

## 2.2 PROGRAMMING TECHNIQUES · 2.2.2(A)–(C)

**Computational methods — Mark scheme**

30 marks · spec 2.2.2(a)–(c)

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

| Q    | ANSWER                                                                                                                                                                                                                    | AO  | MARKS |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------|
| 1(a) | 1 mark each, max 3: can be broken into well-defined steps/algorithm · inputs can be represented as data · clear rules/calculations (no human judgement) · a useful well-defined output · solvable in reasonable time. (3) | AO1 | 3     |
| 1(b) | A valid subjective example (1) + reason it needs human judgement/taste/emotion that cannot be reduced to data & rules (1), e.g. "which song is best". (2)                                                                 | AO2 | 2     |
| 1(c) | A sequence of well-defined steps to solve a problem. (1)                                                                                                                                                                  | AO1 | 1     |

| Q    | ANSWER                                                                                                                                                             | AO  | MARKS |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------|
| 2(a) | Working out exactly what the problem is (1); turning a vague situation into a precisely defined problem (goal/data/constraints) (1). (2)                           | AO1 | 2     |
| 2(b) | 1 mark each, max 4 (must be relevant): visitors per hour · time of day · day of week · type of session/class · membership numbers · weather · public holidays. (4) | AO2 | 4     |

| Q    | ANSWER                                                                                                                                                                                                                                  | AO  | MARKS |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------|
| 3(a) | Breaking a problem into smaller sub-problems (1); each easier to understand/solve (until each is a single task) (1). (2)                                                                                                                | AO1 | 2     |
| 3(b) | 2 reasons developed (point + why), max 4: each sub-problem is simpler to design/test (2); can be shared among a team / worked on in parallel (2); become reusable subroutines (2); easier to find & fix bugs in a small module (2). (4) | AO2 | 4     |

| Q    | ANSWER                                                                                                                                             | AO  | MARKS |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------|
| 4(a) | Recognition = defining the problem precisely (goal/data/constraints) (1); decomposition = breaking that problem into smaller sub-problems (1). (2) | AO1 | 2     |
| 4(b) | A structure diagram (hierarchy chart). (1)                                                                                                         | AO1 | 1     |

| Q                | LEVELS-OF-RESPONSE MARK SCHEME (9 MARKS)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | AO    | MARKS      |                  |                                                                                                                                                                 |                  |                                                                             |                  |                                                |   |                       |                                     |   |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------|------------------|------------------------------------------------|---|-----------------------|-------------------------------------|---|
| 5                | <p>Mark using the levels descriptors below. AO1 (knowledge of solvability), AO2 (application to the traffic system), AO3 (reasoned judgement &amp; conclusion).</p> <table><tr><th>LEVEL</th><th>DESCRIPTOR</th></tr><tr><td>Level 3<br/>(7–9)</td><td>Thorough discussion of several solvability features applied to the traffic problem, with a <b>justified conclusion</b>. Clear reasoning; accurate terminology.</td></tr><tr><td>Level 2<br/>(4–6)</td><td>Several features with some development and application; a basic conclusion.</td></tr><tr><td>Level 1<br/>(1–3)</td><td>A few features listed with little development.</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>• Definable data inputs: sensor counts, vehicle speeds, light timings, time of day — all measurable and storable.</li><li>• Clear rules/process: traffic flow can be modelled with mathematical rules; no human judgement needed; can be expressed as an algorithm.</li><li>• Useful output: predicted flow / optimised light timings.</li><li>• Feasibility: large data volume but computable in reasonable time on suitable hardware (could use concurrency).</li><li>• A justified conclusion (the problem is solvable because inputs, rules and output are all well-defined).</li></ul> | LEVEL | DESCRIPTOR | Level 3<br>(7–9) | Thorough discussion of several solvability features applied to the traffic problem, with a <b>justified conclusion</b> . Clear reasoning; accurate terminology. | Level 2<br>(4–6) | Several features with some development and application; a basic conclusion. | Level 1<br>(1–3) | A few features listed with little development. | 0 | Nothing creditworthy. | AO1<br>×3<br>AO2<br>×3<br>AO3<br>×3 | 9 |
| LEVEL            | DESCRIPTOR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |       |            |                  |                                                                                                                                                                 |                  |                                                                             |                  |                                                |   |                       |                                     |   |
| Level 3<br>(7–9) | Thorough discussion of several solvability features applied to the traffic problem, with a <b>justified conclusion</b> . Clear reasoning; accurate terminology.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |       |            |                  |                                                                                                                                                                 |                  |                                                                             |                  |                                                |   |                       |                                     |   |
| Level 2<br>(4–6) | Several features with some development and application; a basic conclusion.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |            |                  |                                                                                                                                                                 |                  |                                                                             |                  |                                                |   |                       |                                     |   |
| Level 1<br>(1–3) | A few features listed with little development.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |       |            |                  |                                                                                                                                                                 |                  |                                                                             |                  |                                                |   |                       |                                     |   |
| 0                | Nothing creditworthy.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |       |            |                  |                                                                                                                                                                 |                  |                                                                             |                  |                                                |   |                       |                                     |   |

**Total for paper: 30 marks**