

QUIZ 11: THERMAL EXPANSION

Answer the questions using your clicker. If there are no multiple choices, the question is true/false. Use the T and F keys to respond. Please do not mark on this quiz paper. Each question is worth 2 points.

Three rods were tested using the same method that you used in lab. The average diameter of the spindle used was **d = 0.233 cm**.

1. What is the change in the length (in cm) ΔL of **Rod A**? Answer with three sig figs.

$$\Delta L = \left(\frac{\theta}{360^\circ} \right) (\pi d)$$

$$\Delta L = \left(\frac{36}{360} \right) \pi (0.233 \text{ cm}) = 0.0732 \text{ cm}$$

Rod	L_o (cm)	θ (°)	T_i (°C)	T_f (°C)
A	86.5	36	21	100
B	87.0	41	21	100
C	86.4	61.5	21	100

2. What is the coefficient of thermal expansion of α of **Rod A**?

$$\alpha = \frac{\Delta L}{L_o(T_f - T_o)} = \frac{0.0732 \text{ cm}}{(86.5 \text{ cm})(100^\circ - 21^\circ)} = 1.07 \times 10^{-5} / ^\circ\text{C}$$

- A) **$1.07 \times 10^{-5} / ^\circ\text{C}$**
 B) $1.09 \times 10^{-5} / ^\circ\text{C}$
 C) $1.14 \times 10^{-5} / ^\circ\text{C}$
 D) $1.15 \times 10^{-5} / ^\circ\text{C}$
 E) $1.20 \times 10^{-5} / ^\circ\text{C}$

3. This rod is most likely made of

- A) **iron.**
 B) brass.
 C) graphite.
 D) some unknown material.

4. The percent error in the coefficient is

- A) 0.88%
 B) 1.2%
 C) 4.4%
 D) 5.3%
 E) **6.0%**

5. If Rod B is made of the same material as A, why are the measured angles different?

- A) Because the protractor can only measure angles with a precision of $\pm 5^\circ$. They are the same to our ability to measure.
 B) Because someone clearly made a mistake. If Rod B was placed on the spindle with an overhang of a few millimeters, the measured angle would be larger.
 C) **Because Rod B is longer to begin with. The longer rod will expand more, and turn the spindle through a greater angle.**
 D) No, somebody *had* to have made an error. The likeliest mistake is that whoever lined things up placed the spindle at the 90° mark instead of the zero on the protractor.

6. Rod C is most likely

- A) made of the same material as rods A and B. All three rods are iron.
 B) made of the same material as rods A and B, but they are all made of brass.
 C) **not the same as A and B. A and B are probably iron, and C is most likely brass.**
 D) not the same as A and B. A and B are most likely made of brass, but C is clearly iron.

7. **True** or false: A 2-m iron rod will expand more than a 1-m brass rod, given the same temperature change.

8. True or **false**: A 1-m iron rod will expand more than a 1-m brass rod, given the same temperature change.

9. True or **false**: If the diameter of the spindle was improperly measured, using a value larger than the actual dimension would cause the coefficients to be uniformly too small.

10. **True** or false: If the rods were subject to slipping, the spindle would not roll through the complete angle. This would cause the experimental coefficients to be calculated too low.

For questions 11–15, use the following multiple choices:

- A = Doing this would **improve** the accuracy of the experiment.
 B = Doing this would **decrease** the accuracy of the experiment.
 C = Doing this would have **no effect** on the accuracy of the experiment.

11. Measure the initial rod temperature directly (using a probe with a digital thermometer) just before using it. **A**

12. Measure L_o to the end of the rod, then position the rod on the spindle at the center of the rod. **B**

13. Add more water to the steam generator in between trials. **C**

14. Align the indicator needle with the other zero on the protractor scale. **C**

15. Repeat experiment, using the same rod while it's still warm from the previous trial. **B**