(1) $x(n) = 3T(n/2) + n^2$

$c = \log_b a$

$c = \log_2 3 = 1.58$

$n^c = n^{1.58}$

$F(n) = n^2$

$F(n) > n^c$

$n^2 > n^{1.58}$

$T(n) = \Theta(F(n)) = O(n^2)$.

(2) $T(n) = 4T\left(\frac{n}{2}\right) + n^2$

$F(n) = n^2$, $a = 4$, $b = 2$

$c = \log_2 4 = 2\log_2 2 = 2$.

$n^c = n^2$

$F(n) = n^c$

T.C $= T(n) = O(n^2 \log_2 n)$

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

$c = 0$ $F(n) = 2^n$. $F(n) > n^c$ $\Rightarrow$

$n^c = 1$. $T(n) = O(2^n)$

(4) $T(n) = 2^n T\left(\frac{n}{2}\right) + n^n$

$c = \log_2 2^n$ $f(n) = n^n$

$c = n$ $F(n) = n^c$

$T(n) = O(2^n \log_2 n)$

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(5) $T(n) = 2T(\frac{n}{2}) + n\log n$.

$c = \log_2 2$ $\quad F(n) = n\log n$.

$c = 1$

$F(n) > cn$

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

(6). $T(n) = 16T(\frac{n}{4}) + n$

$c = \log_4 4^2$ $\quad F(n) = n$.

$\boxed{c = 2}$ $\quad n^c = n^2$.

$n^c > F(n)$

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

(7) $T(n) = 2T(\frac{n}{2}) + n\log n$.

$c = \log_2 2$ $\quad F(n) = n\log n$

$\boxed{c = 1}$ $\quad n^c = n$

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

(8) $T(n) = 2T(\frac{n}{4}) + n^{0.51}$

$c = \log_4 2$ $\quad F(n) = n^{0.51}$

$4^c = 2^4$ $\quad F(n) = n^c$

$c = 0.05$ $\quad$ or

$T(n) = \Theta(n^{0.5} \log_2 n)$

(9) $T(n) = 0.5T(\frac{n}{2}) + \frac{1}{n}$

$c = \log_b a$ $\quad F(n) = 1/2$,

$F(n) = n^c$

$C = \log_2 0.5$

$c = -1$ $\quad T(n) = \Theta(n^{-1} \log n)$.

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(10) $T(n) = 16T(\frac{n}{4}) + n!$

$c = \log_4 16$ $\quad F(n) = n!$

$c = 2$

$n^c = n^2$. $\quad F(n) < n^c$

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

(11) $T(n) = 4T(\frac{n}{2}) + \log n$.

$F(n) = \log n$.

$c = \log_2 2$ $\quad F(n) < n^c$

$\boxed{c = 1}$ $\quad T(n) = O(n^2)$

$n^c = n^2$

(12) $T(n) = 3T(\frac{n}{2}) + n$

$c = \log_2 3$ $\quad F(n) = n$

$c = 1.58$ $\quad F(n) < n^c$

$\boxed{n^c = n^{1.58}}$ $\quad T(n) = O(n^{1.58})$

(13) ~~$T(n) = 3T(\frac{n}{2}) + n$~~

~~$c = \log$~~

(14) $T(n) = 3T(\frac{n}{3}) + \sqrt{n}$

$c = \log_3 3$ $\quad F(n) = \sqrt{n}$

$\boxed{c = 1}$ $\quad n^c > F(n)$

$n^c = n$ $\quad T(n) = O(n)$

(15) $T(n) = 4T(\frac{n}{2}) + cn$.

$c = \log_2 4$ $\quad F(n) = cn$

$\boxed{c = 2}$ $\quad F(n) < n^c$

$n^c = n^2$ $\quad T(n) = O(n^2)$

(16) $T(n) = 3T(\frac{n}{4}) + n\log n$

$c = \log_4 3$ $\quad F(n) = n\log n$.

$c = 0.79$ $\quad F(n) > n\log n$

$n^c = n^{0.79}$ $\quad T(n) = O(n\log n)$.

(17) $T(n) = 3T(\frac{n}{3}) + n/2$

$c = \log_3 3$ $\quad F(n) = n/2$

$\boxed{c = 1}$ $\quad F(n) < n^c$

$\boxed{n^c = n}$ $\quad T(n) = O(n)$.

(18) $T(n) = 6T(\frac{n}{3}) + n^2\log n$.

$c = \log_3 6$ $\quad F(n) = n^2\log n$

$c = 1.63$ $\quad F(n) > n^c$

$n^c = n^{1.63}$ $\quad T(n) = O(n^2\log n)$.

(19) $T(n) = 4T(\frac{n}{2}) + n\log n$

$c = \log_2 2$ $\quad F(n) = n\log n$.

$c = 1$ $\quad F(n) > n^c$

$n^c = n$ $\quad T(n) = O(n\log n)$.

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

$c = \log_8 64$ $\quad F(n) = -n^2\log n$

$\boxed{c = 2}$ $\quad F(n) < n^c$

$\boxed{n^c = 2^2}$ $\quad T.C = O(n^2)$

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(21) $T(n) = 7T(\frac{n}{3}) + n^2$

$c = \log_3 7$

$c = 1.77$

$n^c = n^{1.77}$

$f(n) = n^2$

$f(n) > n^c$

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

(22) $T(n) = T(\frac{n}{2}) + n(2 - \cos n)$.

$c = \log_2 1$

$c = 0$

$n^c = 1$

$f(n) = n(2 - \cos n)$

$f(n) > n^c$

$T.C = O(n(2 - \cos n))$