Format of the exam: 12 questions (5 or 10 pts each)  
2 or 3 will be “all or nothing” answer  
EXCEPT: -1 point for wrong number of sig figs  
Half off for wrong units  
8 or 9 will be conventional multiple choice  

TOPICS: list on board

How to make the formula sheet  
Extra practice problems on web site  
I encourage you to study together

Office hour Sunday 6-7 SC103 (on College Ave)
An open U-tube is partially filled with water (density $= 1000 \text{ kg/m}^3$). Oil, of density $750 \text{ kg/m}^3$, is poured into the right arm until the water level in the left arm rises 3 cm. What then is the height of the oil column?

Answer: 8 cm
An ice cube (density $= 920 \text{ kg/m}^3$) is pushed to the bottom of a glass of water (density $= 1000 \text{ kg/m}^3$) and then released. Neglecting frictional effects, with what acceleration will the ice cube start to rise?

Answer: 0.087g
59 SSM  Water is moving with a speed of 5.0 m/s through a pipe with a cross-sectional area of 4.0 cm$^2$. The water gradually descends 10 m as the pipe cross-sectional area increases to 8.0 cm$^2$. (a) What is the speed at the lower level? (b) If the pressure at the upper level is $1.5 \times 10^5$ Pa, what is the pressure at the lower level?

Answer: $2.6 \times 10^5$ Pa
10. The equation of a transverse wave traveling along a very long string is \( y = 6.0 \sin(0.020\pi x + 4.0\pi t) \), where \( x \) and \( y \) are expressed in centimeters and \( t \) is in seconds. Determine (a) the amplitude, (b) the wavelength, (c) the frequency, (d) the speed, (e) the direction of propagation of the wave, and (f) the maximum transverse speed of a particle in the string.

Answer: (a) 6.0 cm (b) 100 cm (c) 2 s\(^{-1}\) (d) 200 cm/s (e) negative x direction (f) 24 \( \pi \) cm/s
The tension in a wire clamped at both ends is doubled without appreciably changing the wire’s length between the clamps. What is the ratio of the new to the old wave speed for transverse waves traveling along this wire?

Answer: \((2)^{1/2}\)
One of the resonant frequencies on a string of length 0.6 m is 480 Hz. The next higher resonant frequency is 560 Hz. What is the wave speed?

Answer: 96 m/s
An organ pipe is open at both ends. For the second harmonic \((n = 2)\), how many standing wave nodes are there in the pipe?

Answer: 2 (make a sketch)
Two identical traveling waves, moving in the same direction, are out of phase by $\pi/2$ rad. What is the amplitude of the resultant wave in terms of the common amplitude $y_m$ of the two combining waves?

Answer: $2^{1/2} y_m$
A tuning fork of unknown frequency makes 3.00 beats per second with a standard fork of frequency 384 Hz. The beat frequency decreases when a small piece of wax is put on a prong of the first fork. What is the frequency of this fork?

Answer: 387 Hz
A moth is flying at 3 m/s. It is being chased by a bat flying at 11 m/s (in the same direction as the moth). The bat emits a sound of frequency 50.0 kHz. If this sound reflects off the moth and returns to the bat, what frequency does the bat hear? Speed of sound = 343 m/s.

Answer: 52.4 kHz
A vacuum cleaner has a sound level of 70 $dB$. How many such vacuum cleaners would produce a sound level equal to that of busy traffic, which is about 83 $dB$?

Answer: 20
Two charges exert repulsive forces of 100.0 N on each other. If their separation is then decreased so that it becomes 40% of the initial separation, what will be the new repulsive force between them?

Answer: 6.25 F
A charge of $+2 \, \mu C$ is on the x-axis at $x = +20 \, cm$. An unknown charge $Q$ is on the x-axis at $x = -40 \, cm$. If the electric field is zero at $x = +40 \, cm$, what is the value of $Q$?

Answer: $-32 \, \mu C$
Two identical conducting spheres, fixed in place, attract each other with an electrostatic force of 0.108 N when their center-to-center separation is 50.0 cm. The spheres are then connected by a thin conducting wire. When the wire is removed, the spheres repel each other with an electrostatic force of 0.0360 N.

What are the starting charges on the two spheres?

Answer: -1.00 μC and 3.00 μC
A charge of $+2.0 \ \mu C$ is on the x-axis at $x = +3 \ \text{cm}$, while a charge of $-3.0 \ \mu C$ is on the y-axis at $y = +3 \ \text{cm}$. What is the magnitude of the force on a third charge of $-1.0 \ \mu C$ placed at the origin?

Answer: 36 N
A charge of $+4 \ nC$ is located at the point $(20 \ cm, 15 \ cm)$, and another charge of $+4 \ nC$ is located at $(20 \ cm, -15 \ cm)$. What is the magnitude of the electric field at the origin?

Answer: $9.2 \times 10^2 \ N$
A charge of 100 nC is uniformly distributed along the y axis from \( y = 5.0 \) m to \( y = 10.0 \) m. What is the magnitude of the electric field at the origin?

Answer: \( k \lambda/(10 \text{ m}) = 2.0 \text{ N/C} \)
An electric field of 50 $N/C$ points in the positive X-direction. A proton enters this field with an initial velocity of 23 $m/s$ in the positive Y-direction. After $1 \times 10^{-8}$ seconds, what will be the proton’s X-component of velocity?

Answer: 48 m/s