

BCS THE CHARTERED INSTITUTE FOR IT

BCS Higher Education Qualifications

BCS Level 6 Professional Graduate Diploma in IT

September 2018

EXAMINERS' REPORT

IT AND THE ENVIRONMENT

General Comments

The candidates showed a reasonable knowledge of several syllabus topics.

There is evidence that most answers were focused more on the facts on which the questions were based and candidates could demonstrate an appropriate knowledge of the issues and repeat them. However, improved answers could discuss the implications of those facts to the issue raised, showing a deeper understanding. As stated in previous reports, candidates should look for the pointers in the questions so that they can relate their answer to the questions asked. At Graduate Diploma level, candidates are expected to provide evidence of knowledge but also to show the application of that knowledge to the given scenario.

Knowledge of Remote Sensing demonstrates that some candidates have learned about this use of IT to aid in the monitoring of the environment. However, it is an area where candidates are encouraged to deepen their knowledge.

Section A

- A1. The traditional server room of an organisation relies on air-conditioning to maintain the level of temperature and humidity and help ensure that the servers continue to operate correctly. These air-conditioning systems use substantial amounts of electricity and require regular maintenance.

Your company is moving to a new building and has the opportunity to design new server rooms.

- a) Discuss THREE design options which would help reduce the environmental impact of the server rooms. **(12 marks)**
- b) Select ONE of these design options, which you believe has the best environmental outcome. Write a report for your Board of Directors describing the overall benefits to the organisation of implementing this proposal. **(13 marks)**

Answer Pointers

Part a)

Candidates should discuss three appropriate design options which might reasonably be employed in a mainstream corporate environment. The following options are likely, with a good level of detail and correct technical description:

- Passive cooling using free-air spaces, wind-towers or other non-powered system of air circulation.
- Pumped cold water systems taking advantage of the thermal characteristics of the local water supply to remove excess heat from the server rooms.
- Use of commercially available modular constructions to provide hot/cold corridors between server racks and allow effective management of thermal gradients across the equipment.

A good discussion would consider the particular strengths and weaknesses of each option with respect to the assumptions given by the candidate.

Syllabus Coverage: Environmental Impact Analysis, 3.1 and The Environmental Impact of Information Systems, 4.1, 4.2.

Part b)

The report would consider one of the items from the answer to part a). The report would also comment on the importance to the organisation (for example, its public profile and efficiency of resource management) of gaining and adhering to national and global environmental standards such as the ISO 14000 family – sell green credentials to the board. Talk about standards. The report would be in an appropriate format to provide information to the board.

A better answer could provide more contextual information and discuss the holistic benefits to the organisation, its customers and society at large.

Syllabus Coverage: Environmental Impact Analysis, 3.1 and The Environmental Impact of Information Systems, 4.1, 4.2.

Examiners' Comments

This was a popular question and most candidates did well. In a number of cases, there is evidence that candidates did not provide the required number of examples (three) in part (a) which immediately limited their maximum marks as a result. In other cases, the examples were too similar to allow significant marks to be awarded.

In part (b) there is evidence that a number of candidates gave a very short account of the benefits, which did not score highly as a result and those who failed to use the report format which was requested did not have access to the maximum possible marks.

A2. A company working on behalf of a government environmental agency would like to monitor the change of sea-ice over a 5-year period. The area to be monitored is in a remote southern hemisphere location with almost no human settlement. Particular issues to be investigated are the seasonal dynamics of the ice coverage and whether there is a longer term trend over the 5 year period.

- a) Why would Remote Sensing be useful for this project? **(5 marks)**
- b) The company is considering the use of LiDAR for this project. Discuss the practical aspects of how LiDAR could be used in this context. **(10 marks)**
- c) Discuss how the quality of data obtained during environmental monitoring using LiDAR could be assessed. **(10 marks)**

Answer Pointers

Part a)

The answer should provide a suitable definition of Remote Sensing that identifies its ability to be used to observe and record data about an item without needing direct contact. There should be some discussion to explain how Remote Sensing would address issues related to the scenario, commenting on the location of the sea-ice and the lack of nearby settlements.

Syllabus Coverage: Remote Sensing, 2.1, 2.2.

Part b)

An answer would give an in-depth description of LiDAR technology and a broader analysis of its usability in this context. The answer may include specific examples and an analysis of practical problems in the use of the technology as a tool in the field. For example, discuss the core use of LiDAR as a ranging-tool, and the assumptions which must be made and understood when it is used as a "surrogate" diagnostic tool for other purposes. Differentiation between materials and types of surface, for example, should ideally include elements of ground-control to ensure their applicability. Discussion of the practical use of LiDAR in aircraft systems would also be appropriate.

Syllabus Coverage: Remote Sensing, 2.1, 2.2.

Part c)

An answer would give an example of how LiDAR could give poor or erroneous results in this context. There would be discussion of the importance of using ground control techniques to compare the results obtained with LiDAR to those obtained by another (more costly and labour intensive) ground survey method. Once again, LiDAR in its purest form is merely a system for accurately measuring distances and relative positions. Ground control, or ground survey, techniques allow the comparison of remotely inferred information

with directly observed situations. From this basis, extrapolation of sites which have not been directly observed can be made within agreed quality parameters.

An answer might consider how the use of ground control to add value to the information obtained by LiDAR techniques and how (for example) AI systems can be trained to make this more effective and economical.

Syllabus Coverage: Remote Sensing, 2.1, 2.2.

Examiners' Comments

There were some good answers, but overall there was a low pass rate on this question. In many cases there is evidence that very little information provided was relevant to the question which was being asked. While relevant material was given credit, it often did not form part of a cogent set of arguments, and a pass mark was not obtained.

Section B

- B3. You have been asked to design an “introduction to IT and the environment” course for school students, aged 11 – 14. In particular, you are to explain the environmental impacts of each stage of a product’s life cycle.
- a) Using a laptop and a printer as example products, discuss the main points that you would include in the course for the following lifecycle stages:
 - i. the manufacturing stage;
 - ii. the use stage;
 - iii. the disposal stage.

(15 marks)
 - b) For the same course and the same group of school students (age 11 -14), explain why it is common practice to estimate the carbon footprint of a data centre before it is built. Your answer should show the steps involved in such an audit, discuss the limitations of an estimation process, and explain what might be missed by only considering carbon.

(10 marks)

Answer Pointers

Part a)

An answer would describe the stages of manufacture, mentioning raw material extraction and processing; component fabrication and assembly; transport and packaging; energy and consumable consumption and options for end of use (reuse, recycle, recover). The answer would go on to give further details, including detail of some of the stages – e.g. the types of raw material (minerals and metals); the location(s) involved in transportation; the factors involved in end of use treatments.

An answer could provide a stage-by-stage description of the activities, including comparison of the impacts at each stage; identifying by name the metals, and their location in the devices.

Syllabus Coverage: The Environmental Impact of Information Systems, 4.1, 4.2.

Part b)

Data Centres are major users of energy and therefore producers of carbon, in order to manage that carbon use, it is necessary to measure it. Most tools will involve an audit to determine the capacity of the Data Centres and its estimated energy, then estimate the carbon footprint using some conversion factor for the location and power source(s) involved. There would be a discussion of the audit process, explaining what the different elements of the Data Centres are (servers, networking components etc.) and how they affect the energy use.

An answer could identify how alternative power sources could influence carbon footprint; identify that the estimation process and conversion factor is not precise; recognise that carbon is not the sole measure of resource utilisation which should be considered.

Syllabus Coverage: The Environmental Impact of Information Systems, 4.1, 4.2.

Examiners' Comments

Only a few candidates attempted this question. The evidence shows there were a range of answers including those that showed a good appreciation of the issues relevant when designing a course and could relate the answer to the scenario for laptops, printers and data centres. Some answers were able to articulate some of the issues, but the answers were brief and showed limited appreciation of what would be useful for the scenario.

- B4. A city wishes to install a city-wide environmental, traffic and air quality monitoring system. The proposal is to use Internet of Things (IoT) technology to provide the data gathering parts of this system. There will be a data centre based in government offices to support the analysis and control of the data gathering. It is expected that there will be over 50,000 devices in the monitoring systems.

Some residents are worried about the harmful effects of such a large number of active IT devices using wireless communication across the city.

- a) What information should the city authorities provide to respond to these residents?
(10 marks)
- b) What are the technical advantages and disadvantages of using a wired network with fixed sensors in place of the wireless IoT system?
(15 marks)

Answer Pointers

Part a)

The answer would recognise the concerns of the residents. There could be explanations that it is unlikely that the proposed system will add significantly to the overall volume of wireless communication. The answer would go on to address the benefits of the system in terms of what can be achieved using the data gathered. There could be further discussion to provide more details of those benefits and attempt to give a balance of benefits vs. possible harmful effects.

Syllabus Coverage: The Environmental Effects of Communication Systems, 5.1.

Part b)

Using a wired system means that the operator has more control over the security and privacy of the network but makes expansion more difficult and costly and makes for less flexibility. The answer could then explain that each new part of the system, or any modification, requires a change to the underlying network, and that it misses the chance to exploit already existing sensors and data sources. Ideally, there would be some detail of the security risks of monitoring and control access falling into the wrong hands. The answer might quantify some of the statements made by reference to the types of monitoring required, showing how they can be achieved by use of existing sensor technology, a discussion of how the security concerns could be avoided.

Syllabus Coverage: The Environmental Effects of Communication Systems, 5.1.

Examiners' Comments

This question was popular and was answered well overall. There is evidence that some candidates struggled to relate their answers to the given scenario. Good practice examples are available in this and previous exam papers.

- B5. A country has the natural resources to generate energy from solar, wind, tide and water sources. It wants to make use of its renewable energy sources to replace the current fossil fuel power stations, which use locally-mined coal and supply 100% of the country's energy.
- a) Explain the Information Technology hardware and software systems which will be required to support this new, renewable energy generation. **(10 marks)**
 - b) How will individual citizens be affected by the change of energy systems? **(5 marks)**
 - c) How can citizens become involved in this power generation process, and what IT will be required to enable this? **(10 marks)**

Answer Pointers

Part a)

The answer would discuss the need for a smart grid to be installed, linking the various generation systems to ensure that the overall supply system is functioning effectively. The answer would identify that sensors and controllers are required to deliver this and give some indication of their role and purpose. There would be discussion of the connection of the grid to the consumer equipment (domestic smart meters). The answer is likely to discuss how supply and demand can be balanced.

Syllabus Coverage: IT in the Service of Power Generation & Energy Conservation, 6.1.

Part b)

Citizens should see improvements in their air quality. There would be discussion of the positive effect on their feelings about the country and the energy they use. The answer might mention the loss of jobs in the coal mines, or whether this will mean more or less energy consumption (the rebound effect).

Syllabus Coverage: IT in the Service of Power Generation & Energy Conservation, 6.1.

Part c)

The answer would discuss smart meters being installed allowing users to monitor their energy use, but also involvement as energy suppliers, via solar and wind generation. The discussion would explain that there could be a link between generation and use of energy, and the role of the smart meter in that. The answer might consider peak and off-peak use, of using solar during daylight hours and of the role of the smart meter in managing the consumption patterns of household devices.

Syllabus Coverage: IT in the Service of Power Generation & Energy Conservation, 6.1.

Examiners' Comments

This question was answered well overall. As with other questions, there is evidence that some candidates could identify relevant facts related to the use of a smart grid. Improved answers could show consideration of how such a grid and smart meters would be used and mention issues such as the impact on coal mines.