Pod 116-F
Vector analysis of circular motion 2: Apply Newton's Laws to Circular Motion at a constant speed

Key Principles:

Vectors

- Vectors have magnitude and direction.
- Scalars have only magnitude

Velocity

- Velocity is a vector. It has magnitude and direction.

The magnitude of velocity is called the speed (which is a scalar).

When an object moves in a circle with a constant speed, its velocity is *changing* because the direction is changing.

Acceleration

Acceleration is change in velocity per time.
In normal speech, acceleration only means speeding up,
but in physics, acceleration can mean speeding up, slowing down, or changing direction (because velocity is a vector).
When an object moves in a circle at a constant speed, it changes direction, so it is *accelerating*.

Force:

Whenever an object is moving in a circle, a force called the *centripetal force* pulls it towards the center of the circle.

Newton's First Law:
If an object in motion is subject to no external forces,
it will stay in motion at a constant velocity (speed and direction).
If an object is *let go from the centripetal force*, no force acts on the object, so t will move in a straight line at a constant speed.

Newton's Second Law:
Net Force = mass * acceleration
=>

- If net force is in the same direction as velocity, an object speeds up.
- If net force is in the opposite direction as velocity, an object slows down.
- if net force is in a direction perpendicular to velocity, the object changes direction.

In circular motion at a constant speed, the velocity is tangential and the centripetal force is radial. They are *always perpendicular,* which is a law from geometry.
So, the object always changes direction, but does not speed up or slow down.

Questions:

True or False:

- Newton's Third Law states that if A exerts a force on B, B exerts a force on A with equal magnitude and opposite direction.
This means that any time a gun or cannon is fired, it exerts a strong backwards force on the person holding it called the *recoil*

Someone is trying to design a different type of cannon called a *rotor cannon*. In this cannon, instead of being fired out of a barrel, a cannonball is rotated extremely fast and then let go. A rotor cannon *has no recoil*. Explain this fact by referring to the principles of circular motion and Newton's Laws listed above.