# Physics 122

Assignment # 5
Momentum and Projectile Motion
Due Wednesday, May 1st, 2019

1. Cally is driving her 2006 Pontiac G5 at 72km/h in a direction of $N15^0E$ when she collides with Trevor (intentionally). Trevor is driving a 2001 Ford F-150 at 90km/h in a direction of $E15^0N$. After the collision Cally is travelling at 75km/h in a direction of $E5^0N$. What Trevor's velocity after the collision if truck has a mass of 4000kg and Cally's car has a mass of 3200kg?

2. Divers at Acapulco dive from a cliff that is 50m high. A) If the rocks below the cliff extend outward for 20m, what is the minimum horizontal velocity a diver must have to clear the rocks safely? B) What would the diver's final velocity be just before they hit the water? (include the angle)

3. A hunter aims a rifle directly at a squirrel on a branch of a tree. The squirrel sees the flash of the rifle's firing. Should it stay where it is or drop from the branch in free fall at the instant the rifle is fired? Explain.

4. You are playing tennis and get a little under the ball and hit it over the fence, which is 4.8 meters high. The ball lands at a distance of 10.0m away from the fence. You throw the ball back towards the court with an initial velocity of 15.0/s at an angle of 50º. The ball is 1.00m high when you release it. Did the ball go over the fence, hit the fence or land before the fence?

5. A slightly eccentric physics instructor has decided a small-scale track to test his students. He has come up with one of his most evil designs to date. Based on only a bit of information his expectations are for his students to determine whether the model car below will clear the pond and end up crashing into the trees. The information he has given is as follows: Mass of car 50kg, length of car is 1m. The spring at rest position is 1m long. The block that supports the spring is 50cm in wide. The spring constant is 16292N/m and is compressed 50cm before being released and the center of the circular pond is 17m, from the left side of the starting block, with a diameter of 2m. The ramp has an angle of inclination of 30^0 and is 2m high. The base of the ramp is 12m from the left side of the spring support block. The force of friction on the horizontal section is 50N and 40N on the ramp. His only advice was break the situation into sections - flat, ramp & air. Put all measurements on the diagram. Show your work. Measure everything based on the front of the car except the location of the pond. Work with a friend and don't stress. Note: no actual students were **physically** harmed in the design of this problem.
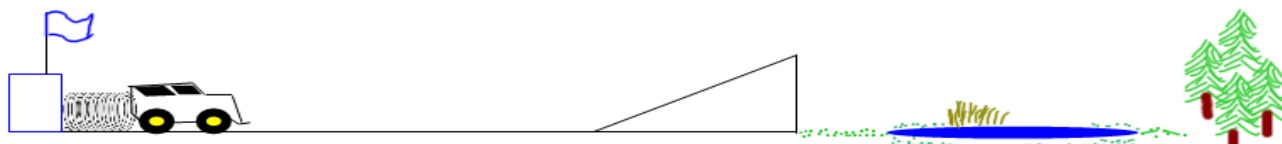
*Not drawn to scale

PRACTICE QUESTIONS
6. A girl throws a water-filled balloon at an angle of 50^0 above the horizontal with a speed of 12.0 m/s. The horizontal component of the balloon's velocity is directed toward a car that is approaching the girl at a constant speed of 8.00 m/s. a) If the balloon is to hit the car at the same height at which it leaves her hand, what is the distance the car can be from the girl when the balloon is thrown? b) What is the maximum height of the ball? **(29.94m, 4.31m)**

7. You are playing tennis and get a little under the ball and hit it over the fence, which is 4.8 meters high. The ball lands at a distance of 12.4m away from the fence. You throw the ball back towards the court with an initial velocity of 12.1m/s at an angle of 55°. The ball is 1.05m high when you release it. Did the ball go over the fence, hit the fence or land before the fence? **(Hits the fence)**

8. A small airplane is traveling with a velocity 270mph at an altitude of 10 000ft when the plane's wheel falls off. How far will the plane travel before the wheel hits the ground? **(1.87miles)**

9. A baseball player hits a baseball at an initial velocity of 30.0m/s at an angle of 50^0. Immediately after the ball is hit an outfielder runs at 4.0m/s toward the infield and catches it at the same height as it was hit.(1.5m) (a) Find the time it takes to get to maximum height. b) Find the maximum height that the object reaches above the ground. c) When is the ball caught? d) How far away was the outfielder from the batter initially? **(2.345sec, 28.44m, 4.69s, 109.2m)**

10. A girl, standing on top of a small building 4.00 m high throws a Molotov cocktail with an initial velocity of 15.0 m/s at an angle of 25° with the ground. (a) Find the maximum height that the object reaches above the ground. (b) Find the total time it is in the air. (c) Find the range of the Molotov cocktail. **(6.05m, 1.758s, 23.90m)**

11. A ball is hit at 20m/s at 60^0 towards a fence that is 30m away and is 8m high. If the ball is hit from a height of 1m will it clear the fence? **(yes)**

12. Trailing by 2 points, and with only 1.2 seconds left on the clock in a high school basketball game, Stretch Jones throws up a jump shot at an angle of 55^0 at a velocity of 10m/s. The release point is 2.55m above the floor and the basket is 3.05m. He hits the shot. a) How much time is left on the clock when the basket is made? b) If the 3-point line is at a radius of 6.02m from the basket, did he tie the game or did his team take the lead? (You all had gym class so you should know a few basketball rules) (**None, Win**)

13. A football kicker kicks a successful field goal from a distance of 40 yards away from the goal post. Find the initial velocity of the football if he kicks it an angle of 40^0 and it clears the crossbar by 5ft. The height of the crossbar is 10ft. State your answer in ft/s.