PHYS 202 Spring 2023 Test #1 Name:_____

$T_F = \frac{9}{5}T_C + 32$ $T_K = T_C + 273$ $\Delta T_F = \frac{9}{5}\Delta T_C$ $\Delta T_K = \Delta T_C$

A. Select the correct answer for the following multiple choice questions and write your answer in the line next to the question number.

$4.2 = \frac{9}{5}T_C + 32$

$-27.8 = \frac{9}{5}T_C$

$-15.4 = T_C$

63

b 1. Express the temperature 4.2°F in the K unit?
a. 223 b. 258 c. 275 d. 277 e. 313

C 2. What is the difference in C° of the two temperatures, -45°F and 63°F?
a. 42 b. 10 c. 60 d.- 7.8 e. 194

f 3. What is the thermometric property of a resistance thermometer?
C 4. What is the thermometric property of a constant volume gas thermometer?
Answers for 3 & 4
a. Length of a liquid column b. Volume of gas c. Pressure of a gas
d. Infrared radiation e. Ultraviolet radiation f. Resistance

d 5. The zeroth law of thermodynamics is,
e 6. The third law of thermodynamics is,
Answers for 5 & 6
a. The law of conservation of energy.
b. Heat flows spontaneously from a substance at a higher temperature to a substance at a lower temperature.
c. Heat flows spontaneously from a substance at a lower temperature to a substance at higher temperature.
d. If two systems individually in thermal equilibrium with a third system, then the two systems are in thermal equilibrium with each other.
e. It is not possible to lower the temperature of any system to absolute zero in a finite number of steps.

b 7. Suppose you want to heat a gas so that its temperature will be as high as possible. Would you heat it under conditions of constant pressure or constant volume?
a. constant pressure b. constant volume

8-9) Deals with the electric field lines of two charges, magnitudes A and B as shown:

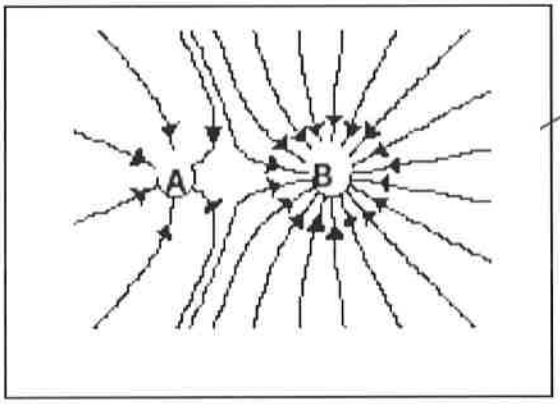
d 8. The polarities of the charges are,

a. A is positive and B is negative

b. B is positive and A is negative

c. Both are positive d. Both are negative

C 9. The ratio B/A is given by,
a. 1 b. 2 c. 3 d. 4 e. 5



18
6

e 10. In thermodynamics the collection of objects upon which attention is being focused is called the ***system,*** while everything else in the environment is called the ***surroundings.*** What is the system for an automobile engine?

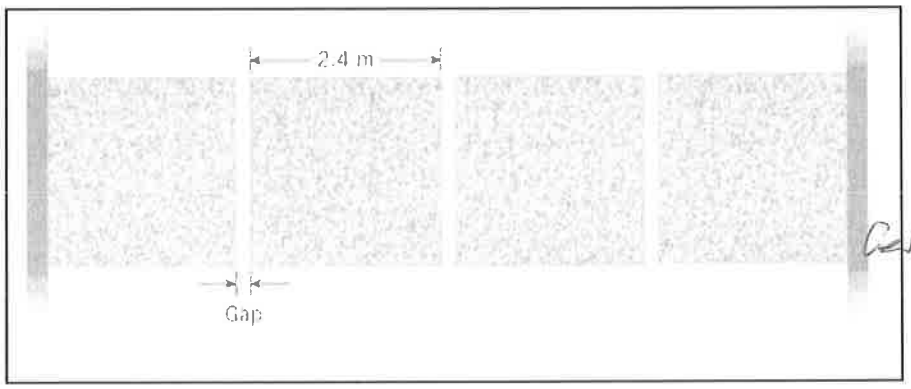
a. Engine b. Radiator c. Wheels d. Body e. burning gasoline/air mixture

a 11. Walls that permit heat to flow through them are called,

a. *diathermal walls* b. *adiabatic walls.*

C 12. Concrete sidewalks are always laid in sections, with gaps between each section. For example, the drawing shows four identical 2.4-m sections, the outer two of which are against immovable walls. The three identical gaps between the sections are provided so that thermal expansion will not create the thermal stress that could lead to cracks. What is the minimum gap width necessary to account for an increase in temperature of 32 C°?

a. 0.92×10^{-3}m b. 1.0×10^{-3}m c. 1.2×10^{-3}m d. 1.3×10^{-3}m e. 1.4×10^{-3}m



$\Delta L = \alpha L_0 \Delta T$

$= 12 \times 10^{-6} \times 2.4 \times 4 \times 32$

b 13. Which one of the following is the correct order of the four strokes of the internal combustion gasoline engine:

a. Power, Intake, Compression, Exhaust
b. Intake, Compression, Power, Exhaust
c. Intake, Power, Compression, Exhaust
d. Compression, Intake, Power, Exhaust
e. Exhaust, Compression, Intake, Power

C 14. Conductors have free_____.

A. Protons B. Neutrons C. Electrons D. Nucleons E. Atoms

A 15. An object is charged by contact using a positively charged rod. What type is the charge on the charged object?

B 16. An object is charged by induction using a positively charged rod. What type is the charge on the charged object?

Answers for 15 -16:

A. Positive B. Negative C. No charge

$\Delta L = \alpha L_0 \Delta T$ $\Delta A = 2\alpha A_0 \Delta T$ $\Delta V = \beta V_0 \Delta T$ $\beta = 3\alpha$, for solids

Volume of a sphere (of radius R) = $V_{sph} = \frac{4}{3}\pi R^3$

Volume of a cylinder (of radius r and height h) = $V_{cyl} = \pi r^2 h$

9 B. A Pyrex round (radius, R = 5.0 cm) bottom flask with a cylindrical (base radius, r = 5.5 mm) stem is used to measure the volume coefficient of expansion of a fluid. The fluid is filled to the brim of the spherical bottom as shown (Fig. a) at a temperature of 23°C. When the fluid is heated to 77°C, it rises to a height, h = 6.5 cm. What is the volume coefficient of expansion of the fluid?
(Pyrex has a negligible thermal expansion)

$\Delta V = \pi r^2 h = \pi \times 0.55^2 \times 6.5 = 6.17\ cm^3$

$V_0 = \frac{4}{3}\pi R^3 = \frac{4}{3} \times \pi \times 5^3 = 523\ cm^3$

$\Delta V = \beta V_0 \Delta T$

$6.17 = \beta \times 523 \times (77 - 23)$

$\beta = \frac{6.17}{523 \times 54}$

$\beta = 2.18 \times 10^{-4}\ [C^0]^{-1}$

$\beta = 218 \times 10^{-6}\ [C^0]^{-1}$

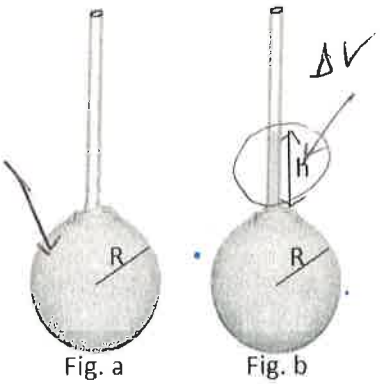
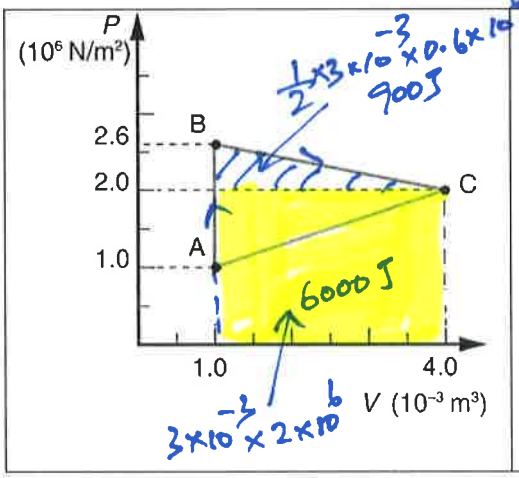


Fig. a Fig. b

18 C. An ideal gas is taken through the three processes (A→B, B→C, and C→A) shown in the drawing.
1. Name the process **AB** Isochoric.

2. For the three processes shown in the drawing, fill in the eight missing entries in the following table.
First Law of thermodynamics: ΔU = Q - W. Work = W= P.ΔV



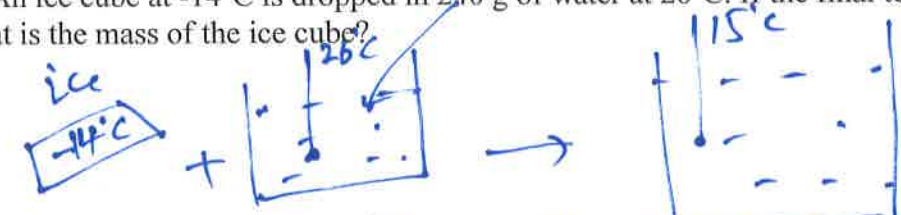
Process	W	Q	ΔU
A→B	a. 0	+2,500 J	b. 2500J
B→C	c. +6900J	d. ΔU+W +10,000J	+3100 J
C→A	e. −4500J	g. −10,100J	f. −5600J
	h. Total work for A→B→C→A = 6900 − 4500 +2400 J		

$-(6000 - \frac{1}{2} \times 3 \times 10^{-3} \times 1 \times 10^6)$
$-(6000 - 1500)$
$-(4500)$

$Q = mc\Delta T$ $\quad Q = mL$

(Specific heat of water = 4186 J/(kg.K), Specific heat of ice = 2000 J/(kg.K), Latent heat of fusion of ice = 33.5 x 10^4 J/kg)

12 D. An ice cube at -14^{0}C is dropped in 240 g of water at 26^{0}C. If the final temperature is 15^{0}C, what is the mass of the ice cube?



Heat gain by ice = Heat loss by water

$m_i C_i (0-(-14)) + m_i L_f + m_i C_w \times 15 = M_w C_w (26-15)$

$m_i \times 2000 \times 14 + m_i \times 33.5 \times 10^4 + m_i \times 4186 \times 15 = 0.24 \times 4186 \times (11)$

$28000 m_i + 335000 m_i + 62790 m_i = 11,051.04$

$425,790 m_i = 11051.04$

$m_i = \frac{11051.04}{425,790} = 0.026\ kg$

$m_i = 26\ g$

13 E. Coulomb's law is given by: $F = k\frac{|Q_1||Q_2|}{r^2}$ Coulomb's constant = k = 9 x 10^9 (SI)

1. Express the SI unit of the Coulomb's constant: $N.M^2/C^2$

2. Figure below shows three point charges that lie along the *x* axis in a vacuum, with no gravity.

a. Draw a free-body diagram for the charge q_3.

b. Determine the magnitude and direction of the net electrostatic force on q_3.

$F_2 = \frac{k|Q_2||Q_3|}{r^2} = \frac{9\times10^9 \times 3\times10^{-6} \times 7\times10^{-6}}{0.3^2} = 2.10N \rightarrow$

$F_1 = \frac{k|Q_1||Q_3|}{r^2} = \frac{9\times10^9 \times 5\times10^{-6} \times 7\times10^{-6}}{0.5^2} = 1.26\ N \leftarrow$

net Force = $F_2 - F_1 = 2.10 - 1.26$

net Force = 0.84 N $\rightarrow$