牛津学科英语基础丛书

GCSE

through diagrams

PHYSICS

牛津图解中学物理

（英汉双语）

Brian Arnold

洪晖　毓明　怡然 译

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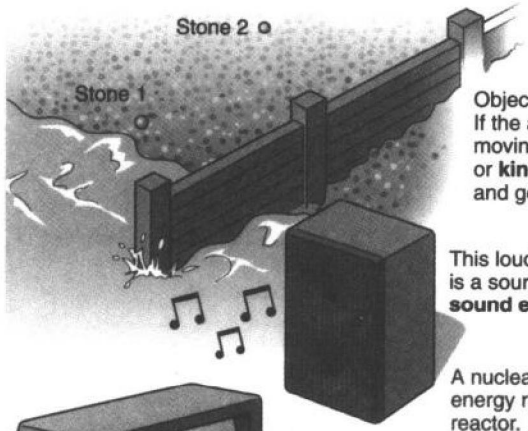
CONTENTS 目 录

A1 Energy (1)

You need **energy** to live, to grow and to do things. Energy makes things happen. Anything which is able to do work is said to **possess** energy. Someone who is capable of doing lots of work is **energetic**. There are many different forms and sources of energy.

DIFFERENT FORMS OF ENERGY

Objects may have energy because of their position. This is called **gravitational potential energy**. Stone 1 has less potential energy. But stone 2, high above the beach has gravitational potential energy and so can .....



The Sun radiates **thermal** energy (heat) and **light** energy.

This radio uses the **stored chemical energy** in the battery to provide its energy needs.

Objects which are moving possess kinetic energy. If the air is still it has no energy but when it is moving ie there if a wind is blowing, its **movement** or **kinetic energy** can be used to turn the turbine and generate electricity.

This loudspeaker is a source of **sound energy**.

This bowl of cereal contains **chemical energy**. Plants use the Sun's energy.

A nuclear submarine obtains all its energy requirements from a nuclear reactor. It uses **nuclear energy**.

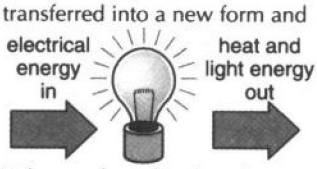
This catapult needs to be stretched before it will work. It then has **strain** or **potential energy** and is capable of shooting a stone a long way.

Electrical energy is one of the most convenient forms of energy it can be used in many different situations. Here it is needed for this TV set to work.

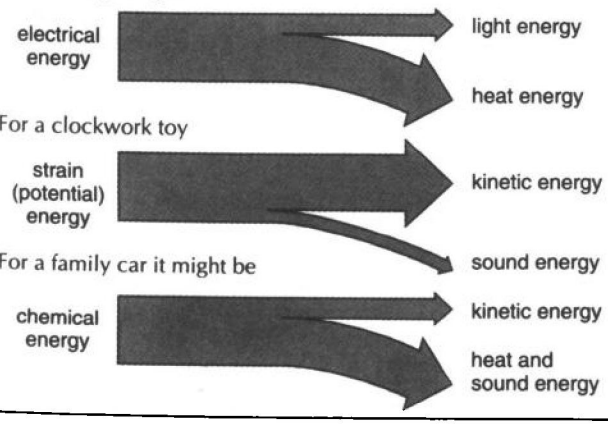
ENERGY TRANSFERS

When energy is converted it is transferred into a new form and work is done.

This light bulb is doing work as it converts electrical energy into heat and light energy.



Energy is measured in **joules** (J). The number of joules of energy before and after a change is the same ie no energy is lost or gained. This is the **law of the conservation of energy**. The work done by the above light bulb can be represented by this (Sankey) diagram.



Other examples of energy transfer

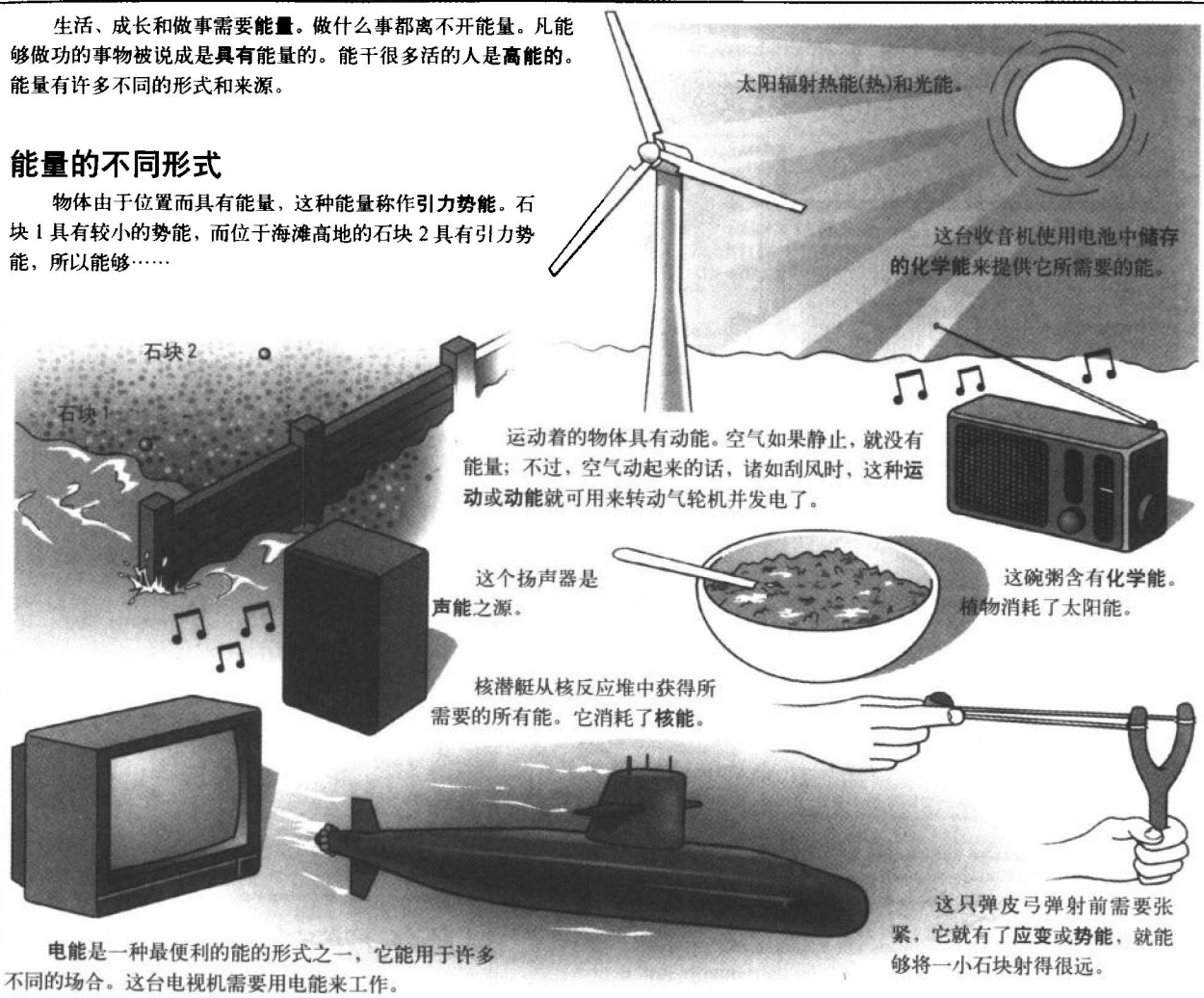
Energy input	Device	Energy output
electrical energy	electric motor	kinetic energy (mechanical work)
chemical energy	candle	heat and light energy
sound energy	microphone	electrical energy
chemical energy	cell or battery	electrical energy
electrical energy	radio	sound energy
potential (strain) energy	clockwork car	kinetic energy
kinetic energy (mechanical work)	generator or dynamo	electrical energy
heat energy	hot air balloon	gravitational potential energy
light energy	tree	chemical energy
chemical energy	match head	heat and light energy
chemical energy	car	kinetic and heat energy

A1 能量（1）

生活、成长和做事需要**能量**。做什么事都离不开能量。凡能够做功的事物被说成是**具有**能量的。能干很多活的人是**高能的**。能量有许多不同的形式和来源。

能量的不同形式

物体由于位置而具有能量，这种能量称作**引力势能**。石块 1 具有较小的势能，而位于海滩高地的石块 2 具有引力势能，所以能够……



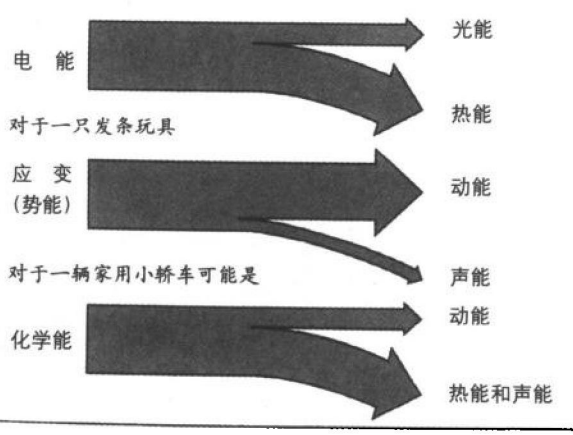
电能是一种最便利的能的形式之一，它能用于许多不同的场合。这台电视机需要用电能来工作。

能量转换

能量转变时，会转换成一种新的形式并做了功。

这只灯泡将电能转换成热能和光能的时候正在做功。

能量用焦耳(焦)来量度。在能量转变前和转变后，其焦耳值是相同的，即能量既没有失去也没有获得。这就是能量守恒定律。上述灯泡所做的功可用这个(桑基)图来表示。



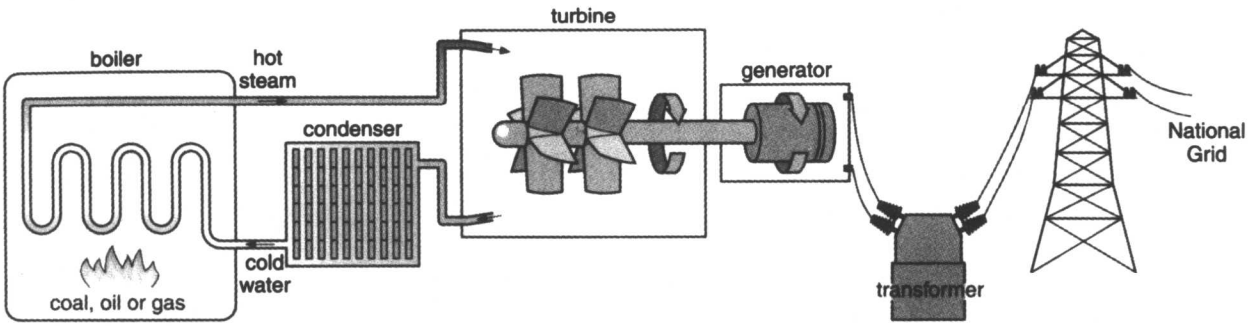
能量转换的其他例子

能量输入	装置	能量输出
电能	电动机	动能（机械功）
化学能	蜡烛	热能和光能
声能	传声器	电能
化学能	电池或干电池	电能
电能	收音机	声能
势(应变)能	发条小汽车	动能
动能(机械功)	发电机或直流发电机	电能
热能	热气球	引力势能
光能	树	化学能
化学能	火柴头	热能和光能
化学能	小轿车	动能和热能

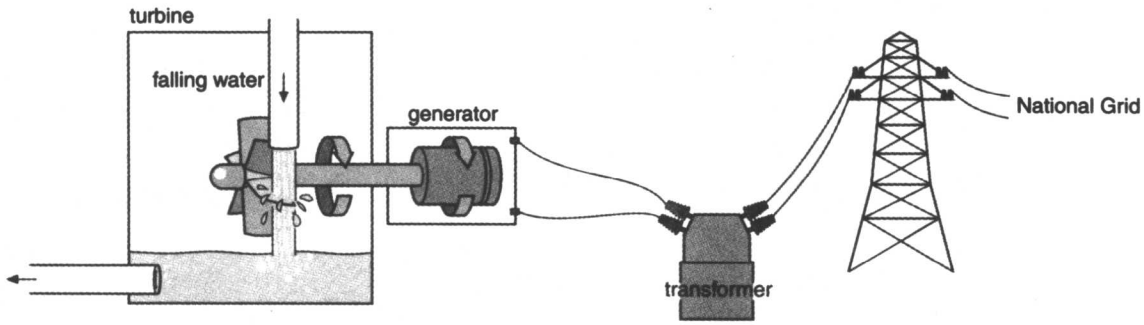
A2 Energy (2)

MAKING ELECTRICITY .... THE POWER STATION

Electrical energy is one of the most convenient forms of energy. At a power station, chemical, nuclear or kinetic energy is converted into electrical energy which is then transmitted through the National Grid to our homes.



At a coal, oil or gas power station the fuel which contains chemical energy is burned in order to release its energy as heat. This energy is then used to produce steam which turns the turbines to make electricity. In a nuclear power station it is a nuclear reaction that releases the energy to produce the steam.



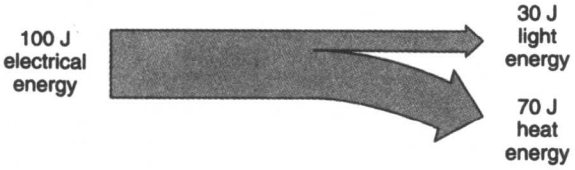
At a hydroelectric power station the flowing water is used to drive the turbines and the generators in order to produce electricity.

EFFICIENCY

Often when energy transformations take place some energy is wasted. The purpose of a bulb is to provide light energy, but it gets hot too.

A bulb which emitted only light would be described as being 100% efficient.

In practice however bulbs also emit heat energy.



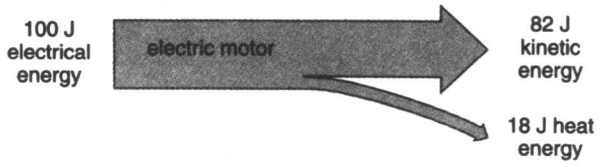
For every 100 J of electrical energy which enter the bulb only 30 J of useful (light) energy are produced.

The efficiency of any energy transfer can be calculated using;

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{energy input}} \times 100\%$$

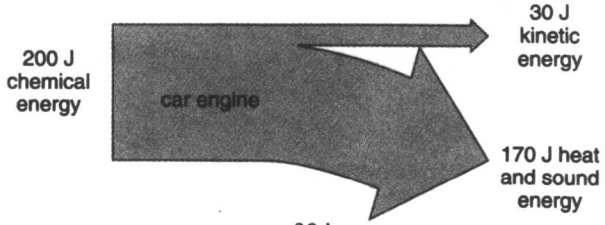
The efficiency of the bulb is therefore:

$$\text{efficiency} = \frac{30\text{ J}}{100\text{ J}} \times 100\% = 30\%$$



$$\text{efficiency of electric motor} = \frac{82\text{ J}}{100\text{ J}} \times 100\% = 82\%$$

$$\text{efficiency of clockwork toy} = \frac{26\text{ J}}{50\text{ J}} \times 100\% = 52\%$$

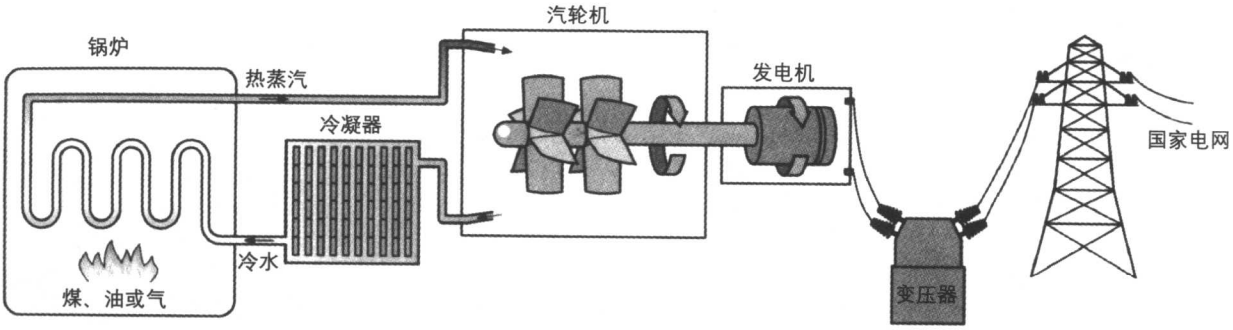


$$\text{efficiency of car engine} = \frac{30\text{ J}}{200\text{ J}} \times 100\% = 15\%$$

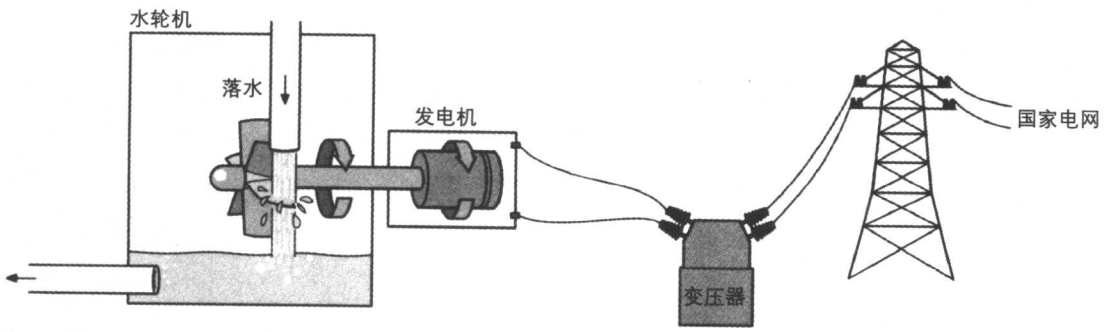
A2 能量（2）

产生电——发电厂

电能是最便利的能的形式之一。在发电厂，化学能、核能或动能被转换为电能，然后通过国家电网传送到各家各户。



在煤、油或气的发电厂，通过燃烧含有化学能的燃料，以热的形式释放其能量。这种能量然后被用来产生蒸汽以转动汽轮机，来产生电。在核电站是通过核反应堆所释放的能量来产生蒸汽的。



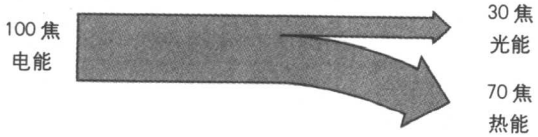
在水力发电站使用有落差的水来驱动水轮机和发电机以产生电的。

效率

能量变换时，通常会发生一些能量被浪费。灯泡的目的在于提供光能，可是它也发热了。

如果一个灯泡只发射光，那么它的效率可以说是100%。

然而事实上灯泡还散发热能。



对输入灯泡的每100焦电能来说，仅产生30焦有用能(光能)。

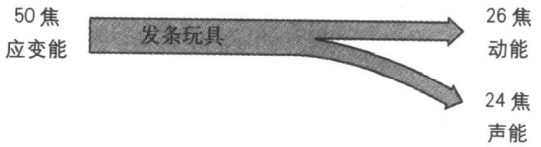
任何能量转换的效率可以使用下式计算:

$$\text{效率} = \frac{\text{输出的有用能量}}{\text{输入的能量}} \times 100\%$$

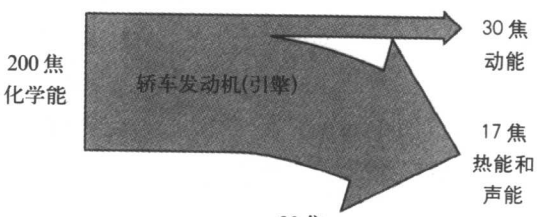
因此，灯泡的效率是:

$$\text{效率} = \frac{30\text{ 焦}}{100\text{ 焦}} \times 100\% = 30\%$$

$$\text{电动机(马达)的效率} = \frac{82\text{ 焦}}{100\text{ 焦}} \times 100\% = 82\%$$



$$\text{发条玩具的效率} = \frac{26\text{ 焦}}{50\text{ 焦}} \times 100\% = 52\%$$

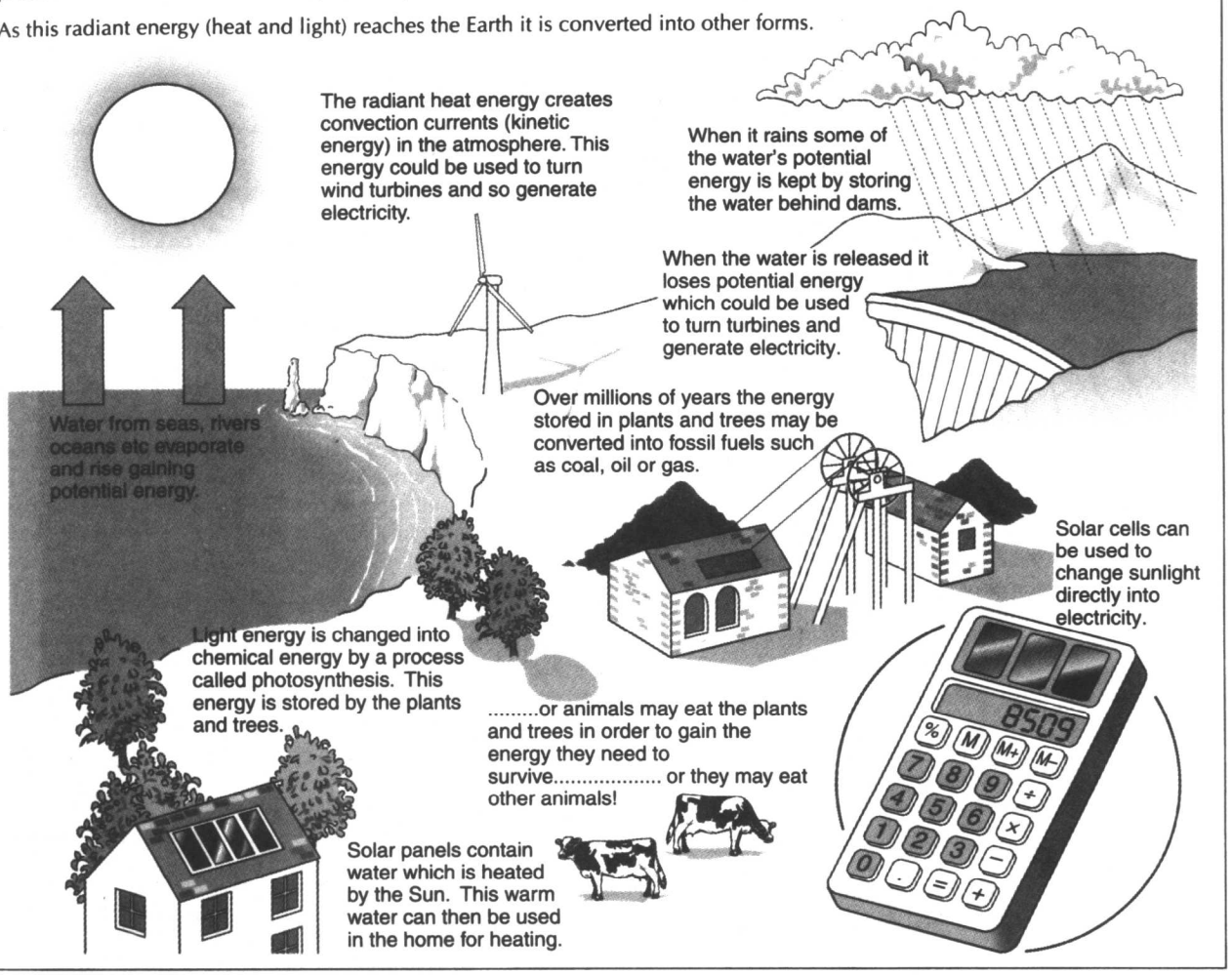


$$\text{轿车发动机(引擎)的效率} = \frac{30\text{ 焦}}{200\text{ 焦}} \times 100\% = 15\%$$

A3 Energy resources

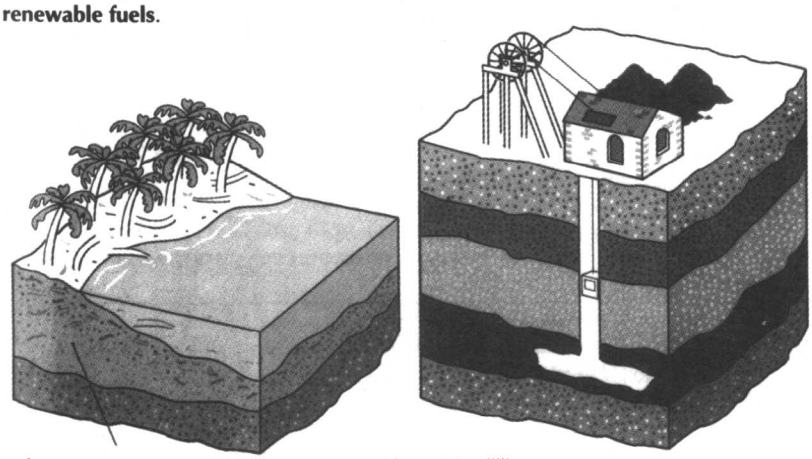
Most of our energy on Earth comes from the Sun. This energy is generated in a nuclear reaction. Two light elements combine to produce a heavier element accompanied by a release of large quantities of energy.

As this radiant energy (heat and light) reaches the Earth it is converted into other forms.



FOSSIL FUELS

Much of the energy an industrial nation such as the UK needs for transport and manufacturing comes from **fossil fuels** such as **coal**, **oil** and **gas**. About 300 million years ago when plants, trees, and animals died they became covered by other plants growing above them and dying. This process happened many, many times. Now deep down in the Earth, these remains were subject to high temperatures and large pressures which over millions of years changed them into fossil fuels. Because it takes so long to make these fuels it is not possible to replace them, they are **non-renewable fuels**.



dead plants and animals become covered and squashed

After 300 milllion years we extract the fossil fuels

ENERGY CRISIS

Although energy is never actually lost it frequently ends up in a dilute form which is not very useful. For example, the kinetic energy of a car originates from the fuel it uses. When the car stops much of this energy is transformed into thermal or heat energy in the surroundings.

If we continue to use concentrated forms of energy such as fossil fuels at the present rate there is a real danger that there will be an energy shortfall early next century. There are two possible ways we could avoid or reduce the effect of this shortfall.

- conserve energy by reducing our demands: increase the efficiency of all machines; reduce heat loss from buildings by greater usage of insulation; reuse and recycle objects and materials rather than throwing them away once they have been used.
- make greater use of **alternative sources of energy**.

A3 能源

地球上绝大部分能量来自太阳。这种能量由核反应产生，即伴随着两种轻元素化合成重元素的同时释放出大量能量。

这种辐射能(热和光)到达地球时，被转换成各种形式。

辐射的热能在大气层产生对流(动能)。这种能量能被用于转动风轮机来发电。

下雨使水的势能保存于拦在堤坝后的水中。

当水被释放时，所失去的势能被用来推动水轮机以发电。

储存在植物和树木中的能量经过数百万年，转换成诸如煤、油或天然气之类的矿物燃料。

来自海、河、洋等的水蒸发并上升以获得势能。

太阳能电池能用于将太阳光直接转变为电。

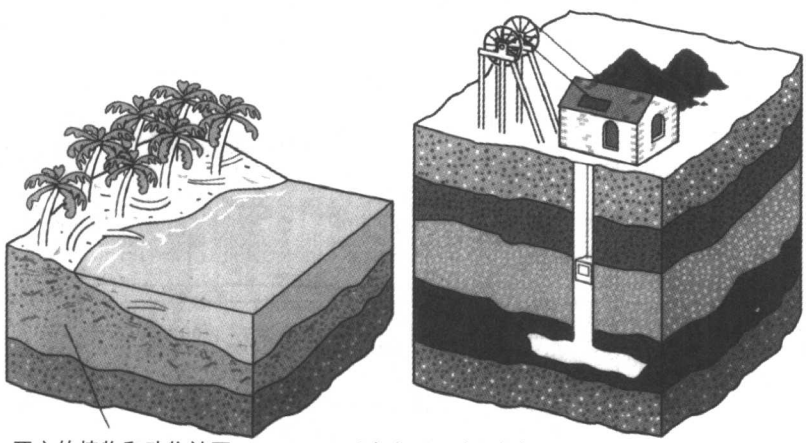
通过称作光合作用的过程，光能被转变成化学能，这种能量储存在植物和树木中。

……动物或者吃植物和树木以获得生存所需要的能量，……或者吃其他动物!

太阳电池板内的水被太阳加热。然后将这种热水用于家庭取暖。

矿物燃料

像英国这样的工业国需要大量的能，用于运输和生产，这些能来自**煤**、**石油**和**天然气**之类的**矿物燃料**。大约3亿年前，植物、树木和动物死了以后，其他植物覆盖其上成长，以后又死亡，这种周而复始的过程经历了许多次。深深地在地表叠压起来的这些遗骸，遭到上百万年的高温和巨压后，变成了矿物燃料。由于形成这些燃料经过如此漫长的岁月，它们不可能再生，因此，这些能源又被称作为**非再生燃料**。



死亡的植物和动物被覆盖和挤压

3亿年后，我们挖掘矿物燃料

能源危机

事实上能量并没有消失，它只是经常以一种没有太大用处的稀释态告终。譬如轿车的动能源于燃料的使用，车子停下后，很大部分能被转化为热能散布于四周。

如果我们继续以目前的速率使用矿石燃料之类的浓缩能源，确实是很危险的，因为这将导致下世纪初陷入能源短缺的境地。下述两种可能的方式，能使我们避免或减轻这种能源短缺的影响。

- 通过减少需求来保存能源：提高所有机械的效率；扩大使用绝热设施以减少建筑物的热损耗；提倡对物质和材料的再使用和再循环，而不是一旦用过就丢弃。
- 扩大**其他可供选择的能源**(代用能源)的利用面。

A4 Alternative sources of energy

SOURCE OF ENERGY	ADVANTAGES AND DISADVANTAGES
Solar energy Radiant energy from the Sun can be captured in several different ways: 1 solar cells convert the radiant energy into electricity eg replace batteries in calculators 2 solar panels ... water passing through the panels is heated by the Sun 3 solar furnaces ... an array of concave mirrors concentrates the Suns ray's creating temperatures in excess of 3000 °C	*Advantages:* • no pollution • renewable source of energy *Disadvantages:* • of limited use in places where there is not continuous sunshine • the initial costs can be very high
Wind energy The kinetic energy of the wind is used to drive wind turbines and generate electricity. Often the turbines are built in clusters ... nicknamed *wind farms.*	*Advantages:* • renewable source of energy • excellent source for isolated communities • low level technology (developing countries) *Disadvantages:* • cause visual and noise pollution • windy site essential • efficiency of energy capture/transfer is very low though more efficient turbines are being developed
Hydroelectric energy Water is collected/stored behind dams usually on high ground such as mountains or hills. It is then released through sluices or pipes and its kinetic energy used to drive generators and produce electricity.	*Advantages:* • renewable source of energy • no pollution *Disadvantages:* • limited number of suitable sites • high initial cost • environmental problems eg flooding of valleys and consequent effect on wildlife
Tidal energy The potential energy of a high tide is stored behind dams and then released at low tide. The flow of water is used to drive generators.	*Advantages:* • renewable source of energy *Disadvantages:* • high initial cost • visual pollution
Wave energy The rocking motion of waves is used to generate electricity.	*Advantages:* • renewable source of energy *Disadvantage:* • very inefficient capture of energy • very large area needed to capture enough energy to be viable....visual pollution
Geothermal energy Nuclear reactions deep in the Earth create high temperatures. Cold water which is pumped through pipes becomes so hot it boils and the steam produced on its return to the surface is used to drive turbines and generate electricity.	*Advantages:* • renewable source of energy *Disadvantages:* • limited number of suitable sites • high cost of drilling deep into the Earth
Biomass Wood is a renewable fuel. When burned it releases its energy. New trees can then be planted to replace those cut down. Sugar cane can be grown and the sugar fermented to produce alcohol which can be used as a fuel instead of petrol.	*Advantages:* • renewable source of energy • low level technology ... good for developing countries *Disadvantages:* • possible pollution and damage to ozone layer • large areas of land will need used to produce enough biomass. This may affect the ecology of the environment
Nuclear energy (fusion) When uranium-235 absorbs a neutron it becomes unstable , splits into two smaller atoms and releases a large amount of energy. This energy is used to turn water into steam to drive turbines and produce electricity.	*Advantages:* • small amounts of fuel produce large amounts of energy *Disadvantages:* • because of the dangers of radioactivity there is the need for very costly, high level safety precautions • the treatment of spent fuel and the decommisioning of nuclear power stations is extremely expensive

A4 其他可供选择的能源

能源	优点和缺点
太阳能 可用下述几种不同的方式获取来自太阳的辐射能。 1. 太阳能电池将辐射能转换成电能，譬如在计算器中用于替换干电池。 2. 太阳电池板——水通过该板后被太阳加热。 3. 太阳灶——一种能聚集太阳光以产生3000℃以上高温的凹面镜阵列。	优点： • 无污染。 • 可再生能源。 缺点： • 在没有连续光照处使用受限制。 • 初始花费较高。
风能 风的动能被用于驱动风轮机来发电。风轮机通常成组建造，故有风农庄的绰号。	优点： • 可再生能源。 • 对独立社区是极好的能源。 • 低水准技术(发展中国家)。 缺点： • 引起视觉和噪声污染。 • 多风的场地是绝对必要的。 • 能量获取／转换效率很低，有待发展高效风轮机。
水电能 水被收集/储存于通常筑在小山或小丘等高地上的大坝后。当水从闸门或管道释放出来时，它的动能用来驱动发电机以发电。	优点： • 可再生能源。 • 无污染。 缺点： • 局限于有限的合适场地。 • 高初始投入。 • 山谷灌满水及伴随着对野生动物的影响之类的环境问题。
潮汐能 高潮时蓄于大坝后的水的势能在低潮时被释放，用这种水流来驱动发电机。	优点： • 可再生能源。 缺点： • 初始投入高。 • 视觉污染。
波能 用波的摆动来发电。	优点： • 可再生能源。 缺点： • 能效很低。 • 为了获得足够的能量必须要有相当大的区域才行，还有视觉污染。
地热能 地球深处的核反应产生高温，使泵入管道中的冷水变得很热以致沸腾，所产生的水蒸气在回到地表时被用来驱动汽轮机以发电。	优点： • 可再生能源。 缺点： • 局限于有限的合适场地。 • 钻入地球深处的高投入。
生物量 森林是可再生燃料。树木燃烧时释放能量，然后栽种新的树木以替换那些被砍伐的。种植甘蔗，用蔗糖发酵来生产的酒精能用作燃料，以替代汽油。	优点： • 可再生能源。 • 低水准技术，有利于发展中国家。 缺点： • 对臭氧层可能产生污染和破坏。 • 需要大片土地以产生足够的生物量。这可能影响生态环境。
核能(聚变) 铀235吸收一个中子就变得不稳定，会分裂成两个较小的原子并释放大量的能。这种能用于将水变成蒸汽来驱动汽轮机以发电。	优点： • 少量的燃料可产生大量的能。 缺点： • 由于存在放射性危险就需要高投入、高水准的安全措施。 • 处理失去效能的燃料(核废料)和废弃核电站的代价十分昂贵。

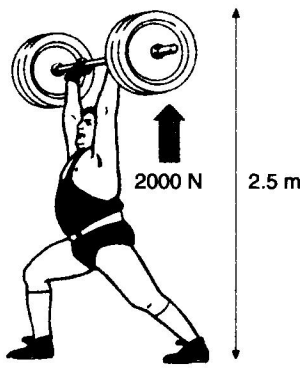
A5 Work and power

WORK

In everyday life the word work has many different meanings but to scientists it is something very precise.

Work is done when a force causes an object to move or prevents it from moving. The amount of work done can be calculated using the equation

work done = force × distance moved in the direction of the force



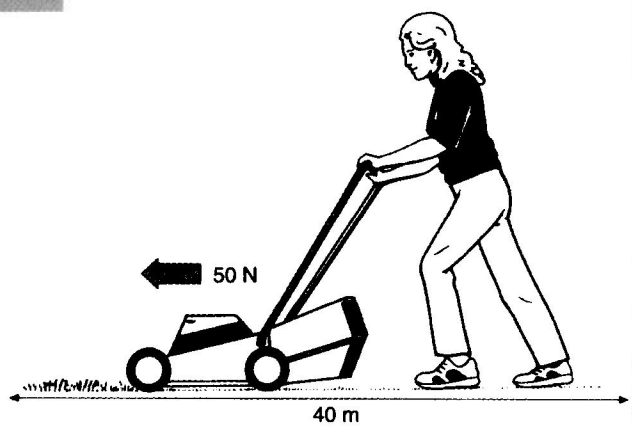
In order to raise the weights above his head this athlete must apply a force which causes them to move. In doing so he is doing work.

The work done by the athlete above is:

work done = force × distance moved

work done = 2000 N × 2.5 m

work done = 5000 J



In order to cut the lawn this lady must push her lawnmower. As she does so she is doing work.

The work done by the gardener above is:

work done = force × distance moved

work done = 50 N × 40 m

work done = 2000 J

If a force of 1 N causes an object to move 1 m then 1 J (joule) of work has been done

POWER

Power is a measure of how rapidly work is being done. It is measured in watts (W).

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

The power of the athlete above is:

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

$$\text{power} = \frac{5000\ \text{J}}{0.5\ \text{s}}$$

power = 10000 W or 10 kW

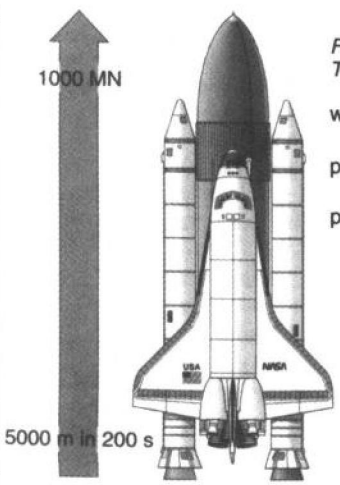
The power of the gardener above is:

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

$$\text{power} = \frac{2000\ \text{J}}{200\ \text{s}}$$

power = 100 W

If a person or machine is doing 1 J of work each second their power rating is **1 W (watt)**.

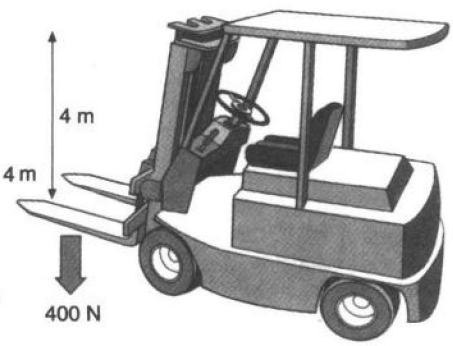


Force developed from rocket motors = 1000000000 N
Time to travel 5000 m = 200 s

work done = 1000000000 N × 5000 m
= 5000000000000 J

$$\text{power of motors} = \frac{5000000000000\ \text{J}}{200\ \text{s}}$$

power of motors = 25000000000 W



work done = 400 N × 4 m
= 1600 J

Time to lift load = 8 s

$$\text{power of lifting motor} = \frac{1600\ \text{J}}{8\ \text{s}}$$

power of lifting motor = 2000 W
or 2 kW

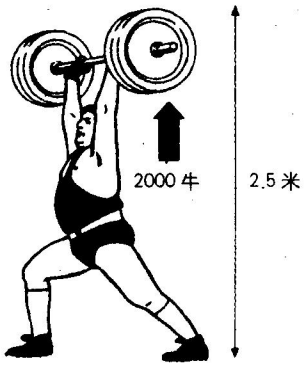
A5 功和功率

功

日常生活中“功”这个词有许多不同的意义，而对于科学家来说，它是有非常确切意义的。

当一个力引起一个物体运动或者对运动着的物体进行阻碍，那么这个力就做了功。所做功的量能使用下式来计算：

所做的功 = 力 × 在力的方向上移动的距离



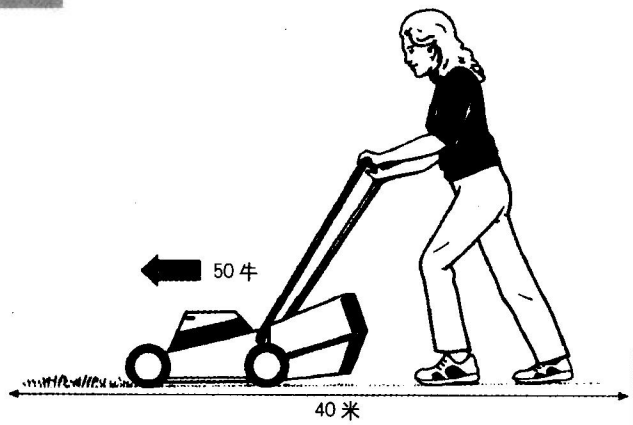
为了将钢铃举过头，这位运动员必须用力使它们移动。在举重过程中，他就在做功。

上述运动员所做的功是：

所做的功 = 力 × 力移动的距离

所做的功 = 2000 牛 × 2.5 米

所做的功 = 5000 焦



为了割草，这位女士必须推动割草机。在这个过程中她做了功。

上述园林工人所做的功是：

所做的功 = 力 × 力移动的距离

所做的功 = 50 牛 × 40 米

所做的功 = 2000 焦

如果 1 牛的力引起物体移动 1 米，那么所做功是 1 焦。

功率

功率是对所做功快慢程度的测量。它用瓦特(瓦)来量度。

$$\text{功率} = \frac{\text{所做的功}}{\text{所花的时间}} \times 100\%$$

上述运动员的功率是：

$$\text{功率} = \frac{\text{所做的功}}{\text{所花的时间}}$$

$$\text{功率} = \frac{5000\text{ 焦}}{0.5\text{ 秒}}$$

功率 =10 000 瓦或 10 千瓦。

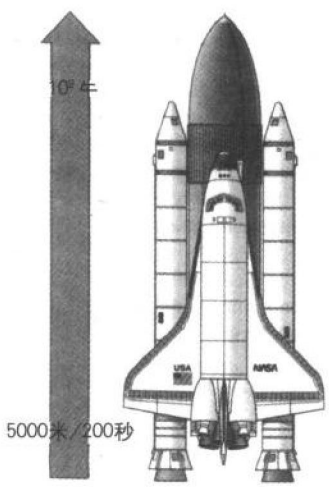
上述园林工人的功率是：

$$\text{功率} = \frac{\text{所做的功}}{\text{所花的时间}}$$

$$\text{功率} = \frac{2000\text{ 焦}}{200\text{ 秒}}$$

功率 =100 瓦

如果一个人或一台机器每秒做 1 焦的功，那么他们的功率额定值是 **1 瓦(瓦特)**。



火箭发动机产生的力 = 1 000 000 000 牛
运行 5000 米的时间 = 200 秒

所做的功 = 1 000 000 000 牛 × 5000 米
= 5 000 000 000 000 焦

$$\text{发动机功率} = \frac{5\,000\,000\,000\,000\text{ 焦}}{200\text{ 秒}}$$

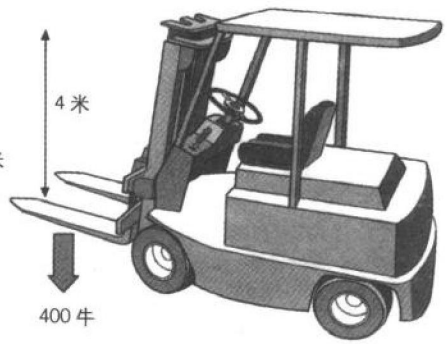
发动机功率 = 25 000 000 000 瓦

所做的功 = 400 牛 × 4 米
= 1600 焦

提升负荷的时间 = 8 秒

$$\text{提升马达的功率} = \frac{1600\text{ 焦}}{8\text{ 秒}}$$

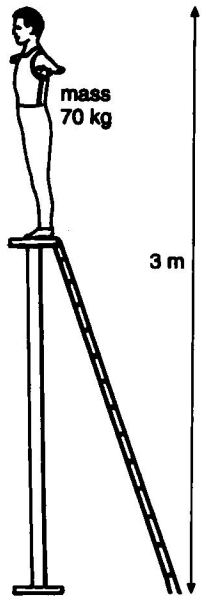
提升马达的功率 = 2000 瓦
或 2 千瓦

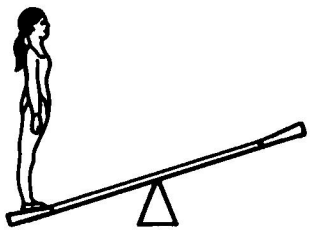


A6 Potential energy and kinetic energy

POTENTIAL ENERGY

When the acrobat above jumps down on to the see-saw he propels (lifts) his partner upwards. In doing so he is doing work and therefore must possess energy. The acrobat has energy because of his position. He would be unable to lift his partner if he was also standing on the ground. Energy possessed by an object because of its position (height above the ground) is called **gravitational potential energy**.





This can be calculated using the formula:

potential energy (PE) = $m \times g \times h$

Where

m = mass of object
g = acceleration due to gravity (9.81 m/s^2)
h = height above the ground

In the case of the acrobat

PE = 70 kg × 9.81 m/s^2 × 3 m

PE = 2060 J

The acrobat in order to gain potential energy had to climb to the top of his stand. In doing so he did work. The amount of work he did was equal to the potential energy he gained.

KINETIC ENERGY

When the acrobat opposite is about to land on the see-saw he has lost nearly all his potential energy. It has been converted into kinetic energy. Kinetic energy is the energy a body possesses because of its motion. The kinetic energy of an object can be calculated using the equation.

kinetic energy (KE) = $\frac{1}{2} mv^2$

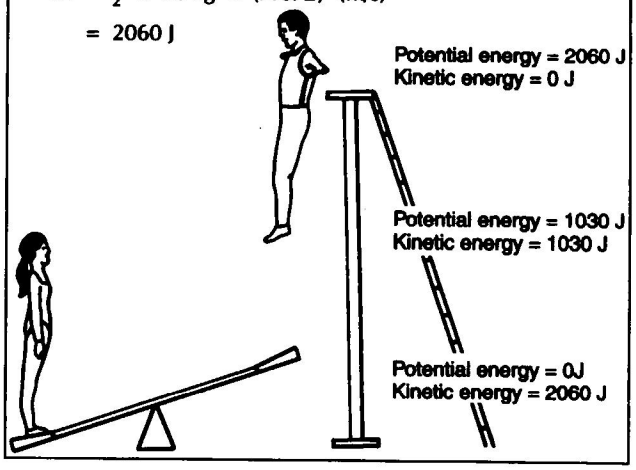
Where

m = mass of object
v = velocity of object

If the acrobat has a mass of 70 kg and as he lands on the see-saw he is falling at a velocity of 7.672 m/s his kinetic energy is

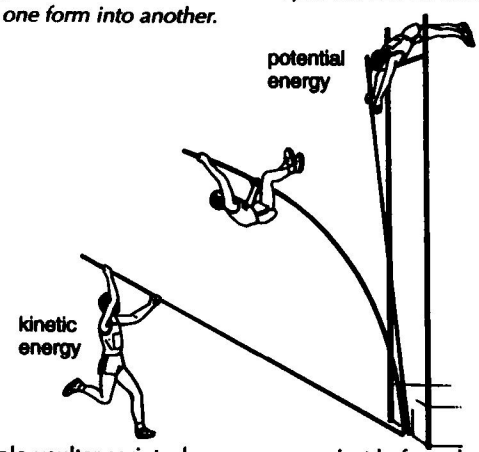
KE = $\frac{1}{2}$ × 70 kg × (7.672)^2 (m/s)^2

= 2060 J



CONSERVATION OF ENERGY

Energy is neither created nor destroyed but can be converted from one form into another.



If a pole-vaulter sprints down a runway, just before planting the pole he will possess a lot of kinetic energy. Using the pole, he can convert this energy into potential energy, so lifting himself up and over the bar. In an ideal situation his kinetic energy at the end of his run up ($\frac{1}{2}mv^2$) should be equal to his potential energy (mgh) as he clears the bar.

$\frac{1}{2} mv^2 = mgh$

Calculate the maximum height a vaulter might clear if his velocity as he plants the pole is 10 m/s

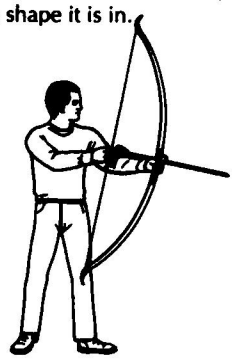
$\frac{1}{2} mv^2 = mgh$

$$h = \frac{\frac{1}{2} \times 10^2}{9.81}$$

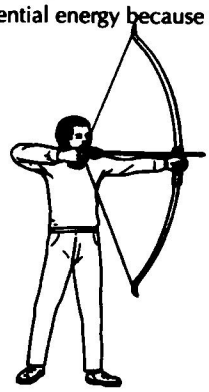
h = 5.1 m

STRAINED POTENTIAL ENERGY

Sometimes an object can posses potential energy because of the shape it is in.



Unstretched, this bow has no energy to give to the arrow.

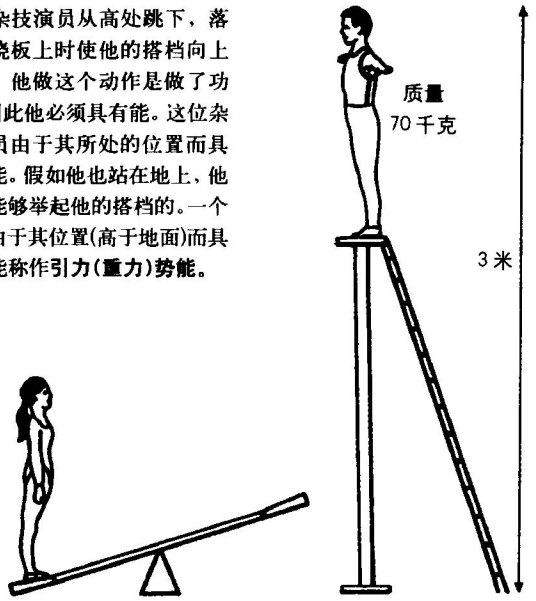


When the bow is stretched it possesses strained potential energy which it can give to the arrow.

A5 势能和动能

势能

杂技演员从高处跳下，落在跷跷板上时使他的搭档向上跃起。他做这个动作是做了功的，因此他必须具有能。这位杂技演员由于其所处的位置而具有了能。假如他也站在地上，他是不能够举起他的搭档的。一个物体由于其位置(高于地面)而具有的能称作**引力(重力)势能**。



势能可使用下述公式计算:

$$\text{势能(PE)} = m \times g \times h$$

这里

m = 物体的质量

g = 重力加速度(9.81 米/秒^2)

h = 离地高度

在杂技演员的情况下

势能 =70 千克 × 9.81 米/秒^2 × 3 米

势能 =2060 焦。

为了得到势能，该杂技演员必须攀上支架的顶端。在这个过程中他做了功。他所做功的量等于他获得的势能。

向上攀缘增加了引力势能

动能

当对面的杂技演员即将落至跷跷板时，他几乎失去所有的势能。势能已被转换成动能。动能是一个物体由于运动而具有的能量。物体的动能可使用下述等式来计算。

$$\text{动能(KE)} = \frac{1}{2} mv^2$$

这里

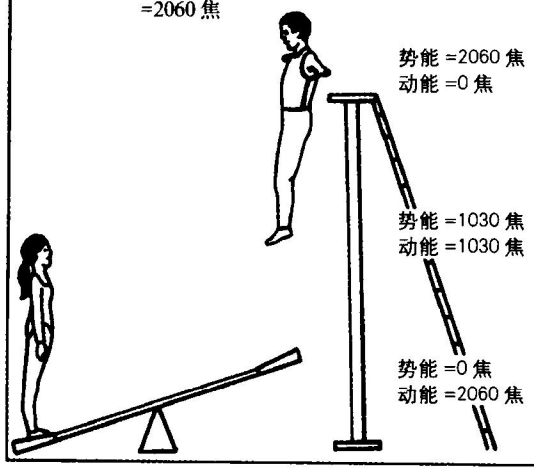
m= 物体的质量

v = 物体的速度

如果该杂技演员质量为 70 千克，他落在跷跷板上的速度是 7.672 米/秒时，那么他的动能是

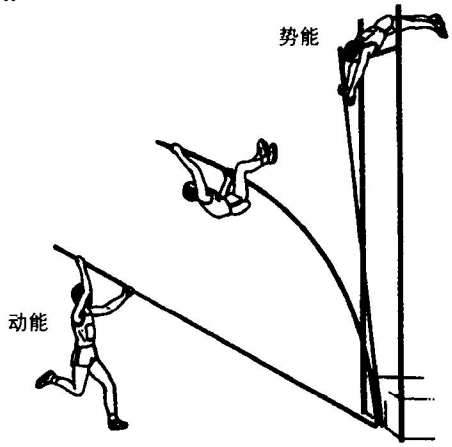
$$\text{动能} = \frac{1}{2} \times 70 \text{千克} \times (7.672 \text{米/秒})^2$$

$$= 2060 \text{焦}$$



能量守恒

能量既不会创生也不会消失，不过可以从一种形式转换成另一种形式。



如果一名撑竿跳运动员沿着跑道全速疾跑的话，那么在插竿之前他具有很大的动能。使用撑竿，他能把这个能量转化为势能，将自身提升起来跃过横竿。在理想的情况下，在起跳线处他的动能($\frac{1}{2} mv^2$)应该等同于他跃过横竿时的势能(mgh):

$$\frac{1}{2} mv^2 = mgh$$

如果他插竿时的速度是 10 米/秒，那么可以计算出可能跃过的最大高度:

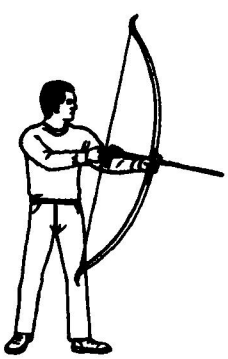
$$\frac{1}{2} mv^2 = mgh$$

$$h = \frac{\frac{1}{2} \times 10^2}{9.81}$$

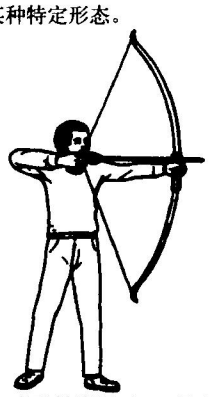
$$h = 5.1 \text{米}$$

应变势能

有时物体具有势能是由于它处于某种特定形态。



弦没张紧，弓就没有能量提供给箭。



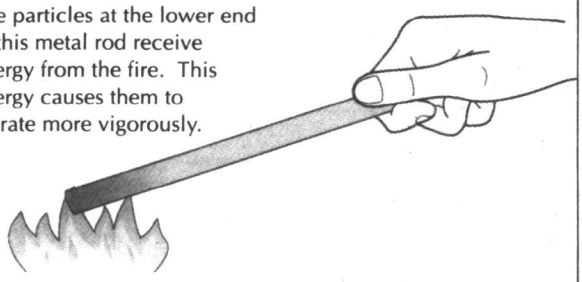
当弦被张紧时，弓具有的应变势能可提供给箭。

B1 Conduction

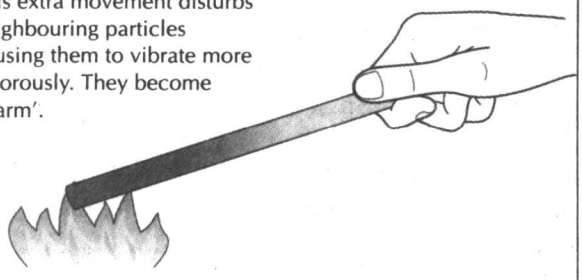
CONDUCTION

Conduction is the transfer of energy through an object without its atoms changing position.

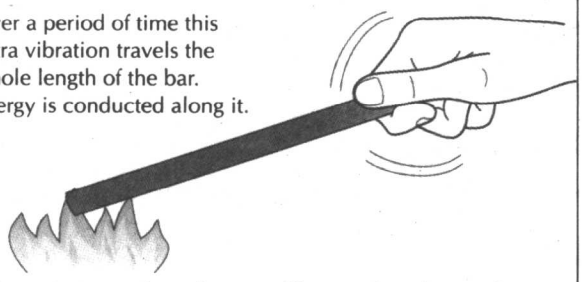
The particles at the lower end of this metal rod receive energy from the fire. This energy causes them to vibrate more vigorously.



This extra movement disturbs neighbouring particles causing them to vibrate more vigorously. They become 'warm'.



Over a period of time this extra vibration travels the whole length of the bar. Energy is conducted along it.



All metal are good **conductors** of heat and easily transfer energy from place to place.
Non metals such as wood, plastics, and ceramics are poor conductors because their particles have very little freedom and are unable to take part in the conduction.

Materials which prevent or restrict heat transfer by conduction are called thermal **insulators**.

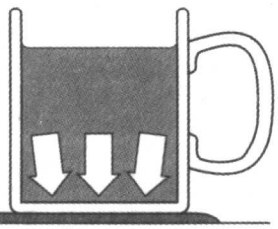
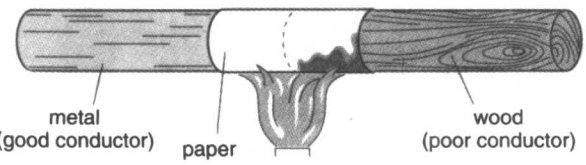


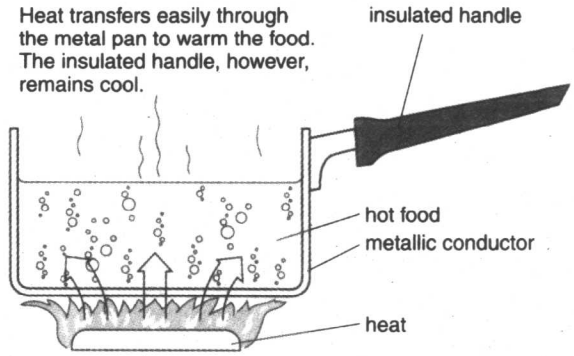
table top insulator

If a piece of paper is wrapped around a bar which is half wood /half metal and heated gently the paper in contact with the wood turns brown. The paper in contact with the metal remains undamaged. This happens because the metallic half of the bar allows heat from the paper to pass through it and escape. The paper does not get too hot and burn. The heat absorbed by the paper in contact with the wood cannot escape as wood is a poor conductor. The paper becomes too hot and burns .



CHOOSING THE RIGHT MATERIAL FOR THE JOB

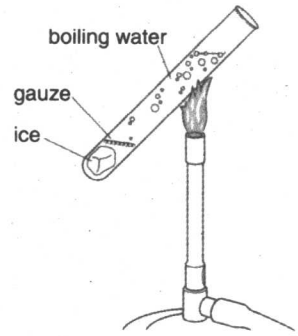
Heat transfers easily through the metal pan to warm the food. The insulated handle, however, remains cool.



Conduction in liquids

Most liquids are poor *conductors* of heat.

Water is such a poor conductor that it is possible to have frozen water and boiling water in the same boiling tube separated by just a few centimetres.



Conduction in gases

Gases are very poor *conductors* of heat. They are in fact excellent insulators and are often used to prevent or reduce the movement of heat by conduction.

Examples of this insulating ability can be seen in the structure of:

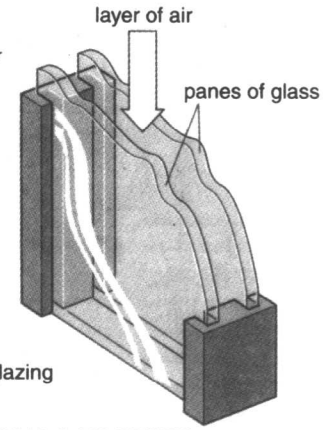
- clothing such as woollen pullovers and string vests

  It is the air trapped within the clothing which reduces the heat loss from our bodies and keeps us warm.

- glass fibre. This is used to insulate lofts or lag water pipes to stop them from freezing in cold weather. It has large quantities of air trapped between its fibres which reduce heat loss.

- double glazing

  Glass is a poor conductor of heat but it is the thin layer of air trapped between the two sheets which makes double glazing a very efficient means of reducing heat loss through windows.



double glazing

CONDUCTION THROUGH A VACUUM

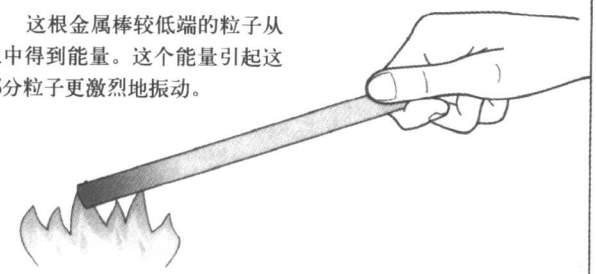
It is not possible for heat to travel by conduction through a vacuum as there are no particles present in a vacuum. For this reason a vacuum can be used stop heat flow by conduction (Thermos flask page B3).

B1 传导

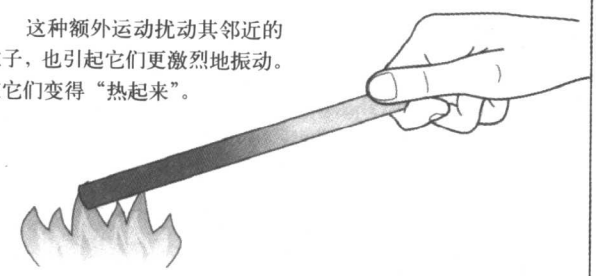
传导

传导是能量通过物体的转移，物体中原子的位置并没有改变。

这根金属棒较低端的粒子从火中得到能量。这个能量引起这部分粒子更激烈地振动。



这种额外运动扰动其邻近的粒子，也引起它们更激烈地振动。使它们变得“热起来”。

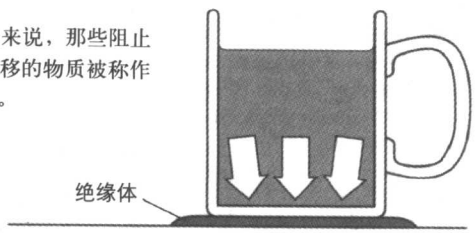


在一个时间周期中，这种额外振动传遍整根棒。能量沿着这根棒传导了。

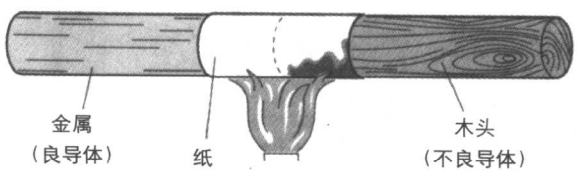
所有金属是热的良**导体**，它们很容易将能量从一处转移到另一处。

非金属，诸如木头、塑料和陶瓷都是热的不良导体，因为它们的粒子几乎没有自由度，是不能够参与传导的。

就传导来说，那些阻止或限制热转移的物质被称作热的**绝缘体**。

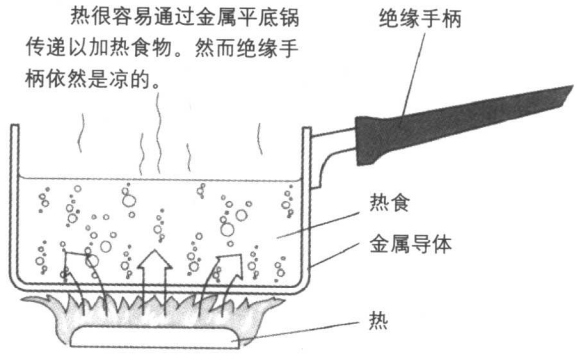


假如用一张纸裹在一半是木头、一半是金属的棒(的连接处)上，然后缓缓加热，与木头相接触部分的纸变成褐色的，而与金属相接触部分的纸依然无损。这种情况的发生缘于半截金属棒允许热通过纸传递给它并散发掉，而纸并没有得到过多的热而燃烧。由于木头是不良导体，与木头相触的纸所吸收的热不能散发掉，纸变得过热而燃烧。



为工作寻找合适材料

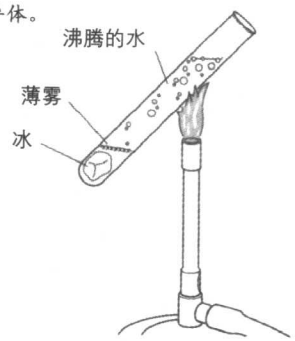
热很容易通过金属平底锅传递以加热食物。然而绝缘手柄依然是凉的。



液体中的传导

绝大多数液体是热的不良导体。

水是这样一种不良导体，也就是说，竟然存在这样的可能性：在同一支加热的试管中，既有部分结冰的水，又有部分沸腾的水，且两者仅距几厘米。

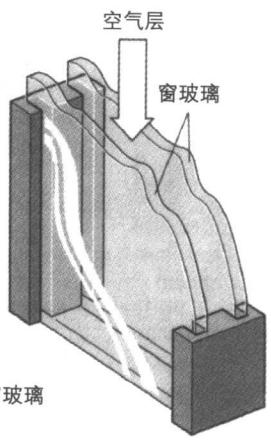


气体中的传导

气体是热的不良导体。事实上，它们是极好的绝缘体，并经常被用于阻止或限制热运动传导。

在下述例子中我们能看到有绝缘能力的结构：

- *羊毛套衫和汗衫等衣服* 由于空气被“捕捉”进衣物中，它能减少我们身体的散热以保暖。
- *玻璃纤维* 用于隔绝楼顶层或包裹水管以防止大冷天被结冰。在玻璃纤维中也“捕捉”了大量空气以减少散热。
- *双层窗玻璃* 玻璃是热的不良导体，可是当薄薄一层空气被“捕捉”在两片玻璃之间就形成双层窗玻璃结构，以有效地减少窗户的散热。



双层窗玻璃

通过真空装置的传导

由于在真空装置中没有粒子，因此热不可能通过真空装置传递。有鉴于此，真空装置能被用于阻止热流传导(热水瓶见 B3)。