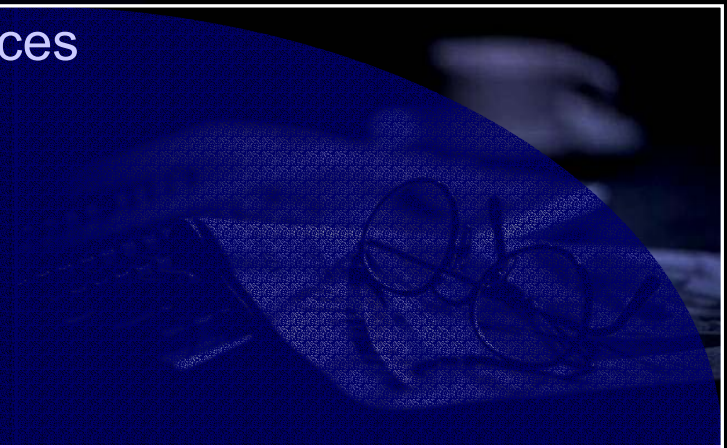
9K Speeding Up...Balanced and unbalanced forces



lesson

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Doing work

Energy is required to do work like lifting, pulling, pushing and stretching. In science, *work is done* if a force pushes, pulls, stretches or lifts an object with a mass. The amount of work done is always measured in joules. The result of doing work, means that an objects gains the following types of energy:

Kinetic energy *Gravitation potential energy* *Heat energy* *Units for work done = Joules*

Look at these examples and determine what kind of energy has been given to the object as a result of doing work ?

Work done:

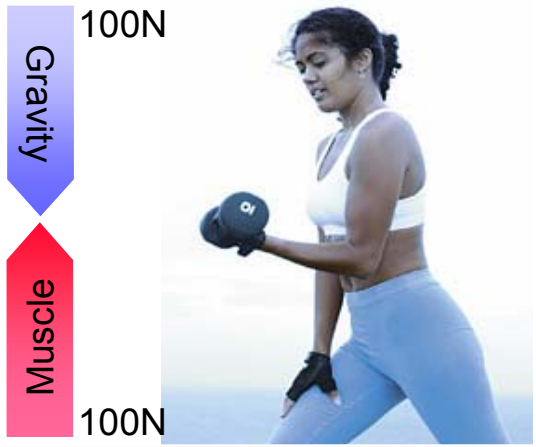
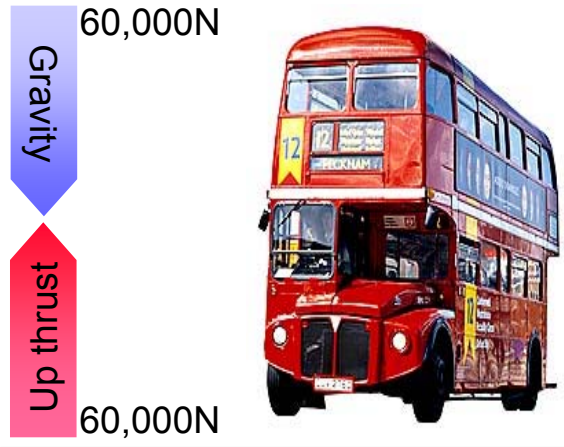
Pushing	Pulling	Lifting	Stretching
			

Pushing: When you push a car, the car starts to move. Energy has been transferred to the car as kinetic energy. *Pulling:* When you pull the rope, the rope will start to move. Energy has been transferred as kinetic energy. *Lifting:* When a object is lifted above ground level by using a force, the gravitational potential energy of the object starts to increase. *Stretching:* If you stretch something it gains elastic potential energy. Repeated stretching, because of friction between the molecules transfers energy into heat energy.

Balanced forces *one*

Although you cannot see forces, you can see the effects of forces and the resulting actions. If an unbalanced force acts on a object, it will either speed up, slow down, change direction or change shape. When forces are balanced, *an object in motion will tend to stay in motion, and an object at rest will tend to stay at rest unless the object is acted upon by an outside force*. When you are sitting on a chair, gravity exerts a force pulling your mass down with the chair exerting an equal and opposite force on your body. Unless there is an external force acting on you, you and the chair will stay at rest. *Give three other examples of objects that are at rest ?*

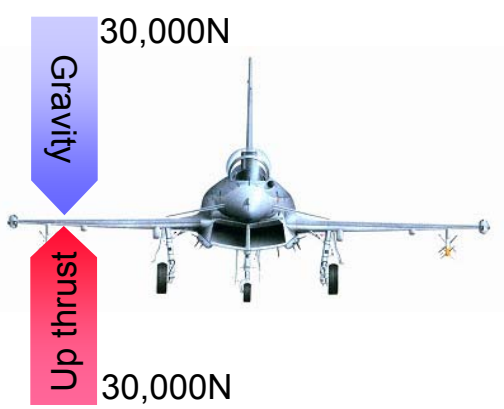
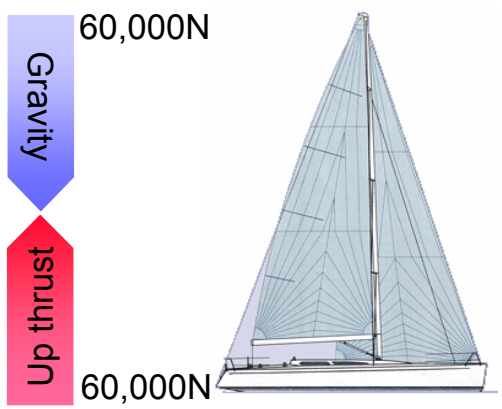
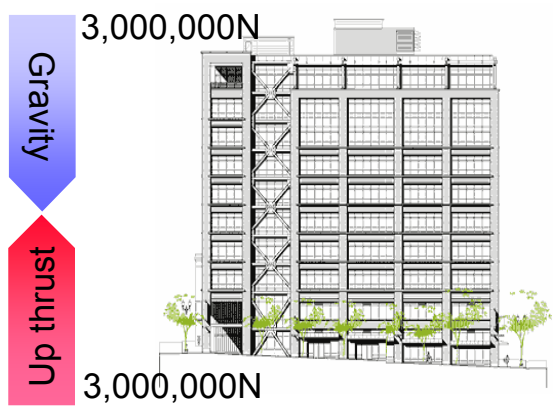
Balanced forces:

	Sitting down	Lifting weights	London bus
Diagram			
Notes	Gravity pulls downwards on the female with a force of 550N. The chair is pushing upwards on the female with the same force of 550N.	Gravity pulls downward on the 10kg weight with a force of 100N. The arm muscles push upwards on the weights with the same force of 100N.	Gravity pulls downward on the red bus with a force of 60,000N. The ground is pushing upwards with the same force of 60,000N, preventing the bus from sinking.

Balanced forces *two*

Understanding balanced forces is simple. You can use arrows to represent the size and direction of a force. The arrow shows the direction of the force with the size of the force being given in Newtons (N) An object will *stay at rest* or *not start to move*, if the forces acting on it are *balanced*. What is more difficult to understand, is that an object will continue in motion at a steady speed when the forces are balanced. A cyclist will achieve a steady speed, where the force applied by the muscles through the gears and wheels is equal to the force of internal resistance and air resistance. *Is it easier to ride behind or front of a group of cyclists...Explain ?*

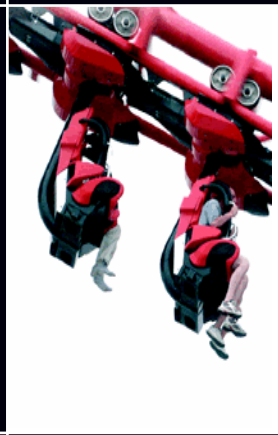
Balanced forces:

	Harrier Jump Jet	Boat sailing	Building
Diagram			
Notes	Gravity pulls downward on the jet with a force of 30,000N. The thrust of the jet engines is pushing upwards on the jet with the same force of 30,000N.	Gravity pulls downward on the boat with a force of 60,000N. The up thrust from the water is pushing upwards on the boat with the same force of 60,000N.	Gravity pulls downwards on the building with a force of 3,000,000N. The ground is pushing upwards with the same force of 3,000,000N, preventing the building from sinking.

Unbalanced forces *one*

Although you cannot see forces, we can see the effects of forces and the resulting actions. If an unbalanced force acts on a object, it will either speed up, slow down, change direction or change shape. On a roller coaster, *gravity* and the forces it exerts on your body will accelerate you, giving you the sensation of falling. Rapid acceleration, twisting and turning gives you that sensation of a near vertical drop whilst still being safe. The force of gravity is far bigger than the force of friction between the moving parts. *Why would a roller coaster on the moon's surface be less scary ?*

Unbalanced forces:

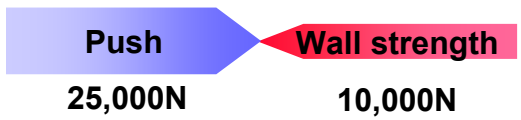
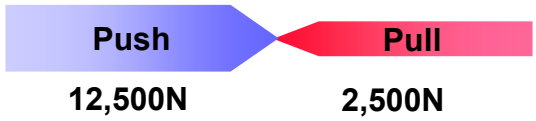
	Roller Coaster	Sprinters	Free Falling
Diagram			
Notes	In this example, two forces exists; Gravity and friction. The largest force is gravity pulling the mass of the roller coaster and people downwards at 10m/s^2.	In this example, two forces exists; work done by the muscles and friction caused internally and by air. The largest force is produced by body muscles which propel the sprinter along the track.	In this example, two forces exists; Gravity and air friction. The largest force is gravity pulling the mass of the parachutist downwards at very high acceleration rates.

Unbalanced forces *two*

An unbalanced force provided by a car, lorry or train combustion engine can accelerate the moving vehicle in a forward direction. Engines provide the force to move a vehicle like a car forward. This force is sufficient to overcome, the internal resistance of all the moving parts and air resistance as the car moves in a forward direction. Continue to put your foot on the accelerator pedal and the car reaches a maximum top speed. This is where the force of the engine is equal to the drag created by air resistance and internal resistance in the engine.

Why are cars designed with a streamlined shape ?

Unbalanced forces:

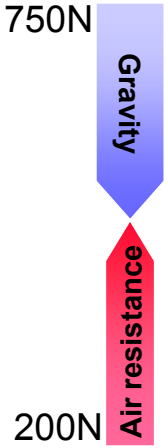
	Crashes	Burn out	Space shuttle launch
Diagram	 	 	 
Notes	In this example, two forces exists. The forward push of the car and the wall's strength. The largest force is the forward push of the car which is far higher than the overall strength of the wall.	In this example two forces exist. The forward push of the engine and the friction between the tyres and tarmac. The largest force is the forward push of the engine which drives the wheels during this burnout.	In this example two forces exist. The upward thrust provided by the shuttle engines and the downward pull of gravity on the shuttles mass. The largest force is the upward thrust of the shuttle engines.

Working with resultant forces

Both the size and the direction of a force is important. A force is called a vector quantity. We can show the direction of the force by using an *arrow* drawn in a particular direction. The size of the force acting in any given direction can be indicated using a scale – for example, *one centimetre* for *one Newton* or by writing above the arrow, the size of the force in *Newtons*. Forces are always in pairs, so the resultant or overall force must be calculated. *Work through these examples, giving your answers in Newtons.*

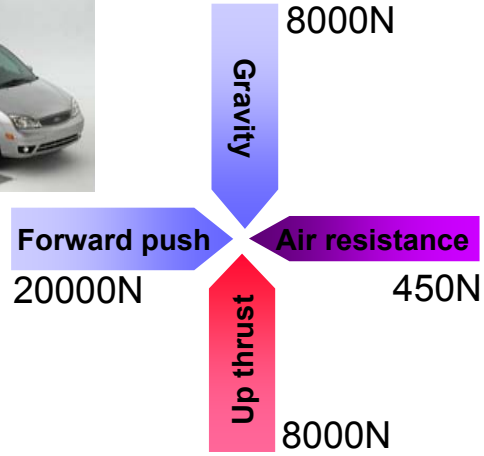
Resultant forces:

Problem one



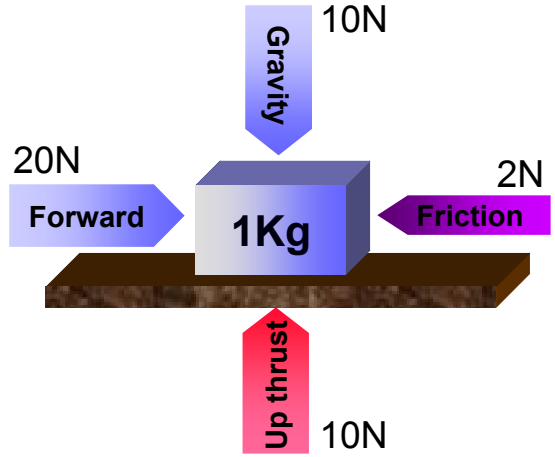
A gravitational force of 750N is acting on the free falling man. Air resistance acts in the opposite direction with a value of 200N. The resultant force acting downwards and accelerating the parachutist is 750N -200N = 550N.

Problem two



There are four forces acting on a car: (i) Downward force of 8000N, (ii) Upward force of 8000N, (iii) Forward engine force of 20,000N (iv) Air resistance force of 450N. Work out the total resultant force. *Which way would the car move ?*

Problem three



There are four forces acting on the one kilogram block: (i) Downward force of 10N, (ii) Upward force of 10N, (iii) Forward push of 20N (iv) Friction force of 2N. Work out the total resultant force. *Which way would the block move ?*