Chapter 4 Worksheet

1. Dare Devil Nick (1550kg car included) has entered in the local dirt track series. To reduce the amount of air friction he experiences as he races around the track, He has coated has car in Vaseline. He blows a kiss to the crowd and the girls in the crowd yell “We love you Nick”. Nick is slightly disturbed by the lone deep voice coming from the crowd. Nick climbs into his car and waits for the starters commands. As the flag drops Nick accelerates for the first 80m. He covers the first 80m in 11.65 seconds and experiences a strong head wind with a coefficient of sliding friction of 0.125. He settles into a grueling pace of 7.4 m/s down the backstretch (120m). At which point a Nick takes the car out of first gear and he covers the next 100m in 2.5 seconds. Nick rounds the final turn and heads into the home stretch. The crowd of girls begins to yell in unison “WHOOOOOOP, WHOOOOOOP!!!” This inspires Nick and he mashes the pedal to the metal, producing a force of 2015N. He crosses the finish line just in front of the rest of the field. He has won the race but in the excitement he loses control of the car and sideswipes the wall. He slides along the wall but lucky for him his car is coated in Vaseline so he slides for 150m before coming to a stop. The coefficient of sliding friction between Nick’s car and the wall is 0.256.
   a. What is Nick and the car’s weight?
   b. What is Nick’s acceleration over the first 80m?
   c. What is his velocity after 80m?
   d. What is the force of friction that Nick experiences from the air?
   e. How long does it take him drive the next 120m?
   f. What is his acceleration over the 120m?
   g. What is his acceleration over the next 100m?
   h. What is his velocity with 100m still to go?
   i. What is Nick’s acceleration over the last 100m?
   j. What is his final velocity as he crosses the finish line
   k. What is Nick’s acceleration after he crosses the finish line?
   What is the friction between Nick’s car and the wall

2. A 3.41kg Jack-O-Lantern sits on Mr. Hutto’s the front porch. A force of 11.75 N can be applied to the pumpkin (in any direction parallel to the surface of the porch) in order for it to move along the surface of the porch at a constant speed toward the end of the porch, where it will fall to its death.

   a. What is the weight of the Jack-O-Lantern?
   b. What force would be required to lift the Jack-O-Lantern upward at a constant rate of speed?
   c. What is the frictional force acting on the Jack-O-Lantern as it moves across the porch at a constant speed?
   d. Why is constant speed important to this problem?
   e. What is the coefficient of sliding friction between the Jack-O-Lantern and the porch?

3. Betty Ann and Molly decide to play a game with Mr Hutto's pumpkin. They each steal (borrow) blowers from a truck that sits in front of Mr. Hutto's house. Betty Ann races to the porch and grabs the Jack-O-Lantern and brings it back to the street. While Betty Ann is getting the Jack-O-Lantern, Molly covers the street in Vaseline. The Jack-O-Lantern is placed between Betty Ann and Molly and is exactly 5 meters from each goal (the end of the Vaseline). Before the game begins they each pull out their physics text (which they carry with them everywhere) and look up the coefficient of sliding friction between a pumpkin and a road covered in Vaseline .085. Katherine is the referee and she sounds the whistle and both Betty Ann and Molly begin to blow. Both blew with a constant force until the pumpkin went in Betty Ann's goal in just 6.9 seconds. The pumpkin comes to a stop in .08 seconds after hitting the Vaseline free road. Betty Ann in anger kicks the Jack-O-Lantern into Mr. Hutto's yard. Betty Ann was sure he would win. He had practiced for hours on his dad's deck and new he could blow with a sustained force of 5.4 N.

a. What was the frictional force opposing the motion of the Jack-O-Lantern?
b. What force was Molly applying to the Jack-O-Lantern?
c. What force was the Vaseline applying to the Jack-O-Lantern?
d. What was the total force acting on the Jack-O-Lantern?
e. What force did the Jack-O-Lantern apply to the Vaseline free road?
f. What force did the road apply to the Jack-O-Lantern?

4. A 15kg box sits on a table. Two ropes are attached to the box on opposite sides. . The coefficient of sliding friction between the box and the table is 0.235. Each boy practices pulling on the box and Elliot is able to accelerate the box at a rate of 20 m/s^2 without friction, Austin pulls is able to pull with a force of 200N. Elliot grabs rope A and Austin grabs rope B. They then pull on the box at the same time with their maximum forces.
   a. What is the mass of the box?
   b. What is the weight of the box?
   c. What is the acceleration due to gravity acting on the box?
   d. What is F_N?
   e. What is the force of friction?
   f. How much force did Elliot apply to the box?
   g. What is the total force acting on the box as Elliot pulls on it(with friction)?
   h. What is the acceleration of the box caused by Austin? Assume friction free.

Now they are both pulling

   i. What is the total force acting on the box as both boys pull and friction is involved?
   j. Towards which boy will the box move?
   k. At what rate will it accelerate towards that boy?
   l. After 5 seconds what is the velocity of the box?
   m. After 5 seconds how far has the box moved?

5. Two masses are connected by a light string passing over a pulley. The inclined surface is frictionless, and the effects of the pulley can be ignored. The mass of $mass_1$= 10 kg and $mass_2$ = 4.8 kg. The angle for the ramp is $\theta = 30^o$.
   a. Find the acceleration of the $mass_1$.
   b. Assume that the surface has a coefficient of friction of .025, what is the acceleration of the mass?
   c. What is the minimal amount of mass required to cause the $mass_1$ to move in the opposite direction.

6. A 0.840 kg $mass_3$ is placed on a level surface. The mass is joined by strings to two hanging masses. $mass_1$ = 4.85 kg and $mass_2$ = 3.62 kg. The picture below might help.
   a. What is the magnitude and direction for the acceleration of the $mass_3$ if it is released?
   b. What is the tension in each string?
   c. What is the acceleration of the $mass_3$ if the coefficient of sliding friction between the $mass_3$ and the surface is 0.47?
   d. What is the tension in each string?

7. Meredith is so anxious about the Holidays that she cannot stand it. She is eager to stuff herself full with Thanksgiving vittles. Her family, including Uncle Jethro and Aunt Eunice (They are from the Copperworser side, the ones the family doesn't like to talk about) all gather around the table for a prayer. Meredith is eyeing down the turkey (the real one not Uncle Jethro). She is going to beat Uncle Jethro Copperworser to the Turkey this year (she is tired of eating necks and tails each year). As the prayer ends, she quickly reaches for a turkey leg and pulls due east with a force of 250 Newtons. Uncle Jethro, not to be out done by some city slicker, grabs the turkey's breast (he is a breast man) and pulls in a direction that is 20^0 west of north with a force of 200N. Aunt Eunice grabs a wing and pulls 40^0 west of south with a force of 130 Newtons. The turkey remains in one piece because sadly Meredith has overcooked it and it is as hard as a rock.

a. Write the vector algebra equation for the force exerted by Meredith pulling on the urkey leg. ______________________________
b. Write the vector algebra equation for the force exerted by Uncle Jethro pulling on the turkey breast. ______________________________
c. Write the vector algebra equation for the force exerted by Aunt Eunice pulling on the turkey wing. ___________________________
d. Write the vector algebra equation for the total force vector. ___________________
e. What is the actual magnitude of the force acting on the turkey? _________________
f. In what direction will the turkey accelerate? ______________________
g. If the turkey has a mass of 10 kg, what will its actual rate of acceleration be?_________________

8. We move to the Gratzick house for a completely separate Thanksgiving incident. Nick is having a great day, he has just finished filling his plate with turkey, ham, sweet potatoes, cranberries and his favorite the mini dill pickle. At that instant his tiny bladder sends a signal to his brain that it is time to go. Having dealt with his bladder his whole life he knows he only has a few seconds before the flood gates open. He dashes for the kiddie card table (which is of course where he sits for Thanksgiving dinner) to set his plate down before he races for the bathroom. However, unbeknownst to Nick, his brother, has covered the hardwood floor with turkey lard. Nick slips on the lard and slides across the floor and straddles a leg of the card table, smashing his little pickle. The leg of the table collapses and all of the food on the table now slides down the collapsed table (ramp) and onto Nick's lap. The table makes a 40^0 angle with Nick's lap and the floor. One lone morsel of food still sits perched at the top of the table, 1.5 m from Nick. It is a brown sugar soaked marshmallow from the yams. The mass of the marshmallow is 1.8 kg. *(OK this is a rather large marshmallow, somewhere in the neighborhood of 4 lbs, but it allows your answers to be a little larger.)* Tears well up in Nick's eyes and he begins to shake uncontrollably as he realizes his new Thanksgiving outfit is ruined and his bladder is now empty. His shaking causes the massive marshmallow to begin to slide down the table and as it slides it leaves a sticky trail of brown sugar syrup behind.
   a. What is the weight of the marshmallow?
   b. What normal force (F_N) is the table applying to the marshmallow?
   c. How much force is being applied to the marshmallow to cause it to slide down the ramp?
   d. How fast is the marshmallow accelerating down the ramp if we assume the table is a frictionless surface
   e. What is the final velocity of the massive marshmallow just before it crashes into poor Nick?
   f. If the actual coefficient of sliding friction between the marshmallow and the table is 0.25, at what rate will the marshmallow actually accelerate?
   g. What will the final velocity be if friction is added?

9. The Wando bridge makes a 20^0 angle with the earth. The bridge is 1600m from the top of the bridge to the ground. Joseph decides to ride his bike down the bridge. He puts on his skin tight speed suit, which is a remnant of his crushed dream to become an Olympic speed skater. He pulls his bike out of the back of his car and positions himself at the top of the hill. He checks his training wheels to make sure they are securely attached, rubs Vaseline over his newly shaved head (he learned it cuts down on the friction during his attempt to become an Olympic swimmer, although he does miss the golden locks) and shoves off. He does not pedal as he goes because he wants to find out just how fast the gravity will accelerate him. He and his bike together have a mass of 90kg. As he goes down the hill, he experiences a head wind of 30 knots but luckily his speed suit just cuts through the wind and it only causes a force of 200N against him.
   a. What is the weight of the Joseph and his bicycle?
   b. What normal force (F_N) is the road applying to the Joseph ?
   c. How much force is being applied to the Joseph to cause him to accelerate down the bridge?
   d. What is the net force causing Joseph to accelerate down the bridge?
   e. How fast is Joseph accelerating down the ramp if we assume the road is a frictionless surface?
   f. What is the final velocity of Joseph just before he reaches the bottom of the bridge?
   g. How far will Joseph on the exit ramp if the coefficient of sliding friction is 0.075? Assume the ramp is a straight line.

Give me an "R", Give me an "A", Give me an "M" give me a "P"

10. The varsity cheerleaders have built a hill by gluing the JV cheerleaders together and covering them with several sheets of plywood, affectionately called "One Cheer Hill". Miffy (45kg) then grabs a sled and heads to the top of the mass of cheerleaders. She positions herself for the ride of her life, puts on her helmet, elbow pads, knee pads and wrist guards. The hill makes a 38^0 angle with the gym floor and the hill is 15m long from where Miffy is to where the hill meets the gym floor. Miffy yells "Go Bishops" and the slides down the hill.
    a. What is the weight of the Miffy
    b. What normal force (F_N) is the hill (plywood) applying to Miffy?
    c. How much force is being applied to the Miffy to cause her to slide down the ramp?
    d. How fast is Miffy accelerating down the ramp if we assume the plywood is a frictionless surface?
    e. If the actual coefficient of sliding friction between Miffy and the hill is 0.15, at what rate will the Miffy actually accelerate?
    f. What force will overcome the friction?
    g. What is the final velocity of Miffy (with friction) just before she slides onto the gym floor?
    h. What is the friction between Miffy and the gym floor if the coefficient of sliding friction 0.25?
    i. What is her acceleration across the gym floor?
    j. What is her velocity after sliding 5 meters across the floor?
    k. Miffy then hits a 50m ramp that has an angle of 15^o, how high up the ramp with she go before she comes to a stop?