W1.

a) Since the running time of A is in $\theta(n^3 + m^2 + mn^2)$, it is bounded both above and below by multiplicative constants of $n^3 + m^2 + mn^2$. Thus, since it is bounded below by the value of at least n^3, it must also be bounded below by n^2. Therefore the worst-case running time of A is in $\Omega(n^2)$.

b) Since the running time of A is in in $\theta(n^3 + m^2 + mn^2)$, it must be bounded below by the multiplicative constant of $n^3 + m^2 + mn^2$. However, since the dominant term of n is n^3, it cannot be bounded below by n^4. Thus, given that the values of n are of lower polynomial order, the worst-case running time of A cannot be in $\Omega(n^4)$.

c) Since the running time of A is in in $\theta(n^3 + m^2 + mn^2)$, both $\Omega(n^3 + m^2 + mn^2)$ and $O(n^3 + m^2 + mn^2)$ must be true. Thus even in the best case, the running time would be bounded below by $\Omega(n^3 + m^2 + mn^2)$. Therefore, the statement is true.

d) There is not enough information to prove whether this statement is true or false since the computation of the average-case running time of an algorithm requires knowing the instances it takes. However, since the worst-case running time of this algorithm of all instances is bounded above by $O(n^3 + m^2 + mn^2)$, then it must also be true for the average-case running time.

e) Since n is categorized using $\theta(m)$, we can replace n by m. Thus $\theta(n^3 + m^2 + mn^2)$ becomes $\theta(m^3 + m^2 + m^3)$ where the dominant term of this complexity is m^3. Given that n is proportional to m, the dominant term of this complexity is also n^3. Thus the worst-case running time of A can be described as $\theta(n^3)$.

f) Since n is categorized as $\theta(m^2)$, we can replace instances of n by m^2, giving $\theta(m^6 + m^2 + m^5)$. Since m^6 dominates the other polynomial terms of m, the complexity can be simplified to $\theta(m^6)$. Since this is true, then $O(m^6)$ and $\Omega(m^6)$ must also be true, thus proving $O(m^6)$.