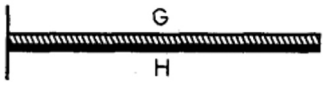
1) Which two temperature changes are equivalent?

A) 1 F° = 1 C° B) 1 C° = 1 K

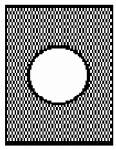
C) 1 K = 1 F° D) none of the above

2) As shown in the figure, a bimetallic strip, consisting of metal G on the top and metal H on the bottom, is rigidly attached to a wall at the left. The coefficient of linear thermal expansion for metal G is greater than that of metal H. If the strip is uniformly heated, it will



A) remain horizontal, but get shorter.
B) curve upward.
C) remain horizontal, but get longer.
D) bend in the middle.
E) curve downward.

3) Consider a flat steel plate with a hole through its center as shown in the figure. When the temperature of the plate is increased, the hole will



A) always contract as the plate expands into it.
B) contract if it takes up less than half the plate's surface area.
C) expand only if it takes up more than half the plate's surface area.
D) remain the same size as the plate expands around it.
E) always expand with the plate.

4) The coefficient of linear expansion for aluminum is $1.8 \times 10^{-6}\ K^{-1}$. What is its coefficient of volume expansion?

A) $5.8 \times 10^{-18}\ K^{-1}$
B) $5.4 \times 10^{-6}\ K^{-1}$
C) $0.60 \times 10^{-6}\ K^{-1}$
D) $3.6 \times 10^{-6}\ K^{-1}$
E) $9.0 \times 10^{-6}\ K^{-1}$

5) Two containers of equal volume each hold samples of the same ideal gas. Container A has twice as many molecules as container B. If the gas pressure is the same in the two containers, the correct statement regarding the absolute temperatures T_A and T_B in containers A and B, respectively, is

A) $T_A = \frac{1}{\sqrt{2}} T_B$.

B) $T_A = 2T_B$.

C) $T_A = \frac{1}{2} T_B$.

D) $T_A = T_B$.

E) $T_A = \frac{1}{4} T_B$.

6) An ideal gas is held in a container of volume V at pressure p. The rms speed of a gas molecule under these conditions is v. If now the volume and pressure are changed to $2V$ and $2p$, the rms speed of a molecule will be

A) $v/4$ B) v C) $4v$ D) $2v$ E) $v/2$

7) A mole of diatomic oxygen molecules and a mole of diatomic nitrogen molecules are at STP. Which statements are true about these molecules? (There could be more than one correct choice.)

A) Both gases have the same average molecular speeds.
B) Both gases have the same average kinetic energy per molecule.
C) Both gases have the same number of molecules.
D) Both gases have the same average momentum per molecule.

8) A sample of an ideal gas is heated and its Kelvin temperature doubles. If the root–mean–square speed of its molecules was originally v, what is the new root–mean–square speed?

A) $v/4$ B) $v\sqrt{2}$ C) $4v$ D) $2v$ E) $v/\sqrt{2}$

9) The absolute temperature of an ideal gas is directly proportional to which of the following quantities?

A) the average speed of its molecules
B) the average kinetic energy of its molecules
C) the average momentum of its molecules
D) the mass of its molecules
E) It is proportional to all of the above quantities.

10) Oxygen molecules are 16 times more massive than hydrogen molecules. At a given temperature, the average molecular kinetic energy of oxygen molecules, compared to that of hydrogen molecules,

A) is greater.
B) is the same.
C) is less.
D) cannot be determined without knowing the pressure and volume.

11) A fixed container holds oxygen and helium gases at the same temperature. Which of the following statements are correct? (There could be more than one correct choice.)

A) The oxygen molecules have the greater speed.
B) The helium molecules have the greater average kinetic energy.
C) The oxygen molecules have the greater average kinetic energy.
D) The helium molecules have the greater speed.
E) The helium molecules have the same average kinetic as the oxygen molecules.

12) A temperature change of 20 C° corresponds to a Fahrenheit temperature change of

13) Nitrogen boils at –196°C. What is the corresponding temperature in the Fahrenheit scale?

14) A steel bridge is 1000 m long at –20°C in winter. What is the change in length when the temperature rises to 40°C in summer? The average coefficient of linear expansion of this steel is $11 \times 10^{-6}\ K^{-1}$.

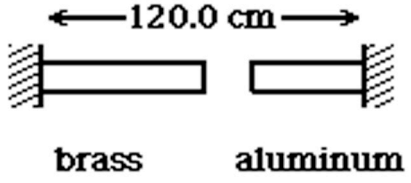
15) A quantity of mercury occupies 400.0 cm^3 at 0°C. What volume will it occupy when heated to 50°C? Mercury has a volume expansion coefficient of $180 \times 10^{-6}\ K^{-1}$.

16) A mercury thermometer has a glass bulb of interior volume 0.100 cm^3 at 10°C. The glass capillary tube above the bulb has an inner cross–sectional area of 0.012 mm^2. The coefficient of volume expansion of mercury is $1.8 \times 10^{-4}\ K^{-1}$. If the expansion of the glass is negligible, how much will the mercury rise in the capillary tube when the temperature rises from 5°C to 35°C if the bulb was full at 5°C?

17) The coefficient of linear expansion of aluminum is $24 \times 10^{-6}\ K^{-1}$ and the coefficient of volume expansion of olive oil is $0.68 \times 10^{-3}\ K^{-1}$. A novice cook, in preparation of some pesto, fills a 1.00–L aluminum pot to the brim and heats the oil and the pot from an initial temperature of 15°C to 190°C. To his consternation some olive oil spills over the top. How much?

18) The coefficient of linear expansion of copper is $17 \times 10^{-6}\ K^{-1}$ and that of steel is $12 \times 10^{-6}\ K^{-1}$. At 12°C a steel rod has a diameter of 2.540 cm and a copper pipe has a diameter of 2.536 cm. Which one of the following quantities is closest to the temperature to which the copper pipe must be heated in order for the unheated steel rod to fit snugly in the copper pipe?

19) A brass rod is 69.5 cm long and an aluminum rod is 49.3 cm long when both rods are at an initial temperature of 0° C. The rods are placed in line with a gap of 1.2 cm between them, as shown in the figure. The distance between the far ends of the rods is maintained at 120.0 cm throughout. The temperature of both rods is raised equally until they are barely in contact. At what temperature does contact occur? The coefficients of linear expansion of brass and aluminum are $2.0 \times 10^{-5}\ K^{-1}$ (brass) and $2.4 \times 10^{-5}\ K^{-1}$ (aluminum).



20) A glass flask has a volume of 500 mL at a temperature of 20° C. The flask contains 492 mL of mercury at an equilibrium temperature of 20°C. The temperature is raised until the mercury reaches the 500 mL reference mark. At what temperature does this occur? The coefficients of volume expansion of mercury and glass are $18 \times 10^{-5}\ K^{-1}$ (mercury) and $2.0 \times 10^{-5}\ K^{-1}$ (glass).

21) How many molecules are in (a) 1.0 cm^3 of air at STP and (b) 1.0 cm^3 of helium at STP? ($R = 8.31$ J/mol . K, $N_A = 6.022 \times 10^{23}$ molecules/mol)

22) A jar holds 2.0 L of ideal nitrogen gas, N_2, at STP. The atomic mass of nitrogen is 14.0 g/mol, the ideal gas constant is $R = 8.31$ J/mol • K, Avogadro's number is $N_A = 6.022 \times 10^{23}$ molecules/mol, and 1.00 atm = 101 kPa.
(a) How many moles of nitrogen are in the jar?
(b) How many nitrogen molecules are in the jar?
(c) What is the mass of the nitrogen in the jar?

23) A balloon originally has a volume of 1.0 m^3 when the gas in it is at 20°C and under a pressure of 1.0 atm. As it rises in the earth's atmosphere, its volume expands. What will be its new volume if its final temperature and pressure are –40°C and 0.10 atm?

24) A certain automobile tire has a volume of 0.0185 m^3. If the absolute (or total) pressure in the tire is 500 kPa and the temperature is 298 K, how many molecules are there inside the tire? ($R = 8.31$ J/mol • K, $N_A = 6.022 \times 10^{23}$ molecules/mol)

25) A 20.0–L pressure vessel holds 2.00 mol of oxygen at 30°C. What is the pressure inside the vessel? ($R = 8.31$ J/mol • K)

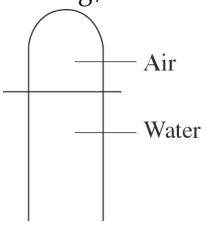
26) A gas–filled vertical cylinder, closed at the bottom end, is fitted at the top with a piston that can move freely. The mass of the piston is 10.0 kg, and the initial height of the piston above the bottom of the cylinder is 25 cm. A mass of 8.0 kg is placed on the piston. What is the resulting height of the piston, assuming that the temperature of the ideal gas is kept constant?

27) A 3.9–L volume of ideal neon gas (monatomic) is at a pressure of 5.6 aym and a temperature of 330 K. The atomic mass of neon is 20.2 g/mol. The temperature of the gas is now increased to 430 K and the volume is increased to 5.9 L. What is the final pressure of the gas?

28) A sealed cylinder fitted with a movable piston contains ideal gas at 27°C, pressure 0.500×10^5 Pa, and volume 1.25 m^3. What will be the final temperature if the gas is compressed to 0.800 m^3 and the pressure rises to 0.820×10^5 Pa?

29) A sealed container holds 0.020 moles of ideal nitrogen (N_2) gas, at a pressure of 1.5 atm and a temperature of 290 K. The atomic mass of nitrogen is 14.0 g/mol. How many molecules of nitrogen are in the container? ($R = 8.31$ J/mol • K, 1 atm = 101 kPa)

30) As shown in the figure, an air pocket at the top of a vertical tube, closed at the upper end and open at the lower, occupies a volume of 560 cm^3 at the surface of a lake where the air pressure is 1.0×10^5 Pa and the temperature is 37°C. What is the volume of the air in the pocket if the tube is taken to a depth of 56 meters, where the temperature is 7°C? Assume that none of the air escapes from the tube. The density of the water in the lake is 1000 kg/m^3.



31) The rms speed of a certain sample of carbon dioxide molecules, with a molecular weight of 44.0 g/mole, is 396 m/s. What is the rms speed of water vapor molecules, with a molecular weight of 18.0 g/mol, at the same temperature as the carbon dioxide?

32) The molecular weight of nitrogen, N_2, is 28 g/mol. What is the rms speed of nitrogen molecules in a cooler at 8.0°C? The Boltzmann constant is 1.38×10^{-23} J/K and $N_A = 6.022 \times 10^{23}$ molecules/mol.

Answer Key
Testname: HW_CH13_TEMPERATURE_KINETIC_THY

1) B
2) E
3) E
4) B
5) C
6) D
7) B, C
8) B
9) B
10) B
11) D, E
12) 36 F°.
13) –321°F
14) 0.66 m
15) 403.6 cm^3
16) 45 mm
17) 0.11 L
18) 105°C
19) 470°C
20) 120°C
21) 2.7×10^{19} molecules in both cases
22) (a) 0.089 mol (b) 5.4×10^{22} molecules (c) 2.5 g
23) 8.0 m^3
24) 2.25×10^{24} molecules
25) 252 kPa
26) 14 cm
27) 4.8 atm
28) 42°C
29) 1.2×10^{22} mol
30) 78 cm^3
31) 619 m/s
32) 500 m/s