

Markscheme

November 2025

Digital society

Higher level

Paper 1

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Section A

1. Virtual reality (VR) history tours used by universities

- (a) (i) Identify **two** characteristics of virtual reality (VR). [2]

Answers may include:

- A form of digital space.
- Interactive, fully immersive digital environment that isolates users from the physical world.
- Experience an entirely artificial environment, which can be interactive, three-dimensional, and computer-generated.
- As you move your head around, what you see changes as well, just as it would in real life.
- VR worlds are usually created with complex 3D computer graphics that change in real time as we move.
- User interacts with glasses/lenses/helmet/headphones/gloves.

Award [1] for each characteristic of virtual reality up to [2].

- (ii) Describe **one** difference between virtual reality (VR) and augmented reality (AR). [2]

Answers may include:

- AR enhances the user's perception of reality in the physical world,
- whereas VR disconnects users from the physical world.

- AR uses a real-world setting,
- whereas VR is completely virtual.

- AR users can control their presence in the real world,
- whereas VR users are controlled by the system.

- VR requires a headset device,
- whereas AR can be accessed with a smartphone.

- VR users move in a completely fictional world,
- whereas AR users are in contact with the real world.

Note: We are looking for differences. We can accept the same answers for 1(a)(i) as long as there is a characteristic of AR that clearly represents a difference to that characteristic of VR (e.g. VR requires a headset, while AR can be accessed with a smartphone).

Award [1] for describing one difference between virtual reality and augmented reality up to [2].

- (iii) Outline why the virtual reality (VR) tour is an example of digitization. [2]

Answers may include:

- Digitization is the conversion of an analog item to a digital one.
- The VR tour is the use of this digital data to provide the user with an experience as if they were at the location.
- Digitization is the process of creating a digital representation of physical objects or attributes.
- The VR tour is a computer generated simulation of an existing physical environment.

Award [1] for identifying why the creation of VR is an example of digitization and [1] for a development of that reason up to [2].

- (b) (i) Explain **two** ways the use of virtual reality (VR) could help with the preservation of sites like Machu Picchu. [4]

Answers may include:

- Reduces the number of people that visit the site.
- Meaning that there is less damage to the site and this its current state is preserved.
- Increase the awareness of the site.
- So more people may be supportive of attempts to preserve it.
- The VR application could be used for fundraising campaigns to find sponsors to invest in the preservation of the site.
- This way, sponsors could be found to invest in the conservation of the site.

Award [1] for identifying a way the use of VR could help with the University of Cuzco Archaeology program to preserve sites such as Machu Picchu and [1] for a development of that way up to [2].

Mark as [2] + [2].

- (ii) Explain **one** technical concern that would be faced by *EJC Technologies* when creating the virtual reality (VR) tour of Machu Picchu [2]

Answers may include:

- The VR tour may require large numbers of 2D images
- Which requires a large storage/processing capacity.
- The software used by the VR headset can't replicate the full sensory experience of real life, including touch, smell, and heat.
- Which means its graphics are not completely realistic.

Award [1] for identifying a technical concern that would be faced by EJC Technologies in creating the virtual reality tour of Machu Picchu and [1] for a development of that technical concern up to [2].

- (c) To what extent can the use of virtual reality (VR) improve teaching and learning at the Cuzco University?

[8]

Answers may include

Advantages

- VR classrooms provide a highly interactive and engaging environment for students (systems).
- Students can virtually visit historical sites, participate in scientific experiments, or engage in cultural experiences from anywhere in the world, providing a global perspective (spaces, systems).
- VR allows for individualized learning experiences, catering to different learning styles and paces (expression, systems, values).
- Immersive experiences in VR can facilitate the development of practical skills, especially in fields such as medicine, engineering, or the arts, where hands-on practice is crucial (change, systems).
- VR can recreate simulations without exposing students to real-world dangers (space).
- It doesn't represent high transportation and accommodation costs, thus democratizing education (change, systems).
- While initial setup costs can be significant, VR classrooms can potentially reduce expenses associated with traditional teaching materials and field trips over time (change, systems).

Disadvantages

- Implementing VR classrooms requires substantial investment in equipment, software, and training, which can pose financial challenges for educational institutions (change, systems).
- Students do not have the full sensory experience of real life, such as touch, smell, and warmth.
- Technical glitches, compatibility issues, or the need for specialized technical support can disrupt the learning process (change, systems).
- Extended use of VR may lead to social isolation as students immerse themselves in virtual environments, potentially diminishing real-world social interactions and interpersonal skills (expression, change, systems, values).
- Prolonged use of VR may cause discomfort, including motion sickness, eye strain, or headaches, raising health concerns that need to be addressed for sustained adoption (change, systems).
- Developing high-quality educational content for VR can be time-consuming, limiting the availability of diverse materials across all subjects and educational levels (change, systems, values).
- Students can become distracted by virtual reality, which hinders learning.

Keywords: *Change, expression, spaces, systems, values, VR, feasibility, education, simulations, compatibility, interoperability, health.*

Please see markband on page 13.

2. Voice authentication and deepfakes

- (a) (i) Identify **two** types of artificial intelligence (AI). [2]

Answers may include:

- Strong
- Full
- General
- Weak
- Narrow
- Domain specified
- Deep learning
- Machine learning
- Neural networks.

Award [1] for each type of AI identified up to [2].

- (ii) Describe the difference between the identification of a customer and the authentication of a customer at *Banco de Cali*. [2]

Answers may include:

- Identification is saying who you are
- Authentication is proving who you purport to be/validating a user in order to enable access to a bank account

Award [1] for describing the difference between identification and authentication up to [2].

- (iii) Identify **two** characteristics of a deepfake. [2]

Answers may include:

- deepfake is an image, or a video or audio recording.
- that has been edited using AI to replace the person in the original with someone else.
- an image or recording that has been convincingly altered and manipulated to misrepresent someone as doing or saying something that was not actually done or said.

Award [1] for identifying each characteristic of a deepfake up to [2].

- (b) (i) Explain **one** reason why it is important for *Banco de Cali* to have an appropriate policy for the **collection** of its customers' data.

[2]

Answers may include:

- To collect only the data that is required.
- Which complies with legal or regulatory requirements.

- To protect customer privacy.
- which builds/maintains customer trust in the bank.

- To reduce security and data-breach risks.
- which protects the bank's reputation.

- To increase operational efficiency and consistency.
- which ensures the accuracy and quality of customer data (i.e., only the data that is needed is collected).

- To comply with legal or regulatory requirements.
- ensuring data collection practices are ethical/fair.

Award [1] for identifying a reason for an appropriate policy for the collection of the data and [1] for an explanation for why it is appropriate up to a maximum of [2].

- (ii) Explain **one** reason why it is important for *Banco de Cali* to have an appropriate policy for the **storage** of its customers' data.

[2]

Answers may include:

- To prevent unauthorized access/misuse/loss of data
- That maintains customer trust and confidence in the bank.
- To ensure sensitive customer information is securely protected
- Which reduces the risk of data breaches/customer fraud, and cyberattacks.
- To ensure data is accessible when needed
- Which makes it easier for the bank to use this data.
- To maintain secure/appropriate data storage (and deletion) practices
- That reduce the risk of data breaches/customer fraud, and cyberattacks.
- To support business continuity and disaster recovery plans
- Which protect the bank's reputation/avoids legal or financial penalties/minimizes downtime.
- To comply with data protection/financial regulations
- That protects the bank's reputation/avoids legal or financial penalties.

Award [1] for identifying a reason for an appropriate policy for the storage of the data and [1] for an explanation for why it is appropriate up to a maximum of [2].

- (iii) Explain **one** reason why it is important for *Banco de Cali* to have an appropriate policy for the **sharing** of its customers' data.

[2]

Answers may include:

- To ensure customer data is shared only with authorized parties.
- Preventing the misuse of this data/unauthorized access/illegal disclosure of this data.
- To protect customers from fraud/identity theft.
- Which maintains customer trust and confidence in the bank.
- To ensure data sharing is transparent and/or ethical.
- Maintaining customer trust and confidence in the bank.
- To clearly state when, how, and with whom data can be shared.
- To reduce operational and security risks associated with third-party partners.
- To comply with privacy, banking, and data-protection laws.
- Which safeguard the bank's reputation/avoid legal penalties.

Award [1] for identifying a reason for an appropriate policy for the sharing of the data and [1] for an explanation for why it is appropriate up to a maximum of [2].

- (c) Discuss the advantages **and** disadvantages of customers of *Banco de Cali* using voice identification to authenticate themselves.

[8]

Answers may include:

Advantages of using voice identification

- Voice identification offers an additional layer of security compared to traditional methods like passwords or PINs (systems).
- Voice identification can potentially enhance the user experience by offering a more convenient and intuitive authentication method (systems).
- Customers may appreciate the simplicity of verifying their identity using their voice without the need to remember complex passwords or provide additional authentication factors (systems).
- It improves accessibility for different types of users who cannot type passwords, PINs, or tokens. (systems)
- Banco de Cali must ensure that the voice recognition process is seamless and user-friendly to avoid frustration or usability issues for customers (change, systems).
- For customers who are already accustomed to using voice identification, it can be a quick and easy way to authenticate themselves (change, systems).
- Introducing the system earlier than other banks gives customers earlier advantage (Change).

Disadvantages of using voice identification

- Criminals are already using deepfakes to gain access to accounts, and this risk is likely to increase over time (change, systems, values).
- Deepfakes are becoming more sophisticated and harder to detect, making them a major concern for security (change, systems, values).
- Voice identification is not foolproof, voice identification can be fooled by recordings or impersonators (change, systems, values).
- The system may be unable to match the voice of the user with the voice in the system (due to temporary health issues, or to incorrectly detecting it as deep fake, etc.)
- It can be a disadvantage for people who cannot use their voice temporarily (due to illness) or permanently (such as the mute) if there is no alternative authentication method.
- Voice identification may be susceptible to other attacks, such as social engineering (change, systems, values).
- Minor changes in the customer's voice or tone, or ambient noise, can prevent access to their account due to authentication errors (change, systems).
- The voice recognition system requires a microphone, and the customer may not have a microphone in his device, or the microphone may be defective.

Keywords: *Change, power, systems, values, data, security, biometrics, banking, business, authentication, identification, trust.*

Please see markband on page 13.

3. HoundBot

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

Answers may include:

- Sensory inputs for spatial, environmental and operational awareness.
- The ability to logically reason with inputs, often using machine vision and/or machine learning.
- The ability to interact and move in physical environments, sometimes remotely.
- The demonstration of some degree of autonomy.

Award [1] for identifying each characteristic of a robot up to [2].

- (ii) Outline **one** benefit of *HoundBot* creating a 3D image of a crime scene. [2]

Answers may include:

- This means the jury/judge/police will not need to visit the crime scene.
- It avoids dangerous, inaccessible, or remote locations.
- It allows for capturing complete and accurate views of the evidence at the scene and generating photorealistic 360-degree views of the location.
- The image will be accurate and not subject to human error.
- The evidence will not be manipulated, nor may it be altered (environmental conditions, etc.).
- This will help to avoid what could lead to legal invalidity.

Award [1] for identifying a benefit of the Houndbot creating a 3D image of a crime scene and [1] for further development up to [2].

- (iii) Outline **one** disadvantage of using the 3D image of a crime scene created by HoundBot. [2]

Answers may include:

- The quality of the 3D image may be poor. If a human isn't checking the quality
- It could represent the scene inaccurately due to technical errors
- Without the expertise of a trained police photographer the robot may miss important information
- Which may not provide useful or usable information.

Award [1] for identifying a disadvantage of using the 3D image of a crime scene created by the Houndbot and [1] for further development up to [2].

- (b) (i) Explain **one** advantage of using supervised learning to train HoundBot. [2]

Answers may include:

- The model is trained on data where the outcomes are known.
- Leads to accurate predictions by matching new data to a data set of possible crime scenes
- The model is trained on data where the outcomes are known.
- This allows the outputs to be compared to real crime scenes to determine their accuracy making it more reliable
- The model is trained on data where the outcomes are known.
- Reduction of the margin of error

Award [1] for identifying an advantage of using supervised learning to train the Houndbots and [1] for an explanation for that advantage up to [2].

- (ii) Explain **one** way bias could be found in the artificial intelligence (AI) algorithms used to analyse crime scenes. [2]

Answers may include:

- If historical crime data used for training reflects existing societal biases.
- The AI model may inadvertently reinforce those biases.
- If the dataset used for training the algorithm is not representative of the diverse range of crime scenes, demographics, and scenarios.
- The model may not generalize well to real-world situations.
- Feedback loops.
- May perpetuate existing biases over time.
- If the teams developing AI algorithms lack diversity.
- there may be a limited understanding of potential biases, leading to oversight during the development process.

Award [1] for identifying a way bias in the algorithms and [1] for an explanation for that way up to [2].

- (iii) Explain **one** reason why the use of a small set of training data may lead to inaccurate predictions in crime scene analysis. [2]

Answers may include:

- The algorithms may not learn effectively / overfitting.
- Works well with training data but does work well with new data.
- It does not include enough variety of scenes.
- This may lead to results only being accurate in very specific scenarios
- Small datasets may be affected by outliers/under-represented groups.
- This may mean the predictions are less accurate as the training data does not reflect the nature of the crimes carried out.

Award [1] for identifying a reason why the use of a small set of training data may lead to inaccurate predictions and [1] for an explanation for that reason up to [2].

- (c) To what extent should the police rely on the evidence collected by autonomous robots such as HoundBot?

[8]

Answers may include

Should rely on the evidence collected by the *Houndbot*

- The *Houndbot* will be able to collect more evidence than a human officer (systems). The greater amount of evidence may lead to greater reliability
- The *Houndbot* will collect evidence without prejudice (systems, values)
- The *Houndbot* will allow police officers to carry out more detailed investigations (systems)
- The *Houndbot* will collect evidence that may be impossible / too difficult or dangerous for police officers to collect. This evidence may provide critical information (spaces, systems).
- If they are verified by human experts who can interpret, question, and correct the conclusions.

Should not rely on the evidence collected by the *Houndbot*

- The evidence collected may not be reliable or accurate (values, systems).
- And Unreliable evidence could lead to wrongful accusations (systems, values).
- The *Houndbot* may inherit biases (systems, values).
- The *HoundBot* could malfunction and provide incorrect data.
- The ethical frameworks, that should address issues such as privacy concerns, data protection, transparency, and accountability for the actions of these machines may not be sufficiently robust (ethics, values).
- Human judgment is still required to make final decisions about the evidence collected (values).
- Will the public trust the *Houndbot* (systems, values)?
- Will the use of the Houndbot lead to a deskilling of the police officers / overreliance on technology (values)?

Keywords: *Change, power, spaces, systems, ethics, trust, law, policies, acceptability, data, accountability, transparency.*

Please see 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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. Meet your food before your first bite!

AlimentosFood is concerned about food waste and is considering a digital intervention.

The Chief Executive Officer (CEO) claims that data analytics can reduce food waste by determining customer preferences, which would improve the efficiency of the supply chain and lower costs.

To what extent do you agree with this claim?

[12]

Answers may include:

Potential to reduce food waste

- Improved decision-making by providing more accurate forecasts of demand leading to a reduction in production/optimising inventory levels and unnecessary waste (change, systems, cost).
- Analysis of food transport leading to improved transit times ensures perishable goods arrive fresher and last longer and are more likely to be sold rather than discarded (change, systems, cost).
- Real-time monitoring can ensure proper storage conditions and minimise spoilage during transportation (change, systems, cost).
- Data analytics will identify bottlenecks and inefficiencies allows targeted solutions to address specific causes of waste (systems, cost).
- A data driven solution can inform strategies to sell items nearing expiry dates, reducing spoilage and waste Reducing prices of food nearing expiry date will decrease cost to customers and ensure this food is sold rather than thrown away (change, systems, cost, innovation).
- Statistics can be provided to customers to educate them in the need for waste reduction (change, systems).

The intervention will not significantly reduce waste because of the following limitations:

- The effectiveness of data analytics relies heavily on the quality and accessibility of data across the entire supply chain, which can be challenging to achieve, especially with fragmented or incomplete data (change, spaces, systems, feasibility, cost, innovation, transparency).
- Implementing data analytics solutions requires investment in technology, expertise, and training, which might not be feasible for all stakeholders in the supply chain, particularly smaller businesses (change, systems, feasibility, equity, cost).
- While data analytics can optimize processes, it primarily focuses on economic efficiency. Addressing other contributing factors like consumer behavior, infrastructure limitations, and social factors might require additional strategies beyond data-driven solutions (change, systems, feasibility, cost, equity, values).

Keywords: change, spaces, systems, ethic, values, smart, data, analytics, algorithm, aggregation, environment, waste, sustainability, innovation

Please use markband on page 16.

5. Monitoring global warming

It is claimed that this intervention will enable climate scientists to accurately predict the impact of changes in sea ice on global climate change.

To what extent do you agree with this claim?

[12]

Answers may include:

The intervention will predict the impact of change of polar sea ice on climate change

- Wider reach: This is crucial for understanding changes in ice cover, wildlife populations, and other environmental factors (change, spaces, systems, feasibility).
- Frequent monitoring: Compared to traditional methods like satellites or research vessels, drones can gather data more frequently and at higher resolutions, offering a more complete picture (change, spaces, systems, feasibility).
- Diverse sensors: Drones can be equipped with various sensors, including cameras, thermal imaging, LiDAR, and atmospheric sensors, collecting various types of data simultaneously (change, spaces, systems, feasibility).
- Cost-effective: Drones are often cheaper to operate than manned aircraft or research vessels, making data collection more affordable (change, spaces, systems, feasibility, cost).
- Reduced risk: Sending drones into hazardous environments minimizes the risk to human life (change, spaces, systems, ethics, feasibility).
- Environmental impact: Compared to traditional methods, drones have a lower carbon footprint, contributing to environmental protection (change, spaces, systems, ethics, feasibility, environment).

The intervention will not predict the impact of change of polar sea ice on climate change

- Drones may not be able to gather information in Extreme weather: Operating drones in the harsh polar environment presents challenges with wind, low temperatures, and limited communication infrastructure (change, spaces, systems, feasibility, cost).
- Safety regulations and environmental concerns could limit the use of drones. Regulations: Establishing clear regulations for drone use in polar regions is crucial to ensure safety and environmental protection (change, spaces, systems, feasibility, values, ethics, regulation, acceptability).
- Missions could be very long and battery life might be a limiting factor. Battery life: Increasing battery life and developing efficient charging methods are necessary for longer and more extensive missions (change, spaces, systems, feasibility, cost, innovation).
- Predicting climate impact depends not only on the physical state of the ice but also on future greenhouse gas emissions. Even with perfect data regarding current ice, climate models cannot predict political decisions, wars, economic crises, or technological advancements that could drastically alter CO₂ emissions in the coming years.
- Uncertainty in Computational Models: Drone data are merely inputs for supercomputers that simulate the climate. Even with perfect input data, limitations in processing power and the physical equations used introduce inevitable margins of error in the predictions.

Keywords: change, power, spaces, systems, ethic, values, feasibility, cost, innovation. smart, data, aggregation, environment, climate change

Please use markband on page 16.

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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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.
