1. (16 marks, a mark for each question) Choose the most correct answer and fill in the provided answer sheet:

1. **The enthalpy of the outlet stream of a compressor is _____ than that of the inlet stream.**
   a) always lower.
   b) always higher.
   c) always equal.
   d) may be higher or lower.

2. **Global warming is caused mainly by**
   a) emissions of CFC.
   b) emissions of HFC.
   c) emissions of SO_X and NO_X.
   d) emissions of CO_2.

3. **The pressure rise for a fan does not exceed _____ bar.**
   a) 0 (a fan does not raise the pressure).
   b) 0.01.
   c) -0.01.
   d) 0.1.

4. **The specific heat at constant volume is**
   a) the amount of heat required to raise the temperature of 1 kg of water through one degree.
   b) the amount of heat required to raise the temperature of unit mass of gas through one degree, at constant pressure.
   c) the amount of heat required to raise the temperature of unit mass of liquid through one degree, at constant pressure.
   d) the amount of heat required to raise the temperature of unit mass of gas through one degree, at constant volume.

5. **The gas constant (R) is equal to the _____ of two specific heats of an ideal gas.**
   a) difference.
   b) sum.
   c) product.
   d) ratio.

6. **When two bodies are in thermal equilibrium with a third body, they are also in thermal equilibrium with each other. This statement is called**
   a) Zeroth law of thermodynamics.
   b) First law of thermodynamics.
   c) Second law of thermodynamics.
   d) Third law of thermodynamics.

7. **The measurement of a thermodynamic property known as temperature is based on _____.**
   a) Ideal gas law.
   b) Zeroth law of thermodynamics.
   c) First law of thermodynamics.
   d) Second law of thermodynamics.

8. **One kg of carbon produces _____ kg of carbon dioxide.**
   a) 11/7.
   b) 7/11.
   c) 3/11.
   d) 11/3.

9. **The processes occurring in an open system which permit the transfer of mass to and from the system, are known as**
   a) non-flow processes.
   b) flow processes.
   c) adiabatic processes.
   d) None of these.

10. **Which of the following is correct?**
   a) Absolute pressure = Gauge pressure + Atmospheric pressure.
   b) Absolute pressure = Gauge pressure - Atmospheric pressure.
   c) Gauge pressure = Absolute pressure + Atmospheric pressure.
   d) Atmospheric pressure = Absolute pressure + Gauge pressure

11. **For a closed system, an adiabatic process is one in which?**
   a) No heat enters or leaves the gas.
   b) The temperature of the gas changes.
   c) The change in internal energy is equal to the mechanical work done.
   d) All of the above.

12. **The specific heat of water is _____ kJ/kg.K.**
   a) 1.0 .
   b) 8.314.
   c) 1.817.
   d) 4.187.

13. **The device in which a pressure reduction occurs isenthalpically is a _____.**
   a) Turbine.
   b) Throttling valve.
   c) Compressor.
   d) Polytropic valve.

14. A series of operations, which takes place in a certain order and restore the initial conditions at the end, is known as _____.
a) Irreversible cycle.
b) Reversible cycle.
c) Thermodynamic cycle. → (reversible + irreversible)
d) None of these.

15. The reference point of steam tables is
a) Liquid water at its critical point.
b) Liquid water at its triple point.
c) Water vapor at its triple point.
d) Water solid at its triple point.

16. In a given process of an ideal gas, $\delta W = 0$ and $\delta Q < 0$, Then for the gas
a) the temperature will increase.
b) the temperature will decrease.
c) the volume will increase.
d) the pressure will remain constant.

$\Delta U = Q - W$
$Q > 0$ → By the system
$W = 0$

2. (9 marks) A steam turbine operates at the conditions in the table below

energy Balance in Turbin
$W = -\Delta H$.

Hout > Hin

	Inlet	Outlet
T (K)	723.15	423.15
P (MPa)	3.5	0.20
Flowrate (kg/h)	10,000	

Answer the following questions and show your calculations. Copy the correct answer to the answers sheet provided.

inlet
$T_C = T_K - 273$
$T_C = 450.15^\circ C$
outlet
$T_C = 150.15^\circ$

17. The enthalpy at the inlet of this turbine is 3358.1 kJ/kg.
a) 3338.1
b) 3238.1
c) 3138.1
d) 2769.1

بالجدول

hout
2769.1

18. The entropy at the outlet of this turbine is 2769.1 kJ/kg.K.
a) 1.5308
b) 7.0074
c) 7.1274
d) 7.2810.

بالجدول

$S_{out} = 7.2810 kJ/kg.K$

19. The power generated in this turbine is _____ kW.

kg/s

$\Delta H = W$
$W = H_{out} - H_{in}$
$W = 2769.1 - 3358.1$
$W = -569 kJ/kg \cdot 10.000 kg$
$W = -569 kJ \mid 10.00 kg \mid 1 h$
kg | h | 3600 s
$W = -1581 \frac{KJ}{s} = KW$

positive.

20. The entropy change in this turbine is _____ kJ/kg.K.

a) -0.2736
b) -0.0736
c) 0.2736
d) 1.2736

$\Delta S = S_{out} - S_{in}$

in turbin $= 7.2960 - 7.007$

$(S_{in} = S_{out})$

The turbine now is replaced with an ideal reversible and adiabatic turbine with the same specifications as below.

	Inlet	Outlet
T (K)	723.15	
P (MPa)	3.5	0.20
Flowrate (kg/h)	10,000	

Answer the following questions and show your calculations. Copy the correct answer to the answers sheet provided.

21. The enthalpy at the outlet of this turbine is _____ kJ/kg.

a) 504.71
b) 2659.3
c) 2706.3
d) 2769.1

enthalpy x flowrate = enthalpy.

inlet
$T = 450.15\,C$
$S = 7.007$ kJ/kg·K
in turbin → $S_{in} = S_{out}$

outlet
$S = 7.007$ kJ/kg·K
$P = 0.2$ MPa
↓
saturated water

22. The quality at the outlet of this turbine is _____.

a) 0.000
b) 0.021
c) 0.979
d) 1.000

$h = x h_v + (1-x) h_L$

$P = 0.2\ \text{MPa} \times \frac{10^6\ \text{Pa}}{1\ \text{MPa}} \times \frac{1\ \text{kPa}}{10^3\ \text{Pa}} = 200$ kPa.

$T = 120.21 + 273 = 393.21$ K

23. The power generated in this turbine is _____ kW.

a) 581
b) 1081
c) 1581
d) 1886

24. The isentropic efficiency of the turbine in the first part is _____%.

a) 75
b) 84
c) 100
d) 119

$(A_1 = A_2)$ $(\rho_1 A_1 v_1 = \rho_2 A_2 v_2)$

25. If the pipe diameter is to be fixed between the inlet and the outlet, then the ratio of the velocity at the outlet to that at the inlet is about _____.

a) 3
b) 10
c) 15
d) 20

$\frac{v_x}{v_1} = \frac{\rho_1}{\rho_2} = \frac{v_2}{v_1}$

$3338.1 = x(270.63) + (1-x)(504.7)$

$3338.1 = 27$

$V = 108\,m^3$

20 student

$A = 36\,m^2$

3. (5 marks) A group of twenty students attend a class in a room which measures 6 m × 6 m and has a three-meter-high ceiling. Assume that each person occupies 0.07 m^3 and gives out about 0.1 kW of heat.

$z = 3m$

1 stud → $0.07\,m^3$

$\dot{Q} = 0.1\,kJ/s$

a) Calculate the air temperature rise occurring within 15 min of the start of the class if the room is completely sealed and insulated. Take c_v for air as 0.718 kJ/(kg.K). Assume that the room is initially at 21°C and 100 kPa.

b) People will start feeling uncomfortable if the temperature exceeds 50°C. At what time will the room reach this temperature?

b)

close system

$\Delta E_k + \Delta E_p + \Delta U = Q - W + \Delta H$

$\Rightarrow \Delta U = Q$

$\Rightarrow \dot{m} C_v \Delta T = \dot{Q}$

$128\,kg \times 0.718\,\frac{kJ}{kg.k} \times (T_f - T_i) = 1800\,kJ/s$

$91.9\,\frac{kJ}{k} (T_f - T_i) = 2\,kJ/s \mid k / 91.9\,kJ$

$(T_f - T_i) = 18.8\,k$

$(T_f - T_i) = 19.58\,k$

$T_f = 19.58\,k + T_i$

$T_f = 313.5\,k$

$T = 21°C$

$T - T_0 = \frac{Q \Delta T}{m C_v}$

T at 15 min → 313.5 k

→ 323 k

1 person → 0.1 kJ/s

20 person → X

$X = 2\,kJ/s = \dot{Q}$ natural

$PV = nRT$

$n = \frac{PV}{RT}$ $\left(n = \frac{pV}{RT}\right)$

$n = 100 \times 10^3\,Pa \mid 108\,m^3 \mid mol.k / 8.314\,J \mid 294\,k$

$n = 4418\,mol$

$m = n * Mw$

$4418 * 29 = 128122\,g$

$m = 128\,kg$

$\frac{2\,kJ}{s} * 15\,min \mid 60\,s / 1\,min$

$Q = 1800\,kJ$

The temp 313.5 k after 15 min

323 k after ??

$313.5k * X = 323k \mid 15\,min$

$X = 15.45\,min$

$t = 2270\,s$

Student Name:
University ID:

	(A)	(B)	(C)	(D)
01	○	●	○	○
02	○	○	○	●
03	●	○	○	○
04	●	○	○	○
05	○	○	○	●
06	●	○	○	○
07	○	○	●	○
08	○	●	○	○
09	○	○	○	●
10	●	○	○	○
11	○	○	○	●
12	○	○	○	●
13	○	●	○	○
14	○	●	○	○
15	○	●	○	○

	(A)	(B)	(C)	(D)
16	○	●	○	○
17	●	○	○	○
18	○	○	○	●
19	○	○	●	○
20	○	○	●	○
21	○	○	●	○
22	○	●	○	○
23	○	○	●	○
24	○	●	○	○
25	○	○	○	○

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Fill the circles completely like this symbol ●.
Don't fill more than one circle for each question. If there are more than one circles filled, you will get a zero for that question.
No answers on the questions sheet will be accepted.
Use a black/blue pen not a pencil.