Feedback — DSP Exercises

You submitted this homework on **Wed 3 Apr 2013 2:09 PM CDT -0500**. You got a score of **0.50** out of **7.00**. You can attempt again, if you'd like.

Question 1

On a 16-bit computer, where *signed* integers are represented with a single 16-bit word, what is the range of numbers that can be represented?

Your Answer	Score	Explanation
$[0, 2^{16} - 1]$		
$[-2^{16}, 2^{16} - 1]$		
$[-2^{15}, 2^{15} - 1]$		
Total	0.00 / 1.00	

Question Explanation

Numbers will range from -2^{15} to $2^{15} - 1$, lying in the interval $[-32768, 32767]$, a total of 2^{16} numbers.

Question 2

What decimal number does the binary number 101010 equal? Type your answer as an integer without a decimal point.

You entered:

Your Answer	Score	Explanation
✘	0.00	
Total	0.00 / 1.00	

Question Explanation

$101010_2 = 1 \cdot 2^5 + 0 \cdot 2^4 + 1 \cdot 2^3 + 0 \cdot 2^2 + 1 \cdot 2^1 + 0 \cdot 2^0 = 32 + 8 + 2 = 42_{10}$
.

Question 3

What is the sum of the two binary numbers 101 and 111 expressed as a binary number?

Your Answer	Score	Explanation
010		
100		
1100		
Total	0.00 / 1.00	

Question Explanation

$101 + 111 = 1100$. Just like in decimal addition, you need to carry a one when the two bits being added both equal 1. For example, $1 + 1 = 10$ and $11 + 01 = 100$.

Question 4

Suppose the *periodic* signal $s(t)$, with its period equalling T, has Fourier series coefficients c_k. What are the Fourier series coefficients of $s\left(t - \frac{T}{2}\right)$ in terms of c_k? Use `ck` to represent c_k. For example, if your answer is $\frac{1}{2} c_k$, type `ck/2`.

You entered:

Preview Help

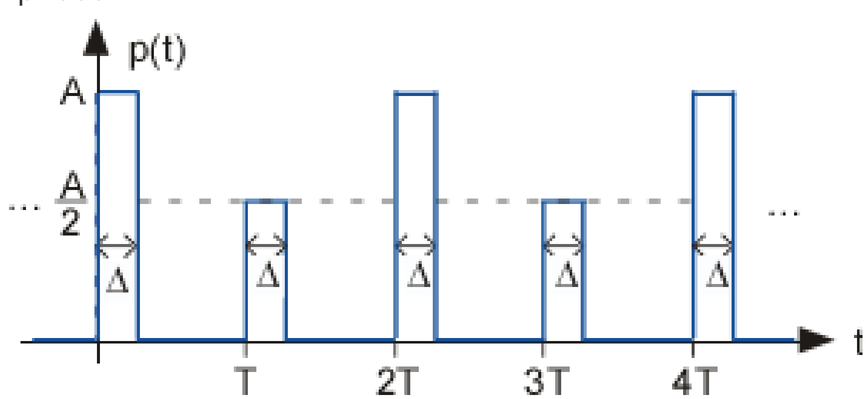
Your Answer		Score	Explanation
	✘	0.00	Could not parse student submission
Total		0.00 / 1.00	

Question Explanation

From the Fourier series properties, $s(t-\tau) \leftrightarrow e^{-j\frac{2\pi k\tau}{T}} c_k$. As $\tau = \frac{T}{2}$, $e^{-j\frac{2\pi kT/2}{T}} = e^{-j\pi k} = (-1)^k$. So the *best* answer simplifies the complex exponential: $(-1)^k c_k$.

Question 5

An A/D converter has a curious problem: every other sampling pulse is half its normal amplitude.



Can this signal be used to sample a signal having highest frequency $W = \frac{1}{2T}$?

Your Answer	Score	Explanation
Yes		
Sometimes		

No

Total	0.00 / 1.00

Question Explanation

Using the answer to the previous problem, we can think of $p(t)$ as the superposition of two periodic pulse signals having period $2T$ with one delayed by T and scaled by a factor of two. The Fourier series coefficients for this signal are given by

$$c_k = Ae^{-j\frac{\pi k\Delta}{2T}} \frac{\sin \frac{\pi k\Delta}{2T}}{\pi k} \left[1 + \frac{1}{2}(-1)^k\right], \; k = \dots, -1, 0, 1, \dots$$

What matters more are the frequencies corresponding to the harmonics of the period: $f_k = \frac{k}{2T}$, $k = \dots, -1, 0, 1, \dots$. Unless Δ is a rational fraction of T, **none** of these coefficients are zero, which means the spacing between the spectral lines is $1/2T$. This signal can be used to sample a signal having a highest frequency equal to *half* this spacing. Consequently, this signal *cannot* be used to sample a signal of bandwidth $\frac{1}{2T}$ without aliasing occurring.

Note: If the pulses all had the same amplitude, the term $\left[1 + \frac{1}{2}(-1)^k\right]$ in the formula for the Fourier coefficients would be $\left[1 + (-1)^k\right]$. This quantity equals zero for k odd and two for k even. In this case, it can (of course!) be used to sample the signal.

Question 6

A discrete-time sinusoid is given by $\sin 2\pi f_0 n$. What is this signal's period?

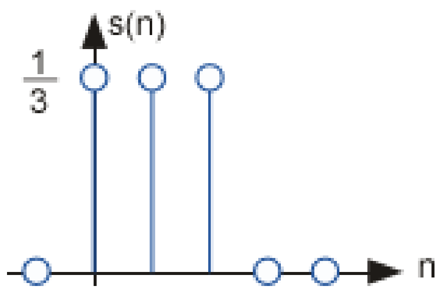
Your Answer	Score	Explanation
$\frac{1}{f_0}$		
N when $f_0 = \frac{1}{N}$.		
The discrete-time sinusoid is not periodic.		
Total	0.00 / 1.00	

Question Explanation

The period would be $1/f_0$ if it were not for the fact that for the sinusoid to be periodic, the period *must* be an integer. In general, the discrete-time sinusoid is periodic *only* if $f_0 = \frac{1}{N}$.

Question 7

Which of the following expressions correspond to the depicted pulse signal? Check *all* that are correct.



Your Answer		Score	Explanation
$\frac{1}{3}\left(\delta(n)+\delta(n-2)\right)$	✔	0.25	
$\frac{1}{3}\left(\mathrm{u}(n)-\mathrm{u}(n-2)\right)$	✔	0.25	
$\frac{1}{3}\left(\mathrm{u}(n)-\mathrm{u}(n-3)\right)$	✘	0.00	
$\frac{1}{3}\left(\delta(n)+\delta(n-1)+\delta(n-2)\right)$	✘	0.00	
Total		0.50 / 1.00	

Question Explanation

This signal can be written as $\frac{1}{3}\left(\mathrm{u}(n)-\mathrm{u}(n-3)\right)$ and as $\frac{1}{3}\left(\delta(n)+\delta(n-1)+\delta(n-2)\right)$.