

© International Baccalaureate Organization 2021

All rights reserved. No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without the prior written permission from the IB. Additionally, the license tied with this product prohibits use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, whether fee-covered or not, is prohibited and is a criminal offense.

More information on how to request written permission in the form of a license can be obtained from <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organisation du Baccalauréat International 2021

Tous droits réservés. Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite préalable de l'IB. De plus, la licence associée à ce produit interdit toute utilisation de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, moyennant paiement ou non, est interdite et constitue une infraction pénale.

Pour plus d'informations sur la procédure à suivre pour obtenir une autorisation écrite sous la forme d'une licence, rendez-vous à l'adresse <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organización del Bachillerato Internacional, 2021

Todos los derechos reservados. No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin la previa autorización por escrito del IB. Además, la licencia vinculada a este producto prohíbe el uso de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales—, ya sea incluido en tasas o no, está prohibido y constituye un delito.

En este enlace encontrará más información sobre cómo solicitar una autorización por escrito en forma de licencia: <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

**Information technology in a global society**  
**Higher level**  
**Paper 1**

Wednesday 19 May 2021 (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]**.

## Section A

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

### 1. A cashless society

In the near future, it is possible that cash will not be accepted as a means of payment in Sweden. People are already using alternative ways of paying such as mobile payment, card payment and internet payment. Currently 94 % of citizens in Sweden have internet access.

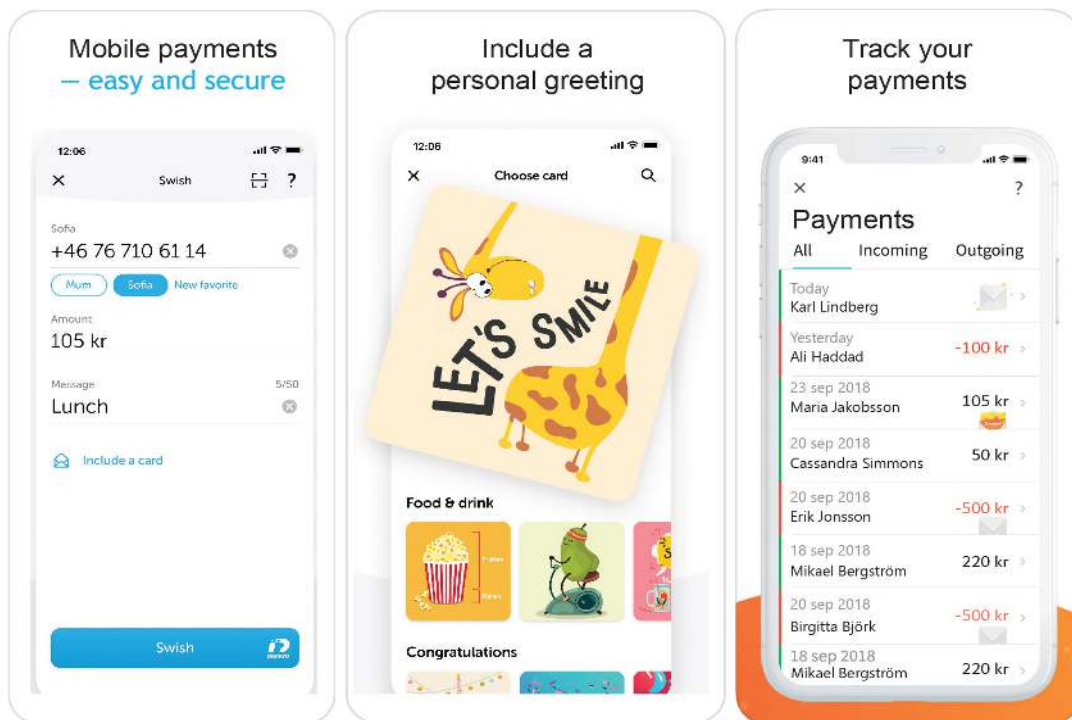
In 2012, a new payment app\* called “Swish” was created that allowed users to transfer money using their cell/mobile phone. The user has to download the *Swish* mobile bank app to their cell phone and create a user ID. Once this has been done the user can register for Swish which connects their bank account to their cell/mobile phone number.

The *Swish* app can be used with all the Swedish banks. The maximum amount of money that can be transferred using the *Swish* app is controlled by the user’s bank.

*Swish* cannot be used if the user does not have a Swedish bank account. However, this only applies to less than 1 % of the Swedish population.

To make a payment using *Swish* you select a person in the contact list on your cell/mobile phone and follow a series of steps, see **Figure 1**.

**Figure 1: The Swish app**



The *Swish* app allows you to send money to friends, companies and organizations. However, it is not widely used when purchasing from a shop. In this case, credit or debit cards are still the preferred method for making payments.

\* app: small specialized program run on mobile devices, the internet, a computer or other electronic device

(This question continues on the following page)

**(Question 1 continued)**

- (a) When a user wants to make a payment with the *Swish* app, the app will need to collect data about the transaction.
- (i) Identify **two** items of data that the app could collect from the user making the payment. [2]
- (ii) Identify the steps taken by the app to make the payment into the bank account of the person receiving the money. [4]
- (b) Explain why it is important that any data sharing agreement between the *Swish* app and the Swedish banks has policies that address both the storing **and** sharing of app users' data. [6]
- (c) Many people in Sweden have seen the advantages of using the *Swish* app. It allows friends to share a restaurant bill, to pay where credit or debit cards are not accepted, to easily pay for babysitting or parking tickets, or make a donation at church.

However, some people in Sweden have expressed concerns about not using cash and making the *Swish* app the only means of payment.

To what extent do the advantages of the *Swish* app as the only means of payment outweigh the disadvantages. [8]

**Turn over**

## 2. Automatic crop watering system

Since 1990, Bertha Ascayo has been the manager of *El Pallar*, a farm in Chacra Province, where fruit trees are grown. In recent years, the climate has become more unpredictable and the farm has suffered from periods of drought, and Bertha is aware that she needs to manage the watering of her fruit trees more than she has had to in the past.

Bertha will need to make some improvements to the watering system by adding a rain sensor and use a computer program to automate the watering process. She has decided to use the proprietary software offered by the company that has installed the equipment for the watering of the trees.

By using this software, Bertha can program a different watering plan for each type of tree. This includes programming the days of the week, times of the day and length of the water cycle for each type of tree to be watered. For example, orange trees will be watered on Mondays and Thursdays at 6am for 45 minutes, and at 8pm for 30 minutes.

- (a) (i) Identify **three** characteristics of proprietary software. [3]
- (ii) A computer program uses the data provided by the rain sensor to decide whether to water the trees. Identify the steps in this program. [3]
- (b) Water is becoming increasingly scarce in Chacra Province and the provincial government is concerned there will be a point when there is not enough water for all of the farms to water their crops or fruit trees.

To manage water for the watering of crops and fruit trees, the provincial government of Chacra Province intends to create a computer model to calculate how much water each farm in the province will receive.

Explain **three** factors that will contribute to the accuracy of the model. [6]

- (c) The farmers of Chacra Province are concerned about the provincial government using a computer model to determine the amount of water they will be allowed to use to water their fruit trees.

To what extent should the farmers of Chacra Province rely on their knowledge and experience, rather than the computer-based solution provided by the provincial government, to manage the watering of the fruit trees? [8]

### 3. Technology disruption in Orams Academy

Many schools use virtual learning environments (VLE) such as Firefly, PowerSchool Learning, Schoology, Final Site LMS and Google Classroom. The VLE is used for document storage, lesson content and homework management as well as for communication between the school, students and parents.

In addition to the VLE, collaborative cloud-based online tools such as Google G Suite and Microsoft Office 365 are used by students and teachers.

Recently, Daniela Stark, the principal at Orams Academy, has become concerned that using only one VLE may not prove to be as beneficial as originally thought. She has heard that some teachers and students are also successfully using social media tools such as Facebook, Twitter or Instagram to share their learning. She has also been told that the lack of bandwidth that the school experiences at times can cause problems.

Daniela is considering an alternative approach and allowing teachers and students to choose the most appropriate tools to manage their learning.

- (a) (i) Identify **two** characteristics of cloud-based storage. [2]
- (ii) Identify **two** reasons why there might be a lack of bandwidth at times on the school's network. [2]
- (iii) Identify **two** potential disadvantages of using online collaborative tools. [2]
- (b) An acceptable-use policy will be required for the appropriate use of virtual learning environments and collaborative online tools in Orams Academy.
- Explain **three** elements that would be included in an acceptable-use policy for Orams Academy. [6]
- (c) Discuss whether Daniela should make every teacher at Orams Academy use the same learning platform **or** she should allow each teacher to choose their own preferred learning management approach. [8]

Turn over

## Section B

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

### 4. Fake news

We see and hear news every day and trust that the information provided is accurate. That belief may soon end.

Artificial intelligence (AI) software is now being developed that can produce fake video footage of public figures using recordings of their own voices. A startup company, *DidYouSayThat*, has used a neural network to turn sound into speech. Using as little as one minute of data, it can reproduce a particular person's voice. The developer of this software demonstrated the results by using the voices of Bill Clinton, George Bush and Barack Obama in a computer generated conversation.

Once a person's voice has been reproduced, *DidYouSayThat* can create a fake video using a neural network that is trained by processing hundreds of videos of the person's face. Video footage of politicians and celebrities are often used as there is so much data available online.

The combination of these two approaches (fake audio and fake video), results in fake video footage where people are shown doing and saying things they never did or said. Twitter and Reddit have already banned the use of fake videos on their platforms.

(a) (i) Identify **three** characteristics of a neural network. [3]

(ii) Alpha testing will be used in the development of the voice synthesis software.

Identify **three** characteristics of alpha testing. [3]

(b) *DidYouSayThat* has created a number of prototypes of their voice synthesis software.

Explain **three** reasons why *DidYouSayThat* would have used prototypes during the development of their voice synthesis software. [6]

(c) Law professor John Silverman commented, as humans we tend to believe what we see, and the increased number of tools to make fake media that is unrecognizable from real media is going to prove a challenge in the future.

*DidYouSayThat* is aware of the ethical implications of this voice synthesis technology. Their ethics policy states that with great innovation comes great responsibility.

To what extent should *DidYouSayThat* be accountable for the fake videos posted by users of their software on social media platforms? [8]

## 5. Mearlet Finances

Alia Khoury, the Chief Executive of *Mearlet Finances*, has received a large number of complaints from customers about the financial products\* they have purchased from her company.

These decisions were based on the recommendations of an expert system, MF v1.0. This system reduced the amount of time it took to recommend a financial product and allowed Alia to reduce the number of staff she employs.

---

\* financial products: such as mortgages, loans, pension schemes and savings accounts

- (a) (i) Identify **two** features of an expert system. [2]
- (ii) Identify **two** responsibilities of a project manager in the development of an expert system such as MF v1.0. [2]
- (iii) Expert systems use inference rules.  
Identify **two** characteristics of inference rules. [2]
- (b) (i) Explain how the quality of the data collected can affect the effectiveness of a knowledge base. [3]
- (ii) Explain why the failure to update data within its knowledge base may cause problems for *Mearlet Finances*. [3]
- (c) Since the introduction of the expert system, *Mearlet Finances* has been able to offer a wider range of financial products. This has attracted more customers. However, Alia believes that the current expert system may not be able to cope with the increased size and complexity of the business.

Alia is considering two options:

- **Option 1:** Purchase a new version of the MF expert system, MF v2.0.
- **Option 2:** Purchase a new artificial intelligence (AI) system that uses machine learning.

Evaluate these two options. [8]

Turn over



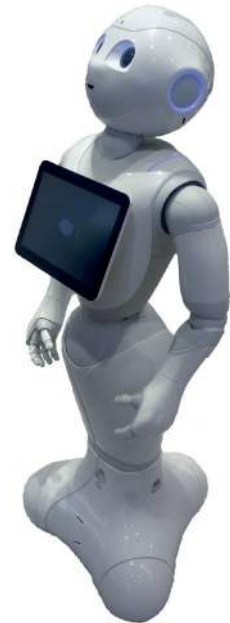
## 6. Pepper

Pepper is a humanoid robot that uses natural language processing, as well as voice recognition, to understand what is being said. Pepper can also identify basic human emotions by analysing verbal and non-verbal clues, see **Figure 2**.

Pepper has multiple sensors, a battery that lasts for 12 hours and is equipped with wireless connectivity. Pepper is released in batches of one thousand and they usually sell out immediately.

Software developers can create new apps\* for Pepper as the robot has a generic profile. So far, Pepper has been successfully used on cruise ships, homes in Japan and with the elderly in the UK. However, Pepper could not answer questions from customers in supermarkets in some parts of the USA and Latin America.

**Figure 2: Pepper the humanoid robot**



---

\* apps: small specialized programs run on mobile devices, the internet, a computer or other electronic device

- (a) (i) Outline **one** reason why Pepper could not answer a customer’s question in a supermarket. [2]
- (ii) Pepper was developed using an agile development methodology.
- Outline **two** reasons why an agile development methodology would have been used for the development of Pepper. [4]
- (b) Pepper could use either machine learning or rule-based learning for its natural language processing.
- Analyse these **two** options. [6]
- (c) *King Robotics* is planning to use robots in schools. The robots will use a unique approach called “care-receiving”. In this approach to teaching the robot does not directly instruct the student, instead the robot makes mistakes and asks the student for help to correct them. Early studies have found that children respond very positively to this approach. The robots will also be able to carry out direct teaching activities.
- Evaluate the advantages and disadvantages of using robots such as Pepper to support the care-receiving teaching approach as well as carrying out direct teaching activities. [8]

#### References:

1. Images with permission from Getswish AB.
6. Wikipedia, 2019. *Pepper (robot)*. [image] Available at: [https://en.wikipedia.org/wiki/Pepper\\_\(robot\)](https://en.wikipedia.org/wiki/Pepper_(robot)) [accessed 21 March 2019].