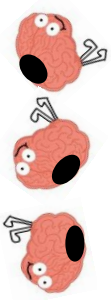
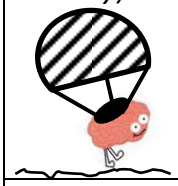
No Brain goes parachuting! Describe what happens after he jumps out of the plane until he reaches the ground safely!

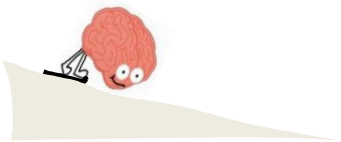


At the start, the air resistance is extremely small and there is only one force acting on No Brain, his weight. This unbalanced force makes him accelerate. As he travels further, the air resistance/drag increases. Eventually the two forces acting in the opposite directions are equal. He stops accelerating and travels at a constant speed (terminal velocity). When NB opens his parachute the large surface area of the parachute material creates a huge amount of drag and reduces his speed to a new, lower, terminal velocity so that he can hit the ground at a relatively low speed, land on his feet and walk away unharmed.



Why does No Brain find it easier to run up a long gentle ramp rather than up a short steep one?

The advantage of using a long gentle ramp is that FORCE is lessened over a longer DISTANCE. ($W = F \times d$) for the same WORK.



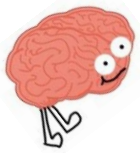
No Brain snowboards down a slope in a straight line. At the bottom his speed is 5.0 m s^{-1}. The mass of NB & his gear is 50 kg. Show that NB's kinetic energy at the bottom of the slope is 625 J. The kinetic energy gained by NB at the bottom of the slope does <u>not</u> equal the potential energy he has lost. Why not?

$E_K = \frac{1}{2} mv^2 = 0.5 \times 50 \times 5^2 = 625J$

Some of the kinetic energy is converted into heat due to friction between the board and the snow and an air resistance between NB and the air.

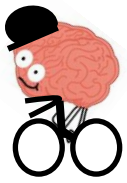
SCIENCE AS 90940
Demonstrate understanding of aspects of mechanics

No Brain Does Sport!



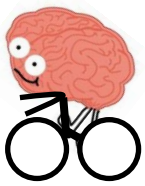
(Mechanics)

No Brain and his bike have a combined mass of 55 kg. He is cycling at a constant speed of 2 ms^{-1} and then accelerates at 0.4 ms^{-2}. What is the net force acting on NB and his bike <u>while he accelerates</u>?



F = ma F = 55 x 0.4 F = 22 N

No Brain is riding a bike with standard tyres, and his friend Fatty Liver is riding a bike with fatter tyres. Assume that the combined mass of NB and his bike is the same as that of FL and his bike. Which tyres exerts less pressure on the ground, and why?



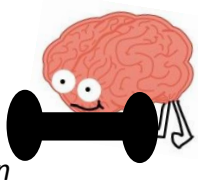
Pressure is inversely proportional to area. A fatter tyre provides a larger area of contact. Since P = F / A, as area is increased, pressure decreases.
There is the same weight force due to same mass as F = mg.

No Brain climbs a rope. His mass is 30 kg and he climbs 3 m up the rope. Calculate the E_P he gains. Explain why the actual amount of energy required to climb 3 m up the rope will be greater than the E_P he gains.

$E_P = mgh$ $E_P = 30 \times 10 \times 3 = 900$ J

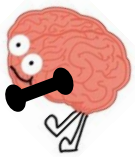
The actual amount of energy used will need to be greater than 900J because some of his energy will be lost as heat energy in muscles as he climbs.

No Brain tries to lift a really heavy set of weights but cannot move them. Is he doing work?



Work is done when a force causes motion in the direction of the force. Here the force is not causing the dumbbell to move, so no work is being done. The dumbbell has not moved up in the direction of the force and has gained no gravitational potential energy.

No Brain holds a dumbbell.



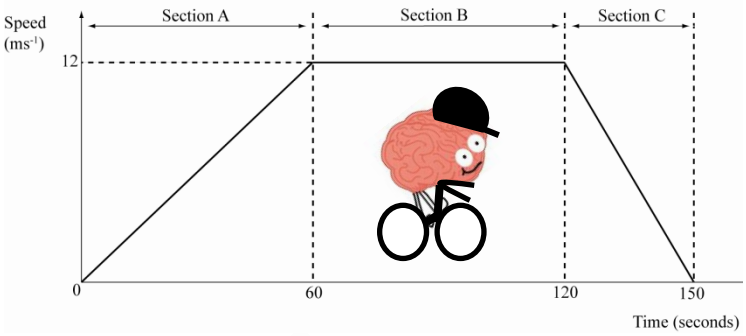
The mass of the dumbbell is 0.75 kg.

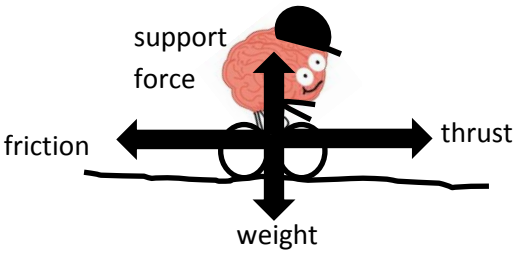
Calculate the weight of the dumbbell. Explain the difference between the terms "mass" and "weight".

$F = mg$ $F = 10 \times 0.75 = 7.5$ N

Mass is the amount of material (matter) in the dumbbell. Weight is the gravitational force on the dumbbell.

No Brain goes for a bike ride. Explain whether the forces in section B are balanced or unbalanced and how these result in the type of motion produced.





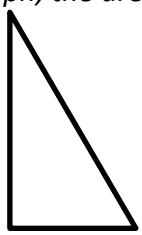
The bike is already moving in Section B, and it continues to move at a constant speed, so the forces are balanced and therefore the net force is zero. An unbalanced force is required to change his speed.

On the same bike ride, No Brain decelerates uniformly in section C and comes to rest – stops!

How far does he travel in section C?

The distance travelled is the area under the graph, the area of the triangle.

12 – 0
= 12



150 – 120 = 30

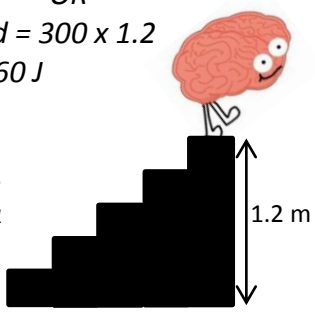
Distance $= \frac{1}{2} \times$ *base* $\times$ *height*

Distance $= \frac{1}{2} \times 30 \times 12 = 180$ *m*

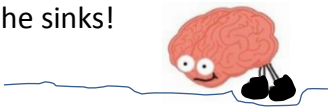
No Brain has a mass of 30 kg and takes 8 seconds to climb a set of steps. What is his power?

$E_P = mgh = 30 \times 10 \times 1.2$
$E_P = 360$ J OR
Work = Fd = 300 x 1.2
Work = 360 J

P = W/t
P = 360/8
P = 45 Js^{-1}
Or 45 W



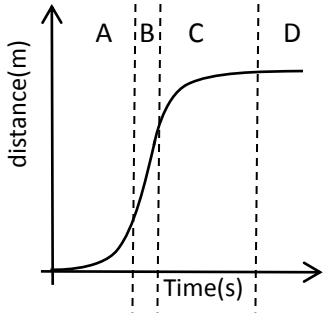
No Brain (mass 30 kg) goes out to play in the snow wearing his boots and find he sinks!



Each boot has a length of 0.15 m and an average width of 0.08 m. What pressure does he exert?

Area of one boot is 0.15 x 0.08 = 0.012 m^2.
Area of both feet = 0.024 m^2.
F=mg F = 10 x 30 = 300N
P = $\frac{F}{A}$ *P =* $\frac{300}{0.024}$ *= 12500 Nm^{-2} or Pa*

No Brain studies a distance-time graph of his performance during a training session. Describe his motion in parts A, B, C & D.



A – accelerating B – constant speed C – decelerating D – at rest (stationary)

$v = \frac{\Delta d}{\Delta t}$ $a = \frac{\Delta v}{\Delta t}$ $F_{net} = ma$ $P = \frac{F}{A}$ $\Delta E_p = mg\Delta h$

$E_K = \frac{1}{2}mv^2$ $W = Fd$ $g = 10 NKg^{-1}$ $P = \frac{W}{t}$