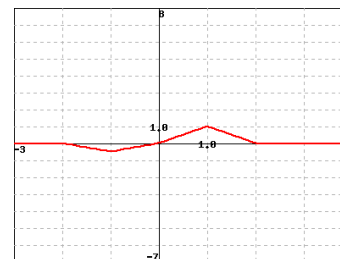


Determine whether or not each of the signals below are periodic or aperiodic. If the signal is periodic, find its period. Else, answer "NA".

	Signal	Periodic/Aperiodic	Period
1	$13 + 18\sin(3\pi t + \frac{\pi}{3})$	[?/Periodic/Aperiodic]	_____
2	$2\sin^2(9t)$	[?/Periodic/Aperiodic]	_____
3	$e^{-t}\cos(11t)$	[?/Periodic/Aperiodic]	_____
4	$21\cos^2(6\pi t + \frac{\pi}{13})$	[?/Periodic/Aperiodic]	_____
5	$\frac{10\cos(t)}{\sin(3t)}$	[?/Periodic/Aperiodic]	_____
6	$8\cos(4\pi t + 10\pi) + 14\sin(10\pi t + \frac{\pi}{5})$	[?/Periodic/Aperiodic]	_____
7	$10\cos(9t) - 11\sin(10\pi t + \frac{\pi}{4})$	[?/Periodic/Aperiodic]	_____
8	$1 + \cos(7t) + e^{j6t}$	[?/Periodic/Aperiodic]	_____

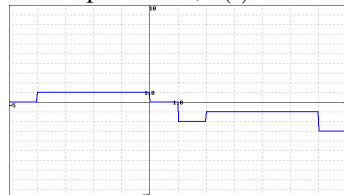


For each signal  $y(t)$  (in blue) shown in the figures 1 to 4, find the coefficients  $a$ ,  $b$ ,  $c$  and  $d$  so that  $y(t) = a + bx(ct - d)$ .

Correct Answers:

- Periodic
- 0.666667
- Periodic
- 0.349066
- Aperiodic
- NA
- Periodic
- 0.166667
- Periodic
- 3.14159
- Periodic
- 1
- Aperiodic
- NA
- Periodic
- 6.28319

Express the signal  $x(t)$  shown in the figure below in terms of the unit step function,  $u(t)$ .



$x(t) =$  \_\_\_\_\_

Correct Answers:

- $u(t+4) - 1*u(t) + (-2)*u(t-1) + 1*u(t-2) + (-2)*u(t-6)$

3A signal,  $x(t)$  is given in the figure below.

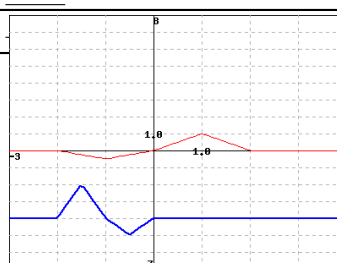


Figure 1

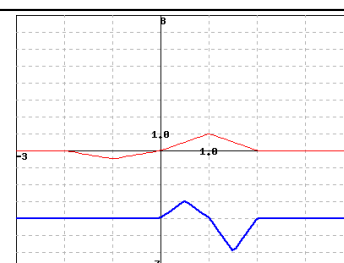


Figure 2

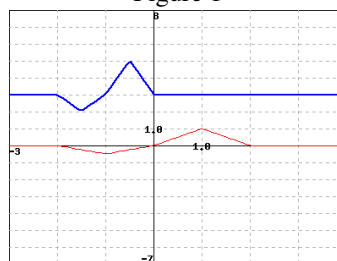


Figure 3

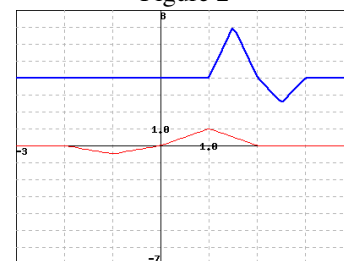


Figure 4

Figure 1:

$a =$  \_\_\_\_,  $b =$  \_\_\_\_,  $c =$  \_\_\_\_,  $d =$  \_\_\_\_

Figure 2:

$a =$  \_\_\_\_,  $b =$  \_\_\_\_,  $c =$  \_\_\_\_,  $d =$  \_\_\_\_

Figure 3:

$a =$  \_\_\_\_,  $b =$  \_\_\_\_,  $c =$  \_\_\_\_,  $d =$  \_\_\_\_

Figure 4:

$a =$  \_\_\_\_,  $b =$  \_\_\_\_,  $c =$  \_\_\_\_,  $d =$  \_\_\_\_

Correct Answers:

- -4
- 2
- -2
- 2
- -4
- -2
- 2
- 2

- 3
- 2
- 2
- -2
- 4
- 3
- -2
- -4

For the signal  $x(t) = \begin{cases} -t & -12 \leq t \leq 0 \\ t & 0 \leq t \leq 12 \\ 0 & \text{otherwise} \end{cases}$ ,

**a)** determine  $z(t)$  so that  $x(t) = |t|z(t)$ . *Hint: Write answers in terms of  $u(t)$*

$z(t) =$  \_\_\_\_\_

**b)** calculate and give the expression for  $y(t) = \frac{d[x(t)]}{dt}$ .  
 $y(t) =$  \_\_\_\_\_

*In your answers, use  $D(t)$  instead of  $\delta(t)$  for the Dirac-delta function.*

*Correct Answers:*

- $u(t+12) - u(t-12)$
- $12 * D(t+12) - u(t+12) + 2 * u(t) - u(t-12) - 12 * D(t-12)$  or  $t | * [u(t+12) - u(t-12)] + |t| * [D(t+12) - D(t-12)]$

$x(t)$  is given as a periodic signal with a fundamental period of  $T_0 = T$ .

**(a)** For each of the signals  $y(t)$  given in the table below, determine whether or not they are periodic. If they are, find their period. And if they aren't, enter "NA".

	Signal, $y(t)$	Periodic/Aperiodic
1	$-7.5x(8t)$	[?/Periodic/Aperiodic]
2	$-1.5 + x(\frac{t}{5})$	[?/Periodic/Aperiodic]
3	$\frac{5}{x(t)}$	[?/Periodic/Aperiodic]
4	$15[x(t) + x(-t)]$ and $x(t)$ is even	[?/Periodic/Aperiodic]

**(b)** Knowing that the signal  $y'(t) = -7.5x'(8t)$  is periodic, we can conclude that  $x'(t)$  is periodic as well. Find the fundamental period of  $x'(t)$  if the period of  $y'(t)$  is 1. Enter "NA" otherwise.

*Correct Answers:*

- Periodic
- $T/8$
- Periodic
- $5 * T$
- Periodic
- $T$
- Periodic
- $T$
- 8

Determine the power and energy of each of the signals given in the table below. Enter "INF" for infinity.

	Signal	Energy	Power
1	$e^{-2t}u(t)$	_____	_____
2	$3\cos(8t) + 2\cos(7t)$	_____	_____

*Correct Answers:*

- 0.25
- 0
- infinity
- 6.5

Note from JY Jan 13, 2020: The original problems with this question have been addressed.

The equation for a causal full-wave rectified signal is given by  $x(t) = 16|\sin(10\pi t)|u(t)$

**a)** The even component of  $x(t)$  is shown by  $x_e(t)$ .

1) Find the equation for  $x_e(t)$ .

$x_e(t) =$  \_\_\_\_\_

2) From the figures 1 to 4 shown below, select the graph that matches  $x_e(t)$ .

Figure: [?/1/2/3/4]

3) Is  $x_e(t)$  causal? [?/Yes/No]

4) Is  $x_e(t)$  periodic? [?/Yes/No]

**b)** The odd component of  $x(t)$  is shown by  $x_o(t)$ .

1) Find the equation for  $x_o(t)$ .

$x_o(t) =$  \_\_\_\_\_

2) From the figures 1 to 4 shown below, select the graph that matches  $x_o(t)$ .

Figure: [?/1/2/3/4]

3) Is  $x_o(t)$  causal? [?/Yes/No]

4) Is  $x_o(t)$  periodic? [?/Yes/No]

*Parts a.2 to a.4 will only be marked correct if part a.1 is correct.  
 Parts b.2 to b.4 will only be marked correct if part b.1 is correct.*

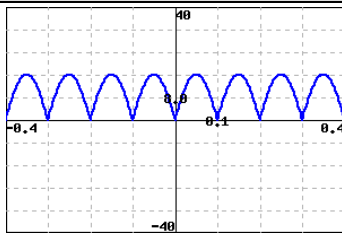


Figure 1

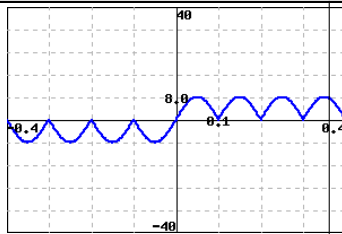


Figure 2

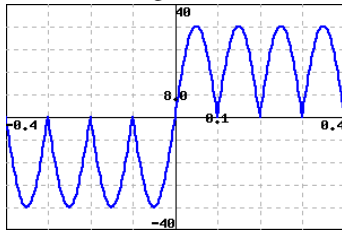


Figure 3

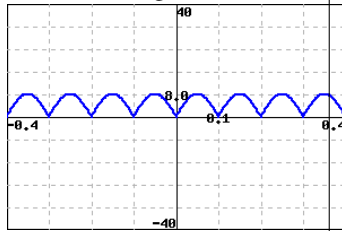


Figure 4

Correct Answers:

- $8.00 * [|\sin(10.00 * \pi * t)| * u(t) + |\sin(-10.00 * \pi * t)| * u(-t)]$  or
- 4
- No
- Yes
- $8.00 * [|\sin(10.00 * \pi * t)| * u(t) - |\sin(-10.00 * \pi * t)| * u(-t)]$
- 2
- No
- No