PECANWOOD
COLLEGE
Prepared for Life

INFORMATION TECHNOLOGY THEORY EXAMINATION
GRADE 11

NAME: Memo **GRADE:** _____

DATE: 20 JULY 2022
EXAMINER: MR SC EILERTSEN
MODERATOR: MR C SEEWALD

MARKS: 145
TIME: 2,5 HOURS

INSTRUCTIONS:

1. This mid-year examination is made up of 17 pages. This includes Addendum A, Addendum B and a single additional page. Please ensure that your paper is complete.
2. There are no trick questions on this paper e.g. a comma that did not print clearly would not be the intention of any of the questions.
3. It is in your interests to write legibly and neatly.
4. You may use a non-programable calculator.
5. Additional paper is provided at the end of this examination paper. If you use it, please label your answer clearly using the same numbering system as the original question.

Question One **Short questions**

Match the term in column A with its definition in column B. Use the answer grid below for your answers – write the letter next to the question number. There are less terms than definitions.

	Column A		Column B
1.1	browser cache	A	That part of the operation system that is always kept in RAM.
1.2	kernel	B	This memory extends the number of addresses that RAM has – pages can be swopped between RAM and the hard drive.
1.3	interpreter	C	The time taken for a component to respond to a request for service – this time should be as short as possible.
1.4	SATA	D	Instead of reading a program line by line from a slow hard drive, several lines are read so subsequent reads are faster.
1.5	buffer	E	Stores the programs and data currently being used.
1.6	multitasking	F	The program that performs the boot sequence which ends with the entire operation system being loaded.
1.7	latency	G	A signal sent to the CPU from hardware or software indicating the need for the CPU's attention.
1.8	CMOS	H	A parallel bus that connects all components on the mother board.
1.9	disk cache	I	When you visit a website, a copy is kept here to increase performance should you visit the same website in future.
1.10	interrupt	J	A temporary storage area in RAM to hold data coming in and going out to compensate for momentary delays.
		K	A battery backed, volatile memory that stores hardware and user settings that are loaded on boot up.
		L	Software that reads each a program line, converts it to machine code, executes it and then moves onto the next line.
		M	A computer bus interface used to connect mass storage devices (mechanical or solid state) to a computer motherboard.
		N	A technique used by the operation system to appear to be running several programs simultaneously.

(10)

Answer grid

Ques	Ans	Ques	Ans	Ques	Ans	Ques	Ans	Ques	Ans
1.1	I	1.2	A	1.3	L	1.4	M	1.5	J
1.6	N	1.7	C	1.8	K	1.9	D	1.10	G

Question two **Hardware**

Busses connect all the computer components, but they operate at different speeds and connect different types of hardware to the computer system.

2.1) Fill in the table below. Note that the internal bus is also known as the front side bus (FSB) or system bus.

A	B	C	D
Types of busses.	**Write "internal bus" or "external bus".**	**Does this bus offer a direct connection between the CPU to the RAM? Write Yes or No.**	**Briefly describe what each bus does mentioned in column A. If relevant you can also mention the type of components, you would expect to find connected to the bus in question.**
Control bus	internal	Yes	Carries the commands between the CPU and RAM
PCI express	external	No	Fast bus for graphics cards, RAID cards, WiFi or SSD's
SATA	external	No	Used for large HDD or SSD. Bulky + slow compared to NVMe
NVMe	external	No	New fast bus interface to connect small SSDs to the PCIe bus

Types of busses – continued.	Write "internal bus" or "external bus"	Does this bus offer a direct connection between the CPU to the RAM? Write Yes or No.	Briefly describe what each bus does mentioned in column A. If relevant you can also mention the type of components, you would expect to find connected to the bus in question.
Data bus	internal	Yes	Transfers the instructions / data between RAm and the CPU.
Address bus	internal	Yes	Transfers the address of the instructions / data between RAm and the CPU
Universal Serial Bus	external	No	Used to connect all manner of peripherals to the motherboard eg keyboard, mouse etc

(22)

2.2) Refer to Addendum A question 2.2. There is diagram A and diagram B.

2.2.1) Explain which one illustrates hyperthreading – A or B? A. One ALU to process but two sets of registers. CPU swops from one set of registers to another. Not simultaneous execution (2)

2.2.2) Explain which one illustrates parallel processing – A or B? B. Two ALU allowing two processes to be excuted at the same time.

(3)

2.3) Examine the three computers in **Addendum A – see Question 2.3**. We are going to compare the theoretical performances of computers 1 , 2 and 3 with one another. Combining all your knowledge about computer architecture, cache memory, shared memory, hyperthreading, multiprocessing, registers, bus speeds etc, answer the following three questions.

2.3.1) Which one would offer the best performance? (1,2 or 3). Explain. 1. Two cores, each with their own dedicated L1, L2 and L3 cache memory.

(3)

2.3.2) Which one would offer mid-range performance? (1,2, or 3). Explain. 2. Two cores with its own L1 cache memory. L2 cache memory is outside the CPU chip and is shared by the two cores. (3)

2.3.3) Which one would offer the lowest performance? (1,2, or 3). Explain. 3. Only one core. L2 cache is outside the CPU chip.

(2) **[35]**

NO credit for wrong choices.

Question three **System Software**

3.1) The boot up process. Describe four advantages of UEFI over traditional BIOS. Runs at 32 bits or 64 bits and not at 16 bits like BIOS. Therefore boots up faster. Can address more memory during boot up. Supports drives bigger than 2.2 TB. User friendly menu system with mouse support. Supports Secure Boot to check for malware during boot up. (4)

3.2) Study the image in **Addendum B question 3.2** and explain whether this illustrates hyperthreading, multitasking, multithreading, or multiprocessing? Multitasking. Multiples programs are loaded into their own memory space in RAM. User can switch between them

(3)

3.3) Study the image in **Addendum B question 3.3** and explain what is meant by virtual memory.

When computer runs low on RAM memory it can use HDD as an extension of RAM. Pages are swapped between RAM and the HDD. **(3) [10]**

Question four **Networking overview**

Write "node", "connecting device", "connection media", "topology" or "internet protocol" in column B, next to each of the words in the column A

4.1)

Column A	Column B
Personal computer	node
NIC	connecting device
TCP/IP	internet protocol
bus	topology
Switch	connecting device
DHCP	internet protocol
Server	node
Printer	node
Radio waves	connection media
NFC (near field communication)	connection media
Mobile devices	node
star	topology
UDP	internet protocol
laptop	node
Router	connecting device
Bridge	connecting device
Shielded twisted pair	connection media
Workstation	node
ARP	internet protocol
ring	topology
Fibre optic	connection media
hybrid	topology
Bluetooth	internet protocol
Network interface card	connecting device
repeater	connecting device
DNS (domain name service)	internet protocol

(26 divide by 2)

4.2) Internet protocols. Write **TCP** or **UDP** next to each situation below.

4.2.1) When watching a movie on Netflix (a streaming media service) which internet protocol will be used? UDP (1)

4.2.2) When downloading an application to install on your local computer. TCP (1)

4.2.3) When chatting to someone on your mobile phone using WhatsApp. UDP (1)

4.2.4) When sending email to a friend. TCP (1)

4.2.5) When submitting your assignment on Ms Teams. TCP (1)

4.3) Generally, when creating a LAN in a local area (school or office) which popular networking **technology** are you likely to use? ethernet (1)

4.4) Generally, when creating a LAN in a local area (school or office) which popular networking **topology** are you likely to use? star (1)

4.5) Generally, when creating a LAN in a local area (school or office) which popular IP **addressing** system are you likely to use? TCP/IP (1) **[21]**

Question 5 **Scenario with reference especially to networking**

The Free State country town Rhese has a declining population. It has a solid but old-fashioned infrastructure that is falling into disuse. The only large buildings are the town hall, the old movie theatre, and a church while the rest of the town is made up of single-story buildings that are either shops along the main street or houses. The town is divided down the middle by the Vaal River; the commercial side of the town is on one side of the river while the houses tend to be on the other side. The whole region around the town is very flat. The nearest large city is Bloemfontein 40 kms away which has a modern and sophisticated IT infrastructure.

It is decided to use the existing town infrastructure and open a satellite campus of the University of Free State (ufs) which is found in Bloemfontein. The university's IT network can be extended to the town.

5.1) What would be the best way to link the university network to the town? Explain your answer.

Underground fibre optic backbone
Line of sight microwave.

(2)

5.2) Once linked to the city the entire town is going to be networked. What are the advantages of creating such a network both for students as well as for the university?

File sharing. Resource sharing. Collaboration
Centralisation. Communication
Network applications. File storage
Data transfer. Productivity

(4)

5.3) The town hall is going to be divided into offices to house the university administration.

5.3.1) A LAN is going to be created that will give access to the universities main central database in the city. Each office will have a desktop computer. These offices need maximum IT security to protect valuable university data as well as student data. Describe how you would design this network to ensure **maximum security, speed, convenience, and reliability**. Mention the **networking topology, the network technology, the cabling, and the connection devices** that you would use.

Nodes connected via UTP to a switch in star topology, using Ethernet technology. A firewall (hardware) to prevent external penetration. Firewall to prevent users going to illegal sites which have malware. Proxy Server with a copy of the university database to prevent direct access to database. Wireless Access Point to create a hotspot for convenience. LAN will enable hardware sharing eg printers, scanners Also file server, web server + mail server

(8)

5.3.2) Cost is always an issue. Some feel that a bus topology, which is cheaper to install would be a good choice. You feel that a star topology, although more expensive is a better option. Explain the advantages of a star topology over a bus topology.

Ease to trouble shoot. When there is a failure only one workstation is affected Ease to expand when new nodes are added. Tried and tested common technology.

(4)

5.3.3) The town hall is going to need several high-powered servers to create a **client-server** environment for university administration staff. Which **type** (not brand) of servers would you install? Explain the function of each server and how it fulfils the needs of the connected client workstations.

File server for local storage
Print server to share printers
Web server to provide security and performance to the whole network (3)
Email server for secure email distribution.

5.4) The houses on the other side of the river are going to be used for student accommodation.

5.4.1) Explain why UTP cabling cannot be used to network the two sides of the town together.

Distance is too far. Not an outside media. (2)

5.4.2) If UTP cannot be used which alternative would you use to extend the university network to the student accommodation on the other side of the river? Fibre optic cable mounted on the bridge that crosses the river. Microwave could also be used. (2)

5.4.3) Students are going to need internet, email, research tools, use the administrations services etc from their student accommodation. What IT networking infrastructure would you install in each student residence to serve their needs? Be specific about the hardware devices or device that you would need to install in each house.

ADSL or fibre to each house. Wireless Access Point in each residence to provide WiFi (2)

5.4.4) The town aims to have over 1000 students living in student accommodation in the various houses converted to meet this need. You cannot have 1000 nodes on one network so the network will have to get divided into segments – each house would be a segment. Which hardware device do we use to join segments together?

Bridge. (1)

5.5) The whole network will continue to use TCP/IP just like the city campus. As each node logs on to the system in the morning it is automatically allocated an IP address from a pool of available address. What do we call this protocol that allocates IP addresses to nodes?

DHCP (1)

5.6) The University of Free State has a website i.e. "ufs.ac.za" (the domain name).

5.6.1) The IP address of this website is "146.182.9.12" What do we call the service that links the IP address with the domain name?

DNS (1)

5.6.2) Is this IP address "146.182.9.12" IPv4 or IPv6. Explain your answer. IPv4. (32 bits) IPv6 (128 bits) eight groups of hexadecimal (2)

5.7) Security is always an issue. If illegal activity is detected on the network the IP manager can query the OSI model, going down to the data link layer to find the MAC address of the culprit. Why would this identify the **exact** computer? Why could you not use the IP address to identify the culprit? IP addresses are shared by DHCP. MAC address is burnt onto the network card of a specific computer (2)

5.8) Despite the convenience of WiFi it has considerable disadvantages over a traditional Ethernet copper cabled LAN. List three disadvantages of WiFi versus Ethernet

Slower. Not as reliable. More difficult to troubleshoot. Not as secure. (3)

5.9) University administrators require all students to own a device which will allow Ms Teams to run. Why do you think the university thinks this is important? What functionality does Ms Team offer that would benefit both the students and the university?

Communication within departments
Collaboration + sharing.
Video + audio meetings.
Online teaching
Assignments (3)

5.10) "Students on-the-go will usually connect to the university network using 3G, LTE or 4G". What does this statement mean?

These are cellular technologies.
Students can use their smart devices mobile devices to connect (1)

to the network using a SIM card
Cannot to various hotspots.

5.11) **Internet protocols**. Some protocols are used for **email**. Some protocols are used to **transfer webpages** from the server to the web browser. Some protocols are used **to download and upload files** from a website. Some protocols can be used to **edit a website on the server** (without having to download it).

5.11.1) Write – **email, transfer, download/upload** or **edit** next to each of the following protocols. (7)

Internet protocol	What it is used for?
SMTP	email
HTTPS	transfer
WebDAV	edit
FTP	download / upload
POP3	email
HTTP	transfer
IMAP	email

[48]

Section Six **Solutions development**

6.1) Methods analysis table for the charAt method in Java.

Fill in the methods analysis table for "charAt" below.

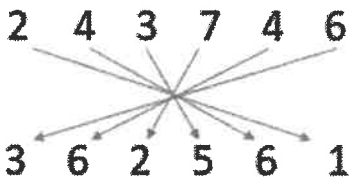
Name of the method	charAt
Describe what the method does.	Returns one character from a specific position ✓
To which class does the method belong?	String ✓
Is the method static or non-static?	non static ✓
Does the method accept arguments / parameters? If so, what datatype does it accept?	Yes. Accepts integer ✓
Does the method offer a return value? If so, what datatype does it return?	Yes. Returns a character ✓
Give your own example of how you would use charAt in a program you were writing	char initial = myName.charAt(0) ✓

(8)

6.2)

Java "for loop" advanced example

The following is a legal line of Java code showing an example of an advanced version of the "for loop"
 	
`for(int i = 10,j = 100; (i < 60) && (j >= 20); i++, j--){`
`  Block of code goes here;`
`}`
So, each of the three sections of the "for loop" are allowed to have more than one expression. We are going to use this knowledge in the pseudocode algorithm below.

Explanation of the algorithm	Diagram A
We have two integer arrays. The first element of the one array must be added to the last element of the other array. The second element of the one array must be added to the second last element of the other array, etc Finally, the six values arrived at should be added together creating a final value for total.	 3 + 10 + 8 + 9 + 10 + 9 = 49

A loop similar the Java "for loop" above would be useful for this application.

Here is the pseudocode version, shown with line numbers

```
1    integerArr1 = {2,4,3,7,4,6}
2    integerArr2 = {3,6,2,5,6,1}
3    total = 0
4    for (i = 0, j = 5; i < 6; i++, j--)
5    begin
6         total = total + (i + j)
7    end
8    display ("The total is " + total)
```

The results of the pseudocode above are **not** as expected. Using the grid below create a trace table to demonstrate what the faulty pseudocode algorithm above actually does.

6.2.1) Start your trace table at line 3. The number of lines in the grid below is not exactly correct and is merely provided for your convenience. Make a column for every variable, the calculation result, the condition, and the output. The line numbers in your trace table must clearly show the operation of the loop. Suggestion – use a pencil.

	Line number	i	j	total	i < 6	Output.
	3					
1	4	0	5		T	
	6			5		
2	4	1	4		T	
	6			10		
3	4	2	3		T	
	6			15		
4	4	3	2		T	
	6			20		
5	4	4	1		T	
	6			25		
6	4	5	0		T	
	6			30		
	4	6	-1		F	
	8					The total is 30
	✓✓	✓	✓	✓	✓✓	✓

(8)

6.2.2) Considering what the algorithm is supposed to do shown in **diagram A** in the previous question, correct the algorithm in the space below. Reminder – you must code in pseudocode, not Java.

NOTE: Rewrite the whole algorithm starting from line 1. Suggestion – use a pencil.

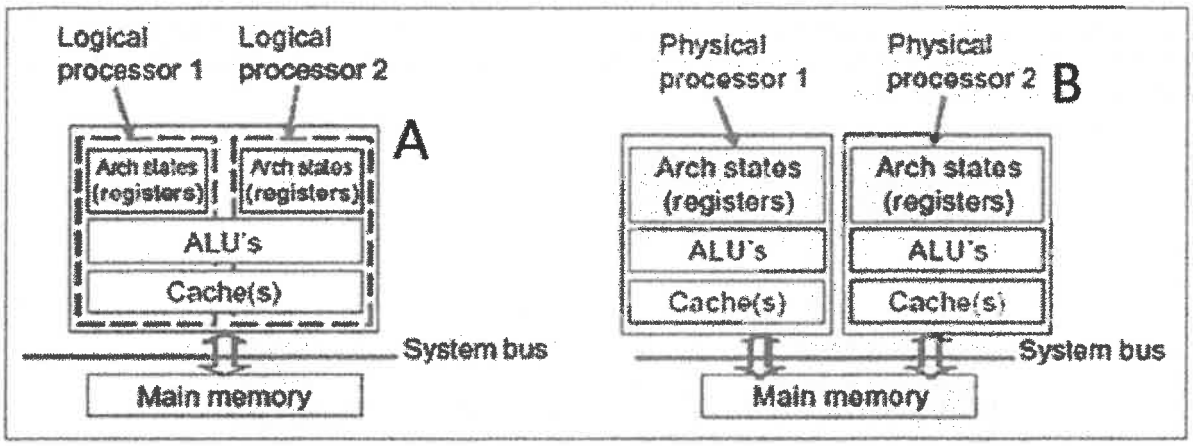
```
1  integerArr1 = {2,4,3,7,4,6}
2  integerArr2 = {3,6,2,5,6,1}
3  total = 0
4  for(i=0, j=5; i<6; i++, j--)
5  begin
6     total = total+(integerArr1[i] +
                      integerArr2[j])
7  end
8  display("The total is " + total)
```

(5) **[21]**

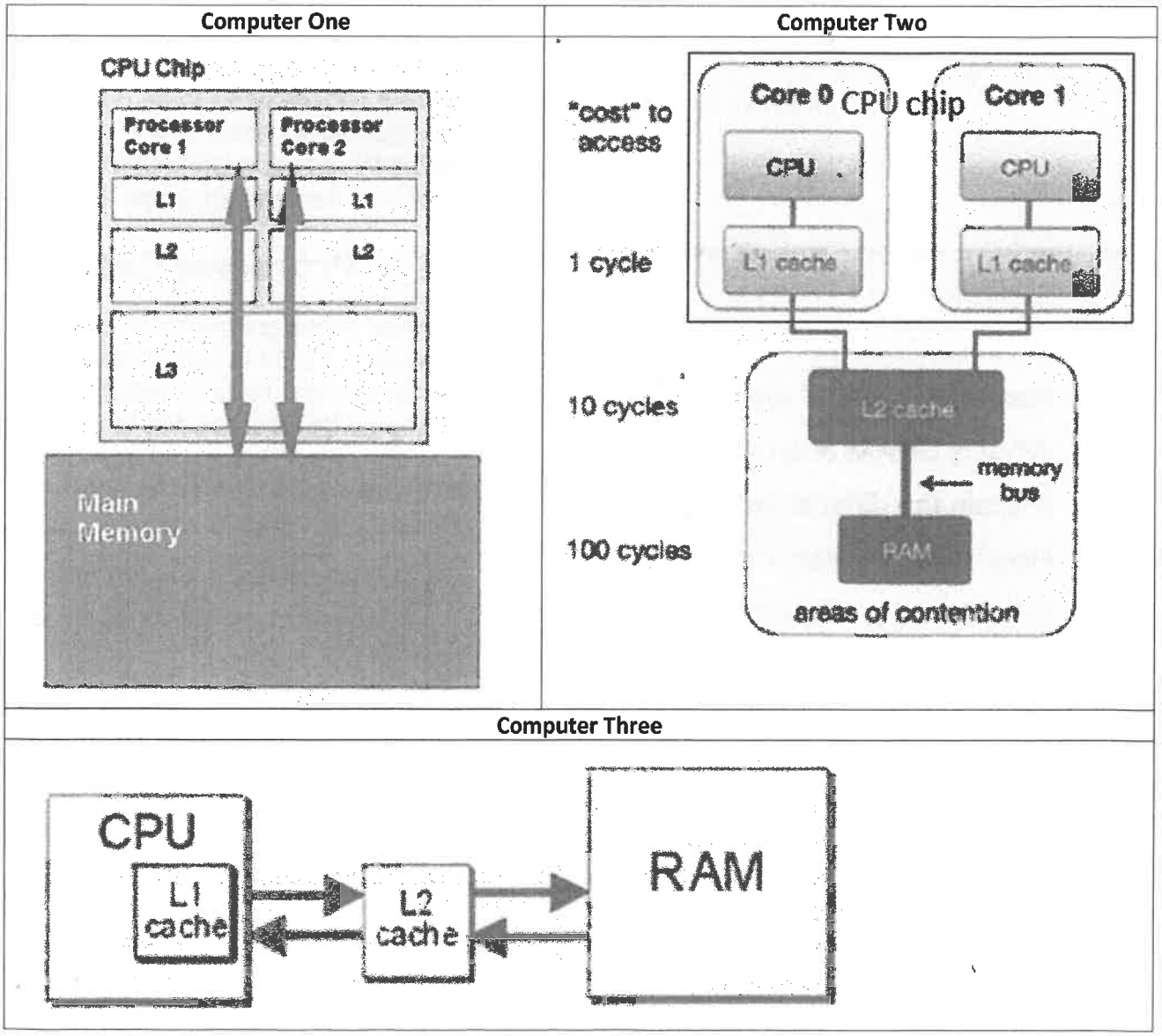
Grand Total: 145

Addendum A

Question 2.2

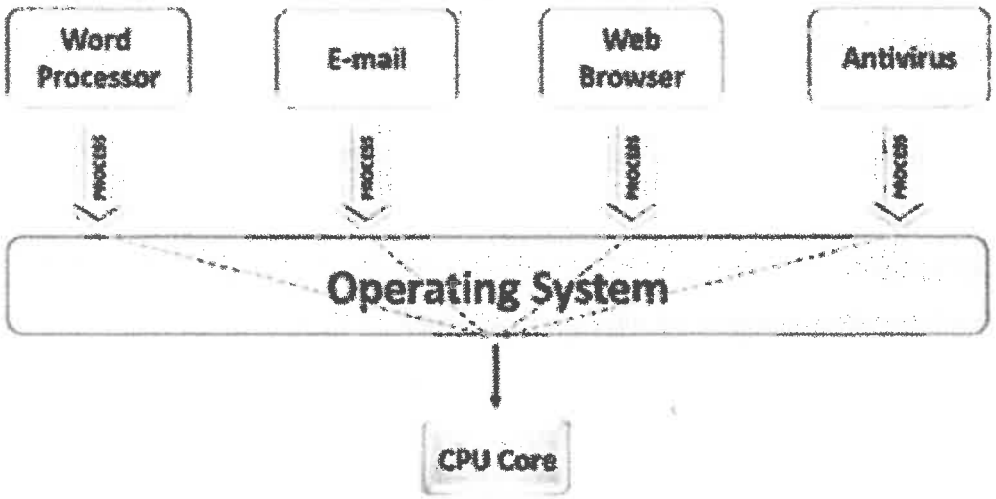


Question 2.3

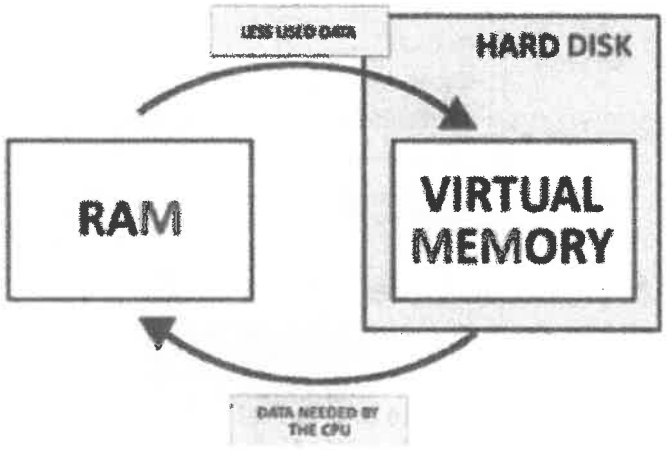


Addendum B

Question 3.2



Question 3.3



Additional Paper: Label your answers clearly