Exercise walk-through

5.2
Stability, rotation and projectiles

International Baccalaureate · IB Diploma · Sports, Exercise and Health Science · HL

Can follow-through keep changing a ball after racket separation?

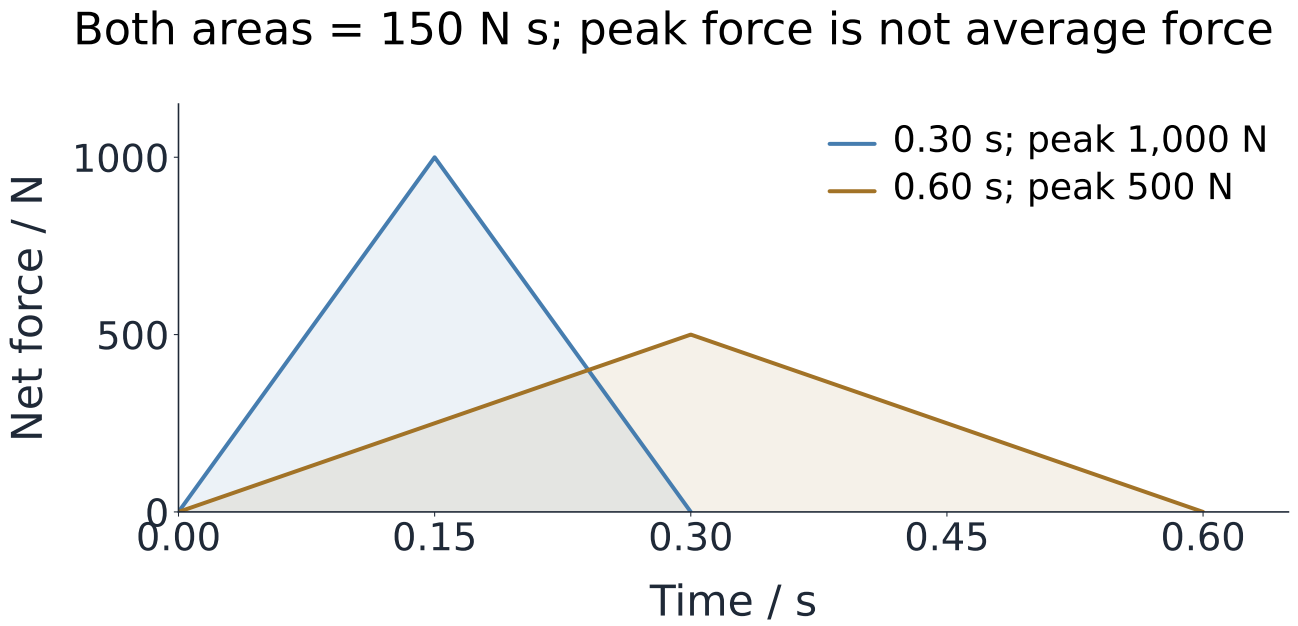
Choose the body, direction and interval

B2 connects Newton's laws, stability, coordinated movement, projectile paths and movement phases.

AHL: collisions, friction, work/power, environmental effects, buoyancy, lift and drag.

All numerical examples and diagrams are invented. Movement after separation cannot supply continued racket–ball contact force.

Signed area measures impulse; peak height does not



Equal areas can arise from different durations and peaks.

Practise with a defined system and signs

Show quantities and interpret the result

Use motion measurements, Newton's laws, force-time area, signed momentum change, ground reaction and angular momentum.

Explain stability, projectile assumptions and operational movement phases.

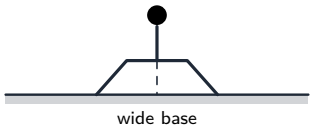
AHL: combine collision conditions and evaluate friction, work/power, relative flow, buoyancy and equipment claims.

Exercises 2.1·2.2

2.1 Define centre of mass, and state where it is for a person standing upright. [2]



2.2 Explain **three** ways a wrestler can make himself more stable. [3]



Exercises 2.1·2.2

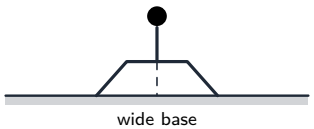
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2.1

the point where the mass of the body can be considered to be concentrated / where gravity acts; about hip level, behind the navel

2.2 Explain **three** ways a wrestler can make himself more stable. [3]

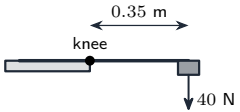


2.2

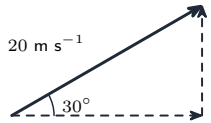
widen his base of support, e.g. feet further apart; lower his centre of mass by bending the knees; keep his line of gravity near the centre of the base, so a push must move it further to topple him

Exercises 2.3·2.4

2.3 A 40 N ankle weight is 0.35 m from the knee joint, acting at right angles to the shin. Calculate the torque about the knee, and state the torque if the perpendicular distance halves. [3]



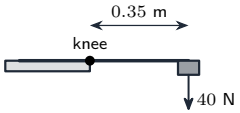
2.4 A ball is kicked at 20 m s^{-1} at 30° above the horizontal. Calculate the horizontal and vertical components of the velocity, and the time to reach the highest point. [3]



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Exercises 2.3·2.4

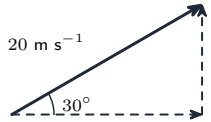
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torque $= 40 \times 0.35 =$ **14** N m; halved distance: **7** N m

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2.4

horizontal $= 20\cos 30° \approx$ **17.3** m s^{-1}, vertical $= 20\sin 30° =$ **10** m s^{-1}; time $= 10 \div 9.81 \approx$ **1.0** s

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Exercise 3.1 (a)

3.1 A diver leaves the board, tucks tightly, then opens out before entering the water.

(a) Explain, using angular momentum, why the diver spins faster in the tuck. [3]



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(a) angular momentum ($L = I\omega$) is constant in the air; tucking brings mass closer to the axis, so moment of inertia falls; so angular velocity must rise

Exercise 3.1 (b)

3.1 A diver leaves the board, tucks tightly, then opens out before entering the water.

(b) State what happens to the rate of spin when the diver opens out. [1]

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(b) State what happens to the rate of spin when the diver opens out. [1]

(b) it slows down

Exercise 3.2 (a)

3.2 A shot-putter releases the shot about 2 m above the ground.

(a) State **three** factors that affect the horizontal distance of the throw. [3]



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(a) release speed; release angle; release height (also air resistance)

Exercise 3.2 (b)

3.2 A shot-putter releases the shot about 2 m above the ground.

(b) Explain why the best release angle for the shot put is less than 45°. [3]

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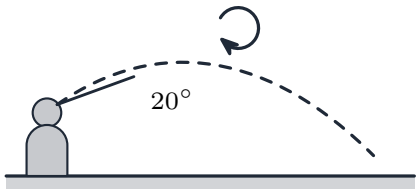
(b) Explain why the best release angle for the shot put is less than 45°. [3]

(b) the shot is released above the landing height; so it lands later and further at a lower angle; 45° is best only when release and landing heights are the same; also the athlete can produce more release speed at lower angles, because the muscles push more horizontally

Exercise 3.3 (a)

3.3 A long jumper takes off at about 20°.

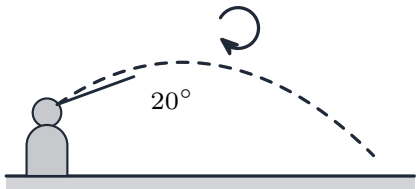
(a) Explain why the take-off angle is much lower than 45°. [2]



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(a) the jumper arrives at high horizontal speed and has only a short contact time; a steeper take-off would need a large loss of horizontal speed, which matters more for distance

Exercise 3.3 (b)

3.3 A long jumper takes off at about 20°.

(b) Explain why the jumper "cycles" the arms and legs in the air. [2]

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(b) Explain why the jumper “cycles” the arms and legs in the air. [2]

(b) take-off gives the body forward angular momentum, which would rotate it forward; rotating the arms and legs forward takes up this angular momentum, so the trunk stays upright for a good landing

Exercise 3.4 (a)

3.4 A basketball player performs a jump shot.

(a) Identify the **three** phases of the skill. [2]

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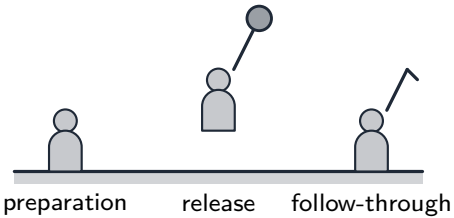
(a) Identify the **three** phases of the skill. [2]

(a) preparation, execution (release), recovery (follow-through); all three for [2], two for [1]

Exercise 3.4 (b)

3.4 A basketball player performs a jump shot.

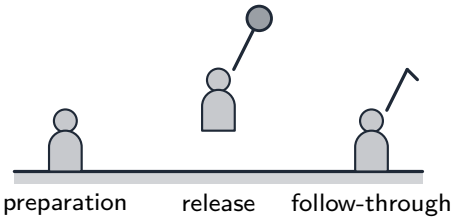
(b) Explain how the sequence of segment movements helps produce a fast, accurate release. [3]



Exercise 3.4 (b)

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(b) movement starts in large, proximal segments (legs, trunk) and moves to small, distal ones (upper arm, forearm, wrist); each segment starts as the previous one reaches its peak speed, so speed is added along the chain; the final wrist flick controls direction and backspin, giving accuracy