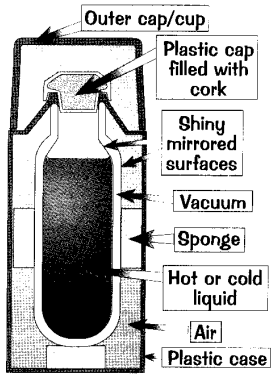
Heat transfer - Keeping things warm

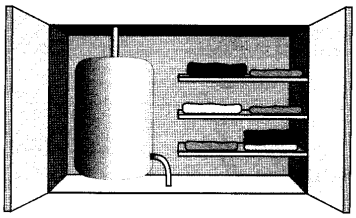
1. The diagram to the right shows a vacuum flask, with features that help to keep it insulated.



For each, state the method of heat transfer that they are reducing

(a) The cap is covered in plastic
(b) The cap is filled with cork
(c) The liquid is contained in a glass bottle
(d) The bottle is double walled
(e) There is a vacuum between the two walls
(f) The inside of each glass layer is silvered
(g) The outside of each glass layer is silvered
(h) The bottle is surrounded by air inside the plastic case
(i) The bottle is supported away from the casing by insulating foam

2. The diagram below shows an uninsulated hot water tank, with a volume of $0.196m^3$ and a surface area of $1.96m^2$.



(a) It is suggested that it can be insulated by wrapping it in shiny foil. Which method of heat transfer would be reduced by this.
(b) Will this be effective on its own?
(c) The density of water is $1000kg/m^3$. What mass of water does the tank contain.
(d) It is found that 4200J of energy is needed to heat up each kg by 1°C. If the initial temperature of the water is 20°C, how much energy is needed to heat a full tank of water to 70°C.
(e) The tank is tested by heating that water to 70°C. One hour later it is found to be at 68°C.
    (i) How much heat energy has been lost (remember, 4200J is lost for each kg, for each °C)
    (ii) What is the heat loss per m^2 of surface
    (iii) What is the rate of heat loss in watts per m^2. (1 watt = 1 joule per second)
(f) An insulating jacket is bought which allows $0.01W/m^2$ per °C through it.
    (i) If the inside of the jacket is 70°C and the outside is 20°C, how much heat energy will be conducted through in one hour.
    (ii) What will be the temperature of the water in the tank after one hour.