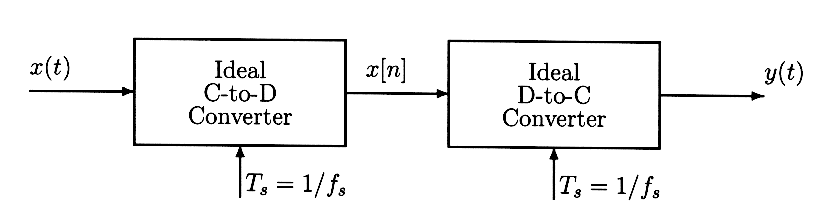
***Seminar 5: Sampling  
[solutions]***

1. Consider the system

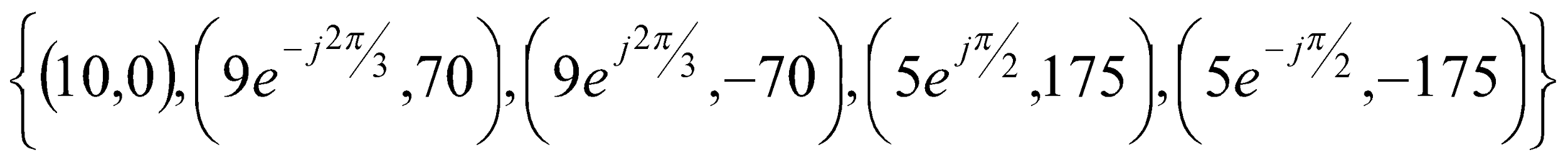


If , what condition has to be satisfied for the sampling frequency , so that y(t) = x(t)?  
**ANSWER**: Using , then

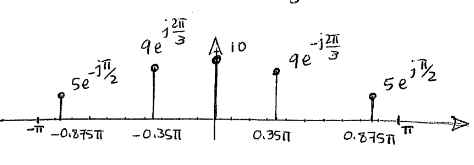
1. Given a signal
   1. Draw a sketch of the spectrum of , labelling the frequencies and complex amplitudes of each component.
   2. Determine the minimum sampling rate that can be used to sample without any aliasing.

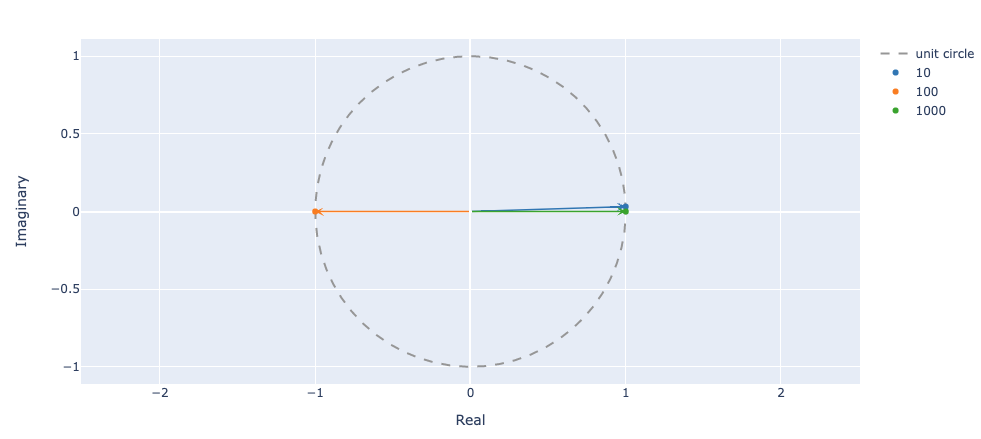
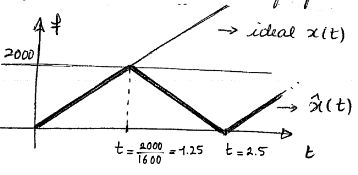
**ANSWER**: trivial using solution of previous exercise.

1. Suppose that a discrete signal was obtained sampling a continuous signals with a sampling frequency samples/sec.
   1. Determine two continuous signals and so that for T =.0002 sec. The two signals have to have a frequency smaller than 5000 Hz. Give an equation for each signal.   
      **ANSWER**: The aliases have frequencies of the form , and there are only 2 aliases with frequencies smaller than , and
   2. Determine the amplitude and phase of the two signals obtained in section (a).  
      **ANSWER**: The aliases have frequencies of the form , and there are only 2 aliases with frequencies smaller than , and
2. A signal *x(t)* has the following spectral representation:



* 1. Write an equation for *x(t)*.  
     **ANSWER**:
  2. The signal *x(t)* is sampled with a sampling frequency samples/sec to obtain a discrete signal . Write an equation for *x*[*n*] and draw the spectrum of *x*[*n*] for normalized frequencies .  
     **ANSWER**:



1. A chirp signal can be synthesized using the following formula:
2. Draw the phasor for the three cases n = 10, 100, 1000  
   **ANSWER**:   
     
   
3. If the signal goes through an D-A converter with a sampling frequency of 4kHz, draw the instantaneous analog frequency (in Hz) with respect to time. Make sure that the coordinates are drawn correctly.  
   **ANSWER**: ideally   
     
   Due to aliasing and folding, the instantaneous frequency cannot exceed
4. Given a signal , the corresponding discrete signal is obtained sampling with a frequency ; and the resulting x[n] can be written as . Determine the values of and for each of the following values of 
   1. 10

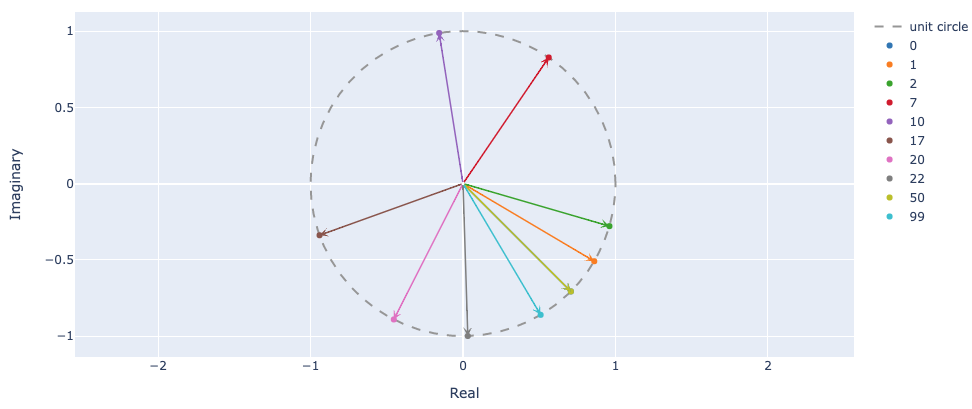
**ANSWER**:

* 1. 25

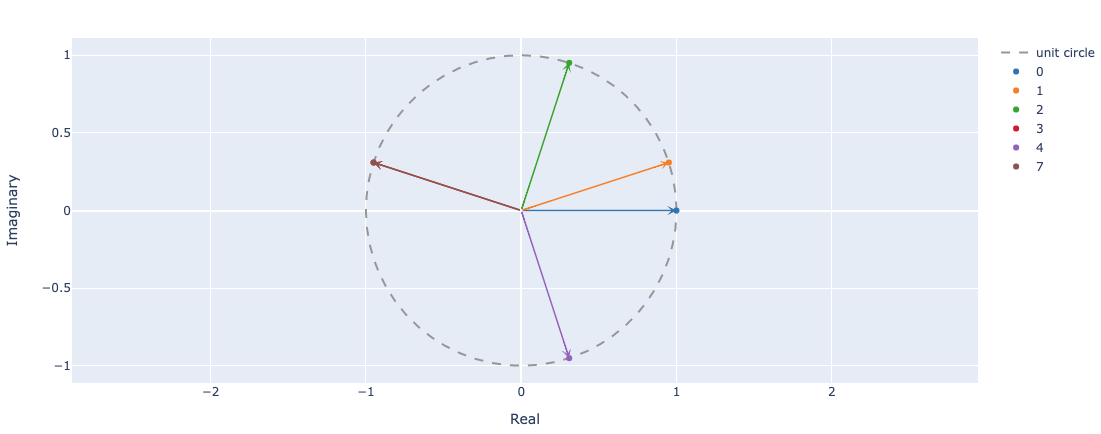
**ANSWER**:

* 1. 15

**ANSWER**:

1. The following complex-valued signal is a phasor: , where is the phase.
   1. When the phase changes by a constant amount versus n, the phasor rotates at a constant speed. For the following phasor: , make a plot of the phasor locations for   
      

Note: the phasor location for n=0 and n=50 are the same, thus we only see the plast one plotted, n=50.

* 1. What is the period of ?  
     **ANSWER**: Period = , which means that z[50]=z[0]
  2. Repeat for the complex phasor that corresponds to the chirp signal: . In this case plot the phasor locations for   
     **ANSWER:   
     **

Note: when , Not periodic