THE BCS PROFESSIONAL EXAMINATION
Certificate

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EXAMINERS' REPORT

Computer & Network Technology

This report is for Sections A and B of the paper. It consists of two sections:

Overall comments
Detailed question report

Overall comments

As in previous sittings, most candidates did not encircle the questions' numbers on the front of their scripts. Candidates failed to write the question number at the top of every page of the scripts. Centres and course providers must be made aware of this so that they can impress the rule on their candidates. The level of English was bad in some centres, hence the inability for candidates to express themselves clearly.

It is also very unfortunate to note that many candidates and course providers did not analyse past trends for this paper. Some elements of the paper have been examined during previous sittings. If candidates had paid attention to this, they would have been better prepared, and accordingly written good answers. It is also worth mentioning that candidates seemed to ignore the amount of marks allocated to questions in section A and B. When writing answers, candidates must carefully keep in mind that questions 1, 2, 3 and 4 each carries 30 marks. Accordingly, candidates must write sufficiently in-depth answers to attract these marks. Short answers which lack depth did not enable candidates to score well in section A.

While marking scripts from various centres, it was felt that candidates did not seem to have studied the various topics well. Course providers must endeavour to explore this syllabus in depth. Computer and Network Technology is a core aspect of an IT Professional. Gap in knowledge with regards to this area can pose serious problems in understanding more advanced and specialist IT concepts. If in doubt, course providers must seek clarification from the BCS examinations office.

Section A

Question 1

(a) In the context of data communications, what is a protocol and why is it required?

(5 marks)

(b) Briefly define the seven levels of the ISO model for open systems interfacing, and state what objective each level is intended to achieve.

(15 marks)

(c) Of the seven layers of the ISO model OSI, the ***physical layer***, is very different to other layers in terms of the level of service it offers. What is this difference and how does the physical layer overcome this limitation?

(10 marks)

Answer Points

a)
A protocol is the set of rules that govern the exchange of data. A protocol ensures which party is able to transmit and when. The protocol deals with the sequencing of messages and ensures an orderly recovery in the event of failure.

b)
The Application Layer
The highest layer of the ISO reference model is the application layer that is concerned with protocols for applications programs (e.g., file transfer, electronic mail). This layer represents the interface with the end-user.
The Presentation Layer
The application layer in one system passes information to the presentation layer below it and receives information back from this layer. The presentation layer's principal function is the translation of data from one code to another. However, this layer performs other important functions such as data encryption and text compression.
The Session Layer
The session layer organizes the dialogue between two presentation layers. It establishes, manages and synchronizes the channel between two application processes. This layer provides dialogue control. The session layer resolves collisions between synchronization requests.
The Transport Layer
The transport layer isolates the session and higher layers from the network itself. The transport layer is responsible for the reliable transmission of messages between two application nodes of a network and for ensuring that the messages are received in the order in which they were sent. The transport layer isolates higher layers from the characteristics of the real networks by providing the reliable economic transmission required by an application independent of the characteristics of the underlying facilities (for example, error detection/correction, multiplexing to reduce cost, splitting to improve throughput, and message reordering). The transport layer doesn't have to know anything about how the network is organized. The transport layer must assemble packets in the correct order, which involves storing the received out-of-sequence packets until the system is ready for them.
The Network Layer
The network layer serves the transport layer above it by conveying data between the local transport layer and the remote transport layer. The network layer is system-dependent unlike the layers above it. Complex communications systems may have many paths between two points. The network layer chooses the optimum path for a message to cross the network or for the establishment of a virtual connection. As an analogy, consider the postal system. Mail sent to a nearby sorting office might be directed to a more distant sorting office if the local office is congested and cannot cope with the volume of traffic. Similarly, in a data transmission network, transmission paths are chosen to minimize the transit time of packets and the cost of transmission
The Data Link Layer
The data link layer establishes an error-free (to a given probability) connection between two adjacent points in a network. Information may be transmitted from one end of a network to the other end directly or via intermediate nodes in a series of hops. The data link layer also detects faulty messages and automatically asks for their retransmission.
The Physical Layer
The lowest layer, the physical layer, is unique because it provides the only physical connection between any two points in a network. The physical layer handles the physical medium (e.g., wire, radio, and optical fibre) and ensures that a stream of bits gets from one place to another.

c)
The physical layer is responsible for receiving the individual bits of a message from the data link layer and for transmitting them over some physical medium to the adjacent physical layer which detects the bits and passes them to the data link layer above it. The physical layer ensures that bits are received in the order they are transmitted.
The physical layer also implements the connection strategy. Circuit switching establishes a permanent connection between two parties for the duration of the information transfer. Message switching stores a message temporarily at each node and then sends it on its way across the network. Circuit switching uses a single route through the network, whereas in message switching different messages may travel via different routes. Packet switching divides a message into units called packets and transmits them across the network. Packet switching doesn't maintain a permanent connection through the network and is similar to message switching.
A datagram service transmits packets independently and they have to be reassembled at their destination (they may arrive out of order). A virtual circuit first establishes a route through the network and then sends all the packets, in order, via this route. The difference between circuit switching and a virtual circuit is that message switching requires a connection for the duration of the connection, whereas the virtual circuit can be used by other messages.
The service offered by the physical layer is a best effort service because it doesn't guarantee reliable delivery of messages. Information sent on the physical medium might be lost or corrupted in transit because of electrical noise interfering with the transmitted data. Layers on top of the physical layer deal with imperfections in this layer. The physical communication path may be copper wires, optical fibres, microwave links or satellite links.

This question required candidates to recall their theoretical knowledge of Computer Networking. This is a core area of the syllabus and must be well understood by candidates. It must be noted that this question has been set in previous sittings.

a) Most candidates were able to explain the meaning of a protocol.
b) Answers provided by most candidates did not fully cover in details the seven levels of the OSI. Candidates limited their answers to brief notes (in some cases one line sentence). Most candidates did not pay attention to the 'objective each level is intended to achieve'.
c) This part of the question was in general poorly attempted. Candidates should have emphasised on the ability of the physical layer for receiving the individual bits of a message from the data link layer and transmitting them over the physical medium. The areas that could have been included are circuit and packet switching techniques.

Question 2

The success of modern computers in terms or computation power, flexibility and connectivity has led to the emergence of new problems.

In particular, a range of programs, collectively called ***malware***, has been created to exploit weaknesses in the security of modern computers. Typical examples of malware are viruses, SPAM, and worms.

Write an essay on the state of malware today.

Your answer should include a discussion of the history of malware, the reason modern computers are vulnerable to malware, the types of malware currently available, and the measures being taken to counter malware.

Your essay should conclude with a comment on what is likely to happen in next few years.

(30 marks)

Answer points

Students should be given the widest latitude when answering this question. Students are expected to define the difference between the virus, Trojan house, worms and spam. Some students might include modern malware such as phishing (i.e., extracting private and financial data from a computer). Credit should be given for an understanding of the history of these problems and their relative importance and impact (together with the complex interrelationship between malware and technology – for example, the virus was the principal danger when programs where exchanged via floppy disks, whereas spam has become pre-eminent in the era of email and the Internet.

Students should explain that modern computers are vulnerable because of the interconnectivity of the Internet and the use of scripting languages and macros that can be exploited by malware.

Students should comment on the future and discuss ways in which the effects of malware can be reduced; for example, by limiting email (e.g., using verification technology).

Most candidates were aware of the state of malware and were able to provide relevant answers. This is perhaps based on their own exposure to various threats. Good answers differentiated between virus, Trojan horse, worms and spam. Candidates should have also included a brief history of malware. They should have explained the various sources of these malware ranging from floppy disks (in the past) to internet (today). It was then necessary to provide comments for the future. Most candidates did not manage to do this properly. Finally, candidates were required to discuss ways to combat the malware. Candidates were able to cover measures such as anti virus, anti spam and firewall.

Question 3

Some people might state that "***the operating system of a personal computer is every bit as important as its hardware***."

Explain why a person may make this statement and discuss, with reasons, the extent to which this statement is true. Your answer should include all the facilities a modern operating system provides (including both resource control functions such as file handling and the user interface).

(30 marks)

Answer Points

Early operating systems provided a simple user interface and controlled the computer's I/O mechanisms and file stores. Modern operating systems are far more complex and are continuing to grow.

The power of a modern computer lies partially in its computational power and partially in its flexibility. In the 1980s running new programs or installing new hardware was difficult and often required both expertise and much trial and error. The modern operating systems included a lot of drivers and implements plug-and-play which allows a new interface such as a printer to install its own drivers. Often, this facility is combined with interfaces such as USB.

Another change in the way in which operating systems have developed is the continuous incorporation of general systems functions. For example, the Internet browser is often seen as an extension of the operating system even though it could, strictly, be called a user applications program. This integration optimizes the use of hardware and ensures a common user interface to different functions.

Some explicit user functions (e.g., spyware detectors) have been incorporated (albeit as add-ons) into Windows operating systems.

Some of the functions carried out by a typical operating system are:
Memory management (control of disk drives and RAID systems)
Control of I/O and interrupt systems
Control of interfaces (USB, FireWire) and integration of peripherals
Network interface and control
Security control (anti virus etc)

Answers for this question varied between candidates. Good answers included a thorough description of various features/facilities of operating systems. Some candidates attempted to provide definitions of system software and other utilities. These were clearly not required.

In their answers, candidates should have included operating systems functions such as:

- memory management (control of disk drives and RAID systems)
- control of I/O and interrupt systems
- control of interfaces (USB, FireWire) and integrated peripherals
- Network interface and control
- Security controls (anti virus, etc)

Question 4

Over the past 30 years, the performance of the microprocessors used in computers has changed dramatically.

A modern microprocessor is of the order of 1,000 faster than a microprocessor in the 1970s.

Some of the increase in performance is derived from improvements in manufacturing techniques (e.g., silicon technology). Some improvements have resulted from changes in computer architecture (e.g., instruction set) and some from changes in computer organization (i.e., how the architecture is implemented at the register and gate level).

Discuss the increase in computer performance over the last 30 years and explain the factors that have increased performance (e.g., the introduction of Intel's Core Duo processor).

Your answer should include a discussion of whether such a level of progress can be sustained over the next 10 years or whether progress in computer design is likely to read natural limits. **(30 marks)**

Answer Points

This question is very open-ended and each answer should be judged on its merits. However, all answers must include some explanation of some of the factors increasing computer performance.

Note – this question may be interpreted in ways I had not anticipated. It should be marked with sympathy and understanding; that is, credit should be given where students have made bone fide attempts and provided relevant information.

Consider the following aspects of computer performance:

Manufacture: Over the years the number of devices on a chip has increased approximately in line with Moore's law (which is entirely empirical). Adding more devices (transistors) to a chip has lead to a growth in complexity (ability to do more operations per clock cycle, and to perform more complex arithmetic and logical operations).

Increased complexity has allows more cache memory to be placed on the chips. Form several bytes in the 1980s to 8Mbytes on a single chip today.

Chip organization has let to significant improvements. The RISC revolution and pipelining exploits instruction level parallelism (i.e., more that one instruction is being executed at any instant). The RISC ideal is to execute one instruction per clock cycle one the pipeline is full.

Instruction level parallelism is a superscalar architecture (multiple processing units) has broken the one-cycle per instruction barrier. However, it has been difficult to design such processors – the more recent Intel Itanium processors has an EPIC (explicitly parallel) architecture that executes three instructions per clock cycle BUT requires the compiler rather than the hardware to select the instructions to be executed in parallel.

Special purpose instruction execution units that perform short vector operations (operations on groups of 8 pixels) have been designed to support multimedia intensive applications – Intel's MMX instruction set is an early example of this.

The conventional computer is continuing to expand in terms of performance – but natural barriers are looming. The so-called memory wall (the fact that memory performance improves more slowly than CPU performance is limiting system performance and the situation will get worse). Multithreaded and multiple core (parallel) processes are being developed to militate against this, but it is not certain whether significant parallelism can be exploited. Certainly, clock rates are unlikely to increase significantly because of power dissipation problems.

This was an open-ended question and accordingly candidates wrote a range of answers. It was however noted that many candidates provided personal comments on the development of the microprocessor without providing any justifications. Such answers should be avoided. Candidates should have use proper pointers when evaluating the increase in the performance of computers.

A good answer could have included issues such as:

- An increase in the number of devices to the chip. Adding more devices e.g. transistors to a chip has led to a growth in its complexity, hence the ability to perform more complex operations.
- More cache memory available
- RISC revolution

In depth answers also required coverage of instruction level parallelism and special purpose instruction execution that perform vector operations.

With regards to expansion over the next 10 years, most candidates were able to comment on the fact the conventional computer is continuing to expand in performance. However, candidates should also appreciate that natural barriers are looming. It is also a fact that memory performance improves more slowly that CPU performance and this limits system performance.

Section B

Question 5

a) Explain the function and importance of a web browser. **(4 marks)**

b) SPAM can seriously affect internet users. Explain what SPAM is. Describe how users can protect themselves against SPAM. **(8 marks)**

Answer Points

a) Candidates were able to write simple answers on web browsers. Good answers should have included examples of contemporary web browsers and their functions.
b) 8 marks were available for this part of the question. Most candidates wrote very brief notes on SPAM. Good answers should have covered in some details issues such as 'wasting people's time' and eating bandwidth. Candidates should have also included simple measures that could be taken to deal with SPAM.

Question 6

Over the past few years, there has been lot of development in peripheral devices.

a) Describe the main features of LCD screens and contrast them with CRT screens. **(6 marks)**

b) What do you understand by ***resolution*** as applied to monitors and printers? **(6 marks)**

Answer Points

This question was set to test candidates' ability to understand the trend in the development of peripheral devices. It is true that with development in CPU and memory, it is necessary to use up to date input, output and backing storage devices.

a) A differentiation between CRT and LCD monitors should reflect candidates own exposure to the use of these devices. Accordingly, many candidates included answers such as size and cost. However for the 6 marks available and in the context of this paper, candidates could have discussed the processes used in producing images by each type of monitor.
b) Resolution has become important as users needs' and demands have become more sophisticated. Candidates should have covered issues such as the dots per inch (dpi) for printers and number of dots (pixels) for monitors when assessing the resolution of these devices. Examples of current printers and monitors would have enabled candidates to score higher marks.

Question 7

Carry out the following operations showing all workings:

a) Convert $9D6_{16}$ to binary **(3 marks)**
b) 11100111_2 XOR 01111111_2 **(3 marks)**
c) BC_{16} + AB_{16} **(3 marks)**
d) 10101011_2 AND 11111001_2 **(3 marks)**

Answer Points

This type of question has been regularly set in the past and candidates, in future, should expect at least one question which tests their numerical skills in computer and network technology. Each section was a simple calculation and was awarded 3 marks. Some candidates managed to attract maximum marks. It was noted that many candidates did not show workings and accordingly marks were deducted for this. It is also important when dealing with different number bases to be accurate and show the actual base one is working with. So, by writing down an answer as 167 and not stating the base is inaccurate. Therefore, in part c, the correct answer should have been written $167_{16.}$

Question 8

In the context of network security, differentiate between the following terms:

a) SSL and SHTTP **(6 marks)**
b) Firewall and Access Control List **(6 marks)**

Answer Points

This question focused on computer and network security.

a) Both SSL and s-HTTP are popular protocols that are widely used today in the context of internet security. Candidates were not well prepared in this area of the paper. Candidates should have explained that SSL uses two keys, a public and a private key, to encrypt data. SSL is used to obtain confidential; user information such as credit card numbers. s-HTTP, on the other hand, creates a secure connection between a client and a server over which any amount of data can be sent securely.
b) This topic had been examined in the past and candidates should have explored it in details. Answers to the question were rather brief and candidates did not manage to score well. Firewall and Access Control Lists (ACL) are widely used network security tools. The firewall is set up to block any data/message that does not meet specified security criteria. The ACL on the other hand is a set of data that informs a computer's operating system which permissions or rights a user or group has to a specific system.

Question 9

a) Describe the following terms:
    i) Domain **(3 marks)**
    ii) Domain Name System (DNS) **(3 marks)**

b) In the context of networks describe and explain CSMA/CD and 100Base-T. **(6 marks)**

Answer Points

Many candidates attempted this question but did not manage to provide good answers.

a) Candidates should have explained that a domain refers to a group of computers and devices on a network that act as a unit with common rules and procedures. Within the internet, domains are defined by the IP addresses. On the other hand, the DNS (Domain Name System) is an internet service that translates domain names into IP addresses. Every time, someone uses a domain name, a DNS service must translate the name into the corresponding IP address.

b) It was unfortunate to note that many candidates were not familiar with such traditional computing techniques. CSMA/CD (Carrier Sense Multiple Access / Collision Detection) refers to a set of rules determining how network devices respond when two devices attempt to use a data channel simultaneously (called a collision). This technique is used by standard Ethernet networks.100BaseT refers to a networking standard that supports data transfer rates of up to 100 Megabits per second. It is also known as Fast Ethernet because it is ten times faster that Ethernet.

Question 10

With development of the internet, many organizations also use intranets and extranets.

a) Describe an intranet. **(6 marks)**
b) Compare and contrast an intranet with an extranet. **(6 marks)**

Answer Points

a) It was noted that some candidates were unaware of the concept behind an intranet. Instead, they confused an intranet to the internet and provided detailed answers on the latter. Most candidates provided brief answers on the intranet and were able to explain that the network was internally accessed by users of an organisation. For higher marks, candidates should have explained that an intranet is a network based on the TCP/IP protocols and belongs to an organisation and is only accessible by the organisation's employees and staff. Candidates should have also explained that an intranet's web sites look and act like any other web sites, but the firewall surrounding an intranet stops any unauthorised access.
b) This section was a continuation of part a. If candidates had properly explained the concept behind an intranet, they would have gone slightly more in depth and differentiated between intranet and extranet. It must be noted that for 6 marks, candidates were not expected to repeat what they wrote in part (a) but to use some of the points to extend their explanations on extranets. The main area to focus on was that in contrast to intranets, an extranet is partially accessible to authorised outsiders.

Question 11

Provide a brief description on each of the following hardware items:

a) expansion slot **(3 marks)**
b) network interface card **(3 marks)**
c) video adapter **(3 marks)**
d) SCSI controller **(3 marks)**

Answer Points

This question required candidates to produce simple and brief explanations of each of the terms associated with peripheral devices. Most candidates were able to provide reasonable answers except for SCSI controllers. Once again, it must be noted that such topics are classified as core to the Computer and Network Technology paper and must be explored in details by candidates in future.

Question 12

Briefly describe the following terms:

a) TCP/IP **(3 marks)**
b) ISDN **(3 marks)**
c) FTP **(3 marks)**
d) GPRS **(3 marks)**

Answer Points

This question was set to test candidates' knowledge in networking. Brief notes were required on each of the core networking terms. As in other questions, answers were rather brief and did not enable candidates to score maximum marks. Candidates had problems mostly with ISDN and GPRS. Both technologies are popular and widely used in transferring data between devices.