Edexcel GCSE Physics

Topic 15: Forces and Matter

Notes

(Content in bold is for Higher Tier only)

Springs

Stretching, bending, and compressing

- More than one force has to be applied
    - If a single force is applied, the object will just move in the force's direction
    - If forced inwards from opposite sides, the object (e.g. a spring) will compress
    - If fixed at one end of the spring and a force is applied at the other, more than one force is still being applied to the spring (a reaction force from the fixed point)

Deformation

- This means changing shape
- Elastic Deformation
    - The object returns to its original shape when the load has been removed
    - Eg. An elastic band
- Plastic Deformation (distortions)
    - The object does not return to its original shape when the load has been removed
    - Eg. A spring when pulled too far

Linear Elastic Distortion, Hooke's Law

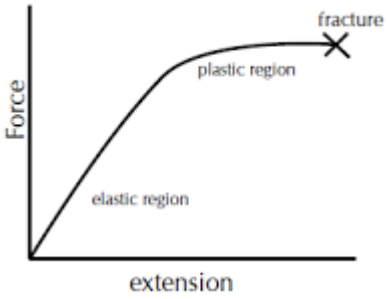
- Spring constant *k* = Force required to extend a spring per metre

$$F = kx$$

Where:

- F is the force applied to the spring, N
- K is the spring constant, Nm^{-1}
- X is the extension, m
    - Hooke's Law: The extension of a spring is directly proportional to the force applied.

Linear line section on a Force/Extension Graph



- This is elastic
- Following Hooke's Law
- Gradient is K (refer to equation above).
- Elastic deformation

The point it stops being linear is the elastic limit

- From then on, it does not obey Hooke's Law

Non-Linear line section

- Not elastic
- Does not follow Hooke's Law
- Plastic Deformation
- If shallow
    - Lots of extension for not a lot of force
    - Easy to stretch
- If graph is just linear, with no "non-linear end section"
    - The material is "brittle", so snaps instead of stretches after the elastic limit

Work Done

- Area under the graph

$$\text{Work Done} = \frac{1}{2}kx^2$$

Atmosphere and Pressure (Physics only)

Atmospheric Pressure is the total weight of the air above a unit area at a certain altitude.
Therefore, atmospheric pressure decreases with increasing height above the Earth's Surface

- The weight of the air is the force which causes the pressure
- So with higher elevation, there are fewer air molecules above the unit area than the same area at lower heights, so there is less weight, so less pressure

Pressure in a fluid (Physics Only)

- A fluid is a liquid or a gas.
- Pressure of a gas (for example held in a balloon) depends on atmospheric pressure
  - The air exerts an inward force on the outer surface of the balloon, and if this force is greater than the outward force exerted by the gas particles inside, the balloon will collapse.
  - In space there is a lower atmospheric pressure, so the gas inside. exerts a greater force outward force on the balloon surface compared to the thinner air from the outside, so the balloon can expand.
  - Increasing the amount of particles in the balloon (blowing into it) increases the amount of collisions the balloon surface experiences per second, so there is a greater pressure on the inside and the balloon will expand.
- Pressure in a fluid causes a force perpendicular to any surface.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Pressure in Liquids Vary (Physics Only)

In fluids:

- **Deeper in a fluid you are, the greater the pressure**
  - **Greater the amount of fluid above the object, so greater weight, so greater force felt, so greater pressure**
- **Denser the fluid is, the greater the pressure**
  - $\mathbf{mass = density \times volume}$ **so greater density means greater weight of fluid on the object, so greater force and pressure**

Factors that influence floating and sinking (Physics only)

An object floats if its weight is less than the weight of the water it displaces

- **So a 1000kg boat will sink into the water until it has displaced 1000kg of water**
  - **Providing the boat doesn't completely submerge before it displaces this amount, then it will float.**

Pressure in a liquid varies with depth and density, and this leads to an upwards force on a partially submerged object.

- **The buoyancy force is the upwards force that counteracts the weight of the floating object**
- **This force is equal to the weight of the fluid displaced by the object**

A ping pong ball floats on water as its density is less than the density of the water, so for the volume displaced, the weight of the equivalent amount of water is greater than the weight of the ping pong ball, so the resultant force is buoyancy, so it floats

Increasing the depth, the greater the weight of the water above you, so greater force felt, so greater pressure

$$\mathbf{pressure\ due\ to\ a\ column\ of\ liquid = height\ of\ column \times density\ of\ liquid \times g}$$