3 a A compiler is used to translate a program into machine code.

i A compiler is modelled as containing a front end and a back end. State the overall aim of the front end and of the back end. [2]

ii Identify **two** processes which are part of the front end. [2]

iii Identify **two** processes which are part of the back end. [2]

b Complete the following Backus–Naur definition of a signed integer:

i <Digit> ::=

ii <Sign> ::=

iii <Unsigned integer> ::=

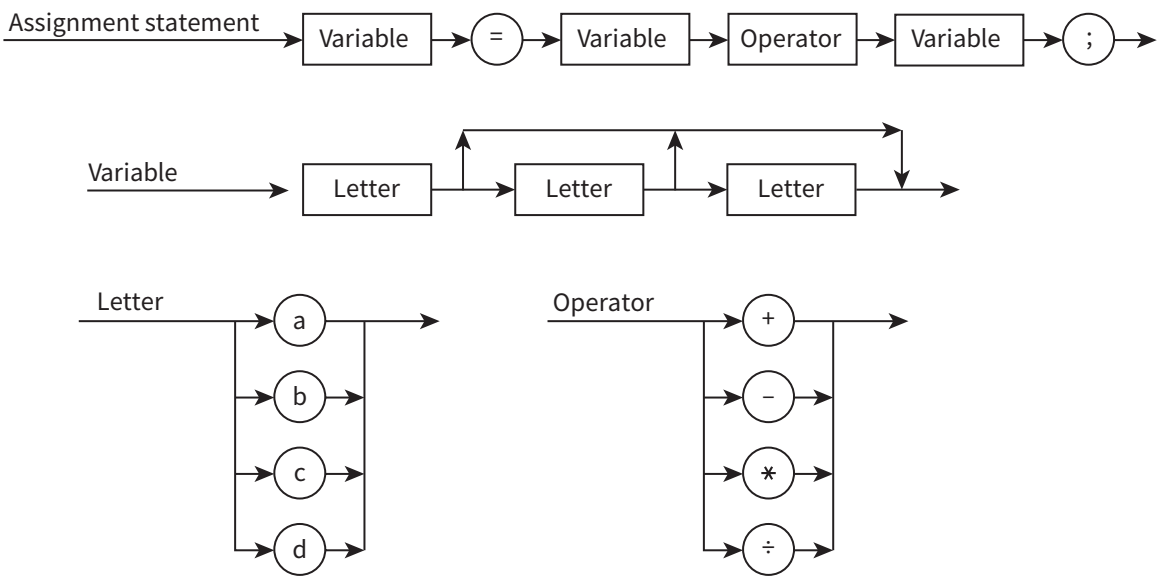
iv <Signed integer> ::= [4]

c Give the Reverse Polish notation equivalent of the expression `(a + 6) + b / c .` [2]

d Give the infix notation equivalent of the Reverse Polish expression `a 3 b * 6 c * - + .` [2]

4 The following syntax diagrams, for a particular programming language, show the syntax of:

- an assignment statement
- a variable
- a letter
- an operator



a The following assignment statements are invalid.

Give the reason in each case.

i `a = b + c` [1]

ii `a = b - 2;` [1]

iii `a = dd * cce;` [1]

b Write the Backus-Naur Form (BNF) for the syntax diagrams shown above.

i <assignmentstatement> ::=

ii <variable> ::=

iii <letter> ::=

iv <operator> ::= [6]

c Rewrite the BNF rule for a variable so that it can be any number of letters.

`<variable> ::=` [2]

d Programmers working for a software development company use both interpreters and compilers.

i The programmers prefer to debug their programs using an interpreter.

Give **one** possible reason why. [1]

ii The company sells compiled versions of its programs.

Give a reason why this helps to protect the security of the source code. [1]

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5 A number of processes are being executed in a computer.

a Explain the difference between a program and a process. [2]

A process can be in one of three states: running, ready or blocked.

b For each of the following, the process is moved from the first state to the second state. Describe the conditions that cause each of the following changes of the state of a process:

i From running to ready

ii From ready to running

iii From running to blocked [6]

c Explain why a process cannot be moved from the blocked state to the running state. [3]

d Explain the role of the high-level scheduler in a multiprogramming operating system. [2]

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