Forces and Motion – Test review

Motoharu Torii

General Units:

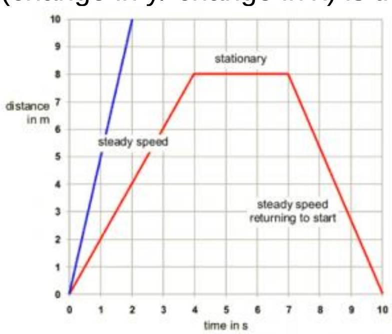
| | |
|---|---|
| Weight | Kg |
| Length | m |
| Velocity | m/s |
| Acceleration | $m/s^2$ |
| Force | N |
| Time | s |
| Moment | Nm |
| Momentum | Kg m/s |

Equations:

- speed = distance/ time taken. $s = d/t$
- acceleration =change in velocity/time taken $a=(v-u)/t$
- $(\text{final speed})^2=(\text{initial speed})^2 + (2 \times \text{acc} \times \text{distance})$ $v^2 = u^2 + (2 \times a \times s)$
- Force = Mass x Acceleration. $F=ma$
- weight = mass × gra field strength(10). $W = mg$
- Stopping distance = Thinking dist + Breaking dist
- momentum = mass x velocity $p = m \times v$
- force=change in momentum/time taken. $F =(mv-mu)/t$
- moment = force x perpendicular distance from the pivot

Distance-time graphs:

A distance time graph has distance on the y axis and time on the x axis. The gradient of the line (change in y/ change in x) is the speed. Flat line means sationary.



Forces and Motion – Test review

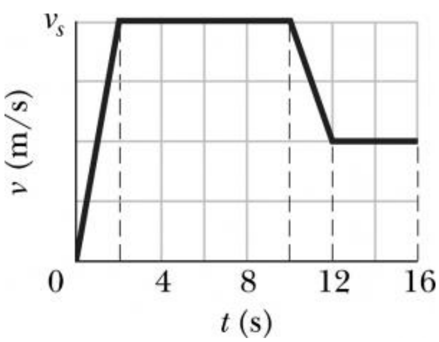
Motoharu Torii

Investigate motion of everyday objects:

- Need stopwatch and metre rule
- mark the start and end for the distance
- measure the distance
- line up car with start point, release and start timer
- stop timer when car passes end point
- improve by repeating and averaging
- calculate average speed: average speed = distance/ time

Velocity-Time graphs:

Velocity is on the y axis and time is on the x axis. If the line is flat then the object is moving at a constant velocity. The gradient is the acceleration. The area under the line is the distance travelled.




Effects of Forces:

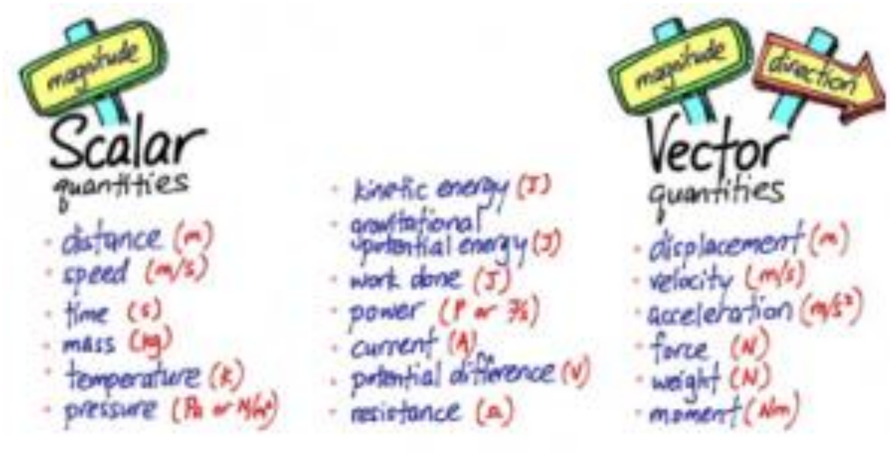
Forces can act on a body to change the velocity, so the speed, direction or both.

Forces (vector quantity):

Gravitational, weight, friction, electrostatic, air resistance (drag), tension (force in a spring), up thrust, lift, thrust

Forces and Motion – Test review

Motoharu Torii




<u>Opposing Forces:</u>

Friction
Normal reaction force
Air resistance

<u>Thinking Distance Factors:</u>

- Tiredness
- Alcohol
- speed of the car
- Drugs

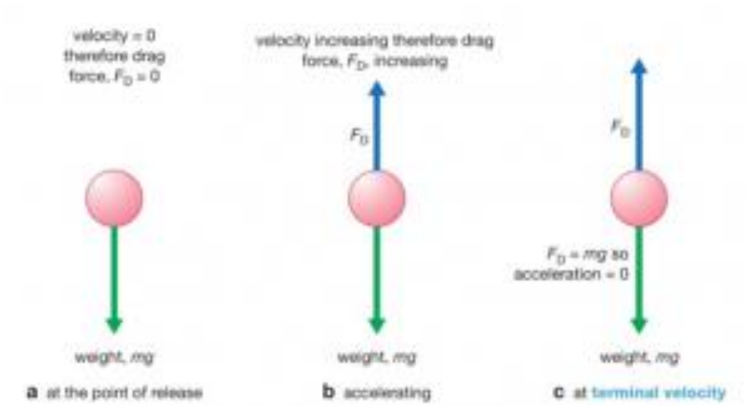
<u>Breaking Distance Factors:</u>

- Road conditions
- Tire conditions
- Brake conditions
- speed of the car
- mass of the car

Motoharu Torii

Terminal Velocity:

Initially the only force is weight as drag is proportional to velocity. So the object accelerates downwards. As it accelerates the velocity so the drag increases as well. meaning there is a smaller resultant force downwards so a smaller acceleration. Until the object reaches a speed where the drag is equal to the weight meaning there is no acceleration, this velocity is know as terminal velocity.

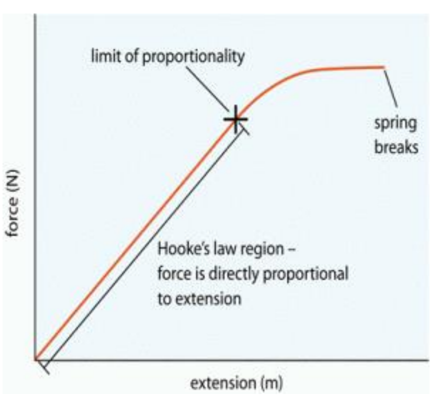



Spring Extention Investigation:

1. Measure the length of your spring without weight added.
2. Hang a mass of 100g on the spring.
3. Measure the new length of the spring.
4. Calculate the **extension** of the spring.
5. Repeat steps 3-5 for increasing the mass in increments of 100g
6. Take note of your results in the table.
7.

Hooke's Law:

Hooke's law is that extension is directly proportional to force applied. This is shown by the straight line on the force-extension graph. Hooke's law is obeyed as long as the line is straight.



Forces and Motion – Test review

Motoharu Torii

Elastic vs Inelastic:

Elastic behaviour is the ability of a material to recover original shape after the force is removed. in a spring this occurs when the force is lower than the elastic limit. loading and unloading force extension curves can be different as long as it returns to its original shape.

Momentum:


A railway truck with a mass of 5000 kg rolling at 3 m/s collides with a stationary truck of mass 10 000 kg. The trucks join together. At what speed do they move after the collision?

We shall assume that friction forces are small enough to ignore, so we can apply the law of conservation of momentum:

momentum before the collision = momentum after the collision

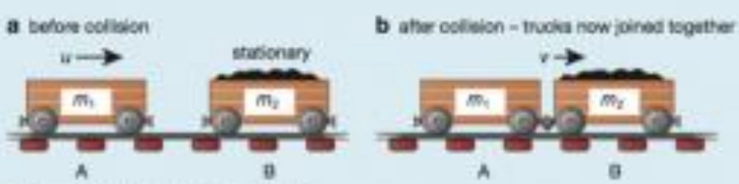



Figure 4.5 Railway trucks in collision

so, momentum of A before collision + momentum of B before collision = momentum of A and B moving together after collision

$$(m_1 \times u) + (m_2 \times 0 \text{ m/s}) = (m_1 + m_2) \times v$$

where $m_1$ is the mass of truck A, $u$ is its velocity before the collision, $m_2$ is the mass of truck B (at rest before the collision so its velocity is 0 m/s), and $v$ is the velocity of the two trucks after the collision.

Substituting these values gives:

$$(5000 \text{ kg} \times 3 \text{ m/s}) + (10\,000 \text{ kg} \times 0 \text{ m/s}) = (5000 \text{ kg} + 10\,000 \text{ kg}) \times v$$

so $$v = \frac{15\,000 \text{ kg m/s}}{15\,000 \text{ kg}} = 1 \text{ m/s}$$

After the collision the trucks move with a velocity of 1 m/s in the same direction that the original truck was travelling.

Newtons third Law:

Every action has an equal and opposite reaction.

Forces and Motion – Test review

Motoharu Torii

Centre of Gravity;

The principle of moments states that when the clockwise moments are equal to the anticlockwise moments a body will be in equilibrium.

when moments are taken from the right hand side as the block is a greater distance the force from the left hand pivot must be bigger to counteract it. The opposite is true for the left hand side.

Moment:

- Force x Perpendicular distance from pivot.

Investigation Questions:

- Description of time, etc
(independent variable).

- Equipment

- Controlled Variables

- Measurement (results, etc)