$T(n) = aT\left(\frac{n}{b}\right) + O(n^k \log^p n)$

where $a \geq 0, b \geq 2, k \geq 0, p \in \mathbb{R}$

(a) $T(n) = 3T\left(\frac{n}{2}\right) + n$

$\Rightarrow a = 3, b = 2, k = 1, p = 0$

$3 > 2^1 \Rightarrow a > b^k$

$\Rightarrow T(n) = \Theta(n^{\log_b a})$

$T(n) = \Theta(n^{\log_2 3})$

(b) $T(n) = 64T\left(\frac{n}{8}\right) - n^2 \log n$

$a = 64, b = 8,$

$\Rightarrow$ violates prerequisites of Master Theorem $f(n)$ is $-ve$.

(c) $T(n) = 2nT(n/2) + n^n$

$\Rightarrow$ Cannot be calculated using master theorem a is not constant & $f(n)$ is not a polynomial

(d) $T(n) = 3T\left(\frac{n}{3}\right) + \frac{n}{2}$

$a=3 \quad b=3 \quad k=1 \quad p=0 \rightarrow p>-1$

$3 = 3^1 \Rightarrow a = b^k$

$\Rightarrow T(n) = \Theta(n^{\log_b a} \log^{p+1} n)$

$T(n) = \Theta(n \log n)$

(e) $T(n) = 7T\left(\frac{n}{3}\right) + n^2$

$a=7 \quad b=3 \quad k=2 \quad p=0$

$7 < 3^2 \quad a < b^k$

$T(n) = O(n^2)$