Given: $r_k = 13$ $r_c = 3$
Solution:

$$e = 1 - \frac{r_p^k - 1}{r_k^{k-1} k(r_c - 1)} = 1 - \frac{3^{1.4} - 1}{13^{1.4-1}(1.4)(3-1)} = \mathbf{0.5320\ or\ 53.20\ \%}$$

16. What is the pressure ratio in an ideal dual combustion cycle if the pressures at the beginning and end of the constant volume portion of combustion are 2500 kPa and 4000 kPa respectively?

A. 1.4 **C. 1.6**
B. 1.5 D. 1.7

Given: $P_2 = 2500$ kPa $P_3 = 4000$ kPa
Solution:

$$r_p = \frac{P_3}{P_2} = \frac{4000}{2500} = \mathbf{1.6}$$

17. An ideal dual combustion cycle operates on 500 grams of air. At the beginning of the compression, the air is at 100 kPa, 45 °C. If $r_p = 1.5$, $r_c = 1.65$, and $r_k = 10$, determine the cycle efficiency.

A. 53.88 % C. 55.88 %
B. 54.88 % **D. 56.88 %**

Given: $r_p = 1.5$ $r_c = 1.65$ $r_k = 10$
Solution:

$$e = 1 - \frac{r_p r_c^k - 1}{r_k^{k-1}[r_p - 1 - r_p k(r_c - 1)]} = 1 - \frac{1.5(1.65^{1.4}) - 1}{10^{1.4-1}[1.5 - 1 - 1.5(1.4)(1.65 - 1)]} = \mathbf{0.5680\ or\ 56.80\ \%}$$

18. A carnot power cycle employing 1 lb of air as working substance is presumed to operate between temperature limits of 600 °F and 70 °F. The pressure at the beginning and end of the isothermal expansion process are 510 psia and 170 psia respectively. Determine the heat supplied to the cycle.

A. 25.5 Btu/lb C. 80.4 Btu/lb
B. 79.8 Btu/lb D. 72.3 Btu/lb

Given: $T_L = 70$ °F = 530 R $P_2 = 510$ psia
$T_H = 600$ °F = 1060 R $P_3 = 170$ psia
Solution:

$$v_2 = \frac{RT_2}{P_2} = \frac{53.34(530)}{510\left(\frac{1\,ft}{12\,in}\right)^2} = 0.769886\ \frac{ft^3}{lb}$$

$$v_3 = \frac{RT_3}{P_3} = \frac{53.34(1060)}{170\left(\frac{1\,ft}{12\,in}\right)^2} = 2.309657\ \frac{ft^3}{lb}$$

$$Q_A = T_H \Delta S = T_H R \ln \frac{v_3}{v_2} = \left[1060(53.34) ln \frac{2.309657}{0.769886}\right]\left(\frac{1\ BTU}{778.69\ ft-;b}\right) = \mathbf{79.82\ \frac{Btu}{lb}}$$

19. What is the efficiency of an Otto cycle with a compression ratio of 6:1? The gas used is air.

A. 0.617 C. 0.488
B. 0.191 **D. 0.512**

Given: $r_k = 6$ air, k = 1.4
Solution: