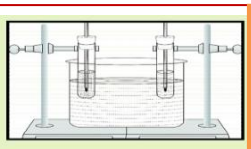
Chapter 1

Heat



M.SRINIVASA RAO,SA(PS)
A.G.K.M.HIGH SCHOOL
GUDIVADA
PH: 9848143855

Textual questions

1. What would be the final temperature of a mixture of 50g of water at 20^0C temperature and 50g of water at 40^0 C temperature? (AS1)

Ans: Given m_1= 50g T_1=20^0C
m_2= 50g T_2=40^0C

Final temperature of mixture, $T = \frac{m1T1+m2T2}{m1+m2} = \frac{50X20+50X40}{50+50} = \frac{1000+2000}{100} = \frac{3000}{100} = 30^0$C

2. Explain why dogs pant during hot summer days using the concept of evaporation? (AS1)

Ans: i) Dogs do no have sweat glands.
ii) When dogs pant, the water molecules on the tongue are evaporates.
iii) Evaporation is the cooling process and temperature fall down.
iv) This evaporation gives feeling of coolness to the dog.

3. Why do we get dew on the surface of a cold soft drink bottle kept in open air? (AS1)

Ans: The temperature of surrounding air is higher than the temperature of the cold soft drink. Air contains water molecules in the form of vapour. When the molecules of water in air, during their motion, strike the surface of cold soft drink bottle which is cool, then the molecules of air lose their kinetic energy which leads to lower the temperature and they get converted into droplets.

4. Write the differences between evaporation and boiling? (AS1)

Ans:

Evaporation	Boiling
1. The process of escaping of molecules from the surface of a liquid at any temperature is called evaporation	1. Boiling is a process in which the liquid phase changes to gaseous phase at a constant temperature at a given pressure.
2. It is surface phenomenon	2. It is bulk phenomenon
3. It takes place at any temperature	3. It takes place at constant temperature
4. It is a cooling process	4. It is not a cooling process
5. It's depends on surface area, temperature, wind speed and humidity	5.It's depends on nature of the substance

5. Does the surrounding air become warm or cool when vapour phase of H_2O condenses? Explain.

Ans:i) The surrounding air becomes warm when vapour phase of H_2O condenses.
ii) Condensation is the process that changes the gas phase to liquid phase.
iii) During the condensation, temperature of the system is increasesd.

6. Answer these. (AS1)

a) How much energy is transferred when 1gm of boiling water at 100^0 C condenses to water at 100^0C?
b) How much energy is transferred when 1gm of boiling water at 100^0C cools to water at 0^0C?
c) How much energy is released or absorbed when 1gm of water at 0^0C freezes to ice at 0^0C?
d) How much energy is released or absorbed when 1gm of steam at 100^0 C turns to ice at 0^0C?

Ans: a) m=1 g L=540 cla/g
Heat energy require to change(Q_1) = mL
=1x540
=540 cal

b) m=1 g s=1 cal/g-^{0}c $\Delta T = T_2 - T_1 = 100-0=100^0$C
Heat energy require to change(Q_2) = msΔT
= 1x1x100

= 100 cal

c) m=1 g L=80 cla/g

Heat energy require to change(Q_3) = mL

=1x80

=80 cal

d) Heat energy require to change(Q)=$Q_1+Q_2+Q_3$

=540+100+80

=720 cal

7. Explain the procedure of finding specific heat of solid experimentally. (AS1)

Ans:

Aim: To find the specific heat of given solid

Material required: calorimeter, thermometer, stirrer, water, steam water, wooden box and lead shots (or) iron bolt

Procedure:

Step-1:

Mass of the calorimeter(m_1)=….

Temperature of the calorimeter(T_1)=..

Let specific heat of calorimeter = S_c

Step-2:

Now fill 1/3rd of the volume of calorimeter with water.

Mass of the calorimeter + water = m_2

Mass of the water= $m_2 - m_1$

Temperature of the water(T_1)=…..

Let specific heat of water= S_w

Step-3:

Take a few lead shots and place them in hot water or steam water.

Temperature of the lead shots(T_2)=..

Let specific heat of lead shots = S_l

Step-4:

Transfer the hot lead shots quickly into the calorimeter.

Mass of the calorimeter + water + lead shots = m_3

Mass of lead shots = m_3-m_2

After some time

Temperature of calorimeter+ water+ lead shots = T_3

According to Principle of method of mixtures

Heat lost by the solid (lead shots) = Heat gain by the calorimeter + Heat gain by the water

$$(m_3- m_2)\, S_l(T_2-T_3) = m_1\, S_c(T_3-T_1)+(m_2-m_1)\, S_w(T_3-T_1)$$

$$S_l = \frac{[m_1S_c+(m_2-m_1)S_w]\,(T_3-T_1)}{(m_3-m_2)(T_2-T_3)}$$

8. Covert 20^0C into Kelvin scale.(AS1)

Ans: C=20^0C K=?

We know that K=C+273

K= 20+273

K=293K

9. Your friend is asked to differentiate between evaporation and boiling. What questions could you ask to make him to know the differences between evaporation and boiling? (AS2)

Ans: a) What is meant by evaporation?

b) What is meant by boiling?

c) At what temperature evaporation takes place?

d) At what temperature boiling takes place?

e) Which one is the Cooling process?

f) Which one is the Warming process?

g) In which process, energy of the system increases?

h) In which process, energy of the system decreases?

(Write any two relevant questions)

10. What happens to the water when wet clothes dry? (AS3)

Ans: Water from the wet clothes evaporates when wet clothes day and mixes with air in the surroundings.

11. Equal amounts of water are kept in a cap and in a dish. Which will evaporate faster?Why? (AS3)

Ans: Water in a dish evaporate faster than cap. Evaporation is depends on the surface area. The surface area of dish is more than the surface area of a cap.

12. Suggest an experiment to prove that the rate of evaporation of a liquid depends on its surface area and vapour already present in surrounding air. (AS3)

Ans:

Aim: The rate of evaporation of liquid depends on its surface area and vapour already present in surrounding air

Apparatus: Two dishes of different surface area and water

Procedure (1): 1) Take two dishes of different surface area
2) Pour equal amounts of water in the both dishes
3) Keep aside for 2 to 3 hours
4) Observe them after sometime. Dish with more surface area has less quantity of water than the dish having less surface area

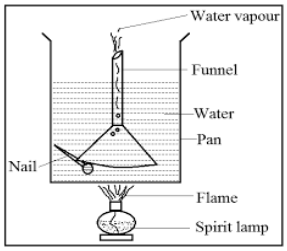
Conclusion: This shows evaporation increases with increasing of surface area

Procedure (2): 1) Take two dishes of equal surface area containing water
2) This experiment should be conducted on more humidity day and less humidity day
3) We may observe that evaporation is less on more humidity day due to more vapour in the air

Conclusion: Hence the rate of evaporation depends upon vapour already present in surrounding air

13. Place a Pyrex glass funnel with its mouth-down in a sauce pan full of water, in such a way that the stem tube of the funnel is above the water or pointing upward into air. Rest the edge of the bottom portion of the funnel on a nail or on a coin so that water can get under it. Place the pan on a stove and heat it till it begins to boil. Where do the bubbles form first? Why? Can you explain how a natural geyser works using this experience. (AS4)

Ans: The bubbles first form at the top of the funnel. Because pressure inside mouth of funnel increases when increasing of heat energy.



Working of Geyser:

i) Geysers are the fountain of hot water coming under the lawyers of the earth.
ii) Water heats up due to high temperatures of the inner layers of the earth.
iii) Pressure is increases at top of the layer
iv) The hot water comes with a narrow hole with high pressure.

14. How do you appreciate the role of the higher specific heat of water in stabilizing atmospheric temperature during winter and summer seasons? (AS6)

Ans: The sun delivers a large amount of energy to the Earth daily. The water sources on Earth, particularly the oceans, absorb this energy for maintaining a relatively constant temperature. The oceans behave like heat “store houses” for the earth. They can absorb large amounts of heat at the equator without appreciable rise in temperature due to high specific heat of water.

15. What role does specific heat play in keeping a watermelon cool for a long time after removing it from a fridge on a hot day? (AS6)

Ans: Water melon brought out from the refrigerator retains its coolness for a longer time than any other fruit because it contains a large percentage of water. Water has greater specific heat.

16. If you are chilly outside the shower stall, why do you feel warm after the bath if you stay in the bathroom? (AS6)

Ans: i)The no.of water vapour molecules per unit volume in the bathroom is greater than the no.of vapour molecules per unit volume outside the bathroom
ii) When we try to dry ourselves with a towel, the vapour molecules surrounding us

condense on our skin

iii) Condensation is a warming process,hence we feel warm

17. Three objects, A at 30^0C, B at 303K and C at 420K are in thermal contact. Then answer the following questions.

(i) Which are in "Thermal equilibrium" among A,B and C.

(ii) From which object to another heat transferred

Ans: 'A' temperature = 30^0C=30+273= 303K

'B' temperature = 303K

'C' temperature = 420K

i) A and B objects are in thermal equilibrium

ii) Heat is transferred from C object to A and B objects

Fill in the blanks

1. The SI unit of specific heat is_____

Ans: J/kg-K

2. _____ flows from a body at higher temperature to a body at lower temperature.

Ans: Heat

3. _____ is a cooling process.

Ans: Evaporation

4. An object 'A' at 10^0C and another object 'B' at 10K are kept in contact, then heat will flow from __ to __

Ans: A,B

5. The latent heat of fusion of ice is _____.

Ans: 80 cal/g

6. Temperature of a body is directly proportional to _____.

Ans: Average kinetic energy of the molecules of the body

7. According to the principle of method of mixtures, the net heat lost by the hot bodies is equal to _____ by the cold bodies.

Ans: net heat gained

8. The sultryness in summer days is due to _____.

Ans: Humidiy

9. _____ is used as a coolant.

Ans: Water

10. Ice floats on water because _____.

Ans: the density of ice is less than that of water

Multiple choice questions

1. Which of the following is a warming process [ ]

a) Evaporation b) condensation c) boiling d) all the above

Ans: b

2. Melting is a process in which solid phase changes to [ ]

a) liquid phase b) liquid phase at constant temperature

c) gaseous phase d) any phase

Ans: b

3. Three bodies A, B and C are in thermal equilibrium. The temperature of B is 45^0 C. then the temperature of C is _____ [ ]

a) 45^0 C b) 50^0 C c) 40^0 C d) any temperature

Ans: a

4. The temperature of a steel rod is 330K. Its temperature in ^{0}C is _____ [ ]

a) 55^0C b) 57^0C c) 59^0C d) 53^0C

Ans: b

5. Specific heat S = [ ]

a) $Q/\Delta T$ b) $Q\Delta T$ c) $Q/m\Delta T$ d) $m\Delta T/Q$

Ans: c

6. Boiling point of water at normal atmospheric pressure is _____ [ ]

a) 0^0 C b) 100^0 C c) 110^0 C d) -5^0 C

Ans: b

7. When ice melts, its temperature [ ]

a) remains constant b) increases c) decreases d) cannot say

Ans: a

Try these

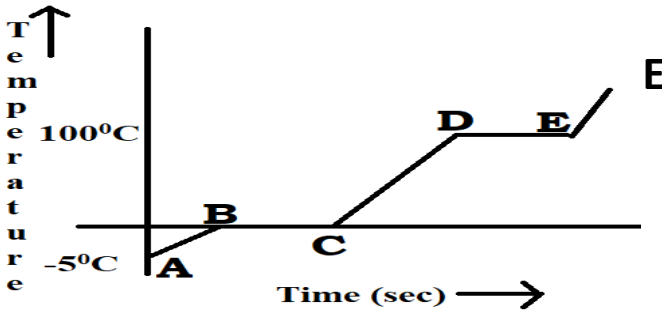
1. Collect information about working of natural geyser and prepare a report. (AS4)

Ans: Working of natural Geyser:

i) Geysers are the fountain of hot water coming under the lawyers of the earth.
ii) Water heats up due to high temperatures of the inner layers of the earth.
iii) Pressure is increases at top of the layer
iv) The hot water comes with a narrow hole with high pressure, like lava from the volcano.

2. Assume that heat is being supplied continuously to 2kg of ice at -5^0C. You know that ice melts at 0^0C and boils at 100^0C. Continue the heating till it starts boiling. Note the temperature every minute. Draw a graph between temperature and time using the values you get. What do you understand from the graph. Write the conclusions. (AS5)

Ans:



Graph represents between temperature and time from ice melting at -5^0C to boils at 100^0C.

From the graph:

i) $\overline{AB}$ indicates that ice warm up from -5^0C to 0^0C (No change in physical state)
ii) $\overline{BC}$ indicates that ice melts into water , ice melts at 0^0C (No rise in temperature)
iii) $\overline{CD}$ indicates that water warm up from 0^0C to100^0C (No change in physical state)
iv) $\overline{DE}$ indicates that water converts into water vapour, water boils at 100^0C (No rise in temperature)

Conclusion:

i) Melting point of ice is 0^0C
ii) Boiling point of water is 100^0C

3. Suppose that 1*l* of water is heated for a certain time to rise and its temperature by 2^0C. If 2*l* of water is heated for the same time, by how much will its temperature rise? (AS6)

Ans: $m_1 = 1\ l$ $\Delta T_1 = 2^0$C

$m_2 = 2\ l$ $\Delta T_2 = ?$

Time duration is same, So $Q_1 = Q_2$

$m_1 s\ \Delta T_1 = m_2 s\ \Delta T_2$

$1x2 = 2x\ \Delta T_2$

$\Delta T_2 = 1$

So the raise in temperature for 2*l* of water = 1^0C

Additional Questions

½ Mark Questions

1. In an experiment regarding melting of ice, What happens to the temperature during the process?
   Ans: Remains constant
2. Convert 20℃ into Kelvin scale
   Ans: 293K
3. Which phenomenon is involved in the formation of fog?
   Ans: Condensation
4. During the winter season water droplets identified on the surface of leaves, grass, etc., What process is responsible for this ?
   Ans: Condensation
5. Which one heat up fast, if the specific heat of earth is more than the specific heat of water in the sea?
   Ans: Water in the sea
6. Alekhya dropped ice cube in water. It float on water. Assume why the ice Cube float on water ?
   Ans: The density of ice is less than of density of water
7. -23^0 C=
   A) 270K B) 250K C) 293K D) NONE
   Ans: B
8. Which device you select to measure the specific heat of a solid in the laboratory?
   Ans: Calorie meter
9. What is the value of latent heat of vaporization of water?
   Ans: 540 cal/g
10. Which phenomenon is the reason behind the formation of dew on the surface of a cold soft drink bottle kept in open air?
    Ans: Condensation
11. What happens to the energy of molecules of liquid during evaporation?
    Ans: Decreases
12. Which of the following is true?
    A)While condensation, the temperature of substance is increases
    B)While freezing,the temperature of substance is increases
    C)At boiling, the temperature of substance remains constant
    D)All the above statements are tue
    Ans: A and C
13. If equal amount of spirit is kept in dish and cap.Which will evaporate faster?
    Ans: Dish
14.

Substance	Copper	Ice	Water	Mercury	Sea water
Specific heat(cal/g-^{0}C)	0.09	0.5	1	0.033	0.95

    Which substance can gain/loss heat energy quickly?
    Ans: Mercury
15. If the temperature of a steel rod is 300K, then its temperature in ^{0}C is
    Ans: 27^0C
16. What is the value of latent heat of fusion of ice ?
    Ans: 80 cal/g-^{0}C
17. Write the formula to find the specific heat of a substance
    Ans: $s = \frac{Q}{m\Delta T}$
18. What is the effect of pressure on melting point of ice
    Ans: If pressure is increases than melting point of ice is decreases
19. What is the C.G.S unit of specific heat?
    Ans: cal/g-^{0}C
20. The heat energy supplied to a substance during melting is known as_____
    Ans: Latent heat of fusion
21. What happens to absolute temperature of a body, when the average kinetic energy of the molecules of the body is doubled

Ans: Doubled

22. Write the relation between C.G.S unit of heat and S.I unit of heat

Ans: 1 cal = 4.186 J

23. If initial temperatures of the two samples of masses m1 and m2 be T1 and T2, then what is the final temperature of the mixture (T) is

Ans: $T = \frac{m1T1+m2T2}{m1+m2}$

1 Mark Questions

1.Why does ice floats on water?

Ans: The density of ice is less than that of water

2.Take two bowls one with hot water and second with cold water. Gently sprinkle food colour on the surface of the water in both bowls and write down your observation?

Ans: We observed that the jiggling of the grains of food colour in hot water is more when compared to the jiggling in cold water (or) We observed that the grains in hot water move more rapidly than the grains in cold water.

3.State the principle of method of mixtures.

Ans: Net heat lost = Net heat gain

4.When two objects are said to be in thermal equilibrium?

Ans: When two objects of different temperatures are placed in thermal contact ,heat energy will be transferred from the Hotter object to the colder object and both objects attains same degree of temperature

5.Distinguish between evaporation and condensation.

Ans:

Evaporation	Condensation
The phase change from liquid to gas at any temperature	The phase change from gas to liquid
Cooling process	Warming process

6. 1 g of ice at 0^0 C and 1 g of water at 40^0 C are mixed. What is resultant temperature ?

Ans: 0^0C

(Explanation: 1g of ice at 0^0C→ 1g of water at 0^0C (Q)=mL=1x80=80 cal
1g of water at 40^0C→ 1g of water at 0^0C (Q)=msΔT=1x1x40=40cal
Heats are not equal, So some ice present in the mixer. Resultant temperature is 0^0C)

7. Define Evaporation

Ans: The process of escaping of molecules from the surface of a liquid at any temperature is called "Evaporation"

8. Define Temperature

Ans: The degree of hotness or coldness of the object is known as temperature

9.What is Humidity? How does humidity forms in the atmosphere?

Ans: The amount of water vapour present in air is called humidity.
Humidity may comes from evaporation of water from the surfaces of rivers, lakes, ponds and from the drying of wet clothes, sweat and so on.

10. Are the volumes of water and ice formed with same amount of water equal?

Ans: No, the volume of ice is greater than volume of water

11. Does the reverse process of evaporation take place? When and how does it take place?

Ans: Yes, Condensation
Heat is taken by the system and condensation takes place

12. What is latent heat of vaporization?

Ans: The heat energy required to change 1 gm of liquid to gas at constant temperature is called Latent heat of Vaporization

13. Pour a few drops of spirit on your palm. Why does your skin becomes colder?

Ans: Due to Evaporation. It is cooling process

14. Why does evaporation always produces cooling?

Ans: The temperature of a system falls during evaporation, So evaporation always produces cooling

15. Why does transfer of heat energy take place between objects (system) ?

Ans: To obtain thermal equilibrium

16. Define Latent heat of Fusion.

Ans: The heat energy required to convert 1 gm of solid completely into liquid at a constant temperature is called Latest heat of fusion

17. While drinking water, Ramesh spilled some water on the floor. After sometime, the water disappeared from the floor. What happened to the water?

Ans: Evaporation takes place

18. The specific heat of Lead, Mercury and water are different. Why it is (the specific heat) the different for different materials?

Ans: Specific heat of a substance depends on its nature.

2 Marks Questions

1.Explains why the temperature of hot water decreases when it is added to cold kerosene?

Ans: i)When two bodies of different temperatures are placed in thermal contact ,heat energy will be transferred from the hotter body to the colder body and both bodies attains same degree of temperature

ii) So heat transferred to hot water to kerosene. The temperature of hot water is decreases and temperature of kerosene is increases

2.Write any two differences between heat and temperature?

Ans:

Heat	Temperature
1.Heat is the energy that flows from a hotter body to a closer body	1.The degree of hotness or coldness of the object is known as temperature
2.It is denoted by 'Q'	2.It is denoted by 'T'
3.S.I unit is Joule	3. S.I unit is Kelvin
4. $Q=ms\Delta T$	4. $K=C+273$

(Write any two differences)

3. How do you appreciate the role of water which is used in coolant in industries?

Ans: Water has high specific heat capacity. So Water is used as a coolent in industries. Water can absorb large amount of heat and machines temperatures are not raise.

4.Temperature of two cities at different times are given as follows

Time/City	At 6 am	At 11.30 am	At 6 pm
A	-3^0C	300K	5^0C
B	271K	27^0C	270K

a) In which city the morning temperature at 6 am relatively high?

b) At what time to both cities are having the equal temperature?

Ans: a) city B

b) At 11.30am

5.Specific heat values of different substances are given under

Substance	Specific heat(J/kg-K)
Lead	130
Brass	380
Copper	399
Iron	483
Aluminium	882

Based on the table answer the questions

i) Same quantity of water is taken in two vessels made with Copper and Aluminium and same quantity of heat is supplied.In which water gain more heat?

ii) What is the CGS unit of specific heat?

Ans: i) Water in Copper vessel

ii) cal/g- ^0C

6. How do you appreciate the specific heat capacity of water playing an important role in our daily life?

Ans: i) Oceans can absorb large amounts of heat at the equator without appreciable rise in temperature, maintaining a relatively constant temperature and stabilizing atmosphere temperature during winter and summer seasons.

ii) Water is used as coolent in automobile engines.

7. Your friend is asked to differentiate between Dew and Fog. What questions could you ask

to make him to know the differentiate between Dew and Fog?

Ans: a) What is Dew and What is Fog?
b) Which phenomenon is first occurred?
c) Thick mist is called as?

8. During winters, we will observe droplets of water in the cricket field, leaves and grass. How are these droplets formed?

Ans: During winter nights,the atmospheric temperature goes down.The air near them becomes saturated with vapour and condensation begins. The water droplets condensed on cricket field, leaves and grass.

4 Marks Questions

1. What are the applications of specific heat ?(AS6)

Ans: Applications of Specific heat capacity

1. The sun delivers a large amount of energy to the Earth daily. The water sources on Earth, particularly the oceans, absorb this energy for maintaining a relatively constant temperature. The oceans behave like heat "store houses" for the earth. They can absorb large amounts of heat at the equator without appreciable rise in temperature due to high specific heat of water.
2. Water melon brought out from the refrigerator retains its coolness for a longer time than any other fruit because it contains a large percentage of water.Water has greater specific heat
3. A samosa appears to be cool outside but it is hot when we eat it because the curry inside the samosa contains ingredients with higher specific heats.

2. How do you prove average kinetic energy of molecules is directly proportional to the absolute temperature? (AS3)

Ans: i) Take two bowls one with hot water and second with cold water. Gently sprinkle food colour on the surface of the water in both bowls.
ii) Observe the motion of the small grains of food colour.
iii) You will notice that the grains of food colour jiggle (move randomly).
iv) We observe that the jiggling of the grains of food colour in hot water is more when compared to the jiggling in cold water.
v) Thus we conclude that the average kinetic energy of molecules /particles of a hotter body is greater than that of a colder body.
vi) The average kinetic energy of the molecules is directly proportional to the absolute temperature

3.Derive $Q=ms\Delta T$ (AS1)

Ans: For same change in temperature the amount of heat (Q) absorbed by a substance is directly proportional to its mass (m)

$Q \alpha m$ ------> 1 (when ΔT is constant)

For the same mass (m) of water the change in temperature is proportional to amount of heat (Q) absorbed by it.

$Q \alpha \Delta T$------> 2 (when 'm' is constant)

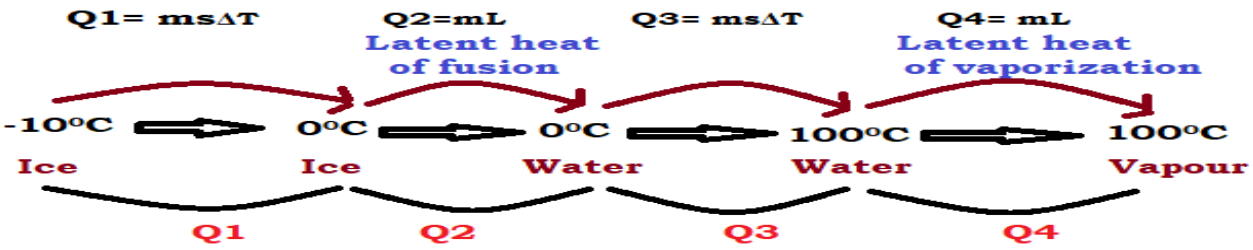
From equation (1) and (2), we get

$Q \alpha m\Delta T$

$Q = mS\Delta T$

4. Calculate the required heat energy to change 12grams of ice at -10^0C into water vapour at 100^0C

Ans:



i) Required heat energy to convert ice at -10^0C to ice at 0^0C (Q_1)= $ms\Delta T$

=12x0.5x(0+10)

=60 cal

ii) Required heat energy to convert ice at 0^0C to water at 0^0C (Q_2)= mL

=12x80

=960 cal

iii) Required heat energy to convert water at 0^0C to water at 100^0C (Q_3)= msΔT

=12x1x(100+0)

=1200 cal

iv) Required heat energy to convert water at100^0C to vapour at 100^0C (Q_4)= mL

=12x540

=6480 cal

Required heat energy to convert ice at -10^0C to vapour at 100^0C (Q)=Q_1+ Q_2+ Q_3+ Q_4

=60+960+1200+6480

=8700 cal

5. Observe the table and answer the following questions (AS4)

Substance	Specific heat	
	In cal/g-°C	In J/kg-K
Lead	0.031	130
Mercury	0.033	139
Brass	0.092	380
Zinc	0.093	391
Copper	0.095	399
Iron	0.115	483
Glass(flint)	0.12	504
Aluminum	0.21	882
Kerosene oil	0.50	2100
Ice	0.50	2100
Water	1	4180
Sea water	0.95	3900

a) What is the SI unit of Specific heat?

Ans: J/kg-K

b) Which metal is best for cooking utensils? Why?

Ans: Copper, lowest specific heat value

c) Which metal is slowly heated up among all given substance?

Ans: Aluminum

d) How much heat energy is required to rise 1^0 C of water of 1 gram?

Ans: 1 cal

e) Which metal is used to soldering the wires? Why?

Ans: Lead. Least specific heat value

f) Why different substances have different specific heats?

Ans: Specific heat is depends on the nature of the substance

g) Write the formula of specific heat of the substance?

Ans: $S = \frac{Q}{m\Delta T}$

h) Convert 1 cal/g- ^{0}C into J/kg-J

Ans: 1 cal/g- ^{0}C = 4.186×10^{-3} J/kg-J

i) Which liquid used as coolant? Why?

Ans: Water. It has highest specific heat value