

Computing Science: National 5 and Higher skills, knowledge and understanding 2018–19

Software design and development		
	National 5	Higher
Development methodologies	Describe and implement the phases of an iterative development process: analysis, design, implementation, testing, documentation, and evaluation, within general programming problem-solving.	Describe and compare the development methodologies: <ul style="list-style-type: none"> ◆ iterative development process ◆ agile methodologies
Analysis	Identify the purpose and functional requirements of a problem that relates to the design and implementation at this level, in terms of: <ul style="list-style-type: none"> ◆ inputs ◆ processes ◆ outputs 	Identify the: <ul style="list-style-type: none"> ◆ purpose ◆ scope ◆ boundaries ◆ functional requirements of a problem that relates to the design and implementation at this level, in terms of: <ul style="list-style-type: none"> ◆ inputs ◆ processes ◆ outputs
Design	Identify the data types and structures required for a problem that relates to the implementation at this level, as listed below. Describe, identify, and be able to read and understand: <ul style="list-style-type: none"> ◆ structure diagrams 	Identify the data types and structures required for a problem that relates to the implementation at this level. Read and understand designs of solutions to problems at this level using the following design techniques: <ul style="list-style-type: none"> ◆ structure diagrams ◆ pseudocode

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	<ul style="list-style-type: none"> ◆ flowcharts ◆ pseudocode <p>Exemplify and implement one of the above design techniques to design efficient solutions to a problem.</p> <p>Describe, exemplify, and implement user-interface design, in terms of input and output, using a wireframe.</p>	<p>Exemplify and implement efficient design solutions to a problem, using a recognised design technique, showing:</p> <ul style="list-style-type: none"> ◆ top level design ◆ the data flow ◆ refinements <p>Describe, exemplify, and implement user-interface design, in terms of input and output, using a wireframe.</p>
Implementation (data types and structures)	<p>Describe, exemplify, and implement appropriately the following data types and structures:</p> <ul style="list-style-type: none"> ◆ character ◆ string ◆ numeric (integer and real) ◆ Boolean ◆ 1-D arrays 	<p>Describe, exemplify and implement appropriately the following structures:</p> <ul style="list-style-type: none"> ◆ parallel 1-D arrays ◆ records ◆ arrays of records
Implementation (computational constructs)	<p>Describe, exemplify, and implement the appropriate constructs in a high-level (textual) language:</p> <ul style="list-style-type: none"> ◆ expressions to assign values ◆ expressions to return values using arithmetic operations (addition, 	<p>Describe, exemplify, and implement the appropriate constructs in a procedural high-level (textual) language:</p> <ul style="list-style-type: none"> ◆ parameter passing (formal and actual) ◆ the scope of local and global variables

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	<p>subtraction, multiplication, division, and exponentiation)</p> <ul style="list-style-type: none"> ◆ expressions to concatenate strings ◆ selection constructs using simple conditional statements with <, >, ≤, ≥, =, ≠ operators ◆ selection constructs using complex conditional statements ◆ logical operators (AND, OR, NOT) ◆ iteration and repetition using fixed and conditional loops ◆ pre-defined functions (with parameters): <ul style="list-style-type: none"> — random — round — length <p>Read and explain code that makes use of the above constructs.</p>	<ul style="list-style-type: none"> ◆ sub-programs/routines, defined by their name and arguments (inputs and outputs): <ul style="list-style-type: none"> — functions — procedures ◆ pre-defined functions (with parameters) to: <ul style="list-style-type: none"> — create substrings — convert from character to ASCII and vice versa — modulus — convert floating-point numbers to integers ◆ file handling <ul style="list-style-type: none"> — sequential CSV and txt files (open, create, read, write, close) <p>Read and explain code that makes use of the above constructs.</p>
Implementation (algorithm specification)	<p>Describe, exemplify, and implement standard algorithms:</p> <ul style="list-style-type: none"> ◆ input validation ◆ running total within loop ◆ traversing a 1-D array 	<p>Describe, exemplify, and implement standard algorithms using 1D arrays or arrays of records:</p> <ul style="list-style-type: none"> ◆ linear search ◆ find minimum and maximum ◆ count occurrences

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Testing	<p>Describe, identify, exemplify, and implement normal, extreme, and exceptional test data for a specific problem, using a test table.</p> <p>Describe and identify syntax, execution, and logic errors.</p>	<p>Describe, exemplify and implement a comprehensive final test plan to show that the functional requirements are met.</p> <p>Identify syntax, execution, and logic errors at this level.</p> <p>Describe and exemplify de-bugging techniques:</p> <ul style="list-style-type: none"> ◆ dry runs ◆ trace tables/tools ◆ breakpoints ◆ watchpoints
Evaluation	<p>Describe, identify, and exemplify the evaluation of a solution in terms of:</p> <ul style="list-style-type: none"> ◆ fitness for purpose ◆ efficient use of coding constructs ◆ robustness ◆ readability: <ul style="list-style-type: none"> — internal commentary — meaningful identifiers — indentation — white space 	<p>Describe, identify, and exemplify the evaluation of a solution in terms of:</p> <ul style="list-style-type: none"> ◆ fitness for purpose ◆ efficient use of coding constructs ◆ usability ◆ maintainability ◆ robustness

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Computer systems		
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Data representation	<p>Describe and exemplify the use of binary to represent positive integers.</p> <p>Describe floating-point representation of positive real numbers using the terms mantissa and exponent.</p> <p>Convert from binary to denary and vice versa.</p> <p>Describe extended ASCII code (8-bit) used to represent characters.</p> <p>Describe the vector graphics method of graphic representation for common objects:</p> <ul style="list-style-type: none"> ◆ rectangle ◆ ellipse ◆ line ◆ polygon <p>with attributes:</p> <ul style="list-style-type: none"> ◆ co-ordinates ◆ fill colour ◆ line colour <p>Describe the bit-mapped method of graphics representation.</p>	<p>Describe and exemplify the use of binary to represent positive and negative integers using two's complement, including the range of numbers that can be represented using a fixed number of bits.</p> <p>Conversion of two's complement numbers from binary to denary and vice versa.</p> <p>Describe and exemplify floating-point representation of positive and negative real numbers using the terms mantissa and exponent.</p> <p>Describe the relationship between the number of bits assigned to the mantissa/exponent, and the range and precision of floating-point numbers.</p> <p>Describe Unicode used to represent characters and its advantage over extended ASCII code (8-bit) in terms of numbers of characters.</p> <p>Describe the relative advantages and disadvantages of bit-mapped graphics versus vector graphics.</p>

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Computer structure	<p>Describe the purpose of the basic computer architecture components and how they are linked together:</p> <ul style="list-style-type: none"> ◆ processor (registers, ALU, control unit) ◆ memory locations with unique addresses ◆ buses (data and address) <p>Explain the need for interpreters and compilers to translate high-level program code to binary (machine code instructions).</p>	<p>Describe the concept of the fetch-execute cycle.</p> <p>Describe the factors affecting computer system performance:</p> <ul style="list-style-type: none"> ◆ number of processors (cores) ◆ width of data bus ◆ cache memory ◆ clock speed
Environmental impact	<p>Describe the energy use of computer systems, the implications on the environment and how these could be reduced through:</p> <ul style="list-style-type: none"> ◆ settings on monitors ◆ power down settings ◆ leaving computers on stand-by 	<p>Describe the environmental impact of intelligent systems:</p> <ul style="list-style-type: none"> ◆ heating systems ◆ traffic control ◆ car management systems

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Security risks and precautions	<p>Describe the role of firewalls.</p> <p>Describe the use made of encryption in electronic communications.</p>	<p>Describe and identify the implications for individuals and businesses of the Computer Misuse Act 1990:</p> <ul style="list-style-type: none"> ◆ unauthorised access to computer material ◆ unauthorised access with intent to commit a further offence ◆ unauthorised modification of programs or data on a computer <p>Describe and identify the security risks of:</p> <ul style="list-style-type: none"> ◆ tracking cookies ◆ DOS (Denial of Service) attacks: <ul style="list-style-type: none"> — symptoms <ul style="list-style-type: none"> ○ slow performance, inability to access — effects <ul style="list-style-type: none"> ○ disruption to users and business — costs <ul style="list-style-type: none"> ○ lost revenue, labour in rectifying fault — type of fault <ul style="list-style-type: none"> ○ bandwidth consumption, resource starvation, Domain Name Service(DNS) — reasons <ul style="list-style-type: none"> ○ financial, political, personal <p>Describe how encryption is used to secure transmission of data:</p> <ul style="list-style-type: none"> ◆ use of public and private keys ◆ digital certificates ◆ digital signatures

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Database design and development		
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Analysis	Identify the end-user and functional requirements of a database problem that relates to the implementation at this level.	Identify the end-user and functional requirements of a database problem that relates to the implementation at this level.
Design	<p>Describe and identify the implications for individuals and businesses of the General Data Protection Regulation (GDPR) — Regulation (EU) 2016/679 that data must be:</p> <ul style="list-style-type: none"> ◆ processed lawfully, fairly and in a transparent manner in relation to individuals ◆ used for the declared purpose only ◆ limited to the data needed for the declared purpose ◆ accurate ◆ not kept for longer than necessary ◆ held securely <p>Describe and exemplify entity relationship diagrams with two entities indicating:</p> <ul style="list-style-type: none"> ◆ entity name ◆ attributes ◆ relationship (one-to-many) 	<p>Describe and exemplify entity relationship diagrams with three or more entities, indicating:</p> <ul style="list-style-type: none"> ◆ entity name ◆ attributes ◆ name of relationship ◆ cardinality of relationship (one-to-one, one-to-many, many-to-many) <p>Describe and exemplify an instance using an entity-occurrence diagram.</p> <p>Describe and exemplify a compound key.</p> <p>Describe and exemplify a data dictionary with three or more entities:</p> <ul style="list-style-type: none"> ◆ entity name ◆ attribute name ◆ primary and foreign key ◆ attribute type: <ul style="list-style-type: none"> — text — number — date

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	<p>Describe and exemplify a data dictionary:</p> <ul style="list-style-type: none"> ◆ entity name ◆ attribute name ◆ primary and foreign key ◆ attribute type: <ul style="list-style-type: none"> — text — number — date — time — boolean ◆ attribute size ◆ validation: <ul style="list-style-type: none"> — presence check — restricted choice — field length — range <p>Exemplify a design of a solution to the query:</p> <ul style="list-style-type: none"> ◆ multiple tables ◆ fields ◆ search criteria ◆ sort order 	<ul style="list-style-type: none"> — time — Boolean ◆ attribute size ◆ validation: <ul style="list-style-type: none"> — presence check — restricted choice — field length — range <p>Exemplify a design of a solution to a query:</p> <ul style="list-style-type: none"> ◆ tables and queries ◆ fields ◆ search criteria ◆ sort order ◆ calculations ◆ grouping

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Implementation	<p>Implement relational databases with two linked tables, to match the design with referential integrity.</p> <p>Describe, exemplify and implement SQL operations for pre-populated relational databases, with a maximum of two linked tables:</p> <ul style="list-style-type: none"> ◆ SELECT: <ul style="list-style-type: none"> — from — where: <ul style="list-style-type: none"> ○ AND, OR, <, >, = ○ order by with a maximum of two fields ◆ INSERT ◆ UPDATE ◆ DELETE ◆ equi-join between tables <p>Read and explain code that makes use of the above SQL.</p>	<p>Describe, exemplify and use SQL operations for pre-populated relational databases with three or more linked tables:</p> <ul style="list-style-type: none"> ◆ UPDATE, SELECT, DELETE, INSERT statements making use of: <ul style="list-style-type: none"> — wildcards — aggregate functions (MIN, MAX, AVG, SUM, COUNT) — calculated fields, alias — GROUP BY — ORDER BY — WHERE <p>Read and explain code that makes use of the above SQL.</p>
Testing	<p>Describe and exemplify testing:</p> <ul style="list-style-type: none"> ◆ SQL operations work correctly at this level 	<p>Describe and exemplify testing:</p> <ul style="list-style-type: none"> ◆ SQL operations work correctly at this level
Evaluation	<p>Evaluate solution in terms of:</p> <ul style="list-style-type: none"> ◆ fitness for purpose ◆ accuracy of output 	<p>Evaluate solution at this level in terms of:</p> <ul style="list-style-type: none"> ◆ fitness for purpose ◆ accuracy of output

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Web design and development		
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Analysis	Identify the end-user and functional requirements of a website problem that relates to the design and implementation at this level.	Identify the end-user and functional requirements of a website problem that relates to the design and implementation at this level.
Design	<p>Describe and exemplify the website structure with a home page, a maximum of four linked multimedia pages, and any necessary external links.</p> <p>Describe, exemplify and implement, taking into account end-user requirements, effective user-interface design (visual layout and readability) using wire-framing:</p> <ul style="list-style-type: none"> ◆ navigational links ◆ consistency across multiple pages ◆ relative vertical positioning of the media displayed ◆ file formats of the media (text, graphics, video, and audio) <p>Describe and identify the implications for individuals and businesses of the Copyright, Designs and Patents Act 1988 relating to:</p>	<p>Describe and exemplify the website structure of a multi-level website with a home page and two additional levels, with no more than four pages per level.</p> <p>Describe, exemplify and implement, taking into account end-user requirements and device type, an effective user-interface design (visual layout and readability) using wire-framing:</p> <ul style="list-style-type: none"> ◆ horizontal navigational bar ◆ relative horizontal and vertical positioning of the media ◆ form inputs ◆ file formats of the media (text, graphics, video, and audio) <p>Describe, exemplify and implement prototyping (low fidelity) from wireframe design at this level.</p>

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	<ul style="list-style-type: none"> ◆ web content (text, graphics, video, and audio) <p>Compare a range of standard file formats:</p> <ul style="list-style-type: none"> ◆ audio standard file formats WAV and MP3 in terms of compression, quality, and file size ◆ bit-mapped graphic standard file formats JPEG, GIF, and PNG in terms of compression, animation, transparency, and colour depth <p>Describe the factors affecting file size and quality, relating to resolution, colour depth, and sampling rate.</p> <p>Describe the need for compression.</p> <p>Describe, exemplify and implement prototyping (low fidelity) from wireframe design at this level.</p>	
Implementation (CSS)	<p>Describe, exemplify and implement internal and external Cascading Style Sheets (CSS):</p> <ul style="list-style-type: none"> ◆ selectors, classes and IDs ◆ properties <ul style="list-style-type: none"> — text: <ul style="list-style-type: none"> ○ font (family, size) ○ color ○ alignment 	<p>Describe, exemplify and implement efficient inline, internal and external Cascading Style Sheets (CSS) using grouping and descendant selectors to:</p> <ul style="list-style-type: none"> ◆ control appearance and positioning: <ul style="list-style-type: none"> — display (block, inline, none) — float (left, right) — clear (both) — margins/padding

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	<ul style="list-style-type: none"> — background colour <p>Read and explain code that makes use of the above CSS.</p>	<ul style="list-style-type: none"> — sizes (height, width) ◆ create horizontal navigation bars: <ul style="list-style-type: none"> — list-style-type:none — hover <p>Read and explain code that makes use of the above CSS.</p>
Implementation (HTML)	<p>Describe, exemplify and implement HTML code:</p> <ul style="list-style-type: none"> ◆ HTML ◆ head ◆ title ◆ body ◆ heading ◆ paragraph ◆ DIV ◆ link ◆ anchor ◆ IMG ◆ audio ◆ video ◆ lists — ol, ul and li <p>Describe and implement hyperlinks (internal and external), relative and absolute addressing.</p>	<p>Describe, exemplify and implement HTML code:</p> <ul style="list-style-type: none"> ◆ nav ◆ header ◆ footer ◆ section ◆ form ◆ id attribute <p>Describe, exemplify and implement form elements:</p> <ul style="list-style-type: none"> ◆ form element: input <ul style="list-style-type: none"> — text — number — textarea — radio — submit ◆ form element: select <p>Describe, exemplify and implement form data validation:</p> <ul style="list-style-type: none"> ◆ length

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	Read and explain code that makes use of the above HTML.	<ul style="list-style-type: none"> ◆ presence ◆ range <p>Read and explain code that makes use of the above HTML.</p>
Implementation (Javascript)	<p>Describe and identify Javascript coding related to mouse events:</p> <ul style="list-style-type: none"> ◆ onmouseover ◆ onmouseout 	<p>Describe, exemplify and implement coding of Javascript functions related to mouse events:</p> <ul style="list-style-type: none"> ◆ onmouseover ◆ onmouseout ◆ onclick
Testing	<p>Describe and exemplify testing:</p> <ul style="list-style-type: none"> ◆ matches user-interface design ◆ links and navigation work correctly ◆ media (such as text, graphics, and video) display correctly ◆ consistency 	<p>Describe, exemplify and implement usability testing using personas, test cases and scenarios based on low fidelity prototypes.</p> <p>Describe and exemplify testing:</p> <ul style="list-style-type: none"> ◆ input validation ◆ navigational bar works ◆ media content displays correctly <p>Description and exemplification of compatibility testing including:</p> <ul style="list-style-type: none"> ◆ device type: <ul style="list-style-type: none"> — tablet, smart phone, desktop ◆ compatibility with the operating system and browser
Evaluation	<p>Evaluate solution in terms of:</p> <ul style="list-style-type: none"> ◆ fitness for purpose 	<p>Evaluate solution at this level in terms of</p> <ul style="list-style-type: none"> ◆ fitness for purpose ◆ usability