**Question 1**

An LTI system has impulse response defined by \( h[n] = \{5, -3, 6\} \) for \( n = \{0, 1, 2\} \).

Determine the output of the system, \( y[n] \), when the input, \( x[n] = A \delta[n] \) for \( A = -1 \).

Provide a single number as your answer which is the total of the values of the output, i.e., \( \sum_{-\infty}^{\infty} y[n] \).

**Question 2**

What are the components one would typically need to construct a digital signal processing system that could take analog signals as input and also output the processed results as an analog signal?

*(Choose all that apply)*

- [ ] Capacitor
- [ ] Resistor
- [ ] CPU
- [ ] op amp
- [ ] analog to digital converter
- [ ] digital to analog converter
- [ ] inductor

**Question 3**
If an input $x(t) = \sin(-3\pi t)$ is sampled with a sampling frequency of $f_s = 3$ samples/sec, what is the discrete frequency of the sampled sinusoidal signal in rad/sample?

Specify your answer with two decimal digits of accuracy.

Question 4  
3 pts

Let $x[n]$ denote a sampled signal from a continuous sinusoidal signal $x(t) = \sin(2\pi ft)$. For $f = 2.7$ Hz, and a sampling interval of $T = 9$ seconds/sample, what the value of $x[3]$?

Keep two decimal digits for result.

Question 5  
3 pts

How many signals listed below are periodic?

1. $x[n] = \sin\left(\frac{6\pi}{7}n + 1\right)$
2. $x[n] = \cos\left(\frac{n}{8} - \pi\right)$
3. $x[n] = \cos\left(\frac{\pi}{8}n - \frac{\pi}{3}\right)$
4. $x[n] = 1$

Note: Constants DO repeat their values.

- [ ] 3
- [ ] 1
- [ ] 0
- [ ] 4

Question 6  
5 pts
If $z_1 = 1 - j2\omega$ and $z_2 = 2 + j4\omega$, simplify the ratio $\frac{z_1}{z_2}$ where $*$ denotes conjugation.

- $\frac{\sqrt{5}}{2\sqrt{2}} e^{j\tan^{-1}(2\omega)}$
- $\frac{\sqrt{5}}{2\sqrt{2}} e^{-j\tan^{-1}(2\omega)}$
- $\frac{1}{2}$
- None of the provided solutions are correct.

**Question 7** 5 pts

(True or False) The signal $x[n] = \sin(A\pi^2 n)$ is periodic.

- True
- False

**Question 8** 3 pts

Which of the functions below are equivalent to the function $\sum_{k=-4}^{\infty} \delta[n + k]$?

- $\mu[n - 4]$
- $\mu[n]$
- $\mu[n + 4]$
- None of the above

**Question 9** 3 pts

What is the angle (in radians) of the complex number $z = -3$?

- $\pi$
- 0
- $2\pi$
- The correct answer is not provided
### Question 10

What is the list of values of \( x[n] = e^{-j5\pi n} \) for \( n = 0, 1, 2, 3? \)

- 1, −1, 1, −1
- −1, 1, −1, 1
- 0, 1, −1, 0
- None of the above

### Question 11

If \( x[n] = 3\delta[n + 1] + 2\delta[n - 2] + 5e^{-n}\mu[n - 1] \) what is the value of \( x[n] \) at \( n = 0 \)?

- \( +\infty \)
- 0
- 5
- The correct answer is not provided

### Question 12

The lengths of two discrete time sequence \( x_1[n] \) and \( x_2[n] \) are 7 and 7 respectively. The maximum length of a sequence \( x_1[n] * x_2[n] \) is ____________

### Question 13

Let \( x[n] = \sin\left(\frac{1}{b} \pi n\right) \). Given that \( b = 19 \), determine the fundamental period of \( x[n] \).
Question 14

Given the signal $x[n] = \mu[n - \alpha]$ where $\alpha = 6$, determine the moment that this signal changes from 0 to 1.

Question 15

Given the system having Discrete Time Fourier Transform as shown below:

$$Y(e^{j\omega}) + e^{-j\omega}Y(e^{j\omega}) = X(e^{j\omega}) + e^{B\omega}X(e^{j\omega})$$

Given that $B=4$, indicate if the system is causal using a (0,1) answer as indicated below.

**Answer with a number [0,1] where:**

1 = Yes the system is causal.
0 = No the system is not causal.

Question 16

Consider a system with input $x[n]$ and output $y[n]$. The input-output relation for the system is defined by the following two properties:

1. $y[n] - ay[n - 1] = x[n]$
2. $y[0] = -1$

**Answer with a number [0,1] where:**

1 = Yes the system is linear and time invariant.
0 = No the system is not linear and time invariant.
Question 17

Consider a system with input $x[n]$ and output $y[n]$. The input-output relation for the system is defined by the following two properties:

1. $y[n] - By[n - 1] = Ax[n]$  
2. $y[0] = -2$

Given that $B = -0.1$ and $A = -2$, indicate if the system is stable using a (0, 1) answer as indicated below.

**Answer with a number [0, 1] where:**

1 = Yes the system is stable.
0 = No the system is not stable.

[ ]

Question 18

If $X[25] = 1 - j$ is the value of the DFT at index $k = 25$. What is the phase of response at $k = 25$?

- $\frac{\pi}{4}$
- $\frac{\pi}{2}$
- $\pi$
- None of the provided answers are correct.

Question 19

If $x[n] = e^{-j\omega_0 n}$ then the DTFT of $x[n]$, $X(e^{j\omega})$ is:

- $\delta(\omega - \omega_0)$
- $\sum_{k=-\infty}^{\infty} 2\pi \delta(\omega - \omega_0 + 2\pi k)$
- $\sum_{k=-\infty}^{\infty} 2\pi \delta(\omega + \omega_0 + 2\pi k)$
- None of the provided answers are correct.
### Question 20

If \( x(t) = \cos(70\pi t) \) is sampled with a sampling period of \( T = \frac{1}{70} \) and \( X[k] \) is the 101-point DFT of \( x[n] \), i.e., \( x[n] \leftrightarrow X[k] \). What index, \( k \), of the DFT is closest to the frequency of the input sinusoid \( x[n] \)?

- 0
- 48
- 52
- 50

### Question 21

If \( x(t) = \cos(300\pi t) \) is sampled with a sampling period of \( T = \frac{1}{150} \) seconds/sample, what is the equation for \( x[n] \)?

- 1
- \( \cos(2n) \)
- \( \cos(n\pi) \)
- none of the above

### Question 22

A system that aliases frequencies is LTI?

- True
- False

### Question 23

Given the signal below

\[
x(t) = 5\cos(100\pi t) + 10\cos(200\pi t) - 15\cos(300\pi t)
\]

which of the following sample rates is the lowest rate that also avoids aliasing?

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**Note:** The question regarding sample rates and avoiding aliasing is incomplete in the context provided. Additional question or context is needed for a comprehensive answer.
Question 24

Indicate if the system $h[n] = -1^n u[n - (-1)]$ is stable.

Answer with a number [0,1] where:

1 = Yes the system is stable.

0 = No the system is not stable.

Question 25

Calculate the output signal by convolving the system, $h[n]$, and the input, $x[n]$, as provided below:

\[
x[n] = u[n]
\]
\[
h[n] = a^n u[n]
\]

where $a = 0.2$.

Using your formula for the solution, determine the output at a specific sample index $n = 3$ by calculating $y[3]$ at that sample index.

To obtain the result with the required accuracy, you should find the closed expression of $y[n]$ then substitute the value of $n$ to it.

Specify your answer with two decimal digits of accuracy.