Chapter 6. Energy stores and transfers

Contents:

New word list:

1.7 Energy, work and power

1.7.1 Energy

Core	Supplement
1 State that energy may be stored as kinetic, gravitational potential, chemical, elastic (strain), nuclear, electrostatic and internal (thermal)	
2 Describe how energy is transferred between stores during events and processes, including examples of transfer by forces (mechanical work done), electrical currents (electrical work done), heating, and by electromagnetic, sound and other waves	
	4 Recall and use the equation for kinetic energy $E_k = \frac{1}{2}mv^2$
	5 Recall and use the equation for the change in gravitational potential energy $\Delta E_p = mg\Delta h$
3 Know the principle of the conservation of energy and apply this principle to simple examples including the interpretation of simple flow diagrams	6 Know the principle of the conservation of energy and apply this principle to complex examples involving multiple stages, including the interpretation of Sankey diagrams

1.7.3 Energy resources

Core

1 Describe how useful energy may be obtained, or electrical power generated, from:

(a) chemical energy stored in fossil fuels

(b) chemical energy stored in biofuels

(c) water, including the energy stored in waves, in tides, and in water behind hydroelectric dams

(d) geothermal resources

(e) nuclear fuel

(f) light from the Sun to generate electrical power (solar cells)

(g) infrared and other electromagnetic waves from the Sun to heat water (solar panels) and be the source of wind energy

including references to a boiler, turbine and generator where they are used

2 Describe advantages and disadvantages of each method in terms of renewability, availability, reliability, scale and environmental impact

3 Understand, qualitatively, the concept of efficiency of energy transfer

Supplement

4 Know that radiation from the Sun is the main source of energy for all our energy resources except geothermal, nuclear and tidal

5 Know that energy is released by nuclear fusion in the Sun

6 Know that research is being carried out to investigate how energy released by nuclear fusion can be used to produce electrical energy on a large scale

7 Define efficiency as:

(a)

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

(b)

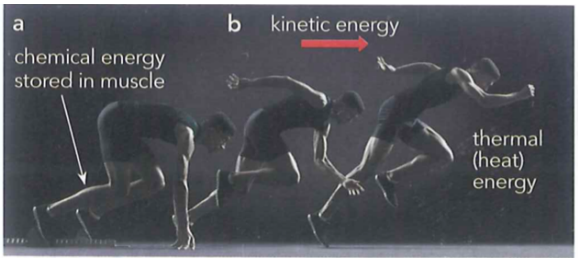
$$(\%)\ \text{efficiency} = \frac{(\text{useful power output})}{(\text{total power input})} \ (\times 100\%)$$

recall and use these equations

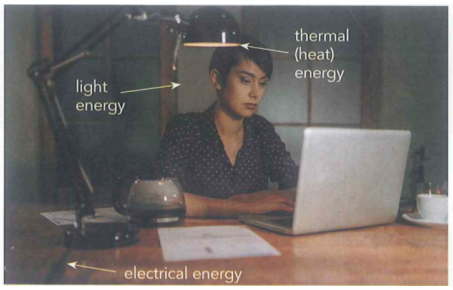
6.1 Energy stores

What do you think is the **energy**? Can you name some types of energy? Think about the **process** of running and the **event** of switching on a light, what kinds of energy are involved in these situations?

Running



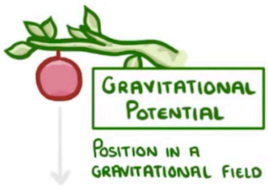
Switching on a light



Difference forms of energy stores

Unit of energy:

a. <u>Gravitational potential energy(g.p.e): energy due to ( )</u>

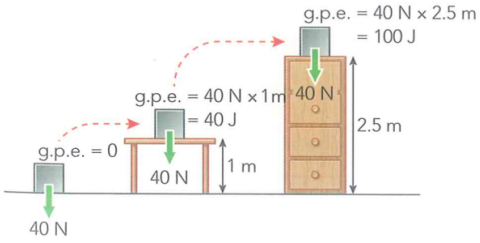


Will you jump higher if you are on the Moon instead of the Earth?

Change in g.p.e:

Depends on:

Note: height:



Exercise 6.1

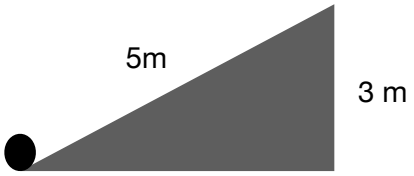
An athlete of mass 50kg runs up a hill. The foot of the hill is 400 meters above the sea-level. The summit is 1200 meters above sea-level. By how much does the athlete's g.p.e. increase?

Exercise 6.2

When a satellite is traveling around the Earth in a circular orbit. How does its g.p.e changes?

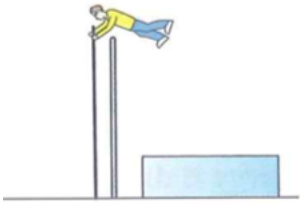
Exercise 6.3

An object of mass 1kg moves along up a ramp shown as below. By how much does its g.p.e. increase?



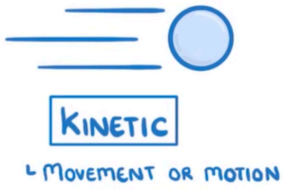
Exercise 6.4

Why does pole-vaulters usually adopt a curved posture to get over the bar?



b. Kinetic energy: energy due to (_____)

Depends on:



Kinetic energy:

Exercise 6.5

A van of mass 2000kg is traveling at 10m/s
A. Calculate its kinetic energy
B. Its speed increases to 20m/s. By how much does its kinetic energy increase?

Exercise 6.6

A ball of 5kg falls from rest for 10 seconds, how much kinetic energy does it gain? (ignore air resistance) How much gravitational potential energy does it lose? What information can you infer from this example?

Exercise 6.7

Planets usually move around stars in elliptical orbit. When it is closer to the star, does it speed increase or decrease? Why?

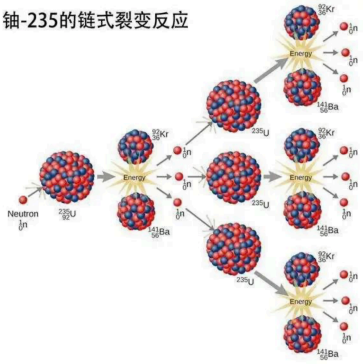
c. Strain energy/elastic energy : energy due to ( )

d. Internal energy

Why does stream have more internal energy than boiling water?

e. Chemical energy

f. Nuclear energy



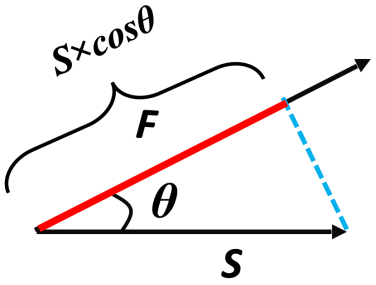
Exercise 6.8

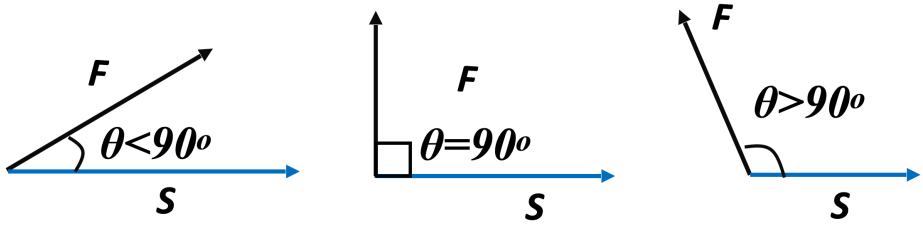
According to the physical clues on the left column, write down which energy store
is changing.

Physical clue	Which energy store is changing?
material changing shape	
object changes speed	
chemical reaction	
change of temperature	
nuclear fission or fusion	
distance between objects changes	

6.2 Energy transfers

a. Doing work (mechanical working)





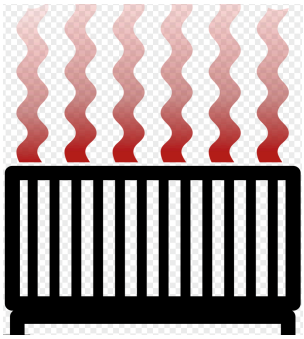
Work done is positive **No work done** **Work done is negative**

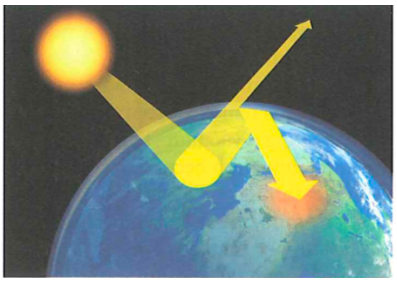
e.g. sound, a way of transferring vibrational kinetic energy

b. Heating (thermal working)

c. Radiation (light)

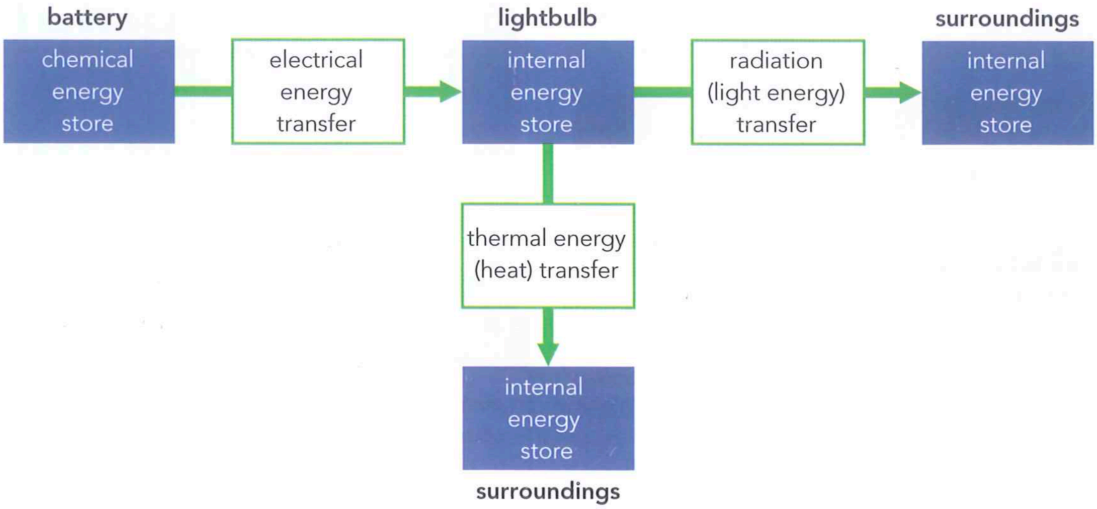
d. Electrical currents(electrical working)



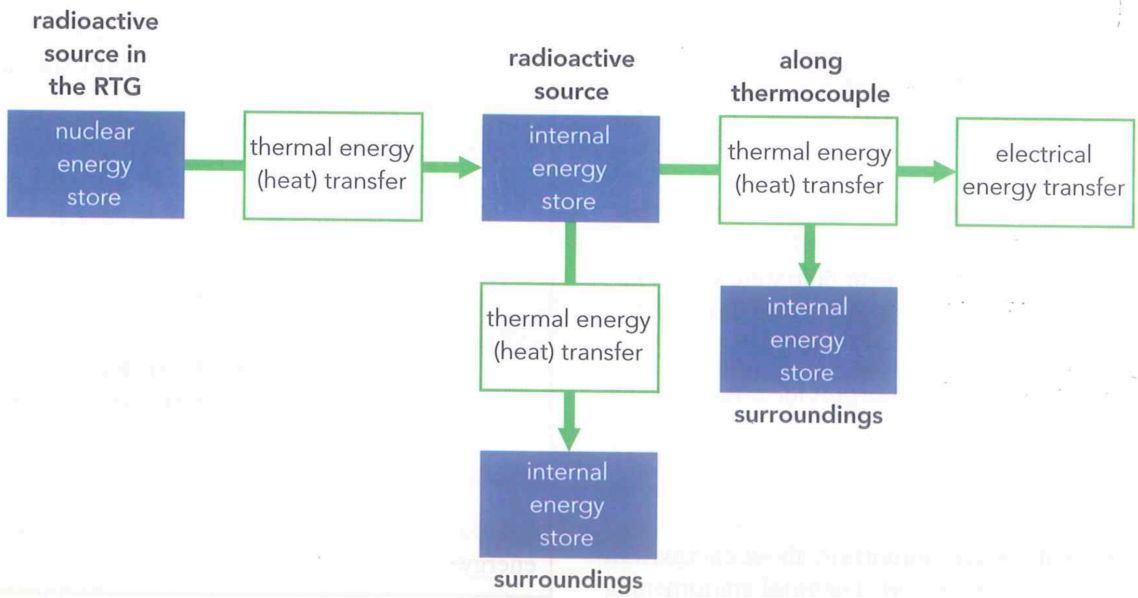


Energy transfer examples:

I. Flashlight

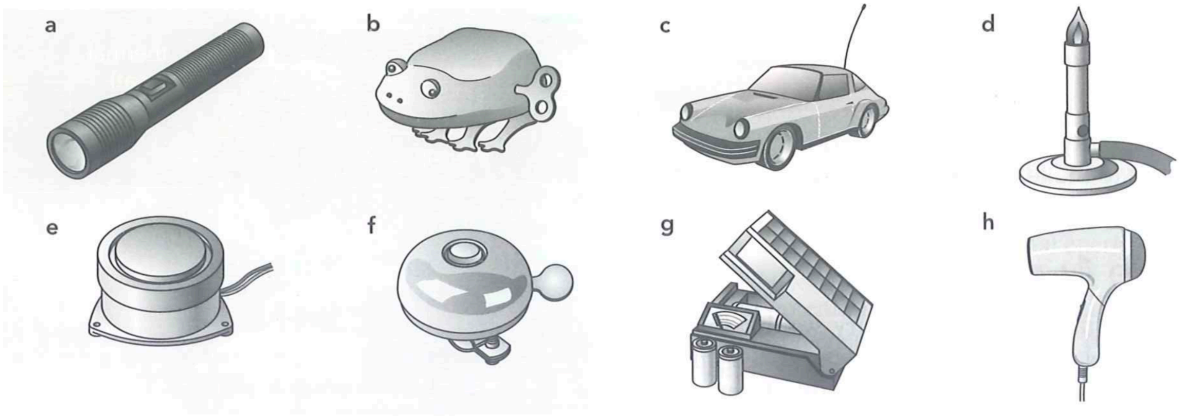


II. RTG (radioisotope thermocouple generator)



Exercise 6.9

Can you explain how energy transfers in the following situations?



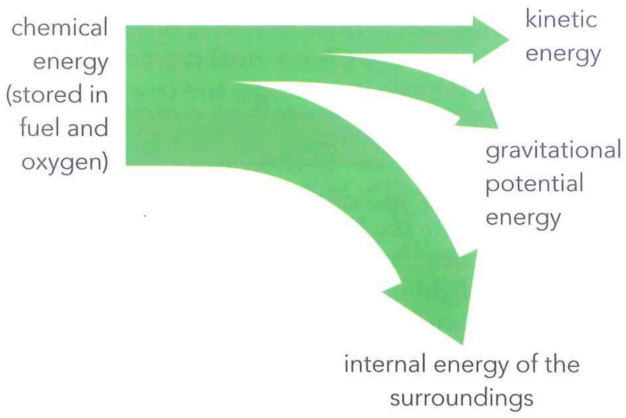
6.3 Energy conservation

Principle of energy conservation:

Exercise 6.10

A car burns 300000J of fuel per second. It has 130000J of kinetic energy and giant 70000J of gravitational potential energy as it goes up a slope. How much energy transfers away from the car through thermal energy transfer?

Sankey diagrams



Exercise 6.11

Draw the Sankey diagram of laughing a rocket.

Energy dissipated:

Energy efficiency

Efficiency =

Percentage efficiency =

Exercise 6.12

When a filament lamp is supplied with 100J of energy, it produces 15J of useful light. What is its efficiency?