TOPLOTNE POJAVE - ZADACI

Prvi deo

Goran Ivkvoić, profeosr fizie

1. Pri normalnom atmosferskom pritisku voda ključa na 100°C. Kolika je tačka ključanja vode u kelvinima?

$$t = 100°C$$

$$T = ?$$

$$T = \left(\frac{t}{°C} + 273\right)K$$

$$T = \left(\frac{100°C}{°C} + 273\right)K$$

$$T = (100 + 273)K$$

$$T = 373\ K$$

2. Apsolutna temperatura topljenja gvožđa je 1900 K. Kolika je ta temperatura u Celzijusovoj skali?

$$\boldsymbol{T = 1900K}$$

$$\boldsymbol{t} = ?$$

$$\boldsymbol{t = \left(\frac{T}{K} - 273\right)°C}$$

$$\boldsymbol{t = \left(\frac{1900K}{K} - 273\right)°C}$$

$$\boldsymbol{t = (1900 - 273)°C}$$

$$\boldsymbol{t = 1627\ °C}$$

3. Temperatura vazduha u toku dana se promeni od 10 $°C$ do 23 $°C$. Kolika je promena temperature u Celzijusovoj i u Kelvinovoj skali?

$t_1 = 10°C$

$t_2 = 23°C$

$\Delta t = ?$

$\Delta T = ?$

$\Delta t = t_2 - t_1$

$\Delta t = 23°C - 10°C$

$\Delta t = 13°C$

$$T_1 = \left(\frac{t_1}{°C} + 273\right)K = \left(\frac{10°C}{°C} + 273\right)K = (10 + 273)K = 283\ K$$

$$T_2 = \left(\frac{t_2}{°C} + 273\right)K = \left(\frac{23°C}{°C} + 273\right)K = (23 + 273)K = 296\ K$$

$$\Delta T = T_2 - T_1$$

$$\Delta T = 296\ K - 283\ K$$

$$\Delta T = 13K$$

4. Temperatura tela se promenila za 50K. Kolika je promena temperature u Celzijusovoj skali?

$\Delta \boldsymbol{T} = \mathbf{50}\boldsymbol{K}$

$\Delta \boldsymbol{t} =?$

$\Delta \boldsymbol{t} = \mathbf{50}°\boldsymbol{C}$

5. Kolika količina toplote je potrebna da se zagreje 5 kg bakra od 20 $°C$ do 100 $°C$? Specifični toplotni kapacitet bakra je 380 $\frac{J}{kgK}$.

$$\boldsymbol{m = 5kg}$$

$$\boldsymbol{t_1 = 20°C}$$

$$\boldsymbol{t_2 = 100°C}$$

$$\boldsymbol{c = 280\frac{J}{kgK} = 280\frac{J}{kg°C}}$$

$$\boldsymbol{Q} = ?$$

$$\boldsymbol{\Delta t = t_2 - t_1}$$

$$\boldsymbol{\Delta t = 100°C - 20°C}$$

$$\boldsymbol{\Delta t = 80°C}$$

$$\boldsymbol{Q = m \cdot c \cdot \Delta t}$$

$$\boldsymbol{Q = 5kg \cdot 280\frac{J}{kg°C} \cdot 80°C}$$

$$\boldsymbol{Q = 112\,000\,J}$$

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Drugi deo

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6. Kolika količina toplote je potrebna da se zagreje 5 litara vode od 18 $°C$ do temperature ključanja? Specifični toplotni kapacitet vode je 4200 $\frac{J}{kg°C}$.

$$V = 5l = 5\ dm^3 = 0,005\ m^3$$

$$t_1 = 18°C$$

$$t_2 = 100°C$$

$$c = 4200\frac{J}{kg°C}$$

$$\rho = 1000\frac{kg}{m^3}$$

$$Q = ?$$

$$m = \rho \cdot V$$

$$m = 1000\frac{kg}{m^3} \cdot 0,005\ m^3$$

$$m = 5kg$$

$$\Delta t = t_2 - t_1$$

$$\Delta t = 100°C - 18°C$$

$$\Delta t = 82°C$$

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

$$Q = 5kg \cdot 4200\frac{J}{kg°C} \cdot 82°C$$

$$Q = 1\ 722\ 000J$$

7. U bakarnoj posudi mase 250g nalazi se 2 l vode. Posuda sa vodom se stavi na peć i zagreje od 18°C do 100°C . Koliku količinu toplote je peć predala posudi sa vodom? Specifični toplotni kapacitet bakra je 380$\frac{J}{kg°C}$ a vode je 4200 $\frac{J}{kg°C}$.-

$$m_b = 250g = 0,25\ kg$$

$$V_v = 2\ l = 2\ dm^3 = 0,002\ m^3$$

$$t_1 = 18°C$$

$$t_2 = 100°C$$

$$c_b = 380\frac{J}{kg°C}$$

$$c_v = 4200\frac{J}{kg°C}$$

$$\rho_v = 1000\frac{kg}{m^3}$$

$$Q_u = ?$$

$$m_v = \rho_v \cdot V_v$$

$$m_v = 1000\frac{kg}{m^3} \cdot 0,002\ m^3$$

$$m_v = 2kg$$

$$\Delta t = t_2 - t_1$$

$$\Delta t = 100°C - 18°C$$

$$\Delta t = 82°C$$

$$Q_b = m_b \cdot c_b \cdot \Delta t$$

$$Q_b = 0,25kg \cdot 380\frac{J}{kg°C} \cdot 82°C$$

$$Q_b = 7\ 790\ J$$

$$Q_v = m_v \cdot c_v \cdot \Delta t$$

$$Q_v = 2kg \cdot 4200\frac{J}{kg°C} \cdot 82°C$$

$$Q_v = 688\ 800\ J$$

$$Q_u = Q_b + Q_v$$

$$Q_u = 7\ 790\ J + 688\ 800\ J$$

$$Q_u = 696590\ \mathrm{J}$$

8. Pri hlađenju 4 kg vode oslobodi se količina toplote 840 kJ. Za koliko se smanjila teperatura vode? Specifični toplotni kapacitet vode je 4200 $\frac{J}{kg°C}$.

$$m = 4kg$$

$$Q = 840\ kJ = 840\ 000J$$

$$c = 4200\frac{J}{kg°C}$$

$$\Delta t = ?$$

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

$$\frac{Q}{m \cdot c} = \Delta t$$

$$\Delta t = \frac{Q}{m \cdot c}$$

$$\Delta t = \frac{Q}{m \cdot c}$$

$$\Delta t = \frac{840\ 000J}{4kg\ \cdot 4200\frac{J}{kg°C}}$$

$$\Delta t = \frac{840\ 000J}{16800\frac{J}{°C}}$$

$$\Delta t = 50°C$$

9. Da bi se telo napravljeno od gvožđa zagrejalo od $20°C$ do $60°C$ utrošena je količina toplote 239,2 kJ. Kolika je masa tela? Specifični toplotni kapacitet gvožđa je $460\,\frac{J}{kg°C}$.

$$t_1 = 20°C$$

$$t_2 = 60°C$$

$$Q = 239,2\ kJ = 239\,200\ J$$

$$c = 460\,\frac{J}{kg°C}$$

$$m = ?$$

$$\Delta t = t_2 - t_1$$

$$\Delta t = 60°C - 20°C$$

$$\Delta t = 40°C$$

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

$$\frac{Q}{\Delta t \cdot c} = m$$

$$m = \frac{Q}{\Delta t \cdot c}$$

$$m = \frac{Q}{\Delta t \cdot c}$$

$$m = \frac{239\,200\ J}{40°C \cdot 460\,\frac{J}{kg°C}}$$

$$m = \frac{239\,200\ J}{18400\,\frac{J}{kg}}$$

$$m = 13\ kg$$

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Treći deo

Goran Ivkvoić, profeosr fizie

10. Kolika temperatura se dobije kada se u kadi pomeša 39kg vode temperature 20°C i 21 kg vode temperature 60°C? Zanemariti količinu toplote koju primi kada.

$$t_1 = 20°C$$
$$m_1 = 39kg$$
$$t_2 = 60°C$$
$$m_2 = 21kg$$

$$t_1 < t_R < t_2$$
$$20°C < t_R < 60°C$$

$$\Delta t_1 = t_R - t_1$$
$$\Delta t_2 = t_2 - t_R$$

$$Q_1 = Q_2$$
$$m_1 \cdot \cancel{c} \cdot \Delta t_1 = m_2 \cdot \cancel{c} \cdot \Delta t_2$$
$$m_1 \cdot \Delta t_1 = m_2 \cdot \Delta t_2$$
$$m_1 \cdot (t_R - t_1) = m_2 \cdot (t_2 - t_R)$$
$$m_1 \cdot t_R - m_1 \cdot t_1 = m_2 \cdot t_2 - m_2 \cdot t_R$$
$$m_1 \cdot t_R + m_2 \cdot t_R = m_2 \cdot t_2 + m_1 \cdot t_1$$
$$t_R \cdot (m_1 + m_2) = m_2 \cdot t_2 + m_1 \cdot t_1$$
$$t_R = \frac{m_2 \cdot t_2 + m_1 \cdot t_1}{m_1 + m_2}$$

$$t_R = \frac{m_2 \cdot t_2 + m_1 \cdot t_1}{m_1 + m_2}$$
$$t_R = \frac{21kg \cdot 60°C + 39kg \cdot 20°C}{39kg + 21kg}$$
$$t_R = \frac{1260kg°C + 780kg°C}{60kg}$$
$$t_R = \frac{2040kg°C}{60kg}$$
$$t_R = 34°C$$

11. U kadu je naliveno 75 litara vode temperature 10 $°C$. Koliko litara vode temperature 100 $°C$ treba dodati da bi se uspostavila temperatura 25 $°C$? Zanemariti količinu toplote koju primi kada.

$$V_1 = 75\ l$$
$$t_1 = 10°C$$
$$t_2 = 100°C$$
$$t_R = 25°C$$
$$V_2 = ?$$

$$t_1 < t_R < t_2$$
$$10°C < 25°C < 100°C$$

$$\Delta t_1 = t_R - t_1 = 25°C - 10°C = 15°C$$

$$\Delta t_2 = t_2 - t_R = 100°C - 25°C = 75°C$$

$$Q_1 = Q_2$$

$$m_1 \cdot c \cdot \Delta t_1 = m_2 \cdot c \cdot \Delta t_2$$

$$V_1 \cdot \rho \cdot \Delta t_1 = V_2 \cdot \rho \cdot \Delta t_2$$

$$V_1 \cdot \Delta t_1 = V_2 \cdot \Delta t_2$$

$$\frac{V_1 \cdot \Delta t_1}{\Delta t_2} = V_2$$

$$V_2 = \frac{V_1 \cdot \Delta t_1}{\Delta t_2}$$

$$V_2 = \frac{V_1 \cdot \Delta t_1}{\Delta t_2}$$

$$V_2 = \frac{75\ l \cdot 15\cancel{°C}}{75\cancel{°C}}$$

$$V_2 = 15\ l$$

12. Čeličana kocka masa 0,09 kg i temperature 840 $°C$ spusti se u sud sa mašinskim uljem temperature 20 $°C$. Nakon toplotene razmene uspostavi se temperatura 70 $°C$. Kolika je masa ulja? Specifični toplotni kapacitet čelika je 460 $\frac{J}{kg°C}$, a ulja je 2100 $\frac{J}{kg°C}$. Smatrati da je toplotna razmena sa sudom zanemarljiva.

$$m_1 = 0,09kg$$
$$t_1 = 840°C$$
$$t_2 = 20°C$$
$$t_R = 70°C$$
$$m_2 = ?$$
$$c_1 = 460\frac{J}{kg°C}$$
$$c_2 = 2100\frac{J}{kg°C}$$

$$t_1 > t_R > t_2$$
$$840°C > 70°C > 20°C$$
$$\Delta t_1 = t_1 - t_R$$
$$\Delta t_1 = 840°C - 70°C$$
$$\Delta t_1 = 770°C$$
$$\Delta t_2 = t_R - t_2$$
$$\Delta t_2 = 70°C - 20°C$$
$$\Delta t_2 = 50°C$$

$$Q_1 = Q_2$$
$$m_1 \cdot c_1 \cdot \Delta t_1 = m_2 \cdot c_2 \cdot \Delta t_2$$
$$\frac{m_1 \cdot c_1 \cdot \Delta t_1}{c_2 \cdot \Delta t_2} = m_2$$
$$m_2 = \frac{m_1 \cdot c_1 \cdot \Delta t_1}{c_2 \cdot \Delta t_2}$$

$$m_2 = \frac{m_1 \cdot c_1 \cdot \Delta t_1}{c_2 \cdot \Delta t_2}$$
$$m_2 = \frac{0,09kg \cdot 460\frac{J}{kg°C} \cdot 770°C}{2100\frac{J}{kg°C} \cdot 50°C}$$
$$m_2 = \frac{31\,878\,kg}{105000}$$
$$m_2 \approx 0,3kg$$

13. U 0,7 kg vode temperature 58 $°C$ ulije se 1,52 kg alkohola temperature 17 $°C$. Odredi temperaturu smeše. Specifični toplotni kapacitet vode je 4200 $\frac{J}{kg°C}$, a alkohola je 2500 $\frac{J}{kg°C}$.

$$m_1 = 0,7kg$$

$$t_1 = 58°C$$

$$m_2 = 1,52kg$$

$$t_2 = 17°C$$

$$t_R = ?$$

$$c_1 = 4200\frac{J}{kg°C}$$

$$c_2 = 2500\frac{J}{kg°C}$$

$$t_1 > t_R > t_2$$

$$58°C > t_R > 17°C$$

$$\Delta t_1 = t_1 - t_R$$

$$\Delta t_2 = t_R - t_2$$

$$Q_1 = Q_2$$

$$m_1 \cdot c_1 \cdot \Delta t_1 = m_2 \cdot c_2 \cdot \Delta t_2$$

$$m_1 \cdot c_1 \cdot (t_1 - t_R) = m_2 \cdot c_2 \cdot (t_R - t_2)$$

$$m_1 \cdot c_1 \cdot t_1 - m_1 \cdot c_1 \cdot t_R = m_2 \cdot c_2 \cdot t_R - m_2 \cdot c_2 \cdot t_2$$

$$m_2 \cdot c_2 \cdot t_2 + m_1 \cdot c_1 \cdot t_1 = m_1 \cdot c_1 \cdot t_R + m_2 \cdot c_2 \cdot t_R$$

$$m_2 \cdot c_2 \cdot t_2 + m_1 \cdot c_1 \cdot t_1 = t_R \cdot (m_1 \cdot c_1 + m_2 \cdot c_2)$$

$$t_R = \frac{m_2 \cdot c_2 \cdot t_2 + m_1 \cdot c_1 \cdot t_1}{m_1 \cdot c_1 + m_2 \cdot c_2}$$

$$t_R = \frac{1,52kg \cdot 2500\frac{J}{kg°C} \cdot 17°C + 0,7kg \cdot 4200\frac{J}{kg°C} \cdot 58°C}{0,7kg \cdot 4200\frac{J}{kg°C} + 1,52kg \cdot 2500\frac{J}{kg°C}}$$

$$t_R = \frac{64\,600J + 170\,520J}{2940\frac{J}{°C} + 3800\frac{J}{°C}}$$

$$t_R = \frac{235\,120J}{6740\frac{J}{°C}}$$

$$t_R \approx 35°C$$