INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

MARKSCHEME

November 2001

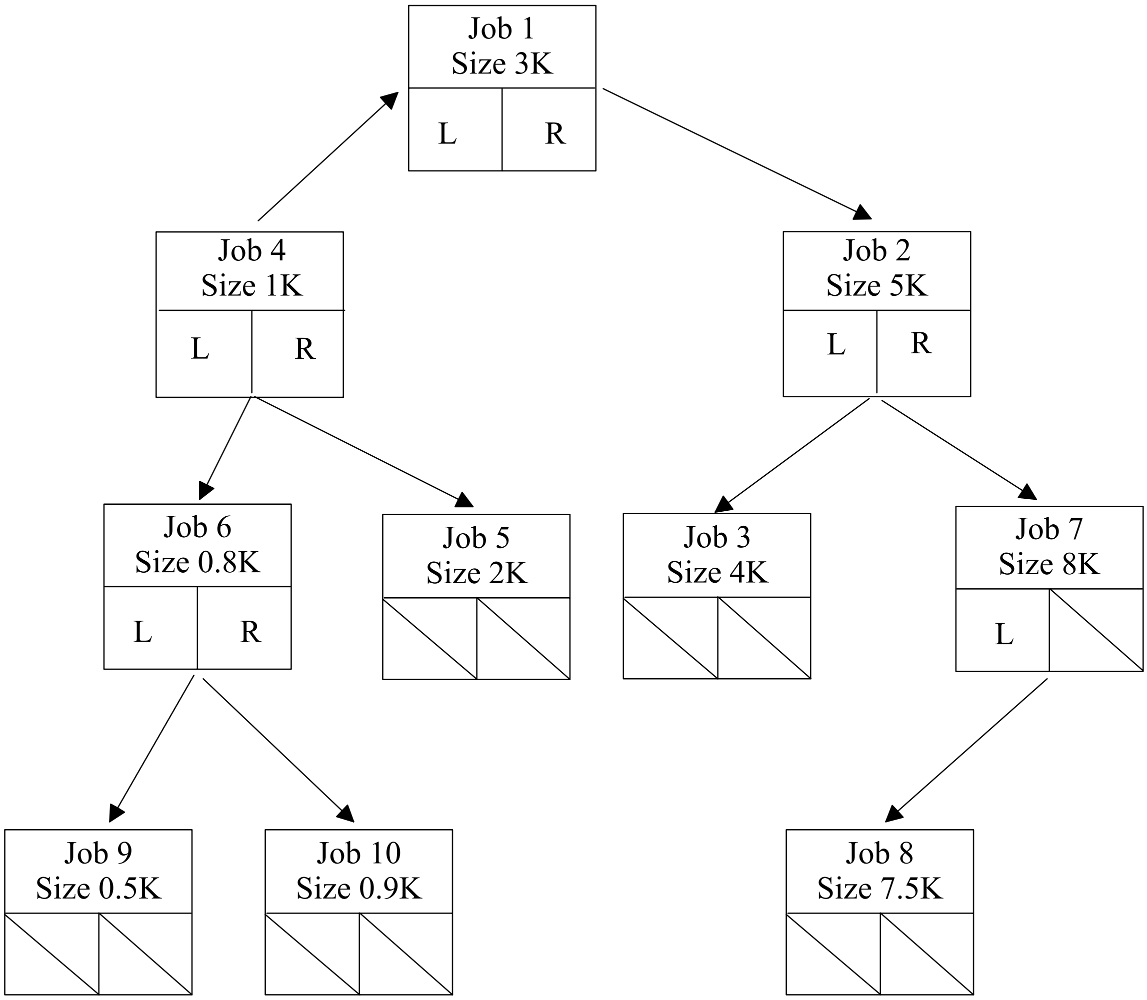
COMPUTER SCIENCE

Higher Level

Paper 2

12 pages

1. (a)



*Award **[1 mark]** for each correct placement in the tree and **[1 mark]** for each correct pair of pointer entries, up to a maximum of **[10 marks]**.*

(b) *Award **[1 mark]** for each of the following, up to a maximum of **[3 marks]**.*
pre-order will go left continually until the shortest is found. Hence straight to required item;
in-order will check items at right pointer when not null;
post-order will find largest jobs quickly but not the smallest;

(c) *Award marks as allocated, up to a maximum of **[8 marks]**.*

[1 mark] remember top node

[1 mark] variables;
loop to address prev, ***[1 mark]*** for loop, ***[1 mark]*** for looping to address, ***[1 mark]*** testing position;

[1 mark] locating next;
[1 mark] pointer to next;
connect next.right to prev.left ***[1 mark]***;

e.g.

```
Procedure removeShortest
  curr <-- topNode
  next <-- curr.left
  while next.left <> null
    curr <-- next
    next <-- curr.left
  endwhile
    if next.right <> null
    curr.left <-- next.right
  else
    curr.left <-- null
end removeShortest
```

(d) *Award marks as allocated, up to a maximum of **[9 marks]**.*

e.g.

[1 mark] remember top node;
[1 mark] for `if then else`;
[1 mark] recursive call;
[1 mark] terminator;

```
Function findShortest(node)
    if node.left = null then
       return node
    else
       return findShortest(node.left)
    endif
  end findShortest
```

or alternatively between the `else` and the `endif` allow

[1 mark] remember top node;
[1 mark] for `if then else`;
[1 mark] recursive call;
[1 mark] finding jump to address;
[1 mark] bypass delete node;

```
  temp <-- findShortest(node.left)
  return temp

  procedure removeShortest(curr)
    next <-- curr.left
    if next.left ≠ null then
       removeShortest(next)
    else
       if next.right = null
       curr.left <-- null
    else
       curr.left = next.right
    endif
  end removeShortest
```

2. (a) *Award **[1 mark]** for a suitable advantage and **[1 mark]** for a suitable disadvantage. For example:*

Advantage

human error such as typing mistakes or misreading the instrument is eliminated;

Disadvantage

if the instrument develops a fault the incorrect data could be transmitted without being noticed;

(b) *Award **[1 mark]** for each reasonable characteristic concerning processing power, storage, networking, up to a maximum of **[2 marks]**. Excessive mainframe characteristics gains **[0 marks]** since they are not needed. For example*:

a LAN ***[1 mark]*** of workstations;

with medium processing power ***[1 mark]***;

enough RAM to run software necessary to translate METAR ***[1 mark]*** into text output;

(c) *Accept **two** distinct error checking methods. Award **[1 mark]** for identifying the method and **[1 mark]** for description, up to a maximum of **[4 marks]**. For example:*

parity bit added to packet. If receiving end does not have even (or odd) number of bits then error detected;

check sum sum of bits added to packet. If receiving end does not have the same sum error detected;

transmit twice and compare the first transmission with the second. If not the same then error detected;

anything more sophisticated accepted if briefly described;

(d) *Award **[2 marks]** for each valid comparison, up to a maximum of **[6 marks]**. For example:*

6250 bpi tapes are sequential access media whereas the disks used in the robotics system are direct access;

tapes have to be physically loaded whereas robotic system programmed to load automatically;

Give credit for tapes can be stored away from the building as soon as they are full whereas disks are left on the system for convenience hence more vulnerable to damage if the building was on fire;

more convenient access from a disk since it can program the appropriate time period and access data. The tape has to be physically found and loaded;

capacity is high on both. There is no mention in the case study as to size of either but any comparison that includes an interpretation of 6250 bpi as 6250 bits per inch would gain a mark;

(e) *Please note that there are **[6 marks]** maximum available for this answer.*

*Award **[1 mark]** for each of the following, up to a maximum of **[4 marks]***
an initial value model (IVM) is used;
observed values of seven variables;
e.g. temperature, barometer readings *etc*.;
variables are fed into seven equations to give forecast;
equations are non-linear and fairly complex maths is applied;

*Also award **[1 mark]** for each of the following, up to a maximum of **[2 marks]***
Advantage
quick enough to give immediate forecast for the next 48 hours;
Disadvantage
limited to seven readings and set equations, other factors not taken into account. Hence cannot always be accurate;

(f) *The two factors mentioned in the Case Study are to improve long term forecasting and keep a track on environmental changes. Award **[1 mark]** for a correct identification and **[2 marks]** for a discussion, up to a maximum of **[6 marks]**. For example:*

Improved long term forecasting
helps farmers to plan crop sowing and harvesting ***[1 mark]*** hence an advantage to the economy ***[1 mark]***;
allows for fuel consumption predictions ***[1 mark]*** better planning means less chance of crisis situations developing ***[1 mark]***;
and many more

Environmental changes
effect on climate of pollution ***[1 mark]*** could persuade governments to take measures ***[1 mark]***;
global changes outside our control such as ice age approaching, change in precipitation patterns ***[1 mark]***;

(g) *Award **[1 mark]** for identifying a factor and **[1 mark]** for how it could be avoided, up to a maximum of **[4 marks]**. For example:*
insufficient data from collection stations ***[1 mark]*** either increase the number of instruments ***[1 mark]*** or open new centres in specific regions ***[1 mark]***;
software not sophisticated enough or not using enough variables ***[1 mark]***. Adapt software to incorporate more sophisticated equations or more variables ***[1 mark]***;

Note: *Do **not** accept factors that state that super computers are not powerful enough.*

3. (a) *Award marks as allocated, up to a maximum of* ***[2 marks]****.*
ID is not null and unique ***[1 mark]***, all others may be null or not unique ***[1 mark]***;

(b) *Award marks as allocated, up to a maximum of* ***[3 marks]****.*
has to be stored in order ***[1 mark]***, adding data may involve shuffling ***[1 mark]***, search involves winding on to data reading keys in between ***[1 mark]***;

(c) *Award marks as allocated, up to a maximum of* ***[2 marks]****.*
stored in order of arrival ***[1 mark]*** hence no shuffling, index consulted for search ***[1 mark]***;

(d) blocking; ***[1 mark]***

(e) *Award marks as allocated, up to a maximum of* ***[4 marks]****.*
a ordered index is maintained using the p-key and record number of each item ***[1 mark]***; when data is needed the index is consulted, the record number retrieved ***[1 mark]*** and the byte address calculated from the record number ***[1 mark]***. The tape is then wound on to the required byte address ***[1 mark]***;

(f) *Award* ***[1 mark]*** *for each of the following, up to a maximum of* ***[3 marks]****.*
direct access ***[1 mark]***;
leads to fragmentation ***[1 mark]***;
same address generated by primary key ***[1 mark]***;
needs collision handling ***[1 mark]***

4. (a) (i) *Award marks as allocated up to a maximum of* ***[2 marks]***.
two integers ***[1 mark]*** both positive, ***[1 mark]***;

(ii) *Award marks as allocated up to a maximum of* ***[2 marks]***.
a simple long integer ***[1 mark]*** positive value ***[1 mark]***;

(iii) 4 characters ***[1 mark]***;

(iv) *Award marks as allocated up to a maximum of* ***[3 marks]***.
single real ***[1 mark]*** positive mantissa ***[1 mark]*** positive exponent ***[1 mark]***;

(b) *Award marks as allocated up to a maximum of* ***[3 marks]***.
number becomes too large or too small ***[1 mark]*** and in overflow mantissa runs into sign bit ***[1 mark]***. In underflow the exponent cannot be held in allocated bits ***[1 mark]***;

(c) *Award marks as allocated up to a maximum of* ***[4 marks]***.
memory limit ***[1 mark]***;
modulo flips to negative ***[1 mark]***;
large number ***[1 mark]***;
may result in negative number ***[1 mark]***;

5. (a) an area of semiconductor memory; ***[1 mark]***

(b) printers cannot accept data at the same speed that processors can deliver it; ***[1 mark]***

(c) store data at high speed and deliver it at printer speed; ***[1 mark]***

(d) *Award marks as allocated, up to a maximum of* ***[5 marks].***
double buffering ***[1 mark]***, whilst the printer is accessing data from one buffer at slow speed ***[1 mark]*** the other buffer can be populated when the CPU is ready ***[1 mark]***, when the first buffer is empty. ***[1 mark]*** the printer can switch to the other buffer ***[1 mark]*** and the process repeated ***[1 mark]***;

(e) *Award* ***[1 mark]*** *for any of the following:*
because it is difficult to interrupt a print job; ***[1 mark]***
because it is designed for a specific task, which is previsible;

(f) *Award marks as allocated, up to a maximum of* ***[6 marks]****.*
dedicated devices have to handle jobs on a FCFS basis ***[1 mark]***, this can lead to IO bound jobs hogging the device ***[1 mark]***. Spooling ***[1 mark]*** can be used to avoid this
either
by creating a virtual device ***[1 mark]*** subject to job allocation policies ***[1 mark]*** and/or interrupts ***[1 mark]***;
or
printing jobs cannot be interleaved ***[1 mark]***. They can be paused/interrupted ***[1 mark]***
or
but must return to the same task ***[1 mark]***;
or
new algorithms in allocating policies are difficult to implement ***[1 mark]*** since difficult to re-program ***[1 mark]*** unless re-wiring takes place ***[1 mark]***.
or
non dedicated printers would have the possibility of making decisions ***[1 mark]*** according to the given job ***[1 mark]***.