Test #1 - Vectors and Forces

Question 1. Name at least six different types of forces. Indicate which of them are fundamental.

Question 2. State Newton's three laws and name an experiment which demonstrates each (explain briefly why it demonstrates the law).

Question 3. What is the difference between a scalar and a vector?

Question 4. Which things stay constant when we scale a triangle (for example double each side)?

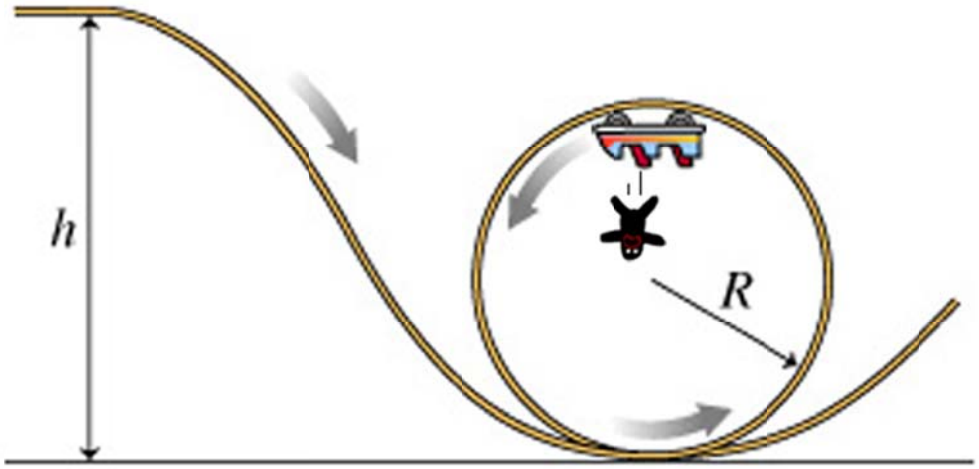
Problem 1. a) Draw the vector $\vec{a} = \begin{bmatrix} 2 \\ 5 \end{bmatrix}$s and $\vec{b} = \begin{bmatrix} -3 \\ 2 \end{bmatrix}$

b) Add the vectors $\vec{a}$ and $\vec{b}$ graphically

c) Add the vectors $\vec{a}$ and $\vec{b}$ numerically

d) Subtract (numerically) $3\vec{a} - 2\vec{b}$

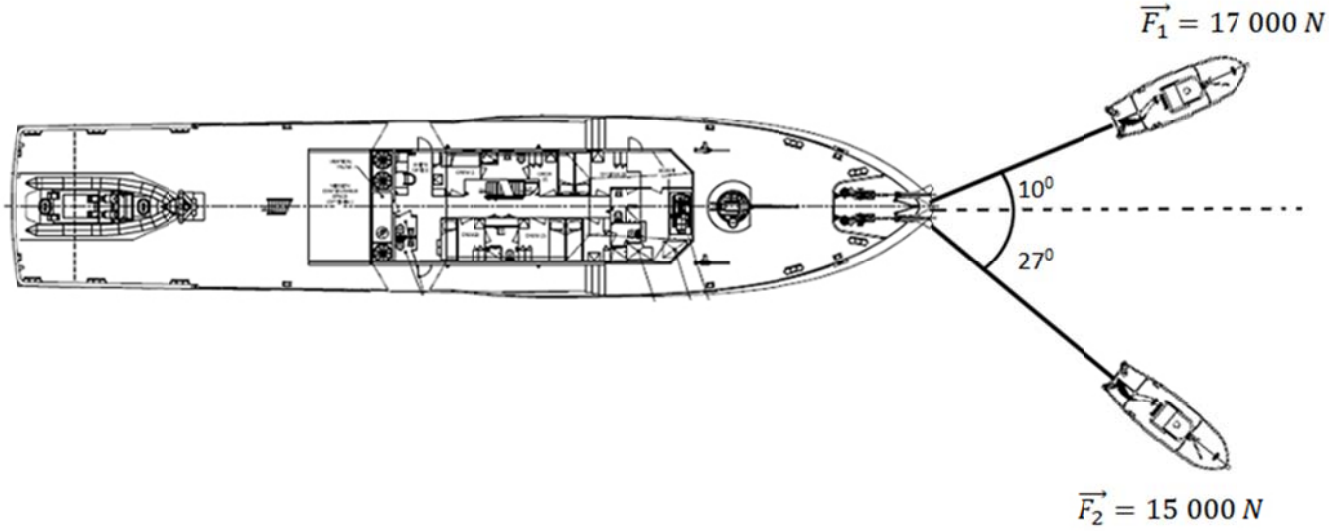
Problem 2. A person is riding on a roller-coster. If the radius of the loop on the picture is 6 m, what is the minimum speed of the cart in order for the person NOT to fall out?



Problem 3. A spring is leaded with 150 kg and as a concequence compresses by 15 cm. What is the spring constant?

Problem 4. Fred ran 4 kilometers West, then 7 kilometers North, then another 2 kilometers East and finally 5 kilometers South. How far away from his original position is he (straight line distance)?

Problem 5. What is the net force on the big boat? What is the angle of that force compared to the horizontal?



Problem 6. A Merry-go-round has a radius of 17 meters. It is spinning at a rate of 10 times per minute.

At what angle will the riders be while the ride is running?

Problem 7. Are you going to be heavier of lighter on Venus? Mass of Venus is $4.869 * 10^{24}$ kg, radius of Venus is 6 051.8 km. ($G = 6.67 * 10^{-11} \frac{m^3}{kg*s^2}$).

Problem 8. If I weigh 80 kg and it takes 470.88 N to move me, what is the coefficient of friction between my ass and the floor?

BONUS A 100 gram rock is being swung in a slingshot at a rate of 80 rotations per minute. The length of the slingshot string is 30 cm. The string behaves like a spring and elongates in response. If the spring constant (or in this case, the string constant) is 60 N/m, and the string breaks if it is stretched more than 4 cm, will it break or not?