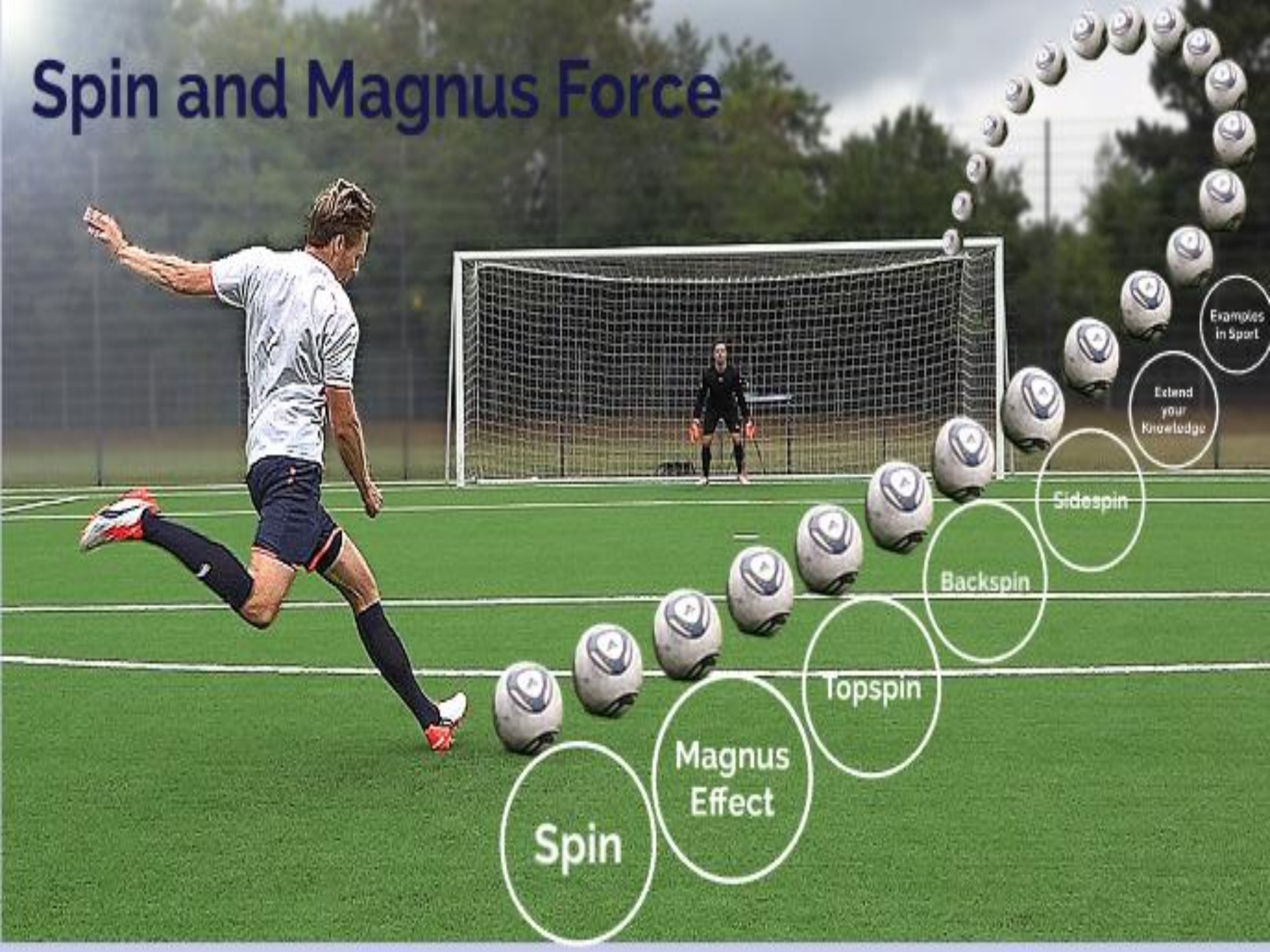
Spin and Magnus Force



Meaning

- Rotation around any axis is known as spin. Rotation around horizontal axis is known as topspin or back spin. Rotation around vertical axis is known as side (left or right) spin.
- Application of spin to an object may result from contact with either a moving surface (implement) or a stationary surface.

Cause of Spin

- The cause of spin is the application of off center force.
- The off center force is the force which does not pass through the center of gravity of the implement.
- Due to spin the path of the ball also changes because the ball is moving in air, so aerodynamics effect is also a factor which is to be studied.

Principles of Spin

1. Effects of Spin on Flight of an Object

- An object propelled without spin tends to waver because of air resistance against the object's irregular surface.
- The amount of waver varies with the density of the object: denser objects are less influenced by air resistance.
- A small amount of spin on an object produces a stabilizing effect which tends to hold it on its line of flight.
- Increased spin will tend to cause the object to curve in the same direction as the spin because of unequal air pressure caused by the spinning.
- The amount that an object will curve in a given distance is determined primarily by (I) the density, (2) the amount of spin, and (3) the speed at which the object travels. Further. the amount and direction of wind and the shape and surface of the object are important influences.

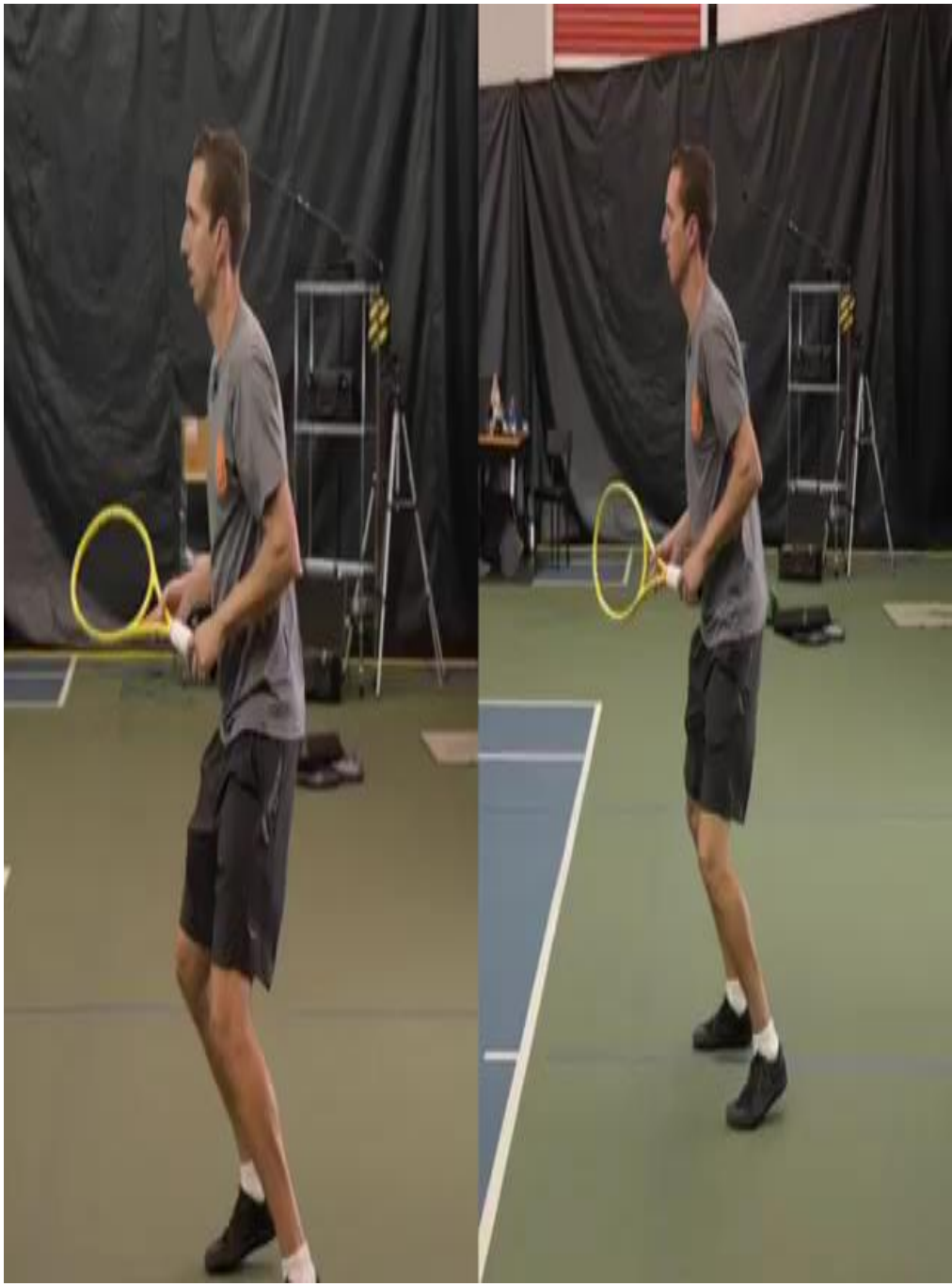
- **Example A**: A volleyball served with slight spin follows a true course of flight determined by the propelling force, but if the ball is contacted decidedly off center, the resulting increase in spin will produce a curve. If the ball is hit directly through its center of gravity, the ball receives no rotary motion, and it tends to waver.
- **Example B**: In baseball pitching, a knuckle ball is thrown with the intention of-causing a wavering action. In this case the amount of waver is related to the speed the object travels. The faster it moves, the more it will waver.

- **Example C**: A counter clock- wise spin (golf hook, baseball outside curve, and volleyball or tennis serve where the ball is contacted on its right side) will cause a ball to curve to the left.
- **A clockwise spin** (golf slice, baseball inside curve, and volleyball or tennis serve where the ball is contacted on its left side) will cause a **curve to the right.**
- **Example D**: If a **golf ball is hit with topspin**, the distance it travels in flight will be reduced because it will **tend to dive rather sharply to the surface**. This action will be followed by a **long roll,** enhanced by the **forward spin.**
- If the ball is **given backspin**, it will tend to rise higher; therefore, it will **stay in flight longer u**pon landing. The **length of its roll will be reduced** by the backspin.

2. Spin Resulting from Striking

- To cause an object to spin in the desired direction, the **striking implement should be drawn across the object in the direction of the desired spin.**
- **Forward (top) spin** is caused by an implement **striking forward-upward.**
- **Back spin** is produced when the strike is made **forward- downward.**
- **Right spin (clockwise)** is generated by drawing the implement across the ball from **right to left.**
- and **left spin** is developed from contact of the implement in a **left to right direction.**

- **Example A**: In tennis driving strokes, the ball should usually be hit with a forward-upward motion (the racket face tends to roll over the ball) in order to apply topspin to the ball. Topspin **causes the ball to drop**, producing a tendency for it to **land within the opponent's court** rather than to be too long. Also, topspin causes the ball to **move faster on the rebound** and to **bounce at a lower angle.**
- **Example B**: If the tennis stroke is a "**cut" or chop shot,** the ball will backspin. A back spinning ball **will "hang" in the air longer** and rebound from the surface at a sharper angle, tending to **rebound higher.**

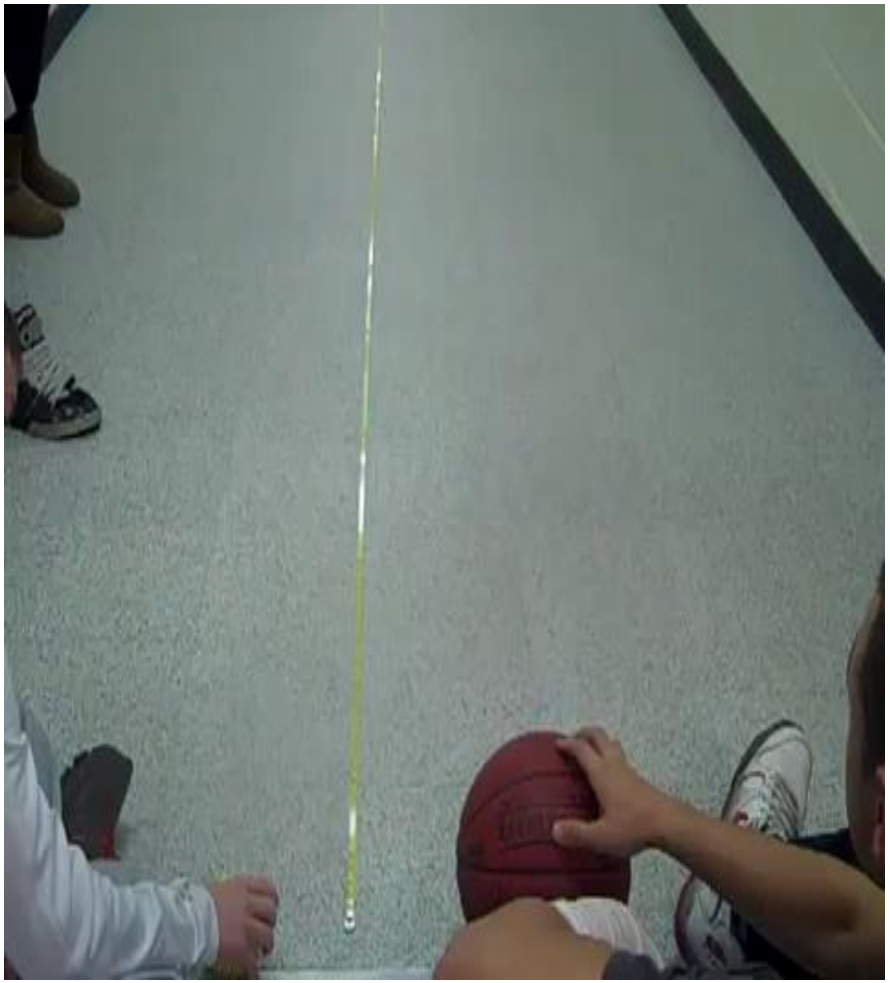


- **Example C**: If a golf club is drawn across the **ball from right to left on contact, right spin (clockwise)** will result. The ball will **slice** (right-handed golfer). The slicer also tends to "**pull" his shot- to the left** when this "outside-in" **swing contacts the ball dead-center.** If the heel of the club leads the toe of the club at contact (face open), a slice results, even though the swing may be straight through.
- **Example D**: If a golf club is **swung "inside-out**" (club head contacts the ball from left to right), the right-handed golfer **will create left spin (counterclockwise),** which **causes the ball to hook.**

3. Spin Resulting from Contact with a Surface

A moving object develops spin in the direction of its motion as a result of contact with a surface.

- Example A: A bowling ball gains an increasing amount of forward spin as it progresses, owing to friction between it and the surface. The additional spin reduces the friction against forward movement of the ball. If the ball is projected with backspin, it loses its velocity more rapidly.



Example B:

When a golf ball or tennis ball lands from its forward flight, it will develop forward spin upon contact. The amount of spin will relate to the ball's horizontal velocity at contact, the angle of approach, and the amount of friction between the ball and the contact surface. If the ball has backspin, the spin tends to be neutralized upon landing. If the backspin is excessive, its effects will supersede the effects of landing, and the ball will discontinue forward motion.

4. Effects of Spin on a ball landing on a Horizontal Surface

- A change may be expected in the rebound angle, in the distance of the bounce, and in the distance of the roll as a spinning ball contacts a horizontal surface:
- ***Topspin:*** Causes a lower angle of rebound, a longer bounce and more roll.
- ***Backspin***: Causes a higher angle of rebound a shorter bounce and less roll.
- ***Sidespin:*** Causes the angle of bounce to change toward the direction of the spin (left spin, left bounce).

The smaller the angle of the approach of the ball to the horizontal surface, the greater is the effect of sidespin. If the approach is perpendicular (90°), sidespin has no effect.

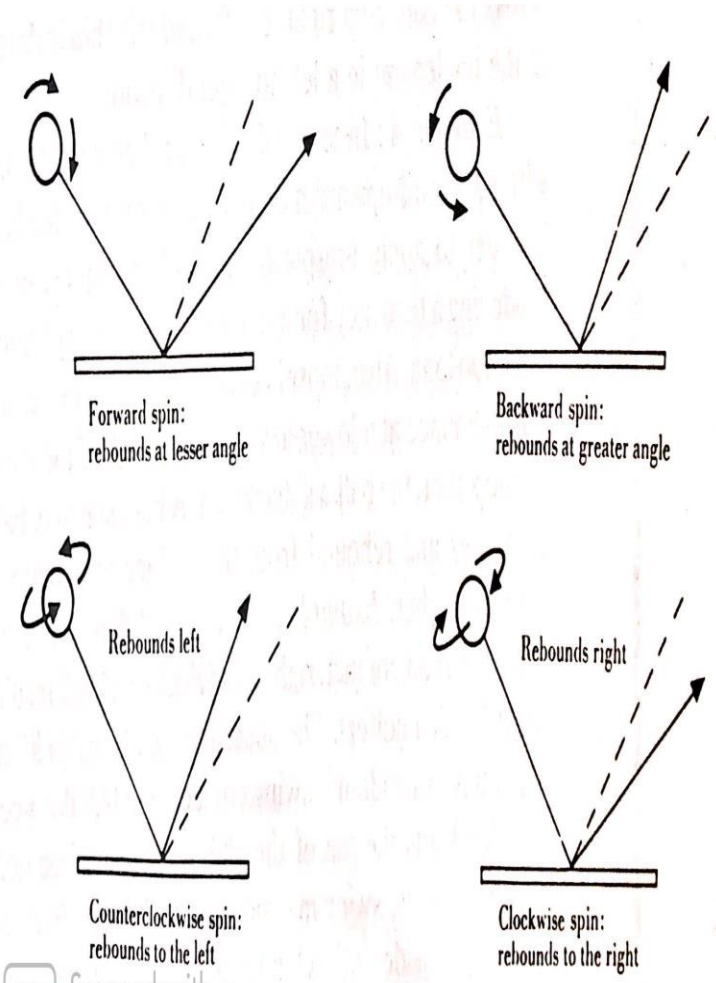
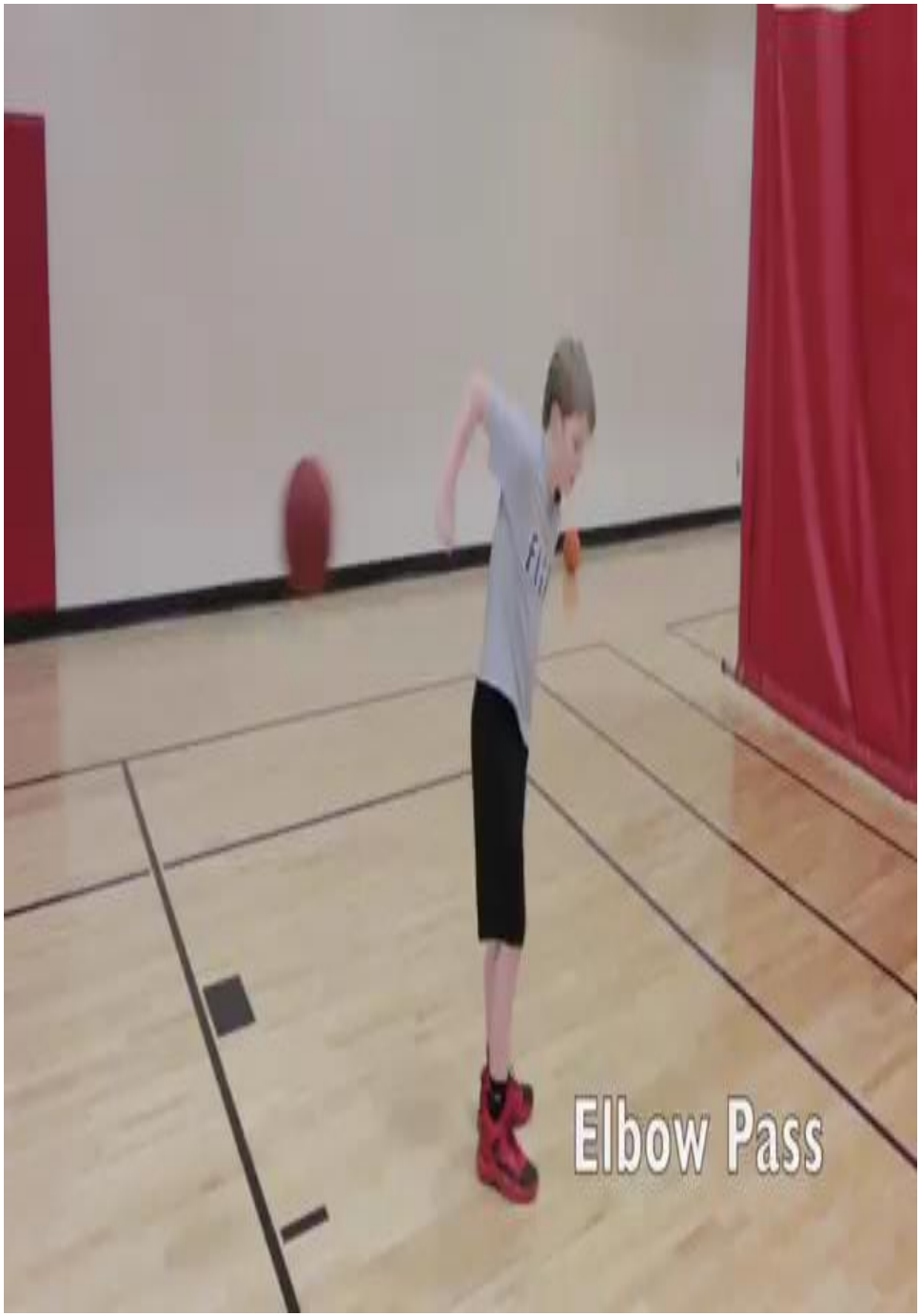
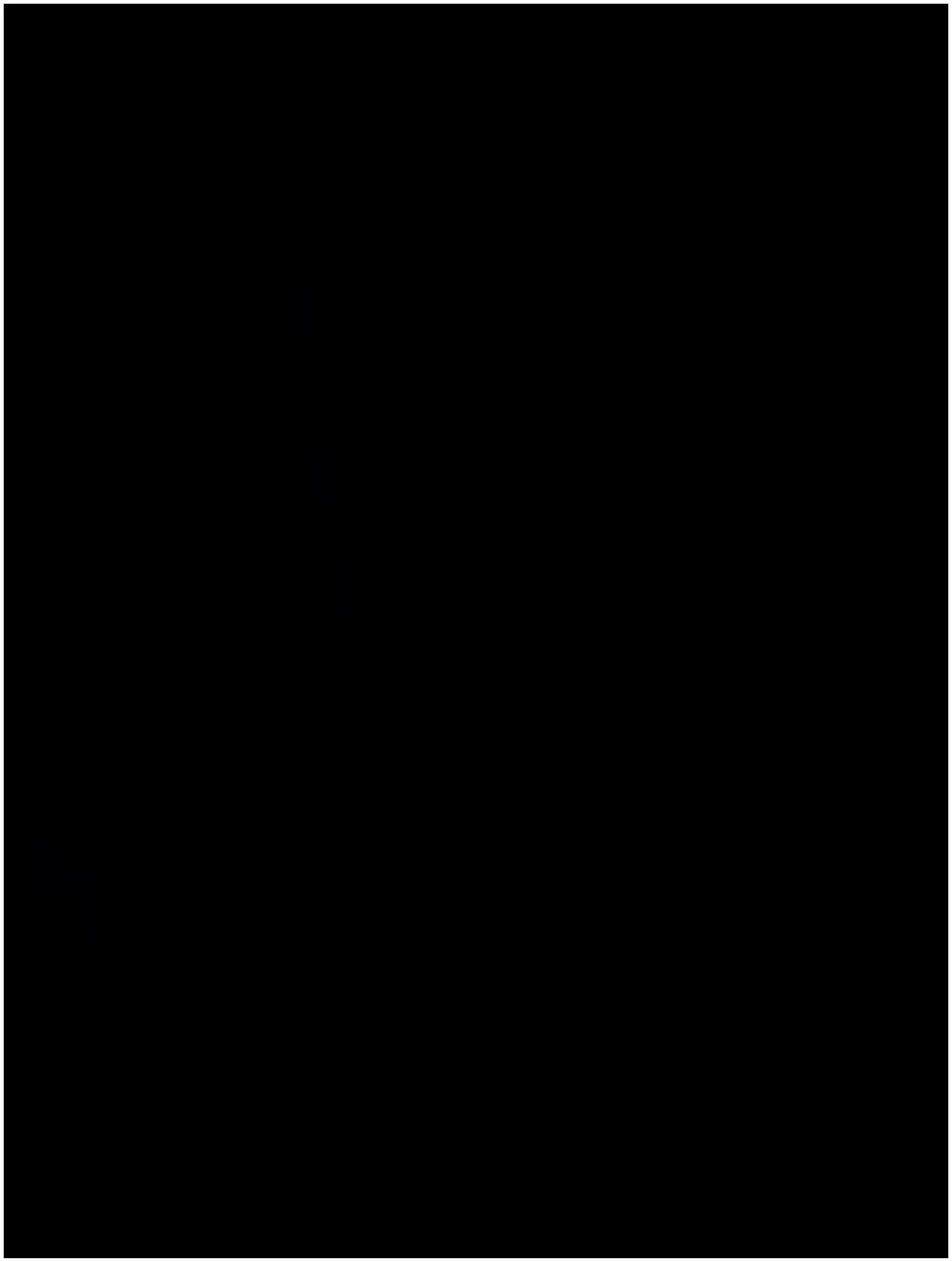


Figure 14-6 Influence of spin an angle of rebound from a horizontal surface.

- **Example A:** A basketball bounce pass may be given sides pin to change the rebound from the floor. If the ball is spinning to the right (clockwise), it will tend to bounce to the right on the rebound. The lower the pass (smaller angle to the floor) and the greater the spin, the greater the ball will deviate from its normal path of rebound.





Example B: An opponent in tennis is often deceived by spin of the ball; for instance, the cut shot (backspin) results in a higher and shorter bounce than anticipated , while a slice shot (clockwise spin) will cause the ball to bounce toward the right.

- **Example C**: The effect of a spin on a football is difficult to predict because of the shape of the ball; as a general rule, a longer roll can be expected when a ball turns end-over-end forward than when it rotates around its long axis (a spiral).
- Hence the quick kick is usually more successful when projected low and end over end.
- Although with such a kick the ball travels less distance through the air, the long roll may result in more total distance, provided the ball is airborne beyond the deepest receiver.

5. Effects of Spin on a Ball Striking a Vertical Surface

- The vertical surface which a moving object strikes may be stationary (basketball backboard, billiard-table rail. or handball front wall) or may be a moving implement (paddle, racket, bat, or hand). The following may be expected from contact with a vertical surface

1 Topspin causes a higher rebound.

2 Backspin causes a lower rebound.

3 Right or clockwise spin causes a rebound to the left.

4 Left or counterclockwise spin causes a rebound to the right.

(It is interesting to note that an object with sidespin responds to a vertical surface in a direction opposite from its response to a horizontal surface.)

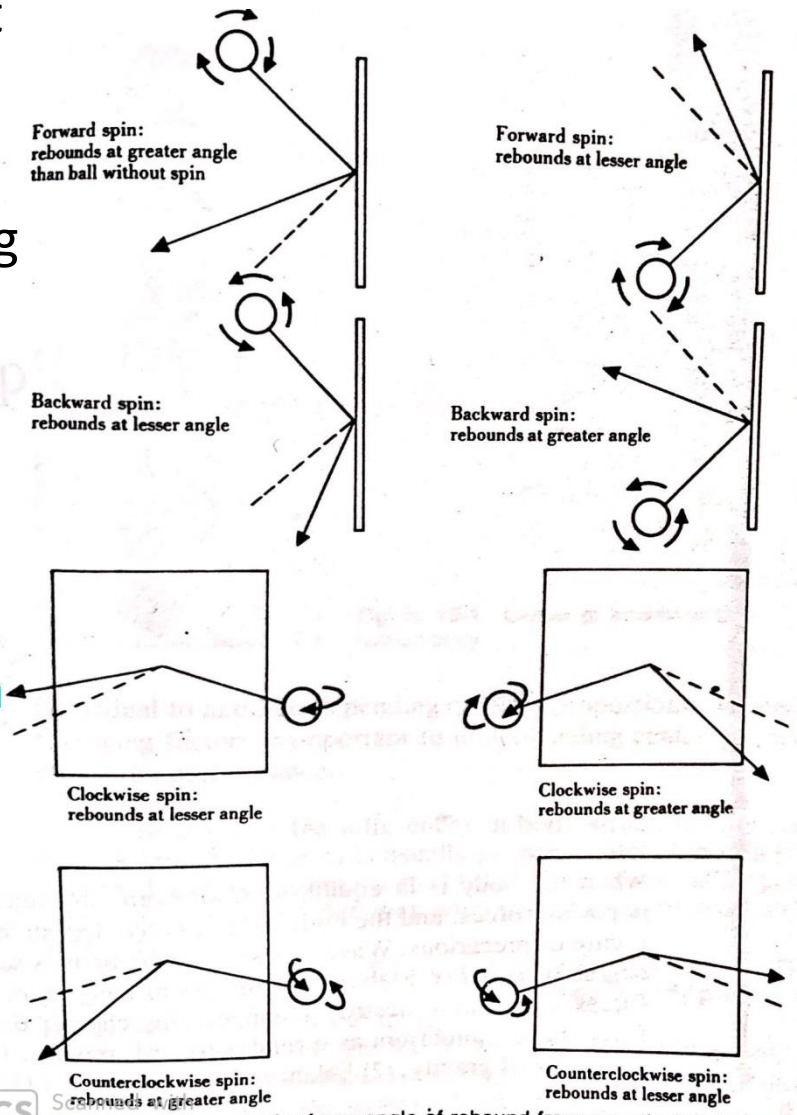


Figure 14-7 Influence of spin an angle of rebound from a vertical surface.

- Example A:

✓ If a tennis opponent delivers a forehand drive with topspin on the ball, compensation in position of the racket face should be made to avoid a return that is too high and too long.

✓ If a cut shot (backspin) is approaching, the performer should adjust the racket face to avoid the tendency of the ball to rebound downward into the net.


Melbourne
EUROSPORT
Live
KIA
KIA
FED 2 2 AD
YOU 0 0

- Example B: A basketball backboard shot from the front will have a better chance to rebound into the basket if it has backspin, because it will rebound at a lower angle.

- Example C: A table-tennis ball served with left spin (counterclockwise) will rebound from the receiver's paddle to the server's right '(receiver's left),

- Example D:

A baseball pitched with excessive backspin will tend to rebound downward upon contact with the bat. The batter would need to swing forward-upward in order to hit a fly ball.

- Example E: The curve ball from a right-handed pitcher has a combination of left spin and top spin, which creates a tendency for the ball to be hit high and to the pitcher's right (left field line).

6. Reducing Effects of Spin by Increasing Striking Force

- The more forceful the contact between an implement and an object, the less will be the effects of spin.
- The rebound path of the object will be dominated more by the path of the striking implement as its momentum increases.
- Spin produces greater effects as the force of impact becomes less.

- **Example A**: The effects of spin produced by the baseball pitcher will be greater for a bunt than for a full swing.
- **Example B**: Tennis players often make errors by attempting to "baby" critically placed shots, because they fail to realize that reducing the force of their stroke increases the effects of spin on the ball.