PHYSICS – problem solving exercises
3. Dynamics: force and motion

Notes: air friction is neglected in all cases, magnitude of free fall acceleration is 10 m/s²

Problem 1:
Only two <u>horizontal</u> forces act on a 3.0 kg body that can move over a frictionless floor. One force is 9.0 N, acting due east, and the other is 8.0 N, acting 62° north of west. What is the magnitude of the body's acceleration?

Problem 2:
If the 1 kg standard body has an acceleration of 2.00 m/s² at 20.0° to the positive direction of an x axis, what are the x and y components of the net force acting on the body?

Problem 3:
A 300 kg sledge accelerates from rest to a speed of 35 m/s in 5 s. What is the magnitude of the force exerted by its motors?

Problem 4:
After reaching the speed of 35 m/s the sledge from Problem 3 starts to move with the constant velocity on a frictionless ice. What is the magnitude of the force which must be exerted by its motors now?

Problem 5:
A 1.5 tons helicopter is uniformly accelerated in vertical direction. An upward thrust of its motors is 20 kN.
(a) What is the magnitude and direction of the net force?
(b) What is the magnitude of the helicopter's acceleration?

Problem 6:
A 1.5 tons helicopter is moving upward with a constant speed of 10 m/s.
(a) What is the magnitude and direction of the net force?
(b) What is an upward thrust of the helicopter's motors?

Problem 7:
A 1.5 tons helicopter is moving horizontally with a constant speed of 10 m/s at a constant height of 500 m.
(a) What is the magnitude and direction of the net force?
(b) What is an upward thrust of the helicopter's motors?

Problem 8:
An elevator cab and its load have a combined mass of 1600 kg. Find the tension in the supporting cable when the cab, originally moving downward at 12 m/s, is brought to rest with constant acceleration in a distance of 42 m.

Problem 9:
There are two forces on the 2.00 kg box in the <u>overhead view</u> of the attached figure, but only one is shown. For $F_1 = 20.0$ N, $a = 12.0$ m/s^2, and $\theta = 30.0°$, find the second force:
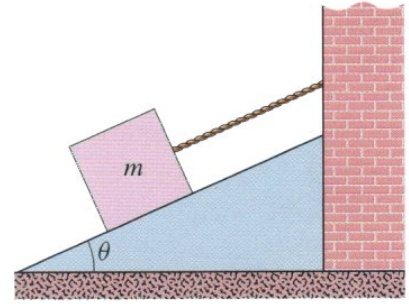(a) as the x and y components
(b) as the magnitude and angle relative to the positive direction of the x axis.
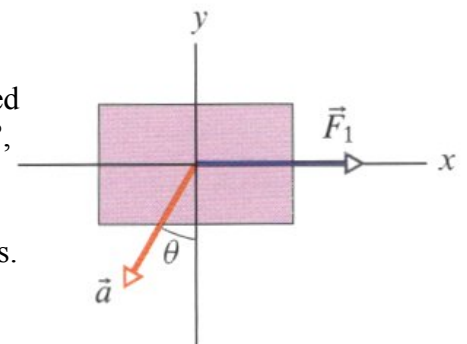
Problem 10:

The mass of the block is 8.5 kg and the angle θ is 30°. Find:
(a) the tension in the cord
(b) the normal force acting on the block
(c) If the cord is cut, find the magnitude of the resulting acceleration of
the block. (Assume no friction)

Problem 11:

An elevator cab that weights 27.8 kN moves upward. What is the tension in the cable if the cab's speed is
(a) increasing at a rate of 1.22 m/s²
(b) decreasing at a rate of 1.22 m/s²?

Problem 12: *optional*

In a two/dimensional tug-of-war, Alex, Betty, and Charles pull horizontally on an automobile tire at the angles shown in the overhead view of the figure. The tire remains stationary in spite of the three pulls. Alex pulls with force F_A of magnitude 220 N, and Charles pulls with force F_C of magnitude 170 N. Note that the direction of F_C is not given. What is the magnitude of Betty's force F_B?
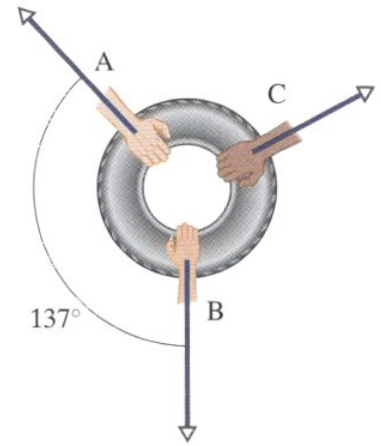
Problem 13: *optional*

A 40 kg girl and an 8.4 kg sled are on the frictionless ice of a frozen lake, 15 m apart but connected by a rope of negligible mass. The girl exerts a horizontal 5.2 N force on the rope. What are the acceleration magnitudes of (a) the sled and (b) the girl? (c) How far from the girl's initial position do they meet?