Clearly show all appropriate work leading to the final answer. Don't forget units and indicate what your final answer is.

1) A particle of mass $4.12 \times 10^{-27}$ kg, moving at $4.62 \times 10^5$ m/s, strikes an identical particle which is initially at rest. After the interaction, the particles (which can't be distinguished) are observed moving at angles $55.3^\circ$ and $34.7^\circ$, both angles being measured with respect to the original direction of motion. What are the final speeds of the particles?

2) A 10.0-kg shell is traveling horizontally to the right at 25.0 m/s relative to the ground when it explodes into two fragments, one of mass 3.00 kg and the other of mass 7.00 kg. The lighter fragment goes directly forward, and the explosion releases $1.50 \times 10^3$ J of mechanical energy to the fragments. Find the magnitude and direction of the velocity of the heavier fragment relative to the ground just after the explosion.
3) In Fig. 9.5, a rope is wrapped around a wheel of radius $R = 2.0$ meters. The wheel is mounted with frictionless bearings on an axle through its center. A block of mass 14 kg is suspended from the end of the rope. When the system is released from rest it is observed that the block descends 10 meters in 2.0 seconds. What is the moment of inertia of the wheel?

4) A futuristic design for a car is to have a large disklike flywheel within the car storing kinetic energy. The flywheel has mass 370 kg with a radius of 0.50 m and can rotate up to 240 rev/s. Assuming all of this stored kinetic energy could be transferred to the linear velocity of the 2400-kg car, find the maximum attainable speed of the car.
5) In Fig. 10.11, a lawn roller in the form of a solid cylinder \((I = \frac{1}{2} mR^2)\) is being pulled horizontally by a horizontal force \(B\) applied to an axle through the center of the roller, as shown in the sketch. The roller has radius 0.92 meters and mass 68 kg. What magnitude of the force \(B\) is required to produce an acceleration \(a = 8.6 \text{ m/s}^2\) of the center of mass of the roller? (Assume that the lawn roller rolls without slipping.)
6) Figure 10.12 represents an Atwood’s machine. There is no slipping between the cord and the surface of the wheel. The blocks have mass of 3.0 kg and 5.7 kg and the wheel has a radius of 0.12 m and mass of 10.3 kg. If the 5.7 kg mass falls 1.5 m, find the speed of each block. (Assume the wheel is in the shape of a disk.)
7) In Fig. 11.12, a 10.0-m long bar is attached by a frictionless hinge to a wall and held horizontal by a rope that makes an angle $\theta$ of 53° with the bar. The bar is uniform and weighs 39.9 N. How far from the hinge should a 10.0-kg mass be suspended for the tension $T$ in the rope to be 177 N?
8) In Fig. 11.13, a uniform ladder 12 meters long rests against a vertical frictionless wall. The ladder weighs 400.0 N and makes an angle $\theta$ of 47° with the floor. A man weighing 768 N climbs slowly up the ladder, the ladder starts to slip. What is $\mu_s$, the coefficient of static friction between the floor and the ladder?
9) What is the difference in the weight of a 69-kg person as measured at sea level and at the top of the Vinson Massif, the highest peak in Antarctica? The product $GM_{\text{earth}} = 3.99 \times 10^{14} \text{ N} \cdot \text{m}^2 \cdot \text{kg}^{-1}$, the radius of the earth is $6.38 \times 10^6 \text{ m}$, and the height above sea level of the Vinson Massif is $5.14 \times 10^3 \text{ m}$. Neglect the flattening of the earth at the poles.

10) (such question may come in the test!) A satellite is in orbit around a planet with orbital speed determined to be 8970 m/s. Find the escape velocity from the planet from this position of its orbit.