

A1

a) $0 = \dot{m}(h_e - h_a) + Q_{aus}$

$Q_{aus} = \dot{m}(h_e - h_a) =$

$h_e - h_a = c_v (T_2 - T_1)$

$n_g(T=70^\circ) = 2626 \cdot 8$

$\dot{m}_{dh} = 0.3 = \dot{m}_{aus}$

$T_{e,m} = 343.15 \text{ K}$

$T_{aus} = 373.75 \text{ K}$

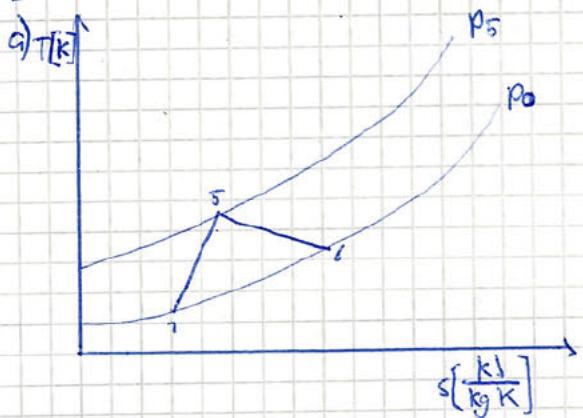
$m_{ges} = 5755 \text{ kg}$

$T_{KF,dh} = 288.15 \text{ K}$

$T_{KF,aus} = 298.15 \text{ K}$

Category	Sub-Categories	Definition	Example
1. General Information	1.1 Personal Details	Name, Age, Gender, Address, Contact Information	Jane Doe, 30, Female, 123 Main St, 555-1234
1. General Information	1.2 Professional Details	Employment Status, Job Title, Company Name, Work Experience	Full-time, Software Engineer, Acme Corp., 5 years
1. General Information	1.3 Academic Details	Education Level, Degree, Major, Graduation Year	Bachelor's, Computer Science, 2018
1. General Information	1.4 Health & Medical History	Medical Conditions, Allergies, Medications, Previous Treatments	Type 2 Diabetes, Penicillin allergy, Metformin, Insulin
2. Financial Information	2.1 Income & Expenses	Gross Income, Net Income, Monthly Expenses, Budget Allocation	\$50,000 gross, \$40,000 net, \$2,000 rent, 30% savings
2. Financial Information	2.2 Investment Portfolio	Stocks, Bonds, Mutual Funds, Cryptocurrency Holdings	10% stocks, 50% bonds, 30% cash, 10% crypto
2. Financial Information	2.3 Retirement Planning	401(k), IRA, Pension, Social Security Benefits	15% 401(k), 5% IRA, 10% pension
2. Financial Information	2.4 Debt Management	Home Mortgage, Auto Loans, Credit Card Debt, Student Loans	\$200k mortgage, \$10k auto loan, \$5k credit card debt
3. Household & Living	3.1 Housing	Type of Residence, Rent/Mortgage, Number of Bedrooms, Square Footage	Single-family home, \$1,500/month, 3 bedrooms, 1,800 sq ft
3. Household & Living	3.2 Utilities	Electricity, Gas, Water, Internet, Phone, Cable	Electricity: \$100/mo, Gas: \$50/mo, Water: \$20/mo, Internet: \$50/mo, Phone: \$30/mo, Cable: \$100/mo
3. Household & Living	3.3 Transportation	Car Payments, Fuel Costs, Maintenance, Public Transport	Car payment: \$500/mo, Fuel: \$100/mo, Maintenance: \$50/mo, Public Transport: \$50/mo
3. Household & Living	3.4 Groceries	Food Shopping, Dining Out, Delivery Services	Food shopping: \$500/mo, Dining out: \$200/mo, Delivery services: \$50/mo
3. Household & Living	3.5 Household Goods	Groceries, Cleaning Supplies, Laundry Services	Groceries: \$200/mo, Cleaning supplies: \$50/mo, Laundry services: \$50/mo
4. Work & Career	4.1 Work Environment	Office Location, Commute Time, Work Hours, Job Satisfaction	Remote work, 1 hour commute, 9-5, 80% satisfied
4. Work & Career	4.2 Professional Development	Training Courses, Certifications, Conferences Attended	Completed Python course, Certified in Data Science, Attended AI conference
4. Work & Career	4.3 Work-Life Balance	Work Hours, Vacation Days, Flexible Scheduling	40-hour work week, 2 weeks vacation, flexible schedule
4. Work & Career	4.4 Job Satisfaction	Job Satisfaction, Career Progression, Job Satisfaction	High job satisfaction, career progression, high job satisfaction
5. Health & Well-being	5.1 Physical Health	Exercise, Diet, Medical Check-ups, Health Concerns	30 minutes exercise, healthy diet, annual check-up, no health concerns
5. Health & Well-being	5.2 Mental Health	Stress Levels, Mood, Therapy Sessions, Medications	Low stress levels, positive mood, weekly therapy sessions, no medications
5. Health & Well-being	5.3 Sleep Quality	Sleep Duration, Sleep Quality, Sleep Disruptions	8 hours sleep, good quality, no disruptions
5. Health & Well-being	5.4 Overall Health	Health Score, Health Status, Health Concerns	Excellent health score, healthy status, no health concerns
6. Social & Community	6.1 Social Network	Friends, Family, Colleagues, Social Media Presence	Close friends, supportive family, professional colleagues, active on social media
6. Social & Community	6.2 Community Involvement	Volunteer Work, Local Events, Civic Engagement	Active volunteer, attends local events, involved in civic engagement
6. Social & Community	6.3 Personal Relationships	Relationship Status, Partner Information, Family Dynamics	Married, partner works at Acme Corp., family dynamics
6. Social & Community	6.4 Social Life	Entertainment Activities, Social Gatherings, Hobbies	Attends social gatherings, enjoys hobbies, participates in entertainment activities
7. Financial Health	7.1 Budgeting	Budgeting Process, Financial Goals, Emergency Fund	Consistent budgeting, financial goals, emergency fund
7. Financial Health	7.2 Investment Strategy	Investment Strategy, Risk Tolerance, Diversification	Diversified investment strategy, moderate risk tolerance
7. Financial Health	7.3 Debt Management	Debt Management Plan, Interest Rates, Payment History	Debt management plan, low interest rates, good payment history
7. Financial Health	7.4 Retirement Planning	Retirement Savings, Investment Allocation, Withdrawal Strategy	High retirement savings, diversified investment allocation, conservative withdrawal strategy
8. Technology & Tools	8.1 Productivity Tools	Project Management Software, Time Tracking, Collaboration Tools	Using Asana for projects, Trello for tasks, Slack for collaboration
8. Technology & Tools	8.2 Communication Tools	Email, Instant Messaging, Video Conferencing, Cloud Storage	Primary communication via email, occasional messaging, video conferencing, cloud storage
8. Technology & Tools	8.3 Data Analysis Tools	Excel, Google Sheets, R, Python, Tableau	Using Excel for basic analysis, Python for more complex models, Tableau for visualizations
8. Technology & Tools	8.4 Digital Marketing Tools	Google Analytics, SEO, SEM, Content Marketing	Utilizing Google Analytics, SEO, SEM, content marketing
9. Personal Growth	9.1 Learning	Books Read, Courses Taken, Online Classes	Reading books on personal development, taking online courses
9. Personal Growth	9.2 Self-care	Exercise, Meditation, Healthy Eating, Sleep	Consistent exercise, meditation, healthy eating, sleep
9. Personal Growth	9.3 Personal Interests	Hobbies, Creative Pursuits, Volunteer Work	Engaged in hobbies, creative pursuits, volunteer work
9. Personal Growth	9.4 Personal Fulfillment	Job Satisfaction, Life Satisfaction, Overall Well-being	High job satisfaction, life satisfaction, overall well-being

A2



	p	T	w
z1	0.91	-30°C	200
z2			
z3			
z4			
z5	0.5	431.9K	220
z6	1	359.3K	

b) w_6, T_6

$$T_6 = T_5 \cdot \left(\frac{0.5}{1} \right)^{\frac{7.4-1}{7.4}} = \underline{359.30 \text{ K}}$$

$$\begin{aligned} c) \Delta e_x &= e_{x,6} - e_{x,1} = m_6 u_6 - m_1 u_1 + \left(\frac{w_6^2}{2} - \frac{w_1^2}{2} \right) \\ &= u_6 - u_1 + \underbrace{\left(\frac{510^2}{2} - \frac{200^2}{2} \right)}_{-110.050} \end{aligned}$$

$$u(T=359.30) = \frac{257.24 - 250.02}{10} \cdot 0.3 + 250.02 = \underline{253.1246}$$

$$u(T=243.15) = \frac{178.28 - 171.13}{250-240} \cdot 3.75 + 171.13 = \underline{173.3823}$$

$$\begin{aligned} \Delta e_{x,\text{sur}} &= (253.1246 - 173.3823) + -110.050 \\ &= \underline{-110.729 \frac{\text{kJ}}{\text{kg}}} \end{aligned}$$

$$d) e_{x,\text{refl}} = \Delta e_{x,\text{sur}} + \left(1 - \frac{T_1}{T_6} \right) Q_{16}$$

Category	Sub-Categories	Definition	Example
1. General Information	1.1 Personal Details	Name, Age, Gender, Address, Contact Information	Jane Doe, 30, Female, 123 Main St, 555-1234
1. General Information	1.2 Professional Details	Employment Status, Job Title, Company Name, Work Experience	Full-time, Software Engineer, Acme Corp., 5 years
1. General Information	1.3 Education	Level of Education, Degree, Major, Institutions Attended	Bachelor's, Computer Science, University of Michigan
1. General Information	1.4 Health & Medical History	Medical Conditions, Allergies, Medications, Previous Treatments	None
2. Academic Record	2.1 Grade Point Average (GPA)	Overall GPA, by semester, by year	3.8, 3.9, 4.0
2. Academic Record	2.2 Coursework	List of courses taken, grades received, descriptions	Calculus I (A), Linear Algebra (B+), Data Structures (A-)
2. Academic Record	2.3 Honors & Awards	Academic awards, scholarships, research grants	Dean's List, National Merit Scholarship
2. Academic Record	2.4 Extracurricular Activities	Participation in clubs, sports, volunteer work	Member of Math Club, Played Basketball
3. Professional Experience	3.1 Internships	Places interned, responsibilities, duration	Google, Summer 2018, 3 months
3. Professional Experience	3.2 Part-time Jobs	Job titles, companies, hours worked per week	Sales Associate at Walmart, 20 hours/week
3. Professional Experience	3.3 Full-time Employment	Job titles, companies, duration, responsibilities	Software Engineer at Acme Corp., 1 year, Develop new features for product X
3. Professional Experience	3.4 Volunteering	Organizations volunteered for, roles, duration	Local Food Bank, 6 months, Assisted with food distribution
4. Personal Interests & Hobbies	4.1 Sports	Types of sports played, skill level, team names	Football, High School Team, Captain
4. Personal Interests & Hobbies	4.2 Music	Instruments played, genres, performance experience	Guitar, Rock Band, Solo Performer
4. Personal Interests & Hobbies	4.3 Art & Creativity	Mediums used, styles, participation in exhibitions	Painting, Abstract, Local Art Show Participant
4. Personal Interests & Hobbies	4.4 Travel	Destinations visited, modes of transport, memorable experiences	Europe, Airplane, Amazing sunsets over the ocean
4. Personal Interests & Hobbies	4.5 Technology	Interest in tech, specific interests like AI, VR, Blockchain	AI, Machine Learning, Deep Learning
5. Skills & Abilities	5.1 Technical Skills	Programming Languages, Database Management, Software Proficiency	Python, MySQL, Microsoft Office
5. Skills & Abilities	5.2 Soft Skills	Communication, Problem Solving, Leadership, Teamwork	Excellent communication skills, Strong problem solver
5. Skills & Abilities	5.3 Physical Abilities	Sports, Exercise, Physical fitness	Swimming, Running, Good physical condition
5. Skills & Abilities	5.4 Language Proficiency	Native language, second languages, fluency levels	English, Spanish, Intermediate
6. References	6.1 Personal References	Names, Relationship to applicant, contact information	Mother, Father, Uncle
6. References	6.2 Professional References	Names, Job Title, Company, Relationship to applicant, contact information	Supervisor, Manager, Boss
6. References	6.3 Academic References	Names, Institution, Relationship to applicant, contact information	Professor, Advisor, Mentor
6. References	6.4 Other References	Names, Type of reference, contact information	Friend, Family Member, Colleague

A3

a) $p_{g,1} \cdot V = mRT$

$$R = \frac{P}{M} = \frac{8.314}{0.05} = 166.28$$

$$m = m_K + m_{EW} = 32 \text{ kg}$$

$$p_{g,1} = p_{amb} + \frac{32 \text{ kg}}{0.05 \text{ m}^3 \cdot \text{J}} = 100000 \text{ Pa} + 100000 \text{ Pa} = 200000 \text{ Pa}$$

$$m = \frac{p \cdot V}{RT} = \frac{100000 \cdot 0.00314}{166.28 \cdot 273.15} = 3.0441 \text{ g}$$

b) $T_{g,2}, p_{g,2}$

$$V_2 = V_1$$

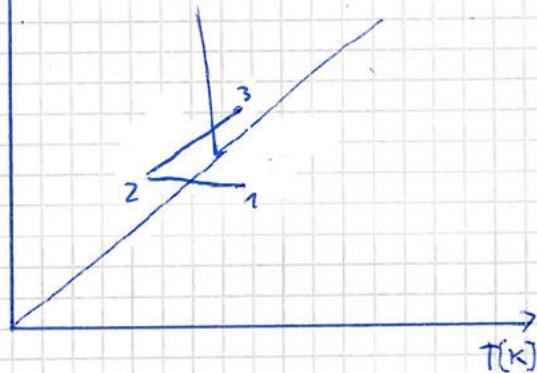
$$T_{g,2} = 0.003^\circ\text{C}$$

$$|Q_{12}| = 1500 \text{ J} = 15 \text{ kJ}$$

c) $x_{eis,2} = \frac{m_{eis,2}}{m_{EW}} =$

A4

a) $p_{\text{sat}}[\text{bar}]$



b) $v_{\text{mfp}, 237.9} = ?$

$$c) x_1 = \frac{h - h_f}{h_g - h_f} = \frac{234.93 - 26.29}{232.85 - 49.29} = \frac{208.64}{183.56} = 1.127$$
$$h(T-22^\circ\text{C}) = 234.93 + (236.54 - 234.93) \cdot \underbrace{\frac{1.127}{1.127 - 0.127}}_{\text{Interpolation}} = 236.54$$
$$d) \dot{Q}_K = \frac{\dot{Q}_{\text{ab}}}{|\dot{Q}_{\text{ab}}| - |\dot{Q}_K|} =$$
$$\dot{Q}_K =$$

e) Annäherung an Temperatur des Kühlmittels