# Lesson 2 – Electricity & energy part 2

**(all answers are given in the online video)**

1. **Question 1** – to answer this question, you'd first find the gravitational field strength on Earth from the data sheet at the start of the paper:

   $g = 9.8\text{N kg}^{-1}$ *(use this for question 2 also)*

A baseball player throws a ball of mass 145g vertically upwards and then catches it at the same height it was released.

The ball rises to a height of 9.0m above the point at which it was released, before falling back downwards.

The baseball player has a height of 1.75m.

(a) Calculate the gain in gravitational potential energy of the ball from leaving the player's hand to its maximum height.

A baseball player throws a ball of mass 145g vertically upwards and then catches it at the same height it was released.

The ball rises to a height of 9.0m above the point at which it was released, before falling back downwards.

The baseball player has a height of 1.75m.

(b) Calculate the speed of the ball as it is caught by the baseball player.

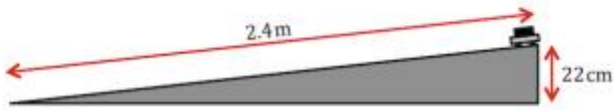
2. **Next question…**

A trolley of mass 510g is moved to the top of a slope of length 2.4 m, one end of which is 22cm higher than the other end. The trolley accelerates down the slope and its speed at the bottom is measured as it passes through a light-gate.

(a) Calculate the gain in gravitational potential energy of the trolley as it is moved to the top of the slope.


The trolley experiences a constant frictional force of 0.15N as it accelerates down the slope.

(b i) Calculate the work done by friction as the trolley accelerates down the slope.



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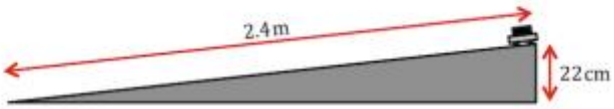
The trolley experiences a constant frictional force of 0.15 N as it accelerates down the slope.

(b ii) Calculate the kinetic energy of the trolley as it passes through the light gate at the bottom of the slope.




3. **Heat –** specific heat capacity of water found in data sheets

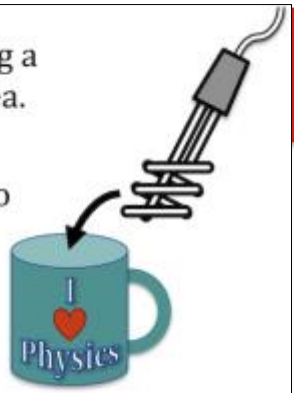
A couple use a 'travel immersion water heater' during a caravan holiday to heat up a mug of water to make tea.

The water in the mug has a mass of 250 g.

The heater has a power rating of 280 W and is used to heat the water from 21 °C to 85 °C.

(a) Calculate the energy required to heat the water to 85 °C.

$c = 4180\ J\ kg^{-1}\ °C^{-1}$

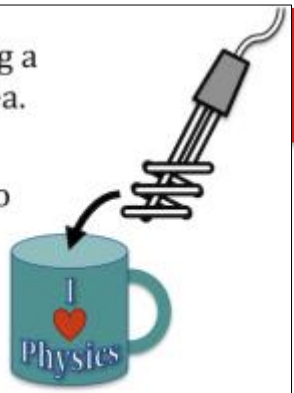



A couple use a 'travel immersion water heater' during a caravan holiday to heat up a mug of water to make tea.

The water in the mug has a mass of 250 g.

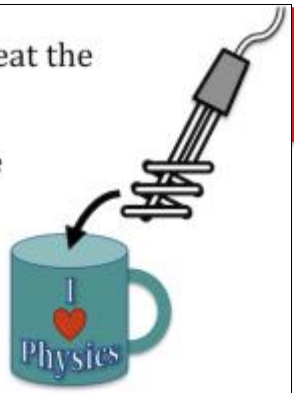
The heater has a power rating of 280 W and is used to heat the water from 21 °C to 85 °C.

(b) Calculate the minimum time required to heat the water to 85 °C.




It was found that the heater required more time to heat the water than calculated.

(c) Explain why the heater would require more time than calculated in part (b) to heat the water.



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4. **Now one on latent heat…** values shown in red for the specific latent heat of fusion and valorisation are for water (from data sheets)

An ice tray is filled with 235g of water then placed in a freezer. It takes 3 minutes to cool the water from 20°C to 0°C, then a further 10 minutes for the water to freeze.

(a) Calculate the energy released when 235g of water at 0°C changes to 235g of ice at 0°C.

Specific latent heat of fusion, $l = 3.34\times10^5$ J kg$^{-1}$

Specific latent heat of vaporisation, $l = 22.6\times10^5$ J kg$^{-1}$

An ice tray is filled with 235g of water then placed in a freezer. It takes 3 minutes to cool the water from 20°C to 0°C, then a further 10 minutes for the water to freeze.

(b) The owner of the freezer calculated that it would take only 7 minutes for the water to freeze rather than 10 minutes. Suggest one reason why it took longer to freeze the water.

5. **Some notes on the gas law equations…**

**The gas laws**

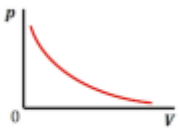
$$\frac{pV}{T} = \text{constant}$$

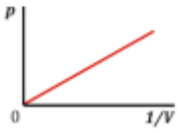
Temperature in kelvin!

0°C = 273 K

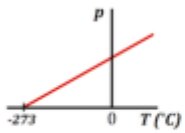
0 K = -273°C

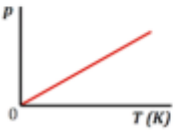
$p_1V_1 = p_2V_2$



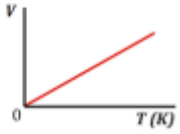




$\frac{p_1}{T_1} = \frac{p_2}{T_2}$




$\frac{V_1}{T_1} = \frac{V_2}{T_2}$


6. **Didn't do –** explained in *'Live – Electricity and energy part 2 revisited').*

The volume of a fixed mass of gas is 3.4m$^3$ at a temperature of 21°C.
The temperature of the gas is now increased to 91°C.
The pressure of the gas remains constant.

Calculate the volume of the gas at 91°C.