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$$e, T(n) = 9(T/3) + (n^3 \log n)$$

$$a = 9$$

$$b = 3$$

$$\log_a b = \log_3 9 = 2$$

$$f(n) = n^3 \log n$$

$$1, \quad n^3 \log n \quad n^{2-\epsilon}$$

$$2, \quad n^3 \log n \quad n^{2 \cdot \log^k n}$$

$$3, \quad n^3 \log n \quad n^{2+\epsilon} \quad \epsilon = 1$$

$$9T(n/3) + (n/3)^3 \cdot \log n/3 \leq 9n^3 \log n$$

$$\frac{n^3}{3} \cdot \log n/3 < 8n^3 \log n$$

$$\frac{n^3}{3} \cdot (\log n - \log 3) < 8n^3 \log n$$

$$\frac{n^3}{3} (\log n - \log 3) < \frac{n^3}{3} \log n$$

$$8 = \frac{1}{3} < 1$$

$$T(n) \text{ is } \Theta(n^3 \log n)$$

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$$d, T(n) = T(n/3) + n.$$

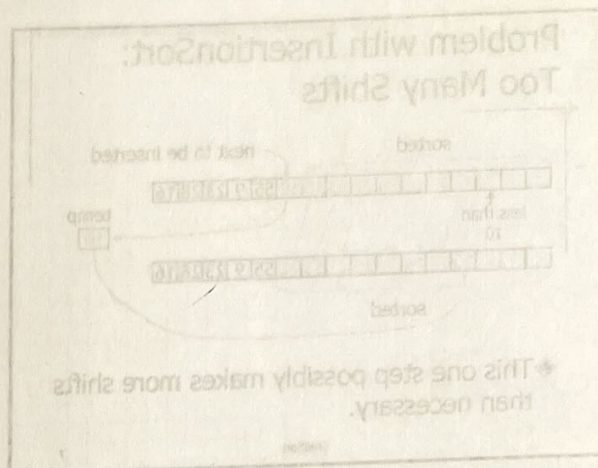
$$a = 3$$

$$b = 3$$

$$\log_a b = \log_3 3 = 1. xxx.$$

$$1, f(n) = n < n^{1. xxx - \epsilon}$$

$$\Rightarrow T(n) \text{ is } \Theta(n^{1. xxx})$$



$$c, T(n) = 16 T(n/2) + (n \log n)^4.$$

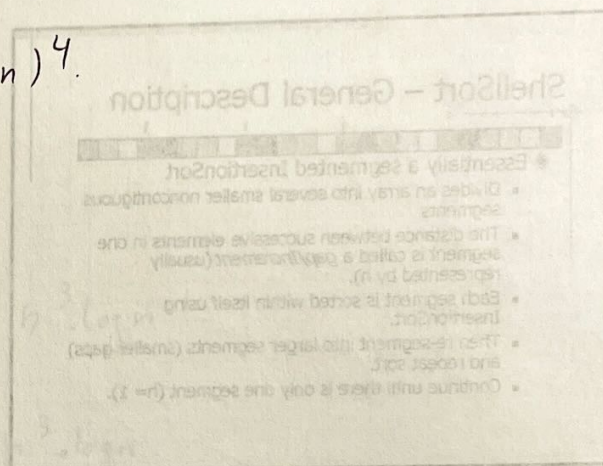
$$a = 16$$

$$b = 2$$

$$\log_a b = \log_2 16 = 4.$$

$$f(n) = (n \log n)^4.$$

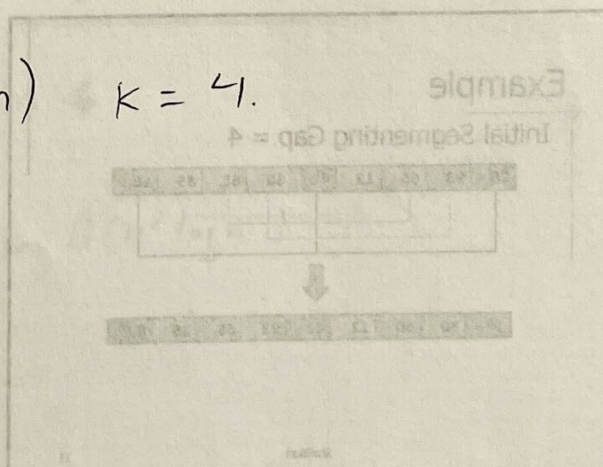
$$1, f(n) = (n \log n)^4 > n^{4 - \epsilon}$$



$$2. f(n) (n^4 \log n)^4 = \Theta(n^4 \log^k n)$$

$$k = 4.$$

$$\Rightarrow T(n) \text{ is } \Theta(n^4 \log^5 n)$$



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$$b = 2$$

$$f(n) = n^2$$

$$\Rightarrow T(n) \text{ is } \Theta(n^3)$$

$$a = 2$$

$$b = 2.$$

$$\log_b a = \log_2 2 = 1.$$

$$1, f(n) = \log n < n^{1-\epsilon}.$$

$$\Rightarrow T(n) \text{ is } \Theta(n)$$