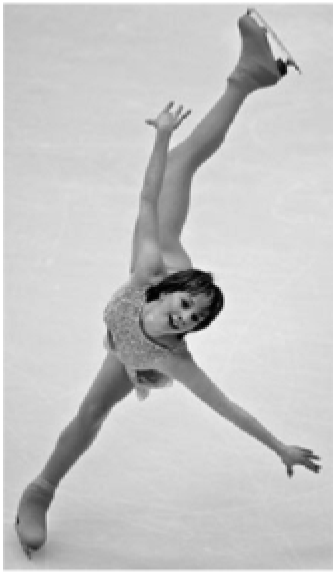
Section Two   Force and Energy

Student ID   Name

Part one

A spiral is an ice-skating position in which the skater glides on one foot with the other foot held above hip level. It's a required element in women's singles figure skating competition and is related to the arabesque performed in ballet. Figure 2.1 shows skater Sarah Hughes executing a spiral during her gold-medal performance at the Winter Olympics in Salt Lake City.



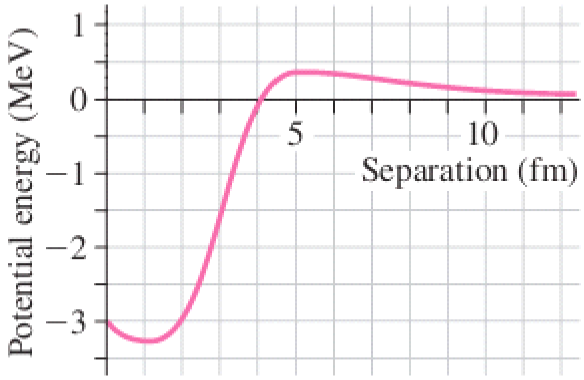
1. From the photo, you can conclude that the skater is
a. executing a turn to her left.
b. executing a turn to her right.
c. moving in a straight line out of the page.

2. The net force on the skater
a. points to her left.
b. points to her right.
c. is zero.

3. If the skater were to execute the same maneuver but at higher speed, the tilt evident in the photo would be
a. less.
b. greater.
c. unchanged.

4. The tilt angle that the skater's body makes with the vertical is given approximately by From this you can conclude that the skater's centripetal acceleration has approximate magnitude
a. 0.
b. $0.5 m/s^2$
c. $5 m/s^2$
d. can't be determined without knowing the skater's speed

Nuclear fusion is the process that powers the Sun. Fusion occurs when two low-mass atomic nuclei fuse together to make a larger nucleus, in the process releasing substantial energy. This is hard to achieve be-cause atomic nuclei carry positive electric charge, and their electrical repulsion makes it difficult to get them close enough for the short-range nuclear force to bind them into a single nucleus. Figure 2.2 shows the potential-energy curve for fusion of two deuterons (heavy hydrogen nuclei). The energy is measured in million electron volts (MeV), a unit commonly used in nuclear physics, and the separation is in femtometers ($1 fm=10^{-15} m$).



5. The force between the deuterons is zero at approximately

a. 3 fm.

b. 4 fm.

c. 5 fm.

d. the force is never zero.

6. In order for initially two widely separated deuterons to get close enough to fuse, their kinetic energy must be about

a. 0.1 MeV.

b. 3 MeV.

c. -3 Mev

d. 0.3 MeV.

7. The energy available in fusion is the energy difference between that of widely separated deuterons and the bound deutrons after they've "fallen" into the deep potential well shown in the figure. That energy is about

a. 0.3 MeV.

b. 1 MeV.

c. 3.3 MeV.

d. 3.6 MeV.

8. When two deuterons are 4 fm apart, the force acting on them

a. is repulsive.

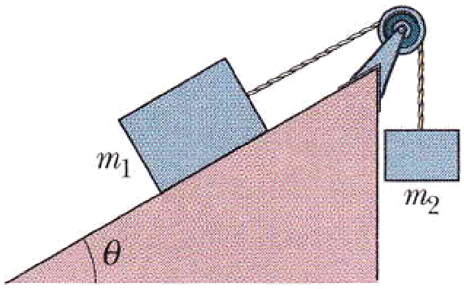
b. is attractive.

c. is zero.

d. can't be determined from the graph.

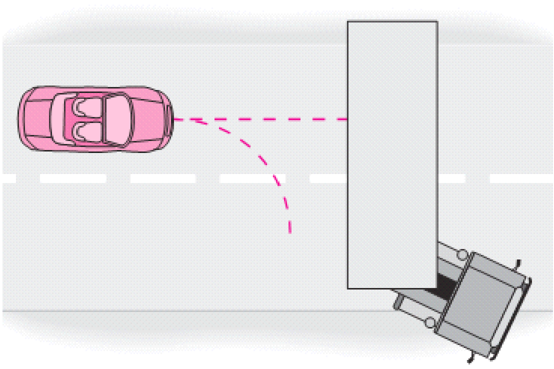
Part Two

A block of mass m1= 3.70 kg on a frictionless plane inclined at angle θ= 30.0˚ is connected by a cord over a massless, frictionless pulley to a second block of mass m2=2.30 kg (Fig. 2.3). What are (a) the magnitude of the acceleration of each block, (b) the direction of the acceleration of the hanging block, and (c) the tension in the cord?



Solution:

Driving in thick fog on a horizontal road, you spot a tractor-trailer truck jackknifed across the road. To avert a collision, you could brake to a stop or swerve in a circular arc, as suggested in Fig. 3.4. Which option offers the greater margin of safety? Assume that there is the same coefficient of static friction in both cases, and that you maintain constant speed if you swerve

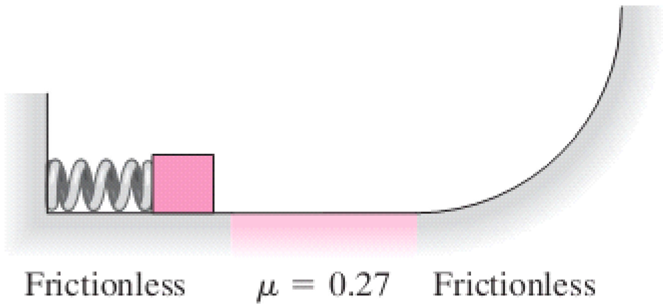


Solution:

The force exerted by an unusual spring when it's compressed a distance x from equilibrium is $F = -kx - cx^3$, where k= 220 N/m and $c = 3.1 N/m^3$ Find the stored energy when it's been compressed 15 cm.

Solution:

A 190-g block is launched by compressing a spring K=200N/m of constant by 15 cm. The spring is mounted horizontally, and the surface directly under it is frictionless. But beyond the equilibrium position of the spring end, the surface has frictional coefficient μ=0.27. This frictional surface extends 85 cm, followed by a frictionless curved rise, as shown in Fig. 2.5. After it's launched, where does the block finally come to rest? Measure from the left end of the frictional zone.



Solution: