QUESTION 1 [25 Marks]

An ideal Otto cycle has a compression ratio of 8. At the beginning of the compression process, air is at 95 kPa and 27°C, and 750 kJ/kg of heat is transferred to air during the constant-volume heat-addition process. Taking into account the variation of specific heats with temperature, determine:

a) the pressure and temperature at the end of the heat addition process, **(10 Marks)**
b) the net work output, **(5 Marks)**
c) the thermal efficiency, and **(5 Marks)**
d) the mean effective pressure for the cycle. **(5 Marks)**

QUESTION 2 [20 Marks]

Consider an ideal air-standard Brayton cycle in which the air into the compressor is at 100 kPa, 20°C, and the pressure ratio across the compressor is 12:1. The maximum temperature in the cycle is 1100°C, and the air flow rate is 10 kg/s. Assume constant specific heat for the air. Determine:

a) the sketch of T-s diagram, **(3 Marks)**
b) the compressor work, **(9 Marks)**
b) the turbine work, and **(4 Marks)**
c) the thermal efficiency of the cycle. **(4 Marks)**

QUESTION 3 [35 Marks]

a) **Figure 1** shows common *T-s* diagram of a simple Rankine cycle. With the aid of diagram, discuss three (3) basic approaches in how to increase the thermal efficiency of the simple Rankine cycle.

(15 Marks)

**Kindly use provided space and figure to answer this question (page 4 and 5). Please submit page 4 and 5 together with your answer script.*

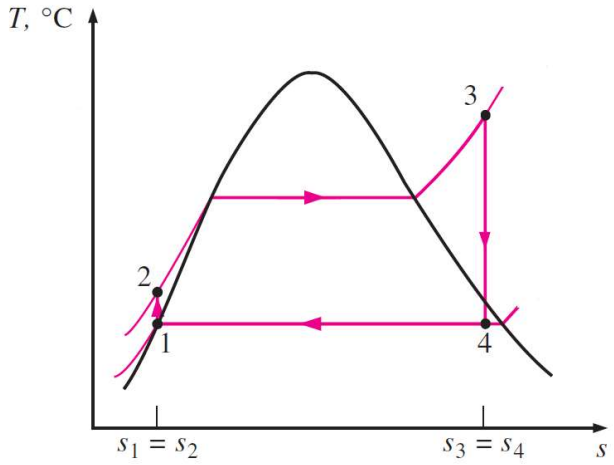
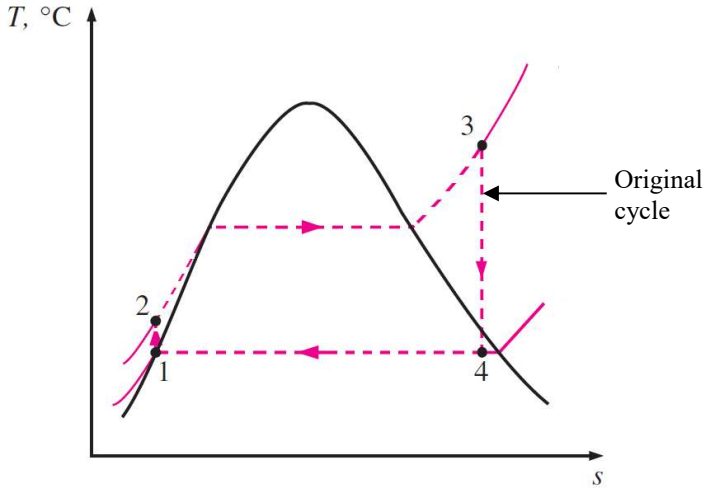


Figure 1: Simple Rankine cycle.

ANSWER SPACE

i)_____ (1 Mark)



(2 Marks)

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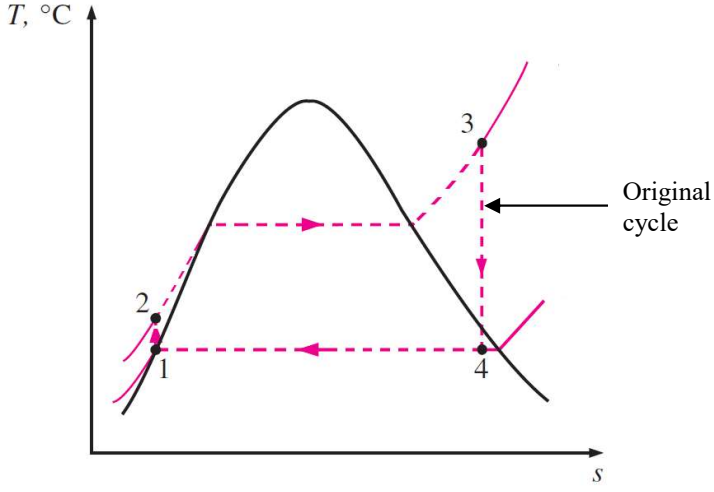
ii)_____ (1 Mark)



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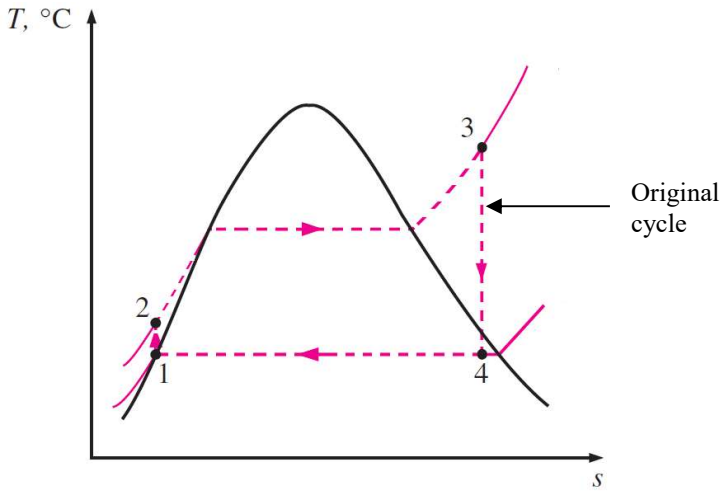
iii)_____ (1 Mark)



(2 Marks)

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_____ (2 Marks)

b) Consider a steam power plant operating on the ideal Rankine cycle. The working pressure of the cycle is between 100 kPa and 4 MPa as shown in **Figure 2**. Meanwhile, the superheated steam enters the turbine at 300°C. For the stated working condition of the plant, determine;

i) thermal efficiency of the plant.

ii) if the thermal efficiency of the plant need to be increased at least **two (2)** percent from the stated working condition by using **one (1)** of the approaches that you have answered in **(a)**, carry out the analysis to accomplish the requirement with your own assumption of the new working condition.

(20 Marks)