Solver: Lee Chong Yan

1) a) i) The scientist develops knowledge and understanding of the physical universe. Science is the pursuit of knowledge in its purest sense without any concern to the needs of the society. Engineer is one who translates into action the dreams of humanity, traditional knowledge and concepts of science to achieve sustainable management of the planet through the creative application of technology. Engineering connects pure science to society by using this knowledge to develop solutions to meet the needs of our society. In this case, the computer engineers put the human neurological concepts, drawn by the medicine field, into application by using computer software to reconnect the severed link between the patient's brain and muscles, thus allowing a paralysed patient to regain his mobility.
As a future computer engineer, I will strengthen my understanding on the technical skills required by the profession to ensure my basic professional competency. This forms the foundation for my future projects which I want to embark on to improve human lives. Besides, I will try to be open-minded and receptive towards new theories and inventions to deliver creative solutions to real-life problems.

ii) The theme is having personal meaning and commitment. For example, artificial lung was developed by engineers motivated by the people who need it. With the task ahead being a challenging one, it is important for the team to find meaning in their work to persevere and bring the project to fruition. As mentioned by Mark Zuckerberg in his Harvard Commencement Speech, it is crucial for us to find a greater purpose beyond ourselves – one which has impact on the world, as compared to simply benefiting personal interests. Hence, the researchers at CWRU have a clear vision and purpose in their work – to help the paralysed patients regain their mobility. The only thing they must do now is align their conviction and forward that vision. With a greater purpose in mind, they will have greater will in overcoming any obstacles that come along the way. This is because they know in their mind that their act of giving up will not simply affect themselves but also diminish the hope of the paralysed community to regain their mobility. Hence, they have to brave on and continue their venture. Eventually, they will succeed and bring the prospect of regaining mobility, previously unthinkable, to reality.

b) i) Engineers should be aware of developments in the history of engineering to understand why things happened and learn from past mistakes. For example, in 1994, Denver International Airport first launched its fastest and most sophisticated baggage system. It was constructed from 10000 motors. It failed upon implementation and it took 10 years to correct it, resulting in a loss of US$1 million. From this, we learn that a system must be designed with back-up system. In the aforementioned example, too much was expected too fast and people did not deal with reality, which resulted in its failure. As such, we learn about the mistakes committed by our predecessors, and out them into considerations for future projects, which prevents us from repeating the same mistakes and making unnecessary wastage of resources. In short, learning from past mistakes enhances our project reliability.

ii) It was the machine age where people made machines to make more machines. Graduate schools emerged. Technological convergence occurred, and standard

machine tools were used across industries. Industrial engineers designed and managed mass production and distribution systems. For example, the creation of moving assembly line improves efficiency. Tinkering became organised research. Individual inventions were organised into systematic innovations, where small things were put together to create a larger invention. This translated ideas into reality.

2) a) i) Ethical dilemmas are situations where moral reasons come into conflict and there are two or more equally undesirable choices. It is not clear of what should be done. It arises in engineering as moral values are many and varied, and can conflict.

ii)
1) Moral clarity: Identify the relevant moral values
2) Conceptual clarity: Clarify key concepts
3) Informed about the facts: Obtain relevant information
4) Informed about the options: Consider all options
5) Well-reasoned: Make a reasonable decision

b) i) Firstly, most codes are restricted to general wordings, hence have areas of vagueness. Secondly, they may not be able to address all situations. Lastly, they can be flawed by omission or because they represent a compromise between deferring judgements.

ii) Firstly, it is clear and coherent. Secondly, it lays out the basic moral values applicable to the profession in a systematic and comprehensive way. Lastly, it provides helpful guidelines in line with the most carefully considered moral convictions about concrete situations.

c) i) Virtual Ethics emphasises character more than rights and rules. Character is the pattern of virtues and vices in an individual. Responsible professionalism covers the public well-being, professional competence, cooperative practices and personal integrity. Basically, it covers the public, personal and occupational aspects of engineers.

ii) Right ethics regards human rights as fundamental and Duty ethics regards duties of respect for autonomy as fundamental. Both theories emphasise respect for individuals' dignity and worth. Both are mirror images of each other. In the Bhopal disaster, people have the right to live and continue their way of life, and Union Carbide has the duty to prevent harm to people and respect their lives. However, the poor management of the plants which resulted in the leakage of MIC gas, causing the deaths of thousands, had seen Union Carbide's breaching its duty.

3) a) i) A standard is a document approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory. SS2 enforces standard on steel for reinforcement on concrete. SS587 enforces standard on the management of end of life ICT equipment.

ii) Singapore uses standards as a strategic enabler by Singapore enterprises to gain global competitive advantage. Furthermore, standards also improve productivity, quality and market access for businesses and industries, protect consumer interests and enhance safety, health and environmental conditions. Firstly, Singapore supports the formation and growth of Singapore enterprises through the development of global standards in niche areas. Secondly, Singapore proactively initiates and facilitates implementation of voluntary standards for greater enterprise productivity and competitiveness by providing trainings and courses for individuals to increase productivity and competitiveness by providing trainings and courses for individuals to increase productivity and competitiveness to perform their jobs to standards.

b) i) Design patent protects designs for articles of manufacture. Utility patent protects processes and machines and any new and useful improvements on them. Patent provides the right to stop others from manufacturing using or selling products that are covered by your patent but does not provide you the right to practice if your invention is based on technology protected by a patent owned by another person. For example, if you invent a sensor which detects rain, thus automating the wiper movement on the windscreen of a car. You cannot manufacture the wiper together with the sensor as the wiper invention may be covered by patent owned by others.

ii) Cross-licensing refers to giving one party a licence to use (patented or copyright material) in return for a similar licence. It is common as technology-based companies usually come up with new innovations based on previous inventions, which requires certain features to be incorporated but are covered by patents. Furthermore, companies usually come up with new inventions that complement with the existing inventions, hence companies need to cross-license to combine these two innovations together into a single product. This is largely due to the dynamic nature of technology landscape, where new inventions are constantly built upon the previous ones.

c) i) Globalisation of Markets is the merging of distinctly separate national markets into a global marketplace. Technological advancement drives it. Advances in communication, information processing and transportation technology have made flows of information and goods possible.

ii) Firstly, Globalisation has resulted in unemployment. This is because globalisation benefits industries with comparative advantage, for example, low cost of production in its home country. However, for industries which do not have the competitive edge, they will not be able to withstand external competition. As a result, these industries will dwindle. However, workers from these sunset industries do not have the relevant skillset to assimilate to other sunrise industries, resulting in structural unemployment.

Secondly, Globalisation has resulted in a dilution of local culture. This is because for industries to cater to international market, their products have to follow the mainstream culture or international standards. As a result, the products will start to lose its unique local taste and touch, resulting in a loss of local culture.

Globalisation brings more benefits. Even though, globalisation has resulted in unemployment and dilution of local culture. These issues can be alleviated with government policies to retrain workers and segmentation of market to safeguard local culture. On the other side, the benefits range from increase in taste and preference to increase in national revenue through exports. Clearly, the benefits outweigh the detriments it brings.

4) a) i) During the Japanese occupation, British and other Europeans were taken as prisoners-of-war. People lived in fear of the Kempeitai and its harsh punishment. The Japanese carried out operation "Sook Ching" aimed at identifying and eliminating suspected anti-Japanese elements among the Chinese community. We learn that Singapore should rely on its own to keep itself safe from external threats as the British was not able to withstand the attack of Japanese, which resulted in the Japanese Occupation. Singapore should build its own military and defence force to deter aggressors. As a result, National Service is introduced to train all Singaporean men to defend for our country.

ii) During our pre-independence years, Singaporeans lived in poor conditions. There was a lack of necessities, especially water and food. Hence, the first political priority was to revamp the living space and sign water agreements. Everything was done to meet the pressing current needs first. In the engineering world, we have seen inventions that solve crucial problems and needs such as computers, which contributed a lot to our work efficiency. NEWater has also addressed a crucial need for water. However, today, some inventions are targeted at frivolous and trivial needs. For example, even though Instagram arguably addressed an important human need – self-expression, its filter invention did not add much tangible value to its social cause. Hence, we should realign out technological vision to solving basic human needs. In the future, I will thrive to solve needs which are basic and important, for instance, poverty or environment conservation. Recently people have devised ways of using old phones equipped with sensor and placing them around the forest to alert the authorities of any deforestation activities, thus effectively reducing illegal logging.

b) i) It means removing barriers to trade, like protectionism and tariffs, to encourage trading between countries so as to boost exports revenue, improve balance of payment and reduce unemployment. This is because import substitution failed due to failure in creating a common market after Singapore's separation from Malaysia. Singapore as a small domestic market and no economies of scale can be reaped, hence she has to rely on the international market.

ii) This is because Singapore is well-known for exporting quality electronics such as semi-conductors. This rise of China's smartphone industry has seen greater demand for these products. Our electronics are trusted as standards are in place to ensure that they meet the international industry standards. Furthermore, with a pool of talents, Singapore's manufacturing sector is more inclined towards the more sophisticated field, which requires advanced skillset, such as electronic engineering.

With electronics production being a main driver of our manufacturing sector, I may have to learn about hardware development to stay relevant. However, if I were to start up my own business, hardware development is not really needed given that freelance software developers are prevalent. As such, the impact on my future career is not significant.

c) i) Firstly, the prevalence of social media has been affecting Singapore's political stability. Social media often spreads exaggerated and biased news, and are not maturely handled by teenagers, who often take these news at face value and believe in its truth. For example, the saga between our Prime Minister, Lee Hsien Loong, and his brother, Lee Hsien Yang gas seen Singaporeans losing confidence in our PM as the social media depicted Lee Hsien Loong as someone who exploited his public status for his own interests.

Secondly, the succession of our next Prime Minister is another key issue. As a parliamentary republic where the Prime Minister is the head of government, a PM role is very important in guiding Singapore's economic growth as well as coordinating with other ministers to ensure a holistic national progress. Should an incompetent leader succeed, investors may lose confidence in investing in Singapore and the different sectors of the market may start to collapse.

ii) Singapore's Defence Philosophy is based on diplomacy and deterrence. Diplomacy means maintaining a cordial relationship with other countries, and getting involved in international movement or committee, such as ASEAN or United Nations. Deterrence means building up our defence force so as to protect our country from aggressors if diplomacy fails. This defence philosophy is important as it maintains the dignity and integrity of our political administration. Without a strong defence framework, other countries will not respect our political leaders as they view us as fragile and vulnerable to external threats. As a result, Singapore will be disadvantaged when negotiating with bid countries.

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