PROBLEMAS RESUELTOS DE CALOR Y TEMPERATURA

(6) ¿Q? → kcal

$m = 50\ g$

$T = 180°C$

$T = -10°C$

Vapor 180°C $\xrightarrow{Q_1}$ Vapor 100°C $\xrightarrow{Q_2}$ Agua(l) 100°C $\xrightarrow{Q_3}$ Agua(l) 0°C $\xrightarrow{Q_4}$

$\xrightarrow{Q_4}$ Hielo 0°C $\xrightarrow{Q_5}$ Hielo -10°C

$$Q_1 = m \cdot c \cdot \Delta T = 50 \cdot 0'46 \cdot (100-180) = -1840\ cal$$

$$Q_2 = m \cdot L = 50 \cdot (-540) = -2'7 \cdot 10^4\ cal$$

$$Q_3 = m \cdot c \cdot \Delta T = 50 \cdot 1 \cdot (0-100) = -5000\ cal$$

$$Q_4 = m \cdot L = 50 \cdot (-80) = -4000\ cal$$

$$Q_5 = m \cdot c \cdot \Delta T = 50 \cdot 0'5 \cdot (-10-0) = -250\ cal$$

$$Q_T = Q_1 + Q_2 + Q_3 + Q_4 + Q_5 =$$

$$= -1840 - 2'7 \cdot 10^4 - 5000 - 4000 - 250 =$$

$$= -3'81 \cdot 10^4\ cal = \boxed{-38'1\ kcal}$$

7 $\Delta T = 10°C$

$Q = 1'23\ kJ = 1230\ J =$
$= 294\ cal$
$m = 525\ g$

$Q = m \cdot c \cdot \Delta T$

$c = \dfrac{Q}{m \cdot \Delta T}$

a) $c = \dfrac{Q}{m \cdot \Delta T} = \dfrac{1'23\ kJ}{0'525\ kg \cdot 10°C} = \boxed{0'234\ \dfrac{kJ}{kg \cdot °C}}$

b) $c = \dfrac{Q}{m \cdot \Delta T} = \dfrac{1230\ J}{525\ g \cdot 10°C} = \boxed{0'234\ \dfrac{J}{g \cdot °C}}$

c) $c = \dfrac{Q}{m \cdot \Delta T} = \dfrac{294\ cal}{525\ g \cdot 10°C} = \boxed{0'056\ \dfrac{cal}{g \cdot °C}}$

d) $c = \dfrac{Q}{m \cdot \Delta T} = \dfrac{0'294\ kcal}{0'525\ kg \cdot 10°C} = \boxed{0'056\ \dfrac{kcal}{kg \cdot °C}}$

(8) a) $20 \dfrac{\cancel{cal}}{\cancel{g} \cdot °C} \cdot \dfrac{1\,kcal}{\cancel{1000}\,\cancel{cal}} \cdot \dfrac{\cancel{1000}\,\cancel{g}}{1\,kg} = \boxed{20 \dfrac{kcal}{kg \cdot °C}}$

b) $20 \dfrac{\cancel{cal}}{g \cdot °C} \cdot \dfrac{4'18\,J}{1\,\cancel{cal}} = \boxed{83'6 \dfrac{J}{g \cdot °C}}$

c) $20 \dfrac{\cancel{cal}}{\cancel{g} \cdot °C} \cdot \dfrac{4'18\,\cancel{J}}{1\,\cancel{cal}} \cdot \dfrac{1\,kJ}{\cancel{1000}\,\cancel{J}} \cdot \dfrac{\cancel{1000}\,\cancel{g}}{1\,kg} =$

$= \boxed{83'6 \dfrac{kJ}{kg \cdot °C}}$

(9) ¿Q?

$m = 200\,g$

$T = 12°C$

$T = 160°C$

$A(s)\ 12°C \xrightarrow{Q_1} A(s)\ 30°C \xrightarrow{Q_2} A(l)\ 30°C \xrightarrow{Q_3} A(l)\ 90°C \xrightarrow{Q_4} A(v)\ 90°C \xrightarrow{Q_5} A(v)\ 160°C$

$Q_1 = m \cdot c \cdot \Delta T = 200 \cdot 0'8 \cdot (30-12) = 2880\,cal$

$Q_2 = m \cdot L = 200 \cdot 120 = 2'4 \cdot 10^4\,cal$

$Q_3 = m \cdot c \cdot \Delta T = 200 \cdot 0'94 \cdot (90-30) = 1'13 \cdot 10^4\,cal$

$Q_4 = m \cdot L = 200 \cdot 350 = 7 \cdot 10^4\,cal$

$Q_5 = m \cdot c \cdot \Delta T = 200 \cdot 0'3 \cdot (160-90) = 4200\,cal$

$Q_T = Q_1 + Q_2 + Q_3 + Q_4 + Q_5 =$

$= 2880 + 2'4 \cdot 10^4 + 1'13 \cdot 10^4 + 7 \cdot 10^4 + 4200 =$

$= 1'12 \cdot 10^5\,cal = \boxed{112\,kcal}$

(10) $a = 10\ m$

$b = 5\ m$

$c = 1'5\ m$

¿m?

¿Q?

$T = 10°C$

$T = 22°C$

¿Coste?

Precio $= 0'18 \dfrac{€}{kW \cdot h}$

$1\ cal = 4'18\ J$

a) $V = a \cdot b \cdot c = 10 \cdot 5 \cdot 1'5 =$

$= 75\ m^3$

$m = d \cdot V = 1000 \dfrac{kg}{\cancel{m^3}} \cdot 75\ \cancel{m^3} =$

$= 75000\ kg = \boxed{75\ ton}$

b) $Q = m \cdot c \cdot \Delta T =$

$= 7'5 \cdot 10^7\ \cancel{g} \cdot 1 \dfrac{cal}{\cancel{g} \cdot \cancel{°C}} \cdot (22-10)\ \cancel{°C} =$

$= 9 \cdot 10^8\ cal = \boxed{9 \cdot 10^5\ kcal}$

c) $\text{Coste} = 0'18 \dfrac{€}{\cancel{kW} \cdot \cancel{h}} \cdot \dfrac{1\ \cancel{kW}}{1000\ \cancel{W}} \cdot \dfrac{1\ \cancel{W}}{1 \dfrac{\cancel{J}}{\cancel{s}}} \cdot \dfrac{1\ \cancel{h}}{3600\ \cancel{s}} \cdot$

$\cdot \dfrac{4'18\ \cancel{J}}{1\ \cancel{cal}} \cdot 9 \cdot 10^8\ \cancel{cal} = \boxed{188\ €}$

11 a) $m = 250\ g$

$T = 17°C$

$T = 50°C$

$T = 25°C$

¿ m ?

b) $V_1 = 3\ l$

$T = 20°C$

$V_2 = 2\ l$

$T = 60°C$

¿ T ?

a) $\underset{17°C}{Agua(l)} \xrightarrow{Q_1} \underset{25°C}{Agua(l)}$

$\underset{50°C}{Agua(l)} \xrightarrow{Q_2} \underset{25°C}{Agua(l)}$

$Q_{ganado} = -Q_{perdido} \Rightarrow Q_1 = -Q_2$

$m_1 \cdot c_1 \cdot \Delta T_1 = -m_2 \cdot c_2 \cdot \Delta T_2$

$250 \cdot 1 \cdot (25-17) = -m_2 \cdot 1 \cdot (25-50)$

$2000 = m_2 \cdot 25$

$m_2 = \frac{2000}{25} = \boxed{80\ g}$

b) $\underset{20°C}{Agua(l)} \xrightarrow{Q_1} \underset{T}{Agua(l)}$

$\underset{60°C}{Agua(l)} \xrightarrow{Q_2} \underset{T}{Agua(l)}$

$Q_{ganado} = -Q_{perdido}$; $Q_1 = -Q_2$

$m_1 \cdot c_1 \cdot \Delta T_1 = -m_2 \cdot c_2 \cdot \Delta T_2$;

$3\cancel{000} \cdot 1 \cdot (T-20) = -2\cancel{000} \cdot 1 \cdot (T-60)$

$3 \cdot T - 60 = -2 \cdot T + 120$; $3 \cdot T + 2 \cdot T = 120 + 60$

$5 \cdot T = 180$; $T = \frac{180}{5} = \boxed{36°C}$

(12) $m = 100\ g$, $T = -8°C$

$m = 27'6\ g$, $T = 130°C$

¿T?

Hielo $-8°C$ $\xrightarrow{Q_1}$ Hielo $0°C$ $\xrightarrow{Q_2}$ Agua(l) $0°C$ $\xrightarrow{Q_3}$ Agua(l) T

Vapor $130°C$ $\xrightarrow{Q_4}$ Vapor $100°C$ $\xrightarrow{Q_5}$ Agua(l) $100°C$ $\xrightarrow{Q_6}$ Agua(l) T

$$Q_1 = m \cdot c \cdot \Delta T = 100 \cdot 0'5 \cdot (0+8) = 400\ cal$$

$$Q_2 = m \cdot L = 100 \cdot 80 = 8000\ cal$$

$$Q_3 = m \cdot c \cdot \Delta T = 100 \cdot 1 \cdot (T-0) = 100 \cdot T\ cal$$

$$Q_4 = m \cdot c \cdot \Delta T = 27'6 \cdot 0'46 \cdot (100-130) = -381\ cal$$

$$Q_5 = m \cdot L = 27'6 \cdot (-540) = -1'49 \cdot 10^4\ cal$$

$$Q_6 = m \cdot c \cdot \Delta T = 27'6 \cdot 1 \cdot (T-100) = 27'6 \cdot T - 2760\ cal$$

$$Q_1 + Q_2 + Q_3 = -Q_4 - Q_5 - Q_6$$

$$400 + 8000 + 100 \cdot T = 381 + 1'49 \cdot 10^4 - 27'6 \cdot T + 2760$$

$$100 \cdot T + 27'6 \cdot T = -400 - 8000 + 381 + 1'49 \cdot 10^4 + 2760$$

$$127'6 \cdot T = 9641$$

$$T = \frac{9641}{127'6} = \boxed{75'6\ °C}$$

(13) $T = -20°C$

$m_2 = 200\ g$

$T = 130°C$

¿m_1?

$T_f = 50°C$

Hielo $-20°C$ $\xrightarrow{Q_1}$ Hielo $0°C$ $\xrightarrow{Q_2}$ Agua(l) $0°C$ $\xrightarrow{Q_3}$ Agua(l) $50°C$

Vapor $130°C$ $\xrightarrow{Q_4}$ Vapor $100°C$ $\xrightarrow{Q_5}$ Agua(l) $100°C$ $\xrightarrow{Q_6}$ Agua(l) $50°C$

$$Q_1 = m_1 \cdot 0'5 \cdot (0+20) = 10 \cdot m_1 \quad cal$$

$$Q_2 = m_1 \cdot L = m_1 \cdot 80 = 80 \cdot m_1 \quad cal$$

$$Q_3 = m_1 \cdot c \cdot \Delta T = m_1 \cdot 1 \cdot (50-0) = 50 \cdot m_1 \quad cal$$

$$Q_4 = m_2 \cdot c \cdot \Delta T = 200 \cdot 0'46 \cdot (100-130) = -2760\ cal$$

$$Q_5 = m_2 \cdot L = 200 \cdot (-540) = -1'08 \cdot 10^5\ cal$$

$$Q_6 = m_2 \cdot c \cdot \Delta T = 200 \cdot 1 \cdot (50-100) = -10^4\ cal$$

$$Q_{ganado} = -Q_{perdido}$$

$$Q_1 + Q_2 + Q_3 = -Q_4 - Q_5 - Q_6$$

$$10 \cdot m_1 + 80 \cdot m_1 + 50 \cdot m_1 = 2760 + 1'08 \cdot 10^5 + 10^4$$

$$140 \cdot m_1 = 1'21 \cdot 10^5$$

$$m_1 = \frac{1'21 \cdot 10^5}{140} = \boxed{864\ g}$$

(14) $D = 1'70\ m$

$h = 2\ m$

a) ¿m?

b) ¿T?

$T = 15°C$

$m = 1\ kg$

$T = 1200°C$

$c_{hierro} = 0'113\ \frac{cal}{g \cdot °C}$

a) $V = \pi \cdot r^2 \cdot h =$

$= \pi \cdot 0'85^2 \cdot 2 = 4'54\ m^3$

$m = d \cdot V = 1000\ \frac{kg}{m^3} \cdot 4'54\ m^3 =$

$= 4540\ kg = \boxed{4'54\ ton}$

b) $Q_{ganado} = -Q_{perdido}$

$m_1 \cdot c_1 \cdot \Delta T_1 = -m_2 \cdot c_2 \cdot \Delta T_2$

$4'54 \cdot 10^6 \cdot 1 \cdot (T - 15) = -1000 \cdot 0'113 \cdot (T - 1200)$

$4'54 \cdot 10^6 \cdot T - 6'81 \cdot 10^7 = -113 \cdot T + 1'36 \cdot 10^5$

$4'54 \cdot 10^6 \cdot T + 113 \cdot T = 6'81 \cdot 10^7 + 1'36 \cdot 10^5$

$4'54 \cdot 10^6 \cdot T = 6'82 \cdot 10^7$

$T = \frac{6'82 \cdot 10^7}{4'54 \cdot 10^6} = \boxed{1502°C}$

(15) $m_{cal} = 55\ g$

$m_2 = 250\ g$

$T = 18°C$

$m_1 = 75\ g$

$T = 100°C$

$T_f = 20'4°C$

¿c?

$c_{cobre} = 0'093\ \frac{cal}{g \cdot °C}$

$$-Q_{\substack{perdido \\ por\ A}} = Q_{\substack{ganado \\ por\ B}} + Q_{cal}$$

$$-m_1 \cdot c_1 \cdot \Delta T_1 = m_2 \cdot c_2 \cdot \Delta T_2 + Q_{cal}$$

$$-75 \cdot c_1 \cdot (20'4 - 100) =$$

$$= 250 \cdot 1 \cdot (20'4 - 18) +$$

$$+ 55 \cdot 0'093 \cdot (20'4 - 18)$$

$$5970 \cdot c_1 = 600 + 12'3$$

$$5970 \cdot c_1 = 612'3$$

$$c_1 = \frac{612'3}{5970} = \boxed{0'103\ \frac{cal}{g \cdot °C}}$$

(16) $k = 40\ g$

$m_2 = 200\ g$

$T = 20°C$

$m_1 = 50\ g$

$T = 90°C$

¿T?

$$-Q_{perdido} = (m + k) \cdot c \cdot \Delta T$$

$$-m_1 \cdot c_1 \cdot \Delta T_1 = (m_2 + k) \cdot c_2 \cdot \Delta T_2$$

$$-50 \cdot 1 \cdot (T - 90) = (200 + 40) \cdot 1 \cdot (T - 20)$$

$$-50 \cdot T + 4500 = 240 \cdot T - 4800$$

$$4800 + 4500 = 240 \cdot T + 50 \cdot T$$

$$9300 = 290 \cdot T$$

$$T = \frac{9300}{290} = \boxed{32'1\ °C}$$

(17) $m_1 = 200\ g$

$T = 20°C$

$m_2 = 300\ g$

$T = 50°C$

$c_{alcohol} = 2450\ \frac{J}{kg \cdot K}$

$c_{agua} = 4180\ \frac{J}{kg \cdot K}$

a) ¿T?

b) ¿$Q_{escapado}$?

$T = 30°C$

a) $Q_{ganado} = -Q_{perdido}$

$m_1 \cdot c_1 \cdot \Delta T_1 = -m_2 \cdot c_2 \cdot \Delta T_2$

$c_1 = 4180\ \frac{\cancel{J}}{\cancel{kg} \cdot \cancel{K}} \cdot \frac{1\ cal}{418\ \cancel{J}} \cdot \frac{1\ \cancel{kg}}{1000\ g} \cdot \frac{1\ \cancel{K}}{1°C} = 1\ \frac{cal}{g \cdot °C}$

$c_2 = 2450\ \frac{\cancel{J}}{\cancel{kg} \cdot \cancel{K}} \cdot \frac{1\ cal}{418\ \cancel{J}} \cdot \frac{1\ \cancel{kg}}{1000\ g} \cdot \frac{1\ \cancel{K}}{1°C} = 0'586\ \frac{cal}{g \cdot °C}$

$200 \cdot 1 \cdot (T - 20) = -300 \cdot 0'586 \cdot (T - 50)$

$200 \cdot T - 4000 = -176 \cdot T + 8790$

$200 \cdot T + 176\ T = 4000 + 8790\ ;\ 376 \cdot T = 12\ 790$

$T = \frac{12790}{376} = \boxed{34°C}$

b) $m_1 \cdot c_1 \cdot \Delta T_1 = -m_2 \cdot c_2 \cdot \Delta T_2 - Q_{escapado}$

$200 \cdot 1 \cdot (30 - 20) = -300 \cdot 0'586 \cdot (30 - 50) - Q_{escapado}$

$2000 = +3516 - Q_{escapado}$

$Q_{escapado} = +3516 - 2000 = \boxed{-1516\ cal}$

(18) $m = 5\,g$

$V = 1\,l$

$T_1 = 10°C$

$T_2 = 47°C$

¿L?

$Q_{cal} = 5\%$

$- Q_{perdido} = Q_{ganado} + Q_{cal}$

$- m_1 \cdot L = m_2 \cdot c \cdot \Delta T$

$- 5 \cdot L \cdot 0'95 = 1000 \cdot 1 \cdot (47-10)$

$L = - \dfrac{1000 \cdot 37}{5 \cdot 0'95} = \boxed{-7790 \dfrac{cal}{g}}$

(19) ¿k?

$m = 200\,g$

$T = 90°C$

$T = 85°C$

$T = 20°C$

$m = 300\,g$

$T = 12°C$

$m = 400\,g$

$T = 95°C$

¿T?

* Equivalente en agua:

$- Q_{perdido} = (m + k) \cdot c \cdot \Delta T$

$- m_1 \cdot c_1 \cdot \Delta T_1 = (m_2 + k) \cdot c_2 \cdot \Delta T_2$

$- 200 \cdot 1 \cdot (85-90) = (0 + k) \cdot 1 \cdot (85-20)$

$1000 = k \cdot 65 \Rightarrow k = \dfrac{1000}{65} = 15'4\,g$

* Temperatura final:

$- Q_{perdido} = (m + k) \cdot c \cdot \Delta T$

$- m_3 \cdot c_3 \cdot \Delta T_3 = (m_4 + k) \cdot c_5 \cdot \Delta T$

$- 400 \cdot 1 \cdot (T-95) = (300 + 15'4) \cdot 1 \cdot (T-12)$

$- 400 \cdot T + 3'8 \cdot 10^4 = 315'4 \cdot T - 3785$

$3785 + 3'8 \cdot 10^4 = 400 \cdot T + 315'4 \cdot T$

$4'18 \cdot 10^4 = 715'4 \cdot T \; ; \; T = \dfrac{4'18 \cdot 10^4}{715'4} = \boxed{58'4°C}$

(20) $V = 3\ l$

$T = 10°C$

$m = 400\ g$

$T = 150°C$

¿T?

$k = 35\ g$

$c_{hierro} = 0'489 \dfrac{J}{g \cdot °C}$

$c_{hierro} = 0'489 \dfrac{\cancel{J}}{g \cdot °C} \cdot \dfrac{1\ cal}{4'18\ \cancel{J}} =$

$= 0'117 \dfrac{cal}{g \cdot °C}$

- $Q_{perdido} = (m + k) \cdot c \cdot \Delta T$
- $m_1 \cdot c_1 \cdot \Delta T_1 = (m_2 + k) \cdot c_2 \cdot \Delta T_2$

$-400 \cdot 0'117 \cdot (T - 150) = (3000 + 35) \cdot 1 \cdot (T - 10)$

$-46'8 \cdot T + 7020 = 3035 \cdot T - 30350$

$30350 + 7020 = 3035 \cdot T + 46'8 \cdot T$

$37370 = 3082 \cdot T$

$T = \dfrac{37370}{3082} = \boxed{12'1\ °C}$