

Product Design
23CGP059

Semester 2 2023/24

In-Person Exam paper

This examination is to take place in-person at a central University venue under exam conditions. The standard length of time for this paper is **2 hours**.

You will not be able to leave the exam hall for the first 30 or final 15 minutes of your exam. Your invigilator will collect your exam paper when you have finished.

Help during the exam

Invigilators are not able to answer queries about the content of your exam paper. Instead, please make a note of your query in your answer script to be considered during the marking process.

If you feel unwell, please raise your hand so that an invigilator can assist you.

You may use a calculator for this exam. It must comply with the University's Calculator Policy for In-Person exams, in particular that it must not be able to transmit or receive information (e.g. mobile devices and smart watches are **not** allowed).

Answer **Any THREE** questions. Each question carries 25 marks.

Candidates should show full working for all calculations and derivations.

Additional material for Q1 has been provided on the final page.

1. (a) (i) It is important to obtain information from stakeholders about the needs for a personal care chemical product. Define what is meant by a stakeholder within the context of product development. [3 marks]
- (ii) Provide 10 examples of the stakeholders for a chemical product of Dulux grey outdoor paint. [4 marks]
- (iii) A new product of paint is planned to be developed. Briefly explain a quick method to identify metrics for the specifications of a new product and provide five examples of specifications of the new product. [3 marks]
- (b) Even though we usually take the colour of pills for granted, it is one of the important issues in the design and manufacture of pills/tablets. Recent research works have demonstrated that red and pink pills are increasingly popular. Pink pills are seen as sweeter and prompt patients to take them to achieve the intended effects. In some other studies, data suggests that middle-aged people preferred red tablets compared to younger adults, and more women prefer red tablets than men. Consequently, most of the pharmaceutical companies put a great deal of time and effort into choosing the precise colour for the pills and the corresponding placebo dosage forms.
- (i) Based on your understanding of healthcare product design, justify the time and effort utilised by the pharmaceutical companies into considering various issues such as choosing the precise colour for the pills and the corresponding placebo dosage forms. [10 marks]
- (ii) Evaluate the issues that should be considered by pharmaceutical companies in order to match the colours of the placebo dosage form and the comparator pill. [5 marks]

2. Personal care companies continually review what their customers want from their products. The attached list on the final page (Q1: Face Moisturiser Needs Statements) shows the unsorted information obtained from five sources.
- (a) Rephrase any similar needs, reinterpret vague statements, and remove any contradictory or redundant needs. Aim to end up with a list of about 20 rephrased needs. Provide a simple commentary for each of your decisions to remove or reinterpret any of the needs statements. [9 marks]
- (b) Organise the needs statements into a structured list, explain your choices of the structure. Rank the sorted needs statements and identify any latent needs. Provide justifications for your ranking of the essential needs. [9 marks]
- (c) Identify any need statement that is likely to lead to quantitative specifications for the final product. Identify four aspects and explain how to gather the information for the specifications of the product design. [7 marks]

3. (a) Compare chemical product design and chemical processing design, highlight the differences and links between them. [5 marks]
- (b) Provide five groups of products (three in one group) such as chemical, biochemical or biomedical products. In each group, one of them is the benchmark product and the other two are developed based on this benchmark product. Use two groups as your examples to explain the advantages and disadvantages of these products compared to the benchmark product. Identify the driving forces of the new products and predict the future market for these two newly developed products. Note: Example of weed killer discussed in the module cannot be used as an example for this question. [10 marks]
- (c) The company plans to develop a new chemical, biochemical or biomedical product, which is different to the six products of two groups you provided in Q3(b). One of the six products provided above can be the benchmark product for the new product. Explain six steps to develop the new product and provide the matrices for selecting one final idea from your two ideas for the new product. [10 marks]
4. (a) The Cross equation for the estimation of the viscosity is shown below:
- where μ_a is apparent viscosity, and $\dot{\gamma}$ is shear rate. Briefly explain the theoretical background of the equation and the influence of the shear on the apparent viscosity. [7 marks]
- (b) Explain the shear thinning and shear thickening phenomena, provide two examples for each phenomenon and describe the links to the Cross equation. [10 marks]
- (c) Describe the four methods of building and organising product development teams in chemical product companies. [8 marks]

END OF PAPER

H Yang and T Sun

Q1: Face Moisturiser Needs Statements

Existing adult woman customer

1. Able to moisturise the skin
2. Spreads easily over the skin
3. Protects parts of the body
4. Can be poured easily
5. Should feel smooth on the skin
6. Cheaper than existing product
7. My cat likes my usual moisturiser
8. Should be packaged in refillable bottles
9. Removes the appearance of wrinkles
10. Can be used on cracked skin

Health and beauty consultant

11. Provide UV protection
12. Deliver an active pharmaceutical ingredient through the skin
13. Should not feel oily or greasy
14. On application, it should appear transparent
15. Should be OK for sensitive skin
16. Should be made from natural ingredients
17. Contains an anti-aging additive
18. Does not degrade in sunlight

Chain store purchasing manager

19. Should not melt below 50°C
20. Higher quality and more expensive than existing product
21. Should not be visible when dried
22. Should not cause an allergic reaction
23. Can be used by men
24. It must have a glossy package

Potential teenage customer

25. Apply a colouring (sun tan) to the skin
26. Clean parts of the body
27. My boyfriend doesn't use moisturiser.
28. Does not flow under gravity, but should not be thick to apply
29. Should not flow out of a tube on its own
30. Does not cause skin irritation
31. Should be pink
32. Should be enjoyable to use
33. Easy to apply a uniform coating
34. Container should be biodegradable
35. Should disguise skin imperfections, such as spots

R&D department

36. Must release any active pharmaceutical ingredient at a controlled rate
37. Should not contain any solvents
38. Can be stored in humid or warm environments
39. Could contain a nutroceutical

You may use the reference numbers given above to identify the needs statements in your answers.