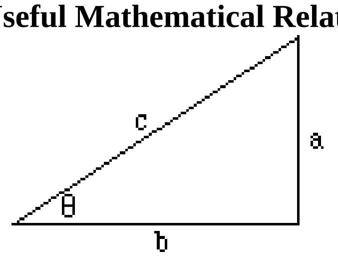
SAMPLE QUIZ 2 - PHYSICS 1301.1

This is a closed book, closed notes quiz. Calculators are permitted. The **ONLY** formulas that may be used are those given below. Define all symbols and justify all mathematical expressions used. Make sure to state all of the assumptions used to solve a problem. Credit is given only for a logical and complete solution that is clearly communicated. Partial credit will be given for a well communicated problem solving strategy based on correct physics such as the strategy illustrated in the Competent Problem Solver. MAKE SURE YOUR NAME, ID #, SECTION #, and TA's NAME ARE ON EACH PAGE!! Each problem is worth 25 points: **In the context of a unified solution**, a useful picture, defining the question, and giving your approach is worth 6 points; a complete physics diagram defining the relevant quantities, identifying the target quantity, and specifying the relevant equations is worth 8 points; planning the solution by constructing the mathematics leading to an algebraic answer and checking the units of that answer is worth 6 points; calculating a numerical value with correct units is worth 3 points; and evaluating the validity of the answer is worth 2 points. The 10 Conceptual Questions are worth a total of 25 points.

Below is information that may be helpful in solving these problems:

Useful Mathematical Relationships:



For a right triangle: $\sin\theta = \frac{a}{c}$, $\cos\theta = \frac{b}{c}$, $\tan\theta = \frac{a}{b}$,

$a^2 + b^2 = c^2$, $\sin^2\theta + \cos^2\theta = 1$

For a circle: $C = 2\pi R$, $A = \pi R^2$

For a sphere: $A = 4\pi R^2$, $V = \frac{4}{3}\pi R^3$

If $Ax^2 + Bx + C = 0$, then $x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$

$\frac{d(z^n)}{dz} = nz^{n-1}$, $\frac{d(\cos z)}{dz} = -\sin z$, $\frac{d(\sin z)}{dz} = \cos z$, $\frac{df(z)}{dt} = \frac{df(z)}{dz}\frac{dz}{dt}$

Fundamental Concepts and Principles:

$v_{av\,x} = \frac{\Delta x}{\Delta t}$	$s_{av} = \frac{dist}{\Delta t}$	$a_{av\,x} = \frac{\Delta v_x}{\Delta t}$	$\frac{d\theta}{dt} = \frac{v}{r}$
$v_x = \frac{dx}{dt}$	$s = \frac{dr}{dt}$	$a_x = \frac{dv_x}{dt}$	$\sum F_x = ma_x$

Under Certain Conditions:

$x = \frac{a_x}{2}(\Delta t)^2 + v_{xo}\Delta t + x_o$	$a = \frac{v^2}{r}$	$F = \mu_k F_n$	$F \le \mu_s F_n$

Useful constants: 1 mile = 5280 ft, g = 9.8 m/s2 = 32 ft/s2 , 1 km = 5/8 mile

Part 2 - Problems

1. You are driving your car uphill along a straight road. Suddenly, you see a car run a red light and enter the intersection just ahead of you. You slam on your brakes and skid in a straight line to a stop, leaving skid marks 100 feet long. A policeman observes the incident and gives a ticket to the other car for running a red light. He also gives you a ticket for exceeding the speed limit of 30 mph. When you get home, you wonder if you should fight the ticket in court. From the tire manufacturer's specifications you find that the coefficient of kinetic friction between your tires and the road was 0.60, and the coefficient of static friction was 0.80. You estimate that the hill made an angle of about 10^{o} with the horizontal. Your owner's manual gives your car's weight as 2,050 lbs.

2. You are working with an ecology group investigating the eyesight of eagles in the wild. To help the observers, you write a program that will run on their handheld computer. In a typical situation, the eagle glides in a horizontal circle at a constant speed with its prey below the center of its path. The eagle banks its wings at a constant angle to accomplish this. The aerodynamic lift is perpendicular to the surface of the wings. To determine the distance over which the eagle can see its prey when it is circling over it, you need an equation that gives this distance as a function of the height of the eagle, the time for the eagle to go once around its circle, and the angle that its wings make with the horizontal.

3. While you are watching a baseball game, the batter hits a ball that is barely off the ground. The ball flies through the air and looks as if it is going to go over the fence 200 ft away for a home run. In a spectacular play, the left fielder runs to the wall, leaps high, and catches the ball just as it clears the top of 10 ft high wall. You wonder how much time the fielder had to react to the hit and make the catch. You estimate that the ball left the bat at an angle of 30^{o}.

Conceptual Questions

1. You are sitting in a car that, according to your friend on side of the road, is traveling west at 30 mph and drop a stone out the window. The instant after you release the stone, your friend determines that it is moving with a velocity

   (a) 30 mph west and an acceleration of 9.8 m/s^2 downward.

   (b) 30 mph east and an acceleration of 9.8 m/s^2 downward.

   (c) 0 mph and an acceleration of 9.8m/s^2 downward.

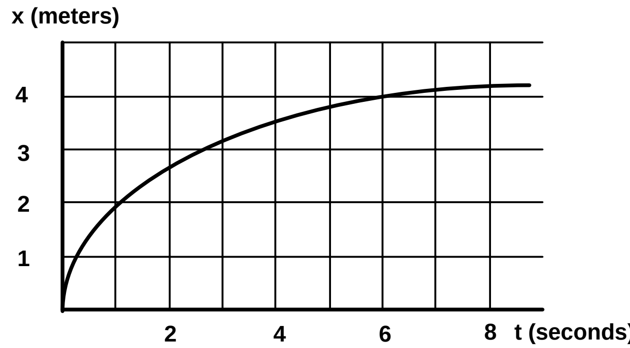
   (d) that is the vector sum of 30 mph west and an acceleration of 9.8 m/s^2.

   (e) that is the vector sum of 30 mph east and an acceleration of 9.8 m/s^2.

2. The graph on the right shows how the position of an object depends on time. Which choice is closest to the magnitude of the *instantaneous velocity* of the object at 6 seconds?

(a) 4 m/s (b) 3/2 m/s (c) 2/3 m/s

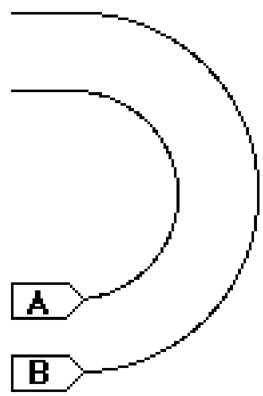
(d) 1/2 m/s (e) 1/4 m/s



3. When you are standing on the floor, the third law pair of your weight is the
   (a) normal force of the floor on your feet.
   (b) contact force of your feet on the floor.
   (c) gravitational force of the earth on you.
   (d) gravitational force of you on the earth.
   (e) push of the air on you.

Questions 4 - 5 refer to the diagram at right.

Two racing boats go around a semicircular turn in a race course. The boats have the *same speed*, but boat A is on the inside while boat B is on the outside, as shown in the drawing

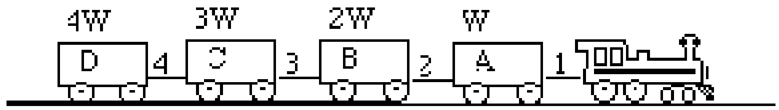


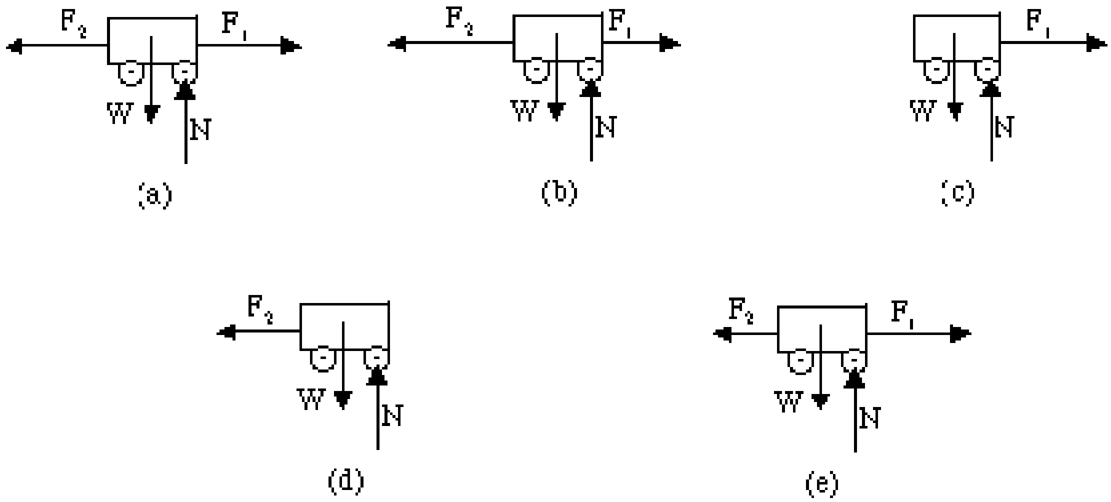
4. Which boat has the greater acceleration while in the turn?
   (a) A (b) B (c) same acceleration (d) can’t tell

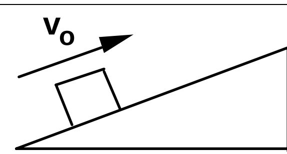
5. At the middle of the turn, the acceleration of boat A is?

(a) 0 (b) ← c) → (d) ↓ (e) ↑

6. A train engine pulls four boxcars, A, B, C, and D, as show in the diagram below. Ignoring friction, which free-body diagram best represents all of the forces acting on carriage A when the train is moving to the right with *increasing speed*?





For questions 7 and 8, a crate is given an initial shove up a ramp. It starts sliding up the ramp with an initial velocity v_o, as shown to the right.	

7. If the ramp is frictionless, the acceleration of the crate is
   (a) always vertical, straight down.
   (b) always the same, down the ramp.
   (c) the same magnitude up the ramp as down the ramp but in the opposite direction.
   (d) greater when moving up the ramp than down the ramp.
   (e) greater when moving down the ramp than up the ramp.

8. If the coefficient of kinetic friction between the crate and the floor is μ_k, the crate's acceleration
   (a) always vertical, straight down.
   (b) always the same, down the ramp.
   (c) the same magnitude up the ramp as down the ramp but in the opposite direction.
   (d) greater when moving up the ramp than down the ramp.
   (e) greater when moving down the ramp than up the ramp.

9. A man pushes his young daughter on her new bicycle so that she is speeding up. He feels the bicycle pushing on him with a force that is

   (a) greater than his push.
   (b) less than his push.
   (c) equal to his push.
   (d) less than the acceleration of the bicycle.
   (e) greater than the acceleration of the bicycle.

10. A bag of groceries has a mass of 10 kg and a *weight* of about

   (a) 1 N. (b) 10 N. (c) 100 N. (d) 1000 N. (e) None of these is even close.