

EGT2
ENGINEERING TRIPOS PART IIA

Thursday 3 May 2018 9.30 to 11.10

Module 3E11

ENVIRONMENTAL SUSTAINABILITY AND BUSINESS

*Answer not more than **two** questions.*

All questions carry the same number of marks.

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

*Write your candidate number **not** your name on the cover sheet.*

STATIONERY REQUIREMENTS

Single-sided script paper

10 minutes reading time is allowed for this paper at the start of the exam.

You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.

1 Product Lifecycle Assessment and Its Uses: The company that manufactures Guinness and other alcoholic drinks has published on its website several illustrative lifecycle assessments. They capture lifecycle impacts of drink production in terms of two metrics: carbon emissions and water consumption.

The data for 1 pint (568ml) of Guinness, produced and consumed in Ireland, are: 170 grams CO₂ and 65 litres of water. 74% of the CO₂ footprint is attributable to the production and packaging lifecycle phases (the other phases are raw ingredient production, transport, and retail/consumer). 79% of the water footprint is attributable to raw ingredient production (the other phases are production, packaging, transport and retail/consumer).

By comparison, the website indicates typical data for:

- A glass (250ml) of milk as: 325 grams CO₂ and 255 litres of water.
- A can (330ml) of cola as: 170 grams CO₂ and 20 litres of water.
- A plastic bottle (330ml) of mineral water as: 140 grams CO₂ and 7 litres of water.

(a) There are three main stages in doing a lifecycle assessment. What are these and what do they convey? Which of these stages do the data on CO₂ emissions and water consumption represent? [20%]

(b) Your vegan friend uses these data to support his choices, by asserting that milk is 'far worse' in terms of its environmental impact, compared to cola, bottled water, or Guinness (which is actively eliminating use of fish membranes as filters, becoming vegan-friendly). Do you agree or disagree with your friend? What additional considerations or data would you need to make a more complete evaluation of the environmental impacts of these beverages? [40%]

(c) On the website, the CO₂ impact of a pint of Guinness is equated to roughly that needed to watch television for two hours. This is in an effort to make the data understandable in the context of people's lifestyles. Would you recommend to company managers that they publish additional metrics (e.g., loads of laundry, or miles driven) and actively communicate these to consumers to dispel concerns about Guinness' environmental footprint? What might be the benefits and risks of such a move? [40%]

2 Water Consumption and Approaches to Mitigate It: The state of California faced a severe water shortage in 2015 due to droughts that affected all of its 39 million residents, as well as industrial and agricultural users of water. At the same time, in the state's agricultural central valley, many farmers were switching from growing 'fallow' crops such as cotton, to the far more lucrative crop of almonds. Almonds are grown in orchards, and the trees need a continuous supply of water in both dry and wet years to survive and thrive. By contrast, a fallow crop like cotton can be left to 'fallow' (die back) in a dry year, and will regrow subsequently and produce a good crop.

(a) Explain why it is favourable for individual farmers to make this crop switch, and what you predict the longer term/larger scale consequences will be, and why. [20%]

(b) A long history of complex water rights and provision in the state of California provides the backdrop for current efforts to develop a groundwater sustainability plan for the state. To date, agricultural producers can drill their own wells and draw groundwater, which has contributed to groundwater contamination and shortages. However, a modified regulatory framework to address issues with agricultural groundwater sustainability will take many years to come into effect. Given what you know about the underlying dynamics of the problem, what other possible approaches are there for managing the agricultural water shortages in this area, and what are their pros and cons? [40%]

(c) Many tout that "water will be the next oil," referring to its increasing scarcity, the impact this will have on industrial and agricultural producers (as well as residents), and the rising price of water provision in some parts of the world. Evaluate this statement in light of how water and oil are used in industrial and agricultural production and the trends associated with each. Do you agree with the statement? Explain why or why not. [40%]

3 Food Retailing and the Circular Economy: Worldwide, between one-third and one-half of all food produced is wasted, according to estimates. In the UK, this varies from about 45% of all fruits and vegetables being wasted, to 30% of cereals, and 20% of meat and dairy. These figures represent total waste arising from suppliers, retailers and consumers. Given that 87% of the food retail market in the UK is controlled by only seven major retailers (Sainsbury's, Tesco, M&S, Asda, Co-op, Waitrose, and Morrisons), the potential for retailers to take individual or collective action to curb food waste is significant.

(a) Imagine you are advising **one** of the major food retailers in the UK about the topic of food waste, versus another important topic, that of packaging (and packaging waste). Using the logic of a materiality matrix, outline the considerations that the company should take into account for each issue (food waste and packaging). Based on these considerations, which issue would you deem 'more material' to the company's business in the next ten years, and why? State any assumptions you make in reaching this conclusion. [30%]

(b) The retailer in 3(a) is enamoured by the idea of the Circular Economy and wishes to take part in innovations in this area, focusing specifically on packaging waste. However, the person you are advising at the company is worried about the lessons you have shared about the difficulties Cook Composites and Polymers (CCP) had when considering developing its concrete coating product for sale. Explain whether you consider this person's worries well founded or not, based on comparisons between the retailer's situation and that of CCP. [40%]

(c) Clearly, to address the food waste problem, action will be needed across the board, as food retailers neither fully control their supply chains, nor consumer behaviour. What is one potentially effective way a single retailer can engage consumers in addressing food waste that might be generated *after* the consumer buys food? Explain why your idea would be appealing to consumers, and, importantly, why it could also be consistent with the food retailer's strategic goals. [30%]

END OF PAPER