HPS Specific Heat & Latent Heat Calcs 2019 Name Key Per ____

Substance	Specific Heat	Substance	Specific Heat
H_2O (s)	2.06 J/g °C	Aluminum (s)	0.900 J/g °C
H_2O (g)	2.02 J/g °C	Benzene (l)	1.74 J/g °C
H_2O (l)	4.18 J/g °C	Ethanol (l)	2.42 J/g °C

Substance	Latent Heat of Fusion	Latent Heat of Vaporization	Boiling Point (K)	Melting Point (K)
H_2O	334 J/g	2260 J/g	373.2	273.2
Benzene	136 J/g	394 J/g	353.2	278.6
Ethanol	99.8 J/g	944 J/g	351.5	158.7
Acetone	98.5 J/g	501 J/g	329.4	179.0

SPECIFIC HEAT

Specific heat is defined as the amount of heat energy needed to raise 1 gram of a substance by 1*C. *Be sure your units for specific heat match the units in the problem.*

The equation is $\mathbf{Q = mC(T_f - T_i)}$ where

Q is the heat energy (joules), *m* is the mass of the sample (grams or kilograms*), *C* is the specific heat of the substance (J/g*C), and $T_f - T_i$ is the change in temperature (*C)

The higher the specific heat, the more energy is required to cause a change in temperature.

**This equation is used when the state of matter does not change.*

$Q = mC\Delta T$

1. How much heat energy is required to raise the temperature of a 1.0 kilogram of steel by 10.0 degrees Celsius? (Specific Heat of steel = 470 J/kg*C)

$Q = (1.0\ kg)(470\ J/kg^\cdot C)(10.0^\cdot C)$

$\boxed{Q = 4700\ J}$

2. What is the mass of a concrete block of concrete that gains 52,800 joules of energy when its temperature is increased by 5.0 *Celsius? (Specific Heat of concrete = 880 J/kg*C)

$52{,}800\ J = (m)(880\ J/kg^\cdot C)(5.0^\cdot C)$

$\boxed{m = 12\ kg}$

3. What is the change in temperature for a 2.0×10^3 gram mass of water that loses 8,500 joules of energy? (Specific Heat of water = 4.18 J/g*C)

$-8{,}500\ J = (2.0 \times 10^3\ g)(4.18\ J/g^\cdot C)(\Delta T)$

$\boxed{\Delta T = -1.0^\circ C}$

LATENT HEAT

Latent heat is defined as the "hidden" heat when a substance absorbs or releases heat without producing a change in the temperature of the substance (ex: during a phase change). *Be sure your units for specific heat match the units in the problem.*

The equation for Latent Heat of Fusion is **$Q = mL_f$** where

Q is the heat energy (joules), *m* is the mass of the sample (grams or kilograms*), L_f is the latent heat of fusion for the substance (J/g)

**This equation is used when the sample is changing from a solid to a liquid.*

The equation for Latent Heat of Vaporization is **$Q = mL_v$** where

Q is the heat energy (joules), *m* is the mass of the sample (grams or kilograms*), L_v is the latent heat of vaporization for the substance (J/g)

**This equation is used when the sample is changing from a liquid to a gas.*

L_f

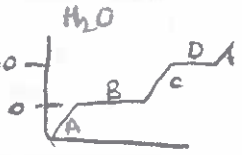
1. How much heat is required to melt 25.0 g of ice at 0°C? $Q = mL_f = (25.0g)(344\ J/g)$ $= 8350\ J$

L_v

2. How much heat is required to boil away 25.0 g of Ethanol at 351.5 K? $Q = mL_v = (25.0g)(944\ J/g)$ $= 23{,}600\ J$

SPECIFIC HEAT AND LATENT HEAT COMBINED

3. You have a sample of H_2O with a mass of 23.0 g at a temperature of –46.0 °C. How many kilojoules (kJ) of heat energy are necessary to:



$Q = mC\Delta T$ A) heat the ice to 0°C? $Q = (23.0g)(2.06\ J/g\cdot C)(46.0^\circ C) = 2179\ J \rightarrow 2.18\ kJ$

$Q = mL_f$ B) melt the ice? $Q = (23.0g)(334\ J/g) = 7682\ J \rightarrow 7.68\ kJ$

$Q = mC\Delta T$ C) heat the water from 0°C to 100°C? $Q = (23.0g)(4.18\ J/g\cdot C)(100^\circ - 0^\circ) = 9614\ J \rightarrow 9.61\ kJ$

$Q = mL_v$ D) boil the water? $Q = (23.0g)(2260\ J/g) = 51980\ J \rightarrow 52.0\ kJ$

$Q = mC\Delta T$ E) heat the steam from 100°C to 109°C? $Q = (23.0g)(2.02\ J/g\cdot C)(109 - 100) = 418\ J \rightarrow .418\ kJ$

$71873 \rightarrow 71.9\ kJ$

4. How much heat is required to change 25.0 g of liquid Ethanol that is at a temperature of 158.7 K to a gas at 351.5 K?

192.8

Liq. $Q = mC\Delta T = (25.0g)(2.42\ J/g\cdot C)(351.5 - 158.7\ K) = 11{,}664\ J$

L→G $Q = mL_v = (25.0g)(944\ J/g) = 23{,}600\ J$ +

$35{,}264 \rightarrow 35{,}300\ J$