

FACULDADE DE CIÊNCIAS DA UNIVERSIDADE DO PORTO

MPA 2023/2024 - MATERIALS PROPERTIES AND APPLICATIONS

Exam 2023/2024 (12 January 2024)

Duration: 120 min | (2 points out of 20 per question).

Name:

1 – Consider the following functionalities “A” and “B” and indicate a material suitable for each application based on its properties and limitations.

Justification: Justify your selection by explaining how the molecular structure and processing of the chosen material align with its properties.

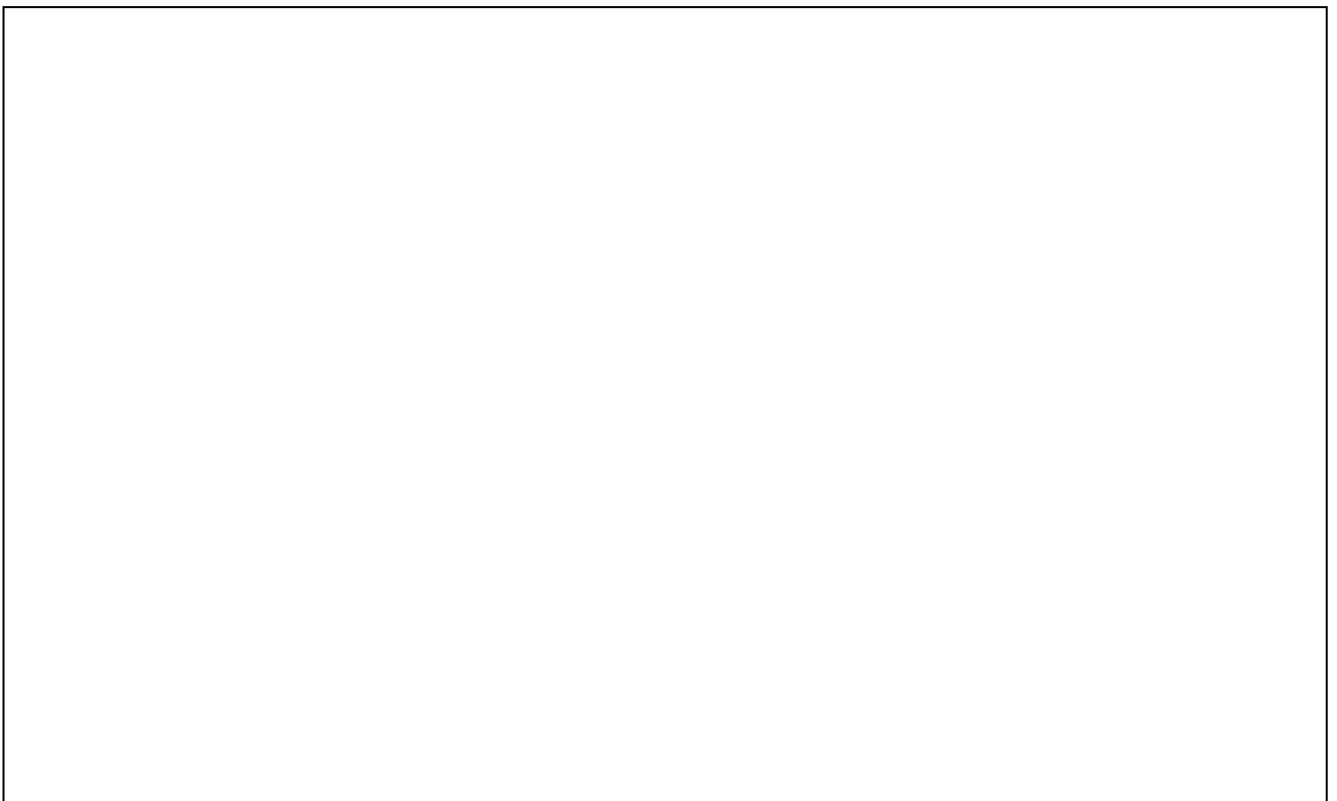
1.1 **A: Antiadherent Coating** (1/20) > Material? :

1.2 **B: High Temperature Thermal Isolation** (1/20) > Material? :


2 – Sketch three **stress-strain curves** on the same graph: curve for a brittle material (**A**); curve for a ductile material (**B**); curve for an elastic material (**C**). In each case, provide an example of a material that exhibits the corresponding stress-strain profile. (2/20)



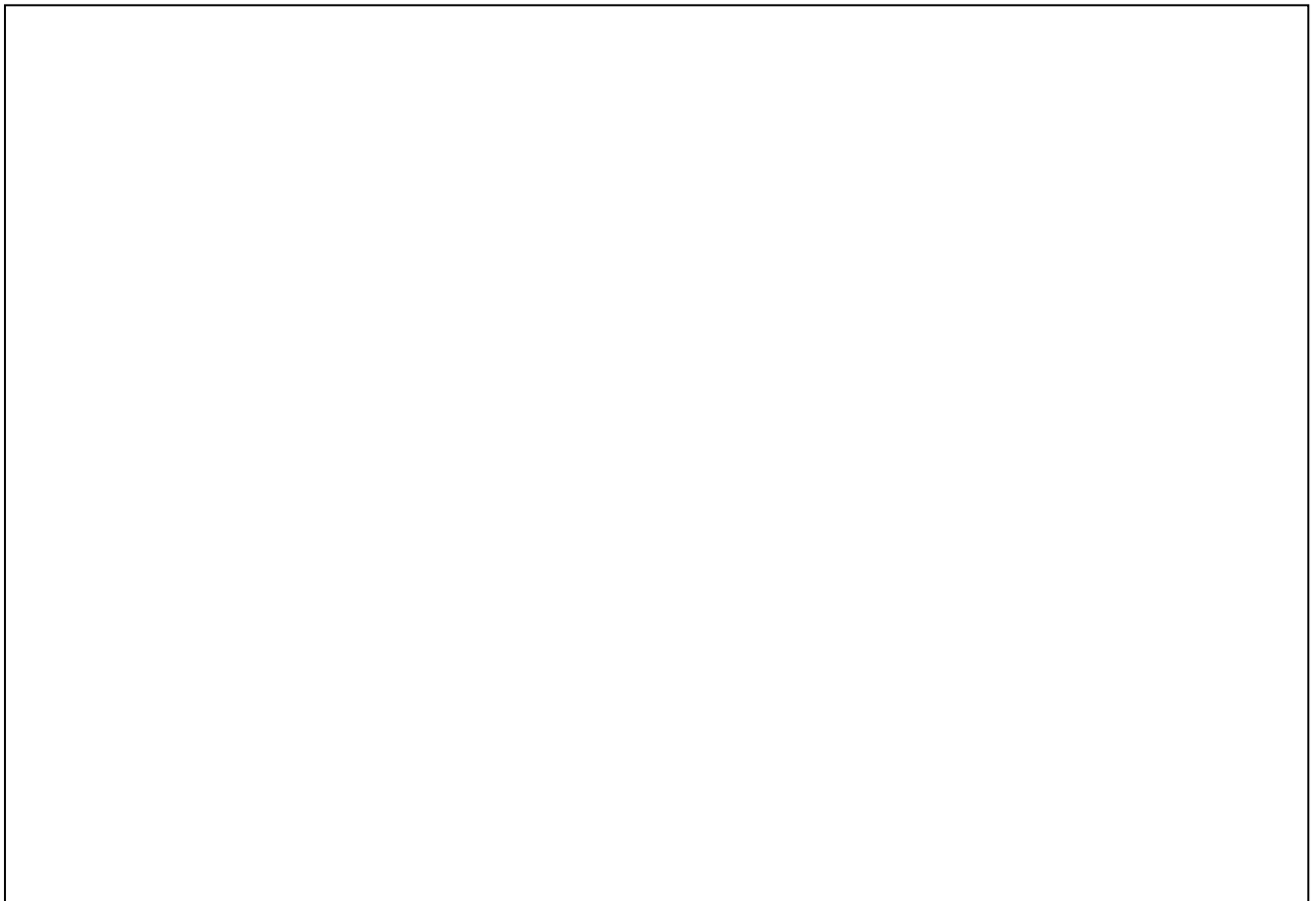
3 – How and why the thermal conductivity and electrical conductivity of a typical **metal** varies with temperature? Justify your answer. (2/20)



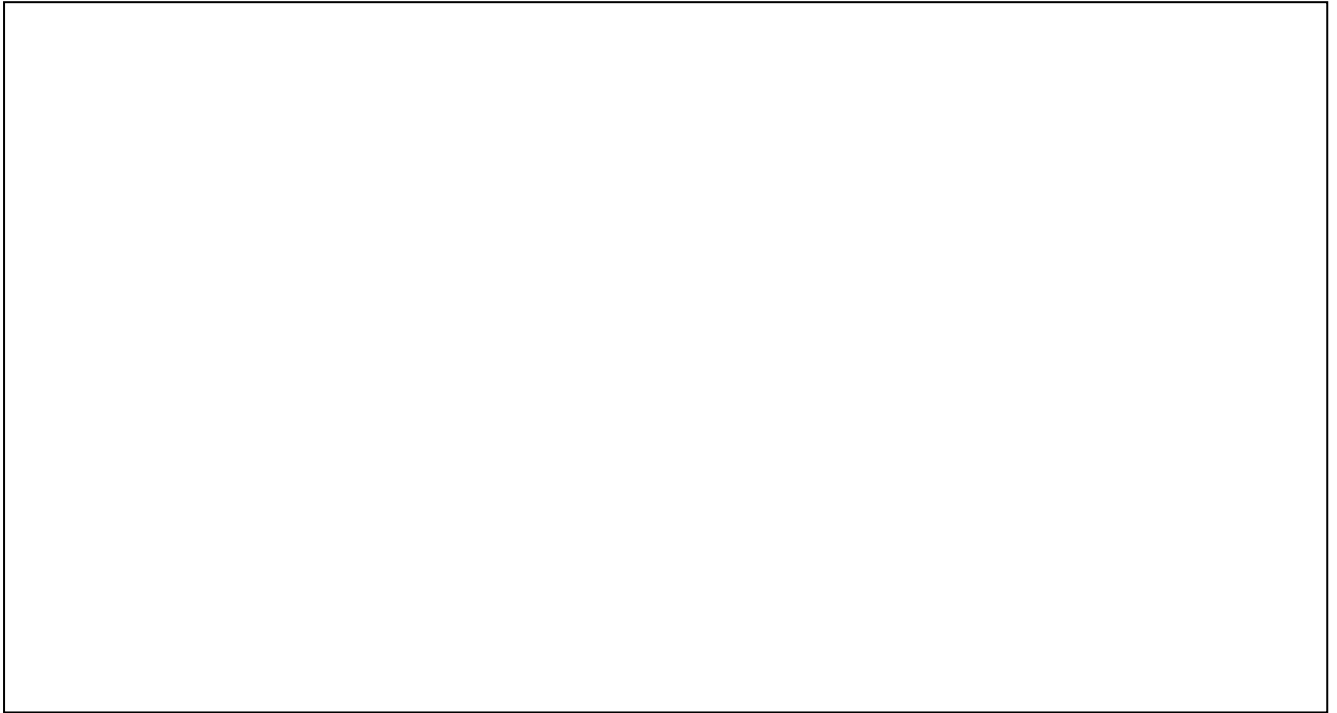
4 – The ductility is the physical property of materials to withstand plastic deformation under the action of force. Provide an example of an interstitial **metal alloy** and explain how interstitial substitution affects the ductility and thermal conductivity of a metal alloy. (2/20)



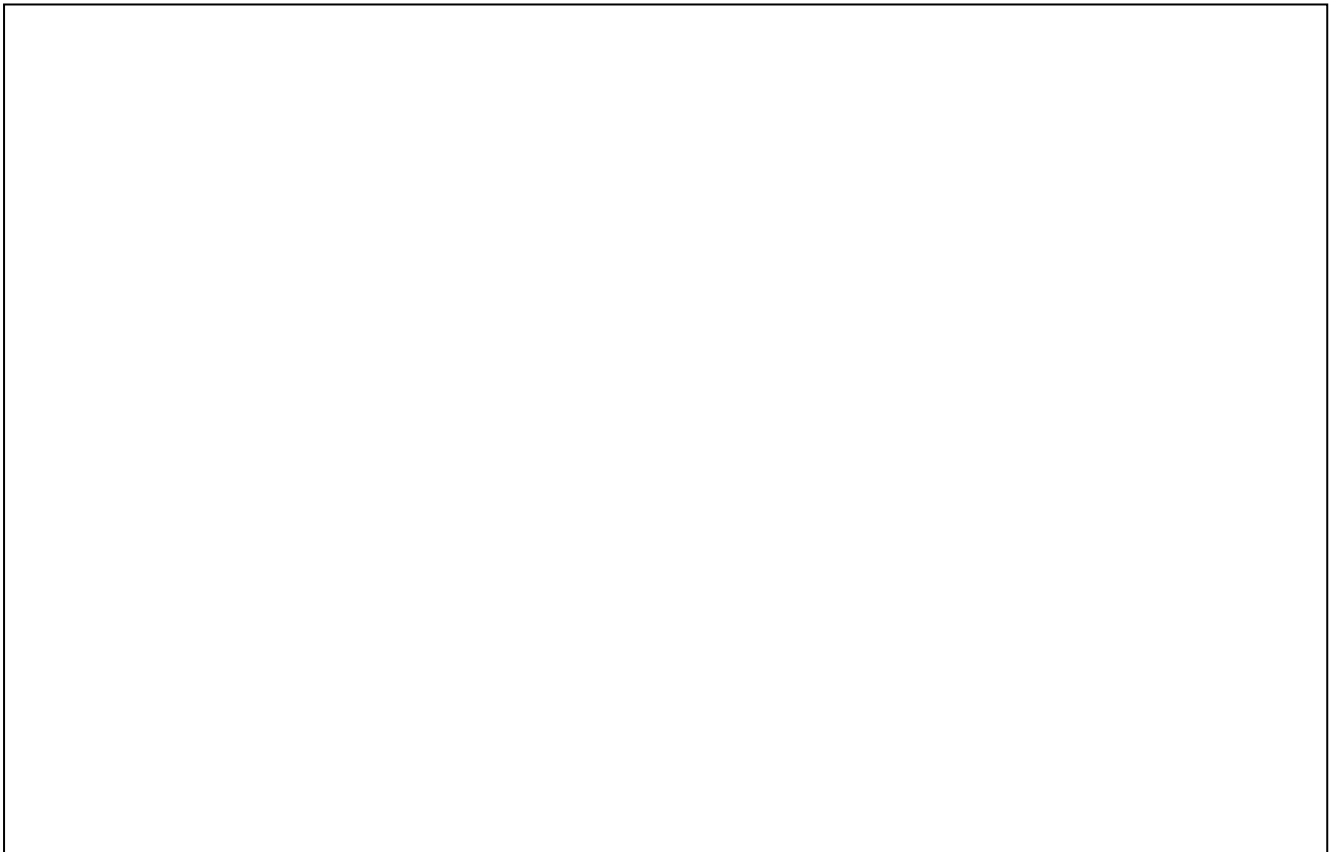
5 – Typically, **ceramics** are characterized by both fragility and high thermal stability. Explain why. (2/20)



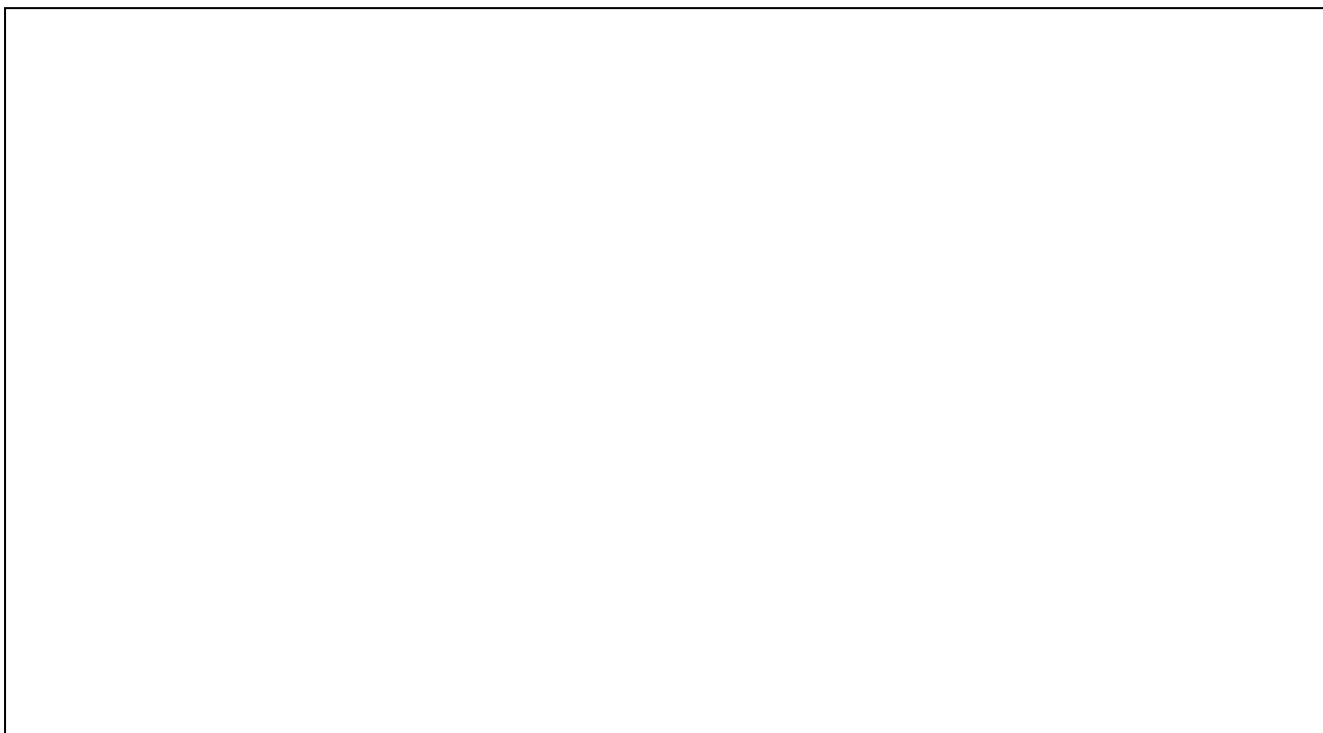
6 – Fluoropolymers are employed in high-tech applications where extreme working conditions are necessary. Provide an example of an application of a fluoropolymer and explain, at the molecular level, some of the reasons why fluoropolymers exhibit high chemical resistance. (2/20)



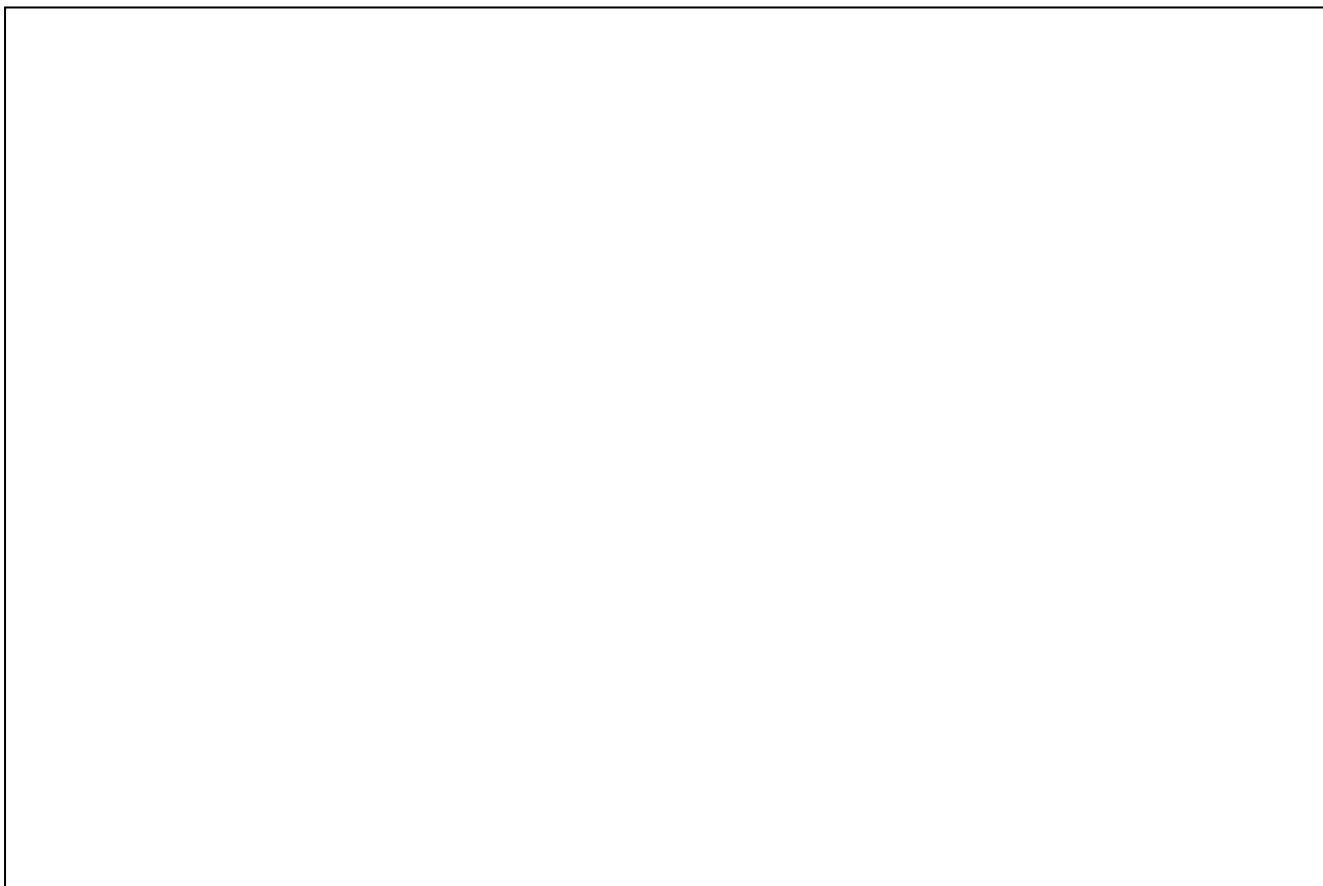
7 – What are the most common features of the matrix in a **composite material**? Provide an example of a typical composite, describing the supporting material and the matrix material. (2/20)



8 – How does the electrical conductivity of a **semiconductor** change with temperature, and what is the explanation for this typical behavior? (2/20)



9 – The glass transition temperature is a key property in the processability and application of an **organic semiconducting film**. Explain why, in what extension the phase stability can limit the applicability of **organic semiconducting films**. (2/20)



10 – Soft matter is typically formed by molecules with an amphiphilic structure which have a part with a predominantly ionic or aromatic nature and a part that is predominantly aliphatic. Give an example of a typical surfactant molecule indicating the lipophilic and hydrophilic parts and describe an application. (2/20)