Name _____

General Physics 121 - Exam 1 – September 26, 2014

Time started _____

Time ended _____

Place taken _____

- To receive full credit for a problem, your work must convincingly demonstrate that you understand the physics involved behind the problem. That means not only providing the correct answer but showing how you obtained your answer.
- Questions represent a mix of conceptual and quantitative issues. Questions are scored according the rubric on the next page
- You may not consult the textbook, your notes, or any source of information other than the equations below.
- You may choose any continuous, uninterrupted 3-hour period in which to take this exam.
- You may use a calculator provided it is not programmed with course-specific information.
- It is important that your answers be neat and clear. Legible handwriting and clear exposition are required, not optional.
- Use only one side of each page of paper.
- Box your final answers to help me locate and identify them quickly
- Use your own, lined paper. Nothing written on this exam will be graded. Do not use paper ripped from a spiral-bound notebook with jagged edges.
- Do not write your name on any of the pages other than this cover sheet.
- Start each answer on a new sheet of paper.
- Include raw algebraic equations and identify variables. Include units (m, s, m/s, etc.) in calculations and carry them through.
- When finished, place this exam atop your paper and staple them together with your responses to the questions in sequential order before handing them in.
- You must turn in the exam to Dr. Pontius unless other arrangements have been made.
- **I reserve the right to assign additional penalties for violating these instructions.**

Honor code:

Reminder: Show all your work. Explain thoroughly and justify everything.

Don't Panic!

$$\Delta x \equiv x_f - x_i \qquad \Delta t \equiv t_f - t_i \qquad \Delta v_x \equiv v_{xf} - v_{xi}$$

$$v_{x,\,av} \equiv \frac{\Delta x}{\Delta t} \qquad v_x = \frac{dx}{dt} \qquad v_{xf} = v_{xi} + a_x \Delta t$$

$$a_{x,\,av} \equiv \frac{\Delta v_x}{\Delta t} \qquad a_x = \frac{dv_x}{dt} \qquad v_{xf}^2 = v_{xi}^2 + 2\, a_x \Delta x$$

$$\vec{F}_{net} = m\,\vec{a} \qquad F_g = m\,g \qquad x_f = x_i + v_{xi}\,\Delta t + \frac{1}{2} a_x (\Delta t)^2$$

$$f_{s,max} = \mu_s F_n \qquad f_k = \mu_k F_n \qquad \vec{F}_{12} = -\vec{F}_{21}$$

$$a_r = \frac{v^2}{r} \qquad v_{av} = \frac{v_f + v_i}{2} \qquad \vec{\mathbf{r}} = x\hat{\mathbf{i}} + y\hat{\mathbf{j}} + z\hat{\mathbf{k}}$$

g = 9.80 N/kg
1 mile = 1619 m
1 ton = 10^3 kg

1 N = 0.225 lb
1ft = 0.305 m
1 mile = 1.609 km

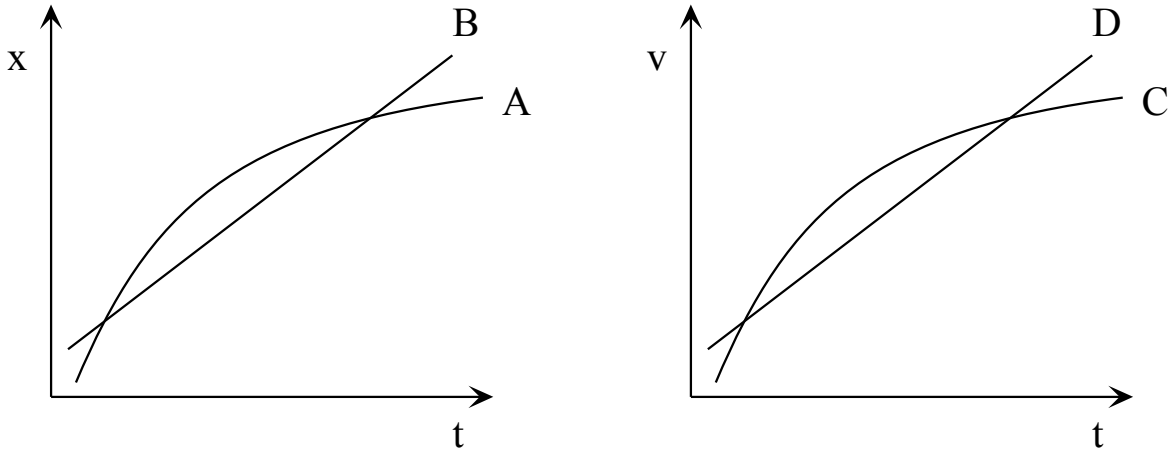
c = 3.00 × 10^8 m/s
1 inch = 2.54 cm
1 Btu = 252 cal

Coefficients of friction	Static	Kinetic
Glass against glass	0.94	0.40
Wood against rubber	0.98	0.67
Plastic on snow	0.43	0.3
Steel on snow	0.07	0.03
Rubber against asphalt	0.95	0.80
Cat claws on couch	3.57	3.56

Grading rubric:

Level of demonstrated understanding	Example	Score
Complete	Correct reasoning and answer	10
	Correct reasoning; minor computational mistakes; reasonable answer	9
Partial	Physics errors (or correct setup but no or incomplete execution)	7
	Major physics errors (or partial justification provided even if answer is correct)	5
Little to none	Little of relevance (or no justification provided even if answer is correct)	3
	Very little of relevance	1
	Blank, or restatement of question	0

1. The two graphs below describe the behavior two pairs of trains on two sets of parallel tracks. **Recopy them accurately on your own paper** and answer the following questions.



a) Compare trains A & B to each other. Describe the motion of each in ordinary (but technically correct) language.

- Mark with the symbol t_p along the time axis any instants where you can determine that the trains are passing each other. If there are any such times, explain which train is moving faster and how you know that to be true. If that is not possible, explain why.
- Mark with the symbol t_{eq} any instants when the two trains have the same velocity. Explain how you know that to be true. Identify the periods when one train is faster than the other, specifying which is faster. If that is not possible, explain why.

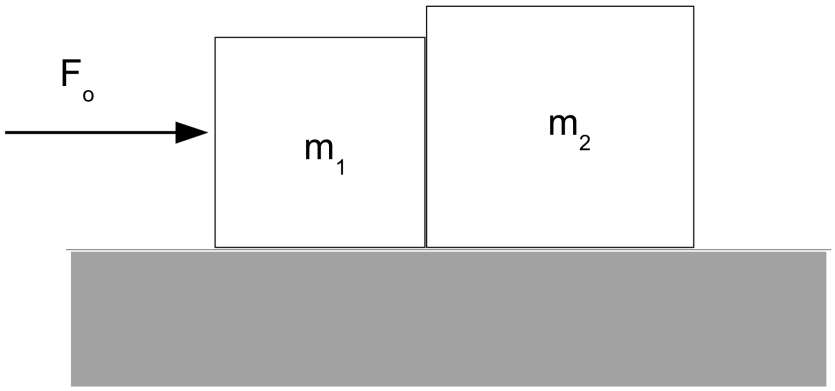
b) Compare trains C & D to each other. Describe the motion of each in ordinary (but technically correct) language.

- Mark with the symbol t_p along the time axis any instants where you can determine that the trains are passing each other. If there are any such times, explain which train is moving faster and how you know that to be true. If that is not possible, explain why.
- Mark with the symbol t_{eq} any instants when the two trains have the same velocity. Explain how you know that to be true. Identify the periods when one train is faster than the other, specifying which is faster. If that is not possible, explain why.

2. You are riding your snazzy Kymko People 150cc motor scooter along a residential street at a slightly excessive speed of 25.3 m/s (about 55 mph), when a large Piggly Wiggly delivery truck pulls out in front of you. When you apply your breaks, you are 29.8 meters from the truck. The only substantial horizontal connection you have with the scooter is via your arms' contact with the handlebars. Yes, there's probably some friction from the seat, but it's negligible. If your scooter can stop before running into the truck, at least in principle, what force would your arms need to exert to bring you to rest? Yes, I mean you. Explain thoroughly.

3. During the last quarter of the 2026 CNFL Superduperbowl, quarterback Tiger DiCaprio da Silva is at fourth down on his own team's 45 meter line. Tiger steps back and throws a bomb (i.e., a long, high pass) with a speed of 22 m/s at an angle of 60° above the horizontal. The ball sails directly down the field. At the instant he unleashes the ball, his receiver Gweneth "Snoopy Meow Meow" Armstrong runs right past him in an all out sprint. She races downfield at constant speed and plucks the ball out of the air just before it reaches the ground. Find her speed and the distance the ball is thrown. Show your work and explain your reasoning.

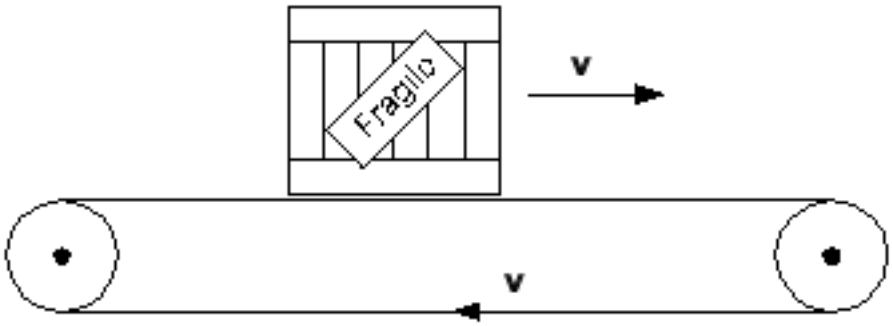
4. Two blocks of masses m_1 and m_2 resting on a frictionless table are pushed from the left by a horizontal force of magnitude F_o, as shown below. Explain all your reasoning thoroughly.



a) Draw a free-body diagram for each of the blocks. Calculate the force of contact between the two blocks in terms of the quantities given. Find the acceleration of the blocks.

b) Suppose now a force of equal magnitude but opposite direction is applied to the block on the right (the original force no longer acts). Answer the same question in this situation.

5. A wooden crate of weight 480 Newtons rests on a rubber conveyor belt. (The belt is actually much longer than illustrated here so you don't have to worry about the crate running off the end.)
a) During the first period, the conveyor belt runs at a steady rate, and the crate moves to the right at a constant speed of 0.80 m/s. Characterize (describe) the force of friction acting on the crate at this time, giving its magnitude and direction. Explain how you know these things.
b) During a second period, the conveyor belt slows down, reducing the speed of the crate without slipping to 0.25 m/s in 3.3 seconds. Again, characterize the force of friction acting on the crate, giving its magnitude and direction. Explain how you know these things.



6. A block of mass m_B is tied to one end of a light cord and a sphere of mass m_S is tied to the other end. The block is placed on a frictionless inclined plane, the cord is passed over an amazing frictionless pulley, and the sphere is allowed to hang, all as shown in the figure below. Calculate the acceleration of the sphere in terms of the masses given, the angle θ, and the gravitational constant g. Interpret your results. Hint: Do all those things I told you to do.