

PRIFYSGOL CYMRU

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UNIVERSITY OF WALES

Trinity Saint David

Examination Answer Book

24 Pages

Instructions to candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right and seal to hide your name.
3. The answers must be **legibly** written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

1	Student Number	P151833
2	Title of Examination Paper	ALGORITHMS AND DATA STRUCTURES
3	Module Code	M5X01023
4	Date and Time of Examination	01/02/2018 11:00
5	Examination Venue	MH312
6	Seat Number	

7	Number of Answer Books handed in	
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[illegible]

Please complete this section and SEAL before the examination starts.

(Block Capitals) Forename(s) NAOMI

Surname JONES

1)

Experiment 1aFunc 1()

Data size	Time taken (msec)
5000	0.02
10 000	0.03
15000	0.04
20 000	0.05
40000	0.11
80 000	0.22
~~160 000~~	~~0.45~~
~~320 000~~	~~0.97~~

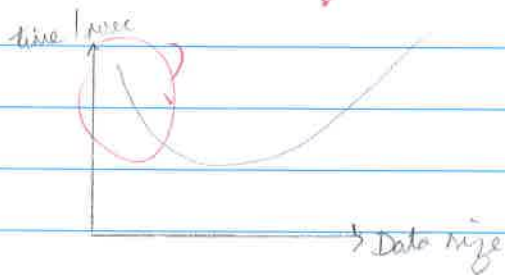
Judging from the data gathered, there appears to be an increase in the time elapsed of approximately 0.01 for every 5,000 items of data added. ~~This would indicate a linear increase in time, or $O(n)$~~ When the data size is doubled, the time increase is ~~0.01, 0.025, 0.06~~ is 0.01 msec, 0.02 msec, 0.06 msec.

~~Note: The graph is only~~ The line on the graph seems to be a curve. This indicates a function of

Experiment 2

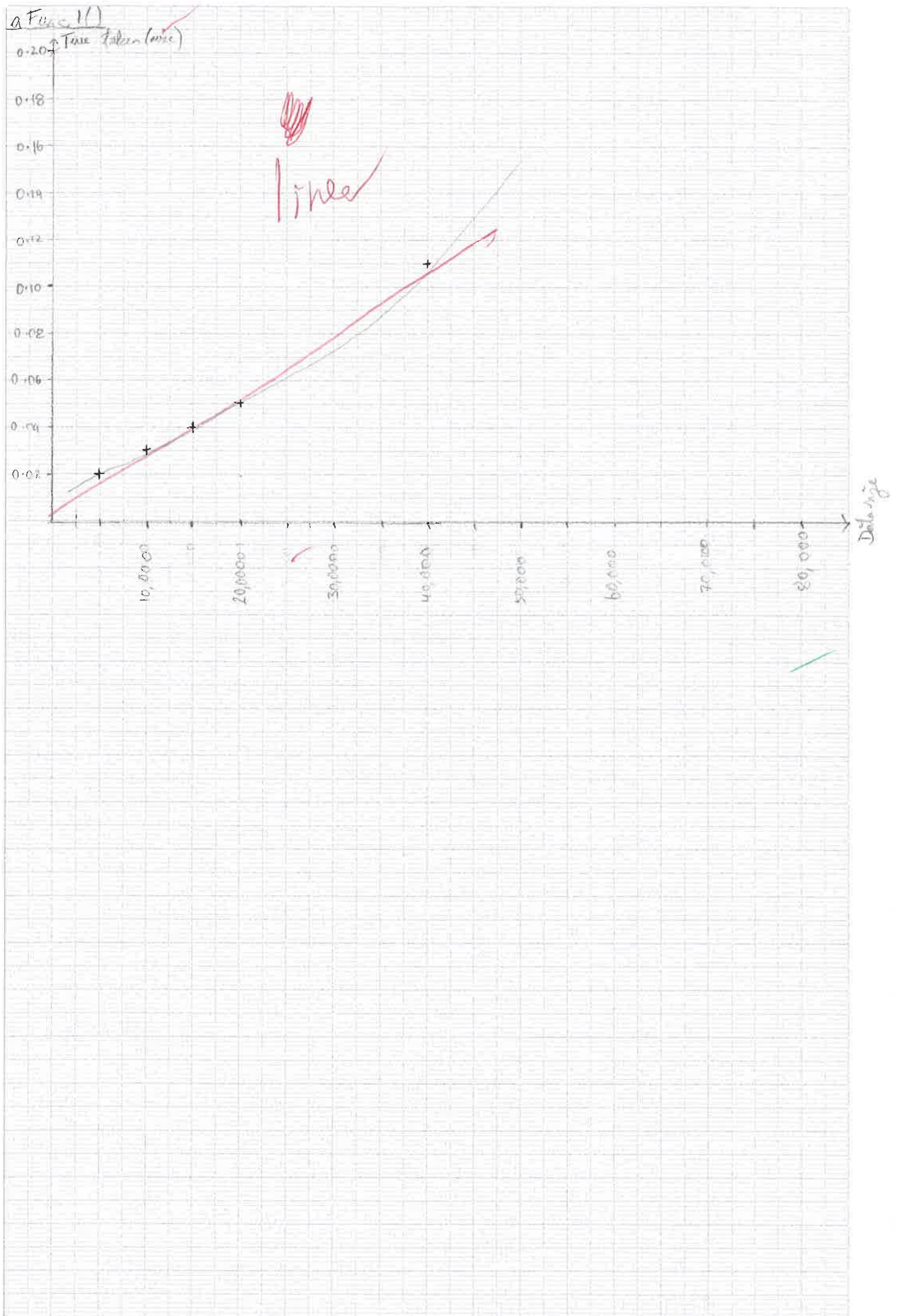
aFunc 2()

Data Size	Time Elapsed (msec)
5000	12.71
10000	12.51
15000	12.40
20000	12.46
40000	12.65



The data goes down and then up again ~~say~~ suggesting a quadratic function.

const



aFunc3()

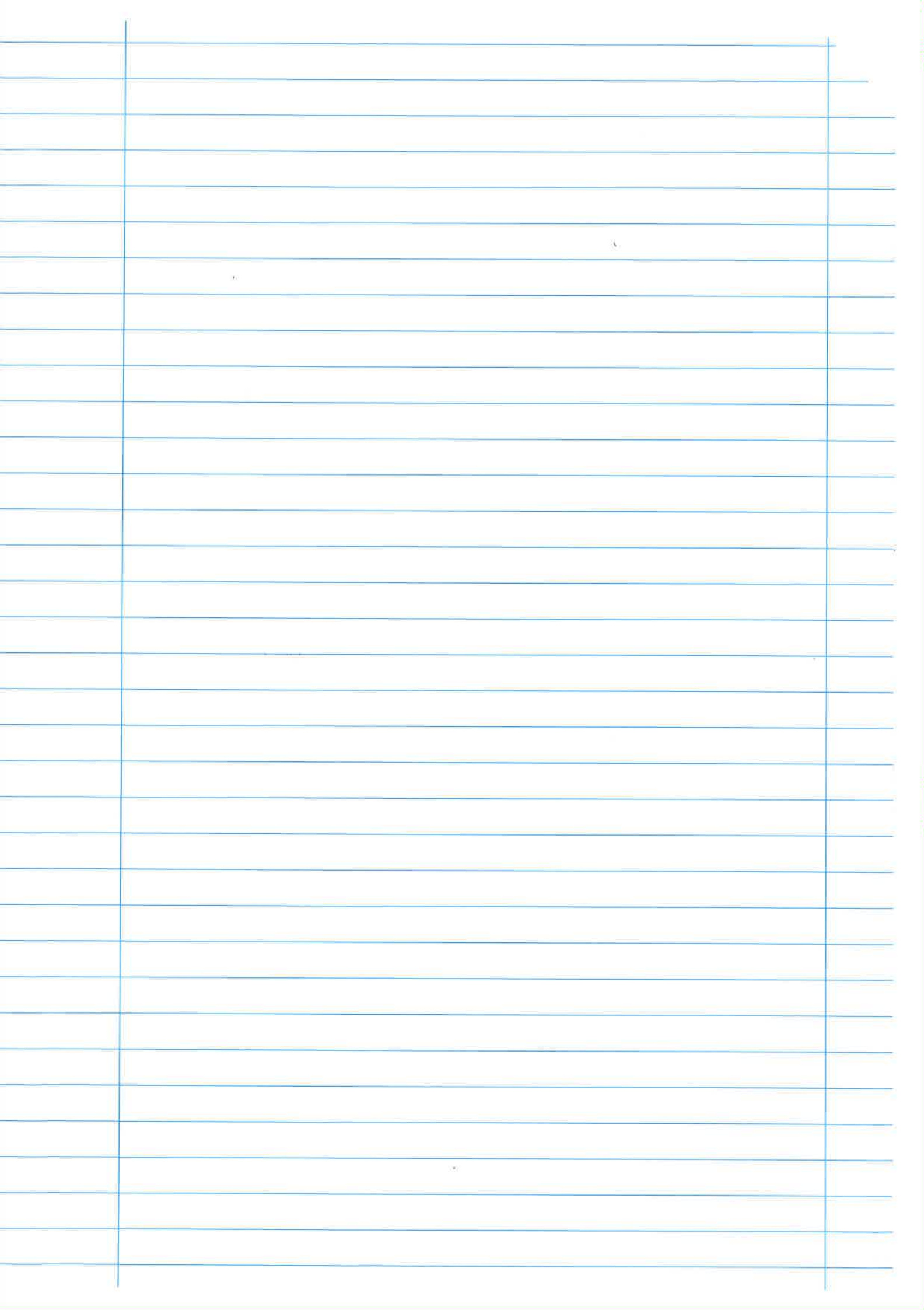
Data Size	Time Elapsed (msec)
5000	7.00
10000	26.78
15000	60.47
20000	163.62
40000	407.74

The ~~data~~ time taken to execute increases massively ^{when} the data size ~~data~~ doubles. In fact, it increases by just under 3x each new data set.

Quadratic

Q1 ——— $\frac{11}{25}$

$\frac{11}{25}$



Section B

2)

a) Static memory allocation means the size of a particular block of memory is determined when the program is ~~compiled~~, such as declaring an array of length 100.

Dynamic memory allocation means the size of the memory allocated is determined while the program is executed. This would involve arrays for example where an input is required to know how long the array needs to be.

So static memory allocation cannot be changed during the execution of the program, whereas dynamic memory allocation can be.

Where on heap?
or stack, etc.

b) A linearly linked list is an abstract data structure that is used to link items of data together. Below is a visual representation.



Each 'Node' in the list points to the next node. The final node is a NULL terminator. linearly means that the list can only be traversed in one direction.

The main operations involved are searching/moving through a list, inserting a node and deleting a node.

Why there?

3/5

c) Needs to do...

- Find where to insert node ✓
- Point new node to next node ✓
- Move pointer from previous node to new node. ✓

Node
procedure add~~Item~~()

~~Find the end of the
move through list~~

~~while node is not null
move to next node
end while~~

newNode.next node $\rightarrow$ NULL

previous node . next node $\rightarrow$ newNode

size of list = size of list + 1

end procedure

previous node $\rightarrow$ next node $\rightarrow$ next node
next node pointer

6/10

This implementation assumes that the new item is being added to the end of the list. OK - but include

~~Also, if there is no previous node is the~~

There is also no check to see if there are any nodes between the start and the end.

general case please!

1.7 0.2d,

d) A stack is a last in, First out structure. This means the last piece of data added will always be the first to be used. The main operations of a stack are peek, push and pop. Peek views the data at the "top" of the stack without removing it. Push adds new data to the stack and Pop removes the element from the top of the stack.

In order to implement a stack using a linearly linked list, you ~~would need an additional pointer that keeps track of~~ to keep track of the size of the list and where the last item could assume that the node that points to null is the last item to have been added, and that you can only add/remove the node before the terminating null node.

could point
set s.p. to
head pointer,
and voila!

$$\begin{array}{r} 15 \\ 25 \\ \hline 40 \end{array}$$

Q25

15/25

Question 3

a)

Pre-order traversal: A, C, E, E, E, H, R, R, T ✓

LNR

Post-order traversal: E, E, C, A, R, H, R, E, T, S ✓

LRN

In-order traversal: S, E, A, C, E, E, R, H, R, T ✓

NLR

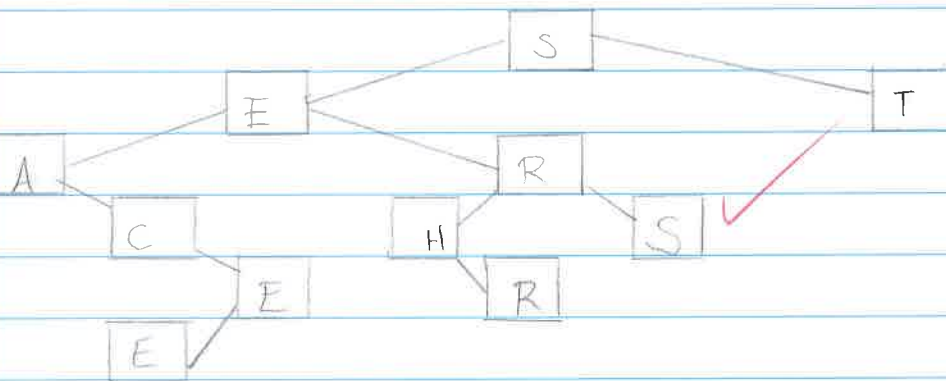
b)

Look at root node and compare to S. They are equal, so it will be assumed that it will go to the left hand side.

Compare E to S. S comes after E so it goes to the right.

Compare R to S. S comes after R so it goes to the right.

There are no more nodes to compare to. The S node is added.



This operation is a recursive function. Each layer of recursion has an if statement in. *always?*

The best case scenario, assuming there is a root node is that it will only have to make a decision once.

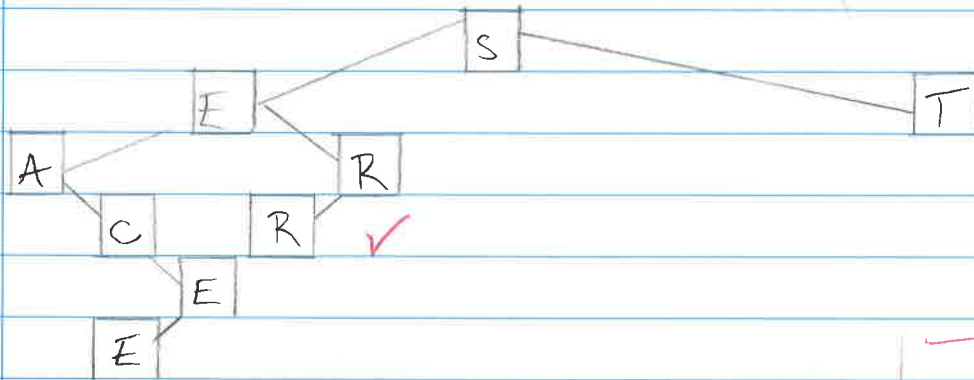
The worst case scenario is that it has to go down every single layer of the binary tree. Each layer doubles the number of comparisons that has to be made in total.

$O(\log n)$ best

$O(n)$ worst

ingram
always
done
1
no

c) First it will look and see if ~~there is a node~~ the H node has any descendants. On this occasion, there is an R node. ✓
This child node is then compared to the parent of H. This is also R. It is assumed when values are equal, that they will be placed to the left. So H is removed, and R is placed to the left of R.



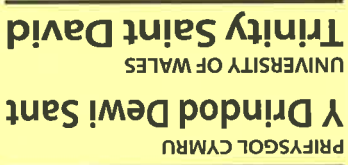
Q3 =

$$\frac{17}{25}$$

$$\frac{17}{25}$$

AR GYFER DEFNYDD GWEINYDDOL YN UNIG, TYNNWCH Y STRIBYN TYLLOG I FFWRDD YN OFALUS

TYNNWCH A
RHWYGWCH



24 Tudalen

8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

1	Rhif Myfyriwr	
2	Teitl y Papur Arholiad	
3	Cod y Modwl	
4	Dyddiad ac Amser yr Arholiad	
5	Lleoliad yr Arholiad	
6	Rhif Sedd	
7	Nifer y Llyfrau Atebion a gyflwynwyd	

[illegible]

(See the other side for English version)

A wneuch chi lenw'r rhan hon a'i SELIO cyn i'r arholiad ddechrau.

Cyfenw

(LLYTHRENNAU BREISION) Enw(au) cyntaf

PLYGWCH