Physics 140 – Fall 2007
midterm #1 review

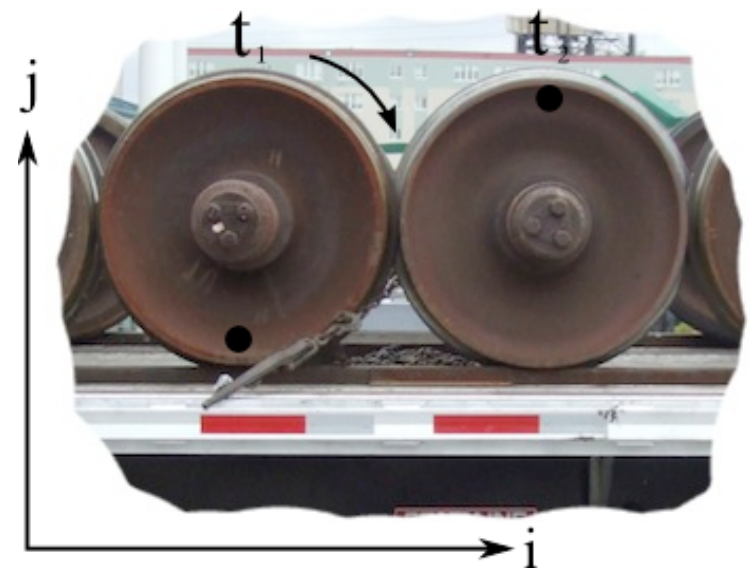
Bad logic -
1. What equation do I use?

Good logic -
1. What information do I know?
2. What information am I being asked to find?
3. What key ideas/conceptual tools should I apply?
4. What equations express these ideas?

A physics lab to determine the acceleration of gravity involves measuring the time of flight of a small ball falling straight down a narrow vertical cylinder.

Suppose this lab is performed inside a car of a TGV moving at a constant speed of 220 km/hr along a curved track. What will be the outcome of the experiment?

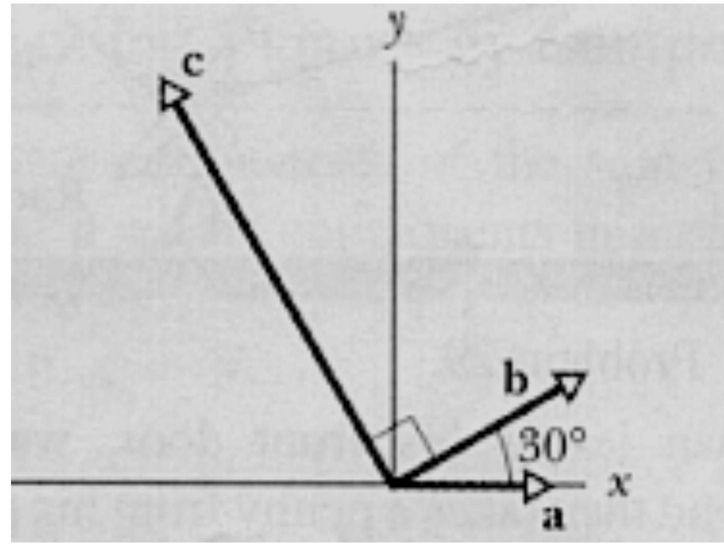
1) The ball will hit the side of the cylinder; the experiment won't work.
2) The ball will drop straight down with acceleration 9.8 m/s^2.
3) The ball will drop straight down with acceleration different from 9.8 m/s^2.
4) None of the above.



A train wheel of radius R with a black dot painted on its edge (point P) is rolling without slipping on a rail. Between times t_1 and t_2 the wheel turns through half a revolution. Over this time interval, the displacement vector of point P, expressed in unit vector notation, is

1. $2R\,\mathrm{i} + 2R\,\mathrm{j}$
2. $2\pi R\,\mathrm{i} + 2R\,\mathrm{j}$
3. $2R\,\mathrm{i} + \pi R\,\mathrm{j}$
4. $\pi R\,\mathrm{i} + 2R\,\mathrm{j}$
5. $\pi R\,\mathrm{i} + R\,\mathrm{j}$

The three vectors labeled **a, b** and **c** have magnitudes of 3, 4 and 10, respectively. Which of the following operations produces a result with the largest magnitude?

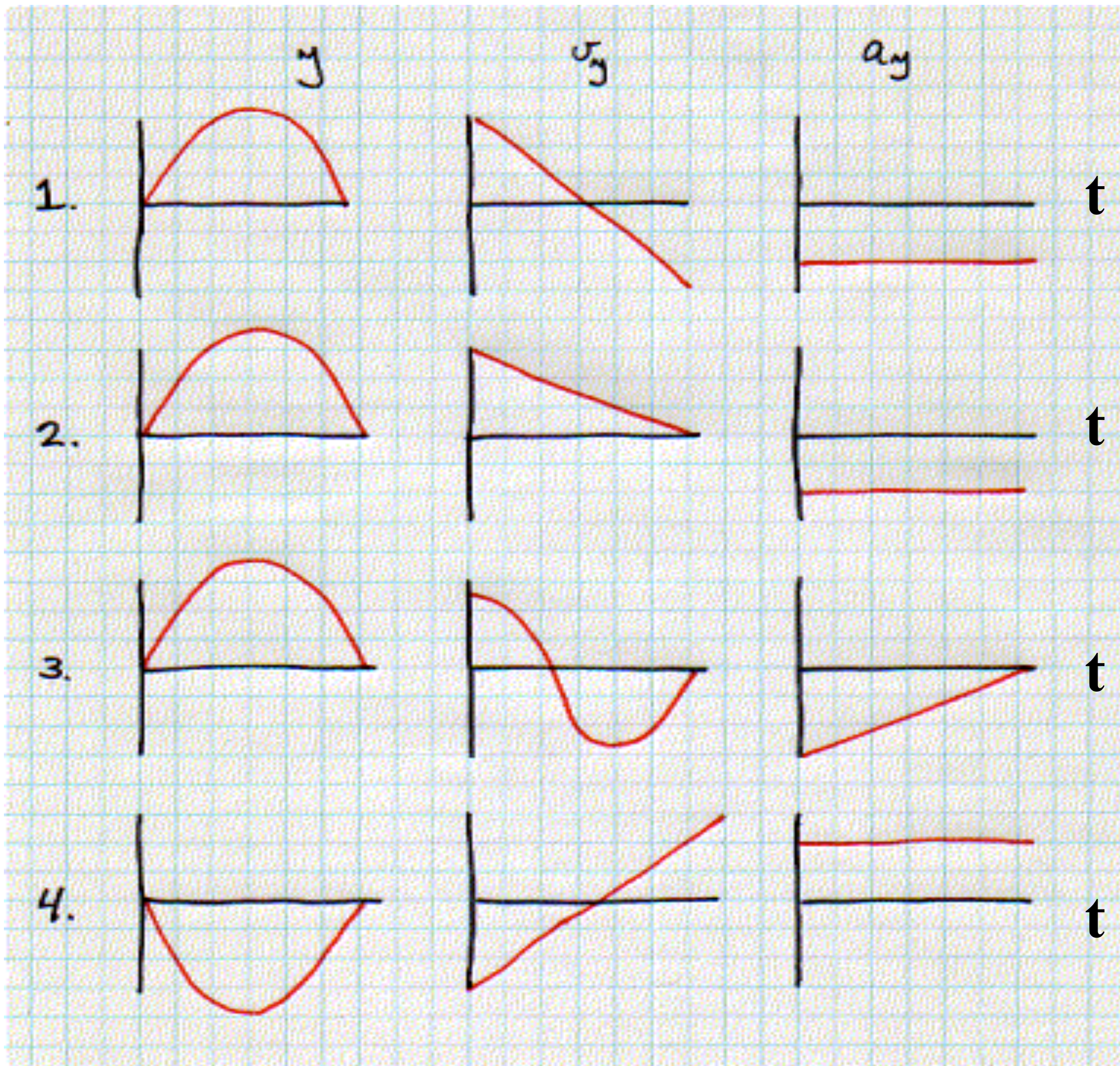


1. |**a** x **b**|
2. |**b** x **c**|
3. |**a** x **c**|
4. **a** • **b**
5. **b** • **c**
6. **a** • **c**

A swimmer stands facing a straight segment of river 200m wide which is flowing to her left at 2m/s. She dives into the water and swims at her top speed to the other shore, keeping her body oriented perpendicular to the shorelines at all times. Which of the following statements about her crossing is true?

1. She emerges downstream of her initial position along the shoreline.
2. Her speed relative to the water is larger than her speed relative to the shoreline.
3. Her trip took the shortest possible time.
4. Both 1 and 2
5. Both 1 and 3
6. All of 1, 2 and 3

Which row of graphs describes the motion of a ball tossed vertically upward and caught on the way down at its initial height? (Note: +y is directed upward.)



Some tips for solving Newton's second law problems:

1. Think! Define the system (or set of systems).

- draw a cartoon and define your coordinate system(s).
- identify all the forces that are acting

2. FBD. Draw a free-body diagram(s) for the system(s).

- imagine a bubble enclosing the system
- "shrink it to a dot"
- draw vector forces in the chosen coordinate system.
- apply Newton's 3rd law, if needed, at interfaces.

3. NSL. Apply $\Sigma \boldsymbol{F} = m\,\boldsymbol{a}$

- in *static* situations, $\Sigma \boldsymbol{F} = 0$.
- in *dynamic* situations involving multiple objects, find the links between the objects (e.g., same acceleration)

Some tips to remember:

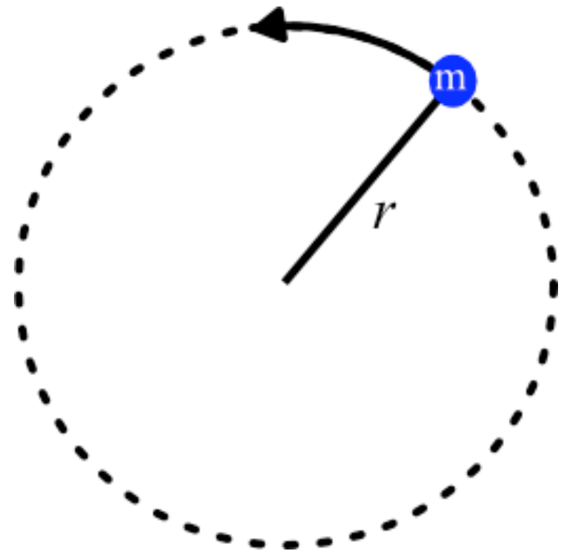
- A "*massless*" and "*frictionless*" pulley changes the direction of tension in a string but not its magnitude.

- Two (or more) objects tied by a taut string or in continuous contact with each other move at the same speed and have the same magnitude (but not necessarily direction) of acceleration.

- Normal forces don't have to act in the vertical direction and don't always equal the weight ("slanty force" problems).

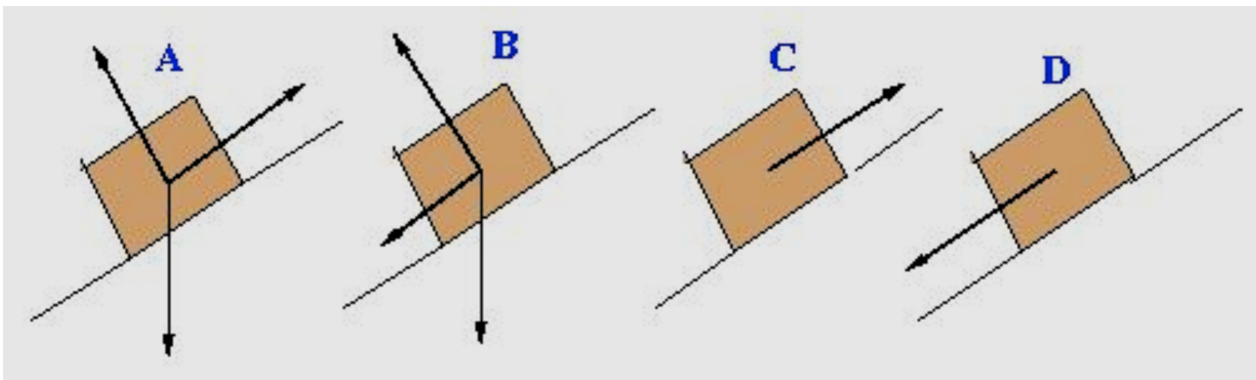
- The direction of the force of static friction is set by the need to balance other forces acting on an object. The direction of the kinetic friction force is always opposed to the velocity of the object (relative to the surface on which it's moving).

A ball is whirled around on a string of length r in a horizontal circle at constant speed v. What change to the tension in the string T would be required if the radius were halved but the velocity kept constant?

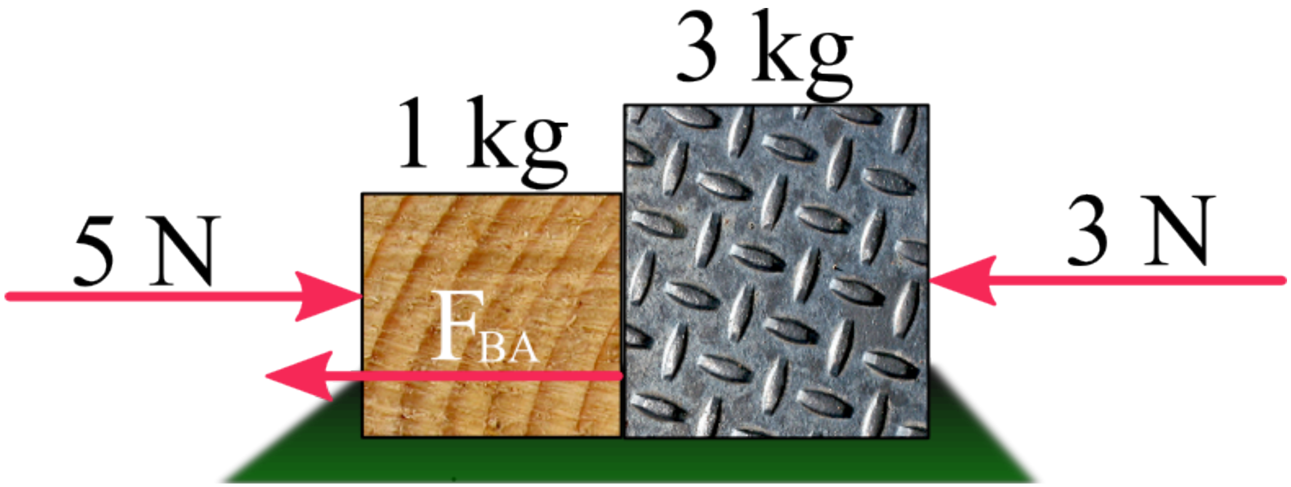


1. T would stay the same
2. T would increase by a factor 2
3. T would decrease by a factor 2
4. T would increase by a factor 4
5. T would decrease by a factor 4

A block is given a push up an inclined plane with friction. After its release and while it is still in motion, which diagram represents the forces acting on the block as it slides up the plane?



1. Diagram A
2. Diagram B
3. Diagram C
4. Diagram D



Taking the + $\boldsymbol{i}$ direction to the right, what is the contact force that block B exerts on block A?

A. zero
B. –1.5 $\boldsymbol{i}$
C. –4.5 $\boldsymbol{i}$
D. 1.5 $\boldsymbol{i}$
E. 4.5 $\boldsymbol{i}$
F. –6.0 $\boldsymbol{i}$

Since your undisclosed hobby is to search for the most exciting elevator (one that produces maximal acceleration), you spend a fair amount of time riding elevators while standing on a bathroom scale. At what point during a *descending* elevator ride does the scale measure its largest value?

1) At the beginning/top of ride.
2) At the end/bottom of ride.
3) At any point in between.
4) It always reads the same.

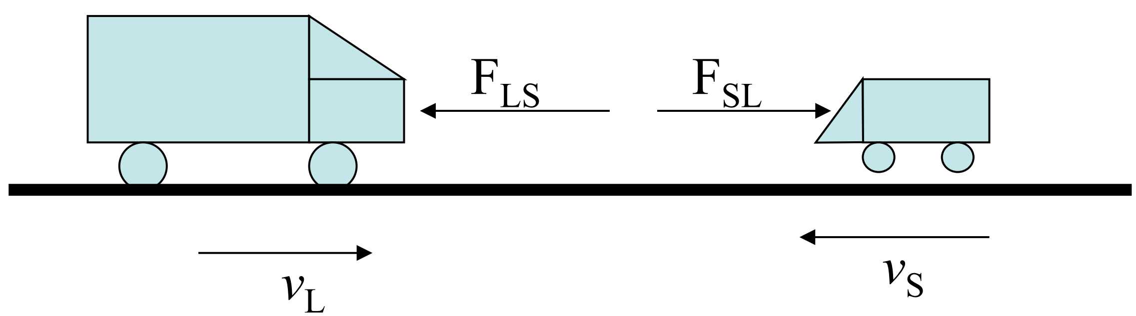
You are standing on a bathroom scale on a beach of an island comfortably situated at Earth's equator. Assuming that the Earth is round and knowing that it is uniformly rotating, how does this reading of your weight compare to the value you would get if you stood on the scale at the North Pole?

1. The reading at the equator is smaller.
2. The reading at the equator is larger.
3. The readings are the same.
4. More information is needed.

Consider a head-on collision between a tiny Geo Metro and a huge Ford Expedition. When they collide, the force exerted on the small car by the large car (F_{SL}) is

1. **larger than**
2. **smaller than**
3. **the same as**

the force exerted on the large car on the large car by the small car (F_{LS}).



Chapter	Concepts	Calculations
1+2	3	3
3	3	3
4+5	3	5
total	9	11