# AQA Product Design Practice Exam (Sample)

## Study Guide


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# Questions

**1. What is a notable feature of self-finishing plastics?**

- **A. They require extensive post-production work**
- **B. They need to be painted after moulding**
- **C. They do not require further finishing once moulded**
- **D. They are always transparent**

**2. What is the primary cause of deterioration in polymers, particularly thermoplastics?**

- **A. Heat exposure**
- **B. Exposure to moisture**
- **C. Oxygen and ultraviolet light**
- **D. High pressure**

**3. What is die casting primarily used for?**

- **A. Molding plastics**
- **B. Creating intricate jewelry**
- **C. Producing car wheels**
- **D. Crafting wood products**

**4. What is the definition of composite materials?**

- **A. A mixture of two or more materials**
- **B. A single material with enhanced properties**
- **C. A material that is purely synthetic**
- **D. A collection of unrelated materials**

**5. What is the primary benefit of industrial die casting compared to sand casting?**

- **A. Lower energy costs**
- **B. Higher accuracy and smoother finish**
- **C. Ability to create larger objects**
- **D. More complex shapes with motor functions**

**6. Which of the following best describes liquid silicon rubber (LSR)?**

- **A. A type of thermoplastic**
- **B. Commonly used for making adhesives**
- **C. A common category of elastomers**
- **D. Known for high brittleness**

**7. How is the polymer formed in Blow Moulding?**

- **A. By heating and folding**
- **B. By extruding and blowing**
- **C. By compressing and heating**
- **D. By cooling and setting**

**8. What is a disadvantage of biodegradable polymers compared to conventional polymers?**

- **A. Higher production costs**
- **B. More environmentally friendly**
- **C. Longer shelf life**
- **D. Lower strength applications**

**9. Which property is associated with sheet-based composites?**

- **A. Weak in all directions**
- **B. Equal strength in all directions**
- **C. Good thermal insulation**
- **D. Susceptible to warping**

**10. Which type of finish involves introducing color to aluminum through an oxide layer?**

- **A. Anodizing**
- **B. Plastic dip coating**
- **C. Galvanizing**
- **D. Oil-based paint**

# Answers

1. C
2. C
3. C
4. A
5. B
6. C
7. B
8. A
9. B
10. A

# Explanations

## 1. What is a notable feature of self-finishing plastics?

**A. They require extensive post-production work**

**B. They need to be painted after moulding**

**C. They do not require further finishing once moulded**

**D. They are always transparent**

**Self-finishing plastics are specifically designed to have a smooth surface and an aesthetically pleasing finish right out of the mold. This characteristic means they do not require any additional surface treatment, such as painting or polishing, after the molding process is completed. This property is particularly beneficial in manufacturing, as it reduces production time and costs by minimizing the need for post-production work. The design and formulation of self-finishing plastics allow them to maintain their appearance and texture without further intervention, making them ideal for a variety of applications in consumer products and components where visual quality is important. Thus, the essence of self-finishing plastics lies in their ability to deliver a finished look immediately after production, which is why this option is the most accurate representation of their notable feature.**

## 2. What is the primary cause of deterioration in polymers, particularly thermoplastics?

**A. Heat exposure**

**B. Exposure to moisture**

**C. Oxygen and ultraviolet light**

**D. High pressure**

**The primary cause of deterioration in polymers, particularly thermoplastics, is due to exposure to oxygen and ultraviolet (UV) light. When thermoplastics are exposed to UV light, it leads to photodegradation, where the chemical structure of the polymer is altered. This process can break down the polymer chains, resulting in a loss of mechanical strength, flexibility, and overall integrity of the material. Oxygen plays a crucial role in this deterioration as well, as it can react with the polymer chains, further accelerating the degradation process. Together, UV light and oxygen contribute significantly to the aging and deterioration of thermoplastics, especially when these materials are exposed to outdoor environments. While heat exposure can also cause polymers to degrade by accelerating their thermal degradation and leading to softening or deforming, and moisture can initiate hydrolysis in some polymer types, the combined effect of oxygen and UV light is typically more pronounced in leading to significant degradation over time. High pressure may affect the physical structure during processing but is not a primary factor in the ongoing deterioration of standard thermoplastic materials in normal use.**

## 3. What is die casting primarily used for?

**A. Molding plastics**

**B. Creating intricate jewelry**

**C. Producing car wheels**

**D. Crafting wood products**

**Die casting is primarily used for producing high-volume, precise metal parts, particularly in industries like automotive. When discussing the automotive industry, the production of components such as car wheels is a prime application of die casting. This process involves forcing molten metal into a mold under high pressure, allowing for detailed shapes and fine finishes, which are crucial for parts like wheels that require durability and structural integrity. In contrast, molding plastics typically utilizes techniques like injection molding, which is distinct from die casting. Jewelry making often involves different methods like lost-wax casting or handcrafting rather than precision die casting. Similarly, crafting wood products involves woodworking techniques and machinery that are not related to die casting processes. Thus, the manufacturing of car wheels from metal via die casting exemplifies the most accurate application of this technique.**

## 4. What is the definition of composite materials?

**A. A mixture of two or more materials**

**B. A single material with enhanced properties**

**C. A material that is purely synthetic**

**D. A collection of unrelated materials**

**Composite materials are defined as a combination of two or more different materials that, when combined, produce a material with enhanced properties compared to the individual components. This definition highlights the importance of synergy between the materials used, which can improve strength, durability, weight, and other characteristics essential for various applications. When considering other options, the notion of a single material with enhanced properties does not encompass the collaborative essence of composites, as composite materials inherently involve multiple components working together. Similarly, a purely synthetic material refers to something manufactured from artificial substances, which doesn't necessarily indicate the combination or enhancement aspect that defines composites. Finally, a collection of unrelated materials suggests a random assortment without the intentional combination to improve performance, which contradicts the fundamental nature of what makes a composite material effective.**

## 5. What is the primary benefit of industrial die casting compared to sand casting?

**A. Lower energy costs**

**B. Higher accuracy and smoother finish**

**C. Ability to create larger objects**

**D. More complex shapes with motor functions**

**The primary benefit of industrial die casting compared to sand casting is higher accuracy and smoother finish. Die casting involves forcing molten metal into a mold at high pressure, which allows for a precise replication of the mold features. This results in components that not only meet tight tolerances but also exhibit a superior surface finish compared to those produced through sand casting, where the mold is made from sand that can create a rougher surface and less detailed shapes. The capability of die casting to produce intricate details with less post-processing makes it particularly advantageous for applications that require exact dimensions and a polished appearance. While other casting methods may excel in certain areas, die casting's focus on precision and surface quality positions it as a preferred choice for many manufacturing applications.**

## 6. Which of the following best describes liquid silicon rubber (LSR)?

**A. A type of thermoplastic**

**B. Commonly used for making adhesives**

**C. A common category of elastomers**

**D. Known for high brittleness**

**Liquid silicon rubber (LSR) is best described as a common category of elastomers. Elastomers are materials that exhibit elastic properties, allowing them to stretch and return to their original shape. LSR is specifically valued for its flexibility, resilience, and ability to maintain its performance over a range of temperatures. These characteristics make LSR suitable for various applications, including medical devices, automotive seals, and kitchenware, where durability and flexibility are essential. This description aligns perfectly with the nature of LSR, highlighting its significance within the elastomer category. While the other choices touch upon different properties or uses of materials, they do not accurately represent the fundamental characteristics of liquid silicon rubber. For instance, LSR is not a thermoplastic, which typically refers to plastics that can be melted and remolded, nor is it primarily known for adhesives despite having adhesive potential in certain formulations. Additionally, LSR is known for its flexibility rather than brittleness, which is contrary to the nature of the material being discussed.**

## 7. How is the polymer formed in Blow Moulding?

**A. By heating and folding**

**B. By extruding and blowing**

**C. By compressing and heating**

**D. By cooling and setting**

**Blow moulding is a specific process used to create hollow plastic parts and involves several key steps. The polymer is formed by extruding a parison, which is a heated tube of plastic, and then inflating it using air. This process begins with the extrusion of the molten polymer through a die to form the parison. Once the parison is in place, air is blown into it, causing the material to expand and take the shape of the mould. This combination of extrusion and blowing is what allows for the production of complex shapes and is characteristic of the blow moulding technique. The process is particularly effective for creating containers and other hollow shapes, effectively utilizing the properties of thermoplastic materials. By focusing on the extrusion and blowing methods, one can see how this technique differentiates itself from other forming processes, which might involve folding, compressing, or cooling without the specific action of blowing to create cavities within the final product.**

## 8. What is a disadvantage of biodegradable polymers compared to conventional polymers?

**A. Higher production costs**

**B. More environmentally friendly**

**C. Longer shelf life**

**D. Lower strength applications**

**Higher production costs are indeed a recognized disadvantage of biodegradable polymers when compared to conventional polymers. The process of creating biodegradable polymers often involves more complex and costly raw materials as well as production technologies. This can make them less favorable for some manufacturers who prioritize cost-effectiveness. While biodegradable polymers are designed with environmental benefits in mind (making them more environmentally friendly), their initial production costs can deter widespread adoption, especially in markets sensitive to price. Additionally, biodegradable polymers might not necessarily have a longer shelf life or suitable strength for every application, which can limit their use in some industries or products. Therefore, the implication of higher production costs remains a significant factor influencing the choice between biodegradable and conventional polymers in product design.**

## 9. Which property is associated with sheet-based composites?

**A. Weak in all directions**

**B. Equal strength in all directions**

**C. Good thermal insulation**

**D. Susceptible to warping**

**The property associated with sheet-based composites being equal in strength in all directions is correct due to the way these materials are structured. Sheet-based composites typically consist of layers of materials—often with fiber reinforcements—arranged in such a way that they can distribute loads evenly across the entire surface. This multidirectional strength is a significant advantage for applications where uniform performance is necessary, such as in construction or automotive components. The layering technique, commonly used in composites, allows for the optimization of performance properties such as strength, stiffness, and weight. This is in contrast to other materials that may exhibit directional weaknesses, where strength could be compromised depending on the orientation of the applied force. In composite materials, fibers can be oriented in various directions, and this design enhances tensile strength, yielding a more robust and reliable product. For additional context, while other options might capture certain characteristics of materials, they do not define the essential property of sheet-based composites accurately. For instance, being weak in all directions contradicts the inherent purpose of composites. Similarly, good thermal insulation might be true for some types of composites but does not reflect the strength aspect crucial to sheet-based materials. Lastly, susceptibility to warping is a limitation rather than a characteristic associated with strength and functionality.**

## 10. Which type of finish involves introducing color to aluminum through an oxide layer?

**A. Anodizing**

**B. Plastic dip coating**

**C. Galvanizing**

**D. Oil-based paint**

**Anodizing is a process that involves electrochemically converting the surface of aluminum into an oxide layer. This method enhances the natural oxide layer already present on aluminum, increasing its thickness and allowing for a variety of colors to be introduced. During anodizing, the aluminum is immersed in an acid electrolyte bath and an electric current is passed through the circuit, which causes the surface to oxidize. The resulting anodic oxide layer is not only a protective coating that improves corrosion resistance but also porous, which allows dye to be absorbed. This capability to accept dyes leads to a wide range of color finishes while maintaining the durability and aesthetic appeal of the aluminum. The other methods of finishing listed, such as plastic dip coating, galvanizing, and oil-based paint, do not involve the same process of anodization and do not create an oxide layer on aluminum. Each of these options serves different purposes and applies finishes in different ways, but none achieves the integrated coloration with an anodic oxide layer as anodizing does.**