Warm Up

What quantity of energy is required to change 9.53 g of ice at 0.00°C to water on an automobile windshield?

$\Delta H_{fus} = ?$

$m = 9.53\,g$

$\Delta H_{fus} = n\Delta H_{fus}$

$\Delta H_{fus} = \left(\frac{9.53\,g}{18.02\,g/mol}\right)\left(6.03\,\frac{kJ}{mol}\right)$

$\Delta H_{fus} = 3.19\,kJ$

Homework - Worksheet

Heat (q)

- change in kinetic energy
- measures transfer of energy when there are temperature changes (heating or cooling)

Enthalpy (H)

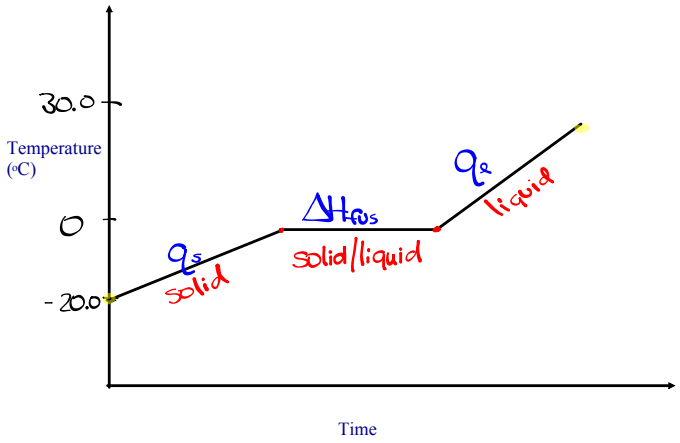
- measures potential energy
- change in energy transfer when system is at constant pressure and same initial and final temperatures

What we've looked at so far...

- Energy changes when the temperature changes (heating water from 20 °C to 50°C) q
- Energy changes when the temperature remains the same. (melting of ice at 0°C) ΔH

What if you heat 10. g of ice at -20. °C until it is water at 30.°C?

Heating Curve of Water



$q_s = mC\Delta T$

$q_s = (10.0\,g)(2.01\,\frac{J}{g\cdot°C})(20.0°C)$

$q_s = 402\,J$

$\Delta H_{fus} = nH_{fus}$

$\Delta H_{fus} = \left(\frac{10.0\,g}{18.02\,g/mol}\right)\left(6.031\,\frac{kJ}{mol}\right)$

$\Delta H_{fus} = 3.346\,kJ$

$q_\ell = mC\Delta T$

$q_\ell = (10.0\,g)(4.19\,\frac{J}{g\cdot°C})(30.0°C)$

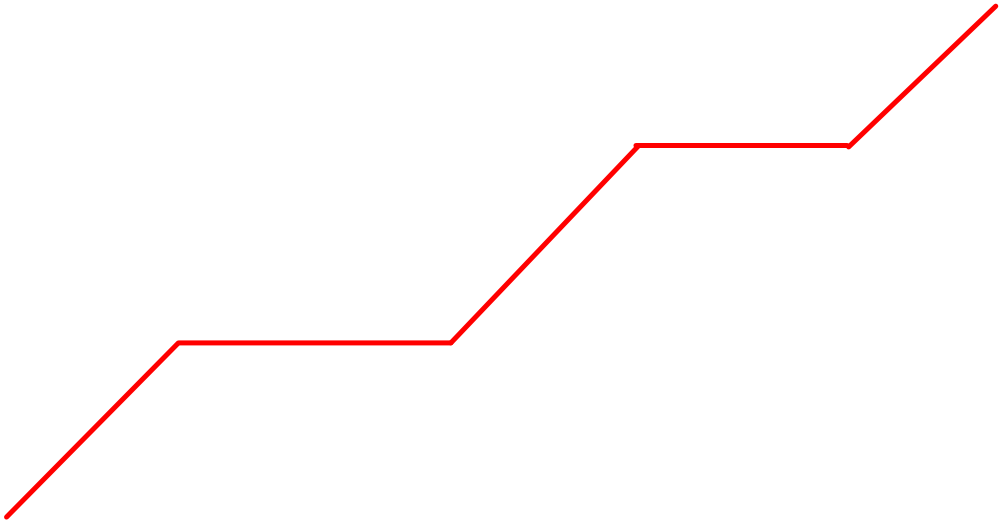
$q_\ell = 1257\,J$

$\Delta E_T = q_s + \Delta H_{fus} + q_\ell$

$\Delta E_T = (402\,J) + (3346\,J) + (1257\,J)$

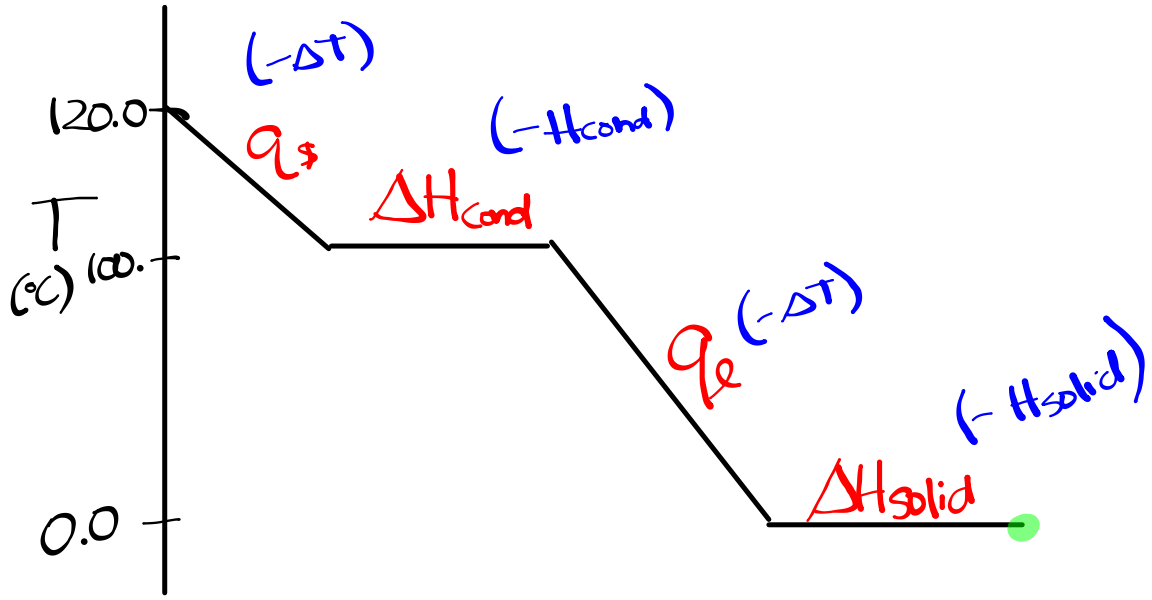
$\Delta E_T = 5005\,J$

$\Delta E_T = 5.0\,kJ$

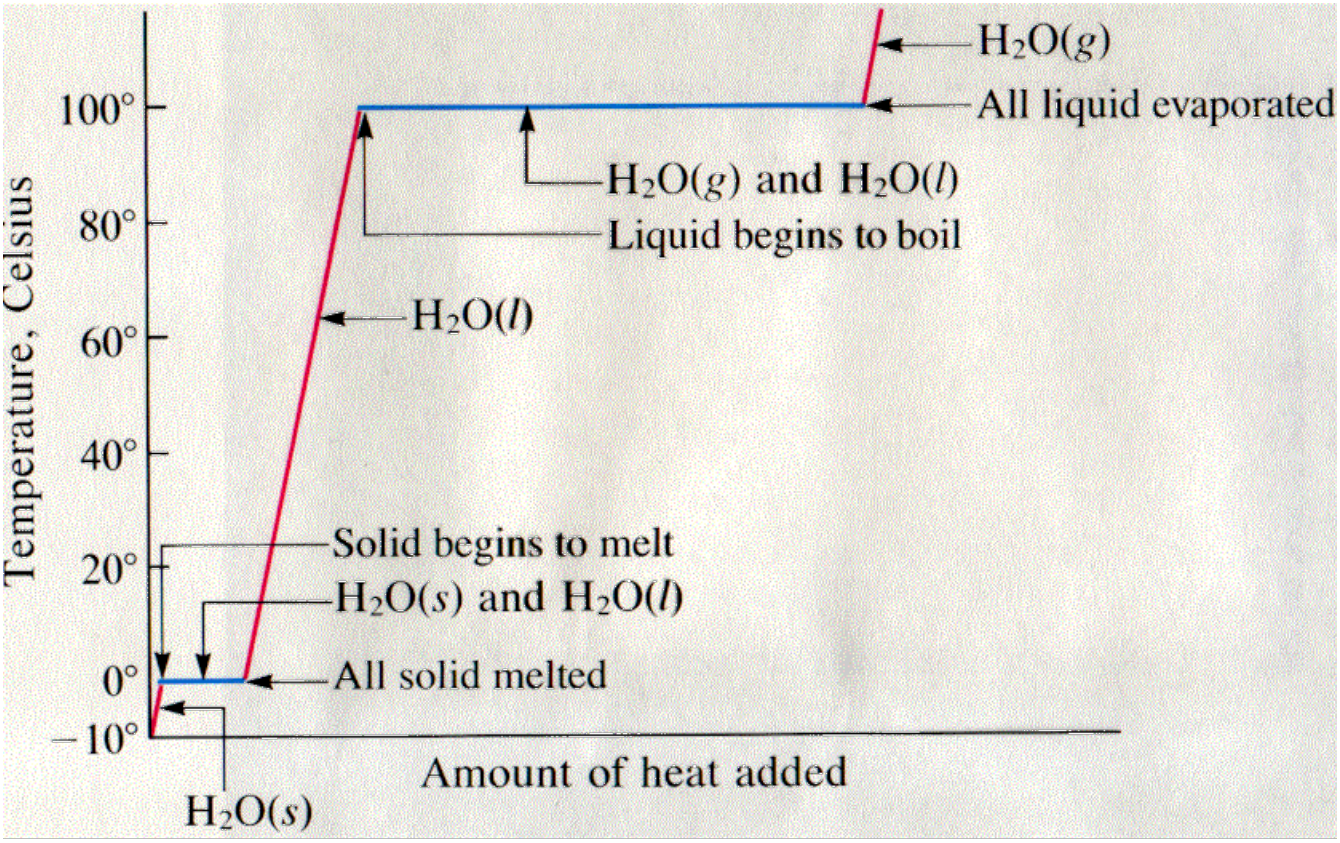


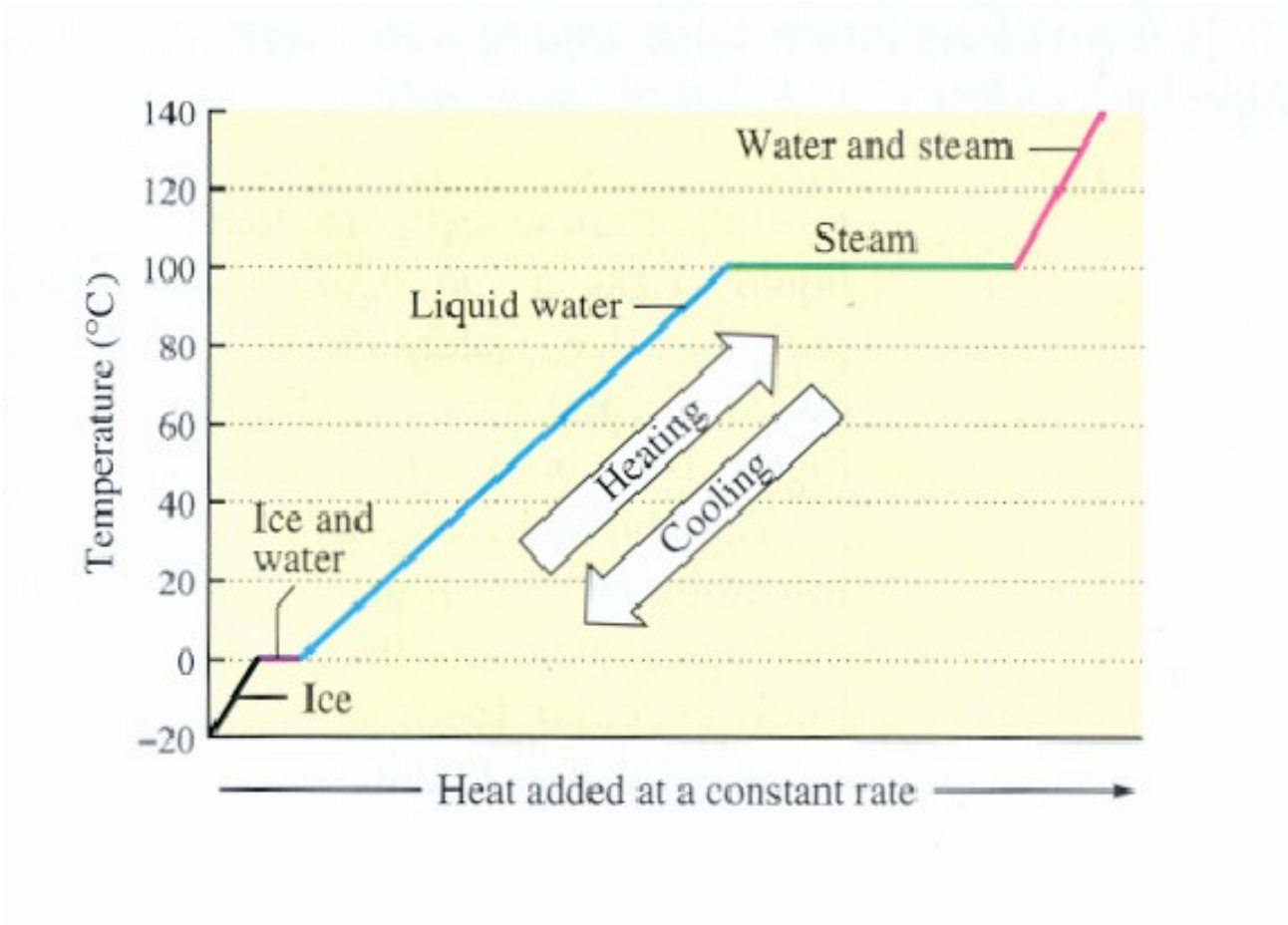
Total Energy Changes

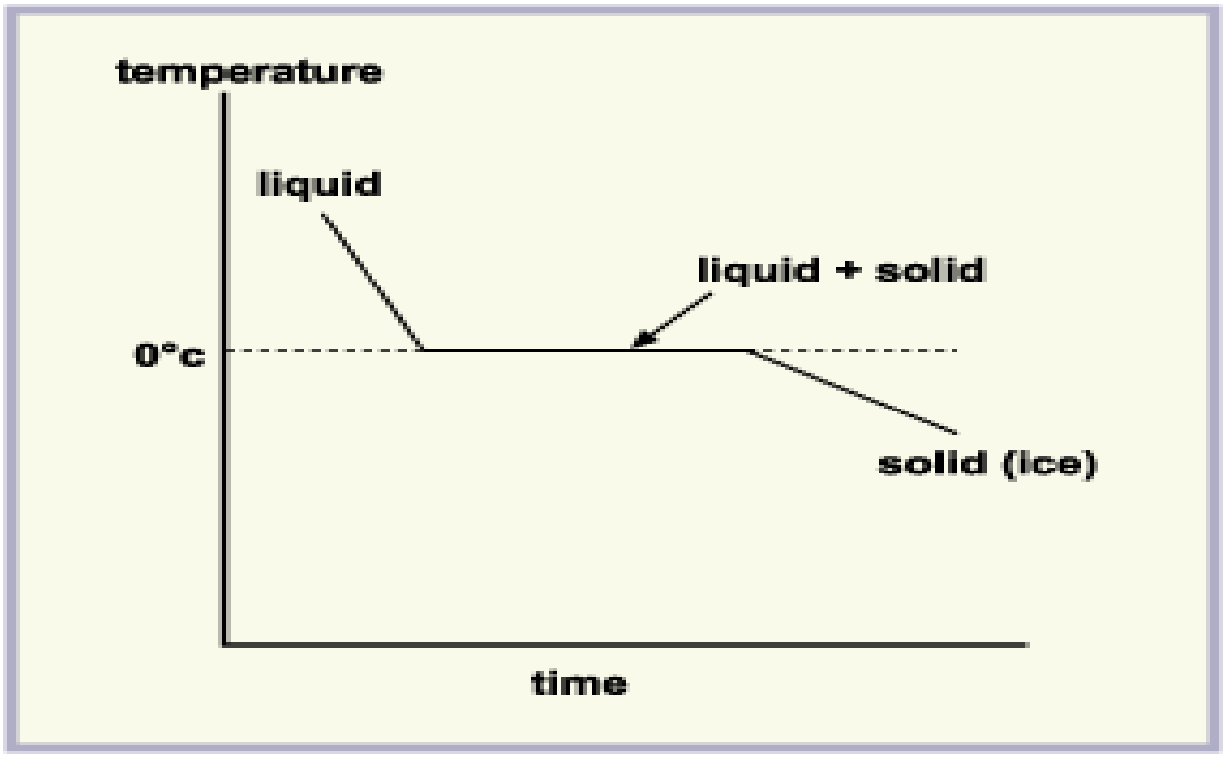
Ex. Calculate the total energy change if 2.50 g of steam at 120.0 °C is completely converted to ice at 0.0°C.

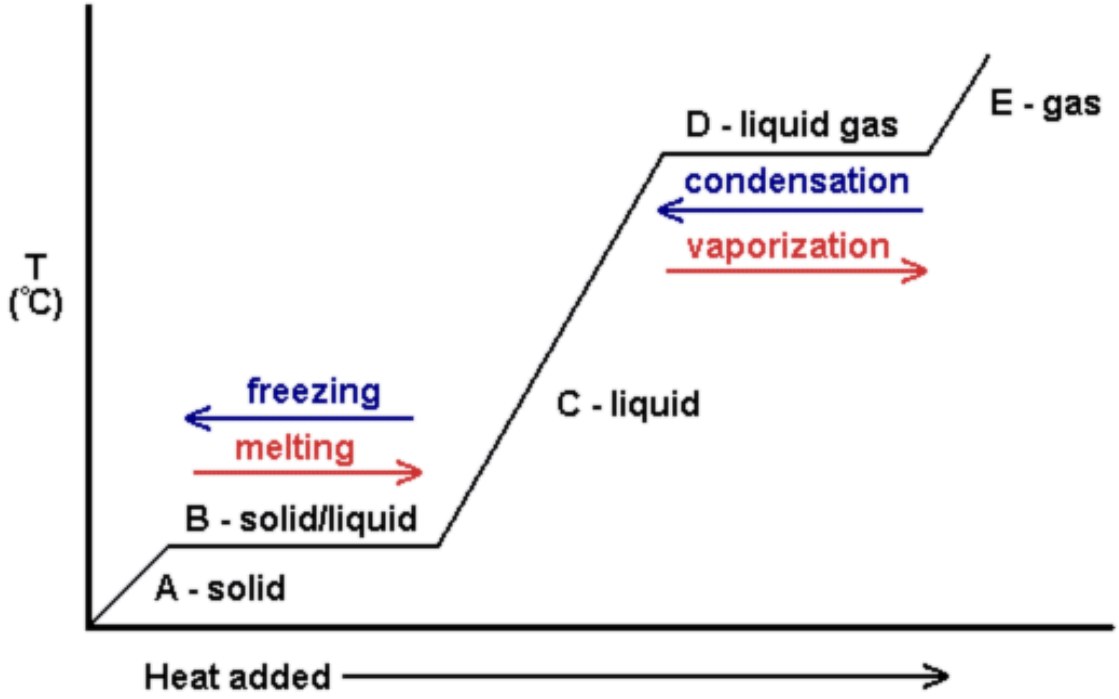


Worksheet


Temperature, Celsius
100°
80°
60°
40°
20°
0°
−10°
$H_2O(g)$
All liquid evaporated
$H_2O(g)$ and $H_2O(l)$
Liquid begins to boil
$H_2O(l)$
Solid begins to melt
$H_2O(s)$ and $H_2O(l)$
All solid melted
Amount of heat added
$H_2O(s)$


140
120
100
80
60
40
20
0
−20
Temperature (°C)
Water and steam
Steam
Liquid water
Heating
Cooling
Ice and water
Ice
Heat added at a constant rate


temperature
liquid
liquid + solid
0°c
solid (ice)
time


T
(°C)
E - gas
D - liquid gas
condensation
vaporization
freezing
melting
C - liquid
B - solid/liquid
A - solid
Heat added