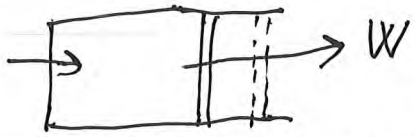
7.309 a) $Q = 14\,kJ$

$W = -6{,}0\,kJ$



$\Delta U = Q + W = (14 - 6{,}0)\,kJ = \underline{8{,}0\,kJ}$

b) $\underline{Q = 0}$ $\quad \Delta U = W = \underline{2{,}0\,kJ}$

7.310 + $T_1 = 273K$

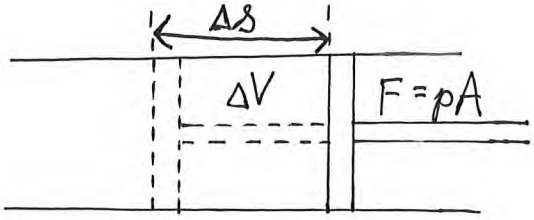
$E_{k1} = \frac{3}{2} N k T_1$ og $E_{k2} = 2E_{k1} = \frac{3}{2} N k T_2$

$2 \cdot \frac{3}{2} N k T_1 = \frac{3}{2} N k T_2$

$T_2 = 2 \cdot T_1 = 2 \cdot 273K = 546K$

$t_2 = T_2 - T_0 = (546 - 273)°C = \underline{273°C}$ dvs 3)

7.312+



a) $p = \frac{F}{A}$ gir $F = pA$

p = konst

b) $W = F \cdot \Delta s = pA\Delta s = p\Delta V$

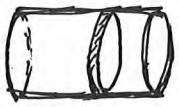
c) $\Delta U = Q + W$ $\quad W = 0$ pga $\Delta V = 0$ ved konstant volum.

Dette gir $\Delta U = Q$

All varme går til temperaturøkning

p = konst $\Rightarrow W = p\Delta V \neq 0$

All varme vil ikke gå til temperaturøkning. Det kreves dermed mer varme for tilsvarende temp. endring.



H_2-gass $\quad V_1 = 5{,}0\ dm^3 \quad p_1 = 147\ kPa$

$t_1 = 7{,}0°C \Rightarrow T_1 = (273 + 7{,}0)K = 280{,}0K$

$T_2 = (273 + 27)K = 300K$

$Q = 180\ J$

d) $V_2 = ?$ $\quad \frac{p_2 V_2}{T_2} = \frac{p_1 V_1}{T_1}$ og $p_2 = p_1$

$$V_2 = V_1 \cdot \frac{T_2}{T_1} = 5{,}0\,dm^3 \cdot \frac{300K}{280K} = 5{,}357\,dm^3 = \underline{5{,}4\,dm^3}$$

e) $W = p\Delta V = p(V_2 - V_1) = 147 \cdot 10^3\ Pa \cdot (5{,}357 - 5{,}0) \cdot 10^{-3}\ m^3$

$= 52{,}479\ J = \underline{52\ J}$

f) $\Delta U = Q + W = 180\ J - 52\ J = \underline{128\ J}$

g) 128 J ettersom $W = 0$ nå og ΔT er som før. 128 J gikk da til ΔU.

7.313+

a) $t_1 = 27^\circ C \Rightarrow T_1 = (273+27)K = 300K$

$p_1 = 2{,}00 \cdot 10^5 Pa \qquad V_1 = 10{,}0\,dm^3 \qquad V_2 = 22{,}4\,dm^3 \qquad T_2 = ?$

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2} \quad \text{og} \quad p_1 = p_2 \qquad \Delta V = V_2 - V_1$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad | \cdot T_1 \cdot T_2$$

$$T_2 \cdot V_1 = T_1 \cdot V_2$$

$$T_2 = T_1 \cdot \frac{V_2}{V_1} = 300K \cdot \frac{22{,}4\,dm^3}{10{,}0\,dm^3} = 672K$$

dvs $t_2 = (672-273)^\circ C = \underline{399^\circ C}$

$$W = p\Delta V = 2{,}00 \cdot 10^5 Pa \cdot (22{,}4 - 10{,}0) \cdot 10^{-3} m^3 = 2480J = \underline{2{,}48kJ}$$

b) V endret lik $22{,}4\,dm^3$

$T_3 = 300K \qquad p_3 = ? \qquad T_2 = 672K$

$$\frac{p_3}{T_3} = \frac{p_2}{T_2}$$

$$p_3 = p_2 \cdot \frac{T_3}{T_2} = 2{,}00 \cdot 10^5 Pa \cdot \frac{300K}{672K} = 8{,}9285 \cdot 10^4 Pa$$

$$= \underline{8{,}93 \cdot 10^4 Pa}$$

$W = 0$ fordi $\Delta V = 0$

c) Varmen strømmer ut, dvs negativ Q i b)

$\Delta U = Q + W$ blir til $\Delta U = Q$ i b) og ΔU er også negativ.

I a) er W negativ, og ΔU positiv (fordi T øker).

Q må dermed være positiv og større enn W er negativ for å gi dette resultatet.

7.318 a) $m_v = 0{,}200\,kg$ vann

$\Delta T = (80{,}0 - 25{,}0)K = 55{,}0\,K$

$c_v = 4{,}18 \cdot 10^3 \frac{J}{kgK}$

$Q = c_v m_v \Delta T = 4{,}18 \cdot 10^3 \frac{J}{kgK} \cdot 0{,}200\,kg \cdot 55{,}0\,K = 45980\,J$

$\underline{Q = 46{,}0\,kJ}$

b) $m_g = 0{,}200\,kg$ $Q = 45980\,J$

$t_1 = 25{,}0\,°C$ $c_g = 2{,}43 \cdot 10^3 \frac{J}{kgK}$

$t_2 = ?$

$Q = c_g m_g \Delta T$

$\Delta T = \frac{Q}{c_g m_g} = \frac{45980\,J}{2{,}43 \cdot 10^3 \frac{J}{kgK} \cdot 0{,}200\,kg} = 94{,}6\,K$

$t_2 = t_1 + \Delta T = (25{,}0 + 94{,}6)\,°C = 119{,}6\,°C$

$\underline{t_2 = 120\,°C}$

7.335 $m_v = 0{,}100\,kg$ $m_K = 0{,}130\,kg$

$t_v = 15\,°C$ $m_{AL} = 0{,}075\,kg$

$t = 25\,°C$ $t_{AL} = 97\,°C$ $c_{AL} = ?$

a) $Q_K = c_K m_K \Delta T_K = 385 \frac{J}{kgK} \cdot 0{,}130\,kg \cdot (25 - 15)K = 500{,}5\,J$

$\underline{Q_K = 0{,}50\,kJ}$

b) $Q_v = c_v m_v \Delta T_v = 4{,}18 \cdot 10^3 \frac{J}{kgK} \cdot 0{,}100\,kg \cdot (25 - 15)K = \underline{4{,}2\,kJ}$

$(4{,}18 \cdot 10^3\,J)$

7.335 c) $Q_{Al} = c_{Al} \cdot m_{Al} \cdot \Delta T_{Al} = Q_{mottatt}$

$Q_{AL} = Q_K + Q_V$

$Q_{AL} = 500{,}57\,J + 4180\,J = 4680\,J$

$\underline{Q_{AL} = 4{,}7\,kJ}$

d) $Q_{AL} = c_{AL} \cdot m_{AL} \cdot \Delta T_{AL}$

$c_{AL} = \frac{Q_{AL}}{m_{AL} \cdot \Delta T_{AL}} = \frac{4680\,J}{0{,}075\,kg \cdot (97-25)K} = 866{,}6\,\frac{J}{kgK}$

$\underline{c_{AL} = 0{,}87\,\frac{kJ}{kgK}}$

e) $Q_{AL} = Q_K + Q_V + Q_{omgiv}$

Q_{AL} er altså noe høyere enn 4680 J

dvs. c_{AL} er også noe høyere

7.340 + $P = 1100\,W = 1100\,\frac{J}{s}$ $t_1 = 20°C$ $\rho_l = 1{,}20\,\frac{kg}{m^3}$ $\frac{\Delta V}{t} = 9{,}0\,\frac{dm^3}{s}$ $c_l = 1{,}00\,\frac{kJ}{kgK}$

a) $Q = 1100\,J$ per sekund

$Q = c_l m_l \Delta T = c_l \cdot \rho_l \cdot V_l \cdot \Delta T$

$\Delta T = \frac{Q}{c_l \cdot \rho_l \cdot V_l} = \frac{1100\,J}{1000\,\frac{J}{kgK} \cdot 1{,}20\,\frac{kg}{m^3} \cdot 9{,}0 \cdot 10^{-3}\,m^3} = 101{,}8°C$

$t_{ny} = t + \Delta t = (20 + 101{,}8)°C = \underline{122°C}$

b) $t_2 = 50°C$ og $t_1 = 122°C$ $\Delta T = t_1 - t_2 = (122-50)°C = 72K$

$P = c_l \cdot \rho_l \cdot V_l \cdot \Delta T = 1000\,\frac{J}{kgK} \cdot 1{,}20\,\frac{kg}{m^3} \cdot 9{,}0 \cdot 10^{-3}\,m^3 \cdot 72K = 777{,}6\,\frac{J}{s}$

$Q_{tot} = P \cdot tid = 777{,}6\,\frac{J}{s} \cdot 2{,}0 \cdot 3600\,s = 5{,}598 \cdot 10^6\,J$

$Q_{tot} = l_{damp} \cdot m$

$m = \frac{Q_{tot}}{l_{damp}} = \frac{5{,}598 \cdot 10^6\,J}{2{,}26 \cdot 10^6\,\frac{J}{kg}} = \underline{2{,}5\,kg}$

7.357 $A = 1{,}5\,m^2$ ⊥ på solstråleretningen.

$\frac{P}{A} = 750\,\frac{W}{m^2}$ 80% går til vannet og beholderen.

a) $E = \frac{80}{100} \cdot P \cdot t = 0{,}80 \cdot \frac{P}{A} \cdot A \cdot t = 0{,}80 \cdot 750\,\frac{W}{m^2} \cdot 1{,}5\,m^2 \cdot 60\,s$

$= 54000\,J = \underline{54\,kJ}$

b) $\Delta T = (100 - 20)\,K = 80\,K$

$t = 6 \cdot 60\,s = 360\,s$

$C_{B+V} = 3{,}7 \cdot 10^3\,\frac{J}{K}$

$E_{total} = E \cdot 6 = 54\,kJ \cdot 6 = 324\,kJ$ ← ant. minutter

$Q = C \cdot \Delta T = 3{,}7\,\frac{kJ}{K} \cdot 80\,K = 296\,kJ$

$Q_{tap} = E_{total} - Q = (324 - 296)\,kJ = \underline{28\,kJ}$

c) Fordamping $l = 2260\,\frac{kJ}{kg}$

$P_{tap} = 2{,}0\,\frac{W}{K} \cdot \Delta t$ $\quad \Delta t = (100 - 20)\,K = 80\,K$

$P_{tap} = 160\,W$

$tid = 3{,}0\,min. = 180\,s$

$Q = \underbrace{m \cdot l}_{\text{til fordamping}} + \underbrace{P_{tap} \cdot tid}_{\text{til omgivelsene}}$ $\quad Q_{tap} = 160\,\frac{J}{s} \cdot 180\,s = 28{,}8\,kJ$

tilført til vannbeholder ↑

($Q_{fordamp} = m\,l$)

$Q = P \cdot tid = m \cdot l + P_{tap} \cdot tid$

$\frac{P \cdot tid - P_{tap} \cdot tid}{l} = m$

$\frac{0{,}80 \cdot 750 \cdot 1{,}5\,\frac{J}{s} \cdot 180\,s - 160\,\frac{J}{s}\,180\,s}{2260 \cdot 10^3\,\frac{J}{kg}} = 0{,}0589\,kg = \underline{59\,g}$

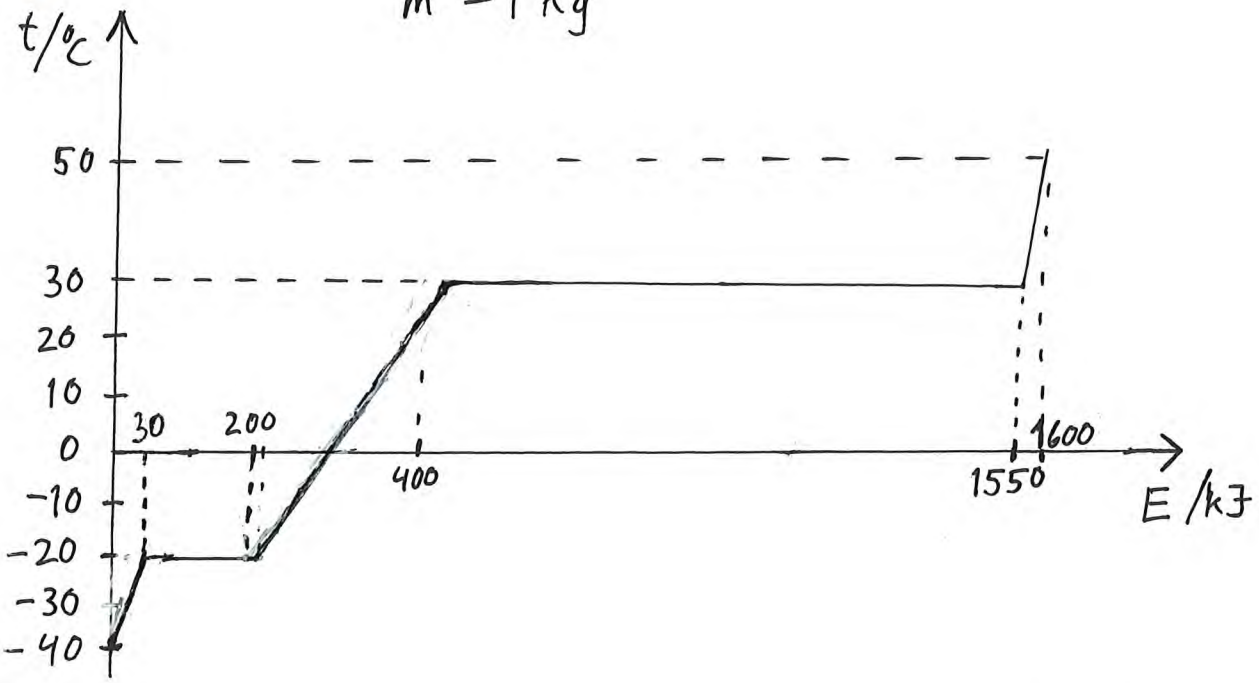
7.345 c) $Q_H = Q_L + W$ $\quad \eta = \frac{W}{Q_H} = \frac{Q_H - Q_L}{Q_H} = 1 - \frac{Q_L}{Q_L}$

$W = Q_H - Q_L$ $\quad \eta = 1 - \frac{T_L}{T_H}$

og $\frac{Q_L}{Q_H} = \frac{T_L}{T_H}$ $\rightarrow$

7.359

$m = 1\,kg$



a) $-20°C$ $\quad$ b) $30°C$ $\quad$ c) $l_s = \frac{Q_s}{m} = \frac{(200-30)kJ}{1kg}$

$l_s = 170\frac{kJ}{kg} = 0{,}17\frac{MJ}{kg}$

d) $l_f = \frac{Q_f}{m} = \frac{(1550-420)kJ}{1kg} = 1130\frac{kJ}{kg} = 1{,}1\frac{MJ}{kg}$

e) $c = \frac{Q}{m\Delta t} = \frac{(30-0)kJ}{1kg\cdot(-20-(-40))K} = \frac{30kJ}{20kgK} = 1{,}5\frac{kJ}{kgK}$

f) $c = \frac{Q}{m\Delta t} = \frac{(420-210)kJ}{1kg\cdot(30-(-20))K} = \frac{210kJ}{50kgK} = 4{,}2\frac{kJ}{kgK}$

g) $c = \frac{Q}{m\Delta t} = \frac{(1600-1550)kJ}{1kg\cdot(50-30)K} = \frac{50kJ}{20Kkg} = 2{,}5\frac{kJ}{kgK}$