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Examiners should be aware that in some cases, candidates may take a different approach, which if appropriate should be rewarded. If in doubt, check with your team leader.

In the case of an "identify" question read all answers and mark positively up to the maximum marks. Disregard incorrect answers. In all other cases where a question asks for a certain number of facts *eg* "describe two kinds", mark the **first two** correct answers. This could include two descriptions, one description and one identification, or two identifications.

It should be recognized that, given time constraints, answers for part (c) questions are likely to include a much narrower range of issues and concepts than identified in the markband. There is no "correct" answer. Examiners must be prepared to award full marks to answers which synthesize and evaluate even if they do not examine all the stimulus material.

Section A

1.   Choosing a search engine

Note to examiners.
- *Part a and part b questions are marked using ticks and annotations where appropriate.*
- *Part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.***

(a)   (i)   Identify **two** advantages to parents if their children use the *Disney* search engine.   **[2]**

Answers may include:
- find legal content faster, more efficient
- will not unintentionally break piracy laws
- less likely to download illegal files containing malware or viruses
- websites more likely to have age-appropriate content / less likely to get inappropriate websites (*eg* adult content etc) listed in the search results.

*Award **[1]** for identifying an advantage of using a piracy free search engine up to a maximum of **[2]**.*

(ii)   Identify **two** ways that the authenticity of a user may be determined.   **[2]**

Answers may include:
- username and password
- two factor authentication (*eg* verification code sent via SMS etc)
- one time password (OTP)
- using digital signatures
- biometric authentication (*eg* fingerprint matching)
- answering a security challenge question.

*Award **[1]** for any of the points stated above up to a maximum of **[2]**.*

(iii)   Identify **one** Boolean operator.   **[1]**

Answers may include:
- AND
- OR
- XOR
- IF THEN
- EXCEPT
- NOT

*Award **[1]** for any of the points stated above.*

(iv)   State a Boolean search that would return the Mickey Mouse movies made in 1931.   **[1]**

Answers may include:
- "Mickey Mouse" **and** "1931"
- "Mickey Mouse" AND "1931"

*Award **[1]** for the correct Boolean search.*

Accept responses that omit the quotation marks ""

(b) (i) Explain **two** reasons why the *Disney* search engine would use cookies.   **[4]**

Answers may include:
- keep users logged in, therefore more convenient than having to keep going through the same process or remembering the passwords
- keeps record of preferences such as language preferences allowing the website that loads to be configured to the user's requirements.

Award [1] for each reason identified, and [1] for each appropriate explanation up to a maximum of [2] for each reason. Mark as [2] + [2]. Award a maximum of [4] for the answer.

(ii) Explain **one** reason why the *Disney* search engine would use authenticity as the key factor in ranking a website.   **[2]**

Answers may include:
- *Disney* sees benefits of being associated with an ethical search engine which fits in with how they are perceived by the public
- the use of authenticity may make the search engine more efficient and promote the websites that should be at the top rather than the ones that may have used unethical practices. Providing better user experiences
- as the search engine is aimed at children and young people, it must ensure appropriateness and quality of content for this particular age group. This is aided by using authenticity as a key factor in ranking websites.

Award [1] for a reason identified, and [1] for an appropriate explanation for that reason up to a maximum of [2] for the answer.

(c)   Evaluate the decision by *Disney* to promote their search engine.   **[8]**

Answers may include:

Benefits of *Disney* promoting their search engine
- gives official site priority – rather than random sites
- will not list sites offering illegal copies of *Disney Movies* sites by ranking popularity
- search results will produce sites free of malware as top ranking would be authentic sites
- protects intellectual property – top ranking sites would be authorized
- searches will result in all official *Disney* resources being listed
- will bring more traffic to their official sites
- may force other search engines to encourage more ethical behavior
- reduces money lost by *Disney* as a result of piracy.

Drawbacks of *Disney* promoting their search engine
- may take up a considerable amount of time to develop for limited results
- the algorithm used by *Disney* may be easily circumvented by unethical website developers so will only have a limited period when it is efficient
- the algorithm used by *Disney* may be easily pirated by other search engine developers which may lead to other companies copying the lead
- *Disney* may not be able to obtain the intellectual property (IP) rights necessary to develop the search engine and give it long enough to become established before other search engines copy it
- there may only be a limited market for the *Disney* search engine
- the search engine might not be as accurate as other search engines
- there is no guarantee that the search engine searches the whole of the web.

In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.

Please see generic markband information sheet on page 26.

2. Restaurant automation

Note to examiners.
- *Part a and part b questions are marked using ticks and annotations where appropriate.*
- *Part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.***

(a) (i) Identify **two** types of data that would be input into the restaurant's self-ordering kiosk system by a customer. **[2]**

Answers may include:
- name
- items ordered
- quality ordered
- quantity ordered
- payment type preferred
- cash tendered
- tip
- credit card swiped for payment
- whether the items will be "eat-in" (customer seated in restaurant) or "take-away"
- customer telephone/mobile phone number.

Accept the following data types:
- text / varchar
- number / numeric.

Award [1] for any of the types of data identified above up to a maximum of [2].

(ii) Outline **two** advantages to customers of the restaurant moving to a self-ordering kiosk or mobile ordering system. **[4]**

Answers may include:
- less waiting time so you do not have to wait for server to place order
- more efficient so there are less errors with order, you enter your own items
- visually appealing as you can see what you are ordering
- items listed on the kiosk may have more information included than on a traditional menu (*eg* ingredients, calorie count, region the food comes from etc)
- can order remotely and pick-up the order when convenient (*eg* can get other things done while order is being prepared)
- may be easier for people who do not speak/understand Japanese to choose items from the self-ordering kiosk (*eg* pictures of the food/multi-language translations etc)
- customers can compare menus/prices etc between different restaurants offering the self-ordering system
- customers can choose items without feeling under pressure from restaurant staff or other customers waiting in line.

Award [1] for identifying an advantage. Award an additional [1] for an explanation of that advantage up to a maximum of [2].

Mark as [2] + [2].

(b)   Explain **three** reasons why a customer may be uncomfortable about sharing their personal information with a third party to obtain the HK loyalty card.   **[6]**

Answers may include:
- data may be shared with a third party who, may then use the data in many ways that the customers is not aware of or may object to leading to privacy issues ("who has access to the data?")
- may receive too many emails or spam messages as a result of third parties having links with advertisers (as a source of revenue)
- collection and analysis of data – can result in the accumulation of vast amounts of information about eating preferences / personal details of the customer. Implications include purchases being investigated by police or customer targeted by criminals
- customers might feel uncomfortable because their location might be tracked when they use the loyalty card
- customers may feel uncomfortable with the storage of data – insecure storage may result in unauthorized access to personal data by employees or hackers breaking into the database.

Award [1] for each reason identified and [1] for an explanation of that reason up to a maximum of [2]. Mark the first three reasons identified.
Mark as [2] + [2] + [2].

The maximum mark for this question is [6].

(c)   Discuss the advantages and disadvantages of restaurants joining the HK loyalty card programme.   **[8]**

Answers may include:

Advantages
- customers will visit restaurant more often to earn rewards – increases repeat business
- increased number of customers – customers like bargains/free meals
- increased sales – customers will spend more if they have rewards to spend/collect more loyalty card points
- can improve customer knowledge – collecting customer information about their spending habits.

Disadvantages
- initial cost to setup and install systems – can be expensive
- maintenance/upgrades of system is ongoing
- customers may not want to share their data – feel like they are being stalked
- may decrease revenue if giving away free items as rewards for the program
- decisions may be based on the aggregated data rather than the pattern of sales at individual restaurants.

In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.

Please see generic markband information sheet on page 26.

3.   Digital citizenship

Note to examiners.
- *Part a and part b questions are marked using ticks and annotations where appropriate.*
- *Part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.***

(a)   (i)   Define the term "digital citizenship".   **[2]**

Answers may include:
- appropriate and responsible use of digital technologies
- safe and ethical use of digital tools
- ability to be a safe and productive citizen online
- awareness about implication of digital technologies such as digital commerce, digital law and digital security.

Award [1] for any of the points stated above up to a maximum of [2].

   (ii)   Identify the steps required to produce the chart in **Figure 3** using spreadsheet software.   **[4]**

Answers may include:
- input the data in the spreadsheet
- select data in columns
- click "create chart" button
- select graph type
- add data labels to graph
- add the title.

Award [1] for each of the steps stated above up to a maximum of [4].

(b)   (i)   Explain **one** benefit to students of learning about digital literacy in schools.   **[2]**

Answers may include:
- teaches responsible/appropriate use of technologies
- prepare students for society full of technology
- learn about inappropriate use and consequences
- develop understanding and skills in using digital technologies.

Award [1] for identifying an advantage. Award an additional [1] for an explanation of the advantage up to a maximum of [2].

(ii) Explain **two** characteristics of a website that can be used to determine
      whether it is a reliable source of information.   **[4]**

      Answers may include:
      • author – a listed author – author is willing to stand behind the information
        presented, author is a recognized expert on the subject of the website
      • date – allows readers to make decisions about whether that information
        is recent and not outdated
      • sources – credible websites should cite the source of the information
        presented
      • domain – domain such as .edu are reserved for colleges and
        universities, .gov is a government website – both are usually credible
        sources for information
      • writing style – poor spelling and grammar are an indication that the site
        may not be credible
      • quality of the sites the website links to – a website that contains many
        links to other high-quality/reliable sites is more likely to be reliable
      • comments left by other visitors – where a website allows comments to
        be posted, endorsements / positive comments may indicate that the
        information on the site is reliable.

      *Award [1] for identifying each characteristic and [1] for an explanation of
      that characteristic up to a maximum of [2].*

      Mark the first two reasons identified.

      The maximum mark for this question is [4].

(c)   To what extent can a school's acceptable-use policy (AUP) ensure that students
       will become responsible digital citizens?   **[8]**

       Answers may include:
       - gives students appropriate access to online resources at an appropriate age
         within a structured framework
       - allows students to explore the online environment in a controlled manner
       - provides parents with the confidence that the school is taking a responsible
         approach to the access of online resources
       - provides parents with a "contract" that may make their child think about how
         they use the internet
       - policies without a previous education campaign/involvement of stakeholders
         may not work
       - teachers/students may feel they can ignore the policies because they do not
         apply to their situation (*eg* downloading copyrighted videos to use in class
         because the school has insufficient bandwidth to stream them)
       - digital citizenship policies are only as effective to the extent which all the
         stakeholders in the school community agree to follow them (*eg* students,
         teachers, parents, administrators etc)
       - acceptable-use policies are only effective if policed by the school
       - acceptable-use policies are limited to the school environment/network.
         Students may not follow the same practices outside the school / the policies
         might have limited overall effect on the students' development as responsible
         digital citizens
       - by exemplifying / enforcing responsible use in school, acceptable-use policies
         may have a wider influence on students / promote good habits even when
         students are not constrained by the policies
       - the school may use technical solutions to support responsible use
         (*eg* blocking certain social networking sites, monitoring students network
         activities) which prevents students developing the skills to appropriately
         navigate the World Wide Web.

       *In part (c) of this question it is expected there will be a balance in the ITGS
       terminology between IT technical terminology and the terminology related to
       social and ethical impacts.*

       Please see generic markband information sheet on page 26.

Section B

4.   Swarm technology

Note to examiners.
- *Part a and part b questions are marked using ticks and annotations where appropriate.*
- *Part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.***

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

Answers may include:
- interacts with the physical world in some way
- moving parts
- computer controlled
- sensors
- source of energy
- actuators
- software uses artificial intelligence.

*Award **[1]** for any of the characteristics of a robot identified above up to a maximum of **[2]**.*

Do not accept "autonomous"

(ii)   Identify **four** steps that could be taken by an autonomous robotic boat (robot boat) to enable it to work cooperatively with the others in the swarm.   **[4]**

Answers may include:
- sensors or radar in individual robotic boat (boat) detects other boats or an anonymous boat or an obstacle
- robotic boat (boat) calculates its position using radar or other communication technology, *eg* GPS
- robotic boat does the same for boat(s) or obstacle it has detected
- robotic boat transmits its own position to whole swarm
- robotic boat sends position of boat(s) or obstacle to all other boats in the swarm
- the swarm performs manoeuvres (based on an algorithm) as required such as encircling an enemy boat, avoiding other (robotic) boats or obstacles, flashing lights to warn the anonymous boat or communicate with the anonymous boat using speakers
- each member of the swarm reacts to the others based on its location with respect to the others.

*Award **[1]** for any of the steps that could be taken by a robot boat to work cooperatively with the others in the swarm identified above up to a maximum of **[4]**.*

(b)   In the future, autonomous robotic boats (robot boats) may be used to carry passengers.

Explain **three** concerns that would need to be addressed before these robot boats could be used for carrying passengers.   **[6]**

Answers may include:
- reliability of devices / concern about failure detection and response so that a safe journey can be guaranteed
- reliability/safety – testing in a variety of extreme conditions/humans so that the users know the vehicles can adapt to changing situations
- autonomous boats are as precise and reliable as humans/ensure unmanned systems remove elements of human error
- decision making of boat is limited to what it knows which may lead to concerns about the safety of an unmanned system in a crisis situation
- mistrust of the IT system (*eg* high speeds involved, accident by hitting other boats/obstacles due to IT error, no person to assist all in an emergency)
- interception of radar by unscrupulous people/pirates which may lead to sensitive information held by the company being shared.

Award [1] for the identification of a consideration that would need to be made before these autonomous boats are accepted by the citizens and an additional [1] for an explanation of the consideration up to a maximum of [2].

Mark as [2] + [2] + [2].

Award a total of [6].

(c)   Sometimes suspicious boats approach the ship that the autonomous robotic boats (robot boats) are protecting. The robot boats have on-board weapons that they can fire in dangerous situations. Currently, a navy officer must decide what the robot boats should do if a suspicious boat does not respond to the swarm's warnings.

Discuss whether the navy should develop the robot boats so that they are able to make their own decision about whether to open fire on suspicious boats.   **[8]**

Answers may include:

To allow the robot boats to act autonomously
- improved efficiency of operations as decisions can be made instantly
- may act as another level of deterrent before human intervention occurs which may make it less likely to escalate the situation
- reduced military costs in terms of personnel
- reduced number of issues related to the safety of personnel as they are not directly involved in the actions.

To not allow the robot boats to act autonomously
- lack of human intervention could escalate the situation unnecessarily
- concern about the algorithms used that lead to the robot boats opening fire, would they be sophisticated enough to deal with the range of situations they may encounter
- concern about the desensitization of military personnel who may not see the consequences of their actions at first hand
- difficult in determining accountability if the crew of the ship killed due to systems errors.

The responses should focus on the swarm features of autonomous technology.

In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.

Please see generic markband information sheet on page 26.

5. Electronic health records (EHR) in hospitals

Note to examiners.
- *All part a questions are marked using ticks and annotations where appropriate.*
- *Part b and part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.***

(a) (i) Identify **two** training methods that could be used to enable medical staff to use the new eHospital electronic health record system. **[2]**

Answers may include:
- Computer-Based Training (CBT)/virtual reality/multimedia
- online/web-based courses
- webinars
- video-conferencing
- self-paced training manual/video tutorials
- face-to-face/classroom or instructor-led training
- blended learning approach.

*Award **[1]** for any of the training methods that could be used to enable medical staff to use eHospital identified above up to a maximum of **[2]**.*

(ii) Identify **two** responsibilities of the IT support staff. **[2]**

Answers may include:
- installing and configuring computer systems
- diagnosing and solving hardware/software problems
- logging customer/employee queries
- analysing call logs to spot trends and underlying issues
- installing and configuring computer hardware operating systems and applications for eHospital
- monitoring and maintaining computer systems and networks
- talking staff or clients through a series of actions, either face-to-face or over the telephone to help set up systems or resolve issues
- supporting the roll-out of new/updated applications
- setting up new users' accounts and profiles and dealing with password issues
- responding within agreed time limits to calls for support
- prioritizing and managing many open cases at one time
- testing and evaluating new technology (*eg* eHospital on new mobile devices)
- conducting electrical safety checks on computer equipment.

*Award **[1]** for any of the responsibilities of the IT support staff identified above up to a maximum of **[2]**.*

(iii) Identify **one** advantage of using questionnaires to survey medical staff
about the eHospital system before its development. **[1]**

Answers may include:
- relatively easy to analyse
- a large sample of the given population can be contacted at relatively low cost
- simple to administer
- the format is familiar to most respondents
- simple and quick for the respondent to complete
- information is collected in a standardised way
- can be used for sensitive topics which users may feel uncomfortable speaking to an interviewer
- can be anonymous so answers will be more honest
- respondents have time to think about their answers; they are not usually required to reply immediately.

*Award **[1]** for any of the advantages of using questionnaires to survey
medical staff prior to the development of the eHospital system identified
above up to a maximum of **[1]**.*

(iv) Identify **one** disadvantage of using questionnaires to survey medical staff
about the eHospital system before its development. **[1]**

Answers may include:
- if you forget to ask a question, you cannot usually go back to respondents, especially if they are anonymous
- it is sometimes difficult to obtain a sufficient number of responses
- those who have an interest in the subject may be more likely to respond, skewing the sample
- respondents may ignore certain questions
- questionnaires may appear impersonal
- questions may be incorrectly completed
- not suitable to investigate long, complex issues
- respondents may misunderstand questions because of poor design and ambiguous language
- questionnaires are unsuitable for some kinds of respondents, *eg* visually impaired
- there is the danger of questionnaire fatigue if surveys are carried out too frequently
- require follow up research to investigate issues in greater depth and identify ways to solve problems highlighted.

*Award **[1]** for any of the disadvantages of using questionnaires to survey
medical staff prior to the development of the eHospital system identified
above up to a maximum of **[1]**.*

(b) Analyse the project manager's decision to use a parallel changeover of the eHospital system instead of a direct changeover.

Analyse these changeover methods. **[6]**

Answers may include:

Advantages of Direct Changeover
- may take less time, new system is up and running immediately
- may be less confusing for staff as they have only one system to understand
- will remove the issues of compatibility between the two systems that may occur with a parallel changeover.

Disadvantages of Direct Changeover
- training is required before the implementation
- may lead to duplication of work if comparisons are made between the systems
- high risk of data loss.

Advantages of Parallel changeover
- may provide time for staff to learn the new system (training)
- may give time to appraise the new system as it is implemented
- very low risk of data loss.

Disadvantages of Parallel changeover
- training is required before the implementation
- duplication of work between the two systems
- confusion for staff because there are two systems to understand.

[0]: No knowledge or understanding of ITGS issues and concepts.
No use of appropriate terminology.

[1–2]: A limited response that indicates very little understanding of the topic or the reasoning is not clear. Uses little or no appropriate terminology.
No reference is made to the scenario in the stimulus material. The response is theoretical.

[3–4]: A description or partial analysis of the advantages and disadvantages of direct and parallel changeover methods. Some relevant examples relating to the scenario are used within the response. There is some use of appropriate terminology in the response.

[5–6]: A thorough analysis of the advantages and disadvantages of direct and parallel changeover methods and why each method is or is not appropriate. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate terminology throughout the response.

(c)   The introduction of new information systems, such as the eHospital electronic health record system, can prove problematic.

To what extent is the success of a new information system dependent on both the training of the staff that use it and the information system itself?   **[8]**

Answers may include:

Staff training
- the new system may not be intuitive so staff training will be necessary
- training may uncover bugs in the system that can be rectified before the system is fully introduced
- training may be cost effective and lead to greater efficiencies in the use of the new system
- training may allow staff to take ownership of the new system and be more accepting of its faults/foibles.

Development of the information system (eHospital electronic health record system)
- if the new information system is badly designed no amount of staff training will make it usable
- the information system should be developed so that it is intuitive and staff training can be minimized
- with an intuitive and well-designed information system staff turnover, and as a result, training costs will be less of a factor
- if end users are involved in the development of the information system the issue of training becomes significantly reduced.

In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.

Please see generic markband information sheet on page 26.

6. Lowell High School learning management system (LMS)

Note to examiners.
• *All part a questions are marked using ticks and annotations where appropriate.*
• *Part b and part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.***

(a)   (i)   Identify **two** methods that Lowell High School could use to collect feedback
from the students.   **[2]**

Answers may include:
• questionnaires/survey
• interviews
• email responses
• class visits
• focus groups
• informal discussions
• online forums/blogs.

*Award **[1]** for any of the methods that the high school could use in order to collect feedback from the teachers up to a maximum of **[2]**.*

(ii) Identify **four** design requirements the teachers should consider when
creating videos for mini lectures.   **[4]**

Answers may include:
• overall structure (storyboard)
• internal structure (details for the video clips)
• video effects, *eg* mouse click effects (both visual and audible),
  zoom features
• script /content for explaining the concept
• collecting quality audio/narration
• sub-titles in the video
• duration/quality vs file size (for streaming/downloading)
• logo/branding
• synchronization of videos and audio/narration
• use of *Creative Commons* images/consideration of copyright for
  included materials
• include interactive activities.

*Award **[1]** for each design requirements identified up to a maximum of **[4]**.*

(b)   Analyse the decision to use an agile rather than a waterfall project management
       methodology for the development of Lowell High School's LMS.   **[6]**

Answers may include:

Advantages of agile
- a flexible approach – programmer can make changes as it is developed /
  project priorities are re-evaluated on a continuing basis
- beneficial for small teams with rapidly changing requirements
- iterative in nature so can respond to challenges that occur during development
- can incorporate new features/ideas as the LMS develops
- leads to the early testing and production of working software modules
- training is "just-in-time" and on-going
- may lead to faster development compared with waterfall method.

Disadvantages of agile
- non-sequential design process – lack of initial plan might lead to inadequate
  resources (*eg* additional hardware/training/time) being set up
- no scope or end point of project
- no long term planning sequence of introduction of features – may be difficult
  for teachers to plan long term
- training is ad-hoc (although can be negated with teachers trialing features and
  showing others)
- needs experienced developer/programmer
- may be difficult to prioritize new features as many stakeholders involved.

Advantages of waterfall
- sequential design process providing clear scope and end point of project
- strategic rather than ad-hoc planning sequence
- resources can be allocated to the project well in advance so training can be
  easily integrated into the timeline
- enables the priorities of the project to be explicitly identified.

Disadvantages of waterfall
- lacks flexibility so issues may not be resolved in a timely and cost effective
  manner
- may need a large team to manage the project
- lines of demarcation may be blurred so all issues end up being escalated
  slowing down the project
- testing may be a bolt-on rather than an integral part of the process
- may take longer to complete than using an agile project management
  methodology.

[0]: No knowledge or understanding of ITGS issues and concepts.
No use of appropriate terminology.

[1–2]: A limited response that indicates very little understanding of the topic or the reasoning is not clear. Uses little or no appropriate terminology.
No reference is made to the scenario in the stimulus material. The response is theoretical.

[3–4]: A description or partial analysis of the advantages and disadvantages of agile and waterfall project management methodologies. Some relevant examples relating to the scenario are used within the response. There is some use of appropriate terminology in the response.

[5–6]: A thorough analysis of the advantages and disadvantages of agile and waterfall project management methodologies. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate terminology throughout the response.

(c)   The Lowell High School administration has two options for developing the learning management system:
  - use an in-house programmer, such as the computer science teacher or network manager
  - use an external software development company.

Evaluate these options.   **[8]**

Answers may include:

Advantages of in-house programmer
- better understanding of how the school works – easier to prioritize features
- cheaper / no travel time / quicker to get feedback / organize meetings with stakeholders
- less time spent in meetings as the single person is the development team: manager, programmer, analyst, project manager.

Disadvantages of in-house programmer
- programmer might leave the school
- may be slower to implement as the programmer has to do all tasks
- may not have all skills required to manage and develop the project
- might not have all technical skills required/need additional training
- may not provide sufficient technical documentation.

Advantages software development company
- wider range of expertise/diverse range of experience
- more expertise with delivering systems
- on contract – more incentive to deliver
- may have experience with similar systems and able to deliver higher quality product
- tasks can be allocated to different team members with specific expertise – quicker/higher quality.

Disadvantages of software company
- have other clients which may cause time delays
- potentially more expensive.

In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.

Please see generic markband information sheet on page 26.

7. **Facial recognition technology**

Note to examiners.
- *Part a and part b questions are marked using ticks and annotations where appropriate.*
- *Part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded.* ***Do not use ticks.***

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

Answers may include:
- a type of artificial intelligence (AI)
- the ability for computers to learn without being explicitly programmed
- computer programs that can teach themselves to grow and change when exposed to new data.

Do not accept "a machine that learns" or similar response.

Award [1] for any of the points identified above up to a maximum of [2].

(ii) Describe **two** ways that the privacy of the research volunteers can be ensured by *CrowdEmotion*. **[4]**

Answers may include:
- restricting the personal information that is collected (*eg* facial recordings, IP addresses, and website usage information using cookies)
- opt-in research policy (*eg* data, including facial images, will only be collected from participants who have given their explicit consent by allowing access to their webcam prior to each media viewing session)
- all personal data will be stored in a secure location (*eg* use industry standard technical and organizational security measures to protect data against unauthorized disclosure or processing)
- personal information will not be with third parties (*eg* may never sell personal information to clients, may share your information in limited ways, may view facial recordings for quality assurance purposes and to help improve software and reporting capabilities)
- how the data is used (*eg* will never try to sell user any products or services, never share personal information with anyone engaged in marketing, telemarketing or other solicitous activities unless consent is given by user)
- how long personal data is kept (*eg* as long as it is required for research and for training, or for emotion recognition libraries)
- use of cookies (*eg* to track research and assess participant behaviour information).

Award [1] for each policy identified and award an additional [1] for an appropriate development of that policy up to a maximum of [2].

Mark as [2] + [2].

Award a maximum of [4] for the answer.

(b)   Machine learning is based on pattern recognition rather than inference rules.

    (i)   Distinguish between pattern recognition and inference rules.   **[4]**

Answers may include:
- inference rules are based on two possible outcomes
- it uses chaining to develop an understanding of complex behaviour or information requests from simple requests such as "does A apply?" with possible answers being "Yes" or "No"
- inference rules are based on exact matches rather than a range of possible responses
- pattern recognition is based on the matching of the image with a known set in a database
- it is intended to provide a range of possible answers
- this may enable the computer to learn about associations in the dataset.

Award [1] for each appropriate statement about inference rules and award an additional [1] for an appropriate development of that statement up to a maximum of [2].

Award [1] for each appropriate statement about pattern recognition and award an additional [1] for an appropriate development of that statement up to a maximum of [2].

Mark as [2] + [2].

Award a total of [4].

    (ii)   Explain **one** reason why *CrowdEmotion* will use pattern recognition rather than inference rules to identify the expressions shown.   **[2]**

Answers may include:
- the possible number of facial expressions may be almost infinite so it will be impossible to create a sufficiently complex set of inference rules to cover all eventualities
- pattern recognition allows the computer to self-learn whereas inference rules require human intervention to increase their range and complexity.

Award [1] for each reason identified and award an additional [1] for an appropriate explanation of that reason up to a maximum of [2].

(c)   To what extent can facial recognition technologies like *CrowdEmotion* be effective in advertising campaigns? **[8]**

Answers may include:

Positive
- provides quick turnaround of reactions to an advertising campaign; allows quicker decision making for where to place advertisements/spend advertising dollars
- can measure reaction by comparing current data with other campaigns that used same software
- increase of database of facial emotions can produce more accurate results over time
- machine learning can improve accuracy of results over time
- availability of devices to record facial expressions increasing over time.

Negative
- reliability in collection and analysis of data could lead to incorrect results
- cultural differences in facial expressions may misdiagnose emotion
- data sets may be insufficient to detect accurate emotion and mislead results
- digital divide: may not be able to collect data from some lower socio-economic groups and therefore unable to test campaign on some groups
- facial expressions may vary depending on location or environment of user (*eg* collected in a public place or in private)
- some people may chose not to participate or give false information if they believe the information gathered is not being used for the intended purpose
- there may be a danger that the scope of the software is increased and the participants are not informed/unethical practices.

In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.

Please see generic markband information sheet on page 26.

SL and HL paper 1 part (c) and HL paper 3 question 3 markband

Marks	Level descriptor
No marks	• *A response with no knowledge or understanding of the relevant ITGS issues and concepts.* • *A response that includes no appropriate ITGS terminology.*
Basic **1–2 marks**	• *A response with minimal knowledge and understanding of the relevant ITGS issues and concepts.* • *A response that includes minimal use of appropriate ITGS terminology.* • *A response that has no evidence of judgments and/or conclusions.* • *No reference is made to the scenario in the stimulus material in the response.* • *The response may be no more than a list.*
Adequate **3–4 marks**	• *A descriptive response with limited knowledge and/or understanding of the relevant ITGS issues and/or concepts.* • *A response that includes limited use of appropriate ITGS terminology.* • *A response that has evidence of conclusions and/or judgments that are no more than unsubstantiated statements. The analysis underpinning them may also be partial or unbalanced.* • *Implicit references are made to the scenario in the stimulus material in the response.*
Competent **5–6 marks**	• *A response with knowledge and understanding of the relevant ITGS issues and/or concepts.* • *A response that uses ITGS terminology appropriately in places.* • *A response that includes conclusions and/or judgments that have limited support and are underpinned by a balanced analysis.* • *Explicit references to the scenario in the stimulus material are made at places in the response.*
Proficient **7–8 marks**	• *A response with a detailed knowledge and understanding of the relevant ITGS issues and/or concepts.* • *A response that uses ITGS terminology appropriately throughout.* • *A response that includes conclusions and/or judgments that are well supported and underpinned by a balanced analysis.* • *Explicit references are made appropriately to the scenario in the stimulus material throughout the response.*