

EEL4935/6936 – Power Plant Engineering

Homework #2: Steam Powerplants

Due: 02/02/09

#1. Overall power plant thermal efficiency will decrease if...

- A. the steam temperature entering the turbine is increased.
- B. the temperature of the feedwater entering the steam generator is increased.
- C. the amount of condensate depression (subcooling) in the main condenser is decreased.
- D. the temperature of the steam at the turbine exhaust is increased.

ANSWER: D.

#2. The theoretical maximum efficiency of a steam cycle is given by the equation:

$$\text{Eff}_{\text{thmax}} = (1 - T_{\text{out}}/T_{\text{in}}) * 100\%,$$

where T_{out} is the absolute temperature for heat rejection and T_{in} is the absolute temperature for heat addition. (Fahrenheit temperature is converted to absolute temperature by adding 460 °.)

A nuclear power plant is operating with a stable steam generator pressure of 900 psia .

What is the approximate theoretical maximum steam cycle efficiency this plant can achieve by establishing its main condenser vacuum at 1.0 psia? (*Hint: Use steam tables to determine the temperature of the working fluid in the two states*)

- A. 35%
- B. 43%
- C. 57%
- D. 65%

ANSWER: B.

From steam tables, 900PSIA = 992K(T_{in}), 1psia = 562k(T_{out})

#3. Main condenser pressure is 1.0 psia. During the cooling process in the condenser, the temperature of the low pressure turbine exhaust decreases to 100 °F, at which time it is a...

- A. saturated liquid.
- B. saturated vapor.
- C. subcooled liquid.
- D. superheated vapor.

ANSWER: C.

#4. A liquid is saturated with 0% quality. Assuming pressure remains constant, the addition of a small amount of heat will...

- A. raise the liquid temperature above the boiling point.
- B. result in a subcooled liquid.
- C. result in vaporization of the liquid.
- D. result in a superheated liquid.

ANSWER: C.

#5. Which one of the following is the approximate steam quality of a steam-water mixture at 467 °F with an enthalpy of 1,000 BTU/lbm?

- A. 25%
- B. 27%
- C. 73%
- D. 75%

ANSWER: C.

#6. If a wet vapor is at 130 °F and has a quality of 90%, its specific enthalpy is approximately...

- A. 1,015 Btu/lbm.
- B. 1,093 Btu/lbm.
- C. 1,118 Btu/lbm.
- D. 1,216 Btu/lbm.

ANSWER: A.

#7. If steam pressure is 230 psia at a temperature of 900 °F, what is the approximate amount of superheat?

- A. 368 °F
- B. 393 °F
- C. 506 °F
- D. 535 °F

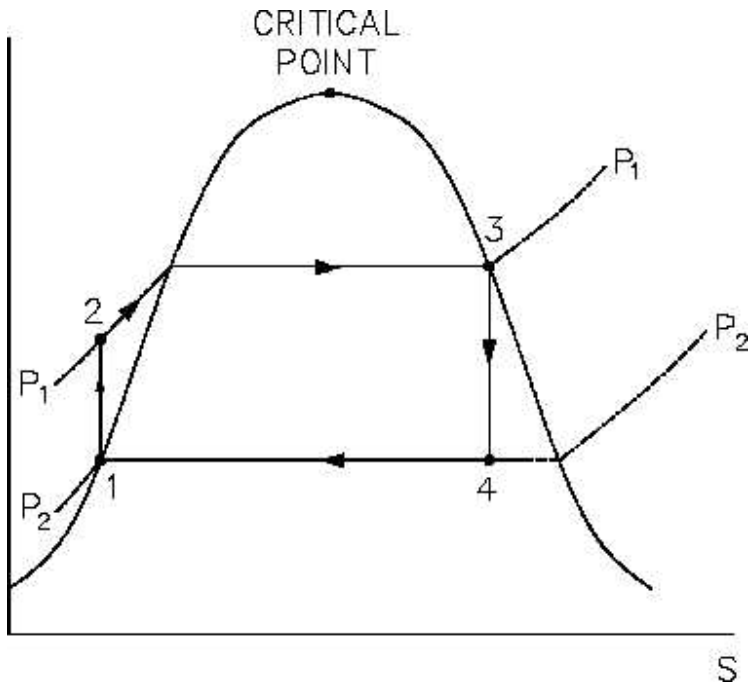
ANSWER: C.

#8. Which one of the following is the approximate amount of heat required to convert 2 lbm of water at 100 °F and 100 psia to a saturated vapor at 100 psia?

- A. 560 Btu
- B. 1,120 Btu
- C. 2,238 Btu
- D. 3,356 Btu

ANSWER: C.

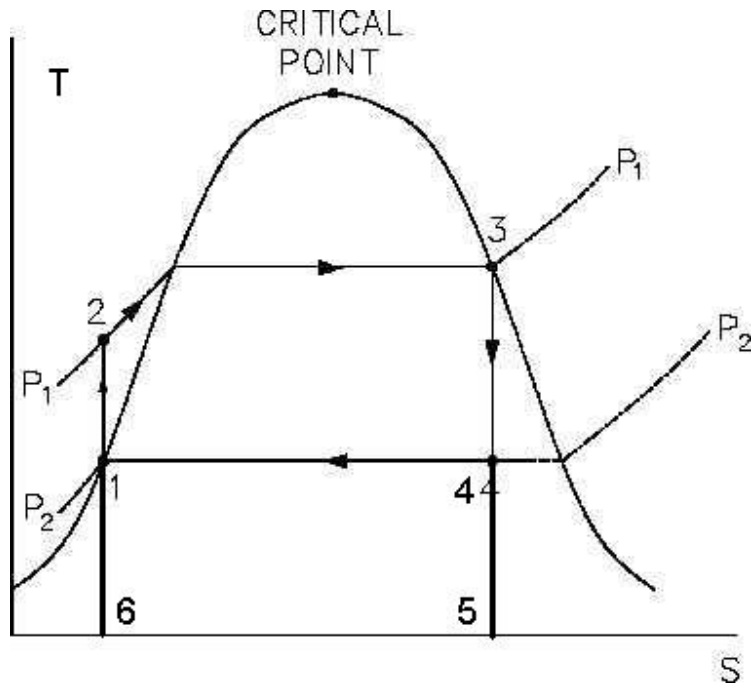
#9. In the basic heat cycle there are 4 processes, compression, expansion, evaporation, and condensation. Referring to the Diagram shown below, which line presents the compression process of the basic steam cycle?



- A. Line 1 -2.
- B. Line 2 -3.
- C. Line 3 -4.
- D. Line 4 -1.

ANSWER: A.

#10. In the basic heat cycle shown below, the heat into the system (Q_{in}) is defined as which block?



- A. Box 1, 2, 3, 4, 1.
- B. Box 6, 2, 3, 5, 6.
- C. Box 6, 1, 4, 5, 6.

ANSWER: B.

#11. Given a temperature of 0°F , what is this temperature in the Rankine Scale? (use formula on page 2.4)

ANSWER: 460°R

#12. Condensate depression is the process of...

- A. removing condensate from turbine exhaust steam.
- B. spraying condensate into turbine exhaust steam.
- C. heating turbine exhaust steam above its saturation temperature.
- D. cooling turbine exhaust steam below its saturation temperature.

ANSWER: D.