14.4

			No. of pages	
R	10,000	10 ⇒	1000	B = 52
S	2000	10 ⇒	200	

① Page nested simple Nested Loop Join

Cost = N + (N × M)

= 200 + (1000 × 200) = 200,200//

② Blocked Nested Loop Join

Cost : $N + M\left(\frac{N}{B-2}\right)$

$= 200 + 1000\left(\frac{200}{50}\right) = 4200$//

③. Min B to maintain this cost is 52.

④ Sort – Merge join

cost = 3 (M+N) [∵ B > √L]

= 3 (1500) = 4500//

Min B = 25.

Exp: 1000/25 = 50 sized

200 = 20 page runs + 4 page runs

24 → Merged in next step

R-gee [13.3.1] + Refinement

⑤ Optimal – Each Rel. read only once

Total cost = M+N

= 1200//

Page Nested Join

B = 202 ← 200 hold small rel, 1 reading R rel, 1 o/p.

⑥ Max. 10,000 (R size) — match with max 1. S.b is PK, no dup

Skinny – Joint tuple double size.

∴ 10/2 → 5 tuples per page

⇒ 5000 pages.

⑦ With R as outer Rel., we need to scan only till S is found (match rec) So on avg. 50% less in Page } 101,000, Block } 3000

B = 52 – No change

Hash, Sort-Merge } Not aff.

14.5

① [Unclustered Index]

Index nested loop Cost

R as outer

1000 + 10,000 (2 + 1) = 31,000//

(2: accessing, 1: finding; 1 I/O per rec since unclustered)

S as outer

200 + 2000 (3 + 5) = 16,200//

(on avg. 5 matches)

Block is cheaper 4200 I/Os

If 5 B pages,

Index cost same

BNJ ⇒ $200 + 1000\left(\frac{200}{5-2}\right) = 67200$

200 + 1000 (67)

If S had only 10 tuples,

∴ R = 1000 P, S = 1 P

Block = $N + M + \left(\left\lceil \frac{N}{B-2} \right\rceil\right)$

$= 1 + 1000\left[\frac{1}{60}\right] = 1 + 1000(1)$

= 1001//

Index

R as outer

$1000 + 10000\left(\frac{1}{1} + (1)\right)$ — find = only 1 page to retrieval cost

$= 21,000$

S as outer

$= 1 + 10\,(1000 + 3) = 10,031$

---

② [Clustered Index] — Access cost is 1 per 10 page ie 1 per tuple

INLJ

R as outer

$1000 + 10,000\,(1 + 2) = 31000$

S as outer

$2000 + 2000\left(\frac{1}{10} + 3\right) = 8200$

till 10 rec, it is 1 I/O

If there were only 5 buff.

INLJ - No change

Block - Same as (1) — 67200

If S had only 10 tuple -

INLJ.

R as outer

$= 1000 + 10,000\,(1 + 1)$ — ∵ only 1 pg — R = 1000 pg, S = 1 pg $= 21,000$

S as outer

$= 1 + 10\left(\frac{100}{1S} + 3\right) = 1021$

1S → 1000 R/10 since clustered.

Block

$1 + 1000\,([1/50]) = 1001$

---

③ 15 B

SMJ Join — R = 1000 — S = 200

R $1000/15 = 67$ — $200/15 = 14$

$67/15 = 5$ — $14/15$: Done

$5/15$: Done

R — 3 pass — S — 2 pass

∴ Cost R = $3 \times \frac{2}{1/b} \times 1000 = 6000$

S = $2 \times 2 \times 200 = 800$

Merge = 1000 + 200 = 1200 — Tot 6800

8000

Hash join

Small rel S,

Hash will give 14 buckets @ 15 pg each

∴ we need 1 + 15 pgs. > 15 B.

∴ Apply hash again rec..

∴ 2 partition + 1 merge

$2\left(\frac{2}{1}(M+N)\right) + (M+N)$

Read + write

$= 4\,(1200) + 1200 = 6000$

---

④ SMJ R & S - 3 passes — 15 B, R - 1000, S - 1000

$\therefore (2 \times 3 \times 1000) + (2 \times 3 \times 1000) = 12000$

+ Merg - (2000) = 14000

Hash, Same steps as above

$2\,[2\,(M+N)] + (M+N) = 4\,(2000) + 2000 = 10,000$

---

⑤ SMJ, $B > \sqrt{N}$ — 52 B+1

Cost: $3\,(M+N) = 3\,(2000) = 6000$

Hash

1 part + 1 merge : $[2\,(M+N)] + [M+N] = 6000$