BIOL2630 STUDY NOTES

Biomechanics

Lecture 1 – What is Biomechanics? Measurement and measurement error

Biomechanics is the study of forces and their effects on living systems

Biomechanics is important in sport, exercise and rehabilitation

Kinematics – the study of motion

Kinetics – the study of forces

Ways to describe data:

- Qualitative (e.g., good, poor, long, fast, etc)
- Quantitative (e.g., 3 sec, 60km/h, 500N etc)

Error

- Systematic error – the instrument always reads incorrectly in a consistent manner
- Random error – your ability to reproduce the measurement

Accuracy – the ruler has 1mm intervals and the accuracy is 0.5mm

Significant figures – how many decimal places used for accuracy

- Non-zero numbers are always significant (e.g., 839 – 3 significant figures)
- Zeros in between non-zero numbers are always significant (e.g., 7403 – 4 significant figures)
- Zeros that come before non-zero numbers are never significant (0.034 – 2 significant figures)
- Zeros that come after non-zero numbers:
  - No decimal place means no zeros are significant (e.g., 320 – 2 significant figures)
  - If there is a decimal place then all zeros are significant (e.g., 420.0 – 4 significant figures)
  - Zeros after a decimal place are significant (72.04800 – 7 significant figures)

Adding and subtracting

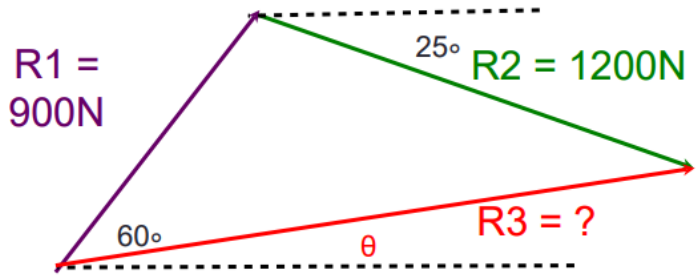
- The answer can have **no more decimals** than the least accurate measure

  150.2km (1 decimal)
  + 0.55km (2 decimal)

θ = 53.123

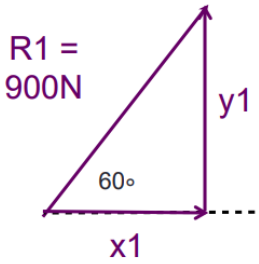
θ = 53°

Vector Addition



R1 + R2 = R3

- Add vectors head to tail
- Sum (R3) is the distance between the tail of R1 and the head of R2



Step 1. Resolve into horizontal and vertical components

R1:

cos θ = adj / hyp

adj = hyp x cos θ

adj = 900 x cos (60°)

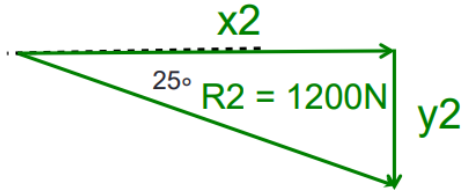
adj = 450 N

sin θ = opp / hyp

opp = hyp x sin θ

opp = 900 x sin (60°)

adj = 780 N



Step 1. Resolve into horizontal and vertical components

R2:

cos θ = adj / hyp

adj = hyp x cos θ

sin θ = opp / hyp

opp = hyp x sin θ

Lecture 4 - Linear Motion - Uniform acceleration, Projectile motion

Acceleration due to gravity = -9.81 m/s^2

If an object has a constant force applied to it then it will have a constant acceleration (f = ma)

When a ball is thrown, its vertical velocity is decreasing because of gravity (but its horizontal velocity remains constant).

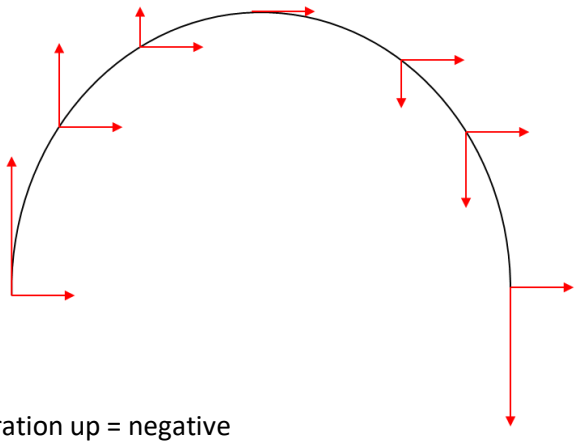
Vertical velocity on the way up is equal but opposite on the way down

The time in the air is determined by the vertical release velocity

Vertical velocity on the way up is positive but decreases due to gravity

Vertical velocity at peak height decreases to zero due to gravity

Vertical velocity on the way down is negative and accelerates down due to gravity



- Velocity up = positive — Acceleration up = negative
- Velocity at peak height = zero — Acceleration at peak height = negative
- Velocity down = negative — Acceleration down = negative

Horizontal displacement (assume no external forces) is determined by horizontal velocity and time in the air

$d = v \times \triangle t$

Projectile motion equations

1. $v_f = v_i + (a \times t)$
2. $d = v_i \times t + ½ (a \times t^2)$
3. $v_f^2 = v_i^2 + 2 (a \times d)$

Lecture 13 – Measuring angular motion, proximal-distal sequencing of movement

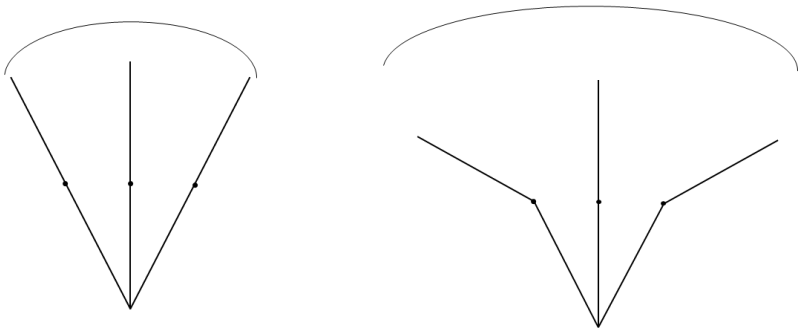
We can quantity angular displacement of a joint during different tasks and compare the differences

Comparing two or more joints

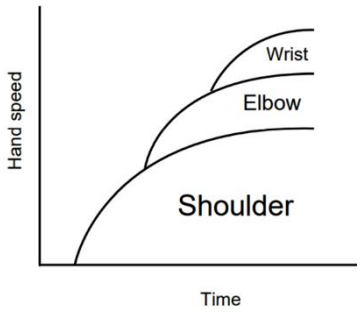
- In-phase – joint angle changes are similar to each other (in sync)
- Out-phase – joint angle changes are very different to each other (out of sync)

Proximal to distal sequences – maximising end-point speeds

The linear velocity on a rotating object is greatest at the distal end



To maximise throwing velocity, move proximal segments (shoulder) first, then the more distal segments (elbow), and finally the most distal segment (wrist). Each of these segments will have summation and the end speed will be the greatest.



Relative Angle: angle between two segments

Absolute Angle: angle relative to the horizontal