Diploma Programme
Programme du diplôme
Programa del Diploma

Information technology in a global society
Higher level
Paper 1

Friday 6 November 2020 (afternoon)

2 hours 15 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Section A: answer two questions.
- Section B: answer one question.
- Each question is worth **[20 marks]**.
- The maximum mark for this examination paper is **[60 marks]**.

8820 – 5511

11 pages

Section A

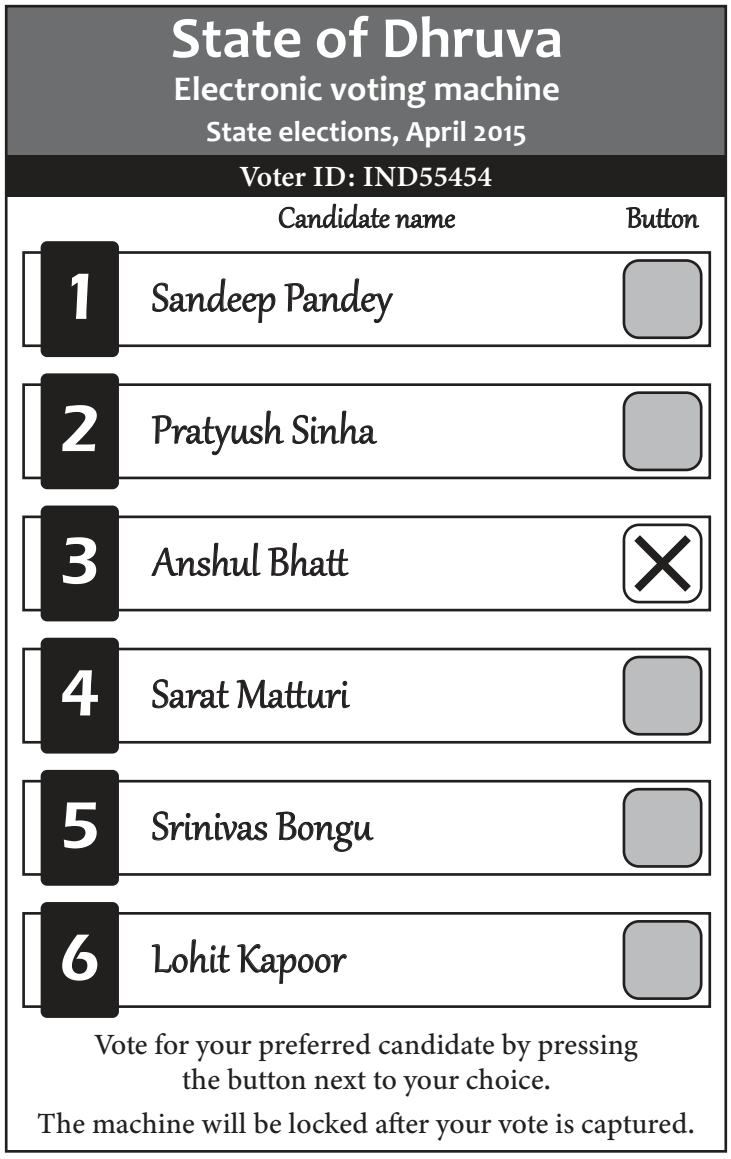
Answer **two** questions. Each question is worth [20 marks].

1. E-voting

A number of countries, such as India, have introduced e-voting systems. Citizens can vote by going to a specified location, such as a school, or they can vote from home using a computer. Each voter is provided with a unique identifier, such as IND55454, that they must enter into the system when they vote.

These e-voting systems usually consist of a user interface, such as the one in **Figure 1**, linked to a relational database (see **Figure 2**).

Figure 1: An e-voting interface



(This question continues on the following page)

(Question 1 continued)

Figure 2: Some of the tables in the voting database

Voter
VoterID
First_name
Surname
Date_of_birth
Gender
More fields

Votes
VoteID
CandidateID
VoterID
Date
Time
More fields

Candidate
CandidateID
Party
First_name
Surname
More fields

(a) (i) State the primary key in the Voter table in **Figure 2**. [1]

(ii) Identify **one** foreign key in the Votes table in **Figure 2**. [1]

(iii) Identify the data type that would be used in the Gender field in **Figure 2**. [1]

(iv) State the relationship between the Candidate table and the Votes table. [1]

(v) Outline why a drop-down list would be used for the Party field in the Candidate table. [2]

(b) A number of individuals and groups were consulted during the design of the e-voting system to enable designers to create an intuitive interface for it.

Analyse questionnaires **and** interviews as methods of data collection to gather this information from these individuals and groups. [6]

(c) Some states are planning to return to a paper-based voting system, where voters put a cross (X) in the column next to the party of their choice.

Discuss whether these states should retain e-voting or return to a paper-based voting system. [8]

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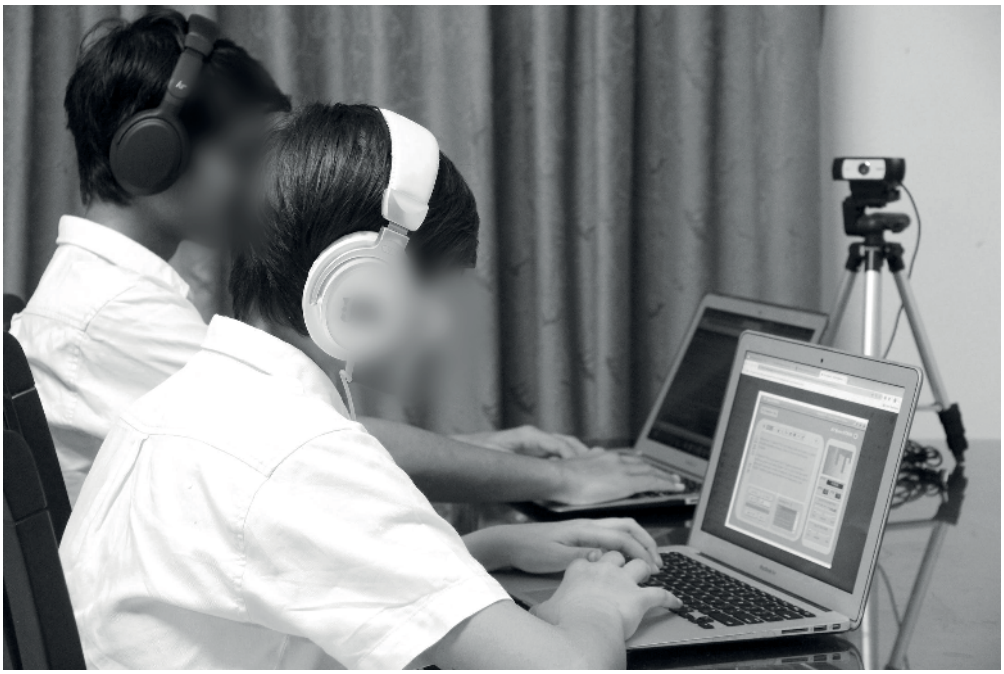
2. BYOD at Xingu Academy

Some students at Xingu Academy have been allowed to "bring your own device (BYOD)" into school so they can use assistive technologies, such as speech-to-text, to support their learning (see **Figure 3**). Mayu Jimenez, the Head of Learning and Teaching, has seen the benefits for these students. A number of other teachers believe there will be benefits if the school becomes a BYOD school. However, before a decision can be made, Alejandro Glandolla, the Head of IT, has been asked to investigate whether the school would be able to cope with the demands of the increased number of devices.

Figure 3: Assistive technologies



(a) (i) Identify **two** pieces of information that would be used to identify a device on the IT network. [2]

(ii) Identify the steps used by speech-to-text software. [4]

(b) Digital citizenship is included in Xingu Academy's IT acceptable-use policy.

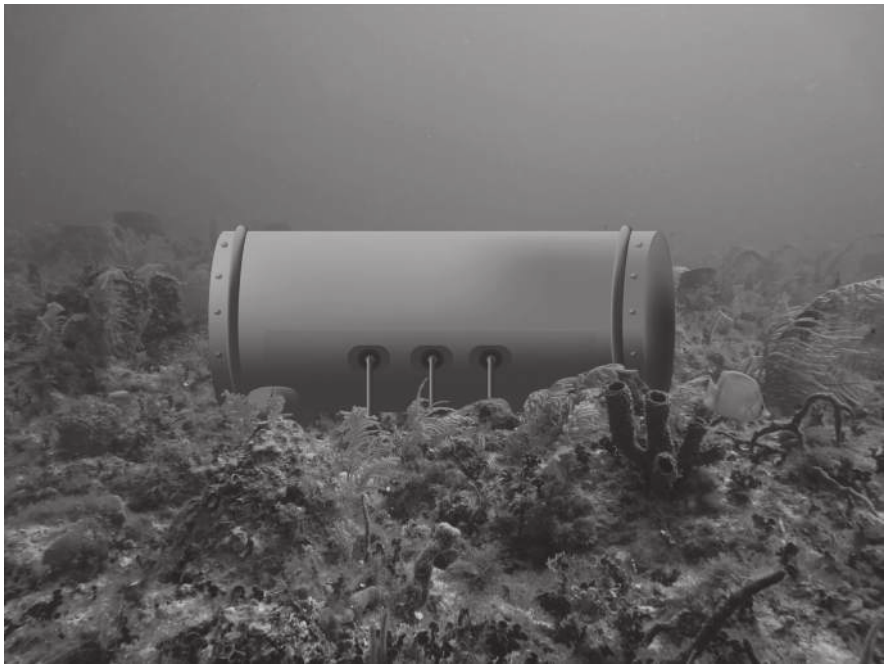
Explain why it is important that students at Xingu Academy are both competent users of digital technologies **and** good digital citizens. [6]

(c) Discuss whether Xingu Academy should become a bring-your-own-device (BYOD) school. [8]

3. Clouds under the sea

Microsoft has located one of its data centres on the seabed. Project Natick is now operating 100 feet below the surface of the North Sea (see **Figure 4**).

Figure 4: An artist's representation of a data centre on the sea bed



Microsoft has chosen to develop data centres on the seabed because concerns have been raised about the impact of data centres built on land. These seabed data centres can be constructed and placed on the sea bed in 90 days. This is compared to the two years that are required for land-based data centres.

The demand for data storage is doubling every two years, so it is likely that an increasing number of data centres will need to be constructed under the sea as cloud computing continues to grow. Google patented their design for an underwater data centre in 2009 but, although functioning prototypes have been trialled, none have been used commercially.

(a) (i) Identify **two** characteristics of cloud computing. [2]

(ii) Servers used in cloud computing hold considerable amounts of data.

Identify **two** forms of backup that could be used for the data on these servers. [2]

(iii) A user is downloading a ZIP (zipped file) from cloud storage.

The ZIP file is 0.6 GB in size and the download rate is 8 mb/s.

Calculate the total time it will take to download the ZIP file.

Note: 1 GB = 1000 MB. [2]

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(Question 3 continued)

(b) (i) Compression software can be used to speed up the upload and download of files.

The ZIP file recently downloaded from the cloud-based server contained a number of images and videos.

Explain why lossy compression techniques would be used for the images that have been downloaded from cloud storage. [2]

(ii) Explain why lossless compression techniques would be used for the videos that have been downloaded from cloud storage. [2]

(iii) Cloud storage providers are responsible for protecting the privacy and anonymity of the individuals whose data is held on their servers.

Distinguish between privacy and anonymity. [2]

(c) Evaluate Microsoft's decision to build data centres on the seabed. [8]

Section B

Answer **one** question. Each question is worth [20 marks].

4. Your personal avatar

SBE Cruise Lines is implementing new IT systems to enhance their passengers' experiences. Recently, the company equipped their ships with touch screens where passengers can interact with their own customizable 3D avatar. Passengers wear a bracelet on their wrist and their 3D avatar appears on touch screens as they walk around the ship (see **Figure 5**).

Figure 5: A child interacting with the avatar

The bracelet tracks a passenger's location on the ship using thousands of sensors, and this data is constantly synchronized with that passenger's data stored in the cloud. This may include their photo, room number or passport information.

To improve the passenger's experience, the avatar developers update the IT systems on the cruise ship every night. To ensure that the IT updates are completed, George Smith, the Project Manager, must communicate with a number of stakeholders.

George believes that to make the best improvements, the avatar developers who are in charge of quality assurance should observe the passengers' real-time interactions with the system.

(a) (i) Identify **two** stakeholders that George, the Project Manager, must consult before implementing the IT updates. [2]

(ii) Identify **two** responsibilities of the Project Manager in addition to consulting stakeholders. [2]

(iii) Identify **two** characteristics of quality assurance. [2]

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(Question 4 continued)

(b) (i) Explain why the avatar developers would not use alpha and beta testing when the nightly updates are implemented. [4]

(ii) Explain one reason why the nightly updates should make use of a project management methodology. [2]

(c) Matt Earle, the CEO of SBE Cruise Lines, has been investigating using artificial intelligence (AI) systems to track passengers and suggest activities they may wish to take part in when they interact with the touch screens on the ship. Some of his colleagues have concerns about taking this approach.

To what extent should Matt rely on the recommendations from the AI system to suggest activities to passengers? [8]

5. Skin care app

SkinSmart is an app[1] that requires the user to take a selfie[2] and answer a few questions about their skin. The expert system linked to the app will then recommend skin care products to suit the user.

As artificial intelligence (AI) is becoming more sophisticated, SkinSmart has developed a new app, SkinSmartPro (SSP), which uses AI instead of an expert system.

Marta is a young woman who uses the SSP app. The developers of SSP say that Marta will gain the most benefit from using the app if she takes a daily selfie and inputs information, such as how she is feeling, how long she has slept, how much she has exercised and what she has done throughout the day. The app will then use machine learning to analyse the data provided by Marta and recommend skin care products for her.

The SSP app is being developed in consultation with MAGS, a data management company. This means that the data of the users of the SSP app could be shared with third parties.

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[1] app: small specialized program run on mobile devices, the internet, a computer or other electronic device

[2] selfie: a photograph a person takes of themselves, usually with a smartphone or webcam

(a) (i) Identify **two** characteristics of artificial intelligence (AI). [2]

(ii) Identify **two** components of an expert system. [2]

(iii) Describe the difference between backward chaining and forward chaining. [2]

(b) Explain the importance of a requirements specification **and** feasibility study in the development of the SSP app. [6]

(c) Some SSP app users have expressed concerns about the AI features in the new SSP app and have decided to change back to the original SkinSmart app despite its use of an expert system.

Evaluate the decision of some SSP app users to change back to the original SkinSmart app. [8]

6. Autonomous weapons

Advances in technology have led to the possibility of fully autonomous weapons, also known as killer robots, being used in war.

The United Nations is trying to create policies for the development and use of fully autonomous weapons. There are currently 125 countries working on these policies.

A major concern associated with fully autonomous weapons is whether the decision to kill a human being should be left completely to a machine.

(a) (i) Identify **two** characteristics of a robot. [2]

(ii) Identify **two** project management methodologies that could be used in the development of autonomous weapons. [2]

(iii) Outline why prototyping would be used in the development of autonomous weapons. [2]

(b) Explain **two** reasons why the development of policies for the use of autonomous weapons may be difficult to achieve. [6]

(c) Discuss who would be accountable if harm were caused by the use of an autonomous weapon. [8]

References:

Figure 1. © International Baccalaureate Organization 2020.

Figure 3. © International Baccalaureate Organization 2020.

Figure 4. Adapted under sea photo by NOAA on Unsplash.

Figure 5. Carnival Corporation.

6. © International Baccalaureate Organization 2020.