

Doggo Cheatsheet - HEAT CAPACITY and SPECIFIC HEAT CAPACITY

Basic Definition

HEAT CAPACITY	The amount of heat energy required to raise the temperature of an object or substance by 1 degree Celsius
SPECIFIC HEAT CAPACITY	The amount of heat energy required to raise the temperature of 1 kilogram of a substance by 1 degree Celsius

SPECIFIC HEAT CAPACITY
= HEAT CAPACITY of 1kg of a substance

Formula for HEAT CAPACITY and SPECIFIC HEAT CAPACITY

$$Q = mc\Delta T = C\Delta T \text{ and } C = mc$$

	unit
Q = Heat energy	Joule (J)
C = HEAT CAPACITY	Joule per degree Celsius ($J^{\circ}C^{-1}$)
m = Mass	Kilogram (kg)
c = SPECIFIC HEAT CAPACITY	Joule per degree Celsius per kilogram ($J^{\circ}C^{-1} kg^{-1}$)
ΔT = Temperature Change	$^{\circ}C$

Formula for Power

	unit
Q = Pt	
P = Power	Joule per second (J s ⁻¹) or Watt (W)
t = Time	second (s)

* 1 kW = 1000W
* 1kWh = 1000 x 60 x 60 = 3600000J

Exam Topic #1 - Water as Heat Buffer

- ✓ High SPECIFIC HEAT CAPACITY of 4200J $^{\circ}C^{-1} kg^{-1}$
- ✓ Absorbs or releases large amounts of heat with minimal temperature change
- ✓ Regulate body temperature and creates a stable internal environment for cellular processes
- ✓ Widely used in engineering systems to store excess thermal energy

Why Water?

- ✓ Relatively abundant and available
- ✓ Less expensive

Exam Topic #3 - Mixing liquids with different temperatures

- ✓ CONSERVATION OF ENERGY → the heat energy gained by the cold objects (and surrounding) should equal to the energy lost by the hot objects
- ✓ For two-object case, ignoring heat loss to the surrounding, $m_1c_1(T_{final} - T_1) = m_2c_2(T_2 - T_{final})$

Example #3.1

Doggy is mixing 1.1kg of liquid 1 and 1.7kg of liquid 2 together. The SPECIFIC HEAT CAPACITY of liquid 1 is 4100J $^{\circ}C^{-1} kg^{-1}$. The SPECIFIC HEAT CAPACITY of liquid 2 is 4200J $^{\circ}C^{-1} kg^{-1}$. The initial temperature of liquid 1 is 17 $^{\circ}C$. The initial temperature of liquid 2 is 70 $^{\circ}C$. What is the final temperature of the mixture?

We want to find the final temperature of the mixture: T_{final} . From the question, we know that

Mass of liquid 1: $m_1 = 1.1$

Mass of liquid 2: $m_2 = 1.7$

SPECIFIC HEAT CAPACITY of liquid 1: $c_1 = 4100$

SPECIFIC HEAT CAPACITY of liquid 2: $c_2 = 4200$

Initial temperature of liquid 1: $T_1 = 17$

Initial temperature of liquid 2: $T_2 = 70$

Plugging in numbers into $m_1c_1(T_{final} - T_1) = m_2c_2(T_2 - T_{final})$

$1.1 \times 4100 \times (T_{final} - 17) = 1.7 \times 4200 \times (70 - T_{final})$

Solving the equation, $T_{final} = 49.48$ (round to 2 d.p.)

Therefore, the final temperature of the mixture is 49.48 $^{\circ}C$

Conservation of Energy

Energy cannot be created or destroyed but only transformed from one form to another

Doggo Quiz



Calculation Quiz: mixing two liquids with different temperatures

Exam Topic #2 - Calculation using the formula $Pt = Q = mc\Delta T = C\Delta T$

- ✓ Get as much information from the questions as possible (you should usually find all but one variables)
- ✓ Plug in the numbers, find the remaining variable

Example #2.1

Doggy is boiling 1.9kg of water using an 800W boiler. Assume no energy loss and no change of state. Use 4200J $^{\circ}C^{-1} kg^{-1}$ as SPECIFIC HEAT CAPACITY of water. How much energy does it take to increase temperature by 47 $^{\circ}C$. How long will it take?

We want to energy (Q) and how long will it take, i.e., time (t)

From the question, we know that:

Mass $m = 1.9kg$

SPECIFIC HEAT CAPACITY $c = 4200J^{\circ}C^{-1} kg^{-1}$

Temperature change $\Delta T = 47^{\circ}C$

We can find Q using $Q = mc\Delta T$

$Q = 1.9 \times 4200 \times 47 = 375,060$

Therefore, heat energy gained is 375,060J

From the question, we also know that:

$P = 800W$

We can find t by plugging in numbers to the formula $Q = Pt$

$375,060 = 800 \times t$

$t = 468.83s$ (round to 2 d.p.)

Therefore, time need is 468.83s

Example 2.2

Doggy has certain amount of substance X with a SPECIFIC HEAT CAPACITY of 3700J $^{\circ}C^{-1} kg^{-1}$. If it gains 3100J of heat energy, its temperature is increased by 40 $^{\circ}C$ without a change of state. What is its mass?

We want to find mass (m) of substance X

From the question, we know that:

Heat Energy $Q = 3100J$

SPECIFIC HEAT CAPACITY $c = 3700J^{\circ}C^{-1} kg^{-1}$

Temperature change $\Delta T = 40^{\circ}C$

We can find m by plugging in numbers into $Q = mc\Delta T$

$3100 = m \times 3700 \times 40$

$m = 0.02$ (round to 2 d.p.)

Therefore, substance X has a mass of 0.02kg

Doggo Quiz



Calculation Quiz: HEAT CAPACITY and SPECIFIC HEAT CAPACITY

