Name: Group member names:
Student number:

Physics 157 Tutorial – week of September 17th

In this tutorial, you will get some practice with some of the main ideas from last week's lectures: temperature scales, the constant volume gas thermometer, and thermal expansion of materials. One of the main goals is to help you learn to solve problems where you need to take into account thermal expansion of different materials – these are important for practical applications and also show up on your homework due next week. **Work in groups of three or four, but hand in your own worksheet,** to be graded for participation credit. You are not required to finish everything on the worksheet. Show your work.

Question 1: A 200 liter tank of nitrogen gas is at 1.00 atm pressure at 20°C. Approximately what is its pressure at 40°C?

A) 0.50 atm B) 0.93 atm C) 1.07 atm D) 2.00 atm

Your TA will ask this as a clicker question.

Question 2: At 20°C, a spherical steel ball has diameter 1.001cm and sits on a 1.000cm wide circular hole in a copper plate, not quite fitting through. If the ball and plate are heated together, at roughly what temperature will the ball fall through the plate? ($\alpha_{steel} = 1.2 \times 10^{-5}\ K^{-1}$ and $\alpha_{copper} = 1.7 \times 10^{-5}\ K^{-1}$)

A) 40°C B) 100°C C) 200°C D) 220°C E) 280°C

Your TA will ask this as a clicker question. See the hint on page 4 if you are stuck.

Question 3: To help raise money to buy Mastering Physics codes, you and some friends decide to sell bottles of home-made kombucha in 0.4L glass bottles for $3.50 each at the Totem Park cafeteria. You have 500 full bottles of kombucha stored at 4.0°C. You are originally planning to sell it chilled, but after attending the first few Physics 157 lectures and looking up the thermal expansion coefficients of kombucha ($\beta_{kombucha} = 34.2 \times 10^{-5}\ K^{-1}$) and glass ($\alpha_{glass} = 5.4 \times 10^{-6}\ K^{-1}$) , you realize that if you dump out all the kombucha into a big container and then re-fill bottles in the cafeteria (at 26.0 °C) to sell warm, you'll make more money. If it costs you $0.50 for each extra glass bottle, how much extra money will you make this way?

See the hints on page 4 if you are stuck.

Question 4: Wendy runs a YouTube channel where she posts videos in which she floats various things on a pool of mercury. She has 487,214 subscribers, but that is not relevant to this question. Wendy doesn't like it that her pool of mercury changes depth due to thermal expansion of the mercury and the container, so she hires you to build a rectangular container out of some material so that the depth of the mercury is the same regardless of temperature. What coefficient of linear expansion α does such a material need to have? ($\beta_{mercury} = 18 \times 10^{-5}\ K^{-1}$)

See the hints on page 4 if you are stuck.

Hints: wait until you are stuck before using the hints, then try them one at a time.

For each hint, write the missing letters in the blank spaces, in order. For example: putting p,y,c,t,r,l in __h__si__s __uto__ia__ in gives “physics tutorial”

Hint for question 2:

missing letters: t, m, t, r, c, g, w, c, d, r, d, t, r, c

Hint: For a __e__pera__u__e __han__e ΔT, ho__ mu__h does the __iffe__ence in __iame__e__ __hange?

Hint 1 for question 3:

missing letters: h, m, c, v, m, b, l, s, c, g, x, n, g, a

__ow __u__h will the __olu__e of the __ott__e__ __han__e due to the e__pa__sion of __l__ss?

Hint 2 for question 3:

Missing letters: m, n, x, r, b, l, f, x, e, v, l, e, k, b, a

How __a__y e__t__a __ott__es can you __ill with the e__c__ss __o__um__ of __om__uch__?

Hint for question 4:

Missing letters: d, t, c, g, h, g, v, m, m, u, y, d, p, h, g, a, a, f, m

Assuming the __ep__h doesn’t __han__e, write a formula for the c__an__e in __olu__e of the __erc__r__ in terms of the __e__th and the c__an__e in __re__ of the __ra__e?