PHYS 202 Fall 2015 Test #1 Name: KEY

Tf = (9/5) Tc + 32, Tk = Tc + 273 $\Delta L = \alpha L_0 \Delta T$

A) For the following questions write your answers in the space next to the question #.

C 1. Which one of the following temperatures is approximately equal to the typical temperature of a classroom?
a. 373 K b. 23 °F c. 23 °C d. 73 °C e. 73 K

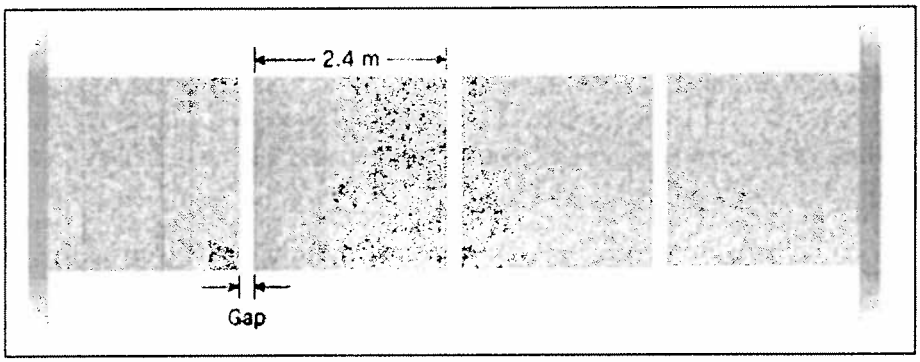
d 2. Express the temperature 4.2 K in °F unit?
a. 39.6 b. – 117 c. – 269 d. – 452 e. – 484

e 3. What is the difference in F° of the two temperatures, -35°C and 62°C?
a. 54 F° b. 15 F° c. 36 F° d.- 2.7 F° e. 175 F°

d 4. What is the thermometric property of an ear thermometer?
a. Length of a liquid column b. Voltage c. Pressure of a gas
d. Infrared radiation e. Ultraviolet radiation

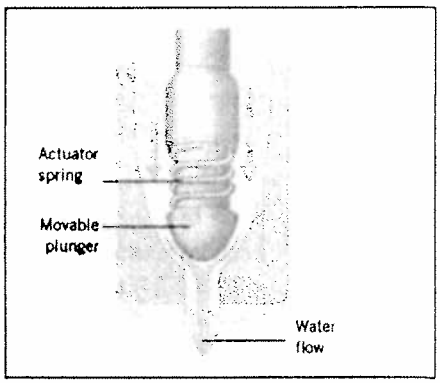
The linear coefficients of thermal expansion are:
$\alpha_{steel} = \alpha_{concrete} = 12x10^{-6}(C^o)^{-1}$, $\alpha_{aluminum} = 23x10^{-6}(C^o)^{-1}$, $\alpha_{copper} = 17x10^{-6}(C^o)^{-1}$.

C 5. 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



$\Delta L = \alpha L_0 \Delta T$
$3\,Gap = 12\times10^{-6} \times (4\times2.4) \times 32$
$Gap = \frac{12\times10^{-6}\times4\times2.4\times32}{3}$
$= 0.00123$ m
$= 1.2\times10^{-3}$

b 6. For the highest accuracy, which of the material is ideal for a tape rule for year-round outdoor use?
a 7. Anti-scalding device shown to the right uses actuator spring to block the flow of hot water. For better results the spring should be made of:
Answers for 6 & 7: a. Aluminum b. Steel c. Copper



e 14. The third 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.

b 15. 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

b 16. Which of the following has greater entropy?
a. 1 kg of ice at 0^0C b. 1 kg of water at 0^0C

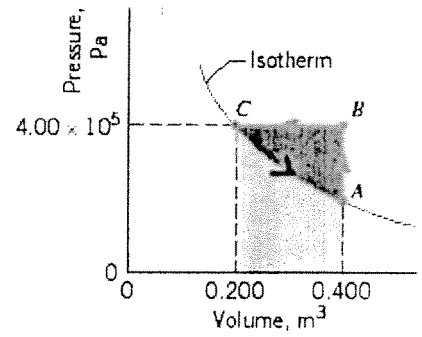
End of MC questions

First Law of thermodynamics: $\Delta U = Q - W$. $W = P.\Delta V$

B. An ideal gas is taken through the three processes (A→B, B→C, and C→A) shown in the drawing, where CA is an isotherm.

1. Name the process **AB** isochoric and **BC** isobaric.

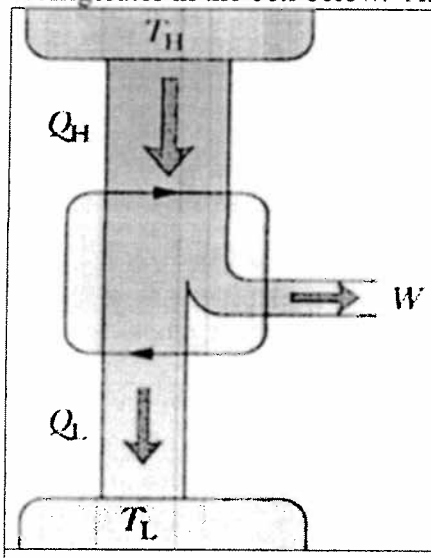
2. For the three processes shown in the drawing, fill in the eight missing entries in the following table.



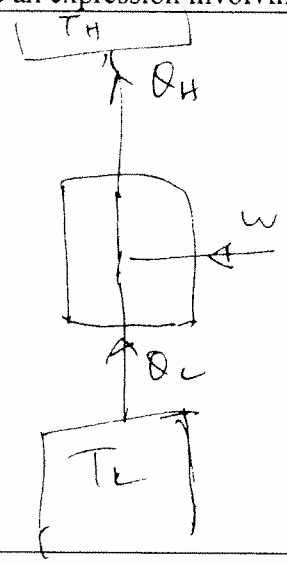
Process	ΔU	Q	W
A→B	b. +70,000 J	+70,000 J	a. 0
B→C	d. −70,000 J	e. −150,000 J	c. −80,000 J
C→A	f. 0	g. 60,000 J	60,000 J

h. Area of the shaded shape ABC= 20,000 J

E. Schematic diagram for a heat engine is shown below. Sketch a similar diagram for a refrigerator in the box below. Also write an expression involving Q_H, Q_L, *and* W.



Heat Engine

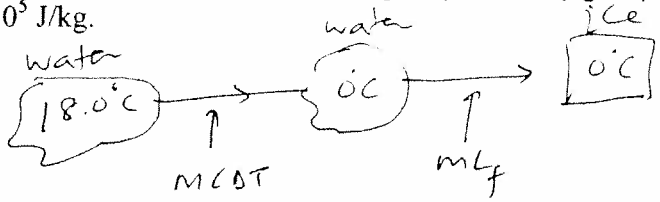


Refrigerator

Expression involving Q_H, Q_L, *and* W. $Q_H = Q_L + W$

$Q = mc\Delta T$ $\quad Q = mL$ $\quad (COP)_{Refri.} = \frac{Q_C}{W}$

F. The wattage of a commercial ice maker is 175 W and is the rate at which it does work. The ice maker operates just like a refrigerator and has a coefficient of performance of 3.40. The water going into the unit has a temperature of 18.0°C, and the ice maker produces ice cubes at 0.0°C. Ignoring the work needed to keep stored ice from melting, find the maximum amount (in kg) of ice that the unit can produce in four hours of continuous operation. Water has a specific heat capacity 4186 J/(kg·C°) and a latent heat of fusion of 3.35×10^5 J/kg.



$COP = \frac{Q_C}{W}$; $Q_C = 3.4 \cdot W = 175 \times 4 \times 3600$

$Q_C = 3.4 \times 175 \times 4 \times 3600 = 8568000\,J = mc\Delta T + mL_f$

$= m[c\Delta T + L_f]$

$8568000 = m[4186 \times 18 + 3.35 \times 10^5]$

$\frac{8568000}{4186 \times 18 + 3.35 \times 10^5} = m$

$m = 20.9\,kg$

PHYS 202 Test #2 Spring 2015 Name: KEY

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

A 2. An object is charged by induction using a negatively charged rod. What type is the charge on the charged object?

Answers for 1 and 2:

A. Positive B. Negative C. No charge

d 3. There is an electric field at point *P*. A very small charge is placed at this point and it experiences a force. Another very small charge is then placed at this point and it experiences a force that differs in both magnitude and direction from that experienced by the first charge. Which of the following statements is true about these charges?

a. Both are identical charges, equal in magnitude and sign of charge.
b. One is positive and the other is negative but equal magnitude of charge on both.
c. One is negative and the other is positive but equal magnitude of charge on both.
d. Both are different charges in sign and magnitude.

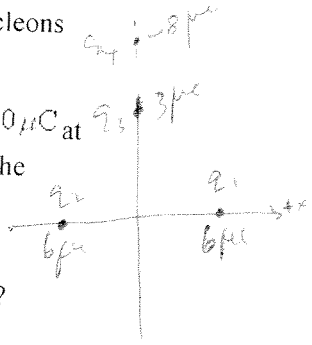
B 4. A plate carries a charge of –3.0 μC, while a rod carries a charge of +2.0 μC. What must be done to make the objects have the same charge?

A. –3.0 μC, transferred from plate to rod. B. –2.5 μC, transferred from plate to rod.
C. –2.5 μC, transferred from rod to plate. D. +3.0 μC, transferred from rod to plate.

C 5. Conductors have free: A. Protons B. Neutrons C. Electrons D. Nucleons

a 6. Two charges are located along the *x* axis: $q_1 = +6.0\,\mu C$ at $x_1 = +4.0$ cm, and $q_2 = +6.0\,\mu C$ at $x_2 = -4.0$ cm. Two other charges are located on the *y* axis: $q_3 = +3.0\,\mu C$ at $y_3 = +5.0$ cm, and $q_4 = -8.0\,\mu C$ at $y_4 = +7.0$ cm. The net electric field from which of the following two charges is zero?

a. q_1 and q_2 b. q_1 and q_3 c. q_1 and q_4 d. q_3 and q_2 e. q_4 and q_2



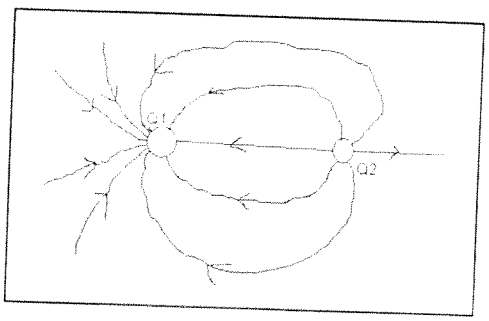
C 7. What is the shape of one of the equipotential surfaces for an isolated point charge?

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

B 8. In a common household circuit, devices are connected in

A. Series B. Parallel

9-10) Deals with the electric field lines of two charges as shown:



B 9. The polarities of the charges are,

A. Q_1 is positive and Q_2 is negative

B. Q_2 is positive and Q_1 is negative

C. Both are positive D. Both are negative

B 10. The ratio Q_1/Q_2 is given by,

A. 1 B. 1.5 C. 2 D. 3 E. 4 F. 5

C. Equations of kinematics (equations 1-4) & Newton's 2nd law are given below:

1.	2.	3.	4.	Newton's 2nd Law:
$v = v_0 + at$	$x = \frac{1}{2}(v + v_0)t$	$x = v_0 t + \frac{1}{2}at^2$	$v^2 = v_0^{\,2} + 2ax$	$\vec{F} = m\vec{a}$

(6) 1. Define electric field, identify it as a vector or scalar, and state its SI unit.

$\vec{E} = \frac{\text{Electric force}}{\text{test charge}}$ SI unit: N/C It is a vector.

$\vec{E} = \vec{F}/q_0$

(15) 2. The right drawing shows an electron entering the lower left side of a parallel plate capacitor and exiting at the upper right side. The initial speed of the electron is 5.00×10^6 m/s. The capacitor is 2.00 cm long, and its plates are separated y 0.150 cm.

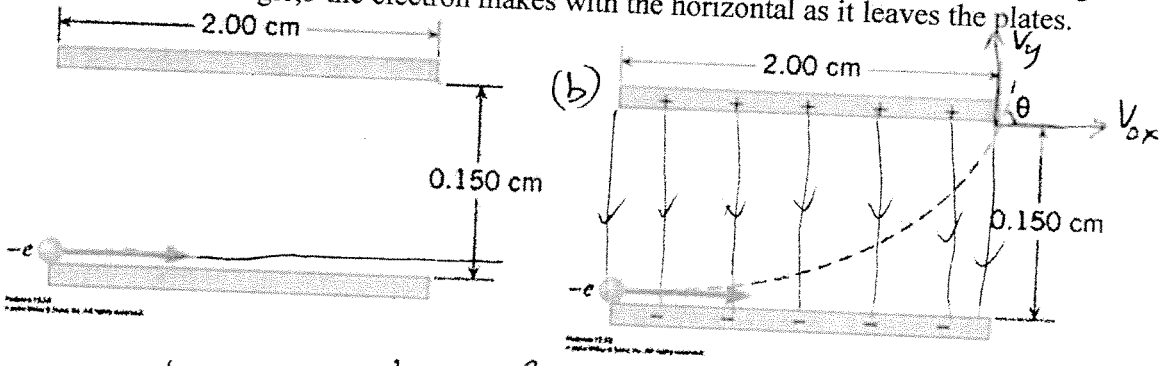
a. When the capacitor plates are not charged, as in the left drawing, draw the subsequent motion of the electron, and determine how long the electron takes to cross the plates.

b. Show the electric field in the right drawing, assuming that the electric field between the plates is uniform everywhere.

c. Determine the vertical acceleration of the electron assuming that the electron escapes the plates as shown in the right drawing.

d. Determine the magnitude of the electric field between the plates in the right drawing.

e. Determine the angle, θ the electron makes with the horizontal as it leaves the plates.



a. $x = vt$

$t = \frac{x}{v} = \frac{2\times10^{-2}}{5\times10^{6}} = 4\times10^{-9}\ s$

$t = 4\ ns$

c. $V_{oy} = 0$, $y = 0.150\ cm = 0.15\times10^{-2}\ m$, $t = 4\times10^{-9}\ s$

$0.15\times10^{-2} = \frac{1}{2}\times a\times(4\times10^{-9})^2$

$a = \frac{2\times0.15\times10^{-2}}{(4\times10^{-9})^2} = 1.875\times10^{14}\ m/s^2$

d. $\vec{E} = \frac{\vec{F}}{q} = \frac{m\vec{a}}{q} = \frac{9.11\times10^{-31}\times1.875\times10^{14}}{1.6\times10^{-19}} = 1068\ N/C$

e. $V_y = V_{oy} + at = 1.875\times10^{14}\times4\times10^{-9} = 7.5\times10^{5}\ m/s$

$\tan\theta = \frac{V_y}{V_{ox}} = \frac{7.5\times10^{5}}{5\times10^{6}} = 0.15$

$\theta = \tan^{-1}(0.15) = 8.5^\circ$ ($\theta = 8.5^\circ$)

11 E. Coulomb's law: $F = k\frac{|Q_1||Q_2|}{r^2}$.

1. In the above equation k is Coulomb's constant, which has the SI value of 9×10^9. Express its SI units. $N \cdot m^2/C^2$

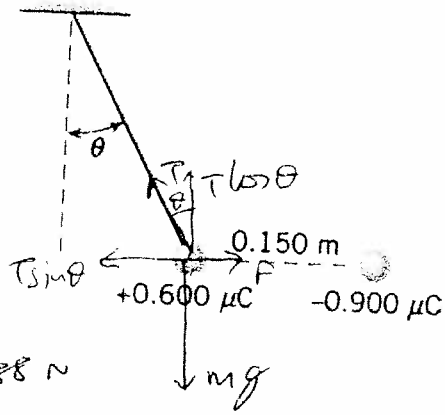
2. A small spherical insulator of mass 60 gram and charge +0.600 μC is hung by a thin wire of negligible mass. A charge of - 0.900 μC is held 0.150 m away from the sphere and directly to the right of it, so the wire makes an angle θ with the vertical (see the drawing). Find (a) the angle θ and (b) the tension in the wire.

$$T\sin\theta = F = \frac{kq_1q_2}{r^2}$$

$$T\sin\theta = \frac{9\times10^{9}\times0.6\times10^{-6}\times0.9\times10^{-6}}{0.15^2}$$

$$T\sin\theta = 0.216\ N$$

$$T\cos\theta = mg = 0.060\times9.8 = 0.588\ N$$



$$T\sin\theta = 0.216$$

$$T\cos\theta = 0.588$$

$$\tan\theta = \frac{0.216}{0.588} \longrightarrow \theta = 20^\circ$$

$$T = \frac{mg}{\cos\theta} = \frac{0.588}{\cos 20} = 0.63\ N$$