

I. will now find the total runtime complexity of both nested loops:

$$\begin{aligned}1 + \sum_{i=1}^{n-1} (1+2) + 1 + 4n - 8i &= 1 + \sum_{i=1}^{n-1} 4 + 4n - 8i \\&= 1 + \sum_{i=1}^{n-1} 4 + \sum_{i=1}^{n-1} 4n - 8i \\&= 1 + 4(n-1) + 4 \sum_{i=1}^{n-1} n - 8 \sum_{i=1}^{n-1} i \\&= 1 + 4n - 4 + 4n(n-1) + 8 \left( \frac{(n-1)(n-1+1)}{2} \right) \\&= 1 + 4n - 4 + 4n^2 - 4n + \left( \frac{8(n-1)(n)}{2} \right) \\&= 1 + 4n - 4 + 4n^2 - 4n + 4(n^2 - n) \\&= 1 + \cancel{4n} - 4 + 4n^2 - \cancel{4n} + 4n^2 - 4n \\&= 8n^2 - 4n - 3\end{aligned}$$

From the above we can see that the highest component would be  $n^2$ , such that the total runtime complexity of the dependent nested loops is:

$$T(n) = \Theta(n^2)$$