Force, work, energy and power

Matter and Mass

- **Mass =** Amount of matter in something

- **Matter =** Anything that takes up space and has a mass

Force

- A Force is a push or a pull to get something to move
- Force = Mass x Acceleration (gravity)
- Gravity is always 10 m/s^2
- Force = Mass x 10 m/s^2

- Units of Force are Newtons (N)
- Example of forces are gravity, electricity and magnetism
- Force can also be known as weight

Weight = Mass x Gravity (10 m/s^2)

Iassac Newtown

Difference between mass and weight

- We have a mass and weight on earth but only a mass in space
- We only have a weight when we are exposed to gravity

- Calculate the weight of a book that has a mass of 1.5 kg?

Weight = Mass x Gravity

- Weight = 1.5 kg x 10 m/s^2
- Weight = 15 N

- Calculate the weight of an object with mass 6 kg

Weight = Mass x Gravity

- **Weight =** 6 kg x 10 m/s^2
- **Weight =** 60 N

- Calculate the force acting on a book of mass 1.2 kg

- **Force =** Mass x Gravity

- **Force =** 1.2 kg x 10 m/s^2
- **Force =** 12 N

Friction

- Friction is a force that tries to stop or slow down a moving object

- Friction - Can be reduced by smooth surfaces or by using a lubricant like oil or grease

Advantages of Friction

- Friction between our shoes and the ground stops our feet slipping backwards.

- Friction between car tyres and the road stops the car skidding

Disadvantages of Friction

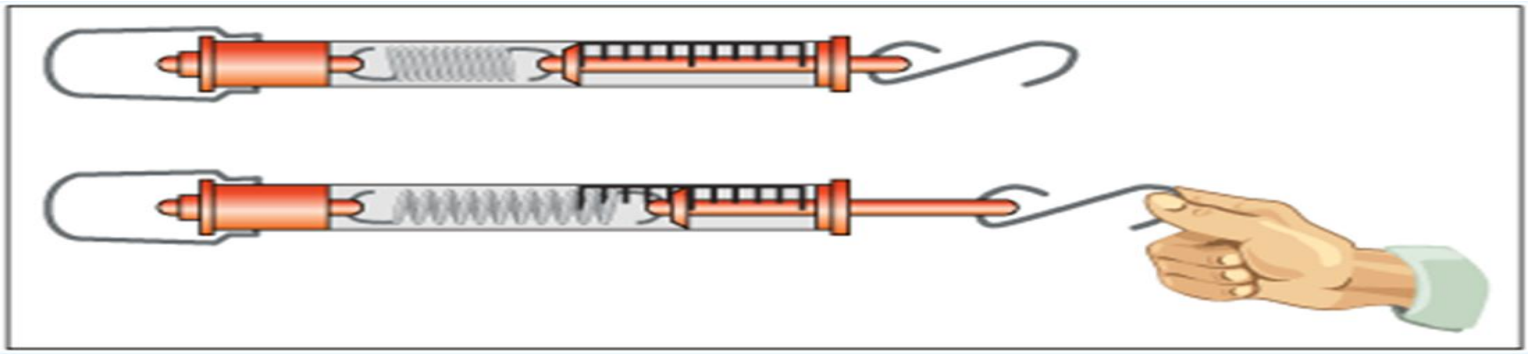
- Wears brake pads on cars
- Need more fuels in cars


WATCH
FOR
ICE

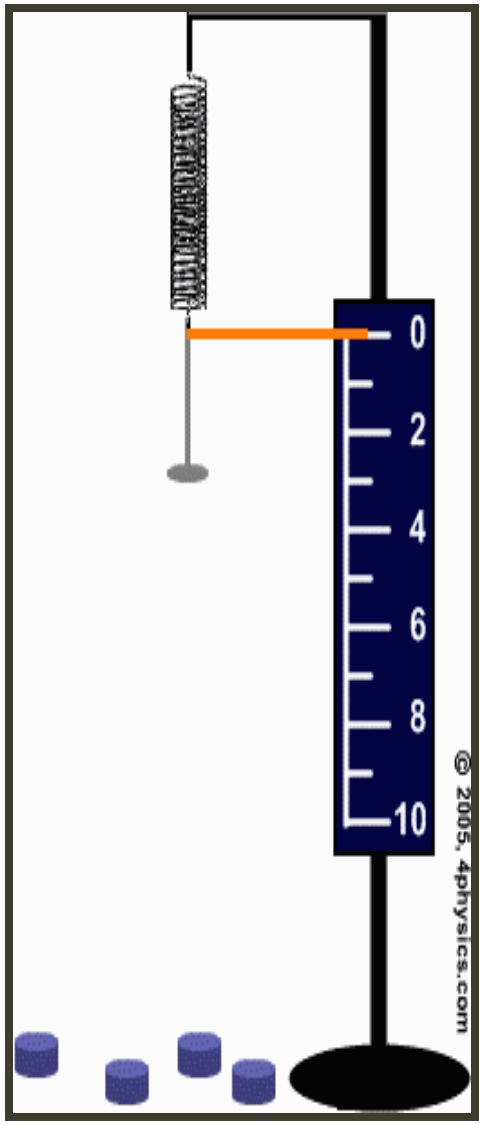
Experiment to investigate Hooke's Law

- Hooke's Law states that the extension of a spring is directly proportional to the force applied to it.

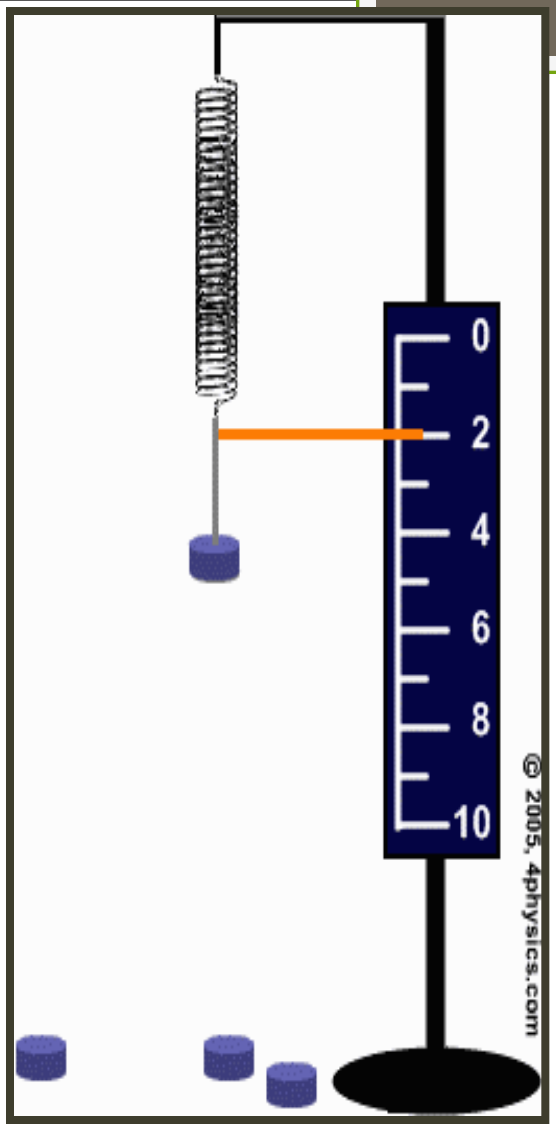
- You use a spring balance. This will tell you the force acting on the spring and also the extension of the spring



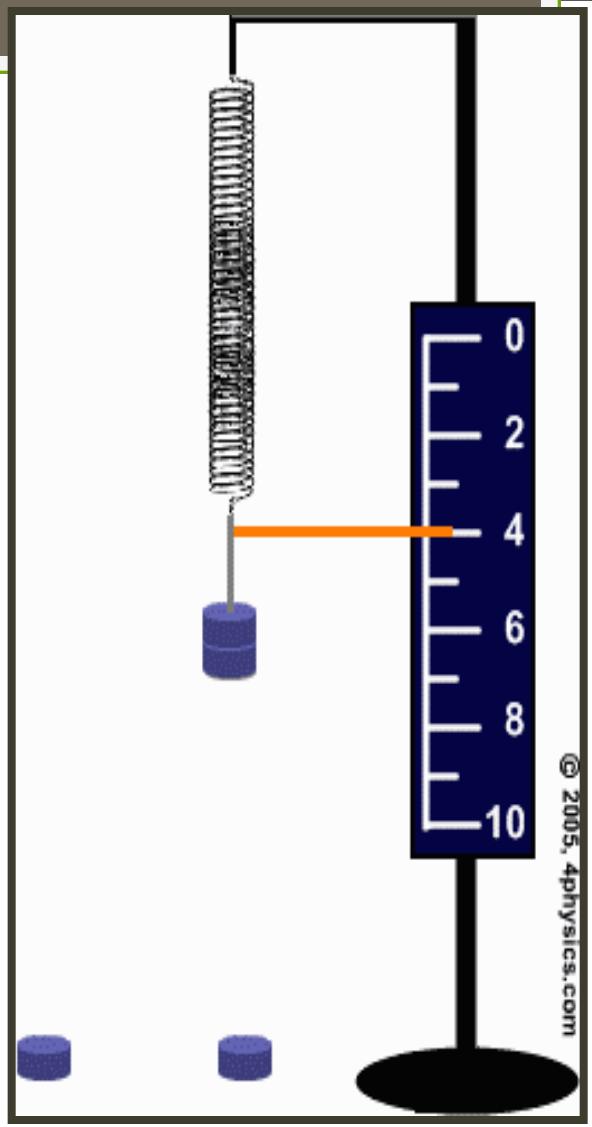
- Apply weights to the spring balance in an increasing order
- Record the weight and the distance on the spring
- Plot a graph of your results



Initial Set Up

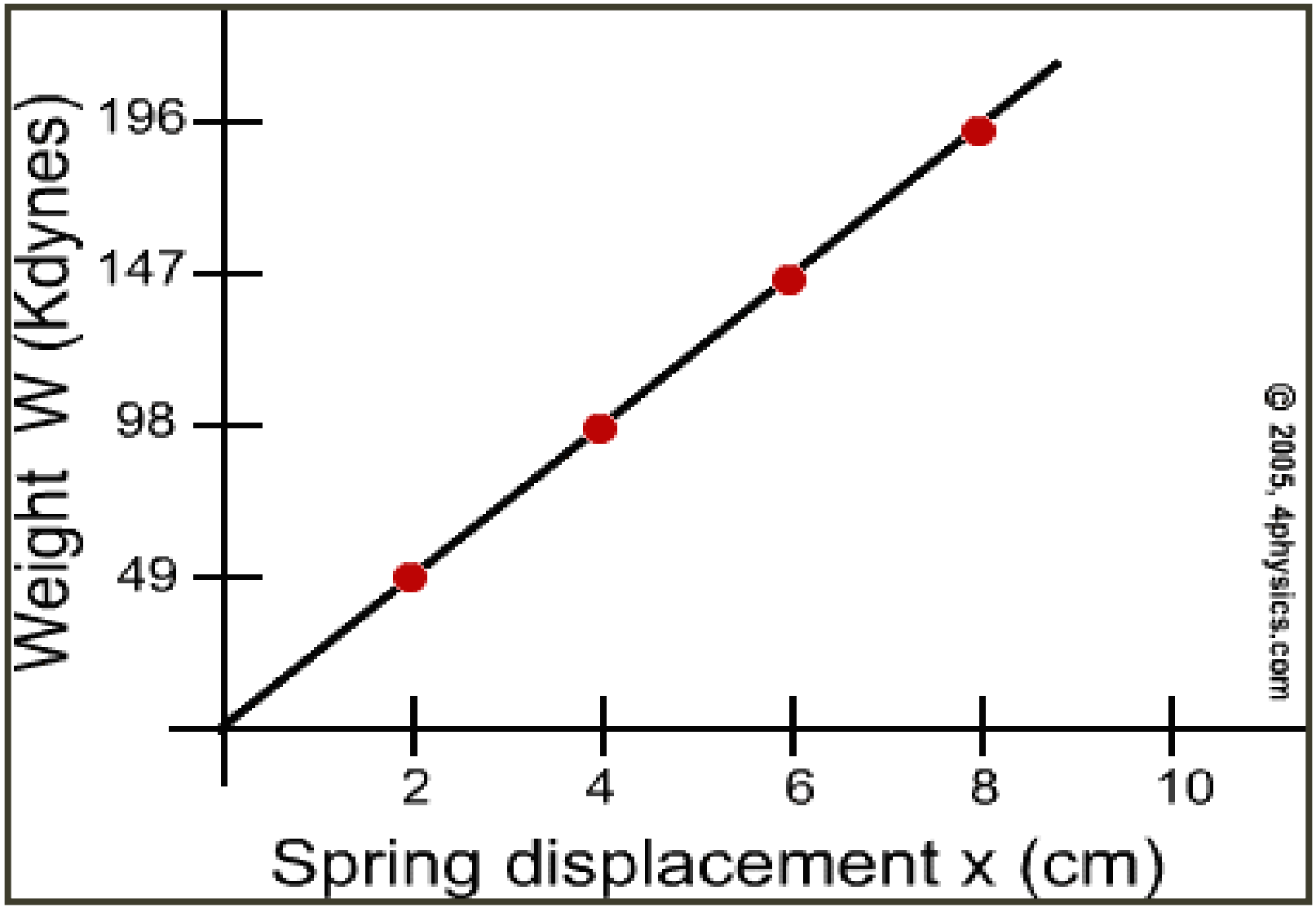


Add a weight and measure the length that the spring stretched.



Repeat for different weights and record in a chart.

Weight / g	0	49	98	147	196
Extension of Spring / cm	0	2	4	6	8


Weight W (Kdynes)
196
147
98
49
2
4
6
8
10
Spring displacement x (cm)
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- Use the graph to estimate what force results in the spring extension of 7 cm
- Use the graph to estimate the spring extension when the force is 49 N
- Does this graph obey Hookes law?

Work

- Work = Force x Distance

- The unit for work is Joules (J)

- A force of 100N moves an object 50m in the direction of the force. What is the work done by the force?

- Work = Force x Distance

- Work = Force x Distance
- Work = 100 N x 50 m
- Work = 5000J

- Calculate the work done when a force of 30 N moves an object 50 m

- Work = Force x Distance

- Work = Force x Distance
- Work = 30 N x 50 m
- Work = 1500J

Energy

- Energy is the ability to do work.
- So the unit for energy is Joules (J)

Power

- Power = $\frac{\text{Work Done}}{\text{Time Taken}}$

- Unit of Power: Watts (W)

- Calculate the power when it takes a person 10 seconds to carry out 50 Joules of work

- Power = $\frac{\text{Work Done}}{\text{Time Taken}}$

- Power = $\frac{\text{Work Done}}{\text{Time Taken}}$

- Power = $\frac{50\ \text{J}}{10\ \text{s}}$

Power = 5 W

- A crane lifts a weight of 5000N a vertical distance of 2m in 4s. What is the power needed?

- We need two things to calculate power

- Work and Time

- Time = 4 seconds
- Work = ?

- Work = Force x Distance
- Work = 5000 N x 2 m
- Work = 10,000J

- Power = $\frac{\text{Work Done}}{\text{Time Taken}}$
- Power = $\frac{10000\ \text{J}}{4\ \text{sec}}$
- Power = 2,500 Watts

- It takes a person 5 seconds to lift a weight of 4000 N vertically 5 m. What power is needed?

- Power = $\frac{\text{Work Done}}{\text{Time Taken}}$

- Work = ?
- Time = 5 seconds

- Work = Force x Distance
- Work = 4000 N x 5 m
- Work = 20,000 Joules

- Power = $\frac{20{,}000\ \text{J}}{5\ \text{sec}}$

- Power = 4,000 Watts