

**Problem 1.1 :****Given:** The following signals

- Daily closes of the stock market.
- Output from phonograph-record pickup.

**Find:** Is each of the following 1-D signals:

- Analog or digital?
- Continuous-time or discrete-time?

- The value of a stock can be any real number, which makes daily closes analog. The stock market closing happens once per day; therefore, stock market closes are discrete-time.
- A phonograph is analog time and continuous time.

**Problem 1.2 :****Given:** The following signals

- a. Image in a telescope eyepiece
- c. Image stored in a digital camera

**Find:** Is each of these 2-D signals

- Analog or digital?
- Continuous or discrete?

- a. An image in the eyepiece of a telescope would be analog because the waves do not have limited values. An image in a telescope would be continuous because you can continue to look through the eyepiece and the image does not end or have a frame-rate.
- c. An image stored in a digital camera is digital, hence the name of the camera, because the image has a limited range of values. An image in a digital camera is also a singular moment in time meaning it is discrete.

**Problem 1.3 :**

**Given:** The following signals are 2-D in space and 1-D in time, so they are 3-D signals.

- b. A movie stored on film
- c. A movie stored on DVD

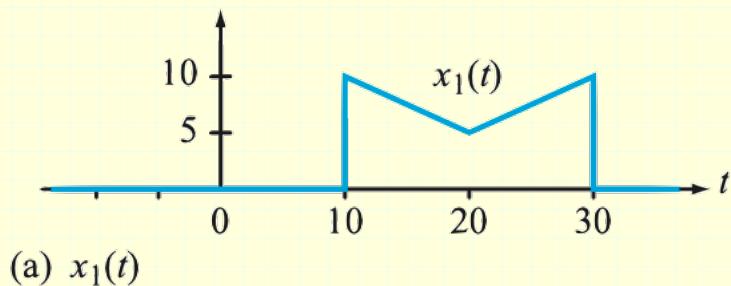
**Find:** Is each of these 3-D signals:

- Analog or digital?
- Continuous or discrete?

- b. A movie stored on film could be considered analog in space and continuous in space because the film's resolution is determined by photons. A movie on film is discrete in time because there individual frames.
- c. A movie stored on DVD could be considered digital and discrete in space because the signal or information is stored in distinct quantities and only so many pixels. A movie stored on DVD could be considered discrete because it still has individual frames or moments in time.

**Problem 1.4 :**

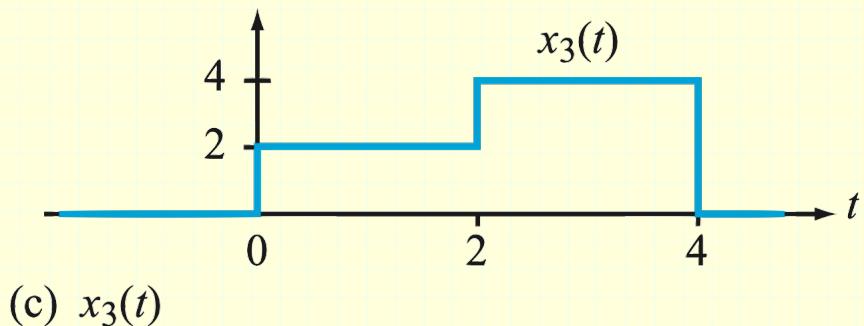
**Given:** The waveform  $x_1(t)$  below



**Find:**  $x_1[-(t + 40)]$

**Problem 1.6 :**

**Given:** The waveform of  $x_3(t)$  in the image below.

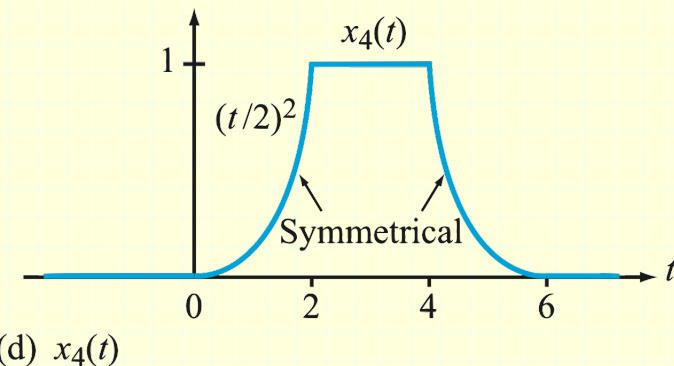


**Find:** generate and plot the waveform of: (b)  $x_3[-2(t - 1)]$ .

**Problem 1.7 :**

**Given:** The waveform  $x_4(t)$  is given by

$$x_4(t) = \begin{cases} 0 & t \leq 0, \\ \left(\frac{t}{2}\right)^2 & 0 \leq t \leq 2s, \\ 1 & 2 \leq t \leq 4s, \\ f(t) & 4 \leq t \leq 6s, \\ 0 & t \geq 6 \end{cases}$$

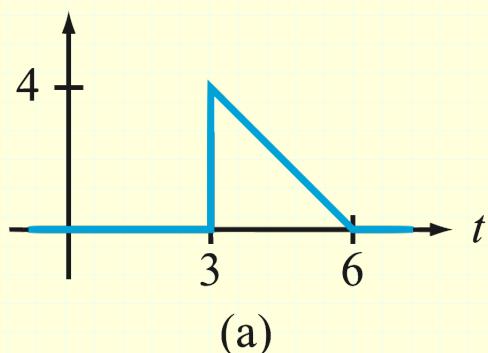


**Find:**

- Obtain an expression for  $f(t)$ , which is the segment covering the time between 4 s and 6 s.
- Obtain an expression for  $x_4(-(t - 4))$  and plot it.

**Problem 1.11 :**

**Given:** Given the waveform of  $x(t)$  shown below



**Find:** Generate and plot the waveform of

- a.  $x(3t + 6)$
- b.  $x(-3t + 6)$
- c.  $x(-3t - 6)$

**Problem H :****Given:** Euler's formula**Find:** Show how to derive

$$\cos x = \frac{e^{jx} + e^{-jx}}{2}$$

and

$$\sin x = \frac{e^{jx} - e^{-jx}}{2j}$$

**Problem I :**

**Given:** The discussion in Lecture and the lecture notes.

**Find:** List at least ten examples of signals encountered in real life.

The following are some examples of signals that can be encountered in real life.

1. music or sound
2. visible light
3. earthquakes or vibrations
4. brain signals
5. radio signals
6. computer images
7. LiDAR signals
8. X-Ray signals
9. Infrared signals
10. electric signals