1(a) DCC Software is a company that creates a wide range of software products for home computers. Its products include image, video and sound editing software.

DCC Software makes significant use of software libraries.

Explain the benefits of using software libraries to create software.

[4]

(b) Once DCC Software has written a piece of software, they use translators to translate the programming code.

i. The table shows different stages of code compilation labelled **A**, **B**, **C** and **D**.

A	Lexical analysis
B	Syntax analysis
C	Code generation
D	Code optimisation

In each box write the letter of the stage that matches each description.

Converts the high level code into low level instructions ☐

Examines the code and improves the efficiency of it without affecting the functionality ☐

Removes comments and whitespace and then converts the high level code into tokens ☐

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Identifies syntax errors and creates an abstract syntax tree

[4]

ii. DCC Software is considering the benefits of both an interpreter and a compiler.

State **two** benefits of using an interpreter.

Benefit 1 .....

.....

Benefit 2 .....

.....

[2]

iii. State **two** benefits of using a compiler.

Benefit 1 .....

.....

Benefit 2 .....

.....

[2]

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2 Beth records how many steps she has completed over a seven-day period.

She stores the total number of steps for each day in a text file. For example:

```
"9000" , "13680" , "11254" , "8258" , "12326" , "9244" , "7542"
```

Beth would like a program that will take the values from the text file and then calculate the average number of steps per day.

Beth needs to translate her code using a compiler or an interpreter.

Describe **one** benefit to Beth of using a compiler instead of an interpreter.

---

[2]

3(a) State the most appropriate application software for each task in the table.

Task	Application Software
Creating graphics such as a logo	
Writing letters to clients to confirm their appointment date and time	
Calculating the company profits at the end of each month	
Storing, searching and updating client details and purchases	
Creating brochures and flyers about the organisation	

[5]

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(b) OCR Solutions make use of software libraries when writing their programming code. They also make use of linkers and loaders to compile and run the program.

i. Describe what **linker** means.

[2]

ii. Describe what **loader** means.

[2]

4 All source code needs to be translated into object code using a translator.

A software development company has written a new computer game in a high-level language.

Identify which type of translator would be the most suitable for the computer game and give a reason why.

Type

Reason

[2]

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5 A secondary school is upgrading their computers. They decide to install "thin client" computers. A thin client computer is when users access their computer in the usual way with a keyboard, mouse and monitor. However, all processing takes place on the virtual machine on a server rather than the computer at their desk.

The virtual machines will have utility software and application software installed.

i. Describe the difference between utility software and application software.

---

[2]

ii. The application software installed will be used by students to complete their school work.

Name **two** different types of application software that may be used by students, giving an example of how each may be used.

TYPE 1

Name ---

Example ---

TYPE 2

Name ---

Example ---

---

[4]

iii. The application software installed on the virtual machines can be closed source software or open source software.

Explain **one** advantage to the school of using open source software.

---

[2]

6 All source code needs to be translated into object code using a translator.

Tick **one** box in each row to indicate which type of translator is being used.

	Compiler	Interpreter	Assembler
Creates an executable file			
Creates one line of object code for each line of source code			
Translates all the high-level code at once			
A program needs to be translated each time it is run			

[4]

7(a) A programmer creates this function shown in **Fig. 5** using a high-level language.

```
function mystery(x,y)
    total = x + y
    while x >= 10 then
        x = x - 10
        y = y - 10
        total = total + x + y
    endwhile
    return total
endfunction
```

Fig. 5

Before the code in **Fig. 5** can be executed, a translator must be used.

i. State the purpose of a translator.

---

[1]

ii. Explain **two** differences between a compiler and an interpreter.

Difference 1 ---

Difference 2 ---

---

[4]

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(b) For each statement shown in **Table 5**, tick (✓) **one** box in each row to indicate which stage of compilation each action takes place at.

	Lexical analysis	Syntax analysis	Code generation
Comments and whitespace are removed			
Keywords are replaced with tokens			
Object code is created			
Symbol table created for variables			
Builds an abstract syntax tree			

Table 5

[5]

(c) Describe the purpose of code optimisation.

---

[2]

8 * Charlie will use database management software to store customers' personal and appointment details. Charlie is considering both open source and closed source database software.

Compare the differences between open source software and closed source software and recommend which type of database software Charlie should use.

You should refer to the following in your answer:

- Cost
- Usability
- Extensibility
- Security
- Support available

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[9]

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9 A simple program is shown below.

```
//Program to calculate number of times
//a number goes into 100
count = 0
num = int(input("Enter a number"))
while (count*num)<=100
       count=count+1
endwhile
count=count-1 //Take one off as gone over

print(str(num) + " goes into 100 " + str(count) + " times.")
```

Fig. 8.1

The program is compiled. The first stage is Lexical Analysis.

Referring to examples in the code in Fig. 8.1, explain what happens in Lexical Analysis.

---

[3]

10 The developer decides she wants to make the software program open source, that allows users with severe mobility issues to input data into a computer.

Explain the benefits to the users of the software being open source.

---

[2]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a		1 mark for each to max 4. • Reduces **development /debugging** time. • Reduced programming knowledge is needed. • Libraries will already be tested. • Libraries are often optimised for performance. • Libraries are designed to work across multiple platforms. • Consistency between applications • Reduces file sizes (DLLs)	4	Allow: 'saves developers time' DNA 'saves time' on its own Examiner's Comments Most candidates were able to explain that libraries have been pre tested and save on development time with some being also saying libraries are optimised. Few candidates were able to access full marks, but many were given 2 or 3 marks.
	b	i	1 mark for each correct match to max 4. C D A B	4	Examiner's Comments Generally, this question was well responded to with many candidates accessing all 4 marks.
		ii	1 mark for each to max 2. • Easier /faster to debug /fix errors /maintain • Easier /faster to test code **line by line** • Code will still run until the first error • Code is portable across different architectures	2	Examiner's Comments Both questions generally successfully responded to however some candidates gave a feature without saying what the benefit was.
		iii	1 mark for each to max 2. • Do not need to distribute source code // protects intellectual property • Do not need run-time environment // code is not re-translated each time it runs • Faster run-time (once compiled) • Produces an executable file • Code is optimised	2	Examiner's Comments Both questions generally successfully responded to however some candidates gave a feature without saying what the benefit was.
			Total	12	

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Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
2			1 mark per bullet up to a maximum of 2 marks: • Only needs to be translated once… • … saving time when the program is run • Generates an executable file … • … doesn't need a compiler / interpreter to run it • Reports all errors (syntax)… • … to assist with debugging • The program may **run** faster… • …as the executable code is run directly by the CPU	(2)	Do not accept "translates all at once" Examiner's Comments Most candidates answered this question correctly, although some did not achieve the second mark for explaining how the compiler would benefit Beth in particular.
			Total	2	

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>3</td><td>a</td><td></td><td>1 mark for each correct application software

<table><tr><th>Task</th><th>Application Software</th></tr><tr><td>Creating graphics such as a logo</td><td>Graphics/image editing software</td></tr><tr><td>Writing letters to clients to confirm their appointment date and time</td><td>Word processing software</td></tr><tr><td>Calculating the company profits at the end of each month</td><td>Spreadsheet/Accounting software</td></tr><tr><td>Storing, searching and updating client details and purchases</td><td>Database software</td></tr><tr><td>Creating brochures and flyers about the organisation</td><td>Desktop publishing software // DTP</td></tr></table></td><td>5</td><td>Allow any sensible software.
e.g. text editor for WP
e.g. photo/image editor for row 1

BOD publication editor for DTP

DNA brand names - ignore brand name if application type is also given.

<u>Examiner’s Comments</u>

Many candidates were able to score at least 4 marks on this question. Those who gave brand names were not given marks as is standard for these types of question. Few candidates were able to give DTP for the fifth application type. Many gave email for the second application type which would not be the most appropriate for writing letters to clients.</td></tr>
<tr><td></td><td>b</td><td>i</td><td>1 mark per bullet to max 2:

• Combines/links code/programs to files/software libraries...
• ...to form a single executable file</td><td>2</td><td>Allow one mark for valid description of static and/or dynamic linkers e.g.
Static linkers combine code and libraries into one file // Dynamic linkers link/add addresses to libraries

<u>Examiner’s Comments</u>

The majority of candidates were able to gain one mark on this question for stating that a linker links code with libraries but few went on to then describe it forming a single executable file.</td></tr>
<tr><td></td><td></td><td>ii</td><td>1 mark per bullet to max 2:

• It is part of the operating system
• Loads an executable file (into memory)...
• ...from secondary storage
• Loads the required software libraries</td><td>2</td><td>MP2 - Allow loads applications/programs

<u>Examiner’s Comments</u>

Many candidates confused loaders with compilers and IDEs and talked about being able to use libraries in source code or loading code into the compiler.</td></tr>
</table>

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Question			Answer/Indicative content	Marks	Guidance
			Total	9	
4			• Compiler ... • ... Would protect their source code // keep their IP secret • ... meaning competitors cannot steal their ideas • ... Protect their money making ideas • ...would mean the game would run quicker (than if it were interpreted).	AO2.1 (2)	Examiner's Comments Although many candidates correctly selected 'compiler' for the type of translator, this was often not followed up with a suitable reason.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
5		i	• Application software allows the **user** to solve a problem / complete a task. • Utility software is designed to monitor / manage / maintain a computer system	AO1.2 (2)	Examiner's Comments This question was generally answered well.
		ii	• Word Processor ... E.g • Allows students to write essays / reports • Spreadsheets ... E.g. • Allow students to track/aggregate/calculate data • Create charts • Model situations / experiments • Presentation ... E.g. • Allows students to create presentations on a particular topic	AO1.1 (2) AO2.1 (2)	Allow any sensible application that could be used in a school environment as part of a student's workflow (e.g. photo editor, email client, web-browser). Example must be specific to a school environment Do not allow brand names for type of application If a brand name is used, allow follow through mark for a valid example Examiner's Comments Although this question was generally answered well, some candidates have used brand names for applications which is not allowed. Where a valid application was given, this was generally followed up with an appropriate example.
		iii	• Open Source Software allows access/modification to/of the **source code**... ...can tailor the software to their specific needs ...may be more widely bug fixed ...there may be a wider pool of support available in the community Or • There will likely be no cost to purchasing a **license** to use the software... ...saving the school money	AO2.1 (2)	Examiner's Comments This question was generally answered well although some candidates stated that the software can be modified rather than stating that the source code can be modified.
			Total	8	

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>6</td><td></td><td></td><td>
<table>
<tr><th></th><th>Compiler</th><th>Interpreter</th><th>Assembler</th></tr>
<tr><td>Creates an executable file</td><td>X</td><td></td><td>(X)</td></tr>
<tr><td>Creates one line of object code for each line of source code</td><td></td><td></td><td>X</td></tr>
<tr><td>Translates all the high-level code at once</td><td>X</td><td></td><td></td></tr>
<tr><td>A program needs to be translated each time it is run</td><td></td><td>X</td><td></td></tr>
</table>
</td><td>AO1.2
(4)</td><td>For “creates an executable file”, accept any of the following combinations:

• Compiler
• Assembler
• Compiler and assembler

<u>Examiner’s Comments</u>

Most candidates gained all four marks for this question. Although the question states to tick ‘one box’, candidates were given a mark if they selected either assembler or compiler or both options for ‘creates an executable file’.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>4</td><td></td></tr>
</table>

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Question			Answer/Indicative content	Marks	Guidance
7	a	i	• To convert (high-level or assembly) code to low level/machine code	1	Do not allow answers referring to making the program executable, given in question. Examiner's Comments This question was generally well answered, though some candidates thought that a translator translated machine code into source code or that it translated code into something the computer could understand, without specifying what that was.
		ii	• Compiler translates code all at once/before it's executed • Interpreter translates code line by line / during runtime • Compiler produces executable file for reuse // Doesn't need to be translated everytime it is run • Interpreter needs to re-translate next time program is run • Compiler lists all errors//Compiled code doesn't run if there are any errors • Interpreter stops at the first error • Compiled programs have the source code hidden • Interpreted programs have the source code visible	4	Mark answers in pairs Max 2 marks per answer space Examiner's Comments This question was well answered by many candidates who showed two distinct differences.

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>b</td><td></td><td>
<table>
<tr><th></th><th>Lexical analysis</th><th>Syntax analysis</th><th>Code generation</th></tr>
<tr><td>Comments and white-space are removed</td><td>x</td><td></td><td></td></tr>
<tr><td>Keywords are replaced with tokens</td><td>x</td><td></td><td></td></tr>
<tr><td>Object code is created</td><td></td><td></td><td>x</td></tr>
<tr><td>Symbol table created for variables</td><td>x</td><td></td><td></td></tr>
<tr><td>Builds an abstract syntax tree</td><td></td><td>x</td><td></td></tr>
</table>
</td><td>5</td><td>One mark per row. No mark if more than one/no box is ticked.

Accept other marks that clearly indicate choice (e.g. X)</td></tr>
<tr><td></td><td>c</td><td></td><td>• To make the program run faster// code is more efficient
• To make the program use fewer resources/less memory</td><td>2</td><td><u>Examiner's Comments</u>
Many candidates gave good descriptions of how code is optimised, but they did not answer the question which asked what the purpose of optimisation is.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>12</td><td></td></tr>
</table>

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Question	Answer/Indicative content	Marks	Guidance
8	**Mark Band 3–High Level** **(7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of open and closed source software; the material is generally accurate and detailed. The candidate has covered all 4 sections of cost, usability, security and Support available and for the top of this mark band will have covered all 4 well. Evidence/examples will be explicitly relevant to the explanation. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Mark Band 2-Mid Level** **(4-6 marks)** The candidate demonstrates reasonable knowledge and understanding of open and closed source software; the material is generally accurate but at times underdeveloped. The candidate has covered all at least 2 of the 4 sections of cost, usability, security and Support available. Evidence/examples are for the most part implicitly relevant to the explanation. *There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.* **Mark Band 1-Low Level** **(1-3 marks)** The candidate demonstrates a basic knowledge of how the layers of open and closed source software; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided. The candidate provides nothing more than an unsupported assertion. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks**	9 (AO1.1) (2) (AO1.2) (2) (AO2.1) (2) (AO3.3) (3)	<u>Knowledge:</u> **Cost** Open Source • (generally) free to use • May have to purchase maintenance contracts • Staff training if “non-standard” Closed Source • (sometimes) have to pay to license the software • If paid will (usually) it will come with some level of support **Usability/extensibility** Open Source • Tends to have a lower focus on UI • Source code released (under license) • Source can be edited • Can be redistributed (under license) Closed Source • Professionally developed • Distributed with a restrictive license • Only executable/object code is distributed//source code not distributed • Cannot be redistributed **Security** Open Source • potentially massive bank of volunteer developers working on the product • Many of the contributors may not be professional • Code available to be scrutinised by anyone… • …but this may include people with malicious intentions Closed Source • Closed teams of developers • More work scrutiny for code • security fixes usually addressed quicker **Support Available** Open Source • Source code released (under license)

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Question	Answer/Indicative content	Marks	Guidance
	No attempt to answer the question or response is not worthy of credit.		• Source can be edited • Open communities mean lots of support options could be available <u>Closed Source</u> • <u>Support may be available from the company producing the software.</u> <u>Application:</u> **Cost** Open Source • Lower overheads to company • Extra staff training and hardware cost could lead to total cost of ownership being higher Closed Source • Support from vendor can lead to quicker fixes. **Usability** Open Source • The ability to edit source code means bespoke functionality can be developed in house • Lower focus on UI can mean a harder to use product (leading to higher training costs) Closed Source • Due to professional development, finish tends to be a higher standard • As the organisation protects their IP they generally tend to be less buggy as the organisation reputation/business model will rely on it • Lack of source code means extra features can only be developed by the vendor. **Security** Open Source • Tends to be less secure as more people working on it, not always under rigorous oversight • No paid developers mean people may not work on security fixes straight away

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Question	Answer/Indicative content	Marks	Guidance
			Closed Source • Developers work under tighter standards • Code being scrutinised more will mean less likely to be ship with bugs • Professional standards lead to quicker turnaround of bugs Support Available Open Source • Editable source code means could self-support • Open communities mean there is vast amounts of knowledge available. <u>Evaluation:</u> Open Source • Open source would lead to potential cost savings if Charlie looked to self support by using online communities or handling the code herself. Closed Source • If Charlie lacked technical skills, the better UI design from professional developers may make the UX smoother • Charlies would have a legal obligation to the data stored for her business. Closed source tighter security may strengthen this • Charlies business will rely on the uptime of her system. Professional support offered by the developers may mean less downtime in the case of software issues. <u>Examiner's Comments</u> Candidates were assessed on the quality of their extended response in this question. Most of the candidates were clear on the basic difference between open and closed source software but did not link this in with the scenario. Mid-level responses were common with few candidates having a balanced discussion with coverage of all four of the required sections.
	Total	9	

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Question			Answer/Indicative content	Marks	Guidance
9			– The comments such as those on the first line, (and whitespace) are removed. – Variable names / identifiers like 'count' are added to a symbol table. – Reserved words / statement components are tokenized. For example 'WHILE' (1 mark per -, max 3)	3 AO2.2	Examiner's Comments This question was poorly attempted by most candidates. Although, many explained what happens during Lexical Analysis few went on to refer to examples from the given code, hence not gaining credit. Candidates should be reminded that they must refer to examples when the question requires them to do so.
			Total	3	
10			- Free of cost - Right to inspect/amend/recompile source code - Can tailor the program to their specific needs - Code open for bugs to be spotted and fixed. (1 Mark per -, Max 2)	2 (AO1.2)	Examiner's Comments Most candidates stated that open source software was free but some went on to explain that users can amend/inspect the code rather than source code. Again, attention to detail is required at this level of study.
			Total	2	

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