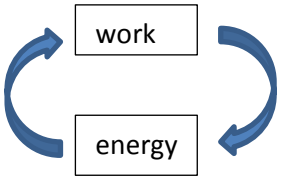
*compare – means to determine if the results are essentially the same/very close or different. If different, which one is greater?

Hypothesis:
You need one for (a) and (b).

Materials & Method:
Your materials and method will be assessed this time as part of your communication mark.
Suggestion: after listing the materials, start with a labeled diagram (diagrams in pencil – but only diagrams and graphs if used). Step #1 in method should then be to instruct to set up as shown in labeled diagram.

Results:
You need to communicate your results in an understandable fashion. A chart of data might work. Do **NOT** put your data at the end. This is the meat of your experiment and should be accessible to your reader. You must include sample calculations of any calculation you do. GRASP is expected.

Conclusion:
Specifically answer the questions posed in your hypothesis.



Analysis:
(please put after conclusion)

1. Use this experiment and to explain the work-energy theorem. Make reference to your set-up and your actual results. Make sure your answer includes a definition of the work-energy theorem. Best answer will include the W-E theorem as a formula **and** also as a graphic illustration. Note: no need to discuss the 'Conservation of Energy' Law here. That is done in #2. (5 marks)

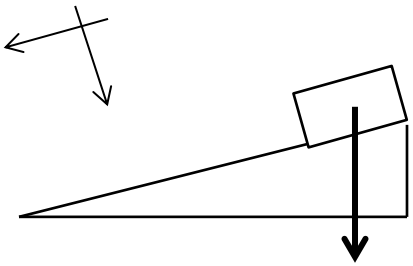
2. a) Did you do positive or negative work on the block/cart? How do you know? (2 marks)
   b) Is the conservation of energy observed in this experiment? Explain. (2 marks)
   c) Use your data for block vs. cart. In which case did friction do more work? How do you know? (3 marks)
   d) Design challenge: Describe 1 way you could increase the efficiency of the ramp at any set angle. Make sure to support your suggestion: why would it be more efficient? (3 marks)

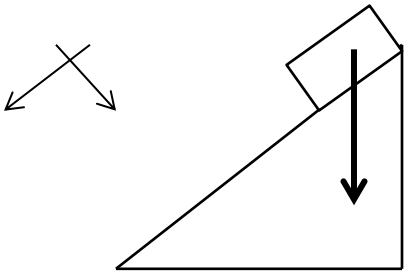
3. Follow the instructions to help you determine <u>why</u> incline angle affects % efficiency.

When we have done x and y vector components before, the x component was horizontal and the y component was vertical. This is just arbitrary. When using a ramp, physicists prefer to have the x component represent 'parallel' to the ramp and the y component 'perpendicular' to the ramp.

a) **<u>Draw</u>** 2 FBD's; one for the low incline ramp and one for the high incline. Include Fg but also break **Fg** into such x and y components on your two FBD's. (Interestingly, the angle of incline of your ramp is also the needed angle to determine components. This can be proven with geometry rules and I can show you if you wish).

Although you changed the angle of incline (Θ), the coefficient of friction between the block and the ramp will stay the same. After all, the 2 surfaces are the same.





b) **<u>Think</u>**: Use your knowledge of components, the coefficient of friction and % efficiency to explain why % efficiency <u>should</u> increase as the ramp incline increases. (They are directly proportional!) The best answers will include mathematical proof in addition to logical explanation.

Criteria		
<u>Communication</u> ***formal lab style&** A1.11 – communicate in a variety of formats using appropriate language. A1.5 – conduct inquiries using appropriate materials	Full marks = 'formal' report style used throughout & very good use of specific vocabulary. No spelling/grammar errors.	**/5**
<u>K & U</u> **Question #1** D3.2 – describe relationship between work & energy	Full marks = answered well. Demonstrates understanding of work, energy, efficiency concepts. No errors or omissions.	**/5**
<u>Inquiry</u> **Question #2** D3.5 - describe conditions for work D3.1 – describe energy transfers / conserve. of energy D2.7 - % efficiency & in/out energy	Full marks = all answered well. Demonstrates understanding of work, energy & % efficiency. No errors or omissions.	**/10**
<u>Application</u> **Question #3** C3.1 – distinguish between forces and describe the effect of each.	Full marks = components calculated corrected. Student demonstrates ability to apply knowledge of friction to this particular scenario. No errors or omissions. Draw & Think	**/5**