Problem 1: Megan Sin

Q1) $5 \text{ platters} \cdot \frac{2 \text{ surfaces}}{\text{platter}} \cdot \frac{8192 \text{ tracks}}{\text{surface}} \cdot \frac{256 \text{ sectors}}{\text{track}} \cdot \frac{512 \text{ Bytes}}{\text{sector}}$

$\approx 1.074 \times 10^{10} \text{ Bytes} \cdot \frac{\text{GB}}{1024^3 \text{ Bytes}} = \boxed{10 \text{ GB}}$

Q2) $10 \text{ GB} \cdot \frac{1024^3 \text{ Bytes}}{\text{GB}} \cdot \frac{\text{block}}{(8 \times 1024) \text{ Bytes}} = \boxed{1310720 \text{ blocks}}$

Q3) 1 rotation $\Rightarrow \frac{60 \text{ sec}}{5400 \text{ rotations}} = 0.0111 \text{ sec}$

$= 11.1 \text{ ms}$

1 block read $\Rightarrow$ size = 8 KB

1 sector = ½ KB

8KB $\rightarrow$ 16 sectors $\times \frac{0.05 \text{ ms}}{\text{sector}} = 0.8 \text{ ms}$

minimum = seek time + latency time + transfer time

0 + 0 + 0.8 ms

= $\boxed{0.8 \text{ ms}}$

maximum = seek time + latency time + transfer time

= 1 ms (warm-up) + $\frac{8192}{500}$ ms + 11.1 ms + 0.8 ms

$\approx \boxed{29.3 \text{ ms}}$

average = seek time + latency time + transfer time

= 1 ms (warm-up) + $\frac{8192}{1000}$ ms + $\frac{11.1}{2}$ ms + 0.8 ms

$\approx \boxed{15.5 \text{ ms}}$

Q4) $1 \text{ block} \cdot \frac{(8 \cdot 1024) \text{ bytes}}{\text{block}} \cdot \frac{\text{record}}{128 \text{ bytes}} = \boxed{64 \text{ records}}$

$1 \text{ file} \cdot \frac{100000 \text{ records}}{\text{file}} \cdot \frac{128 \text{ bytes}}{\text{record}} \cdot \frac{\text{block}}{(8 \cdot 1024) \text{ bytes}} = 1562.5$

$\downarrow$

$\boxed{1563 \text{ blocks}}$

$1 \text{ file} \cdot \frac{100000 \text{ records}}{\text{file}} \cdot \frac{128 \text{ bytes}}{\text{record}} \cdot \frac{\text{sector}}{512 \text{ bytes}} = \boxed{25000 \text{ sectors}}$

Q5) I/O time = seek + latency + transfer

$= 1 \text{ ms (warm-up)} + \frac{100}{500} \text{ ms} + \frac{11.1}{2} \text{ ms}$

$+ 10(0.8 \text{ ms})$

$= \boxed{14.75 \text{ ms}}$

Q6) All 10 blocks can be stacked on top of each other so they can all be read at once → use all 10 surfaces on the 5 platters

Q7) From Q4: 1563 blocks

# of blocks a track can hold:

$1 \text{ track} \cdot \frac{256 \text{ sectors}}{\text{track}} \cdot \frac{512 \text{ bytes}}{\text{sector}} \cdot \frac{\text{block}}{8 \cdot 1024 \text{ bytes}} = 16 \text{ blocks}$

blocks in a cylinder:

5 platters → 10 surfaces → 10 tracks in a cylinder

$10 \text{ tracks} \cdot \frac{16 \text{ blocks}}{\text{track}} = 160 \text{ blocks}$

$$\frac{1563 \text{ blocks}}{160 \text{ blocks/cylinder}} \approx 9.769 \rightarrow 10 \text{ cylinders}$$

Can read 10 block at a time → only need to calculate transfer time for 1563/10 blocks = 156.3 blocks → 157 blocks

Avg time = avg seek time + avg latency time + transfer

$$= \underbrace{\left(1 + \frac{8192}{1000}\right)}_{\text{avg initial seek}} + \underbrace{9\left(1 + \frac{1}{500}\right)}_{\text{time to seek adjacent tracks}}$$

$$+ \underbrace{\left(\frac{11.1}{2}\right)}_{\text{avg initial latency}} + \underbrace{157(0.8)}_{\text{transfer the blocks}}$$

$$\approx \boxed{149.36\text{ms}}$$

Problem 2:

(Q1)

	Header	ID	Name	age	DoB	gender	Address	state
Bytes	8	4	28	4	12	4	60	4

Record size: **124 bytes**

(Q2)

	Header	ID	Name	age	DoB	gender	Address	State
Bytes	8	8	32	8	16	8	64	8

Record size: **152 bytes**

Q3) 4K bytes = 4·1024 bytes = 4096 bytes

4096 − 64 = 4032 bytes available for records

4-bytes boundaries:

4032/124 ≈ 32.52 → **32 records**

8-bytes boundaries:

4032/152 ≈ 26.53 → **26 records**