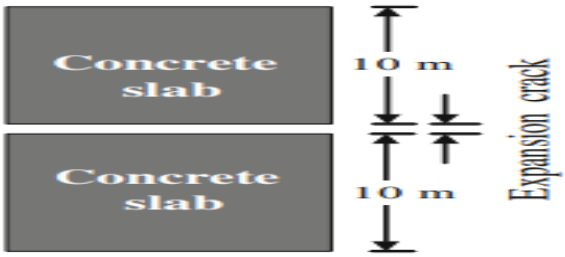
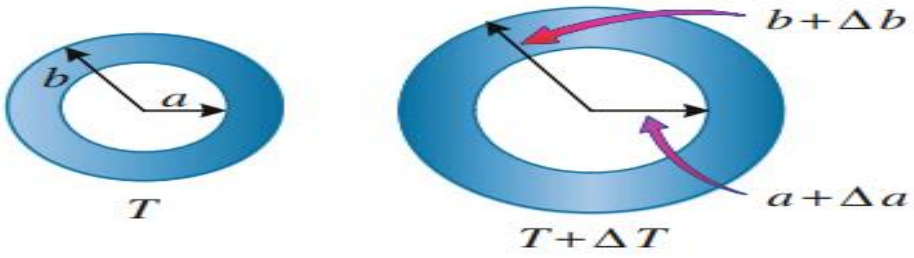
Hawassa University
College of Natural and Computational Science
Department of Physics
General Physics: ***phys-1011*** Worksheet Three

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1. At what temperature does the numerical value in degree Fahrenheit is match the numerical value in degree Celsius?
2. The normal boiling point of nitrogen is −195.75 ^{0}C. If the temperature changes from −195.75 ^{0}C to −100 ^{0}C, find the change in the temperature on the Fahrenheit scale and kelvin
3. Suppose you come across old scientific notes that describe a temperature scale called Z on which the boiling point of water is 65^{0}Z and the freezing point is -14^{0}Z. To what temperature on the Fahrenheit scale would a temperature of T= -98^{0}Z correspond? Assume that the Z scale is linear; that is, the size of a Z degree is the same everywhere on the Z scale.
4. Rubber has a negative average coefficient of linear expansion. What happens to the size of a piece of rubber as it is warmed?
5. Explain why a column of mercury in a thermometer first descends slightly and then rises when the thermometer is placed into hot water.
6. A road is built from concrete slabs, each of 10 m long when formed at 10^{0}C, see Fig. How wide should the expansion cracks between the slabs be at 10^{0}C to prevent road buckling if the range of temperature changes from-5^{0}C in winter to +40^{0}C in summer? The coefficient of linear expansion for concrete is $\alpha = 12 \times 10^{-6}$ /^{0}C.



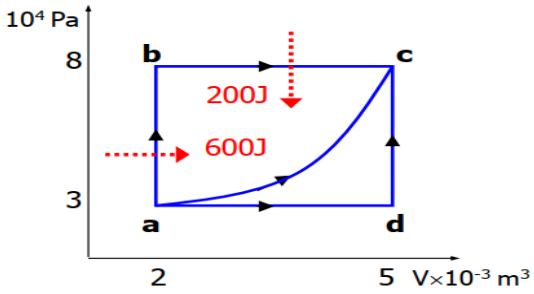
7. A homogeneous metal ring of temperature T has inner and outer radii a and b, respectively. As the metal ring is heated to a temperature of T + ΔT, its inner and outer radii increase linearly to a+ Δa and b + Δb respectively, see Fig. Show that the heating has no effect on the ratio between the inner and the outer radii.



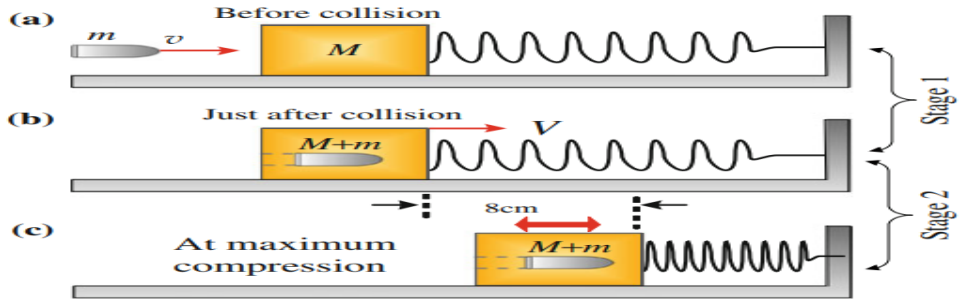
8. When the temperature of a copper coin is raised by 100 ^{0}C, its diameter increases by 0.18%. To two significant figures, give the percent increase in (a) the area of a face, (b) the thickness, (c) the volume, and (d) the mass of the coin. (e) Calculate the coefficient of linear expansion of the coin.

9. A 3.00-g copper penny at 25.0^{0}C drops 50.0 m to the ground. (a) Assuming that 60.0% of the change in potential energy of the penny–Earth system goes into increasing the internal energy of the penny, determine its final temperature.
10. A glass beaker of water is at 20^{0}C. The beaker has a mass mg = 200 g with specific heat c_b = 840 J/kg.^{0}C and contains water of mass mw = 300 g with specific heat c_w = 4,186 J/kg.^{0}C. A quantity of steam initially at 120^{0}C is used to warm the system to 50^{0}C. If the specific heat of steam is c_s = 2,010 J/kg.^{0}C and latent heat of vaporization is LV = 2.26 × 10^6 J/kg, what is the mass of the steam?
11. An Ideal gas is taken from state a to c either through a→b→c or a→d→c. In processes a→b and b→c, 600 J and 200J are given to the system respectively. Calculate

    (i) dU along a→b (ii) dU along a→b→c (iii) Total heat added in a→d→c



12. Determine whether or not the following quantities can be in the same direction for a simple harmonic oscillator:(a) position and velocity, (b) velocity and acceleration, (c) position and acceleration
13. Does the displacement of an oscillating particle between t = 0 and a later time t necessarily equal to the position of the particle at time t? Explain.
14. What happens to the period of a simple pendulum if the pendulum's length is doubled? What happens to the period if the mass of the suspended bob is doubled?
15. A hanging spring stretches by 30.0 cm when an object of mass 450 g is hung on it at rest. In this situation, we define its position as x =0. The object is pulled down an additional 18.0 cm and released from rest to oscillate without friction. What is its position x at a time 50.0 s later?
16. A block of mass m=320 g is fastened to a light spring whose force constant k is 72 N/m. The block is pulled a distance xi = 50 cm from its equilibrium position at x=0 on a horizontal frictionless surface and released at t = 0. (a) What is the mechanical energy of the oscillating block? (b) What is the maximum speed of the oscillating block? (c) Find the velocity, kinetic energy, and potential energy of the block when its position is 30 cm?
17. A bullet of mass m=10 g is fired horizontally with a speed v into a stationary wooden block of mass M=4 kg. The block is resting on a horizontal smooth surface and attached to a massless spring with spring constant k= 150 N/m, where the other end of the spring is fixed through a wall, as shown in Fig. a. In a very short time, the bullet penetrates the block and remains embedded before compressing the spring, as shown in Fig. b. The maximum distance that the block compresses the spring is 8 cm, as shown in Fig. c. (a) what is the speed of the bullet? (b) Find the period T and frequency f of the oscillating system.



18. Bats navigate and search out prey by emitting, and then detecting reflections of, ultrasonic waves, which are sound waves with frequencies greater than can be heard by a human. Suppose a bat emits ultrasound at frequency f_b = 82.52 kHz while flying with velocity as it chases a moth that flies with velocity. What frequency does the moth detect? What frequency does the bat detect in the returning echo from the moth?
19. For a certain transverse wave, the distance between two successive crests is 1.20 m, and eight crests pass a given point along the direction of travel every 12.0 s. Calculate the wave speed.
20. A converging lens of focal length 20 cm forms an image of an object of height 30 cm located at a distance 40 cm from the lens. Locate and describe the image. Draw two rays to locate the image. (Repeat using a diverging lens.)
21. An object is placed 20 cm from a symmetrical lens that has an index of refraction n = 1.65. The lateral magnification of the object produced by the lens is M = -1/4. (a) Determine the type of the lens and describe the image. (b) What is the focal length of the lens?
22. A beam of light having a wavelength λ = 600 nm is incident perpendicular to a glass plate of thickness d = 2 cm and index of refraction n = 1.5. (a) How long does it take a point on the beam to pass through the plate? (b) Calculate the number of wavelengths in the glass plate