

## 1.2 SOFTWARE &amp; SOFTWARE DEVELOPMENT · 1.2.2

**Translators & the stages of compilation — Mark scheme**

35 marks · spec 1.2.2(d)(e)(f)

**AO key:** AO1 = knowledge & understanding · AO2 = application · AO3 = reasoned judgements. Accept any valid alternative; do not award the same point twice.

| Q    | ANSWER                                                                                                | AO  | MARKS |
|------|-------------------------------------------------------------------------------------------------------|-----|-------|
| 1(a) | To convert source code from one language into another, usually into machine code the CPU can run. (1) | AO1 | 1     |
| 1(b) | Assembler (1); compiler (1); interpreter (1). (3)                                                     | AO1 | 3     |

| Q    | ANSWER                                                                                                                                                                                                                                                                                                                                            | AO  | MARKS |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------|
| 2(a) | 2 differences, 1 mark each side, max 4, e.g.: <ul style="list-style-type: none"> <li>• a compiler translates the whole program at once; an interpreter one line at a time (1+1)</li> <li>• a compiler produces a saved object file; an interpreter does not (1+1)</li> <li>• compiled code runs faster; interpreted code is slower (1)</li> </ul> | AO1 | 4     |
| 2(b) | Any one + reason, max 2: the object code runs faster (1) / can be distributed without the source or compiler (1). (2)                                                                                                                                                                                                                             | AO1 | 2     |

| Q    | ANSWER                                                                                                                                      | AO  | MARKS |
|------|---------------------------------------------------------------------------------------------------------------------------------------------|-----|-------|
| 3(a) | Lexical analysis, syntax analysis, code generation, optimisation (2).<br>2 marks if fully correct order; 1 mark if one error/transposition. | AO1 | 2     |
| 3(b) | Source code is broken into tokens (1); whitespace/comments removed and a symbol table is built (1). (2)                                     | AO1 | 2     |
| 3(c) | To make the code run faster / use less memory (1) without changing what it does (1). (2)                                                    | AO1 | 2     |

| Q    | ANSWER                                                                                                               | AO  | MARKS |
|------|----------------------------------------------------------------------------------------------------------------------|-----|-------|
| 4(a) | Combines the object code with library/other object files (1) into a single executable, resolving references (1). (2) | AO1 | 2     |
| 4(b) | Copies the executable into memory (RAM) (1) and prepares it to run (1). (2)                                          | AO1 | 2     |
| 4(c) | Any one + development, max 2: code is reusable/pre-tested (1) so it saves time / is more reliable (1). (2)           | AO2 | 2     |

| Q    | ANSWER                                                                                                                                                       | AO  | MARKS |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------|
| 5(a) | A collection of pre-written, compiled, reusable code/subroutines (1); plus a valid description (1) and an example use, e.g. graphics/maths routines (1). (3) | AO1 | 3     |
| 5(b) | Any one: the programmer cannot see/trust the code / library may be larger than needed / version or compatibility issues. (1)                                 | AO1 | 1     |

| Q                | LEVELS-OF-RESPONSE MARK SCHEME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | AO    | MARKS      |                  |                                                                                                                                                                                                                                         |                  |                                                                                                           |                  |                                                                                             |   |                       |                        |   |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------------------|---|-----------------------|------------------------|---|
| 6                | <p>Mark using the levels descriptors below. AO1 (knowledge of the stages), AO2 (application to producing a distributable program with library code).</p> <table><tr><th>LEVEL</th><th>DESCRIPTOR</th></tr><tr><td>Level 3<br/>(7–9)</td><td>Accurately describes the four stages of compilation <b>in order</b> and clearly explains how the <b>linker</b> brings library code in and the <b>loader</b> places the program in memory. Well structured and uses correct terminology.</td></tr><tr><td>Level 2<br/>(4–6)</td><td>Describes most stages with <b>some</b> reference to linking/loading; may have minor gaps or order errors.</td></tr><tr><td>Level 1<br/>(1–3)</td><td>Basic points about compilation with little structure and little mention of linking/loading.</td></tr><tr><td>0</td><td>Nothing creditworthy.</td></tr></table> <p><b>Indicative content</b> (credit any valid point):</p> <ul style="list-style-type: none"><li>• Lexical analysis: source broken into tokens, whitespace removed, symbol table built.</li><li>• Syntax analysis: tokens checked against grammar rules; syntax errors reported; parse tree built.</li><li>• Code generation: object (machine) code produced; optimisation: improves speed/memory without changing behaviour.</li><li>• Linker: combines the object code with the graphics library's object code into one executable; loader: copies the executable into RAM so it can run on the customer's machine.</li></ul> | LEVEL | DESCRIPTOR | Level 3<br>(7–9) | Accurately describes the four stages of compilation <b>in order</b> and clearly explains how the <b>linker</b> brings library code in and the <b>loader</b> places the program in memory. Well structured and uses correct terminology. | Level 2<br>(4–6) | Describes most stages with <b>some</b> reference to linking/loading; may have minor gaps or order errors. | Level 1<br>(1–3) | Basic points about compilation with little structure and little mention of linking/loading. | 0 | Nothing creditworthy. | AO1<br>×5<br>AO2<br>×4 | 9 |
| LEVEL            | DESCRIPTOR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |       |            |                  |                                                                                                                                                                                                                                         |                  |                                                                                                           |                  |                                                                                             |   |                       |                        |   |
| Level 3<br>(7–9) | Accurately describes the four stages of compilation <b>in order</b> and clearly explains how the <b>linker</b> brings library code in and the <b>loader</b> places the program in memory. Well structured and uses correct terminology.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |            |                  |                                                                                                                                                                                                                                         |                  |                                                                                                           |                  |                                                                                             |   |                       |                        |   |
| Level 2<br>(4–6) | Describes most stages with <b>some</b> reference to linking/loading; may have minor gaps or order errors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |            |                  |                                                                                                                                                                                                                                         |                  |                                                                                                           |                  |                                                                                             |   |                       |                        |   |
| Level 1<br>(1–3) | Basic points about compilation with little structure and little mention of linking/loading.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |       |            |                  |                                                                                                                                                                                                                                         |                  |                                                                                                           |                  |                                                                                             |   |                       |                        |   |
| 0                | Nothing creditworthy.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |       |            |                  |                                                                                                                                                                                                                                         |                  |                                                                                                           |                  |                                                                                             |   |                       |                        |   |

Total for paper: 35 marks