Thermodynamics exercise 1st and 2nd law, volumetric work, heat - 2020

d) W·s

Glencoe p. 326 – Example problem + practice problems Glencoe p. 328 - dtto Glencoe p. 329 – consider problems

Glencoe p. 334 – practice problems

1. The working cycle of the Carnot ideal engine consists of:

a) only one isothermal and adiabatic process

b) one isothermal and two adiabatic processes

c) two isothermal and two adiabatic processes

d) two isochoric and two isobaric processes

e) No answer is correct.

2. The unit of heat capacity is: a) J b) $J \cdot m^{-3}$ c) $J \cdot mol^{-1}$

e) No answer is correct.

3. The First law of thermodynamics represents:

a) a rule describing spontaneous increase of disorder in an isolated system

b) a rule describing transformation of heat in free energy

c) a rule describing spontaneous decrease of disorder in an isolated system

d) a special application of the law of conservation of energy

e) No answer is correct.

4. The 2nd law of thermodynamics represents:

a) a special formulation of energy conservation principle

b) a rule describing decrease of entropy in an isolated system

c) a rule describing spontaneous ordering of an isolated system

d) a rule describing spontaneous increase of disorder in an isolated system

e) No answer is correct.

5. The 2nd law of thermodynamics represents:

a) a special formulation of energy conservation principle

b) a rule describing increase of entropy in an isolated system

c) a rule describing spontaneous ordering of an isolated system

d) a rule describing spontaneous descrease of disorder in an isolated system

e) No answer is correct.

6. The mechanical (volumetric) work of a perfect gas is proportional:

- a) to its volume b) to its temperature
- c) to its pressure d) to the gas entropy
- e) No answer is correct.

7. The work done by an ideal (perfect) gas at constant pressure is given by the term:
a) p/V
b) p·ΔV
c) n·R·T
d) Δp·V
e) No answer is correct.

8. The work done by an ideal (perfect) gas at constant volume is given by the term:

a) p/V b) $p \cdot V$ c) $n \cdot R \cdot T$ d) $\Delta p \cdot V$ e) No answer is correct.

9. The term $c \cdot m \cdot \Delta t$, where *c* is specific heat of the homogeneous body, *m* is a mass of this body, and *t* its temperature, has the same unit as:

a) universal gas constant R d) Avogadro constant	b) pressure c) work e) No answer is correct.
10. Heat cannot be exchanged by systems:a) without having a mutual mechanical conc) with the same temperaturese) No answer is correct.	tact b) with different temperatures d) occurring in a non-equilibrium state
 11. Gas pressure is always directly proporti a) the square (second power) of mean veloc b) size of gas molecules. c d) specific evaporation heat of the gas. 	onal to: bity of gas molecules.) gas thermal conductivity. e) No answer is correct.
Phase transitions	
Glencoe 333 – sample problems + practice problems Glencoe 339 – consider Section 2 problems Glencoe 342 – 345 good training, test highly recommended	
 Ice (with initial temperature of 0 °C) me pressure. As a result of it, the temperature i a) did not change. b) decreased. d) first increased and then decreased. 	elted partly in an isolated vessel due to the action of high nside the vessel c) increased. e) No answer is correct.
 2. A certain amount of snow (with initial te NaCl (of the same temperature) and melted inside the vessel a) did not change. b) decreased. d) first increased and then decreased. 	 mperature of 0 °C) was mixed in an isolated vessel with as a result of it. During the melting, the temperature c) increased. e) No answer is correct.
 3. Ice was mixed with concentrated solution in its partial melting. During that, its temperal did not change b) lowered by several d) increased at first and then lowered 	n of urea in a thermally insulated vessel, which resulted rature: l degrees c) increased by several degrees e) no answer is correct
 4. Which of the following processes can be a) boiler incrustation b) forr c) formation of kidney stones d) whe e) no answer is correct 	condensation? nation of sediments on sea bed en the windowpanes become foggy
 5. Which of the following statements is true a) Evaporating water releases heat. b) C ice absorbs heat during sublimation (eva d) Water vapour absorbs heat during condered 	e?) Water absorbs heat during condensation poration). nsation. e) no answer is correct
 6. Which of the following statements is true a) Melting ice absorbs heat. b) Fr c) Water absorbs heat during condensation. d) Melting ice releases heat. e) no a 	e? eezing water absorbs heat. mswer is correct
7. Which of the following processes is a de	sublimation?

a) formation of tooth tartar b) formation of deposits on the sea bottom

c) formation of ice "flowers" (frostwork) on windowpanes in winter

d) fogging up of windows in a damp room

e) No answer is correct.

Some problems taken from Glencoe:

1. A drill bores a small hole in a 0.4 kg block of aluminium and heats the aluminium by 5 °C. How much work did the drill do in boring the hole?

Idea: all the work was transformed into heat (due to friction)! Specific heat capacity of aluminium is 897 J/(K.kg)

2. When you stir a cup of tea, you do about 0.050 J of work each time you circle the spoon in the cup. How many times would you have to stir the spoon to heat a 0.15 kg cup of tea by 2.0 °C?

Idea: all the work is transformed into heat (due to friction)! Tea = water

3. 81 g of ice melts and warms to 10 °C. How much thermal energy is absorbed from the surrounding when it occurs?

Idea: during melting of ice and warming water some heat is absorbed.

4. How much heat is required to heat 87 g of ice at 14 K to water vapour at 140 °C? **Idea:** during melting of ice and warming water some heat is absorbed. (Latent) heat of fusion/solidification/melting of ice $H_f = 3.34 \times 10^5$ J/kg (Latent) heat of vaporisation/condensation of water $H_V = 2.26 \times 10^6$ Specific heat of ice C = 2060 J/(K.kg), water 4180 J/(K.kg), water vapour 2020 J/(K.kg) In a real case, the amount of heat we need is higher. Why?