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| **1.2 Software and software development** | | | | |
| Topic Area | Sub Topic | How I feel | | |
|  | | Red | Amber | Green |
| 1.2.1 Systems Software | The need for, function and purpose of operating systems. |  |  |  |
| Your notes | | |
| 1.2.1 Systems Software | Memory Management (paging, segmentation and virtual memory). |  |  |  |
| Your notes | | |
| 1.2.1 Systems Software | Interrupts, the role of interrupts and Interrupt Service Routines (ISR), role within the Fetch‑Decode-Execute Cycle. |  |  |  |
| Your notes | | |
| 1.2.1 Systems Software | Scheduling: round robin, first come first served, multi-level feedback queues, shortest job first and shortest remaining time. |  |  |  |
| Your notes | | |
| 1.2.1 Systems Software | Distributed, embedded, multi-tasking, multi-user and Real Time operating systems. |  |  |  |
| Your notes | | |
| 1.2.1 Systems Software | BIOS |  |  |  |
| Your notes | | |
| 1.2.1 Systems Software | Device drivers |  |  |  |
| Your notes | | |
| 1.2.1 Systems Software | Virtual machines, any instance where software is used to take on the function of a machine, including executing intermediate code or running an operating system within another. |  |  |  |
| Your notes | | |
| 1.2.2 Applications Generation | The nature of applications, justifying suitable applications for a specific purpose. |  |  |  |
| Your notes | | |
| 1.2.2 Applications Generation | Utilities |  |  |  |
| Your notes | | |
| 1.2.2 Applications Generation | Open source vs closed source. |  |  |  |
| Your notes | | |
| 1.2.2 Applications Generation | Translators: Interpreters, compilers and assemblers. |  |  |  |
| Your notes | | |
| 1.2.2 Applications Generation | Stages of compilation (lexical analysis, syntax analysis, code generation and optimisation) |  |  |  |
| Your notes | | |
| 1.2.2 Applications Generation | Linkers and loaders and use of libraries. |  |  |  |
| Your notes | | |
| 1.2.3 Software Development | Understand the waterfall lifecycle, agile methodologies, extreme programming, the spiral model and rapid application development. |  |  |  |
| Your notes | | |
| 1.2.3 Software Development | The relative merits and drawbacks of different methodologies and when they might be used. |  |  |  |
| Your notes | | |
| 1.2.3 Software Development | Writing and following algorithms. |  |  |  |
| Your notes | | |
| 1.2.4 Types of Programming Language | Need for and characteristics of a variety of programming paradigms. |  |  |  |
| Your notes | | |
| 1.2.4 Types of Programming Language | Procedural languages. |  |  |  |
| Your notes | | |
| 1.2.4 Types of Programming Language | Assembly language (including following and writing simple programs with the Little Man Computer instruction set). |  |  |  |
| Your notes | | |
| 1.2.4 Types of Programming Language | Modes of addressing memory (immediate, direct, indirect and indexed). |  |  |  |
| Your notes | | |
| 1.2.4 Types of Programming Language | Modes of addressing memory (immediate, direct, indirect and indexed).  Object-oriented languages with an understanding of classes, objects, methods, attributes, inheritance, encapsulation and polymorphism. |  |  |  |
| Your notes | | |
| 1.2.4 Types of Programming Language | Object-oriented languages with an understanding of classes, objects, methods, attributes, inheritance, encapsulation and polymorphism. |  |  |  |
| Your notes | | |

Exam Questions

1. (a) An operating system uses interrupts which have priorities. Describe the sequence of steps which would be carried out by the interrupt handler when an interrupt is received and handled.

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(b) The operating system of a personal computer supports multi -tasking. One of the operating system functions is memory management. Describe **two** different strategies which could be used to manage the available memory.

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2. (a) An operating system uses scheduling. One method of scheduling is first come, first served.

(i) Explain why the first come, first served scheduling method may not be efficient?

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(ii) Describe one other scheduling method.

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(iii) Explain why scheduling is necessary.

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(b) Explain why memory management is necessary.

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(c) Paging may be used in memory management. Describe paging.

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3. (a) Describe what is meant by

(i) an interrupt

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(ii) a buffer

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(b) A computer system includes a printer.

(i) Explain the role of the printer buffer in the transfer of a job from the computer to the printer.

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(ii) Explain why an interrupt is necessary during the transfer of data from the computer to the printer.

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4. List four features of the user interface which you would expect to find on a smartphone but not on a PC.

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5. Compare and contrast the functions of operating systems designed for a personal computer and a satellite-navigation system in a car. In this question you will also be assessed on your ability to use good English and to organise your answer clearly in complete sentences, using specialist vocabulary where appropriate.

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6. (a) Software can be classified as either **system** or **application software**. What is meant by

(i) system software?

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(ii) application software?

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(b) Give an example of each type of software.

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7. A company sells widgets via an online web store. The process of updating the website and processing sales involves many different types of software.

Below is a list of software:

**Operating system, Utility software, Special-purpose software, General purpose**

**application software, Bespoke software**

Complete the table below by writing one software category beside each use. You should not use a category more than once.

|  |  |
| --- | --- |
| Software | Category |
| Firewall software installed on the web server |  |
| Store's own online ordering system designed for their products and systems |  |
| Graphics software to crop product images suitable for uploading to the site |  |
| Online payment verification software |  |

8. Describe **three** reasons why a company might choose to purchase an 'off-the-shelf" special purpose software package rather than a suite of programs written specifically for their needs.

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9. A student owns a computer which he uses for:

• producing project work in hard copy form

• playing games with friends on the internet

• downloading video and music files

He uses a number of pieces of utility software.

State the purpose of each of the following types of utility software and describe how the student would use them.

1. Compression software

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1. Anti-virus software

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1. Backup utility

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10. A programmer is asked to write a program and can choose between using a low-level language or an imperative high-level language.

Outline the major differences between these two types of languages, naming an example of each.

For each language explain:

• advantages and disadvantages of each one compared to the other

• what translation software would be used, if applicable

• a situation when each one would be the most appropriate choice

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11. (a) When translating computer languages, intermediate code may be produced.

Explain the need for intermediate code and its purpose in a virtual machine.

The quality of written communication will be assessed in your answer to this question.

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(b) State three benefits of using library routines when a program is written.

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12. The following source code is written in Python. It contains errors.

numbers = [9, 5, 4, 15, 3, 8, 11, 2]

numItems = len (numbers)

for i in range(numItems - 1) :

for j in range(numItems - i - 1):

if numbers[j] > numbers[j + 1] :

#swap the numbers

temp = numbers[10]

numbers[j] = numbers[j + 1]

numbers[j + 1] = tern

drint (numbers)

Using lines of code from the above program to illustrate your answer, state two things that would be done in each of the following stages of compilation:

1. Lexical analysis

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1. Syntax analysis

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13. The process of compilation involves a number of stages. Name the stage at which each of the following would be detected.

(a) An illegal identifier.

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(b) An arithmetic operator is applied to an operator of the data type Boolean.

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(c) An operand is omitted from an arithmetic expression.

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14. A systems analyst/developer is planning a system for the administration of student courses to be used in an office in a college.

Describe three tasks that may be carried out by the analyst to establish the requirements of the system.

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15. (a) Explain what is meant by the **prototyping/agile** approach to system analysis and design.

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1. What are the advantages of this approach

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1. (i) Describe briefly two other approaches to systems development.

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(ii) Describe the advantages and disadvantages of each of these approaches.

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(iii) State circumstances in which each of the methods you have described would be appropriate.

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16. Explain the difference between black box testing and white box testing.

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17. In a football league, the results of each match are input to the computer, which updates each team's points.

In the case of a draw, each team (Team A and Team B) gets one point.

If Team A wins, then Team A gets 3 points and Team B gets no points.

The algorithm for updating points in the case of a draw is:

if TeamAGoals == TeamBGoals then

TeamAPoints TeamAPoints + I

TeamBPoints = TeamBPoints + I

endif

Write an algorithm for updating the points if there is a winner.

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18. Expert jugglers learn new juggling patterns according to certain rules represented by numbers. In this example, the rules for patterns of three numbers are:

Rule 1: the total value of the numbers in the list must be a multiple of 3

Rule 2: No number must be one less than the previous number, even if the pattern is repeated indefinitely.

Here are some valid patterns of three numbers:

7 4 4

4 4 1

Here are some examples of invalid patterns with three numbers:

4 2 1 (4 + 2 + 1 = 7, which is not a multiple of 3, so does not obey rule 1)

6 5 1 (5 is one less than the previous number, so this does not obey rule 2)

6 2 7 (when this is repeated, 6 2 7 6 2 7 6 2 7 ... 6 is one less than the previous number, so this does not obey rule 2)

(a) State why the following lists of 3 numbers are not valid patterns of numbers.

(i) 5 1 6

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(ii) 4 4 2

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(b) Write pseudocode for a program which:

• Prompts the user to enter 3 numbers, one after the other

• Outputs "INVALID PATIERN" if the sequence of numbers does not obey the

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19. Jose works for a company that provides loans to its customers. When customers take out a loan they decide how much money to borrow and for how many years.

The interest rate is currently 10% but it may change in the future.

Jose writes the following program to calculate the monthly payment for a loan.

01 program loanCalculator

02

03 CONST INTEREST\_RATE = 10

04

05 begin

06 amount = input("Enter amount : ")

07 years = input( "Enter years : ")

08 annual Interest = amount \* interestRate / 100

09 totalToPay = (annualInterest \* years) + amount

10 monthlyPayment = totalToPay / (years \* 12)

11 print ("Monthly Payment: " , monthlyPayment )

12 end

(a) Using the code above, show the value that will be output if the inputs are:

Amount: 600

Years: 5

You **must** show all your working.

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(b) Parentheses have been used in lines 09 and 10.

(i) State why the parentheses in line 09 are **not** essential.

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(ii) Explain why the parentheses in line 09 are useful.

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(iii) Explain why the parentheses in line 10 are essential.

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(c) The algorithm uses a constant.

Identify the constant, and explain why a constant has been used.

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(d) The company also offers a savings plan. Customers pay a fixed amount each year into the savings plan. At the end of each year, the company adds the value of the savings plan at the start of the year to the amount paid, and then adds interest of 10% to obtain the final value for the year.

For example, if a customer saves £100 each year, the value of the savings plan for 5 years is shown in the table below

Year Start Paid in Interest Final

1 0.00 100.00 10.00 110.00

2 110.00 10 0.00 21.00 231.00

3 231.00 100.00 33.10 364.10

4 364.10 100.00 46.41 510.51

5 510.51 100.00 61.05 671.56

Write an algorithm which allows the user to input the amount saved each year and the number of years, and outputs the growth of the savings plan in the format shown above.

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20. A programming paradigm is a style of computer programming. Procedural programming, supported by languages such as Python or Pascal, which have a series of instructions that tell the computer what to do with the input in order to solve the problem, is one example of a paradigm.

Name and briefly describe **two** other programming paradigms, giving an example of an application of each and a language which supports it.

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(a) Explain what is meant by the term class in object-oriented programming.

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(b) An institution categorises its staff as either **Academic** or **Administration**. Administration staff may be either **Salaried** or **HourlyPaid**.

Five classes are to be created in an object-oriented programming language.

1. Draw a class diagram for the five classes.

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1. Describe what is meant by polymorphism.

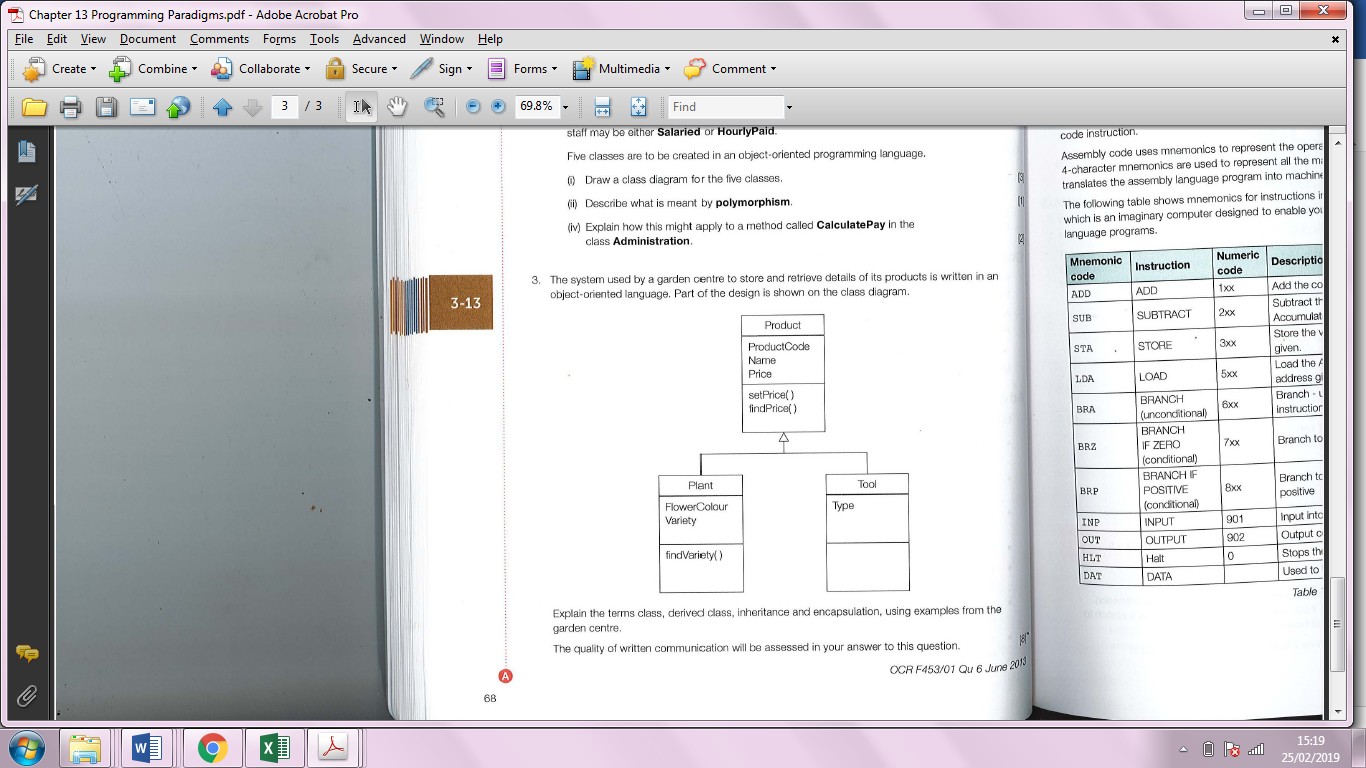
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(iii) Explain how this might apply to a method called Calculate Pay in the

class Administration.

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21. The system used by a garden centre to store and retrieve details of its products is written in an object-oriented language. Part of the design is shown on the class diagram.

Explain the terms class, derived class, inheritance and encapsulation, using examples from the garden centre.

The quality of written communication will be assessed in your answer to this question.

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22. In a particular machine code, the opcode is stored in 6 bits and the operand is stored in 12 bits. What is the maximum number of operations in the machine’s instruction set?

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(b) Explain, with the aid of examples, the difference between immediate, direct and indirect addressing.

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23. Using instructions

ADD x (Add number stored in x to the accumulator)

LDA x (Load into the accumulator the value stored in x)

STA x (Store the value in the accumulator in location x)

write an assembly language program that adds together the values stored in memory locations num1 and num2, storing the resulting total in memory location num3.

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24. Write an assembly language program which counts and outputs the number of values entered by the user, and the total of the values input. End of input is signalled by dummy value 0. You may assume that memory locations called *increments, total* and *numvals* contain 1, 0 and 0 respectively. (Use LMC assembly language instructions.)

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