1.

a). $(30+10+10+30+10+10+1+4+4)+1 = 110$ bytes

b). $bfr = \lfloor \frac{B}{R} \rfloor = \lfloor \frac{512}{110} \rfloor = 4$ records per block

$b = \lceil \frac{3000}{4} \rceil = 750$ blocks

c). (i) index record size $R_i = (10+6) = 16$ bytes

$ibfr = \lfloor \frac{512}{16} \rfloor = 32$

(ii) First level index entry = 750 entries

N First level index blocks $= \lceil \frac{750}{32} \rceil = 24$ blocks

(iii) $\lceil \frac{24}{32} \rceil = 1$ the second level will reach to 1 block.

So we only need two levels.

(iv). $24+1 = 25$ blocks.

(v). $2+1 = 3$

d). (i). index record size $R_i = (10+6) = 16$ bytes

$ibfr = \lfloor \frac{512}{16} \rfloor = 32$

(iii). 3000 entries

$\lceil \frac{3000}{32} \rceil = 94$ blocks

(iiii) $\lceil \frac{94}{32} \rceil = 3$ blocks $\lceil \frac{3}{32} \rceil = 1$ blocks

we need 3 levels indexing

(iv). $94 + 3 + 1 = 98$ blocks.

(v.) $3 + 1 = 4$

e). (i). Index record size $= 10 + 6 = 16$ bytes

$ibfr = \left\lfloor \frac{512}{16} \right\rfloor = 32$

(ii). $\frac{3000}{100} = 30$ records per department

$30 \times 7 = 210$ bytes < 512 bytes

We need 100 blocks.

(iii) 100 entries

$\left\lceil \frac{100}{32} \right\rceil = 4$ blocks

(iv). $\left\lceil \frac{4}{32} \right\rceil = 1$ block We only need 2 levels

(v). $1 + 4 + 100 = 105$ blocks

(vi). $2 + 1 + 30 = 33$ accesses

f). (i)

Index record size $= 10 + 6 = 16$ bytes

$ibfr = \left\lfloor \frac{512}{16} \right\rfloor = 32$

(ii) 100 entries.

$\lceil \frac{100}{32} \rceil = 4$ blocks

(iii). $\lceil \frac{4}{32} \rceil = 1$ we need only 2 levels

(iv). $1 + 4 = 5$ blocks

(v). $\lceil \frac{30}{4} \rceil = 8$ blocks $\Rightarrow 2 + 8 = 10$ blocks accesses

9. (i) For internal nodes:

$p \times 6 + (p-1) \times 10 \leq 512 \Rightarrow p = 32$

$p_{leaf} \times (10+7) \leq 512 \Rightarrow p_{leaf} = 30$

(ii) $30 \times 0.69 = 21$ key values

$\lceil \frac{3000}{21} \rceil = 143$ blocks

(iii) $32 \times 0.69 = 23$

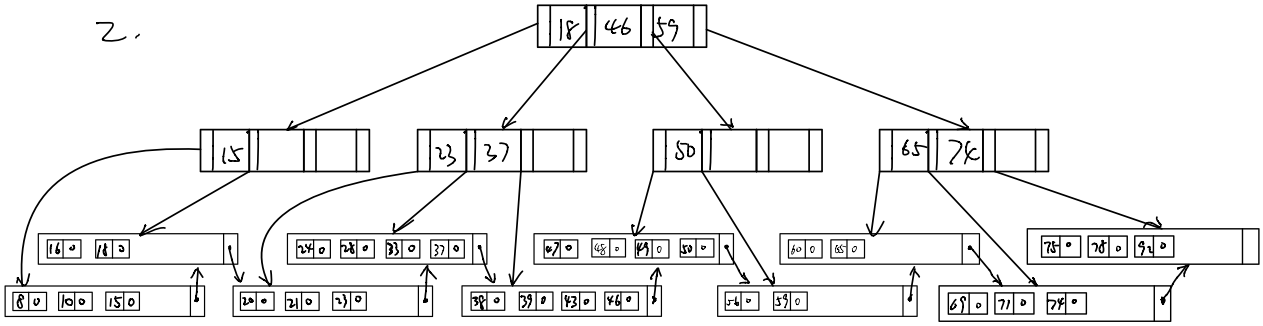
$\lceil \frac{143}{23} \rceil = 7 \quad \lceil \frac{7}{23} \rceil = 1$

We need 3 levels (counting leaf level)

(iv) $143 + 7 + 1 = 151$ blocks

(v). 3+1=4 accesses

2.



3. (a) conflict $T_1 \rightleftarrows T_3$

(b). conflict $T_1 \rightleftarrows T_3$

(c). Serializable

$T_3 \rightarrow T_1$

$\uparrow \quad \nearrow$

T_2

Equal to: r2(X); r3(X); w3(X); r1(X); w1(X);

(d). conflict $T_3 \rightleftarrows T_1$

4. S1:

$T_1 \xrightarrow{z} T_2$

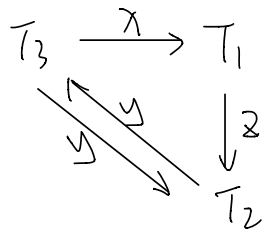
$x \uparrow \quad \nearrow y$

T_3

It is serializable.

$\Rightarrow \quad T_3 \rightarrow T_1 \rightarrow T_2$

S2:



Not serilizable.

3.

1.Transactions should be treated as a whole.
2.The transaction must be correct executed
    such that the database will always be in consistant state.
3.Concurrent execution of transactions that
    shares the usage of the same content must be controlled correctly.
4.And once the transaction is committed,
    changes to the database is permanently recorded.

In addition to serializability, the two phase locking protocol
with locking mechanism can ensure isolation.