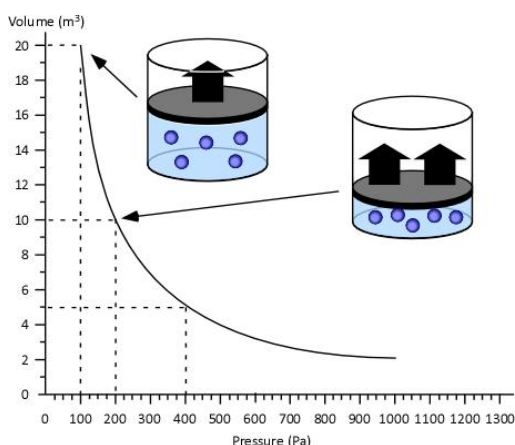
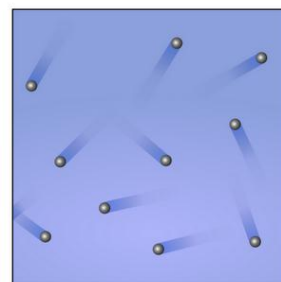


## Thermal Physics review questions

### 1) Molecular models

In both solids and liquids particles can move past each other,

- “Brownian” motion can be observed in both states of matter. Explain what “Brownian” motion is and how it can be observed.
- Why do gases fill a container but liquids don't?
- What happens to the motion of particles as temperature is increased?



### 2) Pressure changes

- In the graph the changing pressure results in a changing volume. Copy and complete this table:

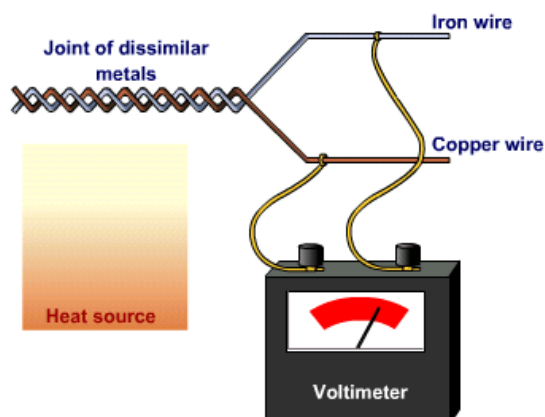
P (Pa)	V (m <sup>3</sup> )	PV (Nm)
100	20	2,000
200	10	
400	5	
800		

- If the gas was squeezed to 1000 Pa what would the volume be?
- If the gas is heated how would this affect the pressure?

### 3) Expansion and contraction

In many countries temperatures vary by up to 50°C from the extremes of winter to the extremes of summer. Steel expands by x% for a 50 degree change temperature. 10 metres of track will expand by 5mm with this temperature change.

- Explain why most materials expand when heated.
- By how much would a continuously welded section of 500m expand for the same temperature change?
- Explain why the buckling shown opposite is caused by this expansion.
- How might this kind of buckling be prevented? (There are a few answers to this – home research?)

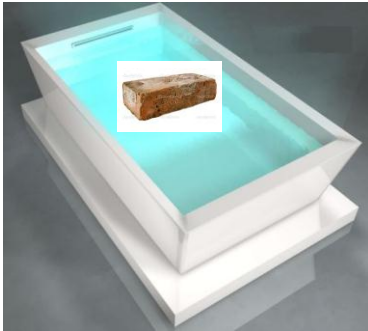


### 4) Measuring temperature

The diagram shows a thermocouple where the voltage recorded changes if the jointed metals temperature changes. Write down possible missing words in these sentences

- A mercury thermometer is quite easy to design because the \_\_\_\_\_ is proportional to \_\_\_\_\_.
- A liquid in glass thermometer reacts quite slowly because glass is an \_\_\_\_\_ so the heat takes time to transfer.
- A thermocouple reacts \_\_\_\_\_ to changes in temperature because the metals are good \_\_\_\_\_ and the voltage change occurs \_\_\_\_\_.

## 5) Thermal (heat) capacity



One ancient method of warming bath water was to place hot bricks from the fire into the bath. A brick has a heat capacity of about  $2.5 \text{ kJ/}^\circ\text{C}$ .

(a) Explain what heat capacity means.

(b) If the brick was at  $180^\circ\text{C}$  and cools to  $30^\circ\text{C}$  in the bath how much thermal energy has it provided?

The specific heat capacity of water is  $4.2 \text{ kJ/kg}^\circ\text{C}$  and the bath has  $50 \text{ kg}$  of water.

(c) Calculate how much energy would be needed to heat up the bath from  $20^\circ\text{C}$  to  $30^\circ\text{C}$  and hence the number of bricks needed to warm the bath.

## 6) In the sauna

a) The latent heat of vaporization of water is  $2260 \text{ kJ/kg}$ . What does this mean?

In the sauna a ladle of water is poured onto hot rocks. The rocks must first heat the water to its boiling point before boiling it.

b) What is the boiling point of water i) in  $^\circ\text{C}$ , ii) in Kelvin.

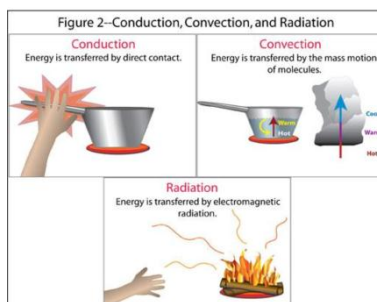
c) Explain, using ideas about particles and bonds, why energy is needed to boil water.

d) If  $0.01 \text{ kg}$  ( $10 \text{ g}$ ) of water is boiled by the rocks how much energy was transferred?

e) If the heat capacity of the rocks was  $50 \text{ kJ/}^\circ\text{C}$  by how much would they cool down.



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## 7) How heat transfer occurs.

a) Explain how conduction, convection and radiation occur. You **must** use the following words in your explanation. vibration, bonds, expand, density, infra-red, electro-magnetic radiation

b) Explain how evaporation occurs and why the liquid left behind can be cooler than its surroundings.

## 8) Insulation

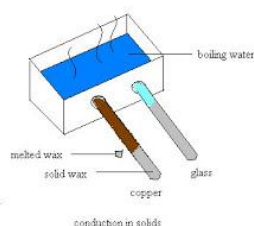
The diagram shows an experiment to test three materials' insulating abilities. The bottles are filled with hot water.

(a) What measurements will be taken?

(b) What control variables need to be kept the same to make the test fair?

(c) Which type of heat transfer will aluminium be the best at reducing?

(d) Which type of heat transfer will Styrofoam be the best at reducing?



## 9) Describe one of the following experiments:

a) Measuring the latent heat of fusion (melting) of ice.

b) Measuring the latent heat of vaporization (boiling) of water

c) Comparing the conduction rates of glass and metal