25CGP059-1-EX1
Product Design

Semester 2 Academic Year (25/26) 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).

You **MUST** answer **Q1** and **ONE** further question from Q2 and Q3.

Each question carries 25 marks.

Candidates should show full working for all calculations and derivations.

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Q1 - COMPULSORY

1. (a) Describe a technology you try to develop in your research project in this academic year (or your previous research project if you do not do any research project this year). Describe 6 potential chemical (or biochemical, bioengineering) products with application of this technology. [8 marks]

   (b) The company intends to offer you an opportunity to develop the product you proposed in (a). Describe six key steps you would follow in the new product development process and explain the purpose and target of each step. [9 marks]

   (c) After completing these six steps, your product has been approved for further manufacturing and market launch. Compare the differences and relationships between chemical product design and chemical process design. [8 marks]

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Answer **ONE** question from this section

2. Personal care companies continually review what their customers want from their products. The following list provided on the next page (Q2: Needs Statements for the Sun Protection Gel) 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 (with original needs number). [9 marks]

   (b) Organise the needs statements into a structured list (with original needs number), 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) Peptides, due to their favourable pharmacological properties and inherent characteristics, are an ideal starting point for developing new therapeutics. Their high specificity often results in excellent safety, tolerability, and efficacy in humans. Compare and contrast the liquid and solid phase methods for peptide synthesis; assess their feasibilities for small- and large-scale manufacturing of peptides as biopharmaceuticals. [7 marks]

Continued/…

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Q2 Continued/…

Q2: Needs Statements for the Sun Protection Gel

Existing adult woman customer

1. Able to protect the skin from sunlight
2. Spreads easily over the skin
3. Should feel light on the skin
4. Should not feel sticky after application
5. Cheaper than existing product
6. My dog likes the smell of my sunscreen
7. Should be packed in refillable containers
8. Should not leave a white residue on the skin
9. Can be used on the face and body
10. Should be water resistant

Health and beauty consultant

11. Should provide high SPF protection
12. Should provide UVA and UVB protection
13. Should be transparent on application
14. Should be suitable for sensitive skin
15. Should be made from natural ingredients
16. Contains anti-ageing additives
17. Does not degrade in sunlight
18. Should contain antioxidants

Chain store purchasing manager

19. Should remain stable in hot weather
20. Higher quality and more expensive than existing product
21. Should not cause an allergic reaction
22. Can be used by men
23. It must have an attractive glossy package
24. Should have a long shelf life
25. Should comply with sunscreen safety regulations

Potential teenage customer

26. Should help prevent sunburn during sport
27. Should make the skin look tanned
28. My boyfriend does not use sunscreen
29. Should not run into the eyes when sweating
30. Should not flow out of the tube on its own
31. Should be enjoyable to use
32. Should smell fresh
33. Should disguise skin imperfections
34. Container should be biodegradable

R&D department

35. Should not contain organic solvents
36. Can be stored in warm or humid environments
37. Should be easy to apply as a uniform coating
38. Could deliver a skin-beneficial active ingredient
39. Should be easy to manufacture at scale

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3. (a) Provide five groups of products (three products in one group, that is a total of 15 products) such as chemical, biochemical or biomedical products. In each group, one of the products is the benchmark and the other two are developed based on this benchmark product. [5 marks]

   (b) 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 discussed in the module and the previous question examples cannot be directly used as solution examples for this question unless you have new examples added in to the group. [5 marks]

   (c) Explain the influence of the shear on the apparent viscosity and the mechanism or equation behind the influence. [5 marks]

   (d) Explain the rheology application of paint, ketchup and whipped cream. [5 marks]

   (e) Explain the rheology application of helmets and elbow pads. [5 marks]

END OF PAPER

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