QUESTION 1.

3 A computer operating system (OS) uses paging for memory management.

In paging:

- main memory is divided into equal-size blocks, called page frames
- each process that is executed is divided into blocks of the same size, called pages
- each process has a page table that is used to manage the pages of this process

The following table is the incomplete page table for a process X.

Page	Presence flag	Page frame address	Additional data
1	1	132	
2	1	245	
3	1	232	
4	0	0	
5	1	542	
6	0	0	
135	0	0	

When a particular page of the process is currently in main memory, the Presence flag entry in the page table is set to 1.

If the page is not currently present in memory, the Presence flag is set to 0.

(a) The page frame address entry for Page 2 is 245.

State what the value 245 could represent.

..... [1]

(b) Process X executes until the next instruction is the first instruction in Page 4. Page 4 is not currently in main memory.

State a hardware device that could be storing this page.

..... [1]

(c) When an instruction to be accessed is not present in main memory, its page is loaded into a page frame. If all page frames are currently in use, the contents of a page frame are overwritten with this new page.

The page that is to be replaced is determined by a page replacement algorithm.

One possible algorithm is to replace the page that has been resident in main memory for the longest time.

(i) Give the additional data that would need to be stored in the page table.

.....

..... [1]

(ii) Complete the table entries below to show what happens when Page 4 is swapped into main memory. Assume that Page 5 is the one to be replaced.

In the final column, give an example of the data you have identified in **part (c)(i)**.

Page	Presence flag	Page frame address	Additional data
4	.....	.....	.....

[3]

An alternative algorithm is to replace the page that has been used least.

(iii) Give the different additional data that the page table would now need to store.

.....

..... [1]

(iv) In the following table, complete the missing data to show what happens when Page 3 is swapped into main memory. Assume that Page 1 is the one to be replaced.

In the final column, give an example of the data you have identified in **part (c)(iii)**.

Page	Presence flag	Page frame address	Additional data
3	.....	.....	.....

[3]

(d) Explain why the algorithms given in **part (c)** may not be the best choice for c
management.

Longest resident .....

.....

.....

.....

Least used .....

.....

.....

QUESTION 2.

3 A computer operating system (OS) uses paging for memory management.

In paging:

- main memory is divided into equal-size blocks, called page frames
- each process that is executed is divided into blocks of the same size, called pages
- each process has a page table that is used to manage the pages of this process

The following table is the incomplete page table for a process, Y.

Page	Presence flag	Page frame address	Additional data
1	1	221	
2	1	222	
3	0	0	
4	0	0	
5	1	542	
6	0	0	
⌒	⌒	⌒	⌒
249	0	0	

(a) State **two** facts about Page 5.

1 .....

.....

2 .....

..... [2]

(b) Process Y executes the last instruction in Page 5. This instruction is not a branch instruction.

(i) Explain the problem that now arises in the continued execution of process Y.

.....

.....

.....

.....

.....

..... [2]

(ii) Explain how interrupts help to solve the problem that you explained in **p**

.....

.....

.....

.....

.....

..... [3]

(c) When the next instruction is not present in main memory, the OS must load its page into a page frame. If all page frames are currently in use, the OS overwrites the contents of a page frame with the required page.

The page that is to be replaced is determined by a page replacement algorithm.

One possible algorithm is to replace the page which has been in memory the shortest amount of time.

(i) Give the additional data that would need to be stored in the page table.

.....

..... [1]

(ii) Complete the table entry below to show what happens when Page 6 is swapped into main memory. Include the data you have identified in **part (c)(i)** in the final column. Assume that Page 1 is the one to be replaced.

In the final column, give an example of the data you have identified in **part (c)(i)**.

Page	Presence flag	Page frame address	Additional data
6	.....	.....	.....

[3]

Process Y contains instructions that result in the execution of a loop, a very times. All instructions within the loop are in Page 1.

The loop contains a call to a procedure whose instructions are all in Page 3.

All page frames are currently in use. Page 1 is the page that has been in memory for shortest time.

(iii) Explain what happens to Page 1 and Page 3, each time the loop is executed.

.....

.....

.....

.....

.....

..... [3]

(iv) Name the condition described in **part (c)(iii)**.

QUESTION 3.

3 A computer operating system (OS) uses paging for memory management.

In paging:

- main memory is divided into equal-size blocks, called page frames
- each process that is executed is divided into blocks of the same size, called pages
- each process has a page table that is used to manage the pages of this process

The following table is the incomplete page table for a process X.

Page	Presence flag	Page frame address	Additional data
1	1	132	
2	1	245	
3	1	232	
4	0	0	
5	1	542	
6	0	0	
135	0	0	

When a particular page of the process is currently in main memory, the Presence flag entry in the page table is set to 1.

If the page is not currently present in memory, the Presence flag is set to 0.

(a) The page frame address entry for Page 2 is 245.

State what the value 245 could represent.

..... [1]

(b) Process X executes until the next instruction is the first instruction in Page 4. Page 4 is not currently in main memory.

State a hardware device that could be storing this page.

..... [1]

(c) When an instruction to be accessed is not present in main memory, its page is loaded into a page frame. If all page frames are currently in use, the contents of a page frame are overwritten with this new page.

The page that is to be replaced is determined by a page replacement algorithm.

One possible algorithm is to replace the page that has been resident in main memory for the longest time.

(i) Give the additional data that would need to be stored in the page table.

.....

..... [1]

(ii) Complete the table entries below to show what happens when Page 4 is swapped into main memory. Assume that Page 5 is the one to be replaced.

In the final column, give an example of the data you have identified in **part (c)(i)**.

Page	Presence flag	Page frame address	Additional data
4	.....	.....	.....

[3]

An alternative algorithm is to replace the page that has been used least.

(iii) Give the different additional data that the page table would now need to store.

.....

..... [1]

(iv) In the following table, complete the missing data to show what happens when Page 3 is swapped into main memory. Assume that Page 1 is the one to be replaced.

In the final column, give an example of the data you have identified in **part (c)(iii)**.

Page	Presence flag	Page frame address	Additional data
3	.....	.....	.....

[3]

(d) Explain why the algorithms given in **part (c)** may not be the best choice for c
management.

Longest resident .....

.....

.....

.....

Least used .....

.....

.....

QUESTION 4.

6 A computer system is used to manage some of the functions in a vehicle. The vehicle has a number of sensors and actuators. One sensor is used to monitor the moisture on the screen. If the moisture exceeds a pre-set value, the windscreen wiper motor turns on automatically.

The software used in the computer system is dedicated to the sensor management functions. When the system starts, the software runs some initial tasks. It then loops continuously until the system is switched off.

(a) (i) State the name given to the type of system described.

.....[1]

(ii) Explain your answer to **part (i)**.

.....

.....[1]

(b) Within the software loop, the value of each sensor is read in turn. The value read from the sensor is then processed.

State **two** drawbacks with this method of reading and processing sensor data.

Drawback 1 .....

.....

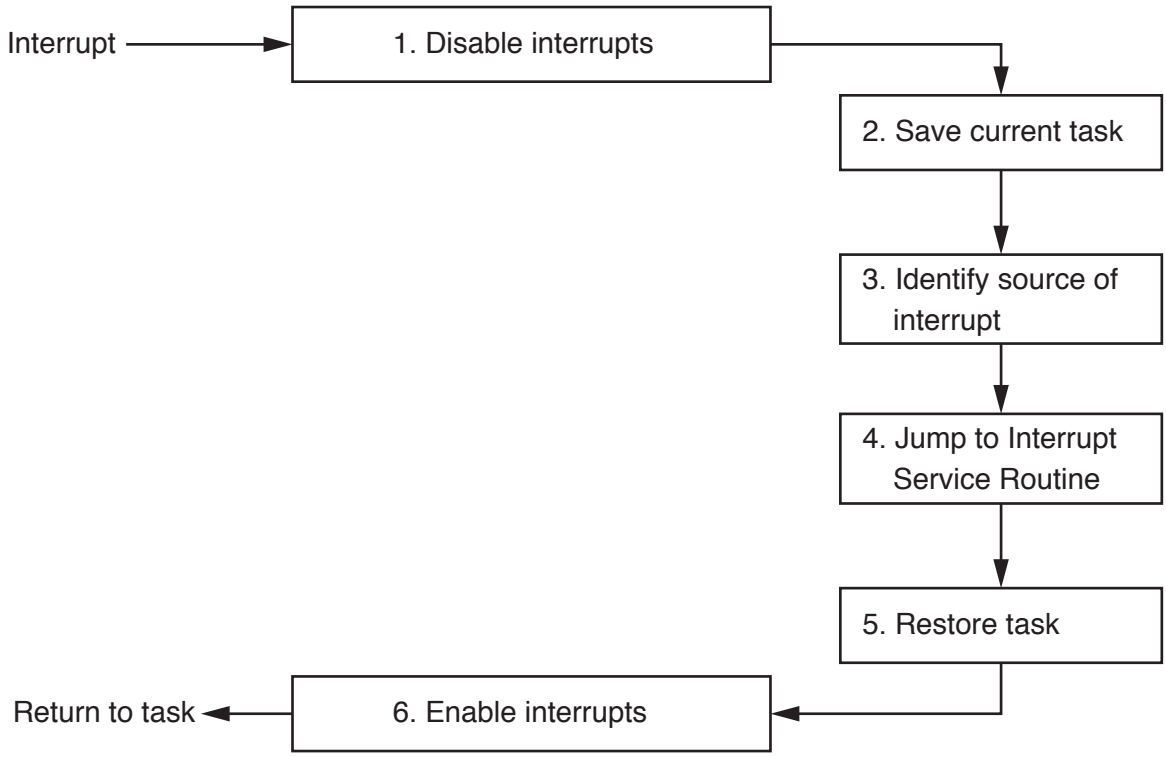
Drawback 2 .....

.....

[2]

(c) An alternative method of reading and processing sensor data is to use interru
is connected so that it can send an interrupt signal to the processor if its value

On receipt of an interrupt signal, the processor carries out a number of steps as sho
following diagram.



(i) State the purpose of step 1.

.....

.....

.....[1]

(ii) State the purpose of step 6.

.....

.....

.....[1]

(iii) Explain how the current task is saved in step 2.

.....

.....

.....

.....[2]

QUESTION 5.

5 A computer process can be in one of three states: running, ready or blocked.

(a) Explain how the processes are affected when the following events take place.

(i) The running process needs to read a file from a disk.

.....

.....

.....

.....[2]

(ii) The running process uses up its time slice.

.....

.....

.....

.....[2]

(b) **(i)** State the conditions that are necessary for a process to move from the ready to the running state.

.....

.....

.....

.....[2]

(ii) State the conditions that are necessary for a process to move from the blocked to the ready state.

.....

.....

.....

.....[2]

(c) Give **three** reasons why process scheduling is needed.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

QUESTION 6.

6 **(a)** An operating system (OS) uses a memory management technique called pa

Explain what is meant by the following terms.

Page .....

.....

.....

Page frame .....

.....

.....

Page table .....

.....

.....

[3]

(b) Explain why an operating system needs to use scheduling algorithms.

.....

.....

.....

.....

.....

..... [3]

(c) State what is meant by an **interrupt**.

.....

..... [1]

(d) For a computer system using multi-programming, the low-level schedule… process will get next use of the processor.

One algorithm could be a round-robin, which means every process gets use of the p… in sequence for a fixed amount of time (time-slice).

For a round-robin algorithm, five processes are currently loaded and get the use of the processor in the sequence:

JOB21 – JOBSS – JOBPT – JOB32 – JOB42, then return to JOB21

Process JOB32 has just completed its time-slice.

The following paragraph describes what happens next. Complete the paragraph by inserting the missing processes.

Interrupt received from the low-level scheduler. Save all register contents for

..... .

Copy the saved registers for ..... to the CPU.

The processor will now process ..... .

[3]

QUESTION 7.

4 Physical memory is managed using virtual memory and paging.

(a) Describe what is meant by **virtual memory**.

.....

.....

.....

..... [2]

(b) **(i)** Explain how paging is used to manage virtual memory.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Give a suitable page replacement algorithm for this process.

..... [1]

(iii) One drawback of using virtual memory is disk thrashing.

Describe what is meant by the term **disk thrashing**.

.....

.....

.....

..... [2]