**Newton’s Second Law Practice**

1. David Purley, a racing driver, survived deceleration from 173 km/h to 0 km/h over a distance of 0.660 m when his car crashed. Assume that Purley’s mass is 70.0 kg. What is the average force acting on him during the crash? Compare this force to Purley’s weight. (Hint: Calculate the average acceleration first.)
2. A giant crane in Washington, D. C. was tested by lifting a 2.232  106 kg load.
   1. Find the magnitude of the force needed to lift the load with a net acceleration of 0 m/s2.
   2. If the same force is applied to pull the load up a smooth slope that makes a 30.0° angle with the horizontal, what would be the acceleration?
3. When the click beetle jumps in the air, its acceleration upward can be as large as 400.0 times the acceleration due to gravity. (An acceleration this large would instantly kill any human being.) For a beetle whose mass is 40.00 mg, calculate the magnitude of the force exerted by the beetle on the ground at the beginning of the jump with gravity taken into account. Calculate the magnitude of the force with gravity neglected. Use 9.807 m/s2 as the value for free-fall acceleration.
4. In 1994, a Bulgarian athlete named Minchev lifted a mass of 157.5 kg. By comparison, his own mass was only 54.0 kg. Calculate the force acting on each of his feet at the moment he was lifting the mass with an upward acceleration of 1.00 m/s2. Assume that the downward force on each foot is the same.
5. In 1967, one of the high school football teams in California had a tackle named Bob whose mass was 2.20  102 kg. Suppose that after winning a game the happy teammates throw Bob up in the air but fail to catch him. When Bob hits the ground, his average upward acceleration over the course of the collision is 75.0 m/s2. (Note that this acceleration has a much greater magnitude than free-fall acceleration.) Find the average force that the ground exerts on Bob during the collision.
6. In 1991, a lobster with a mass of 20.0 kg was caught off the coast of Nova Scotia, Canada. Imagine this lobster involved in a friendly tug of war with several smaller lobsters on a horizontal plane at the bottom of the sea. Suppose the smaller lobsters are able to drag the large lobster, so that after the large lobster has been moved 1.55 m its speed is 0.550 m/s. If the lobster is initially at rest, what is the magnitude of the net force applied to it by the smaller lobsters? Assume that friction and resistance due to moving through water are negligible.
7. A 0.5 mm wire made of carbon and manganese can just barely support the weight of a 70.0 kg person. Suppose this wire is used to lift a 45.0 kg load. What maximum upward acceleration can be achieved without breaking the wire?
8. An average newborn blue whale has a mass of 3.00x103 kg. Suppose the whale becomes stranded on the shore and a team of rescuers tries to pull it back to sea. The rescuers attach a cable to the whale and pull it at an angle of 20.0° above the horizontal with a force of 4.00 kN. There is, however, a horizontal force opposing the motion that is 12.0 percent of the whale’s weight. Calculate the magnitude of the whale’s net acceleration during the rescue pull.
9. One end of the cable of an elevator is attached to the elevator car, and the other end of the cable is attached to a counterweight. The counter-weight consists of heavy metal blocks with a total mass almost the same as the car’s. By using the counterweight, the motor used to lift and lower the car needs to exert a force that is only about equal to the total weight of the passengers in the car. Suppose the car with passengers has a mass of 1.600 x103 kg and the counterweight has a mass of 1.200x103 kg. Calculate the magnitude of the car’s net acceleration as it falls from rest at the top of the shaft to the ground 25.0 m below. Calculate the car’s final speed.
10. The largest squash ever grown had a mass of 409 kg. Suppose you want to push a squash with this mass up a smooth ramp that is 6.00 m long and that makes a 30.0° angle with the horizontal. If you push the squash with a force of 2080 N up the incline, what is
    1. the net force exerted on the squash?
    2. the net acceleration of the squash?
    3. the time required for the squash to reach the top of the ramp?