Name:_____ ID:_____ Lab (day/time)_____

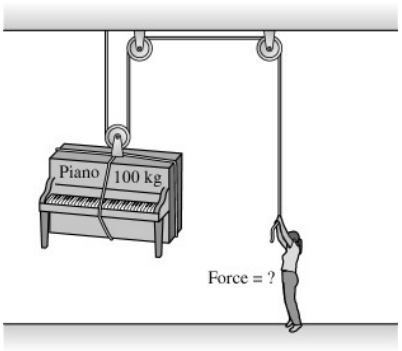
Physics 201

Midterm Exam 2

7/6/2016

Collaboration is not allowed. Allowed on your desk are: up to ten 8.5 x 11 inch doubled sided sheets of notes that are bound together, non-communicating/graphing scientific calculator, 1 page of scratch paper, writing utensils, and the exam. You will have **50** minutes to complete this exam.

1. (8 points) The 110 kg piano is lifted with the aid of a frictionless pulley system.
   (a) If the piano is moving at a constant rate of 0.2 m/s upward, what is the force of the person pulling down on the rope?
   (b) If the piano is instead accelerating upward at a rate of 2.0 m/s^2, what is the force of the person pulling down on the rope?
   (c) If the person moved to the right so that the rope was no longer vertical at their location, would this increase, decrease, or not change the tension in the rope. Assume the piano is in equilibrium during this move.



FBD(Piano + Pulley)

ID

$\Sigma F_x \Rightarrow 2F^T - mg = ma$

(a) $a = 0$, $F^T = \frac{mg}{2} = 539\,N$

F^T is also transmitted unchanged to person

(b) w/ $a = 0.2\ m/s^2$

$F^T = \frac{m(a+g)}{2} = 649\,N$

(c) doesn't effect piano FBD

So No change to tension

Rubric

1.5 pt - FBD

1.5 pt - ΣF

1 pt - F^T on person

1 pt - Answer (a) w/ units

1 pt - Solving for F^T w/ $a \neq 0$

1 pt - Answer (b) w/ units

1 pt - (c)

For questions 2 through 4 circle all correct answers, a given problem may have more than one correct answer. Each correctly circled answer will receive two points. There are **5** correct answers in this section and only the first **5** circled answers will be graded. There is no partial credit.

2. You need to make a sharp turn on a flat road, making a radius of curvature of 15 meters. How does the required force of static friction between your tires compare if you make the turn at 30 mph vs. 60 mph?

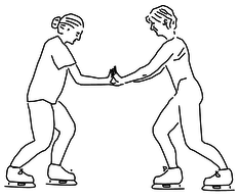
[T] (a) The force of friction needs to be four times as large.
[F] (b) The force of friction needs to be twice as large.
[F] (c) The force of friction is the same for both speeds since the radius of curvature is the same.
[F] (d) The force of friction is half as large.
[F] (e) The force of friction is a quarter as large.

3. An object is moving to the right in a straight line. The net force acting on the object is also directed to the right, but the magnitude of the force is decreasing with time. The object will

[T] (a) continue to move to the right, with its speed increasing with time.
[F] (b) continue to move to the right, with its speed decreasing with time.
[F] (c) continue to move to the right with a constant speed.
[F] (d) stop and then begin moving to the left.

4. A father and daughter are at rest on ice when they press their hands together and push off from one another. Which of the following statements are true regarding the time their hands are touching.

[T] (a) The center of mass of the daughter has a *greater* acceleration than the fathers.
[F] (b) The center of mass of the daughter has the *same* acceleration as the father.
[F] (c) The force of the daughter on the father is *less than* the father on the daughter.
[T] (d) The force of the daughter on the father is *equal to* the father on the daughter.
[T] (e) The point where their hands meet does not move.



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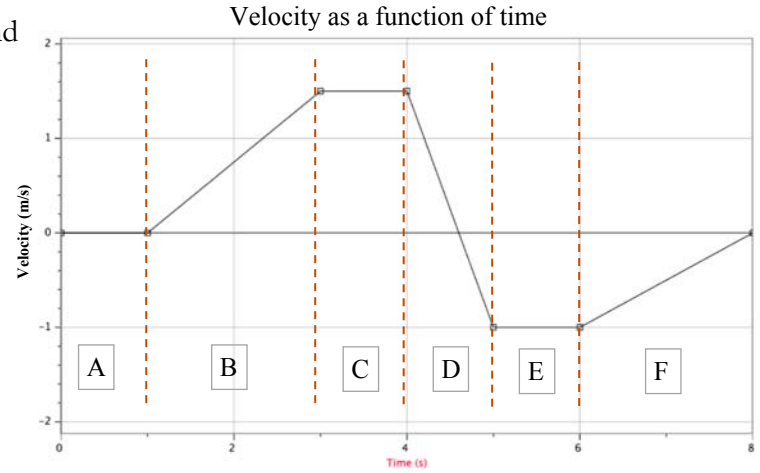
5. (4 points) Suppose the force of wind resistance is proportional to the speed of the object and in the direction opposite the object's velocity. If you throw an object upward, when is the magnitude of the acceleration the highest, (i) right after the object is released, (ii) at the top of its trajectory, or (iii) its the same throughout the entire trajectory? Explain your reasoning.

(i) Right after released. That is the point where the drag is the greatest and points in the same direction as gravity, creating the greatest net force and thus acceleration.

Rubric
2pt - Answer
2pt - Reasoning

6. (4 points) A particle moves along a straight line and its velocity as a function of time is plotted in the figure. Rank the net force acting on the particle, most negative to most positive, for regions **A** through **F**.



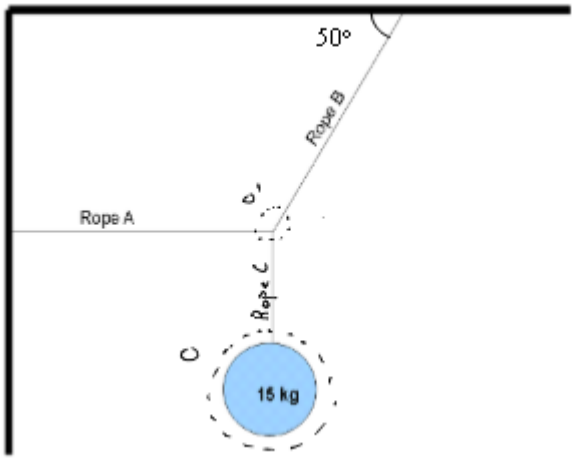
$a = \frac{\Sigma F}{m}$ * $\bar{a} = \frac{\Delta v}{\Delta t}$ ← slope, greater slope, greater ΣF

$a_D < a_A = a_C = a_E < a_F < a_B$

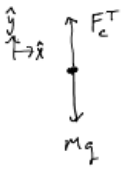
neg zero pos.

Rubric
1pt - zeros
1pt - neg is most negative
2pt - order

7. (8 points) A 15-kg mass is held by three very light ropes, as shown in the figure. If the system is in equilibrium, what is the tension in all three ropes?



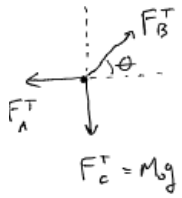
FBD (O)



$\Sigma F_y \Rightarrow F_C^T - mg = m a_y^{\nearrow 0}$

$F_C^T = mg = 147\,N$

FBD (O')



$\Sigma F_y \Rightarrow F_B^T \sin\theta - mg = m a_y^{\nearrow 0} \longrightarrow F_B^T = \frac{mg}{\sin\theta} = 192\,N$

$\Sigma F_x \Rightarrow F_B^T \cos\theta - F_A^T = m a_x^{\nearrow 0} \longrightarrow F_A^T = F_B^T \cos\theta$

$F_A^T = \frac{mg}{\tan\theta} = 123\,N$

Rubric
1.5pt - $F_C^T = mg$
.5pt - FBD
1.5pt - ΣF_x
1.5pt - ΣF_y
1pt - Algebra
1pt - Answers F_A^T & F_B^T w/ units

Scores:

Problems

1	2-4	5	6	7

Exam Total