PHYS 202 Spring 2016 Test #1 Name: KEY

$T_F = \frac{9}{5}T_C + 32$ $T_K = T_C + 273$ $\Delta L = \alpha L_0 \Delta T$

48 (3pts each)

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

b 1. Which one of the following temperatures is approximately equal to the temperature inside the freezer of a refrigerator?

a. 33 ^{0}F b. 23 ^{0}F c. 23 ^{0}C d. 33 ^{0}C e. 23 K

c 2. Express the temperature 77 K in ^{o}F unit?

a. 171 b. – 117 c. – 321 d. – 353 e. – 196

b 3. What is the thermometric property of a thermocouple?

a. Length of a liquid column b. Voltage c. Pressure of a gas
d. Infrared radiation e. Ultraviolet radiation

c 4. When the temperature of a coin changes from 20^{0}C to 108.5 ^{0}C, the coin's diameter increases by 2.55 x 10^{-5} m. If the original diameter is 1.95 x 10^{-2} m, find the coefficient of linear expansion in $[C^0]^{-1}$.

a. 8.64 b. 3.47 x 10^{-6} c. 1.48 x 10^{-5} d. 1.2 x 10^{-5}

b 5. Which one of the following will create more entropy?

a. Two kilograms of ice melts into water at 273 K
b. Two kilograms of water changes into steam at 373 K.

d 6. The zeroth law of thermodynamics is,

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.

c 7. Conductors have free_____.

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

c 8. What is the shape of one of the equipotential surfaces for an isolated point charge?

a 9. What is the shape of one of the equipotential surfaces for a parallel plate capacitor?

Answers for 8-9

a. plane b. circle c. sphere d. parabola e. ellipse

A 10. An object is charged by contact using a positively charged rod. What type is the charge on the charged object?

A 11. An object is charged by induction using a negatively charged rod. What type is the charge on the charged object?

Answers for 10 -11:

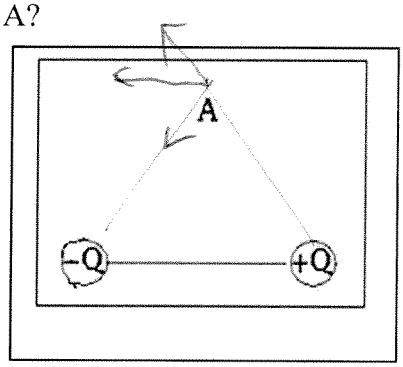
A. Positive B. Negative C. No charge

D 12. Two charges –Q and +Q with equal magnitudes are located as shown below. Point A is at equal distance from the charges. What is the net electric field at A?

A. Vertical and down B. Vertical and up

C. Horizontal and to the right D. Horizontal and to the left

E. There is none



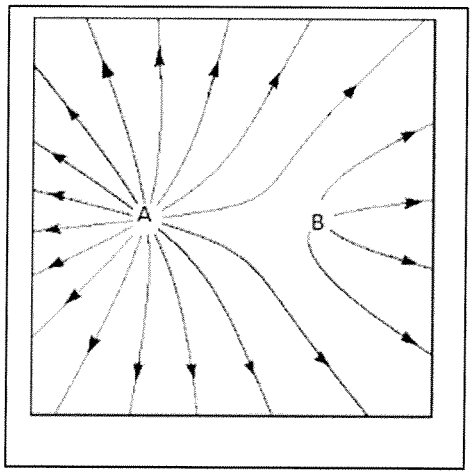
13-14) Deals with the electric field lines of two charges, magnitudes A and B as shown:

C 13. 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



d 14. The ratio A/B is given by,

a. 1 b. 2 c. 3 d. 4 e. 5

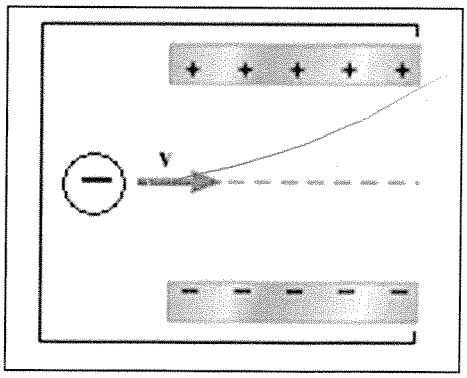
15 & 16) A negatively charged particle of negligible mass is moving horizontally when it enters the region between the plates of a capacitor, as the drawing illustrates.

C 15. The electric field between the plates is:

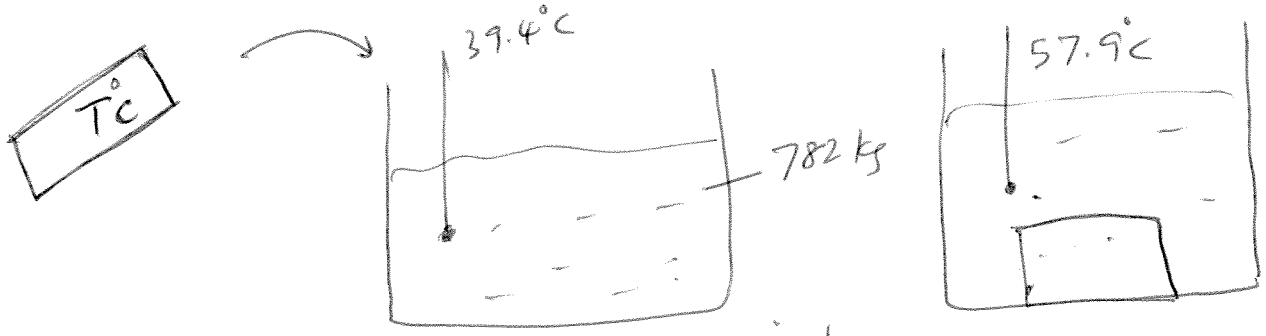
a. Vertical, pointing up d. Horizontal, pointing to the right

c. Vertical, pointing down e. Horizontal, pointing to the left

16. Sketch the subsequent path of the charge particle in the diagram.



(12) B. At a fabrication plant, a hot metal forging has a mass of 87.9 kg and a specific heat capacity of 430 J/(kg C°). To harden it, the forging is quenched by immersion in 782 kg of oil that has a temperature of 39.4 °C and a specific heat capacity of 2810 J/(kg C°). The final temperature of the oil and forging at thermal equilibrium is 57.9 °C. Assuming that heat flows only between the forging and the oil, determine the initial temperature in degrees Celsius of the forging. $[Q = mc\Delta T]$



Heat loss by metal = Heat gain by oil

$m_m C_m \Delta T_m = M_o C_o \Delta T_o$

$87.9 \times (430) \times (T - 57.9) = 782 \times (2810) \times (57.9 - 39.4)$

$37797 (T - 57.9) = 40652270$

$T - 57.9 = \frac{40652270}{37797} = 1075.5$

$T = 1075.5 + 57.9 = 1133.4$

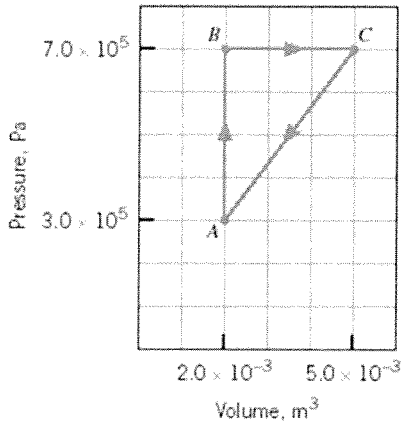
$T = 1133\ ^\circ C$

(2) 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 and **BC** Isobaric.

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. W= P.ΔV]

(14)



Process	W	Q	ΔU
A→B	a. 0	+2,000 J	b. +2000 J
B→C	c. +2100 J	d. +5100 J	+3000 J
C→A	e. −1500 J	g. −6500 J	f. −5000 J

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

(2)

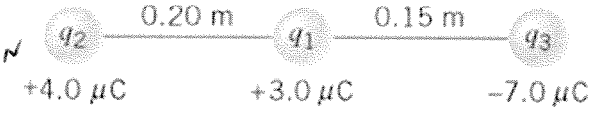
1. Express the SI unit of the Coulomb's constant: $N \cdot m^2/C^2$

(10)

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.

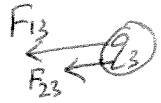
b. Determine the magnitude and direction of the net electrostatic force on q_3.



q_1's pull on $q_3 = F_{13} = \frac{k|q_1||q_2|}{r^2}$

$F_{13} = \frac{9\times10^9 \times 3\times10^{-6} \times 7\times10^{-6}}{0.15^2} = 8.4N$

q_2's pull on $q_3 = F_{23} = \frac{k|q_2||q_3|}{r^2} = \frac{9\times10^9 \times 4\times10^{-6} \times 7\times10^{-6}}{(0.35)^2} = 2.06N$



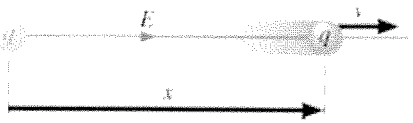
Net force = $F_{13} + F_{23} = 10.5$ N ←

$v = v_0 + at$	$x = \frac{1}{2}(v + v_0)t$	$x = v_0 t + \frac{1}{2}at^2$	$v^2 = v_0^2 + 2ax$	$\vec{F} = m\vec{a}$ $\vec{E} = \frac{\vec{F}}{q}$

(12)

E. A particle of charge +12μC and mass 2.3×10^{-5} kg is released from rest in a region where there is a constant electric field of +670 N/C. What is the velocity and displacement of the particle after a time of 4.6×10^{-2} s?

$\vec{F} = q\vec{E} = 12\times10^{-6} \times 670 = 0.00804$ N



$a = \frac{F}{m} = \frac{12\times10^{-6} \times 670}{2.3\times10^{-5}} = 3.495\times10^2$ m/s²

$a = 349.5$ m/s²

$V = V_0 + at = 0 + 349.5 \times 4.6\times10^{-2} = 16.08$ m/s $\simeq 16$ m/s

$X = V_0 t + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times 349.5 \times (4.6\times10^{-2})^2 = 0.369$ m

$x = 0.37$m

$V = 16$ m/s