Conceptual Questions and Short Problems. (2 points each) Circle the BEST answer.

1. In order to lift a bucket of concrete, you must pull up harder on the bucket than it pulls down on you.
   a. TRUE  b. FALSE

2. Three boxes slide on a frictionless horizontal surface when pulled by a force of magnitude \( F \). When we compare the tensions \( T_1 \) and \( T_2 \) with the force \( F \), we find that
   a. \( T_1 = T_2 = F \).
   b. \( T_1 = F > T_2 \).
   c. \( F > T_1 = T_2 \).
   d. \( F > T_1 > T_2 \).
   e. \( F - T_1 < T_1 - T_2 \).

3. A shell explodes into two fragments, one 25 times heavier than the other. The momentum change of the lighter fragment is 25 times as great as the momentum change of the heavier fragment.   A) True  B) False.

4. A new roller coaster contains a loop-the-loop in which the car and rider are completely upside down. If the radius of the loop is 13.2 m, with what minimum speed must the car traverse the loop so that the rider does not fall out while upside down at the top? Assume the rider is not strapped to the car.
   A) 10.1 m/s
   B) 12.5 m/s
   C) 11.4 m/s
   D) 14.9 m/s

5. When a baseball player hits a home run, the baseball receives a greater impulse from the bat than the bat does from the ball.   a. True  b. False

6. A heavy weight is supported by two cables that exert tensions of magnitude \( T_1 \) and \( T_2 \).
   Which statement is correct?
   a. \( T_1 = T_2 \).
   b. \( T_1 = T_2 \).
   c. \( T_1 > T_2 \).
   d. \( T_1 < T_2 \).

7. A car enters a level, unbanked semi-circular hairpin turn of 300 m radius at a speed of 40 m/s. The coefficient of friction between the tires and the road is \( \mu = 0.25 \). If the car maintains a constant speed of 40 m/s, it will
   a. attempt to dig into the road surface.
   b. tend to veer toward the center of the semicircle.
   c. arrive safely at the end of the semicircle.
   d. tend to veer toward the outside of the circle.
   e. veer toward the center for the first quarter-circle, then veer toward the outside

8. The turntable of a record player has an angular velocity of 8.0 rad/s when it is turned off. The turntable comes to rest 2.5 s after being turned off. Through how many radians does the turntable rotate after being turned off? Assume constant angular acceleration.
   a. 12 rad
   b. 8.0 rad
   c. 10 rad
   d. 16 rad
   e. 6.8 rad

9. If you swing a bucket of water fast enough in a vertical circle, at the highest point the water does not spill out because an outward force balances the pull of gravity on the water.   A) True  B) False

10. A ball rolls up a ramp, then back down. Which is the correct acceleration graph?
Problems Circle the best answer. You must show your work for credit. Box final answers.
1. (15 points) The three blocks shown are released from rest and are observed to move with accelerations that have a magnitude of 1.5 m/s². What is the magnitude of the friction force on the block that slides horizontally? Disregard any pulley mass or friction in the pulley and let $M = 2.0$ kg.
   a. 6.0 N  
   b. 5.1 N  
   c. 5.5 N  
   d. 4.6 N  
   e. 3.7 N

2. (15 points) A 0.30-kg mass attached to the end of a string swings in a vertical circle ($R = 1.6$ m). At an instant when $\theta = 50^\circ$ above the lowest point on its way up, the tension in the string is 8.0 N. What is the magnitude of the total force on the mass at this instant? Sketch the FBD of the mass.
   a. 5.6 N  
   b. 6.0 N  
   c. 6.5 N  
   d. 5.1 N  
   e. 2.2 N
3. (15 points) A 4.0-kg mass has a velocity of 4.0 m/s, east when it explodes into two 2.0-kg masses. After the explosion one of the masses has a velocity of 3.0 m/s at an angle of 30° north of east. What is the magnitude of the velocity of the other mass after the explosion? Draw the vector diagram showing the before and after momentum as a vector sum. (Do not use law of sines and cosines to do this.)

   a.  4 m/s
   b.  2.5 m/s
   c.  5.6 m/s
   d.  8.6 m/s
   e.  10.6 m/s

4. (15 pts) A 600-kg car traveling at 30.0 m/s is going around a curve having a radius of 120 m that is banked at an angle of 25.0°. The coefficient of static friction between the car's tires and the road is 0.22. What is the magnitude of the force exerted by friction on the car? Draw the FBD for the car.
   A) 1590 N
   B) 3430 N
   C) 7240 N
   D) 7820 N
   E) 795 N
5. (20pts) The figure shows two packages that start sliding down a $20^\circ$ ramp from rest a distance $d = 6.6$ m along the ramp from the bottom. Package $A$ has a mass of 5.0 kg and a coefficient of kinetic friction 0.20 between it and the ramp. Package $B$ has a mass of 10 kg and a coefficient of kinetic friction 0.15 between it and the ramp.

a) Draw FBD for BOTH blocks. (not in the diagram!!)

b) How long does it take package $A$ to reach the bottom?

c) What is the force that Package $B$ pushes on Package $A$?

Show all your work and BOX your answers. NEATNESS COUNTS.