Rehas Q1 a,b,c, akshat - Q1 d,e
2 - Auro , Chanakya
3 - Vivek
4 - sriteja
5 - subash

1a) Capacity = Number of surfaces X Number of tracks X Number of sectors X Number of bytes per sector = 8 X 8192 X 256 X 512 bytes = 8 GB (1.5 for formula + 0.5 mark for correct calculation)

1b) 1 sector has 512 bytes = 512 X 8 bits. So bit density / sector = 512 X 8 = 4096 bits/sector (1.5 for formula + 0.5 mark for correct calculation)

1c) The maximum seek time occurs when the heads have to move across all the tracks. Thus, substitute 8192 (really 8191) for n in the formula 1+.002n to get 17.382 milliseconds. (1.5 for formula + 0.5 mark for correct calculation)

1d) The maximum rotational latency is one full revolution. Since the disk rotates at 3840 rpm, it takes 1/3840 of a minute, or 15.625 milliseconds. (1.5 for formula + 0.5 mark for correct calculation)

Special cases:

1. If maximum rotational latency is taken as time taken for one half revolution: 0 marks awarded
2. If unit wrong: 0.5 marks deducted

1e) The *transfer time* is the time in which the sectors of the block, and any gaps between them, rotate past the head. Since we can calculate how much time it takes to make one rotation, if we can come up with the degrees of arc the disks rotate for that particular block, we can get the transfer time.
the time it takes to make one rotation is 15.625 milliseconds. Since the block occupies 32 sectors, the heads must pass over 32 sectors and 31 gaps between them (0.5 mark). Recall that the gaps represent 10% of the circle and sectors the remaining 90%. There are 256 gaps and 256 sectors around the circle. Since the gaps together cover 36 degrees of arc and sectors the remaining 324 degrees (0.5 mark), the total degrees of arc covered by 31 gaps and 32 sectors is:
31/256 X 36 + 32/256 X 324 = 44.86 (0.5 mark)
The *transfer time* is thus 44.86/360 * 15.625 ms = 1.947 ms. (0.5 mark)

Special cases:

1. If gaps not accounted : only 0.5 marks awarded
2. If unit wrong: 0.5 marks deducted

3. If rotational latency and seek time added to final answer: 0.5 marks deducted

3) 01110010
10000111
10001011
11000011
Xor sum = 10111101

01110010
10000111
10001011

Raid = 11000011
Recovered data = xorsum = 10111101
(If process is correct and final result is wrong 4.5/5 else 5/5.If not attempted 0.If just answer is written without explanation 4)

Q2.

(2 Marks for calculating B(R))
→ -1 in case of calculation mistake in this step

B(R) = No. of blocks required to hold relation R assuming a block only contains tuples belonging to R

Size of the block = 4096 bytes
Size of each tuple = 100 bytes
No. of tuples/block = floor(4096/100) = 40
B(R) = 10^7/40 = 250000 = 2.5x10^5
If spanned record assumption given, full marks. If no assumption but direct divided, 1.

Main memory Size = M = 50MB = 50*2^20 Bytes

(2 Marks for checking the condition)

In order for 2 Phase Merge Sort to be possible the following condition should hold:

No of records to be sorted < M^2/RB = 6.7 x 10^9

B=size of block
R=size of tuple
M=main memory size

Which holds, hence 2 phase merge sort can be carried out.

(2 Marks for the explanation)
→ Also consider if writing the final list back into memory is considered => 4*B(R)

Determining the time order of 2 phase merge sort:

1. Time to Read R in buckets of size 50MB = O(B(R))
2. Time to sort each bucket of size 50MB and Write it back to memory = O(B(R))
3. Time to merge-sort the buckets (Read each bucket back into memory) = O(B(R))

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Total time taken is of the order O(3*B(R))

(2.5 Marks)
→ Avg transfer time = 1.5 marks
→ Avg seek and rotation time = 1 mark

Calculate Transfer time per Block according to Q1:

Avg time to read/write a block = Avg seek time + Avg rotational latency + Avg transfer time

Calculation of avg transfer time:

Disk blocks are 4096 bytes Each sector holds 512 bytes => 8 sectors per block
In order to read a single block 8 sectors and 7 gaps must pass underneath the disk head.
Gaps cover 36 degrees of a track and Sectors cover 324 degrees.
Avg track holds 256 sectors and gaps each.
Degrees covered per block read = 7/256 * 36 + 8/256 * 324 = 0.984 + 10.125 = 11.109
One rotation takes 15.625 ms
=> Time Taken to transfer a block = 11.109/360 * 15.625 = 0.48 ms

Avg seek time = 1 + 0.002 * 8192/3 = 6.46 ms

(we find that the average distance traveled is one third of the way across the disk -- book)

Avg rotational latency = ½ * (time for one revolution) = 0.5 * 15.625 = 7.8125 ms

Total = 0.48 + 6.46 + 7.8125 = 14.75 ms

(1.5 Marks for the final answer)
→ HAS to be completely right. partial marking in this step, if one of the answers in block transfer time slightly off. If partial marks not given even still, write clarification.

→ Which means any mistake in the above steps would automatically lead to a 0 here
→ Error of a small magnitude is acceptable

Therefore time taken to sort = 3 * B(R) * (Time to read a block into Memory) = FINAL ANSWER

= 3 * 250000 * 14.75 = 11062500 ms = 11062.5
15000 if 4*B(R).

Q5: Blocks to store data and index file

(a) Dense Index
  (i) ceil(n/4) for storing records
  (ii) ceil(n/12) for storing pointers to all the records
  (iii) Ans = ceil(n/4)+ceil(n/12)

Marking: correct expression (3), reasoning (1) and ceil function (1)

(b) Sparse Index
  (i) ceil(n/4) for storing records
  (ii) ceil(ceil(n/4)/12) for storing pointers to each block
  (iii) Ans = ceil(n/4)+ceil(ceil(n/4)/12)

Marking: correct expression (3), reasoning (1) and ceil function(1)