PROBLEM 1 – 5 points

A box is placed on a horizontal board and then the angle between the board and the horizontal is gradually increased until that angle is 30˚. During this process the box remains at rest on the board.

During this process, while the angle of the board is increasing from 0˚ to 30˚ :

(i) the magnitude of the component of the force of gravity acting on the box that is directed parallel to the slope:

[ ] increases [ ] decreases [ ] stays the same

(ii) the magnitude of the component of the force of gravity acting on the box that is directed perpendicular to the slope:

[ ] increases [ ] decreases [ ] stays the same

(iii) the magnitude of the normal force exerted on the box by the board:

[ ] increases [ ] decreases [ ] stays the same

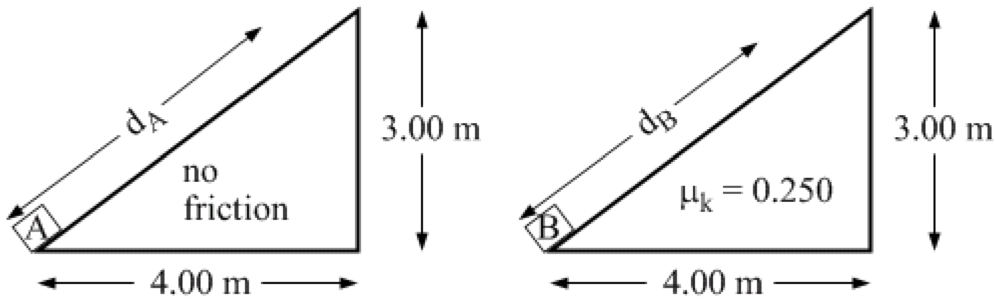
(iv) the magnitude of the force of friction exerted on the box by the board:

[ ] increases [ ] decreases [ ] stays the same

(v) the magnitude of the maximum possible force of friction the box could exert on the board:

[ ] increases [ ] decreases [ ] stays the same

PROBLEM 2 – 20 points



Two identical blocks, A and B, are placed at the bottom of almost-identical ramps and given **initial velocities of 6.00 m/s up their ramps**. Both ramps are in the shape of 3-4-5 triangles, as shown, but block A's ramp is frictionless while the coefficient of kinetic friction between block B and its ramp is 0.250. Both blocks slide up and down their ramps. Use $\mathbf{g = 10.0\ m/s^2}$.

[6 points] (a) Block A travels a distance of d_A up its ramp before turning around. Sketch a free-body diagram of block A as it is sliding up the slope, and use this to determine the distance d_A.

[10 points] (b) Sketch a free-body diagram of block B as it is sliding up its ramp. For how much time is block B sliding up the ramp?

[4 points] (c) Select all the true statements about this situation from the list below. Grading scheme: +1 for each correct answer, –1 for each incorrect answer (but you can't get less than 0).

- [ ] Block A travels a larger distance up its ramp than does block B.
- [ ] Block A takes the same time to slide up the ramp as it does to slide down.
- [ ] Block B takes the same time to slide up the ramp as it does to slide down.
- [ ] Block B's average speed on the way up is larger than its average speed on the way down.
- [ ] The time it takes block A to reach its highest point is the same as the time it takes block B to reach its highest point.
- [ ] On the way up the slope the net force on block A is zero.
- [ ] On the way down the slope the net force on block A is directed up the slope.
- [ ] When the blocks are sliding down their ramps the magnitude of the net force on block A is larger than the magnitude of the net force on block B.

PROBLEM 3 – 15 points

Two identical boxes of mass m are sliding along a horizontal floor, but both eventually come to rest because of friction. Box A has an initial speed of v_i, while box B has an initial speed of $2v_i$. The coefficient of kinetic friction between each box and the floor is μ_K, and the acceleration due to gravity is g.

(a) If it takes box A a time T to come to a stop, how much time does it take for box B to come to a stop?

(b) Find an expression for T in terms of the variables specified above.

(c) If box A travels a distance D before coming to rest, how far does box B travel before coming to rest?

(d) Find an expression for D in terms of the variables specified above.

(e) How does D, the stopping distance for box A, change if m is doubled?