HEATING AND COOLING SUMMARY

1. Heat, Temperature and Internal Energy
   - what are they?
   - how are they measured?
   - explain total energy in terms of kinetic and potential energy
   - remember substances can have the same temperature but one have more heat energy e.g. steam and boiling water can have same temperature but burns more server from steam (why?)

2. Kinetic Theory and the Gas Laws
   - know the assumptions of the kinetic theory
   - explain solids, liquids and gases in terms of kinetic energy, potential energy and bonds
   - know the gas laws and their effects on temperature, pressure and volume
   - be able to do calculations on the ideal gas law.

3. Energy Conservation and Degradation
   - what is energy conservation and energy degradation?
   - be able to explain high and low energy forms
   - what is efficiency?
   - implications of energy degradation

4. Conduction, Convection and Radiation
   - what are they and how do they occur?
   - effects of different colours and surfaces on radiation
   - effect of surface area

5. Specific Heat Capacity, Latent Heat, and Method of Mixtures.
   - what are they? (not just formulas but understand the physics!!!)
   - simple calculations using formulas
   - typical heating curve for substances (graph), explain what different sections of the graph mean
   - remember heat gained equals heat lost (energy conserved)
   - complex calculations involving phase changes as well as heating within a phase

6. Evaporation
   - what is it
   - how can it cause cooling (Latent heat)

7. Heat and the Human Body
   - list ways body can be heated and cooled
   - explain , in terms of physics, how these changes heat and cool the human body

Written type questions:

1. Explain the difference between heat, temperature and internal energy.
2. It is 4.00 am on a very cold winter morning. You are woken up by your cat climbing on the bed and curling up next to you. You reach out and touch the cat and find that she is very fluffy. Explain, using physics principles, how having a fluffy coat keeps the cat warm.
3. Dogs don't have sweat glands so they pant. In panting, they have a very wet tongue which they expose to the outside air. Explain how this might cool them down.
4. Why is water the best liquid to use in a cooling system such as a radiator of a car?
5. Why do spray cans feel cold after they have been used?
6. Explain why your feet feel much colder when you walk on slate tiles in a house than when you walk on a carpet. The temperature in the house is the same all over.

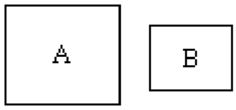
Short answer type questions:

1. A weather balloon has a volume of 50 L at a temperature of 20^0C when it is on the ground (atmospheric pressure is 1.0 atm). When released into the air it rises to where the temperature is -4^0C and the atmospheric pressure is 0.4 atm. What is the new volume of the balloon?
2. A 100 g lump of copper (c = 390 J kg^{-1} K^{-1}) has 6.0 x 10^3 J of energy added to it. If it was initially at 20^0C, what is its final temperature?
3. An emersion heater heats 2.5 L of water which was initially at 15^0C. If it takes 3.5 minutes to bring the water to boiling point (100^0C), at what rate (in joules per second) is the water gaining heat energy?
4. 0.5 kg of water at 20^0C is all boiled away to steam at 100^0C. How much heat energy is required?
5. How much ice at 0^0C must be added to 250 mL coffee in an insulated cup (assume no loss of heat to the container) to cool the coffee from 95^0C to 65^0C (use c = 4.18 x 10^3 J kg^{-1} K^{-1} for coffee)?
6. In a factory, a machine you are using applies a force of 8000 N to push a 30 kg lump of steel (c = 445 J kg^{-1} K^{-1}) 10 m across the factory floor. If the stainless steel was initially at 20^0C, what is its new temperature after you have pushed it across the floor?

Problem Solving type questions:

1. How much heat energy is needed to change 1.0 kg ice at -5^0C to steam at 100^0C?
2. An insulated calorimeter of mass 41 g has 100 mL of water at 15^0C placed in it. 50 g of iron is heated to 160^0C then carefully lowered into the water. What would be the final temperature of the water? (c_{iron} = 477 J kg^{-1} K^{-1}, c_{copper} = 385 J kg^{-1} K^{-1}).
3. A block of an unknown alloy, mass 6 kg, at 25^0C, is placed in an insulated copper calorimeter, mass 10 kg, containing 2 kg of water at 15^0C. If the resulting temperature is 18^0C, what is the specific heat of the unknown alloy?
4. An insulated aluminium calorimeter with a mass of 154 g, contains 90 mL of water at a temperature of 80^0C. 10 g of ice at -20^0C is added to the water and the mixture stirred until the ice has dissolved. What is the final temperature of the water? (specific heat aluminium = 880 $Jkg^{-1}K^{-1}$)

Some Heat Revision Questions:



1. Two blocks, as shown below, are of the same material but one is twice the size of the other. If each is at the same temperature,

   a. which has the greater potential energy?
   b. which has the greater average kinetic energy? Explain:
   c. which has the greater internal energy?

   Block B is now heated until it is twice the temperature of A. The blocks are then brought in contact.
   d. in which direction will the heat flow?
   e. which has the greater average kinetic energy?

2. a. Convert 35^{0}C to Kelvin   b. Convert 123 K to degrees Celsius.

3. Explain why convection can't occur in solids.

4. In what way is radiation different form the other two forms of heat transfer?

5. Humans lose heat by all three forms of heat transfer. Explain how. How does evaporation cool the human body?

6. If you place your hand on a slate tile it will feel cold, however if you place your hand on a carpet rug in the same room, it is not cold. Why does the slate feel cold even though the two materials are at the same temperature?

7. Explain why a steam burn is more server than a hot water burn even if both are at 100^{0}C.

8. A large whether balloon is on the ground (air temperature 25.0^0 C) waiting to be released. It has a volume of 150 L and a pressure of 101.3 kPa. When it reaches a height of 1.5 km, the temperature is –40.0 ^{0} C, and the pressure is 20 kPa. What is the volume of the balloon at this temperature?

9. 750 g of water at 80.0^{0}C is cooled to 10.0^{0}C. How much heat energy is removed?

10. The human body can secrete a maximum of 700 mL of sweat per hour. How much energy will this remove from the body?

11. 0.50 kg of ice at –15.0^{0}C is heated to steam at 105^{0}C. How much heat energy is added to the ice?

12. 0.25 kg of water at 100^{0}C is placed in an insulated glass cup of mass 0.40 kg which is at 20.0^0. What is the specific heat of the glass cup if the final temperature is 80.0^{0}C?

13. 34.0 g of steel at 355^{0}C is placed in a large insulated copper calorimeter (mass 500 g) which contains water at a temperature of 10^{0}C. The final temperature of the water and steel is 15.0^{0}C. What mass of water was in the calorimeter?

14. Ice at -10.0^{0}C is placed in an insulated aluminium container which has a mass of 90.0 g. The container contains 50.0 mL of water and both are at a temperature of 80.0^{0}C. How much ice is needed to bring the temperature down to 50.0^{0}C?

An insulated copper calorimeter (mass 43.0 g) contains 40.0 mL of water at a temperature of 65.0^{0}C. 15.0 g of ice at -15.0^{0}C is added to the water and the mixture stirred until the ice has dissolved. What is the final temperature of the water?