

CONFIDENTIAL**UNIVERSITI TUN HUSSEIN ONN MALAYSIA****FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022**

COURSE NAME : SUSTAINABLE MANUFACTURING
COURSE CODE : MDP 10803
PROGRAMME CODE : MDM
EXAMINATION DATE : JANUARY / FEBRUARY 2022
DURATION : 3 HOURS
INSTRUCTION :
1. ANSWER FIVE (5) QUESTIONS ONLY
2. THIS FINAL EXAMINATION IS AN
**ONLINE ASSESSMENT AND
CONDUCTED VIA OPEN BOOK**

THIS QUESTION PAPER CONSISTS OF SEVEN (7) PAGES**CONFIDENTIAL**

- Q1** (a) The concept of sustainability consists of three pillars namely environmental, social, and economy. Please explain the importance to embed sustainability concepts into the current product.
- (2 marks)
- (b) In achieving sustainable manufacturing, it stresses on the elements of personal health and operational safety. Kindly justify both of these elements.
- (3 marks)
- (c) Product life cycle is an important element used to explain a product performance. Please recommend **TWO (2)** strategies should be taken to extend or enhance a product life cycle in the product use phase?
- (5 marks)
- (d) Waste minimization is one of the important strategies to reduce residual waste in industry. Kindly recommend **TWO (2)** potential strategies at the material purchasing and **TWO (2)** strategies at the production planning to reduce the solid waste generation along with the production workstations.
- (10 marks)
- Q2** (a) Please explain the importance of Design for Sustainability in product design.
- (2 marks)
- (b) Electronic waste (e-waste) is a global environmental issue. Many regulations and policies have been imposed to battle e-waste especially from the context of product design. Please determine **TWO (2)** compliance used to reduce e-waste problem.
- (3 marks)
- (c) In the product development phase, the designer plays a vital role to decide the overall product performance in term of sustainability context. Please examine how a designer to ensure their product design meeting less energy usage in terms of material selection during the manufacturing process.
- (5 marks)

- (d) Given **Figure Q2(d)** and **Figure Q2(e)**, please compose your answers with strategies to be implemented in order to achieve environmental sustainability. Your answers need to include the aspect of functional design, material selection, manufacturing process, and product packaging.

(10 marks)

- Q3** (a) In product use phase, there are some strategies can be implemented in order to extend the product recovery rate. What are your suggestions?

(2 marks)

- (b) Given **Figure Q3(b)**, it shows the waste hierarchy for a product design. Please explain why reuse is higher than recycling and composition?

(3 marks)

- (c) In new product development, material saving is one of the major requirements. Given **Figure Q3(c)**, it shows a part design of metal plate with holes, please propose **ONE** (1) suggestions with sketching how to ensure less waste generation in the shopfloor.

(5 marks)

- (d) The speaker shown in **Figure Q3(d)** has reached its end-of-life. However, some of the components can be remanufactured and become a new product. Therefore, as a Product Engineer:

- i. Predict which component can be and cannot be remanufactured.
- ii. Evaluate the product and propose in detail the process flow together with the working elements of the remanufacturing process.

(10 marks)

- Q4** (a) Please explain why product remanufacturing is less energy intensity use compared to the recycling process?

(2 marks)

- (b) As a green product designer, please justify why mixed materials used need to be avoided in a product design. Your answer **MUST** follow the requirement of Design for Recycling guidelines

(3 marks)

- (c) Green manufacturing is a trend of the current industry moving towards sustainable manufacturing. However, there are many barriers may occurring especially to the small and medium sized companies (SME). Please examine the potential barriers may exists in a traditional SME if they wanted to transform towards green manufacturer.

(5 marks)

- (d) Green strategies implementation are motivted by internal and external drivers. If your company is doing business on automotive part remanufacturing, kindly defend your company business with potential drivers in formulating the green strategies. Your answers should consists of the drivers and the strategies across different departments (top management, product design, manufacturing, packaging).

(10 marks)

- Q5** (a) Please explain the benefits to perform a product life cycle assessment during the product design phase.

(2 marks)

- (b) Interpret the endpoint categories with indicators and characterization factors in Life Cycle Impact Assessment (LCIA) stages.

(3 marks)

- (c) Cultural perspective represent a set of choices and assumptions on different issues consisting of time perspective and technology development. Differentiate **THREE (3)** cultural perspectives in ReCiPe method and choose the most commonly used and justify your answer.

(5 marks)

- (d) Plastic waste is a global issue in advanced and developing countries. By applying the ISO14040 standard, kindly compose a sustainable framework to reduce the plastics waste issue, especially the products that are made from various types of plastics in the market.

(10 marks)

- Q6** (a) Carbon foot print is an indicator to measure the environmental impact of a product. Please explain with **TWO (2)** benefits why a product should be designed with lower green house gases (GHG) emissions.

(2 marks)

- (b) Climate change is a global issue which particularly is due to the fast growing of manufacturing industries around the world. As an industry practitioner in coal sector, please examine **TWO (2)** practical approaches that could reduce the green house gases emission.

(3 marks)

- (c) Please determine the advantages and disadvantages of renewable and non-renewable energy, your answer must be supported with an example of an energy source.

(5 marks)

- (d) **Table Q6(d)** depicts the amount of gasses transmitted (100 years period) in life cycle inventories of steel by International Iron and Steel Institute 2015 report. Evaluate the global warming potential by converting with CO₂ equivalent coefficient from the Intergovernmental Panel on Climate Change. (Refer to Intergovernmental Panel on Climate Change Fourth Assessment Report, 2007).

(10 marks)

-END OF QUESTIONS -

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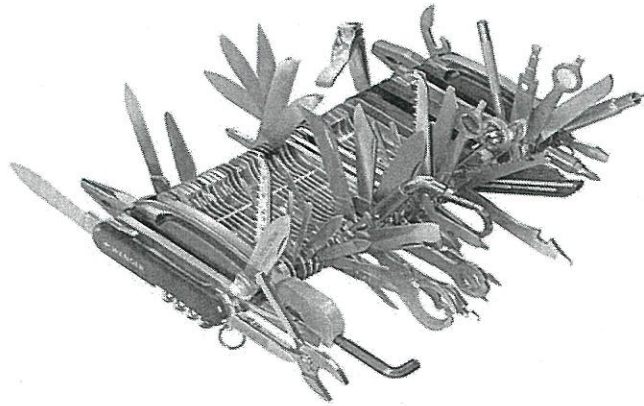


Figure Q2(d): Product A

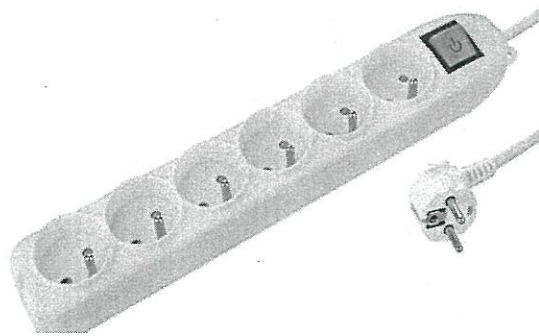


Figure Q2(e): Product B



Figure Q3(b): Waste hierarchy for a product design

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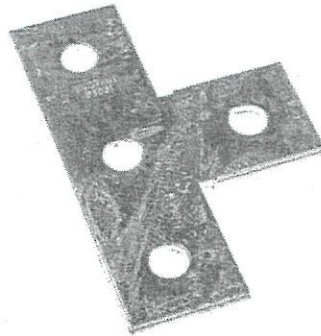


Figure Q3(c): Metal plate with holes

Item No	Name	Material	Quantity
1	Stand	Plastic	1
2	Metal plate	Metal	1
3	Stand plate	Plastic	1
4	Main body cover	Plastic	1
5	Speaker assembly	Metal	1
6	Front cover	Plastic	1
7	Screw	Metal	4

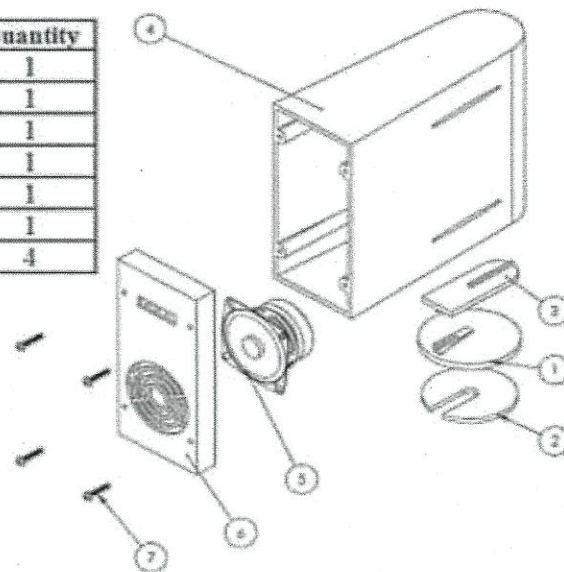


Figure Q3(c): Personal computer speaker

Table Q6(d): Amount of gasses in product life cycle

Type of gas	Chemical formula	Amount
Carbon dioxide	CO ₂	3.571 kg
Methane	CH ₄	3.6 g
Nitrous oxide	N ₂ O	0.018 g
Hydrochlorofluorocarbons	HCF-23	837 mg