

Material Science Introduction — Demo Worksheet

Answers

Instruction

Use this worksheet to organize your answers to questions during the material science demonstration. Please fill in the blanks and answer questions as the demonstration is conducted.

Observations

1. Indicate the correct material class for each material listed:

<u>B</u>	tile	A. metal
<u>C</u>	Popsicle stick	B. ceramic
<u>D</u>	plastic bag	C. composite
<u>A</u>	paper clip	D. polymer

2. Circle the type of deformation for each material. Write a brief description of the selected deformation.

tile: elastic plastic

Description:

Material did not permanently bend or change shape.

Popsicle stick: elastic plastic

Description:

Metal does behave elastically. However, predominate deformation is plastic. Material could bend (very compliant), however springs back to original position. No permanent shape change.

paper clip: elastic plastic

Description:

Permanent shape change when bent.

plastic bag: elastic plastic

Description:

Plastic bag was somewhat elastic under mild pulling, but plastically deformed when pulled with greater force.

3. Describe the failure of each material. Include deformation observations and failure features.

tile:

No visible bending prior to fracture. Rapid (brittle) fracture an indication of no plastic behavior.

Popsicle stick:

No visible deformation prior to fracture. Fibrous fracture and does not completely fail like the ceramic tile. Composites can yield mixed mode fracture, meaning one phase behaves like a ceramic or more elastic, while the other behaves like a metal or plastic.

paper clip:

Visible permanent set or plastic behavior prior to fracture. Had to bend clip multiple times prior to fracture. Extreme plastic behavior.

plastic bag:

Visible permanent set or plastic behavior prior to fracture.

Name: _____ Date: _____

4. Characterize each material failure as either *brittle* or *ductile*. Circle your answers.

- **tile:** brittle ductile
- **Popsicle stick:** brittle ductile
- **paper clip:** brittle ductile
- **plastic bag:** brittle ductile

Questions

5. What are the differences between metals and ceramics when subjected to force?
Explain the differences in two sentences.

Under extreme force, metals plastically deform, whereas ceramics elastically deform.

Metals are, typically, not subject to brittle fracture, while ceramics are very brittle.

6. What similarities do polymers and metals have when subjected to a force?
Explain the differences in two sentences.

They both can behave elastically under mild forces, but do predominately plastically deform.

Metals and polymers can deform or change shape to extreme dimensions, hence have high ductility.

7. Why would a metal be preferred as a bridge building material as opposed to a ceramic material?

Metals are less susceptible to brittle fracture and can deform (give a warning) prior to failure.

Brittle fracture is a catastrophic fracture with no warning signs.