Energy transferred = mass x specific heat capacity x change in temperature $\Delta E = m \times c \times \Delta\theta$

Energy transferred = mass x specific latent heat $\Delta E = m \times L$

Calculating energy transferred when temperature rises

1. How much energy is required to increase the temperature of 1 kg of water (SHC = 4200 J/Kg ^{0}C) by 30^{0}C? **(126,000).**
2. How much energy is required to increase the temperature of 300g of water (SHC = 4200 J/Kg ^{0}C) by 30^{0}C? **(37,800).**
3. How much energy is required to increase the temperature of 1 kg of water (SHC = 4200 J/Kg ^{0}C) by 100^{0}C? **(420,000).**
4. Calculate the energy required to raise the temperature of a 5kg iron block at 20^{0}C to its melting point of 1535^{0}C. The specific heat capacity of iron is 450 J/kg.

Calculating the specific heat capacity of a substance

4. 5,000 J of energy is transferred to 1 kg of an unknown liquid. The temperature of the liquid rises by 5^{0}C. Calculate the specific heat capacity of the liquid **(1000).**

Calculating the mass of a substance

5. 50 Watts of energy is transferred to a liquid with a specific heat capacity of 780 J/Kg ^{0}C for 5 minutes. The temperature of the liquid increases by 4^{0}C. What is the mass of the liquid? **(4.81).**
(Hint: for this question, you need to convert Watts (J/s) into total energy transferred)

Calculating the temperature of a substance

6. The initial temperature of a glass of water (SHC = 4200 J/Kg ^{0}C) is 35^{0}C. It has a mass of 250g. 5000 J of energy is transferred into the water. What will its new temperature be? **(39.8).**

Calculate the energy transferred to change state

8. Calculate the energy required to melt a 5kg block of iron. The specific latent heat of fusion for iron is 272000 J/kg.

Calculate total energy transferred using specific heat capacity AND specific latent heat

9. Calculate the energy to raise the temperature of a 5kg solid block of iron at 20^{0}C to 5kg of liquid iron at 1535^{0}C. The specific latent heat of fusion for iron is 272000 J/kg. The specific heat capacity of iron is 450 J/kg.

Annotated answers

Calculating energy transferred when temperature rises

1. How much energy is required to increase the temperature of 1 kg of water (SHC = 4200 J/Kg ^{0}C) by 30^{0}C?

As there is a change in temperature we use this equation: $\Delta E = m \times c \times \Delta\theta$
Substitute the values from the question into the equation: $\Delta E = 1 \times 4200 \times 30$
Calculate: ΔE = 126 000 J (do not forget the units)

2. How much energy is required to increase the temperature of 300g of water (SHC = 4200 J/Kg ^{0}C) by 30^{0}C?

As there is a change in temperature we use this equation: $\Delta E = m \times c \times \Delta\theta$
First convert the mass in g to mass in kg. 300/1000 = 0.3kg
Substitute the values from the question into the equation: $\Delta E = 0.3 \times 4200 \times 30$
Calculate: ΔE = 37 000 J (do not forget the units)

3. How much energy is required to increase the temperature of 1 kg of water (SHC = 4200 J/Kg ^{0}C) by 100^{0}C?

As there is a change in temperature we use this equation: $\Delta E = m \times c \times \Delta\theta$
Substitute the values from the question into the equation: $\Delta E = 1 \times 4200 \times 100$
Calculate: ΔE = 420 000 J (do not forget the units)

4. Calculate the energy required to raise the temperature of a 5kg iron block at 20^{0}C to its melting point of 1535^{0}C. The specific heat capacity of iron is 450 J/kg.

First calculate the change in temperature.
Change in temperature = final temperature – initial temperature = 1535 – 20 = 1515
As there is a change in temperature we use this equation: $\Delta E = m \times c \times \Delta\theta$
Substitute the values from the question into the equation: $\Delta E = 5 \times 450 \times 1515$
Calculate: ΔE = 3 408 750 J (do not forget the units)

Calculating the specific heat capacity of a substance

4. 5,000 J of energy is transferred to 1 kg of an unknown liquid. The temperature of the liquid rises by 5^{0}C. Calculate the specific heat capacity of the liquid.

As there is a change in temperature we use this equation: $\Delta E = m \times c \times \Delta\theta$
Substitute the values from the question into the equation: 5000 J = 1 x c x 5
Simplify the right side of equation by multiplying numbers together: 5000 = 5c
Divide the number on the left by the number on the right to calculate c
c= 5000 / 5 = 100 J / Kg ^{O}C (do not forget the units)

Calculating the mass of a substance

5. 50 Watts of energy is transferred to a liquid with a specific heat capacity of 780J/Kg ^{0}C for 5 minutes. The temperature of the liquid increases by 4^{0}C. What is the mass of the liquid? **(4.81).**
(Hint: for this question, you need to convert Watts (J/s) into total energy transferred)

First, we need to calculate the amount of energy transferred
Use the equation E = P x t
First convert minutes into seconds 5 minutes = 5 x 60 = 300 seconds
E = 50 x 300
E = 15 000J
As there is a change in temperature we use this equation: **Δ**E = m x c x **Δθ**
Substitute the values from the question into the equation: 15 000 = m x 780 x 4
Simplify the right side of equation by multiplying numbers together: 15 000 = 3120m
Divide the number on the left by the number on the right to calculate m
m= 15 000 / 3120 = 4.81 Kg (do not forget the units)

Calculating the temperature of a substance

6. The initial temperature of a glass of water (SHC = 4200J/Kg ^{0}C) is 35^{0}C. It has a mass of 250g. 5000J of energy is transferred into the water. What will its new temperature be?
With this question, we will need to calculate the change in temperature first. Then we can add that to the initial temperature to calculate the final temperature.
First convert the mass in g to mass in kg. 250/1000 = 0.250kg
As there is a change in temperature we use this equation: **Δ**E = m x c x **Δθ**
Substitute the values from the question into the equation: 5000 = 0.25 x 4200 x **Δθ**
Simplify the right side of equation by multiplying numbers together: 5000 = 1050 **Δθ**
Divide the number on the left by the number on the right to calculate m
m= 5000 / 1050 = 4.8^{0}C (do not forget the units)
We now add the change in temperature to the initial temperature to find the final temperature
4.8^{0}C + 35^{0}C = 39.8^{0}C

Calculate the energy transferred to change state

8. Calculate the energy required to melt a 5kg block of iron. The specific latent heat of fusion for iron is 272000J/kg.
As there is a change in state we use this equation **Δ**E = m x L
Substitute the values from the question into the equation: **Δ**E = 5 x 272 000
ΔE = 1 360 000J

Calculate total energy transferred using specific heat capacity AND specific latent heat

9. Calculate the energy to raise the temperature of a 5kg solid block of iron at 20^{0}C to 5kg of liquid iron at 1535^{0}C. The specific latent heat of fusion for iron is 272000J/kg. The specific heat capacity of iron is 450J/kg.
For this question, we need to split it into two sections. First, we use this formula, **Δ**E = m x c x **Δθ**, to calculate the energy required to raise the temperature of iron from 20^{0}C to 1535^{0}C. We then need to use the formula **Δ**E = m x L, to calculate the energy required to change the state of iron (solid to liquid).

For the change in temperature we use this equation: **Δ**E = m x c x **Δθ**

First calculate the change in temperature.
Change in temperature = final temperature – initial temperature = 1535 – 20 = 1515
Substitute the values from the question into the equation: $\Delta E = 5 \times 450 \times 1515$
$\Delta E = 3\ 408\ 750 J$

For the change in state we use this equation $\Delta E = m \times L$
Substitute the values from the question into the equation: $\Delta E = 5 \times 272\ 000$
$\Delta E = 1\ 360\ 000 J$

To calculate the total amount of energy used we add to two figures together
Total energy transferred = 3 408 750J + 1 360 000J = 4 768 750J