1. A body oscillates with simple harmonic motion along the x-axis. Its displacement varies with time according to the equation $x = 5\sin(\pi t + \frac{\pi}{3})$. The velocity in m/s of the body at $t = 1s$ is

   (a) $+8$

   (b) -8

   (c) -14

   (d) $+14$

   (e) -5

2. When a damping force is applied to a simple harmonic oscillator which has period T_0 in the absence of damping, the new period T is such that

   (a) $T < T_0$

   (b) $T = T_0$

   (c) $T > T_0$

   (d) $\omega T < \omega_0 T_0$

   (e) $\omega T > \omega_0 T_0$

3. The lowest A on a piano has a frequency of $27.5 Hz$. If the tension in the 2.0 meter string is $308N$, and one- half wavelength occupies the wire, what is the mass of the wire in kg?

   (a) 0.025

   (b) 0.051

   (c) 0.072

   (d) 0.081

   (e) 0.037

4. Two harmonic waves traveling in opposite directions interfere to produce a standing wave described by $y = 3\sin(2x)\cos(5t)$ where x is in m and t is in s. What is the wavelength in m of the interfering waves?

   (a) π

   (b) $\frac{\pi}{3}$

   (c) 2π

(d) 4π

(e) $\frac{\pi}{2}$

5. If $y = 0.02sin(30x - 400t)$ (SI units), the velocity of the wave in m/s is

(a) $\frac{3}{40}$

(b) $\frac{40}{3}$

(c) $\frac{60\pi}{400}$

(d) $\frac{400}{60\pi}$

(e) 400

6. Unpolarized light is passed through three successive Polaroid filters, each with its transmission axis at 45 to the preceding filter. What percentage of light gets through?

(a) 0%

(b) 12.5%

(c) 25%

(d) 50%

(e) 33%

7. A $500Hz$ tone is sounded at a train station as a train moves toward the station at $20m/s$. What frequency in Hz does the engineer hear if the speed of sound is $335m/s$?

(a) 530

(b) 535

(c) 475

(d) 495

(e) 515

8. The longest wavelength that a standing wave can have on a stretched string of length L is

(a) $2L$

(b) $3L$

(c) $5L$

(d) $7L$

(e) $9L$

9. The speed of light waves in air is $3 \times 10^8 m/s$. The speed of sound waves in air is $333 m/s$. How long in s is the time interval between the time a lightning flash is seen and the thunderclap is heard if the lightning flash is 1 kilometer away?

   (a) 3
   (b) 5
   (c) 7
   (d) 10
   (e) 1

10. Two speakers that are in synchronization are connected to a sine wave source. Waves of $2.2m$ wavelength travel to point P from the speakers. The phase difference, $\Delta\phi_{21}$, between the waves from $S2$ and $S1$ when they arrive at point P is
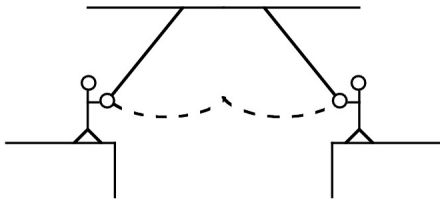

   (a) 0
   (b) π
   (c) 2.05π
   (d) 8π
   (e) 9π
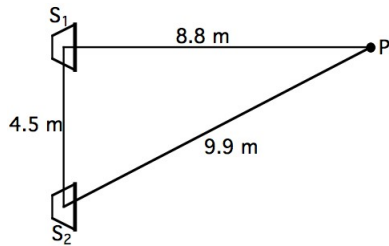
11. If $F = -kx$, then $\frac{k}{m}$ is

   (a) A
   (b) ω
   (c) ω^2
   (d) $A\omega$
   (e) $A^2\omega$

12. Two circus clowns (each having a mass of $50kg$) swing on two flying trapezes (negligible mass, length $25m$) shown in the figure. At the peak of the swing, one grabs the other, and the two swing back to one platform. The time for the forward and return motion in s is

(a) 10

(b) 5

(c) 15

(d) 20

(e) 25

13. An ocean harbor has a rectangular shape, with one shorter side open to the sea. On a day when the speed of waves in the harbor is $20 m/s$, standing waves can be produced along the length of the harbor if their wavelength is
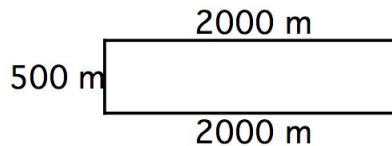
(a) $1600m$

(b) $3200m$

(c) $4000m$

(d) $5000m$

(e) $7000m$

14. . A simple pendulum on the Earth has a period of one second. What would be its period in s on the moon where the acceleration due to gravity is $1/6$ that of Earth?

(a) 6.00

(b) 2.45

(c) 1.00

(d) 0.408

(e) 0.167