Mechanics Mind Map (A Level Physics)

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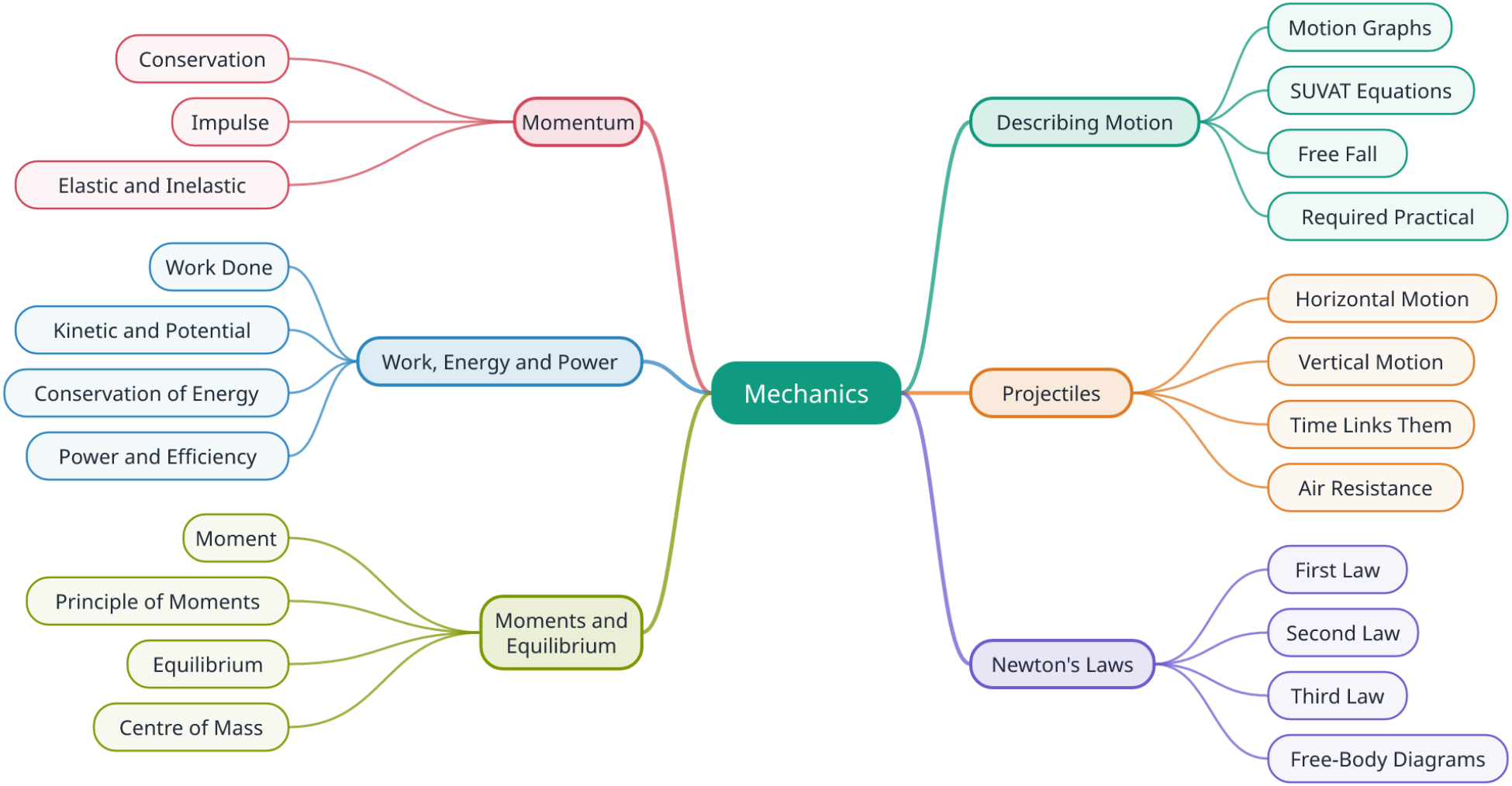

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Mechanics mind map explained

Describing Motion

Displacement, velocity and acceleration are vectors; distance and speed are scalars.

Motion Graphs

The gradient of a displacement-time graph is velocity. The gradient of a velocity-time graph is acceleration, and the area under it is displacement.

SUVAT Equations

For constant acceleration:

- $v = u + at$
- $s = ut + \frac{1}{2}at^2$
- $v^2 = u^2 + 2as$
- $s = \frac{1}{2}(u + v)t$

Free Fall

With no air resistance, every object accelerates at g, 9.81 m s^-2 near the Earth's surface.

Required Practical

AQA required practical: measure g by timing a falling object over different heights, for example with light gates. The gradient of a suitable graph gives g.

Projectiles

Treat the horizontal and vertical motion separately.

Horizontal Motion

With no air resistance, the horizontal velocity is constant.

Vertical Motion

The vertical motion has a constant acceleration of g downwards. Use SUVAT on it.

Time Links Them

The time of flight is the same for both directions, so find it from one and use it in the other.

Air Resistance

Drag increases with speed. When drag equals weight, the object falls at its terminal velocity.

Newton's Laws

The rules connecting forces and motion.

First Law

An object stays at rest or moves at constant velocity unless a resultant force acts on it.

Second Law

F = ma for constant mass. More generally, the resultant force equals the rate of change of momentum.

Third Law

If A exerts a force on B, B exerts an equal and opposite force of the same type on A.

Free-Body Diagrams

Draw every force acting on one object, then find the resultant.

Momentum

Momentum p = mv, a vector measured in kg m s^-1.

Conservation

In a closed system, total momentum before a collision or explosion equals total momentum after.

Impulse

Impulse = Fdelta t = change in momentum, equal to the area under a force-time graph. Crumple zones and airbags increase the time, reducing the force.

Elastic and Inelastic

Kinetic energy is conserved in an elastic collision but not in an inelastic one. Momentum is conserved in both.

Work, Energy and Power

Energy is transferred when a force does work.

Work Done

W = Fs cos theta, where theta is the angle between the force and the direction of motion.

Kinetic and Potential

Kinetic energy = ½mv². Change in gravitational potential energy = mgdelta h.

Conservation of Energy

Energy cannot be created or destroyed, only transferred. For a falling object with no air resistance, the loss in potential energy equals the gain in kinetic energy.

Power and Efficiency

Power = work done ÷ time = Fv. Efficiency = useful output ÷ total input, as a fraction or percentage.

Moments and Equilibrium

The turning effect of forces.

Moment

Moment = force × perpendicular distance from the pivot.

Principle of Moments

For an object in equilibrium, the sum of clockwise moments equals the sum of anticlockwise moments about any point.

Equilibrium

The resultant force is zero and the resultant moment is zero. Resolve forces into perpendicular components to check.

Centre of Mass

The point where the whole weight of an object can be taken to act. An object topples when its centre of mass moves beyond its base.

How to revise with this mind map

1. Learn the SUVAT equations and practise choosing the right one: list the three values you know and the one you want, then pick the equation that links them.

2. Split projectiles into horizontal and vertical motion every time, and use time to connect them.

3. Draw a free-body diagram before every force question. Most errors come from a missing force or a wrong direction.

4. For momentum and energy, state the conservation law you are using, and remember momentum is a vector: choose a positive direction.

5. Make it yours. Build your own mechanics map in Mindmapi from your notes, and ask the AI to talk you through any problem type. The answer is saved into that branch's notes for next time.