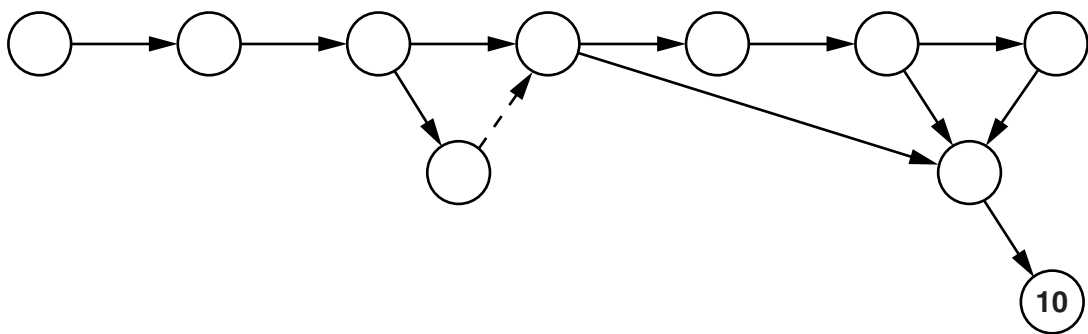1 A large software house has been asked to supply a computerised solution for a business. The project manager has drawn up a list of activities and their likely duration.

Activity	Description	Weeks to complete
A	Write requirement specification	5
B	Produce program design	5
C	Write module code	15
D	Module testing	10
E	Integration testing	5
F	Alpha testing	3
G	Install software and acceptance testing	5
H	Write end user training guide	5
J	Write technical documentation	10
K	End user training	4
L	Sign off final system	1

(a) The project manager decides to construct a Program Evaluation Review Technique (PERT) chart from this data.

(i) Complete the PERT chart. [7]

(ii) State the critical path.

....[2]

(iii) Calculate the minimum number of weeks for the completion of this solution.

....[1]

(b) For activity J:

   (i) State the earliest start time.

      Week number ....

   (ii) State the latest start time.

      Week number .... [1]

(c) Give a reason why the project manager used a PERT chart.

....

.... [1]

QUESTION 2.

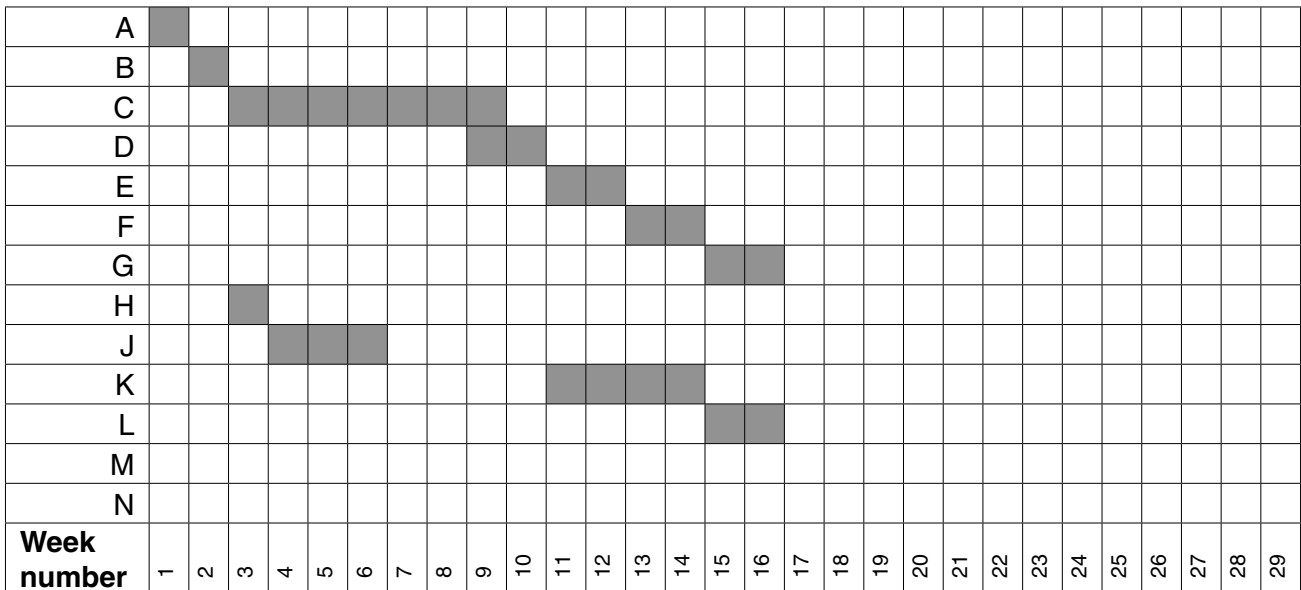Programming language ....

1 A large software house has been asked to supply a computerised solution for a business. The project manager has drawn up a list of activities and their likely duration.

Activity	Description	Weeks to complete
A	Write requirement specification	1
B	Produce program design	1
C	Write module code	7
D	Module testing	2
E	Integration testing	2
F	Alpha testing	2
G	Install software and carry out acceptance testing	2
H	Research and order hardware	1
J	Install delivered hardware	3
K	Write technical documentation	4
L	Write user training guide	2
M	Train users on installed hardware and software	1
N	Sign off final system	1

(a) From this data a GANTT chart is constructed.

Activity

Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
A	▓																												
B		▓																											
C			▓	▓	▓	▓	▓	▓	▓																				
D									▓	▓																			
E											▓	▓																	
F													▓	▓															
G															▓	▓													
H			▓																										
J				▓	▓	▓																							
K											▓	▓	▓	▓															
L															▓	▓													
M																													
N																													
Week number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29

    (i) Complete the GANTT chart by adding activities M and N.

    (ii) State the earliest completion date.

        Week number ....

(b) There are problems with the progress of the project:

- Activity E showed that the code contained major errors. The senior programmer now estimates that:
  - further module coding will require another 2 weeks
  - further module testing will require another 2 weeks
  - further integration testing will require another 2 weeks
- The hardware delivery is delayed by 16 weeks.

A revised GANTT chart is now required.

    (i) Complete the chart in the grid below.

Activity

Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
A	▓																												
B		▓																											
C			▓	▓	▓	▓	▓	▓																					
D									▓	▓																			
E											▓	▓																	
F																													
G																													
H			▓																										
J																													
K																													
L																													
M																													
N																													
Week number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29

[9]

    (ii) State the new estimated completion date.

        Week number .... [1]

QUESTION 3.

2 **(a)** A project manager is planning to create a new computer game. The following activities and the estimated number of weeks to complete each activity.

Activity	Description	Weeks to complete
A	Interview end user	1
B	Produce requirements analysis	2
C	Design program structure	3
D	Design Interface	1
E	Program development	12
F	Black-box testing	2
G	Produce technical documentation	4
H	Acceptance testing	1
I	Installation	1

Complete the labelling of the Program Evaluation Review Technique (PERT) chart using the data in the table. The first two activities have been done for you.
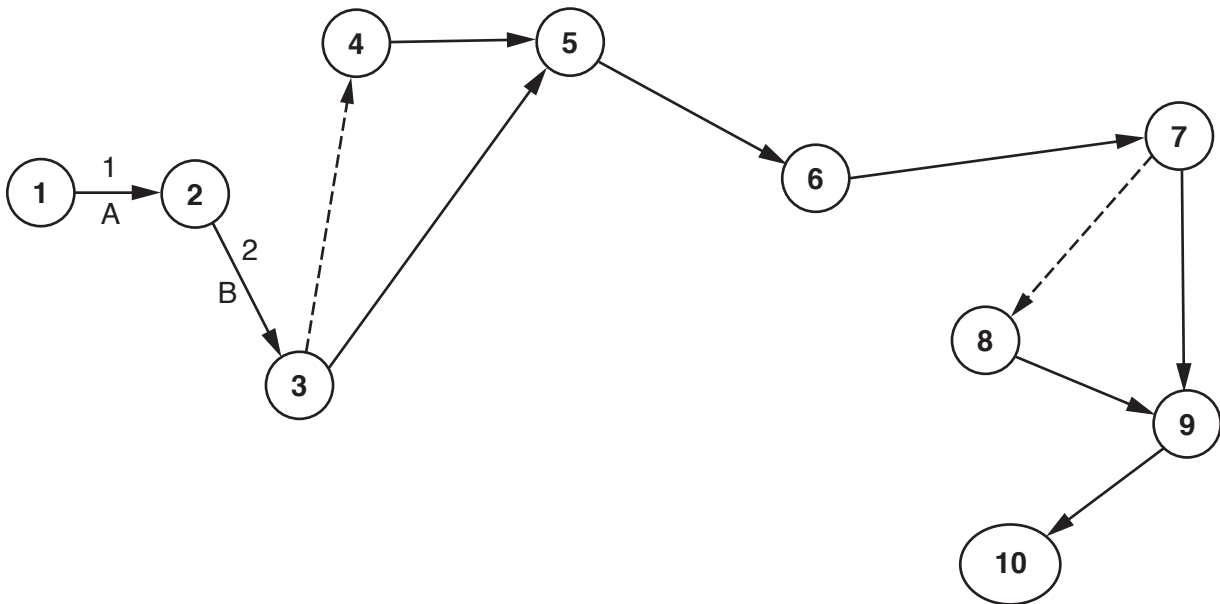
[7]

(b) State what the dashed lines in the PERT chart represent.

....

....[1]

5 A Program Evaluation Review Technique (PERT) chart has been constructed for at the planning stage.
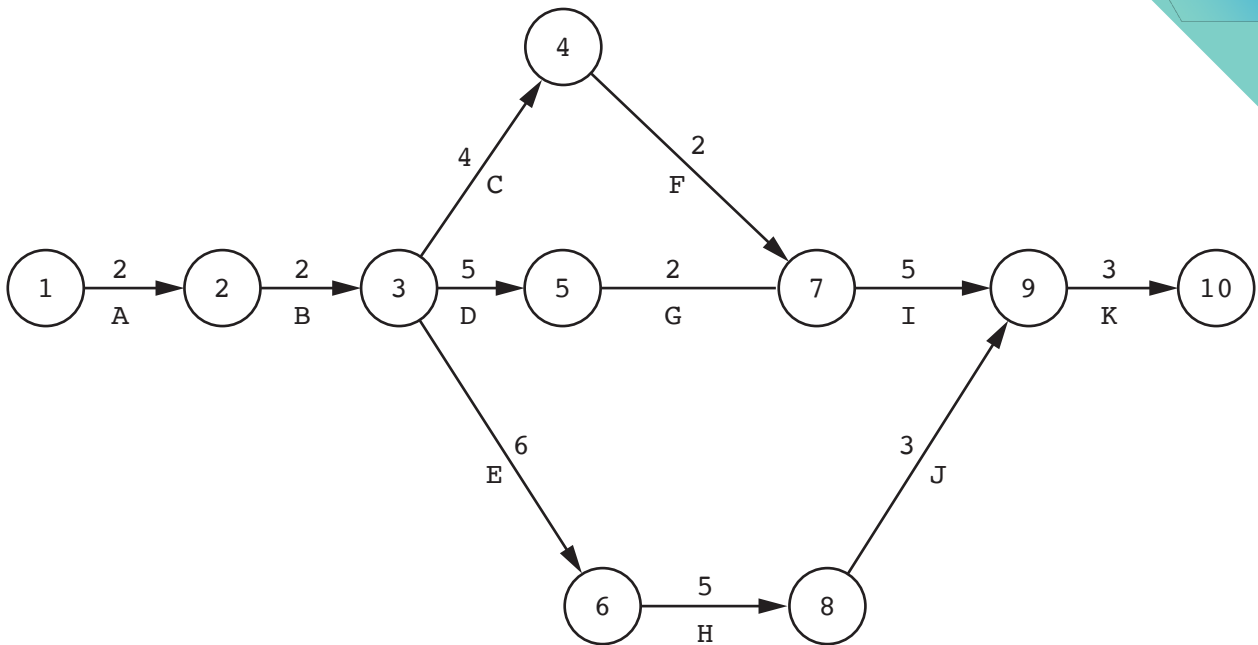
(a) Complete the following GANTT chart using the information in the PERT chart.

A	�	▒																							
B			▒	▒																					
C																									
D																									
E																									
F																									
G																									
H																									
I																									
J																									
K																									
Week number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

[5]

(b) There are three teams working on the project. Each team is able to wo............
activities.

Explain, with reference to the PERT chart, how work can be allocated to the three te....

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.... [2]

(c) The PERT chart is used to calculate the critical path for the project.

(i) List the activities that form the critical path using the given PERT chart on page 12.

.... [1]

(ii) Explain the importance of the critical path for project delivery.

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.... [2]

1 Each student at CIE University needs a printing account to print documents computers.

The university is developing software to manage each student's printing account and the process.

(a) Developing the software will include the following activities.

Activity	Description	Time in weeks	Predecessor
A	Identify requirements	1	-
B	Produce design	3	A
C	Write code	10	B
D	Test modules	7	B
E	Final system black-box testing	3	C, D
F	Install software	1	E
G	Acceptance testing	2	F
H	Create user documentation	2	F

(i) Add the correct activities and times to the following Program Evaluation Review Technique (PERT) chart for the software development.

Two activities and times have been done for you.

[6]

3
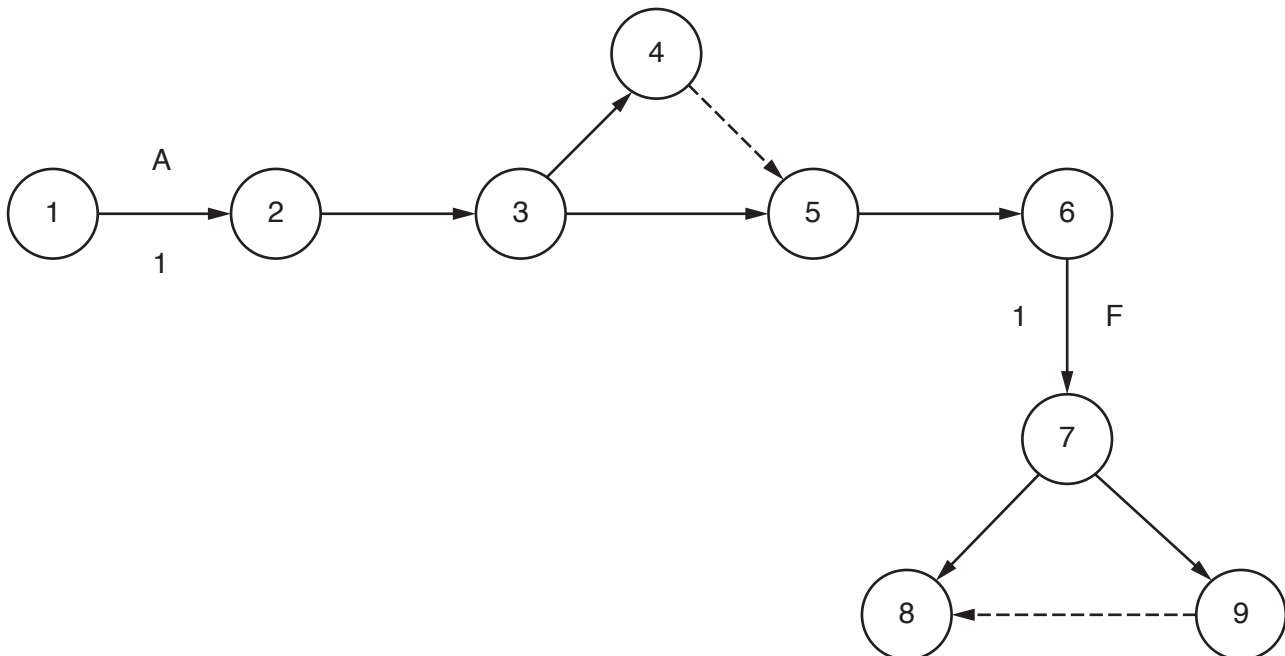
 (ii) State what is meant by the **critical path** in a PERT chart.

 ....

 ....

 (iii) Identify **and** describe a project planning technique, other than a PERT chart.

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 .... [2]

 (b) When a student prints a document, a print job is created. The print job is sent to a print server.

 The print server uses a queue to hold each print job waiting to be printed.

 (i) The queue is circular and has six spaces to hold jobs.

 The queue currently holds four jobs waiting to be printed. The jobs have arrived in the order A, B, D, C.

 Complete the diagram to show the current contents of the queue.

 Start Pointer   End Pointer
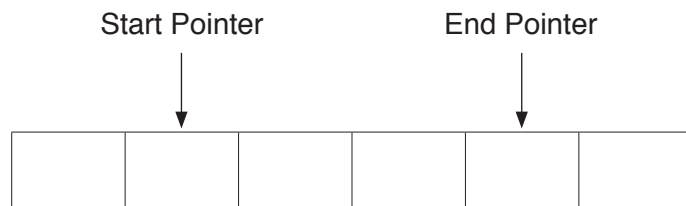
 [1]

 (ii) Print jobs A and B are now complete. Four more print jobs have arrived in the order E, F, G, H.

 Complete the diagram to show the current contents and pointers for the queue.

 [3]

 (iii) State what would happen if another print job is added to the queue in the status in **part (b)(ii)**.

 ....

 .... [1]

(iv) The queue is stored as an array, `Queue`, with six elements. The fo... removes a print job from the queue and returns it.

Complete the following **pseudocode** for the function `Remove`.

```
FUNCTION Remove RETURNS STRING
    DECLARE PrintJob : STRING
    IF .......................................................... = EndPointer
        THEN
            RETURN "Empty"
        ELSE
            PrintJob ← Queue[..............................................]
            IF StartPointer = ..............................................
                THEN
                    StartPointer ← ..........................................
                ELSE
                    StartPointer ← StartPointer + 1
            ENDIF
            RETURN PrintJob
    ENDIF
ENDFUNCTION
```
[4]

(v) Explain why the circular queue could not be implemented as a stack.

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.... [2]

(c) The university wants to analyse how a printer and a print server deal with the

The following table shows the transitions from one state to another for the process

Current state	Event	Next state
Printer idle	Print job sent	Printer active
Printer active	Print job added to queue	Print job received
Print job received	Print job in progress	Print job successful
Print job received	Print job in progress	Print job unsuccessful
Print job successful	Check print queue	Printer active
Print job unsuccessful	Error message displayed	Printer active
Printer active	Timeout	Printer idle

Complete the state-transition diagram for the table.

[5]
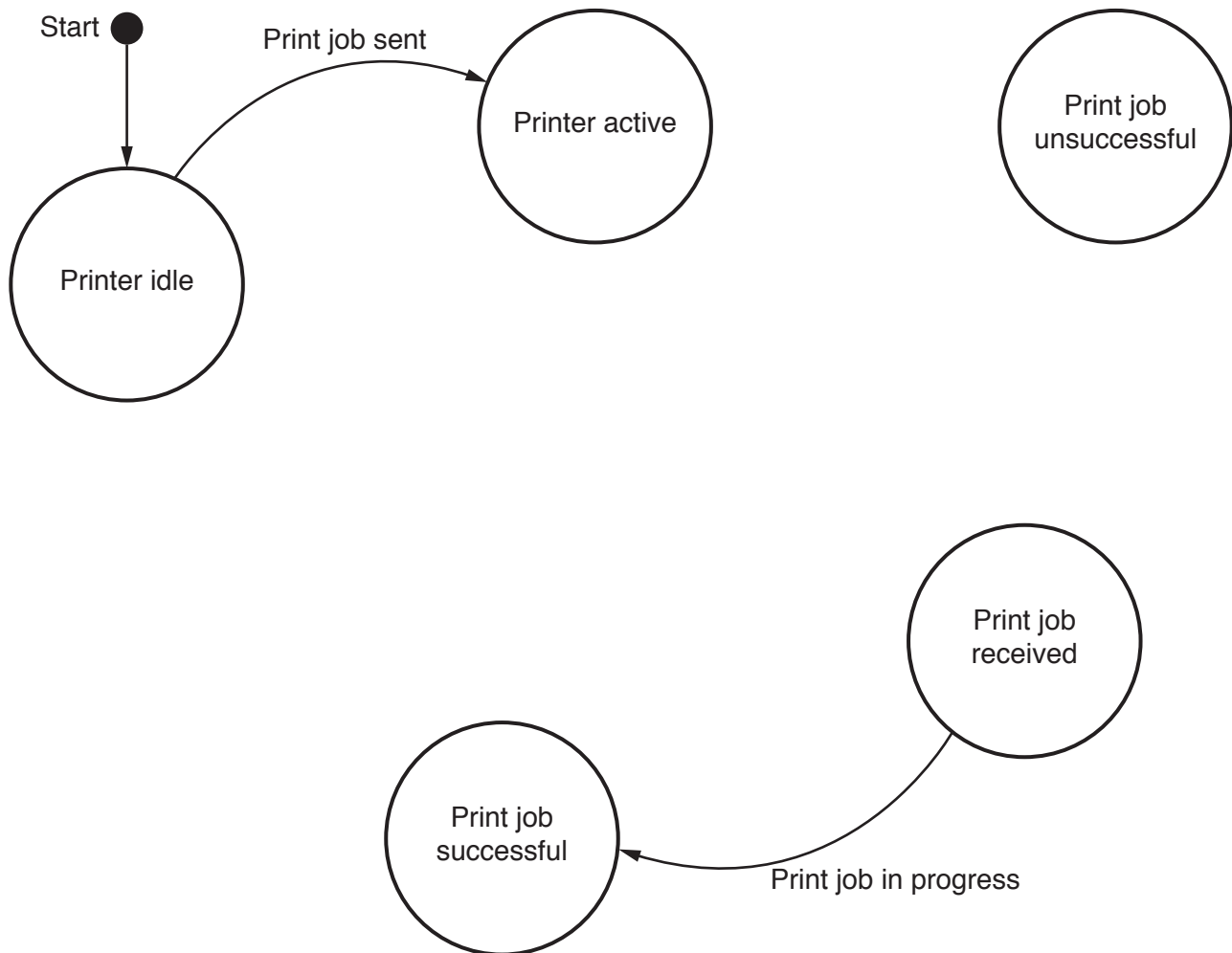
(d) The university wants to assess troubleshooting issues with a printer. It wants … table to do this.

The troubleshooting actions are:

- check the connection from computer to printer, if the error light is flashing **and** … document has not been printed
- check the ink status, if the quality is poor
- check whether there is a paper jam, if the error light is flashing **and** the document has not been printed
- check the paper size selected, if the paper size is incorrect.

(i) Describe the purpose of a decision table.

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.... [2]

(ii) Complete the rules for the actions in the following decision table.

		Rules							
Conditions	Document printed but the quality is poor	Y	Y	Y	Y	N	N	N	N
	Error light is flashing on printer	Y	Y	N	N	Y	Y	N	N
	Document printed but paper size is incorrect	Y	N	Y	N	Y	N	Y	N
Actions	Check connection from computer to printer								
	Check ink status								
	Check if there is a paper jam								
	Check the paper size selected								

[4]

(iii) Simplify your solution by removing redundancies.

		Rules							
Conditions	Document printed but the quality is poor								
	Error light is flashing on printer								
	Document printed but paper size is incorrect								
Actions	Check connection from computer to printer								
	Check ink status								
	Check if there is a paper jam								
	Check the paper size selected								

[5]

(e) There are 1000 students at the university. They will each require a printing a [...]

Students need to buy printing credits that will be added to their account. Each p [...] uses one printing credit.

The university needs software to keep track of the number of printing credits each student [...] in their account. The university has decided to implement the software using object-oriente [...] programming (OOP).

The following diagram shows the design for the class `PrintAccount`. This includes the attributes and methods.

PrintAccount
FirstName : STRING   // parameter sent to Constructor()
LastName   : STRING   // parameter sent to Constructor()
PrintID   : STRING   // parameter sent to Constructor()
Credits   : INTEGER // initialised to 50

Constructor()   // instantiates an object of the PrintAccount class,
                  // and assigns initial values to the attributes
GetName()   // returns FirstName and LastName concatenated
                  // with a space between them
GetPrintID()   // returns PrintID
SetFirstName()   // sets the FirstName for a student
SetLastName()   // sets the LastName for a student
SetPrintID()   // sets the PrintID for a student
AddCredits()   // increases the number of credits for a student
RemoveCredits()   // removes credits from a student account

(i) Write **program code** for the `Constructor()` method.

Programming language ....

Program code

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.... [4]

(ii) Write **program code** for the `SetFirstName()` method.

Programming language ....

Program code

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.... [2]

(iii) Write **program code** for the `GetName()` method.

Programming language ....

Program code

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.... [2]

(iv) The method `AddCredits()` calculates the number of printing credits and adds the printing credits to the student's account.

- Credits cost $1 for 25 credits.
- If a student buys $20 or more of credits in a single payment, they receive an 50 credits.
- If a student buys between $10 and $19 (inclusive) of credits in a single payment, they receive an extra 25 credits.

Payment from a student is stored in the variable `MoneyInput`. This is passed as a parameter.

Write **program code** for `AddCredits()`. Use constants for the values that do not change.

Programming language ....

Program code

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.... [6]

(v) A global array, StudentAccounts, stores 1000 instances of PrintAcc

Write **pseudocode** to declare the array StudentAccounts.

....

.... [2]

(vi) The main program has a procedure, `CreateID()`, that:

- takes the first name and last name as parameters
- creates `PrintID` that is a concatenation of:

  ○ the first three letters of the first name in lower case
  ○ the first three letters of the last name in lower case
  ○ the character '1'
    for example, the name Bill Smith would produce `"bilsmi1"`
- checks if the `PrintID` created already exists in the global array `StudentAccounts`:

  ○ If `PrintID` does not exist, it creates an instance of `PrintAccount` in the next free index in `StudentAccounts`.
  ○ If `PrintID` does exist, the number is incremented until a unique ID is created, for example, `"bilsmi2"`. It then creates an instance of `PrintAccount` in the next free index in `StudentAccounts`.

The global variable `NumberStudents` stores the number of print accounts that have currently been created.

Write **program code** for the procedure `CreateID()`. Do not write the procedure header.

Programming language ....

Program code

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QUESTION 6.

1 A technology company needs software to calculate how much each employee sh...

(a) Developing the software will involve the following activities:

Activity	Description	Time to complete (weeks)	Predecessor
A	Identify requirements	1	–
B	Observe current system	1	A
C	Create algorithm design	3	B
D	Write code	10	C
E	Test modules	7	C
F	White box testing	2	D
G	Black box testing	3	D
H	Install software	1	E, F, G
I	Acceptance testing	2	H
J	Create user documentation	2	H

(i) Add the correct activities and times to the following Program Evaluation Review Technique (PERT) chart for the software development.

Three of the activities and times have been done for you.

[7]
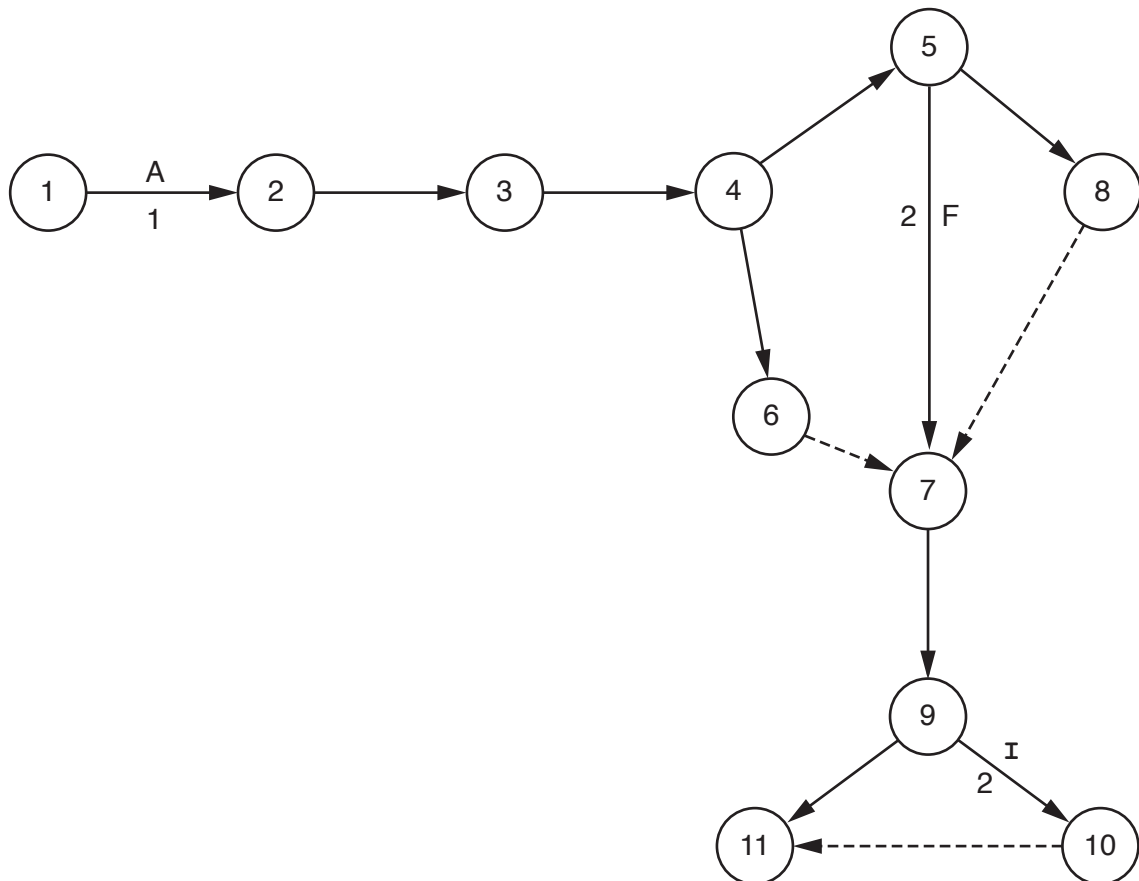
   (ii)   The dashed line connecting nodes 10 and 11 indicates a dummy activity.

   State the purpose of a dummy activity.

   ....

   .... [1]

(b) A bonus payment may be added to an employee's salary. A pension payment may also be subtracted from an employee's salary.

   The company needs to assess what additions and subtractions should be made to the salary of each employee. There are three conditions to check:

   *   If the employee has worked a public holiday, they receive a 3% bonus payment.
   *   If the employee has worked 160 or more hours in a month, they receive an additional 5% bonus payment.
   *   If the employee pays into a pension, the company subtracts 4% for the pension payment.

   Complete the decision table to show the additions and subtractions.

		Rules							
Conditions	**Public holiday**	Y	Y	Y	Y	N	N	N	N
	Hours >= 160	Y	Y	N	N	Y	Y	N	N
	Pension	Y	N	Y	N	Y	N	Y	N
Actions	**3% bonus payment**	X	X	X	X				
	5% bonus payment	X	X			X	X		
	4% pension payment	X		X		X		X	

[3]

4

(c) The company decides to implement a program for the software using object-oriented programming (OOP).

Each employee has a unique employee ID, name, address and date of birth. There are two types of employee: salary and apprenticeship.

Salaried employees are paid a fixed monthly payment. The hours a salary employee works in a month are recorded to calculate bonus payments. They may receive bonus payments and make pension payments (given in **part(b)**).

Apprenticeship employees are paid weekly. They receive an hourly rate of pay. Apprenticeship employees do not receive bonus payments or make pension payments.

(i) Complete the following class diagram for the program.

Employee
EmployeeID : STRING
Name : STRING
Address : STRING
DateOfBirth : Date
Constructor()
GetEmployeeID()
GetName()
GetAddress()
GetDateOfBirth()
SetEmployeeID()
SetName()
SetAddress()
SetDateOfBirth()

SalaryEmployee
MonthlyPayment : CURRENCY
HoursThisMonth: REAL
PublicHoliday : BOOLEAN
Pension : BOOLEAN
Constructor()
GetMonthlyPayment()
GetHoursThisMonth()
GetPublicHoliday()
GetPension()
SetMonthlyPayment()
SetHoursThisMonth()
SetPublicHoliday()
SetPension()

ApprenticeshipEmployee
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GetHourlyRate()
GetHoursThisWeek()
SetHourlyRate()

[3]

(ii) Write **program code** for the `Constructor()` in the `Employee` class.

All properties are sent as parameters.

Programming language ....

Program code

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.... [4]

(iii) Write **program code** for the `GetEmployeeID()` method in the `Employee` class.

The get method returns the value of the `EmployeeID` property.

Programming language ....

Program code

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.... [2]

(iv) Write **program code** for the SetEmployeeID() method in the Employ

The set method takes the new value as its parameter.

Programming language ....

Program code

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.... [2]

(v) Write **program code** for the SetPension() method in the SalaryEmployee() class.

- The method takes a new value for Pension as a parameter.
- If the parameter's value is valid (it is TRUE or FALSE), the method returns TRUE and sets the parameter's value.
- Otherwise the method returns FALSE and does not set Pension.

Programming language ....

Program code

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.... [4]

Question 1 continues on the next page.

(vi) A `SalaryEmployee` is paid a fixed monthly payment.

- If the employee has worked a public holiday, they receive a 3% bonus. This is calculated from their `MonthlyPayment`.
- If the employee has worked 160 or more hours in a month, they receive an additional 5% bonus payment, calculated from their `MonthlyPayment`.
- If the employee pays into a pension, 4% will be subtracted from their `MonthlyPayment`.

Monthly salary is the final payment the employee receives.

For example, Chris is a `SalaryEmployee`. His fixed `MonthlyPayment` is $1000. He has worked a public holiday. He has worked 165 hours this month. He pays into a pension.

- The public holiday bonus is $30 (3% of $1000)
- The hours worked bonus payment is $50 (5% of $1000)
- The pension payment is $40 (4% of $1000)

Chris's monthly salary is calculated as ($1000 + $30 + $50) − $40 = $1040

The function `CalculateMonthlySalary()` is used to calculate the monthly salary. It:

- takes a `SalaryEmployee` as a parameter
- calculates the bonus payments and pension payment
- outputs the pension payment and total bonus payment
- calculates and returns the monthly salary.

Write **program code** for the function `CalculateMonthlySalary()`.

Programming language ....

Program code

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[8]

(d) Noona describes an example of a feature of object-oriented programming (O

"One method exists in the parent class but is overwritten in the child class,
differently."

Identify the feature Noona has described.