(For the following problems, assume gravity is 9.8 m/s^2 where applicable)

1. A driver travelling at 20 m/s is texting and does not notice the wreck 180 meters up ahead. If the car brakes decelerate the vehicle at 4 m/s^2, what is the maximum amount of time before the driver looks up and applies the brakes?
2. A car travelling at an initial velocity accelerates at 0.12 m/s^2. After 5 seconds it travels 100 meters. Find the initial and final velocities.
3. Repeat problem 2 but with acceleration being (0.12t) m/s^2.
4. You are standing 9.6 meters from a 3.6 meter tall vertical cliff face. You want to throw a baseball so that it reaches the top of the cliff face at the apex of its arc. Find the initial speed and angle needed to throw the baseball in this way.
5. A typical rubber band has a spring constant of 88 N/m and an un-stretched length of 80 mm. The band will break if stretched past 191 mm. What is the max mass that can be hung from the band? How much potential energy has been added to the band?
6. A 7 kilogram curling stone is travelling on ice with a starting velocity of 5 m/s. It travels 8.5 meters before stopping. Find the coefficient of friction between the stone and the ice. Find the time it took for the stone to come to a stop.
7. An 8 kilogram mass is travelling north at 4 m/s and west at 3 m/s. The 8 kilogram mass has a completely inelastic collision with a 2 kilogram mass. Their final velocity is straight north at the same speed that the 8 kilogram mass initially. Find the speed and angle of the 2 kilogram mass before the collision.
8. A model rocket is attached to a 1.2 meter massless rod. The rocket can be treated as a point mass of 4.0 kg. The rocket has a constant thrust of 25.0 newtons. The rocket-rod system starts from rest and rotates around a fixed axis attached to the rod. Find:
   1. Torque
   2. Moment of inertia
   3. Angular acceleration
   4. Angular velocity after 3 seconds
9. A merry-go-round makes 1.2 revolutions per minute. If you have a mass of 90 kg and feel a centripetal force of 4.3 newtons, how far from the axis of rotation are you sitting?
10. List 3 ways to calculate angular momentum.
11. A tightrope walker is carrying a pole 3 meter long with a mass of 2 kg. The walker is moving north on a rope and is hit by a gust of wind that that creates a steady torque of 25 N m south. What direction should the tightrope walker move the pole to attempt rebalancing? Is the pole long enough to allow this?
12. How far up from the surface of the Earth do you need to be so that gravity is halved? Mass of Earth = 5.97 x 10^24 kg and radius = 6.37 x 10^6 m
13. A pendulum has a 5 kg mass at the end of a 3.4 meter long massless rod. Find the period. Now the 5 kg mass is removed and a 10 kilogram mass is added 1 meter down from the axis of rotation. Find the new period.
14. A man is holding a 5 meter pole. He then moves at a speed so that a stationary observer sees the pole as 3 meters. How fast is the man moving relative to the observer?

Answers

1. 6.5 sec
2. Vinitial = 19.7 m/s, Vfinal = 20.3 m/s
3. Vinitial = 19.5 m/s, Vfinal = 21.5 m/s
4. 14 m/s at 36.87 degrees above the x axis
5. 1 kg, 0.542 J
6. Coefficient of friction = 0.15, time = 3.4 sec
7. 15 m/s, 36.87 degrees above the x axis
8. a)30 N\*m, b)5.76 kg\*m2, c)5.21 rad/s2 d) 15.63 rad/s
9. 3.026 m
10. L= I\*ω, L = r X p, L = integral of torque dt
11. East. Yes the center of the pole should be moved 1.28 m from the walker.
12. 2.65 x 10^6 m
13. 3.70 sec, 2.00 sec
14. 0.8 c (240000000 m/s)