402 Homework Problems 1

Section 4.3 Newton's Second Law of Motion

1. An airplane has a mass of 3.1×10^4 kg and takes off under the influence of a constant net force of 3.7×10^4 N. What is the net force that acts on the plane's 78-kg pilot?

2. A boat has a mass of 6800 kg. Its engines generate a drive force of 4100 N due west, while the wind exerts a force of 800 N due east and the water exerts a resistive force of 1200 N due east. What are the magnitude and direction of the boat's acceleration?

4. In the amusement park ride known as Magic Mountain Superman, powerful magnets accelerate a car and its riders from rest to 45 m/s (about 100 mi/h) in a time of 7.0 s. The combined mass of the car and riders is 5.5×10^3 kg. Find the average net force exerted on the car and riders by the magnets.

5. A person in a kayak starts paddling, and it accelerates from 0 to 0.60 m/s in a distance of 0.41 m. If the combined mass of the person and the kayak is 73 kg, what is the magnitude of the net force acting on the kayak?

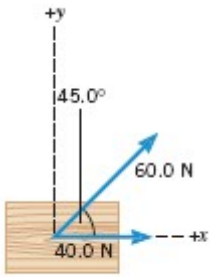
6. Scientists are experimenting with a kind of gun that may eventually be used to fire payloads directly into orbit. In one test, this gun accelerates a 5.0-kg projectile from rest to a speed of 4.0×10^3 m/s. The net force accelerating the projectile is 4.9×10^5 N. How much time is required for the projectile to come up to speed?

7. A 1580-kg car is traveling with a speed of 15.0 m/s. What is the magnitude of the horizontal net force that is required to bring the car to a halt in a distance of 50.0 m?

8. The space probe *Deep Space 1* was launched on October 24, 1998. Its mass was 474 kg. The goal of the mission was to test a new kind of engine called an ion propulsion drive. This engine generated only a weak thrust, but it could do so over long periods of time with the consumption of only small amounts of fuel. The mission was spectacularly successful. At a thrust of 56 mN how many days were required for the probe to attain a velocity of 805 m/s (1800 mi/h), assuming that the probe started from rest and that the mass remained nearly constant?

Section 4.5 Newton's Third Law of Motion

11. Only two forces act on an object (mass = 3.00 kg), as in the drawing. Find the magnitude and direction (relative to the *x* axis) of the acceleration of the object.



Problem 11

12. At an instant when a soccer ball is in contact with the foot of a player kicking it, the horizontal or x component of the ball's acceleration is 810 m/s^2 and the vertical or y component of its acceleration is 1100 m/s^2. The ball's mass is 0.43 kg. What is the magnitude of the net force acting on the soccer ball at this instant?

13. **ssm mmh** A rocket of mass 4.50×10^5 kg is in flight. Its thrust is directed at an angle of 55.0° above the horizontal and has a magnitude of 7.50×10^6 N. Find the magnitude and direction of the rocket's acceleration. Give the direction as an angle above the horizontal.

14. GO A billiard ball strikes and rebounds from the cushion of a pool table perpendicularly. The mass of the ball is 0.38 kg. The ball approaches the cushion with a velocity of +2.1 m/s and rebounds with a velocity of –2.0 m/s. The ball remains in contact with the cushion for a time of 3.3×10^{-3} s. What is the average net force (magnitude and direction) exerted on the ball by the cushion?

16. GO Two skaters, a man and a woman, are standing on ice. Neglect any friction between the skate blades and the ice. The mass of the man is 82 kg, and the mass of the woman is 48 kg. The woman pushes on the man with a force of 45 N due east. Determine the acceleration (magnitude and direction) of **(a)** the man and **(b)** the woman.

18. At a time when mining asteroids has become feasible, astronauts have connected a line between their 3500-kg space tug and a 6200-kg asteroid. Using their tug's engine, they pull on the asteroid with a force of 490 N. Initially the tug and the asteroid are at rest, 450 m apart. How much time does it take for the tug and the asteroid to meet?