

Answers

Chapter 1

1. Convert numbers to decimal
 - a. $1011 = 11$
 - b. $1001\ 1111 = 159$
 - c. $1010\ 1010 = 170$
 - d. $1111\ 1110 = 254$
2. Convert numbers to binary
 - a. $122 = 0111\ 1010$
 - b. $193 = 1100\ 0001$
 - c. $256 = 0001\ 0000\ 0000$
 - d. $1023 = 0011\ 1111\ 1111$
3. Convert numbers to two's complement
 - a. $+6 = 0110$ $-6 = 1010$
 - b. $+25 = 0001\ 1001$ $-25 = 1110\ 0111$
 - c. $+92 = 0101\ 1100$ $-92 = 1010\ 0100$
 - d. $+120 = 0111\ 1000$ $-120 = 1000\ 1000$
4. Express numbers using a binary point
 - a. $0.25 = 0.01$
 - b. $7.375 = 0111.011$
 - c. $15.53125 = 1111.10001$
5. Convert the following real numbers into binary using floating point representation. Assume that 16 bits is available for the mantissa and 8 bits for the exponent.
 - a. $27.5 = 0000\ 0000\ 0011\ 011.1$
 $= .1101\ 1100\ 0000\ 0000 \times 2^{0000\ 0101}$
 - b. $134.125 = 0000\ 0100\ 0011\ 0.001$
 $= .1000\ 0110\ 0010\ 0000 \times 2^{0000\ 1000}$
 - c. $4200.25 = 0100\ 0001\ 1010\ 00.01$
 $= .100\ 0001\ 1010\ 00010 \times 2^{0000\ 1101}$
6.
 - a. The largest binary number a nibble can hold is 1111.
 - b. The range of numbers that can be held in a nibble is from 0000 to 1111, or 0 to 15 in decimal, making a total of 16 different numbers.
7. Calculations carried out using numbers represented by floating point may not always give the correct answer because of the limited storage available for the number in the computer's memory. If the number is too large to fit in the space available, part of the number will be lost, for instance by rounding or truncation errors.
 8. The effect of increasing the number of bits used to store the exponent is to increase the range of the numbers that may be stored.
 9. If four bytes are used for the mantissa and one byte for the exponent, then
 $.1111\ 1111\ 1111\ 1111\ 1111\ 1111\ 1111\ 1111$
 $\times 2^{1111\ 1111}$
 may be stored (ignoring two's complement)
 10. User's own program
 11.
 - a. A character is a symbol or letter on the computer keyboard.
 - b. A character set is a list of all the characters a computer can process and store.
 - c. A control character does not print on the screen in the normal way. It is used to control certain operations of the computer system.
 12.
 - a. ASCII stands for American Standard Code for Information Interchange.
 - b. ASCII can represent 128 different characters.
 - c. ASCII is a 7 bit code and $2^7 = 128$.
 - d. Use an 8 bit code because $2^8 = 256$.
 - e. i. 'e' = 101
 ii. 'E' = 69
 13.
 - a. Unicode is a method of representing text using 16 bits, which is designed to represent all the world's character sets.
 - b. Unicode can represent more characters than ASCII (65,536 compared to 128).
 14.
 - a. 56 bits per character for bitmap
 - b. 7 bits per character for ASCII
 - c. 16 bits for Unicode
 - d. ASCII is the most efficient method of storing this character
 15. Bit mapped graphics have a direct relationship between the pixels displayed on the monitor and the contents of the computer's memory.
 16. Vector graphics are stored by using a list of attributes for each graphic object in the image.
 17.
 - a. True colour on a computer screen is when 24 bits per pixel are used for the colour depth, giving over 16 million different colours.
 - b. 24 bits

18. a. Resolution is the quality of the picture.
b. Resolution independence is the ability of a graphics package to print out at the full resolution of the output device, e.g. printer.
c. Vector graphics are resolution independent.
19. a. i, iv, vi
b. ii, iii, v, vii
20. Draw two overlapping shapes and try to separate them. If the two shapes separate successfully then it is a vector package. Try to zoom in on the graphic and edit the pixels. If this is possible, then it is a bitmapped package.
21. A page description language is a high level language used to describe the page set up and objects to be sent to a printer.
22. Example *Postscript*TM program to draw a square of size two inches:
- ```
1. 0 0 moveto
2. 144 0 lineto
3. 0 144 lineto
4. closepath fill
5. showpage
```
23. a. a  $640 \times 480 = 307200$  pixels ; total pixels 256 colours = 8 bits ; bit depth  $307200 \times 8 = 2457600$  bits = 307200 bytes = 300 Kilobytes  
b. 1 megapixel =  $1024 \times 1024$  pixels; total pixels 16 bits; bit depth  $1024 \times 1024 \times 16 = 16777216$  bits = 2097152 bytes = 2048K = 2 Mb  
c.  $4 \times 6 \times 600 \times 600$  pixels ; total pixels = 1.0299 Mb  
d. monochrome = 1 bit ; bit depth  $4 \times 6 \times 600 \times 600 \times 1 = 8640000$  bits = 1080000 bytes = 1054.6875 Kilobytes
24. 8 bits means that 256 different colours or shades of grey may be stored.
25. a. green  
b. blue  
c. black  
d. white
26. a. increased by 8 times to 2 Mb  
b. same at 512 Kb  
c. increased by 16 times to 8 Mb
27. Data compression is reducing the size of a file in order to save backing storage space.
28. Data compression is used on bit-mapped graphics files because of the large amount of storage space that uncompressed files take up.
29. a. Lossy compression involves sacrificing some of the data in order to reduce the file size.  
b. Lossless compression means that none of the original data is lost.  
c. Lossy gives the smaller file size.  
d. i. lossless  
ii. lossy
30. a. JPEG  
b. TIFF
31. a. 448.03 Kb  
b. Figure 1.11 has a compression ratio of 2.3:1 and figure 1.12 has a compression ratio of 5.6:1.
32. a. 8.1 Mb  
b. 8 megapixels  
c. This reduction shows the image has been compressed with a compression ratio of 5.3:1. The likely reason for this is that a compressed file format such as JPEG has been used in order to save storage space on the camera's flash card.

## Chapter 2

1. The arithmetic and logic unit, the control unit and the registers. The control unit in the processor controls all the other parts of the processor and makes sure that the program instructions of the computer are carried out in the correct order. The arithmetic and logic unit carries out the calculations and performs the logical operations. The registers are a group of storage locations in the processor which are used to hold data being processed, instructions being executed and addresses to be accessed.
2. A set of wires which carries data between the processor and the other components.
3. Address bus, data bus and control bus. The address bus carries the address information from the processor to the main memory. The data bus carries the data to and from the processor and the main memory. The control bus is a series of separate lines: read, write, interrupt, non-maskable interrupt, clock and reset.
4. a. Address bus  
b. Data bus  
c. Control bus  
d. The number of wires in the bus

- e. i. An increase in the number of storage locations which may be addressed  
ii. An increase in the quantity of data which may be carried by the bus
5. a. A binary number used to identify a storage location  
b. The method of identifying a storage location  
c. A place in memory where an item of data is stored  
d. The number of bits that can be processed by the processor in a single operation
6. a. A device attached to a processor which keeps the operation of the components in step with one another  
b. The rate at which the clock produces pulses  
c. One complete pulse  
d. A method by which a peripheral can attract the processor's attention  
e. An interrupt which cannot be ignored
7. When an interrupt occurs, the processor saves a copy of what it is doing at that moment, runs a program to deal with the interrupt, and then reloads its original task and continues what it was doing before the interrupt occurred.
8. To return the computer to its initial state as if it had just been switched on.
9. The instruction is carried out.
10. a. The processor sets up the address bus with the required memory address. It does this by placing a value in the Memory Address Register. The control unit of the processor activates the read line on the control bus. The contents of the particular storage location in memory are released onto the data bus and are copied into the processor's Memory Data Register. If it is an instruction, it is decoded and executed (carried out).  
b. The processor sets up the address bus with the required memory address. It does this by placing a value in the Memory Address Register. The processor sets up the data bus with the value to be written to memory. It does this by placing the value in the Memory Data Register. The control unit of the processor activates the write line on the control bus. The contents of the Memory Data Register are transferred to the required storage location in the computer's memory.
11. Total addressable memory = Number of storage locations x size of each storage location
12. a. 1  
b. 2  
c. 4
13. a. Registers, cache, main memory and backing storage  
b. Registers, cache, main memory and backing storage
14. Two types of main memory are RAM and ROM.  
a. Random Access Memory and Read Only Memory  
b. When the computer system is turned off, then the contents of RAM are lost.
15. Two types of RAM are Static RAM (SRAM) and Dynamic RAM (DRAM).  
a. SRAM gives faster access than DRAM. SRAM does not need to be constantly refreshed.  
b. DRAM is less expensive to buy than SRAM.
16. a. A relatively small amount of memory between the processor and the main memory  
b. Video random access memory
17. To reduce the chance of them being copied
18. Flash ROM
19. Clock speed, MIPS, FLOPS, and application-based tests
20. Data bus width, use of cache memory and rate of data transfer to and from peripherals
21. a. None, because the quantity of memory actually installed has not increased.  
b. Increase, because the quantity of data which can be transferred by each 'fetch', will increase.
22. The clock speed of the bus will slow down the processor, causing a 'bottleneck'
23. a. More data and programs may be held in RAM, and it is much faster to access RAM than hard disk  
b. Cache memory holds frequently accessed instructions and it is faster for the processor to fetch instructions from the cache than from main memory
24. Most programs do not require the maximum amount of main memory in order to run. Providing more main memory would increase the cost of the computer above that of competitor's machines.

25. a. You could say Sarah was correct because it will take less time to process instructions on the machine with the higher clock speed. However, Mary's computer may have other differences, like a wider data bus or a larger cache which could improve its performance despite its slower clock speed.
- b. An application based test would show which machine was faster, if any.
26. Increasing clock speeds, increasing memory and backing storage capacity.

### Chapter 3

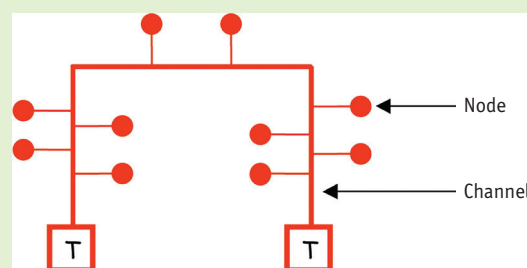
1. Five functions of an interface are buffering, data format conversion, voltage conversion, protocol conversion and the handling of status signals.
2. a. Handling of status signals, for example, ready or paper out
- b. Buffering, for example holding characters temporarily
3. A serial interface is one which uses serial data transmission, sending the bits for each character in the data along the same data line.
4. A parallel interface is one which uses parallel data transmission, sending each bit which makes up a character simultaneously along separate data lines.
5. a. The address and data buses use parallel data transmission.
- b. The control bus and the universal serial bus (USB) do not use parallel data transmission.
6. A protocol is a standard that enables the connection, communication, and data transfer between computers or between a computer system and a peripheral.
7. Parity is an example of a protocol used during data transmission. Parity is used to check for errors. One bit in every byte of data is reserved as the parity bit.
8. Odd parity would be useful to check for errors like 0000 0000 0000, since a continuous sequence of '0' would become 1000 0000 1000 0000 and so on, using odd parity. Similarly, 1111 1111 1111 .... Would become 0111 1111 0111 1111 .....
9. Three standard interfaces are USB, IEEE 1394 and SATA.
10. The use of interface standards by a computer manufacturer means that their computers will be able to connect to peripherals using the same standards. The use of interface standards by a peripheral manufacturer means that their peripherals will connect to a computer which uses the same standards.
11. A buffer is an area of memory used for the transfer of the data between the computer and a peripheral.
12. A spooler is a program which uses fast backing storage such as a hard disk for the temporary storage of print jobs.
13. A spooler using a hard disk drive is more appropriate when large documents or a large number of small documents have to be sent to a printer. RAM in a buffer has a limited capacity.
14. The likely speed of a spooler using a hard disk drive will be slower than a buffer using RAM because the speed of access to a hard disk drive is much slower than RAM.
15. Switching off background printing would mean that the user would have to wait until printing was complete before continuing with a task.
16. A printer server uses a spooler.
17. a. A solid-state storage device is one which has no moving parts.
- b. Flash ROM is the storage medium used in solid state storage devices.
- c. In this context 'solid' means that there are no spaces containing moving parts in the device.
- d. Solid-state storage devices are much more robust than hard disk drives.
18. This device is a flash card reader.
19. Development trends in backing storage devices include increased capacity, increased read and write speeds, reduced physical size and lower cost per unit of storage.
20. Trends in interfaces include increasing interface speeds and wireless communication between peripherals and CPU.
21. Two methods of wireless communication between peripherals and the CPU are WiFi and Bluetooth.
22. a. Digital video camera
- b. Network switch
- c. Digital still camera.

## Chapter 4

1. A network is two or more computers linked together in such a way that programs, data and messages may be exchanged between them.
2. A stand-alone computer is one which is not connected to a network.
3. A local area network (LAN) covers a small area such as a room or a building.
4. A network interface card is a small circuit board.
5. The purpose of a NIC is to allow the computer to communicate with a network.
6. A MAC address is a *Media Access Control Address provided by a NIC*.
7.  $2^{48}$
8. A wireless local area network
9. WiFi
10. A wireless network interface card
11. A wireless base station
12. An area where wireless network signals may be received.
13. (a) university campus (b) outside a building with a WLAN
14. A client-server network is a method of organisation in which client workstations make use of resources available on one or more servers.
15. A peer-to-peer network is when every workstation has a similar status in the hierarchy, each having its own local storage devices for programs and data.
16. Increased security over peer-to-peer – each user must log in to server, different users can be given different levels of access to data.
17. If the file server is not working then users cannot access their data, client-server is more expensive than peer-to-peer – it is necessary to buy a server and server software.
18. A wide area network covers a large geographical area.
19. A mainframe computer is a very large computer system, which can process a very large amount of data at high speed.
20. A dumb terminal has no processor and no local storage devices, just a screen and a keyboard.
21. Mainframe has dumb terminals – each network station has its own processor. Mainframe does all of the processing – each network terminal does its own processing. Mainframe is multi-user.

Network of computers is single user.

22. A supercomputer is the fastest and most powerful type of computer, used for intensive mathematical calculations. It has many parallel processors and can process data simultaneously.
23. The network topology is the way in which the nodes or workstations on a network are connected together.
24. A communications channel is the connection between two nodes on a network.
25. Copper wire
26. A bus topology:



27. The terminator catches stray signals and prevents them from interfering with other signals on the bus.
28. A mesh topology would be very costly to implement on a LAN because of the multiple connections required. It would also be technically difficult in a single room – if there were 20 computers, each computer would have to have 19 connections for a fully connected mesh.
29.

| Failure | Star                                                                       | Ring                                                      |
|---------|----------------------------------------------------------------------------|-----------------------------------------------------------|
| Node    | Network down if central node down – otherwise no effect on rest of network | Failed node can be bypassed to maintain integrity of ring |
| Channel | No effect on rest of network                                               | Network down                                              |
30. A repeater is a device which amplifies a signal on a cable.
31. A hub is a multi-port repeater.
32. A switch is like a 'smart' hub which divides a network into separate segments, one segment for each connected machine.

- 33.** Workstations which are connected via a switch benefit because there are no collisions between signals to reduce the speed of the network.
- 34.** A router is a device which links two or more networks. A router looks at the destination addresses of the packets of data passing through it, and decides which route each packet should take.
- 35.** File, print and web
- 36.** Redundant Array of Inexpensive Disks
- 37.** Using two hard disks to hold exactly the same data.
- 38.** Uninterruptible Power Supply
- 39.** a. File server  
b. To provide central disk storage for user's programs and data on a network
- 40.** A spooler stores data temporarily while it is in transit to the printer, on a fast backing storage device like a hard disk drive.
- 41.** Print server
- 42.** In order of when the print jobs were sent into the queue, or by giving priorities to some users over others.
- 43.** A jukebox can be used to hold a number of CD-ROMs at once, or to make backups of network data on multiple recordable disks.
- 44.** A LAN
- 45.** Unshielded Twisted Pair – it is a type of copper cable.
- 46.** There is no point in printing a document if you have to travel a distance to collect it.
- 47.** An Intranet is a private network belonging to a company or organization, for internal use only, although it may be geographically widespread.
- 48.** The main purpose of an Intranet is to share company information and computing resources among employees.
- 49.** An Internetwork is a collection of two or more local area networks.
- 50.** Higher bandwidth and wireless communication
- 51.** Asymmetric Digital Subscriber Line
- 52.** The maximum distance for 512 Kbps ADSL is 5.5 km, falling to 3.5 km for 2 Mbps.
- 53.** A network cloud is a collection of hotspots or areas within the range of wireless base stations.
- 54.** Warchalking symbols are used to identify hotspots where a wireless connection may be made.
- 55.** WiFi is the Wireless Fidelity Alliance standard for wireless networking
- 56.** IEEE 802.11b has a maximum bandwidth of 11 Mbps and operates at a typical range of 20–30 metres.
- 57.** Bluetooth is the name for IEEE 802.15.1 wireless standard, with a range of up to 10 metres and a bandwidth of 1 Mbps.
- 58.** WiFi has a greater range (20–30 metres) over Bluetooth (10 metres).
- 59.** Advances in computer hardware and improved network related software
- 60.** Data transfer rates are also increasing, for instance, 10 Mbps Ethernet is being replaced by 100 Mbps. This improvement in bandwidth allows larger files to be transferred in less time.
- 61.** Browsers and network operating systems.
- 62.** The laws which apply to the misuse of networks include the Copyright, Designs and Patents Act, the Computer Misuse Act and the Data Protection Act.
- 63.** Using multiple copies of commercial software without an adequate license
- 64.** Hacking is gaining/trying to gain unauthorised access to a computer system.
- 65.** a. A skilled hacker who uses his or her ability to pursue their interest illegally  
b. A honeypot is a system which is deliberately left open to attract the activities of black hats, in the same way as bears are attracted to honey.
- 66.** Spyware is a type of computer program which can record the user's keystrokes, like passwords and forward them to another computer.
- 67.** Phishing is an attempt to trick someone using the internet by pretending to be a well-known company into giving away personal information.

### Chapter 5

1. The operating system is a program that controls the entire operation of the computer and any devices which are attached to it.
2. The operating system runs in a computer all the time from the moment it is switched on until the computer is switched off.
3. It is not always necessary to load the entire operating system on start-up for a disk-based operating system.

4. a. Interpreting user's commands (takes the instructions from the user and passes them on to the rest of the operating system), file management (controls the organisation of backing storage), memory management (controls where programs and data are placed in main memory), input/output management (communicates between the computer system and the input and output devices), managing processes (controls processes and handles interrupts)
- You issue the command to the CLI, `SAVE myfile`, either by entering the instruction or by choosing from a menu.
  - The kernel suspends the current CLI process, and passes the request to the FMS.
  - The FMS requests the I/O system to read the disk's catalog track, and loads a list of the filenames.
  - If the filename is present on the disk, then the FMS passes a warning message to the CLI to inform the user, otherwise
  - The MMS passes the file to the I/O system.
  - The I/O system places the file on disk.
  - The kernel allows the CLI process to resume, and you again have control of the computer.
- b. The disk may be full.  
c. CLI
5. The bootstrap loader loads the rest of the operating system from disk when the computer is switched on.
6. a. A disk formatter  
b. An anti-virus program
7. a. No  
b. Because some RAM is used up to hold the operating system.
8. To load the operating system from disk on start-up.
9. In ROM.
10. Resource allocation is the way of managing which resources are available for use at any one time by a process.
11. When the current process in the processor becomes blocked, or terminates, then the scheduler is able to allocate a free process to the processor, until that process terminates or is blocked.

12.

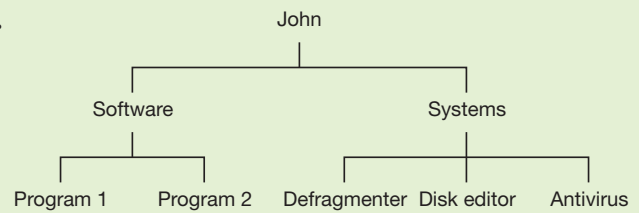


Figure 5.16 Hierarchical filing system answer

13. A utility program is a type of systems software designed to perform an everyday task, for example, transferring data from one backing storage device to another.
14. a. Virus checking software should be able to detect the occurrence of a virus infection and remove it from a computer system.  
b. A disc editor allows the user to edit data directly on the surface of a disk, by-passing the normal loading and saving features of the operating system.  
c. A defragmenter program defragments a disk, gathering all the free space on the disk together and reuniting scattered file fragments.
15. a. If your disk became slow to access  
b. See figure 5.6.
16. JPEG, GIF and TIFF
17. a. Joint Photographic Experts Group  
b. Graphics Interchange Format  
c. Tag Image File Format.
18. a. 16.7 million  
b. 256
19. a. Compatible software is software which works on a particular computer system.  
b. Software compatibility issues include: memory requirements, storage requirements and OS compatibility.  
c. The user should be able to tell whether the software is compatible with their computer system before buying it.  
d. Operating system, processor, clock speed, RAM requirements, Backing storage requirements, any peripheral requirements, for instance, monitor resolution.
20. a. TIFF  
b. TIFF files are very large.  
c. GIF  
d. GIF only allows 256 colours.  
e. JPEG offers variable compression.  
f. JPEG allows the user to balance file size against quality required.

21.
  - a. Not enough disk space for installation
  - b. Either not enough RAM or incompatible version of operating system
  - c. File management system – change disk catalogue; I/O management system – write new catalogue to disk
22. A virus is a program which can destroy or cause damage to data stored on a computer system.
23. File virus, boot sector virus, macro virus.
24. A worm is a program which can make copies of itself and spread between computers without having to be attached to a file.
25. A Trojan is a program that appears to be safe, but hidden inside is usually something harmful, like a worm or a virus.
26.
  - a. A worm can make copies of itself and spread between computers without having to be attached to a file, unlike a virus, which infects other *host* files and is distributed along with them.
  - b. Trojan horse is disguised as another type of file, but a virus is attached to, or becomes part of, another file.
27. Replication, camouflage, watching and delivery
28.
  - a. A checksum is performed on an uninfected program. Repeating the calculation on a suspect program allows the anti-virus software to test if the program has been changed, and if so, it will issue a warning that the program may be infected with a virus
  - b. A virus signature is a characteristic pattern or sequence of bytes that is part of a virus. If a virus scanner finds such a pattern in a file, it notifies the user that the file is infected.
  - c. Heuristics allow rules to be set up to detect new viruses that have not been seen before – for example, if it looks like a virus, and behaves like a virus, then it probably *is* a virus.
  - d. Anti-virus software which stays in the computer's memory and constantly checks the computer for the presence of viruses.
29.
  - a. A blended threat uses a variety of techniques to increase the spread and the severity of virus infection, typically a virus, a worm and a Trojan horse may be involved in a blended threat infection.
  - b. The 'I Love You' virus
30. Delete it immediately without opening it.

## Chapter 6

1. The software development process is a series of seven stages for the development of software Analysis, Design, Implementation, Testing, Documentation, Evaluation and Maintenance.
2. Iterative as applied to the software development process means revisiting parts of the process in order to correct mistakes or improve the solution.
3.
  - a. analysis
  - b. analysis
  - c. implementation
4. The process of planning the solution to a problem is called design.
5. Internal documentation is comment lines which may be inserted in program code to provide a description of what the code does.
6. Field testing is allowing users (other than the people who wrote the program) to test the program.
7.
  - a. The pre-release version of a program is called the beta version.
  - b. The software company distributes this version so that the program can be tested on as wide a variety of hardware as possible, in order to improve the chances of finding mistakes in the code.
8. A test report summarises the results of testing a program.
9. An evaluation is when the software solution is reviewed against suitable criteria, such as the original software specification.
10. Questions for the evaluation stage are:
  - Is the software able to cope with errors during execution without failing? (robustness)
  - How well does the software operate without stopping due to design faults? (reliability)
  - Can the developed software be used on a computer other than that for which it was originally designed? (portability)
  - Does the software require excessive resources in order to run properly? (efficiency)
  - How easy is it to correct and/or update the software in future? (maintainability)
11. Program maintenance is changing a program, often some time after it has been written.
12. Student's comments on their own program.

13. One design methodology is top-down design. This involves looking at the overall problem and breaking it down into a series of steps.
14. Bottom-up design begins with writing modules or procedures.
15. One design notation is pseudocode. Pseudocode is ordinary language used to define problems and sub-problems before they are changed into code in a high level language.
16. Design methodology is the approach that the programmer takes to the design of the solution. Design notation is a way of describing a program design.
17. The purpose of test data is to check whether or not the software meets the specification, or does what it is supposed to do.
18. Three types of test data are normal, extreme and exceptional.
19. Appropriate set of test data for two of the given problems.
20. Exhaustive testing involves testing a program with all of the possible sets of program inputs that it is designed to handle.
21.
  - a. A structured listing is a formatted display or a printout of the program code.
  - b. A structured listing can aid the programmer by helping her to spot mistakes in the structure of the program, such as unclosed loops.
22.
  - a. A run-time error is an error which shows up during program execution. These include overflow, rounding, truncation and division by zero.
  - b. A linking error is when a program is incorrectly linked to a subroutine or module library.
  - c. A syntax error is when the rules of the programming language are broken.
23.
  - a. A logical error can be detected if the program runs, but does not do what it is expected to do, for instance, produces the wrong results.
  - b. An example of a logic error is: `count% = count%+0`
24. COMAL for MacOS has a trace facility and a check syntax facility.
25. Hand testing is reading through a printout of the code in order to find mistakes.
26. An error from the operating system could be 'printer jammed'.
27. Portability is of economic importance because of the cost of software development. If a developer does not have to produce different versions of software to run on different computers then a great deal of money can be saved.
28.
  - a. A hardware platform is a particular combination of processor and operating system.
  - b. Windows XP, Intel Pentium, IBM desktop computer
29. Efficiency is desirable because it means that the software does not require excessive resources in order to run.
30. The software specification may have to be enforced in a court of law if the software meets the specification but the client refuses to pay.
31. The software development team would have wasted time and money and would have to start the software development process over again.
32. Project manager, systems analyst, programmer, independent test group and the client.
33. The systems analyst
34. Making observation notes, using questionnaires, interviewing the client, examining information sources.
35. The project manager
36. The client
37. Top-down design and bottom-up design
38. Pseudocode is said to be language independent because it uses ordinary English terms rather than the special keywords used in high level languages.
39. A structure diagram, plus appropriate drawing (see figure 6.9)
40. The terms used are in:, out: and in-out.
41. The choice of language, the computer platform and the requirement for specific hardware features.
42. The name of the program or module, what the program or module should do, the test data and the expected results from the test data.
43. This can be true if it is impossible to test all the program pathways.
44. Testing.

45. Any two from:
- Examine the source code, object code, test plan and results of testing already carried out by the software developer;
  - Document additional tests to be carried out if appropriate;
  - Re-test the software, repeating all the original tests and performing any additional tests;
  - Document any errors found and communicate these to the software developer for correction;
  - Receive corrected code from the developer;
  - Repeat all tests on the corrected code.
46. Debugging is the process of finding and correcting errors in a program.
47. Misspelling a keyword e.g. PRUNT instead of PRINT; FOR without a corresponding NEXT.
4. When a program written in a procedural language is run, the sequence of instructions is followed from the beginning of the program to the end in the programmed order.
5. BASIC, COMAL and Pascal are examples of procedural languages.
6. A declarative language may be thought of as the opposite of a procedural language. Instead of giving a concise list of instructions set out in the correct order, a declarative language states 'what to do' rather than 'how to do it'.
7. Prolog
8. a. hot(tea)  
b. cold(ice cream)
9. Facts and rules make up the knowledge base in a declarative language.
10. Programs written in event-driven languages have no definite start or end. When the program is running, the user interacts with the event-driven language by selecting from a choice of screen objects.
11. It is much quicker to design a program with a graphical user interface when using an event-driven language.
12. The action of clicking on, or selecting, a screen object is called an event. The event is detected by the program, hence the name event-driven language.
13. Visual Basic
14. A scripting language allows the user to tailor an application package to carry out additional operations other than those provided in the original menus.
15. A macro is a set of keystrokes and instructions that are recorded, saved, and assigned to a single key or a combination of keys. When the key code is typed, the recorded keystrokes and instructions are carried out.
16. A macro may be created either by recording a sequence of keystrokes and mouse actions, or by entering a suitable script in an appropriate language into an editor.
17. The need for scripting languages arises from the requirement to be able to make changes to the commands or menus, or to automate tasks within an application package or an operating system.

### Sample answer to Analysis practice questions

#### Problem description

Write a program which will ask the user for two numbers and give their sum, product and quotient

#### Assumptions

Both numbers are integers (whole numbers)

The maximum number is 10

The minimum number is 1

The sum and product are integers and the quotient is a real (fractional) number

#### Input

Two integers within the range 1–10

#### Process

Sum, multiply and divide the numbers

#### Output

The sum and product as integers and the quotient as a real number

### Chapter 7

1. Procedural, declarative, event-driven and scripting
2. A procedural language is one in which the user sets out a list of instructions in the correct sequence in order to solve a problem.
3. Data storage using variables of different types, Arithmetic and logical operations, Program control using sequence, repetition and selection, Subprograms or procedures, Data flow using parameters

18. The benefits of scripting languages are that they allow application packages to be enhanced with additional commands, automate tasks for an expert user and allow a beginner to perform tasks that they would not otherwise be able to undertake.
19. The main stimulus to the development of high level languages was the need to reduce the time taken for software development, when using machine oriented languages like machine code.
20. A translator is a computer program used to convert program code from one language to another.
21. Translators are used because it is very difficult to write programs directly in machine code. It is much easier for the programmer to write the program in a high level language and then have it changed into machine code by a translator program.
22. The function of a compiler is to translate a high level language program (source code), into machine code (object code).
23. Source code is a high level language program, before translation.
24. Object code is a machine code program produced as the result of translation.
25. An interpreter does not produce object code.
26. **a.** In the **lexical analysis** stage, each recognised keyword in the source code is changed into a token.  
**b.** During the **syntax analysis** stage, the language statements are checked against the rules or grammar of the language.  
**c.** The **code generation** stage produces the object code, which is a machine code representation of the source code.
27. **a.** Compiled – Pascal  
**b.** Interpreted – COMAL.
28. Machine code programs are not portable because machine code is the computer's own language and is specific to the processor being used.
29. A cross-compiler takes a high level language program as source code, and can produce object code for more than one type of processor.
30. The function of an interpreter is to translate and run a high level language program one instruction at a time.

31.

| Interpreted programs                  | Compiled programs                        |
|---------------------------------------|------------------------------------------|
| Run slow                              | Run fast                                 |
| Report mistakes immediately           | Report mistakes at end of compilation    |
| Translate and run is a single process | Translate and run are separate processes |
| Cannot save translated version        | Can save object code                     |
| Interpreter required to run the code  | Compiler not required to run the code    |

32. A compiler is to be preferred over an interpreter if the code needs to be run fast (final version). An interpreter is to be preferred over a compiler when the code is being developed.
33. The source code is required if the program is to be maintained in the future.
34. Selling the source code would be giving away the programmer's expertise and would allow the user to change the program, or steal part of the code to be used elsewhere.
35. A stand alone version of a program is independent of the translator program and may be run on its own.
36. The programmer does not need to supply a translator program to accompany the code. Providing a translator would also increase the cost of the software.
37. A module library is part of a software library. A software library is a collection of software held permanently accessible on backing storage. A software library will typically include complete programs, a module library and a set of machine code routines, which may be loaded into user programs when required.
38. **a.** The design has already been done when the module was created in the first place.  
**b.** A programmer would not write a procedure to sort numbers each time this was required in a new program, the procedure would simply be loaded from a module library.  
**c.** All of the modules in a module library are already tested and known to be free from errors, so these modules do not need to be tested again.  
**d.** Each module in a module library is already fully documented.

39. A text editor allows source code to be entered and edited.

### Chapter 8

1.
  - a. The syntax of a programming language is the way in which you give instructions to the computer.
  - b. The semantics of a particular instruction is its meaning or its effect.  
picDisplay.Print "Hello World !" and PRINT "Hello World !" display the same text. They have the same semantics but different syntax. The statement "number = 10" has the same syntax but different meanings (semantics) depending upon the language in use.
2. *number* :+ 1 and *number* ++ 1 have the same semantics but different syntax. They have the same effect, but are written differently.
3. Modularity means that when a program is designed and written, it is divided into smaller sections called subprograms.
4. A procedure produces an effect and a function returns a value.
5.
  - a. A user-defined function is a function which is created within a program rather than being already present or pre-defined as part of the normal syntax of a programming language.
  - b. The SQR function is an example of a pre-defined function.
6. A reference parameter allows data from a procedure to be passed back out to a program.
7.
  - a. An operation is a process which is carried out on an item of data.
  - b. An object is the item of data which is involved in the process.
8.
  - a. Concatenation is joining two strings.
  - b. Substrings is selecting parts of strings.
9.
  - a. Logical operators include OR and NOT
  - b. Arithmetical operators include + and –
  - c. Relational operators include = and >
10. Formatting of input/output is arranging the appearance of the data on the screen when input or output is taking place.
11.
  - a. 38
  - b. 1820
12. Control, data storage and data flow
13.
  - a. Sequence, selection and repetition
  - b. Sequence is the order in which things are done. Take in a number; find square of number; display answer – is a sequence which will only operate when the statements are arranged in the correct order.
14. Age=18 – is a simple condition. Month >= 1 AND Month <= 12 – is a complex condition
15. The condition determines the course of action which should be taken, for instance, "switch heating on" OR "switch heating off" are two courses of action. The control structure is the framework which allows the choice to take place, for example IF average temperature is less than 15 degrees Celsius THEN "switch heating on".
16.
  - a. A variable is the name that a programmer uses to identify a storage location.
  - b. Local variables are defined only for use in one part of a program.
  - c. Global variables may be used anywhere in a program.
  - d. The scope of a variable is the range of statements for which a variable is valid.
  - e. The kind of data which is being stored, for example, alphanumeric, numeric or Boolean.
17.
  - a. A sub-program
  - b. The whole program
18. Selection and repetition
19. Array
20. Arrays are particularly useful for handling a set of data items in a program. Because an array uses a single identifier, each element of the array may be easily found using a subscript.
21. A parameter is information about a data item being supplied to a subprogram when it is called into use.
22.
  - a.
    - i. Parameters are passed by value when a parameter is passed into a procedure but does not require to be passed back out again to be used in another procedure.
    - ii. Parameters are passed by reference when the parameter requires to be passed in to a procedure, updated and then passed back out of the procedure again.
  - b. One exception to this rule exists for the array data structure only. When an array is being passed as a parameter, it is always passed by reference.
23.
  - a.
    - i. The purpose of sequence is to ensure that instructions given to the computer in the form of a computer program are carried out in the correct order.

- ii. The purpose of repetition is to allow statements in a program to be repeated as many times as is necessary.
- iii. The purpose of selection is to allow a choice to be made in a program, like changing the order or sequence of execution of program statements.
- b. Repetition
- c. A loop which is contained within another loop
24. a. A logical error  
b. In this case it will lead to an infinite loop.
25. The amount of data to be processed need not be known in advance.
26. Using test at start means that the loop does not need to run if the condition is not met. Using test at end means that the loop must always run at least once – in order to reach the test condition statement.
27. a. To end a conditional loop with test at end  
b. 1. loop REPEAT  
2. take in a word  
3. ask user to enter a word  
4. UNTIL the word 'end' is entered
28. When a multiple outcome selection has to take place:
1. CASE destination OF
  2. WHEN town
  3. take credit card
  4. WHEN pool
  5. take swimming costume
  6. WHEN beach
  7. take bucket and spade
  8. WHEN hillwalking
  9. take rucksack + food
  10. WHEN disco
  11. take ID card
  12. OTHERWISE
  13. watch TV
  14. END CASE
29. One example answer only for: Calculate the area of a circle given the radius as input ( $\pi r^2$ )
1. Ask user for radius
  2. Take in radius
  3. Calculate area by using the formula  $\pi r^2$
  4. Display answer
30. It is necessary to describe the data flow in a program in order to work out how the parameters should be passed between the main program and any sub-programs and between the sub-programs themselves.

## 31. a. Grade 3

```
b. CASE mark OF
WHEN >= 70
display grade 1
WHEN >= 60
display grade 2
WHEN >= 50
display grade 3
END CASE
```

## 32. UNTIL word\$ = 'END' OR word\$ = "end" – the purpose of the "OR" is to allow either "END" or "end" to stop the conditional loop

## 33. a. Output

```
99 bottles of beer on the wall.
99 bottles of beer.
Take one down, pass it around.
98 bottles of beer.....
.....
.....
Take one down, pass it around.
1 bottle of beer.
1 bottle of beer on the wall.
1 bottle of beer.
Take one down, pass it around.
0 bottles of beer.
```

## b. Practical work on computer in COMAL

## 34. Practical work on World Wide Web

```
Programming language: C++ (object orientated)
// C++ version of 99 Bottles of Beer, object oriented paradigm
// programmer: Tim Robinson timtrox@ionet.net
#include <fstream.h>

enum Bottle { BeerBottle };

class Shelf {
 unsigned BottlesLeft;
public:
 Shelf(unsigned bottlesbought)
 {
 BottlesLeft(bottlesbought)
 }
 void TakeOneDown()
 {
 if (!BottlesLeft)
 throw BeerBottle;
 BottlesLeft--;
 }
 operator int () { return BottlesLeft; }
};

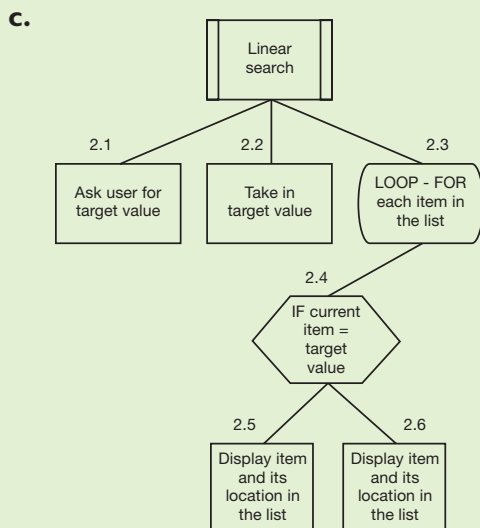
int main(int, char **)
{
 Shelf Beer(99);
 try {
 for (;;) {
 char *plural = (int)Beer !=1 ? "s" : "";
 cout << (int)Beer << " bottle" << plural
 << " of beer on the wall," << endl;
 cout << (int)Beer << " bottle" << plural
 << " of beer," << endl;
 Beer.TakeOneDown();
 cout << "Take one down, pass it around," << endl;
 plural = (int)Beer !=1 ? "s" : "";
 cout << (int)Beer << " bottle" << plural
 << " of beer on the wall." << endl;
 }
 }
 catch (Bottle) {
 cout << "Go to the store and buy some more," << endl;
 cout << "99 bottles of beer on the wall." << endl;
 }
 return 0;
}
```

Figure 8.22 99 Bottles of Beer in C++

## 35. Repetition

## Chapter 9

1. Design
2.
  - a. Input validation
  - b. Linear search
  - c. Count occurrences
  - d. Find maximum / minimum
3.
  - a. Pseudocode
  - b. In pseudocode, each line represents a line of code, so it is easy to see the relationship between the code and the design.



**Figure 9.5** Structure diagram for Linear Search algorithm

4. Input validation
5. The linear search algorithm uses a Boolean variable, found. The counting occurrences algorithm uses a counter for the number of hits. Both algorithms compare each item in the list with the target value.
6. The search can stop when an item smaller (or larger) than the target item has been reached. This is an advantage when large lists are being searched.
7. There is no maximum number of attempted entries.
8.
  - 4.1 READ in the first item from the list
  - 4.2 set the maximum value to be equal to the first item
  - 4.3 set the minimum value to be equal to the first item
  - 4.4 loop - REPEAT

- 4.5 READ in the next item from the list of data
- 4.6 IF the current item is greater than the maximum value THEN
- 4.7 set the maximum value to be equal to the current item
- 4.8 END IF
- 4.9 IF the current item is less than the minimum value THEN
- 4.10 set the minimum value to be equal to the current item
- 4.11 END IF
- 4.12 end loop - UNTIL end of data has been reached
- 4.13 display maximum value
- 4.14 display minimum value

9. Depends upon chosen software development environment

10.
  - a. Nothing
  - b. In COMAL:

```

FOR position% := 1 TO no_of_items%
 DO
 IF list% (position%) = target%
 THEN
 PRINT "Item found"
 PRINT "The item"; target%;
 "was found at position";
 position%; "in the list"
 ELSE
 PRINT "The item"; target%;
 "was not found in the list"
 ENDIF
 NEXT position%
11.
2.1 ask user for target value
2.2 take in the target value
2.3 loop WHILE target value is
 less than 1 OR target value
 is greater than 100
2.4 prompt to re-enter target
 value
2.5 take in the data
2.6 end loop
2.7 loop - FOR each item in
 the list
2.8 IF current item = target
 value THEN

```

2.9        display found message  
 2.10       display item and its  
              location in the list  
 2.11       END IF  
 2.12       end loop - NEXT item

- 12.** Answer depends upon software development environment in use.
- 13.** Zero may not be a value in the list, the list may consist entirely of negative numbers, or the minimum value may be less than zero (negative).

## Appendix

- 1.**
- Force quit the program by pressing a sequence of keys, or press the reset button.
  - Free RAM is the quantity of RAM left for use after the operating system has been loaded.
  - The program requires 256 Megabytes, leaving no room for the operating system to load.
    - Buy and install more RAM or use virtual memory.
    - Buy more RAM – advantage – new program will run – disadvantage – cost of RAM. Use virtual memory – advantage – no cost option – disadvantage – slows down computer.
  - Use a printer spooler program, which temporarily saves print jobs to hard disk and allows the user to continue working, or buy a new printer with a large buffer, or install more RAM into the existing printer.
- 2.**
- 3 megapixels
  - One million pixels
  - It takes the same quantity of backing storage space to store shades of grey as it does colour for each pixel.
  - A solid-state storage device which uses flash ROM to store data.
  - Each photograph is compressed, and so takes up much less than 7 Megabytes, in this case, around 1.4 Megabytes each (128/90).
  - By connecting the camera to the computer using a (USB) cable, or put the camera's memory card into a card reader.
- 3.**
- One million floating point operations per second.
  - MIPs – millions of instructions per second.
- A test which times how long it takes for an application program to complete a task, for example, spell check a 100 page document.
    - The type of application tested is not known.
    - Using the processor clock rate on its own is not a good measure of performance, because there are many other factors which influence the speed at which a computer system operates, for example, the width of the data bus.
    - The Panic chip, with its dual core, has two processors. The Paramecium chip only has one processor, albeit a larger cache memory. The Panic chip will give better test results than the Paramecium chip if the test programs are able to recognise the presence of, and take advantage of the two processors. If not, the results of the tests will be much harder to predict.
  - Every workstation on a peer-to-peer network has a similar status in the hierarchy, each having its own local storage devices for programs and data.
    - A mainframe terminal is a screen and a keyboard with some RAM. It has no processor.
      - The mainframe terminal cannot operate unless it is connected to the mainframe computer.
      - James should choose a laptop computer because it will be able to be used anywhere in his house, OR he should choose a desktop computer because it is likely to have a larger screen than the laptop, and he may prefer using a mouse to using a trackpad.
    - A hub is a multi-port repeater.
      - The company should buy switches because workstations which are connected via a switch benefit because there are no collisions between signals to reduce the speed of the network.
    - The network topology is the way in which the nodes on a network are connected together.
      - If one channel on a star topology fails, then only one node is affected. If the channel on a bus network fails, then the whole network cannot operate.

- e.** i. Hardware – file server. Software – file server software.  
ii. Client-server allows centralised control of backup, peer-to-peer – users are responsible for their own backups.
- f.** A wireless base station
- 5.** **a.** i. A bit-mapped graphics package  
ii. ‘ideal for digital camera or scanner output’  
**b.** The software can open files and create files in many different standard data formats.  
**c.** JPEG, GIF, TIFF, BMP  
**d.** A scripting language  
**e.** The user can load scripts from the library rather than having to write them themselves.  
**f.** True colour is 24 bit colour, 8 bits per pixel (RGB), 16.7 million different colours.  
**g.** The users can be kept informed of software updates and special offers. The company can benefit from user feedback about its products, and can send advertising about its products to users on a mailing list.
- h.** i. Graphics Interchange Format  
ii. GIF files are much smaller than TIFF files, and so will download faster from the Internet.
- 6.** **a.** No CD-ROMs or packaging need be created, no delivery costs. The company will save money.  
**b.** A utility program is a type of systems software designed to perform an everyday task, for example, formatting a disk.  
**c.** Helen’s computer’s hard disk is faulty.  
**d.** Encryption is putting data into a code so that it cannot be read by unauthorised persons.  
**e.** A decompressor.  
**f.** A text editor or word processor.  
**g.** The files are too large to fit on a floppy disk.  
**h.** A CD writer.  
**i.** A start-up disk is one which may be used to start up the computer when it is switched on.  
**j.** A copy of the operating system program.