Diploma Programme
Programme du diplôme
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Markscheme

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Information technology in a global society

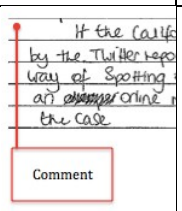
Higher level

Paper 1

25 pages

The following are the annotations available to use when marking responses.

Annotation	Explanation	Comment	Short cut
	Correct point	Use for identify, state, outline, describe	
	Incorrect point	Use for identify, state, outline, describe	
	Benefit of the doubt	Answer is close enough to give some credit, indicates that you see some merit in it.	
NBOD	No benefit of doubt	Not quite enough to earn any credit.	
	Seen	Indicates that the text has been noted, but no credit has been given, or used on a blank page to ensure that RM Assessor and/or staff in Cardiff know that you have seen the page	
OC	Off course		
	Too vague	Point is unclear, or not specific enough to answer the question.	
	Repetition	Repeats a point previously made, not necessarily worded in the same way.	
REF	Reference	This is used to indicate a reference to the stimulus material, article or the Case Study (Paper 2 or Paper 3)	
D	Description	Candidate has added descriptive information to an initial idea that has been named or identified.	
A+	Analysis / Explanation	Candidate has explained **why** something occurs, or why it is important to the point s/he is making, or described the consequences of a policy/action/use of IT.	
B+	Balanced argument involving detailed analysis	Use in the examiner's comments at the end of extended response questions. Balanced arguments involving detailed analysis can occur within paragraphs as well as at the end of the response. Often, a transition word to link/compare ideas, such as "however" or "on the other hand" is used. Can also be structured analysis of ideas, *eg* good vs bad, for X and against X.	
EVAL	Evaluation – beyond the ideas presented to reach a conclusion or overall comment.	Use only if **evaluation is supported**, not just stated. Note that evaluation can occur in the body of an extended response as an evaluative comment about an idea as well as at the end in the conclusion. Fully evaluated requires a well-supported conclusion. Evaluation and detailed analysis can overlap when evaluation is within a paragraph.	
O	Opinion	Use only if opinion is supported, not just stated. Note that opinion can occur in the body of an extended response as well as at the end.	

	Dynamic, Horizontal	Indicates a valid point that the student will need to support in an extended response.	
	Dynamic, Horizontal Wavy	Used for incorrect statements/phrase	
	Dynamic, Vertical Wavy	Indicates that the candidate has veered off course, *ie* either by not answering the question that is asked or has moved in a direction unrelated to the question. Can also use OC annotation	
	Text box with extended vertical line.	Used to mark and comment on a block of writing that makes a valid point. Note that the text box and the vertical line are connected.	
Text box	Insert comments	Used for comments at the end of questions where the mark needs to be JUSTIFIED. Often with AO2 command terms – EXPLAIN. ALWAYS with AO3 command terms – EVALUATE, JUSTIFY, TO WHAT EXTENT, and DISCUSS.	

You **must** make sure you have looked at all pages. Please put the SEEN annotation on any blank page, to indicate that you have seen it.

Critical Thinking – explanation, analysis and evaluation

These trigger words often signal critical thinking. The bold words are the key terms in the various criteria.
Explanation – *Because, as a result of, due to, therefore, consequently, for example*
Analysis – *Furthermore, additionally, however, but, conversely, likewise, in addition, on the other hand, whereas*
Evaluation – *My opinion, overall, although, despite, on balance, weighing up*

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. IT support for staff laptop computers at *RZX*

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** functions of an operating system. **[2]**

Answers may include:
- provide user interface/GUI
- allows users to run programs
- manages memory
- controlling hard drive
- controlling process of time
- managing peripherals
- launching applications
- file management
- control system resources
- providing utilities.

*Award **[1]** mark for identifying each function of an operating system up to a maximum of **[2]** marks.*

(ii) Identify **two** characteristics of random access memory (RAM). **[2]**

Answers may include:
- RAM stores data that is currently being used
- RAM stores information from the software programs that are currently running
- RAM is volatile – will be erased when the computer is turned off
- accessing data in RAM is much faster than accessing it from the hard disk
- when an application is run/executed the data is placed into RAM.

*Award **[1]** mark for identifying each characteristic of random access memory up to a maximum of **[2]** marks.*

(iii) Identify **two** devices that could be used to store a backup of the files that employees have saved on their laptops. **[2]**

Answers may include:
- USB drive/flash drive/thumb drive
- external hard drive
- cloud
- DVD.

*Award **[1]** mark for identifying a device that could be used to store the backup to a maximum of **[2]** marks.*

(b) Analyse the advantages and disadvantages of using cloud-based storage for an *RZX* employee's work files. **[6]**

Answers may include:

Advantages:
- files stored in the cloud can be accessed from anywhere with internet access
- if more storage space is needed then *RZX* can arrange with the cloud storage provider to make this possible almost immediately
- security measures are provided by the cloud service (backups, firewalls, access, *etc*) which may reduce the burden on *RZX*'s IT department
- it may be cost effective for *RZX* to purchase cloud storage rather than purchasing extra storage
- the IT department will spend less time managing staff files.

Disadvantages:
- files cannot be accessed if there is no internet access
- if internet access is unavailable staff files cannot be saved in the cloud. Employees may save files to their laptop. This can lead to problems as files could be deleted/lost or even accessed by an unauthorized user
- employees may find if there are issues relating to the storage of their data getting them resolved may be more time consuming than simply walking to an employee in the same office
- security of staff files depends on the security measures provided by the cloud service. *RZX* needs to be assured that the cloud security is adequate.

Marks	Level descriptor
0	No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.
1–2	A limited response that indicates very little understanding of the topic or the reason is not clear. Uses little or no appropriate ITGS terminology. No reference is made to the scenario in the stimulus material. The response is theoretical.
3–4	A description, unbalanced or partial analysis of the issues related to the use of cloud-based storage for an employee's work files. There is some use of appropriate ITGS terminology in the response.
5–6	A balanced and detailed analysis of the relative advantages and disadvantages of cloud-based storage for an employee's work files. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.

(c) The disposal of old IT equipment is becoming a problem. *RZX* is considering two options:
- donating the equipment to a charitable organization
- sending the equipment to a recycling service.

Evaluate the implications of these **two** options. **[8]**

Answers may include:

Donating the equipment:
- may be seen as an altruistic gesture and good PR for the company
- is a relatively simple process and ensures that existing equipment can extend its working life
- there may be financial benefits from donating such as tax relief compared to recycling
- donating provides IT equipment to less fortunate people
- a disclaimer would be essential so the recipients don't expect *RZX* to install/set up the donated equipment or fix any problems
- all proprietary software would need to be deleted as this would breach licensing agreements
- all personal and company files would need to be deleted to avoid privacy and security issues.

Recycling the equipment:
- recycling is a better option for items that cannot be donated as they are out of date
- will reduce the environmental impact as less raw materials may need to be extracted, *etc*
- may be a more straight forward process than donating, the items are simply collected from the offices
- the recycling process may be unethical, for example, children working long hours in poor conditions in some countries.

Issues relating to proprietary software and company/personal files also apply to recycling as the equipment could be taken home by someone at the recycling depot.

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 25.

2. Medical centre budgets

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** characteristics of voice over internet protocol (VOIP). **[2]**

Answers may include:
- communication carried out using the internet
- may take the form of voice or multimedia
- an example of VOIP is Skype.

*Award **[1]** mark for identifying each characteristic of voice over internet protocol (VOIP) up to a maximum of **[2]** marks.*

(ii) Identify the steps that Dr Schultz must follow to list only the surgeries carried out by Dr Tirbau using the spreadsheet software. **[2]**

Answers may include:
- filter the Doctor field to show only “Dr Tirbau”
- filter the Procedures field to show only “Surgery”.

*Award **[1]** for identifying each of the steps followed by Dr Schultz in the spreadsheet software to list only the surgeries done by Dr Tirbau up to a maximum of **[2]** marks.*

(iii) Identify **two** reasons why Dr Schultz would use a spreadsheet instead of a database for record keeping. **[2]**

Answers may include:
- spreadsheets are much easier to set up than databases and can be set up in-house with no cost for IT expertise
- spreadsheets require less staff training whereas databases can be complicated for staff who are not IT literate
- the volume of medical data may not necessitate the time and effort required to set up a database
- the spreadsheet software may already come as part of the pre-loaded software whereas the database software may not.

*Award **[1]** mark for identifying each reason why Dr Schultz would use a spreadsheet for the record keeping rather than a database up to a maximum of **[2]** marks.*

(b) Dr Schultz has arranged to speak to the local authorities in an attempt to get more funding for the medical centre. He intends to use presentation software to create a slideshow to support this speech. Dr Schultz is aware that many people in the audience are annoyed when slideshows are poorly designed.

Explain **three** design errors Dr Schultz should avoid when creating his slideshow for the local authorities. **[6]**

Answers may include:

Small font size
- Dr Schultz should avoid using a small font which makes the text difficult to read
- or results in too much text on a slide reducing its effectiveness.

Excessive/inappropriate transitions
- Dr Schultz should ensure that the nature of the transition is appropriate for the audience
- in this case he should avoid excessive flying in, *etc*.

Too many slides
- too many slides can mean that the slides do not remain visible long enough for the audience to engage with them
- or the key points associated with each slide become blurred in the overall message.

Poor choice of colours
- Dr Schultz needs to ensure the mix of colours makes the slides easy to read
- therefore may want to avoid certain combinations such as red or green that may cause some of the audience difficulty in reading the information.

Inappropriate language
- Dr Schultz should ensure the language used is appropriate for the intended audience
- this should ensure that overly complex terms or specialist medical terminology are not used.

Inappropriate or overuse of multimedia
- it may be appropriate to incorporate a video (*eg* interview with a patient)
- but irrelevant music/videos can be annoying and detract from the message.

N.B. *the response requires an identification of a common design error followed by an explanation of why it is a problem. If no design error is mentioned but from the explanation it can be determined this should be credited.*

Award ***[1]*** *mark for identifying a common design error and* ***[1]*** *mark for an explanation why it is a problem up to a maximum of* ***[2]*** *marks.*

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

(c) The Okavango Medical Center has received additional funding from the local authority. The centre is investigating the possibility of using these funds to purchase IT equipment that would allow surgeons in Gaborone to carry out surgery remotely.

Evaluate the impact of the purchase of this IT equipment on the medical centre and its patients. **[8]**

Answers may include:

Advantages of purchasing more IT equipment so that operations can be carried out remotely:

- specialized surgeries (*eg* cardiac) can be done remotely
- adding specialist surgeons to this type of clinic would be expensive and inefficient as there would be a limited number of cases for them
- the doctors in Okavango could assist in and/or observe the surgery, thus improving their general surgical skills.

Disadvantages of purchasing more IT equipment so that operations can be carried out remotely:

- the internet connection may not be sufficient to support remote controlled surgery because the surgery requires high-tech video and phone links
- latency in the connection is also a safety issue. Lag times can cause serious errors
- the remote surgery equipment may not be used frequently enough to justify the expense
- it might be wiser to spend the money on other medical needs
- patients in the area might be uncomfortable with the idea of a remote-controlled robot
- the data will need to be encrypted to protect patient privacy
- robotic surgery would use public networks raising security concerns including hacking.

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 25.

3. Digital currency

Note to examiners.

- *All part a and part b questions are marked using ticks and annotations where appropriate*
- *Part c is 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 peer-to-peer (P2P) network. **[2]**

Answers may include:

- there is no central administrator
- all users of the network have the same importance
- each computer acts as both client and server
- each computer can exchange files directly with every other computer on the network.

*Award **[1]** mark for identifying each characteristic of a peer-to-peer network up to a maximum of **[2]** marks.*

(ii) Identify **two** characteristics of a strong password. **[2]**

Answers may include:

- sufficient length (usually more than six characters)
- made up of a mixture of letters, numbers and symbols
- uses upper and lower case characters.

*Award **[1]** mark for identifying each characteristic of a strong password up to a maximum of **[2]** marks.*

(iii) The use of a password is one method of authentication.

Identify **two** other methods of authentication. **[2]**

Answers may include:

- biometrics
- voice recognition
- PIN.

*Award **[1]** mark for identifying each additional method of authentication up to a maximum of **[2]** marks.*

(b) (i) Explain **one** reason why Bitcoin makes use of private key and public key encryption. **[2]**

Answers may include:
- secure because every Bitcoin address has a matching private key (saved in the wallet file) of user
- private keys can be kept in computer files
- secure because it is impossible to determine a private key from corresponding public key.

*Award **[1]** for the reason identified and an additional **[1]** for the explanation why Bitcoin uses private key and public key encryption up to a maximum of **[2]** marks.*

(ii) Explain **one** reason why it may be difficult to ensure the security of information in a large peer-to-peer network such as Bitcoin. **[2]**

Answers may include:
- the security may be carried out at the level of the individual user. This may mean that the network's security may only be as strong as the weakest link
- there is no central control which manages the security of each computer by providing virus protection/firewall
- an inexperienced user may unintentionally allow access to his whole hard drive instead of allowing access to specific folders.

*Award **[1]** for the reason why the security of information may be difficult to maintain in a large peer-to-peer network such as Bitcoin and an additional **[1]** for the explanation up to a maximum of **[2]**.*

(iii) Some users of Bitcoins are concerned that their anonymity may be compromised by their Bitcoin address.

Explain **one** way the Bitcoin address may be used to reveal information about a Bitcoin user. **[2]**

Answers may include:
- the Bitcoin address when transmitted may include additional information, such as the IP address of the user's device
- this information may be aggregated from a number of sources and this larger data set will then provide sufficient information to link the Bitcoin address to a person's identity.

*Award **[1]** for identifying how the Bitcoin address may be used to reveal the name of a Bitcoin user and an additional **[1]** for the explanation up to a maximum of **[2]** marks.*

(c) Bitcoin is a form of digital currency. Bitcoin transactions are made between individuals without the knowledge of banks, governments or credit card companies. Some governments are investigating whether they should regulate digital transactions, such as those made using Bitcoins.

To what extent is it appropriate for governments to regulate digital transactions, such as those made using Bitcoins? **[8]**

Answers may include:

- if transactions can be done without disclosing the name of the individuals, it could be a way to use money obtained illegally (money laundering)
- governments will not be able to see all commercial transactions and therefore miss the possibility to tax commercial activities – informality
- bitcoin wallet providers may have an agreement with clients not to disclose information – privacy invasion
- it is also possible to send a payment without revealing your identity. This allows people to transfer funds across country borders without cost but also allows users to buy illegal products anonymously
- unregulated services such as Bitcoin do not provide the protection of regulated services such as banks
- for governments to be able to forecast financial trends they need to have all of the information available. If some information is withheld, this makes forecasting more problematic
- there is the ongoing debate between the privacy of the user versus the security of the state. The questions could be reframed as what is an acceptable level of regulation?
- if regulation is too strict it will stifle innovation and may prevent worthwhile developments in digital currency.

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 25.

Section B

4. The future of police robots

Note to examiners.
- *All part a and part b questions are marked using ticks and annotations where appropriate*
- *Part c is 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:
- a device that is controlled by a computer (often using AI)
- it interacts with the physical world
- it can be multifunctional
- it can be mechanical
- it uses sensors to interact with the physical world
- can be autonomous
- can be semi-autonomous
- can be controlled wirelessly i.e. remotely
- are non-sentient
- can move around in the world using movable segments, wheels, *etc.*

Award ***[1]*** *mark for each of the characteristics identified above up to a maximum of* ***[2]*** *marks.*

(ii) Identify **two** output devices the robot might have. **[2]**

Answers may include:
- extendable arm
- wheels
- speaker
- microphone
- end effector (*ie* claw, gripper, screwdriver, *etc*)
- screen.

Award ***[1]*** *mark for each output device identified up to a maximum of* ***[2]*** *marks.*

(iii) The police department has technical support staff.

Identify **two** duties of the staff that supports the robot. **[2]**

Answers may include:
- diagnose hardware/software failures (robot maintenance)
- provide training on how to use the robots
- classify/prioritize incidents
- keep a log of incidents
- keeping the robot's software up to date.

Award ***[1]*** *mark for each duty identified up to a maximum of* ***[2]*** *marks.*

(b) (i) The company that supplied the robots spoke with both end-users and clients.

Distinguish between an end-user and a client. **[2]**

Answers may include:
- end-user – the person who operates the system
- client – the person who commissions/pays for the system.

*Award **[1]** for a response that only identifies either the nature of the end-user or the client.*
*Award **[2]** for a response that covers both the end-user and client in the points above.*

(ii) Explain **two** reasons why product development involving robots would require an agile project management method. **[4]**

Answers may include:
- supports the use of prototypes as needed throughout the process
- requirements and capabilities may evolve rapidly / may involve frequent input from the client
- iterative in nature so team can respond to challenges that occur during development
- so it can include new features as the need for them arises
- lends itself to a collaborative approach *ie* revolves around multiple small activities in contrast to a linear plan.

*Award **[1]** for the identification why any product development regarding robots will require agile project management method, and an additional **[1]** for the explanation of that reason.*
*Mark as **[2 + 2]**.*
*Award a maximum of **[4]** for the question.*

(c) Toby Walsh, professor of Artificial Intelligence at the University of New South Wales, Australia, notes that the use of police robots raises "many important questions that we, as a society, have to think about".

To what extent should police departments rely on the human element of policing, rather than robots? **[8]**

Answers may include:

Benefits of robots:
- robots can save lives (can defuse bombs, can be sent into other situations that would be dangerous for humans)
- under pressure human being can make mistakes that robots would not make
- robot's sensors may be able to detect things that a human could not (for example, smell gases, facial recognition, *etc*.)
- emotions will not affect the decisions/behaviour of the robot.

Problems with robots:
- how do we keep robots from being hacked, *ie* taken over by third parties?
- will police departments be tempted to weaponize their robots in order to minimize the risk to officers?
- will communities accept their use?
- humans can be held responsible for their actions while there is doubt about who to blame with a robot
- humans can detect aspects of a situation that a robot cannot
- people may feel safer with human officers rather than with robots.

Decision making and guidelines that determine the extent to which robots can be used in policing:
- who should decide how they are used?
- what kinds of robots should be available to police?
- what are the guidelines for remotely killing a human being?
- how should police who use robots be trained?

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 25.

5. Artificial intelligence (AI) in health care

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) Define *algorithm*. **[2]**

Answers may include:
- a step-by-step procedure
- a set of instructions
- created to perform a specific task
- used by computers to perform operations/tasks
- must be followed in a specific order.

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

(ii) Identify **two** characteristics of pattern recognition. **[2]**

Answers may include:
- uses training data
- learns from examples
- once trained, the software can identify new examples of the items it has "learned"
- gives an estimate of the accuracy of the identification
- recognizes shapes within an image
- supervised AI.

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

(iii) During the development of the algorithm, *Google* may use a data flow diagram.

Define *data flow diagram*. **[2]**

Answers may include:
- visualizes the flow of data through an information system
- does not show types of relationships between types of data
- shows processes that use and produce data
- shows type of input and output
- shows where the data will be stored
- shows where the data will come from and go to.

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

(b) *Google* has chosen to use a neural network for this project, rather than an expert system.

Distinguish between an expert system and neural network. **[6]**

Answers may include:

Expert systems:
- depend on the knowledge of human experts
- utilize if/then rules
- have two components, an inference engine and a knowledge base
- the knowledge base consists of facts about the domain/rules about the domain
- the inference engine applies the rules to the known facts to deduce new facts or possibilities
- users can ask questions of the expert system
- sometimes use fuzzy logic.

Neural networks:
- use large quantities of data, *ie* examples
- do not depend on expert knowledge
- imitate the way electric impulses travel through neurons in the human brain
- need training before they can be used in any practical way
- use multiple single processors
- learn by trial and error, not a rule-based approach
- use a series of nodes with different weights to analyze data.

Marks	Level descriptor
0	No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.
1–2	A limited response that indicates very little understanding of the difference between an expert system and a neural network. There is some use of appropriate terminology. Uses little or no appropriate ITGS terminology.
3–4	A description or partial comparison of expert systems and neural networks. Some knowledge and understanding. Some use of appropriate ITGS terminology.
5–6	An explicit and detailed comparison of expert systems and neural networks demonstrating a thorough understanding of both topics. Uses appropriate ITGS terminology.

(c) It is claimed that the NHS's partnership with *Google* is beneficial for both stakeholders. However concerns have been raised about the ethical implications of this data sharing agreement.

To what extent is it ethical for the NHS to share patient information about eye scans from Moorfields Eye Hospital with *Google*? **[8]**

Answers may include:

Ethical problems:
- can the patients decide whether to opt in or opt out?
- *Google* is likely to profit from what they learn from this project
- *Google* will benefit from improvements in its algorithm
- *Google* will need to guarantee that the data is kept secure
- *Google* will need to guarantee that the data is kept private
- *Google* will need to guarantee that the data is only used for this project
- does this scheme cause harm to the patients, is it ethical?

Benefits for the NHS and its patients:
- *Google* could provide free access to the system to the NHS vs other health providers
- the knowledge gained about preserving sight could be shared with doctors around the world therefore benefiting many people at risk of losing their sight
- this data may be mined and other associations established that may lead to preventative health care in unrelated fields
- patients may feel the benefits of sharing their data outweigh the negative implications of their data being shared.

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 25.

6. Exoskeletons for workers

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** reasons why the Robo-Mate requires sensors. **[2]**

Answers may include:
- to sense how close the object to be lifted is
- to sense the weight of the object
- to sense how quickly the exoskeleton is moving
- to sense the center of gravity of the wearer
- to sense how much pressure the wearer is exerting on the object being lifted
- to sense vital signs (blood glucose levels, blood pressure, cardiac and respiratory activities).

(ii) Identify **two** characteristics of a prototype. **[2]**

Answers may include:
- early working model of a system or subsystem
- used to test the system (*eg* interface, functioning)
- used to demonstrate how the system will work
- used to check whether the systems will meet the target user's requirements.

(iii) Identify **two** key stakeholders involved in this project. **[2]**

Answers may include:
- manufacturer of the exoskeleton
- workers
- programmers
- designers
- employers (in the workplaces where Robo-Mate is used, i.e. the company purchasing the Robo-Mate).

(b) The researchers involved in the Robo-Mate project decided to use a Pert chart instead of a Gantt chart to guide the project.

Explain why the researchers used a Pert chart instead of a Gantt chart to guide the project. **[6]**

Answers may include:

Advantages of a Pert chart:
- easy identification of order of precedence of the activities
- shows relationships between tasks
- easy identification of the critical path
- shows early start, late start and slack for each activity *ie* more realistic estimation of time for each activity
- can show slack time so resources can be moved to more critical activities
- more appropriate for large and complex projects compared with Gantt chart which is appropriate for small projects.

Disadvantages of a Pert chart:
- charts can be very complicated
- can underestimate completion time particularly if delays occur
- inaccurate time estimates can make the entire plan incorrect.

Advantages of a Gantt chart:
- use of a Gantt chart visualizes the process, *eg* helps to maintain organization
- it illustrates which tasks must be completed before the next one can begin
- task can be viewed against a calendar showing start and end dates
- resources required for tasks can be linked to the tasks on the chart
- more appropriate for small projects (chart becomes too complex for larger projects).

Disadvantages of a Gantt chart:
- it is a linear (*ie* step-by-step) process so it is very inflexible. Changes are difficult to make
- errors are difficult to correct
- changes could result in significant costs
- chart can be too simplistic and does not provide enough detail for a complex project (*eg* this chart leaves out the construction of the database)
- it is difficult to show where there is slack time in the project
- inaccurate time estimates can make the entire plan incorrect.

Marks	Level descriptor
0	No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.
1–2	A limited response that indicates very little understanding of Gantt and Pert charts. Uses little or no appropriate ITGS terminology. No reference is made to the development of the exoskeleton.
3–4	A description or partial explanation of the reasons for using Gantt and Pert charts with some knowledge and understanding of the implications for the exoskeleton project. Some use of appropriate terminology relating to the topic. Some reference is made to the scenario in the stimulus material.
5–6	A thorough explanation of the reasons for using Gantt and Pert charts with thorough knowledge and understanding of the implications for the exoskeleton project. An examination that uses appropriate ITGS terminology. Explicit and relevant references are made to the scenario in the stimulus material.

(c) Other than for the prevention of injuries, discuss the impacts for workers and employers of the use of exoskeletons in the workplace. **[8]**

Possible impacts include:

- employers might increase expectations of workers, which could lead to more injuries, *ie* dehumanize workers
- workers might push themselves because the exoskeleton seems to make work easier, possibly resulting in injuries
- exoskeletons could collect data on the user, including private information
- if person is injured by someone wearing an exoskeleton, who is responsible? The manufacturer of the exoskeleton, the user, the company that purchased it?
- older workers can stay in jobs longer
- productivity improvement
- will workers accept the technology?
- injured workers may be equipped with the exoskeleton and returned to work earlier
- saves company money/reduces sick time
- cost to employer of purchasing/maintaining exoskeleton
- cost to employer of training workers to us the exoskeleton
- reliance on the technology: What happens if it breaks down? Can workers still do their work?

N.B. *some students may develop the impact of injuries on the workers or the companies. If they go beyond what is already stated in the question, this is an acceptable approach.*

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 25.

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.*