Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

GLOBAL PERSPECTIVES AND RESEARCH **9239/11**

Paper 1 Written Examination **May/June 2017**

1 hour 30 minutes

INSERT (RESOURCE BOOKLET)

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READ THESE INSTRUCTIONS FIRST

This Resource Booklet contains Documents 1 and 2 which you should use to answer the questions.

You should spend approximately 10 minutes reading the documents before attempting to answer the questions. This is allowed for within the time set for the examination.

This document consists of **3** printed pages and **1** blank page.

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The documents below consider issues related to artificial intelligence. Read them **both** in order to answer **all** the questions on the paper.

Document 1: adapted from *Navigating Driverless Cars*, an article by Emma Poole, written in the World Intellectual Property Organisation (WIPO) magazine in 2014. The author is a lawyer and worked as Executive Research Officer for WIPO, Geneva.

According to the US Department of Transportation, a vehicle is driverless if its operation doesn't require driver input to control the steering, acceleration or braking. Such driverless vehicles are now common in certain controlled environments, separate from other transport. You may have already travelled on a driverless light rail system in Vancouver, London, Singapore or between terminals at airports around the world. Shuttle buses in the Netherlands use dedicated bus lanes and mining company Rio Tinto has self-driving trucks at an iron ore mine in Australia.

In 2014, The Economist magazine debated whether *completely* self-driving cars could become a reality in the near future and asked its readers' opinion. The 32% who voted "no" have obviously missed the news that driverless cars are more than a possibility, you can actually buy them. These driverless cars have already navigated the Italian city of Parma and driven from Italy to China almost unaided (a human had to drive through Moscow and pay the tolls), and the Google Self-Driving Car Project has now completed over 700,000 test kilometres. The prototype cars cannot always navigate potholes, see a traffic light with the sun behind it or drive in the rain, but research by the Boston Consulting Group suggests that research and development investment has rapidly expanded recently, increasing their effectiveness.

The benefits of driverless cars are also about to make them a near-reality. A leading investment company, Exane BNP Paribas, predicts that the technology and telecommunication sectors will see the greatest financial benefits because of the huge amount of computer development needed. Driverless cars operate by collecting and processing information from various sources, including cameras, sensors and geo-location devices, which car computers use to drive them. These processes simulate the hugely complex task human drivers undertake when they monitor the road, the car and themselves in order to drive. Already Google has benefited from a patent on reading traffic lights.

Driverless cars will also remove the need for driving restrictions related to age and ability. A six-year-old may take himself to school, or an older person may stay independent for longer. This increase in access to mobility should assist 22% of the world's population who will be over 60 in 2050. To highlight the potential of driverless cars to assist people with disabilities, a Google car has recently driven a blind man to an American fast food outlet for a take-out.

Fully automated vehicle technologies are also set to increase road safety because around 90% of traffic accidents are caused by human error. These technologies offer the potential to avoid human driver error completely and to combine robotically rapid responses with 360-degree awareness.

Thus, driverless cars are already a reality, set to reshape our world, moved on by their huge benefits.

Document 2: adapted from *Driverless Cars Are Further Away Than You Think*, an article written by Will Knight in 2013 as editor of Artificial Intelligence in the Massachusetts Institute of Technology (MIT) Technology Review. The magazine seeks to help its audiences understand the world of technology.

Car manufacturers are developing vehicles that have an increasing ability to drive themselves, potentially reducing accidents and traffic congestion. Data recently published by the US Insurance Institute for Highway Safety suggests that these partly automated features are already helping to reduce crashes. Its figures, collected from various US car insurers, show that cars which either warn the driver about an impending crash or apply the brakes automatically are involved in far fewer crashes than cars without these features. Also, a recent engineering study concluded that automation could theoretically allow nearly four times as many cars to travel on a given stretch of road. That could save some of the 5.5 billion hours and 2.9 billion gallons of fuel that the Texas Transportation Institute says are wasted by traffic congestion each year.

However, such figures tend to overlook just how challenging it will be to make a driverless car. It could take decades for the technology to come down in cost, and it might take even longer for it to work safely enough for us to trust fully automated vehicles to drive us around.

Google's Self-Driving Car Project has attracted much attention, but for all its expertise in developing search technology and software, Google has zero experience of building cars. To understand how automated driving is more likely to emerge, it is more instructive to find out what some of the world's most advanced automakers are working on.

Many of the sensors and computers found in BMW's self-driving car, and in other prototypes, are too expensive to be widely used. Also, achieving even more complete automation will probably mean using more advanced, more expensive sensors and computers. Such instruments will also need to be miniaturized and redesigned, adding more cost, since few car designers would place the existing ones on to a sleek new model.

I visited John Leonard, an MIT professor who works on robot navigation, to find out more about the limits of vehicle automation. He pointed out that poor weather can significantly reduce the reliability of sensors. He added, "If the system relies on a very accurate pre-existing map, then the work of keeping those maps up to date shouldn't be underestimated."

Most worrying, however, are the remaining artificial intelligence challenges. The technology still can't respond to problems created by the uncertainties of oncoming traffic, roundabouts, intersections and pedestrians. Ralf Herttwich, who leads research and engineering in driver assistance systems at the German automotive giant Mercedes, explained that interpreting a situation becomes increasingly more difficult as the road becomes more complex. "Just looking at a traffic light and deciding if it is for you is a very, very complex problem."

Finally, there is the difficulty of re-engaging distracted drivers, who have lost focus because they trust the car to drive itself. Clifford Nass, co-director of Stanford University's Center for Automotive Research, told me, "This may be the most dangerous moment for self-driving vehicles." I discovered this during my BMW and Mercedes prototype test drives – it's all too easy to lose focus, and difficult to suddenly hit the brakes if you need to resume control.

So, given these challenges, it seems all too obvious that we shouldn't expect self-driving cars to take over the roads anytime soon.

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