Note: Students are encouraged to work together and discuss the problems. However, each student must arrive at her/his own final answers. Show all your work. Simply copied homework will result in zero.

1. (10 points) (a) What is the momentum of a 15 ounce football thrown by NY Giants QB Daniel Jones at 48 mph? (b) If the ball is caught by Sterling Shepard during a 15 ms period, what is the force exerted on the ball by Sterling?

2. (15 points) Prof. Jung drops an egg from 1.1 m above a table. (a) What is the velocity of the egg right before it hits the table? (b) What is the momentum at that instance? The mass of the egg is 50 g. (c) What is the impulse when the egg hits the table? (d) If the time of contact between the egg and the table-top is 2 ms, what is the force exerted on the egg by the table? (e) If the egg is dropped on to a sponge instead and thereby the contact time is lengthened to 20 ms, what is the force exerted on the egg by the sponge and the table?

3. (10 points) A bullet with a mass of 80 g is shot by a rifle and has a speed of 280 m/s. What is the recoil velocity of rifle as the bullet is fired? Assume the mass of the rifle is 4.6 kg.

4. (10 points) During the 2018 Winter Olympics Women’s 3000 m short track speed-skating relay race, Shim, Suk-hee pushes her teammate from behind to give her a boost as they relay the race. Just before the push, Shim is skating at a speed of 9.0 m/s and her teammate, Choi, Min-jeong, is skating at a speed of 3.5 m/s. After the push her teammate speeds up to 7.5 m/s. If Shim has a mass of 56 kg, and Choi has a mass of 54 kg, what is Shim’s speed after she pushed Choi?

5. (15 points) At the Jets football game played last Sunday, Jets' running back Le’Veon Bell with a mass of 225 lbs and running at 8.5 m/s was tackled in the air by a Jaguar linebacker with a mass of 270 lbs. Right after the tackle the two were stuck together and moved in the same direction as the initial direction of Bell at a speed of 1.2 m/s. (a) What is the speed and direction of the linebacker before the tackle? (b) What is the impulse applied to the linebacker by Bell? (Assume that at the moment of collision both players were up in the air. Namely, their feet were not applying force on the ground. Consider only horizontal direction in this problem.)