

## 19-5 Thermal Expansion

19-05

Question 191

A certain rod has a length of 25.0000 cm when measured at a room temperature of 22 degrees C. When the length of the rod is measured at 26 degree C it was found to be 25.0024 cm. The linear expansion coefficient of the rod material must be

- (a)  $3.6 \times 10^{-5} \text{ (C degree)}^{-1}$ .
- (b)  $3.9 \times 10^{-5} \text{ (C degree)}^{-1}$ .
- (c)  $8.2 \times 10^{-5} \text{ (C degree)}^{-1}$ .
- (d)  $2.4 \times 10^{-5} \text{ (C degree)}^{-1}$ .
- (e)  $1.7 \times 10^{-5} \text{ (C degree)}^{-1}$ .

19-05

6.53-37%

Question 192

Consider a steel plate with area  $2.0 \text{ m}^2$  at 20 degrees Celsius. What is magnitude of the change in its area when the temperature is lowered to -20 degrees Celsius? The coefficient of linear expansion of steel ( $\alpha$ ) =  $11.7 \times 10^{-6} \text{ /Celsius degrees}$ .

- (a)  $1.2 \times 10^{-3} \text{ m}^2$
- (b)  $1.9 \times 10^{-6} \text{ m}^2$
- (c)  $2.3 \times 10^{-5} \text{ m}^2$
- (d)  $1.9 \times 10^{-3} \text{ m}^2$
- (e)  $1.2 \times 10^{-6} \text{ m}^2$

19-05

2.46-46%

Question 193

Calculate the change in the length of a 2.0 m aluminum thin wire if its temperature is changed by 54 F-degrees. (the coefficient of thermal expansion for aluminum is equal to  $23 \times 10^{-6} \text{ /C-degrees}$ ).

- (a) 1.2 mm
- (b) 2.5 mm
- (c) 4.5 mm
- (d) 1.4 mm
- (e) 9.6 mm

19-05

Question 194

The volume expansion coefficient of benzene is  $1.24 \times 10^{-4} \text{ /C-degree}$ . If a  $100 \text{ cm}^3$  steel container is filled with benzene when the temperature is 20.0 degrees-C, how much benzene will spill over when the temperature is raised to 50.0 degrees-C? (neglect the thermal expansion of the steel container.)

- (a)  $0.436 \text{ cm}^3$
- (b)  $0.236 \text{ cm}^3$
- (c)  $0.372 \text{ cm}^3$
- (d)  $0.865 \text{ cm}^3$
- (e)  $0.124 \text{ cm}^3$

19-05

Question 195

A gold ring has a diameter of 2.168 cm at a temperature of 15 degree-C. Determine its diameter when the temperature is 215 degree-C. ( $\alpha$  of gold =  $1.42 \times 10^{-5} \text{ /C-degree}$ .)

- (a) 3.185 cm
- (b) 50.16 cm
- (c) 3.514 cm
- (d) 2.397 cm
- (e) 2.174 cm

Question 19619-05  
0.31-37%

Find the change in volume of an aluminum sphere, with initial radius of 0.1 m, when it is heated from 0.0 degrees-C to 100 degrees-C. (Coefficient of linear expansion of aluminum ( $\alpha$ ) is  $23 \times 10^{-6} / \text{C-degree}$ )

- (a) 29 cm<sup>3</sup>
- (b) 34 cm<sup>3</sup>
- (c) 64 cm<sup>3</sup>
- (d) 78 cm<sup>3</sup>
- (e) 50 cm<sup>3</sup>

Question 197

19-05

A bridge is made with segments of concrete 50 m long. If the linear expansion coefficient of concrete is  $12.0 \times 10^{-6} (\text{Celsius degree})^{-1}$ , how much spacing is needed to allow for expansion for an extreme change in temperature of 150 degrees Fahrenheit? (Assume that the linear expansion coefficient is not a temperature dependent)

- (a) 7.5 cm.
- (b) 9.5 cm.
- (c) 5.0 cm.
- (d) 10 cm.
- (e) 2.5 cm.

Question 198

19-05

An iron ball has a diameter of 6.0 cm and is 0.01 mm too large to pass through a hole in a brass ring when both are at a temperature of 30 degrees Celsius. To what temperature should the brass ring be heated so that the ball just passes through the hole? [The coefficient of volume expansion of iron =  $3.6 \times 10^{-5} \text{ K}^{-1}$  and of brass =  $5.7 \times 10^{-5} \text{ K}^{-1}$ ]

- (a) 52 degrees Celsius.
- (b) 59 degrees Celsius.
- (c) 47 degrees Celsius.
- (d) 32 degrees Celsius.
- (e) 39 degrees Celsius.

Question 19919-05  
0.22-67%

The coefficient of linear expansion of gold is  $14.20 \times 10^{-6} / \text{K}$ . If the density of gold is 19.30 g/cm<sup>3</sup> at 20 degrees Celsius, the density of gold at 90 degrees Celsius will be:

- (a) 19.28 g/cm<sup>3</sup>.
- (b) 19.00 g/cm<sup>3</sup>.
- (c) 19.24 g/cm<sup>3</sup>.
- (d) 19.38 g/cm<sup>3</sup>.
- (e) 19.34 g/cm<sup>3</sup>.

Question 20019-05  
0.43-44%

An ordinary glass cup is filled to the top with 0.3 Liters of water at 10 degree C. If the temperature is now increased to 40 degree C, how much water (if any) will spill from the glass? Coefficient of volume expansion of water is  $21 \times 10^{-5} \text{ K}^{-1}$  and for glass is  $27 \times 10^{-6} \text{ K}^{-1}$ .

- (a)  $1.65 \times 10^{-3}$  Liters.
- (b)  $0.12 \times 10^{-3}$  Liters.
- (c)  $3.44 \times 10^{-3}$  Liters.
- (d)  $6.67 \times 10^{-3}$  Liters.
- (e) zero Liters.

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Question 201

A steel washer (ring) has an inner diameter of 4.000 cm and an outer diameter of 4.500 cm at 20 deg C. To what temperature must the washer be heated to just fit over a rod that is 4.010 cm in diameter? (Coefficient of linear expansion of steel,  $\alpha = 11 \times 10^{-6}$  per C deg)

- (a) -40 deg C
- (b) 509 deg C
- (c) 247 deg C
- (d) 100 deg C
- (e) 315 deg C

19-05

0.52-66%

Question 202

A metal rod has a length of 10.000 cm at 20 degrees-C, and a length of 10.025 cm at the boiling point of water. What is the temperature if the length of the rod is 10.015 cm ?

- (a) 74 degrees-C
- (b) 56 degrees-C
- (c) 70 degrees-C
- (d) 50 degrees-C
- (e) 68 degrees-C

19-05

0.54-69%

Question 203

A cylindrical glass beaker of radius 1.5 cm contains 20 mL of water at 5.0 degrees-C. What is the change in the water level when the temperature rises to 90 degrees-C. Ignore the change in the volume of the glass beaker. [The coefficient of volume expansion of water is  $2.1 \times 10^{-4}$  (degrees-C)<sup>-1</sup> and 1 mL = 1 cm<sup>3</sup>].

- (a) 360 mm
- (b) 0.11 mm
- (c) 0.51 mm
- (d) 16 mm
- (e) 0.35 mm

19-05

Question 204

When the temperature of a sphere is raised by 75 degrees Celsius the spheres volume increases by  $6.9 \times 10^{-5}$  m<sup>3</sup>. If the original volume is  $1.8 \times 10^{-2}$  m<sup>3</sup>, find the coefficient of linear expansion of the sphere.

- (a)  $9.0 \times 10^{-5}$  (Celsius degrees)<sup>-1</sup>.
- (b)  $1.7 \times 10^{-5}$  (Celsius degrees)<sup>-1</sup>.
- (c)  $2.8 \times 10^{-5}$  (Celsius degrees)<sup>-1</sup>.
- (d)  $5.1 \times 10^{-5}$  (Celsius degrees)<sup>-1</sup>.
- (e)  $3.4 \times 10^{-5}$  (Celsius degrees)<sup>-1</sup>.

19-05

0.32-28%

Question 205

A certain metal rod has a length of 10.00 m at 100.00 degree-C and a length of 10.04 m at 773 K. Find its length at zero degree-C.

- (a) 9.99 m.
- (b) 10.01 m.
- (c) 9.00 m.
- (d) 9.83 m.
- (e) 10.03 m.