6.1, 6.2 ⇒ Thermal Energy + Heat

p. 274-1, 4, 6
p. 280 1→5

p. 274

(1) Temperature - is a measure of the Average kinetic energy of particles in a substance whereas

Thermal Energy - is the total amount of thermal energy and potential energy of substance.

(or)

Temp. ⇒ E_K average

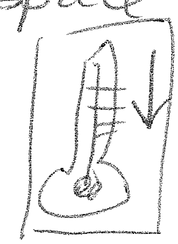
Therm. Energy = $E_K + E_p$ (bond energy)

(4)

Substance	Boiling Pt °C	Boiling Pt °K
Sodium	882.9	(1155.9)
Helium	(-268.8)	4.22
Copper	2567	(2840)
Mercury	(357)	630

* $T_K = T_C + 273$ // $T_C = T_K - 273$

(6) When a thermometer is placed in a cold place, the glass particles collide with slower moving colder particles. This slows the glass particles down, which in turn slow down the alcohol particles. When particles move slower, the take up less space so the red alcohol shrinks.



so the thermometer reads a <u>lower</u> temperature.

pg 280 # 1→5

(1) Thermal energy = <u>E_K + $E_{POTENTIAL}$</u> of atoms in substance

Temperature = <u>average E_K</u> of atoms in substance.

Heat = is the <u>transfer</u> of thermal energy from high temperature substance to low temperature substance.

(2) conduction – transfer of thermal energy when warmer objects are touching colder objects.

convection – transfer of thermal energy through a fluid (liquid or gas).

radiation – movement of thermal energy as electromagnetic waves.

(3) Tile is a good conductor of heat so when you step on tile in barefeet, the thermal energy from your feet rapidly transfers to tile ∴ feeling "cold".

(4) 4%. energy in an electric furnace is light energy (glows) + possibly sound energy.

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(5) copper pot – good conductor – heats up food quickly when stovetop

wooden spoon – poor conducter – my hand doesn't get hot when I stir hot soup metal ice-cube tray - good conductor - cools quickly a ice freezes.

down-filled sleeping bag - poor conductor - in fact its an insulator. It keeps my heat near me so I stay warm.

6.3 Heat Capacity p. 257 # 2,3,4

(2.) $m = 25.0 g = 0.025 kg$ silver

$T_1 = 50.0°c$

$T_2 = 80.0°c$

$\therefore \Delta T = T_2 - T_1 = +30°c$

$c_{silver} = 2.4 \times 10^2 \frac{J}{kg \cdot °c}$

$Q = ?$

$Q = mc\Delta T$

$= (0.025 kg) \times (2.4 \times 10^2 \frac{J}{kg \cdot °c}) \times 30°c$

$= \underline{180 J}$ required (need to add)

(3.) $m = 260.0 g = 0.260 kg$

$T_1 = -1.0°C$

$T_2 = -20°c$

$\Delta T = T_2 - T_1 = (-20) - (-1) = \underline{-19°C}$

$C_{ice} = 2.1 \times 10^3 \frac{J}{kg \cdot °c}$

$$Q = mc\Delta T$$

$$= (0.260\ kg)\left(2.1\times10^3 \frac{J}{kg\cdot°C}\right)(-19)$$

$$= -10{,}374$$

= loss of 10,000 J = 1×10^4 J

(or 10 kJ)

(4) $m = 0.050\ kg$

$Q = -1520\ J$ (release/loss of heat)

$T_1 = 100°C$, $T_2 = 20°C$ > $\Delta T = -80°C$

metal = ? Find c to identify metal

$$Q = mc\Delta T$$

$$c = \frac{Q}{m\cdot\Delta T} = \frac{-1520}{(0.050)(-80)}$$

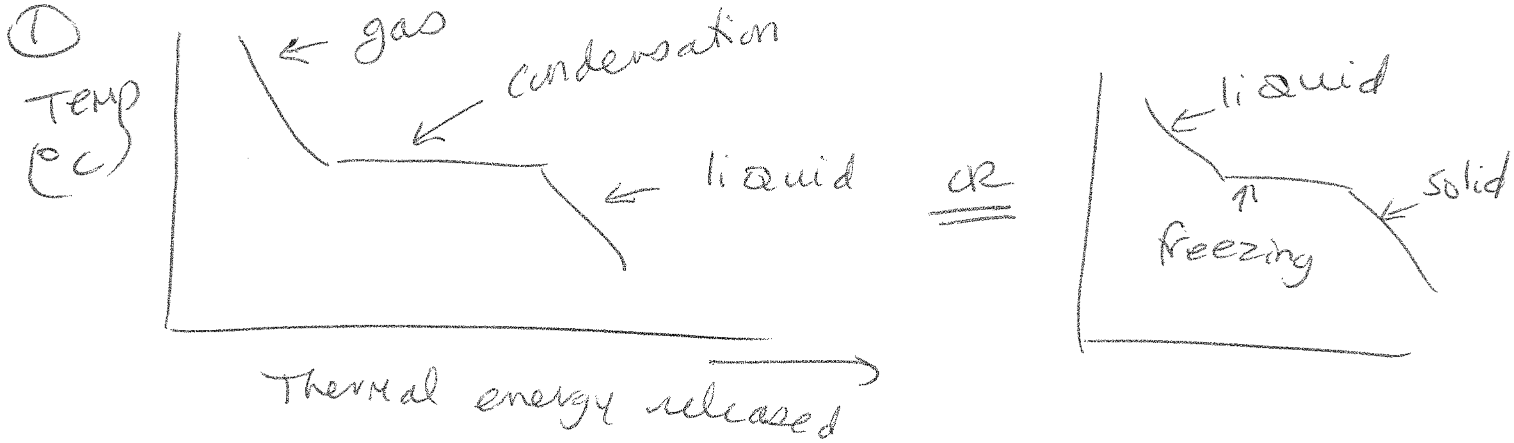
$$c = 380\ J/kg\cdot°C$$

It is copper

6.7 Latent Heat Capacity

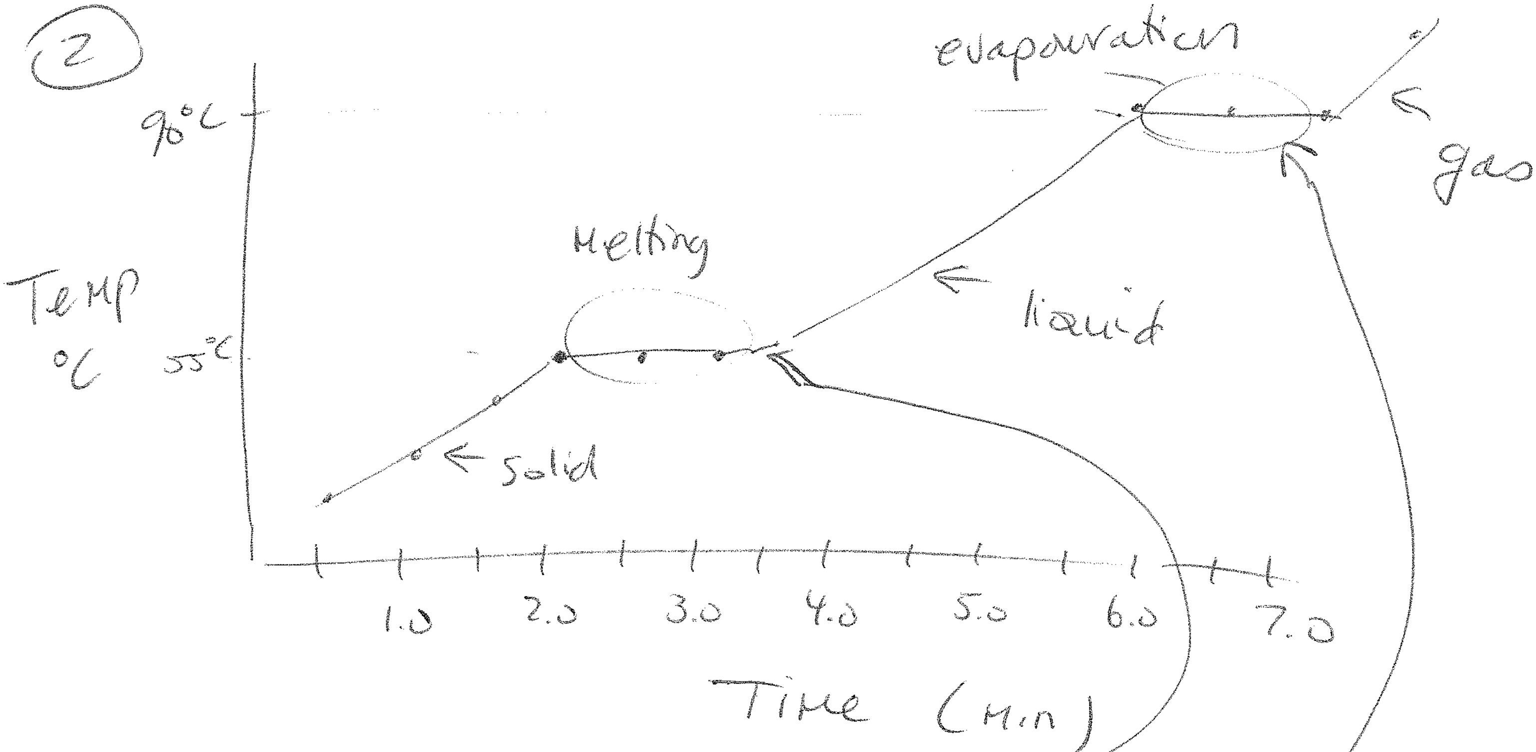
p. 295
1, 2, 5, 6, 7

(1)



Cooling curve because temperature is lowering. There is no way to determine whether its gas → liquid or liquid → solid.

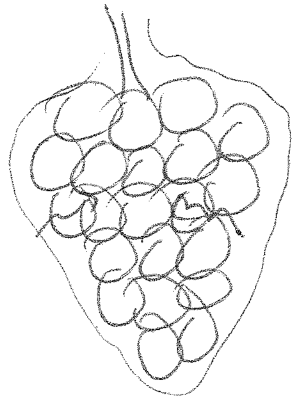
(2)



Melting point = 55°C

boiling point = 90°C

(5)



grape crop – thin layer of water when this water *freezes* it releases *heat* (liquid → solid requires loss of thermal energy). This heat is released to the *grapes* thus protecting them from freezing. This only works if it is a *few* degrees below zero & not for very long (a few hours overnight max.)

(6) $m = 2.40 kg$

$L_f = 1.1 \times 10^6 \; J/kg \qquad Q_f = ?$

$$Q_f = m \cdot L_f$$
$$= (2.40 \, kg) \cdot (1.1 \times 10^6 \; J/kg)$$
$$= 2.6 \times 10^6 \; J$$

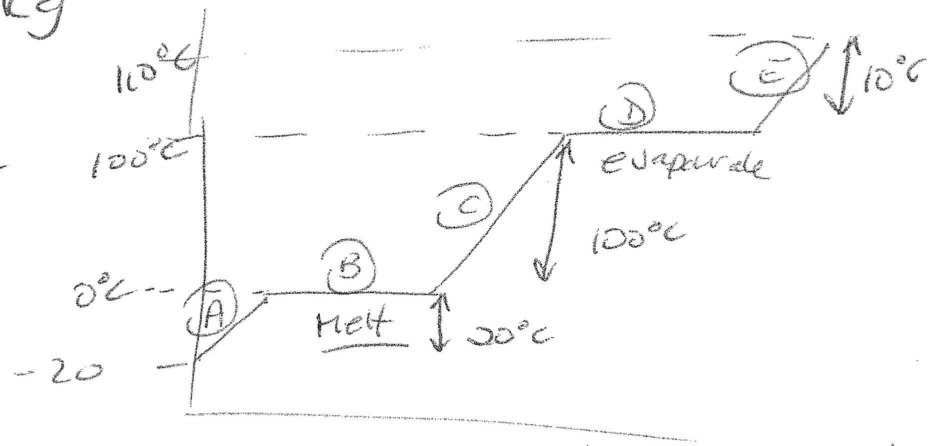
or 2.6 MJ

(7) $m = 0.100$ kg

$T_1 = -20°C$

$T_2 = 110°C$

$Q_{TOTAL} = ?$



There are 5 stages to consider (A, B, C, D, E.)
Calculate each + add together.

(A) heating ice. (chart p. 281) $\Delta T = +20°C$

$Q = mc\Delta T$

$= (0.100\text{ kg})(2.1 \times 10^3 \frac{J}{kg \cdot °C})(20°C) = \boxed{4200\text{ J}}$

(B) Melting ice (chart p. 291)

$Q = m \cdot L_f$

$= (0.100\text{ kg})(3.4 \times 10^5\text{ J/kg}) = \boxed{3.4 \times 10^4\text{ J}}$

(C) heating water (chart p. 281) $\Delta T = +100°C$

$Q = mc\Delta T$

$= (0.100\text{ kg})(4.18 \times 10^3 \frac{J}{kg \cdot °C})(100°C) = \boxed{41800\text{ J}}$

(D) evaporating water (chart p. 291)

$Q = m \cdot L_v$

$= (0.100\text{ kg})(2.3 \times 10^6\text{ J/kg}) = \boxed{2.3 \times 10^5\text{ J}}$

(E) Heating steam (chart p. 281) $\Delta T = +10°C$

$Q = mc\Delta T$

$= (0.100\text{ kg})(4.18 \times 10^3 \frac{J}{kg \cdot °C})(10°C) = \boxed{4180\text{ J}}$