View Results

Assignment 5 (Ch 8 & 9)

Name: SIAMAK KIANI **Attempt:** 1 / 3 **Out of:** 15

Started: March 23, 2009 6:41pm **Finished:** March 25, 2009 2:31am **Time spent:** 31 hr, 50 min., 9 sec.

Question 1 (1 point)

Which kind of fracture is associated with the **transgranular** crack propagation mechanism?

Student response:

Correct Response	Student Response	Answer Choices
		a. Ductile
▶	▶	b. Brittle
		c. Either ductile or brittle

General feedback: Transgranular fractures are **brittle** in nature, and crack propagation is **through** the grains.

For more information, see the section on **Brittle Fracture** in the text.

Score: 1 / 1

Question 2 (1 point)

A brittle polymer component that has a surface crack length of 0.310 mm must not fail when a tensile load is applied.

Determine the maximum stress (in MPa) that may be applied if the specific surface energy of this polymer is 0.483 J/m^2. Assume an elastic modulus of 305 GPa.

Use decimal notation, digits after decimal: 1

Student response: 1.7 MPa

Correct answer: 17.4 MPa

General feedback: See equation 8.3 in the text.

Score: 0.1 / 1

Question 3 (1 point)

The fracture strength of glass may be increased by etching away a thin surface layer. It is believed that the etching may alter the surface crack geometry (i.e. reduce crack length and increase tip radius).

Calculate the ratio of the original to the etched crack tip radius if the *stress concentration factor* is increased by a factor of 2.45 when 26.1% of the crack length is removed.

Use decimal notation, digits after decimal: 2

Student response: 4.44

Correct answer: 4.44

General feedback: Using equation 8.2 in the text, rearrange to solve for the original crack tip radius ρ_{t_1}.

Using equation 8.2 again, multiply K_t by the factor of increase and *a* by (100 - % decrease in crack length), and then rearrange the equation to solve for the etched crack tip radius ρ_{t_2}.

To solve for the ratio of original to etched crack tip radii, divide ρ_{t_1} by ρ_{t_2}.

Score: 1 / 1

Question 4 (1 point)

A fatigue test was conducted on a specimen having an initial surface crack length of 1.28 mm and a value of 1.58 for *Y*. If values for the mean stress and stress amplitude are 31 MPa and 172 MPa, respectively, calculate the stress intensity factor range ΔK (in **MPa*m^0.5**) at the crack tip.

$$\Delta K = Y \Delta\sigma \, (pi*a)^{1/2}$$

Crack growth stops or is negligible for the compression portion of the stress cycle; thus, if σ_{min} is compressive, then σ_{min} is taken to be zero and $\sigma_{max} = \Delta\sigma$.

Use decimal notation, digits after decimal: 1

Student response: 20.3 MPa*m^0.5

Correct answer: 20.3 MPa*m^0.5

General feedback: Use the equation given to solve for the stress intensity factor range ΔK.

$\Delta\sigma = \sigma_{max} = \sigma_m + \sigma_a$.

See section **8.7 Cyclic Stresses** in the text for more information.

Score: 1 / 1

Question 5 (2 points)

Consider the Cu-Ag phase diagram in Figure 9.7 in the text. At a temperature of 900 degree C and a composition of 40 wt% Ag, how much of each phase is present?

Student response:

Percent Value	Correct Response	Student Response	Answer Choices	
0.0%			a.	$W_\alpha = 0.1$ $W_\beta = 0.9$
0.0%			b.	$W_L = 0.4$ $W_\beta = 0.6$
0.0%			c.	$W_\alpha = 0.4$ $W_\beta = 0.6$
100.0%	▶	▶	d.	$W_\alpha = 0.1$ $W_L = 0.9$

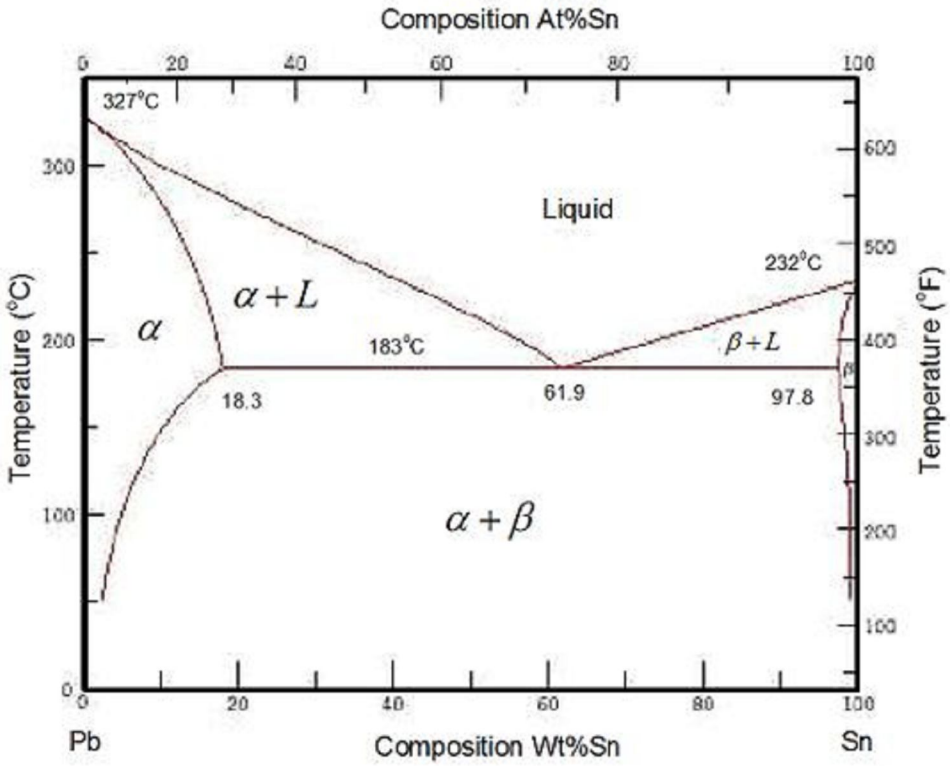
General feedback: See example problem 9.3 to see how to solve such problems.

Score: 2 / 2

Question 6 (2 points)

The lead-tin phase diagram is shown below.

For an alloy with a composition of 25 wt% Sn - 75 wt% Pb, select the **phase(s) present** and their **composition(s)** at 300°C.



Student response:

Correct Response	Student Response	Answer Choices
		a. L = 25 wt% Sn - 75 wt% Pb; α = 10 wt% Sn - 90 wt% Pb.
▶	▶	b. L = 25 wt% Sn - 75 wt% Pb.
		c. L = 90 wt% Sn - 10 wt% Pb; α = 10 wt% Sn - 90 wt% Pb.
		d. L = 10 wt% Sn - 90 wt% Pb; α = 10 wt% Sn - 90 wt% Pb.

General feedback: At 300°C only the **liquid phase** is present.

Its composition is the same as that of the overall alloy (i.e., 25 wt% Sn - 75 wt% Pb).

For more information, see the section on **Interpretation of Phase Diagrams** in the text.

Score: 2 / 2

Question 7 (2 points)

Consider Figure 9.20 in the text.
At a temperature of 300 degree C, determine the **weight fraction** (leave units blank) of Mg_2Pb if the mixture consists of 45 wt% Pb.

Use scientific notation, significant figures in answer: 3

Student response: 4.36E-1

Correct answer: 4.42E-1 ($4.42 * 10^{-1}$)

General feedback: Given that Mg_2Pb is a chemical compound, the wt% of Pb in it is easily calculated using $M_{Pb}/[2* M_{Mg}+ M_{Pb}] *100\%$, where M is the molar mass of the element. The composition of the α-phase at this temperature should be approximated at about 16.5 wt% Pb. After this, follow problem 9.3 in the text.

Score: 2 / 2

Question 8 (1 point)

True of False?

*At room temperature, pure iron has an **FCC** crystal structure.*

Student response:

Correct Response	Student Response	Answer Choices	
		a.	True
▶	▶	b.	False

General feedback: **False**. The stable form of pure iron at room temperature is called **ferrite**. Ferrite has a **BCC** crystal structure.

For more information, see the section on **The Iron-Iron Carbide Phase Diagram** in the text.

Score: 1 / 1

Question 9 (1 point)

An iron-carbon alloy has a composition of 0.6 wt% C.

This is a _____ alloy.

Student response:

Correct Response	Student Response	Answer Choices	
		a.	eutectic
		b.	hypoeutectic
▶	▶	c.	hypoeutectoid
		d.	eutectoid
		e.	hypereutectoid
		f.	hypereutectic

General feedback: An alloy of 0.6 wt% C has **less** carbon than the eutectoid composition (0.76 wt% C). It is therefore called a ***hypo*eutectoid** alloy.

For more information, see the section on **Development of Microstructure in Iron-Carbon Alloys** in the text.

Score: 1 / 1

Question 10 (1 point)

Which phase regions will you find on an isomorphous **binary composition-temperature** phase diagram?

Student response:

Correct Response	Student Response	Answer Choices	
		a.	Liquid
		b.	Liquid + α
		c.	α
		d.	α + β
		e.	All of the above.
▶	▶	f.	a, b, and c above.

General feedback: In an isomorphous system the two components are completely miscible in both the liquid and solid phases.

The **phase regions** in a binary composition-temperature phase diagram are:

Liquid
Liquid + α
α

For more information, see the section on **Binary Isomorphous Systems** in the text.

Score: 1 / 1

Question 11 (1 point)

Once a system is at equilibrium, is it possible to change its state?

Student response:

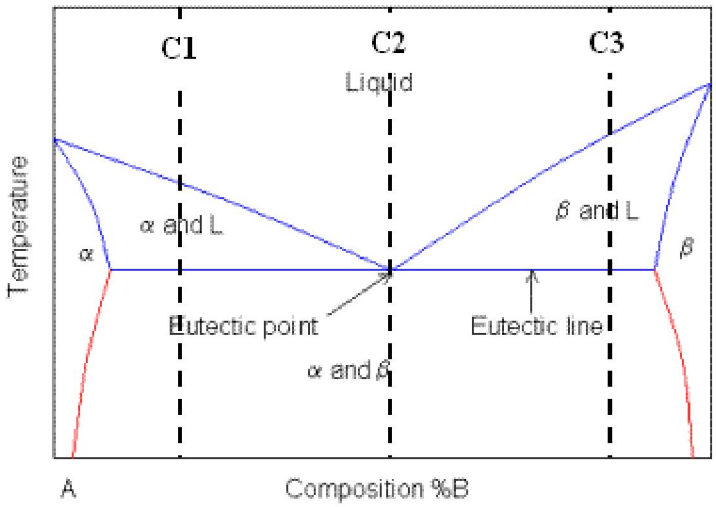
Percent Value	Correct Response	Student Response	Answer Choices	
100.0%	▶	▶	a.	Yes
0.0%			b.	No

General feedback: *Yes*. It is possible to change a system's equilibrium state to another state.

Score: 1 / 1

Question 12 (1 point)

Consider an alloy at composition C1 just above the eutectic temperature. What are the approximate compositions of the two phases present in terms of wt%B?



Student response:

Percent Value	Correct Response	Student Response	Answer Choices	
0.0%			a.	10wt%B and 90wt%B
100.0%	▶	▶	b.	10wt%B and 50wt%B
0.0%			c.	90wt%B and 50wt%B
0.0%			d.	none of the above

General feedback: For more information refer to Chapter 9

Score: 1 / 1

Total score: **14.1 / 15** = **94.0%**