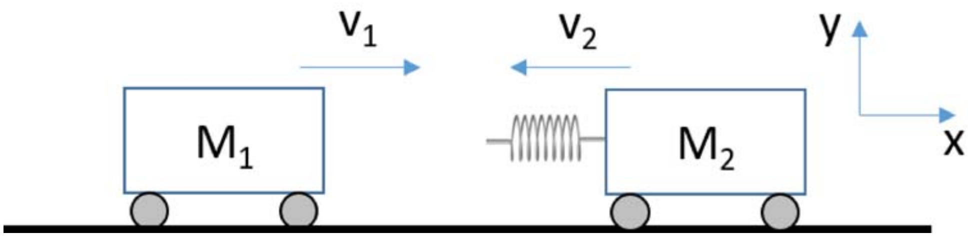
Enter here the question setup

The next two questions pertain to the situation described below.



Cart m_1 with mass m_1 = 0.6 kg moving to the right (+x-direction) on a frictionless linear air track at an initial speed of 1.2 m/s undergoes an elastic collision with a cart with mass m_2 =0.25 kg initially moving to the left with speed 1.8 m/s.

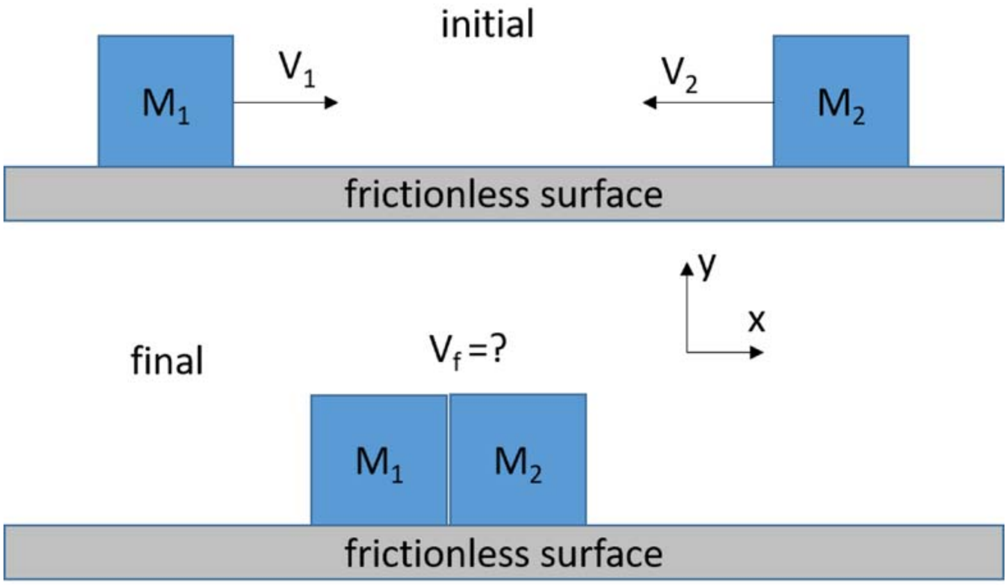
1) What is V_{cm}, the x component of the velocity of the center of mass of the two cart system?

a. V_{cm} = 1.4 m/s
b. V_{cm} = 0.85 m/s
c. V_{cm} = 0.32 m/s

2) What is V_{1f}, the velocity of cart 1 after the collision?

a. V_{1f} = -0.88 m/s
b. V_{1f} = -2.1 m/s
c. V_{1f} = 0.5 m/s
d. V_{1f} = -0.56 m/s
e. V_{1f} = 1.8 m/s

The next three questions pertain to the situation described below.



Prior to colliding, two blocks with masses M_1 = 1.5 kg, M_2 = 4.5 kg move towards each other on a horizontal frictionless surface with speeds V_1 = 6 m/s and V_2 = 1.5 m/s. The collision is completely inelastic and, afterward, the two blocks are joined together.

3) After the collision the two blocks

a. move in the negative *x*-direction.
b. move in the positive *x*-direction.
c. are stationary.

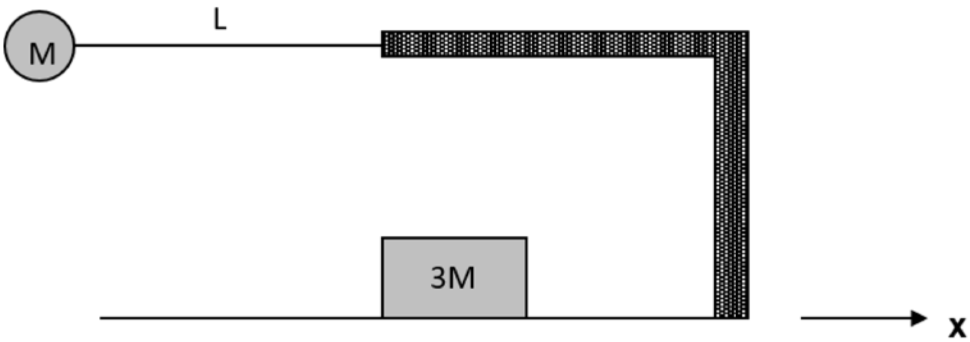
4) The ratio of the total initial kinetic energy to the total final kinetic energy, K_i / K_f is

a. K_i / K_f = 76
b. K_i / K_f = 1.55
c. K_i / K_f = 400
d. K_i / K_f = 8.16
e. K_i / K_f = 144

5) Which of the following best describes v^*, the velocity of the two blocks in the *center of mass reference frame* after the collision?

a. v^* is **zero**
b. v^* is in the **negative** *x* direction
c. v^* is in the **positive** *x* direction

The next three questions pertain to the situation described below.



A steel ball of mass M is attached to the end of a massless string of length $L = 0.75$ m which is fixed at the opposite end. The string is pulled taut and held horizontally, as shown above. The ball is then released from rest. At the bottom of the path, the ball strikes a steel block of mass $3M$ initially at rest on a horizontal frictionless surface.

6) What is the speed of the ball just before the collision?

a. 2.7 m/s
b. 3.8 m/s
c. 0.28 m/s

7) Let v represent the velocity of the ball just before the collision. If the velocity of the ball just after the collision is $-v/3$, what is the velocity of the block just after the collision?

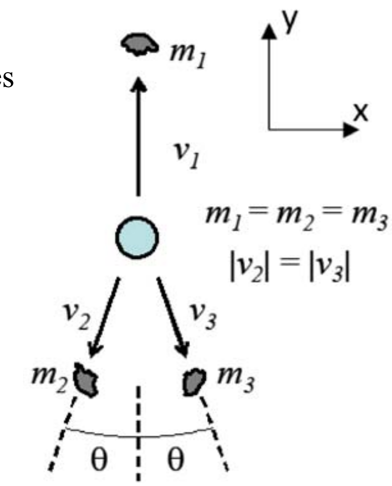
a. $3v/4$
b. $3v/2$
c. v
d. $4v/9$
e. $2v/3$

8) What can you tell about the character of the collision?

a. The collision was completely elastic.
b. The collision was inelastic.
c. There is not enough information to determine the elasticity of the collision.

The next two questions pertain to the situation described below.

An object is at rest just before it explodes into three equally massive fragments. Right after the explosion, one of the fragments, m_1, travels in the positive *y*-direction with a velocity v_1. The other two fragments travel downward, at angles $\pm\theta$ with respect to the negative *y*-axis



9) What is K_1/K_2, the ratio of the kinetic energy of fragment 1 to the kinetic energy of fragment 2 ?

a. $K_1/K_2 = 2\cos^2\theta$
b. $K_1/K_2 = 2\sin^2\theta$
c. $K_1/K_2 = 4$
d. $K_1/K_2 = 2$
e. $K_1/K_2 = 4\cos^2\theta$

10) If the explosion resulted in particles 2 and 3 leaving at a larger angle θ

a. the center of mass after the explosion would move upward.
b. the center of mass after the explosion would move downward.
c. the center of mass after the explosion would remain at rest.

The next two questions pertain to the situation described below.

A person with a mass 80 kg is standing still on a frictionless horizontal ice surface and then throws a 0.25 kg ball in the horizontal direction. After throwing the ball, the person is observed to be sliding backwards with a speed of 0.04 m/s with respect to the ice.

11) What is v_{ball}, the horizontal component of the speed of the ball with respect to the ice?

a. $v_{\text{ball}} = 0.04$ m/s

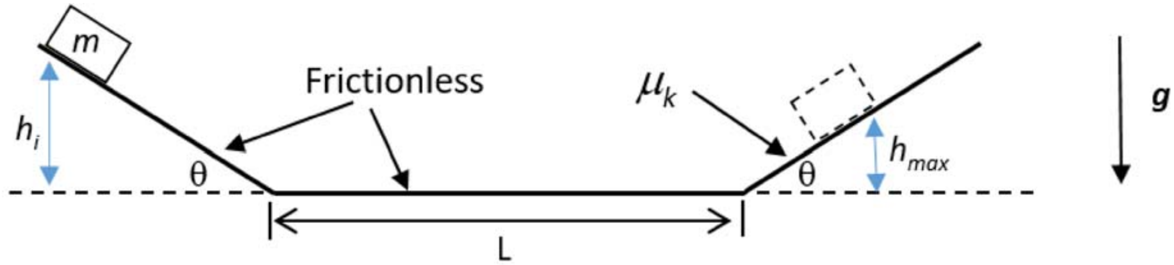
b. $v_{\text{ball}} = 1.2 \times 10^{-4}$ m/s

c. $v_{\text{ball}} = 13$ m/s

12) What is the magnitude of the average horizontal force by the hand on the ball, assuming it took 0.15 seconds to accelerate the ball from rest to its final speed?

a. 0 N
b. 0.0667 N
c. 21.3 N

The next two questions pertain to the situation described below.



A block of mass m=1.5 kg is released from rest a height h_i = 1.5 m on a frictionless inclined plane that makes an angle θ = 35° with respect to the horizontal. At the bottom of the incline, the mass encounters a frictionless horizontal surface of length L = 2.5 m. After sliding across the horizontal surface, the mass goes up a second incline that makes an angle θ = 35° with respect to the horizontal and has a kinetic coefficient of friction μ_k = 0.45, and static coefficient of friction μ_s = 0.52.

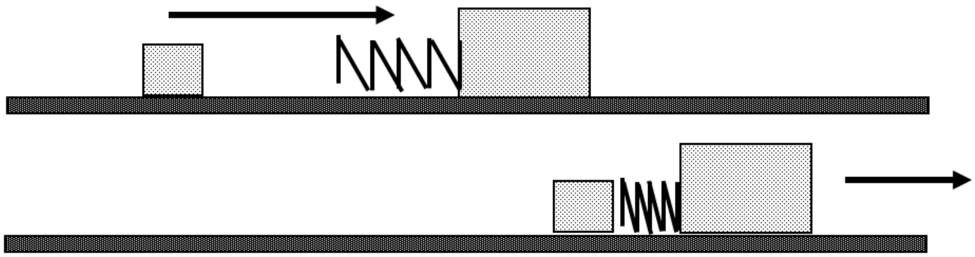
13) What is the maximum height h_{max} that the block reaches on the right ramp?

a. h_{max} = 0.913 m
b. h_{max} = 1.03 m
c. h_{max} = 0.861 m
d. h_{max} = 0.987 m
e. h_{max} = 1.14 m

14) After reaching h_{max} the block

a. slides all of the way down the ramp and back across the frictionless horizontal surface.
b. stops and remains at that position.
c. slides part way down the ramp and comes to a stop.

The next two questions pertain to the situation described below.



A block of mass M_1 slides on a horizontal, frictionless surface with a velocity of V_1. It collides with an ideal, massless spring which is attached to a block of mass M_2 which is initially at rest. The spring has a spring constant of k = 175 N/m.

15) What is the common speed V_c that the two masses (and spring) will be moving when the spring is maximally compressed?

a. $V_c = M_2 V_1 / M_1$
b. $V_c = M_1 V_1 / M_2$
c. $V_c = M_1 V_1 / (M_1 + M_2)$

16) If M_1 = 1.5 kg, M_2 = 6 kg, and the common velocity at the maximum spring compression V_c = 0.4 m/s, what is Δx_{max}, the maximum spring compression?

a. Δx_{max}= 0.037 m
b. Δx_{max}= 0.0414 m
c. Δx_{max}= 0.166 m
d. Δx_{max}= 0.0741 m
e. Δx_{max}= 0.0828 m

The next two questions pertain to the situation described below.

A block of mass m=2.8 kg starts from rest and is pulled across a rough floor by a horizontal rope. There is friction between the box and the floor with kinetic coefficient of friction μ_k. The tension in the rope is T = 22 N. After moving the box a distance 2 m, the box has a velocity of 3.9 m/s.

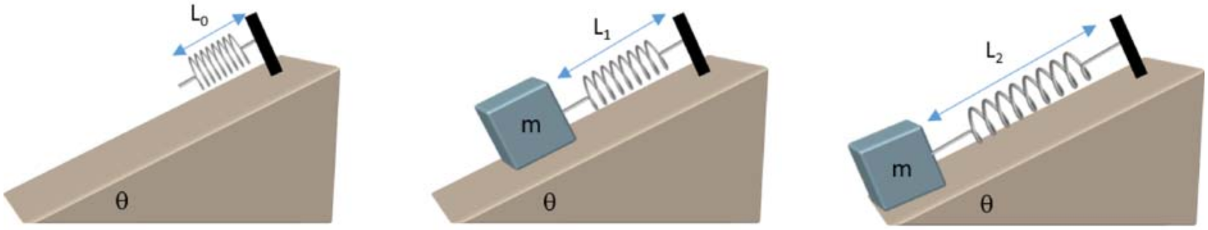
17) What is W_r, the work done by the rope as the block is moved 2 m?

a. $W_r = 0$ J
b. $W_r = 44$ J
c. $W_r = -44$ J

18) What is μ_k, the coefficient of kinetic friction between the block and the floor?

a. $\mu_k = 1.2$
b. $\mu_k = 0.53$
c. $\mu_k = 0.8$
d. $\mu_k = 0.41$
e. $\mu_k = 0.31$

The next three questions pertain to the situation described below.



A spring with spring constant k = 250 N/m is fixed to a frictionless inclined plane that makes and angle θ = 28° with the horizontal. The relaxed length of the spring is L_0 as shown in the left figure. A block of mass m=2.8 kg is attached to the spring. The new equilibrium length is L_1 = 0.4 m as shown in the middle image.

19) How far does the spring stretch when the block is attached to it?

a. $L_1 - L_0$ = 0.124 m
b. $L_1 - L_0$ = 0.0516 m
c. $L_1 - L_0$ = 0.11 m
d. $L_1 - L_0$ = 0.097 m
e. $L_1 - L_0$ = 0.234 m

20) The block is then pulled down the ramp (further stretching the spring) to a length L_2 = 0.48 m as illustrated in the right image, and released. As the block slides up and down the ramp, at what spring length will it be moving the fastest?

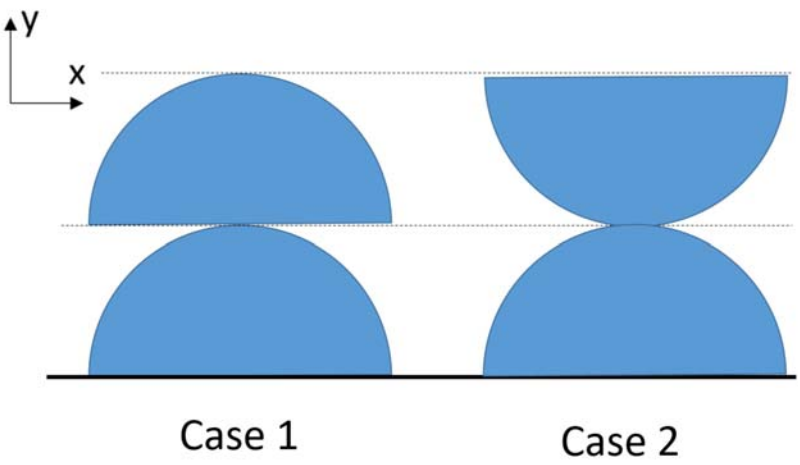
a. $L_1 + 0.5*(L_2 - L_1)$
b. L_1
c. L_0

21) What is the speed of the block when the spring's length is 0.35 m?

a. $V_{0.35}$ = 0.59 m/s
b. $V_{0.35}$ = 1.26 m/s
c. $V_{0.35}$ = 1.23 m/s
d. $V_{0.35}$ = 1.6 m/s
e. $V_{0.35}$ = 0.483 m/s

22) A satellite of mass $m = 200$ kg is released from rest a distance $H = 1.5 \times 10^6$ m above the surface of the moon. With what speed is it travelling when it hits the surface? ($M_{moon} = 7.4 \times 10^{22}$ kg, $R_{moon} = 1.738 \times 10^6$ m)?

a. $V_f = 2380$ m/s
b. $V_f = 2570$ m/s
c. $V_f = 1750$ m/s
d. $V_f = 1620$ m/s
e. $V_f = 76700$ m/s



23) Compare the y-component of the center of mass for the two sets of semicircles shown above.

a. $y_1 > y_2$
b. $y_1 = y_2$
c. $y_1 < y_2$

24) Identical constant forces are applied to two blocks, one of mass *M* and one of mass 2*M*, both initially at rest on a frictionless floor. In order for the blocks to end up with identical speeds, you would need to

a. apply the forces over identical distances.
b. apply the force to block 2*M* over twice the distance compared to block *M*.
c. apply the forces over identical time periods.