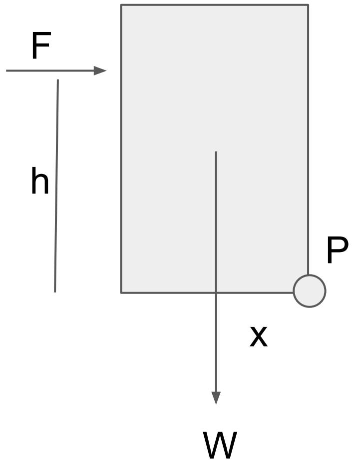
WJEC England A-Level Physics

3C The Physics of Sport

Flashcards



At what point would this object topple?

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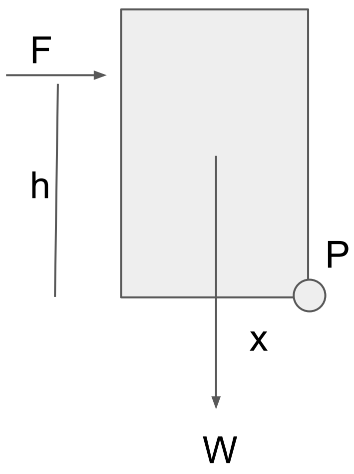

If it were to topple it would rotate clockwise about the point P. We can find the moment about P as Fh-Wx. So if this is >0 then F>Wx/h.

What increases the stability of an object?

What increases the stability of an object?

The wider the base, the more stable it is.

How do rugby players use stability in tackling?

How do rugby players use stability in tackling?

Rugby players going to tackle keep a low centre of gravity and have their feet wide apart, so the impact force from contact with another player is close to the centre of gravity. This produces a small moment. The rugby player being tackled has a higher centre of gravity and is much less stable and so more likely to topple.

What is the coefficient of restitution, e?

What is the coefficient of restitution, *e*?

e = relative speed after a collision / relative speed before a collision

Also e = h/H where h is the height of the bounce and H is the height of the drop.

What is the moment of inertia?

What is the moment of inertia?

A measure of how difficult it is to alter an object's rotational speed

$$I = \Sigma m_i r_i^2$$

I = moment of inertia (kg m^2), m = mass (kg)

r = distance from axis of rotation (m)

What is the moment of inertia of an extended object?

What is the moment of inertia of an extended object?

$$I = \sum mr^2$$

Add the individual moments of inertia for each point mass that makes up the object.

What is the new moment of inertia for a solid sphere?

What is the new moment of inertia for a solid sphere?

$$I = 2/5mr^2$$

What is the new moment of inertia for a thin spherical shell?

What is the new moment of inertia for a thin spherical shell?

$$I = 3/5mr^2$$

What affects the moment of inertia of a rotating object?

What affects the moment of inertia of a rotating object?

The mass and mass distribution of the object, the position of the axis of rotation, and how far away the mass is from it.

What is the rotational kinetic energy of an object?

What is the rotational kinetic energy of an object?

$$E_k = \frac{1}{2} I\omega^2$$

I is the moment of inertia (kg m^2) and ω is the angular speed (rad s^{-1})

What is torque?

What is torque?

A measure of how much a force causes an object to rotate about an axis. Measured in Newton meters (N m).

$$\tau = I\alpha$$

What are angular velocity and angular speed?

What are angular velocity and angular speed?

Angular speed = change in angle / time (magnitude only). Measured in rad s^{-1}

Angular velocity = change in angular displacement / time (magnitude and direction). Measured in rad s^{-1}

What is the angular acceleration?

What is the angular acceleration?

$\alpha = \omega_2 - \omega_1 / t$ rad s^{-2}

The rate of change of the angular velocity from initial ω_1 to final ω_2.

Plot graphs of angular displacement against time for uniform and non-uniform acceleration.

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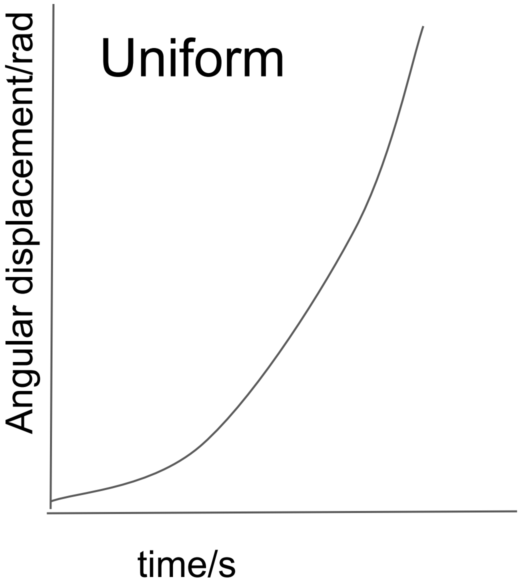

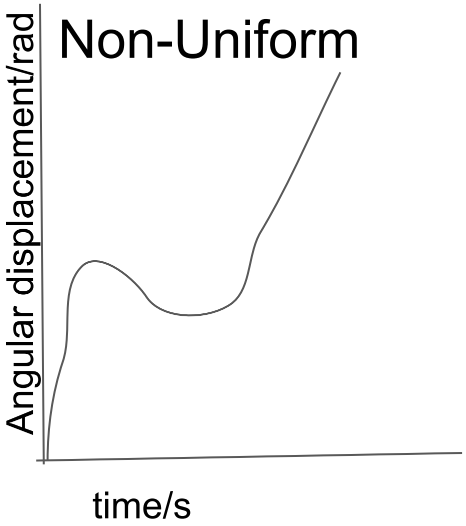

For constant angular acceleration, angular displacement $\propto t^2$ shown by a smooth curve through the origin.

Draw the graph for angular velocity against time when angular acceleration is constant.

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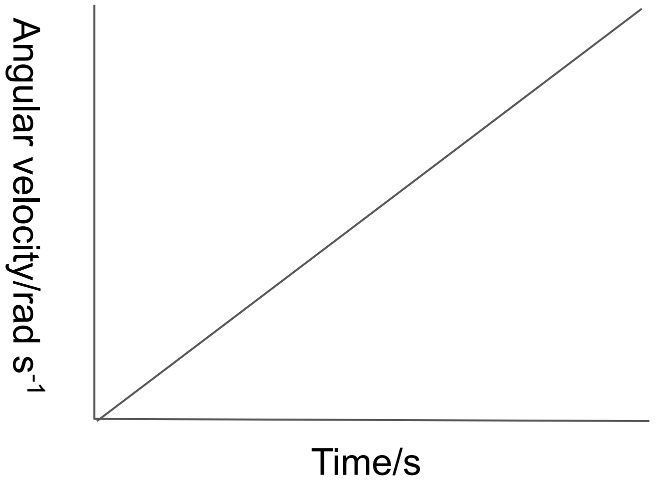
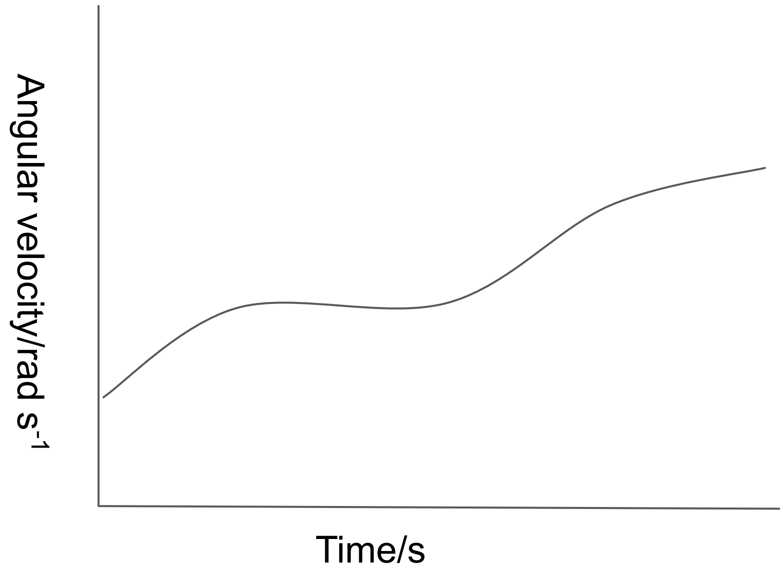


Draw the graph for angular velocity against time when angular acceleration is not constant.

Draw the graph for angular velocity against time when angular acceleration is not constant.



Match up the linear quantities with their rotational equivalent.

$s =$

$v =$

$a =$

Match up the linear quantities with their rotational equivalent.

s = θ, angle through which a point has been rotated.

v = ω, angle a point rotates through per second.

a = α, rate of change of angular velocity.

What equations can be used to calculate torque?

What equations can be used to calculate torque?

T = Fr = Force x perpendicular distance from axis of rotation to point of applied force

T = Iα = Moment of inertia x angular acceleration

What is angular momentum?

What is angular momentum?

$J = I\omega$ = moment of inertia x angular velocity.

Measured in N m s

When is angular momentum conserved?

When is angular momentum conserved?

It is conserved only when no external forces act on the object.

How can you calculate the work done when rotating an object?

How can you calculate the work done when rotating an object?

$$W = T\theta$$

Work done = Torque x Angular displacement

How can the work done be calculated graphically with a non-constant torque?

How can the work done be calculated graphically with a non-constant torque?

The work done is the area under the torque-angular displacement graph.

How can you calculate the power expended in rotating an object?

How can you calculate the power expended in rotating an object?

$$P = T\omega$$

Power = Torque x Angular velocity

What is Bernoulli’s equation?

What is Bernoulli's equation?

This is given in the form $p = p_o - \frac{1}{2} \rho v^2$

Where p is the pressure, p_o is the static pressure, ρ is the density and v is the velocity.

What is drag coefficient C_D?

What the drag coefficient C_D?

This is a quantity with no units and is used to show the amount of resistance (or drag) that an object is subjected to in a fluid (air or water).