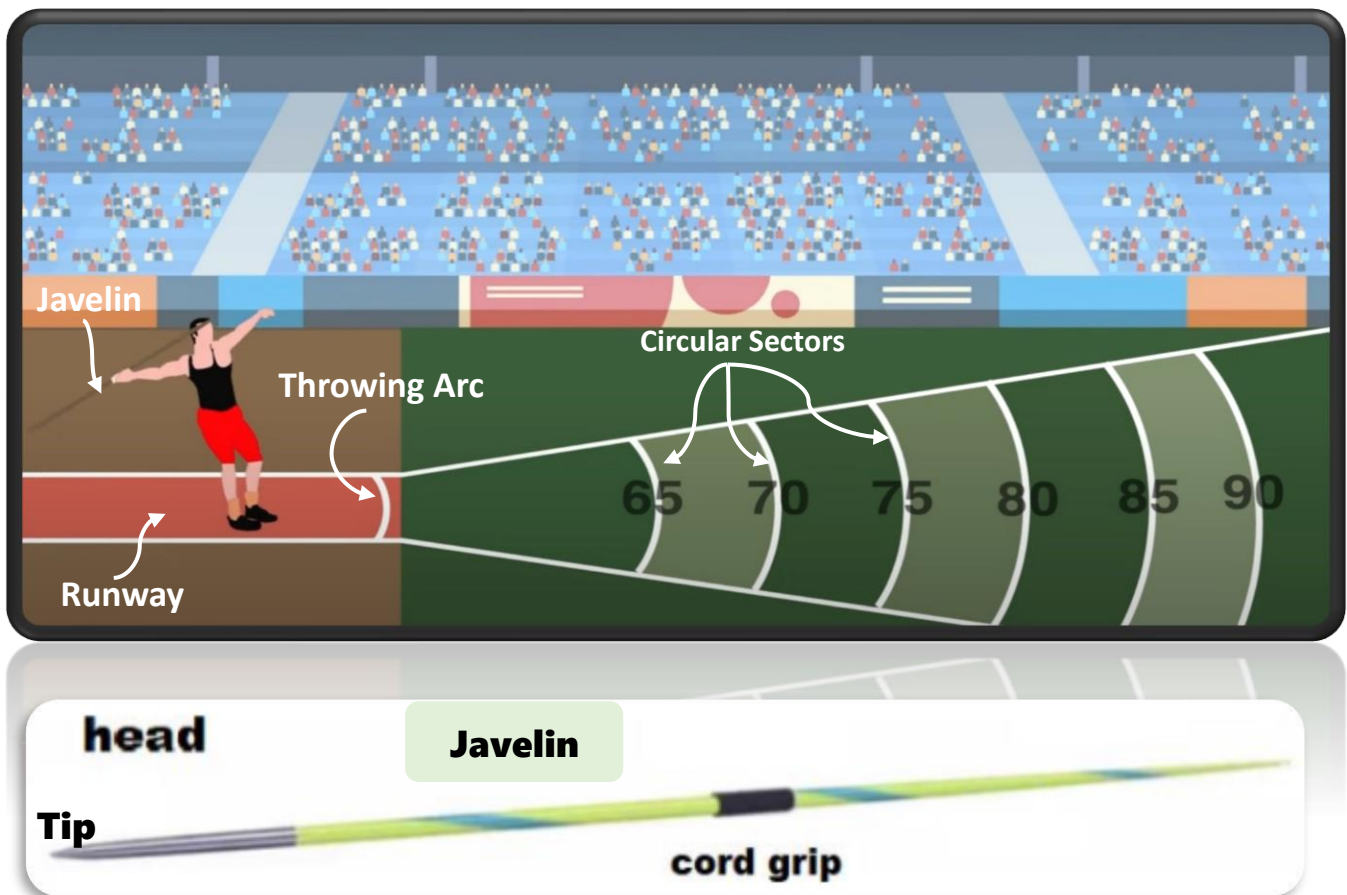


Javelin Throwing Project

- **Project Description:**

1. This project combines **theoretical modeling** with **practical simulation** to understand the dynamics involved in **javelin throwing** رمي الرمح.



Javelin: its length between 2.6 and 2.7 m in length and 800 g in weight. The javelin has a **grip**, about 150 mm located at the javelin's center of gravity. The javelin must be held at its grip.

Runway: 4 m wide and at least 30 m in length. athletes typically use this distance to gain momentum in a "run-up" to their throw.

Throwing arc: the runway ends in an 8m-radius throwing arc from which their throw is measured.

Circular sector: The javelin is thrown towards a 28.96° circular sector that is centered on the center point of the throwing arc.

The distance of the throw is measured from the throwing arc to the point where the tip of the javelin landed, rounded down to the nearest centimeter.

- **Project Tasks:** Guided by the soccer game direct foul kick scenario of *Problems 6 & 7 of Exercise Sheet 1* and neglecting drag forces for now:
 1. **Derive a mathematical model** relating terminal distance to the javelin's launching speed and angle (Only the governing equation is required).
For simplification assume that:
 - The javelin is represented by a particle of the same mass as the javelin and concentrated at its center of mass.
 - The javelin is fired at the ground level for now.
 2. **Calculate the optimum firing angle** for maximum distance, for a given launching speed.
 3. **Create a computer simulation** displaying the javelin's trajectory and related metrics such as distance traveled, peak height, and time of flight. Any programming language/ environment is allowed. You have to specifically **display**:
 - **The javelin trajectory** (in terms of its Center of Gravity only, the CG would be the point in the javelin that follows a parabolic path when the javelin is thrown) with a **motion display-speed control**.
عرض مسار رمي الرمح (من حيث مركز الثقل فقط) مع إمكانية التحكم في سرعة عرض الحركة
 - **The launching speed** (input)
 - **The firing angle** (input)
 - **The throwing distance** (output)

Notes for the program:

- Like the other throwing events, the competitor may not leave the throwing area (the runway) until after the javelin lands.
مثل أحداث الرمي الأخرى، لا يجوز للمنافس مغادرة منطقة الرمي (المدرج) إلا بعد هبوط الرمح.
- The need to come to a stop behind the throwing arc limits both how close the athlete can come to the line before the release, as well as the maximum speed achieved at the time of release. إن الحاجة إلى التوقف خلف قوس الرمي تحد من مدى قرب الرياضي من الخط قبل الإطلاق، وكذلك السرعة القصوى التي تحققت في وقت الإطلاق.
- A throw is only legal if the tip of the javelin lands within this sector and first strikes the ground with its tip before any other part.
- Competition rules:
 - A round consists of one attempt by each competitor in turn.
 - Three to six rounds.
 - The longest single legal throw (over all rounds) is the winner.
- 4. Detailed calculations (concerning the first two requirements) should appear in a **technical report** containing:
 - Model design idea
 - Mathematical derivations
 - References
- **Submission Guidelines:**
 1. A detailed technical report and a computer simulation are to be submitted by **May 7**.
 2. An online presentation of simulation on **May 9 @6:00 pm**.
- **Grading (10 points):** 5 for the report, 5 for the presentation.

3-min Explanation Video

Read the statement too!