

Markscheme

November 2019

Information technology in a global society

Higher level

Paper 3

9 pages

No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without written permission from the IB.

Additionally, the license tied with this product prohibits commercial use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, is not permitted and is subject to the IB's prior written consent via a license. More information on how to request a license can be obtained from <http://www.ibo.org/contact-the-ib/media-inquiries/for-publishers/guidance-for-third-party-publishers-and-providers/how-to-apply-for-a-license>.

Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite de l'IB.

De plus, la licence associée à ce produit interdit toute utilisation commerciale de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, n'est pas autorisée et est soumise au consentement écrit préalable de l'IB par l'intermédiaire d'une licence. Pour plus d'informations sur la procédure à suivre pour demander une licence, rendez-vous à l'adresse <http://www.ibo.org/fr/contact-the-ib/media-inquiries/for-publishers/guidance-for-third-party-publishers-and-providers/how-to-apply-for-a-license>.

No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin que medie la autorización escrita del IB.

Además, la licencia vinculada a este producto prohíbe el uso con fines comerciales de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales— no está permitido y estará sujeto al otorgamiento previo de una licencia escrita por parte del IB. En este enlace encontrará más información sobre cómo solicitar una licencia: <http://www.ibo.org/es/contact-the-ib/media-inquiries/for-publishers/guidance-for-third-party-publishers-and-providers/how-to-apply-for-a-license>.

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.

If candidates answer more than the prescribed number of questions:

- In the case of an “identify” question read all answers and mark positively up to the maximum marks. Disregard incorrect answers.
- In the case of a “describe” question, which 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.
- In the case of an “explain” question, which asks for a specified number of explanations *eg* “explain two reasons”, mark the **first two** correct answers. This could include two full explanations, one explanation, one partial explanation *etc.*

1. (a) Identify **two** factors that could make the sensors in driverless cars become unreliable. [2]

Answers may include:

- sensor failure
- vibrations/shocks
- incorrect mounting/positioning
- incorrect calibration
- malicious attacks.

Award [1] for identifying factor that may lead to the sensors in driverless cars to be unreliable up to maximum of [2].

- (b) Driverless cars at level 5 on the Society of Automotive Engineers (SAE) scale could be designed so that they do not have a steering wheel.

Outline **one** reason why the World Driverless Vehicle Federation (WDVF) would want a level 5 driverless car to have a steering wheel. [2]

Answers may include:

- reason: gain human trust and acceptance
- development: humans may not feel comfortable getting in a vehicle with no option for a human to take over control of the vehicle, having a steering wheel will allow driverless vehicles to be more accepted by citizens.
- reason: humans may need to take manual control of the vehicle
- development: in the event of an emergency or unpredicted event/technical problems with the hardware or software or network / driving into remote areas where the infrastructure is not in place, a human can gain control of the vehicle.

Award [1] for identifying a reason why the WDVF would want the steering wheel to be retained and [1] for a development of that reason up to maximum of [2].

2. (a) Explain how radar sensors inform the driverless vehicle of the conditions in its surrounding area. [2]

Answers may include:

- radar sensors enable the car to be aware of position of vehicles in front and/or behind it
- enables a driverless car to maintain an appropriate distance between them.

Award [1] for identifying a way that radar sensors inform the driverless vehicle of the conditions in its surrounding area and [1] for a development of that way up to maximum of [2].

- (b) Explain why latency is an issue for driverless vehicles. [4]

Answers may include:

- latency is the time difference between the input to a system and the desired outcome or the delay when data gets sent or received by the vehicle
- latency is a critical consideration for driverless cars because a high latency may lead to serious consequences if the driverless car is unable to “react” in time
- latency would not be acceptable if it takes three seconds for your car to notice the boy running into the road and avoid him. You can’t have a second or two of delay receiving signals from a traffic light or an approaching bus
- latency may occur while the DV perceives its immediate environment or while it is making the correct driving decision when using the rule based system.

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

[1–2]: *A superficial explanation of why latency may be an issue for driverless vehicles. There is some use of appropriate ITGS terminology in the response.*

[3–4]: *A detailed explanation of why latency may be an issue for driverless vehicles. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.*

3. It was recently reported that a driverless vehicle had collided with a baby’s stroller (push chair) that had rolled into the road. The driverless vehicle “chose” to run over the stroller rather than swerve to avoid it, as swerving would have put pedestrians at risk. Luckily there was no baby in the stroller. This incident led to a discussion about the ethics of the decisions made by the driverless vehicle.

Discuss whether it is possible for an ethical framework to be developed for driverless vehicles that will lead to the minimum amount of harm being caused when an accident occurs.

[8]

Answers may include:

Reasons why it is possible to develop an ethical framework

- ethical framework can be based on – recognizing an ethical issue, getting the facts, evaluating alternative actions, making a decision that is acted on and then reflecting it. Such an approach is a standard approach that can be adopted and implemented
- the framework can be developed that is then translated into the algorithms for the driverless car
- the actions to take would depend on the ethical standards adopted. Students may approach this response by using their research on different ethical approaches eg utilitarian approach, consequentialism *etc*, to discuss how the frameworks must support the idea of minimal harm when accidents occur.

Reasons why it is not possible to develop an ethical framework

- decision makers may disagree on what these ethical approaches entail and what human and civil rights mean
- decision makers may have different views on what the common good is and what counts as a good and a harm
- the different approaches may give different outcomes and therefore how would you choose which one to use?
- how would a system be put in place to evaluate and reflect on the actions taken and learn from it?
- an ethical framework would need to ensure that the DV behaved reasonably in any given situation, but there are always situations that are unforeseen
- the DV would be programmed to perform the right action, however, the pedestrians and other drivers may not be abiding by the rules.

Please see generic markband information sheet on page 7.

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

Marks	Level descriptor
No marks	<ul style="list-style-type: none"> • No knowledge or understanding of the relevant ITGS issues and concepts. • No ITGS terminology.
Basic 1–2 marks	<ul style="list-style-type: none"> • Shows only a little ITGS knowledge. • Makes at least one argument. • May not have any comparison/conclusion.
Adequate 3–4 marks	<ul style="list-style-type: none"> • Shows a little more ITGS knowledge but still weak. • Has more arguments, (at least two) and possibly from different stakeholders. • Has a conclusion or judgments which are probably not backed by much reasoning.
Competent 5–6 marks	<ul style="list-style-type: none"> • Shows good ITGS knowledge and detail. • Has more arguments and they are balanced (+ and –) and for different stakeholders. • Conclusion/judgments are supported by the arguments and is well thought out.
Proficient 7–8 marks	<ul style="list-style-type: none"> • Shows very good ITGS knowledge. • Arguments are very balanced and detailed. • Conclusion is based completely on the arguments.

4. To what extent will the introduction of driverless vehicles be of benefit to society? [12]

Answers may include:

Reasons why the introduction of driverless vehicles will be beneficial to society

- provide mobility to those who currently cannot drive
- safer transportation with reduced number of crashes
- reduced number of cases in hospital due to road accidents
- more efficient use of road space which can reduce traffic congestion
- cooperative route planning can reduce congested routes
- society can use drive time more productively (eg work can be done on the journey home, instead of driving)
- more use of car pooling
- could provide on-demand vehicles improving transport for people on low incomes/ providing 24/7 service
- could change car ownership, leading to a reduced demand for parking space, garages
- more efficient delivery of goods, as drivers will not need to rest
- environmental benefits with reduced pollution.

Reasons why the introduction of driverless vehicles will not be beneficial to society

- those without a valid driving license may still not be able to be responsible for a DV as they may need to take over in an emergency
- loss of a skill – users may lack the skill to drive, or take back control if needed
- loss of driving jobs
- loss of car culture
- citizens may not “trust” the DV and refuse to use them
- existing road structure may not be adequate for DV and would need considerable funding to develop
- safety would need to be redefined – could mean more expensive Road Worthy tests and more frequent testing which can be costly
- technical failures could lead to fatal accidents
- breaches of cyber security may cause more accidents
- increase in digital divide, those who can afford a DV can be guaranteed more safety compared to those who can't, leading to certain districts being safer than others
- cities may lose revenues with less fines because DV follow the rules
- society will need to develop legal systems to deal with road accidents
- potential increase in e-waste with an increase in the use of DV
- moral dilemmas when a DV must choose between two risky outcomes.

Please see generic markband information sheet on page 9.

HL paper 3 question 4 markband

Marks	Level descriptor
No marks	<ul style="list-style-type: none"> • A response with no knowledge or understanding of the relevant ITGS issues and concepts. • A response that includes no appropriate ITGS terminology.
Basic 1–3 marks	<ul style="list-style-type: none"> • 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, conclusions or future strategies. • No reference is made to the information in the case study or independent research in the response. • The response may be no more than a list.
Adequate 4–6 marks	<ul style="list-style-type: none"> • 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, judgments or future strategies that are no more than unsubstantiated statements. The analysis underpinning them may also be partial or unbalanced. • Implicit references are made to the information in the case study or independent research in the response.
Competent 7–9 marks	<ul style="list-style-type: none"> • 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 information in the case study or independent research are made at places in the response.
Proficient 10–12 marks	<ul style="list-style-type: none"> • 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, judgments or future strategies that are well supported and underpinned by a balanced analysis. • Explicit references are made appropriately to the information in the case study and independent research throughout the response.