Final

NYA SIR

CSE360

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Q1) Assum that the access time is 35 ns and the recharge time is 55 ns

a) what is the memory cycle time? what is the maximum data rate this DRAM can sustain, assuming a 2 bit output?

b) constructing a 64 bit memory system using these chips yields what data transfer rate?

Ans to the question no: 01 (a)

The memory cycle time $(55+35)$ ns

$= 90$ ns

Thereefor,

The maximum data rate is 2 bit in every 90 ns

90×10^{-9} sec $= 2$ bit

ns — 90 sec $= 2\times10^{9}$ bit

ps — 1 sec $= 2\times10^{9}/90$ bit

ms — $= 22222222.22$ bit $/10^6$

sec — $= 22.22$ megabit

which is 22.22 mbps (Ans)

Ans to the question no: 01 (b)

If 2 bit in every 90 ns then

For 64 bit memory system data rate ~~64×90~~ (64×22.22) mbps

$= 1422.08$ mbps

8.192 mbps equal 1 mB/sec

1 " " $1/8.192$ "

1422.08 " " $1\times1422.08/8.192$ mB/sec

$= 173.59$ mB/sec

(Ans)

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Problem 01:—

Consider a disk pack with the following specification

16 surfaces

128 tracks per surfaces

256 sector per track

512 bytes per sector

01) what is the capacity of disk pack ?

Ans:—

capacity = (surface x track x sector x sector size)

$= (16 \times 128 \times 256 \times 512)$

$= (2^4 \times 2^7 \times 2^8 \times 2^9)$

$= 2^{28}$ byte

$= 256$ MB (Ans)

02) what is the numbers of bits requires to address the sector?

Ans:—

Total number of sector: (surface x track x sector)

$= (16 \times 128 \times 256)$

$= 2^4 \times 2^7 \times 2^8$

$= 2^{19}$ sector.

$= 19$ Bits (Ans)

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03) If the format overhead is 32 bytes per sector what is the formatted disk space?

Ans:—

Format overhead : (total number of sector x overhead per sector)

$= (2^{19} \times 32)$

$= 16$ MB

Formatted disk space : (Total disk space - Format overhead)

$= (256 - 16)$

$= 240$ MB

(Ans)

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04) If the format overhead 64 bytes per sector how much amount of memory lost to formating ?

Ans :—

Format overhead : (Total sector number × Format overhead per sector)

$= (2^{19} \times 64)$

$= 32$ MB

(Ans)

05) If the diameter of innermost track is 21 cm what is the maximum recording density ?

Ans :—

Storage capasity of a track : (sector × sector size)

$= 256 \times 512$

$= 2^8 \times 2^9$

$= 2^{17}$

$= 128$ KB

Innermost track : (π × diameter)

$= (3.1416 \times 21)$ cm

$= 65.97$ cm

max recording density : $\dfrac{\text{capacity of a track}}{\text{innermost track}}$

$= 128/65.97$

$= 1.94$ KB/cm

(Ans)

06) If the diameter of innermost track 21cm with 2KB/cm what is the capasity of one disk ?

Ans :—

Innermost track : (π × diameter)

$= 3.1416 \times 21$

$= 65.97$ CM

capacity of a track : (Innermost track × density)

$= 65.97 \times 2$

$= 131.94$ KB

$= 132$ KB (Ans)

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07) If the disk is rotating at 3600 RPM, what is data transfer rate?

Ans :-

Number of rotations in one(01) sec $(3600/60)$

$= 60$ rotation/sec

Data transfer rate : $\{$heads $\times$ (capacity of one track) $\times$ rotation$\}$

$= \{16 \times (256 \times 512) \times 60\}$

$= \{2^4 \times (2^8 \times 2^9) \times 60\}$

$= 2^{21} \times 60$ byte $= 125829120/1024^2$

$= 120$ MB/sec (Ans)

08) If the disk system has rotational speed of 3000 RPM, what is the average access time with a seek time of 11.5 ms?

Ans :-

Time for one (01) full rotation $(60/3000)$

$= 0.02$ s

$= (0.02 \times 1000)$ ms

$= 20$ ms

Rotational latency $(20/2)$ ms

$= 10$ ms

Average access time $= (11.5 + 10 + 0)$

$= 21.5$ ms

(Ans)

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1024 byte equal to 1 KB 1024 MB equal to 01 GB
1024 KB equal to 1 MB 1024 GB equal to 1 TB

Problem 02 :— what is the average access time for transferring 512 bytes of data with the following specification :—

- Average seek time 5 ms
- Disk rotation 6000 RPM
- Data rate 40 KB/sec
- controller overhead 0.1 ms

Ans :—

Time for one(01) full rotation $(60/6000)$

$= 0.01$ s

$= 0.01 \times 1000$ ms

$= 10$ ms

- Rotational latency $10/2$ ms

$= 5$ ms

Transfer time :—

1024 byte equal to 1 KB

1 " " " $1/1024$

512 " " " $512/1024$

$= 0.5$ KB

- Transfer time $0.5/40$

$= 0.0125$ s

$= 12.5$ ms

Average access time $(5+5+12.5+0.1)$

$= 22.6$ ms

Ans

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Problem 03:– A certain moving arm disk storage with one head has the following specification:–

Number of track per surface 200

Disk rotation speed 2400 RPM

Track storage capacity 62500 bits

Average latency P ms

Data transfer rate Q bits/sec

What is the P and Q value?

Ans:–

Time for one (01) full rotation $60/2400$

$= 0.025 s$

$= 25 ms$

Average latency : $25/2$

$= 12.5 ms$ (Ans)

Number of rotation is one (01) sec $2400/60$

$= 40$ rotation/sec

Data transfer rate : $(1 \times 62500 \times 40)$

$= 2500000$ bit/sec

(Ans)

~~Solem~~

~~Store m m ← (x,y,x)~~

~~40 B~~

$8 \text{ bit} = 1 \text{ byte}$ $\quad 1 \sim \frac{1}{2}$ $\quad \pi \times 2r$

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Problem 07:- A disk pack has 19 surfaces and storage one each surface has an outer diameter of 33cm and inner diameter of 22cm The maximum recording storage density one any track is 200 bits/cm and minimum spacing between track is 0.25 mm calculate the capacity of disk pack.

Ans:-

surfaces 19
outer diameter 33cm
Inner diameter 22 cm
maximum recording storage dencity 200 bits/sec
Inter track gap 0.25 mm

Number of tracks one each surface $\dfrac{(\text{outer radius} - \text{inner radius})}{\text{Inter track gap}}$

$= (16.5 - 11) / 0.25$
$= 5.5 \text{ cm} / 0.25 \text{mm}$
$= (5.5 \times 10) \text{ mm} / 0.25 \text{mm}$
$= 55 / 0.25$
$= 220$ tracks

capacity of track : (storage density × Innermost track)
$= \{\text{storage density} \times (\pi \times \text{Innerdiameter})\}$
$= (200 \times 3.1416 \times 22)$
$= 13823.04 \text{ bits} / 8$
$= 1727.88$ byte

capasity of disk pack : surface × Number of track one surface × capacity of track
$= (19 \times 220 \times 1727.88)$
$= 7222538.4$ byte
$= 7.21$ MB (Ans)

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Problem 05:— Consider a typical disk that rotates at 15000 RPM and has a transfer rate of 50×10^6 bytes/sec. If the average seek time of the disk is twice the average rotational delay and the contro controller's transfer time is 10 times the disk transfer time. What is the average time (ms) to read or write a 512 byte sector of the disk?

Ans:—

Rotational speed 15000 RPM

Transfer rate 50×10^6 byte/sec

Average seek time $2 \times$ Average rotational delay

controller transfer time $10 \times$ Disk transfer time

Time for one (01) full rotation $(60/15000)$
$= 4 \times 10^{-3}$ s
$= 4$ ms

Rotational latency $4/2$ ms
$= 2$ ms

Average seek time (2×2) ms
$= 4$ ms

Transfer time $(512/50 \times 10^6)$
$= 1.024 \times 10^{-5}$ s
$= 0.01624$ ms

Controller transfer time (10×0.01024) ms
$= 0.1024$ ms

Average time to read or write 512 byte:
$(2 + 4 + 0.01024 + 0.1024)$
$= 6.11$ ms

(Ans)

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Problem 06:- A hard disk system has the following parameters:-

Number of tracks 500

Number of sectors per track 100

Number of bytes per sector 500

Time taken by the head to move from one track to another adjacent track 1 ms

Rotation speed 600 RPM

what is the average time taken for transferring 250 byte from the disk?

Ans :-

$\{0+(k-1)t\}/2$

Average seek time $\{(0+499\times 1\,ms)/2\}$

$=(499\,ms/2)$

$=249.5\,ms$

Time for one(or) full rotation $(60/600)$

$=0.1\,s$

$=100\,ms$

~~Rotatio~~ Rotational latency $100/2$

$=50\,ms$

capacity of one track $=$ (sector $\times$ sectorsize)

$=(100\times 500)$

$=50000$ bytes

Data transfer rate $=$ (Head $\times$ capacity $\times$ rotation one sec)

$=\{1\times 50000\times(600/60)\}$

$=50000\times 10$

$=500000$ byte/sec

Transfer time $250/500000$

$=5\times 10^{-4}\,s$

$=0.5\,ms$

Average time taken for transferring 250 byte: $(0.5+50+249.5)$

$=300\,ms$

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Problem 01:- Consider a magnetic disk drive with 8 surfaces, 512 tracks per surface and 64 sector per track. sector size 1 KB. The average seeking time 8 ms the track to track access time is 1.5 ms and drive rotates at 3600 RPM successive tracks in a cylinder can be read without head movement.

a) what is the disk capacity?

Ans:-

Capacity :- surface × track × sector × sector size

= 8 × 512 × 64 × 1 KB

= 262144 KB

= 256 MB (Ans)

b) what is the average access time? Assum this file is stored in successive sectors and tracks of successive cylinders starting at sector 0, track 0 of cylinder i.

Ans:-

Assum this file is store .... at sector 0, track 0, of cylinder i.

Time for one (01) full rotation ($60/3600$)

= 0.0167 s

= 16.7 ms

Rotational latency $16.7/2$

= 8.35 ms

Average access time : 8 + 8.35 + 1.5

= 17.85 ms

(Ans)

c) calculate the number of track, sector, and cylinders for a 5 MB hard disk?

Ans:-

1 MB equal (1024 × 1024) Byte

5 " " 5242880 Byte

$\frac{5MB}{sector \times sector\ size}$ $\frac{5242880}{1KB \times 64} = \frac{5242880}{(1024 \times 1) \times 64}$

$\frac{5242880}{65536}$ = 80 track

(80 × 64) = 5120 sector (track × sector per track)

(80/8) = 10 cylinder track/surface

(Ans)

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Problem 02:— Consider a signal platter disk with the following parameters:—

Rotation speed 7200 RPM

. Number of tracks on one side of platter 30000

Number of sectors per track 600

Seek time one ms for every hundred (100) tracks traverse

Let the disk receive a request to access a random sector a random track and assume the ~~head~~ head starts at track 0.

a) what is the average seek time ?

Ans:—

Assum, $\{0 + (1-k)t\}$

Head start at track 0

If the request track 29999

seek time one (01) ms for every hundre (100) track traversed

Now

$\left(\frac{29999}{100} \times 1ms\right)$

$= 299.99\ ms$

seek time to access the track 0 = 0 ms

Seektime to " " " 29999 = 299.99 ms

Average seek time $\left(0 + 299.99/2\right)$ ms

$= 149.99$ ms (Ans)

b) what is the average rotational latency ?

Ans:—

Time for one (01) full rotation $(60/7200)$

$= 8.33 \times 10^{-3}$ s

$= 8.33$ ms

Rotational latency $8.33/2$

$= 4.165$ ms

c) what is transfer time for a sector ?

Ans:— 7200 RPM one revolution $60/7200$

$= 8.33$ ms

transfer time one (01) sector $\frac{8.33}{600}$

$= 0.01389$ ms

$= 13.89\ \mu s$ (Ans)

1000X1000

Quiz

A magnetic disk has 5 platters. upper part of each platter has 1024 tracks and lower part has 512 tracks. Each track has 32 sector and sector size is 2048 bytes.

a) calculated the size of the disk ?

Ans:—

Platters 5

Total Each platter has track (1024 + 512)

= 1536

Each track has sector 32

Sector size 2048

The size of the disk = 5×1536 × 32 × 2048 bytes

= 503316480 bytes

= 480 MB = $503316480/1024^2$

= 0.46875 GB

(Ans)

b) A disk rotates at 7200 RPM, what is the rotational latency ?

(Ans)

Time for one (01) full rotation $60/7200$

= 8.33×10^{-3} s

= 8.33 ms

Rotational latency $8.33/2$

= 4.167 ms

(Ans)

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1 byte = 10^{-6} MB

Byte
KiloByte

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Consider a magnetic disk drive with 10 double sided magnetic disks inside it. upper surface of every disk contains 150 tracks and lower surface only has 100 tracks. Each track has 100 sectors where sector size is 2KB suppose average seek time is 5.5 ms track to track access time is 1 ms and drive rotates at 4000 Rmp.

a) calculate the size of the disk?

Ans:—

Total tracks (150 + 100) ~~200~~

= 250

Disk drive 10 x double side

sector 100

sectorsize 2KB

The size of disk : 10x2 x 250x 100 x 2KB

= 1000000 KB = 1000000/1024

= 976.57 MB

(Ans)

b) Find the average access time ?

Ans :—

Average seek time 5.5 ms

Track to track access time 1 ms

Time for one(01) full rotation 60/4000

= 0.0125

= 15 ms

Rotational latency 15/2

= 7.5 ms

Average access time (7.5 + 1 + 5.5)

= 14 ms

(Ans)

c) what is total time needed to ~~transfer a 10 MB file from drive~~
Time required to transfers 20MB of file

rotation 4000/60

= 66.67 rotation/sec

Data transfer rate 20 X 100X2 KB X 66.67

side

= 266680 KB/sec
1024

= 260.43 MB/sec

So, In ~~1 sec it transfer 260.43 MB~~ = 0.0383 sec

Hence 10MB file need 10/260.43 = 38.3 ms

Total access time 15 + 38.3

!(11)

i) A magnetic disk has an average seek time of 5 ms. The transfer rate is 50 MB/sec. The disk rotates at 10000 rpm and the controller overhead is 0.2 ms. Find the average to read or write 1024 bytes of data.

Ans:—

Average seek time 5 ms

Time for one (01) full rotation $60/10000$

$= 6$ ms

Average rotational latency $6/2$

$= 3$ ms

Transfer time $9.766 \times 10^{-4}/50$

$= 0.0196$ ms

$\frac{1024 \text{ byte}}{50 \times 1024} = 0.0196$

Total time $5 + 3 + 0.0196 + 0.2$

$= 8.21$ (Ans)

ii) A hard disk with 5 platter has 1024 track per platter 512 sectors per track and 512 byte/sector. Find the total capasity of the disk?

Ans:-

capacity : platter × track × sector × sector size

$= 5 \times 1024 \times 512 \times 512$

$= 1342177280$ byte

$= 1280$ MB (Ans)

iii) calculated how many platters are required for a 40 GB disk if there are 1024 bytes / sector 2048 / track 4096 per platter

Ans:—

capacity $= 1024 \times 2048 \times 4096$

$= 8$ GB

40 GB hard disk,

we needed $40/8$

$= 5$ platters (Ans)

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Type:02

Byte
KB
MB

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Ans to the question no: 6

a) Time for one full rotation $60/8550$

$= 7.01 \times 10^{-3}$ sec $\times 1000$

$= 7.01$ ms

Rotational latency $7.01/2$

$= 3.505$ ms (Ans)

b) seek time 31 ms

controller overhead 3 ms

Rotational latency 3.505 ms

transfer rate $= 33$ MB/sec

3600 Bytes $/ 1024^2$

$= 3.43 \times 10^{-3}$ MB

Transfer time $3.43 \times 10^{-3} / 33$

$= 1.03 \times 10^{-4}$

$= 0.103$ ms

Average access time to read a data block 3600 bytes

$(0.103 + 3.505 + 3 + 31)$

$= 37.608$ ms (Ans)

Type 02

a) Time for one full rotation $60/6000$

$= 0.01 \times 1000$

$= 10$ ms

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Average rotational latency $10/2 = 5$ ms

b) Number of rotation one second $6000/60$

$= 100$ rotation/sec

Data transfer rate = Head × Byte per track × Rotation per s

$= 1 \times 15000 \times 100$

$= 1500000$ Byte/sec $/ 1024^2$

$= 1.43$ MB/sec

c)

Transfer time 2500 Byte / 1.43 MB/sec

$= 2.38 \times 10^{-3} / 1.43$

$= 1.67 \times 10^{-3}$ s

$= 1.67$ ms

Access time: $1.67 + 45 + 5$

$= 51.67$ ms

(Ans)

Type 03.

A hard disk has 600 cylinders, 40 tracks per cylinders 60 sector per track and 1 KB can be used stored in one sector. what is the capacity.

Ans:-

capacity = cylinders × tracks per cylinders × sector per track × sector size
= 600 × 40 × 60 × 1 KB
= 1440000 KB / 1024
= 1406.25 mB Ans

Type 04 A megnatic disk has an average seek time 5 ms. The transfer rate is 50 MB/sec. The disk rotation speed 10,000 rpm and the controller overhead 0.2 ms

a) calculated the average time to read or write 1024 bytes?

b) calculated how many platters are required for 80 GB disk if there 512 byte / setor - 1024 sectors / track and 4096 track per pallters?

Ans: seek time 5 ms

time for one full rotation $60/10000$
= 6 ms

a) Rotational latency = $6/2$
= 3 ms

1024 Byte
$\Rightarrow 1024/1024^2$
$\Rightarrow 9.77 \times 10^{-4}$ mB

transfer time $9.77 \times 10^{-4}/50$
= 0.019 ms

Average time to read or write 1024 Byte (5+3+0.019+0.2)
= 8.219 ms

b) capacity per track : 512 × 1024 × 4096
= 2147483648 Byte
= 2 GB

80 GB hard disk,

we needed $80/2$
= 40 platters

Ans

$\frac{\text{Total hard disk capasity}}{\text{capacity per track (2GB)}}$

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Problem 7.17:— A 32 bit computer has two selector channels and one multiplexer channel. Each selector channel supports two magnetic disk and two magnite tape units. The multiplexor channel has two line printers, two card readers and 10 VDT terminals connected to it.

Assum the following transfer rate:—

Disk drive 800 Kbytes/sec ✓ ✓ card reader 1.2 Kbytes/sec

Magnetic tapedrive 200 kbytes/sec VDT 1 kbytes/sec ✓

✓ line printer 6.6 Kbytes/sec

Estimate the maximum aggregate I/O transfer rate?

Ans to the question no: 7.17

Disk drive transfer rate 800 Kbytes/sec

Tape drive transfer rate 200 Kbytes/sec

The maximum of these rate is 800 Kbytes/sec

For ~~se~~ two (or) selectors 800×2

~~For~~ ~~two~~ = 1600 ~~kb~~ kbytes/sec

For two (or) printers 6.6×2

= 13.2 Kbytes/sec

For two (or) card reader 1.2×2

= 2.4 Kbytes

For ~~VDT~~ Ten (10) VDT terminals = 10×1

= 10 Kbytes/sec

~~so, the total max aggregate I/O transfer rate~~

Multiplexer I/O transfer rate (10+2.4+13.2)

⇒ 25.6 Kbytes/sec

total max. aggregate I/O transfer rate 1600 + 25.6

= 1625.6 Kbytes/sec

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2) A 64 bit computer has three selector channels and ~~two~~ one multiplexor channel. Each selector channel supports four magnetic disks and ~~two~~ three magnetic tape units. The multiplexor channel has one line printer, two card readers and 13 VDT terminals connected to it.

- Disk drive 830 KB/s
- Card reader 1.2 KB/s
- Magntic tape drive 265 KB/s
- VDT 1.1 KB/s
- Line printer 6.5 KB/s

Estimate the max aggregate I/O transfer rate in this?

Ans to the question no:- 02

Disk drive transfer rate 830 KB/s

Tape drive transfer rate 265 KB/s

The maximum of these rate 830 KB/s

For three (03) selector $(830 \times 3 \text{ KB/s})$
$= 2490$ KB/s

For line printer (01) is 1×6.5
$= 6.5$ KB/s

For two (02) card readers 1.2×2
$= 2.4$ KB/s

For 13 VDT treminal 1.1×13 13×1.1
$= 14.3$ KB/s

Multiplexor I/O transfer rate $(14.3 + 2.4 + 6.5)$
$= 23.2$ KB/s

The max aggregation I/O transfer rate $23.2 + 2490$
$= 2513.2$ KB/s
$= 2513.2$ KB/s

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Disk drive transfer rate 650 KB/s

Tape drive transfer rate 176 KB/s

The minimum of these rate 176KB/s

For three (03) selector 176×3

= 528 KB/s

For three (03) line printers 4.6×3

= 13.8 KB/s

For four (04) card readers 2.1×4

= 8.4 KB/s

For 11 VDT Terminals = 11× 1.35

= 14.85 KB/s

~~Total~~ ~~aggr~~ Multiplexor I/O transfer rate (14.85+8.4+13.8)

= 37.05

Total minimum aggregate I/O transfer rate 528 + 37.05

= 565.05 KB/s

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7.14:— Examination of the timing diagram of the 8237A indicates that once a block transfer begins it takes three (03) bus clock cycles. During the DMA cycle the 8237A transfer one byte of information between memory and I/O devices.

a) suppose we clock the 8237A at a rate of 5 MHz. How long dose it take to transfer one byte?

b) what would be the max attainable data transfer rate?

c) Assume that the memory is not fast enough and we have to insert two wait states per DMA cycle, what will be the actual data transfer rate.

Ans to the question 7.14

a) At 5MHz

5000000 cycle takes 1 second

1 " " $1/5000000$ second

$= 2\times10^{-7}$ second

$= 2\times10^{-7}\times1000000$

$= 0.2\ \mu s$

one(01) clock cycle takes $0.2\ \mu s$

Three(03) " " " 0.2×3

$= 0.6\ \mu s$ (Ans)

b) Data transfer rate $= 1\text{ byte}/0.6\ \mu s$

$= 1/0.6\times10^{-6}$

$= \frac{1666666.67}{1024^2}$

$= 1.5894$ MB/s (Ans)

$1/0.6$

$= \frac{1.666666667}{10^6}$

c) Two wait states add $(0.2 + 0.2)$

$= 0.4\ \mu s$

Transfer one byte takes $(0.6 + 0.4)$

$= 1\ \mu s = 1000000\ s$

$1\ \mu s$ need to transfer 1 byte

$1/1000000$ second is required to transfer 1 Byte

1 second is required to transfer $1 / 1/10^6$

$= 10^6$ Byte

$= 10^6/1024^2$

$= 0.96$ MB

The resulting data rate $0.96\ MB / (0.6 + 0.4) \times 10^{-6}$

$= 0.96 / 1 \times 10^{-6} = \boxed{960000/1024^2}$

$= 0.92$ MB/s (Ans)

Proof

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a) At 3.25 MHz

3250000 cycles takes 1 sec

1 " " $1/3250000$

$= 3.07 \times 10^{-7} \times 10^{6}$

$= 0.307\ \mu s$

one clock cycles takes $0.307\ \mu s$

six " " " (0.307×6)

$= 1.842\ \mu s$

A transfer two bytes takes $1.842\ \mu s$

A " one " " $1.842/2$

$= 0.921\ \mu s$ (Ans)

b) The transfer rate :

$2/1.842 \times 10^{-6}$

$= 1085776.33/1024^2$

$= 1.035$ MB/sec

(Ans)

c) Four wait state add (0.307×4)

$= 1.228\ \mu s$

A transfer two byte takes $(1.842 + 1.228)$

$= 3.07\ \mu s$

$3.07\ \mu s$ need to transfer 2 bytes

$3.07/10^6$ sec required to transfer 2 bytes

1 " " " $2/(3.07/10^6)$

~~$= \ldots$~~

$= 651465.798$ bytes$/1024^2$

$= 0.63$ MB

3.07×10^{-6} sec $= 2$

" 2×10^6

3.07 " $2 \times 10^6/3.07$

1

Resulting data rate $0.63/3.07\ \mu s$

$= 0.2052 \times 10^6$

$= 205200/1024^2$

$= 0.1956$ MB/sec (Ans)

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a) 8 MHz

8000000 cycles takes 1 sec

1 " " $1/8000000$ sec

$= 1.25 \times 10^{-7} \times 10^6$

$= 0.125\ \mu s$

one clock cycle takes $0.125\ \mu s$

Five " " " (0.125×5)

$= 0.625\ \mu s$

A transfer one byte takes $0.625\ \mu s$ (Ans)

b) Transfer data rate: $1/0.625 \times 10^{-6}$

$= 1600000/1024^2$

$= 1.53$ MB/sec

c) Three wait states (0.125×3)

$= 0.375\ \mu s$

A Transfer one bytes takes $(0.375 + 0.625)$

$= 1\ \mu s$

$1\ \mu s$ needs to transfer one byte

$1/10^6$ sec required to transfer $1/1/10^6$

$= 1000000$ Byte$/1024^2$

$=$ 0.96 MB

Resulting transfer rate $0.96/1 \times 10^{-6}$

$= 960000/1024^2$

$= 0.92$ MB/sec (Ans)

Example :— A DMA controller transfer 32 bit words to memory using cycle stealing. The words are assembled from a device that transmits characters at a rate of 4800 characters per second. The cpu is fetching and executing instructions at an average rate of one MIPS. By how much will the CPU be slowed down because of the DMA transfer?

Ans to the question no :—

The DMA controller transfer data in 32 bit or 4 bytes

The device transmits characters at a rate of 4800 characters per s

1 character equal 1 byte

Time take to transmit 1 byte $1/4800$ second

Time " " " 4 byte $4\times1/4800$ "

$= 1/1200$ second

1200 characters will be transferred in $1/1200$ second

The cpu executing instruction at ~~average~~ a rate of one (01) MIPS the slowdown (%) due to DMA transfer

slowdown $1200\times100/10^6\times1$

$= 0.12\%$ (Ans)

A DMA controller transfer is 32 bit
= 4 byte

1) The device transmited charactere at a rate of 4800 per characters per second [1 Charater = 1 byte]

For 1 byte it will take $1/4800$ sec

For 4 " " " " $1 \times 4 / 4800$ "

$= 1/1200$ sec

so, 1200 character will be transfer in cycle stealing mode ~~that~~ and it is given the cpu is fetching and executing instruction at an averag rate of one (1) MIPS. slow down (%) in DMA transfer

$$\frac{100 \times 1200}{10^6 \times 1}$$

$= 0.12\%$ (Ans)

2) A DMA control transfer is 128 bit
= 16 byte

The device transmits characters at a rate of 9600 character per second [1 Character = 1 byte]

For 1 byte it will take $1/9600$ sec

16 " " " " $16/9600$ "

$= 1/600$ sec

so, 600 character will be transfer in cycle stealing and it is given the cpu is fetching and executing instruction at an average rate of four (04) MIPS. Slow down (%) in DMA transfer:

$$\frac{100 \times 600}{10^6 \times 4}$$

$= 0.015\%$ (Ans)

Date
Page

NO	EA	operand
a	201	500
b	500	1100
c	1100	1700
d	702	1302
e	600	1200
f	R_1	400
g	400	1000
h	400	1000

200 → start word

location 201 → 500 (A)

$R_1 \to 400$ (A)

Base value 100

Assum,

399 → 999 | 600

400 → 1000

Ans

a) Immediate:—

EA = 201

operand A

= 500

b) Direct:—

EA = A

= 500

operand 500 + 600

= 1100

c) Indirect:—

EA = ((A))

= 1100

operand 1100 + 600

= 1700

d) pc relative

EA = PC + A

= 202 + 500

= 702

operand 702 + 600

= 1302

e) Displacement:—

EA = Base + A

= 100 + 500

= 600

operand 600 + 600

= 1200

f) Register:—

EA = R_1

operand 400

g) Register indirect:—

EA = (R_1)

= 400

operand 400 + 600

= 1000

h) Autoindexing:—

EA = 400

operand 400 + 600

= 1000

Hossain Mim

NO	EA	operand
a)	525	1225
b)	Not applicable	525
c)	1225	1925
d)	752	1457
E)	675	1375
F)	R_1	620
G)	620	1320
H)	620	1320

Start word → 230

location 231 → 525 (A)

R_1 → 620 (A)

Base value 150

Assum,

298 → 998

299 → 999 | 700

a) Direct :-

EA = A

= 525

operand 525 + 700

= 1225

b) Immediate :-

operand A

= 525

EA = Not applicable Because the operand is part of the instruction itself not fetched from a memory address

c) Indirect :-

EA = (A)

= 1225

operand 1225 + 700

= 1925

d) PC Relative :-

EA = PC + A

= 232 + 525

= 757

operand 757 + 700

= 1457

E) Displacement :-

EA = Base + A

= 150 + 525

= 675

operand 675 + 700

= 1375

G) Register indirect :-

EA = (R_1)

= 620

operand = 620 + 700

= 1320

F) Register :-

EA = R_1

operand 620

H) Aout indexing :-

EA = 620

operand 1320

five stage:— FI, DI, CA, FO, EI
8 Instruction and ~~6~~ 2nd instruction branee

Time   Banch penalty

Instruction	1	2	3	4	5	6	7	8	9	10	11	12
I_1	FI	DI	CA	FO	EI							
I_2		FI	DI	CA	FO	EI						
I_3			FI	DI	CA	FO						
I_4				FI	DI	CA						
I_5					FI	DI						
I_6						FI						
I_7							FI	DI	CA	FO	EI	
I_8								FI	DI	CA	FO	EI

Five stages: FI, DI, CA, FO, EI
sequence 9 instruction and Branch 3 instruction

Instruction	1	2	3	4	5	6	7	8	9	10	11	12	13
I_1	FI	DI	CA	FO	EI								
I_2		FI	DI	CA	FO	EI							
I_3			FI	DI	CA	FO	EI						
I_4				FI	DI	CA	FO						
I_5					FI	DI	CA						
I_6						FI	DI						
I_7							FI						
I_8								FI	DI	CA	FO	EI	
I_9									FI	DI	CA	FO	EI

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Five stages:— FI, DI, CA, FO EI
9 instruction and branch 4th instruction:

Page :

time.

Branch penalty

Instruction	1	2	3	4	5	6	7	8	9	10	11	12	13
I1	FI	DI	CA	FO	EI								
I2		FI	DI	CA	FO	EI							
I3			FI	DI	CA	FO	EI						
I4				FI	DI	CA	FO	EI					
I5					FI	DI	CA	FO					
I6						FI	DI	CA					
I7							FI	DI					
I8								FI					
I9									FI	DI	CA	FO	EI

Ans

A non-pipelined processor has a clock rate 2.5 GHz and average CPI of 4. An upgrade to the processor introduces a five stage pipeline. However due to internal pipeline delays such as latch delay the clock rate of the new processor has to be reduced to ~~the~~ be reduced to 2 GHz.

a) what is the speedup achieved for a typical program

b) what is the MIPS rate for each processor

Ans:—

Old

Clock rate 2.5 GHz

cycle time $1/2.5$

$= 1/2.5\times10^9 = 4\times10^{-10}$ sec

$= 4\times10^{-10}\times10^9$ ns

$= 0.4$ ns

CPI $= 4$

Exection time per instruction 4×0.4

$= 1.6$ ns

New

Clock rate 2 GHz

cycle time $1/2$ GHz

$= 1/2\times10^9$

$= 0.5$ ns

Execution time per instruction 1×0.5

$= 0.5$ ns

$$\text{speed up} = \frac{\text{Execution time old}}{\text{Execution time new}}$$

$= 1.6/0.5$

$= 3.2$ ns (Ans)

b) non-pipelined processor:—

clock rate 2.5 GHz

CPI 4

$$\text{MIPS} = \frac{f}{\text{CPI}\times10^6}$$

$= 2.5\times10^9/4\times10^6$

$= 625$ MIPS

(Ans)

Piplined processor:—

clock rate 2 GHz

CPI 1

$$\text{MIPS} = f/\text{CPI}\times10^6$$

$= 2\times10^9/1\times10^6$

$= 2000$ MIPS

(Ans)

Hossain Mim

$+$ | (*) | AB*CD+E*+F+ $\left(A+\frac{B}{C}-D\right)/(E-F+G)$

-/) ABC/- DE*+/

$X = (A*B) + (C+D)*E+F$

PUSH A
PUSH B
MUL
PUSH C
PUSH D
ADD
PUSH E
MUL
ADD
PUSH F
ADD
POP X

$X = \dfrac{A-B/C}{D+E*F}$

Zero Address:—

PUSH A
PUSH B
PUSH C
DIV
SUB
PUSH D
PUSH E
MUL
ADD
DIV
POP X

One Address

Load E	AC ← E
MUL F	AC ← AC*F
ADD D	AC ← AC+D
Store X	X ← AC
Load B	AC ← B
DIV C	AC ← AC/C
~~Load~~	
Store Y	Y ← AC
Load A	AC ← A
SUB Y	AC ← AC-Y
~~Store X~~	
DIV X	AC = AC÷X, A÷C
Store X	X ← AC

Two Address:—

~~MOVE X, B~~ ~~X ← B~~
~~DIV X, C~~ ~~X ← X/C~~

Two Address:—

MOVE X, A	X ← A
MOVE Y, B	Y ← B
DIV Y, C	Y ← Y/C
SUB X, Y	X ← X-Y
MOVE Z, E	Z ← E
MUL Z, F	Z ← Z*F
ADD Z, D	Z ← Z+D
DIV X, Z	X ← X÷Z

$|{-x \atop -1}|$ xyzx− ABC/+ − DF/+

M   AC 10 20 − LD 10

20

$M = (x - y*z) - (A + B/C) + D/F$

Stack or 0 Address	one address or single	
push x	Load B	$AC \leftarrow B$
push y	Div C	$AC \leftarrow AC/C$
push z	Add A	$AC \leftarrow AC + A$
MUL	Store x_1	$x_1 \leftarrow AC$
sub	Load D	$AC \leftarrow D$
push A	Div F	$AC \leftarrow AC/F$
push B	Add x_1	$AC \leftarrow AC + x_1$
push C	Store x_2	$x_2 \leftarrow AC$
Div	Load y	$AC \leftarrow y$
Add	MUL z	$AC \leftarrow AC*z$
sub	store x_3	$x_3 \leftarrow AC$
push D	Load x	$AC \leftarrow x$
push F	sub x_3	$AC \leftarrow x - x_3$
Div	sub x_2	$AC \leftarrow AC - x_2$
Add	Store M	$M \leftarrow AC$
POP M		
instruction : 16	Instruction 15	
memory access : 16op+9d	Memory access 15op+15d	

two or general

- Load R_1, y $R_1 \leftarrow y$
- MUL R_1, z $R_1 \leftarrow R_1 * z$
- Load R_2, x $R_2 \leftarrow x$
- sub R_2, R_1 $R_2 \leftarrow R_2 - R_1$
- Load R_3, B $R_3 \leftarrow B$
- Div R_3, C $R_3 \leftarrow R_3/C$
- Add R_3, A $R_3 \leftarrow R_3 + A$
- Load R_4, D $R_4 \leftarrow D$
- Div R_4, F $R_4 \leftarrow R_4/F$
- Add R_4, R_3 $R_4 \leftarrow R_4 + R_3$
- sub R_2, R_4 $R_2 \leftarrow R_2 - R_4$
- Store R_2, M

12op+9d