36.71 The overall efficiency of a gas turbine combined cycle is 55%. The gas turbine cycle standing alone has an efficiency of 40%. What is the efficiency of the Rankine cycle?

A. 9%

B. 25%

C. 75%

D. 91%

Refer to the Brayton Cycle for the gas turbine standing alone. Refer to the Combined Cycle when waste heat recovery is included. The heat recovery section can be modeled as a Rankine Cycle. The product of the *losses* from the Brayton Cycle and the *losses* from the Rankine Cycle equals the *losses* from the Combined Cycle. Solve for the efficiency of the Rankine Cycle.

$$(1 - \eta_{Brayton})(1 - \eta_{Rankine}) = (1 - \eta_{Combined})$$

$$(1 - 0.4)(1 - \eta_{Rankine}) = (1 - 0.55)$$

$$1 - \eta_{Rankine} = \left(\frac{0.45}{0.6}\right) = 0.75$$

$$\eta_{Rankine} = 0.25$$

Another way to conceptualize this scenario is to notice that since the standalone Brayton Cycle has 40% efficiency, that implies 60% losses. Reason that to increase the overall efficiency of the combined cycle to from 40% to 55%, 15% of the wasted 60% must be converted into useful work, which is one fourth or 25% of the waste energy from the Brayton Cycle which is heat input to the Rankine Cycle.

Answer B