Sound & Wave Review 2015 Name_____ Hr._____

$\lambda_{red} = 6.50 \times 10^{-7}$ m
$\lambda_{orange} = 5.90 \times 10^{-7}$ m
$\lambda_{yellow} = 5.70 \times 10^{-7}$ m
$\lambda_{green} = 5.10 \times 10^{-7}$ m
$\lambda_{blue} = 4.75 \times 10^{-7}$ m
$\lambda_{indigo} = 4.45 \times 10^{-7}$ m
$\lambda_{violet} = 4.00 \times 10^{-7}$ m

Assume chain saw has an audio power of 75W →

Default speed of sound=340m/s
Speed of light = 3E8 m/s
Luminosity of the sun 2.82E28 lm
The visual magnitude of an object can be found using the following formula:
- Log (lux) = .4(visual magnitude+14.2).

1. A student wants to compare the audio power from an explosion to that of a chainsaw. The explosion is rated at +70 dB with respect to the chain saw. The explosion is 200 m away. The chainsaw is 1.5m away. A) How does the power of the explosion compare to the power of the chainsaw? B) What is the intensity and the dB of the explosion at 1609m away assuming no atmospheric absorption or background noise? C) If the atmosphere absorbs sound at 300 dB/Km and there is 20db of background noise when will the dB due to the explosion be zero?

2. The Crab pulsar is a rapidly rotating neutron star located inside of the Crab Nebula which is located 6.788 E19m away. It was formed by a Super Nova explosion in 1054. The intensity of the light when it reaches the Earth is about 5.24E-13 W/m^2. A) What is the luminous flux of the star? B) How does that compare to the brightness of the sun? C) When the star went nova in 1054 it could be seen during the day with a visual magnitude -6, what was it luminous flux in 1054?

lumen

3. Using a resonance tube and water the student determines that the closed tube resonates when its effective length is 20 cm for a frequency of 440 HZ. A) What is the speed of sound measured by the student? B) If the student's % error is close to zero what is the temperature of the room in °C? C) What is the fundamental frequency of an open pipe with a length of 15cm in the same room?

4. Modern sirens can reach up to 135 decibels when measured 30 m away from the siren. A) What is the power output of the siren? B) What is the amount of energy used during a normal 5 minute running time? C) At what distance will the sound be 50dB assuming that the atmosphere does not absorb sound and there is no background noise? D) If the atmosphere absorbs sound at 314.0dB/Km and there is 50db of background noise when will the dB due to the siren be zero?

5. Bob is standing outside at noon hears the Civil Defense Siren going off with a frequency of 349HZ when he is standing still. Megan is 8 times the distance away. A) What is the difference in the decibel level heard by Megan as compared to Bob? B) Bob is moving toward the civil defense siren at 40m/s what is the frequency heard by Bob? C) Megan is moving away from the siren at 20 m/s what is the frequency heard by Megan?

6. The distance between a Node and an Node is 1/2 of a wavelength.

7. The wave pattern ANANANANANANANAN would use the formula f= 15 v/ 4 L

8. The speed of sound in the room at the current time is 345 m/s What is the first three harmonics for a 1.4 m closed tube? List only audible harmonics.

9. An iridium rod 50cm long is stretched so it vibrates at it resonance frequency while being held in the middle. What is the resonance frequency of this rod if its Young's Modulus is 5.28E11 and its density is 22.56 E3 kg/m^3?

10. Mary is walking through the streets of downtown Tualatin and comes to an intersection where the walk signal is blinking to stop walking. Mary thinks she is smarter than the signal though and she tries to make a last minute run for the other side of the street. She realizes she isn't going to make it when a speeding truck coming toward her at the speed of 24 m/s is honking its horn at the frequency of 6037 Hz. What frequency does Mary hear?

11, As a train pulls out of the station going 50 m/s it blasts its horn, what is the frequency heard by the train if the passengers still at the station are hearing 384 Hz?

1. A) $dB = 10 \log I/I_o$

$dB = 10 \log I_{Explosion} / I_{saw}$

$70 = 10 \log \frac{I_{Explosion}}{I_{saw}}$

$70 = 10 \log \frac{Power_{Explosion}}{4\pi(200)^2} \cdot \frac{4\pi(1.5)^2}{Power_{saw}}$

$7 = \log \left(\frac{Power\ Explosion}{Power\ saw} \frac{1.5^2}{200^2} \right)$

$10^7 = \frac{Power\ Explosion}{power\ saw}\ 5.625E^{-5}$

$\frac{Power\ of\ Explosion}{power\ of\ saw} \approx 1.78E11$

B) If saw has an audio power of 75watts

$\frac{Power\ of\ Explosion}{75} \approx 1.78E11$

Power of Explosion $1.335E13W$

$I = \frac{Power}{4\pi r^2} = \frac{1.335E13\,W}{4\pi(1609)^2} = 410354.6 \frac{W}{m^2}$

$dB = 10 \log \left(\frac{410354.6}{1E^{-12}} \right) = 176.13dB$

c) Graph

$y_1 = \left[10 \log \left(\frac{1.335E13}{(4\pi r^2)} \right) \right] - .300r$

$y_2 = 20$

$r = 551.44\,m = \frac{1}{3}mi$

2.A $I = \frac{Power}{4\pi r^2}$

$5.24E^{-13} = \frac{Power}{4\pi(6.788E19)^2}$

Power = 3.03E28 lumens

B. $\frac{3.03E28 \text{ lumens}}{1} \cdot \frac{1 \text{ sun OL}}{2.80E28 \text{ lumens}} = 1.07 \text{ OL}$

C.) $-\log(14x) = .4(-6 + 14.2)$

$-\log(14x) = 3.28$

$14x = 5.24E^{-4} \text{ lm/m}^2$

$= 5.24E^{-4} \text{ 14x}$

$I = \frac{power}{4\pi(6.788E19)^2}$

$5.24E^{-4} = \frac{power}{5.776E40}$

Power 3.03E37 lumens or 1.07E9 OL

---

3 A)

$f = \frac{V}{\lambda}$

$f = \frac{V}{4L}$

$440 = V/(4(.2))$

$V = 352 \text{ m/s}$

B)

$V = 331\sqrt{\frac{T}{273}}$

$352 = 331\sqrt{\frac{T}{273}}$

$T = 308.14 \text{ K} = \boxed{35.7°C} = 96°F$

C)

$f = \frac{V}{\lambda} = \frac{V}{2L}$

$f = 352/(2(.15)) = 1173.33 \text{ Hz}$

4. A) $dB = 10 \log (I/I_0)$

$135 = 10 \log (I/1E^{-12})$

$I = 31.62 \text{ W/m}^2$

$I = \frac{\text{Power}}{4\pi r^2}$

$31.62 = \frac{\text{power}}{4\pi(30)^2}$

$\text{power} = 357\,613 \text{ W}$

B) $\frac{357613 \text{ J}}{5} \cdot \frac{5 \text{ min}}{1} \cdot \frac{60 \text{ sec}}{1 \text{ min}} = \boxed{1.07E8 \text{ J}}$ $= 29.72 \text{ kW·hr}$ so it cost about \$3.56 to Run the siren

C) $dB = 10 \log \frac{I}{1E^{-12}}$

$50 = 10 \log \frac{I}{1E^{-12}}$

$5 = \log \frac{I}{1E^{-12}}$

$1E5 = I/1E^{-12}$

$I = 1E^{-7}$

$1E^{-7} = \frac{357613}{4\pi r^2}$

$r = \boxed{533,459 \text{ m}} = 331.5 \text{ mi}$

D) Graph

$y_1 = (10 \log(((\frac{357613}{(4\pi r^2)})/1E^{-12})) - .314r$

$y_2 = 50$

$\boxed{r = 216 \text{ m}}$

5.

A) $dB = 10 \log \frac{I}{I_0}$

$dB = 10 \log \left(\frac{I_{Megan}}{I_{Bob}}\right)$

$dB = 10 \log \left(\frac{Power}{4\pi(8r)^2} \cdot \frac{4\pi r^2}{Power}\right)$

$dB = 10 \log \frac{1}{64}$

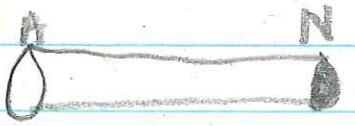
$dB = -18.06$

B) $f = f_0\left(\frac{V \pm V_0}{V \pm V_S}\right)$

$f = 349\left(\frac{340+40}{340}\right) = 349\left(\frac{380}{340}\right) = 390.05\,Hz$

C) $f = 349\left(\frac{340-20}{340}\right) = 349\left(\frac{320}{340}\right) = 328.47\,Hz$

8.



$f = \frac{v}{\lambda} = \frac{345}{4(1.4)}$

1st - 61.60 Hz

3rd $f_0 \times 3 = 184.82\,Hz$

5th $f_0 \times 5 = 308\,Hz$

9.

$f = \frac{v}{\lambda} = \frac{v}{2L} = \frac{4837.8}{2(.50)} = 4837.8\,Hz$

$V_{sound\,solid} = \sqrt{\frac{Young}{Density}} = 4837.8$

10. $f = f_0 \left(\frac{V \pm V_0}{V \mp V_S}\right)$

$= 6037 \left(\frac{340 + 0}{340 - 24}\right)$

$= 6495.5\ Hz$

11. $f = f_0 \left(\frac{V \pm V_0}{V \mp V_S}\right)$

$384 = f_0 \left(\frac{340}{340 + 50}\right)$

$384 = f_0 \left(\frac{340}{390}\right)$

$f_0 = 440.47\ Hz$