2224 – 5504M

Diploma Programme
Programme du diplôme
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Markscheme

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Digital Society

Higher level

Paper 1

17 pages

Section A

1. Diggi the health service robot

(a) (i) Identify **two** output devices that might be included on a service robot. **[2]**

Answers may include:
- Robotic arm.
- Wheels (to move).
- Screen / monitor.
- LED display (face).
- Speaker.
- Activator/motor system for storage container.
- Electronic lock on storage container.

*Award **[1]** for identifying each output device which might be included on a service robot up to **[2]**.*

(ii) Identify **two** sensors that Diggi would use to help it navigate a hospital's corridors. **[2]**

Answers may include:
- Beacon/RFID reader / sensors for geo fences (or similar) based on scanning locations in hospital.
- Colour sensor / Line following to follow a route on the floor / light sensor.
- QR code / Bar code reader – to read route information from the floor.
- Character recognition – could read the signs in the hospital to locate itself.
- LIDAR / Radar.
- Cameras / Character recognition (could read the signs in the hospital to locate itself).
- Ultrasonic / proximity sensor.

*Award **[1]** for identifying each sensor Diggi would use to help it to navigate through the hospital corridors up to **[2]**.*

(iii) Identify **two** ways in which the developers of Diggi might make the robot seem more human. **[2]**

Answers may include
- Facial features / expressions that can express various emotions.
- Could communicate with people via text to speech / human like voice.
- Could communicate in text via the display panel.
- Has a 'name' (Diggi).
- Has a head and torso – for example, human shape / two arms and legs.
- Human' movement' – for example, can turn its head / can 'wave' with its arm / walks on two legs.

*Award **[1]** for identifying each way that the developers of Diggi might make the robot seem to human like up to **[2]**.*

(b) (i) Diggi's design was based on data gathered by primary and secondary research.

Explain **three** methods of primary data collection that would provide information that could enable Diggi to complete its tasks. **[6]**

Note to examiners: This part (b) question should be marked with ticks.

Answers may include

- Focus groups.
- Would allow small groups of interested users/parties to provide information about how earlier versions/prototypes of Diggi appear and/or function.

- Interviews.
- Would allow interested users/parties to provide detailed information about how prototypes of Diggi appear and/or function.

- Observation.
- Would allow interested users/parties to see how Diggi functions.

- Survey / Questionnaire.
- Ask people what they need from a robot like Diggi.

*Award **[1]** for identifying the method of primary data collection used to inform the design of Diggi and **[1]** for a development of why this primary data collection type is appropriate up to **[2]**.*

*Mark as **[2]** + **[2]** + **[2]***

(c) Evaluate the opportunities **and** dilemmas associated with the use of service robots, such as Diggi, in the healthcare sector. **[8]**

Answers may include

Opportunities:

- Does tedious tasks (such as fetching equipment) for the nurses.
- Allows nurses and doctors more time to spend treating patients as it does the fetching and carrying (ethics, change).
- Can keep the patients schedules and files so that no-one is given the wrong medication or medication at the wrong time (systems, ethics).
- Some evidence that robots can provide companionship and alleviate some of the stress of loneliness (ethics, identity).
- Employment – shortage of nurse and support staff, nurse having to do support staff jobs (ethics).
- Could deliver food or medicines to patients who are in isolation / have infectious diseases.

Dilemmas:

- People might feel that their jobs are being taken by the robots / deskilling (ethics). change
- Robots can malfunction and might end up hurting someone (systems, ethics)
- Access to medical records may lead to privacy issues (ethics).
- Ethics of allowing robots to make decisions about patient care – who will be responsible if something goes wrong (ethics, accountability).
- Deskilling of nurses – may lose the ability to correctly order supplies and this will mean if the robot isn't there they will be less effective (change, systems, ethics).
- Some people might feel uncomfortable having a robot in the room (systems). This may relate to a person's age/ culture (identity)
- Security and secureness of the robot if carrying drugs or acting as a terminal to records (systems, ethics).
- If delivering medication – risk of hacking and tampering with medications (systems, ethics).
- Could spread disease and infection while moving between patients if not sanitised properly.
- Nurses (and other hospital staff) might have additional jobs to do as a result of the robot needing to be instructed / maintained / restocked etc.

Keywords: *robots, change, identity, systems, ethics, values, accountability, transparency, trust*

Please see SL paper 1 part (c) and HL paper 1, Section A part (c) markband on page 13.

2. "Art is dead"

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

Answers may include:

- A set of rules (that are followed by a computer in problem solving).
- A sequence of step-by-step unambiguous instructions.
- Unambiguous.
- (well dfined) inputs and/or outputs.
- Finite (number of steps).
- Feasible.

Do not accept 'well defined' on its own.

*Award **[1]** for identifying each characteristic of an algorithm up to **[2]**.*

(ii) Identify **two** types of artificial intelligence (AI). **[2]**

Answers may include:

- strong
- full
- general
- weak
- narrow
- domain-specified / domain specific / subject specific.

*Award **[1]** for identifying each type of artificial intelligence up to **[2]**.*

(iii) Identify **two** image formats that may be used by PIX-ia. **[2]**

Answers may include:

- gif
- jpeg/jpg
- bmp
- png.

*Award **[1]** for identifying each image format that may be up to **[2]**.*

(b) (i) Explain **one** advantage of using the open-source software development community to develop PIX-ia. **[2]**

Note to examiners: This part (b) question should be marked with ticks.

Answers may include:

- The community has greater control over the scope of the project.
- Such as the timing, sequencing.

- It allows for the faster evolution / is more agile.
- Because there is less corporate bureaucracy to get in the way.

- Updates / repairs can be made more rapidly than for proprietary software.
- Because there are members of the community who are ready to step in and solve problems.

- Distributed in nature.
- So the community has ownership of the product.

- Lower cost than proprietary software.
- By the use of sweat equity.

- Dataset (copyright free images) could be bigger and more diverse if developed by the open-source community compared to proprietary software.
- As there is a larger developer community.

Note: Answers must focus on the OSS development community and not the software itself.

*Award **[1]** for identifying an advantage of using the open-source community and **[1]** for a development of that advantage up to **[2]**.*

(ii) Suggest **two** ways in which PIX-ia could obtain copyright-free images. **[4]**

Note to examiners: This part (b) question should be marked with ticks.

Answers may include:

- Develop a "sweat equity" scheme.
- This requires the user to contribute a CC image in exchange for access/use.

- Using search filters.
- to search for images tagged under suitable creative commons / copyleft licenses.

- Developing partnerships with open source/creative commons licensed sites like Wikimedia, flickr etc.
- That have an extensive library of images available.

- Having the user community contribute to the database under a CC license.
- In order to build a larger and more diverse dataset to share with other users.

*Award **[1]** for identifying a way that PIX-ia can obtain copyright-free images and **[1]** for an elaboration up to **[2]**.*

*Mark as **[2]** + **[2]***

(c) Discuss the opportunities **and** dilemmas of using artificial intelligence (AI) to create new artworks. **[8]**

Answers may include

Opportunities

- Anyone can 'create' art for themselves at minimal cost (systems, change).
- Speed - multiple cover produced in short space of time (systems).
- Broader selection of images for the cover than artist would have available from anywhere in the world (space)
- Ability to have low-cost experimentation (systems, expression).
- Develop ideas/concepts/combinations that MJ has not been exposed to or considered (expression).
- Potentially up to date with current trends or trends within the music sub-culture (expression).
- Would be cheaper than employing an artist (ethics, change).
- Companies may pay artists to develop content to include in their AI systems.

Dilemmas

- Potential copyright infringement (ethics).
- Determining the ownership of AI-generated art raises complex questions about intellectual property rights, such as whether the credit should go to the programmer, the user, or the AI itself. (ethics, system).
- Graphic designers/artists will lose work as people will now just use the tool (systems, change, ethics).
- Potential ongoing liability in future when someone discovers their image has been used beyond the license agreement (ethics).
- Potential lack of flexibility in development of cover – ability to change individual components/images or placements (systems).
- AI systems do not emulate emotional intelligence and will therefore be unable to produce artwork that may have deeper meaning or hidden messages.
- Potential for humans to become less creative as AI can do much of the work for them.
- Bias in datasets and algorithms could lead to images which are not representative of the population for whom they are made.

Keywords: *artificial intelligence, ownership, change, identity, expression, systems, ethics, values, transparency, trust*

Please see SL paper 1 part (c) and HL paper 1, Section A part (c) markband on page 13.

3. Connecting the unconnected

(a) (i) Identify **two** items of hardware that are needed for a student to connect to the internet at home. **[2]**

Answers may include:

- Modem.
- Router.
- Network interface card / wireless card.
- Digital device / computer (laptop / tablet / smart phone / PC etc).

*Award **[1]** for identifying each item of hardware that are needed to connect to the Internet up to **[2]**.*

(ii) Identify **two** services provided by an internet service provider (ISP) **other than** access to the World Wide Web. **[2]**

Answers may include:

- Email.
- Chat / texting / online messaging.
- File sharing.
- Cloud storage.
- VOIP / video conferencing.
- SaaS / PaaS / IaaS.
- Customer support services and technical assistance.
- Data security / antivirus / firewall / monitoring for malware and phishing attempts.

*Award **[1]** for identifying each service provided to by an internet service provider (ISP) in addition to access to the World Wide Web up to **[2]**.*

(iii) Identify **two** ways in which students could use the internet to collaborate online. **[2]**

Answers may include:

- Collaborative documents – Google Docs/Slides/Sheets/wiki/padlets.
- Social media – posts, groups.
- Sharing resources – shared folders.
- Asynchronous communications – email, SMS/messaging, online forums, discussion platforms, WhatsApp group/chats.
- Synchronous communications – chats, VOIP (voice/video calls), Discord chats/calls, MS Teams chats/calls.

*Award **[1]** for identifying each way that students could use the internet to collaborate online up to **[2]**.*

(b) (i) Distinguish between the internet and the World Wide Web. **[2]**

Note to examiners: This part (b) question should be marked with ticks.

Answers may include
- The internet is a worldwide network of networks/ a hardware-based infrastructure / WAN (wide area network) / GAN (global area network) (whereas)
- The www is the collection of webpages, hosted on webservers and accessible via web browsers. It is a subset of the Internet.

*Award **[1]** for identifying a distinguishing characteristic of each of the Internet and the WWW up to a maximum of **[2]**.*

(ii) Suggest **two** reasons why some communities have limited access to the internet. **[4]**

Note to examiners: This part (b) question should be marked with ticks.

Answers may include
- Geography of the location / The network was in a region with mountains.
- So faster means of connecting (fiber cables) could not be installed.

- Economic reasons / Not enough paying customers / Fewer people in rural areas / less concentrated population / less customers have the computer infrastructure required.
- Therefore it is not economically viable for the ISPs to put in services.

- Education.
- People lack literacy/digital literacy to use the services.

- Government policies.
- Some communities may not be high priority and governments will not have put the effort into providing access.

- Cultural or religious reasons.
- Some communities may want to limit access to technologies such as the internet / stop or discourage community members from using the technology.

*Award **[1]** for identifying a reason why some communities have limited access to the internet and **[1]** for a development of that reason up to **[2]**.*

*Mark as **[2]** + **[2]***

(c) Discuss whether it is acceptable for schools to require students to access the internet when completing their homework outside of school. **[8]**

Answers may include

Is acceptable because

- Access to the internet is fast becoming a necessity for teaching and learning and a basic human right (ethics, change).
- Many people have cell phones / mobile phones which can be used to access the internet (systems).
- Public hotspots (library / schools / government buildings) are available to students to do their homework (systems).
- Hotspots in businesses (such as coffee shops / malls / fast food restaurants etc) provide access (systems).
- In countries where there are schemes to provide devices and data (either through the school or other social agencies) (systems).
- The pace of development cannot be at the pace of the slowest, measures need to be introduced to ensure the disadvantaged are not further disadvantaged (ethics, change, space).
- The Internet offers a wealth of research resources, interactive learning opportunities, educational tools, ... " (system, space, change).

Is not acceptable

- Where Some students do not have access to devices or even electricity to run those devices (ethics, systems, space).
- If schools don't also provide devices and/or data the students who are already disadvantaged may be further disadvantaged (systems, ethics).
- If there is a large gap between students in the school / some students do and some don't have access (systems, ethics).
- Because The exacerbation of the differences between the haves and have nots is contrary to the guiding principles of the web (systems, ethics).
- Where the school cannot put into place measures to protect students from harmful content on the internet whilst they are using it unsupervised (systems, ethics, values).

Note to examiners: *Do not credit responses that discuss the opportunities and dilemmas associated with the use of the Internet as a resource in education (this is a much broader and different discussion to that required for this question).*

Keywords: *networks, internet, hardware, connectivity, teaching, learning, change, spaces, systems, ethics, values, equity*

Please see SL paper 1 part (c) and HL paper 1, Section A part (c) markband on page 13.

The following markbands should be used with responses to part (c).

SL and HL Paper 1, part (c)	
Marks	**Level descriptor**
0	The work does not reach a standard described by the descriptors below.
1–2	• The response shows limited understanding of the demands of the question. • There is limited relevant knowledge. The response is descriptive and consists mostly of unsupported generalizations. • The response has limited organization or is only a list of items.
3–4	• The response shows some understanding of the demands of the question. • Some relevant knowledge is demonstrated, but this is not always accurate and may not be used appropriately or effectively • The response moves beyond description to include some analysis, but this is not always sustained or effective. • The response is partially organized.
5–6	• The response shows adequate understanding of the demands of the question. • Response demonstrates adequate and effective analysis supported with relevant and accurate knowledge. • The response is adequately organized.
7–8	• The response is focused and demonstrates an in-depth understanding of the demands of the question. • Response demonstrates sustained evaluation and synthesis that is effectively and consistently supported with relevant and accurate knowledge. • The response is well-structured and effectively organised.

Section B

4. Responsibly managing e-waste

One intervention to address this is a service where computer hardware and mobile devices are taken to a central location and either donated to local schools or shipped to another country to be recycled.

It is claimed that this service will reduce the amount and impact of e-waste.

To what extent do you agree with this claim? **[12]**

Note to examiners:
The paper specifies that items are sent to a Central Location first. After this, the items go to a local charity/School AND/OR are shipped to another country.
Underline every credible point to help support your decision in what mark to award. Use the dynamic horizontal annotation.

Answers may include:
Support of the claim arguments (managing e-waste):

- Extends lifespan ethically: Donating functional devices gives them a second life, so they can be reused rather than disposed and will delay the need to produce new electronics (systems, ethics).
- Access Equity: Potentially assisting less advantaged or those without devices (equity, ethics).
- Recycling pieces and components of hardware and devices reduces the environmental impact (sustainability) (systems, ethics).
- The government/charity may support this service through educational campaigns to increase the collection of devices (equity).

Counter claim arguments (managing e-waste):

- Are the recipients willing to receive this e-waste? (power, acceptability).
- e-waste is a result of developing technology, and these strategies meet our obligations towards future generations (ethics).
- e-Waste handling might expose communities to toxic materials so schools and countries might lack proper regulations for this process (ethics).
- Solution might be limited to big urban centres only (equity).
- How is this service financially sustainable? Central location service relies on employees and logistics and if the basic costs are not covered, the service can be suspended which will have a direct impact on managing what they have received (cost, acceptability).
- There is no guarantee the e-waste that is shipped/donated is processed responsibly (ethics). What guarantees can be put into place? (For example, using the devices for profit generation - selling) (ethics).

Sending items to a Central Location

- Donors send the equipment to the central location for proper set-up/ test (feasibility).
- The central location can regulate the distribution of who receives the donation (ethics; power)
- Time consuming for the central location employees if there are no clear guidelines for donors (cost, feasibility).

From Central Location to local school as a donation:
Reduce the impact of e-waste

- Donating to local charities and schools means the distance the hardware travels are minimized, so fewer miles (equivalent of food miles). This would be more feasible and cost effective than sending items overseas (feasibility).

Will NOT reduce the impact of e-waste

- The local charities and schools might not have the infrastructure and/or IT personnel to use it, converting the hardware and devices to e-waste again (systems, feasibility).
- Not all components are recycled so the remainder will still be e-waste. So this is only a part solution (acceptability).

From Central Location to another country for recycling:
Reduce the impact of e-waste

- Resource recovery: The receiver country might have e-waste processing facilities that can extract valuable materials such as copper, gold, etc. (feasibility).

Will NOT reduce the impact of e-waste

- This may not be economically feasible (cost, feasibility).
- Shipping to another country may lead to the hardware components travelling large distances, so not environmentally friendly as it will be using a transportation system that uses fossil-derived fuels (degraded air quality). (acceptability).

Keywords: hardware, recycling, reuse, upcycling, environment, e-waste, pollution, waste prevention, sustainable, sustainability, acceptability, equity

Please see HL Paper 1, Section B markband on page 17.

5. Utilizing artificial intelligence in employment application screening

One intervention is the use of artificial intelligence (AI) to help employers rank job applicants.

It is claimed that the use of AI will accurately rank job applicants.

To what extent do you agree with this claim? [12]

Note to examiners:
Underline every credible point to help support your decision in what mark to award. Use the dynamic horizontal annotation.

Answers may include:
The use of artificial intelligence will accurately rank job applicants

- There are complex and ever-changing employee behavioral patterns (eg after Covid) that are better recognized by machine learning (systems, innovation)
- Saves time (sourcing and screening) but costly to set up. (systems, cost, feasibility)
- Improves the quality and objectivity of recruitment (ethics, equity)
- If the algorithms are published there may be transparency (ethics, transparency, acceptability).
- The algorithms in the AI might avoid language/gender/ethnicity bias (power, ethics, equity) if well trained.

The use of artificial intelligence will not accurately rank job applicants

- May lead to the rejection of talented and innovative people who simply do not fit the profile. For example physical attributes such as height, weight, scars, tattoos (systems, ethics, equity)
- Some candidates may be uncomfortable using this system, they may be applying for a job that does not require IT skills. It may advantage the more IT literate candidates What steps can be taken to overcome this concern? (acceptability, equity)
- May lead to learn how the system works in your favour (ethics).
- The algorithms in the AI might reinforce language/gender/ethnicity bias (power, ethics, equity).
- Impersonal, lack of human connection (ethics, values).
- The algorithms are not shared / there is opacity in the system (ethics, transparency, power).
- The investment of the system was low, making the AI system not of good quality (systems).
- The poor quality of the video due to bad equipment/light/connection might affect less privileged candidates (systems).
- Lack of security in the AI system may lead to hacking possibilities to favour a specific candidate or specific race, gender, etc (systems).
- Not able to detect character, personality, soft skills (values).

Keywords: algorithm, bias, stereotypes, transparency, equity, fairness, inclusivity, discrimination, diversity, economic, automation, employment

Please see HL Paper 1, Section B markband on page 17.

The following markbands should be used with responses to Section B.

Paper 1, Section B markband	
Marks	**Level descriptor**
0	The work does not reach a standard described by the descriptors below.
1–3	• The response shows a limited understanding of the demands of the question. • There is limited relevant knowledge. • The response is descriptive and consists mostly of unsupported generalizations. • Counter-claims are not considered or addressed. • The response has limited organization.
4–6	• The response shows some understanding of the demands of the question. • Some relevant knowledge demonstrated but this is not always accurate and may not be used appropriately or effectively. • The response is primarily descriptive with some analysis, but this is not sustained. • Counter-claims are only partially addressed. • The response is partially organized.
7–9	• The response shows adequate understanding of the demands of the question. • The response demonstrates adequate and effective analysis supported with relevant and accurate knowledge. • Counter-claims are adequately addressed. • The response is adequately organized.
10–12	• The response is focused and shows an in-depth understanding of the demands of the question. • The response demonstrates evaluation and synthesis that is effectively and consistently supported with relevant and accurate knowledge. • Counter-claims are effectively addressed in the response. • The response is well-structured and effectively organized.