

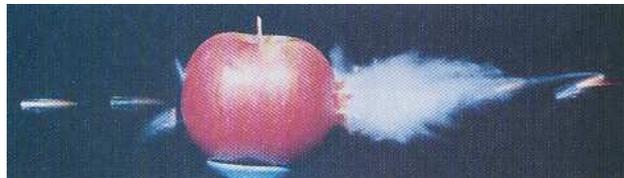
Name _____

Hour _____

AP Physics: Chapter 6
Momentum

Question A:

An 8.0 g bullet strikes an apple with a velocity of 800.0 m/s, as shown in the figure at right. At a time of 1.0×10^{-4} sec later, the bullet emerges from the apple with a velocity of 700.0 m/s.



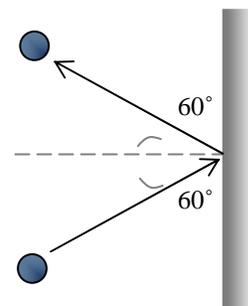
- Calculate the impulse exerted on the bullet by the apple.
- Calculate the work done on the bullet by the apple.
- Calculate the force exerted on the bullet by the apple.

Question B:

An open box slides across a frictionless, icy surface of a frozen lake. What happens to the speed of the box as water from a rain shower collects in it, assuming that the rain falls vertically downward into the box? Explain.

Question C:

A 3.0 kg steel ball strikes a massive wall with a velocity of 10.0 m/s at an angle of 60.0° with the plane of the wall. It bounces off with the same speed and angle, as shown in the diagram at right. If the ball is in contact with the wall for .20 s, what is the average force exerted on the ball by the wall?



Question D:

Gary the golfer hits a .050 kg golf ball with a force of 130.0 N for a period of .025 sec.

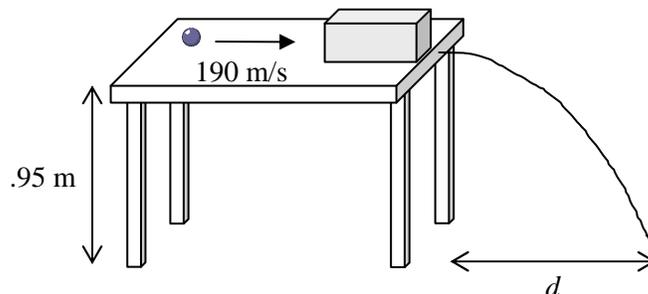
- What impulse does Gary exert upon the golf ball?
- What is the resulting velocity of the golf ball?

Question E:

A 9500 kg cannon initially at rest fires a 3.5 kg cannon ball. Calculate the recoil velocity of the cannon if the cannonball's velocity is 135 m/s.

Question F:

A 7.00 gram bullet is fired with a velocity of 190 m/s into a 2.0 kg block of wood that is initially at rest on the edge of a .95 m tall table, as shown in the diagram at right. The bullet remains in the block of wood, and the combination travels off of the table and on to the floor. Determine the horizontal distance from the table to the landing position of the bullet-block combination.



Question G:

A ballistic pendulum is used to determine the velocity of objects that would otherwise move too fast to be easily measured. Suppose a 10.00 g bullet is fired into the .500 kg block of a ballistic pendulum, which is originally at rest. The bullet embeds itself in the block and the combination travels a distance of 1.15 m on the rough surface of a floor. Calculate the initial velocity of the bullet if the coefficient of friction between the block and the floor is .55.

AP Physics: Chapter 7
Uniform Circular Motion

Question A:

An airplane is flying in a horizontal circle with a radius of 165 m. The 80.0 kg pilot does not want her centripetal acceleration to exceed $7g$.

- Calculate the maximum speed of the airplane in this path.
- Calculate the force causing the centripetal acceleration of the pilot at this speed.

Question B:

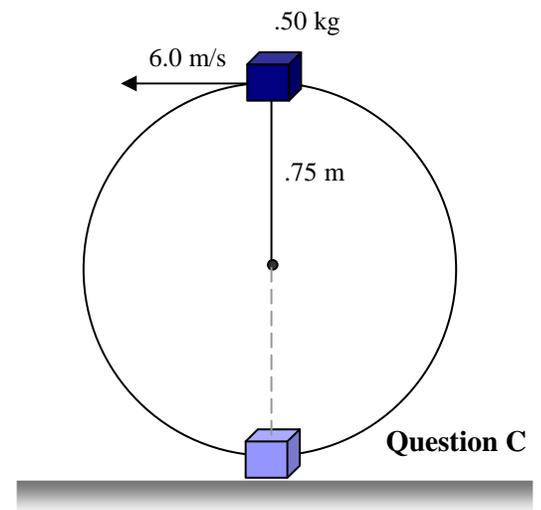
A child stands at the rim of a merry-go-round with a radius of 2.00 m, rotating once every 3.0 seconds.

- What is the child's centripetal acceleration?
- What minimum coefficient of static friction is required between the child's feet and the floor of the merry-go-round in order to keep the child moving in the circular path? Is this a reasonable answer? In other words, is the child likely to stay on the merry-go-round?

Question C:

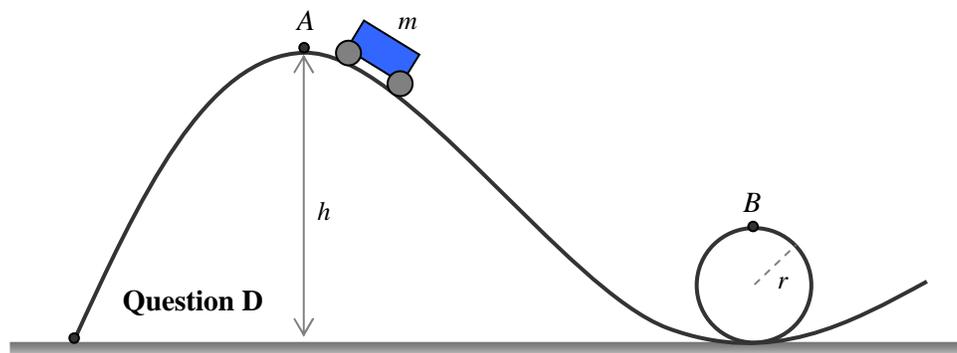
Jerry attaches a .50 kg mass to a .75 m string and swings it freely in a vertical circle without friction. The velocity of the mass as it passes through the top of the circular path is 6.0 m/s.

- Calculate the tension in the string when the mass is at the top of the circular path.
- Calculate the velocity of the mass as it passes through the bottom of the circular path.
- Calculate the tension in the string when the mass is at the bottom of the circular path.



Question D:

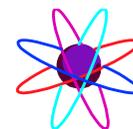
A roller coaster car of mass m follows the track shown in the diagram above. The car comes briefly to a stop at a height h , shown by Point A on the diagram. It then rolls without friction down the track and around a vertical loop of radius r . Point B on the diagram above indicates the highest point reached by the car on the vertical loop.



- In terms of r and appropriate constants, derive an expression for the minimum velocity v_B of the car at Point B in order for it to safely remain on the track.
- In terms of r and appropriate constants, derive an expression for the minimum height h_A of the car at Point A in order for it to safely traverse the vertical loop.

Question E:

At the Fermilab particle accelerator in Illinois, electromagnets accelerate protons around a large circular chamber of radius 1.0 km. Each proton has a mass of 1.67×10^{-27} kg and completes one full revolution around the chamber in 2.0×10^{-4} seconds.



- Calculate the tangential velocity of a proton in the particle accelerator.
- Calculate the centripetal acceleration of a proton in the particle accelerator.

Question F:

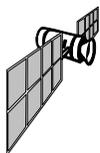
Sally swings a .50 kg bucket of water in a vertical circle of radius .60 m. Determine the velocity of the bucket at the top of the circle if the tension in her arm is 8.0 N at that time.

Question G:

In a science fiction movie, the mad scientist uses his Gravity Gadget to measure the gravitational pull between two objects. When a 1.0 kg mass is placed 1.0 m away from a large marble statue of Aristotle, the Gravity Gadget measures a gravitational force of 2.40×10^{-8} N between them. Calculate the mass of the marble statue.

Question H:

The main character in “*The Little Prince*” has a mass of 55.0 kg. He visits B612, a small asteroid, with a radius of only 20.0 m and a mass of only 1.00×10^4 kg. Calculate the acceleration of gravity on asteroid B612 and the weight of the Little Prince when he is on its surface.

**Question I:**

A synchronous communications satellite is used to relay radio and TV signals around the Earth. Such satellites keep a fixed position above one location on the Earth’s surface and move eastward with the Earth as it rotates on its axis. These satellites orbit at a distance of 4.23×10^7 m from the center of the Earth. Calculate the tangential velocity of these satellites in orbit.

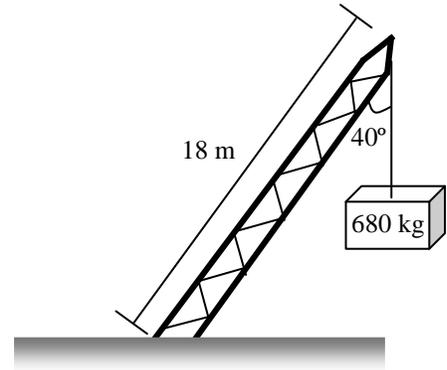
Question J:

Triton is a tiny moon of Neptune, only slightly larger than Australia, with a mass of only 2.14×10^{22} kg. Its orbit about the 1.02×10^{26} kg Neptune has a radius of 3.55×10^8 m. Calculate the gravitational potential energy between Neptun and Triton.

AP Physics: Chapter 8
Torque & Rotational Motion

Question A:

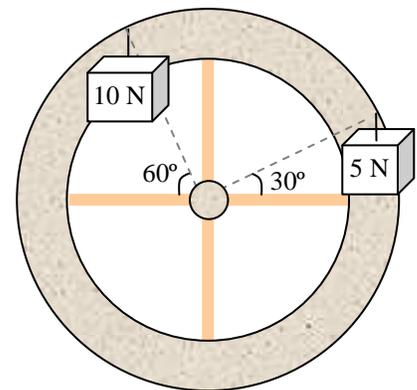
A construction crane of length 18.0 meters supports a load of 680 kg at one end. The angle between the load and the crane is 40° , as shown in the diagram below. Calculate the torque exerted on the crane about an axis at the ground level.



Question B:

A wheel with uniformly distributed mass is free to rotate without friction around its center axis. The radius of the wheel is .75 m. A weight of 5 N is attached to the wheel at an angle of 30° from the positive x -axis, and a second weight of 10 N is attached at an angle of 60° from the negative x -axis.

- Calculate the torque about the center axis exerted by the 5 N weight.
- Calculate the torque about the center axis exerted by the 10 N weight.
- Which way (clockwise or counter-clockwise) does the wheel turn? Explain your answer.



Question C:

Wiley Coyote has a mass of 20.0 kg and sits on a wooden lever, 1.5 m from the fulcrum. Hoping to rid himself of the pesky Coyote, Roadrunner jumps on the lever, 2.0 m from the fulcrum, and lifts the unsuspecting Coyote into the air.



- Calculate the torque that Wiley exerts on the lever.
- Determine the amount of force that Roadrunner must exert in order to produce the same amount of torque on the other side of the lever.