Diploma Programme
Programme du diplôme
Programa del Diploma

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

18 May 2023

**Zone A** afternoon | **Zone B** afternoon | **Zone C** 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]**.

International Baccalaureate
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# Section A

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

1. **Intelligent transport monitoring**

    The government of the Republic of Uganda has required all motor vehicles to be fitted with a global positioning system (GPS) device. The government has adopted this strategy to reduce crimes that often involve the use of motor vehicles. **Figure 1** shows that a GPS device can be hidden inside a car.

    **Figure 1: How the transport monitoring system works**

    

    Monitoring centre

    Car number plate — ABC 12345

    GPS device hidden
    inside the car
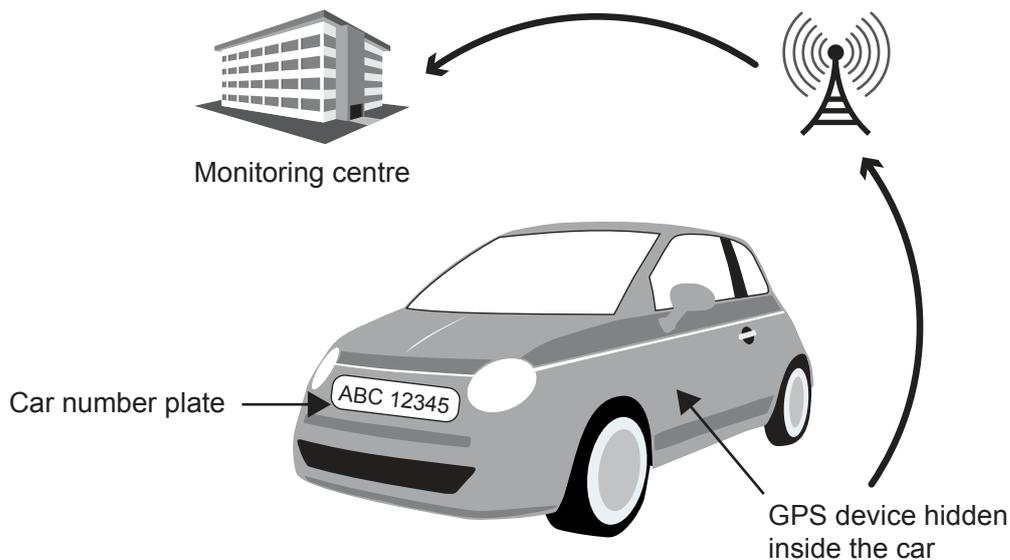
    The GPS device within the vehicle will communicate with a monitoring centre to send the data from the car using mobile/cellphone technology. If the device is disconnected from the vehicle, an alert will be sent to the monitoring centre.

    In addition to the information captured by the GPS device, there are roadside cameras that capture images of the number plates of passing cars.

    This initiative is called the Intelligent Transport Monitoring System (ITMS).

    However, civil liberty groups in the Republic of Uganda have raised concerns about the Intelligent Transport Monitoring System.

    (a)  (i)   State **two** file formats that could be used for the images of car number plates.          [2]

         (ii)  Identify **two** pieces of information, in addition to the location of the vehicle, that could be communicated from a vehicle to the monitoring centre.          [2]

         (iii) The government is considering using the data from the Intelligent Transport Monitoring System (ITMS) to create a model of the traffic patterns in a city.

               Identify **two** factors that should be taken into account when developing this model.    [2]

**(This question continues on the following page)**

**(Question 1 continued)**

    (b)    (i)    The government also wants to use the Intelligent Transport Monitoring System (ITMS) to produce a simulation of traffic patterns.

                 Explain **one** benefit of producing a simulation of traffic patterns.    [2]

        The Ugandan government is outsourcing the development of the Intelligent Transport Monitoring System (ITMS) to a technology company in another country. This company will also develop and operate the software that monitors vehicles in the system (ITMS).

        (ii)    Explain **one** advantage of outsourcing the development and operation of the Intelligent Transport Monitoring System (ITMS) to a company in another country.    [2]

        (iii)    Explain **one** disadvantage of outsourcing the development and operation of the Intelligent Transport Monitoring System (ITMS) to a company in another country.    [2]

    (c)    Discuss whether the advantages for the government of monitoring the movement of vehicles in the Republic of Uganda outweigh the disadvantages.    [8]

**Turn over**

**2.    EyesOnU**

*EyesOnU* is a facial recognition website that allows people to upload a picture of a person and find matching images on the World Wide Web. Each image found is given a rating based on how similar it is to the uploaded picture (see **Figure 2**).

**Figure 2: Example of a search on the *EyesOnU* website**
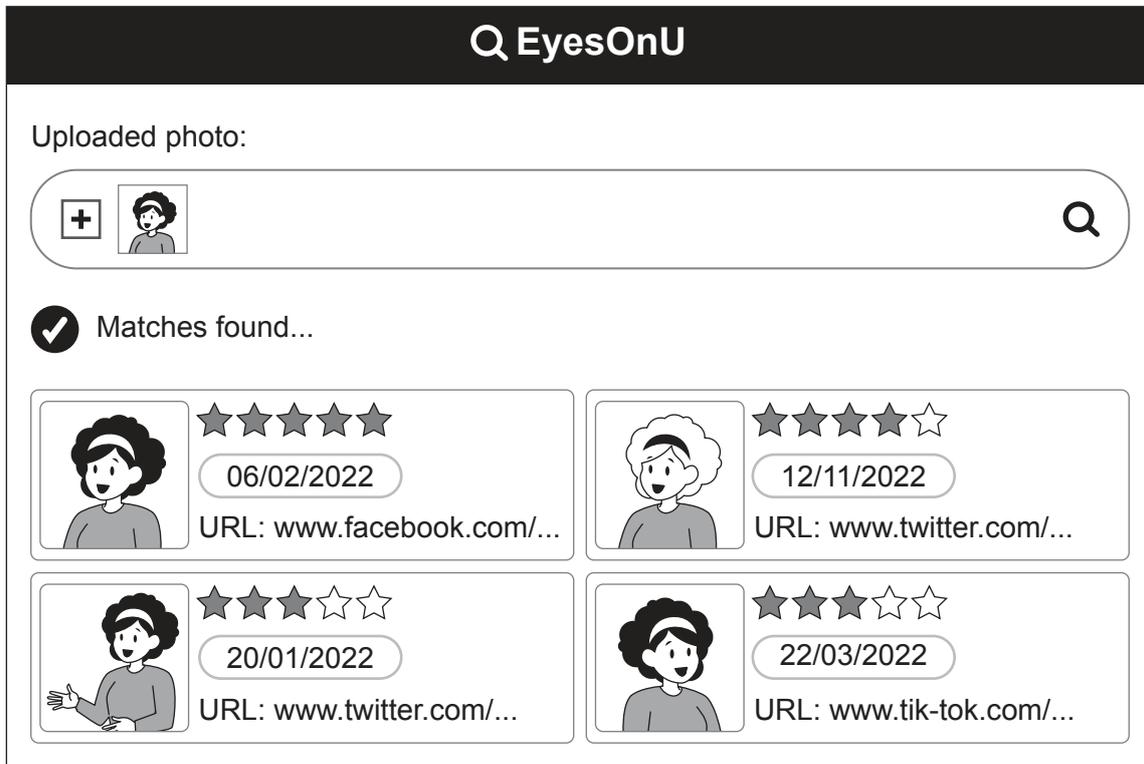


*EyesOnU* is marketed as an online tool that allows a user to see if somebody else has used an image that includes them without their permission.

*EyesOnU* aims to encourage its users to behave ethically.

*EyesOnU* stores the data in a relational database (see **Figure 3**).

**Figure 3: Part of the *EyesOnU* relational database**

| Users |
| :---: |
| UserID |
| FirstName |
| Surname |
| DateOfBirth |
| … |

| Images |
| :---: |
| ImageID |
| UserID |
| DateAndTime |
| … |

**(This question continues on the following page)**

**(Question 2 continued)**

(a) (i) State the primary key in the Users table in **Figure 3**. [1]

(ii) State the relationship between the Users table and Images table in **Figure 3**. [1]

(iii) Identify **two** reasons for using a relational database to store this information. [2]

(iv) Describe the difference between the internet and the World Wide Web. [2]

(b) The *EyesOnU* facial recognition tool has drawn criticism from privacy campaigners who say that the tool could be used to compromise a user's privacy. *EyesOnU* has stated that their privacy policy will prevent this.

Explain **three** rules that could be included in a privacy policy for *EyesOnU*. [6]

(c) There have been concerns raised about the way people use facial recognition sites like *EyesOnU*.

To what extent is it the responsibility of the website owners **and** the users of *EyesOnU* to ensure that users act ethically? [8]

**Turn over**

**3.      Fake news**

In 2021, 96 % of Brazilians with access to a smartphone used free internet messaging apps as their only method of communication and obtaining news (see **Figure 4**).

**Figure 4: An example of a smartphone with a free messaging app**
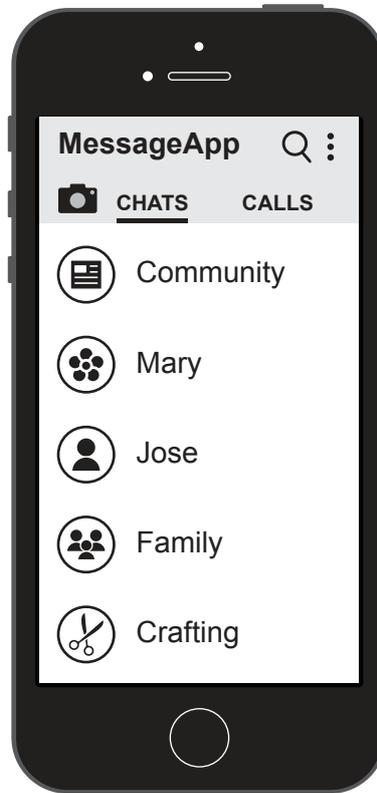


However, these messaging apps are leading to the spread of false information. This is because messages are often forwarded many times, especially when users are using messaging groups that allow messages to be shared between several people. These forwarded messages may not have been written by a member of the group. Being able to check whether the information in the messages is true can be very difficult.

One of the issues that has arisen as a result of false information being spread by such groups is that people in communities far from large towns are refusing medical treatment (such as vaccinations against preventable diseases).

The messaging app company has said that, because the messages on its platform are encrypted, there is nothing it can do to remove messages containing false information (see **Figure 5**).

**(This question continues on the following page)**

**(Question 3 continued)**

**Figure 5: An example of a message spreading false information**
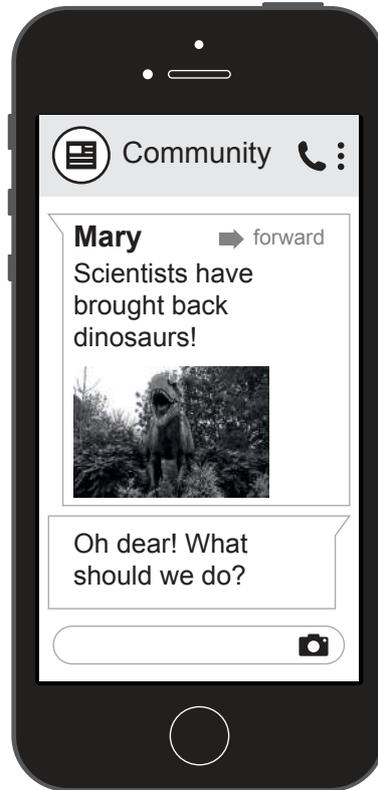


(a) (i) State **two** output devices on a smartphone. [2]

(ii) Identify the steps used in public and private key encryption. [4]

(b) It has been proposed that the following measures could be introduced to reduce the risk of users spreading false information:
• Limiting the size of messaging app groups.
• Limiting the number of times a message can be forwarded.
• Labelling messages as being forwarded.

Analyse this proposal. [6]

(c) To what extent is it the responsibility of the individuals within these communities to address the issue of false information being spread on social media? [8]

# Section B

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

4.   **SLF Law**

*SLF Law*, a legal firm, is planning to modernize their business. They intend to purchase software from *Legal Help*, a software development company, which will enable them to conduct research into legal cases.

The software, called Quick Research, consists of an expert system with the addition of natural language processing. The natural language processing software uses machine learning. It can be used by lawyers for legal searches but can also be used to provide information or advice to clients on a self-serve* basis.

*Legal Help* plans to use a Gantt chart rather than a PERT chart to manage the development of the software.

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\*   self serve: (self-service) a system in which a customer uses the software themselves without assistance

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

(ii)   Outline **one** advantage of using a Gantt chart rather than a PERT chart. [2]

(iii)   Identify **two** types of machine learning. [2]

(b)   (i)   **Figure 6** shows part of a decision tree where a person has been in an accident and may need a lawyer.

Study the rules below, then copy and complete the decision tree.

- A person has been in an accident.
- If the person has been in an accident **and** has been accused of causing the accident, they will need a lawyer.
- If the person does not meet both these requirements, they will receive the following message: "You do not require a lawyer". [3]

**(This question continues on the following page)**

**(Question 4 continued)**

**Figure 6: Part of the decision tree used by *SLF Law***
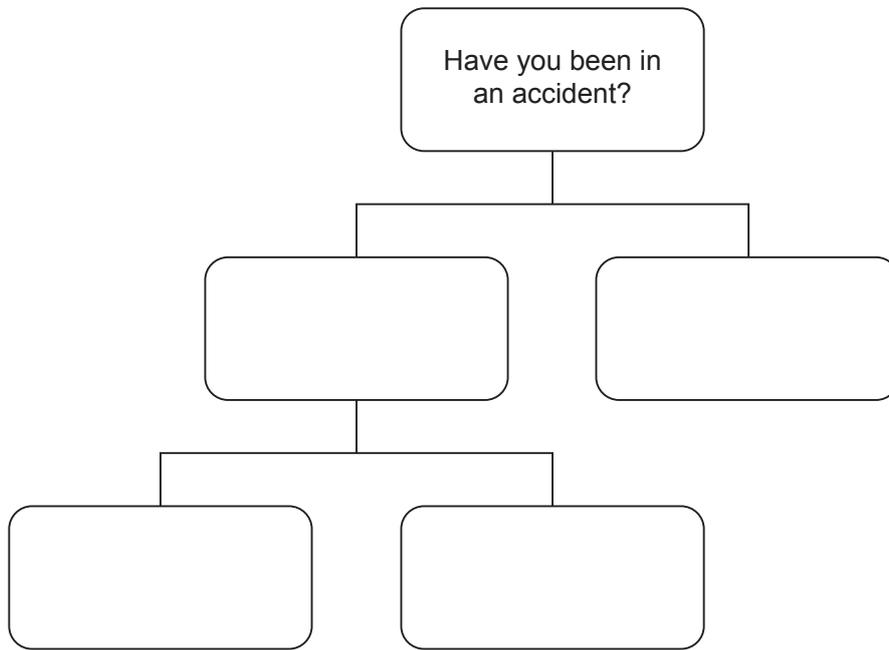


       (ii)    Distinguish between white-box testing and black-box testing.       [3]

    (c)    *SLF Law* have decided to purchase the Quick Research expert system.

           To what extent will the use of an expert system like Quick Research be beneficial to *SLF Law*?       [8]

**5.    Recruiting new staff for *TS Employment***

*TS Employment* is planning to purchase software that uses artificial intelligence (AI). This will enable them to speed up the recruitment of new staff.

The software will allow *TS Employment* to input the information provided by the job applicants and recommend the ones that should be invited to a face-to-face interview. Each job application would include details about the applicant like their age, gender and ethnicity, as well as a photo.

However, the software developers are aware that machine learning algorithms can replicate bias of various kinds, so they are looking for ways to prevent this. After research, they have concluded that the tendency to offer employment to particular groups may be due to inappropriate data in the initial data training sets or bias in the algorithms.

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

       (ii)   Identify **two** types of feasibility study that the software developers might use in
              the development of this software.                                                                         [2]

       (iii)  Identify **two** activities that may take place in the maintenance phase of the
              system development life cycle (SDLC).                                                               [2]

(b)    (i)    Concerns have been raised about information technology (IT) projects that are
              completed in a very short time.

              Explain **one** reason why completing IT projects in a short time may lead
              to problems.                                                                                                        [3]

       (ii)   Explain why the software developers have chosen the agile (scrum) development
              methodology for this project.                                                                              [3]

(c)    Two additional processes have been proposed during the development of the artificial
       intelligence (AI) software. They are:
       1.  Involving end users at all stages of the project.
       2.  Checking that the data being input into the system is not biased.

       Discuss whether these two processes should be included in the development of the
       AI software.                                                                                                               [8]

6. **Autonomous tanks**

   Many armies have replaced traditional tanks with robots that resemble tanks but are not manned by any military personnel (see **Figure 7**). The robots are equipped with a variety of weapons and sensors.

   The robots are controlled by military personnel and can do all the tasks that a traditional tank can do. They can also drag wounded soldiers to safety.

   A stakeholder analysis and feasibility studies were carried out during the development of the robots.

   There are plans to make the robots fully autonomous.

   **Figure 7: A robotic tank**

   

   (a)  (i)   Identify **two** methods of data collection that could be used for a stakeholder
              analysis during the development of the robots.                                    [2]

        (ii)  State **two** information technology (IT) personnel who would be involved in the
              development of the robots.                                                          [2]

        (iii) Identify **two** characteristics of an autonomous robot.                            [2]

   (b)  (i)   Multiple stakeholders will be affected by this project.

              Explain why a stakeholder analysis will lead to better project outcomes.           [3]

        (ii)  Explain why user acceptance testing is a critical part of the development of
              the robots.                                                                         [3]

   (c)  There have been concerns raised about the use of autonomous robots in war.

        Discuss whether it is acceptable to use autonomous robots in war.                         [8]

**References:**

**Figure 1**     Anon, n.d. [Vector image of car]. [online] Available at: https://publicdomainvectors.org/en/free-clipart/Green-car-vector-image/10093.html [Accessed 7 March 2022]. Public domain.

Anon, n.d. [Vector image of a building]. [online] Available at: https://publicdomainvectors.org/en/free-clipart/Building-3D-graphics/70653.html [Accessed 7 March 2022]. Public domain.

**Figure 5**     Mike, 2017. *Brown T-rex statue*. [online] Available at: https://www.pexels.com/photo/brown-t-rex-statue-410856/ [Accessed 7 March 2022]. Source adapted.