Question No. 1 of 10

Instructions: (1) Read the problem and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.	
Question #01	**1.** What is the most important factor to cause a state change of matter? (A) Pressure (B) Temperature (C) Density (D) Velocity
Feedback on Each Answer Choice	A. Incorrect. Pressure will affect the motion of molecules and it does relate to the change of state of matter. For instance, as pressure increases, melting points may be decrease. However, pressure is not the key for state change of matter. State of matter cannot be changed only by changing pressure.
	B. Correct! Temperature is an index for the intensity of motion of molecules. As temperature increases, the motion of molecules becomes intense. So, temperature is the key for state change of matter.
	C. Incorrect. Density is a material property. It reveals the mass per volume. Though gas has a lower density than solid, density has nothing to do with the motion of molecules and, hence, density does not relate to state of matter.
	D. Incorrect. Velocity describes the motion of objects. It does not relate to the state of matter.
Solution	Definition of “State of Matter” Matter is normally classified as being one of the three states- solid, liquid, or gas. The state-change relates to the motion of molecules. As the motion becomes intense, the state changes from solid to gas. Check the relevant terms and definitions. **The correct answer is (B).**

Instructions: (1) Read the problem and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.	
Question #02	**2.** Which of the following is the correct definition of elastic limits? (A) The extreme of elastic modulus (B) The maximum tensile length of a solid (C) The point on the stress-strain curve above which plastic deformation occurs (D) The maximum sustainable stress of a solid (E) The maximum stress that the solid is in proportional deformation region
Feedback on Each Answer Choice	A. Incorrect. Elastic modulus is the ratio of stress and strain when deformation is in the elastic region. So, for a given solid, elastic modulus are determined.
	B. Incorrect. The maximum tensile length relates to the strain at breaking points.
	C. Correct! This satisfies the definition of elastic limits
	D. Incorrect. The maximum sustainable stress of a solid often occurs during plastic deformation region.
Solution	Define “Elastic limits” On the stress-strain curve, the point above which plastic deformation occurs. This would be the rounded hump on the stress strain curve. Check the terminologies provided. **The correct answer is (C).**

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Instructions: (1) Read the problem and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.	
Question #03	**3.** A car has 80.00 cm diameter rubber tires with a thermal expansion coefficient of 0.0002 K^{-1}. After driving on the highway, the tires are 20 K warmer than when they started out. What is the new circumference of the tires? (A) 80.003π cm (B) 80.004π cm (C) 80.03π cm (D) 80.04π cm
Feedback on Each Answer Choice	A. Incorrect. Circumference is related to the diameter by a factor of π. In any case, the change in diameter is incorrect.
	B. Correct. Although the fractional change in diameter is 0.004, this must be multiplied by the original diameter to find the change in diameter.
	C. Incorrect! The fractional change in diameter is the product of the thermal expansion coefficient and the change in temperature, which is 0.0004. The increase diameter is 0.0004×(80 cm) ≈0.03 cm, so 80.03p is the new circumference. See the solution below.
	D. Incorrect. Consider the definition of the thermal expansion coefficient
Solution	$d-d_o=\alpha\Delta T$ $=d-80.0\text{cm}=\left(0.0002\ K^{-1}\right)\times\left(20\ K\right)$. $d=80.04\text{cm}$. The new circumference can be found by multiplying the new diameter (80.04 cm) by π, so the correct answer is (B).

Question No. 4 of 10

Instructions: (1) Read the problem and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.	
Question #04	**4.** Steel has a bulk modulus of 1.4×10^{11} Pa. What pressure is needed to compress steel to 99.0% of the volume it occupies at 10^5 Pa? (A) 2×10^5 Pa (B) 1.4×10^9 Pa (C) 1.4×10^{10} Pa (D) 1.4×10^{11} Pa
Feedback on Each Answer Choice	A. Incorrect. This is approximately twice the initial pressure, but has no relation to the bulk modulus.
	B. Correct! The change in pressure can be written in terms of bulk modulus and the fractional change in volume. See the solution below.
	C. Incorrect. The steel is compressed 1%, not 10%.
	D. Incorrect. Consider how much the steel is being compressed in terms of the fractional change in volume.
Solution	Recall the definition of the bulk modulus: $B=-\frac{\Delta p}{\Delta V/V}$. The fractional change in volume is -1%; this can be rewritten as $\frac{\Delta V}{V}=-0.01.$ The change in pressure can be written in terms of bulk modulus and the fractional change in volume $\Delta p=-B\frac{\Delta V}{V}=1.4\times10^{11}\times\left(0.01\right)»1.4\times10^{9}$. This change in pressure is much larger than the initial pressure, so the pressure required is 1.4×10^9 Pa. **(B) is the correct answer.**

Instructions: (1) Read the problem and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.	
Question #05	**5.** A cylindrical steel rod is subject to a compressive force of 1.0×10^{4} N. If the length of the rod is 2.0 m and the radius is 10.0 cm, what is change in length of the rod? (Young's modulus of steel is 2.0×10^{11} N/m^2.) (A) 5.0 micrometers (B) 1.6 micrometers (C) 3.1 micrometers (D) none of the above
Feedback on Each Answer Choice	A. Incorrect. This is approximately twice the initial pressure, but has no relation to the bulk modulus.
	B. Incorrect. The ratio of the stress to Young's modulus must be multiplied by the original length of the rod.
	C. Correct! Calculate the strain from Young's modulus and the strain, then multiply by the original length of the rod. See the solution below.
	D. Incorrect. Consider how much the steel is being compressed in terms of the fractional change in volume.
Solution	Recall the definition of Young's modulus, which is the ratio of stress to strain: $Y=\frac{F/A}{\Delta L/L}$. The change in length of the rod is given by: $\Delta L=\frac{F/A}{Y}L$. The change in length can be written in terms of Young's modulus, the stress, and the original length of the rod. $\Delta L=\frac{\left(1.0\times10^{4}\text{ N}\right)/\left[\pi(.10\text{ m})^{2}\right]}{2\times10^{11}\text{ N/m}^{2}}(2.000\text{ m})\approx3.2\times10^{-6}\text{ m}=3.1\ \mu\text{m}$. So (C) is the correct answer choice.

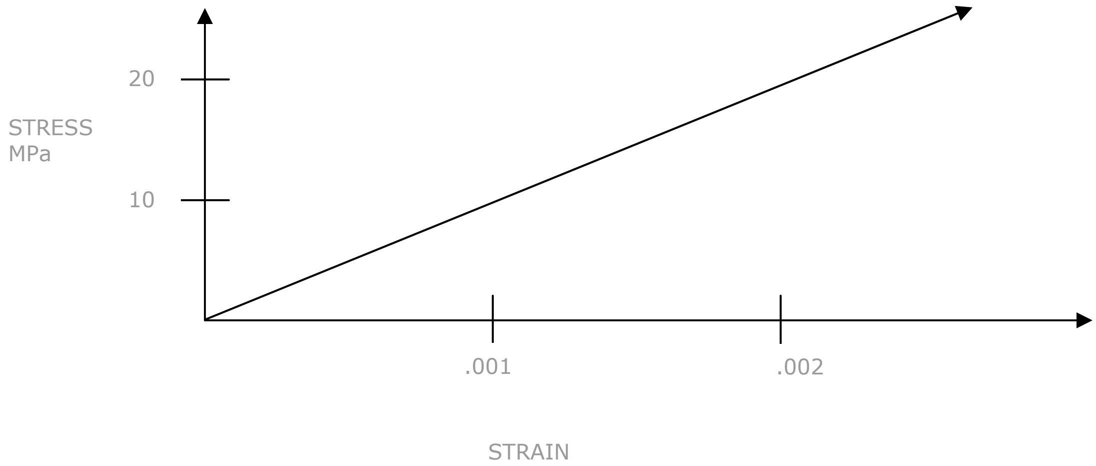
Question No. 6 of 10

Instructions: (1) Read the problem and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.	
Question #06	**6.** Suppose a steel alloy has a shear modulus of 8×10^{11} N/m^2, and an aluminum alloy has a shear modulus of 2×10^{10} N/m^2. If a rectangular rod of steel alloy has the same dimensions as a rectangular rod of aluminum alloy, and the same force is applied to both, what is the ratio of the deformation of the aluminum alloy to deformation of the steel alloy? (A) 1:40 (B) 1:1 (C) 40:1 (D) None of the above
Feedback on Each Answer Choice	A. Incorrect. Since the aluminum alloy has a smaller shear modulus than the steel alloy, the deformation of the aluminum alloy is larger; thus this answer is incorrect.
	B. Incorrect. The deformation depends on the shear modulus, so this choice can be discarded.
	C. Correct! The deformation is inversely proportional to the shear modulus
	D. Incorrect. Consider how much the steel is being compressed in terms of the fractional change in volume.
Solution	Recall how the force applied is related to the shear modulus, deformation, and dimensions of the rods: $F=S\frac{\Delta x}{h}A$. The deformation in the rod can be written as: $\Delta x=\left(\frac{Fh}{A}\right)\frac{1}{S}$. Let S_A denote the shear modulus of the aluminum alloy, and S_S denote the shear modulus of the steel alloy. Let Δx_A denotes the deformation of the aluminum alloy, and Δx_S denotes the deformation of the steel alloy; using the preceding equation, we can write the ratio of the deformation of the aluminum alloy to the deformation of the steel alloy as: $\frac{\Delta x_A}{\Delta x_S}=\frac{S_S}{S_A}$, Since *Fh*/*A* is constant for both rods. This ratio is 40:1. (C) is the correct answer.

Question No. 7 of 10

Instructions: (1) Read the problem and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.	
Question #07	**7.** Based on the validity of the following statements, which of the following is true? I. In the elastic region, the stress-strain curve of a solid material obeys a linear relationship. II. After stress exceeds the elastic limit, a solid material undergoes plastic behavior. III. A solid material ruptures at the proportional limit. (A) I only (B) I and II (C) I and III (D) II and III
Feedback on Each Answer Choice	A. Incorrect. II is also true.
	B. Correct! Both statements I and II are true, but III is false.
	C. Incorrect. Although I is true, III is false.
	D. Incorrect. Although II is true, III is false.
Solution	We should address the stress-strain curves. The stress is a measure for the force causing deformation and the strain is the degree of deformation. For example, when a solid bar is stretched. The stress can be regarded as the force applied while the strain can be regarded as the elongation of the bar. In the right figure, a typical stress-strain relationship is illustrated. In the first stage, stress increase linearly with the strain, this period is called elastic behavior and the limitation is called proportional limit. As strain increases further, the solid will entered a yield state. The point corresponding to the maximum strain for this yield state is called elastic limit, above which the solid will goes into plastic behavior state until breaking point occurs. Thus we see statements I and II are true, while statement III is false. So the correct answer choice is (B).

Question No. 8 of 10

Instructions: (1) Read the problem and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.	
Question #08	**8.** What is the elastic modulus for the stress-strain graph shown below?  (A) 10 kPa (B) 10 MPa (C) 10 GPa (D) None of the above
Feedback on Each Answer Choice	A. Incorrect. This would be the slope if the stress were in Pa = N/m^2; however, the stress is in MPa.
	B. Incorrect! This is a factor of 1000 too small.
	C. Correct! The slope is 10^4 MPa = 10^{10} Pa = 10 GPa, and the elastic modulus is slope of stress versus strain,
	D. Incorrect. One of the choices above is correct. Consider the slope of the graph.
Solution	We should address the stress-strain curves. The stress is a measure for the force causing deformation and the strain is the degree of deformation. For example, when a solid bar is stretched. The stress can be regarded as the force applied while the strain can be regarded as the elongation of the bar. In the right figure, a typical stress-strain relationship is illustrated. In the first stage, stress increase linearly with the strain, this period is called elastic behavior. In the plot provided, we are looking at the linear region. In the linear region, the slope of stress versus strain is the elastic modulus. Since the stresses are in MPa, we must multiply the slope by 10^6 Pa to get the correct value of elastic modulus. Note that Pascals (Pa) are equivalent to N/m^2 for expressing elastic moduli. Thus the answer is 10^{10} Pa = 10 GPa. (C) is the correct answer.

Question No. 9 of 10

Instructions: (1) Read the problem and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.	
Question #09	**9.** What are the physical processes that differ between crystalline and amorphous solids? (A) Conductivity (B) Density (C) Melting process (D) Transparency
Feedback on Each Answer Choice	A. Incorrect. This statement is not true in general.
	B. Incorrect. This statement is not true in general.
	C. Correct! Amorphous solids do not have a defined melting point, whereas crystalline solids do. See below for a fuller explanation.
	D. Incorrect. A salt crystal is an example of a transparent crystalline solid, while glass is an example of an amorphous crystalline solid. Thus transparency doesn't depend on what type of solid we are looking at.
Solution	Crystalline solids have an ordered atomic structure, and they have a melting point. On the other hand, amorphous solids have a randomly arranged atomic structure, and no melting point. Other physical and chemical properties may or may not differ between these two categories. Using this information. (C) is the correct choice.

Question No. 10 of 10

Instructions: (1) Read the problem and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.	
Question #10	**10.** The ultimate strength of bone is 1.7×10^8 N/m2. If the diameter of a female's ring finger is 10 mm, at what applied force would this bone break? (A) 1.3×10^4 N (B) 1.7×10^8 N (C) 2.2×10^{12} N (D) None of the above
Feedback on Each Answer Choice	A. Correct! The ultimate strength of multiplied by the cross-sectional area gives the force causing something to break. See the solution below.
	B. Incorrect. The force is related to the cross sectional area.
	C. Incorrect. Do not divide the ultimate strength by the cross-sectional area.
	D. Incorrect. One of the above choices is correct.
Solution	The force required for the bone to break is given by $F=S_uA$ Where S_u is the ultimate strength for bone, and A is the cross-sectional area of the bone. A can be computed as: $A=\pi\left(\frac{10\times10^{-3}\ \text{m}}{2}\right)^2=8\times10^{-5}\ \text{m}^2$. Thus the force required for the bone to break is: $F=\left(1.7\times10^8\ \text{N/m}^2\right)\left(8\times10^{-5}\ \text{m}^2\right)»13\times10^3\ \text{N}=1.3\times10^4\ \text{N}$ (A) is the correct answer choice.

