Instructions and Tips

- The speed of sound in air (c_{air}) is = 340 $m \cdot s^{-1}$; the speed of sound in water (c_{water}) is = $4 \cdot c_{air}$.
- Remember that $\log_{10}(2) = 0.3$.
- A calculator is not necessary to answer any of these questions.

1. Write the equation for a line with a slope of 1, 3 and 5, each having a y-intercept equal to its slope.

   (a) Line 1: ***$y = 1 \cdot x + 1$***

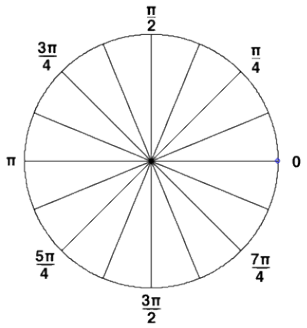
   (b) Line 2: ***$y = 3 \cdot x + 3$***

   (c) Line 2: ***$y = 5 \cdot x + 5$***

2. Draw the *unit circle* and label points at every $\pi/4$ radians starting from $x=1$, $y=0$. What angle (θ) in degrees corresponds to each $\pi/4$ radian point starting from $x=1$, $y=0$?

   Angles are every 45°.

   θ = 45°, 90°, 135°, 180°, 225°, 270°, 315°, 360° starting from the reference point $x=1, y=0$.



3. (a) Write the equation that describes the instantaneous pressure, $P(t)$, of a sine wave with a peak amplitude of 4 Pascals (Pa), a period (T) of 1 ms, and a starting phase angle (θ) of 3.14 radians (rad).

   $A = 4$ Pa; $T = 1$ ms $= 0.001$ s; $f = 1/T$; $f = 1/0.001$; $f = 1000/1$; $\therefore f = 1000$ Hz ; $\theta = 3.14$ rad $= 180° = \pi$

   $P(t) = 4 \cdot \sin(2\pi \cdot 1000 \cdot t + \pi)$

   (b) Write the equation for the instantaneous pressure of the above sound if the frequency (f) is doubled and the starting phase angle (θ) is shifted by -90°.

   IF $f = 1000$ Hz in 3(a), THEN $f = 2000$ Hz in 3(b) ; $\theta = 180° - 90° = 90° = \pi/2$

   $P(t) = 4 \cdot \sin(2\pi \cdot 2000 \cdot t + \pi/2)$

   (c) Write the equation that describes the instantaneous pressure, $P(t)$, of a sine wave with a peak amplitude of 0.01 Pa, a frequency (f) of 5000 Hz, and a starting phase angle (θ) of 270°.

   $A = 0.01$ Pa ; $f = 5000$ Hz ; $\theta = 270° = 3/2 \cdot \pi$ or $-1/2 \cdot \pi$

   $P(t) = 0.01 \cdot \sin(2\pi \cdot 5000 \cdot t + 3/2 \cdot \pi)$ or $P(t) = 0.01 \cdot \sin(2\pi \cdot 5000 \cdot t - 1/2 \cdot \pi)$

4. What is the period (T) of a sine wave with a frequency (f) of:

(a)	10 Hz?	***T = 0.1 s (or 100 ms)***	(e)	1000 Hz?	***T = 0.001 s (or 1 ms)***
(b)	100 Hz?	***T = 0.01 s (or 10 ms)***	(f)	2 kHz?	***T = 0.0005 s (or 0.5 ms)***
(c)	333 Hz?	***T = 0.003 s (or 3 ms)***	(g)	5 kHz?	***T = 0.0002 s (or 0.2 ms)***
(d)	500 Hz?	***T = 0.002 s (or 2 ms)***	(h)	10 kHz?	***T = 0.0001 s (or 0.1 ms)***

5. What is the frequency (f) of a sine wave with a period (T) of:

(a)	1000 ms?	***f = 1/1000 ms = 1 Hz***	(d)	0.333 ms?	***f = 1/0.333 ms = 3000 Hz***
(b)	200 ms?	***f = 1/200 ms = 5 Hz***	(e)	0.1 ms?	***f = 1/0.1 ms = 10,000 Hz***
(c)	20 ms?	***f = 1/20 ms = 50 Hz***	(f)	0.01 ms?	***f = 1/0.01 ms = 100,000 Hz***

(g) If the signals in Q#5 were sounds, which one(s) could a human **NOT** hear?

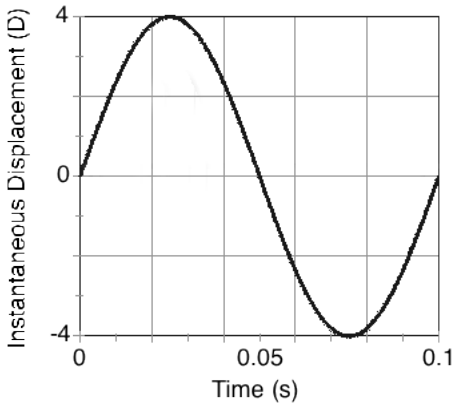
Signals (a) & (b) are below the limit of human hearing; 5(f) is above the highest audible frequency.

6. Draw the sine waves described by the following equations. Be certain to label both axes.

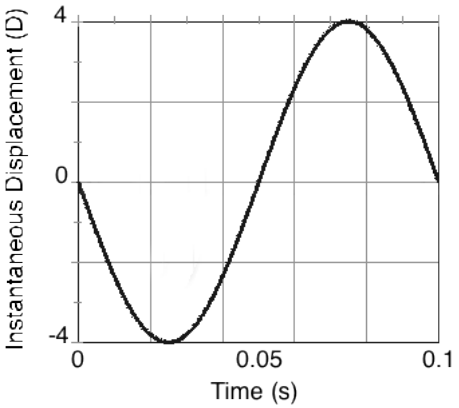
(a) $D(t) = 4 \cdot \sin(2\pi \cdot 10 \cdot t)$

(b) $D(t) = 4 \cdot \sin(2\pi \cdot 10 \cdot t - \pi)$

(a)



(b)



(c) What would be heard if the sine waves in 6(a) and 6(b) were played simultaneously from a speaker?

No sound would be heard because the two signals are perfectly out of phase, thus destructive interference would occur and the two signals would cancel each other.

7. Provide the answer to the following logarithmic expressions.

(a) $\log_{10}(10) =$ ***1***

(b) $\log_{10}(100) =$ ***2***

(c) $\log_{10}(20) =$ ***$\log_{10}(10 \cdot 2) = \log_{10}(10) + \log_{10}(2) = 1 + 0.3 = 1.3$***

(d) $\log_{10}(10^5) =$ ***$5 \cdot \log_{10}(10) = 5$***

(e) $\log_{10}(10^6/2) =$ ***$\log_{10}(10^6) - \log_{10}(2) = 6 \cdot \log_{10}(10) - \log_{10}(2) = 6 - 0.3 = 5.7$***

(f) $\log_{10}(10^7/10) =$ ***$\log_{10}(10^7) - \log_{10}(10) = 7 \cdot \log_{10}(10) - \log_{10}(10) = 7 - 1 = 6$***

(g) $\log_{10}(2) =$ ***0.3***

(h) $\log_{10}(0.5) =$ ***-0.3***

(i) $\log_{10}(0.05) =$ ***$\log_{10}(1/2 \cdot 10^{-1}) = \log_{10}(1/2) + \log_{10}(10^{-1}) = \log_{10}(1/2) + (-1 \cdot \log_{10}(10)) = -0.3 + (-1) = -1.3$***