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Information technology in a global society
Standard level
Paper 1

Friday 10 May 2019 (afternoon)

1 hour 30 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer two questions. Each question is worth **[20 marks]**.
- The maximum mark for this examination paper is **[40 marks]**.

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

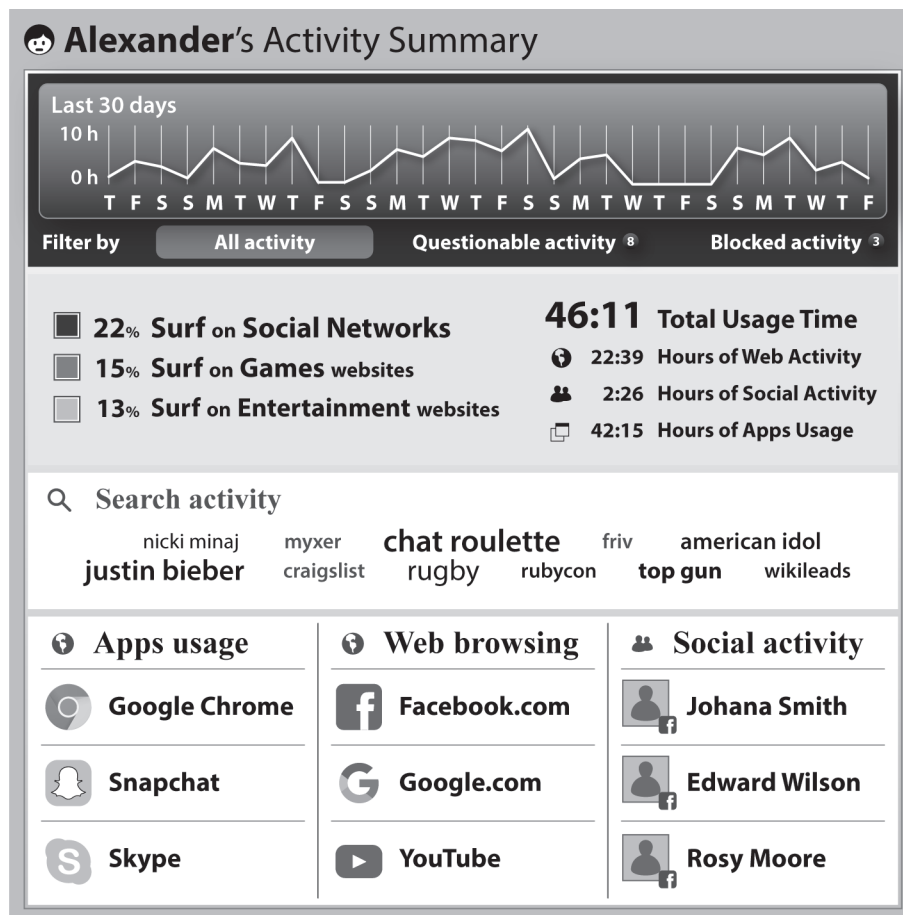
1. Parents “cyber-spying” on their children

The *New York Times* reports that an increasing number of parents use technology to protect their children and keep track of their online activities.

Many companies are developing cell/mobile phone apps* to sell to parents who want to keep an eye on their child’s online activities. Some apps operate as a simple global positioning system (GPS) tracking device, but others are much more advanced. For example:

- Qustodio restricts internet browsing and monitors for signs of cyber-bullying by detecting keywords in social media.
- TeenSafe lets parents see all the texts, web history and apps on the child’s phone, tablet or computer. With one of its options, the parents can receive copies of all the messages that the child sends and receives. Parents can also receive weekly activity reports, similar to the one in **Figure 1**.

Figure 1: Example of a weekly report that can be sent to parents



[Source: with kind permission from Qustodio]

(This question continues on the following page)

(Question 1 continued)

Some of the apps are invisible to the children, so they do not always know they are being monitored by their parents. Some child psychologists believe that this approach to parenting is wrong. They argue that parents should develop trust with their children, rather than using spyware and engaging in online surveillance.

* apps: an app (application software) is typically a small, specialized program downloaded onto mobile devices; apps can also run on the internet, on a computer, or on a cell/mobile phone or other electronic device

- (a) (i) Identify **two** features of spyware. [2]
- (ii) Identify the steps taken by a GPS device to determine its location. [4]
- (b) The developers of Qustodio decided to use automated keyword detection to monitor for signs of cyber-bullying.
- Analyse this decision. [6]
- (c) To what extent is it acceptable for parents to use apps such as Qustodio and TeenSafe to monitor their child's online activities? [8]

2. Braille keyboards

According to the World Health Organization, over 250 million people worldwide are blind or visually impaired. Many of them use a tactile writing system called Braille, which they read with their hands by touching patterns of raised dots with their fingertips.

Several companies have recently developed Braille keyboards, such as the one shown in **Figure 2**. Braille keyboards use different combinations of the nine main keys to form characters.

Figure 2: A Braille keyboard



[Source: with the permission of HumanWare]

Braille keyboards are usually very expensive. They can cost twenty or thirty times more than standard keyboards. They are always protected by patents and cannot be cheaply reproduced.

Umair Osman, a young teacher in Pakistan, has invented a system that uses a flexible plastic overlay¹ to imitate the layout of a Braille keyboard.

Umair has also developed software that converts the combinations of keys pressed on the overlay to the corresponding ASCII² character. The overlay, together with the software, enables visually impaired students to convert a standard keyboard into a Braille keyboard.

Umair has decided to release his software as open source software and is considering using crowdfunding³ for future projects.

¹ overlay: a flexible plastic cover that is placed over the keyboard to allow combinations of keys to be pressed by the user

² ASCII: American Standard Code for Information Interchange

³ crowdfunding: funding projects from donations made by a large number of people via the internet

(This question continues on the following page)

(Question 2 continued)

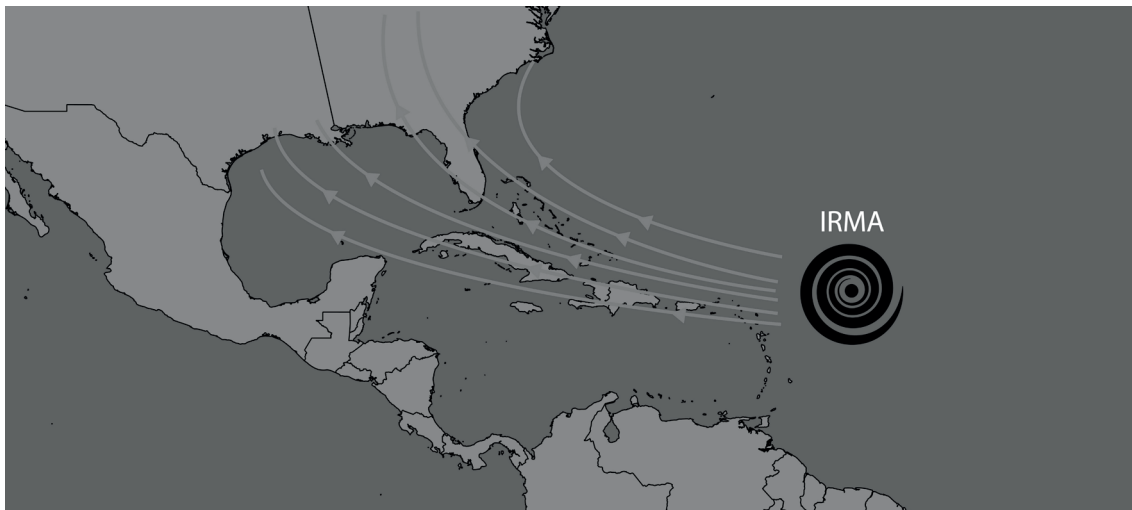
- (a) (i) Identify **two** features of American Standard Code for Information Interchange (ASCII). [2]
- (ii) Describe **two** methods that Umair could have used to gather information from visually impaired people during the development of his system. [4]
- (b) Umair has decided to release his Braille software as open source software, rather than proprietary software.
- Explain why Umair took this decision. [6]
- (c) Umair has two options:
- Option 1: he could continue to develop his software and Braille keyboard by using crowdfunding.
 - Option 2: he could sell the intellectual property rights to *AssistivIT*, a large company that develops software.
- Evaluate these **two** options. [8]

3. Hurricane warning systems

In 2017, Hurricane Irma was a catastrophic disaster. Unfortunately the computer models did not accurately predict its track (course) in time to warn residents in the areas affected. Accurately predicting the track of a hurricane is critical for protecting life and property.

The potential tracks that Hurricane Irma could have taken are shown in **Figure 3**.

Figure 3: Potential tracks of Hurricane Irma



The European computer model, run by the European Centre for Medium-Range Weather Forecasts, performed far better than the American model, known as the Global Forecast System. However a new model created by the electronics company *Panasonic*, called PWS, performed best.

The American and European models depend on data gathered from weather balloons. *Panasonic*, on the other hand, creates systems that collect real-time weather data from over 3500 aircraft every day.

The PWS model resulted in accurate simulations of the track of the hurricane four to seven days in advance.

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(Question 3 continued)

- (a) (i) Identify **two** file types that could be used for the image in **Figure 3**, which shows the potential tracks of Hurricane Irma. [2]
- (ii) Outline the difference between data and information. [2]
- (iii) Outline why visualization is used to present data. [2]
- (b) (i) Distinguish between a model and a simulation. [2]
- (ii) Different weather variables, such as wind speed and temperature, need to be collected in order to predict the track of a hurricane. Wind speed data is sampled more frequently than temperature data in a hurricane.
- Explain **one** reason why wind speed data would be sampled more frequently than temperature data in a hurricane. [2]
- (iii) Explain why the data collected about Hurricane Irma was not encrypted prior to being transmitted. [2]
- (c) *Panasonic* does not make its PWS model available to governments, as the company says that doing so would compromise its commercial interests.
- Discuss whether governments should be able to make private companies such as *Panasonic* share their data. [8]

4. Electronic voting (e-voting)

E-voting is a form of voting that uses a computer instead of a printed ballot paper. Voters go to a polling station and cast their vote using an electronic voting machine (EVM), such as the one shown in **Figure 4**.

Voters must be authenticated by the system before casting their vote. The votes are then stored in an encrypted form in a relational database.

The graphical user interface (GUI) of the EVM can be adjusted for different voters. For example, the font size can be increased for voters who have limited vision.

Figure 4: Example of an electronic voting machine (EVM)



[Source: cmannphoto/istock]

E-voting is already used for local elections in the towns and cities of several countries, such as Belgium, Canada and Estonia. Countries such as Finland are now considering whether to use e-voting for the whole population in their national elections.

- (a) (i) Other than font size, identify **two** features of the GUI that could be customized so that it is accessible for all voters, including people with physical, sensory and other challenges. [2]
- (ii) Identify **two** features of authentication. [2]
- (iii) Identify **two** features of encryption. [2]
- (b) Elections using e-voting in countries such as Finland will create significant amounts of personal data. The government of Finland will have to ensure it has appropriate policies for the **collection**, **storage** and **sharing** of the data.
- Explain why it is important to have an appropriate policy for the **collection**, **storage** and **sharing** of the data from elections that use e-voting. [6]
- (c) Evaluate the advantages and disadvantages of e-voting. [8]