Metals Study Guide

You will need a copy of ASTM B221-14.

To improve the toughness of quenched steel by gently reheating and then cooling it.

a. Melting
b. Tempering
c. Austenizing
d. Quenching

The rapid cooling of a workpiece in water, oil, air or other media to obtain certain material properties.

a. Quenching
b. Agitation
c. Annealing
d. Drawing
e. Tempering

Hypoeutectoid alloys contain ___________ between grains of pearlite.

a. Proeutectoid Ferrite (alpha)
b. Proeutectoid Cementite (Fe3C)
c. Austenite
d. Delta Iron

According to ASTM B221, what is the minimum tensile strength of 6061 aluminum?

a. The tensile strength depends on the temper. So there is not enough information to answer the question.
b. 35.0 ksi
c. 22.0 ksi
d. 38.0 ksi
e. 26.0 ksi

______ is the quality of being capable of being shaped by compressive forces such as hammering or rolling.

a. Nonferrous
b. Ductile
c. Ferrous
d. Transitory
e. Malleable

If the density of steel is approximately .284 lbs/in^3, how much would a 1 in x 1 in steel bar weigh if it were 8 inches long? Enter your answer in pounds to 2 decimal places.

This test measures hardenability of steels. hardenability is a measure of the capacity of a steel to be hardened in depth when quenched from its austenitizing temperature. This test involves cooling the specimen from one end, simulating the effect of quenching a larger steel component in water.

a. Jominy End Quench Test

b. Hominy End Quench Test

c. Harmony End Quench Test

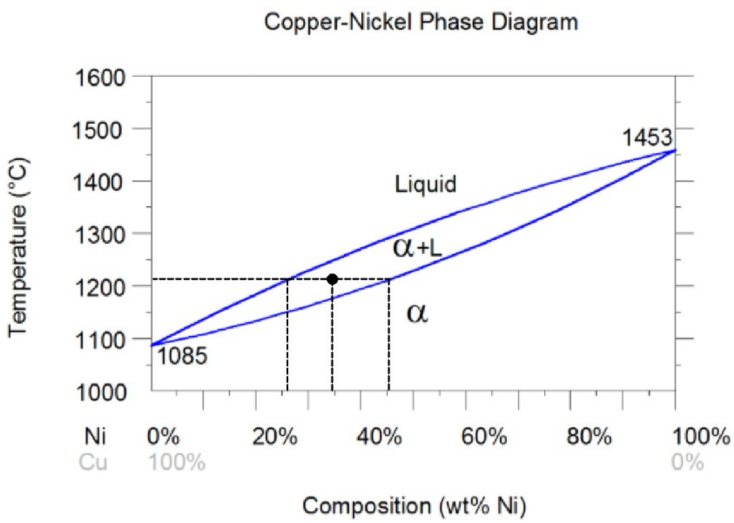
d. Anomaly End Quench Test

e. Homily End Quench Test

Carburizing, nitriding, and carbonitriding are examples of what type of surface heat treatment?

a. Carbonitriding
b. Differential/selective surface heating
c. Differential metal structure hardening
d. Carburizing

What is the copper content of the liquid portion of the point indicated on the diagram?
Enter your answer in percent (not decimal).
Your answer needs to be correct to the nearest 3%



Any of the metals of group I (first column) of the periodic table comprising lithium, sodium, potassium, rubidium, cesium, and francium

a. Rare-earth elements
b. Transition metals
c. Alkaline earth metals
d. Post-transition or poor metals
e. Alkali metals

The difference between steel and cast iron is that:

a. Cast iron has less than 2.14% chromium, steel has more
b. Cast iron has less than 2.14% carbon, steel has more
c. Steel has less than 2.14% carbon, cast iron has more
d. There is no technical difference. The two terms are synonymous
e. Steel has less than 2.14% chromium, cast iron has more

What is the carbon content of SAE 1018?

a. .0018%
b. 10%
c .18%
d. 1.8%
e. 18%

Generally speaking, this group of stainless steels has the most nickel content.

a. Duplex
b. Austenitic
c. Precipitation hardening
d. Martensitic

This type of solution occurs when a solute atom is small enough to fit into the spaces between solvent atoms.

a. Interstitial Solution
b. Insoluble
c. Substitutional Solution

The density of steel is .284 lb/in^3. How long would a 1.0 x 1.0 inch square bar need to be to weigh 7.3 pounds?

Enter your answer in inches to two decimal places.

According to ASTM B221, what are the composition limits for silicon in 6061?

a. .2 to .6%

b. 1.3 to 1.6%
c. 1.2% max, but there is not minimum
d. 1.2% minimum, but there is no maximum
e. .4 to .8%

A substance composed of two or more metals or of a metal and a nonmetal intimately united usually by being fused together and dissolving in each other when molten.

a. Aluminum
b. Alloy
c. Isotope
d. Ion
e. Lattice
f. Composite

A material property that is indicative of the extent to which a material expands upon heating.

a. Coefficient of thermal expansion
b. Young's modulus
c. Yield point
d. Poisson's ratio
e. Modulus of rigidity
f. Specific heat
g. Modulus of elasticity

Which of the following would result in a smaller grain size?

(Check all that apply)

a. Slower grain growth rate
b. Faster nucleation rate
c. Faster grain growth rate
d. Slower nucleation rate

A curve in a phase diagram (temperature and composition of a mixture), above which the substance is entirely liquid.

a. Solvus
b. Inflection Point
c. Solubility Limit
d. Solidus
e. Liquidus

The phase diagrams used in metallurgy tend to be of which type?

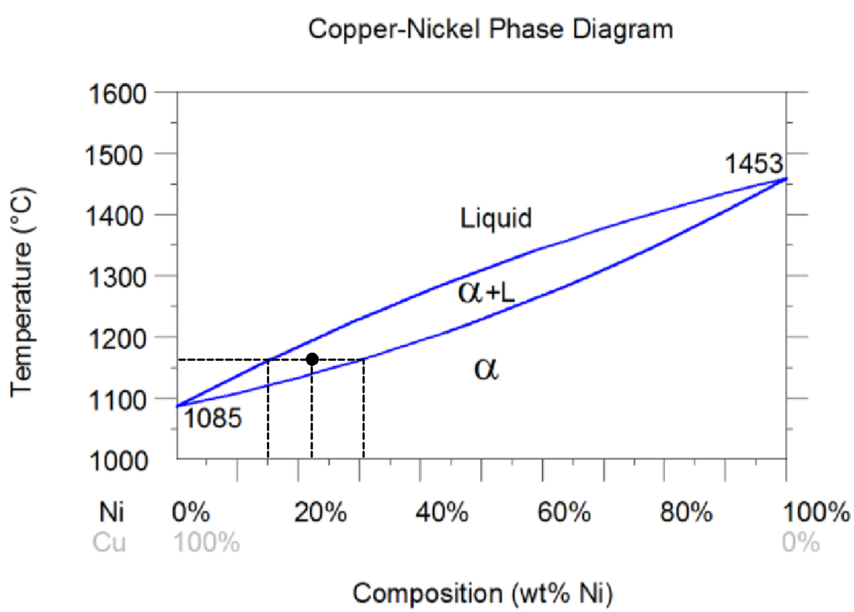
a. Time-Pressure
b. Pressure-Temperature
c. Composition-Temperature
d. Composition-Pressure

A temporary shape change that is self-reversing after the force is removed, so that the object returns to its original shape.

a. Hardness
b. Plastic deformation
c. Ionic transformation
d. Elastic deformation
e. Toughness

What is the nickel content of the liquid portion of the point indicated on the diagram?

- Enter your answer in percent (not decimal)
- For example: enter **50** for fifty percent)
- Do not enter units
- Your answer needs to be correct to the nearest 2%



A two-dimensional "map" that shows which phases are stable under a given set of conditions.

a. Scatter Diagram
b. Phase Diagram
c. T-T-T Diagram
d. Psychrometric Chart
e. Smith Chart
f. Contour Map

According to ASTM B221, what is the minimum tensile strength of 6061-0?

a. There is only a maximum tensile strength for this alloy and temper combination.
b. This alloy is unpredictable until final manufacturing is complete, so not enough infrmation is given to answer the question.
c. The tensile strength depends on the temper, so there is not enough information to answer the question.
d. 38.0 ksi
e. 22.0 ksi

This process involves heating a material above its recrystallization temperature, maintaining a suitable temperature for a suitable amount of time, and then cooling slowly. This process puts the metal in its softest possible state.

a. Normalizing
b. Annealing
c. Tempering
d. Spheroidizing

Isothermal transformation diagrams (also known as _________) are plots of temperature versus time (usually on a logarithmic scale). They are generated from percentage transformation-vs time measurements, and are useful for understanding the transformations of an alloy steel at elevated temperatures.

a. Composition phase diagrams
b. Time-temperature-transformation (TTT) diagrams
c. Jominy end-quench hardenability diagrams
d. Binary isomorphous phase diagrams
e. Binary eutectic system phase diagrams

_____ are elements that give up electrons to form cations. They tend to be lustrous, conduct electricity and are malleable and ductile.

a. Materials
b. Polymers
c. Rare earth elements
d. Metalloids
e. Metals

The ability of a material to absorb energy and plastically deform without fracturing. The amount of energy per unit volume that a material can absorb before rupturing. Equivalent to the area under the stress-strain curve.

a. Hardness

b. Ultimate tensile strength

c. Toughness

d. Yield strength

e. Yield point elongation

The ability of a material to have its shape changed (as by being drawn out into wire or thread) without losing strength or breaking.
a. Ephemeral
b. Ductile
c. Malleable
d. Transitory
e. Insolent

A measure of the resistance to localized plastic deformation induced by either mechanical indentation or abrasion.

a. Tensile strength
b. Toughness
c. Yield strength
d. Stiffness
e. Hardness

What would be the percent carbon content of an SAE 4117 Steel? Enter your answer to two decimal places.

For a steel to be heat treatable, it needs to have a significant ____ content.

a. Oxygen

b. Phosphorous

c. Stainless

d. Chromium

e. Carbon

Ferrous metals have a major concentration of _____ in them.

a. Chromium
b. Ferritic Stainless Steel
c. Manganese
d. Iron
e. Magnesium
f. Cast Iron
g. Ferrous Sulfate

Which of these elements is an austenite stabilizer that is commonly used in stainless steels.

a. Nickel
b. Molybdenum
c. Chromium
d. Sta-Bil
e. Tungsten

The distinction between steel and cast iron is based on which of the following?

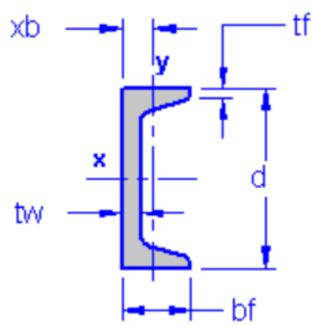
a. Whether the material is cast or machined.
b. There is no difference between these two. The terms refer to the same material.
c. The amount of chromium present in the alloy.
d. The amount of carbon present in the alloy.
e. Cast iron is pure iron. Steel is an alloy.

A beam is to be made using C15x50 channel. The beam is to be 63 inches long. If the density of ASTM A36 is .284 pounds per cubic inch, how much will the beam weigh?

Enter your answer to the nearest pound.

Hint: There are really two ways to solve this problem. I suggest you use the density given. Density is given in lbs per unit volume. So if you multiply this value by a volume in cubic inches (length x area), the result will be pounds.

The alternative solution is to use the information coded in the channel specification. The 50 is the weight of that product in pounds per foot. Convert to the length to feet and multiply. You might use both methods and see how closely they agree. You have a tolerance of 5% on your answer.



in x lb/ft	Area (in^2)	d (in)	bf (in)	tf (in)	tw (in)	Ixx (in^4)	Iyy (in^4)	xb (in)
C15x50	14.7	15	3.716	0.65	0.716	404	11	0.798
C15x40	11.8	15	3.52	0.65	0.52	349	9.23	0.777
C15x33.9	9.96	15	3.4	0.65	0.4	315	8.13	0.787

Cast iron is often machined without coolant. T/F