1 a) $6 \text{ surface} \times \frac{10{,}000 \text{ track}}{\text{surface}} \times \frac{500 \text{ sector}}{\text{track}} \times \frac{1024 \text{ B}}{\text{sector}} = 30 \text{ GB}$

b) access time = seek time + rotational delay + transfer time

$= 10\text{ms} + \frac{1}{2} \cdot \frac{1 \text{ rot}}{6000 \text{ rot}} \cdot \frac{60 \text{ s}}{1 \text{ min}} + \frac{60 \text{ s}}{6000 \text{ rot}} \cdot \frac{1 \text{ track}}{500 \text{ sector}}$

$= 15.02 \text{ ms}$

c) size per tuple = 72 B

1000 tuples $= 72{,}000 \text{ B} \times \frac{\text{sector}}{1024 \text{ B}} = 71 \text{ blocks}$

d) transfer time $= 71 \times 0.02 \text{ ms}$

$= 1.42 \text{ ms}$

access time $= 16.42 \text{ ms}$

e) transfer time = 20 ms

seek time $= 24 (10) = 240 \text{ ms}$

rot delay $= \frac{1}{2} (10 \text{ ms}) 24 = 120 \text{ ms}$

access time = 380 ms

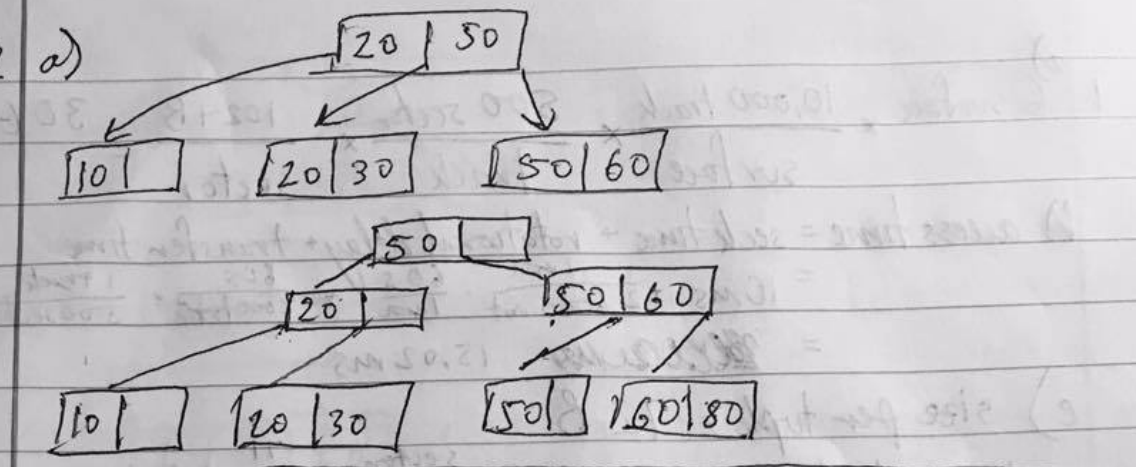
---

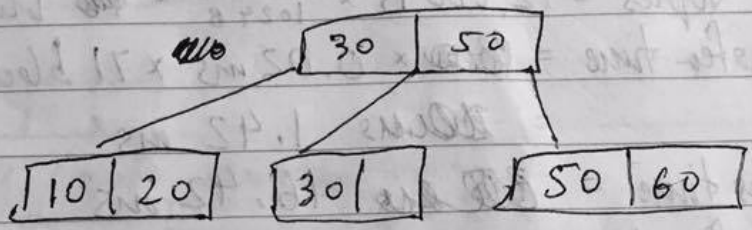
time $= 24 (10 + 5 + 3(.02)) = 361.44 \text{ ms}$

f) access 1 block = 15.02 ms

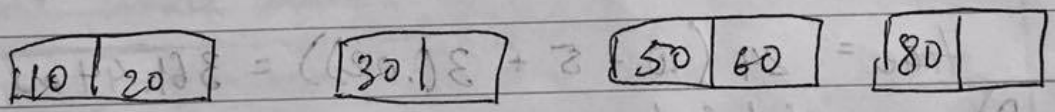
query time $= 10 \times 15.02 = 150.2 \text{ ms}$

2 a)

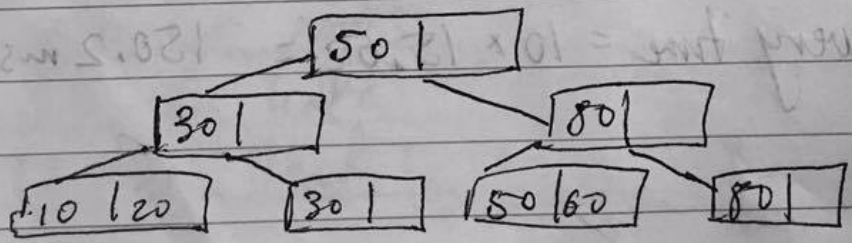

20 | 50
10 |
20 | 30
50 | 60
50 |
20 |
50 | 60
10 |
20 | 30
50 |
60 | 80


30 | 50
10 | 20
30 |
50 | 60

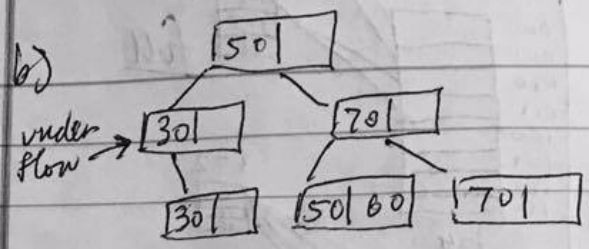

50 |
30 |
80 |

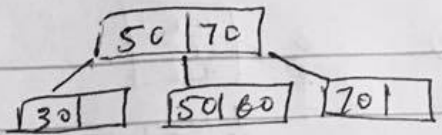

10 | 20
30 |
50 | 60
80 |

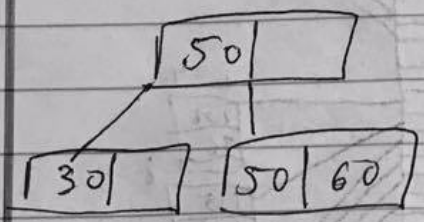
(a)


50 |
30 |
80 |
10 | 20
30 |
50 | 60
80 |

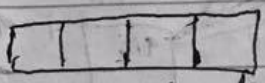
b)







3



4 key / node ~~max~~ ~~min~~ max

need 75 leaf nodes at min b/c $75 = \frac{300}{4}$

15 non leaf to point at 75 leaves $\frac{75}{5}$

3 non leaf

1 root

→ 4 level ~~max~~ ~~min~~ min if node full

---

2 ~~3~~ key / node ~~min~~ ~~max~~

need ~~150~~ 150 leaf nodes

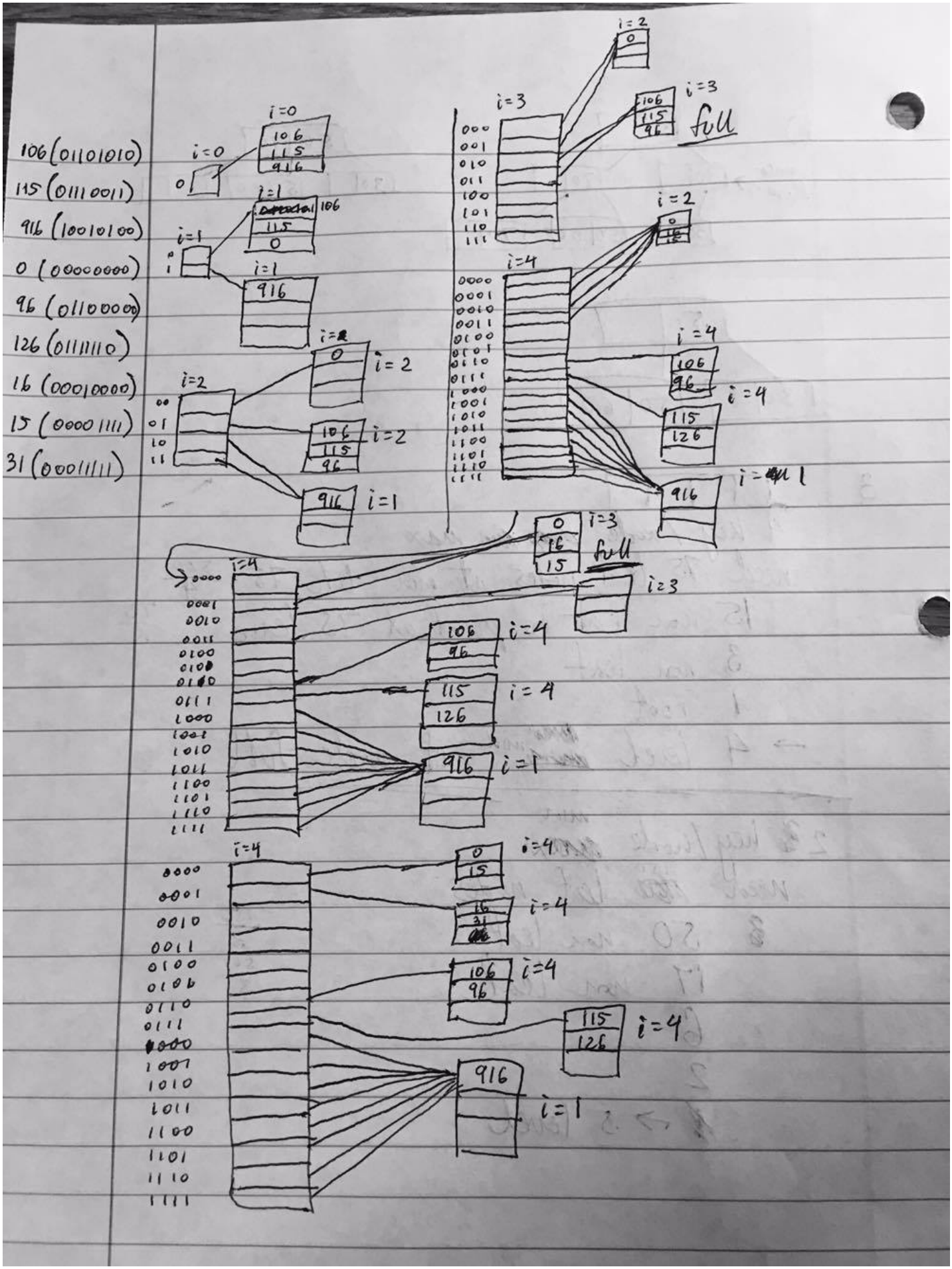
~~3~~ 50 non leaf $\frac{150}{3}$

17 non leaf $\frac{50}{3}$

6

2

~~1~~ → 5 level


106 (01101010)
115 (01110011)
916 (10010100)
0 (00000000)
96 (01100000)
126 (01111110)
16 (00010000)
15 (00001111)
31 (00011111)
i=0
i=1
i=2
i=3
i=4
full
106
115
916
0
96
126
16
15