Physics 6B Practice Midterm

1. A pair of speakers is hooked up to a stereo and placed 4m apart. The same sound is emitted by both speakers and it has a frequency of 68Hz. If you stand between the speakers, at what distance from the left speaker would the sound get quiet (destructive interference)? Use 340 m/s for the speed of sound.
   a) 1.42 m
   b) 2.50 m
   c) 3.25 m
   d) 3.63 m

2. You are in the front row at a concert, standing 1m away from the speakers. The sound intensity level is an ear-splitting 120 db, so you decide to move away to a quieter position. How far away from the speaker do you need to be so that the level is only 80 db?
   a) 10m
   b) 40m
   c) 100m
   d) 200m

3. A loudspeaker playing a constant frequency tone is dropped off a cliff. As it accelerates downward, a person standing at the bottom of the cliff will hear a sound of:
   a) increasing frequency and decreasing amplitude
   b) constant frequency and increasing amplitude
   c) increasing frequency and increasing amplitude
   d) decreasing frequency and constant amplitude

4. Two strings on the same guitar (same length) are tuned so that string B is one octave higher frequency than string A. Given that string A has 4 times the mass of string B, what is the ratio of the tensions in the strings? (Hint: One octave higher frequency means the frequency is twice as high).
   a) String A has 4 times the tension of String B
   b) String A has 2 times the tension of String B
   c) The tensions in the strings are equal
   d) String A has half the tension of String B

5. One of the harmonics on a string that is 1.30 m long has a frequency of 15.60 Hz. The next higher harmonic has frequency 23.40 Hz. Find the fundamental frequency and the speed of the waves on the string.
   a) 7.80 Hz, 20.3 m/s
   b) 15.6 Hz, 24.3 m/s
   c) 23.4 Hz, 9.8 m/s
   d) 39.0 Hz, 20.3 m/s

6. Charge q₁ = -5.4µC is placed at the origin, and charge q₂ = -2.2 µC is on the x-axis at x=1m. Where should a charge q₃ be placed between q₁ and q₂ so that the net force acting on it is zero?
   a) x=0.20 m
   b) x=0.42 m
   c) x=0.61 m
   d) x=1.2 m

7. An object with a charge of – 3.6µC and a mass of 12g experiences an upward electric force, due to a uniform electric field, equal in magnitude to its weight. Find the direction and magnitude of the electric field.
   a) 33,000 N/C upward
   b) 33,000 N/C downward
   c) 33,000 N/C to the right
   d) 66,000 N/C downward

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8. Two conducting spheres have net charges $q_1 = +8 \, \mu C$ and $q_2 = -2 \, \mu C$. The spheres touch and some charge is transferred. How many electrons are transferred, and to which sphere?
   a) $3.1 \times 10^{13}$ electrons are transferred to sphere 1
   b) $3.1 \times 10^{13}$ electrons are transferred to sphere 2
   c) $5 \times 10^6$ electrons are transferred to sphere 1
   d) $5 \times 10^6$ electrons are transferred to sphere 2

9. During a lightning strike, electrons are transferred from the bottom of a thundercloud to the ground. During this process, the electrons:
   a) gain potential energy as they move toward a higher potential
   b) lose potential energy as they move toward a lower potential
   c) gain potential energy as they move toward a lower potential
   d) lose potential energy as they move toward a higher potential

10. During a lightning strike, electrons are transferred from the bottom of a thundercloud to the ground. This occurs due to dielectric breakdown of the air, when the electric field is greater than $3 \times 10^6 \, V/m$. The distance from the ground to the cloud is 1000m. Find the magnitude of the potential difference between the cloud and the ground.
    a) $3000 \, V$
    b) $3 \times 10^6 \, V$
    c) $9 \times 10^6 \, V$
    d) $3 \times 10^9 \, V$

11. An electric dipole consists of two equal charges, $+q$ and $-q$, a distance $d$ apart. Find the total electric potential at a point that is a distance of $d/2$ to the right of the positive charge, as shown.
    a) $kq/d$
    b) $2kq/d$
    c) $(4/3)kq/d$
    d) $(1/2)kq/d$

12. How much charge is on each plate of the capacitors in the circuit shown? The battery has voltage 12V, and the capacitances are: $C_1 = 3 \mu F$, $C_2 = 2 \mu F$, $C_3 = 4 \mu F$.
    a) $Q_1 = 24 \, \mu C$; $Q_2 = 8 \, \mu C$; $Q_3 = 16 \, \mu C$
    b) $Q_1 = 24 \, \mu C$; $Q_2 = 16 \, \mu C$; $Q_3 = 8 \, \mu C$
    c) $Q_1 = 12 \, \mu C$; $Q_2 = 4 \, \mu C$; $Q_3 = 8 \, \mu C$
    d) $Q_1 = 12 \, \mu C$; $Q_2 = 8 \, \mu C$; $Q_3 = 16 \, \mu C$

13. A parallel-plate capacitor is initially charged by a battery with voltage $V$. The battery is disconnected, and a dielectric with constant $k$ is inserted between the plates. What happens to the energy stored in the capacitor?
    a) The stored energy increases by a factor of $k^2$
    b) The stored energy increases by a factor of $k$
    c) The stored energy decreases by a factor of $k$
    d) The stored energy decreased by a factor of $2k$
14. How much power is dissipated in each of the resistors in the circuit shown? The battery has voltage 12V, and the resistances are: \( R_1 = 4\Omega \), \( R_2 = 3\Omega \), \( R_3 = 6\Omega \).

a) \( P_1 = 16\ W; P_2 = 5.3\ W; P_3 = 2.7\ W \)
b) \( P_1 = 16\ W; P_2 = 3\ W; P_3 = 3\ W \)
c) \( P_1 = 16\ W; P_2 = 1.5\ W; P_3 = 4.5\ W \)
d) \( P_1 = 4\ W; P_2 = 6\ W; P_3 = 2\ W \)

15. In the circuit below all the bulbs have the same resistance. When the switch is closed, what happens to bulb A?

a) Bulb A gets brighter
b) Bulb A gets dimmer
c) Bulb A remains the same
d) Bulb A gets burned out by physics

16. Resistor 1 is a solid cylinder with length \( L \) and diameter \( D \). Resistor 2 is made of the same material, but it has length \( 2L \) and diameter \( 2D \). Compared to the resistance of resistor 1, resistance 2 is:

a) twice as large
b) half as large
c) the same
d) four times as large

17. Consider the three electric charges shown below. Charge B is equidistant from charges A and C. List the charges in order of the magnitude of the force they experience, from smallest to largest.

a) A, B, C
b) A, C, B
c) C, A, B
d) C, B, A

Answers: 1)c  2)c  3)c  4)c  5)a  6)c  7)b  8)a  9)d  10)d  11)c  12)a  13)c  14)a  15)a  16)b  17)c